Asia-Pacific
Economic Cooperation

Study Report on APEC Environmental Services-Related Technology Market

APEC Committee on Trade and Investment

APEC Group on Services

August 2013

APEC Project: CTI 35 2011T

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ISBN 978-981-07-7407-3
APEC #213-CT-01.7

Acknowledgements

This report is one of the final results and outputs of the project "**Study Programme on APEC Environmental Services-Related Technology Market** (CTI 35 2011T)" which is supported by Committee on Trade and Investment/Group on Services, Asia-Pacific Economic Cooperation (APEC). This project is designed to enhance the understanding of ES and ES-related technology and examine and learn the general information on the ES-related technology market in Asia-Pacific region by capacity building, needs and supply assessment, so as to promote ES trade and ES-related technology market and improve capacities of APEC economies to develop this sector.

In order to reach the objectives of this project, large amounts of literature have been reviewed; surveys by questionnaires have been conducted among some APEC economies. The workshop on ES and ES-related technology was held in Singapore in 2012, and received good results. Field surveys were carried out in Japan, Malaysia, and Indonesia to survey the ES-related technology market.

The project director was Ms. Fadzilah Abu Hasan from APEC Secretariat, and the project executive was Ms. Belinda Chok.

The consultants of this project were Ms. Li Liping, Mr. Yuan Qingdan, and Mr. Zhou Jun of Policy Research Center for Environment and Economy (PRCEE). Ms. Li Liping was the director of the project team. Ms. Zhao Jia was the coordinator in this project. Ms. Song Xuna was the secretary of the project.

The study report is structured into five chapters as listed in contents, and is written by project team members with their responsibilities as follows: Chapter One was written by Ms. Li Liping, Mr. Zhang Bin and Ms. Zhao Jia; Chapter Two by Ms. Li Liping and Ms. Chen Chao; Chapter Three by Mr. Zhang Bin and Mr. Zhou Jun; Chapter Four by Ms. Li Liping and Mr. Zhang Bin, Chapter Five by Ms. Li Liping. The questionnaire was developed by Ms. Li Liping, Mr. Zhou Jun and Ms. Zhao Jia. Ms. Li Liping compiled the draft version and modified it into the final version according to comments from overseer of the project and external experts.

During the project implementation, many people provided the team with valuable guidance and kind support. Mr. Chen Chao, Ms. Zhao Jie, Mr. Wu Guoliang from Ministry of Commerce of China, Ms. Cui Dandan and Ms. Dong Yao from Ministry of Environmental Protection, China gave many important suggestions and much needed support to the consultants. Also, the team would like to thank Ms. Ling Ling Chui, Mr. Abdul Aziz Chik from Ministry of Natural Resources & Environment of Malaysia, Mr. Arif Wibowo, Mr. Noer Adi Wardojo from Ministry of Environment of Indonesia for their great help and support when organizing the field surveys, and Ministry of the Environment of

Japan, Ministry of Natural Resources & Environment of Malaysia, Ministry of Environment of Indonesia, International Center for Environmental Technology Transfer, Sumitomo Osaka Cement, AMITA Group, Kitakyushu International Techno-cooperative Association, Green Technology Promotion Corporation, etc, for their kind cooperation during the surveys.

Last but not the least, the team would like to offer sincere thanks to the APEC Secretariat for its financial support to the project, and all member economies for their comments.

Table of Contents

Study Report on APEC Environmental Services-Related Technology Market

1. Introduction

1.1 Background of the Project

Asia-Pacific Economic Cooperation (APEC) has put green growth and sustainable development as one of the top priorities. In the context of implementing APEC's green growth agenda, Leaders in 2010 emphasized that: "*We will increase the dissemination and utilization of environmental goods and services.*" Also, they instructed that "*Both economic growth and environmental sustainability should be advanced in a holistic manner, and progress toward a green economy should be accelerated by promoting trade and investment in environmental goods and services (EGS), developing this sector in APEC economies.*" In fact, starting with 2007, APEC has identified, in the joint statements of the Leaders and Ministers each year, EGS and EGS-related technology as an important means of prompting sustainable growth and mitigating climate change (see ANNEX I). Even, APEC published the APEC EGS Work Programme with the aim of encouraging consensus on the following actions: increasing the dissemination and utilization of environmental goods and services; reducing existing barriers and refrain from introducing new barriers to trade and investment in such goods and services; enhancing members' capabilities to develop this sector (see ANNEX II). By exploring the key factors that enable Environmental Services（ES）-Related Technology to better access and perform in the green growth process, this project is geared precisely towards this Leaders' priority.

Study on APEC ES-Related Technology Market also responds directly to Leaders' determination to path toward an economically-integrated community. In their 2010 Declaration, Leaders pointed out that "*APEC should contribute to the pursuit of a* Free Trade Agreement of the Asia Pacific (FT*AAP) by continuing and further developing its work on sectoral initiatives in such areas as investment; services; e-commerce; rules of origin; standards and conformance; trade facilitation; and environmental goods and services*." By identifying specific ways in which APEC can support the more widespread diffusion of ES technology, this project will directly serve this aspect of the APEC agenda.

Furthermore, this study responds directly to priorities established by the APEC Leaders in Yokohama in 2010, which said "*We will increase the dissemination and utilization of environmental goods and services, reduce existing barriers and refrain from introducing new barriers to trade and investment in such goods and services, and enhance our capabilities to develop this sector, by prioritizing work related to addressing non-tariff measures on environmental goods, technology, and services*."

Considering the above situation, to design and carry out a project with activities on market survey and analysis on ES-related technology will be very important and necessary. It is envisaged that this project will serve as a very good base for facilitating future trade and investment in ES, dissemination of ES-related technology, and also help to strengthen the entire value chain of ES in APEC, including R&D, demand, supply and trade of EGS.

1.2 Objectives of the Project

Since ES has become one of the important themes for both Committee on Trade and Investment (CTI) and Group on Services (GOS), it is necessary to help GOS participants and other stakeholders enhance capacity and understanding on ES and ES related technology through a comprehensive study programme, which will build up good basis for GOS' future contribution to green growth goal, particularly from the angles of services and technology under EGS Work Programme.

This project is designed to enhance the understanding of ES and ES-related technology and examine and learn the general information on the ES-related technology market in Asia-Pacific region by capacity building, needs and supply assessment, so as to promote ES trade and ES-related technology market and improve capacities of APEC economies to develop this sector.

The project aims to achieve comprehensive study on ES and ES- related technologies market, including relevant general concepts and links between ES and ES-related technology, etc. At the meantime, several specific sectors, for instance, sewage services and solid waste management, etc., will be touched upon as well.

1.3 Framework of the Report

This report consists of 5 chapters, and all the chapters of this report are internal correlated and logical consistent.

In the first chapter, the background, objectives, methodologies and main elements of this project are introduced in brief.

In the second chapter, the definition and classification of ES in different international organizations are introduced and compared, and then the concept and classification used in this report are presented.

In the third chapter, an ES-related technology list or database is established according to the definition and classification of ES set in chapter 2, and 883 ES-related technologies were collected through combining, screening and analyzing the list of ES-related technologies in different APEC economies.

In the fourth chapter, case study on the top three categories (sewage treatment, solid waste disposal and waste gas treatment) of ES-related technology list is conducted, and the markets of these three categories of ES-related technologies are analyzed.

In the last chapter, some conclusions and suggestions of ES-related technology market within APEC were put forward.

1.4 Methodology of the Report

Considering the difficulties in compiling statistics and the lack of data on environmental services, the inconsistencies in the definition and classification of environmental services by different economies, as well as the shortage of existing quantitative analysis models, this research project, based on the review of large amounts of literature, begins with a questionnaire (see ANNEX III) and field surveys. Experts, company owners, officials and NGOs from China, Singapore, Japan, Indonesia and Malaysia have been interviewed. It then provides a data base and in-depth analysis of the situation of ES-related technology market, which reflected both of the demand side and supply side. Finally, comprehensive conclusions are given and relevant suggestions are provided.

The research methodology applied in this report include: literature review, surveys by questionnaire in APEC economies, interviews with experts and case study on ES-related technology market.

In order to design questionnaire properly, several expert workshops were held. After taking experts' opinions into account, the questionnaire on APEC Environmental Services (ES) and ES-Related Technology Market was designed and divided into 6 parts: the background of the survey is introduced at the beginning of the questionnaire, and the following parts are the main body of the questionnaire: a. basic information on ES and ES-Related Technology in respondents' economy, b. The role of different stakeholders in developing ES-Related Technology Market, c. The challenges and difficulties of ES-related technology dissemination, and d. suggestions on way forward to develop and disseminate the ES-related technology, the final part is used to collect some basic information on the respondents.

During the progress of this project, field surveys were conducted in Singapore, Malaysia, Indonesia, and etc. within APEC economies to get the information on APEC ES and ES-Related Technology Market through questionnaire distribution.

More details about methods used in this research can be found in ANNEX IV

Except where otherwise indicated, the views and conclusions contained in this report (including, for example, with respect to the analysis of ES-related market) are those of its authors and do not necessarily reflect the views of APEC economies, either individually or as a whole. The report is designed as an input into furthering the APEC Group on Services' work on environmental services.

2. Definition and Classification of Environmental Services

By now, there is no unified definition and classification of environmental services in the international context. Different economies have different understandings and classifications towards environmental services. Therefore, it is very important to clarify what environmental services are in this report.

2.1 Definition and Classification of Environmental Services in the International Context

Influential classifications do exist in the following aspects, for example, the Central Product Classification (CPC), Services Sectoral Classification List (SSCL) under GATS W/120 (1991), OECD/Eurostat classification (1999) and EU proposals in the WTO etc.

2.1.1 Definition and Classification of CPC

The Central Product Classification (CPC) was reviewed by the Statistical Commission of the United Nations. Versions include the Provisional Central Product Classification (so-called CPC prov.) which was published by the United Nations in 1991. So far, CPC prov. is widely used for scheduling purposes under the WTO, GPA negotiation, member commitments and the Free Trade Agreement (FTA) negotiation.

The CPC prov. includes 7 sub-categories of environmental services, i.e. sewage services (CPC 9401), refuse disposal services (CPC 9402), sanitation services (CPC 9403), cleaning of exhaust gases (CPC 9404), noise abatement services (CPC 9405), nature and landscape protection services (CPC 9406) and other environmental protection services (CPC 9409). Details about CPC prov. can be referred to ANNEX V.

2.1.2 Definition and Classification of GATS

The services sectoral classification list (MTN.GNS/W/120) is provided by the WTO for the negotiation and statistics use, recognized by the Services Trade Council. According to MTN.GNS/W/120, there are 12 sectors in the list: business services, communication services, construction and related engineering services, distribution services, educational services, environmental services, financial services, heath related and social services, tourism and travel related services, recreational cultural

and sporting services, transport services and other services not included elsewhere.

Environmental services include four sub-sectors, as follows: sewage services, refuse disposal services, sanitation and similar services and other (See ANNEX VI). In addition, sewage services, refuse disposal services etc. are not classified in sub-sectors. The classification system is used by most WTO members in the schedules of specific commitments.

2.1.3 Definition and Classification of OECD/EUROSTAT

The OECD and the Statistical Office of the European Union (Eurostat) developed a classification that breaks down environmental goods and services into two broad categories: one is the services provided for one or more environmental protection, pollution control, remediation or prevention activity, including analytical services and monitoring, construction and engineering, environmental research, training and education, environmental accounting, consulting and other environmental matters. The other is the services provided for specific environmental media, including wastewater management, solid waste management, air pollution control and noise abatement services.（see ANNEX VII）

2.1.4 Definition and Classification of EU Proposal

In the negotiation of Council for Trade in Services, the EU proposes a new classification for “core” ES and relevant sectors (see ANNEX VIII). The proposed classification comprises of services which can undisputedly be classified as “purely” environmental services and conceptual services such as design, engineering, R&D and consulting services which remain classified elsewhere in GATS.

“Purely” ES in the classification of EU proposal include: water for human use & wastewater management, solid/hazardous waste management, protection of ambient air and climate, remediation and cleanup of soil & water, noise & vibration abatement, protection of biodiversity and landscape, and other environmental & ancillary services.

2.2 Classification of ES in this Research Context

In this research, re-classification of ES was proposed based on the following considerations:

a. Although the classifications of ES mentioned above are different, they still have some in common, for example, ES are generally classified by elements and types;

b. All the classifications mentioned above are overgeneralization, and meanwhile new needs of ES arise and the boundary of ES is extended with the deteriorating trend of environmental pollution and the highlight of global environmental problems;

c. According to the scale of environment, one kind of classification of ES was put forward in the last project we did, that is, environmental services should be divided into 3 categories: indoor environmental services, outdoor environmental services, and global environmental services. Still it was just a framework. Further development is needed.

Considering the situation, based on the work we have done, a new and more specific classification of ES was established (see table 2.1). In this classification, there are 10 categories of ES, and it not only covers air pollution control services, waste water treatment and delivery services, solid and hazardous waste management services, noise and vibration abatement services, contaminated soil remediation services and environmental monitoring and analysis services; but also covers administration services for nature risk, natural resource protection and ecologic conservation services, environmentally preferable services, international environmental conventions-related and climate change mitigation services.

Detailed information about the classification of ES used in this research can be found in ANNEX IX

Tab. 2.1 Classification and description of ES

No	category	Examples or Description
1	air pollution control services	dust collect, desulfurization, denitrification and etc.
2	waste water treatment and delivery services	industrial wastewater treatment, sewage treatment, sludge treatment and others
3	solid and hazardous waste management services	combustible waste, noncombustible waste, recyclable waste and etc.
4	noise and vibration abatement services	advanced technology, industrial noise, traffic noise and others
5	contaminated soil remediation services	treatment technologies, in situ remediation technologies, containment technologies and other technologies
6	environmental monitoring and analysis services	air pollution continuous monitoring technology and water pollution continuous monitoring
7	administration services for nature risk	emergency monitoring and environmental risk assessment technology for heavy metal pollution, leaking detecting and pre-warning system of impervious barrier in landfill
8	natural resource protection and ecologic conservation services	recycling technologies, treatment technology for rural pollution, ecological conservation and

		reclamation
9	environmentally preferable services	biomass co-fired boilers, energy efficiency technologies, and etc.
10	international environmental conventions-related and climate change mitigation services	capture, storage, sequestration or disposal of greenhouse gases; greenhouse gas monitoring and others

3. APEC ES-Related Technology and Case Study

ES-related technology is the important foundation for protecting the environment and important components of ES trade. ES-related technology includes waste water treatment technology, solid waste management technology, air pollution control technology and noise abatement technology and so on.

3.1 APEC Environmental Service-Related Technology

In order to develop the APEC ES-related technology database, we considered not only supply side, but also demand side; not only international organizations' experiences, like OECD, but also APEC economies, for example, the 2012 national demonstrate list of advanced pollution prevention technologies in China, the 2012 national encouraged development list of pollution prevention technologies in China[1], Environmental Technology Database of Global Environmental Centre in Japan[2], Environmental Technology Verification Program of US EPA[3].

From the methodology aspect, we did that not only by literature review, but also by field survey, interview, questionnaire, brain storming, etc. For example, we visited Japan, Indonesia, Malaysia, Singapore and interviewed more than 50 experts in related fields.

Following above, the ES-related technology database has 10 categories, 65 items and 883 ES-related technologies. Moreover, it is an open list. The reason is that ES-related technology upgrades and develops very fast as information technology does. In addition, due to the limited resources and time, we could not visit all APEC economies and learn their demands or supplies. The distribution of ES-related technology in different categories is shown in table 3.1. Detailed information see ANNEX X.

Tab. 3.1 APEC ES-related technology

No	category	Item	Technology
1	air pollution control technology	10	183
2	waste water treatment and delivery technology	4	176

1 "the 2012 national demonstrate list of advanced pollution prevention technologies in China" and "the 2012 national encouraged development list of pollution prevention technologies in China" can be found at http://www.mep.gov.cn/gkml/hbb/bgg/201207/t20120711_233344.htm.
2 "Environmental Technology Database of Global Environmental Centre in Japan" can be found at http://nett21.gec.jp/gec/database/.
3 "Environmental Technology Verification Program of US EPA" can be found at http://www.epa.gov/nrmrl/std/etv/verifiedtechnologies.html.

3	solid and hazardous waste management technology	27	253
4	noise and vibration abatement technology	4	12
5	contaminated soil remediation technology	4	40
6	environmental monitoring and analysis technology	2	95
7	administration technology for nature risk	2	2
8	natural resource protection and ecologic conservation technology	4	45
9	environmentally preferable technology	6	65
10	international environmental conventions-related and climate change mitigation technology	2	12

In the database, it can be easily demonstrated that air pollution control technology, waste water treatment and delivery technology and solid and hazardous waste management technology, which take 70% of the total amount of ES-related technologies, rank top three items. The ratios of ES-related technologies in different categories are shown in figure 3.1.

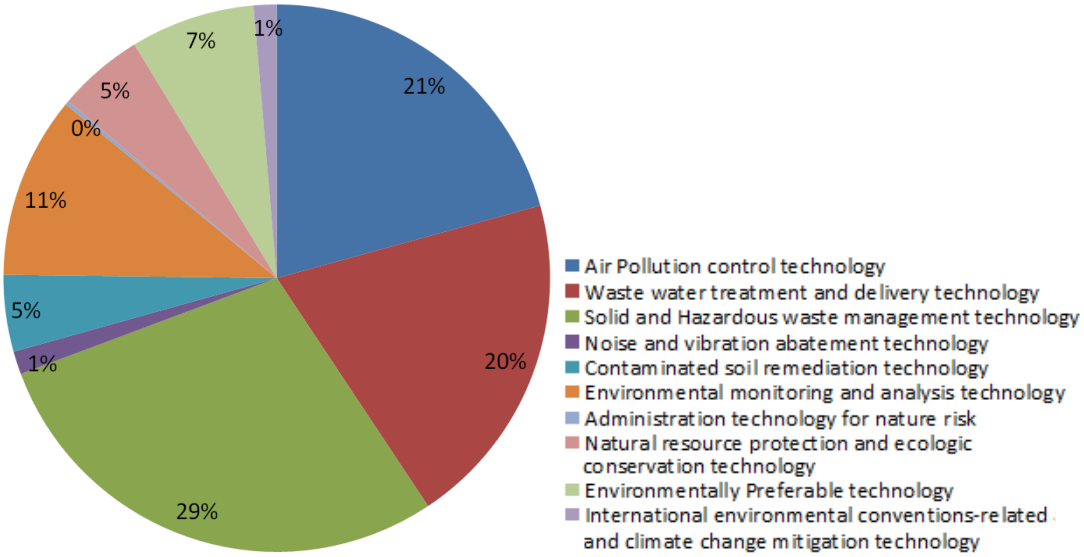

Fig. 3.1 The ratios of ES-related technologies in different categories

3.2 Case Study of APEC Environmental Service-Related Technology

According to the ranking and ratio of different categories in the list, we mainly focused on waste water treatment technology, solid waste disposal technology, and air pollution control technology here.

3.2.1 Wastewater Treatment Technology

Based on WTO/120 and CPC classification, wastewater treatment service mainly refers to sewage services. Therefore, the report focuses on sewage treatment technology.

I Current Development of Sewage Treatment Technology

Sewage treatment technology mainly involves biological, physical, chemical methods and the combination of the above. At present, 30 sewage treatment technologies are in use. They can be classified into the following three categories according to the source of sewage treatment technologies: 1) transplantation and development of existing technology of big and medium sized sewage treatment plant in the world such as Carrousel and Obal technology. 2) introduction of international sewage treatment technologies under research, improvement or primary applications and directly apply them in sewage treatment plants in China, for example some derivatives of SBR such as MSBR, CSBR, IDEA, AICS and SAF. 3) transplantation industrial effluent treatment technologies for sewage treatment. The most representative technologies include fine diatomite absorption, biological fluidized bed, hydrolysis acidification, contact oxidation process and so on. More details about the ES-related technologies for sewage treatment could be found in ANNEX XI.

II Analysis on Development Trend of Sewage Treatment Technologies

Based on current status of sewage treatment technologies above, the future development trend of sewage treatment technologies is mainly reflected in the following three areas: 1) with the development of pollution control from “discharge meeting the standard”, “discharge meeting more stringent standard”, “low-level recycling of neutralized water or partial recycling” to “high-level and scaled recycling”, membrane separation technology will be applied widely in sewage treatment, transforming sewage treatment from simple purification into “manufacturer of recycled water” with sewage as raw material. 2) with the development of water quality control from control of conventional pollutants (including primary and secondary treatment) to the control of nitrogen, phosphorus and salt (tertiary treatment with consideration of environment carrying capacity) to concern about ecological security, the secondary treatment technologies focusing on phosphorus and nitrogen removal and tertiary treatment technologies such as various kinds of flocculation and sedimentation technologies, high-efficient filtration technology, modern sterilization technology and ecological purification technology including artificial wetland will enjoy wide extension. 3) sewage treatment and operation technologies will develop from “artificial/micro computer control”, to “intelligent control of some treatment equipment” and then to “whole-process optimized and intelligent control” in order to reduce existing energy consumption level.

3.2.2 Solid Waste Disposal Technology

According to WTO/120 classification of environmental service, solid waste disposal mainly refers to solid waste disposal service. Solid waste disposal service refers to the services of collection, treatment and disposal of hazardous waste and non-hazardous waste. Targeting on garbage disposal and technologies for disposing hazardous waste, the current report will analyze the service technologies for disposal of solid waste.

I Urban Garbage Treatment Technologies

Urban garbage treatment technologies include: landfill technologies, incineration technologies, compost technologies and comprehensive treatment technologies.

(I) Landfill technology

Landfill technology is the key method employed for disposal of garbage. Here, we just discuss sanitary landfill technology. In recent years, many cities in China begin using landfill technology for garbage. Sanitary landfill is the landfill approach that controls leachate and biogas. Sanitary landfill is the major garbage treatment method employed in the world due to mature technology, simple operation and management, big treatment amount and low investment and operational cost.

(II) Incineration technology

Incineration treatment technology is classified into the following three types: simple incinerator, domestically-made incineration facilities and comprehensive incineration facilities. Simple incinerators have been gradually replaced. Domestically-made incineration facilities can be divided into domestically-made furnace and fluidized bed. Comprehensive incineration facilities refer to the garbage incineration system that combines introduced foreign equipment with domestic equipment.

(III) Compost technology

There are three types of composting: simple compost, aerobic high-temperature compost and anaerobic digestion. Garbage compost especially urban garbage compost used to be under stagnation and even shrinkage in developed economies due to reasons including market demand. It has been going up since 1990s due to the fact that high-temperature compost can turn organic matter in garbage into farmland fertilizers, minimize environmental pollution, kill the pathogenic bacteria in garbage and has environment-friendly and recycling characteristics.

