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Development of an Energy Conservation Voluntary Agreement Pilot Project in the Steel Sector in Shandong Province

Project Report to the State Economic and Trade Commission, People's Republic of China

January 2003

Lynn Price, Jiang Yun, Ernst Worrell, Du Wenwei, Jonathan E. Sinton

Lawrence Berkeley National Laboratory
China Energy Conservation Association

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Acronyms and Abbreviations

ACEEE	American Council for an Energy-Efficient Economy
CECA	China Energy Conservation Association
CECIC	China Energy Conservation Investment Corporation
CIPEC	Canadian Industry Program for Energy Conservation
CO_2	Carbon dioxide
DEFRA	Department for Environment, Food & Rural Affairs (UK)
DSM	Demand side management
ECEEE	European Council for an Energy-Efficient Economy
ECL	Energy Conservation Law
ECR	Energy conservation rate
EEI	Energy efficiency index
EI	Energy intensity
EJ	Exajoule
EMAS	Eco-management and audit scheme
EMC	Energy management company
ESCO	Energy service company
ETC	Economic and Trade Commission
GEF	Global Environmental Facility
GHG	Greenhouse gas
IRR	Internal rate of return
ISO	International Organization for Standardization
kgce	kilogram coal equivalent
LBNL	Lawrence Berkeley National Laboratory
LTA	Long Term Agreement
MACC	Make a Corporate Commitment
MOST	Ministry of Science & Technology
Mtce	Million tons coal equivalent
NOVEM	Dutch Agency for Energy and Environment
R&D	Research & Development
SDPC	State Development Planning Commission
SETC	State Economic and Trade Commission
STEM	Swedish National Energy Administration
tce	ton of coal equivalent
TRT	Top pressure recovery turbines
UK	United Kingdom
UNDP	United Nations Development Program
US	United States
VA	Voluntary Agreement
WTO	World Trade Organization

Development of an Energy Conservation Voluntary Agreement Pilot Project in the Steel Sector in Shandong Province

Project Report to the State Economic and Trade Commission

Executive Summary

China faces a significant challenge in the years ahead to continue to provide essential materials and products for a rapidly-growing economy while addressing pressing environmental concerns. Energy is a fundamental element of the national economy and the conditions of its use have a direct impact on China's ability to reach its sustainable development goals. China's industrial sector, which accounts for over 70% of the nation's total energy consumption each year, provides materials such as steel and cement that build the nation's roads, bridges, homes, offices and other buildings. Industrial products include bicycles, cars, buses, trains, ships, office equipment, appliances, furniture, packaging, pharmaceuticals, and many other components of everyday life in an increasingly modern society. This vital production of materials and products, however, comes with considerable problems. China's industrial sector is heavily dependent on the country's abundant, yet polluting, coal resources. Industrial production locally pollutes the air with emissions of particulates, carbon monoxide, sulfur dioxide, and nitrogen oxides, uses scarce water and oil resources, emits greenhouse gases contributing to the warming global atmosphere, and often produces hazardous and polluting wastes. Fostering innovative approaches to reduce the use of polluting energy resources and to diminish pollution from industrial production that are tailored to China's emerging market-based economy is one of the most important challenges facing the nation today.

The pressures of rapid industrial production growth, continued environmental degradation, and increased competition create a situation that calls for a strategically-planned evolution of China's industries into world-class production facilities that are competitive, energy-efficient and less polluting. Such a transition requires the complete commitment of industrial enterprises and the government to work together to transform the industrial facilities of China. Internationally, such a transformation of the industrial sector has been realized in a number of countries using an innovative policy mechanism called Voluntary Agreements.[1] Voluntary Agreements are "essentially a contract between the government and industry, or negotiated targets with commitments and time schedules on the part of all participating parties."[2] These agreements typically have a long-term outlook, covering a period of five to ten years, so that strategic energy-efficiency investments can be planned and implemented. A key element of Voluntary Agreements is that they focus the attention of all actors on energy efficiency or emission reduction goals.

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[1] Over 300 environmental Voluntary Agreements have been negotiated between national governments and industry in Europe. Paton, B., 2002. "Voluntary Environmental Initiatives and Sustainable Industry," in ten Brink, P., ed., 2002. *Voluntary Environmental Agreements: Process, Practice and Future Use*. Sheffield, UK: Greenleaf Publishing Ltd.

[2] International Energy Agency, 1997. *Voluntary Actions for Energy-Related CO_2 Abatement*. Paris: OECD/IEA.

Internationally, Voluntary Agreements have been shown to result in increased energy efficiency, with the more successful programs even doubling autonomous energy efficiency improvement rates. In addition, Voluntary Agreements have important longer-term impacts including changes of attitudes and awareness of managerial and technical staff regarding energy efficiency, addressing barriers to technology adoption and innovation, creating market transformation to establish greater potential for sustainable energy-efficiency investments, promoting positive dynamic interactions between different actors involved in technology research and development, deployment, and market development, and facilitating cooperative arrangements that provide learning mechanisms within an industry.[3,4]

The essential steps for reaching a Voluntary Agreement are the assessment of the energy-efficiency potential of the participants as well as target-setting through a negotiated process. Participation by industries is motivated through the use of "carrots" and "sticks", which refers to incentives and disincentives. Supporting programs and policies (the "carrots"), such as enterprise audits, assessments, benchmarking, monitoring, information dissemination, and financial incentives all play an important role in assisting the participants in meeting the target goals. Some of the more successful Voluntary Agreement programs are based on some reduction of environmental regulations or taxes (the "sticks") for participants. Overall, international experience shows that Voluntary Agreements are an innovative and effective means to motivate industry to improve energy efficiency and reduce related emissions, if implemented within a comprehensive and transparent framework.[5,6]

Voluntary Agreements were chosen by the State Economic and Trade Commission (SETC) as a new policy mechanism to test in China's industrial sector where the movement toward a market economy is demanding innovative methods for supporting and transforming essential enterprises. Analysis of the potential for energy efficiency improvement in various energy-intensive industrial sectors in China led to the choice of the iron and steel industry for a pilot project to evaluate this new concept. SETC chose Jinan Iron and Steel Company (Jigang) and Laiwu Iron and Steel Company (Laigang) to test this innovative policy mechanism. The Pilot Project has been developed collaboratively with representatives from Jigang and Laigang, SETC, and the Shandong Economic and Trade Commission (ETC).[7] This report provides information on international experience with Voluntary Agreements and then provides methodologies and guidelines for developing and implementing a pilot Energy Conservation Voluntary Agreement with the two steel enterprises in Shandong Province.

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[3] Dowd, J., Friedman, K, and Boyd, G., 2001. "How Well Do Voluntary Agreements and Programs Perform At Improving Industrial Energy Efficiency," *Proceedings of the 2001 ACEEE Summer Study on Energy Efficiency in Industry*. Washington, DC: American Council for an Energy-Efficient Economy.

[4] Delmas, M. and Terlaak, A., 2000. "Voluntary Agreements for the Environment: Innovation and Transaction Costs," CAVA Working Paper 00/02/13, February.

[5] International Energy Agency, 1997. *Voluntary Approaches for Mitigating Greenhouse Gas Emissions*. Conference Proceedings, Bonn, Germany 30-31 October 1995. Paris: OECD/IEA.

[6] International Energy Agency, 1997. *Voluntary Actions for Energy-Related CO2 Ab*atement. Paris: OECD/IEA.

[7] Jiang Yun of the China Energy Conservation Association has directed this collaboration. International experts who have participated in development of the Pilot Project are Lynn Price, Ernst Worrell, and Jonathan Sinton of Lawrence Berkeley National Laboratory (USA), Kornelis Blok and Dian Phylipsen of Ecofys (The Netherlands), and Wil Nuijen of Novem (The Netherlands).

1. Introduction

1.1 Importance of Industrial Energy Conservation

China faces a significant challenge in the years ahead to continue to provide essential materials and products for a rapidly-growing economy while addressing pressing environmental concerns. Energy is a fundamental element of the national economy and the conditions of its use have a direct impact on China's ability to reach its sustainable development goals. China's industrial sector, which accounts for over 70% of the nation's total energy consumption each year, provides materials such as steel and cement that build the nation's roads, bridges, homes, offices and other buildings. Industrial products include bicycles, cars, buses, trains, ships, office equipment, appliances, furniture, packaging, pharmaceuticals, and many other components of everyday life in an increasingly modern society. This vital production of materials and products, however, comes with considerable problems. China's industrial sector is heavily dependent on the country's abundant, yet polluting, coal resources. Industrial production locally pollutes the air with emissions of particulates, carbon monoxide, sulfur dioxide, and nitrogen oxides, uses scarce water and oil resources, emits greenhouse gases contributing to the warming global atmosphere, and often produces hazardous and polluting wastes. Fostering innovative approaches to reduce the use of polluting energy resources and to diminish pollution from industrial production that are tailored to China's emerging market-based economy is one of the most important challenges facing the nation today.

China has a history of taking effective actions to limit industrial energy consumption. In 1980, China introduced the energy strategy of "insisting on both resource development and resource conservation with the conservation as the first priority". Numerous energy-efficiency polices were adopted that successfully reduced energy use while the economy grew at a rapid pace. Through these programs China was able to decouple energy use from economic growth, allowing the nation to industrialize without draining the national budget to pay exorbitant energy costs that would have occurred without such a concerted effort.[8] During the past 20 years, China experienced an average annual increase of 4-5% in energy consumption while maintaining average annual economic growth of 8-9%, realizing the macro-goal of meeting increased energy demand half through energy development and half through energy saving.[9] These successful programs and policies, however, were implemented during a different era in China - a time when there was nearly complete government control over the nation's major industrial producers.

Today China faces a new situation: as it moves toward a market-based socialist economy, government control is weakening and enterprises are privatizing or becoming much more heavily influenced by market pressures. Issues related domestic and international competitiveness are growing in importance. Entry into the World Trade Organization (WTO) introduces new rules

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[8] Sinton, J.E., Levine, M.D., and Wang, Q., 1998. "Energy Efficiency in China: Accomplishments and Challenges," *Energy Policy*, Vol. 26, No. 11: 813-829.

[9] Xie Xuren, Vice Director of SETC, 2002. Opening address for 2002 China International Energy and Environmental Protection Exhibition & Workshop, Beijing, November 5, 2002.

and new challenges for China's industries. At the same time, production of industrial materials is growing faster than ever experienced before.

While tremendous energy conservation and environmental protection achievements were realized in the past, there remains a great gulf between the China's level of energy efficiency and that of the advanced countries of the world. Sustainable development of China will be confronted with many obstacles. On the one hand, due to the large population, China possesses a relative lack of resources, especially oil resources, and the tension between oil supply and oil demand is becoming increasingly obvious. On the other hand, there is a great deal of wasted energy and many examples of low energy efficiency. At present, China's energy consumption per unit of GDP is more than two times higher than world average and energy consumption for production of the main energy-intensive products in China is 40% higher than international consumption. Thus, sustainable utilization of natural resources has become a strategy for safeguarding the nation's long-term economic development.

1.2 Government and Industry Efforts to Encourage Industrial Energy Conservation: Introduction of Voluntary Agreements

The pressures of rapid industrial production growth, continued environmental degradation, and increased competition create a situation that calls for a strategically-planned evolution of China's industries into world-class production facilities that are competitive, energy-efficient and less polluting. Such a transition requires the complete commitment of industrial enterprises and the government to work together to transform the industrial facilities of China.

Internationally, such a transformation of the industrial sector has been realized in a number of countries using an innovative policy mechanism called Voluntary Agreements.[10] The International Energy Agency has identified two broad categories of Voluntary Agreements: "(1) informal programmes, self-commitments and declarations, where the parties entering into the action with the government set their own targets and often do their own monitoring and reporting; and (2) more formal voluntary approaches where there is essentially a contract between the government and industry, or negotiated targets with commitments and time schedules on the part of all participating parties."[11] Voluntary Agreements typically have a long-term outlook, covering a period of five to ten years, so that strategic energy-efficiency investments can be planned and implemented. A key element of Voluntary Agreements is that they focus the attention of all actors on energy efficiency or emission reduction goals.

A recent analysis of seven Voluntary Agreement programs in Europe and the U.S. found that the programs could be attributed with about 50% of the observed energy-efficiency improvement or

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[10] Over 300 environmental Voluntary Agreements have been negotiated between national governments and industry in Europe. Paton, B., 2002. "Voluntary Environmental Initiatives and Sustainable Industry," in ten Brink, P., ed., 2002. *Voluntary Environmental Agreements: Process, Practice and Future Use*. Sheffield, UK: Greenleaf Publishing Ltd.

[11] International Energy Agency, 1997. *Voluntary Actions for Energy-Related CO_2 Abatement*. Paris: OECD/IEA.

emissions reductions. For example, in The Netherlands the historical energy intensity improvement rate of about 1% per year was more than doubled during the 10-year period covered by the industrial Voluntary Agreement program. In addition to direct energy savings, there are also important medium and long-term impacts associated with this policy mechanism including changes of attitudes and awareness of managerial and technical staff regarding energy efficiency; addressing market, institutional, regulatory, and other barriers to technology adoption and innovation; fostering market transformation to establish greater potential for sustainable energy-efficiency investments; promoting positive dynamic interactions between different actors involved in technology research and development, deployment, and market development; and facilitating cooperative arrangements that provide learning mechanisms within a sector or industry to combine knowledge and develop new competencies in industry.[12, 13] These characteristics of Voluntary Agreements are what distinguish them from other energy-saving policies; changes in attitudes and approaches coupled with reducing barriers to innovation and technological change lead to greater overall energy savings than have been seen in other market-based energy-efficiency approaches in the industrial sector.

The essential components of the process of reaching a Voluntary Agreement are the assessment of the energy-efficiency potential of the participants as well as target-setting through a negotiated process. Participation by industries is motivated through the use of "carrots" and "sticks", which refers to incentives and disincentives. Supporting programs and policies (the "carrots"), such as enterprise audits, assessments, benchmarking, monitoring, information dissemination, and financial incentives all play an important role in assisting the participants in meeting the target goals. Some of the more successful Voluntary Agreement programs are based on some reduction of environmental regulations or taxes (the "sticks") for participants. Overall, international experience shows that Voluntary Agreements are an innovative and effective means to motivate industry to improve energy efficiency and reduce related emissions, if implemented within a comprehensive and transparent framework.[14,15]

After assessing China's existing policies and guidelines for energy conservation as well as international advanced energy efficiency policies, the applicability of Voluntary Agreements to China was further studied. Given their significant success in improving energy efficiency in other countries, Voluntary Agreements were chosen by the State Economic and Trade Commission (SETC) as a new policy mechanism to test in China's industrial sector where the movement toward a market economy is demanding innovative methods for supporting and transforming essential enterprises. Analysis of the potential for energy efficiency improvement in various energy-intensive industrial sectors in China led to the choice of the iron and steel

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[12] Dowd, J., Friedman, K, and Boyd, G., 2001. "How Well Do Voluntary Agreements and Programs Perform At Improving Industrial Energy Efficiency," *Proceedings of the 2001 ACEEE Summer Study on Energy Efficiency in Industry*. Washington, DC: American Council for an Energy-Efficient Economy.

[13] Delmas, M. and Terlaak, A., 2000. "Voluntary Agreements for the Environment: Innovation and Transaction Costs," CAVA Working Paper 00/02/13, February.

[14] International Energy Agency, 1997. *Voluntary Approaches for Mitigating Greenhouse Gas Emissions*. Conference Proceedings, Bonn, Germany 30-31 October 1995. Paris: OECD/IEA.

[15] International Energy Agency, 1997. *Voluntary Actions for Energy-Related CO2 Ab*atement. Paris: OECD/IEA.

industry for a pilot project to evaluate this new concept. SETC issued a formal declaration titled "Notice on Conducting the Pilot Program of Energy Conservation Voluntary Agreement" which stated that "Jigang and Laigang of Shandong Province are chosen as the pilot enterprises to carry out energy conservation voluntary agreement pilot, for the sake of learning from international successful experience, expediting development of new mechanisms which fit to market economy and Chinese characteristics, pushing further the work of national energy conservation and improving increasingly the competition of China's enterprises". Thus, Jinan Iron and Steel Company (Jigang) and Laiwu Iron and Steel Company (Laigang), will be the first to test this innovative policy mechanism. The pilot will be directed by Economic Trade Commission (ETC) of Shandong Province and will be undertaken with the participation of independent organizations such as the China Energy Conservation Association (CECA), as well as the two pilot enterprises.

Based on experience to date, the lessons learned for designing and implementing Voluntary Agreements show that a comprehensive assessment of enterprise energy-efficiency potential as well as ambitious but realistic targets that are beyond "business-as-usual" and specific timetables for achieving those targets are essential. In addition, clear monitoring guidelines, that include evaluation of progress using physical energy intensity measurements, and independent verification of progress, must be implemented. Finally, long-lasting government support in the form of policies and programs that assist industries in implementing energy-efficiency improvements and reaching their targets are essential.[16] A recent analysis of five industrial sector Voluntary Agreement programs concluded that "the effectiveness of Voluntary Agreements can be seen as strongly dependent on the accompanying policy mix and the supporting framework which has to be adapted to the specific conditions" of the participating industries.[17] In The Netherlands, experience showed that the cost to the government for implementing the Voluntary Agreement supporting policies was almost one-third less than the costs for providing direct subsidies to industry for purchase of energy-efficient equipment.[18]

One objective of the pilot Energy Conservation Voluntary Agreement in Shandong Province is to provide the participants in the pilot with the tools and conditions required for successful implementation of a Voluntary Agreement. A further objective is to provide a template for the development of Voluntary Agreements as a national level industrial sector policy. The use of Voluntary Agreements is also being tested within the United Nations Development Program (UNDP)/Global Environmental Facility (GEF) project on Energy Conservation and Greenhouse Gas Emission Reduction in Chinese Township and Village Enterprises and has been proposed as a key element of the SETC/UNDP/GEF End-use Energy Efficiency Program in China.

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[16] Blok, K., 2000. "Experiences with Long Term Agreements on Energy-efficiency Improvements in the European Union," Presentation at the *Workshop on Learning from International Best Practice Energy Policies in the Industrial Sector*, May 22-23, 2000, Beijing.

[17] Krarup, S. and Ramesohl, S., 2000. Voluntary *Agreements in Energy Policy – Implementation and Efficiency: Final Report.* Copenhagen: AKF.

[18] Blok, K., 2002. "Establishing Targets for Energy Consumption in Energy-intensive Industries: Examples," Presentation at the *Workshop on Voluntary Agreements for China's Industrial Sector: Integrating International Experiences into Designing a Pilot Program*, Beijing, February 25-27, 2002.

1.3 Implementing Framework for the Pilot Project

This Pilot Project has been developed collaboratively with representatives from the Jigang and Laigang steel enterprises, SETC and the Shandong ETC.[19] International experts visited the participating steel enterprises and held discussions with representatives from these enterprises as well as with representatives of the Shandong ETC in May, 2000. A workshop on *Voluntary Agreements for China's Industrial Sector: Integrating International Experiences into Designing a Pilot Program* was held in Beijing in February 2001 in which international experts provided detailed descriptions of successful Voluntary Agreement programs in other countries and worked with the Pilot Project participants to refine their roles and responsibilities within the pilot. Further meetings with the Pilot Project participants, as well as a one-week workshop on *Voluntary Agreements for China's Industrial Sector: Designing an Energy Conservation Voluntary Agreement Pilot Project in the Steel Sector in Shandong Province* in The Netherlands in July 2002, has resulted in the design of the Pilot Project outlined in this report.

This report provides information on international experience with the various components of Voluntary Agreements as well as Chinese experience in these areas. It then provides methodologies and guidelines for developing and implementing a pilot Energy Conservation Voluntary Agreement with the two steel enterprises in Shandong Province.

The report provides information on the international experience with Voluntary Agreements in Section 2. Over 300 environmental Voluntary Agreements have been negotiated between national governments and industry in Europe alone.[20] The report describes programs in three countries (The Netherlands, Denmark, and Canada) in more depth. In its review of 350 voluntary actions and programs, the International Energy Agency found that "past and present experiences with voluntary actions show that, properly designed and implemented, they can achieve stated objectives, sometimes even exceeding those of minimum regulatory standards, and help integrate economic and environmental goals."[21]

Section 3 reviews the history of energy conservation in China and provides a description of an example pilot Energy Conservation Voluntary Agreement and justification of the choice of the steel sector and of Shandong Province. Designing an Energy Conservation Voluntary Agreement pilot policy program for China's industrial sector involves drawing from the successful elements of the energy-efficiency programs and policies China had during the 1980s in order to develop a policy more similar to those of current Voluntary Agreement programs in developed countries. Such a policy program must take into account unique, China-specific conditions such as rapid economic growth, the need to improve environmental quality, the need to maintain employment

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[19] Jiang Yun of the China Energy Conservation Association has directed this collaboration. International experts who have participated in development of the Pilot Project are Lynn Price, Ernst Worrell, and Jonathan Sinton of Lawrence Berkeley National Laboratory (USA), Kornelis Blok and Dian Phylipsen of Ecofys (The Netherlands), and Wil Nuijen of Novem (The Netherlands).

[20] Paton, B., 2002. "Voluntary Environmental Initiatives and Sustainable Industry," in ten Brink, P., ed., 2002. *Voluntary Environmental Agreements: Process, Practice and Future Use*. Sheffield, UK: Greenleaf Publishing Ltd.

[21] International Energy Agency, 1997. *Voluntary Actions for Energy-Related CO2 Abatement*. Paris: OECD/IEA.

levels, and the need to improve the competitiveness of enterprises in light of the WTO accession. The main participants in the Energy Conservation Voluntary Agreement Pilot Project are two iron and steel enterprises in Shandong Province – Jigang and Laigang, the Shandong ETC, SETC, and CECA. Using international Voluntary Agreement schemes as a model, the sector targets are set through a process in which the government and enterprises negotiate the target level based on detailed evaluations of the potential for energy-efficiency improvement in each enterprise. SETC and the Shandong ETC will fulfill the government role in the pilot project and will determine which supporting policies and programs will be included in the pilot to assist the enterprises in reaching their energy-efficiency targets. Supporting programs can include audits and assessments, information dissemination, priority in energy efficiency projects, financial assistance, and awards and recognition. CECA will fulfill the role of the independent third party and will also convene an expert Technical Team to provide technical assistance throughout the Pilot Project.

The process for signing and implementing the pilot Energy Conservation Voluntary Agreements is outlined in Section 4 of this report. Flow charts are provided that outline the duties and obligations of all parties to the agreements as well as the process steps for moving from initiation to signing of the Voluntary Agreements and for implementation of the Voluntary Agreements. The process of signing the Voluntary Agreements begins with an application by the enterprise and submission of a Summary Report by CECA requesting approval for the Pilot Project. SETC is responsible for granting approval and issuing a Letter of Support indicating that the Pilot Project can proceed.

At this point, the enterprises begin to assess their energy-efficiency potential. Section 5 of this report describes international methods as well as the Chinese experience with such assessments. A *Methodology for Assessment of Enterprise Energy-Efficiency Potential* that incorporates key elements of the various methods used in other countries and in China to determine energy-efficiency potential is presented. The energy-efficiency assessment methodology involves determination of current steel production energy consumption and energy intensity by process of the pilot iron and steel enterprises. Once this has been calculated, the energy-efficiency potential is calculated by comparing the steel production energy intensity for each pilot enterprise with benchmark energy intensities that represent state-of-the-art iron and steel mills. The energy efficiency potential is determined by identification of inefficient processes within each enterprise and identification of technologies and measures that could be implemented to improve the energy efficiency of the enterprise, based on availability of technologies and cost-effectiveness criteria. The potential energy intensity reductions associated with implementation of these technologies and measures are estimated to determine the achievable energy-efficiency potential, which is in turn used to set the Energy Conservation Voluntary Agreement pilot project targets.

Section 6 of this report describes international experience with target-setting and provides a *Methodology for Target-Setting for Pilot Enterprises*. For this pilot, there will be an interim target in 2005 and a final target for 2010. The targets are set by first developing the business-as-usual situation and then, using the information from the assessment of enterprise energy-efficiency improvement potential, calculating the additional energy efficiency improvement that could be achieved with the Voluntary Agreements. Once the targets are formulated by the enterprises, they will be evaluated by CECA and the Technical Team of experts to determine if

they are realistic, yet ambitious, given the results of the energy-efficiency potential assessment as well as the supporting policies offered by the government.

While the enterprises are assessing their energy-efficiency potential, the Shandong ETC will formulate a list of possible supporting policies that can be offered to the participating enterprises to assist them in achieving their energy-efficiency targets. Supporting policies, such as information dissemination, government and public recognition, audits and assessments, exemption from taxes or regulations, and financial assistance and incentives are the key motivational element to encourage enterprises to participate fully in the Voluntary Agreement program. Section 7 of this report reviews a variety of supporting policies that are used in existing Voluntary Agreement programs to motivate and assist industry in reaching its energy efficiency or greenhouse gas emission reduction goals. This section also outlines the possible supporting policies that could be used in China for this Energy Conservation Voluntary Agreement Pilot Project.

SETC and Shandong ETC will select potential supporting policies those that are suitable for China's conditions and that will promote enterprises' participation in the Voluntary Agreement program, as well as aid enterprises to achieve the energy-conservation targets. The enterprises will take the supporting policies offered by the government into account in further developing their energy-conservation targets. Through negotiations, all the parties will agree on the targets and sign the Voluntary Agreements. Section 8 of this report discusses the essential elements of a Voluntary Agreement contract, provides examples of such contracts from other countries, and provides an example contract for use in this Energy Conservation Voluntary Agreement Pilot Project.

Implementation of the Energy Conservation Voluntary Agreement will begin with the development of an Energy Conservation Plan by each enterprise that outlines the steps that will be taken to reach their targets. Chapter 9 of this report provides Guidelines for Development of an Energy Conservation Plan that gives guidance to the enterprises in developing their Energy Conservation Plans based on the experience in The Netherlands. Once the Energy Conservation Plan is developed, CECA and the Technical Team will evaluate the Plan to ensure that it outlines the required energy-efficiency improvements to reach the 2005 and 2010 targets. While the enterprise is developing the Energy Conservation Plan, Shandong ETC and SETC will take the necessary actions to ensure that the supporting policies are in place and that the enterprise can take advantage of them during the implementation of the Energy Conservation Plan. The implementation of the Energy Conservation Plan is in two periods: from start of the Voluntary Agreement to 2005 and from 2005 to 2010. During the two periods, the enterprise will implement the measures outlined in the Energy Conservation Plan. If needed, CECA and the Technical Team can provide technical support to the enterprises during the implementation of the Energy Conservation Plan.

At the end of each year, the enterprise will submit a Supervision Report to CECA and the Technical Team for evaluation, as outlined in the Methodology for Supervision and Evaluation provided in Section 10 of this report. In addition to these annual evaluations, interim and final evaluations of the results of the implementation of the Energy Conservation Plan will be

performed in 2005 and 2010, respectively. The evaluations will determine if the target has been met. Following the interim and final evaluations in 2005 and 2010, all parties will decide whether to proceed. In 2005, this will merely involve deciding to proceed toward the 2010 targets using the existing Energy Conservation Plan for 2010. In 2010, this will involve deciding whether to proceed with a new Energy Conservation Voluntary Agreement. At the conclusion of the Energy Conservation Voluntary Agreement period, SETC or Shandong ETC awards the enterprise according to its performance, honoring the enterprise with either a "Model Enterprise in the China Energy Voluntary Agreement" or a "Progressive Enterprise Within its Sector in Voluntary Agreement" as well as providing media publicity. Further, in meetings and conferences to promote the exchange of enterprise experience, the enterprise can use its own situation to make recommendations to others interested in Voluntary Agreements. CECA and the Technical Team can use its experience in its evaluation of the pilot program to suggest promotion ideas, suggest changes to improve the effectiveness and efficiency of the Voluntary Agreements, and demonstrate that the concept of Voluntary Agreements is feasible in different sectors and regions in China.

Internationally, Voluntary Agreements have been shown to result in increased energy efficiency, with the more successful programs even doubling the autonomous energy efficiency improvement rates. In addition, Voluntary Agreements also have important medium and long-term impacts including changes of attitudes and awareness of managerial and technical staff regarding energy efficiency, addressing barriers (market, institutional, regulatory, and other) to technology adoption and innovation, creating market transformation to establish greater potential for sustainable energy-efficiency investments, promoting positive dynamic interactions between different actors involved in technology research and development, deployment, and market development, and facilitating cooperative arrangements that provide learning mechanisms within a sector or industry to combine knowledge and develop new competencies in industry.[22,23] Overall, Voluntary Agreements are viewed as an innovative and effective means to motivate industry to improve energy efficiency.

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[22] Dowd, J., Friedman, K, and Boyd, G., 2001. "How Well Do Voluntary Agreements and Programs Perform At Improving Industrial Energy Efficiency," *Proceedings of the 2001 ACEEE Summer Study on Energy Efficiency in Industry*. Washington, DC: American Council for an Energy-Efficient Economy.

[23] Delmas, M. and Terlaak, A., 2000. "Voluntary Agreements for the Environment: Innovation and Transaction Costs," CAVA Working Paper 00/02/13, February.

2. Voluntary Agreements: Overview and Experience in Key Countries

There are many types of policies and programs that have been used in countries worldwide to improve energy efficiency in the industrial sector. These policies and programs include regulations, efficiency standards, taxes on energy or emissions, investment tax credits, rebates, agreements or sector targets, benchmarking, reporting, audits, assessments, information dissemination, demonstration, and research and development. Some of these policies and programs are implemented in specific industrial sectors. For example, agreements and targets are usually made with an association or entity representing a particular sector, such as the iron and steel or cement industries. Other polices and programs are directed at equipment that is found in many sectors. For example, regulations or standards for motors will affect motor energy use in almost all industrial sectors.

The most effective way to improve industrial energy efficiency is through a *comprehensive integrated approach*, where a number of policies and programs are combined to create a strong overall industrial energy-efficiency policy that addresses a variety of needs in many industrial sectors. Such an integrated approach can be found in the industrial sector Voluntary Agreement programs that were established in a number of countries in the 1990s.

2.1 Overview of Voluntary Agreements

Agreements to meet specific energy use or energy efficiency targets are used in the industrial sector in many countries around the world.[24,25,26,27,28,29] Such agreements can be viewed as a tool for developing a long-term strategic plan for increasing industrial energy efficiency that fully engages not only the engineers and management at industrial facilities, but also includes government, industry associations, financial institutions, and others. The International Energy Agency has identified two broad categories of Voluntary Agreements: "(1) informal programmes, self-commitments and declarations, where the parties entering into the action with

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[24] Bertoldi, P., 1999. "The Use of Long-Term Agreements to Improve Energy Efficiency in the Industrial Sector: Overview of the European Experiences and Proposal for a Common Framework," *Proceedings of the 1999 American Council for an Energy-Efficient Economy Summer Study on Energy Efficiency in Industry*. Washington, DC: ACEEE.

[25] Chidiak, M., 1999. "Voluntary Agreements for Energy Efficiency in Five EU Countries," in *Energy Efficiency and CO2 Reduction: The Dimensions of Social Change: 1999 European Council for an Energy-Efficient Economy Summer Study*, May 31-June 4, Mandelieu, France.

[26] Hansen, K, and Larsen, A., 1999. "Voluntary Agreements in Industry: A Comparative Description of the Process and a Normative Analysis," *Proceedings of the 1999 American Council for an Energy-Efficient Economy Summer Study on Energy Efficiency in Industry*. Washington, DC: ACEEE.

[27] Mazurek, J. and Lehman, B., 1999. "Monitoring and Verification of Long-Term Voluntary Approaches in the Industrial Sector: An Initial Survey," *Proceedings of the 1999 American Council for an Energy-Efficient Economy Summer Study on Energy Efficiency in Industry*. Washington, DC: ACEEE.

[28] Newman, J., 1998. "Evaluation of Energy-Related Voluntary Agreements," in Martin et al., (eds.) *Industrial Energy Efficiency Policies: Understanding Success and Failure: Proceedings of a Workshop Organized by the International Network for Energy Demand Analysis in the Industrial Sector*. Utrecht, The Netherlands, June 11-12, 1998. (LBNL-42368).

[29] Paton, B., 2002. "Voluntary Environmental Initiatives and Sustainable Industry," in ten Brink, P., ed., 2002. *Voluntary Environmental Agreements: Process, Practice and Future Use*. Sheffield, UK: Greenleaf Publishing Ltd.

the government set their own targets and often do their own monitoring and reporting; and (2) more formal voluntary approaches where there is essentially a contract between the government and industry, or negotiated targets with commitments and time schedules on the part of all participating parties."[30] An agreement or target can be formulated in various ways; two common methods are those based on specified energy efficiency (or energy intensity) improvement targets and those based on absolute energy use or greenhouse gas emissions reduction commitments. Either an individual company or an industrial subsector, as represented by a party such as an industry association, can enter into such agreements.

There is a wide range of Voluntary Agreement activities in the industrial sector. Some programs are fully voluntary and rely on information-sharing as the key element to educate and motivate industries to reduce their energy use or greenhouse gas emissions. Others are viewed as virtually mandatory because they are offered by the government as a means to avoid outright regulation or taxation. Still others fall between these two extremes.

Examples of industrial sector Voluntary Agreement and target programs include the following:

- *Australia*: Energy Smart Business Program[31], Greenhouse Challenge[32]
- *Canada*: Industry Program for Energy Conservation (CIPEC)[33,34]
- *Denmark*: Agreements on Industrial Energy Efficiency[35,36]
- *France*: Voluntary Agreements on CO_2 Emission Reductions[37]
- *Finland*: Agreements on Industrial Energy Conservation Measures[38]
- *Germany*: Declaration of German Industry on Global Warming Prevention[39]

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[30] International Energy Agency, 1997. *Voluntary Actions for Energy-Related CO2 Abatement*. Paris: OECD/IEA.

[31] Cooper, D., Duncan, R., Precious, B., Williamson, A., and Workum, N., 1998. "Creating Demand for Energy Efficiency in Australian Industry," *Proceedings of the 1999 American Council for an Energy-Efficient Economy Summer Study on Energy Efficiency in Industry*. Washington, DC: ACEEE.

[32] Australian Government Office, 2002. *Greenhouse Challenge*. http://www.greenhouse.gov.au/challenge/html/about/about.html

[33] Jago, P., 1999. "The Canadian Industry Program for Energy Conservation (CIPEC): the Dynamics of a 24-year Partnership Between Government and Industry," *Proceedings of the 1999 American Council for an Energy-Efficient Economy Summer Study on Energy Efficiency in Industry*. Washington, DC: ACEEE.

[34] McKenzie, R., 1994. "Canada's National Partnership Strategy for Industrial Energy Efficiency," *in* International Energy Agency, *Conference Proceedings - Industrial Energy Efficiency: Policies and Programs*, Washington, DC, 26-27 May, 1994.

[35] Togeby, M., Bjorner, T.B., and Johannsen, K., 1998. "Evaluation of the Danish CO2 Taxes and Agreements," in Martin et al., (eds.) *Industrial Energy Efficiency Policies: Understanding Success and Failure: Proceedings of a Workshop Organized by the International Network for Energy Demand Analysis in the Industrial Sector*. Utrecht, The Netherlands, June 11-12, 1998. (LBNL-42368).

[36] Togeby, M., Johannsen, K., Ingrslev, C., Thingvad, K., and Madsen, J., 1999. "Evaluations of the Danish *Agreement* System," *Proceedings of the 1999 American Council for an Energy-Efficient Economy Summer Study on Energy Efficiency in Industry*. Washington, DC: ACEEE.

[37] Chidiak, M. 2000. Voluntary Agreements – Implementation and Efficiency. The French Country Study: Case Studies in the Sectors of Packaging, Glass, and Aluminum. Paris: CERNA.

[38] Kraemer, T., *Energy Policy Instruments: Description of Selected Countries*. Denmark: Institute of Local Government Studies.

[39] Ramesohl, S. and Kristof, K., 1999. "What is the Role of Energy-Related Voluntary *Approaches* in the Post-Kyoto Climate Policy? A Process Oriented Analysis of the 'Declaration of German Industry on Global Warming

- *Japan*: Keidanren Voluntary Action Plan on the Environment[40]
- *Netherlands*: Long-Term Agreements on Energy Efficiency, Benchmarking Covenant[41,42,43]
- *Norway*: Norwegian Industrial Energy Efficiency Network[44,45]
- *Sweden*: EKO-Energi[46]
- *U.K.*: Climate Change Levy, Energy Efficiency Best Practice Program, Make a Corporate Commitment Campaign (MCCC), Energy-Intensive Industry Sector Efficiency Targets[47,48,49]
- *U.S.*: Voluntary Aluminum Industrial Partnership; PFC Emissions Reduction Partnership for the Semi-Conductor Industry[50]

Voluntary Agreements typically have a long-term outlook, covering a period of five to ten years. The agreements focus the attention of all actors on energy efficiency or greenhouse gas emissions reduction goals. The key elements of Voluntary Agreement programs are the assessment of energy-efficiency potential of the participants as well as target-setting through a negotiated process with all parties. Supporting programs and policies, such as audits, assessments, benchmarking, monitoring, information dissemination, and financial incentives, all play an essential role in assisting the participants in meeting the target goals. Overall, Voluntary Agreements are viewed as an innovative and effective means to motivate industry to improve energy efficiency and reduce greenhouse gas emissions.

Prevention'," in *Energy Efficiency and CO2 Reduction: The Dimensions of Social Change: 1999 European Council for an Energy-Efficient Economy Summer Study*, May 31-June 4, Mandelieu, France.

[40] Japan Federation of Economic Organizations, 1998. *Outline of the 1st Follow-up Under the Keidanren Voluntary Action Plan on the Environment*, http://www.keidanren.or.jp/english/policy/pol097/outline/html.

[41] Ministry of Economic Affairs, 1998. *Long Term Agreements on Energy Efficiency: Progress in 1996*. The Hague: The Netherlands: Ministry of Economic Affairs.

[42] Nuijen, W., 1998. "Long Term Agreements on Energy Efficiency in Industry," in Martin et al., (eds.) *Industrial Energy Efficiency Policies: Understanding Success and Failure: Proceedings of a Workshop Organized by the International Network for Energy Demand Analysis in the Industrial Sector.* Utrecht, The Netherlands, June 11-12, 1998. (LBNL-42368).

[43] Rietbergen, M., Farla, J., and Blok, K., 1998. "Quantitative Evaluation of Voluntary Agreements on Energy Efficiency," in Martin et al., (eds.) *Industrial Energy Efficiency Policies: Understanding Success and Failure: Proceedings of a Workshop Organized by the International Network for Energy Demand Analysis in the Industrial Sector.* Utrecht, The Netherlands, June 11-12, 1998. (LBNL-42368).

[44] Institute for Energy Technology, 1998. *Norwegian Industrial Energy Efficiency Network*. Kjeller, *Norway*: Institute for Energy Technology.

[45] Finden, P., 1998. "Norwegian Industry's Network for Energy Conservation," in Martin et al., (eds.) *Industrial Energy Efficiency Policies: Understanding Success and Failure: Proceedings of a Workshop Organized by the International Network for Energy Demand Analysis in the Industrial Sector.* Utrecht, The Netherlands, June 11-12, 1998. (LBNL-42368).

[46] Uggla, U. and Avasoo, D., 2001. "EKO-Energi – Successful Voluntary Agreements on Energy Efficiency and Environmental Control in Swedish Industry." *Proceedings of the 2001 ECEEE Summer Study*. European Council for an Energy-Efficient Economy.

[47] Miles, J., 1994. "*The* UK Energy Efficiency Best Practice Programme," in International Energy Agency, *Conference Proceedings - Industrial Energy Efficiency: Policies and Programs*, Washington, DC, 26-27 May, 1994.

[48] Environment News Service, 1999. "UK Industries Trade Emissions Cuts for Tax Rebate," http://ens.lycos.com/ens/dec99/1999L-12-23-03.html

[49] ETSU - AEA Technology, 2001. *Climate Change Agreements – Sectoral Energy Efficiency Targets*. Version 2. Oxfordshire, UK: ETSU – AEA Technology.

[50] U.S. Environmental Protection Agency, 2002. *Voluntary Aluminum Industrial Partnership (VIAP) Program*. http://www.epa.gov/highgwp1/vaip/

2.2 Experience with Voluntary Agreements in Key Countries

Among the numerous industrial sector Voluntary Agreements, some can be seen as models because they have proven to be successful and contain elements that can be transferred to other programs. A description of three such programs is provided below.

2.2.1 The Netherlands

The industrial sector Voluntary Agreements in The Netherlands provide an excellent example of a program based on sector-specific targets. The Dutch Long-Term Agreements on Energy Efficiency were negotiated between government and industry associations over a two-year period and signed in 1992. The agreements were aimed at meeting a national carbon dioxide (CO_2) emission reduction target of 3 to 5% in 2000 compared to 1989. Each industry association signed an agreement with the Dutch Ministry of Economic Affairs committing that industry to achieve specific energy efficiency improvements by 2000. In total, 29 agreements were signed involving about 1000 industrial companies and representing about 90% of industrial primary energy consumption in The Netherlands. The average target was a 20% improvement in energy efficiency over 1989 levels by 2000.[51] The overall LTA program ended in 2000 with an average improvement in energy efficiency of 22.3% over the period 1989 to 2000.[52]

The process for setting the targets involved making a preliminary assessment of the energy efficiency potential of each industry as well as an inventory of economically viable measures that could be implemented by the companies within an industry association. These assessments, which were made by an independent government research agency, provided the basis for discussions and negotiations between the industries and the government. The assessments were further used as a basis for the industry Long Term Plans which include an assessment of energy consumption in the base year (1989 in this case), a survey of opportunities for energy efficiency improvement, company energy plans, monitoring and energy management in each company, research and development of new low-energy technologies, demonstration projects for energy savings measures, assistance to individual companies, and information dissemination.[53] Once the Long Term Plan was established, the Long Term Agreement was signed by the industry association, the Ministry of Economic Affairs, and the independent government agency (Netherlands Organization for Energy and the Environment, NOVEM). The Long Term Agreements were contracts under civil law which were legally binding and pre-empted future regulatory requirements.

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[51] Nuijen, W., 1998. "Long Term Agreements on Energy Efficiency in Industry," in Martin et al., (eds.) *Industrial Energy Efficiency Policies: Understanding Success and Failure: Proceedings of a Workshop Organized by the International Network for Energy Demand Analysis in the Industrial Sector.* Utrecht, The Netherlands, June 11-12, 1998. (LBNL-42368).

[52] Kerssemeechers, M., 2002. *The Dutch Long Term Voluntary Agreements on Energy Efficiency Improvement in Industry.* Utrecht, The Netherlands: Ecofys. (Note, however, that due to a stronger than expected growth in industrial production, absolute energy consumption and CO_2 emissions increased compared to the 1989 level).

[53] Nuijen, W., 1998. "Long Term Agreements on Energy Efficiency in Industry," in Martin et al., (eds.) *Industrial Energy Efficiency Policies: Understanding Success and Failure: Proceedings of a Workshop Organized by the International Network for Energy Demand Analysis in the Industrial Sector*. Utrecht, The Netherlands, June 11-12, 1998. (LBNL-42368).

An essential element of the agreements was the supporting policies of the government. The Dutch Ministry of Economic Affairs provided a great deal of support to the industries that signed Long Term Agreements including tax rebates for energy-efficient investments, subsidies, audits of industrial facilities (including an inventory of energy-consuming equipment, assessment of energy use, and identification of cost-effective energy-efficient investments) and coordination of regulatory measures aimed at energy efficiency in industry.[54]

Recent evaluations of the Long-Term Agreements have found that the agreements helped industries to focus attention on energy efficiency and find low-cost options within commonly-used investment criteria.[55,56] Although the agreements themselves proved to be successful and cost-effective,[57] various support measures were implemented within the system of Voluntary Agreements. It is difficult to attribute the energy savings to a specific policy instrument; rather, it is the result of a comprehensive effort to increase implementation and development of energy-efficient practices and technologies in industry by removing or reducing barriers. This emphasizes the importance of offering a package instead of a set of individual measures, which may give the idea of competing measures or instruments rather than a concerted action. Evaluations also found that the costs of Voluntary Agreements, from the perspective of the government, are about $50/t of carbon reduced compared with costs of about $140/t of carbon reduced through subsidy schemes.[58]

2.2.2 Denmark

Denmark has unilaterally committed to reduce national CO_2 emissions from all sectors by 20% in the year 2005 compared to 1988 emissions.[59] The industrial sector is expected to contribute to this goal by reducing CO_2 emissions by 4.6% in 2005 relative to 1988 emissions.[60] The Danish Agreements on Industrial Energy Efficiency are based on the imposition of a mandatory CO_2 tax

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[54] Nuijen, W., 1998. "Long Term Agreements on Energy Efficiency in Industry," in Martin et al., (eds.) *Industrial Energy Efficiency Policies: Understanding Success and Failure: Proceedings of a Workshop Organized by the International Network for Energy Demand Analysis in the Industrial Sector.* Utrecht, The Netherlands, June 11-12, 1998. (LBNL-42368).

[55] Korevaar, E., J. Farla, K. Blok and K. Schulte Fischedick, 1997. "A Preliminary Analysis of the Dutch Voluntary Agreements on Energy Efficiency Improvement" *The Energy Efficiency Challenge, Proceedings of the 1997 ECEEE Summer Study*, Splinderuv Mlyn, Czech Republic, 9-14 June 1997.

[56] Rietbergen, M., Farla, J., and Blok, K., 1998. "Quantitative Evaluation of Voluntary Agreements on Energy Efficiency," in Martin et al., (eds.) *Industrial Energy Efficiency Policies: Understanding Success and Failure: Proceedings of a Workshop Organized by the International Network for Energy Demand Analysis in the Industrial Sector.* Utrecht, The Netherlands, June 11-12, 1998. (LBNL-42368).

[57] Ibid.

[58] Blok, K., 2002. "Establishing Targets for Energy Consumption in Energy-intensive Industries: Examples," Presentation at the *Workshop on Voluntary Agreements for China's Industrial Sector: Integrating International Experiences into Designing a Pilot Program*, February 25-27, 2002, Beijing.

[59] Togeby, M., Johannsen, K., Ingrslev, C., Thingvad, K., and Madsen, J., 1999. "Evaluations of the Danish Agreement System," *Proceedings of the 1999 American Council for an Energy-Efficient Economy Summer Study on Energy Efficiency in Industry*. Washington, DC: ACEEE.

[60] Togeby, M., Bjorner, T.B., and Johannsen, K., 1998. "Evaluation of the Danish CO2 Taxes and Agreements," in Martin et al., (eds.) *Industrial Energy Efficiency Policies: Understanding Success and Failure: Proceedings of a Workshop Organized by the International Network for Energy Demand Analysis in the Industrial Sector*. Utrecht, The Netherlands, June 11-12, 1998. (LBNL-42368).

where the level of taxation depends on the purpose of the energy use, the type of energy used, and whether an agreement exists between the company and the Danish Energy Agency. The agreements, which are made by an individual company or an association of companies with the Energy Agency, are made for a period of three years in order to qualify for a lower CO_2 tax rate. Between 1996 and 1998, 143 companies entered into agreements with the Danish Energy Agency, representing 45% of total industrial energy consumption in Denmark. Under the agreements, the companies are required to implement all "profitable" energy savings projects which are defined as projects with payback periods of up to four years as identified in an energy audit. The energy audits are performed by an authorized energy consultant or company staff and they must be verified by an independent certified organization. In addition, companies must introduce energy management and motivate staff to ensure investments in new equipment will be energy efficient. Subsidies are provided for up to 30% of the cost of these investments in energy-efficient projects.

One analysis of this program found that firms with an agreement had electricity savings of 7% while those who did not have agreements (and were subject to the full CO_2 tax) had electricity savings of 8%,[61] illustrating that similar savings can be achieved through policies and measures as those achieved using taxation alone. These agreements have seen a reduction of 2 to 4% of total energy consumption per agreement after three years (exceeding business-as-usual by about 1% per year).[62] If this rate of improvement continues, it is projected that the goal of 4.6% reduction in total CO_2 emissions from industry in 2005 relative to 1988 will be met.[63]

2.2.3 Canada

The Canadian Industry Program for Energy Conservation (CIPEC) is a completely voluntary program in which collective targets are set for each industrial sector. There are 21 sector tasks forces representing 31 trade associations and about 3000 companies included in the program. Under the program, the sector tasks forces identify energy- efficiency opportunities, review and address the barriers associated with these opportunities, and develop and implement strategies for their realization. The program includes annual measuring and reporting by industry participants. Benchmarking is conducted in which facilities are compared to the industry mean as well as to a "best practice" which is defined as the top quartile. Since 1990, this program has seen an average annual aggregate energy intensity improvement of 2.4%.[64]

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[61] Bjorner, T.B. and Togeby, M., 1999. "Industrial Companies' Demand for Energy Based on a Micro Panel Database – Effects of CO2 Taxation and Agreements in Energy Savings," in *Energy Efficiency and CO2 Reduction: The Dimensions of Social Change: 1999 European Council for an Energy-Efficient Economy Summer Study*, May 31-June 4, Mandelieu, France.

[62] Togeby, M., Johannsen, K., Ingrslev, C., Thingvad, K., and Madsen, J., 1999. "Evaluations of the Danish *Agreement* System," *Proceedings of the 1999 American Council for an Energy-Efficient Economy Summer Study on Energy Efficiency in Industry*. Washington, DC: ACEEE.

[63] Togeby, M., Bjorner, T.B., and Johannsen, K., 1998. "Evaluation of the Danish CO2 Taxes and Agreements," in Martin et al., (eds.) *Industrial Energy Efficiency Policies: Understanding Success and Failure: Proceedings of a Workshop Organized by the International Network for Energy Demand Analysis in the Industrial Sector*. Utrecht, The Netherlands, June 11-12, 1998. (LBNL-42368).

[64] Natural Resources Canada, 2002. *CIPEC 2000/2001 Annual Report – Efforts of CIPEC Participants Bear Fruit*. Ottawa, NRCan.

2.3 Evaluations of Voluntary Agreements

In its review of 350 voluntary actions and programs, the International Energy Agency found that "past and present experiences with voluntary actions show that, properly designed and implemented, they can achieve stated objectives, sometimes even exceeding those of minimum regulatory standards, and help integrate economic and environmental goals."[65]

A recent analysis of five industrial sector Voluntary Agreement programs found significant differences between the structure of the agreements and the performance and effectiveness of the agreements. This analysis concluded that "the effectiveness of Voluntary Agreements can be seen as strongly dependent on the accompanying policy mix and the supporting framework which has to be adapted to the specific conditions of the target group envisaged".[66]

Another analysis of seven Voluntary Agreement programs found that the programs could be attributed with about 50% of the observed energy-efficiency improvement or emissions reductions. In addition to these so-called direct effects of the programs, there are also important medium and long-term impacts including changes of attitudes and awareness of managerial and technical staff regarding energy efficiency; addressing market, institutional, and regulatory barriers to technology adoption and innovation; fostering market transformation to establish greater potential for sustainable energy-efficiency investments; promoting positive dynamic interactions between different actors involved in technology research and development, deployment, and market development; and facilitating cooperative arrangements that provide learning mechanisms within a sector or industry to combine knowledge and develop new competencies in industry.[67,68]

Based on experience to date, the "Seven Golden Rules" for these type of agreements are: 1) make sure they are negotiated agreements based on assessments of energy efficiency potentials that are more than "business-as-usual", 2) set clear, well-defined targets and specific timetables for achieving those targets, 3) ensure long-lasting government support in the form of policies and programs that assist industries in implementing energy-efficiency improvements, 4) focus on large, energy-intensive industries to start with because this is where the greatest savings are found, 5) establish clear monitoring guidelines, 6) evaluate progress using physical energy intensity measurements, and 7) provide for independent verification of progress.[69]

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[65] International Energy Agency, 1997. *Voluntary Actions for Energy-Related CO2 Abatement*. Paris: OECD/IEA.

[66] Krarup, S. and Ramesohl, S., 2000. *Voluntary Agreements in Energy Policy – Implementation and Efficiency: Final Report*. Copenhagen: AKF.

[67] Dowd, J., Friedman, K, and Boyd, G., 2001. "How Well Do Voluntary Agreements and Programs Perform At Improving Industrial Energy Efficiency," *Proceedings of the 2001 ACEEE Summer Study on Energy Efficiency in Industry*. Washington, DC: American Council for an Energy-Efficient Economy.

[68] Delmas, M. and Terlaak, A., 2000. "Voluntary Agreements for the Environment: Innovation and Transaction Costs," CAVA Working Paper 00/02/13, February.

[69] Blok, K., 2000. "Experiences with Long Term Agreements on Energy-efficiency Improvements in the European Union," Presentation at the *Workshop on Learning from International Best Practice Energy Policies in the Industrial Sector*, May 22-23, 2000, Beijing.

3. Description of China Energy Conservation Voluntary Agreement Pilot Project

In 1999, CECA began an effort to promote "new planning in energy-intensive sectors for energy efficiency to reduce energy consumption of key enterprises". This project has undertaken a number of research efforts to determine the best approach for reaching these goals. These efforts include analyzing international industrial energy efficiency policies and programs and their adaptability to China, analyzing the status and opportunities for energy conservation in key energy-intensive industrial sectors, and reviewing existing energy conservation regulations and policies and making recommendations for new regulations and policies that work well under a "market-based" economy. Following completion of this research, CECA recommended the use of sector Voluntary Agreements as an integrating energy-efficiency policy for the industrial sector in China. Development of such an integrating policy for improving energy efficiency in the industrial sector, which includes clear targets for improvement and effective supporting programs to help enterprises achieve their goals, can provide the foundation for achieving significant progress in the effort to make China's industrial enterprises more energy-efficient, cleaner, and ultimately more competitive.

3.1 Historical and Current Chinese Energy Conservation Situation

Energy conservation efforts in China began in earnest in 1978 and can generally be divided into the following four phases.[70,71]

3.1.1 Initial reforms (1978-1985)

Initial reforms related to energy conservation were carried out under the planned economy and were under full administrative management of the government. This phase was characterized by implementation of the energy rationing system and the rationing management system, enhancement of fundamental energy conservation work in individual enterprises, issuance of the five Energy Conservation Instructions by the State Council, comprehensive normalization of energy conservation work, reinforcement of the investment fund and establishment of preferential economic policies for energy conservation, and establishment of the annual nationwide "energy conservation month".

3.1.2 Extension of reforms (1986-1993)

A significant development during the extension phase was the issuance of the Energy Conservation Management Provisional Ordinance in 1986 by the State Council that comprehensively regulated energy conservation work and ushered in the upsurge of the energy conservation movement. A series of preferential economic policies for energy conservation were

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[70] Li, G. and Zeng, G. 2000. "Overview of the Energy Efficiency Policies and Regulations in Energy Intensive Sectors of China," *Learning from International Best Practice Energy Policies in the Industrial Sector*, May 22-23, 2000. Beijing: CECA

[71] Yin, 2000. "Overview of History and Present – Industry Energy Efficiency Policy in China." Presentation of Prof. Yin Xixun, consultant expert of CECA, at the Workshop on *Learning from International Best Practice Energy Policies in the Industrial Sector*, Beijing, May 22, 2000.

also established, including policies for low loan rates, pretax loan repayment, three years exemption of the product tax and the value added tax for new energy conservation products, and tariff exemption for imported energy conservation equipment and technology. The policy of an energy conservation bonus was adopted by enterprises and the bonus was included in the cost of the products. Energy conservation management activities were upgraded and international exchanges were launched, including joint personnel training with the European Communities and Japan and the joint issuance of Strategic Research on the Greenhouse Gas Emission Control with the World Bank.

Energy management offices, departments, and agencies were established at all levels of government to implement, manage, monitor, and enforce the numerous rules, standards, and programs related to energy conservation. The Office of Energy Conservation Work in the State Council oversaw all of the efforts, including offices in conservation, resources, electricity conservation, science and technology, and standards. Ministries for specific industrial sectors, such as the Metallurgy Ministry, focused on sector-specific issues. CECA, the National Supervising Center of Energy Conservation, and the Energy Conservation Testing Technology Service Centers, along with provincial energy conservation agencies, were also established

Energy efficiency and energy conservation management for the industrial sector during this period involved controlling energy intensity and energy supply through the use of quotas. Energy conservation goals were set in the form of physical energy intensity standards for various manufacturing processes. Other standards addressed industrial equipment such as boilers and motors. Success in attainment of the standards was considered when allocating energy supply quotas for industrial enterprises.[72,73] Other energy management efforts included dissemination of energy-efficient technologies and products, retiring energy-intensive mechanical and electrical devices, restricting energy-wasting production practices, and monitoring enterprise energy conservation.

Information on energy use and intensities was gathered through the national resources conservation and comprehensive utilization network and statistics were compiled by the energy statistical reporting system. National, local, and sectoral energy conservation technology service centers were also established. Education and training programs included the establishment of energy conservation training centers. Over 200 energy conservation centers were established during this period to provide energy monitoring and efficiency services, develop and promote energy-saving technologies, and perform feasibility studies.[74]

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[72] Sinton, J.E., Levine, M.D., and Wang, Q. 1998. "Energy Efficiency in China: Accomplishments and Challenges," *Energy Policy* 26(11):813-829.

[73] Liu, Z.P., Sinton, J.E., Yang, F.Q., Levine, M.D., and Ting, M.K. 1994. *Industrial Sector Energy Conservation Programs in the People's Republic of China during the Seventh Five-Year Plan (1986-1990).* Berkeley, CA: Lawrence Berkeley National Laboratory (LBL-36395).

[74] Liu, Z.P., Sinton, J.E., Yang, F.Q., Levine, M.D., and Ting, M.K. 1994. *Industrial Sector Energy Conservation Programs in the People's Republic of China during the Seventh Five-Year Plan (1986-1990).* Berkeley, CA: Lawrence Berkeley National Laboratory (LBL-36395).

An analysis of the energy savings that resulted from these energy-efficiency efforts found that if energy intensity had remained frozen at 1977 levels, then China would have used 80 EJ in 1995, more than twice as high as the actual consumption of 36 EJ that year (Sinton et al. 1998). Decomposition analyses have shown that most of the energy savings during this period were due to reductions in energy intensity, not structural shifts toward less energy-intensive industry.[75,76,77,78,79,80]

3.1.3 Adapting to market-oriented economy system (1994-1997)

In 1993, China decided to implement the socialist market-oriented economy system that included a number of significant financial reforms, initiating China's transition to a market-based economy. Energy price reforms included deregulation of coal prices, increases in oil prices, and partial deregulation of electricity prices. A simplified tax code introduced in 1994 eliminated tax rate reductions and tax breaks on energy-efficiency technology development and investment projects. Some banks also began to reduce low-interest lending for efficiency projects.

China began to test new ways to establish energy conservation under the market-oriented economy through such activities as establishing energy service companies and through experiments with demand-side management and integrated resource planning. In 1997, SETC established the China Energy Conservation Information Dissemination Center. A number of international projects were initiated during this period, including the Green Lights Project with UNDP, the establishment of the Dalian Energy Conservation Training Center with Japan, the GEF/World Bank China Energy Conservation Promotion Project, the Industrial Boiler Project, and the Asian Development Bank China Energy Conservation Promotion Project. Also during this period, energy quotas were eliminated and monitoring of energy intensity levels declined as a result.

3.1.4 Current Situation

In 1998, the Energy Conservation Law of the People's Republic of China was issued indicating that energy conservation in China began a new period under legal administration. Article 20 of the Energy Conservation Law requires substantial improvement in industrial energy efficiency in 7200 key energy-consuming industrial facilities in China. This portion of the Law states that "the State will enhance energy conservation management in key energy-consuming entities." A

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[75] Huang, J-P. 1993. "Industry Energy Use and Structural Change: A Case Study of the People's Republic of China," *Energy Economics* 15(2): 131-136.

[76] Lin, X. 1992. "Declining Energy Intensity in China's Industrial Sector," *The Journal of Energy and Development*, 16(2): 195-218.

[77] Palmer, W. 1992. E*lectric Power Shortages and the Chinese Economy*. PhD dissertation. Madison: University of Wisconsin, Department of Economics.

[78] Sinton, J.E. 1996. *Energy Efficiency in Chinese Industry: Positive and Negative Influences of Economic System Reforms*. PhD dissertation. Berkeley, CA: University of California, Energy and Resources Group.

[79] Sinton, J.E. and Levine, M.D. 1994. "Changing Energy Intensity in Chinese Industry: The Relative Importance of Structural Shift and Intensity Change," *Energy Policy* 22(3): 239-258.

[80] Worrell, E., Price, L., Martin, N., Farla, J., and Schaeffer, R. 1997. "Energy Intensity in the Iron and Steel Industry: A Comparison of Physical and Economic Indicators," *Energy Policy* 25(7-9): 727-744.

number of provincial administrations have formulated implementing regulations in accordance with the Energy Conservation Law: Shandong, Shanghai, Beijing, Zhejiang, Jiangsu, Shanxi, Gansu, Sichuan, Yunnan, and Hubei. Although a review of the Shandong, Zhejiang, and Shanghai implementing regulations characterized them as vague (Wang, 1999),[81] they are still an important step toward providing provincial governments with the tools required to implement energy conservation programs within their jurisdictions.

The 10th Five-Year Plan was promulgated in March 2001. A number of energy-efficiency policies were included in this Plan. These policies include a renewed focus on energy end-use efficiency and productivity improvement, development of supporting regulations for the Energy Conservation Law at the local and sectoral levels, formulation of annual energy conservation plans to improve energy utilization efficiency and productivity, formulation of preferential economic policies to support energy conservation demonstration and dissemination projects, enhanced energy management of key energy-using enterprises, and harnessing of grass-roots social forces to save energy. In addition, targets for specific energy consumption levels for key energy-intensive industries have been recommended.[82] The 10th Five-Year Plan also takes into account the terms of accession to the World Trade Organization, including exposing many industrial enterprises to international competition.[83]

Since the 1990s, the reform of China's economic system has steadily continued. With a series of profound changes brought about by the significant reform of the economic system, energy conservation efforts are confronted with new problems. In the course of establishing the socialist market economy, the direct enforcement by the governmental departments of the past has been weakened and the industrial enterprise management systems that were previously stipulated by industrial regulations are being changed. In 1998, a number of national industrial departments were dismantled and reduced to the administration of some State bureaus. As a result, the energy conservation management organizations of these industrial departments disappeared. In addition, the energy conservation administrative legislation and the policy documents issued by the State will also be revised. Therefore, the establishment and implementation of the policies and regulations applicable to the new economic system is a significant task for the State energy conservation administration departments, as well as the extensive number of energy conservation workers. The implementation of the Energy Conservation Law in January 1998 indicated that China's energy conservation work is now operating under the legal administration. However, the Energy Conservation Law is very general and needs supporting regulations, standards, and implementation methods.

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[81] Wang, A.L. 1999. *A Comparative Analysis of the 1997 Energy Conservation Law of China and the Implementing Regulations of Shandong, Zhejiang, and Shanghai*. NY: Natural Resources Defense Council.

[82] Chen, H. 2000a. "Targets and Policies for Energy Conservation in the 10th Five-Year Plan (2001-2005). Presentation at the China Sustainable Energy Program, Policy Advisory Council *Workshop on Energy Efficiency Status and Improvement Scenarios for China*, November 16, 2000, Beijing.

[83] Sinton, J., Levine, M.D., Fridley, D., Yang, F., and Lin, J. 1999. *Status Report on Energy Efficiency Policy and Programs in China*. Berkeley, CA: Lawrence Berkeley National Laboratory (LBNL-44605).

In 1999, SETC issued a catalogue of "Outdated Technology Processes and Products" initiating an effort to phase out non-competitive processes or products that consume too much energy or are polluting. The two volumes of this catalogue address 11 industrial sectors.[84] SETC also mandated closure of some inefficient petrochemical plants as well as hundreds of small cement and glass plants, mainly in northern China, small refineries, coal mines, sugar mills, and paper mills for financial, energy efficiency and environmental reasons. This campaign was extended in 2000 to include over 200 small iron and steel plants.[85,86,87]

In recent years with the transition to a market economy, the relationship between economic benefits and energy consumption has become more obvious to enterprises. Since the 1980s, energy prices in China have steadily increased, but the negative effects on the economic benefits of the enterprises were concealed by the profits brought through production increases. That situation came to an end in the middle of the Ninth Five Year Plan period. With increasing exposure to the world market and continuously increasing energy prices, the financial situation of several key energy-consuming industries worsened because the cost of energy consumption constitutes a major portion of total costs in these industries. This situation forced the enterprises to reduce costs through decreasing energy consumption, changing the approach of the enterprises from seeking more energy sources to meet energy shortages to reducing energy consumption to reduce costs. It should be noted that the enthusiasm for energy conservation that is now apparent in the enterprises leads to an overall situation that is quite favorable for the achievement of further energy conservation work.

However, with the changing government function, China's historical system of energy conservation management is suffering. The energy conservation incentive policies and regulations formed under the planned economy now fail to meet the new economic conditions, so new energy conservation incentive policy mechanisms must be established.

3.2 New Energy Conservation Incentive Policy Mechanism: Voluntary Agreements

The research conducted in this project led to the conclusion that China's existing regulations and standards for energy conservation are neither integral nor adapted to the market-oriented economy. China has had experience with energy conservation for more than 20 years, including a relatively complete management system for energy conservation, energy-saving technical service networks with broad coverage, and a team dedicated to large quality energy conservation. However, China is experiencing a transformation from the planned economy to a market economy, which determines that in the process of building a legal system it is critical to incorporate experience from the successful practices with energy conservation in developed market economies. Regulations and policies to be developed should fit the market economy

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[84] China Environmental Review, 2000. *Legislation on Redundant Technology in China*, Summer 2000.

[85] China Daily. 2000. "China to Close Down 50 Small Steelworks." 29 June. http://www.chinadaily.com.cn.

[86] China Daily. 2000. "Polluting Firms to be Closed Down." 9 May. http://www.chinadaily.com.cn.

[87] Nengyuan. 2000. Goals for the Reduction in Production and Mine Closures for the Coal Industry in 2000. *Nengyuan* 2000(3):14. March.

system and reflect a combination of mandatory means with non-mandatory ones. Some mandatory means can be adopted, such as energy-efficiency standards, taxes, labeling, restrictions on high-energy consuming technologies and processes, and the elimination of equipment of low efficiency. Non-mandatory policies and programs, such as energy service companies (ESCOs), demand-side management (DSM), and Voluntary Agreements, should also be adopted to fully take advantage of market elements that promote energy conservation.

CECA convened a Policy Research Team in the Fall of 2000 to analyze the applicability of various industrial sector energy-efficiency policies to China. Based on CECA's survey of international industrial energy-efficiency policies and programs, CECA and the Policy Research Team agreed to focus on an in-depth review of Voluntary Agreements. The experts from China and abroad actively discussed how to initiate a program in China similar to the Voluntary Agreement programs in many developed countries. The following observations were made:

- Although Voluntary Agreements have been widely applied as an energy-efficiency policy in Europe and other developed countries, they have never been introduced in China and it is worthwhile, in the process of China's economic transformation, to initiate a pilot program.
- Currently, there are relatively few preferential policies for energy conservation in China. It is rather difficult at the present stage for the country to issue a set of preferential policies to promote the practice of Voluntary Agreements. It is highly recommended that, on the basis of the existing energy conservation preferential policies, an "energy-efficiency sector targets" pilot be conducted before possible expansion in the future with enough lessons and experiences. It is foreseen that the government will issue relevant preferential policies to promote the adoption of "energy-efficiency sector targets" once convincing gains resulting from the pilot are achieved.
- The Policy Research Team recommended targeting an energy-intensive sector, such as iron and steel, petrochemical, building materials, non-ferrous, and the chemical industry, in an Energy Conservation Voluntary Agreement pilot program.

The research also showed that designing an Energy Conservation Voluntary Agreement pilot policy program for China's industrial sector involves drawing from the successful elements of the energy-efficiency programs and policies China had during the 1980s in order to develop a policy more similar to those of current Voluntary Agreement programs in developed countries. Such a policy program must take into account unique, China-specific conditions such as rapid economic growth, the need to improve environmental quality, the need to maintain employment levels, and the need to improve the competitiveness of enterprises in light of WTO accession.

Figure 3-1 provides a schematic outline of the necessary inputs for designing an Energy Conservation Voluntary Agreement pilot policy program in China. It is envisioned that a policy based on energy-efficiency sector targets, supported by a number of essential programs, can address the China-specific conditions while providing incentives to enterprises to improve their energy efficiency at an accelerated rate.

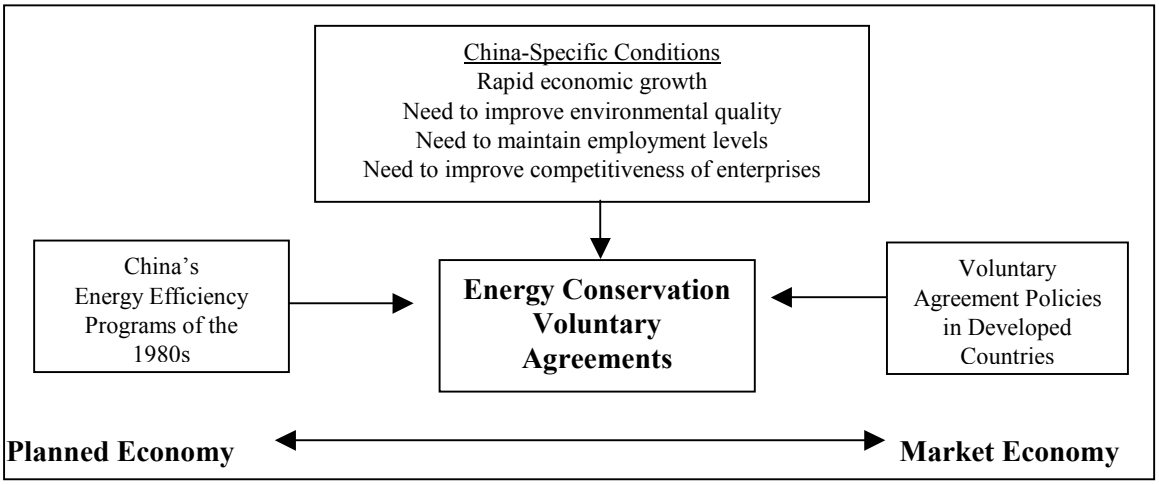

Figure 3-1. Designing an Energy Conservation Voluntary Agreement Pilot Policy for China.

The concept of meeting a sector target is not foreign to enterprises in China. Enterprise-level quotas were used during the 1980s to allocate scarce energy resources. Energy conservation goals were set in the form of physical energy intensity standards for various manufacturing processes. Success in attainment of the standards was considered when allocating energy supply quotas for industrial enterprises.[88,89] In addition, sector targets are currently used in China in three ways. First, there are budget forecasts prepared by the State Development Planning Commission (SDPC) or research institutions for specific sectors. Second, guiding targets are provided by research institutions and rolled into the five year plans. Third, annual administrative or compulsory targets for energy use reduction are set through a coordinated effort of SDPC and SETC.

3.3 Choosing the Voluntary Agreement Pilot Project Industrial Sector

Table 3-2 shows the criteria that were used to select an industrial sector for this Pilot Project. First, it is important that there is a large potential for energy-efficiency improvement in the sector in order to ensure that identifying technologies and practices for energy-efficiency improvement will not be difficult. Sectors with large potential for energy-efficiency improvement will also most likely have more low-cost opportunities and will be motivated to improve their energy efficiency, especially as energy costs and competitiveness issues increase during the transition to a market-based economy.

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[88] Sinton, J.E., Levine, M.D., and Wang, Q. 1998. "Energy Efficiency in China: Accomplishments and Challenges," *Energy Policy* 26(11):813-829.

[89] Liu, Z.P., Sinton, J.E., Yang, F.Q., Levine, M.D., and Ting, M.K. 1994. *Industrial Sector Energy Conservation Programs in the People's Republic of China during the Seventh Five-Year Plan (1986-1990)*. Berkeley, CA: Lawrence Berkeley National Laboratory (LBL-36395).