(IV) Comprehensive treatment

Comprehensive treatment can address the problems occurred in the way of mixed treatment. All the easy degradable and combustible matters are employed after adopting the comprehensive treatment process, therefore, landfill amount is quite small, only accounting for 15% ~ 20% of the total volume. The main ingredients of landfill materials are inorganic garbage such as broken brick and tiles, which would not cause serious secondary pollution and save land area for landfill. In addition, incinerating combustible garbage in comprehensive treatment has high heat value and small secondary pollution. The compost process in comprehensive treatment method only treats easy-to-degrade organic matters that are simple in ingredient, easy to compose, low in treatment cost and good in product.

II Hazardous Waste (Medical Waste) Treatment and Disposal Technologies

Hazardous waste treatment and disposal technologies can be divided into treatment technology and disposal technology according to the destiny of hazardous waste. Before final disposal of hazardous waste, various kinds of treatment technologies can be employed. No matter in what way to classify disposing technologies for hazardous waste, the aim is achievement of reduce, recycle and reuse of hazardous wastes. Technologies such as rotary kiln, pyrolysis incineration, landfill, solidification and stabilization, high-temperature vapor sterilization, chemical sterilization and microwave sterilization have been effectively employed in treatment and disposal of hazardous waste. Special technologies such as plasma, emergency response, risk control and fly ash treatment have been under primary exploration and demonstration. There is also some development in the technologies that control the pollution in processes such as collection, package, tentative storage and on-line monitoring. The development of the above technologies has met the requirement of “Reduce, Recycle and Reuse” of hazardous waste and upgraded hazardous waste treatment and disposal technical level of China in an all-round way.

3.2.3 Air Pollution Control Technology

In view of different pollutants in waste gases, relevant environmental service technologies for controlling air pollution have been developed such as particle pollutant control technology, sulfur and sulfide treatment technology and nitrogen and NOx treatment technology and so on.

I Current Status and Development Trend of Particle Pollutant Treatment Technology

In developed economies, electrostatic process is widely employed due to high emission standard. For example, the dust emission limit (under standard circumstance) of EU “2001/80/EC Directive” is 30 mg/m^3. Electrostatic precipitators account for about 85% of total dust removing devices. The United States required

dust emission limit at 20 mg/m^3 in 2005, electrostatic precipitator takes up 80% of the total. In Japan, dust emission limit identified by most local governments is 20 mg/m^3. Nearly all coal fueled power plants in Japan employ electrostatic precipitator. In India, 90% coal fueled power plants employ electrostatic precipitators due to the coal characteristics such as high ash content, high mass resistivity and low sulfur content. In China, power plants have similar conditions and over 90% employ electrostatic precipitator.

At present, the main treatment technologies could be classified into the following four types based on the grain size of pollutants: dry method (dust removal by machinery), wet method, filtration method and electrostatic method. The corresponding most common treatment equipment are cyclone scrubber, foam scrubber, bag scrubber and electrostatic precipitator. Wet method scrubbers basically belong to the phasing out facilities because of low efficiency, big water demand and secondary water pollution. Except special occasion as primary dust removal or material recycling device, dry (machine) scrubbers usually are not employed for end-of-pipe treatment due to relatively low dust removal efficiency. Therefore, current development of smoke dust control technologies mainly focuses on bag process and electrostatic process. Although there appeared the combination of electrostatic and bad process in the past few years, its application is few.

II Current Status and Development Trend of Treatment Technologies for Sulfur and SOx

Developed economies such as the United States, Britain, and Japan have conducted a great deal develop and research on flue gas desulphurization. More than 100 flue gas desulphurization technologies have been developed, about 10 of them have achieved commercialization. At present, most coal fueled power plants in developed economies have installed flue gas desulphurization devices. Japan is the economy with the largest scale application of wet flue gas desulphurization system (FGD). The technology adopted is mainly limestone-gypsum method, accounting for over 75%. The gypsum employed basically is the recycling products from flue gas desulphurization process. The research on flue gas desulphurization technology in the United States is slightly later than that of Japan, 80% of desulphurization process employs limestone-gypsum method. At present, over 90% FGD devices employ limestone-gypsum method, over 75% industrial gypsum comes from desulphurization process.

With independent research and development, introduction, adsorption and digest, and re-innovation, China has made great process in industrialization of flue gas desulphurization. A dozen of existing flue gas desulphurization technologies such as limestone-gypsum method, circulating fluidized bed, marine water desulphurization method, integration of desulphurization and dust removal, semidry method, limestone injection into furnace and activation of unreacted calcium (LIFAC) and active coke

adsorption method have been widely applied. Similar to other economies, limestone-gypsum method is still the mainstream technology among many desulphurization technologies. According to statistics, in all thermal power plant flue gas desulphurization projects that have been put into operation, under construction and signed contract, over 93% employ the wet limestone-gypsum desulphurization method; while marine water desulphurization method, flue gas circulating fluidized bed method and ammonia method account for 7%. It can be said that China has all existing advanced and mature desulphurization technologies in the world for thermal power plants; the mainstream desulphurization technology is still the limestone-gypsum method. At present, domestically made rate of desulphurization equipment in China reaches over 90%. China has independent intellectual property right of the main desulphurization technologies and the capacity in overall contracting of flue gas desulphurization project.

III Current Status and Development Trend of Treatment Technologies for Nitrogen and NOx

There are the following three types of measures for the control of NOx emissions: 1) fuel denitrification; 2) reducing NOx emission by improving combustion technology; 3) installing flue gas denitrification devices.

Flue gas denitrification is the most popular method in the world for reducing NOx emission. There are many technologies having been developed, however, only SCR and SNCR have mainly been applied in projects. In early 1990s, the total installed capacity of power generating units with denitrification devices exceeded 30 million kW in Japan and Germany with the biggest installed capacity of one unit at 1 million kW. Up to now, the United States has installed flue gas denitrification device for over 10 million kW power generating capacity. Most of these denitrification devices employ SCR method.

The research and development of low-nitrogen combustion technology have obtained great progress over the past few years with self-design, self-manufacturing and self-installation and debugging. This not only provides feasible technology for NOx control in power plants, but also enables China having the production capacity in equipping low-nitrogen combustion equipment. At present, most flue gas denitrification technologies employed in thermal power generating units that have been put into operation and under construction employ SCR method, a few employ SNCR method, which is consistent with the development trend of flue gas denitrification technology in the world. However, in terms of technical level, the flue gas denitrification technology applied in China.

SCR flue gas denitrification technology employed by most power plants is still at introduction, digest, adsorption and primary application stage except the core technology with independent intellectual property right developed by individual

environmental engineering companies. For SCR denitrification technology, China lacks key technologies such as catalyst manufacturing technology and flow field mixing and optimizing technology and lacks the experience in project design and operation. While SNCR core technologies are under the protection of foreign intellectual property right, China presently only utilizes the technology. The digestion, adsorption and re-innovation of this technology have not been included in its agenda and have not obtained any basic progress. In addition, the domestication of catalyst determines the amount of primary investment and routine operational cost and is one of the main bottlenecks constraining the industrialization of denitrification technology. Although some Chinese enterprises have established catalyst joint ventures with foreign company, these joint ventures are small in production scale, the research and development progress of catalyst cannot meet the demand of denitrification projects.

4. ES-Related Technology Market-Taking China as an Example

To study ES-related technology market, the project takes China as an example. The reasons are as the following:1) the availability of materials and data; 2)China is the largest developing economy and the second largest trade economy in the world;3) China possesses both ES-related technology demander and supplier.

4.1 Market and Application of Sewage Treatment Technologies

4.1.1 Market of Sewage Treatment Services Technology

Up to 2010, total sewage treatment capacity of China reached 125 million m^3 per day, and sewage treatment rate of cities reached 77.5%. At present, the main sewage treatment technology employed in China is still the biochemical treatment process with stable and simple operation as well as low cost. Among all kinds of sewage treatment services technology, oxidation ditch, SBR and A2/O technologies have widely employed in sewage treatment and are the main technologies for sewage treatment plants. Due to relatively high quality of yielding water, MBR is increasingly employed in China. The statistical analysis of the technologies employed in 2870 sewage treatment plants in 2010 in China shows that 14.7% adopted traditional activated sludge process, 24.6% adopted oxidation ditch process, 21.8% adopted A2/O process, 16.3% employed SBR process and improved process, 2.8% employed biological contact oxidation process, 4.0% adopted AO process and 15.8% adopted other processes (See Figure 4.1).

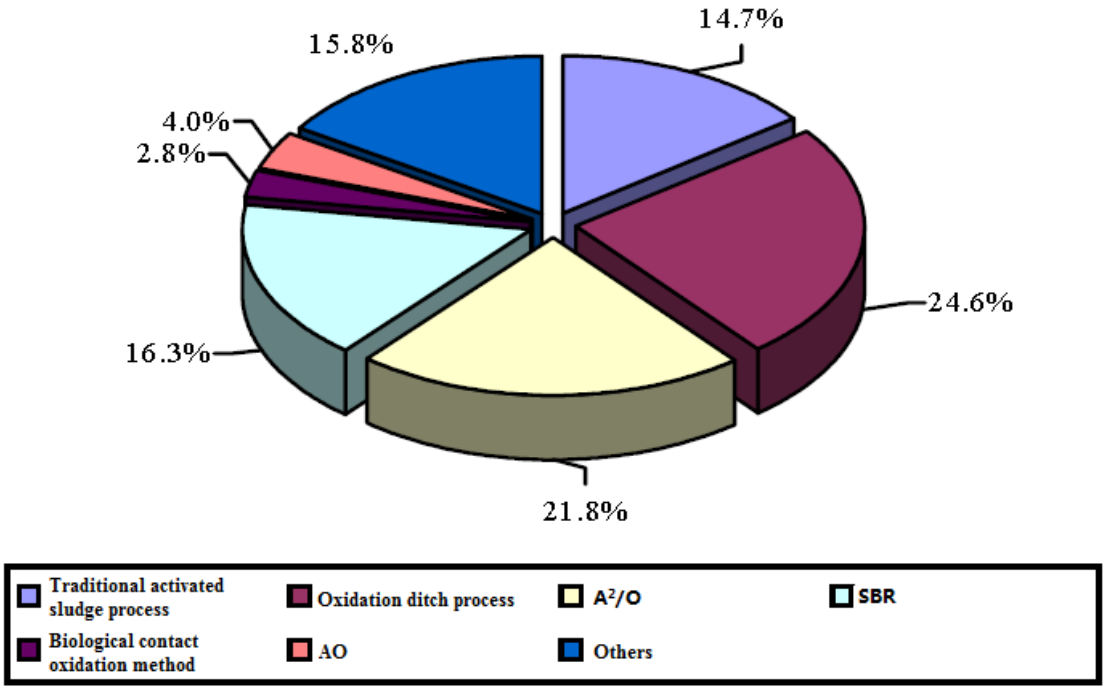

Fig. 4.1 Percent of various secondary treatment process for sewage

In terms of sewage treatment amount, about 92% urban sewage is treated by various kinds of biochemical treatment processes. It can be seen from the 2012 List of Environmental Protection Technologies Encouraged by the State released by Ministry of Environmental Protection on July 5, 2012 that among the 19 technologies for treatment of urban sewage, sludge and landfill leachate as well as restoration of water bodies, 16 employ biochemical treatment process. In the 2012 National List of Advanced Demonstration Technologies for Prevention and Control of Pollution, there are technologies on treatment of urban sewage, sludge and landfill leachate as well as restoration of water bodies, 3 of them involve in biochemical treatment process. Therefore, biochemical treatment process still dominates the market for sewage treatment in China.

4.1.2 Prediction of the Market for Sewage Treatment

As the accelerated progress of urbanization and industrialization, China has the largest market for sewage and wastewater treatment. Therefore, the prediction of the market for sewage and wastewater treatment in China can reflect the development of the market for sewage and wastewater treatment in APEC.

The control on water pollution in the future in China will be more stringent. The changes of policies mainly include the following five areas: adding ammonia nitrogen as a compulsory control indicator, more efforts in reuse of recycled water, compulsory treatment of sludge, raising sewage treatment rate and equipment operation load and including agricultural water pollution into management system. The General Office of

the State Council printed out and distributed the “12th Five-Year Plan for Construction of Urban Sewage Treatment and Recycling Facilities (Guobanfa No.[2012] 24) (hereinafter referred to as the Plan) on April 19, 2012. The Plan points out that China still has the problems such as failure of some sewage treatment facilities to fully meet new environmental protection requirements, no environment-friendly disposal of most sludge, low rate of recycling and reuse of sludge, insufficient fund for construction and operation of facilities and operation supervision not in place. To this end, the Plan identifies the following main targets for the “12th Five-Year Plan” period: improvement of collective capacity for sewage treatment, sewage treatment rate, use rate of recycled water and operational efficiency of sewage treatment facilities. In sewage treatment technologies, biochemical process as the mainstream technology for sewage treatment has several development orientation. However, with activated sludge process as the bases, different technical routes have been evolved to strengthen treatment capacity of activated sludge with different methods. The momentum for next round development of the industry mainly is the requirement for high quality of yield water. Therefore, the following two kinds of technologies will become the focus of next round development: 1) BAF process will enjoy rapid development due to higher quality of the yield water, some reduction of the cost with technology progress and reduction of follow-up cost for sludge treatment. 2) MBR process will be the major sewage treatment technology in the next period due to its big advantage of high quality of yield water. However, its application requires relevant policy momentum due to its relatively high cost.

4.1.3 Trade of Sewage Treatment Services and Technologies between China and the World

The import and export volume of China in the field of sewage treatment has been rising year by year. The import and export mainly focus on areas such as project financing and construction, key equipment and components.

In project financing and construction, the amount of foreign enterprises and projects that invest and operate sewage treatment plants has been increased year by year since China attracts foreign investment for construction and operation of sewage treatment plants in BOT or TOT form, for example, Sino French Water, Veolia Water, Kardan Water and Berlin Water (Wasser Berlin) and so on. At present, over 20% sewage treatment capacity in China is under direct and indirect sewage treatment services provided by foreign enterprises. In export, technical service trade of China enters international market. The export destiny is mainly developing economies such as Saudi Arabia and India. In 2010, China carried out 93 overseas technical projects for design, construction and technical services of environmental protection with revenue of 99 million Yuan. It had 3 overseas projects on operation of environmental pollution treatment facilities with revenue of 15.5 million Yuan.

In area of key equipment and components for sewage treatment, the output of sewage treatment equipment in 1998 was 2.22 billion yuan RMB with sales volume at 5.85 billion yuan. In 2010, the output of sewage treatment equipment reached 41.17 billion yuan RMB with sales volume at 125.13 billion yuan, increase of 18.5 times of output and 21 times of sales volume in 12 years. The compound growth rate is 38.3% and 40.5% respectively. The growth of sales volume is far higher than the global annual average of 6.4%. In 2007, obtained $587 million foreign exchange for export of sewage treatment equipment and spent $529 million for import with 2.63% increase of surplus. The import equipment mainly includes high-performance membrane materials, intelligent process operation control system and software and special equipment such as high-pressure pump for reverse osmosis.

Although there is year-on-year increase of technical trade in the field of sewage treatment, the trade development speed is still slow with small growth of economic aggregate, low application of high-technology in export equipment, narrow exporting types and regions, weak capacity in complete set of sewage treatment equipment and overall contract and lack of competitive force in international market.

4.2 Market and Application of Solid Waste Disposal Technologies

4.2.1 Market and Application of Urban Garbage Disposal Technologies

I Market for Urban Garbage Disposal Technologies

(I) Landfill

Collection and utilization of landfill biogas is the main direction for sanitary landfill in China. At present, the utilization of landfill biogas is mainly direct combustion to generate electricity. In 2011, provinces such as Zhejiang, Fujian and Shandong had new power generating plants putting into operation with landfill biogas as the fuel. According to investigations, there were 43 biogas power generating plants having put into operation up to the end of 2011 with total installed capacity over 100 MW. In 2011 (up to November 15, 2011), 18 new landfill biogas utilization projects obtained the approval of NDRC (ANNEX XII), which will reduce about 2.8 million t CO_2 equivalent.

(II) Environmental service technology for incineration treatment

There has been rapid development of garbage incineration in China over the past few years. According to the *Year Book on Urban Construction*, both the amount and treatment capacity of garbage incineration plants have gone up year on year; so has

the proportion of incineration in garbage environment-friendly treatment facilities. All these show increasing importance of incineration technology in garbage treatment in China (See Table 4.1).

Tab. 4.1 Statistics of garbage incineration in China

Year	Amount of incineration plant	Treatment Capacity (t/a)	Proportion of incineration to all treatment methods (%)
2001	36	2151608	2.9
2002	45	3356436	4.7
2003	47	4956250	6.8
2004	54	5579310	7.1
2005	67	10893300	12.9
2006	69	13188780	15.5
2007	76	15954765	16.1
2008	82	18658942	17.1
2009	93	20221987	12.9
2010	107	31325621	18.75

Source: Statistic Year Book of Urban Construction

(III) Current status of compost treatment facilities

In 2011, compost of urban garbage kept on stagnation and shrinkage. Some compost treatment plants employing separation treatment exist in the name of comprehensive treatment plant. However, their treatment effects cannot meet the requirement. At present, biodegradable organic garbage mainly include the sludge from urban sewage treatment plants, kitchen garbage from hotels and restaurants and excrement. With further promotion of classified management of garbage, more and more family kitchen garbage, out-of-date food garbage and garbage from parks and greening activities will be separately collected and there will be great increase of biodegradable organic garbage that can be recycled and reused.

II Development Trend of Garbage Treatment Technologies

First, shift from simple garbage treatment to comprehensive management. China begins the whole-process comprehensive management of garbage involving classification and collection at the source, recycling and reuse and treatment and disposal.

Second, high technology is applied in garbage industry. Modern machinery is employed in garbage sorting. The application of bioengineering technology in the construction of landfill facilities can greatly reduce leachate concentration. The application of thermal physical heat transfer technology to improve garbage incineration system can increase incineration power generation by over one time. The application of biotechnology in garbage compost can raise the efficiency and quality.

Modern information system is employed in garbage comprehensive management system.

Third, accelerat the development of domestic incineration equipment. At present, all existing incineration equipment in China is foreign products. Therefore, accelerating domestication of incinerating equipment is the key for China in the development of garbage incineration. The focus is the research and development of domestically made incinerator and fume purification equipment.

4.2.2 Market and Application of Technologies for Disposing Hazardous Waste (Medical Waste)

The technology for disposing hazardous waste (medical waste) became mature and has been under wide application. Rotary kiln, pyrolysis incineration and high-temperature vapor sterilization treatment have become mainstream technologies. Semi-dry flue gas purification or dry-wet joint method is employed to strictly control dioxin emission and secondary pollution.

In treatment and disposal of hazardous waste, solid stabilization, incineration and safe landfill technologies have been widely applied in China. Up to the end of 2010, five collective incineration facilities for hazardous waste have been put into operation, 12 have been basically constructed, 12 have been under construction, 5 have finished primary design and another 5 were still at early stage. There were two hazardous waste collective landfill facilities that have been put into operation; 3 such facilities have been basically constructed; 5 such facilities have been under construction, 4 such facilities have finished primary design and 3 were still at early stage. In addition, up to the end of 2010, there were over 50 comprehensive hazardous waste disposing facilities at province level. All hazardous waste collective disposing centers at province level have been equipped with disposing facilities with rotary kiln as the main technology and disposing mode combining solid stabilization and safe landfill technology. The total capacity in collective disposal of hazardous waste in China was 964100 t/a, up by 3.2 times compared with that before 2003.

In disposal of medical waste, a total of 28 provinces in China have medical waste disposing facilities. The disposing technologies include rotary kiln incineration, pyrolysis incineration, high-temperature vapor, dry chemical sterilization and microwave sterilization and so on. There are 273 medical waste disposal facilities having put into operation. Among them, 137 employ pyrolysis and incineration equipment, taking up 50% of the total. 136 employ non-incineration disposing facilities. In medical waste disposal technologies, incineration technology and non-incineration technology takes up 50% respectively. The capacity in disposing medical waste is 1365 t/d, up by 9.9 times compared with that before 2003.

4.2.3 Trade of Garbage Disposal Service Technologies

Garbage treatment technologies in China mainly focus on sanitary landfill, compost and incineration. Among them, only garbage incineration depends on introduction of foreign advanced technology. Sanitary landfill and garbage compost completely depend upon the technologies independently developed by China.

Garbage incineration technology is at the development stage in China. Because of accelerated urbanization process, “reduce and recycle” of garbage becomes a focus for garbage treatment. Therefore, there still is big gap in China in terms of state-of-the-art incineration technology. Grate furnace and circulating fluidized bed technology still depend on import.

Much practice shows that accelerating the establishment of diversified investment and financing system is of great help to the improvement of garbage incineration technology in China. Right now, garbage incineration facilities in China mainly focus on directly attracting foreign companies to set up foreign investment or joint venture enterprises in China in modes such as BOT and BOO. Meanwhile, it provides favorable conditions for purchase, introduction, adsorption and domestication of foreign advanced incineration technology. Because of complexity and use of many high-technology in garbage incineration, the construction of large grate furnace incineration plant mainly depends on introduction of state-of-the-art incinerator with relatively high investment. The main foreign suppliers and types of incinerators in incineration market of China include Japan Mitsubishi Heavy Industries, Limited Company (Mitsubishi-Martin inverse grate), Japan Takuma Ltd, Co. (SN grate), Japan Hitachi Zosen Corporation, Japan JFE Corporation, German Noel Kerz Company (staircase pusher type fire grate), German Steinmuller Company (reciprocating pusher type fire grate), French Alstom Company (CITY2000 inclined reciprocating grate), Belgium Seegers Company (SHA multi-stage grate furnace) and Swiss VonRoll Company (R-10540 type grate furnace). Among them, the imported incinerator with most application is Mitsubishi-Martin inverse grate (mainly applied in Shenzhen Huanwei Comprehensive Treatment Plant, Stage I of Likeng Garbage Incineration Plant in Guangzhou, Zhongshan Central Garbage Incineration Plant and Binjiang Luneng Garbage Incineration Plant in Hangzhou); Japanese Takuma SN reciprocating grate furnace (mainly used in Shuanggang Garbage Incineration Plant in Tianjin, Gao’antun Garbage Incineration Plant in Beijing, Zhangjiagang Garbage Incineration Plant, etc.); and Belgium SHA multi-stage grate furnace (mainly applied in Shenzhen Nanshan Garbage Incineration Plant, Shenzhen Yantian Garbage Incineration Plant, Shenzhen Laohukeng Garbage Incineration Plant, Suzhou Garbage Incineration Plant, Changzhou Jinjia Garbage Incineration Plant, Changshu Garbage Incineration Plant, Tianjin Guanzhuang Garbage Incineration Plant, etc.) Up to 2010, China had 93 garbage incineration plants. The total investment of all

in-service garbage incineration plants was 1.8 billion Yuan. Two incineration plants employ grate furnace technology; four such plants employ circulating fluidized bed technology. At present, garbage incineration technology in China mainly depends on introduction of foreign advanced technology. Efforts have been made to absorb and domesticate such technology, which is not involved in export of technical services.

4.3 Market Scale and Application of Air Pollution Control Technologies

At present, the main application market of environmental service technologies for air pollution control is in industries such as thermal power, industrial boilers, iron and steel and building materials.

4.3.1 Particle Pollutant Treatment Technologies

The main particl pollutant treatment technologies in China could be classified into the following four types based on the grain size of pollutants: dry method (dust removal by machinery), wet method, filtration method and electrostatic method. The corresponding most common treatment equipment includes cyclone scrubber, foam scrubber, bag scrubber and electrostatic precipitator. Wet method scrubbers basically belong to the phasing out facilities because of low efficiency, big water demand and secondary water pollution. Except special occasion as primary dust removal or material recycling device, dry (machine) scrubbers usually are not employed for end-of-pipe treatment due to relatively low dust removal efficiency. Therefore, current development of smoke dust control technologies mainly focuses on bag process and electrostatic process. Although there appeared the combination of electrostatic and bad process in the past few years, its application is few. In developed economies, electrostatic process is widely employed due to relatively high emission standard, accounting to 85%.

I Thermal Power Industry

Up to the end of 2009, 95% boiler capacity in power plants in China employed electrostatic precipitator. The average efficiency of precipitators of coal fueled power plants with installed capacity at or above 6000 kW had been raised to over 98.5%. In the new coal fueled generating units putting into operation, the average efficiency is over 99%. The dust removal technology in power industry has enjoyed historical breakthrough in this period. Bag filter and electrostatic precipitators suitable for power plant boilers have achieved domestication and have been applied in power generating units with the capacity of 200,000~600,000 kW. The application of large amount of high-efficiency dust collecting equipment has greatly facilitated the control of smoke

dust, thus, smoke dust emissions from coal fueled power plants in China have been basically under effective control.

II Industrial Boiler Industry

Up to the end of 2008, there were over 568,800 various kinds of industrial boilers in China. Among them, about 480,000 were coal fueled boilers with smoke emission of 3.75 million t, accounting for 41.6% of total smoke emissions in China. The control of smoke emissions of coal fueled boilers in China began in 1970s. At first, the most widely used was mechanical dust collectors such as inertial dust separator and cyclone dust collector with the latter in dominance. With increasingly stringent environmental protection requirement, wet dust collector enjoys rapid development, mainly including the Venturi water dust scrubber, which has been widely applied in coal fueled boilers with capacity at and above 10t/h. In the past few years, the boilers for uses such as newly built small-scale co-generation or collective heating facilities have been equipped with electrostatic precipitator or bag dust collector due to stringent local emission standard. Moreover, there are more and more mechanical dust collectors or wet dust collectors have been reformed to electrostatic precipitator or bag dust collector.

III Iron and Steel Industry

Particle pollutants of iron and steel industry in China mainly come from sintering machines. According to the statistics of relevant department, up to the end of 2009, there were 970 in-service sintering machines with sintering area of 92,000 m^2 in iron & steel industry. The dust removing technology of sintering machines is mainly bag dust collector and electrostatic precipitator. Among them, bag dust collectors account for over 95% of the total, while electrostatic precipitators take up about 5%.

IV Building Material Industry

In 2010, smoke and dust emissions of cement industry in building materials industry of China ranked No.1 in terms of smoke and dust emissions, accounting for 40% of total emission of particle pollutants. Among them, dust pollution of cement industry is the most prominent and takes up over 70% of total dust emissions. The dust removing technologies employed in cement plants mainly include gravity dust separator, inertial dust separator, dust filter, electrostatic precipitator and wet dust collection. Among them, bag dust collector (dust filter) and electrostatic precipitator are in dominance. In cement industry, China is able to manufacture super dust collector supporting clinker production line with capacity of 10,000 t/d, treating air volume at 2 million m^3/h. However, the dust collecting efficiency of electrostatic precipitator is constrained by dust specific resistance, energy consumption and primary investment will be much higher than that of bad dust collection method if the enterprise wants high dust removal rate. Meanwhile, the dust removal rate of electrostatic precipitator is poor for

particles at 0.1 ~ 2 μm. Therefore, high-efficient dust removing technologies are more and more tend to the application of bag dust collector. The main characteristics of bad dust collector are stable operation, strong adaptability and its efficiency is seldom subject to the change of air volume; in addition, it can filter submicron particles, which is not affected by the influence of the nature of gas and dust. Internationally, 90% waste gases from cement plants in Germany are purified through bag dust collector. This makes the loss of cement dust less than 0.05% of its output and protects local ambient environment. In China, more and more bag dust collectors have been employed in the head and end of kiln of new production lines. All the big cement corporations such as China United Cement Co., Ltd., Jidong Cement Co., Ltd., Huaxin Cement Co., Ltd., Heidelberg Cement, Sinoma International and Yadong Cement Co., Ltd. employ bag dust collectors in their new 5,000~10,000 t/d production lines. To reduce emission, over 100 new dry cement production lines of China United Cement Co., Ltd. gradually begin replacing their electrostatic precipitators by bag dust collectors. Therefore, bag dust collectors are the key dust removal technology adopted in cement manufacturers in China.

4.3.2 Sulfur and Sulfide Treatment Technology

In China, a dozen of existing flue gas desulphurization technologies such as limestone-gypsum method, circulating fluidized bed, marine water desulphurization method, integration of desulphurization and dust removal, semidry method, limestone injection into furnace and activation of unreacted calcium (LIFAC) and active coke adsorption method have been widely applied. According to statistics, in all thermal power plant flue gas desulphurization projects that have been put into operation, under construction and signed contract, over 93% employ the wet limestone-gypsum desulphurization method.

I Thermal Power Industry

The sulfur and sulfides come from combustion of carbon of thermal power industry. Up to the end of 2010, the total installed capacity of coal fueled power plant with desulphurization facilities was 532 million kW, the percent of total installed capacity of desulphurization facilities went up from 12% in 2005 to 82.6%. SO_2 emission performance value of thermal power plants went down from 3.8 g/(kW•h) in 2008 to 3.2 g/(kW•h) in 2009. The key desulphurization technology of thermal power plants in China is limestone-gypsum method, accounting for 92%; followed by marine water method, accounting for 3%; circulating fluidized method, taking up 2%, ammonia nitrogen method, taking up 2% and others, taking up 1%.

II Industrial Boiler Industry

The SO_2 emission of industrial boiler industry is 5.19 million t each year, accounting

for 22.2% of total emissions. NOx emission is 1.87 million t, second only to thermal power industry and vehicles, ranking No.3 in China. The wet desulphurization technologies having been commercialized or finished pilot trial include lime (limestone) method, double alkali method, ammonia absorption method, ammonium phosphate compound fertilizer method, dilute sulfuric acid absorption method, seawater desulphurization and magnesium oxide method.

Among these methods, the wet calcium method is in dominance with advantages such as mature technology, high desulphurization rate, low Ca/S ratio, simple in operation, cheap and available adsorbent and convenient use of by-products. Among the wet calcium methods, the lime (limestone) method was put forward by Royal Chemical Industry as early as 1930s and is the most popular desulphurization technology at present. The application of alkaline compounds as absorbent is the key method for removing SO_2. Double alkali method has relatively popular application in other economies. Research and development of the double alkali method have good progress and become one of major technologies for flue gas desulphurization of industrial boilers in China.

III Iron and Steel Industry

In nearly 50 desulphurization devices in operation or under construction in China, the desulphurization technologies are divided into the following two types based on desulphurization by-products: ① “Calcium-based” desulphurization technology with desulphurization residue as by-product. This is the most commonly used technology, accounting for about 80%. “Calcium-based” desulphurization technologies include wet, semi-dry and dry methods of limestone. ② “Ammonia-ammonium sulfate desulphurization technology”, accounting for about 20%. With ammonia as desulphurization reagent, ammonia-ammonium sulfate desulphurization technology generates $(NH_3)_2SO_4$ as the by-product. Sintering desulphurization employs many types of technologies in China. Most desulphurization facilities in operation are at trail operation or wait-for-examination stage due to short operational period.

IV Building Material Industry

SO_2 emissions from cement plant mainly depend on sulfur content in raw materials or volatile ingredient of fuel. The cement kilns employing low-sulfur or free-of-sulfur fuel have small SO_2 emission. For example, SO_2 emission of some cement kilns can be less than 10 mg/m^3 without any purification measure. Because most sulfur in cement kiln retains in clinker in the form of sulfate, SO_2 emission is not a prominent problem. However, the application of raw materials with high concentration of volatile sulfur still causes SO_2 pollution. At this time, purification measures are needed. The possible options include spraying adsorbent such as $Ca(OH)_2$ at raw powder or kiln exhaust gas followed by dry and wet washing and filtration by activated carbon. These methods can reduce emission concentration to less than 200~400 mg/m^3.

4.3.3 Nitrogen and NOx treatment technology

There are the following three types of measures for the control of NOx emissions: 1) fuel denitrification; 2) reducing NOx emission by improving combustion technology; 3) installing flue gas denitrification devices. Flue gas denitrification is the most popular method in the world for reducing NOx emission.

In thermal power industry, a group of new thermal power plants began NOx control since 2003 when the Chinese Government released the Emission Standard of Air Pollutants for Thermal Power Plants (GB 13223-2003). Most of them have adopted relatively advanced low NOx combustion technology. All in-service power generating units have installed low NOx burner. Because this is a necessary device for boilers, it must be employed as long as boiler is put into operation and in general has NOx reduction effect. The technology adopted is mainly SCR, accounting for over 90%; while SNCR takes up less than 10%. However, there are quite many problems in the operation of built denitrifiction devices in thermal power plants. Except for some thermal power plants with continuous operation of denitrifiction devices, most thermal power plants have discontinuous running of such device. Some thermal power plants even no longer operate denitrifiction devices after check and acceptance of the power generating units.

In industrial boiler industry, NO and NOx are the main ingredients (over 90%) of NOx emissions of cement kilns. At present, the adopted NOx control technologies include flame cooling, low NOx burner, staged combustion, adding mineralizer, SNCR and SCR. Some new dry kilns adopt low NOx emission design, control the combustion of decomposing furnace to create reductive environment to reduce some NOx, leading to emission concentration less than 500 mg/m^3.

4.3.4 Trade of Air Pollution Control Technologies

I Particle Pollutant Treatment Technology

According to statistics of registered member of bag dust collector in 2010, the export volume of the industry had some increase compared with that of 2009, reaching $258 million, $37 million more than that of 2009, up by 16.7%. The total export volume of main equipment is $182 million, $16 million more than that of 2009, up by 9.63%. Among them, the export of bag dust collector of Yantai Spendex Group, Tianjin Zhongtian Shiming Co., Ltd., Sinosteel Tiancheng Co., Ltd., Hefei Cement Institue, Zhejiang Feida Co., Ltd., Zhejiang Jieda Co., Ltd., Kelin Environmental Protection Equipment Inc. and Jiehua Holdings has some increase. The export volume of fiber and filtration materials is $72 million, 21 million more than that of 2009. The export volume of fitting enterprises is $4 million, slightly less compared with that of 2009.

The export business of electrostatic precipitator enterprises is mainly equipment manufacturing. Some enterprises also provide overseas installation and debugging service. According to 2010 statistics, the total contract volume of 24 Chinese enterprises is 16.29 billion yuan RMB with output value at 13.69 billion yuan. The environmental protection sales revenue is 11.24 billion yuan RMB, the export volume is 2.31 billion yuan. The total environmental protection sale volume of 19 power supply enterprises is 720 million yuan with export volume at 99.18 million yuan.

II Sulfur and SOx Treatment Technology

Foreign trade of sulfur and SOx treatment technology mainly concentrates on introduction, digestion, adsorption and reinnovation of advanced foreign technologies. Chinese enterprises have introduced technologies such as limestone-gypsum method, circulating fluidized bed method and seawater desulphurization method from developed economies such as the United States, Germany and Japan over the past few years. With these as the bases, some enterprises have achieved re-innovation. For example, Suyuan Environmental Protection Engineering Co., Ltd. has developed its limestone-gypsum wet technology for flue gas desulphurization with independent intellectual property right and successfully applied it in flue gas desulphurization project of Stage II two power generating units with capacity at 300,000 kW of Taicang Power Co., Ltd.. Digesting and make reinnovation of the introduced German technology, Longyuan Environmental Protection Company of Beijing Guodian Corporation has developed its limestone-gypsum wet technology for flue gas desulphurization with independent intellectual property right and successfully applied it in the desulphurization facilities of two power generating units with capacity at 330,000 kW of Stage III construction project of Sulong Power Co., Ltd. in Jiangyin City.

III Nitrogen and NOx Treatment Technology

Foreign trade of nitrogen and NOx treatment technology mainly concentrates on introduction of denitrification technology and manufacturing technology of denitrification catalysts.

Foreign trade of denitrification technologies also focuses on the introduction, digestion, adsorption and reinnovation of advanced foreign technologies. The main exporting economies of nitrogen and NOx treatment technologies are the United States, Japan, Germany, Denmark and Italy. Based on adsorbing advanced technologies, China has developed new denitrification technology. For example, Suyuan Environmental Protection Engineering Co., Ltd. in Jiangsu Province and Japan Hitachi Zosen Corporation jointly developed OI2-SCR flue gas denitrification technology for large thermal power generating unit. Based on technical achievements in flue gas denitrification and capacity in developing large technological system with combination of existing flue gas denitrification technology and long-term experience of Hitachi

Zosen Corporation, OI2-SCR flue gas denitrification technology with independent intellectual property right suitable to national conditions of China has been developed and applied in Guohua Taicang Power Plant with good operational effect.

Apart from introducing foreign denitrification technologies, manufacturing technology for denitrification catalyst is another focus of introduction. In 2005, Dongfang Boiler Group Co., Ltd. invested 9.1 million Euro dollars to establish Chengdu DKC with foreign investment of German KWH Company to manufacture denitrification catalyst with designed capacity of SCR catalyst at 4500 m^3. Apart from sales to Chinese market and SCR power plants of Dongfang Boiler Group Co., Ltd., the catalyst products also are marketed in Europe and the United States. Longyuan Company of China Guodian Corporation has introduced catalyst manufacturing technology of Japan Catalytic Chemical Company. Longyuan Company and Environmental Protection Institute of China Guodian Corporation as partner have established Jiangsu Longyuan Catalyst Co., Ltd. for production of denitrification catalyst with annual output at 3,000 m^3 at Stage I and 5,000 m^3 at Stage II; the first batch of catalyst was manufactured in April of 2009.

5. Conclusions and Suggestions

From the analysis above, in a word, some conclusions can be drawn and suggestions will be given. To be sure, the following conclusions and suggestions are made by the researchers, as an input into the APEC Group on Services' further work on environmental services. They do not necessarily represent the views of APEC economies.

5.1 Conclusions

1) At present, there is no unified definition and classification of environmental service in the world. Influential classifications of environmental services are included in WTO/120 document, CPC and OECD/EUROSTAT. However, there is some common understanding about classification on environmental elements. All of the four classifications include sewage services, waste disposal services etc..

2) In recent years, ES-related technology has been developing and upgrading rapidly with more investment and huge environmental pollution control demand. Based on our research, more than 800 ES-related technologies existed and more are needed. Therein, the dominant technologies are air pollution control technology, waste water treatment and delivery technology and solid and hazardous waste management technology.

3) ES-related technology market is imbalance. The gap of ES-related technologies between developed economies and developing economies exist. Most of ES-related technology market is in the developed areas, but there is huge potential in developing areas. For example, China still imports sewage treatment technologies in BOT or TOT form. Though there are some exports to developing economies, China is still at the low end of foreign trade due to lack of independent intellectual property right.

4) Even to deal with the same pollutant and provide the same environmental service, different sectors require different ES-related technology. For example, in thermal power plants, the key desulphurization technology is limestone-gypsum method, but the dominance one in industrial boiler industry is the wet calcium method.

5) The capacity building on ES-related technology is urgently necessary. For most of interviewees we interviewed, ES and ES-related technology were new term and heard them at the first time. Only 2 filled questionnaires came back to us.

5.2 Suggestions

1) APEC should address environmental services and ES-related technology as the same as environmental goods. APEC should develop a classification of environmental services as APEC environmental goods list. And to make it as a specific action and activity of initiating the EGS Work Program Framework. Our suggestion of a classification of environmental services considers indoor, outdoor and global scales. Specifically, it should include 10 categories: air pollution control technology, waste water treatment and delivery technology, solid and hazardous waste management technology, noise and vibration abatement technology, contaminated soil remediation technology, environmental monitoring and analysis technology, administration technology for nature risk, natural resource protection and ecologic conservation technology, environmentally preferable technology, international environmental conventions-related and climate change mitigation technology.

2) APEC should create an APEC Action Plan to promote and facilitate the dissemination of ES-related technology. The APEC Action Plan should set out 5 major areas: capacity building, supply and needs assessment, information exchange, enabling environment, business involvement.

3) APEC should strengthen capacity building on dissemination of ES-related technology, particularly those of developing economies to attract, use and develop EGS technologies, as well as develop their EGS industries. To launch an APEC Public Environmental Education and Awareness Raising Program for SMEs. To improve stakeholders' and officials' capacities, trainings on ES-related technology dissemination could be conducted in the margin of GOS.

4) APEC should strengthen experience and information sharing among government officials, institutes and private sectors of APEC economies. Exhibitions, forums, and seminars on APEC ES-related technology could be hosted periodically. To strengthen business involvement, Public-Private Partnership (PPP) cooperation could be explored and participation of Small and Medium Enterprises (SMEs) could be promoted.

5) APEC should promote understanding, knowledge and communication on the supply and demands on ES-related technology, by conducting research and delivering report on APEC ES-related technology. Database on ES-related technology could be further developed based on the database we provided in the project and uploaded to the APEC EGS website and upgraded periodically. The database will be an information communication platform and reflect the

information from both of supply side and demand side.

6) APEC should enhance the policy cooperation, including areas of addressing barriers that handicap ES-related technology dissemination, developing best practice and guidelines for ES-related technology dissemination, cooperation on environmental codes and standards, joint R&D, etc., and thus enable the environment of regional ES-related technology dissemination.

ANNEX I Contents of Environmental Goods and Services (EGS) in Statements by APEC Leaders and Ministers

Year	Location	APEC literature	
		Document	**Citations**
2007	Sydney, Australia	Joint Statement of the 19th APEC Ministerial Meeting	We instructed officials to continue their work on environmental goods and services and explore ways to reduce trade barriers in this area. We agreed that market opening in the WTO would advance our climate and energy security goals. ”
		Sydney APEC Leaders' Declaration on Climate Change, Energy Security and Clean Development	Further measures in trade in environmental goods and services, aviation transport, alternative and low carbon energy uses, energy security, the protection of marine biological resources, policy analysis capabilities and a co-benefit approach. An open global trade and investment system is central to our clean development objectives and market opening in the World Trade Organization (WTO) would advance our climate and energy security goals. We therefore agree to review and discuss at the 2008 APEC Leaders' meeting the progress achieved in the WTO Doha Development Agenda negotiations on the liberalization of trade in environmental goods and services.
2008	Lima, Peru	Joint Statement of the 20th APEC Ministerial Meeting	We acknowledged the importance of continued research and development, and application, of environmental goods and services for achieving the region's environmental and sustainable development priorities. We welcomed the progress made in APEC in this area in 2008. We welcomed the Environmental Goods and Services (EGS) Framework to advance work on EGS as a basis for the development of a concrete EGS work program to be delivered to Ministers Responsible for Trade at their meeting in 2009. We also support continued efforts to promote the exchange of information in this important sector. We have reviewed progress in the World Trade Organization (WTO) negotiations to increase market access for environmental goods and services, and we reaffirmed that an open global trade and investment system is central to our clean development objectives and market opening in the WTO would help to advance our climate and energy security goals.
2009	Singapore	Statement of the 17th APEC Economic Leaders' Meeting	Responding to climate change through transition to green economies also offers opportunities. We will ensure that efforts to address climate change are consistent with our international trade obligations. A key thrust in APEC's sustainable growth agenda is the APEC Environmental Goods and Services (EGS) Work Programme, under which we will develop and implement a set of concrete actions to support sustainable growth in the region, advance work to increase utilization and dissemination of EGS, reduce existing barriers and refrain from introducing new barriers to trade and investment in EGS, and enhance capabilities of economies to develop their EGS sectors. We also commit to rationalize and phase out over the medium term fossil fuel subsidies that encourage wasteful consumption, while recognizing the importance of providing those in need with essential energy services. We will review progress on this at our meeting in 2010. We will also take steps to facilitate the diffusion of climate-friendly technologies, including through economic and technical cooperation (ECOTECH) and capacity building activities.
		Statement by APEC Leaders "A New Growth Paradigm for a Connected Asia-pacific in	We will explore ways to reduce barriers to trade and investment in environmental goods and services (EGS) and will refrain from introducing new barriers to trade in EGS.