It is also important that the pilot sector has a limited number of large enterprises so that the pilot can easily focus on a small set of large enterprises. Within this small set, it is also essential that there be leading energy-efficient enterprises that will be aware of the value of energy-efficiency improvements and can provide leadership for the other enterprises in the sector. Another selection criterion is that of technical knowledge of energy efficiency in the sector. It is important that the enterprises and their association show strong technical knowledge and that there are also adequate sources of technical information on this sector both within China and internationally.

The sector should also be strong in terms of organization and management skills. The sector should have a strong association that can provide leadership and guidance during the negotiation of sector target agreements. Significant other benefits associated with energy-efficiency improvements in the sector, such as reduced emissions of pollutants, reduced water use, and increased employment, are also an important criterion. Finally, the sector's level of vulnerability to increased pressures from international competition following China's accession to the WTO could make the enterprises within the sector more motivated to improve energy efficiency in an effort to reduce costs.

Based on these selection criteria, the iron and steel sector was chosen for the pilot program. Specific reasons for choosing the iron and steel sector are:

- The energy-efficiency potential is the largest compared with the other key sectors.
- There are 75 large and medium scale enterprises and there are several leading energy-efficient enterprises (such as Baogang and Hangang) in this sector.
- A sector association, the China Iron and Steel Association, was established in 1998.
- The accession of China to the WTO has significant influence to this sector because of the high quality and low price of some of the foreign products. Thus, enterprises in this sector will be motivated to improve their energy-efficiency in light of increasing international competition.

Table 3-2. Selection Criteria for Choosing a Sector for Energy Conservation Voluntary Agreement Pilot Project

	Energy-Efficiency Potential (Mtce/yr)	Number of Large Enterprises	Technical Knowledge of Energy Efficiency	Sector Strength: Organization, Management, Association	Other Benefits	WTO Competition
Metallurgy: Iron and steel	28	75 large and mid scale enterprises	***	Association established in 1998.	Reducing pollution, water and electricity saving.	Significant influence because of the high quality and low price of the foreign products.
Non-Ferrous: Aluminum	6.7	About 20	**	Association to be established after April, 2001.	Reducing pollution, water and electricity saving.	Great shock of price because the international price of alumina is lower than that of China.
Non-Ferrous: Copper	2.3	About 20	**	Association to be established after April 2001.	Reducing pollution, water and electricity saving.	Great shock of price because the international price of copper is lower than that of China.
Building materials: Cement	23	17 plants (3000 tpd), ~100 plants (700-2000 tpd)	*	Association established for 20 years, but being adjusted for restructuring.	Reducing pollution, especially the emission of dusts.	Limited influence. The export will be increased for larger production and cheaper raw materials.
Chemicals: Ammonia	2.6	30 large enterprises	**	Association established for 13 years.	Reducing pollution, water saving.	Certain influence because the price of raw materials in China is a little bit higher.
Chemicals: Ammonia	2.4	53 medium enterprises	**	Association established for 13 years.	Reducing pollution, water saving.	Certain influence because the price of raw materials in China is a little bit higher.
Petroleum Refining	1.6-8.1	21 oil and gas fields 45 petroleum refineries	***	The industry association is not responsible for energy conservation, but most of the enterprises are members of CECA.	Water and electricity saving.	Limited influence because the oil price in China has joined the international oil prices system for several years.

3.4 Choosing the Voluntary Agreement Pilot Project Location

Once the iron and steel sector was chosen, a pilot project location was needed. Table 3-3 provides the criteria for selecting a geographical location for the pilot sector. One criterion was whether the location already had implementing regulations for the Energy Conservation Law in place. Three locations in China (Zhejiang Province, Shandong Province, and Shanghai Municipality) have already enacted such regulations. Similarly, another criterion was whether the government and enterprises in the location were already active in the area of energy efficiency. The number of industrial enterprises in the selected pilot sector that are located in the geographical region is also taken into consideration. The presence of an active Energy Management Company (EMC) could help the pilot project in the area of auditing and assessments. The presence of an Energy Conservation Center could help the pilot project in the areas of statistical collection, monitoring, benchmarking, information dissemination, etc. Table 3-4 provides some additional information about the steel sector in the evaluated provinces.

Based on these selection criteria, Shandong Province was chosen for the pilot program. The reasons for choosing Shandong Province are:

- In general, the iron and steel sector is advanced and the iron and steel enterprises have significant influence on the other enterprises of the country. There is relatively large energy-efficiency potential in these enterprises.
- Shandong Province is the first of the provinces in China that established local ECL implementing rules and regulations and is always active in energy conservation.
- There is an Energy Management Center that is among the several initially established in China.
- There is an Energy Conservation Center in Jinan, Shandong Province.
- Shandong Province has shown enthusiasm for the pilot of a new energy conservation mechanism.
- The economic development level of Shandong is among the first-class in China, and there is a large potential for economic development, which is very beneficial to the popularization of the pilot's experiences.
- Although Liaoning and Hebei have more iron and steel plants and more steel production capacity, their economic development level is low.
- The iron and steel enterprises in Shanghai are at a high level of energy efficiency, so the potential for saving energy is limited.

Table 3-3. Selection Criteria for Choosing a Geographical Location for Energy Conservation Voluntary Agreement Pilot Project.

	ECL Implementing Regulations	Active in Energy Efficiency	Number of Industrial Enterprises in Selected Sector	Presence of an EMC	Presence of an Energy Conservation Center
Shanghai	Yes	***	4		Yes
Shandong	Yes	***	4	Yes	Yes
Jiangsu	Yes	***	5		Yes
Liaoning		**	8	Yes	Yes
Hebei		**	7		Yes

3.5 Overview of the Energy Conservation Voluntary Agreement Pilot Project

The Energy Conservation Voluntary Agreement Pilot Project with two iron and steel enterprises in Shandong Province will be modeled after successful international industrial Voluntary Agreement programs, taking China-specific conditions into consideration. The main participants in the pilot project are two iron and steel enterprises in Shandong Province – Jigang Iron and Steel and Laigang Iron and Steel, the Shandong ETC, SETC, and CECA.

The two iron and steel enterprises will be responsible for assessing the energy-efficiency potential of their enterprises, developing energy-efficiency targets and energy conservation plans, and implementing these plans in order to achieve the agreed-upon targets. The energy-efficiency sector targets of the Energy Conservation Voluntary pilot policy program will be similar to those that have already been used in China because they will be set using physical energy intensity metrics and will apply to specific sectors. Using international Voluntary Agreement schemes as a model, the sector targets will be set through a process in which the government and enterprises negotiate the target level based on detailed evaluations of the potential for energy-efficiency

improvement in a given industrial sector. Article 4 of the ECL provides general guidance for establishment of such a program, stating that "the State Council and the governments of provinces, autonomous regions and municipalities directly under the central government should: strengthen their efforts in energy conservation; restructure industry, enterprises, products, and energy consumption patterns; promote technological progress for energy conservation; reduce energy consumption per unit of economic output and energy consumption per physical unit of product;…and encourage the national economy to develop in an energy-efficient manner".[90]

Table 3-4. The Status of the Iron and Steel Sectors in Various Geographical Locations.

	Shandong	**Shanghai**	**Jiangsu**	**Liaoning**	**Hebei**
Names of Steel Plants	1) Jinan Steel & Iron Group Company 2) Laiwu Steel &Iron Plant 3) Qingdao Steel & Iron Group Company 4) Zhangdian Steel & Iron Plant	1) Baoshan Steel & Iron Group Ltd. 2) Shanghai Pudong Steel & Iron (Group) Ltd 3) Shanghang No.1 Steel & Iron (Group) Ltd. 4) Shanghang No.5 Steel & Iron (Group) Ltd.	1) Nanjing Steel & Iron Group Ltd. 2) Jiangsu Shagang Group Company 3) Jiangsu Xigang Group Ltd. 4) Jiangsu Xixing Group Company 5) Jiangsu Sugang Group Ltd.	1) Benxi Steel & Iron (Group) Limited Liability Company 2) Anshan Steel & Iron (Group) Company 3) Beitai Steel & Iron (Group) Ltd. 4) Fushun Special Steel Ltd. 5) Fushun Steel & Iron Company 6) Dalian Steel & Iron Group Ltd 7) Lingyuan Steel & Iron Company 8) Shenyang Steel & Iron Plant	1) Handan Steel & Iron Group Limited Liability Company 2) Tangshan Steel & Iron Group Limited Liability Company 3) Xuanhua Steel & Iron Company 4) Chengde Steel & Iron Group Ltd. 5) Xinxing Tube Founding (Group) Limited Liability Company 6) Shjiazhuang Steel & Iron Limited Liability Company 7) Xingtai Steel & Iron Limited Liability Company
Capacity of Steel Plants	7 Million Tons	15 Million Tons	4 Million Tons	14 Million Tons	10 Million Tons
Leaders in Energy Efficiency	Jinan Steel & Iron Group Company Laiwu Steel &Iron Plant	Baoshan Steel & Iron Group Ltd.	Jiangsu Shagang Group Company	Anshan Steel & Iron (Group) Company	Handan Steel & Iron Group Limited Liability Company

SETC and the Shandong ETC will fulfill the government role in the pilot project and will determine which supporting programs will be included in the pilot to assist the enterprises in reaching their energy-efficiency targets. These supporting programs can include audits and assessments, information dissemination, priority in energy efficiency projects, financial assistance, and awards and recognition. Other supporting programs could be conducted by the local energy conservation centers, the Shandong Supervising Center of Energy Conservation, or universities. CECA and the Shandong Energy Conservation Center will fulfill the role of the independent third party. CECA will also convene an expert Technical Team to assist in evaluating the enterprises' targets as well as supervising and evaluating the project progress annually.

[90] People's Republic of China, 1997. *The Law on Energy Conservation of the People's Republic of China.* Approved at the 28th Session of the Standing Committee of the Eighth National People's Congress.

4. Process of Signing and Implementing the Voluntary Agreements in the Energy Conservation Voluntary Agreement Pilot Project

The main participants in the Energy Conservation Voluntary Agreement Pilot Project – SETC and the Shandong ETC, the enterprises, and CECA – have all agreed upon the process outlined below for signing and implementing the Voluntary Agreements. This process is broken into two distinct phases: 1) Initiation to Signing of the Voluntary Agreement, and 2) Implementation of the Voluntary Agreement. The role of all parties in both phases is described below.

4.1 Process from Initiation to Signing of the Voluntary Agreement

Figure 4-1 provides a flow chart of the process from initiation to signing of the Voluntary Agreement. The three parties to the agreement are designated as Party A: SETC and Shandong ETC, Party B: Enterprises, and Party C: CECA. CECA will also convene a Management Team to provide oversight of the Pilot Project as well as a Technical Team to provide technical assistance that will include both domestic and international experts (these Teams are described in Section 10 of this report). Rectangular boxes in the flow charts represent actions to be taken by the three parties as indicated within the boxes. Diamonds represent evaluations and approvals that are needed in order to proceed to the next step.

4.1.1 Letter of Support (Party A: SETC and Shandong ETC)

SETC begins the process by issuing a Letter of Support identifying the pilot enterprises and indicating that the Pilot Project can proceed.

4.1.2 Assessment of Energy Efficiency Improvement Potential (Party B: Enterprises)

Once the Letter of Support is granted by SETC, the pilot enterprises will begin an assessment of their energy-efficiency improvement potential. A *Methodology for Assessment of Enterprise Energy-Efficiency Improvement Potential*, outlined in Section 5 of this report, is provided as one method for making such an assessment. This methodology provides an assessment of enterprise energy intensity by specific iron- and steel-making processes, compares that intensity to international best practice, and provides detailed information on technologies and measures to reduce energy use. For example, enterprises can save energy by strengthening management, improving techniques, renovating equipment, enlarging the scale of enterprise, and reforming the structure and method of energy consumption. CECA and the Technical Team can provide technical support to the enterprises during this assessment phase. When the assessment is complete, the enterprises submit an application for the Voluntary Agreement with the assistance of CECA.

4.1.3 Prepare Contract Model and Methodologies (Party C: CECA)

CECA and the Technical Team will prepare a model Energy Conservation Voluntary Agreement contract for use by the parties to the agreements. CECA and the Technical Team will also prepare methodologies and guidance for the assessment of enterprise energy-efficiency potential, target-setting, development of the Energy Conservation Plan, and for supervision and evaluation of the Pilot Project during implementation.

4.1.4 Formulation of Supporting Policies (Party A: SETC and Shandong ETC)

SETC and Shandong ETC will formulate supporting policies that can be offered to the participating enterprises to assist them in achieving their energy efficiency targets. Such supporting policies can include, but are not limited to, audits and assessments, information dissemination, priority in energy-efficiency projects, financial assistance, and awards and recognition. Section 7 of this report describes supporting policies used in Voluntary Agreements throughout the world and also outlines possible supporting policies for use in this Pilot Project. Shandong ETC will work with the enterprises, CECA, and SETC to understand and evaluate all possible potential supporting policies. Shandong ETC will submit a description of the proposed supporting policies to SETC for approval. Once the supporting policies have been established, Shandong ETC will provide the list and description of the offered supporting policies to the enterprises and to CECA.

4.1.5 Propose Energy-Efficiency Target (Party B: Enterprises)

Once the assessment of enterprise energy-efficiency improvement potential has been successfully completed and Shandong ETC has established the supporting policies that it will offer to the enterprises, the enterprises have the responsibility of formulating an energy-efficiency target. A *Methodology for Target-Setting for Pilot Enterprises*, which is outlined in Section 6 of this report, is a methodology for setting such targets. Based on the enterprise's current conditions and energy-efficiency improvement potential as determined by an analysis of energy use during various production process, how advanced its equipment is, as well as technical and financial ability, the enterprise will formulate an interim energy efficiency target for 2005 and a final energy efficiency target for 2010. When an enterprise establishes energy efficiency targets, it should take into account the level of existing equipment and technology in its country and internationally and then apply pressure on itself to achieve a higher level of efficiency.

4.1.6 Negotiation of Energy-Efficiency Target (Party C: CECA)

CECA and the Technical Team will evaluate the energy-efficiency target given both the results of the assessment of enterprise energy-efficiency improvement potential and the supporting policies offered by Shandong ETC and SETC. If CECA and the Technical Team determine that the proposed energy-efficiency targets are either too weak or too difficult to achieve, the evaluation will result in a "no" and the enterprise will be asked to formulate a different target. If CECA and the Technical Team determine that the proposed energy-efficiency target is appropriate, then a "yes" will result and the targets will be recommended for approval. A report describing the results of the third party evaluations of the assessment of enterprise energy-efficiency improvement potential and the targets will be submitted to SETC and Shandong ETC.

4.1.7 Conditions Agreed Upon (Parties A and B)

Based on the recommendation of CECA and the Technical Team, Shandong ETC will review the proposed energy-efficiency target of the enterprise. Looking from a wider perspective and with more authority to control and adjust, the government confirms the reasonableness of the targets, which include if the targets fit into the country's current policy and regulations. Once the targets

are approved, they become the targets the enterprise promises to achieve within the Voluntary Agreement contract.

4.1.8 Government, Enterprise and Third Party Sign the Voluntary Agreement

The Shandong ETC, the enterprise and CECA sign the Voluntary Agreement based on the "Model Voluntary Agreement Contract". The model contract is provided in Section 8 of this report. The title of "China Energy Conservation Voluntary Agreement Model Enterprise" is conferred on the enterprise by the Shandong ETC.

4.2 Implementation of the Voluntary Agreement

Figure 4-2 provides a flow chart of the process for implementation of the Voluntary Agreements once the Voluntary Agreement has been signed.

4.2.1 Development of an Energy Conservation Plan (Party B: Enterprises)

The enterprises will use the information from their assessment of energy-efficiency improvement potential combined with information on potential energy-efficiency projects as well as potential financial resources to develop an Energy Conservation Plan for 2005 and 2010. *Guidelines for Development of an Energy Conservation Plan* are provided in Section 9 of this report. CECA and the Technical Team can provide technical support to the enterprises during the development of the Energy Conservation Plan.

4.2.2 Provision of Supporting Policies (Party A: SETC and Shandong ETC)

While the enterprises are developing the Energy Conservation Plan, Shandong ETC and SETC will take the necessary actions to ensure that the supporting policies are in place and that the enterprise can take advantage of them during the implementation of the Energy Conservation Plan.

4.2.3 Review of Energy Conservation Plan (Party C: CECA)

Once the Energy Conservation Plan is developed, CECA and the Technical Team will evaluate the plan to ensure that it outlines the required energy-efficiency improvements to reach the 2005 and 2010 targets. If CECA and the Technical Team conclude that the Energy Conservation Plan is not adequate to meet the targets, then a “no” will be given and the enterprise will be requested to revise the Plan. If CECA and the Technical Team conclude that the Energy Conservation Plan is adequate to meet the targets, then a “yes” will be given and the project can proceed.

4.2.4 Implementation of Energy Conservation Plan (Party B: Enterprises)

The implementation of the Energy Conservation Plan is in two periods: from start to the interim 2005 target and from 2005 to the 2010 final target. During the two periods, the enterprises will implement the measures outlined in the Energy Conservation Plan. CECA and the Technical Team can provide technical support to the enterprises during the implementation of the Energy Conservation Plan.

4.2.5 Supervision and Evaluation (Party B: Enterprises)

At the end of each year, the enterprise will submit a Supervision Report including information as outlined in the *Methodology for Supervision and Evaluation*, which is described in Section 10 of this report.

4.2.6 Annual Third Party Evaluation of Implementation of Energy Conservation Plan (Party C: CECA)

CECA and the Technical Team will evaluate the Supervision Report provided by the enterprise annually. This review will either result in approval ("yes") of the progress that has been made and recommendation to proceed or a finding ("no") that progress was not sufficient and the recommendation that the Energy Conservation Plan be adjusted and then implemented for the following year. The approved annual Supervision Report will be given to SETC and the Shandong ETC.

4.2.7 Interim and Final Third Party Evaluation of Implementation of Energy Conservation Plan (Party C: CECA)

Interim and final evaluations of the results of the implementation of the Energy Conservation Plan will be performed in 2005 and 2010, respectively, by all parties. The evaluations will determine if the target has been met.

4.2.8 Awards Given to Enterprise (Party A: SETC and Shandong ETC)

At the conclusion of the Energy Conservation Voluntary Agreement period, SETC and the Shandong ETC commend the enterprise according to its performance, honoring the enterprise with either a "Model Enterprise in the China Energy Voluntary Agreement" or a "Progressive Enterprise Within its Sector in Voluntary Agreement" as well as providing media publicity. Further, in meetings and conferences to promote the exchange of enterprise experience, the enterprise can use its own situation to make recommendations to eager participants of a Voluntary Agreement. CECA and the Technical Team can use its experience in its evaluation of the Pilot Program to suggest promotion ideas and demonstrate that the Voluntary Agreement is feasible in different sectors and regions in China.

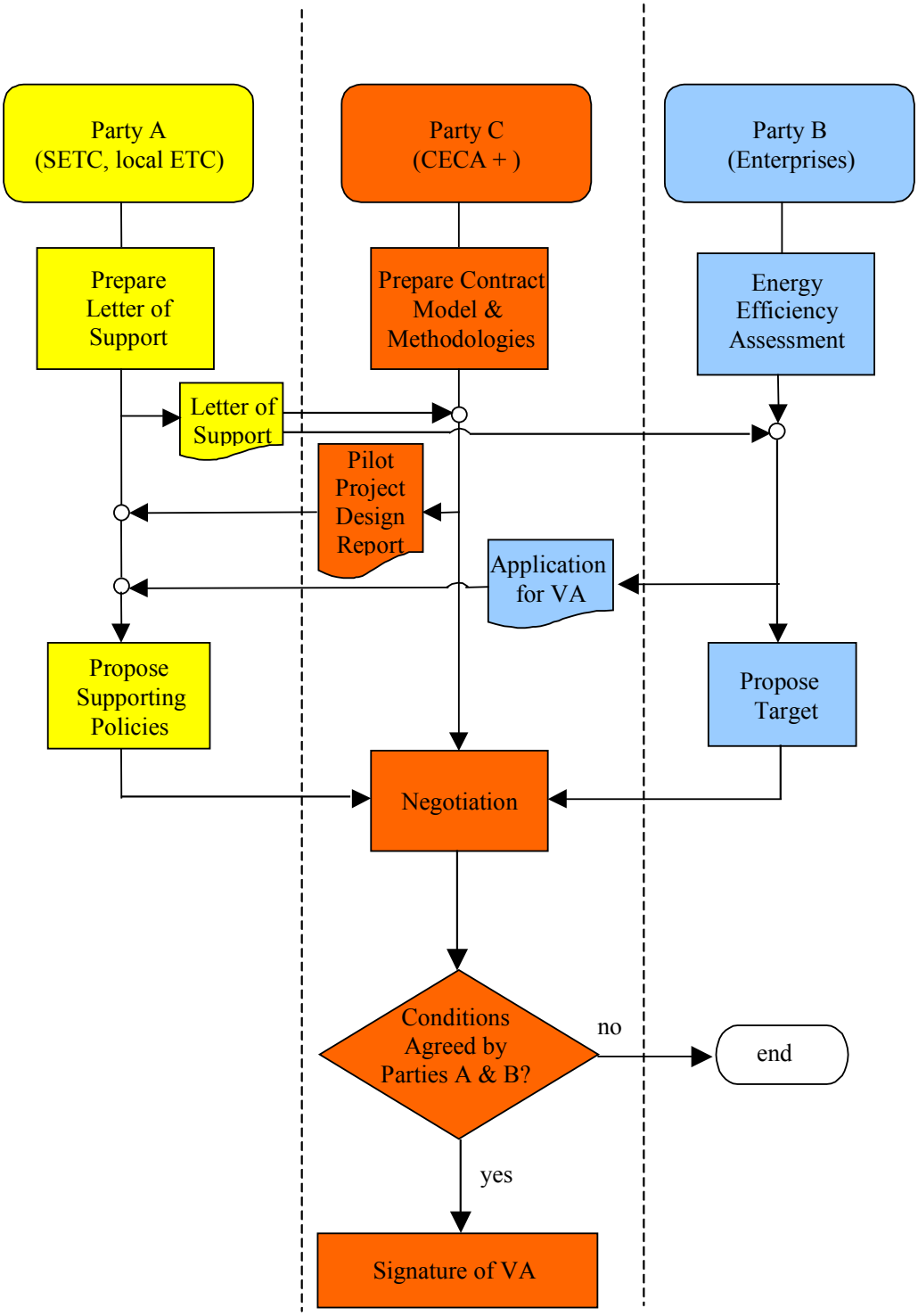

Figure 4-1. Flow Chart of Process Initiation to Signing of Energy Conservation Voluntary Agreements

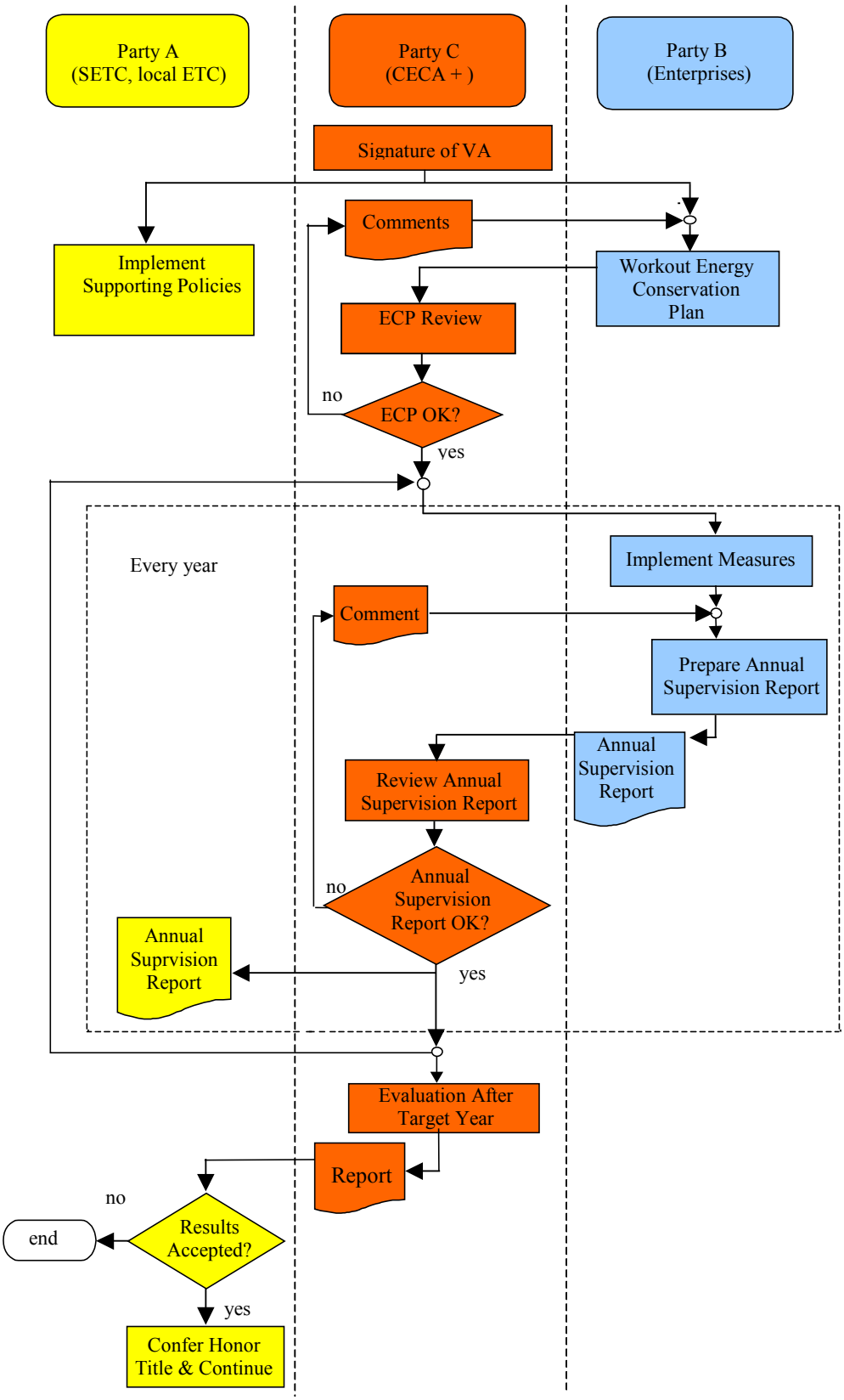

Figure 4-2. Flow Chart of Process of Implementation of Energy Conservation Voluntary Agreement Pilot Project

5. Methodology for Assessment of Enterprise Energy-Efficiency Improvement Potential

The assessment of the energy-efficiency improvement potential for each participating enterprise is an essential element in the design of an Energy Conservation Voluntary Agreement Pilot Program because it provides all parties to the Voluntary Agreement with the same information regarding the current energy consumption at the enterprise as well as the options available to reduce energy consumption. This information is essential for negotiating an ambitious, yet realistic energy conservation target. Once the energy-efficiency assessment has been completed, the enterprise can develop energy-efficiency targets (described in Section 6 of this report) and develop a detailed Energy Conservation Plan (described in Section 9 of this report) to document the actions to be taken to reach the Voluntary Agreement targets.

5.1 International Experience with Assessment of Energy Efficiency Potential

Assessments of plant energy-efficiency potential typically involve plant audits, technology assessments, benchmarking of plant energy consumption, or a combination of these techniques.

5.1.1 Plant Audits

Auditing enterprises involves collecting data on all of the major energy-consuming processes and equipment in a plant as well as documenting specific technologies used in the production process and identifying opportunities for energy efficiency improvement throughout the plant. Plant audits are used in both the Long-Term Agreements in The Netherlands and in the Danish CO_2 Tax Rebate Scheme for Energy-Intensive Industries, as described below.

5.1.1.1 Audits in the Dutch Long-Term Agreements

The process for setting energy-efficiency targets in the Dutch Long-Term Agreements involved making a preliminary assessment of the energy-efficiency potential of each industry as well as an inventory of economically-viable measures that could be implemented by the companies within an industry sector. Individual plant audits included a description of the sector, an assessment of the plant's energy consumption in the base year, a survey of opportunities for energy-efficiency improvement, and a description of the monitoring and energy management techniques used.[91] Identified energy-efficiency measures were categorized in five categories: good housekeeping/energy management, retrofit or strategic investments, energy-efficiency investments, cogeneration and other measures (e.g. changes in feedstock). The individual enterprise audits were done by the company itself and/or by independent consultants. The results of the audits were reported to an independent government agency, and provided the basis for final discussions and negotiations between the industries and the government to establish the final target for the sector. The assessments were further used as a basis for the company Energy Savings Plan which included an assessment of energy consumption in the base year (1989 in the case of the steel industry), a survey of opportunities for energy-efficiency improvement,

[91] Nuijen, W., 2002. "Energy Auditing, Assessments, and Energy Plans in The Netherlands," Presentation at the Workshop on Voluntary Agreements for China's Industrial Sector: Integrating International Experiences into Designing a Pilot Program, February 25-27, 2002.

monitoring and energy management, research and development of new energy-efficient technologies, and demonstration projects of energy-saving measures. The individual company plans provide the basis for the sector-wide plan. All companies report the results of the energy monitoring, as well as the implemented projects, annually. Based on the performance, the Energy Savings Plan was adapted in order to achieve the agreed-upon target. The costs of the audits were subsidized approximately 50% by the Dutch government.

5.1.1.2 Audits in the Danish CO_2 Tax Rebate Scheme for Energy-Intensive Industries

As part of the Danish CO_2 Tax Rebate Scheme for Energy-Intensive Industries, energy audits of individual plants are conducted by independent, approved consultants. The energy audit must include the following: an energy balance for the plant with a detailed breakdown of energy consumption by processes, description of the energy-efficiency projects at the plant, including potential future projects, recommendations for energy management, and recommendations for energy conservation investments.[92] The audits are verified by an independent certified verification agency. Sector-wide reports are also prepared. These reports provide a sector-wide analysis of energy consumption and production processes and identify the general potential for energy-efficiency improvement in the companies within the sector.

Once the audits have been completed, individual companies as well as the sector representatives negotiate with the Danish Energy Agency. Companies are generally required to implement all "profitable" energy-savings projects that are defined as all projects with financial payback periods of up to 4 years, as identified in the energy audit. Companies must also introduce an energy management system and motivate their staff to ensure investments in new equipment will be energy-efficient.[93]

5.1.2 Technology Assessments

Technology assessments involve identifying existing technology in the enterprise as well as more advanced technologies that could be installed within the period covered by the Voluntary Agreement. A technology assessment starts with a comprehensive list of technologies for a sector. This approach involves identifying and listing equipment and then calculating the energy-efficiency potential and costs associated with replacing outdated equipment with more advanced equipment. This method is more applicable for sector-wide studies.[94] However, it can serve as a checklist for audits to make sure that most technology options are included and considered in the audit.

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[92] Ezban, R., Tang, E., and Togeby, M., 1994. "The Danish CO_2-Tax Scheme," in International Energy Agency, *Conference Proceedings – Industrial Energy Efficiency: Policies and Programs*, Washington DC, 26-27 May, 1994.

[93] Togeby, M., Bjorner, T.B., and Johannsen, K., 1998. "Evaluation of the Danish CO_2 Taxes and Agreements," in Martin et al., (eds.) *Industrial Energy Efficiency Policies: Understanding Success and Failure: Proceedings of a Workshop Organized by the International Network for Energy Demand Analysis in the Industrial Sector*. Utrecht, The Netherlands, June 11-12, 1998. (LBNL-42368).

[94] For example, see Worrell E., Martin, N., and Price, L., 1999.*Energy Efficiency and Carbon Dioxide Emissions Reduction Opportunities in the U.S. Iron and Steel Sector*. Berkeley, CA: Lawrence Berkeley National Laboratory, LBNL-41724.

5.1.3 Benchmarking[95]

Energy benchmarking is a process in which the energy performance of an individual plant or an entire sector of similar plants is compared against a common metric, or benchmark, that represents "standard" or "optimal" performance. Benchmarks have two important characteristics. First, because they are applied to plants of different sizes and outputs, they can be constructed irrespective of plant size. This is accomplished by analyzing the plant's energy intensity by process step, which measures energy use *per unit of output* of the major energy-consuming process steps at the plant. Generally industrial benchmark studies use a physical measure of output, e.g. tons of hot rolled steel or tons of slabs produced. Second, benchmarks can be applicable to a wide range of facilities because they are able to compensate for differences in production at similar facilities.

In designing a benchmark that accounts for production differences, it is necessary to understand the steelmaking production processes and account for the various steps used. In such a process-step benchmarking approach, the key process steps are identified and a benchmark is assigned to each step. The performance of a plant is then evaluated incorporating information about energy use at each step in the plant.

There are four key steps to such a process-step benchmarking approach:

Step 1: Understand the Production Processes. The process-step benchmarking approach begins with an understanding of the production processes used for steelmaking. Often, there are a number of pathways that lead to the production of the main intermediate product – such as hot metal in the steel industry. The production of this product encompasses the most energy-intensive production steps. There are then more pathways that lead from the main intermediate product to a number of final products – such as the wide range of steel products like wire, rod, and bars. An understanding of the production pathways and key products is needed to correctly set up a benchmarking system.

Step 2: Determine the Boundaries. After the key process steps are understood, a decision is required about which process steps are included in the analysis and which will be outside the analysis boundary. The most energy-intensive steps should always be included, and steps with lower energy-intensity can be excluded, particularly if the data required for accurate evaluation are difficult to acquire. It is important that all potentially substitutable steps fall on the same side of the analysis boundary, whether that is inside or outside of the analysis. Setting up such boundaries helps to make sure that all plants are evaluated fairly, and also helps to limit the data requirements by focusing the analysis on the energy-intensive process steps. Each of these steps

[95] Based on Ruth, M., Worrell, E., and Price, L., 2001. "A Process-Step Benchmarking Approach to Energy Use at Industrial Facilities: Examples from the Iron and Steel and Cement Industries," *Proceedings of the 2001 ACEEE Summer Study on Energy Efficiency in Industry*. Washington, DC: American Council for an Energy-Efficient Economy.

must have some sort of measurable physical throughput that can be used as the basis of an intensity index.

Step 3: Calculating Process-Step Energy Intensities. Once the process steps that will be used in the analysis have been determined, the energy intensity of each process step can be calculated by dividing the energy used for each process step by the amount of product produced at that step.[96]

Step 4: Determine Values for the Benchmarks. The final step is to establish benchmark intensities for each process step. There are two different approaches to determining the benchmark values. The first approach is to compile performance information from existing plants and to base the benchmark value on these data. Another approach is to construct a hypothetical best-practice plant that combines the best-practice energy intensity of each process step into a hypothetical plant.[97]

5.2 Chinese Experience with Assessments of Enterprise Energy-Efficiency Potential[98]

Chinese experience with energy management and energy conservation has shown that it is necessary to evaluate the entire energy-consuming process in order to assess an enterprises' potential for energy conservation. Figure 5-1 provides a diagram of the energy-consuming processes that can be analyzed based on the national standard *Methods for Enterprise Energy Balances*.

Enterprise energy conservation potential can be determined by comparing the enterprise energy consumption analysis results to standards in national policies, rules, and laws, or to levels of domestic and foreign enterprises of the same industry. Enterprises meet energy-saving targets by strengthening management, improving technology, renovating equipment, enlarging the scale of enterprise, and improving the structure and methods of energy consumption. These opportunities are the direction and potential for enterprise energy efficiency.

The potential for enterprise energy efficiency is typically obtained by analyzing and evaluating the four stages of enterprise energy consumption.

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[96] At this point, is it necessary to determine whether to include all of the energy types in the analysis, or whether to focus on the main energy sources in order to simplify the analysis while still capturing the important information. Also, special consideration is needed for secondary energy carriers, including electricity and steam, to determine the primary energy savings associated with saving one unit of each of these. The choices made in steps 2 and 3 determine the accuracy and the potential use of the benchmarking method and results.

[97] Note that the best practice energy intensities by process are based on commercially available technologies that currently exist in an operating plant.

[98] Excerpt from Jiang Yun, Meng Zhaoli, Du Wenwei, 2002. "Methodology for Assessment of Enterprises Energy Efficiency Potential," *Energy Information Newsletter*, issue No. 388, June 17, 2002 and issue No. 389, July 17, 2002.

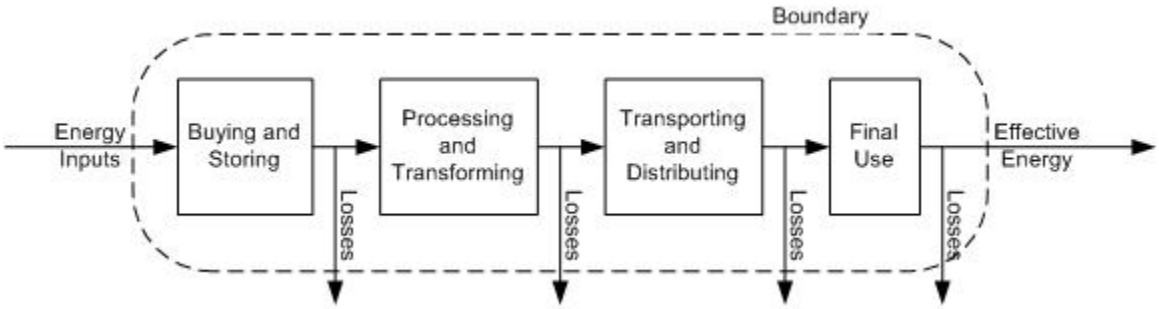

Figure 5-1. Diagram of Energy Consumption System of Enterprises

5.2.1 The Four Processes of Enterprise Energy Consumption

5.2.1.1 Purchasing and Storing Energy

Energy purchasing and storage is a critical stage for understanding total energy consumption of an enterprise. Generally, the energy bought and stored by the enterprise is primary energy or secondary energy. The total amounts of different types of energy inputs are first determined, and then converted to equivalent price and energy values (i.e., tce or Terajoule; 10^{12} J). Later, these different types of energy can be compared, summed, and balanced.

5.2.1.2 Processing and Transforming Energy

Some energy inputs are directly used, while others require processing and transformation into secondary energy or energy consumption working media. Processing and transforming is an energy transformation stage that entails direct consumption by an enterprise's technology, including primary and secondary transformation. The processing and transformation stage has many types of equipment that consume large amounts of energy, and the stage represents a large reservoir of energy-efficiency potential.

5.2.1.3 Transporting and Distributing Energy

Transport and distribution of energy is an important stage for enterprises to deliver useful energy to points of end use. Transport and distribution of energy can be divided two types: transporting energy by pipeline (including fuel oil, natural gas, coal gas, steam, hot water, compressed air, etc.) and transporting and distributing electric power by electric lines.

5.2.1.4 Final Use of Energy

The final use of energy is the most complex process in the enterprises' energy consumption system. Energy consumption in different types of enterprises varies greatly, especially between enterprises in different industries. The national standard, *General Rules for Enterprise Energy Balances*, (GB/J3484—93) describes the different stages of final energy use in enterprises. These are: main production processes, secondary production processes, heating and cooling,

illumination, transportation, and residential. These categories can be further divided. For example, main production and ancillary production processes can be divided into different production departments, and production departments can be further divided according to their energy consumption. The level of detail in which the final energy consumption process should be divided is dependent upon the level of detail desired in the analysis. Generally, it is divided into production departments or workshops. For the iron and steel industries, these would be the main production steps, e.g. coke making, ore agglomeration (sintering, pelleting), ironmaking, steelmaking (basic oxygen furnace, electric arc furnace), refining, casting (continuous, ingot), hot rolling (section, plate, strip, profile, wire rod), and cold rolling (strip).

5.2.2 Analysis of Enterprise Energy-Efficiency Potential

5.2.1.1 Quantification of Energy Savings

Energy-savings quantification indicates the difference, within a given period, between actual energy consumption at an enterprise and a benchmark level of energy consumption. Enterprise energy-savings quantities can be classified as overall enterprise energy-savings quantities, unit product energy-savings quantities, unit economic output energy-savings quantities, energy-efficient technology project energy-savings quantities, and single-process energy-efficient energy-savings quantities

5.2.2.2 Evaluation Indexes

While there are a number of evaluation indices used in China, the key index for use within a Voluntary Agreement program is the unit energy consumption index. The processes that consume large amounts of energy and where the energy saving potential is large can be identified through the energy consumption indexes. The unit energy consumption index measures the amount of energy consumed per unit product or unit production value, and is divided into three types: process energy consumption, comprehensive energy consumption per ton of steel, and comparable energy consumption per ton of steel.

The process energy consumption index measures either the physical (tce/unit product) or economic (tce/production value of 10,000 yuan) energy intensity. The physical process energy consumption index is based on the total amount of a specific type of energy consumption divided by the output of a specific product. The economic process energy consumption index is based on the total amount of a specific type of energy consumption divided by the net production value. Process energy consumption can directly reflect the type and the constitution of energy consumption. The processes that consume large amounts of energy and where energy saving potential is large can be identified through the single item energy consumption.

Process energy consumption indices

$$\text{Physical process energy consumption index (tce/unit product)} = \frac{\text{Total process energy consumption}}{\text{Output of a specific type of product}}$$

$$\text{Economic process energy consumption index (tce/production value of 10,000 yuan)} = \frac{\text{Total process energy consumption}}{\text{Net production value (10,000 yuan)}}$$

Comparable energy intensity per ton of steel for steelmaking covers ironmaking (including coking and sintering processes), steelmaking (including blooming and continuous casting), and all processes up to production of final steel products and all necessary consumption of energy, including production and distribution of fuel gas and fuel oil, on-site transport, energy losses, and other energy use that can be directly attributed to the production of steel. The scope of the comparable energy intensity indicator especially emphasizes the concept of "matched" production processes contributing to steel manufacturing, cutting out the energy-consuming processes that do not feed directly into making steel. This includes, for instance, purchases or sales of pig iron – which, when calculating comparable steel energy intensity, requires adding or subtracting the energy required for making that iron to the total energy use for the enterprise. The level of an enterprise's comparable steel energy intensity reflects the management of production and energy, level of production technology and equipment, and other differences, and makes possible comparative analyses among enterprises. Comparable energy intensity is an index that artificially removes a portion of the structural differences between enterprises' energy intensity and its calculation is relatively complicated. The index reflects differences between the main iron and steel production processes, leaving out other non-essential activities.

Comparable energy consumption indices

$$\text{Physical comparable energy consumption (tce/unit product)} = \frac{\text{Total energy consumption}}{\text{Standard output of product}}$$

$$\text{Economic comparable energy consumption (tce/10,000yuan)} = \frac{\text{Total energy consumption}}{\text{Output of product (10,000 yuan)}}$$

The comprehensive energy consumption index provides a more complete assessment of the level of energy use in the enterprise, also measuring either the physical or economic energy intensity. Physical comprehensive energy consumption is the total amount of energy consumption divided by the total product output. Economic comprehensive energy consumption is the total amount of energy consumption divided by the net production value. The comprehensive energy consumption index can reflect the effect of the substitution of energy and can be conveniently compared between the same products. As such it is the most suitable basis for evaluating the potential for energy-efficiency improvement in an enterprise, while the other indices serve as background information or are useful for more specific applications (e.g. comparison of energy intensity of different enterprises). However, the "total amount of energy consumption" value must be corrected to exclude offsite energy and energy

used for non-productive purposes, e.g. energy consumed by the enterprise for activities other than production of iron or steel.[99]

Comprehensive energy consumption indices

$$\text{Physical comprehensive energy consumption (tce/unit product)} = \frac{\text{Total energy consumption}}{\text{Output of product}}$$

$$\text{Economic comprehensive energy consumption (tce/production value of 10,000 yuan)} = \frac{\text{Total energy consumption}}{\text{Net production value (10,000 yuan)}}$$

5.2.2.3 Analyzing Energy-Efficiency Potential

Through quantifying and analyzing the four process stages outlined in Figure 5-1 above, one can understand an enterprise's total energy consumption, transport and distribution, end uses, etc., and then prepare energy balances and draw energy network diagrams for the enterprise. Table 5-1 provides an example of the enterprise energy balance table. Enterprise energy consumption can be determined based on the energy balance table. One can then directly understand the enterprise's energy consumption situation and the various indexes of energy consumption can be calculated. These indicators can be compared with national or industry standards, or indicators of advanced domestic and foreign enterprises in the same industry to determine the potential for enterprise energy conservation.

[99] Offsite energy use includes energy used to heat homes and buildings that are not directly part of the iron and steel plant, as well as energy used for transport outside the plant. Internal transport energy use is included. See Price, L., Sinton, J., Worrell, E., Phylipsen, D., Hu, X., and Li, J., 2002. "Energy Use and Carbon Dioxide Emissions from Steel Production in China," *Energy* 27: 429-446.

Table 5-1. Enterprise Energy Balance Table

statistic period: year Unit: tce

Items		Buying and storage			Processing and transformation				Transport and distribution	Final use	
		Physical quantity	Equal value	Equivalent value	Power station	Refrigerating station	Others	Total		Major production	Secondary production
Energy source		1	2	3	4	5	6	7	8	9	10
Energy Inputs	Steam										
	Electric power										
	Diesel oil										
	Gasoline										
	Coal										
	Condensation water										
	Hot water										
	Total										
Effective energy	Steam										
	Electric power										
	Diesel oil										
	Gasoline										
	Coal										
	Condensation water										
	Hot water										
	Total										
Recovery and using											
Lost energy											
Total											

Efficiency of enterprise using energy = $\frac{\quad}{\times\times\times\times}$

5.3 Methodology for Assessment of Enterprise Energy-Efficiency Potential

Scientists at Lawrence Berkeley National Laboratory (LBNL) have developed a *Methodology for Assessment of Enterprise Energy-Efficiency Potential* for the steel industry Energy Conservation Voluntary Agreement Pilot Project that incorporates key elements of the various methods used in other countries as well as in China to determine the energy-efficiency potential of an enterprise. LBNL scientists have also developed a simple computer spreadsheet tool to assist the pilot enterprises in implementing this methodology (see Appendix A).

The energy-efficiency assessment methodology involves determination of the enterprise's physical comprehensive energy consumption index based on only total energy consumption for production of iron and steel at that enterprise (subtracting the offsite energy and energy used for non-production purposes).[100] This value is called the "total production energy intensity." The total production energy intensity is calculated for each major process step at the enterprise.

Once the total production energy intensity has been calculated, the technical and achievable energy-efficiency potentials for each enterprise are determined. The technical energy-efficiency potential is calculated by comparing the total production energy intensity for each pilot enterprise with benchmark energy intensities that represent state-of-the-art iron and steel production processes. The achievable energy-efficiency potential is determined by identification of inefficient processes within each enterprise and identification of technologies and measures that could be implemented to improve the energy efficiency of the enterprise, based on availability of technologies and cost-effectiveness criteria. The potential energy intensity reductions associated with implementation of these technologies and measures will be estimated to determine the achievable energy-efficiency potential, which will in turn be used to set the Energy Conservation Voluntary Agreement Pilot Project targets, as described in Section 6 of this report.

5.3.1 Determination of Total Production Energy Intensity of the Pilot Iron and Steel Enterprises

The energy-consuming processes of iron and steel enterprises can be analyzed based on the *Survey of Energy Consumption by Process* for the iron and steel industry, which documents the energy used by fuel type for each process step in the production of iron and steel. The survey includes all energy inputs, accounts for recovered energy and energy used for self-generation, and provides the data required to calculate the process-step total production energy intensity of the enterprise. An example of the Survey of Energy Consumption by Process for the iron and steel industry is provided in Table 5-2.

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[100] Offsite energy use includes energy used to heat homes and buildings that are not directly part of the iron and steel plant, as well as energy used for transport outside the plant. Internal transport energy use is included. See Price, L., Sinton, J., Worrell, E., Phylipsen, D., Hu, X., and Li, J., 2002. "Energy Use and Carbon Dioxide Emissions from Steel Production in China," *Energy* 27: 429-446.

5.3.2 Benchmark Energy Intensity for "State-of-the-Art" Iron and Steel Production

In order to determine the technical energy-efficiency potential for the pilot iron and steel enterprises, the enterprise process-step total production energy intensity must be compared to the process-step energy intensity of a benchmark "state-of-the-art" iron and steel enterprise. Such benchmarks can be constructed using either a hypothetical energy-efficient steel plant[101] or benchmarking to an actual energy-efficient steel plant.[102] For the Energy Conservation Voluntary Agreement Pilot Project an energy-efficiency assessment spreadsheet tool has been developed using a hypothetical energy-efficient steel plant that provides benchmark energy-efficiency values for each major steelmaking process step.[103]

5.4 Estimating the Enterprise Energy-Efficiency Potential

Energy-efficiency improvement potentials are unique for each enterprise and depend on the raw materials and equipment used, products produced, and the management of the equipment. The potential for energy-efficiency improvement for the period of the Voluntary Agreement will be estimated based on an assessment of technology and management opportunities to improve energy efficiency.

5.4.1 Energy Efficiency Index and Energy Conservation Rate

Once the enterprise total production energy intensity and the benchmark energy intensity have been calculated, they can be used to construct an Energy Efficiency Index (EEI). The EEI is a measurement of the total production energy intensity of an enterprise compared to a benchmark energy intensity value. For the Energy Conservation Voluntary Agreements, the EEI is used to calculate enterprise energy-efficiency potential and it is used for supervising and evaluating enterprise progress toward the chosen energy intensity target, as described in Section 10 of this report.

The EEI can be used to calculate enterprise energy-efficiency potential by comparing actual enterprise total production energy intensity to the energy intensity that would result if the enterprise used "state-of-the-art" technology for each process step. The difference between the actual total production energy intensity, which is the energy use per ton of product produced, and that of the reference or benchmark technology is calculated for each of the key process steps of

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[101] Data for a construction of a hypothetical energy-efficient steel plant are available from the International Iron and Steel Institute in IISI, 1998, *Energy Use in the Steel Industry,* Brussels: IISI. This document provides data for both a hypothetical "All-Tech" plant that includes technologies that may not be currently economical but lead to significant energy savings and a hypothetical "Eco-Tech" plant that is based on the use of technologies and measures that are considered economical. These values can be used to construct a benchmark "All-Tech" or "Eco-Tech" comparable energy intensity. The difference between this benchmark value and the total production energy intensity values for each pilot enterprise could be considered to represent the technical energy-efficiency potential.

[102] Another source of data for a "state-of-the-art" benchmark are values for an actual energy-efficient steel enterprise, such as the Shanghai Baosteel plant. Data from this plant or other world-class energy-efficient steel enterprises could be used to calculate a "state-of-the-art" benchmark comparable energy intensity.

[103] The simple computer spreadsheet tool that has been developed for use in the Energy Conservation Voluntary Agreement Pilot Project is based on the "Eco-Tech" plant from the International Iron and Steel Institute, 1998. *Energy Use in the Steel Industry*, Brussels: IISI

the enterprise and then aggregated for the entire enterprise. The aggregated EEI is calculated as follows:

$$EEI = 100 * \frac{\sum_{i=1}^{n} P_i \cdot EI_i}{\sum_{i=1}^{n} P_i \cdot EI_{i,B}} = 100 * \frac{E_{tot}}{\sum_{i=1}^{n} P_i \cdot EI_{i,B}}$$

Where:

EEI	= energy efficiency index
n	= number of process steps to be aggregated
EI_i	= actual energy intensity (EI) of process step i
$EI_{i,B}$	= benchmark energy intensity (EI) of process step i
P_i	= production quantity for process step i
E_{tot}	= total actual energy consumption for all process steps

Once the EEI is calculated it provides an indication of how the actual total production energy intensity of the enterprise compares to the benchmark energy intensity. By definition a plant that uses the benchmark technology will have an EEI of 100. In practice, all plants will have an EEI greater than 100. The gap between actual enterprise total production energy intensity at each process step and the reference level energy consumption can be viewed as the energy-efficiency potential of the plant. The EEI is an initial screening tool that helps to identify which processes are most efficient and which are most inefficient compared to state-of-the-art conditions and which are most likely to have a substantial potential for energy-efficiency improvement.

The Energy Conservation Rate (ECR) is the ratio of the difference between the target year EEI and the base year EEI to the base year EEI. The calculation formula for the ECR is as follows:

$$a = \frac{EI_0 - EI_i}{EI_0}$$

$$b = 1 - \sqrt[n]{\log(EI_i/EI_o)}$$

where: a = total project energy conservation rate
b = annual energy conservation rate
EI_i = unit product consumption of the target year, ton standard coal/ ton product
EI_o = unit product consumption of the base year, ton standard coal/ ton product
n = interval between the target year and the base year

5.4.2 Technology Assessment

Once the EEI has been calculated and the initial assessment of the relative efficiency of the individual process steps has been made, each enterprise will need to undertake an evaluation of its specific conditions in order to determine the achievable energy efficiency potential. After completing the *Survey of Energy Consumption by Process* and calculating the total production energy intensity of each process step, a survey of energy-efficiency improvement measures will be used to estimate the plant-wide potential for energy efficiency improvement by 2005 and 2010. To determine the achievable energy-efficiency potential for each pilot enterprise, inefficient processes within each enterprise are identified by making process-specific comparisons between the energy used for each process at the enterprise and that used for the energy-efficiency benchmarks developed above. Once the inefficient processes are identified, then energy-efficiency technologies and measures that could be implemented to improve the energy efficiency of the processes are identified.[104] The survey will include all cost-effective measures for each process and overall, and assess all commercially available energy efficient technologies. The energy savings that will result from adoption of these technologies and measures is calculated.

The information developed using the *Methodology for Assessment of Enterprise Energy-Efficiency Potential*, including the enterprise *Survey of Energy Consumption by Process*, total production energy intensity by process step, EEI, technical energy-efficiency potential by process step, and achievable energy-efficiency potential by process step are all essential points of information for determining the enterprise Voluntary Agreement target.

5.5 Example of Assessment of Energy-Efficiency Potential Using Energy Consumption by Process

In this example, reference values are taken from the 2000 data on energy use for the coke-making process. Assume that the total production energy intensity of coke-making at an enterprise was 213.2 kgce/ton product in 2000 and the international best practice benchmark energy intensity for coke-making is 81.8 kgce/ton. The technical potential EEI for that process is calculated as follows:

$$coking\ process\ EEI = \frac{process\ energy\ intensity}{process\ benchmark\ energy\ intensity} = \frac{213.2}{81.8} = 2.61\ (x100) = 261$$

[104] There are different sources of information regarding steel sector energy-efficient technologies and measures. For example, a study of energy-efficiency opportunities for the U.S. steel industry that contains information on energy savings and costs of about 50 energy-efficiency technologies and measures (Worrell E., Martin, N., and Price, L., 1999. *Energy Efficiency and Carbon Dioxide Emissions Reduction Opportunities in the U.S. Iron and Steel Sector*. Berkeley, CA: Lawrence Berkeley National Laboratory, LBNL-41724), and the ICARUS database for the iron and steel sector (Michels, K., 2000.*ICARUS-4: Sector Study for the Iron and Steel Industry. Revision 2*. Utrecht, The Netherlands: Utrecht University, Department of Science, Technology and Society, NWS-E-2000-10). This database provides information on the costs and energy savings of the energy-efficiency measures taken at the Corus/Hoogovens steel plant in The Netherlands during the Long-Term Agreements program.

At this point, a more detailed technical assessment of the coke-making energy-efficiency potential is undertaken. Assume that four energy-efficient technologies and projects for the coking process are identified as applicable to the enterprise. The energy-savings impacts of these measures are 47.8 kgce/ton product for coke dry quenching, 3.4 kgce/ton product for control of coal moisture content, 1.7 kgce/ton product for use of variable speed drives on coke oven gas compressors, and 2.9 kgce/ton product for program control of heating. Summing these four projects together gives overall energy-savings potential for the coking process stage of 55.8 kgce/ton product. Subtracting this from the actual coke-making energy intensity of 213.2 kgce/ton product, gives an achievable potential of 157.4 kgce/ton product. The EEI based on this achievable potential would then be:

$$coking\ process\ EEI = \frac{process\ energy\ intensity}{process\ benchmark\ energy\ intensity} = \frac{157.5}{81.8} = 1.93\,(x100) = 193$$

By adding the achievable energy-savings potentials of all process steps (sintering, pelleting, coking, ironmaking, steelmaking, refining, casting, and rolling), one can obtain the overall energy-savings potential of the enterprise, which is helpful for target-setting (see Section 6 of this report).

Table 5-2. Survey of Energy Consumption by Process for Pilot Iron and Steel Enterprises

钢铁企业各工序耗能情况调查表

	工序	Process	烧结	球团	焦化	高炉炼铁	转炉	电炉炼钢	炉外精练转炉	板坯连铸机	小方坯连铸机	轧钢工序	热轧：带钢	热轧：棒材	热轧：盘条	锅炉	铁合金	非生产用能	其他
			Sintering	Pelleting	Coking	Blast-furnace iron smelting	BOF steel making	EAF steel making	Refining	Slab continuous casting	Small billet continuous casting	Steel rolling	Hot rolling: strip steel	Hot rolling: bars	Hot rolling: wire	Boilers	Ferro-alloys	Non-production energy use	Other
Energy Input 能源投入量		**Production (Mt)**																	
	能源品种	**Energy Type***																	
	煤	Coal																	
	重油	Fuel oil																	
	煤气	Coal gas																	
	电	Electricity																	
	天然气	Natural gas																	
	蒸汽	Steam																	
	鼓风带入热量	Heat content of compressed air																	
	焦炭	Coke																	
	水**	Water**																	
		Compressed air																	
		Oxygen																	
	其他（风/氧气/柴油）	Diesel																	
	小计（吨标煤）	**Subtotal** (tce)																	

	工序	Process	烧结	球团	焦化	高炉炼铁	转炉	电炉炼钢	炉外精练转炉	板坯连铸机	小方坯连铸机	轧钢工序	热轧：带钢	热轧：棒材	热轧：盘条	锅炉	铁合金	非生产用能	其他
			Sintering	Pelleting	Coking	Blast-furnace iron smelting	BOF steel making	EAF steel making	Refining	Slab continuous casting	Small billet continuous casting	Steel rolling	Hot rolling: strip steel	Hot rolling: bars	Hot rolling: wire	Boilers	Ferro-alloys	Non-production energy use	Other
源产出量（包括回收） Energy Output (including recovered energy)	焦炭	Coke																	
	煤气	Coal gas																	
	蒸汽	Steam																	
	电	Electricity																	
	粗苯	Crude benzene																	
	焦油	Tar																	
	**																		
	**																		
	其他	Other																	
	小计（吨标煤）	**Subtotal** (tce)																	
	工序单耗	Unit energy consumption by process																	

注：*：可用实物量或吨标煤表示。（以上数据为标煤，单位：万吨）

Usable energy in physical units or tce (10,000 tce)

**：可根据贵企业的具体情况，增加能源的投入和产出品种或增加工序，并在表中注明。

These are to be filled in based on the specific condition of each plant. Insert energy type or process and data in the table as appropriate.

Table 5.3. Survey of Self-Generation at Iron and Steel Enterprises

钢铁企业自发电情况调查表

	工序	Process	焦化	高炉炼铁	锅炉房电站	**	**	其他
			Coking	Blast furnace iron smelting	Power generation boilers			Other
	能源品种 *	**Fuel***						
转入自发电能源投入量 Energy Input for Self-Generation	煤	Coal						
	石油	Oil						
	煤气	Coal gas						
	电	Electricity						
	天然气	Natural gas						
	蒸汽	Steam						
	**							
	**							
	其他	Other						
	小计（吨标煤）	**Subtotal**						
发电量		Power generation (kWh)						

注：*：。 可用实物量或吨标煤表示

Usable energy in physical units or tce (10,000 tce)

**： 可根据贵企业的具体情况，增加能源投入品种或增加工序，并在表中注明。

These are to be filled in based on the specific condition of each plant. Insert energy type or process and data in the table as appropriate.

6. Methodology for Target-Setting for Pilot Enterprises

Target-setting is an essential element of Voluntary Agreements. Targets provide all parties to the agreement with a quantitative goal to be reached within the period of the Voluntary Agreement. There are a number of different types of targets that can be used for setting goals in Voluntary Agreements. An important precondition for realistic yet ambitious target-setting is that all parties have the same information regarding the enterprise energy-efficiency potential as well as the governmental supporting policies to assist the enterprise in implementing energy-efficiency technologies and measures.

6.1 Target Types

There are three basic types of targets that can be used for setting goals in Voluntary Agreements. These are absolute targets, intensity targets, and economic targets.

6.1.1 Absolute Targets

Absolute targets set an energy consumption (or CO_2 or greenhouse gas emission) target that should be accomplished at the completion of the Voluntary Agreement period. For example, if a steel plant consumed 2.8 million tons of coal equivalent (Mtce) in 1995, an absolute target of 2.2 Mtce could be set for 2000, assuming that such energy savings potential was identified through an energy audit or assessment of energy-efficiency potential.

The advantage of an absolute target is that it provides a clear reduction in energy use or emissions. This may be especially attractive in the case of pollution reduction. The disadvantage is that the goal is independent of changes in production volume and product mix. Hence, targets may be more easy or difficult to achieve than expected at the start of the Voluntary Agreement, depending on economic and other conditions.

6.1.2 Intensity Targets

Intensity targets are based on calculation of a plant's physical energy intensity and/or its Energy Efficiency Index (EEI). Targets are then set based on a relative energy intensity or EEI reduction, an absolute energy intensity or EEI requirement, or through benchmarking (i.e. based on energy-efficiency improvement potentials).

The energy intensity is calculated as follows:

$$\text{Energy Intensity} = \frac{E}{P}$$

where E = energy consumption by the plant or sector and P = production by the plant or sector.

Once a plant's energy intensity has been calculated, a target can be set based on past trends or through benchmarking. The energy intensity is most useful for industries with a relatively simple

product mix, e.g. a single energy-intensive product. In case of multiple products, it is better to use the EEI. The EEI combines the energy intensity of different process steps into one indicator.

Using the past-trends approach, a target can be set that is an improvement over recent energy intensity trends. This target can be based on either a relative energy intensity reduction or an absolute energy intensity requirement. For example, if a given steel plant has reduced its energy intensity from 1.2 tce/t steel to 0.9 tce/t steel over the previous 5-year period, then the average annual improvement in the energy intensity was 5.6% per year. Depending upon the circumstances at the plant during the previous 5 years, this trend may be viewed as "business-as-usual" and a *relative energy intensity reduction target* could be set for a higher annual improvement in the energy intensity such as "the energy intensity should be reduced by 6.5% per year". An *absolute energy intensity reduction target* would specify the goal in terms of the energy intensity desired at the end of the agreement period, such as "the energy intensity should reach a level of 0.64 tce/t steel".

The Dutch Long-Term Agreements used relative EEI reduction targets. The overall national energy-efficiency improvement target was a 20% reduction in EEI between 1989 and 2000. This target was divided among the industries, with most industries also using a target of 20% reduction, but some using different targets based on assessments of their energy-efficiency potential. For example, the petroleum refining industry's overall target was a 10% reduction, while the target for Philips Lighting was a 25% reduction. The target for the iron and steel industry was a 20% reduction of the EEI over the period of the Voluntary Agreement.

Using benchmarking to determine an energy intensity-based target involves deciding what reference energy intensity to use for the benchmark. The benchmark could be the world average, the best-plant level (either domestically or in the world), the best-practice level (which combines the process-step best practices from a number of plants operating around the world), or the thermodynamic minimum.

6.1.3 Economic Targets

Economic targets take into account the costs of energy efficiency improvements. They are expressed in terms of costs per unit of energy saved. For example, an economic target could be that an enterprise is required to implement all measures that have investment costs below a certain threshold value per ton of steel produced. Economic targets can also be expressed in terms of payback time, which is the amount of time it takes to recoup the investment costs through saved energy costs. Such a target could be that all measures with a payback period of 5 years should be implemented. Internal rate of return (IRR) can also be used as an economic target by stating that all measures with a certain IRR should be implemented.

The Danish CO_2 Tax Rebate Scheme for Energy-Intensive Industries uses an economic target that stipulates that participants must implement all measures with payback periods of less than 4 years in order to be exempt from the carbon tax. Current agreements in The Netherlands require implementation of all measures with payback times less than 5 years in the case of buildings and

less than 3 years for facilities and processes, for those industries that do not participate in the benchmarking agreement.

6.2 Methodology for Target-Setting for Pilot Enterprises

Using information developed through the assessment of enterprise energy-efficiency improvement potential, as well as information on historical and planned energy intensity reductions at each plant, CECA and the Technical Team will work with representatives at the enterprises and the local government to set achievable yet aggressive targets for energy-efficiency improvement within the Pilot Project.

During the assessment of enterprise energy-efficiency improvement potential, the calculations of current total production energy consumption and energy intensity by process, as well as the EEI, will be made for each of the pilot enterprises. The potential EEI in 2010 will also be calculated for both a "business-as-usual" and a "with Voluntary Agreement" scenario. These values, combined with information on historical and planned energy intensity reductions at each enterprise, will be used by all parties to the Voluntary Agreement to determine the targets for the Energy Conservation Voluntary Agreement Pilot Project.

The essential steps in target-setting are as follows: choose a type of target (absolute, intensity, economic), choose a base year and target year(s), evaluate energy-efficiency potential information, and set the target.

6.2.1 Select Target Type

The parties to the Voluntary Agreement have decided to use an intensity target based on the total production Energy Efficiency Index (EEI). This kind of index allows for changes in production volume and product mix, and will not affect the potential future growth of output of the enterprises participating in the Pilot Project. In addition, the Energy Conservation Rate (ECR), based on total production EEI and as a supplementary index, will be calculated to measure the change in EEI over time.

6.2.2 Choose a Base Year and Target Year

In keeping with the national Five-Year Plan schedule, the base year for the targets will be 2000. 2005 will be an interim target year and 2010 will be the final target year.

6.2.3 Evaluate Energy-Efficiency Improvement Potential Information and Set Target

Each pilot enterprise will provide the results of their calculations of the *Assessment of Enterprise Energy-Efficiency Improvement Potential* (as described in Section 5 of this report), including the following information for 2000, 2001, and 2002 (if available): enterprise *Survey of Energy Consumption by Process*, enterprise actual total production energy intensity by process step, enterprise technical potential energy intensity by process step, the enterprise achievable potential energy intensity by process step and the Energy Efficiency Index to all parties. In addition, historical and Five-Year Plan information will be provided to all parties. The parties to the

Voluntary Agreement will then work together to determine the targets for 2005 and 2010, based on the above information as well as on information regarding the supporting policies to be offered by the government to assist the enterprise in achieving the Voluntary Agreement target.

6.3 Example of Target-Setting Based on Energy-Efficiency Potential Information

Using the same information as presented in the example in Section 5.5 of this report, assuming that the energy intensity of coke-making was 213.24 kgce/ton product in 2000 and that the technical potential is 81.8 kgce/ton, resulting in a current EEI for coke-making of 261. The enterprise has identified four energy-efficient measures in the coke-making process that if implemented would reduce the EEI to 193. Thus, if the enterprises believe that they will be able to successfully implement all four measures because the supporting policies from the government are sufficient to enable implementation, the target could be set to be an EEI of 193 by 2010, which would result in a total Energy Conservation Rate (ECR) of 35% and an annual ECR of 2.97%. Of course, for the Voluntary Agreements, the EEI and ECR will be calculated for all energy-intensive steel-making processes at the enterprise, not just for coke-making.

7. Supporting Policies in Voluntary Agreement Programs Throughout the World

Supporting policies are the key motivational element to encourage enterprises to participate fully in the Voluntary Agreement program. Supporting programs and policies (the "carrots"), such as government facilitation of the Voluntary Agreement negotiation and implementation process (including provision of technical assistance and information dissemination programs), enterprise audits and assessments, financial assistance and incentives, and government and public recognition all play an important role in assisting the participants in meeting the target goals. Supporting policies also include elimination or reduction of environmental regulations or taxes (the "sticks") for participants.

Development of these supporting policies requires discussions with enterprises to determine their needs and desires and discussions with government representatives to determine their ability to deliver specific incentives. It is essential to develop a package of supporting incentive policies to motivate and assist the enterprises in reaching their energy-efficiency targets.

7.1 Supporting Policies Used in Voluntary Agreement Programs in Other Countries

Existing Voluntary Agreement programs use a variety of supporting policies to motivate and assist industry in reaching its energy efficiency or greenhouse gas emission reduction goals. Table 7-1 provides an overview of the supporting policies and measures in a number of different Voluntary Agreement programs.

Table 7-1. Overview of Supporting Policies and Measures in Selected Voluntary Agreement Programs

		Supporting Policies and Measures				
Country	**VA Scheme**	**Government Facilitation of VA Process**	**Audits and Assessments**	**Financial Assistance and Incentives**	**Government and Public Recognition**	**Exemption from Regulation and Taxes**
Australia	Greenhouse Challenge	X			X	
Canada	Industry Program for Energy Conservation	X			X	
Denmark	Agreements on Industrial Energy Efficiency	X	X	X		X
Germany	Declaration of German Industry on Global Warming Prevention; Agreement on Climate Protection	X				X
Netherlands	Long Term Agreements	X	X	X		X
Sweden	EKO-Energi	X	X		X	
UK	Make a Corporate Commitment, Climate Change Agreements	X			X	X

7.1.1 Government Facilitation of Voluntary Agreement Process through Technical Assistance and Information Dissemination

Governments can provide significant assistance in implementation of Voluntary Agreements through facilitation of the negotiation and implementation process as well as provision of technical assistance and information dissemination programs.

In the Australian Greenhouse Challenge program, the government provides assistance to firms wishing to develop and implement agreements. Workbooks and information are provided to members, including model agreements, program and reporting guidelines and methodologies, a framework for undertaking and reporting on actions to abate emissions, and technical workbooks for preparing inventories and action plans. Technical expertise on identifying, monitoring and forecasting greenhouse gas emissions, as well as the internal systems and structures to collect emissions data, monitor and manage it are also provided. Web-based tools like emissions calculators and reporting templates are available. The government undertakes targeted reviews to verify program outcomes and reports publicly on the overall program progress and outcomes of the program. The government promotes and runs workshops and training programs related to the agreements and assists industry association in researching and gathering data to facilitate participation in the agreements. Finally, government consults with industry to identify and seek to address impediments to greenhouse gas emissions reductions such as inconsistencies in government policies and measures to improve energy efficiency, process efficiency, etc.[105,106]

The Canadian Industry Program for Energy Conservation coordinates activities related to identifying energy efficiency obstacles and opportunities, setting sector-level energy-intensive targets, and developing strategies to reach the targets. CIPEC working groups provide information and expertise on energy issues for the individual sectors. CIPEC also provides analyses to assist industrial sectors in identifying operational and technical opportunities to meet their sector targets.[107] The Canadian government provides assistance through third party (federal statistical agency) collection of relevant data to measure and report industry's progress toward meeting their targets.[108] Finally, CIPEC is responsible for a "strong communications and awareness program" that includes a twice-monthly newsletter, regular features in selected trade magazines, energy conferences and workshops, exchange of non-competitive information at regular sector task force meetings, and publication of an annual report outlining progress by sector.[109]

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[105] The Australian Greenhouse Office, 1998. *Greenhouse Challenge*, Commonwealth of Australia.

[106] Australian Greenhouse Office (AGO) website: http://www.greenhouse.gov.au

[107] Kraemer, T.P., n.d. *Energy Policy Instruments: Description of Selected Countries*, Denmark: AKF, Institute of Local Government Studies.

[108] Jago, P., 1999. "The Canadian Industry Program for Energy Conservation (CIPEC): the Dynamics of a 24-year Partnership Between Government and Industry," *Proceedings of the 1999 ACEEE Summer Study on Energy Efficiency in Industry*. Washington DC: American Council for an Energy-Efficient Economy.

[109] Canadian Industry Program for Energy Conservation, 2000. *1999/2000 Annual Report*. Ottawa: Natural Resources Canada, Office of Energy Efficiency.