		the 21st Century	
		Joint Statement of the 21st APEC Ministerial Meeting	We will seek to ensure that economic growth is consistent with sustainable development. Anthropogenic climate change is one of the biggest challenges facing the world. As APEC's key response to addressing this challenge, our sustainable growth agenda will include improved access for Environmental Goods and Services (EGS), development of EGS sectors of APEC economies, enhancing energy efficiency and sustainable forest management and rehabilitation. The EGS market has a key role to play in fostering sustainable growth and advancing efforts to combat climate change. The Intergovernmental Panel on Climate Change has highlighted that many climate-friendly technologies and goods are already commercially available and that more are expected to be commercialized soon. These technologies will benefit from trade liberalization. The World Bank has estimated that the removal of barriers for trade in four basic clean energy technologies (i.e. wind, solar, clean coal, and efficient lighting) alone could boost their trade by as much as 13 percent. We welcome APEC's efforts to enhance understanding of remanufactured products, which reuses inputs and uses less energy than manufacturing new goods. We will explore ways to reduce existing barriers to trade and investment, and refrain from introducing new barriers in EGS. We will also take steps to facilitate the diffusion of climate-friendly and other EGS technologies, including through economic and technical cooperation (ECOTECH) and capacity building activities. We welcome the launch of the APEC EGS Information Exchange to promote greater transparency, information sharing, collaboration, and dissemination of EGS in APEC and globally. We endorse APEC's EGS work programme which has helped to raise awareness of what needs to be done to facilitate trade, investment and development in EGS, and instruct officials to report progress on this work at AMM 2010. We reaffirm that an open global trade and investment system is central to our clean development objectives and market opening in the WTO would advance our climate and energy security goals. We recognize that joint research, development, deployment and transfer of low and zero emission technologies will be crucial in our shared efforts to address climate change.
2010	Yokohama, Japan	Statement of the 18th Informal Meeting of Leaders	● Vision - Robust community: A community with higher quality growth We aim to further enhance the quality of growth so that the Asia-Pacific region can realize sustained growth and continue to be an engine of economic activity and progress in the world economy. Policies that promote balanced growth within and among APEC economies should be adopted. All sectors of society, in particular potentially disadvantaged and marginalized groups, should be provided opportunities to fully realize their potential. Both economic growth and environmental sustainability should be advanced in a holistic manner, and progress toward a green economy should be accelerated by promoting trade and investment in environmental goods and services, developing this sector in APEC economies, and enhancing energy efficiency and sustainable forest management and rehabilitation. Innovative growth should be advanced within and across our economies through the adoption of policies and regulatory environments that best enable economies to support innovation, utilize information and communication technologies, develop a skilled workforce, and increase research and development. ● Path toward an economically-integrated community APEC should contribute to the pursuit of an FTAAP by continuing and further developing its work on sectoral initiatives in such areas as investment; services; e-commerce; rules of origin; standards and

			conformance; trade facilitation; and environmental goods and services. ● Path toward a robust community We will increase the dissemination and utilization of environmental goods and services, reduce existing barriers and refrain from introducing new barriers to trade and investment in such goods and services, and enhance our capabilities to develop this sector, by prioritizing work related to addressing non-tariff measures on environmental goods, technology, and services.
		The 22nd APEC Ministerial Meeting Joint Statement	We reaffirmed that Environmental Goods and Services (EGS) have a key role to play in fostering sustainable growth, advancing efforts to combat climate change and to protect the environment. We reiterated our support for increasing the utilization and dissemination of EGS, reducing barriers to trade and investment in EGS, and enhancing the capabilities of economies to develop their EGS sectors. We commended achievements made on projects undertaken to implement the EGS Work Programme this year, which take advantage of APEC's strengths, including cross-fora collaboration among groups. We noted the findings from a mapping exercise of energy efficiency products to address non-tariff barriers which could arise through unnecessary divergences among APEC economies' energy efficiency standards, labeling and testing procedures. We also noted the development of capacity building activities. In particular, we welcomed the completion of the case studies on developing APEC economies' EGS markets, such as the study on Malaysia, and instructed officials to undertake additional case studies in 2011. Building on the achievement made this year, we instructed officials to take further concrete actions on EGS, prioritizing work related to addressing non-tariff measures on environmental goods, technology, and services. We will support progress on the EGS negotiations in the WTO DDA. We also welcomed the ongoing work on facilitating trade in remanufactured products, which saves natural resources and contributes to green growth, and instructed officials to take further steps in this regard in 2011. We recognize that joint research, development, deployment and transfer of technologies will be crucial in our shared efforts to address climate change.
2011	Hawaii, United States	Statement of the 19th Informal Meeting of Leaders: The Honolulu Declaration-Toward a Seamless Regional Economy	We are committed to advancing our shared green growth objectives. We can and must address both the region's economic and environmental challenges by speeding the transition toward a global low-carbon economy in a way that enhances energy security and creates new sources of economic growth and employment. We have advanced these objectives significantly in 2011. In 2012, economies will work to develop an APEC list of environmental goods that directly and positively contribute to our green growth and sustainable development objectives, on which we are resolved to reduce by the end of 2015 our applied tariff rates to 5% or less, taking into account economies' economic circumstances, without prejudice to APEC economies' positions in the WTO. Economies will also eliminate non-tariff barriers, including local content requirements that distort environmental goods and services trade (see Annex C). Taking these concrete actions will help our businesses and citizens access important environmental technologies at lower costs, which in turn will facilitate their use, contributing significantly to APEC's sustainable development goals.
		Statement of the 19th Informal Meeting of Leaders- Annex C - Trade and Investment in Environmental Goods and	Abstract: The annex summarized APEC's work on promoting sustainable development and environmental goods and services trade and investment. The annex has also posted several concrete actions to promote environmental goods and services trade and investment by APEC. ● In 2012, economies will work to develop an APEC list of environmental goods that directly and positively contribute to

		Services	our green growth and sustainable development objectives, on which we are resolved to reduce by the end of 2015 our applied tariff rates to 5% or less, taking into account economies' economic circumstances, without prejudice to APEC economies' positions in the WTO. ● Eliminate, consistent with our WTO obligations, existing local content requirements that distort environmental goods and services trade in the region by the end of 2012, and refrain from adopting new ones, including as part of any future domestic clean energy policy. ● Ensure that all government support and incentive programs aimed at promoting environmental goods and services are transparent and consistent with economies' WTO obligations. ● Ensure that all government procurement policies pertaining to environmental goods and services are transparent, consistent with the 1999 APEC Non-Binding Principles on Government Procurement. ● Promote regulatory coherence and cooperation in areas affecting environmental goods, including by better aligning approaches to standards and conformance in the environmental goods sector. ● Affirm our commitment to pursue liberalization of environmental goods and services in the World Trade Organization (WTO), including by exploring creative and innovative solutions to advance the Doha mandate to reduce and, as appropriate, eliminate tariff and non-tariff barriers to these goods and services. ● Pursue progressive liberalization of trade in environmental goods and services in our Free Trade Agreements.
		The 23rd APEC Ministerial Meeting Joint Statement	Promoting Liberalization of Trade and Investment in Environmental Goods and Services We advanced work to promote liberalization in trade and investment in environmental goods and services, and submitted the issue to APEC Leaders' to consider how best to take this work forward.
2012	Vladivostok, Russia	Statement of the 20th Informal Meeting of Leaders: Vladivostok Declaration - Integrate to Grow, Innovate to Prosper	We reaffirm our commitment to promote green growth and to seeking practical, trade-enhancing solutions to address global environmental challenges. In 2012, we made considerable progress in this regard. We welcome and endorse the APEC List of Environmental Goods that directly and positively contribute to our green growth and sustainable development objectives (see Annex C). We reaffirm our commitment to reduce our applied tariff rates to five percent or less on these environmental goods by the end of 2015, taking into account economies' economic circumstances without prejudice to their positions in the WTO. By reducing tariffs on environmental goods, we will help our businesses and citizens to access important environmental technologies, which will facilitate their deployment, and use contributing significantly to our green growth and trade liberalization objectives.
		The 24th APEC Ministerial Meeting Joint Statement	Promoting trade in environmental goods This year, we made considerable progress towards implementing the 2011 Leaders' commitments to promote trade and investment in environmental goods and services, as a key part of our green growth and sustainable development agenda. We dedicated all available resources to fulfill our Leaders' instruction in 2011 to develop an APEC List of Environmental Goods that directly and positively contribute to our green growth and sustainable development objectives.

ANNEX II APEC EGS Work Programme

In Sydney in 2007 APEC Leaders committed, through wide-ranging and ambitious actions, as set out in the Sydney Action Agenda, "to ensuring the energy needs of the economies whilst addressing the issue of environmental quality and contributing to the reduction of greenhouse gas emissions." Leaders also affirmed that "An open global trade and investment system is central to our clean development objectives and market opening in the World Trade Organization (WTO) would advance our climate and energy security goals." and recognized that "Joint research, development, deployment and transfer of low and zero emission technologies will be crucial in our shared efforts to address climate change."

The 2007 Leader's Action Agenda included co-operative actions and initiatives designed to achieve an objective of supporting economic growth and development of the Asia Pacific region and to further contribute to the reduction of global greenhouse gas emissions.

The Committee on Trade and Investment (CTI) has worked since then to address Leaders' instructions, including by developing an EGS work program as a contribution to APEC's broader objective of promoting sustainable economic growth in the region. Central to the CTI's work in this area is the recognition that an open global trade and investment system is necessary for the dissemination and increased utilization of EGS, and that this would be part of APEC's contribution to global development, economic, and environment objectives.

The **APEC EGS Programme Framework** was endorsed by Ministers at the 2008 AMM. The objectives of the Framework are to support the development of the EGS sector in APEC and to provide a coherent setting for the work under way in various APEC bodies. The Framework has four components: (a) research and development, (b) supply, (c) trade and (d) demand. The full description of the four framework components is as follows:

a. **Research and development**: For both goods and services, this refers to developing new and better EGS through innovation and R&D which address not only trade in EGS but also environment and development (i.e. rural development, job creation and applied technology). APEC economies can share ideas and best practices on innovation and R&D programmes that spur the development of EGS.
b. **Supply**: For goods, this includes the incorporation of cleaner, more resource and energy efficient technologies. For services, this includes the training of skilled personnel. Both entail a need for more focus and investment in the EGS industry. APEC economies can explore ways to facilitate investment in EGS and share best practices in developing the EGS industry sector.
c. **Trade**: This component aims to improve trade in EGS through trade facilitation and trade liberalization. For the former, APEC MAG (Market Access Group)/GOS (Group on Services) have been developing projects that facilitate trade in EGS. For trade liberalization, this component adheres to the Doha Para 31(iii) mandate. Recognizing that the negotiations will be done in the WTO, APEC MAG/GOS can come up with ways to support the negotiations in the WTO.
d. **Demand**: An increase in demand will create incentive for the market to increase R&D and investment in EGS. APEC economies can look into sharing best practices in public education on EGS and pro-EGS consumer policies, such as measuring and showing the impact of EGS on the environment.

Based on the results of the mapping exercise, APEC members agreed to take the following actions in order to support sustainable economic growth in the region, advance APEC's work to increase utilization of EGS, reduce barriers to trade and investment in EGS and enhance the capabilities of members to develop their EGS sectors:

- Launch and continue to contribute to the Environmental Goods and Services Information Exchange (EGSIE), a Web site that will serve as a foundation for future work on EGS in APEC, and will promote greater transparency, information-sharing, collaboration, and dissemination of EGS in the APEC region and globally.
- Identify a "package" of follow-up actions that would enable economies to enhance their sustainable economic development and contribute to the growth of the APEC region. Three key aspects of this would be an identification of: (1) goods and services for which, via increased utilization, an economy would be able to contribute towards climate change mitigation as well as sustainable economic development; (2) concrete steps to facilitate the diffusion of climate friendly and other EGS technologies so as to increase the capabilities of economies to maintain sustainable growth; and (3) capacity-building activities to help ensure that APEC economies, especially developing economies, are able to cultivate and further develop their EGS sectors and meet their sustainable growth goals, including identifying areas of technology transfer of interest to economies and initiating a series of case studies so as to better understand the needs of developing economies in this area.
- Promote greater dissemination and utilization of EGS by raising awareness of the differing economic conditions and resultant needs of economies; undertaking work to address nontariff barriers and

enhance market drivers to environmental goods through close cooperation among relevant fora, such as local content requirements; explore greater harmonization and convergence of standards, particularly in the area of energy efficiency; facilitate investment in the EGS sector; and

- Improve understanding and market access for environmental services and services relevant to climate change mitigation.

ANNEX III Questionnaire on APEC Environmental Services (ES) and ES-Related Technology Market

Dear Sir or Madam,

One of APEC objectives is to promote green growth. In order to speed the transition toward an environment friendly and low-carbon economy fighting the region's economic and environmental challenges, the APEC leaders in their Declaration in 2011, required to take concrete actions to help businesses and citizens access important environmental technologies at lower costs, which in turn will facilitate their use, contributing significantly to APEC's sustainable development goals.

For this purpose and based on the background above, China proposed a Study Programme on APEC Environmental Services-Related Technology Market, which has then endorsed by APEC member economies. The following questionnaire is an important part of this project. It will be much appreciated if you could take a few minutes to fill it out and return it to Ms. Li Liping **before 20 April 2013** at the following address by _____.

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No.1, Yuhuinanlu, Chaoyang District, Beijing, 100029, China
Tel: +86 10 84665317 +86 10 84665308
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Email: zhang.bin@prcee.org; li.liping@prcee.org;

Thank you in advance for your time and cooperation in this endeavor.

Questionnaire on APEC Environmental Services (ES) and ES-Related Technology Market

I Basic information on ES and ES-Related Technology in your economy

A. What is the definition of ES in your economy?

B. What is the definition of ES-related technology in your economy?

C. Please describe the classification of ES-Related Technology in your economy. The following is an example of classification and you might add or revise according to your economy's situation.

1. Air Pollution control technology (e.g. separating dispersed particles from gases or vapours by liquid as separating agent, use of additives to fuels or fires for particular purposes for reducing smoke development)
2. Waste water treatment and delivery technology (e.g. cleaning or keeping clear the surface of open water)
3. Solid and Hazardous waste management technology (e.g. gathering or removal of domestic or like refuse, production of liquid hydrocarbon mixtures from rubber or rubber waste)
4. Noise and vibration abatement technology (e.g. sound absorption and insulation treatment)
5. Contaminated soil remediation technology (e.g. reclamation of contaminated soil)
6. Environmental monitoring and analysis technology (e.g. monitoring exhaust-gas treatment apparatus)
7. Nature risk management technology
8. Natural resource protection and ecologic conservation technology
9. Environmentally Preferable technology
10. International environmental conventions-related and climate change mitigation technology (e.g. CO2 capture by absorption)
11. Others

D. Please list the most popular 5 technologies with the classification above in your economy.

	1	2	3	4	5
1. Air Pollution control technology					
2. Drinking water/waste water treatment and delivery technology					
3. Solid and Hazardous waste management technology					

4. Noise and vibration abatement technology					
5. Contaminated soil remediation technology					
6. Environmental monitoring and analysis technology					
7. Nature risk management technology					
8. Natural resource protection and ecologic conservation technology					
9. Environmentally Preferable technology					
10. International environmental conventions-related and climate change mitigation technology					

E. Please list the top exported 5 ES-Related Technology with the classification above in your economy

	1	2	3	4	5
1. Air Pollution control technology					
2. Drinking water/waste water treatment and delivery technology					
3. Solid and Hazardous waste management technology					

4. Noise and vibration abatement technology					
5. Contaminated soil remediation technology					
6. Environmental monitoring and analysis technology					
7. Nature risk management technology					
8. Natural resource protection and ecologic conservation technology					
9. Environmentally Preferable technology					
10. International environmental conventions-related and climate change mitigation technology					

F. Please list the most needed or top imported 5 ES-Related Technology with the classification above in your economy.

	1	2	3	4	5
1. Air Pollution control technology					
2. Drinking water/waste water treatment and delivery technology					
3. Solid and Hazardous waste management technology					

4. Noise and vibration abatement technology					
5. Contaminated soil remediation technology					
6. Environmental monitoring and analysis technology					
7. Nature risk management technology					
8. Natural resource protection and ecologic conservation technology					
9. Environmentally Preferable technology					
10. International environmental conventions-related and climate change mitigation technology					

G. What policies and measures to promote ES industry are taking in your economy

H. What policies and measures to promote ES-related technology development and dissemination are taking in your economy

II The role of different stakeholders in developing ES-Related Technology Market. (The score is ranged from 0-5. The score 0= do nothing; 5= do perfect)

A. Please give the remark score of governments' work in developing Environmental Services-Related Technology Market in your economy:

Major work	1	2	3	4	5
1. Making environmental industry planning to guide Environmental Services-Related					

Technology					
2. Making economic stimulus policy including fiscal and taxation policies to encourage development of Environmental Services-Related Technology					
3. Making environmental technology and standard polices to promote the upgrade of Environmental Services-Related Technology					
4. regularly implementing the survey on Environmental Services-Related Technology					
5. other (please specify)					

Please list the policies and standard relevant to the ES-related technology and its market in your economy:

_____

B. Please give the remark score of work of research institutes, universities and colleges in developing Environmental Services-Related Technology Market in your economy:

Major work	1	2	3	4	5
1. Developing the pollution control technology fitted to your economy situation					
2. applying the new pollution control technology to industrialization					
3. other (please specify)					

C. Please give the remark score of enterprises' work in developing Environmental Services-Related Technology Market in your economy:

Major work	1	2	3	4	5
1. Developing the pollution control technology by itself					
2. Importing the advanced technology					
3. other (please specify)					

D. Please give the remark score of NGOs' effect on developing Environmental Services-Related Technology Market in your economy:

Major effect	1	2	3	4	5
1. exert pressure on government or enterprises to improve environment quality by developing ES-related technology					
2. act as medium agencies to provide ES-related technology information					
3. other (please specify)					

III The challenges and difficulties of ES-related technology dissemination

A. Please rank the challenges of development and dissemination on ES-related technology(the first is the most important challenge)

1. information access difficulties

2. intellectual property protection

3. the transferring will of the technology owner

4. the price of ES-technology is so high

5. lack of human resource

6. regulation barriers

7. other (please specify)_____

Please rank it: _____

B. Which kind model of cooperation is suitable for the dissemination on ES-related technology in APEC economies?(choose as many as appropriate)

1. cooperative production

2. investment

3. pilot project

4. technology training

5. personnel exchanges

6. other (please specify) _____

C. Which kind financial mechanism is suitable for the dissemination on ES-related technology among APEC economies?(choose as many as appropriate)

1. through the international fund of technology dissemination

2. preferential loans project with government subsidy

3. technology cooperation with importing complete set of equipment

4. other (please specify)_____

D. As demand side, what measures should be taken to promote the import of ES-related technology?

1. government should make stimulating financial policy on technology supply private sectors

2. government should make special regulations to protect the intellectual property on ES-related technology dissemination issue

3. government should strengthen the human capacity building

4. government should improve technology dissemination requirement when approving the technology cooperation project

5 other (please specify)_____

E. As supply side, what measures should be taken to promote the export of ES-related technology in APEC economies?

1. government should act the leading role on technology dissemination

2. government should make subsidy or reward policies to encourage private sector to implement technology dissemination

3. government should implement training on private sectors to improve their social responsibility on environment issue

4. other (please specify)_____

IV suggestions on way forward to develop and disseminate the ES-related technology

A. Which measures should be taken by APEC to improve the Capacity building of ES-related technology dissemination(choose as many as appropriate)

1. hold the training course on officers, researcher, managers, sellers and engineers in companies

2. develop APEC guideline and good practice

3. launch an APEC Public Environmental Education and Awareness Program for SMEs

4. other (please specify)_____

B. For assessment of environmental technology need and supply, please rank the following measures: (the first one is the most important)

1. launch a study project for the needs/supply assessment tool and standards of ES-related tech. dissemination

2. launch a research project to better understand the needs/supply, identify key fields of the dissemination

3. other (please specify)_____

Please rank it: _____

C. For platforms Building and information exchange, please rank the following measures: (the first one is the most important)

1. hold an exposition of APEC ES-related technology

2. set and monthly update a database of APEC ES-related technology in the APEC web to form a comprehensive database and information management system

3. provide URLs in supporting SMEs to access standards and conformance related information on ES-related technology

4. hold workshops on sharing ES-related technology information annually

5. promote the APEC ES-related Technology Multilateral Certification

6. other (please specify)_____

Please rank it: _____

D. For Setting up APEC mechanism on ES-related tech. dissemination, please rank the following measures: (the first one is the most important)

1. Build policy dialogue mechanism to demand and discuss the dissemination way of the technology under APEC framework

2. Set up an APEC Information Exchange Center of ES-related technology

3. Establish ES-related technology Fund for the ES-related technology

4. Strengthen APEC cross-fora collaboration among groups such as CTI, MAG, SCSC and EWG on EGS and ES-related tech.

5. other (please specify)_____

Please rank it: _____

E. What measures should be taken by APEC to develop and disseminate the ES-related technology?

Please provide the following information:

1. Your economy:
2. Your organization:
3. Your name:
   Title: email:
   Tel: Fax:
4. Key contact person(if different with you)
   Name:
   Title: email:
   Tel: Fax:

Many thanks for your kind cooperation!

ANNEX IV Technic and Method Used in Investigation and Analysis

1. Literature review

In order to get a better understanding on Environmental Service (ES)-related technology of current knowledge, define the research concepts and goals well, and find out the critical points of theoretical and methodological contributions to ES-related technology, its investigation and survey, a literature review should be conducted in this research.

In this step, a lot of literature on Environmental technology, ES-related technology, statistic and investigation methods will be reviewed to get a general idea on the technologies and methodologies which have been already studied, and then find out the shortcomings of previous research and what we should do in our research to improve it.

2. Brainstorming

In order to find indicators and methods of assessing and analyzing the dissemination of ES-related within APEC members as many as possible in this research, brainstorming will be adopted in this session.

Brainstorming is a group or individual creativity technique by which efforts are made to find a conclusion for a specific problem by gathering a list of ideas spontaneously contributed by its members. It emphasizes the quantity of the ideas, withholding criticism, deferring the judgment and combining the ideas. If a brainstorming will be conducted effectively, six measures should be taken as follows.

a Agenda Set

Topic and purpose of the brainstorming will be set and then given to the participants in advance. Most of the time, the abstract level of the topic should be paid enough attention to. The more abstract the topic is, the more creative the brainstorming will be, but the difficulty of hosting the brainstorming will increase.

b Preparation

Before starting the brainstorming, background and basic concept about ES-related technology and its dissemination should be introduced by the hosts. The more details about the research were given, the better the effect of the brainstorming will be. Besides, round-table meeting room is better than traditional classroom as the place of brainstorming when you want to inspire the ideas of the participants.

c Candidates Identification

The quantity of Candidates is best confined to around 12 persons, including both experts and novices, because the more people take part in the brainstorming, the more ideas will be inspired, but the less time will be left to explain them and exchange information.

d Job Assignment

Every person taking part in brainstorming has his/her own assignment. There should be an anchorperson and a recorder. The anchorperson should organize the brainstorming and summarize the ideas which are presented by the participants, and the recorder should write those ideas and gives his/her opinions. All the participants should put themselves into the activities thoroughly.

e Provision of Disciplines

Rules and disciplines of the brainstorming should be provided on the meeting, such as positively engaging, no

charting, expressing directly and so on. The only object of the rules and disciplines is making sure express ideas freely and inspire them as many as possible.

f Time mastering

Time spent on the brainstorming should be well controlled in order to get a perfect effect. If the meeting lasts too long, the participants will feel tired and exhausted else they won't have enough time to express their ideas fully. Therefore, the expert suggests that 30-45 minutes is best for the meeting of brainstorming.