Under the Danish Agreements on Industrial Energy Efficiency, the Danish Energy Agency negotiates the collective agreements with industrial associations so that the individual companies do not have to negotiate individually with the government. The Danish Energy Agency has also developed specific guidelines regarding the implementation of energy management systems and the energy audits, as required by the agreements.[110] Government officials also provide information on energy-saving potentials and technologies, administer investment grants available to the industry, and monitors the progress of the companies during implementation.[111]

Under the 1996 Declaration of German Industry on Global Warming Prevention, the government had a limited role because the declaration was unilaterally provided by the industries without participation of the government. However, the German government has hosted 10 best-practice workshops and has entrusted a research institution to carry out annual monitoring of progress based on reports provided by the industrial sectors.[112] In 2000, German government and industry signed a new "Agreement on Climate Protection between the Government of the Federal Republic of Germany and German Business". Under this agreement, the regular implementation monitoring through an independent scientific institute will be continued and the Federal Government, represented by the Federal Ministry of Economics and the Federal Ministry for the Environment, will continue to contribute 50% towards financing climate protection monitoring.[113]

In the Dutch Long-Term Agreements, the Dutch government, through the Ministry of Economic Affairs and NOVEM (the organization for energy and environment), provides significant support to the Voluntary Agreement process. NOVEM is responsible for making preparations for signing declarations of intent and the Long-Term Agreements, monitoring of the agreements through verifying the data in the progress reports of the individual firms and drawing up official statistics, and supporting the transfer of knowledge on energy-efficiency improvement between different industrial sectors.[114] NOVEM aggregates the individual company reports to a sector report. This yearly sector report is public after approval of a quality commission from NOVEM and the Ministry of Economic Affairs.[115]

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[110] Ingerslev, C., 1999. "Incentives in Energy Policy – A Comparison Between the Danish Policy Mix and a Voluntary Approach to CO2 Abatement," *Proceedings of the 1999 ECEEE Summer Study on Energy Efficiency and CO2 Reduction: The Dimensions of Social Change*.

[111] Johannsen, K.S. and Larson, A., 2000. *Voluntary Agreements – Implementation and Efficiency. The Danish Country Study: Case Studies in the Sectors of Paper and Milk Condensing*. Copenhagen: AKF Forlaget.

[112] Ramesohl, S. and Kristof, K., 2001. "The Declaration of German Industry on Global Warming Prevention – A Dynamic Analysis of Current Performance and Future Prospects for Development," *Journal of Cleaner Production*.

[113] *Agreement on Climate Protection between the Government of the Federal Republic of Germany and German Business*, September 11, 2000.

[114] Glasbergen, P., M.C. Das, P.P.J. Driessen, N. Habermehl, W.J.V. Vermeulen, K. Blok, J. Farla, 1997, en E. Korevaar, *Afspraken werken;* e*valuatie Meerjarenafspraken over energie-efficiency* (Evaluation of Long Term Agreements on Energy-Efficiency), Den Haag, The Netherlands: Ministerie van Economische Zaken, Directoraat-Generaal voor Energie.

[115] Kerssemeeckers, M. 2002. *The Dutch Long Term Voluntary Agreements on Energy Efficiency Improvement in Industry*. Utrecht, The Netherlands: Ecofys.

In the Swedish EKO-Energi program, the the Swedish National Energy Administration (STEM) provides free energy and environmental audits, a comprehensive material flow analysis as well as introductory comparison of the company environmental awareness and environmental management compared to guidelines based on the Eco-Management and Audit Scheme (EMAS) or International Organization for Standardization (ISO) 14001 standards. STEM provides an educational package on the process of energy-efficient industrial purchasing, ENEU 94. In addition, participants are granted free access to information materials produced by STEM related to energy-efficient installations and machinery. Finally, STEM is now conducting regional network meetings for the participants that include "success story" presentations as well as presentations by guest speakers.[116]

The UK's Make a Corporate Commitment (MACC) program, which began in 1991, provides a government registry for participants to register their targets, a handbook, and assistance in assessing current levels of resource efficiency and setting realistic targets for improvement. The target-setting and negotiations in the UK's Climate Change Agreements are handled by the Department for Environment, Food & Rural Affairs (DEFRA) with technical advice and facilitation provided by ETSU. For participants in the Climate Change Agreements there are guidance documents as well as a database of energy use and energy saving potential in the main industrial sectors. ETSU assists in the negotiation of the targets and has access to information on each sector's current energy use, its management approach to energy efficiency, and use of energy efficient technologies.[117]

7.1.2 Audits and Assessments

Under the Danish Agreements on Industrial Energy Efficiency, companies that sign the agreements are required to undertake an energy audit. The audit can be done by either an energy consultant or company staff. The audit is the basis for negotiation between the company and the Danish Energy Agency because it determines whether the company qualifies as "energy efficient" (and is thus exempt from the CO_2 tax) or whether the company must undertake investments in energy-saving measures in order to qualify as energy-efficient. The audits must be verified by a certified verification agency that verifies that they have been carried out acording to the established rules. Companies can apply for subsidies of 30-50% of their expenses for the energy audit and the verification.[118]

In the Dutch Long-Term Agreements, sector audits that were prepared in advance of the agreements were financed 100% by the government. After signing the Voluntary Agreement, individual companies also executed audits in order to investigate opportunities for energy-

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[116] Uggla, U. and Avasoo, D., 2001. "EKO-Energi – Successful Voluntary Agreements on Energy Efficiency and Environmental Control in Swedish Industry." *Proceedings of the 2001 ECEEE Summer Study*. European Council for an Energy-Efficient Economy.

[117] ETSU - AEA Technology, 2001. *Climate Change Agreements – Sectoral Enregy Efficiency Targets*. Version 2. Oxfordshire, UK: ETSU – AEA Technology.

[118] Johannsen, K.S. and Larson, A., 2000. *Voluntary Agreements – Implementation and Efficiency. The Danish Country Study: Case Studies in the Sectors of Paper and Milk Condensing*. Copenhagen: AKF Forlaget.

efficiency improvement that served as input for their energy conservation plans. These audits were subsidized approximately 50% by NOVEM.[119]

In the Swedish EKO-Energi program, the Swedish National Energy Administration (STEM) provides free energy and environmental audits that include a comprehensive inventory and analysis of energy use in the company production and premises, including a list of suggested measures to be taken.

7.1.3 Financial Assistance and Incentives

Denmark has a CO_2 tax on energy use for space heating as well as light and heavy industrial processes. Companies that sign agreements with the Danish Energy Agency through the Danish Agreements on Industrial Energy Efficiency program qualify for reduced CO_2 taxes. The revenue from the CO_2 tax is used by the Danish government to provide subsidies for investment in energy-efficiency improvements. The subsidies are for up to 30% of the investment cost of projects with payback periods of 3 to 9 years. Subsidies can also be used for energy audits, demonstration and development projects, and general projects related to energy efficiency.[120]

Under the Dutch Long Term Agreements, various subsidies on investments, research, development and demonstration projects are available, mainly from the Ministry of Economic Affairs and executed by NOVEM. Important subsidy schemes in the last ten years included support for energy savings, solar energy, and CHP, subsidies for feasibility studies, demonstration projects and market introduction programmes for new technologies, subsidies for energy saving projects, renewable energy and environment-related projects (waste, emissions), and stimulation of co-operation between firms in the area of environment and energy. The Energy Investment Allowance permits deduction of a certain percentage of investments in energy-saving measures from the companies' profit that results in a lower income tax and thus a financial benefit for the investor. In addition, under the VAMIL program, investors are allowed to deduct the investment in energy-saving measures from income or profit whenever they choose. This is important because depending upon the profits of a company, the year in which to subtract the investment can make a difference on the income taxes to be paid.

7.1.4 Government and Public Recognition

In the Australian Greenhouse Challenge program, members have access to the Greenhouse Challenge Members' Logo to use on products and corporate information. The Greenhouse Challenge itself also promotes the achievements of the program, building public awareness and recognition for all members.[121]

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[119] Kerssemeeckers, M. 2002. *The Dutch Long Term Voluntary Agreements on Energy Efficiency Improvement in Industry*. Utrecht, The Netherlands: Ecofys.

[120] Togeby, M., Johannsen, K., Ingerslev, C., Thingvad, K., and Madsen, J., 1999. "Evaluations of the Danish Agreement System," *Proceedings of the 1999 ACEEE Summer Study on Energy Efficiency in Industry*. Washington DC: American Council for an Energy-Efficient Economy.

[121] Australian Greenhouse Office (AGO) website: http://www.greenhouse.gov.au

The Canadian Industry Program for Energy Conservation highlights individual company "Success Stories" in its Annual Reports and also publicize companies that have received "Energy Efficiency Awards" from the Natural Resources Canada Office of Energy Efficiency. [122]

In the Swedish voluntary agreement program EKO-Energi, STEM arranges publicity activities such as spreading success stories to the press and appointing the successful EKO energy companies year at the EKO-Energi award ceremony which is covered by the media and attended by government officials, politicians, and energy experts. Participants also can use the EKO-Energi logo in promotional activities.[123]

The UK's MACC program includes a publicly available database of the commitments of all organizations that have signed an agreement.

7.1.5 Exemption from Regulations and Taxes

The Danish Agreements on Industrial Energy Efficiency are based on the imposition of a mandatory carbon dioxide emissions tax where the level of taxation depends on the purpose of the energy use, the type of energy used, and whether an agreement exists between the company and the Danish Energy Agency. The agreements, which are made by an individual company or an association of companies with the Energy Agency, are made for a period of three years in order to qualify for a lower CO_2 tax rate.

Under the 1996 Declaration of German Industry on Global Warming Prevention, the German government withdrew plans to introduce a waste heat regulation and promised participating industries an exemption from a possible European energy tax.[124] With the 2000 "Agreement on Climate Protection between the Government of the Federal Republic of Germany and German Business" the government promised not to take any initiative to achieve the climate protection targets through command and control measures and decided against introducing a binding energy audit. The government futher promised to ensure that further development of the German ecological tax reform will not cause any competitive disadvantages on the international level for the industries involved in the agreement. Regarding European Union energy taxation, the German government promised to advocate solutions compatible with competition and to endeavour to guarantee that on the European level due account will be taken of the contributions by German Business and other players made to date.[125]

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[122] Canadian Industry Program for Energy Conservation, 2000. *1999/2000 Annual Report*. Ottawa: Natural Resources Canada, Office of Energy Efficiency.

[123] Uggla, U. and Avasoo, D., 2001. "EKO-Energi – Successful Voluntary Agreements on Energy Efficiency and Environmental Control in Swedish Industry." *Proceedings of the 2001 ECEEE Summer Study*. European Council for an Energy-Efficient Economy.

[124] Ramesohl, S., and Kristof, K., 2001. "The Declaration of German Industry on Global Warming Prevention – A Dynamic Analysis of Current Performance and Future Prospects for Development," *Journal of Cleaner Production*.

[125] *Agreement on Climate Protection between the Government of the Federal Republic of Germany and German Business*, September 11, 2000.

In The Netherlands, environmental permits issued by provincial governments include an energy component. The process of receiving an environmental permit is easier for companies that signed the Long Term Agreements, because the provinces are asked to consider the agreement as an environmental permit. In addition, the province is asked not to come up with any extra demands on the companies once the energy saving plan is accepted by NOVEM. Individual firms can be excluded from the agreements if they fail to provide an energy conservation plan and annual monitoring results. Firms will the be subject to existing environmental permit regulations. In addition, the Ministry of Economic Affairs has agreed not to implement any other taxes or fiscal punishments in order to stimulate energy savings for those industries that participate in the Long Term Agreements.[126]

Participants who commit to greenhouse gas emission reduction targets in the UK's Climate Change Agreements are eligible for an 80% reduction in the country's CO_2 tax until 31 March 2003. Eligibility for the discount after that will depend on whether the first targets set in the agreements have been met.[127]

7.2 Supporting Policies for Steel Sector Energy Conservation Voluntary Agreement Pilot Project in China

This section focuses on five areas where potential supporting policies for the steel sector Energy Conservation Voluntary Agreement may be identified. These areas are: energy policy, environmental protection policy, financial and tax policy, industrial policy, and information dissemination policy. This section discusses the laws, regulations, and policies related to the Energy Conservation Voluntary Agreement and then suggests possible supporting policies for the Pilot Project.

7.2.1 Energy Policy

Energy policy in China is guided by the *Energy Conservation Law of the People's Republic of China (Energy Conservation Law),* enacted on January 1, 1998, and related implementing regulations for this fundamental law. Energy policy has been further outlined in the 10th Five Year Plan and in the soon-to-be enacted Clean Energy Production law.

7.2.1 Energy Conservation Law of People's Republic of China

The *Energy Conservation Law* is a comprehensive law on energy conservation based on systematically summarizing the experience in the construction of law and regulations on using energy reasonably in China and abroad, considering actual Chinese conditions. It serves as the "constitution" in energy conservation work in China and specifies that energy conservation is a long-term strategy for economic sustainable development. It stipulates the obligations borne by

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[126] Kerssemeeckers, M. 2002. *The Dutch Long Term Voluntary Agreements on Energy Efficiency Improvement in Industry*. Utrecht, The Netherlands: Ecofys.

[127] U.K. Department for Environment, Food and Rural Affairs, 2002. *Climate Change Agreements*. http://www2.defra.gov.uk/environment/ccl/intro.htm

governments and departments at all levels related to energy conservation work, the rights and obligations held and borne by energy-using units, the rights and obligations in quality control of energy-using products, and the promotion of advanced energy-using products for any individual and unit who produces energy-using products and equipment.

In order to implement and fulfill the *Energy Conservation Law*, the Chinese government established some complementary laws, regulations, and policies, including *Management on Energy Conservation in Key Energy-Intensive Enterprises, Management on Electricity saving*, and *Provisions on Developing Co-generation,* etc. Further development of complementary laws and regulations for the *Energy Conservation Law* is being organized by the relevant departments in China that are studying and establishing regulations on *Management on Oil Conservation*, *Management on Energy Efficiency Identification, Recycle Law on Regenerate Resource*. The goals of these laws are to strengthen energy conservation management, to establish maximum energy-consumption limits and set standards, to develop certification systems and energy-efficiency identification systems for mass-produced energy-consuming products.

Management on Energy Conservation for Key Energy-Intensive Enterprise

Management on Energy Conservation for Key Energy-Intensive Enterprise stipulates that key energy-using units shall be supervised and managed by the Economic and Trade Commission at all levels, and an energy-consumption reporting system shall be established in the key energy-using units. The units shall establish an energy conservation responsibility system, employ energy-conservation managers, strengthen the reasonable and efficient utilization of energy, initiate scientific research and development, reform technology, provide publicity and training regarding energy conservation, perform statistical analysis of energy, and regularly submit reports on energy consumption. Both the government at all levels and the energy-using units shall encourage and reward the individual and unit that make a noticeable achievement in energy conservation and energy conservation innovation and punish those who waste energy.

Management on Electricity Saving

Management on Electricity Saving stipulates that the state and local Economic and Trade Commission shall be responsible for establishing economic electricity policy, issuing information on electricity saving, regularly publicizing the maximum unit specification of electricity consumption by product and the domestic advanced index on electricity consumption for key products with high electricity consumption, regularly publicizing the catalogue of eliminated technology and equipment with low efficiency and high electricity consumption, encouraging and supporting the research and popularization of electricity-saving technology, encouraging the introduction of advanced foreign electricity-saving products, and encouraging and promoting electricity-saving products that have achieved the energy conservation certification established by the State. The production and distribution of the equipment and products with low efficiency and high electricity consumption is forbidden. The relevant department of the State and enterprise shall command and reward the collective and individual that makes a noticeable achievement in electricity saving.

Provisions on Developing Co-Generation

Provisions on Developing Co-Generation points out that use of co-generation produces benefits such as energy conservation, environmental improvement, improvement of heat supply quality, and increased power supply. It stipulates that the co-generation program shall be conducted according to the principles of unified planning, gradual implementation, determining electricity based on the existing level of produced heat (plants are not allowed to produce more heat in order to produce more electricity), taking the heat supply as the major task on the condition that it improves environmental quality, conserving energy, and improving heat supply quality. Each region and department is required to allocate a certain fund in developing co-generation and central heat supply in annual municipal construction. The price of thermal energy and electricity in thermo-electric plants shall be established as stipulated in *Price Law of People's Republic of China and Electric Power Law of People's Republic of China.*

7.2.1.2 Energy Development Strategy During the Tenth Five-Year Plan

The energy development strategy in the period of the Tenth Five Year Plan (2001-2005) is as follows: Safeguard the safety of energy, optimize the structure of energy, improve the efficiency of energy, protect the environment and continually reform and increase the development in West Region of China. The overall goal is to make noticeable headway in optimizing energy structure so that energy supply can meet the basic needs of the national economy and social development, make further improvements in energy efficiency, and establish an energy management system within the socialistic market economy.

7.2.1.3 Promotion Law on Clean Energy Production

The *Promotion Law on Clean Energy Production,* which will be implemented on January 1, 2003, states that any enterprise is allowed to sign voluntarily an agreement with the competent economic and trade and environmental protection authority for the purposes of further conserving resources and reducing pollutant discharge, assuming the basis of pollutant discharge thereof is within the standard established by the State and region. The competent authority shall publicize the enterprise's name and achievement in conserving resources and the prevention and treatment of pollution in local major media.

7.2.1.4 Analysis of Available Supporting Energy Policies for the Energy Conservation Voluntary Agreement on Pilot Project

The government shall recognize and reward the actions of the pilot enterprises to voluntarily improve energy efficiency and protect the environment so as to encourage other enterprises to do the same. This is also an incentive for enterprises to participate the Energy Conservation Voluntary Agreement. Clause 23 in the *Energy Conservation Law* stipulates that "The energy-using unit shall establish the responsibility system on energy conservation work and shall encourage and reward the collective and individual who makes achievements". In the spirit of the above clause, it is recommended that the title of "Voluntary Agreement Pilot Enterprise" be conferred on the enterprises that participate in the Energy Conservation Voluntary Agreement Pilot Project.

7.2.2 Environmental Protection Policy

At present, China is a signatory of international environmental conventions including the *United Nations Framework Convention on Climate Change* and the *Montreal Protocol on Ozone Depletion.* As evidenced by the many occasions of giving publicity to China's tremendous efforts and achievements related to the *Climate Change Convention,* the Chinese government views energy conservation and new energy development as a significant achievement.

"Three transformations" took place in guiding the concept of preventing and treating industrial pollution including 1) a gradual shift from a focus on pollution treatment to a focus on control of the overall process of industrial production as the basic strategy of preventing and treating pollution, 2) a shift in the focus on concentration to combine concentration with overall control of discharging pollutants, and 3) a shift in the focus on the control of source and spot pollutants which stressed decentralization to the combination of central control and decentralized pollution treatment. After many years, the Chinese system of law, regulations, and policy on the prevention and treatment of industrial pollution has been established. To prevent and treat pollution efficiently, the Chinese government established three major policies for environment control: 1) to put prevention first and combine prevention with treatment, 2) to hold those who cause pollution responsible to improve environmental protection and management, and 3) to emphasize resource comprehensive utilization which focuses on integrated technology reform for preventing and treating industrial pollution, urban environment integrated control and rectify policy, environmental protection technology policy, environmental protection industrial policy, etc.

7.2.2.1 Law of Environmental Protection of the People's Republic of China

The *Law of Environmental Protection of the People's Republic of China,* enacted in 1989, is the basic law on environmental protection in China. The law established the basic guidelines to maintain coordinated development among economic construction, social development and environmental protection, as well as stipulated the environmental protection rights and obligations of governments at various levels, units, and individuals.

Following enactment of this law, China established and promulgated many environmental protection laws including the *Law on the Prevention and Treatment of Water Pollution, Law on the Prevention and Treatment of Atmosphere Pollution, Law of Environmental Prevention and Treatment of Solid Waste Pollution, Mineral Resource Law, Water Law, Management on Environmental Protection of Construction Project,* etc. The State has promulgated 6 environmental protection laws, 10 resource laws and more than 30 administrative regulations on environmental protection. About 90 environmental protection rules and 427 national environmental protection standards have been established and there are 1020 regional environmental protection law and regulations. Shandong Province, the province for the Energy Conservation Voluntary Agreement Pilot Project, promulgated and implemented the *Shandong Environmental Protection Regulations* in December 1996.

While enacting laws and regulations to protect environment, the Chinese government is also increasing investment in environmental protection and strengthening the supervision and control through economic and administrative measures, mainly involving the following aspects:

- Establishing preferential policies related to environmental protection including investment, financing, revenue, and import and export to attract foreign funds to environmental protection projects.
- Using the bond and securities market to expand the financial means for environmental protection. Giving full attention to loan policies and encouraging commercial banks to actively support pollution control and ecological protection projects; in addition, the state bank also actively supports environmental protection projects.
- Advancing the reform of the administrative charge and tax on environmental protection, studying the issue of imposing an environmental tax on products that pollute or damage the environment when used or produced, studying the issue of utilizing existing taxes to consolidate the macro-level regulatory function of tax revenue on resource conservation and environmental protection, perfecting the waste recycling policy.
- Implementing the fee system on total pollutant discharge. The fee shall be reasonable in order to mobilize the enthusiasm of enterprises. The urban sewage disposal fee, urban trash disposal fee, and dangerous waste disposal fee shall be fully collected and the fee level shall be gradually increased to a level that is slightly profitable after compensating for the rational cost
- Establishing an economic policy to facilitate the desulfurization of electric power plants. Developing the research on the desirable sulfur dioxide pollutant discharge transaction, reducing the costs of controlling sulfur dioxide pollution, and reducing its discharge amount.

7.2.2.2 The Tenth Five-Year Plan on Environmental Protection of the State

The Tenth Five Year Plan on Environmental Protection of the State put forward a definite and clear policy on the prevention and treatment of pollution in the metallurgy industry: "Boost vigorously clean production technology reform, adopt actively advanced technology including coke dry quenching, high-efficiency continuous casting and so on, fully popularize the comprehensive utilization of residual energy, residual heat and waste gas, waste water and waste residue."

7.2.2.3 Analysis of Available Supporting Environmental Protection Policies for the Energy Conservation Voluntary Agreement on Pilot Project

The Energy Conservation Voluntary Agreement Pilot Project will result in significant environmental protection benefits. Although China attaches great importance to environmental protection, enacts many laws in this regard, offers large investment and has made remarkable improvements, it is not now possible to adopt the approach of collecting a carbon dioxide emission tax as is done in some developed countries. Implementing the Energy Conservation Voluntary Agreement Pilot Project can produce environmental protection benefit and the act shall be encouraged and rewarded but call for further coordinated work on implemented way.

7.2.3 Financial and Tax Policy

A set of financial supporting policies on energy-efficiency investment has not yet been established in China. In the mid-1980s, the State established a series of policies to encourage energy conservation due to the shortage of energy. With the transformation of the economic system from a planned to a market economy, some of these incentives and temporary policies were canceled or lost their original function.

International experience shows that there are four key actors for energy-efficiency investment support: investors, manufacturers, distributors, and consumers. At least four types of financial supporting policies can be used to influence these actors, including tax policies, subsidy policies, price policies and low and discount interest policies. Experience shows that different supporting policies applied to different actors can result in different outcomes.

The selection and determination of financial policies shall not only suit the characteristics of Chinese energy, resource, technology, and economy but also that of the current finance, tax revenue, price and economic management systems in China. In addition, the establishment of policy shall be implemented in stages; in other words, vigorous support shall be given to mature technologies.

From the perspective of development, the government's support is short-term, while market forces are more enduring. Hence, the supporting policies of government shall vary through different periods of technological development on energy conservation and energy efficiency instead of being invariable. The support of government is designed to promote the market adoption of energy-conservation products, improve their competitiveness, and foster their development and survival under market economy conditions.

Incentive policies are not the only financial policy mechanism; administrative and legal restrictive policies can also be used. For example, use of motor products and equipment that exceed the standard of energy consumption shall be forbidden or restricted. Thus, as incentive policy is established, consideration shall also be given to the necessary and matching restrictive policies and measures.

7.2.3.1 Tax Policy

Income Tax

The enterprise income tax rate is levied at a universal rate of 33%. Enterprises in the high and new technology industry development zone will be levied a 15% income tax, the income tax will be exempted for two years from the year of initiation of the newly constructed high technology enterprise, and the income tax shall be reduced or exempted within five years for the enterprise which uses waste gas, waste water, and waste residue as major raw materials in production. The income tax may be levied by the local taxation bureau, depending on the profit situation of enterprise. In the case of an enterprise using a bank loan, the income tax may be levied before or after loan payment. Paying the loan before the tax is a way to reduce or exempt the enterprise

from income tax. Another approach to reduce or exempt taxes is to use accelerated depreciation. The accelerated depreciation approach can be applied to energy conservation reform on water pumps and air blowers.

Approved by the State Council on May 22, 2000, the Finance Ministry and State Tax Bureau issued the notice of *Provisional Measures on Deducting and Exempting Enterprise Income Tax by Investing the Technology Rehabilitation in Domestic Equipment.* The measures stipulate that a 40% investment in domestic equipment required by the project may be deducted or exempted from the additional enterprise income tax in the year in which the equipment was purchased for enterprise technology reform projects than that in the previous year, with regard to any enterprise which invests in technology reform projects that meet the industry policy established by the State.

Value-added tax and value-added tax addition

Value-added tax and value-added tax addition are taxes to be paid to the central financial department. The level of these taxes is established by the central government. Local government cannot change the value-added tax rate or reduce or exempt the tax, but has the right to reduce or exempt value-added tax addition.

Since the implementation of the new tax system, SETC and relevant departments established a preferable tax policy on resource comprehensive utilization. With this tax policy, the amount of tax reduction and exemption amounts to more than 2 billion yuan annually, which has greatly influence the enterprises and constitutes a major reason why such remarkable achievement was made in resource comprehensive utilization in the past few years. From 2001 on, China is implementing the policy of collection and exemption at one time on value-added tax, or collecting by half on the payable tax amount of value-added tax for the resource comprehensive utilization product. For example, in order to expedite the innovation on wall body material, the State implements a new preferable policy and offers the preference of reducing and exempting value-added tax on the products listed on the *Product Catalogue of New Type Wall Body Material*, facilitating the application and popularization of new type of wall body material.

At present, neither the central government nor the local government has established the preferential policy on value-added tax and value-added tax addition on energy conservation products.

Reduction and exemption of import tariffs

Import tariffs shall be reduced or exempted on energy conservation equipment, including testing instrument and apparatus. This will assist in implementing technology reform in enterprises according to stipulations in the tax law established by the State.

7.2.3.2 Subsidy Policy

Project Expense Subsidy

In order to encourage the development and popularization of energy conservation technology, the organization or office for managing and organizing energy conservation is established in the state macro-regulation department and the local governmental department. The office has made a great progress on energy conservation development, industrial development, science research, and promotion and demonstration. The central finance department provides the funds both for the operation and activity of these offices.

Research and Development Subsidy

Through the State Development and Planning Commission (SDPC) and the Ministry of Science & Technology (MOST), the central government provides the funds to address key problems in energy conservation science and technology. In addition, other relevant departments in the central government also allocate small funds for research and development in energy conservation technology.

Investment Subsidy

Through relevant departments, the central government provides a subsidy for energy conservation demonstration projects. The discount fund is allocated by the central finance government (Ministry of Finance). The Ministry of Foreign Economic and Trade Cooperation and Financial Ministry issued *Management on Discount Funds in Technology Reform and Update Project Loan* in 2000, which stipulates that discount funds will be provided for technology update loans and reform projects. Thus, the State provides appropriate assistance for the interest of middle or short-term loans (excluding the loan on current funds) of enterprises on technology reform and update projects.

To boost domestic demand and support the modernization of industrial structure and trade, the Chinese government began to issue more national bonds in the second half of 1999 with the aim to support enterprise technology reform. From 1999 to 2001, the State allocated a total of 26.54 billion yuan in national bonds for technology reform; another 9 billion yuan will be invested in technology reform in 2002.

In the six principals on financing technology reform by national bonds determined by SETC in *2002 Technology Reform Emphases in 10 Major Sectors with National Bonds,* the two principles relating to the Energy Conservation Voluntary Agreement are: 1) conserve energy and reduce consumption to protect the environment by adopting new technology and process and 2) give priority to select the advantageous enterprise which is a leader in the sector in terms of domestic market share on key products, has a good reputation in banking, and has overall strength and strong management. The focus of technology reform in the metallurgy industry is to increase the variety of primary steels, improve the quality of products, save energy and save water, reduce

consumption and improve the environment, vigorously popularize highly efficient technology including coke dry quenching. SETC has also simplified the procedures for approval on technology reform projects, retaining the requirements for a feasible study report and expanding the initial design, bank loan commitment, and environmental assessments, while eliminating the requirements for a project proposal, industry comment, and appraisal on equipment purchase. The procedures will be further simplified in the future.

2002 Eight Key Works in Resource Conservation and Comprehensive Utilization established by SETC pointed out that: "More efforts shall be given to promote technology innovation so as to improve the comprehensive utilization level on resource conservation. Qualified projects shall be selected from the demonstration projects on resource conservation and environmental protection recommended by various regions, and then be listed on the program of 'national bonds' technology reform and the 'one outstanding and two high' technology reform project." During the period of the Tenth Five Year Plan, SETC will select 100 landmark projects with tremendous breakthroughs in technology in 10 sectors related to water saving, energy conservation, and resource comprehensive utilization and environmental protection, and will organize and implement significant demonstration projects on energy conservation and environmental protection.

Local Government Subsidies

Subsidies provided by the local government play an important role in boosting technology research and development and technology updates, which also includes the development of energy conservation technology. Primarily, it shows that the local government supports energy conservation promotion and demonstration as well as to support research institutions. Secondly, the popularization of energy conservation is supported by the local government in a variety of ways. Shangdong provincial government has now allocated special funds on research and development in high and new technology every year.

7.2.3.3 Analysis of Available Supporting Subsidy Policies for the Energy Conservation Voluntary Agreement on Pilot Project

Many areas covered by Voluntary Agreements (e.g. improvement of energy efficiency, resource comprehensive utilization, energy conservation, reduction of environmental pollution) are covered in the work of national science and technology and resource comprehensive utilization. As a result, it is proposed that regarding financial supporting policies for the Energy Conservation Voluntary Agreement, that the pilot enterprises are given primary consideration in applying for preferential treatment on the national bonds discount projects, resource conservation projects, and *one outstanding and two high* comprehensive utilization projects. Additionally, it is proposed that the pilot enterprises be allowed to apply for an income tax exemption on the energy conservation resulting from energy conservation projects undertaken as part of this Energy Conservation Voluntary Agreement Pilot Project and that the pilot enterprises can use the exempted income tax to accumulate special funds for further energy conservation projects.

7.3 Industrial Policy

7.3.1 Adjustment of Energy Structure

Between 2000 and 2005, a significant change will take place in the energy structure in China; the proportion of coal use in primary energy consumption will drop, while cleaner forms of energy such as natural gas, hydropower, and electricity will be increased. As for energy system reform in the period of the Tenth Five Year Plan, an open and competitive market will be established after completion of restructuring of the electric power sector; coal, oil and natural gas enterprises will also complete the transition to modern business systems characterized by "operating independently and solely responsible for profits and losses."

To promote the adjustment of industrial structure, Shangdong Province recently brought forward the goal of concentrating on making successful three major high and new technology fields and six major traditional sectors in last three years of the Tenth Five Year Plan. The developing direction and key points of the six major traditional sectors includes that the metallurgy industry will focus on developing steel and steel products, as well as aluminum processing.

7.3.2 Energy Conservation Goals in The Tenth Five Year Plan of the Steel Industry

In the *Tenth Five Year Plan on Energy Conservation and Resource Comprehensive Utilization* and the *Tenth Five Year Plan Program of Metallurgy Industry* established by SETC, the goals relating to the steel industry are:

- Energy consumption: Comprehensive energy consumption was 0.92 tons of standard coal per ton steel in large and medium steel enterprise in 2000. This consumption will be decreased to below 0.8 tons of standard coal per ton in 2005.
- Environmental protection: The discharge of primary pollutants from steel enterprises basically met the standard in 2000 and the goal of controlling total pollutants was fulfilled. The total discharge of primary pollutants will be reduced by another 10% in 2005 compare with that in 2000.
- Water saving: Thirty cubic meters of water is consumed for production of each ton of steel; this will be decreased to below 16 cubic meters in 2005.
- Emissions: The discharge of major pollutants including smoke (powder) dust and sulfur dioxide will be decreased by 10%.

7.3.3 Adjustment in the Structure of Technology and Equipment of the Metallurgy Industry

For adjustment in the structure of technology and equipment of the metallurgy industry, the *Tenth Five Year Plan Program of Metallurgy* requires the following:

- Popularize advanced and mature technology with an emphasis on common key technologies such as pellet and pellet sintering, coke dry quenching, top pressure recovery turbines (TRT), etc., for optimizing the production process flow in enterprises and reducing production costs. If conditions allow, the enterprise shall have large-scale, continual and automatic process and equipment.
- Actively promote "clean production". To fulfill sustainable development goals, the metallurgy industry must be reformed to be a less polluting industry. With the view of

realizing this goal, the concept of actively promoting "clean production" and channeling investments to energy conservation, environmental protection and comprehensive utilization must be promoted. In the implementation, the focus shall be on improved energy conservation, environmental protection, and resource development.

7.3.4 Existing Industry Preferential Policy

In various measures, the Chinese government supports the development of innovation that complies with policy guidelines established by the State. SETC decided to vigorously develop technology innovation and implement the technology innovation project, to establish the laws, regulations, policies, and measures for facilitating technology innovation, especially to establish an incentive policy to support and encourage technology innovation by combining with the reform in enterprises, banking, tax and finance, and science and technology systems.

For example, China provides subsidies for renewable resource energy technologies, MOST and SPDC provide funds for addressing key problems in science and technology regarding renewable energy technology. MOST invested 60 million yuan in the development of renewable energy during period of the Ninth Five Year Plan. In addition, SETC provides an annual discount loan of 120 million yuan for supporting development of renewable energy.

MOST provides three funds for science and technology: funds for trial production expenses on new products, testing expenses and subsidies for significant science and technology projects. The three funds constitute an important part of appropriate funds by state finance, and serve as an important source of funds for implementing key science and technology plan programs. Moreover, MOST also provides *Special Funds on High Technology Research* (8.63 funds covers the energy field).

The *Law on Promoting Clean Energy Production* to be implemented on January 1, 2003 stipulates that any project which engages in research, demonstration and training on clean energy production and implements key clean production technology reform under the technology reform project set forth in the voluntary agreement on reducing pollutant discharge according to the stipulation in Article 29 of the law, shall be listed in the scope of special funds support on technology innovation provided by the same level finance of State Council and local government above the county level.

In order to establish a Research & Development (R&D) investment system on high and new technology guided by governmental investment, the Shandong finance department provided special funds to implement the R&D Program on Shandong High & New Technology, and support research and development on key technologies and primary products for the purpose of increasing the sustainability of high and new technology industry.

7.3.5 Analysis of Available Supporting Industrial Policies for the Energy Conservation Voluntary Agreement on Pilot Project

For the Energy Conservation Voluntary Agreement Pilot Project with the purpose of improving energy efficiency, conserving energy, reducing discharges for environmental protection, and

realize clean production, it is suggested that the governments, according to relevant policy, allocate and pay some technology innovation fund to be used as the start-up funds to address key problems of science and technology in the pilot enterprises, and give strong backing for supporting the pilot work of the Energy Conservation Voluntary Agreement. It is proposed that the enterprises be allowed to apply to the SETC and MOST for listing in the project of science & technology innovation or science & technology three funds, in order to seek funds for science & technology research, development, and implementation.