After taking these measures and holding the brainstorming meeting, ideas about how to assess and analyze the dissemination of ES-related within APEC members will be collected and form a summary.

3. Expert Workshop

In order to find the most proper indicators or scope the indicators to assess the dissemination of ES-related within APEC members, expert workshop should be hold to refine and remark the ideas got on the brainstorming meeting hold before.

Moreover, in order to determine the methods which will be used to analyze the ES-related technology dissemination in this research and create the hierarchical system and catalogue of ES-related technology list, expert workshop should also be hold to discuss the study methods and ES-related technology list.

4. Survey and Investigation

In order to get a better effect of survey on dissemination of environmental technology within APEC, it is important to design sampling and questionnaire effectively.

4.1 Sampling Method

a. Population definition

Successful statistical practice is based on focused problem definition. In sampling, this includes defining the population from which our sample is drawn. A population can be defined as including all people or items with the characteristics one wishes to understand.

In this research, we want to analyze Environment Services (ES)-related technology market within APEC economies to facilitate potential ES and ES-related technology trade and investment, and promote greater dissemination of ES-related technology. In order to achieve the research goals, the population is defined as all the stakeholders and members in the ES-related technology markets within APEC economies. From the perspective of factors in the ES-related technology markets, population of interest includes governments, enterprises, investors, customers and those who are related to the innovation of ES-related technology. On the other hand, population would probably consist of all the members within APEC economies from geographical scope.

b. Sample size determination

Several fundamental facts of mathematical statistics, including the law of large numbers and the central limit theorem, could describe a phenomenon that larger sample sizes generally lead to increased precision when estimating unknown parameters. Actually, the relationship between sample size and precision of survey is not simply linear in many cases. In some situations, the increase in accuracy for larger sample sizes is minimal, or even non-existent. This can result from the presence of systematic errors or strong dependence in the data, or if the data follow a heavy-tailed distribution.

In order to solve this problem and maximize the precision and effect of the survey, some statistic methods are adopted in our research.

The formula is as below:

Correction for finite population:

Where:

n = sample size for infinite population

$\bar{n}$ = Corrected sample size for finite population, if population is infinite, $\bar{n}$ equals n

Z = Z value

1-α = confidence level, expressed as percentage

P = percentage picking a choice, expressed as decimal (0.5 used for sample size needed)

C = confidence interval, expressed as decimal

pop = population

The relationship between Z value and confidence level is as below:

If confidence level was given, Z value can be easily found out through tab.IV-1 as below.

Tab.IV-1 Z Scores and confidence level

Z-Score	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0	0.00%	0.80%	1.60%	2.40%	3.20%	3.98%	4.78%	5.58%	6.38%	7.18%
0.1	7.96%	8.76%	9.56%	10.34%	11.14%	11.92%	12.72%	13.50%	14.28%	15.06%
0.2	15.86%	16.64%	17.42%	18.20%	18.96%	19.74%	20.52%	21.28%	22.06%	22.82%
0.3	23.58%	24.34%	25.10%	25.86%	26.62%	27.36%	28.12%	28.86%	29.60%	30.34%
0.4	31.08%	31.82%	32.56%	33.28%	34.00%	34.72%	35.44%	36.16%	36.88%	37.58%
0.5	38.30%	39.00%	39.70%	40.38%	41.08%	41.76%	42.46%	43.14%	43.80%	44.48%
0.6	45.14%	45.82%	46.48%	47.14%	47.78%	48.44%	49.08%	49.72%	50.34%	50.98%
0.7	51.60%	52.22%	52.84%	53.46%	54.08%	54.68%	55.28%	55.88%	56.46%	57.04%
0.8	57.62%	58.20%	58.78%	59.34%	59.90%	60.46%	61.02%	61.56%	62.12%	62.66%
0.9	63.18%	63.72%	64.24%	64.76%	65.28%	65.78%	66.30%	66.80%	67.30%	67.78%
1	68.26%	68.76%	69.22%	69.70%	70.16%	70.62%	71.08%	71.54%	71.98%	72.42%
1.1	72.86%	73.30%	73.72%	74.16%	74.58%	74.98%	75.40%	75.80%	76.20%	76.60%
1.2	76.98%	77.38%	77.76%	78.14%	78.50%	78.88%	79.24%	79.60%	79.94%	80.30%
1.3	80.64%	80.98%	81.32%	81.64%	81.98%	82.30%	82.62%	82.94%	83.24%	83.54%
1.4	83.84%	84.14%	84.44%	84.72%	85.02%	85.30%	85.58%	85.84%	86.12%	86.38%
1.5	86.64%	86.90%	87.14%	87.40%	87.64%	87.88%	88.12%	88.36%	88.58%	88.82%
1.6	89.04%	89.26%	89.48%	89.68%	89.90%	90.10%	90.30%	90.50%	90.70%	90.90%

1.7	91.08%	91.28%	91.46%	91.64%	91.82%	91.98%	92.16%	92.32%	92.50%	92.66%
1.8	92.82%	92.98%	93.12%	93.28%	93.42%	93.56%	93.72%	93.86%	93.98%	94.12%
1.9	94.26%	94.38%	94.52%	94.64%	94.76%	94.88%	95.00%	95.12%	95.22%	95.34%
2	95.44%	95.56%	95.66%	95.76%	95.86%	95.96%	96.06%	96.16%	96.24%	96.34%
2.1	96.42%	96.52%	96.60%	96.68%	96.76%	96.84%	96.92%	97.00%	97.08%	97.14%
2.2	97.22%	97.28%	97.36%	97.42%	97.50%	97.56%	97.62%	97.68%	97.74%	97.80%
2.3	97.86%	97.92%	97.96%	98.02%	98.08%	98.12%	98.18%	98.22%	98.26%	98.32%
2.4	98.36%	98.40%	98.44%	98.50%	98.54%	98.58%	98.62%	98.64%	98.68%	98.72%
2.5	98.76%	98.80%	98.82%	98.86%	98.90%	98.92%	98.96%	98.98%	99.02%	99.04%
2.6	99.06%	99.10%	99.12%	99.14%	99.18%	99.20%	99.22%	99.24%	99.26%	99.28%
2.7	99.30%	99.32%	99.34%	99.36%	99.38%	99.40%	99.42%	99.44%	99.46%	99.48%
2.8	99.48%	99.50%	99.52%	99.54%	99.54%	99.56%	99.58%	99.58%	99.60%	99.62%
2.9	99.62%	99.64%	99.64%	99.66%	99.68%	99.68%	99.70%	99.70%	99.72%	99.72%
3	99.74%									

Note: The entries in this table stand for confidence level, the first row of this table stand for the percentile of Z-scores.

Time spent in making the sampled population and population of concern precise is often well considered. Sometimes the sample size, which was calculated by statistic methods, will be adjusted according to the experience in order to balance the time, cost and precision of making surveys.

4.2 Questionnaire

a. Questionnaire Design

Questionnaires have advantages over some other types of surveys in that they are cheap, do not require as much effort from the questioner as verbal or telephone surveys, and often have standardized answers that make it simple to compile data. Therefore, Questionnaires were adopted as one of the best way to get the real idea of all the stakeholders on ES and ES-related technology within APEC economies in this research.

In order to make questionnaires effectively to get the real information, some basic principles for questionnaire design should be obeyed as follows:

- Use statements which are interpreted in the same way by members of different subpopulations of the population of interest.
- Use statements where persons that have different opinions or traits will give different answers.
- Think of having an "open" answer category after a list of possible answers.
- Use only one aspect of the construct you are interested in per item.
- Use positive statements and avoid negatives or double negatives.
- Do not make assumptions about the respondent.
- Use clear and comprehensible wording, easily understandable for all educational levels
- Avoid items that contain more than one question per item.

Followed the principles, questionnaire was designed and consisted of open-ended and closed-ended questions. An open-ended question asks the respondent to formulate his own answer, whereas a closed-ended question has the respondent pick an answer from a given number of options. There were mainly four types of closed-ended questions in this questionnaire: a. dichotomous, where the respondent has two options, b. Nominal-polytomous, where the respondent has more than two unordered options, c. Ordinal-polytomous, where the respondent has more than two ordered options, d. (Bounded) Continuous, where the respondent is presented with a continuous

scale.

Finally, this questionnaire was divided into 6 parts in this research: a. background and brief introduction about this research, b. basic information on ES and ES-Related Technology in respondents' economy, c. the role of different stakeholders in developing ES-related technology market, d. the role of different stakeholders in developing ES-related technology market, e. suggestions on way forward to develop and disseminate the ES-related technology, f. personal information of the respondents.

b. Questionnaire Administration and Distribution

There are many questionnaire administration and distribution modes, such as face to face questionnaire administration, paper and pencil questionnaire administration, computerized questionnaire administration, and adaptive computerized questionnaire administration. Sometimes mixed-mode is used to improve coverage when a single mode can't adequately cover the population of interest or when contact information is not available for the desired mode of data collection. Due to the limitation of time, energy and resources, only "face to face" and "paper and pencil" questionnaire administration modes were adopted in this research.

At the very beginning, invitations with a brief introduction on this research and a sincere enquiry were sent out. Meanwhile, several questionnaires were handed out on the summit of APEC, in the factories or in the academies which are related to ES technology in order to cover all the stakeholders of this research. In this way, using alternatives for different respondents in the same survey period can more or less improve the response rates as well as reduce the coverage error.

ANNEX V Classifications of CPC Prov.

Service Type	CPC	Description
Sewage services	9401	It often refers to sewage removal, treatment and disposal services using waste pipes, sewers or drains, cesspools or septic tanks by the processes utilized may be dilution, screening and filtering, sedimentation, chemical precipitation, etc. Collection, purification and distribution services of water classified in subclass 18000 (Natural water) and construction, repair and alteration work of sewers classified in subclass 51330 (construction work for waterways, harbours, dams and other waterworks) are not included.
Refuse disposal services	9402	It refers to collection services of garbage, trash, rubbish and waste, whether from households or from industrial and commercial establishments, transport services and disposal services by incineration or by other means. Waste reduction services are also included. Dealing services in wastes or scraps classified in subclass 62118 (sales on a fee or contract basis of goods) and 62278 (wholesale trade services of waste and scrap and materials for recycling) are not included. Research and experimental development services on environmental issues are classified in division 85. Regulatory administrative services by the government related to environmental issues are classified in subclass 91123 (Administrative housing and community amenity services) and 91132 (Administrative fuel and energy related services).
Sanitation and similar services	9403	It refers to other sanitation and similar services including outdoor sweeping services and snow and ice clearing services. Disinfecting and exterminating services for buildings and other non-agricultural structures classified in subclass 87401 and pest control services in connection with agriculture classified in subclass 88110 (services incidental to agriculture) are not included.
Cleaning of exhaust gases	9404	It refers to emission monitoring and control services of pollutants into the air, whether from mobile or stationary sources, mostly caused by the burning of fossil fuels and to concentration monitoring, control and reduction services of pollutants in ambient air, especially in urban areas.
Noise abatement services	9405	It refers to noise pollution monitoring, control and abatement services, e.g. traffic related noise abatement services in urban areas.
Landscape protection services	9406	It refers to ecological system protection services, e.g. of lakes, coastlines and coastal waters, dry land, etc., including their respective fauna, flora and habitats and services consisting in studies on the interrelationship between environment and climate (e.g. greenhouse effect), including natural disaster assessment and abatement services. Landscape protection services not elsewhere classified. Forest and damage assessment and abatement services classified in group 881 (services incidental to agriculture, hunting and forestry) are not included.
Other environmental protection services	9409	It refers to other services not elsewhere classified, e.g. acidifying deposition ("acid rain") monitoring, controlling and damage assessment services.

ANNEX VI GATS W/120, CPC Prov. and CPC Version 1.0 Classifications of Environmental Services

GATS Sectoral classification 6	**CPC Prov. Division 94**	**CPC Version1.0 Division 94**
Environmental services	Sewage and refuse disposal, sanitation and other environmental protection services	Sewage and refuse disposal, sanitation and other environmental protection services
Sewage services	9401 Sewage services	941 Sewage services 94110 Sewage treatment services 94120 Tank emptying and cleaning services
Refuse disposal services	9402 Refuse disposal services	942 Refuse disposal services 94211 Non-hazardous waste collection services 94212 Non-hazardous waste treatment and disposal services
Sanitation and similar services	9403 Sanitation and similar services	943 Sanitation and similar services 94310 Sweeping and snow removal services 94390 Other sanitation services
Other	9404 Cleaning services of exhaust gases 9405 Noise abatement services 9406 Nature and landscape protection services 9409 Other environmental protection services n.e.c.	949 Other environmental protection services n.e.c.

ANNEX VII OECD/EUROSTAT Descriptions and Classifications

Service type	Examples/descriptions
(Ⅰ) Services provided for one or more environmental protection, pollution control, remediation or prevention activity	
Design consulting and engineering	Engineering services for environmental plant, equipment and facilities, including consulting services, e.g. feasibility studies, costing ● Architecture and design services for environmental plant, equipment and facilities, including related urban planning and landscape architecture ● Environmental impact studies
Preparation of sites and construction, installation and assembly, repair and maintenance	For environmental facilities, plant and equipment e.g. sewage and water management, solid and hazardous waste collection and treatment systems, landfill and incineration sites, etc. ● Engineering services relating to site preparation; inspection during construction ● Surface and subsurface surveying ● Site investigation, formation and clearance ● Construction, installation and assembly of environmental utilities, plant and equipment (e.g. laying of sewers and water pipelines, construction of treatment plants, construction of landfills and other disposal sites) ● Installing septic systems and disposal fields ● Construction and installation work on buildings ● Repair and maintenance of machinery and equipment
Project management services	● Supervision of design, engineering and construction and installation, as an integrated project
Environmental research and development	● Scientific and technological activities to develop cleaner products, processes and technologies ● Scientific and technological activities to reduce or eliminate emissions and improve environmental quality ● Research to improve knowledge of eco-system and the impact o f human activities on the environment
Analytical services, data collection, testing, analysis and assessment	● Environmental monitoring, controlling and damage assessment services e.g. acid rain, natural disaster assessment and abatement services ● Composition and purity testing and laboratory analysis services (e.g. for health, safety, toxicology purposes) ● Computer modeling of pollution effects ● Sampling and monitoring of air and water quality ● Forestry assessment and damage abatement services

Remediation and cleanup of soil, surface water and groundwater	Services to reduce the quality of polluting material in soil or water, including surface, groundwater and seawater: ● Consultancy and engineering services for assessment ● Use of cleaning-up systems in situ or mobile, emergency response, spills cleanup; natural disaster assessment and abatement services. ● Treatment of water and dredging residues. ● Specialized treatment of polluted soils; see solid waste management
Eco-system and landscape protection services	● Consultancy and assessment services for ecological system, nature and landscape protection services, e.g. lakes, coastlines and coastal waters, wetlands, dry land, etc., including fauna, flora and habitats
Environmental education, training and information	● Environmental education or training by specialized institutions or specialized suppliers provided outside the school/university system for the general public or specific workplaces, e.g. training courses on environmental protection or operation of environmental facilities ● Adult education and specific-subject education courses not defined by level of pupil.
(Ⅱ) services provided for specific environmental media	
Water and wastewater management (A)sewage services (B)water for human use	● Operation and maintenance of facilities and equipment for sewage removal, sewage treatment and disposal, tank emptying, cleaning and servicing, transport of wastewater ● Potable water collection, purification treatment and distribution through mains

Solid and hazardous waste management (A) refuse disposal services (B) recycling services (C)sanitation services	Including "horizontal" services in section (Ⅰ) ● Collection and transport, treatment and disposal services of household, commercial and industrial trash, rubbish and waste (non-hazardous and hazardous). ● Treatment and disposal by incineration, dumping, composting, landfill or storage. Includes waste reduction services and specialized treatment of polluted soils *Excludes* dealing and wholesale services of waste and scrap-see below ● Metal waste and scrape recycling services, on a contract or fee basis, e.g. recycling of aluminium and steel ● Non-metal waste and scrap recycling services, on a contract or fee basis, e.g. recycling of paper, plastic and glass ● Dealing, wholesale and retail services of recycled waste, scrap and other material, e.g. sale of paper, cans or bottles for recycling ● Street, park, beach and other outdoor sweeping, snow and ice removal, other sanitation services e.g. drain unblocking Excludes disinfecting and extermination services of buildings, etc., and pest control services in connection with agriculture
Air pollution control, including "horizontal" services in section Ⅰ	Services for the assessment, treatment and /or removal of exhaust gases and particulate matter from both mobile and stationary sources: ● Emission monitoring and control services ● Concentration monitoring, control and reduction services of pollutants in ambient air, especially in urban areas. ● Cleaning of exhaust gas system of vehicles, commercial and industrial buildings and complexes.
Noise and vibration abatement, including "horizontal" services in section Ⅰ	Services for the assessment, reduction or elimination of noise and vibration both at source and dispersed: ● Noise pollution monitoring, control and abatement ● Design, management, etc., of systems for acoustic and sound-proof screening and covering

***Source*: OECD, Environmental Goods and Services, the benefits of further global trade liberalization. 2001, P21-23.**

ANNEX VIII Classification of EU Proposal in Environmental Services

ENVIRONMENTAL "CORE" SUB-SECTORS	
CLASSES AND SERVICES	EXAMPLES/DESCRIPTIONS
A）Water for human use & wastewater management	
Water collection, purification and distribution services through mains, except steam & hot water	—potable water treatment, purification and distribution including monitoring
Waste Water Services	—removal, treatment and disposal of household, commercial and industrial sewage and other waste waters including tank emptying & cleaning, monitoring, removal and treatment of solid wastes
B）Solid/hazardous waste management	
Refuse disposal services	—hazardous & non-hazardous waste collection, treatment and disposal (incineration, composting, landfill)
Sanitation & similar services	—sweeping & snow removal —other sanitation services
C）Protection of ambient air and climate	
Services to reduce exhaust gases and other emissions and improve air quality	—services at power stations or industrial complexes to remove air pollutants —monitoring of mobile emissions and implementation of control systems or reduction programmes
D）Remediation and cleanup of soil & water	
Treatment, remediation of contaminated/polluted soil and water	—cleaning-up systems in situ or mobile, emergency response, clean-up and longer term abatement from spills and natural disasters —rehabilitation programmes (e.g. recovery of mining sites) including monitoring
E）Noise & vibration abatement	
Noise abatement services	—monitoring programmes, installation of noise reduction systems and screens
F）Protection of biodiversity and landscape	
Nature & landscape protection services	—ecology and habitat protection —protection of forests and promoting sustainable

	forestry
G）Other environmental & ancillary services	
Other services not classified elsewhere	—other environmental protection services —services related to environmental impact assessment
ENVIRONMENTAL RELATED SUB-SECTORS	
BUSINESS SERVICES WITH AN ENVIRONMENTAL COMPONENT	
Architectural services	
Services related to recycling on a fee or contract basis	—Services related to recycling of, for example plastic, paper, glass, batteries, aluminium and steel
R&D WITH AN ENVIRONMENTAL COMPONENT	
Environmental R&D services	
CONSULTING, CONTRACTING & ENGINEERING WITH AN ENVIRONMENTAL COMPONENT	
Design & Engineering	—e.g. feasibility studies and design of waste water treatment plants
Education, Training and Technical Assistance	—training courses on environmental protection or operation & maintenance of environmental facilities —training sessions for employees and/or contractors for performing proper sampling
Consulting services	—environment consulting services —related consulting services for tourism, transport, fishing, sustainable land use
Integrated engineering services	
Project management services	e.g. supervision of construction of sewage treatment facilities
Composition & purity testing & analysis services	—includes accredited environmental testing services —includes both field and laboratory testing
Modelling	—computer simulations of movement of pollutants through air, water, or soil —software development for engineering programs
Monitoring & testing	—monitoring of air and water quality
Subsurface & surface surveying services	—mapping —use of global positioning system (GPS)

CONSTRUCTION WITH AN ENVIRONMENTAL COMPONENT	
Septic system installation services	—installing septic tanks and disposal fields
Construction services	—laying of sewers —laying of water pipelines —construction of treatment plants —construction of landfills
Installation services of other goods	—installation of equipment used in sewage treatment facilities
Insulation services	
DISTRIBUTION WITH AN ENVIRONMENTAL COMPONENT	
Wholesale & retail trade services of waste, scrap, and other material for recycling	—sale of paper for recycling —sale of aluminium cans for recycling
Storage	—hazardous & non-hazardous waste storage —operation of disposal site
TRANSPORT WITH AN ENVIRONMENTAL COMPONENT	
Land transportation under various modes	—movement of waste material by rail or road
Water transportation under various modes	—movement of waste material by barge or ship
OTHERS WITH AN ENVIRONMENTAL COMPONENT	
Repair services of machinery & equipment	—repair of various environmental equipment & facilities, e.g. water treatment plants, wastewater treatment plants, sanitary land fills
Urban planning services	
Others	—public awareness programmes

ANNEX IX Classification of Environmental Services in the Research

No	category	Item
1	Air Pollution control Service	Dust Collect
		Dust Collect, Desulfurization, Denitrification
		Desulfurization
		Denitrification
		NOx Abatement By Combustion Modification
		Deodorization
		Solvent Recovery
		Exhaust Gas Treatment
		Miscellaneous
2	Waste water treatment and delivery Service	Industrial Wastewater Treatment
		Sewage Treatment
		Sludge Treatment
		Others
3	Solid and Hazardous waste management Service	Combustible waste
		Noncombustible waste
		Recyclable waste
		Ashes (Municipal Solid Waste)
		Others
		End-of-life vehicles
		Hazardous Municipal wastes (explosive,toxic or epidemical, etc)
		Ashes
		Sludge
		Waste oil
		Waste acid
		Waste alkali
		Waste plastics
		Waste paper
		Waste wood
		Waste fibers
		Solid waste related to animals or plants
		Solid wastes related to fowls of being slaughtered or scraped
		Waste pieces of rubber
		Waste pieces of metal
		Waste pieces of glass, concrete and ceramics
		Pieces of broken concrete produced in the newly building, rebuilding or removal of structures
		Excrements of animals
		Dead animals

		Soot and dust
		Hazardous Industrial wastes (explosive,toxiic or epidemical, etc)
		Advanced technology of comprehensive utilization
4	Noise and vibration abatement Service	Advanced technology
		Industrial noise
		Traffic noise
		Other
5	Contaminated soil remediation Service	Treatment Technologies
		In Situ Remediation Technologies
		Containment Technologies
		Other Technologies
6	Environmental monitoring and analysis Service	Air Pollution Continuous Monitoring Technology
		Water Pollution Continuous Monitoring
7	Administration Service for nature risk	Emergency monitoring and environmental risk assessment technology for heavy metal pollution
		Leaking detecting and pre-warning system of impervious barrier in landfill
8	Natural resource protection and ecologic conservation Service	Recycling technologies
		Treatment technology for rural pollution
		Ecological conservation
		Reclamation
9	Environmentally Preferable Service	Biomass Co-Fired Boilers
		Energy Efficiency technologies
		Green Buildings/Energy Efficient
		Oil and Gas Industry
		Transportation
		Industrial cleaning production technology
10	International environmental conventions-related and climate change mitigation Service	Capture, Storage, Sequestration or disposal of Greenhouse gases
		Greenhouse Gas Monitoring and Others

ANNEX X The List or Database of APEC ES-Related Technologies

No	Category	Item	Techniques
1	Air Pollution control technology	Dust Collect	Particulate reduction technology Electrostatic Precipitator (Dry-type Low-temperature EP)
			ELECTROSTATIC PRECIPITATOR FOR HIGH RESISTIVITY DUST
			SMEC's Electrostatic Precipitator Wide Spacing and High Voltage System: Dry and Wet Type
			Electrostatic Precipitator Combined Pulse charge section with Moving electrode section for High Resistivity Dust
			TEC-Lodge Sturtevant Electrostatic Precipitator
			Bag Filter for Heavy Metals Dust Collection
			BAG FILTER
			DUST COLLECTOR FOR COAL-FIRED BOILER
			ENERGY-SAVING OPERATION SYSTEM FOR DUST COLLECTOR
			THE FLUE GAS TREATMENT SYSTEM OF THE MUNICIPAL SOLID WASTE INCINERATION PLANT
			NS High-performance Bag Filters for Refuse Incinerators
			EDV TYPE FLUE GAS TREATMENT SYSTEM
			KAWASAKI GRANULAR FILTER (KGF)
			KSM-S TYPE AXIAL-FLOWINVERSION SYSTEM MULTI-CYCLONE DUST PRECIPITATOR
			BLUE SKY 2000 PROCESS
			ELECTRIC PRECIPITATOR
			BAG FILTER DUST PRECIPITATOR
			Wet-type electrostatic demisting technology
			Bag filter technology for smoke from 1000mw boiler unit of coal-fired power plant
			Moving Electrode Type Electrostatic Precipitating technology
			Filtering Exhausts technology for diesel
			Bag filter for 600mv boiler unit of coal-fired power plant
			Bag filter for blast furnace gas
			Dry type Gas Dust Removal technology for gas from large sealed calcium carbide furnace

			electric-bag composite dust collector	
			The 4th generation OG converter for flue gas purification and gas recovery	
			Clean combustion for industrial pulverized coal boiler and flue gas pollution controlling technology	
		Dust Collect, Desulfurization, Denitrification	Advanced Technology	Moving Electrode Type Electrostatic Precipitating technology
				Recycling technology for magnetite material industry
				Wet-type electrostatic demisting technology
				Flue Gas Desulfurization for sintering machine and circulating fluidized bed
				Titanium dioxide （Denitration catalyst） industrialization technology
				Technology of Combining low-nitrogen combustion with SNCR

				Technology of Combining low-nitrogen combustion with SCR
				Technology of Combining low-nitrogen combustion with jet flow in furnace
		Desulfurization	Flue Gas Desulfurization technology with ammonia recycling process	
			Flue Gas Desulfurization for sintering machine	
			Simplified Limestone/Lime Gypsum Process	
			Limestone-Gypsum Flue Gas Desulfurization System	
			MITSUI-GE TYPE FLUE GAS SO2REMOVAL SYSTEM	
			Hitachi Wet Limestone-Gypsum FGD System	
			BLUE SKY 2000 PROCESS	
			THE FLUE GAS TREATMENT SYSTEM OF THE MUNICIPAL SOLID WASTE INCINERATION PLANT	
			IHI In-line Type Flue Gas Desulfurization System	
			SOx reduction technology Wet Type Desulfurization System	
			WET TYPE HYDROGEN CHLORIDE AND SULFUR OXIDES REMOVAL SYSTEM	
			DRY TYPE HYDROGEN CHLORIDE AND SULFUR OXIDES REMOVAL SYSTEM	
			STACK TYPE SIMPLIFIED WET LIMESTONE GYPSUM FLUE GAS DESULFURIZATION SYSTEM	
			The KOBELCO Flue Gas Desulfurization Process for the Iron Ore Sintering Plant	
			Magnesium Process	
			Magnesium-Hydroxide Flue Gas Desulfurization System	
			FLUE GAS DESULFURIZATION SYSTEM USING THE MAGNESIUM PROCESS	

			OG-Type Flue Gas Desulfurization System with Easy Maintenance
			MAGNESIUM HYDROXIDE METHOD FLUE GAS DESULFURIZATION SYSTEM
			S - Magyp (Simplified Mg to Gypsum) FGD Process
			S- Magyp Flue Gas Treatment System - Zero Emissions with Low Cost -
			MITSUI-BF DRY TYPE DeSOx/DeNOx PROCESS / MITSUI MINING CO., LTD.
			NKK LIMAR - Bag System (Dry type)
			NKK LIMAR-Bag System (Semi-Dry Type)
			Semi Dry Type SO2Removal System
			LILAC (SEMI-DRY) FLUE GAS DESULFURIZATION SYSTEM
			SEMI-DRY FLUE GAS DESULFURIZATION SYSTEM
			SEMI-DRY TYPE HYDROGEN CHLORIDE AND SULFUR OXIDES REMOVAL SYSTEM
			SOx and NOx reduction measures Simultaneous Desulfurization and Denitrification System (Electron Beam Method)
			Desulfurization and Decyanization System (Fumaks Process and Rhodacs Process)
			SOx reduction technology Atmospheric Fluidized Bed Combustion Boiler System (AFBC: Atmospheric Fluidized Bed Combustion)
			DRY TYPE FLUE GAS TREATMENT SYSTEM
			WET TYPE FLUE GAS TREATMENT SYSTEM
			BOILER DIRECT DESULFURIZATION & DENITRATION TECHNOLOGY
			KYOWA WET SCRUBBER
			Seawater Scrubber for SO2Removal
			Mitsui Limestone-Gypsum Process Flue Gas Desulfurization System Liquid Fluidized Bed Scrubber (LFBS)
			Bag filter and wet desulfurization technology for boiler flue gas in coal-fired industries
			Limestone-gypsum wet flue gas desulfurization technology
			Waste sludge (alkali) flue gas desulfurization technology
			Recycling for Sintering Gas and Desulfuration

			Technique with chelated iron
			Dust Collect and Desulfurization integration technology for Large cupola
			CFB-FGD
			Ammonia desulphurization for coal-fired plant
			Desulfurization technology for flue gas from steel making slag
		Denitrification	Low-nitrogen combustion+SNCR technology for cement kiln
			Low-nitrogen combustion+SCR technology for cement kiln
			De-NOx catalyst
			KAWASAKI SELECTIVE CATALYTIC NOx REMOVAL SYSTEM (S.C.R.)
			IHI DRY SELECTIVE CATALYTIC NOx REMOVAL SYSTEM
			DRY SELECTIVE CATALYTIC NOx REMOVAL SYSTEM
			NOx REMOVAL SYSTEM BY SCR PROCESS
			SELECTIVE CATALYTIC REDUCTION SYSTEM OF NITROGEN OXIDES
			NOx reduction technology Dry Type Denitrification System (Ammonia Reduction Process)
			NKK Selective Catalytic NOx Reduction System
			Hitachi Selective Catalytic NOx Removal (SCR) System
			NIPPON SHOKUBAI'S De-NOx Catalyst
			Small Size De-NOx System
			Urea Reduction De-NOx System (U-CLEAR)
			NONCATALYTIC REDUCTION SYSTEM OF NITROGEN OXIDE
			NKK Selective Non-Catalytic NOx Reduction System
			MITSUI-BF DRY TYPE DeSOx/DeNOx PROCESS / MITSUI MINING CO., LTD.
			SOx and NOx reduction measures Simultaneous Desulfurization and Denitrification System (Electron Beam Method)
			BOILER DIRECT DESULFURIZATION & DENITRATION TECHNOLOGY
			AW GAS CLEANER
			AW GAS ADSORBER

			KYOWA WET SCRUBBER
			SCR for coal-fired boiler
			SNCR for coal-fired boiler
		NOx Abatement By Combustion Modification	Reduction of NOx Emission by High-Temperature Combustion Catalyst
			Low NOx Combustion Technology
			NOx reduction technology Combustion Improvement System
			Low NOx Burner for Industrial Furnace
			Sumitomo High Efficiency Burners (SHEB: Low NOx & Save Energy)
			3-STAGE LOW NOx COMBUSTION SYSTEM
		Deodorization	Catalytic Oxidation Deodorizing Techniques
			Thermal Oxidation Deodorizing Techniques
			SMEC's Catalytic Combustion Type Deodorizer
			SMEC's Direct Combustion Type Deodorizer
			SMEC's Concentration Type Deodorizer
			COR-PAK Thermal Oxidizer
			KEM-PAK Chemical Scrubber for treating foundry process gases
			Honeycomb Type Deodorization System
			Honeycomb Type Deodorization System (Package type)
			TOYO RIGIDON Deodorizing System
			Ozone Decomposing/Deodorizing Catalyst (TSO)
			Biological Deodorization Techniques
			Wet-type Deodorizing Techniques
			A ROCKWOOL TYPE DEODORIZING Techniques
			DEODORIZER USING THE WETTED NET SCRUBBER
			AW GAS CLEANER
			AW GAS ADSORBER
		Solvent Recovery	Fluidized-bed Solvent Recovery System
			Solvent Recovery and Recycling
			SOLVENT/FREON RECOVERY SYSTEM
			ACTIVATED CHARCOAL FIBER SOLVENT GAS ADSORBER
			KYOWA TYPE ADR VOC RECYCLING SYSTEM
			VOC recovery and Deodorizing
			Treatment technology for waste acid from washing flue gas

		Exhaust Gas Treatment	Advanced Technology	“Alcohol-soluble ink +adsorption+Solvent separation ” VOCs treatment technology
				“paint mist purification+activated carbon adsorption+reclamation” VOCs treatment technology
				Treatment technology for volatile organic chemcials （VOCs） in furniture industry
				Treatment technology for VOCs with non-thermal plasma
				Desulfurization and defluorination integration technology for flue gas from aluminum electrolysis cell
			Toxic substance removal technology The flue gas	

			treatment system of the municipal solid waste incineration plant
			WET TOXIC GAS REMOVAL SYSTEM
			BAG FILTER TYPE EXHAUST GAS TREATMENT SYSTEM
			PIPE FILTER (Exhaust Gas Processing Unit)
			Desulfurization and Decyanization System (Fumaks Process and Rhodacs Process)
			Acid gas purification techniques for CO2 (carbon dioxide) Benfield Process
			Acid gas purification techniques for H2S (hydrogen sulfide) Stretford Process
			WET TYPE HYDROGEN CHLORIDE AND SULFUR OXIDES REMOVAL SYSTEM
			SEMI-DRY TYPE HYDROGEN CHLORIDE AND SULFUR OXIDES REMOVAL SYSTEM
			DRY TYPE HYDROGEN CHLORIDE AND SULFUR OXIDES REMOVAL SYSTEM
			Catalytic Incinerator
			DRY TYPE FLUE GAS TREATMENT SYSTEM
			WET TYPE FLUE GAS TREATMENT SYSTEM
			EDV TYPE FLUE GAS TREATMENT SYSTEM
			An Organic Halogen-Gas Purification System: The "HALOCAT" Catalytic-Incineration Exhaust-Gas Treatment Apparatus
			THE FLUE GAS TREATMENT SYSTEM OF THE MUNICIPAL SOLID WASTE INCINERATION PLANT
			NKK LIMAR - Bag System (Dry type)
			NKK LIMAR-Bag System (Semi-Dry Type)
			ABB FILSORPTION SYSTEM for controlling toxic elements in flue gas
			Waste Ozone Decomposition System
			Quench tower
		Miscellaneous	Wastewater Utilization after Desulfurization and Decyanization (Compact Process)
			LAMELLAR MIST SEPARATOR
			Air washer for removal of chemical compounds in cleanroom
			Ion Scrubber
			Complete vaporizing gas cooler
			Flue gas purification technology for coke oven
			exhaust gas treatment technology for Lead powder

			machine in lead-acid batteries industry	
			4 inches Electro-magnetic Pulse Valve injection technology	
			Moving valve block Electro-magnetic Pulse Valve for bag filter	
			Manufacturing technology for filter material of 3-D dissymmetric cellular structure PPS needled mat	
			Rectifier with high frequency and high voltage for electric precipitation	
			Regenerative Thermal Oxidizer(RTO) for organic exhaust gas	
			Adsorption, concentration and catalytic oxidation integration purification technology for VOCs	
			Purification technology for bituminous flue gas from green anode workshop	
			Recycling technology for exhaust gas of yellow phosphorus	
			"Adsorption+Re-use" VOCs treatment technology	
			"Adsorption+catalytic combustion" VOCs treatment technology	
			Treatment technology for smell gas from double-dielectric barrier discharge plasma industry	
			Oil and gas recovery technology	
			Microbial treatment technology for fetor	
			Acid scrubbing purification technology for exhaust gas from sulfuric acid industry	
			Treatment technology for flue gas from spraying granulation	
			Purification technology for flue gas from aluminum electrolysis process	
2	Waste water treatment and delivery technology	Industrial Wastewater Treatment	Advanced Technology	Treatment technology for nonferrous metals Smeltering Waste Water mixed with arsenic and copper

				AMMONIA REMOVAL PROCESS FOR WASTEWATER
				AUTOMATIC BACKBLOW CLEAN FILTER
				DE HOXAR SPIRAL SEPARATOR
				MEMBRANE BIO-REACTOR SYSTEM (MBR SYSTEM)
				KHDS
				GRAVITY BELT THICKENER
			Physicochemical Treatment	KUBOTA SPIRAL MASTER
				SUBMERGED MEMBRANE UNIT
				SUPER HIGH-SPEED DISSOLVED AIR FLOATATION SYSTEM
				SUPER HIGH-SPEED SEDIMENTATION SYSTEM
				UNIFLO SAND FILTER
				WABE SAND FILTER
				WASTE WATER TREATMENT SYETEM IN THERMAL POWER PLANTS

				BIOGUARD (BIOLOGICAL DEODRIZING SYSTEM)
				Activated Sludge System using Membrane Filtration
				BIO-CARRIER SYSTEM
				Continuous Aerated Bio-reactor
				HIGH EFFICIENT BIOLOGICAL NITROGEN REMOVAL SYSTEM
			Aerobic Biochemical Treatment	HITACHI MEMBRANE BIO-REACTOR SYSTEM (HITACHI MBR SYSTEM)
				HITACHI OXIDATION DITCH SYSTEM BY USING SPAROTORS
				HITACHI SPIRAL AERATOR "SPAROTOR ACE"
				HITACHI SPIRAL AERATOR "SPAROTOR"
				VERTICAL TYPE AERATION AGITATOR

				KUBOTA SUBMERGED MEMBRANE UNIT
				SUBMERGED FILTER BED SYSTEM (waste water)
				SUBMERSIBLE AERATOR
				TSK AERATION PANEL
			Anaerobic Biochemical Treatment	EXPANDED GRANULAR SLUDGE BED SYSTEM
				VERTICAL-SHAFT TYPE AGITATOR
				SUBMERSIBLE AERATOR
				SUBMERSIBLE MIXER
			Advanced technology of high-concentration ammonia-nitrogen industrial waste water	Sulfur, carbon and nitrogen synchronous removal technology for organic waste water
				Aerobic biological denitrification technology
				Advanced treatment technology of aeration biological fluidized bed for wastewater

				Treatment technology for landfill leachate using mechanical compression and Ion Exchange
				Energy-efficient deamination technology for gas
				Advanced treatment technology for coking waste water using super paramagnetic resin
			High-concentration ammonia-nitrogen industrial waste water	Treatment technology for landfill leachate
				Treatment technology for ammonia-nitrogen waste water using airflow closed circuit method
				Microbial treatment technology for coking waste water

				Treatment technology for high concentration and refractory organic industrial waste water
				Efficient microbial treatment technology for tannery waste water
				3D over potential electrolysis - composite microbial treatment technology for refractory industrial waste water
				Comprehensive utilization technique of protein extraction from potato starch waste water
				Waste water treatment technology using granular Sludge Bed

				Integration technology for pollution in tannery industry
				Treatment and reuse technology for high-concentration waste water
				Discharging and recycling technology for waste water from producing nitrogenous fertilizer
			Other advanced technology	New type artificial molecular sieve water treatment technology
				Purification and recycling technology for Jeans washing sewage

				Treatment technology for waste water from chemical industry for making chlorine and alkali
				Concentration and recycling sodium cyanide by membrane
				Treatment and recycling technology for toxic organic industrial waste water by absorption
				Applied technology of compound mineral in the dyeing and finishing effluents treatment process
				Recycling technology for oil field waste water

				Environment friendly circulating cooling water treatment technology
			Others	FOOD PLANT WASTE WATER TREATMENT SYSTEM
				HEAVY METAL WASTE WATER TREATMENT SYSTEM
				Waste Water Recycling System
				WASTE WATER RECYCLING SYSTEM IN OPTICAL DISK MASTERING PROCESS
				WASTE WATER TREATMENT SYSTEM IN ELECTRO GALVANIZING PROCESS
				Wet(acid dissolving) detoxication technology for chromium slag

				Recycling technology and equipment for waste water from nickel plating
				Treatment and recycling technology for electroplating waste water
				Discharging reduction technology for low copper waste water
				water treatment technology by electric flocculation
				Technology for terminal waste water of electrolytic manganese enterprises to reach the discharging standard

				Discharging reduction technology for waste water from electrolytic manganese process
				Advanced treatment technology for waste water from nonferrous metal smelting process
				Membrane treatment technology for wastewater from mining
				Integration membrane separation technique for heavy metal waste water containing Cr and Cd
				High concentration slurry method for heavy metal waste water

				Treatment technology for waste water from lead-acid battery industry
				Advanced treatment and recycling technology for heavy metal waste water
				Electrochemical treatment technology for heavy metal waste water
				Direct enriching combustion technology for molasses waste water
				Enriching high concentrated organic waste water and combustion for power generation
				Treatment technology for bactericide waste water

				high effective denitrogenation and low slug production technology for waste water treatment
				Waste water treatment technology for petrochemical industry
				Advanced efficient folder anaerobic reaction technology
				Internal Circulation（IC）
				Treatment technology for gentamicin waste water
				Integrated technology of bio treatment-high efficiency clarifying-filtering for printing and dyeing waste water

				Recycling technology for printing and dyeing waste water
				Centralized treatment technology for printing and dyeing waste water
				Recycling technology for filature waste water and waste heat
				Treatment and recycling technology for dyestuff waste water
				Integrated waste water treatment technology by chemical fiber reduction
				Integrated waste water treatment and recycling technology for iron and steel enterprises

				Waste water treatment technology for paint industry
				Treatment technology for waste water from flue gas desulfurization process in thermal power plant
				Recycling technology of chromic salts in tannery waste water
				Advanced treatment and recycling technology for、waste water from ASP flooding oil extraction
				Technology of recycling concentrated water and reusing reclaimed water by UFRO

				UFRO for difficultly treated wastewater
				Advanced treatment for papermaking waste water
		Sewage Treatment	Advanced technology	"source reduction by microorganism+deep dehydration+recycling combustion"
				Stabilization treatment for sludge from municipal wastewater treatment plant by pyrolysis
				Anaerobic digestion technology by classification and parvafacies
				Digesting sludge by tubificidae in situ
			Comprehensive treatment	A_2/O
				Oxidation ditch with activated sludge process
				SBR
				UNITANK

				ABFB
				Hydrolysis+ABFB
				BMBR
				MBR
				high efficient BAF
				Diversion aerating filter
				Recycling technology for waste water by electro absorption desalting
				suspended chain aerating technology for waste water treatment
				Super magnetic separation technology for water purification
			Physicochemical Treatment	All PLASTIC SLUDGE COLLECTOR
				AMMONIA REMOVAL PROCESS FOR WASTEWATER
				BELT THICKENER
				CENTRIACE (Dewatering Centrifugal Decanter)

				CENTRIHOPE (Thickening centrifugal decanter)
				DOUBLE-LAYERED CYLINDRICAL FILTER PRESS
				HITACHI MEMBRANE BIO-REACTOR SYSTEM (HITACHI MBR SYSTEM)
				GRAVITY BELT THICKENER
				KUBOTA SPIRAL MASTER
				SUBMERGED MEMBRANE UNIT
				SUPER HIGH-SPEED DISSOLVED AIR FLOATATION SYSTEM
				SUPER HIGH-SPEED SEDIMENTATION SYSTEM
				MULTI AUTO SAND FILTER/ MARIMO
				SLUDGE MELTING SYSTEM
				UNIFLO SAND FILTER
			Aerobic Biochemical Treatment	BIOGUARD (BIOLOGICAL DEODRIZING SYSTEM)

				Continuous Aerated Bio-reactor
				HITACHI MEMBRANE BIO-REACTOR SYSTEM (HITACHI MBR SYSTEM)
				HITACHI OXIDATION DITCH SYSTEM BY USING SPAROTORS
				HITACHI SPIRAL AERATOR "SPAROTOR ACE"
				HITACHI SPIRAL AERATOR "SPAROTOR"
				VERTICAL TYPE AERATION AGITATOR
				KUBOTA SUBMERGED MEMBRANE UNIT
				MARINE SEWAGE TREATMENT DEVICE
				MARINE SEWAGE TREATMENT UNIT (SBH)
				SUBMERSIBLE AERATOR
				TSK AERATION PANEL
			Anaerobic Biochemical	ATAKA BIO-CARRIER SYSTEM

			Treatment	BIO-BALL HIGH RATE FILTRATION SYSTEM
				EFFECTIVE UTILIZATION SYSTEM OF DIGESTION GAS
				HITACHI VERTICAL-SHAFT TYPE AGITATOR "VERTIMIXER"
				SUBMERSIBLE AERATOR
				SUBMERSIBLE MIXER
			Others	EJECTER TYPE VACUUM SEWERAGE STATION
				SEWAGE REMOVAL SYSTEM (kitchen waste water)
				SOLID SEPARATION SYSTEM
		Sludge Treatment	Physicochemical Treatment	BELT THICKENER
				CENTRIACE (Dewatering Centrifugal Decanter)
				CENTRIHOPE (Thickening centrifugal decanter)
				CIRCULATING FLUIDIZED BED INCINERATOR