7.4 Information Dissemination Policy

7.4.1 Communication of Chinese Energy Conservation Information

Although the existing energy conservation service centers throughout China under the government at various levels play a certain role in communicating energy conservation information, there are weaknesses in the information quality, the information carriers, and the communication channels, such as:

- A great deal of energy conservation technology that is technically and economically feasible has been not popularized and applied widely as a result of failure to implement appropriate and comprehensive review, summarization and communication on many aspects including technology, economics and finance, with regard to proven and feasible energy conservation technology and measures.
- Most of energy conservation information is focused on the technical aspects of energy conservation measure in the absence of analyzing costs and results thereof; such information scarcely arouses the interest of enterprise managers and decision-makers.
- Due to the absence of resources and contacts for energy conservation technology and measures in the present information, interested enterprises find no way to get reliable energy technology or to select and use the energy conservation services.
- Being less authoritative, the present energy conservation communication institution is greatly limited.
- Most present information on energy conservation is published in the technical bulletin in the form of technical reports or product introduction, rather than delivered effectively to the technical, financial, and managing personnel and decision-makers, making it difficult to gain the recognition of users.

Amid tough competition, enterprises need a variety of information on policy and technology to effectively implement energy conservation. While the enterprises are actively seeking various forms of information, the Economic and Trade Commission and intermediary institutions at all levels must provide such information on energy conservation by strengthening service awareness and perfecting service function, especially using advanced communication technology such as computer information network.

7.4.2 Analysis of Available Supporting Information Dissemination Policies for the Energy Conservation Voluntary Agreement on Pilot Project

To overcome the limitations and inadequacies in the collection, development, and communication mechanisms related to Chinese energy conservation information, increased efforts to facilitate the development and communication of new forms of energy conservation information that can satisfy the needs of enterprises related to energy conservation are needed. It is important to gradually perfect the communication system of energy information in line with a socialistic market economy, guiding enterprises to increase investments in energy conservation projects and adopt energy conservation measures in order to effectively promote energy conservation.

With the ultimate goal of stimulating enterprises to develop energy management and implement energy conservation projects, China should make the following efforts in developing efficient communications related to energy:

- Establish a new market-oriented information system on energy conservation, give full play to the delivered function of existing energy conservation management system, mobilize the enthusiasm of local or sector energy conservation service centers and increase the capacity for collecting, assessing, and communicating information of China.
- Strengthen and improve the existing information network on energy conservation in China, and make it the most authoritative information network on energy conservation all over the country, utilizing the longitudinal influence from the sector association and the driving force from local energy conservation center.
- Develop practical energy conservation information for the enterprises. The development of new information on energy conservation shall take into account different needs of the decision-makers in finance, management, and technology of the enterprises, and put emphasis on the analysis on economic return available for enterprises from energy conservation projects, for the purpose of making decision-makers aware of energy conservation and its vital role in strengthening competitive capacity and vitality.
- Communicate information on energy conservation efficiently. The new information shall target the decision-makers in finance and management. Furthermore, the existing and comparatively authoritative information channel shall be adapted to new channels according to the needs of communication.

Therefore, it is proposed that pilot enterprises be given primary consideration in international cooperation projects.

7.5 Proposed Supporting Policies for the Energy Conservation Voluntary Agreement Pilot Project

After above analysis, it is proposed that the following five practical supporting policies for the Energy Conservation Voluntary Agreement Pilot Project:

1. The title of "Voluntary Agreement Pilot Enterprise" will be conferred on the enterprises that participate in the Energy Conservation Voluntary Agreement Pilot Project.

2. Primary consideration will be given to the pilot enterprises applying for preferential treatment on the national bonds discount projects, resource conservation projects, and *one outstanding and two high* comprehensive utilization projects.

3. The pilot enterprises will be allowed to apply for an income tax exemption on the energy conservation resulting from energy conservation projects undertaken as part of this Energy Conservation Voluntary Agreement Pilot Project and that the pilot enterprises can use the exempted income tax to accumulate special funds for further energy conservation projects.

4. The pilot enterprises can apply to SETC and the Ministry of Science & Technology for listing in the project of science & technology innovation or science & technology three funds, in order to seek funds for science & technology research, development, and implementation.

5. The pilot enterprises will be given primary consideration in international cooperation projects.

As for the five supporting policies, a policy feasibility study was conducted to measure the expectations of the pilot enterprises regarding the supporting policies for the Energy Conservation Voluntary Agreement and possible support scale provided by the government. The policies agreed upon by the parties are surely the most powerful support policy to pilot work on the Voluntary Agreement.

7.6 Assessment of Desirability of Supporting Policies to Enterprises and Government

The desirability of the five supporting policies is different for the two pilot enterprises. The assessment of the level of desirability is based on the assumption that the package of five supporting policies is 100% desirable and each supporting policy contributes a share to this full amount. Due to differing conditions, each enterprise and the government rate the importance of the supporting policies differently.

Figures 1 and 2 show that both Laiwu Steel Corporation and Jinan Steel Corporation view the national bonds discount (35%), the developing funds for science & technology (30%), and the income tax policy (25%) as the most desirable supporting policies. Public recognition (5%) and international cooperation (5%) are not valued as highly. Figure 3 shows that the government views the public recognition (40%), national bonds discount (30%), and international cooperation (20%) as the most desirable supporting policies. The developing fund for science & technology (5%) and the income tax policy (5%) are not valued as highly by the government.

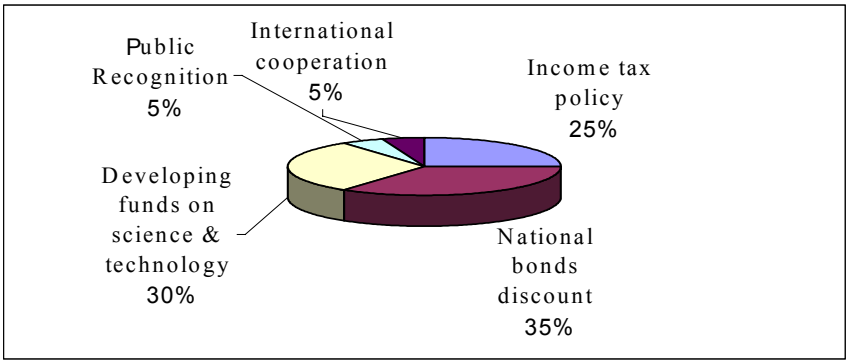

Figure 7-1. Desirability of Supporting Policies for Laiwu Steel Corporation

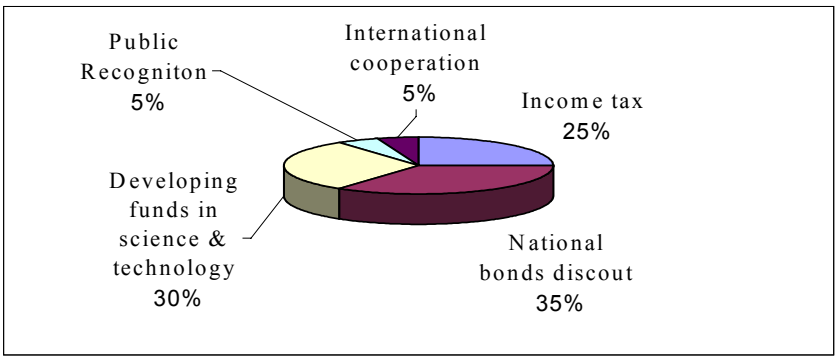

Figure 7-2. Desirability of Supporting Policies for Jinan Steel Corporation

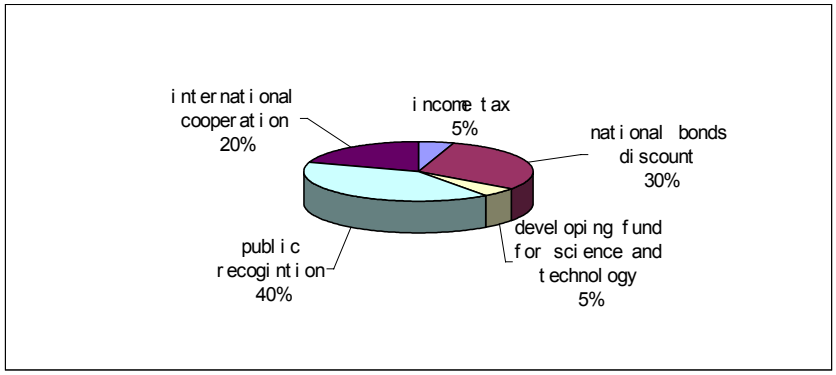

Figure 7-3. Desirability of Supporting Policies for the Governments

8. Energy Conservation Voluntary Agreement Contracts

Over 300 environmental Voluntary Agreements have been negotiated between national governments and industry in Europe,[128] and countless other such agreements have been established in Japan, Canada, the U.S. and other countries. Thus, there are many variations in the types of contracts that are used within these Voluntary Agreements.

8.1 Essential Elements of Voluntary Agreement Contracts

Although there are many variations in Voluntary Agreement contracts, the essential elements of the more successful agreements are: 1) definition of the parties to the agreement, 2) outline of the roles and obligations of the parties, 3) description of the energy-efficiency improvement target, 4) description of how the target will be met (e.g. an Energy Conservation Plan), 5) description of the evaluation and supervision requirements, and 6) agreed upon terms for modification and termination of the agreement.

8.2 Examples of Voluntary Agreement Contracts from Other Countries

8.2.1 The Netherlands

The "Long-Term Agreement Between the Association of Dutch Iron and Steel Producing Industries (NIJSI) and the Dutch Ministry of Economic Affairs concerning the Improvement of Energy Efficiency" is provided at the end of this report as Appendix B.

8.2.2 The UK

The "Umbrella Climate Change Agreement for the Steel Sector" is provided at the end of this report as Appendix C.

8.3 Example Contract for Voluntary Agreement Pilot Project in Shandong Province[*]

The example Energy Conservation Voluntary Agreement provided below has been reviewed by all parties to the agreement as well as by legal counsel. The example contract contains all of the essential elements for a Voluntary Agreement.

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[128] Paton, B., 2002. "Voluntary Environmental Initiatives and Sustainable Industry," in ten Brink, P., ed., 2002. *Voluntary Environmental Agreements: Process, Practice and Future Use*. Sheffield, UK: Greenleaf Publishing Ltd.

[*] For reference only; the actual contract will be discussed and developed by Party A and Party B based on the reference.

Voluntary Agreement on Energy Conservation

Chapter 1 Preface

Paragraph 1 General Provisions

Article 1. The project is designed to establish the supporting law and regulations and relevant criterion of the *Energy Conservation Law.* The Energy Conservation Voluntary Agreement is enacted in order to successfully combine the macro-control policy from government with voluntary energy conservation actions from enterprise so as to improve energy efficiency.

Chapter 2 Substantive Terms and Conditions

Paragraph 2: Definition

Article 2: Voluntary Agreement on Energy Conservation is an agreement that is entered voluntarily by and between a trade organization or individual enterprise and the government in order to improve energy efficiency.

Article 3: "Pilot project" means "The pilot project of developing the Energy Conservation target for Chinese industry (Voluntary Agreement)".

Article 4: "Pilot enterprise" means the industry corporate (legal) units that join voluntarily in the Energy Conservation Voluntary Agreement pilot project

Article 5: "Government" or "central government" means "State Economic & Trade Commission", a state competent authority responsible for energy conservation. "Local government" means the provincial competent authority responsible for Energy Conservation. In the pilot project the "local government" means Shandong Economic & Trade Commission.

Article 6: "Independent third party" or "third party" means the corporative organization or research institution that is independent of government and enterprise. In the pilot project "the third party" refers to China Energy Conservation Association.

Paragraph 3: Parties to the Voluntary Agreement

Article 7: The Voluntary Agreement is entered by the following three parties.

Party A: Shangdong Economic & Trade Committee
Address: No.1, Fuqian Street, Jinan City
Party B: Jinan Steel Group General Company (or Laiwu Steel Group Co., Ltd.)
Address:
Party C: China Energy Conservation Association
Address: No.18, Bei San Huan Dong Lu , Beijing

Paragraph 4: Purpose and Targets of the Voluntary Agreement

Article 8: The Voluntary Agreement is designed to define the rights and obligations of all parties, supervise and urge the parties to comply with their acts, to endeavor to fulfill the commitment respectively and ensure the successful implementation of the project.

Article 9: The Voluntary Agreement established the following Energy Conservation targets:

Party B shall achieve the interim target in December 2005, and the final goal in December 2010 under the support of Party A and Party C.

Interim target: In comparison with the goal in the reference year, the Energy Efficiency Index shall be reduced by _____%, and/or the Energy Conservation Rate shall be increased by _____%.

Final target: In comparison with the reference year, the Energy Efficiency Index shall be reduced by _____%, and/or the Energy Conservation Rate shall be increased by _____%.

Paragraph 5: Commitment to Perform Obligations

The parties to the agreement accept and guarantee to perform the obligations specified by the agreement, and hereby sign the clause for confirmation.

Paragraph 6: Benefits and Obligations for Party A

Article 10: The Voluntary Agreement will be helpful to bring Party A the following benefits:

I. Fulfill the transformation of governmental function and achieve the same goal on Energy Conservation without direct control.

II. Explore a new administrative mechanism on energy –saving that is suit for a market economy and to underlie the future decision-making for the government.

III. Reduce the high costs to establish and fulfill more prescriptive laws and regulations so as to save government expenditure.

Article 11. Obligations of Party A

I. Under the support of the State Economic & Trade Commission, Party A shall establish and fulfill the national and regional preferable policies for assisting Party B in implementing energy-saving measures during the Pilot Project.

II. Examine and approve the Energy Conservation Plan submitted by Party B.

III. Evaluate the interim and final reports that are submitted by Party B in 2005 and 2010 respectively and decide one the future direction of pilot project.

IV. After Party B fulfills the target established by the agreement, Party A shall make conclusions and recommendations for the pilot program as well as award Party B the honorable title while also introducing and promoting the experience of Party B in the pilot in some media.

V. Summarize and popularize the experience of Voluntary Agreement on Energy Conservation.

Paragraph 7: Obligations of Party B

Article 12: The voluntary agreement will be helpful to bring Party B the following benefits:

I. Possibility to avoid the future more mandatory law and regulations established by the government for improving energy efficiency.

II. Save energy, protect environment, cut production cost and maximize profit.

III. Establish the sound image of the enterprise and expand the market share so as to increase the value of intangible assets.

Article 13: Obligations of Party B

I. In order to fulfill the goal of Energy Conservation on time, Party B shall establish a concrete Energy Conservation Plan, and implement and organize it carefully.

II. In performing period of the agreement, Party B shall submit an annual Supervision Report to Party A and Party C in writing every year. The report shall include the Survey of Energy Consumption by Process, total production energy intensity by process step, the annual Energy Efficiency Index (EEI), the annual Energy Conservation Rate (ECR), information on energy-efficiency activities undertaken during the year (including energy management measures and their effects, energy efficiency projects and their effects, other projects that have led to energy efficiency improvements), research and development activities, and any changes in the plan for activities still to be performed as part of the energy efficiency plan.

III. At the end of 2005, the interim target year for the pilot project and at the end of 2010, the final target year for the pilot project, Party B shall submit an interim report and final appraisal report in writing to Party A and Party C respectively, including the information included in the annual Supervision Report as well as the lessons learned and suggestions to improve the Energy Conservation Voluntary Agreement.

IV. Coordinate the popularization of Voluntary Agreements in Shandong Province and throughout the country.

Paragraph 8: Obligations of Party C

Article 14. The Voluntary Agreement will be helpful to bring Party C the following benefits:

I. In the economic transformation, Party C will target its appropriate location and fully realize its communication function as a bridge.

II. Fulfill and strengthen professional technology and information.

III. Accumulate experience in policy mechanism study.

IV. Facilitate international exchange and communication.

Article 15. Obligations of Party C

I. In the pilot project, Party C shall coordinate the relationship between Party A and Party B, and that between them and relevant departments.

II. Be responsible for evaluation in the implementation of the pilot, including the evaluation of the Energy Conservation Plan, annual Supervision Reports, the interim report, and the final report submitted by Party B. Inform Party A and Party B of the appraisal result in writing report. The appraisal report shall cover evaluated comments on the authenticity of data, on Energy Conservation Plan and projects of Party B, on the completed situation of target and on the correction of any project deviation.

III. Provide Party B with the technology and information service, including analysis on technology and projects which is helpful for Party B to fulfill the target, provide relevant data on advanced technology and information at home and abroad and the solutions to obstacle encountered in completing energy-saving projects.

IV. Popularization of the concept and experience on Energy Conservation Voluntary Agreement.

Paragraph 9: Confidentiality

Article 16: Both Party A and Party C guarantee that they will keep the detailed information and data provided by Party B confidential for 20 years after the validated period of the agreement. This does not cover the EEI or ECR data. Notwithstanding the foregoing, the undertakings of the agreement shall survive this expiration date as long as the information and data concerned have value to Party B in the reasonable opinion of Party B.

1.3.1 Chapter 3 Supplementary Articles

Paragraph 10: Default clause

Article 17: If Party B fails to carry out the obligations stipulated in Paragraph 6, Party B shall no longer be offered the preferential policies of the Voluntary Agreement pilot established by the State and local government. In addition, Party B shall return all gained preferential benefits in the course of implementing the pilot.

Article 18: If Party A fails to carry out the obligations stipulated in Paragraph 7, Party B shall be entitled to terminated implementation of the project.

Article 19: If Party C fails to carry out obligations stipulated in Paragraph 8, Party A and Party B shall be entitled to terminate implementation of the project.

Paragraph 11: Effective date

Article 20: The agreement shall come into force from the date it is signed and be invalid on December 31, 2010. No party shall modify or cancel the agreement randomly during implementation. Any pending matters in the agreement shall be discussed jointly by the three parties and an additional agreement shall be entered and being equally valid.

Article 21: The agreement has been executed in six copies of which the parties shall hold two each. Any copy shall be equally valid.

Paragraph 12: Signature of parties to the agreement

Party A (seal)	Party B (seal)	Party C (seal)
Authorized representative	Authorized representative	Authorized representative
Signature	Signature	Signature
Date	Date	Date

9. Guidelines for Development of an Energy Conservation Plan

Following the assessment of enterprise energy-efficiency potential (as outlined in Section 5 of this report), the establishment of interim and final energy-efficiency targets for 2005 and 2010, respectively (as outlined in Section 6 of this report), the establishment of supporting policies (as outlined in Section 7 of this report), and the signing of the Energy Conservation Voluntary Agreement (as outlined in Section 8 of this report), the enterprises will develop a detailed Energy Conservation Plan that outlines how they plan to achieve the agree-upon energy-efficiency targets for 2005 and 2010. CECA and the Technical Team can provide technical support to the enterprises during the development of the Energy Conservation Plan. This section provides guidelines for development of the Energy Conservation Plan.[129]

9.1. Purpose of the Energy Conservation Plan

The Energy Conservation Plan outlines the enterprise's plan for improving energy-efficiency during the period covered by the Voluntary Agreement, including the measures they will implement to achieve the agree-upon energy-efficiency targets for 2005 and 2010. The Energy Conservation Plan is primarily the guidance for the internal implementation of the Voluntary Agreement activities. It also serves as a reference to evaluate progress in the annual Supervision Report (see Section 10 of this report).

9.2 Contents of the Energy Conservation Plan

The Energy Conservation Plan outlines the enterprise's plan for improving energy-efficiency during the period covered by the Voluntary Agreement. The Plan will include the following:

- description of the enterprise with respect to energy
- description of the energy-efficiency measures considered
- description of the planned energy-efficiency measures
- timeframe for implementation of the energy-efficiency measures
- expected results in terms of energy efficiency

Once the Energy Conservation Plan is drafted, the independent 3rd party (CECA and the Technical Team) reviews and approves the plan or makes suggestions for adjustments. If conditions change at the plant or if planned energy-efficiency projects change, the Energy Conservation Plan should be revised and submitted to the independent 3rd party for review.

[129] The following section draws from the Dutch Long-Term Agreement Energy Conservation Plan Guide.

9.2.1 Introduction

The Energy Conservation Plan introduction includes general information regarding energy consumption at the enterprise, outlines the enterprise target for energy-efficiency improvement, and discusses the general plan for achieving the target.

9.2.2 Current Situation

This section of the Energy Conservation Plan provides insight in the current situation at the enterprise. It will describe:

- the current energy consumption at the enterprise
- the amount of primary products produced
- the process steps
- the energy flows
- the production and energy consumption values to be used in the calculation of the EEI for the year of reference
- description of the implementation of energy management in the enterprise, addressing the assigned responsibilities
- the management of energy-related matters (e.g. procurement of energy and equipment, investments, maintenance, project progress, etc.)
- the methodology and procedures for measuring, supervision, evaluation and reporting related to energy consumption

9.2.3 Energy Conservation Opportunities

This section of the Energy Conservation Plan provides a brief description of the method used to identify energy-efficiency opportunities and outlines the energy conservation measures that were considered by the enterprise. These can include measures related to

- energy management
- manufacturing processes
- utilities (steam, compressed air, etc.)
- buildings
- cogeneration

9.2.4 Planned Energy Conservation Measures

This section of the Energy Conservation Plan provides a description of the energy-efficiency measures that will be implemented in order to reach the interim (2005) and final (2010) targets. The Energy Conservation measures should be divided into:

- energy management
- process
- utilities
- buildings
- strategic projects (new facilities, major revisions)

For each planned energy-efficiency measure, the Plan will include the planned date of start of construction or implementation, the planned date of start of operation, the costs and simple payback period, the expected energy savings, and contribution to the EEI. The Plan should also include an overview of the investments for energy-efficiency measures and the budgets assigned. The Plan should make a distinction between unconditional measures, which are those that will definitely be implemented, and conditional measures, which are those that will be implemented given certain conditions, such as a need to increase production. Table 9-1 provides a template for this part of the Energy Conservation Plan.

Table 9-1. Template for Listing Energy-Efficiency Measures in the Enterprise Energy Conservation Plan

Measure	Date of start of construction	Date of start of operation	Costs and simple payback period	Expected energy savings	Contribution to EEI
Energy Management:					
Process measures:					
Utilities and buildings:					
Strategic projects:					
TOTAL					

9.2.5 Supervision and Reporting

The Energy Conservation Plan also includes a description of the supervision and reporting procedures within the enterprise (see Section 10 of this report for recommendations related to annual supervision and evaluation).

9.3 Evaluation of the Energy Conservation Plan

Once the Energy Conservation Plan is developed, CECA and the Technical Team will evaluate the plan to ensure that it outlines the required energy-efficiency improvements to reach the 2005 and 2010 targets. The evaluation will also address whether:

- the energy-efficiency targets are ambitious and clearly stated

- the enterprise adequately identified and evaluated all of the potential energy-efficiency measures
- the planned energy-efficiency measures are ambitious, include state-of-the-art technologies, and will lead to realization of the target

The evaluation will also determine that the Energy Conservation Plan is realistic with respect to timeframe and investment levels.

If CECA and the Technical Team conclude that the Energy Conservation Plan is not adequate to meet the targets, then a "no" will be given and the enterprise will be requested to revise the Plan. If CECA and the Technical Team conclude that the Energy Conservation Plan is adequate to meet the targets, then a "yes" will be given and the project can proceed.

The Energy Conservation Plan should be updated regularly and at least once every two years. Changes in the Energy Conservation Plan can be reported in the annual Supervision Report (see Section 10 of this report).

10. Methodology for Supervision and Evaluation

10.1 International Experience in Supervision and Evaluation

Supervision (also called monitoring) and evaluation guidelines for energy efficiency and greenhouse gas mitigation projects have been developed by numerous entities in order to understand the progress and results of specific projects. These include monitoring and evaluation components in the World Business Council for Sustainable Development and World Resources Institute's Greenhouse Gas Protocol Initiative,[130] the Global Reporting Initiative's Energy Consumption Protocol,[131] the U.S. Initiative on Joint Implementation, the World Bank's guidelines for the Global Environment Facility, the International Performance Measurement and Verification Protocol, the U.S. Environmental Protection Agency's Conservation Verification Protocols, and the Dutch Long-Term Agreements.[132]

The monitoring and evaluation requirements of the Dutch Long-Term Agreements involved reporting on the energy-efficiency improvement achieved annually. The report included data on total energy use, the realized Energy Efficiency Index and a list of the projects carried out to reach the Energy Efficiency Index for that year. The data required for the steel industry included total primary energy consumption for twelve types of steel end products, including four intermediate steel products (e.g. coke, sinter, pellets and pig iron). For each product step the energy consumption was converted into primary energy consumption and the energy intensity of each step was calculated. Corrections were allowed for changes in the mix of products, extra energy use as a result of stricter environmental regulations, and the degree of capacity utilization of existing product installations.[133,134] The annual reports were submitted to an independent third party (NOVEM) to check the reported values for accuracy and to calculate the Energy Efficiency Index on different levels of aggregation. The annual reports were then approved by a group composed of representatives of the steel industry, the government, and NOVEM.[135]

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[130] World Business Council for Sustainable Development and World Resources Institute, 2002. *Greenhouse Gas Protocol Initiative*. http://www.ghgprotocol.org/

[131] Global Reporting Initiative, 2002. *Energy Consumption Protocol* http://www.globalreporting.org/GRIGuidelines/Protocols/EnergyProtocol.pdf

[132] Vine, E. and Sathaye, J., 1997. *The Monitoring, Evaluation, Reporting and Verification of Climate Change Mitigation Projects: Discussion of Issues and Methodologies and Review of Existing Protocols and Guidelines*. LBNL-40316. Berkeley, CA: Lawrence Berkeley National Laboratory.

[133] Hoogovens Technical Services, June 1992. *Energy Monitoring Hoogovens Ijmuiden: Calculation of the Energy Efficiency Index.*

[134] *Long-Term Agreement between the Association of Dutch Iron and Steel Producing Industries (NIJSI) and the Dutch Ministry of Economic Affairs concerning the Improvement of Energy Efficiency*, May 25, 1992.

[135] Nuijen, W., 2002. "Energy Efficiency Monitoring in Dutch Industry," Presentation at the *Workshop on Voluntary Agreements for China's Industrial Sector: Integrating International Experiences into Designing a Pilot Program*, February 25-27, 2002.

10.2 Methodology for Supervision and Evaluation for the Energy Conservation Voluntary Agreement Pilot Project

CECA will convene a Leadership Team, an Implementation Management Team, and a Technical Team to oversee implementation of the Energy Conservation Voluntary Agreement Pilot Project. In order to provide all participants in the Voluntary Agreements information regarding implementation of the enterprise Energy Conservation Plan and the results achieved, each enterprise will report standard information annually to CECA, the Management Team, Implementation Team, and the Technical Team for purposes of supervision and evaluation.

10.2.1 Leadership Team

The Leadership Team will be comprised of the Head of the Resources Department of SETC, the General Secretary of CECA, the Director of Shandong ETC, and the General Managers of the pilot enterprises. The Leadership Team provides overall management of the Energy Conservation Voluntary Agreement Pilot Project.

10.2.2 Implementation Management Team

The Implementation Management Team is comprised of the Head of the Energy Conservation Division of the Resources Department of SETC, the General Secretary of CECA, the Head of the Resources Department of Shandong ETC, and the Deputy Managers of the pilot enterprises.

The Implementation Management Team has the following tasks:

- Contract management: Sign and implement the Voluntary Agreement
- Perform annual inspection of progress under Voluntary Agreement and recommend adjustments
- Dissemination and promotion of Voluntary Agreements. Summarize interim results of Voluntary Agreement pilot project, direct next stages of work.
- Organization and coordination: Coordinate the relationships between the three signatories to the Voluntary Agreement. Supervise the execution of the various responsibilities of the parties to the Voluntary Agreement, as outlined below:

  Party A (SETC and Shandong ETC)

  - Establish supporting policies for implementation of the Voluntary Agreements.
  - Ensure that proposed targets in the Voluntary Agreements are in accordance with overall national targets.

  Party B (Enterprises)

  - Propose energy-conservation targets and programs (e.g. strengthened management, adoption of new technology, processes, methods and equipment to undertake energy-efficiency renovations).

- Implement Energy Conservation Plan
- Provide statistical data in the annual Supervision Report (as outlined in section 10.)

Party C (CECA)

- During the process of implementing the Voluntary Agreements, take responsibility for coordination between Party A and Party B.
- Organize the Technical Team, complete all work pertaining to the technical assessments required under the Voluntary Agreements.
- Take responsibility for outreach work to promote understanding of the VA concept and to spread awareness of the pilot project

10.3.3 Technical Team

The Technical Team is comprised of energy technology and management staff of the pilot enterprises, experts from the Lawrence Berkeley National Laboratory (U.S), Ecofys (The Netherlands) and NOVEM (The Netherlands), experts from the National Energy Conservation Supervision Management Center, experts from Shandong Energy Conservation Supervision Center, domestic energy and environment experts, a domestic economist, and a domestic legal expert.

The responsibilities of the Technical Team include:

- Evaluate the results of the enterprise assessment of energy efficiency improvement potential to determine if the assessment has been done correctly and adequately
- Evaluate the proposed energy-efficiency targets to determine if they are realistic, yet ambitious, and beyond business-as-usual
- Report to SETC on the evaluations
- Evaluate the enterprise Energy Conservation Plans
- Evaluate the annual Supervision Reports (described below)
- Conduct interim (2005) and final (2010) evaluations (described below)

10.2.4 Annual Supervision Reports

An annual Supervision Report will be prepared by the enterprise that describes the energy-efficiency achievements at the enterprise during the previous year in both quantitative and qualitative terms.

10.2.4.1 Energy Conservation Data Required

Supervision and evaluation will be based on enterprise self-reporting of specific data and information in an annual Supervision Report. The data required are:

- annual Survey of Energy Consumption by Process for the enterprise
- annual total production by process

- annual total energy consumption by process
- annual Energy Efficiency Index (EEI)
- annual Energy Conservation Rate (ECR)

The methods for calculating the EEI and the ECR are described in Section 6 of this report. A simple spreadsheet tool has been developed that will calculate the annual EEI and ECR after the enterprises enter the data in the S*urvey of Energy Consumption by Process*. The annual EEI is then tracked against the target EEI, and the ECR is calculated to evaluate progress toward the energy-efficiency targets. A spreadsheet tool has been developed for the purpose of self-reporting for the annual Supervision Report (see Appendix D).

10.2.4.2 Energy Conservation Information Required

In addition to the data described above, enterprises will also submit information on energy-efficiency activities undertaken during the year, including:

- Energy management measures and their effects

Energy management is executing organizational, technical and behavior measurements in a structured and economical way to minimize the use of energy and raw materials. Energy management is part of the organization structure of an enterprise and can easily being integrated in a quality system such as ISO 9000 and 14000. The approach of energy management depends on the character of the enterprise. The Supervision Report must include a description of how energy management is integrated in the enterprise.

- Energy-efficiency improvement projects and their effects

A list of energy efficiency improvement projects is part of the Energy Conservation Plan. Each project is described and the projected energy savings, costs, and year of implementation are provided. During the supervision year some of these projects are executed and the effect on the energy efficiency of the process will be known. Sometimes projects are cancelled and other projects are defined. Reporting of these facts should be done in the Supervision Report.

- Other projects that have led to energy-efficiency improvements

A company starts often projects which improve energy efficiency but which are implemented for reasons other than energy savings. Replacement investments are a good example. These projects must be described in the Energy Conservation Plan and the Supervision Report.

- Research and development activities

Activities in the area of research and development are a good indicator of the potential of future energy efficiency improvement projects. A description of on-going research and development activities should be included in the Supervision Report.

- Changes in the schedule for activities still to be performed as part of the Energy Conservation Plan.

10.2.5 Evaluation and Follow-Up Actions

In the first quarter of the year subsequent to the reporting year, the enterprise will submit the Supervision Report. The Supervision Report will be evaluated by CECA and the Technical Team to assess the progress the enterprise is making toward the energy-efficiency target. This review will either result in approval ("yes") of the progress that has been made and recommendation to proceed or a finding ("no") that progress was not sufficient and the recommendation that the Energy Conservation Plan be adjusted and then implemented for the following year.

10.2.6 Interim and Final Evaluations

Interim and final evaluations of the results of the implementation of the Energy Conservation Plan will be performed in 2005 and 2010, respectively, by all parties. The evaluations will determine if the target has been met.

References

Agreement on Climate Protection between the Government of the Federal Republic of Germany and German Business, September 11, 2000.

Australian *Government* Office, 2002. *Greenhouse Challenge*. http://www.greenhouse.gov.au/challenge/html/about/about.html

Bertoldi, P., 1999. "The Use of Long-Term Agreements to Improve Energy Efficiency in the Industrial Sector: Overview of the European Experiences and Proposal for a Common Framework," *Proceedings of the 1999 American Council for an Energy-Efficient Economy Summer Study on Energy Efficiency in Industry*. Washington, DC: ACEEE.

Bjorner, T.B. and Togeby, M., 1999. "Industrial Companies' Demand for Energy Based on a Micro Panel Database – Effects of CO2 Taxation and Agreements in Energy Savings," in *Energy Efficiency and CO2 Reduction: The Dimensions of Social Change: 1999 European Council for an Energy-Efficient Economy Summer Study*, May 31-June 4, Mandelieu, France.

Blok, K., 2000. "Experiences with Long Term Agreements on Energy-efficiency Improvements in the European Union," Presentation at the *Workshop on Learning from International Best Practice Energy Policies in the Industrial Sector*, May 22-23, 2000, Beijing.

Blok, K., 2002. "Establishing Targets for Energy Consumption in Energy-intensive Industries: Examples," Presentation at the *Workshop on Voluntary Agreements for China's Industrial Sector: Integrating International Experiences into Designing a Pilot Program*, February 25-27, 2002, Beijing.

Canadian Industry Program for Energy Conservation, 2000. *1999/2000 Annual Report*. Ottawa: Natural Resources Canada, Office of Energy Efficiency.

Chen, H. 2000a. "Targets and Policies for Energy Conservation in the 10th Five-Year Plan (2001-2005). Presentation at the China Sustainable Energy Program, Policy Advisory Council *Workshop on Energy Efficiency Status and Improvement Scenarios for China*, November 16, 2000, Beijing.

Chidiak, M., 1999. "Voluntary Agreements for Energy Efficiency in Five EU Countries," in *Energy Efficiency and CO2 Reduction: The Dimensions of Social Change: 1999 European Council for an Energy-Efficient Economy Summer Study*, May 31-June 4, Mandelieu, France.

Chidiak, M. 2000. *Voluntary Agreements – Implementation and Efficiency. The French Country Study: Case Studies in the Sectors of Packaging, Glass, and Aluminum*. Paris: CERNA.

China Daily. 2000. "China to Close Down 50 Small Steelworks." 29 June. http://www.chinadaily.com.cn.

China Daily. 2000. "Polluting Firms to be Closed Down." 9 May. http://www.chinadaily.com.cn.

China Environmental Review, 2000. *Legislation on Redundant Technology in China*, Summer 2000.

Cooper, D., Duncan, R., Precious, B., Williamson, A., and Workum, N., 1998. "Creating Demand for Energy Efficiency in Australian Industry," *Proceedings of the 1999 American Council for an Energy-Efficient Economy Summer Study on Energy Efficiency in Industry*. Washington, DC: ACEEE.

Delmas, M. and Terlaak, A., 2000. "Voluntary Agreements for the Environment: Innovation and Transaction Costs," CAVA Working Paper 00/02/13, February.

Dowd, J., Friedman, K, and Boyd, G., 2001. "How Well Do Voluntary Agreements and Programs Perform At Improving Industrial Energy Efficiency," *Proceedings of the 2001 ACEEE Summer Study on Energy Efficiency in Industry*. Washington, DC: American Council for an Energy-Efficient Economy.

Environment News Service, 1999. "UK Industries Trade Emissions Cuts for Tax Rebate," http://ens.lycos.com/ens/dec99/1999L-12-23-03.html

ETSU - AEA Technology, 2001. *Climate Change Agreements – Sectoral Energy Efficiency Targets*. Version 2. Oxfordshire, UK: ETSU – AEA Technology.

Ezban, R., Tang, E., and Togeby, M., 1994. "The Danish CO_2-Tax Scheme," in International Energy Agency, *Conference Proceedings – Industrial Energy Efficiency: Policies and Programs*, Washington DC, 26-27 May, 1994.

Finden, P., 1998. "Norwegian Industry's Network for Energy Conservation," in Martin et al., (eds.*) Industrial Energy Efficiency Policies: Understanding Success and Failure: Proceedings of a Workshop Organized by the International Network for Energy Demand Analysis in the Industrial Sector.* Utrecht, The Netherlands, June 11-12, 1998. (LBNL-42368).