				DOUBLE-LAYERED CYLINDRICAL FILTER PRESS
				SLUDGE DEHYDRATING AND DRYING DEVICE
				ULTRASONIC WAVE SLUDGE REDUCTION DEVICE
			Aerobic Biochemical Treatment	SLUDGE DEHYDRATING AND DRYING DEVICE
				S-TE PROCESS
			Anaerobic Biochemical Treatment	EFFECTIVE UTILIZATION SYSTEM OF DIGESTION GAS
				SLUDGE DEHYDRATING AND DRYING DEVICE
				SUBMERSIBLE MIXER
			Others	BIOLOGICAL DEODORIZING SYSTEM
				DE HOXAR SPIRAL SEPARATOR
				SLUDGE DEHYDRATING AND DRYING DEVICE

				Sludge dewatering technology through pressing and filtering with high pressure diaphragm
				Advanced sludge dewatering technology through drying with adding calcium
				Sludge drying and clean combustion technology
				High-temperature aerobic fermentation and eco-utilization technology for sludge
				Automatic compost and comprehensive utilization technology for sludge
		Others	CLOSED SYSTEM OF FINAL DISPOSAL SITE, AND LEACHATE TREATMENT FACILITY	
			Ebara Mebius System	
			MARINE 15ppm BILGE SEPARATOR	
			SCREW CUTTER	

			HIGH EFFICIENT BIOLOGICAL NITROGEN REMOVAL SYSTEM
3	Solid and Hazardous waste management technology	Combustible waste	EBARA HPCC21 STOKER SYSTEM
			FLUDIZED BED INCINERATION TIF REVOLVING TYPE
			FLUIDIZED BED TYPE GASIFICATION & SWIRL-FLOW MELTING FURNACE
			HIGH TEMPERATURE AND HIGH PRESSURE BOILER
			HITZ ROTARY KILN INCINERATION PLANT
			INTERNAL CIRCULATION FLUIDIZED BED INCINERATOR
			KAWASAKI FLUIDIZED BED GASIFICATION AND MELTING SYSTEM
			KAWASAKI STOKER-TYPE REFUSE INCINERATION SYSTEM
			HIGH-SPEED VERTICAL SHREDDER
			MASTIFF NEO Single-shaft shredders
			MITSUBISHI - MARTIN REFUSE INCINERATION SYSTEM
			MITSUBISHI ROTARY KILN SYSTEM
			MITSUBISHI STOKER INCINERATION SYSTEM
			NISHIHARA OPEN FIELD COMPOSTING
			NISHIHARA ROTARY DRUM COMPOSTING
			PYROLYSIS GAS MELTING SYSTEM
			REFUSE-DERIVED FUEL(RDF)MANUFACTURING PLANT
			SLUDGE TREATMENT SYSTEM BY EFFECTIVE USE OF EXHAUST GAS FROM SMALL SCALE WASTE INCINERATORS
			DRY-TYPE BIOGAS PROCESS
			FLUIDIZED BED TYPE INDUSTRIAL WASTE INCINERATING DISPOSAL SYSTEM
			MASS-BURN RENAISSANCE SYSTEM
			ROTARY KILN TYPE INDUSTRIAL WASTE INCINERATION SYSTEM
			STOKER TYPE INDUSTRIAL WASTE INCINERATION SYSTEM
			STOKER TYPE MUNICIPAL SOLID WASTE INCINERATION SYSTEM
			Combustion technology for household garbage
			≥600t/d waste-to-energy power generation

			technology
		Noncombustible waste	HIGH TEMPERATURE AND HIGH PRESSURE BOILER
			HITACHI ZOSEN BULKY WASTE TREATMENT SYSTEM
			HIGH-SPEED VERTICAL SHREDDER
			MITSUBISHI - MARTIN REFUSE INCINERATION SYSTEM
			MITSUBISHI STOKER INCINERATION SYSTEM
			RECYCLING SYSTEM
			SEMI-AEROBIC LANDFILL (FUKUOKA METHOD)
			Self-slaking of slag by covering
		Recyclable waste	FLUDIZED BED INCINERATION TIF REVOLVING TYPE
			HIGH TEMPERATURE AND HIGH PRESSURE BOILER
			HITACHI ZOSEN BULKY WASTE TREATMENT FACILITY
			INTERNALLY CIRCULATING FLUIDIZED BED BOILER ICFB
			MASTIFF NEO Single-shaft shredders
			MITSUBISHI - MARTIN REFUSE INCINERATION SYSTEM
			ROTARY KILN SYSTEM
			MITSUBISHI STOKER INCINERATION SYSTEM
			PYROLYSIS GAS MELTING SYSTEM
			RECYCLING SYSTEM
			MASS-BURN RENAISSANCE SYSTEM
			STOKER TYPE MUNICIPAL SOLID WASTE INCINERATION SYSTEM
			Recycling technology for tailings of cyanide
			Recycling technology and equipment for waste lubricating oil
			Recycling technology for white bole from alkali recovery
			Utilization technology of waste yeast from producing beer
			Recycling technology of vinasse
			Harmless and beneficial treatment technology for waste vinasse

			Recycling technology for solid waste from curriery	
			Technology of producing protein by waste from abattoir and leather factory	
			Recycling technology for liquation of Na_2CO_3 from waste alkali combustion	
		Ashes (Municipal Solid Waste)	PYROLYSIS GAS MELTING SYSTEM	
			ASH MELTING SYSTEM	
			MASS-BURN RENAISSANCE SYSTEM	
			SEMI-AEROBIC LANDFILL (FUKUOKA METHOD)	
		Others	Advanced Technology	Wet treatment technology for flue gas from copper smelting
				Solidification and stabilization technology for waste residue of electrolytic manganese mixed with heavy metal ion
			HIGH TEMPERATURE AND HIGH PRESSURE BOILER	
			MITSUBISHI - MARTIN REFUSE INCINERATION SYSTEM	
			MITSUBISHI STOKER INCINERATION SYSTEM	
			RECYCLE PROJECT FOR DAM-COLLECTEDDRIFTWOOD, ETC. (KANDEN EL-FARM)	
			MASS-BURN RENAISSANCE SYSTEM	
			STOKER TYPE MUNICIPAL SOLID WASTE INCINERATION SYSTEM	
		End-of-life vehicles	HIGH-SPEED VERTICAL SHREDDER	
		Hazardous	EBARA HPCC21 STOKER SYSTEM	

		Municipal wastes (explosive, toxic or epidemical, etc.)	ROTARY KILN SYSTEM	
		Ashes	ASH MELTING SYSTEM	
			EBARA HPCC21 STOKER SYSTEM	
			HITZ ROTARY KILN INCINERATION SYSTEM	
			HITZ SLAGGING KILN INCINERATION SYSTEM	
			PYROLYSIS GAS MELTING SYSTEM	
			MASS-BURN RENAISSANCE SYSTEM	
		Sludge	Advanced Technology	Separation technique for nickel and chromium in sludge
				Treatment technology for tailing slurry of gold mine mixed with arsenic and cyanide
				Wet treatment technology for sludge with arsenic, copper and rhenium
			DRYING AND INCINERATING SYSTEM FOR SEWAGE DISPOSAL PLANT	
			FLUDIZED BED INCINERATION TIF REVOLVING TYPE	
			HIGH TEMPERATURE AND HIGH PRESSURE BOILER	
			HITZ ROTARY KILN INCINERATION PLANT	
			HITZ SLAGGING KILN INCINERATION PLANT	

			INTERNALLY CIRCULATING FLUIDIZED BED BOILER ICFB
			MITSUBISHI - MARTIN REFUSE INCINERATION SYSTEM
			ROTARY KILN SYSTEM
			MITSUBISHI STOKER INCINERATION SYSTEM
			NISHIHARA OPEN FIELD COMPOSTING
			NISHIHARA ROTARY DRUM COMPOSTING
			PYROLYSIS GAS MELTING SYSTEM
			SLUDGE TREATMENT SYSTEM BY EFFECTIVE USE OF EXHAUST GAS FROM SMALL SCALE WASTE INCINERATORS
			ASH MELTING SYSTEM
			FLUIDIZED BED TYPE INDSUTRIAL WASTE INCINERATING DISPOSAL SYSTEM
			MASS-BURN RENAISSANCE SYSTEM
			ROTARY KILN TYPE INDUSTRIAL WASTE INCINERATION SYSTEM
			STOKER TYPE INDUSTRIAL WASTE INCINERATION SYSTEM
			STOKER TYPE MUNICIPAL SOLID WASTE INCINERATION SYSTEM
			Technology of blasting treatment by superheated steam for oily sludge
			Bioleaching technology for sludge
		Waste oil	BATCH LOADING GASIFICATION INCINERATOR
			COMPACT SMOKELESS INCINERATOR FOR WASTE PLASTIC AND GARBAGE
			FLUDIZED BED INCINERATION TIF REVOLVING TYPE
			HIGH TEMPERATURE AND HIGH PRESSURE BOILER
			HITACHI ZOSEN BIO DIESEL FUEL (BDF) PRODUCTION SYSTEM
			HITZ ROTARY KILN INCINERATION SYSTEM
			HITZ SLAGGING KILN INCINERATION SYSTEM
			INTERNALLY CIRCULATING FLUIDIZED BED BOILER ICFB
			MITSUBISHI - MARTIN REFUSE

			INCINERATION SYSTEM
			ROTARY KILN SYSTEM
			MITSUBISHI STOKER INCINERATION SYSTEM
			SLUDGE TREATMENT SYSTEM BY EFFECTIVE USE OF EXHAUST GAS FROM SMALL SCALE WASTE INCINERATORS
		Waste acid	HIGH TEMPERATURE AND HIGH PRESSURE BOILER
			HITZ ROTARY KILN INCINERATION SYSTEM
			HITZ SLAGGING KILN INCINERATION SYSTEM
			MITSUBISHI - MARTIN REFUSE INCINERATION SYSTEM
			MITSUBISHI STOKER INCINERATION SYSTEM
		Waste alkali	HIGH TEMPERATURE AND HIGH PRESSURE BOILER
			HITZ ROTARY KILN INCINERATION SYSTEM
			HITZ SLAGGING KILN INCINERATION SYSTEM
			MITSUBISHI - MARTIN REFUSE INCINERATION SYSTEM
			MITSUBISHI STOKER INCINERATION SYSTEM
		Waste plastics	BATCH LOADING GASIFICATION INCINERATOR
			COMPACT SMOKELESS INCINERATOR FOR WASTE PLASTIC AND GARBAGE
			FLUDIZED BED INCINERATION TIF REVOLVING TYPE
			HIGH TEMPERATURE AND HIGH PRESSURE BOILER
			HITZ ROTARY KILN INCINERATION SYSTEM
			HITZ SLAGGING KILN INCINERATION SYSTEM
			INTERNALLY CIRCULATING FLUIDIZED BED BOILER ICFB
			HIGH-SPEED VERTICAL SHREDDER
			MASTIFF NEO Single-shaft shredders

			MITSUBISHI - MARTIN REFUSE INCINERATION SYSTEM
			ROTARY KILN SYSTEM
			MITSUBISHI STOKER INCINERATION SYSTEM
			PYROLYSIS GAS MELTING SYSTEM
			SLUDGE TREATMENT SYSTEM BY EFFECTIVE USE OF EXHAUST GAS FROM SMALL SCALE WASTE INCINERATORS
			ASH MELTING SYSTEM
			FLUIDIZED BED TYPE INDSUTRIAL WASTE INCINERATING DISPOSAL SYSTEM
			MASS-BURN RENAISSANCE SYSTEM
			ROTARY KILN TYPE INDUSTRIAL WASTE INCINERATION PLANT
			STOKER TYPE INDUSTRIAL WASTE INCINERATION SYSTEM
			STOKER TYPE MUNICIPAL SOLID WASTE INCINERATION PLANT
		Waste paper	BATCH LOADING GASIFICATION INCINERATOR
			COMPACT SMOKELESS INCINERATOR FOR WASTE PLASTIC AND GARBAGE
			HIGH TEMPERATURE AND HIGH PRESSURE BOILER
			HITZ ROTARY KILN INCINERATION SYSTEM
			HITZ SLAGGING KILN INCINERATION SYSTEM
			MASTIFF NEO Single-shaft shredders
			MITSUBISHI - MARTIN REFUSE INCINERATION SYSTEM
			ROTARY KILN SYSTEM
			MITSUBISHI STOKER INCINERATION SYSTEM
			PYROLYSIS GAS MELTING SYSTEM
			SLUDGE TREATMENT SYSTEM BY EFFECTIVE USE OF EXHAUST GAS FROM SMALL SCALE WASTE INCINERATORS
			FLUIDIZED BED TYPE INDSUTRIAL WASTE INCINERATING DISPOSAL SYSTEM
			MASS-BURN RENAISSANCE SYSTEM
			STOKER TYPE MUNICIPAL SOLID WASTE

			INCINERATION PLANT
		Waste wood	BATCH LOADING GASIFICATION INCINERATOR
			COMPACT SMOKELESS INCINERATOR FOR WASTE PLASTIC AND GARBAGE
			HIGH TEMPERATURE AND HIGH PRESSURE BOILER
			HITZ ROTARY KILN INCINERATION SYSTEM
			HITZ SLAGGING KILN INCINERATION SYSTEM
			HIGH-SPEED VERTICAL SHREDDER
			MASTIFF NEO Single-shaft shredders
			MITSUBISHI - MARTIN REFUSE INCINERATION SYSTEM
			ROTARY KILN SYSTEM
			MITSUBISHI STOKER INCINERATION SYSTEM
			PYROLYSIS GAS MELTING SYSTEM
			SLUDGE TREATMENT SYSTEM BY EFFECTIVE USE OF EXHAUST GAS FROM SMALL SCALE WASTE INCINERATORS
			FLUIDIZED BED TYPE INDSUTRIAL WASTE INCINERATING DISPOSAL SYSTEM
			MASS-BURN RENAISSANCE SYSTEM
			ROTARY KILN TYPE INDUSTRIAL WASTE INCINERATION PLANT
			STOKER TYPE INDUSTRIAL WASTE INCINERATION SYSTEM
			STOKER TYPE MUNICIPAL SOLID WASTE INCINERATION PLANT
			WASTE INCINERATOR AND HEAT COLLECTION SYSTEM
		Waste fibers	BATCH LOADING GASIFICATION INCINERATOR
			COMPACT SMOKELESS INCINERATOR FOR WASTE PLASTIC AND GARBAGE
			HIGH TEMPERATURE AND HIGH PRESSURE BOILER
			HITZ ROTARY KILN INCINERATION SYSTEM
			HITZ SLAGGING KILN INCINERATION SYSTEM

			MASTIFF NEO Single-shaft shredders
			MITSUBISHI - MARTIN REFUSE INCINERATION SYSTEM
			ROTARY KILN SYSTEM
			MITSUBISHI STOKER INCINERATION SYSTEM
			PYROLYSIS GAS MELTING SYSTEM
			FLUIDIZED BED TYPE INDSUTRIAL WASTE INCINERATING DISPOSAL SYSTEM
			MASS-BURN RENAISSANCE SYSTEM
			STOKER TYPE MUNICIPAL SOLID WASTE INCINERATION PLANT
		Solid waste related to animals or plants	HIGH TEMPERATURE AND HIGH PRESSURE BOILER
			HITZ ROTARY KILN INCINERATION SYSTEM
			HITZ SLAGGING KILN INCINERATION SYSTEM
			MITSUBISHI - MARTIN REFUSE INCINERATION SYSTEM
			ROTARY KILN SYSTEM
			MITSUBISHI STOKER INCINERATION SYSTEM
			PYROLYSIS GAS MELTING SYSTEM
			DRY-TYPE BIOGAS PROCESS (KOMPOGAS PROCESS)
			FLUIDIZED BED TYPE INDSUTRIAL WASTE INCINERATING DISPOSAL SYSTEM
			WASTE REDUCING SYSTEM FOR FOOD PROCESSING PLANTS
		Solid wastes related to fowls of being slaughtered or scraped	HIGH TEMPERATURE AND HIGH PRESSURE BOILER
			MITSUBISHI - MARTIN REFUSE INCINERATION SYSTEM
			MITSUBISHI STOKER INCINERATION SYSTEM
		Waste pieces of rubber	BATCH LOADING GASIFICATION INCINERATOR
			COMPACT SMOKELESS INCINERATOR FOR WASTE PLASTIC AND GARBAGE
			HIGH TEMPERATURE AND HIGH PRESSURE BOILER
			HITZ ROTARY KILN INCINERATION

			SYSTEM
			HITZ SLAGGING KILN INCINERATION SYSTEM
			MASTIFF NEO Single-shaft shredders
			MITSUBISHI - MARTIN REFUSE INCINERATION SYSTEM
			ROTARY KILN SYSTEM
			MITSUBISHI STOKER INCINERATION SYSTEM
			SLUDGE TREATMENT SYSTEM BY EFFECTIVE USE OF EXHAUST GAS FROM SMALL SCALE WASTE INCINERATORS
			FLUIDIZED BED TYPE INDSUTRIAL WASTE INCINERATING DISPOSAL SYSTEM
		Waste pieces of metal	HITZ ROTARY KILN INCINERATION SYSTEM
			HITZ SLAGGING KILN INCINERATION SYSTEM
			HIGH-SPEED VERTICAL SHREDDER
		Waste pieces of glass, concrete and ceramics	DISPOSED CRT RECYCLING TECHNIQUES
			HITZ ROTARY KILN INCINERATION SYSTEM
			HITZ SLAGGING KILN INCINERATION SYSTEM
		Pieces of broken concrete produced in the newly building, rebuilding or removal of structures	HITZ ROTARY KILN INCINERATION SYSTEM
			HITZ SLAGGING KILN INCINERATION SYSTEM
		Excrements of animals	HIGH TEMPERATURE AND HIGH PRESSURE BOILER
			HITZ ROTARY KILN INCINERATION SYSTEM
			HITZ SLAGGING KILN INCINERATION SYSTEM
			MITSUBISHI - MARTIN REFUSE INCINERATION SYSTEM
			ROTARY KILN SYSTEM
			MITSUBISHI STOKER INCINERATION SYSTEM
			NISHIHARA OPEN FIELD COMPOSTING

			NISHIHARA ROTARY DRUM COMPOSTING
			PYROLYSIS GAS MELTING SYSTEM
			FLUIDIZED BED TYPE INDSUTRIAL WASTE INCINERATING DISPOSAL SYSTEM
		Dead animals	HIGH TEMPERATURE AND HIGH PRESSURE BOILER
			HITZ SLAGGING KILN INCINERATION SYSTEM
			MITSUBISHI - MARTIN REFUSE INCINERATION SYSTEM
			MITSUBISHI STOKER INCINERATION SYSTEM
		Soot and dust	HITZ ROTARY KILN INCINERATION SYSTEM
			HITZ SLAGGING KILN INCINERATION SYSTEM
			PYROLYSIS GAS MELTING SYSTEM
			ASH MELTING SYSTEM
			MASS-BURN RENAISSANCE SYSTEM
		Hazardous Industrial wastes (explosive, toxic or epidemical, etc.)	HITZ ROTARY KILN INCINERATION PLANT
			ROTARY KILN TYPE INDUSTRIAL WASTE INCINERATION SYSTEM
			STOKER TYPE INDUSTRIAL WASTE INCINERATION SYSTEM
			Non-combustion treatment technology for medical waste
			Combustion Treatment technology for hazardous industrial waste
			Combustion in rotary kiln technology for hazardous waste and medical waste
		Advanced technology of comprehensive utilization	Technology of making α-semi-hydrated gypsum by atmospheric saline solution method with secondary product from calcium-based wet method
			Recycling technology for FGD gypsum
			Recycling and treatment technology for electronic waste
			Treatment technology for industrial salt solid waste
			Recycling technology for making feed with manioc waste
			New type rotary furnace for hazardous waste
			sanitary landfill technology for combustion ash stabilized by agentia
			Treatment technology for fermenting methane

			waste	
			Cleaning pulping from straw technology and recycling technology for its effluent	
4	Noise and vibration abatement technology	Advanced technology	Vibration isolation technology of damping spring floating slab for rail	
			Array noise control technology	
		Industrial noise	Measures to decrease the noise of air exhaust from a packing machine	
			A means to reduce noise from an exhaust duct of a blower	
			Measures against the noise of an aerial conveyor	
			Comprehensive noise control technology for big PowerStation	
			Noise control technology for hyperbolic cooling tower	
			Noise control technology for natural ventilation hyperbolic cooling tower	
		Traffic noise	Material, structure and application technology of noise barrier for road	
		Other	Comprehensive noise control technology for large converter station of DC transmission project	
			Comprehensive control technology and equipment for indoor low frequency noise	
			Comprehensive noise control technology for municipal large gas-Fired cogeneration plant	
5	Contaminated soil remediation technology	Treatment Technologies	Advanced technology	Micro-biological degradation and restoration technology for residual pesticide in soil
				Ecological restoration technology for PCBs polluted soil

				Soil vapor extraction and bio-venting technology for VOCs
				Bio pile restoration technology for soil polluted by polycyclic aromatic hydrocarbon
			Separation Technologies	Micro Bubbles Entraining Method
				Soil Washing
				Soil Washing with Flotation
				Thermal Treatment of Heavy Metal Contaminated Soil
				Cleaning Contaminated Soil Using the Steam Heating Method
				Chlorination
				The Soil Vapor Treatment by Fabric Activated Carbon

				The Catalytic Oxidation of VOCs
				Catalytic Decomposition of VOCs
				Decomposition of VOCs Contained in Water by Ultraviolet Rays
				Groundwater Treatment with Ultraviolet Ray Oxidation
			Decomposition Technologies	Reductive Dechlorination of Volatile Chlorinated Organic Compounds
				Cleaning of Contaminated Soil by BCD Process
				Oil Contaminated Soil Thermal Treatment System
				Bio-Pile Method
		In Situ Remediation Technologies	In Situ Decomposition Technologies	Soil Check Simplified Method
				Buggy Mounted Type Sampling Technology for Underground Substances

				Remediation beneath Buildings with Horizontal Wells
				Remediation of Vadose Zone by Air Injection
				Air Sparging for Groundwater Treatment
				Electrokinetic Remediation
			In Situ Extraction Technologies	Electromigration Technology for Clean-up Soil Contaminated with Heavy Metals
				High-pressure Jet-propelled Agitation, Displacement, Solidification
		Containment Technologies	In Situ Containment Technologies	In Situ Vitrification
		Other Technologies	In Situ Decomposition Technologies	Groundwater Remediation System Using Reactive Barrier
			In Situ Extraction Technologies	Two-Phase Extraction System

				Soil Remediation System Using Lime
			Treatment Technologies	Decomposition of Gaseous Chlorinated Compounds
				Treatment by Low-temperature Heating
			Advanced technology	Molecular bonding technology for heavy metal polluted soil
				Restoration technology for heavy metal polluted soil using hyperaccumulator intercropping with cash crop
			Others	Ecological restoration technology for oil polluted soil
				Indirect thermal desorption treatment technology for soil polluted by PCBs and pesticide

				In situ restoration technology for compositing heavy metal polluted soil
				Ecological restoration technology for red mud stacking area
				Phytoremediation technology for arsenic polluted soil
6	Environmental monitoring and analysis technology	Air Pollution Continuous Monitoring Technology	Advanced technology	Automatic/Online monitoring technology of Fourier transform infrared spectroscopy for gaseous Pollutant
				Online monitoring technology for gaseous mercury emitted from stationary pollution source

				Online monitoring technology for denitration
				Non-dispersive infrared online monitoring technology for Nox
				Online monitoring technology for Nox by DOAS
				Online monitoring technology for VOC
				Online monitoring technology for green gas by Infrared-ultraviolet
				Online monitoring technology for green gas
				Detecting technology for heavy metal by gas chromatography-mass spectrography

				Emergency detection technology of chromatography-mass spectrography
				Online monitoring technology for heavy metal （particulate） in air
				Online monitoring technology for heavy metal （particulate） in flue gas
			Sulfur dioxide (SO2)	ATMOSPHERIC SO2 ANALIZER (Type: GFS-153)
				ATMOSPHERIC SO2 ANALIZER (Ype: GRH-102)
				Ambient SO2 Air Pollution Monitor
				Sulfur Dioxide Monitoring System
				SULFUR DIOXIDE ANALYZER
			Nitrogen oxide (NO2)	Ambient NOx Air Pollution Monitor

				Nitrous Oxides Monitoring System
				NITROGEN OXIDES ANALYZER
				ATMOSPHERIC NOx ANALIZER (Type: GLN-154)
				ATMOSPHERIC NOx ANALIZER (Type: GPH-104)
			Suspend particulate matter (SPM)	Suspended Particulate Matter Analyzer
				SUSPENDED PARTICULATE MATTER MONITOR
				Suspended Particulate Matter Monitoring System
				Suspended Particulate Matter Air Pollution Monitor
			Oxidants (Ox), Ozone (O3)	ATMOSPHERIC OZONE ANALYZE
				ATMOSPHERIC OXIDANT ANALYZER
				Ambient O3 Air Pollution Monitor
				Ozone Monitoring System
				OZONE ANALYZER
			Carbon monoxide (CO)	Carbon Monoxide Monitoring System

				Ambient CO Air Pollution Monitor
				ATMOSPHERIC CARBON MONOXIDE ANALYZER
			Hydrocarbons (HC)	Ambient THC, NMHC, and CH4 Air Pollution Monitor
				HYDROCARBON ANALYZER
				Non-methane Hydrocarbons Monitor
				ATMOSPHERIC NON-METHANE HYDROCARBON ANALYZER
			Ammonia (NH3)	AMMONIA ANALYZER
				Ambient NH3 or H2S Air Pollution Monitor
			Acid rain	ACID RAIN MONITOR (Type: AR-107SNA)
				ACID RAIN MONITOR (Type: AR-110)
				AUTOMATIC RAINFALL/SNOWFALL ANALYZER
				ACID RAIN MONITOR (Type: DRM-200E)
				Automatic Acid Rain Analyzer

				Cup Anemometer
			Anemometer	Anemometer (Ultrasonic type direction of the wind gauge)
				Anemometer (Windmill type direction of the wind gauge)
				Anemometer (Pressure-tube type)
				Anemometer (Hot-wire type)
			Anemoscope	Anemoscope (Arrow vane type direction of the wind gauge)
				Anemoscope (Tail plane type direction of the wind gauge)
			Wind vane & anemometer	Ultrasonic Wind Vane & Anemometer
				Windmill Wind Vane & Anemometer
			Thermometer	Thermometer (Expansion type)
				Thermometer (Resistance type)
				Thermometer

				Hygrometer (Hair type)
				Hygrometer (Dew-point type)
				Hair Hygrometer
				Capacitance Type Hygrometer
			Hygrometer	Capacitance Type Hygrometer (Capacitance type temperature and hygrometer)
				Capacitance Type Hygrometer (Wet and dry bulb thermometer (psychrometer) type)
			Pryheliometer	Pyrheliometer
				Pyrheliometer (All-sky type pyrheliometer)
			Rain gauge	Tipping Bucket Rain Gauge
				Rain Gage
			Ultraviolet dositer	Ultraviolet Dosimeter
			Vehicle detector	ULTRASONIC VEHICLE DETECTOR
			Others	STANDARD GAS CALIBRATOR
				CALIBRATION GAS STANDARDS GENERATOR
				Compact pH Meter

				Compact Conductivity Meter
				Atmospheric Monitoring Vehicle
				Acid Rain Sample Collector
				Air - Monitoring Mobile Station
				Microcomputer Control System for Air Monitoring
				Air Pollution Monitor Monitoring System
				simply instantaneous conditions（quality method） emission detecting technology
				Online monitoring technology for water in flue gas
		Water Pollution Continuous Monitoring	Advanced technology	In site fast fluorescence monitoring technology for algae in water
			Atomic Absorption Spectrophotometer	
			Ultraviolet and Visible Spectrophotometer	
			X-ray Fluorescence Spectrometer	

			Inductively Coupled Plasma Emission Spectrophotometer	
			Gas Chromatograph Mass Spectrometer	
			Gas Chromatograph	
			High Performance Liquid Chromatograph	
			Total Nitrogen Analyzer	
			Total Organic Carbon(TOC) Analyzer	
			Oil Content Meter	
			Water Quality Checker (pH, DO, TB, Water Temperature)	
			Water Temperature Meter	
			Rain Gauge	
			Online monitoring technology for heavy metal in water	
7	Administration technology for nature risk	Emergency monitoring and environmental risk assessment technology for heavy metal pollution		
		Leaking detecting and pre-warning system of impervious barrier in landfill		
8	Natural resource protection and ecologic conservation technology	Recycling technologies	Advanced technology	Cleaning treatment and recycling technology for chromium slags by extraction method
				Recycling technology for heavy metal in WPCB and sludge by microbiological method
				New type recycling technology for ammoniacal etching liquid

				Recycling technology for mercuric chloride in spent catalyst by controlled oxygen carbonization method
				Recycling technology for waste battery
				Recycling technology for valuable metal in copper smelting slag by cyclone electrolytic method
				Recycling technology for arsenic, copper, lead, zinc and rare valuable heavy metal in smoke of melting non-ferrous metal by firing
				Recycling technology for heavy metal by membrane separation method
			Recycling of Waste Plastic Containers and Packaging from Households	

			Recycling of Waste Plastic Containers and Packaging from Households and Waste Plastics from Industries
			Recycling of Waste PET Bottles
			Recycling of Waste Wood and Waste Plastics into Recycled Plywood
			Recycling of Waste Paper/Waste Paper Containers and Packaging
			Recycling of Various Waste Paper Containing Foreign Matter
			Bio Gasification of Food Waste and Organic Waste from Food Manufacturing Industries, Food Retailers and Household, etc.
			Recycling of Used Home Appliances (1)
			Recycling of Used Home Appliances (2)
			Recycling of Used Florescent Lamps
			Recycling of sludge/dusts containing valuable metals (Nickel/Zinc)
			Landfill gas-fired steam power technology
			Biogas technology
			Technology of making automotive fuel from landfill gas
			Recycling technology for slag of purified terephthalic acid
			Comprehensive utility technology for coking organic solid waste
			Comprehensive utility technology for organic solid waste in furfural factory
			Recycling technology waste battery by dry method
			Recycling technology waste battery by whole wet method of preliminary desulfurization-electrolytic deposition
			Lead smelting technology of oxidizing in bottom blowing furnace and reduction smelting in blast furnace
		Treatment technology for rural pollution	Improved integration oxidation ditch technology for sewage
			Integration treatment technology for sewage in rural
			Treatment technology for soil polluted by high load underground leachate
			Treatment technology for sewage by constructed wetland
			Multifunction treatment technology for sewage in

			rural by constructed wetland	
			Treatment technology for sewage in rural by constructed vertical flow wetland of reed bed	
			Treatment technology for poultry excrement by producing methane in anaerobic environment	
			Soft biogas digester and bladder tank of biogas	
			Treatment and utilization technology for feces from livestock and poultry farm	
			Treatment technology for feces by earthworm	
			Biological fermentation technology for feces for pig farm	
			Ecological aquaculture technology	
			Technology for generation power by biomass	
			Drainage technology in negative pressure by source separation	
			Zero discharge technology of sewage from raising hogs by biological fermentation	
		Ecological conservation	Ecological restoration technology for lake by using aquatic plant	
		Reclamation	Advanced technology	Treatment technology for drink water in the area polluted by arsenic
9	Environmentally Preferable technology	Biomass Co-Fired Boilers	Pelletized wood fuel, co-fired with coal	
			Wood waste co-fired with coal	
		Energy Efficiency technologies	Power load management technologies	
			Heat and cold energy storage technologies	
			Green lighting technologies	
			Energy-efficient home appliances	
			Heat pump, gas and steam combining cycle power generation technologies	
			Ultra-infrared, microwave, or high-power/mid-frequency inducted heating technologies	
			High-power/low-frequency electric source metallurgical technologies	
			Speed adjusting operation technology for alternate current electric motors	
			High efficiency fans, water pumps, electric motors	

			and transmitters	
			Heat treatment, electric plating, moulding and oxygen production technologies	
			Non-power automatic supplement technology	
			High efficiency batteries	
			Renewable energy technologies: hydropower, solar energy, biomass, wind power, nuclear power	
		Green Buildings/Energy Efficient	EarthLinked Ground-Source Heat Pump Water Heating System	
		Oil and Gas Industry	Seal Assist System (Phase I)	
			Seal Assist System (Phase II)	
			Environmental Vapor Recovery Unit (EVRU)	
			Emissions Packing (Phase I)	
			Automated Fuel Cleaning and Maintenance System	
			Pin-Tech Bubble Tight <500 ppm Relief Vent	
		Transportation	Fuel-Efficient High-Performance (FEHP) SAE 75W90 Rear Axle Gear Lubricant	
			Diesel Fuel Catalyzer Fuel Additive	
			The Condensator Diesel Engine Retrofit Crankcase Ventilation System	
		Industrial cleaning production technology	Advanced technology	Clean chromium salt production technology by redox
				extraction technology of citric acid by chromatography
				Dry type production technology of acetylene

				Staining technology using suspended solids of micro protein fiber
				Staining technology without auxiliaries and waterwashing for dacron
				Production technology of oxidized white liquor
				Antirust technology for single prop in the coal mine
				Technology of reducing ammonia nitrogen discharge in curriery
				Battery formation appliance of low acid mist emission
				Cleaning production technology of lead accumulator
				Film-forming technology on metal surface

				Pretreatment technology for metal coating
				Production technology for pigment of sulfide in rare earth
				Acid copper plating technology without cyanogen and formaldehyde
				Cleaning gold-plating technology
			Cleaning technology for flue gas from boiler using brine of calcium sulfate	
			Green electroplating technique	
			Recycling technology of water used by wet-process phosphoric acid	
			Treatment technology for sulfate in brine by freezing method	
			Low discharge technology for nitrogenous fertilizer enterprise	
			Discharge reduction and cleaning product technology for sewage from nitrogenous fertilizer enterprise	
			Low pressure hydrolysis technology for condensate in urea producing process	
			Recycling technology for ammonia in the process of producing indigotin	
			Concentration and recycling technology for DEG in the process of producing organic pigments	
			Treatment and recycling technology for dye waste water by membrane	
			Cleaning producing technology for dye	

			Recycling technology of saponification rosin in wax printing industry	
			Digital jet printing technology	
			Dyeing and finishing technology by foam	
			Staining technology by high temperature and high pressure air	
			Pretreatment technology for cotton cold heap	
			Efficient and brightness cleaning bleach technology for bamboo pulp	
			Bleach technology for paper pulp with assistance of biont	
			Cleaning producing technology for beer	
			Producing technology of lactic acid and calcium lactate from bottom pot flavor of brewing	
			Energy saving and emission reduction technology of low effect and low voltage of aluminum electrolysis	
			Environment friendly lime calcining technology of annular sleeve kiln	
			New type efficient and cleaning treatment technology for multiple tungsten alloy surface	
			Producing technology of low mercury catalyst	
			Producing and applying technology of antirust coating using Iron-titanium compound powder instead of lead and chromium pigment	
10	International environmental conventions-related and climate change mitigation technology	Capture, Storage, Sequestration or disposal of Greenhouse gases	CO2 capture or storage (CCS)	Capture by biological separation
				Capture by chemical separation
				Capture by absorption
				Capture by adsorption
				Capture by membranes or diffusion
				Capture by rectification and condensation
				Subterranean or submarine CO2 storage

			Capture or disposal of greenhouse gases other than CO2	of nitrous oxide (N2O)[N1006]
				of methane [N1006]
				of per fluorocarbons [PFC], hydro fluorocarbons [HFC] or sulfur hexafluoride [SF6] [N1006]
		Greenhouse Gas Monitoring and Others	Parametric Emissions Monitoring System (PEMs)	
			SLE-1001 Sight Glass Monitor	

ANNEX XI ES-related Technologies for Sewage Treatment

Type	Method	Starting time		Technical characteristics	
		Overseas	China	Advantage	Disadvantage
Biological	Traditional active sludge process	Invented in 1912. The first trial site employing this technology was established in Manchester	Beiqu Sewage Treatment Plant was built in Shanghai in 1921 with capacity of 3500 t/d	BOD5 removal rate at 90% ~ 95%, relatively flexible treatment degree	Occupying large area, possibility of oxygen supply bigger than the demand at the end, relatively poor adaptation to impact load
	Oxidation ditch	The first oxidation ditch sewage treatment plant was built in the Netherlands in 1954.	Study and practice beginning in 1970s	Good water quality of outflow water, strong anti-shock loading capacity, high efficiency in the removal of phosphorus and nitrogen, stable sludge, energy efficient and convenient for automatic control	Sludge bulking, foam, sludge floating, uneven flow rate, sludge deposition and no treatment capacity for wastewater with small BOD, etc.

	Anoxic - aerobic method (A/O)	—	—	High efficiency, simple flowchart, low investment, low operational cost; high degradation efficiency of pollutants in the anoxic denitrification process; high volume load; strong anti-shock loading capacity	No independent sludge return system, no capacity in cultivating sludge with unique functions; relatively low degradation rate of difficult substances; increase of internal circulation rate to raise denitrification efficiency leading to higher operational cost; Denitrification rate hard to reach 90%
	A^2/O method	Developed by some American experts in 1970s based on AO denitrification process	Begin introducing A^2/O method in 1980s	Hydraulic retention time less than that of other processes, very low possibility of filamentous sludge bulking, high phosphorus level in sludge with relatively high fertility, low operational cost	Big difficulty in further raising removal rate of phosphorus and nitrogen; certain limit for sludge growth; high requirement for the concentration of dissolved oxygen

	SBR method	Invented by British scholars Ardern and Locket in 1914. The first SBR sewage treatment plant with automatic control was built in Indiana, United States in 1980.	The first SBR sewage treatment plant was put into operation in Shanghai in 1985 with design capacity of 2400 t/d	Global recognition and adoption, stable operation, short period required, high efficiency, good purification, strong anti-shock loading capacity, flexibility in operation, small amount of treatment equipment, simple structure, convenience for operation and maintenance, simple process and low cost	High requirement for automatic control, very high requirement for decanter, high requirement for post-treatment equipment, generation of scum due to no detritus tank
	Biological contact oxidation process	Invented in early 1970s	Beginning the application of this process in mid 1970s	High removal rate of BOD_5, COD_{Cr} and SS; good outcomes in removing ammonia nitrogen; simple in operation and management; very few sludge; operation under air-tight conditions with no impact on the environment	Relatively high price of biomembrane, the actual amount of biomembrane varying with BOD load; improper selection of filling materials would affect normal use

Biological	Absorption-biological degradation process	Developed in mid 1970s and began application in engineering practice in early 1980s	Began study on AB process from late 1970s to early 1980s with application in sewage treatment in 1980s	High removal rate of organic matters; stable system operation; good nitrogen and phosphorus removing outcomes; low operational cost, low electricity consumption and recycling of biogas	Prone to generation of odor in case of poor control of A section during operation; low efficiency in denitrification in case of high requirements for removing phosphorus and nitrogen; high generation rate of sludge
	CCAS	Successful development of SBR process as early as 1914	Environmental Protection Center of Engineering Design and Research Institute of PLA General Armament Department conducted systematic simulation test in lab in 1994	During aeration, sewage and sludge are under ideal mixing status with 95% removal rate for BOD and COD and over 80% removal rate for nitrogen and phosphorus. After deposition, SS level of outflow is very low that ensures good outcomes for phosphorus removal	It is impossible for artificial control due to simultaneous discontinuous running of all pools, so the control depends on computer. This presents very high requirements for the management of sewage treatment plant. Relatively high requirements for activities such as design, training, installation and debugging

	BAF process	Appeared in late 1970s and early 1980s in Europe, basically mature after great development in the mid and late 1980s	BAF is under extension stage in China. Malanhe Sewage Treatment Plant in Dalian is the first urban sewage treatment plant employing BAF process	High treatment load, good quality of outflow and occupying small land area	Relatively high requirements for SS concentration of inflow water, relatively big lift head for inflow, insufficient washing of filter materials may lead to glomeration. The sludge amount is slightly bigger than that of activated sludge process, relatively poor sludge stability
	MBR process	Presented by Smith (an American) and others in the end of 1960s. Improvement of biomembrane manufacturing after 1980s has facilitated the development of membrane bioreactor technology, leading to rapid development of MBR technology. MBR technology has enjoyed the most rapid development since 1990s and entered application	Although China is late in the study on membrane bioreactor, it has fast development. In 1991, Qin Yunhua gave an overview of the application of membrane bioreactors. Many research on the technologies for sewage treatment by membrane bioreactors have been conducted since 1995, involving many research	High removal rate of pollutants, relatively big flexibility and workability, addressing the difficulty in disposing excess sludge	Relatively high cost

		stage	institutes.		
	Others	CCB process, SPR process for high-turbidity sewage, BIOLAK process, etc.			
Chemical	Organic (artificial synthesis, natural), inorganic (aluminum series and iron series)	This type of process mainly aims at treatment of industrial effluent with high acidity, alkalinity or toxicity or the effluent that cannot be treated by biological method. Those effluents cannot be treated until chemical reagents are added in the process.			
Physical	Activated carbon method, exchange resin method	Approaches such as absorption by activated carbon, membrane filtration and exchange resin are employed to remove the pollutants in sewage. Physical method usually is employed with combination of biological or chemical method.			

ANNEX XII CDM Landfill Biogas Utilization Projects in China

No.	Project Name	Owner	Foreign Partner	Estimated annual reduction of CO_2 (t)
1	Biogas Power Generation Project of Zhouliu Urban Garbage Sanitary Landfill Facilities in Jiaozuo City	Shanghai BCCY New Power Industry Co. Ltd	I S.A. SICAR	49,102
2	Dagang Garbage Incineration Power Plant in Binhai New Area	Tianjin Binhai Environmental Industry Development Co., Ltd.	Environment Project Management Inc.	82,285
3	Garbage Incineration Power Generation Project in Yuhuan County	Yuhuan Weiming Environmental Energy Co., Ltd.		52,632
4	Garbage Incineration Power Plant in west Xiamen	Xiamen Environmental Energy Investment and Development Co., Ltd.	J-TEC Co., Ltd	87,018
5	Garbage Incineration Power Plant in east Xiamen	Xiamen Environmental Energy Investment and Development Co., Ltd.	J-TEC Co., Ltd	86,477
6	Garbage Incineration Power Generation Project in Hui'an County	Chuangguan Environmental Protection (Hui'an) Co., Ltd.	Fine Carbon Fund Ky, Nordic Carbon Fund Ky, GreenStream Network Plc	169,144
7	Biogas Power Generation Project of Zhuzhou Urban Garbage Landfill Facilities	Hunan Huiming Environmental Energy Co., Ltd.	Innovative Carbon Capital	143,647
8	Biogas Power Generation Project of Tanggou Garbage Sanitary Landfill Facilities in Anyang City	Shanghai BCCY New Power Industry Co. Ltd	Climate change investment, I S.A. SICAR	77,395
9	Biogas recycling and reuse project of Huangshan Lishiting Garbage Landfill Facilities in Anhui Province	Huangshan Garbage Treatment Center	Sweden Energy Agency and ADB	20,000
10	Biogas Power Generation Project of Yinzhou Garbage Landfill Facilities in Jingbo	Ningbo Qiyao New Energy Co., Ltd.	Climate Bridge	52,986
11	Biogas Power Generation Project of Xinyang Garbage Landfill Facilities	Shanghai BCCY New Power Industry Co. Ltd	UPM Environment Project Management Inc.	54,200
12	Nanhai Second Garbage Incineration Power Plant in	Foshan Nanhai Lüdian Renewable Energy Co., Ltd.	Climate Bridge	137,146

	Foshan City			
13	Jiangbeixibu (Xingou) Garbage Incineration Power Generation Project	Wuhan Shenneng Environmental Protection Xingou Garbage Power Co., Ltd.	Natural Gas Industry Marketing and Trading Company	151,232
14	Garbage Incineration Power Plant in west Qinhuangdao City	Zhejiang Weiming Environmental Protection Co., Ltd.	Eco Frontier Carbon Partners Limited	88,618
15	Stage II expansion project of Linjiang Garbage Incineration Power Plant in Wenzhou City	Zhejiang Weiming Environmental Protection Co., Ltd.	Eco Frontier Carbon Partners Limited	210,851
16	Garbage Incineration Power Generation Project in Linhai City	Linhai City Weiming Environmental Protection Co., Ltd.	Eco Frontier Carbon Partners Limited	110,927
17	Biogas Recycling and Power Generation Project of Weifang Garbage Landfill Facilities	Weifang Ruitong Bioenergy Co., Ltd.	RWE Power Aktiengesellschaft	56,135
18	Zhoushan City Garbage Incineration Power Generation Project	Zhoushan Wangneng Environmental Energy Co., Ltd.	Originate Carbon Limited	73,530

Source: NDRC website (January 1 ~ October 15, 2011).

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Produced for
Asia-Pacific Economic Cooperation Secretariat
Address: 35 Heng Mui Keng Terrace, Singapore 119616
Tel: (65) 6891 9600 Fax: (65) 6891 9690
Email: info@apec.org; Website: www.apec.org

ISBN 978-981-07-7407-3
APEC #213-CT-01.7