Glasbergen, P., M.C. Das, P.P.J. Driessen, N. Habermehl, W.J.V. Vermeulen, K. Blok, J. Farla, 1997, en E. Korevaar, *Afspraken werken;* e*valuatie Meerjarenafspraken over energie-efficiency* (Evaluation of Long Term Agreements on Energy-Efficiency), Den Haag, The Netherlands: Ministerie van Economische Zaken, Directoraat-Generaal voor Energie.

Global Reporting Initiative, 2002. *Energy Consumption Protocol* http://www.globalreporting.org/GRIGuidelines/Protocols/EnergyProtocol.pdf

Hansen, K, and Larsen, A., 1999. "Voluntary Agreements in Industry: A Comparative Description of the Process and a Normative Analysis," *Proceedings of the 1999 American Council for an Energy-Efficient Economy Summer Study on Energy Efficiency in Industry*. Washington, DC: ACEEE.

Hofstede, G., 1991. *Cultures and Organizations: Software of the Mind*. London: McGraw-Hill.

Hoogovens Technical Services, June 1992. *Energy Monitoring Hoogovens Ijmuiden: Calculation of the Energy Efficiency Index*.

Huang, J-P. 1993. "Industry Energy Use and Structural Change: A Case Study of the People's Republic of China," *Energy Economics* 15(2): 131-136.

Ingerslev, C., 1999. "Incentives in Energy Policy – A Comparison Between the Danish Policy Mix and a Voluntary Approach to CO2 Abatement," *Proceedings of the 1999 ECEEE Summer Study on Energy Efficiency and CO2 Reduction: The Dimensions of Social Change*.

Institute for Energy Technology, 1998. *Norwegian Industrial Energy Efficiency Network*. Kjeller, *Norway*: Institute for Energy Technology.

International Energy Agency, 1997. *Voluntary Approaches for Mitigating Greenhouse Gas Emissions*. Conference Proceedings, Bonn, Germany 30-31 October 1995. Paris: OECD/IEA.

International Energy Agency, 1997. *Voluntary Actions for Energy-Related CO2 Ab*atement. Paris: OECD/IEA.

International Iron and Steel Institute, 1998. *Energy Use in the Steel Industry*, Brussels: IISI

Jago, P., 1999. "The Canadian Industry Program for Energy Conservation (CIPEC): the Dynamics of a 24-year Partnership Between Government and Industry," *Proceedings of the 1999 American Council for an Energy-Efficient Economy Summer Study on Energy Efficiency in Industry*. Washington, DC: ACEEE.

Japan Federation of Economic Organizations, 1998. *Outline of the 1st Follow-up Under the Keidanren Voluntary Action Plan on the Environment*, http://www.keidanren.or.jp/english/policy/pol097/outline/html.

Jiang Yun, Meng Zhaoli, Du Wenwei, 2002. "Methodology for Assessment of Enterprises Energy Efficiency Potential," *Energy Information Newsletter*, issue No. 388, June 17, 2002 and issue No. 389, July 17, 2002.

Johannsen, K.S. and Larson, A., 2000. *Voluntary Agreements – Implementation and Efficiency. The Danish Country Study: Case Studies in the Sectors of Paper and Milk Condensing*. Copenhagen: AKF Forlaget.

Krarup, S. and Ramesohl, S., 2000. *Voluntary Agreements in Energy Policy – Implementation and Efficiency: Final Report*. Copenhagen: AKF

Kerssemeechers, M., 2002. *The Dutch Long Term Voluntary Agreements on Energy Efficiency Improvement in Industry.* Utrecht, The Netherlands: Ecofys.

Korevaar, E., J. Farla, K. Blok and K. Schulte Fischedick, 1997. "A Preliminary Analysis of the Dutch Voluntary Agreements on Energy Efficiency Improvement" *The Energy Efficiency*

Challenge, Proceedings of the 1997 ECEEE Summer Study, Splinderuv Mlyn, Czech Republic, 9-14 June 1997.

Kraemer, T.P, n.d. *Energy Policy Instruments: Description of Selected Countries*. Denmark: AKF,Institute of Local Government Studies.

Li, G. and Zeng, G. 2000. "Overview of the Energy Efficiency Policies and Regulations in Energy Intensive Sectors of China," *Learning from International Best Practice Energy Policies in the Industrial Sector*, May 22-23, 2000. Beijing: CECA.

Lin, X. 1992. "Declining Energy Intensity in China's Industrial Sector," *The Journal of Energy and Development*, 16(2): 195-218.

Liu, Z.P., Sinton, J.E., Yang, F.Q., Levine, M.D., and Ting, M.K. 1994. *Industrial Sector Energy Conservation Programs in the People's Republic of China during the Seventh Five-Year Plan (1986-1990).* Berkeley, CA: Lawrence Berkeley National Laboratory (LBL-36395).

Long-Term Agreement between the Association of Dutch Iron and Steel Producing Industries (NIJSI) and the Dutch Ministry of Economic Affairs concerning the Improvement of Energy Efficiency, May 25, 1992.

Mazurek, J. and Lehman, B., 1999. "Monitoring and Verification of Long-Term Voluntary Approaches in the Industrial Sector: An Initial Survey," *Proceedings of the 1999 American Council for an Energy-Efficient Economy Summer Study on Energy Efficiency in Industry*. Washington, DC: ACEEE.

McKenzie, R., 1994. "Canada's National Partnership Strategy for Industrial Energy Efficiency," *in* International Energy Agency, *Conference Proceedings - Industrial Energy Efficiency: Policies and Programs*, Washington, DC, 26-27 May, 1994.

Michels, K., 2000.*ICARUS-4: Sector Study for the Iron and Steel Industry. Revision 2*. Utrecht, The Netherlands: Utrecht University, Department of Science, Technology and Society, NWS-E-2000-10

Miles, J., 1994. "*The* UK Energy Efficiency Best Practice Programme," in International Energy Agency, *Conference Proceedings - Industrial Energy Efficiency: Policies and Programs*, Washington, DC, 26-27 May, 1994.

Ministry of Economic Affairs, 1998. *Long Term Agreements on Energy Efficiency: Progress in 1996*. The Hague: The Netherlands: Ministry of Economic Affairs.

Natural Resources Canada, 2002. *CIPEC 2000/2001 Annual Report – Efforts of CIPEC Participants Bear Fruit*. Ottawa, NRCan.

Nengyuan. 2000. Goals for the Reduction in Production and Mine Closures for the Coal Industry in 2000. *Nengyuan* 2000(3):14. March.

Newman, J., 1998. "Evaluation of Energy-Related Voluntary Agreements," in Martin et al., (eds.) *Industrial Energy Efficiency Policies: Understanding Success and Failure: Proceedings of a Workshop Organized by the International Network for Energy Demand Analysis in the Industrial Sector*. Utrecht, The Netherlands, June 11-12, 1998. (LBNL-42368).

Nuijen, W., 1998. "Long Term Agreements on Energy Efficiency in Industry," in Martin et al., (eds.) *Industrial Energy Efficiency Policies: Understanding Success and Failure: Proceedings of a Workshop Organized by the International Network for Energy Demand Analysis in the Industrial Sector.* Utrecht, The Netherlands, June 11-12, 1998. (LBNL-42368).

Nuijen, W., 2002. "Cultures and Policy Instruments," Presentation at the *Workshop on Voluntary Agreements for China's Industrial Sector: Integrating International Experiences into Designing a Pilot Program*, February 25-27, 2002, Beijing.

Nuijen, W., 2002. "Energy Auditing, Assessments, and Energy Plans in The Netherlands," Presentation at the *Workshop on Voluntary Agreements for China's Industrial Sector: Integrating International Experiences into Designing a Pilot Program*, February 25-27, 2002.

Nuijen, W., 2002. "Energy Efficiency Monitoring in Dutch Industry," Presentation at the Workshop on *Voluntary Agreements for China's Industrial Sector: Integrating International Experiences into Designing a Pilot Program*, February 25-27, 2002.

Palmer, W. 1992. *Electric Power Shortages and the Chinese Economy*. PhD dissertation. Madison: University of Wisconsin, Department of Economics.

Paton, B., 2002. "Voluntary Environmental Initiatives and Sustainable Industry," in ten Brink, P., ed., 2002. *Voluntary Environmental Agreements: Process, Practice and Future Use*. Sheffield, UK: Greenleaf Publishing Ltd.

People's Republic of China, 1997. *The Law on Energy Conservation of the People's Republic of China.* Approved at the 28th Session of the Standing Committee of the Eighth National People's Congress.

Price, L., Sinton, J., Worrell, E., Phylipsen, D., Hu, X., and Li, J., 2002. "Energy Use and Carbon Dioxide Emissions from Steel Production in China," *Energy* 27: 429-446.

Ramesohl, S. and Kristof, K., 1999. "What is the Role of Energy-Related Voluntary *Approaches* in the Post-Kyoto Climate Policy? A Process Oriented Analysis of the 'Declaration of German Industry on Global Warming Prevention'," in *Energy Efficiency and CO2 Reduction: The Dimensions of Social Change: 1999 European Council for an Energy-Efficient Economy Summer Study*, May 31-June 4, Mandelieu, France.

Ramesohl, S. and Kristof, K., 2001. "The Declaration of German Industry on Global Warming Prevention – A Dynamic Analysis of Current Performance and Future Prospects for Development," *Journal of Cleaner Production*.

Rietbergen, M., Farla, J., and Blok, K., 1998. "Quantitative Evaluation of Voluntary Agreements on Energy Efficiency," in Martin et al., (eds.) *Industrial Energy Efficiency Policies: Understanding Success and Failure: Proceedings of a Workshop Organized by the International Network for Energy Demand Analysis in the Industrial Sector.* Utrecht, The Netherlands, June 11-12, 1998. (LBNL-42368).

Ruth, M., Worrell, E., and Price, L., 2001. "A Process-Step Benchmarking Approach to Energy Use at Industrial Facilities: Examples from the Iron and Steel and Cement Industries," *Proceedings of the 2001 ACEEE Summer Study on Energy Efficiency in Industry*. Washington, DC: American Council for an Energy-Efficient Economy.

Sinton, J.E. 1996. *Energy Efficiency in Chinese Industry: Positive and Negative Influences of Economic System Reforms*. PhD dissertation. Berkeley, CA: University of California, Energy and Resources Group.

Sinton, J.E. and Levine, M.D. 1994. "Changing Energy Intensity in Chinese Industry: The Relative Importance of Structural Shift and Intensity Change," *Energy Policy* 22(3): 239-258.

Sinton, J.E., Levine, M.D., and Wang, Q., 1998. "Energy Efficiency in China: Accomplishments and Challenges," *Energy Policy*, Vol. 26, No. 11: 813-829.

Sinton, J., Levine, M.D., Fridley, D., Yang, F., and Lin, J. 1999. *Status Report on Energy Efficiency Policy and Programs in China*. Berkeley, CA: Lawrence Berkeley National Laboratory (LBNL-44605).

Togeby, M., Bjorner, T.B., and Johannsen, K., 1998. "Evaluation of the Danish CO2 Taxes and Agreements," in Martin et al., (eds.) *Industrial Energy Efficiency Policies: Understanding Success and Failure: Proceedings of a Workshop Organized by the International Network for Energy Demand Analysis in the Industrial Sector*. Utrecht, The Netherlands, June 11-12, 1998. (LBNL-42368).

Togeby, M., Johannsen, K., Ingrslev, C., Thingvad, K., and Madsen, J., 1999. "Evaluations of the Danish Agreement System," *Proceedings of the 1999 American Council for an Energy-Efficient Economy Summer Study on Energy Efficiency in Industry*. Washington, DC: ACEEE

Uggla, U. and Avasoo, D., 2001. "EKO-Energi – Successful Voluntary Agreements on Energy Efficiency and Environmental Control in Swedish Industry." *Proceedings of the 2001 ECEEE Summer Study*. European Council for an Energy-Efficient Economy.

U.K. Department for Environment, Food and Rural Affairs, 2002. *Climate Change Agreements*. http://www2.defra.gov.uk/environment/ccl/intro.htm

U.S. Environmental Protection Agency, 2002. *Voluntary Aluminum Industrial Partnership (VIAP) Program*. http://www.epa.gov/highgwp1/vaip/

Vine, E. and Sathaye, J., 1997. *The Monitoring, Evaluation, Reporting and Verification of Climate Change Mitigation Projects: Discussion of Issues and Methodologies and Review of Existing Protocols and Guidelines*. LBNL-40316. Berkeley, CA: Lawrence Berkeley National Laboratory.

Wang, A.L. 1999. *A Comparative Analysis of the 1997 Energy Conservation Law of China and the Implementing Regulations of Shandong, Zhejiang, and Shanghai*. NY: Natural Resources Defense Council.

World Business Council for Sustainable Development and World Resources Institute, 2002. *Greenhouse Gas Protocol Initiative*. http://www.ghgprotocol.org/

Worrell, E., Price, L., Martin, N., Farla, J., and Schaeffer, R. 1997. "Energy Intensity in the Iron and Steel Industry: A Comparison of Physical and Economic Indicators," *Energy Policy* 25(7-9): 727-744.

Worrell E., Martin, N., and Price, L., 1999.*Energy Efficiency and Carbon Dioxide Emissions Reduction Opportunities in the U.S. Iron and Steel Sector*. Berkeley, CA: Lawrence Berkeley National Laboratory, LBNL-41724.

Xie Xuren, Vice Director of SETC, 2002. Opening address for 2002 China International Energy and Environmental Protection Exhibition & Workshop, Beijing, November 5, 2002.

Yin, 2000. "Overview of History and Present – Industry Energy Efficiency Policy in China." Presentation of Prof. Yin Xixun, consultant expert of CECA, at the Workshop on *Learning from International Best Practice Energy Policies in the Industrial Sector*, Beijing, May 22, 2000.

SPREADSHEET TOOL FOR THE

ASSESSMENT OF ENERGY-EFFICIENCY POTENTIAL IN IRON AND STEEL MILLS

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Information contained in this spreadsheet tool is derived from the following:

International Iron and Steel Institute, 1998. Energy Use in the Steel Industry. Brussels: IISI.
Worrell, E., Martin, N., Price, L., 1999. Energy Efficiency and Carbon Dioxide Emissions Reduction Opportunites in the U.S. Iron and Steel Sector Berkeley, CA: Lawrence Berkeley National Laboratory (LBNL-41724).
Einstein, D., Worrell, E., Khrushch, M., 2001. "Steam Systems in Industry: Energy Use and energy Efficiency Improvement Potentials," Proceedings of the 2001 ACEEE Summer Study on Energy Efficiency in Industry. Washington, DC: American Council for an Energy-Efficient Economy.

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Appendix A. Spreadsheet Tool for the Assessment of Energy-Efficiency Potential in Iron and Steel Mills: Hypothetical Example of a Steel Mill in China

Instructions to Users

Instructions to Users:

Only fill in the white cells. Grey cells are copied or calculated, while green cells provide calculation end-results.

This workbook consists of the following worksheets:

1. Energy Input Sheet
Plant energy consumption and production data, as well as production data, for each process step have to be input here.
The sheet provides a energy balance by process, using standard Chinese statistical data collection definitions.
Do not input comparable energy consumption data !

2. Energy Intensity
Energy use by fuel and by process for an individual steel mill is entered into this worksheet. The worksheet then calculates energy intensity by process as well as the overall energy intensity. This is then benchmarked to best practice.

3. Benchmarking
The worksheet benchmarks the plant data against the IISI Ecotech-technology as defined in the 1998 IISI report (see below).
A benchmark value for the total plant is calculated.
Each process is benchmarked to allow a quick scan of energy efficiency by process step.

4. Energy Efficiency Measures (EE_..)
The six spreadsheets (ironmaking, BOF, EAF, Casting, Rolling, General) provide information on the energy savings and costs associated with various energy efficiency measures that can be used in iron and steel mills.
The worksheets are used to estimate the potential for energy efficiency improvement by 2010.
In each worksheet, select the potential share of production for that process to which the energy efficient technology can be applied by 2010.

5. Total Potential for Energy Efficiency Improvement
In this worksheet the total potential for energy efficiency improvement is estimated for the plant.
This is a rough estimate and does not include all energy efficiency measures. However, it provides guidance for setting a target.
The worksheet calculates the impact on the EEI as well as estimates energy efficiency improvement potential.

6. Formulas
This worksheet provides common conversion factors for calculations. Do not make changes in this sheet.

7. Other sheets
Provide background information for energy efficient technologies in SI-units.

Energy Input Sheet

钢铁企业各工序耗能情况调查表

Survey of Energy Consumption by Process in Iron and Steel Enterprises

Unit: 10,000 tce

工序	Process	烧结 Sintering	球团 Pelleting	焦化 Coking	高炉炼铁 Blast- furnace iron smelting	转炉 BOF steelmaking	电炉炼钢 EAF steel making	炉外精练转炉 Refining	板坯连铸机 Slab continuous casting	小方坯连铸机 Small billet continuous casting	轧钢工序 Steel rolling	热轧：带钢 Hot rolling: strip steel	热轧：棒材 Hot rolling: bars	热轧：盘条 Hot rolling: wire	Cold rolling	Finishing	锅炉 Boilers	铁合金 Ferroalloys	非生产用能 Non-production energy use	其他 Other	TOTAL
	Production (Mt)	1.75	1.05	0.78	1.75	1.85	0.35	1.85	1.00	1.10	0.88	0.45	0.42								
能源品种	**Energy Type (10,000 tce)***																				**Million tce**
能源投入量 Energy Input	煤 Coal	2.35		105.35	15.33		0.00				0.10						13.01				1.36
	重油 Fuel oil										0.25										0.00
	煤气 Coal gas	0.85	1.90	10.00	13.50	1.10			0.20	0.22	6.77	1.77	5.05				8.10				0.49
	电 Electricity	3.25	0.90	0.85	2.48	0.17	9.10	1.50	0.16	0.19	5.06	1.61	3.25				1.00				1.18
	天然气 Natural gas																				0.00
	蒸汽 Steam	0.25		0.80	0.38	0.02				0.02	0.12	0.08	0.08								0.02
	鼓风带入热量 Heat content of compressed air																				0.00
	焦炭 Coke	10.70			93.00																1.04
	水** Water**	0.02	0.01	0.05	0.15	0.00	0.04	0.00		0.00	0.05	0.00	0.03				0.03				0.00
	Compressed air				6.52	3.20	0.79			0.05	0.02	0.00	0.02								0.11
	Oxygen					2.00															0.02
	其他（风/氧气/柴油） Diesel																				0.00
	小计（吨标煤） **Subtotal (10,000 tce)**	17.42	2.81	117.05	131.36	6.49	9.93	1.50	0.36	0.48	12.37	3.47	8.43	0.00	0.00	0.00	22.14	0.00	0.00	0.00	4.23
能源产出量（包括回收） Energy Output (including recovered energy)	焦炭 Coke			75.68																	0.76
	煤气 Coal gas			21.01	35.00	0.00															0.56
	蒸汽 Steam					0.00											16.98				0.22
	电 Electricity																				0.00
	粗苯 Crude benzene			1.29																	0.01
	焦油 Tar			5.22																	0.05
	**																				0.00
	**																				0.00
	其他 Other																				0.00
	小计（吨标煤） **Subtotal (10,000 tce)**	0.00	0.00	103.20	35.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.98	0.00	0.00	0.00	1.60
工序单耗	**Unit final energy consumption by process**	17.42	2.81	13.85	96.36	6.49	9.93	1.50	0.36	0.48	12.37	3.47	8.43	0.00	0.00	0.00	5.16	0.00	0.00	0.00	
	Total Primary Energy Consumption (10,000 tce)																				**2.622**

注：*：可用实物量或吨标煤表示。（以上数据为标煤，单位：万吨）

Usable energy in physical units or tce. (Data above are in units of 10,000 tce.)

**：可根据贵企业的具体情况，增加能源的投入和产出品种或增加工序，并在表中注明。

These are to be filled in based on the specific condition of each plant. Insert energy type or process and data in the table as appropriate.

钢铁企业自发电情况调查表

Survey of Self-Generation at Iron and Steel Enterprises

工序		Process	焦化 Coking	高炉炼铁 Blast furnace iron smelting	锅炉房电站 Power generation boilers	**	**	其他 Other	TOTAL
能源品种 *		Fuel*							
转入自发电能源投入量 Energy Input for Self-Generation	煤	Coal			2.45				2.45
	石油	Oil							0.00
	煤气	Coal gas							0.00
	电	Electricity							0.00
	天然气	Natural gas							0.00
	蒸汽	Steam							0.00
	**								0.00
	**								0.00
	其他	Other							0.00
	小计（吨标煤）	Subtotal			2.45				2.45
发电量		Power generation (kWh)			50000000				50000000.00

注：*：可用实物量或吨标煤表示。

Usable energy in physical units or tce. (Data above are in units of 10,000 tce.)

**：可根据贵企业的具体情况，增加能源投入品种或增加工序，并在表中注明。

These are to be filled in based on the specific condition of each plant. Insert energy type or process and data in the table as appropriate.

钢铁企业各工序耗能情况调查表

Survey of Energy Consumption by Process in Iron and Steel Enterprises

Unit: 10,000 tce

工序	Process	烧结 Sintering	球团 Pelleting	焦化 Coking	高炉炼铁 Blast- furnace iron smelting	转炉 BOF steelmaking	电炉炼钢 EAF steel making	炉外精练转炉 Refining	板坯连铸机 Slab continuous casting	小方坯连铸机 Small billet continuous casting	轧钢工序 Steel rolling	热轧：带钢 Hot rolling: strip steel	热轧：棒材 Hot rolling: bars	热轧：盘条 Hot rolling: wire	Cold rolling	Finishing	锅炉 Boilers	铁合金 Ferroalloys	非生产用能 Non-production energy use	其他 Other	TOTAL
	Production (Mt)	1.75	1.05	0.78	1.75	1.85	0.35	1.85	1.00	1.10	0.88	0.45	0.42								
能源品种	**Energy Type (10,000 tce)***																				**Million tce**
能源投入量 Energy Input: 煤	Coal	2.35		105.35	15.33		0.00				0.10						13.01				1.36
重油	Fuel oil										0.25										0.00
煤气	Coal gas	0.85	1.90	10.00	13.50	1.10			0.20	0.22	6.77	1.77	5.05				8.10				0.49
电	Electricity	3.25	0.90	0.85	2.48	0.17	9.10	1.50	0.16	0.19	5.06	1.61	3.25				1.00				1.18
天然气	Natural gas																				0.00
蒸汽	Steam	0.25		0.80	0.38	0.02				0.02	0.12	0.08	0.08								0.02
鼓风带入热量	Heat content of compressed air																				0.00
焦炭	Coke	10.70			93.00																1.04
水**	Water**	0.02	0.01	0.05	0.15	0.00	0.04	0.00		0.00	0.05	0.00	0.03				0.03				0.00
	Compressed air				6.52	3.20	0.79			0.05	0.02	0.00	0.02								0.11
	Oxygen					2.00															0.02
其他（风/氧气/柴油）	Diesel																				0.00
小计（吨标煤）	**Subtotal (10,000 tce)**	17.42	2.81	117.05	131.36	6.49	9.93	1.50	0.36	0.48	12.37	3.47	8.43	0.00	0.00	0.00	22.14	0.00	0.00	0.00	4.23
能源产出量（包括回收）Energy Output (including recovered energy): 焦炭	Coke			75.68																	0.76
煤气	Coal gas			21.01	35.00	0.00															0.56
蒸汽	Steam					0.00											16.98				0.22
电	Electricity																				0.00
粗苯	Crude benzene			1.29																	0.01
焦油	Tar			5.22																	0.05
**																					0.00
**																					0.00
其他	Other																				0.00
小计（吨标煤）	**Subtotal (10,000 tce)**	0.00	0.00	103.20	35.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.98	0.00	0.00	0.00	1.60
工序单耗	**Unit final energy consumption by process**	17.42	2.81	13.85	96.36	6.49	9.93	1.50	0.36	0.48	12.37	3.47	8.43	0.00	0.00	0.00	5.16	0.00	0.00	0.00	
	Total Primary Energy Consumption (10,000 tce)																				**2.622**

注：*：可用实物量或吨标煤表示。（以上数据为标煤，单位：万吨）

Usable energy in physical units or tce. (Data above are in units of 10,000 tce.)

**：可根据贵企业的具体情况，增加能源的投入和产出品种或增加工序，并在表中注明。

These are to be filled in based on the specific condition of each plant. Insert energy type or process and data in the table as appropriate.

Energy Intensity Sheet

Calculation of Energy Intensity

	Process	烧结 Sintering	球团 Pelleting	焦化 Coking	高炉炼铁 Blast-furnace iron smelting	转炉 BOF steelmaking	电炉炼钢 EAF steel making	炉外精练转炉 Refining	板坯连铸机 Slab continuous casting	小方坯连铸机 Small billet continuous casting	轧钢工序 Steel rolling	热轧：带钢 Hot rolling: strip steel	热轧：棒材 Hot rolling: bars	热轧：盘条 Hot rolling: wire	Cold rolling	Finishing	锅炉 Boilers	铁合金 Ferroalloys	非生产用能 Non-production energy use	** Other	TOTAL
	Production (Mt)	1.75	1.05	0.78	1.75	1.85	0.35	1.85	1.00	1.10	0.88	0.45	0.42	0.00	0.00	0.00	0.00	0.00	0	0	2.20
	Energy Type (10,000 tce)*																				
	Fuel in	14.24	1.91	116.44	129.00	4.33	0.83	0.00	0.20	0.29	7.35	1.88	5.20	0.00	0.00	0.00	21.14	0.00	0.00	0.00	302.83
	Electricity in	3.25	0.90	0.85	2.48	0.17	9.10	1.50	0.16	0.19	5.06	1.61	3.25	0.00	0.00	0.00	1.00	0.00	0.00	0.00	29.52
	Oxygen in	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
	Fuel out	0.00	0.00	103.20	35.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.14	0.00	0.00	0.00	160.34
	Electricity out	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SEC	SEC-Fuel kgce/ton	81.39	18.24	169.78	537.14	23.40	23.73	0.00	2	2.65	83.96	41.82	123.91	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	647.66
	SEC-Electricity kgce/ton	18.57	8.57	10.90	14.17	11.73	260.00	8.11	1.6	1.73	57.83	35.78	77.38	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	136.46
	SEC-Primary kgce/ton	155.46	52.42	213.24	593.66	70.18	1060.62	32.34	8.38	9.54	314.58	184.50	432.51	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	1191.88
	Total Primary Energy (tce)																				2622.13

Benchmarking Sheet

	Process		烧结 Sintering	球团 Pelleting	焦化 Coking	高炉炼铁 Blast-furnace iron smelting	转炉 BOF steelmaking	电炉炼钢 EAF steel making	炉外精练转炉 Refining	板坯连铸机 Slab continuous casting	小方坯连铸机 Small billet continuous casting	轧钢工序 Steel rolling	热轧：带钢 Hot rolling: strip steel	热轧：棒材 Hot rolling: bars	热轧：盘条 Hot rolling: wire		Cold rolling	Finishing	锅炉 Boilers	铁合金 Ferroalloys	非生产用能 Non-production energy use	** Other	TOTAL
	Production (Mt)		1.75	1.05	0.78	1.75	1.85	0.35	1.85	1.00	1.10	0.88	0.45	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0	0	2.20
Plant	SEC - Fuel	kgce/ton	81.39	18.24	169.78	537.14	23.40	23.73	0.00	2.00	2.65	83.96	41.82	123.91	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Plant	SEC-Electricity	kgce/ton	18.57	8.57	10.90	14.17	11.73	260.00	8.11	1.60	1.73	57.83	35.78	77.38	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Plant	SEC-Primary	kgce/ton	155.46	52.42	213.24	593.66	70.18	1060.62	32.34	8.38	9.54	314.58	184.50	432.51	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Benchmark	Fuel	kgce/ton	42.31	22.53	71.75	409.69	-3.09	18.28	0.00	1.02	1.02	36.83	43.47	51.19	54.61	5.34	35.35	0.00	0.00	0.00	0.00	0.00	790.30
Benchmark	Electricity	kgce/ton	3.69	4.78	3.82	3.14	3.19	50.25	4.30	0.95	0.95	9.76	9.69	8.36	12.90	8.84	4.30	0.00	0.00	0.00	0.00	0.00	128.92
Benchmark	Oxygen	kgce/ton	0.00	0.00	0.00	7.76	11.54	8.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.53
Benchmark	Primary	kgce/ton	52.01	35.10	81.80	425.72	16.85	158.75	11.32	3.51	3.51	62.51	68.97	73.20	88.56	28.60	46.67	0.00	0.00	0.00	0.00	0.00	
	Energy Efficiency Index (EEI)		299	149	261	139	416	668	286	239	272	503	268	591	NA	NA	NA	NA	NA	NA	NA	NA	

DO NOT CHANGE

TOTAL PLANT BENCHMARK EEI = 224 (100 = BEST PRACTICE)

Energy-Efficiency Measures – Blast Furnace

BLAST FURNACE - ENERGY EFFICIENCY MEASURES (kgce/ton product)

Select the share of production in a production step to which the measure can still be applied (100% is all of pig iron produced)
Please make sure that the total share of competing measures does not exceed 100%
Default value is set at 100%, or lower for competing technologies.

	POTENTIAL APPLICATION (% of production)	ENERGY SAVINGS LOW	ENERGY SAVINGS MEDIUM	ENERGY SAVINGS HIGH	POTENTIAL ENERGY SAVINGS (2010, kgce/ton)	CAPITAL COSTS LOW	CAPITAL COSTS MEDIUM	CAPITAL COSTS HIGH	OTHER BENEFITS
COKE PLANT									
Coal moisture control	100%	3.4			3.4			High	Extends coke oven life.
Programmed heating	100%		5.8		5.8	Low			Extends coke oven life.
Variable speed drive on coke oven gas compressors	100%	1.7			1.7	Low			
Coke dry quenching	100%			47.8	47.8			High	Reduces water use and dust emissions
Heat recovery COG by-product gas	100%		10.2		10.2		Medium		
Heat recovery waste gas	100%	3.4			3.4			High	
Coke oven aspiration (NH3)	100%	2.0			2.0		Medium		
Fuel gas preheating	100%	1.0			1.0		Medium		
Jumbo Coke Reactor	0%		10.0		0.0			High	Reduced emissions
SINTER PLANT									
Sinter plant heat recovery	100%		6.8		6.8			High	Reduction of NOx, CO, SOx, dioxin, and PM
Use of waste fuels in the sinter plant	100%		6.1			Low			Reduced disposal costs
Reduction of air leakage	100%	1.7			1.7		Medium		
Increasing bed depth	100%	2.4			2.4	Low			
Improved process control (ignition furnace)	100%	0.7			0.7	Low			
Combustion control	100%	0.7			0.7	Low			
Energy Optimized Sintering (EOS)	0%		4.4		0.0			High	
BLAST FURNACE									
Pulverized coal injection (130 kg/thm)	100%		18.8		18.8	Low			Reduces coke-related emissions.
Pulverized coal injection (225 kg/thm)	50%		23.9		11.9	Low			Reduces coke-related emissions.
Injection of natural gas	0%		5.5		0.0	Low			Reduces coke-related emissions.
Top pressure recovery turbines (wet type)	100%	2.4	4.8		4.8			High	
Top pressure recovery turbines (dry type)	0%		6.1		0.0			High	
Recovery of blast furnace gas (2-bell)	100%		11.9		11.9	Low			
Hot blast stove automation	100%		6.8		6.8	Low			Increased reliability of operation, increased stove lifetime, optimized gas mix
Recuperator on the hot blast stove	50%	3.4			1.7			High	
Oxygen enrichment combustion air	0%	1.4			0.0			High	
Improved blast furnace control	100%	6.8	13.7		13.7	Low			Reduction of coke use and increased productivity.
Smelt Reduction - COREX	0%			51.2	0.0			High	No coke use, close coke ovens

Total Potential Energy Savings	**Coke Oven**	**75.4 kgce/ton**
	Sinter Plant	**12.3 kgce/ton**
	Blast Furnace	**69.6 kgce/ton**

Energy-Efficiency Measures: Basic Oxygen Furnace

BOF - ENERGY EFFICIENCY MEASURES (kgce/ton product)

Select the share of production in a production step to which the measure can still be applied (100% is all of pig iron produced)
Please make sure that the total share of competing measures does not exceed 100%
Default value is set at 100%, or lower for competing technologies.

	POTENTIAL APPLICATION (% of production)	ENERGY SAVINGS LOW	MEDIUM	HIGH	POTENTIAL ENERGY (2010, kgce/ton)	CAPITAL COSTS LOW	MEDIUM	HIGH	OTHER BENEFITS
BOF STEELMAKING									
BOF Gas recovery	0%		23.9		0.0		Medium		
BOF Steam recovery	0%		6.8		0.0			High	
BOF gas & sensible heat recovery (repressed combustion)	100%		30.7		30.7				Material losses reduced to 1%
Computer controls Gas Recovery	100%	1.0			1.0	Low			
Vessel bottom steering	100%	4.8			4.8		Medium		
Variable speed drive on ventilation fans	100%	0.3			0.3		Medium		
Management of oxygen make-up	100%	1.7			1.7		Medium		
Oxygen/Nitrogen Speicher	0%	1.7			0.0		Medium		
REFINING									
Ladle Preheating	100%	0.7			0.7	Low			

TOTAL POTENTIAL ENERGY SAVINGS	**BOF**	**38.6**	**kgce/ton**
	Ladle Refining	**0.7**	**kgce/ton**

Energy-Efficiency Measures: Electric Arc Furnace

EAF - ENERGY EFFICIENCY MEASURES (kgce/ton product)

Select the share of production in a production step to which the measure can still be applied (100% is all of pig iron produced)
Please make sure that the total share of competing measures does not exceed 100%
Default value is set at 100%, or lower for competing technologies.

	POTENTIAL APPLICATION (% of production)	ENERGY SAVINGS LOW	ENERGY SAVINGS MEDIUM	ENERGY SAVINGS HIGH	ENERGY SAVINGS (2010, kgce/ton)	CAPITAL COSTS LOW	CAPITAL COSTS MEDIUM	CAPITAL COSTS HIGH	OTHER BENEFITS
ELECTRIC ARC FURNACE									
Improved process control (neural networks)	100%		18.6		18.6	Low			Average increase in productivity of 9-12% and reduced electrode consumption of 25%
Flue gas monitoring and control	100%	7.4			7.4	Low			
Transformer efficiency measures	100%	1.5	8.3		8.3		Medium		
Bottom stirring/gas injection	100%	5.4	10.8		10.8		Medium		Increased yield of 0.5%
Foamy slag practices	100%	3.4			3.4	Low			
Oxy-fuel burners/lancing	100%		14.7	34.3	24.5		Medium		Reduced tap-to-tap time of 6%; O2 injection improves product quality
Post-combustion	100%		24.5	39.2	31.9		Medium		
Eccentric bottom tapping (EBT)	100%		7.4		7.4		Medium		reduced tap-to-tap time, reduced maintenance
Direct current (DC) arc furnaces	0%	4.9		44.1	0.0			High	Reduced tap-to-tap time; reduced electrode use, increase refractory life, improved stability
Consteel process	0%			29.4	0.0			High	Increased productivity by 33%, reduced electrode consumption by 40%, reduced dust emissions
Fuchs shaft furnace	100%			58.8	58.8			High	Reduced electrode consumption, reduced flue gas dust emissions (25%), increased yield of 0.25-2.0%, 20% productivity increase,
Twin shell DC arc furnace	0%	4.9	9.8		0.0			High	Reduced tap-to-tap time
TOTAL POTENTIAL ENERGY SAVINGS	**EAF**				**171.0**	**kgce/ton**			

Energy-Efficiency Measures: Casting

CASTING - ENERGY EFFICIENCY MEASURES (kgce/ton product)

Select the share of production in a production step to which the measure can still be applied (100% is all of pig iron produced)
Please make sure that the total share of competing measures does not exceed 100%
Default value is set at 100%, or lower for competing technologies.

	POTENTIAL APPLICATION (% of production)	ENERGY SAVINGS LOW	MEDIUM	HIGH	ENERGY SAVINGS (2010, kgce/ton)	CAPITAL COSTS LOW	MEDIUM	HIGH	OTHER BENEFITS
CASTING									
Abandon ingot casting, adopt continuous casting	0%			102.4	0.0			High	Reduced material losses from about 8% to 2%, reduces cooling water needs
Efficient ladle preheating	100%	0.7			0.7	Low			
Thin slab casting	100%	See Rolling						High	Reduces material losses and cooling water use
TOTAL POTENTIAL ENERGY SAVINGS	CASTING				0.7	kgce/ton			

Energy-Efficiency Measures: Rolling

ROLLING - ENERGY EFFICIENCY MEASURES (kgce/ton product)

Select the share of production in a production step to which the measure can still be applied (100% is all of pig iron produced)
Please make sure that the total share of competing measures does not exceed 100%
Default value is set at 100%, or lower for competing technologies.

	POTENTIAL APPLICATION (% of production)	ENERGY SAVINGS LOW	ENERGY SAVINGS MEDIUM	ENERGY SAVINGS HIGH	ENERGY SAVINGS (2010, kgce/ton)	CAPITAL COSTS LOW	CAPITAL COSTS MEDIUM	CAPITAL COSTS HIGH	OTHER BENEFITS
HOT ROLLING									
Hot charging	0%			20.5	0.0			High	Improves material quality, reduces material losses, improves productivity (by up to 6%), may reduce slab stocking
Thin slab casting	60%			170.6	102.4			High	Improves material quality, reduces material losses, improves productivity, reduces water use
Recuperative burners in the reheating furnace	100%		12.6	23.9	91.6	Low			
Unfired preheat zone	100%		5.1				Medium		
Combustion control & variable speed drives on combustion air fans	100%	0.3	10.2		10.2	Low			
Process control/scheduling	100%	0.7	6.8		6.8	Low			increases productivity, increases quality, reduced rejection of product, reduced down time
Insulation of furnaces	100%		5.5		5.5		Medium		
Energy efficient drives in the hot rolling mill	100%	0.7			0.7		Medium		
Waste heat recovery from cooling water	0%	1.4			0.0		Medium		Reduces cooling water use
SECTION & PLATE MILLS									
Near net shape casting	50%			170.6	85.3			High	
Discharge temperature, scheduling	50%		7.5		3.8	Low			
Use COG	100%	2.4	3.4		3.4	Low			
Increased capacity utilization	75%	2.4			1.8	Low			
Process control system	100%	2.4	6.8		6.8	Low			
Increased furnace pressure	75%	1.7			1.3	Low			
Recuperative burners	50%		6.8		3.4		Medium		lower NOx emissions
Insulation	50%	1.7			0.9		Medium		
Hot charging	50%		27.3	47.8	25.6			High	
COLD ROLLING									
Automated monitoring & targeting system	0%			20.5	0.0	Low			Reduces effluents.
Reduced steam use in the pickling line	0%		6.8		0.0		Medium		
Teflon heat exchangers pickling	0%	2.4			0.0		Medium		
Reduced bath temperature	0%	0.3				Low			
Condensate recovery acid bath	0%	0.3			0.0		Medium		
Gas fired driers (instead of steam)	0%	2.4			0.0		Medium		Reduces make-up water use
Series washing/cascading	0%	0.9			0.0				
FINISHING									
Heat recovery on the annealing line	0%		10.2		0.0		Medium		
Continuous Annealing	0%		6.8		0.0			High	
Recuperative burners - batch annealing	0%		5.1		0.0	Low			
Waste heat boiler - continuous annealing	0%		5.1		0.0		Medium		

TOTAL POTENTIAL ENERGY SAVINGS	**HOT ROLLING**	**217.2**	**kgce/ton**
	PLATE/SECTION MILL	**132.3**	**kgce/ton**
	COLD ROLLING	**0.0**	**kgce/ton**
	FINISHING	**0.0**	**kgce/ton**

Energy-Efficiency Measures: General

GENERAL - ENERGY EFFICIENCY MEASURES (kgce/ton product)

Select the share of production in a production step to which the measure can still be applied (100% is all of pig iron produced)
Please make sure that the total share of competing measures does not exceed 100%
Default value is set at 100%, or lower for competing technologies.

	POTENTIAL APPLICATION (% of production)	ENERGY SAVINGS LOW	ENERGY SAVINGS MEDIUM	ENERGY SAVINGS HIGH	ENERGY SAVINGS (2010, kgce/ton)	CAPITAL COSTS LOW	CAPITAL COSTS MEDIUM	CAPITAL COSTS HIGH	OTHER BENEFITS
GENERAL									
Preventative maintenance	100%		17.1		17.1	Low			
Energy monitoring and management	100%		5.1		5.1	Low			
MOTOR SYSTEMS									
Efficient motors	100%	3.4			3.4		Medium		
Variable speed drives for flue gas control, pumps, and fans	100%	3.4			3.4		Medium		
BOILERS									
Improved process control	100%	1.7			1.7	Low			Reduces make-up water use
Reduced flue gas quantity	100%	1.7			1.7	Low			Reduces make-up water use
Reduced excess air	100%	3.4			3.4	Low			Reduces make-up water use
Improved insulation	100%	3.1	6.8		6.8	Low			Reduces make-up water use
Boiler maintenance	100%	5.1			5.1	Low			Reduces make-up water use
Flue gas heat recovery	100%	0.5			0.5	Low			Reduces make-up water use
Blowdown steam heat recovery	100%	0.7			0.7	Low			Reduces make-up water use
Super heater/economizer	100%	2.6	5.1		5.1		Medium		Reduces make-up water use
STEAM DISTRIBUTION									
Improved insulation	100%	1.4	6.8		6.8	Low			Reduces make-up water use
Steam trap maintenance	100%	5.1	8.5		8.5	Low			Reduces make-up water use
Automatic steam trap monitoring	100%	2.7			2.7	Low			Reduces make-up water use
Leak repair	100%	1.7			1.7	Low			Reduces make-up water use
Flash steam recovery/ condensate return	100%		5.1		5.1		Medium		Reduces make-up water use
COGENERATION									
Back pressure turbine	0%				0.0		Medium		
Combined cycle (BFG, COG)	100%			37.5	37.5			High	
TOTAL POTENTIAL ENERGY SAVINGS	**GENERAL**				**116.6**	**kgce/ton steel**			

Total Potential Energy Savings

TOTAL POTENTIAL ENERGY SAVINGS

	Total Savings kgce/ton	Production Million tons	Total Savings Million tce	EEI Before	EEI After	Improvement %
Coke Plant	75.4	0.78	0.06			35.4%
Sinter Plant	12.3	1.75	0.02			5.8%
Blast Furnace	69.6	1.75	0.12			11.7%
BOF	38.6	1.85	0.07			55.0%
Refining	0.7	1.85	0.00			2.1%
EAF	171.0	0.35	0.06			16.1%
Casting - slab	0.7	1.00	0.00			8.1%
Casting - billet	0.7	1.10	0.00			7.2%
Plate Mill	132.3	0.88	0.12			42.0%
Hot Strip Mill	217.2	0.45	0.10			117.7%
Bar Mill	132.3	0.42	0.06			30.6%
Wire Mill	132.3	0.00	0.00			NA
Cold Rolling	0.0	0.00	0.00			NA
Finishing	0.0	0.00	0.00			NA
General	116.6	2.20	0.26			NA
Total			**0.86**	**224**	**151**	**32.9%**

Appendix B

Long-Term Agreement Between the Association of Dutch Iron and Steel Producing Industries (NIJSI) and the Dutch Ministry of Economic Affairs concerning the Improvement of Energy Efficiency

Parties,

1. The Dutch Minister for Economic Affairs
2. The association of Dutch Iron and Steel Producing Industries (NIJSI) as well as its members, Hoogovens Group Inc. and NEDSTAAL Inc., hereinafter called "parties"

Considering

I General

- that in the National Environmental Policy Plan Plus (NMP+), which was published in June 1990, the tightened objective for the reduction of carbon dioxide emissions was stated, namely stabilization of CO_2 emissions in 1994/1995 at the level of 1989/1990 and an absolute reduction of national CO_2 emissions in the year 2000 by 3 to 5 %;
- that a substantial part of the targeted reduction of CO_2 emissions is to be achieved through energy conservation;
- that in the Memorandum on Energy Conservation, which was published by the Dutch Ministry of Economic Affairs at the same time as the NMP+, the energy conservation policy for the coming years was laid down;
- that, taking into account a production increase in industry, the energy conservation objective is stated as: an efficiency improvement of 20% in the year 2000 compared to 1989. Feedstock energy use – in the case of NIJSI this refers to the coal and cokes used in the reduction process for iron and steel production – is not taken into account here;
- that the Dutch Ministry of Economic Affairs implements measures in the area of energy conservation so that a financial contribution can be made to studies, research, development, demonstration, market introduction and technology transfer;
- that the energy use of the pig iron and steel industry amounts to approximately 8% of the total energy use (excluding feedstocks) of Dutch industry;
- that the parties agree that entering into a long-term agreement concerning energy conservation is at this point in time the most effective way to realize the energy conservation objective for NIJSI as stated in the NMP+ and the Memorandum on Energy Conservation. That at the possible introduction of new instruments (including energy taxes) in the future, one must weigh to what extent the instrument conflicts with the effective implementation of long-term agreements or adversely affects the international competitiveness of this branch of industry;

II Implementation of the Energy Conservation Policy at NIJSI

- that on March 22, 1991, NIJSI signed a statement with the Dutch Ministry of Economic Affairs stating that NIJSI's objective is an energy efficiency improvement of 20% in its own sector in the year 2000 compared to 1989;

- that NIJSI has also stated that it believes that an efficiency improvement objective of an average of 2% per year for the period of 1989 through 1995 is largely feasible based on existing energy price scenarios, existing technological and financial-economical possibilities and the instruments of the Dutch Ministry of Economic Affairs;
- that the members of NIJSI and the Dutch Ministry of Economic Affairs are among the parties that signed the declaration of intent concerning the implementation of the energy policy in the primary metals industry on March 10, 1992;
- that the declaration of intent shows that this long-term agreement would be part of that declaration of intent. That in case procedural stipulations of this long-term agreement conflict with those of the declaration of intent, the stipulations of the latter will take precedence;
- that in the declaration of intent it has been laid down that the companies will develop a corporate environmental plan concerning the implementation and that they will report on the implementation annually and that the energy conservation measures will be part of this;
- that the governmental institutions which issue permits are thus enabled to take into account in the allocation of permits the agreements the parties reached;
- that the members of NIJSI have listed the energy conservation measures that they can implement before 1996 and that they presently also wish to agree with the Dutch Minister for Economic Affairs that it is their objective to implement those measures providing that the conditions set down as part of the long-term agreement are met while retaining their own responsibility in the matter;
- that where the talks between the parties have not yet led to concrete agreements for the period of 1996 through 2000, this is due to the lack of a complete understanding by the members of NIJSI of future processes, technology and/or markets and feared financial-economic impracticabilities, but that there is every reason to assume that continued research, development and demonstration within a reasonable time frame will potentially lead to additional agreements;
- that achieving the energy efficiency improvement for this branch of industry is seen as a responsibility of both parties.

Agree

A General

- that this long-term agreement expires December 31, 1995;
- that the parties will come together to talk about the period through 2000 on January 1, 1995, at the latest;
- that where Hoogovens Group Inc. is a party, only Hoogovens IJmuiden is bound by the commitments that Hoogovens Group Inc. takes on
- that it is NIJSI's objective to improve its energy efficiency by 10% in the year 1995 compared to 1989 and that the members will seek to implement the measures recorded in the annexes which were formulated to realize this objective;

- that NIJSI seeks to improve efficiency by 20% in the year 2000 compared to 1989, as recorded in the statement of March 22, 1991, and that the members of NIJSI will develop measures to further improve energy efficiency after 1996.
- that the members of NIJSI have the right to adapt the activities carried out to realize the objective to the most recent insights at their own discretion in the interim, while adhering to the formulated objective, the modifications of which will be specified in the annexes;
- that NIJSI commits to attaching much importance in establishing internal priorities to innovation and investment efforts which will contribute to the realization of the aforementioned objective;
- that potential improvements will be made where this is technically, economically, and environmentally sound and where this does not compromise safety;
- that the economic calculations of energy conservation investments will be carried out using methodologies that are customary in industry. In making investment decisions, the procedures that are customary in industry will be observed;
- that state of the art technology will be used for new construction, where this is economically sound, considering the need to retain a competitive position (internationally). Ultimately, it is the individual company which chooses the process;
- that where possible companies focus on process-integrated solutions, which optimize energy use, product quality, the environment, etc.

B Annexes

- that the members of NIJSI have specified the energy conservation activities in bilateral agreements (annexes) with Novem (the Netherlands Organization for Energy and the Environment);
- that the annexes contain company information and are therefore confidential;
- that in the annexes the following has been specified for each member of NIJSI;
  - objective for energy efficiency improvement;
  - a list of the proposed activities to be carried out to realize the objective;
  - an estimate of the time frame for the activities;
  - a method to determine the efficiency index;
  - a method to report.
- that the annexes can be used to determine that the total energy use of the members of NIJSI is approximately 60 PJ, which corresponds with approximately 8% of the energy use of Dutch industry. The share of energy carriers that are used as feedstock has not been taken into account here.
- that on the basis of these annexes the following subdivision can be made in the set of projects proposed to realize the objective of a 10% efficiency improvement in 1995;
  - Projects in relation to “good housekeeping”.
    Examples are projects such as optimization of the division of energy flows and technical gases, reuse of waste steam, and adjustable speed drives. Generally, projects in this category have to do with energy management and require a relatively minor investment. More than 10% of the objective can be achieved through these projects.
- Projects which for the most part focus on energy conservation.

Examples are projects such as Combined Heat & Power, heat transformer, the use of flare gases and the use of expansion energy from natural gas. These projects are motivated solely by and the costs are recovered exclusively through the energy efficiency improvement achieved. Through these projects approximately 50% of the objective can be achieved.

- Projects of a more strategic or retrofitting nature which also improve energy efficiency.

  Examples are projects such as the increased use of coal injection in the blast furnaces instead of cokes production, increased use of scrap, etc. These are projects which carry a strategic need for the company involved, for example in relation to improvement of product quality, availability of raw materials, capacity changes. Through these projects the remaining part of 40% of the objective can be realized.

- that in order to realize the aforementioned 10% efficiency improvement, NIJSI will have to make extra investments for a sum of more than 200 million guilders in the period of 1989/1995.

C Company Environmental Plans/Target Group Policy

- that the objective of the energy conservation policy has partly been derived from the objective for the reduction of CO_2 emissions in the NMP+. That therefore there is a relation between the implementation of the energy policy and the target group policy, which is used to implement the NMP+;
- that in order to make the necessary integration of the energy conservation policy into the environmental policy possible at the level of individual companies, the members of NIJSI will integrate the main points of their energy conservation activities in the corporate environmental plan, as intended in the declaration of intent of the basic metal industry;
- that the objective for energy efficiency improvement at NIJSI was added to the agenda of the target group committee for the basic metal industry as part of the Integrated Environmental Objective (IMT);
- that on the basis of this agreement the energy conservation task force described below will indicate what actual CO_2 emission effect this energy efficiency objective has, based on mutually agreed assumptions regarding the expected growth of this branch of industry, the degree of distributed electricity generation, etc.

D Contribution Dutch Minister for Economic Affairs

- that the Dutch Ministry of Economic Affairs will in principle make financial contributions to studies, technology transfer, research, development and demonstrations and market introduction as part of the relevant measures instituted for this purpose. These measures can be implemented by the Dutch Ministry of Economic Affairs itself or by Novem (the Netherlands Organization for Energy and the Environment);
- that the budget for the Novem program “industrial sectors” presently consists of approximately 30 million guilders per year and that this program is in principle available for companies and branches of industry which have made it clear that

they wish to enter into agreements with the Dutch Ministry of Economic Affairs regarding energy conservation;

- that part of the budget will become available for NIJSI and that NIJSI's share will partly be determined on the basis of the energy use and the contribution to be made to the conservation potential in the steel industry;
- that in the implementation of the other subsidy schemes, the criteria and support percentages of the relevant scheme will be complied with;
- that the Dutch Ministry of Economic Affairs will seek to support the LTAs with its financial instruments geared to industry;
- that in the period through 2000 the Dutch Minister for Economic Affairs will strive to maintain the aforementioned stimulation program and to keep part of it available for NIJSI;
- that the Dutch Minister for Economic Affairs strives to maintain the EU research and demonstration programs regarding energy, Joule and Thermie respectively.

E Modifications and Termination

- that if in the period before 1996 the circumstances change significantly compared to the situation in 1991/1992, such as in relation to:
  - policy insights regarding energy and the environment and technological insights in these areas;
  - the available and prognosticated budget means for the stimulation of energy conservation;
  - legislation (specifically regarding taxes and the environment) and jurisprudence;
  - expectations regarding economic growth, the international competitive position and developments with respect to the company's returns;
  - serious, undesirable socio-economic consequences for NIJSI as a result of the implementation of this long-term agreement and
  - the feasibility of the objective which have substantial consequences for the implementation of this long-term agreement, the parties shall come together to talk in order to establish to what extent the content of this long-term agreement needs to be modified;
- that if the aforementioned talks do not lead to mutual agreement within 6 months, each of the parties mentioned can terminate this agreement. The aforementioned periods of time will start at the moment that one of the parties has notified the other through certified mail.
- that the fact that this long-term agreement is part of the declaration of intent (IV) regarding the implementation of the environmental policy for the basic metal industry does not mean that the termination of the IV will lead to the cancellation of this long-term agreement.

F Monitoring Efficiency Improvement

- that the individual members of NIJSI will each year report to Novem on the energy efficiency improvement achieved. This report will include data on total energy use, the realized energy efficiency index and a list of the projects carried out to realize the energy efficiency index for that year;

- that Novem will each year report to the energy conservation task force (see part G) on the energy efficiency improvement realized by NIJSI for that year. This report will at least include a quantification of the energy efficiency index realized by the NIJSI members as a group. This report will be based on the data of the individual members of NIJSI;
- that the energy use and production volume of the year 1989 is used as a reference for the energy efficiency index. Feedstock energy use is not taken into account when calculating energy use. The value of the energy efficiency index for the year 1989 is determined to be 100;
- that the energy efficiency index is defined as the quotient of energy use in the relevant year on the one hand and the product of the realized production volumes in the relevant year and the specific energy use of the products in the reference year 1989 on the other hand;
- that in the calculation of the energy efficiency index corrections can be made for:
  - changes in the mix of products;
  - extra energy use as a result of stricter environmental regulations;
  - the degree of capacity utilization of existing product installations.

  The results of these corrections on the index will be made clear;
- that the list of projects carried out to realize the energy efficiency index should cover at least 80%.

G Task Force

- that the parties will come together to talk about and mutually agree on an energy conservation task force, made up of representatives of NIJSI, the Dutch Ministry of Economic Affairs and Novem. The Dutch Ministry of Economic Affairs will function as chairman, NIJSI will be the secretary.

The task of the task force is:

- to advise the Dutch Minister for Economic Affairs, whether the advice is solicited or unsolicited, regarding the main points of the implementation of the energy conservation policy relevant for NIJSI;
- to produce annual progress reports;
- to supervise the use of the system set up to monitor and to report progress to the Dutch Ministry of Economic Affairs;
- to provide CO_2 emission data in a separate report to the Dutch Ministry of Economic Affairs for the benefit of the target group committee;
- communication and coordination among the parties;
- to coordinate the activities carried out as part of this long-term agreement and those which are carried out by the Gasunie as part of the Environmental Plan for Industry (MPI), so that these activities and the MPI activities reinforce each other;
- that the task group reports to the IV task force for the basic metal industry (defined in paragraph 4 of the IV)
- that the parties will cover the cost of labor as well as travel and accommodation for their representatives.

H Publicity

- that the task force will each year issue a publication describing its progress with respect to energy efficiency improvement at NIJSI. Demonstration projects are mentioned as an example. The necessary attention will be paid to more comprehensive information for stakeholder groups;
- that the task force and Novem specify how the activities will be carried out.

I 1995 and after

- that the parties will begin to evaluate whether the 10% objective will be reached no later than January 1, 1995; the parties will also investigate at this point whether follow-up agreements can be made that will lead to an energy efficiency improvement of another 10% in the period up to 2000, or that other measures are necessary to realize such an efficiency improvement.

J Novem

- that the Netherlands Organization for Energy and the Environment Inc. (Novem) will cosign this long-term agreement for sections B, F, G and H.

The Hague, May 25, 1992

Signed by:

The association of Dutch Iron and Steel Producing Industries, and Hoogovens Group Inc.

Dr. J.E. Andriessen, Minister for Economic Affairs

O.H.A. van Royen, P.E., Chairman of NIJSI and Chairman of the Board of Directors of Hoogovens Group Inc.

The Netherlands Organization for Energy and the Environment Inc. (Novem)

A.M. van Haagen, P.E., Division Manager Industry Novem

The association of Dutch Iron and Steel Producing Industries, and NEDSTAAL Inc.

C. Paganoni, P.E., Ph.D., Member of the Board of NIJSI and General Manager of NEDSTAAL Inc.

Appendix C

UK Umbrella Climate Change Agreement for the Steel Sector

THIS AGREEMENT is made the day of
BETWEEN :
(1) the Secretary of State for the Environment, Transport and the Regions ("the Secretary of State"); and
(2) UK Steel (Environmental) Limited ("the sector association").

RECITALS

Section 30 of, and Schedule 6 to, the Finance Act 2000 makes provision for a new tax known as the climate change levy. The levy will be charged on the supply of taxable commodities. Paragraph 42(1)(c) of Schedule 6 provides that the amount payable by way of levy on the supply of taxable commodities shall be 20% of the full rate if the supply is a reduced-rate supply.

Paragraphs 44 to 52 of Schedule 6 set out the circumstances in which a supply is a reduced-rate supply. To be a reduced-rate supply a supply has to be supplied to a facility which is certified by the Secretary of State as being covered by a climate change agreement.

Paragraph 46(b) of Schedule 6 provides that a climate change agreement may consist of a combination of agreements that falls within paragraph 48 of that Schedule. Paragraph 48 provides that the combination is a combination of an umbrella agreement and an underlying agreement.

This agreement is an umbrella agreement entered into for the purposes of the reduced rate of climate change levy. It is not intended to give rise to contractual obligations between the parties.
The sector association is a representative (as defined in paragraph 47(2) of Schedule 6) of each facility to which this agreement applies.

The provision for a reduction in the climate change levy in respect of taxable commodities supplied to facilities covered by a climate change agreement is subject to approval by the European Commission under the state aid rules. Approval is currently being considered by the Commission. This agreement and the underlying agreements are entered into on the assumption that state aids approval will apply to the provision for a reduction in the climate change levy throughout the duration of the agreements. Clause 9.3 makes provision for the termination of this agreement if state aids approval is not granted by the Commission or ceases to apply. Paragraph 6 of Schedule 6 makes provision for the variation of this agreement if the terms of the state aids approval are significantly different at any time during this agreement from the assumed state aid approval terms as defined in that paragraph of that Schedule.

INTERPRETATION AND NOTICES

In this agreement, unless the context otherwise requires-

> " acceptable currency" means a currency described in paragraph 5 of Schedule 2 and references to an absolute target, a relative target, a carbon target or an energy target shall be construed in accordance with that paragraph;
> "certification period" means, in relation to a facility to which this agreement applies, a period set out in Part 2 of Schedule 1 for that facility; and "first certification period" and "subsequent certification periods" means, in relation to such a facility, the first certification period and the subsequent certification periods set out in that Part of that Schedule for that facility respectively;
> "facility" shall be construed in accordance with clause 3;
> " fuel" means coal, coke, gas oil, heavy fuel oil, petrol, liquid petroleum gas, jet kerosene, ethane, naphtha, refinery gas, petroleum coke, natural gas and electricity;
> " notice" includes any document whether in paper or electronic form;
> " operator" means the operator of a facility to which this agreement applies who enters into an underlying agreement applying to the facility or a person who enters into such an agreement on the operator's behalf;
> " relevant trading limit" has the meaning given by paragraph 1.2C of Schedule 2 to the relevant underlying agreement;
> " sector" means the sector consisting of facilities which in accordance with clause 3.3 belong to the steel sector;
> " sector target" means the targets for the sector set by clause 5.2 as varied from time to time;
> "served" includes copied;
> "target period", in relation to a sector, has the meaning given by paragraph 1.1 of Schedule 2 and, in relation to a facility, has the meaning given by paragraph 1.1 of Schedule 2 to the relevant underlying agreement;
> " target unit" has the meaning given by clause 2.1 of the relevant underlying agreements;
> " termination notice" means a notice served by the Secretary of State on the sector association under clause 6.13 or 9.3 or paragraph 2.13, 4.13 or 5.12 of Schedule 6 to terminate this agreement;

"throughput" means input or output depending on how it is calculated under paragraph 4 of Schedule 2 to the relevant underlying agreement;
" underlying agreement" means an agreement applying to one or more of the facilities identified in Part 1 of Schedule 1 between the Secretary of State and the operator of the facilities to which it applies which is expressed to be entered into for the purposes of this agreement;
"variation certificate" means a variation certificate under paragraph 45 of Schedule 6 to the Finance Act 2000; and "working day" means any day other than a Saturday, Sunday, Christmas Day, Good Friday or a day falling on a bank holiday in any part of the United Kingdom.

Any notice served under this agreement shall be in writing.

A notice served on the sector association may be served by sending it by post to:

Association Company Secretary
UK Steel (Environmental) Limited,
UK Steel Association,
Millbank Tower,
21/24 Millbank,
London,
SW1P 4Q

or electronically to:

ccla@uksteel.org.uk

2.4 A notice served on the Secretary of State may be served by sending it by post to:
The Climate Change Levy Secretariat,
EEWD,
DETR,
Ashdown House,
123 Victoria St,
London SW1E 6DE,

or electronically to:

levy_agreements@detr.gsi.gov.uk

2.5 A notice served on an operator may be served in accordance with clause 2.3 of the relevant underlying agreement.

FACILITIES TO WHICH THIS AGREEMENT APPLIES

3.1 This agreement applies to the facilities identified in Part 1 of Schedule 1 but subject to the following provisions of this agreement.

3.2 A facility is only eligible at any time for inclusion in this agreement if, and to the extent that, at that time-

(a) it is a facility within the meaning of paragraph 50(2) to (6) of Schedule 6 to the Finance Act 2000;

(b) it belongs to the steel sector; and

(c) it is not included in another agreement falling within paragraph 47 of Schedule 6 to the Finance Act 2000 or another combination of agreements falling within paragraph 48 of that Schedule.

3.3 A facility belongs to the steel sector if it is a facility which is used for

manufacturing iron or steel products or carrying on related activities of a description agreed between the sector association and the Secretary of State. In this clause-

" iron" and "steel" include any alloy where the iron content is at least 50% by weight;

"iron or steel products" means-

(i) pig iron used for steelmaking or related purposes;

(ii) steel ingots, blooms, billets and slabs;

(iii) semi-finished steel for tube making;

(iv) uncoated and coated rolled products, bright steel bars, wire, tubes and pipes;

(v) railway rails and accessories (including light rails), tyres, wheels, axles, rolled steel rings, wheel-pairs, steel arches and forgings;

"manufacturing" means making, rolling, casting, forging, or drawing iron or steel.

3.4 A facility which is eligible for inclusion in this agreement may be added to the list of facilities identified in Part 1 of Schedule 1 by varying this agreement in accordance with paragraph 1 of Schedule 6.

3.5 A facility which is identified in the list of facilities in Part 1 of Schedule 1-

(a) may be removed from that list by varying this agreement in accordance with paragraph 1 of Schedule 6; and

(b) shall be removed from that list in the circumstances specified in paragraph 3.3 of that Schedule..

CERTIFICATION PERIODS

4.1 The certification periods for a facility to which this agreement and an underlying agreement apply are the periods set out in Part 2 of Schedule 1 in relation to that facility.

TARGETS AND CURRENCIES

5.1 The targets set for a facility to which this agreement and an underlying agreement apply consist of -

(a) the sector targets set by clause 5.2; and

(b) the targets set for the facility in the relevant underlying agreement.

5.2 The sector targets for the facilities to which this agreement applies are the targets set out in paragraph 1.1 of Schedule 2.

5.3 The Secretary of State shall carry out a review at the end of the year 2004 of the sector targets for the final three target periods and shall carry out a further review at the end of the year 2008 of the sector target for the final target period.

5.4 Any such review shall be to ensure that the sector targets being reviewed continue to represent the potential for cost effective energy savings taking account of any changes in technical or market circumstances.

5.5 In carrying out any such review the Secretary of State shall consult with the sector association and take account of its representations on the review.

5.6 The sector targets shall be varied, where appropriate, to take account of the results of any such review in accordance with the procedure set out in paragraph 5 of Schedule 6.

5.7 A similar approach to that adopted when the original sector targets were set shall be adopted when the targets are revised following a review under clause 5.3.

5.8 The acceptable currencies for sector targets, the conversion conventions for those

currencies and the requirement for those currencies to be co-ordinated with the currency of targets in the underlying agreements are set out in Part 2 of Schedule 2.

6. OBLIGATIONS OF THE SECTOR ASSOCIATION

6.1 The sector association shall encourage the members of the UK Steel Association who operate facilities within the sector to enter into underlying agreements with the Secretary of State.

6.2 The sector association shall not impose unreasonable requirements on non-members who operate facilities within the sector and wish to enter into underlying agreements with the Secretary of State.

6.3 The sector association shall not, in particular, impose unreasonable charges on operators or potential operators (whether members or non-members) in respect of the negotiation of this agreement or underlying agreements or the carrying out of its obligations under this agreement.

6.4 The sector association shall meet with the Secretary of State by the end of February in alternate years commencing with the year 2002 to review the operation of this agreement.

6.5 Subject to clause 6.6, by the end of January in alternate years commencing with the year 2003 the sector association shall, in relation to the most recently completed target period, supply the Secretary of State with -

(a) the information specified in Part 1 of Schedule 3; and

(b) if the sector target is not met, the information specified in Part 2 of that Schedule.

6.6 If the sector association is unable to comply with clause 6.5 because of the failure of any operator to comply with clause 6.5 of the relevant underlying agreement, the association shall -

(a) serve notice on the Secretary of State informing him that this is the case and giving the facility number of the facility concerned; and

(b) supply him with the information which would have been required if the facility had not been a facility to which this agreement applies.

6.7 Where the Secretary of State receives notice under clause 6.6(a) and is supplied with the information required by clause 6.6(b), he may terminate the relevant underlying agreement by notice under clause 9.3 of that agreement and vary the sector targets in accordance with paragraph 8 of Schedule 6.

6.8 The Secretary of State may at any time serve a notice on the sector association requesting it to supply him with such information as he may require in connection with his functions under Schedule 6 to the Finance Act 2000 within such period as may be specified in the notice (not being less than 10 working days or, if information is required from an operator, 15 working days).

6.9 Where the Secretary of State serves a notice under clause 6.8, the sector association shall supply the information requested within the period specified in the notice

6.10 The sector association may serve a notice on an operator requesting it to supply the association with such information as it requires to comply with a request from the Secretary of State for information under clause 6.8

6.11 The Secretary of State may appoint a person to undertake an independent audit of information provided by the sector association (and information provided by operators to the association) and the sector association shall co-operate with any person so appointed; and, for that purpose, the sector association shall keep proper records and make them available for inspection when required by the auditor.

6.12. Where the Secretary of State considers that the sector association has failed to comply with an obligation under this clause, he may serve a notice on the sector association identifying -

(a) the obligation which he considers has not been complied with; and

(b) the steps that he considers the sector association should take to comply with that obligation.

6.13 Where the Secretary of State serves a notice under clause 6.12 and the sector association fails to take the steps set out in the notice, he may terminate this agreement by serving a termination notice on the sector association.

6.14 A termination notice under clause 6.13 shall specify the date on which this agreement ceases to have effect (which shall be at least 10 working days after the date on which the notice is served) and this agreement shall cease to have effect on the date specified in the termination notice unless the notice is withdrawn before that date. Where this agreement ceases to have effect in this way no new certificate will be given under clause 7 for any further certification periods and any existing certificates given under that clause will be terminated by a variation certificate.

7 CERTIFICATION OF FACILITIES BY THE SECRETARY OF STATE

7.1 Subject to clause 7.8 and 7.9, the Secretary of State shall certify that a facility to which this agreement and an underlying agreement apply is covered by a climate change agreement for the first certification period for that facility.

7.2 Subject to clause 7.8 and 7.9, the Secretary of State shall certify that a facility to which this agreement and an underlying agreement apply is covered by a climate change agreement for a subsequent certification period for that facility if it appears to him that progress made in the immediately preceding certification period towards meeting the targets set for the facility is satisfactory.

7.3 For the purpose of clause 7.2, progress made in an immediately preceding certification period towards meeting the targets set for a facility is to be taken as being satisfactory if -

(a) the sector target for the target period falling within the immediately preceding certification period has been met;

(b) the target set for the facility in the relevant underlying agreement for that target period has been met and -.

(i) there is not a tolerance band in the underlying agreement in relation to that target;

(ii) there is such a tolerance band but the target has been met without needing to take account of it; or

(iii) there is such a tolerance band, the target has only been met by taking account of it and the circumstances are as set out in clause 7.4(a); or

(c) the circumstances are as set out in clause 7.4(a) and either (b) or (c).

7.4 The circumstances mentioned in clause 7.3 are that-

(a) the qualitative requirements set for the facility in the relevant underlying agreement for the purpose of this clause have been met;

(b) the target set for the facility in the relevant underlying agreement for the target period falling within the immediately preceding certification period has not been met because of a relevant constraint or requirement which had a major impact on the performance of the operator of the facility and prevented the target from being achieved;

(c) no trading scheme has been established or approved by the Secretary of State for the purposes of paragraph 1.3 of Schedule 2 to the relevant underlying agreement.

7.5 In clause 7.4(b) "relevant constraint or requirement" means, in relation to a target-

(a) a constraint or requirement imposed by or under town and country planning, environmental, health and safety or food hygiene legislation;

(b) a constraint or requirement imposed on the construction or operation of a combined heat and power plant under section 14 of the Energy Act 1976 or section 36 of the Electricity Act 1989; or

(c) a constraint imposed by the gas or electricity network, where the constraint or requirement is inconsistent with an assumption used for setting or reviewing the target.

7.6 In clause 7.5 "constraint" includes a delay.

7.7 Where the Secretary of State certifies that a facility to which this agreement applies is covered by a climate change agreement for a certification period he shall give a certificate to the Commissioners of Customs and Excise stating that for that period the facility is to be taken as being covered by a climate change agreement and shall copy that certificate to the sector association and to the operator of the facility. A copy of any relevant variation certificate given to the Commissioners of Customs and Excise shall also be copied to the sector association and the operator of the facility.

7.8 The Secretary of State will not certify that a facility to which this agreement applies is covered by a climate change agreement (or where a certificate has already been issued, will issue a variation certificate) if -

(a) the facility is by virtue of clause 3.2 not eligible for inclusion in this agreement; or

(b) the conditions for issuing a certificate under clause 7.1 or 7.2 are not met; or

(c) the facility is excluded from this agreement under paragraph 1.3 or 3.3 of Schedule 6.

7.9 The Secretary of State may decide not to certify that a facility to which this agreement applies is covered by a climate change agreement (or where a certificate has already been issued, decide to issue a variation certificate) if -

(a) the sector association has failed to supply him with the information required in relation to that facility or the information supplied is incomplete or inaccurate;

(b) the sector association or the operator of the facility has failed -

(i) to co-operate with a person appointed under clause 6.11 in relation to the carrying out of an audit of information provided in relation to that facility; or

(ii) to keep proper records for that purpose or make them available for inspection by the auditor;

(c) the operator of the facility has failed to comply with any obligation in clause 6 of the underlying agreement applying to the facility; or

(d) the sector association or the operator fails to meet its share of the costs of an adjudication in relation to which it is a party.

7.10 Subject to clause 7.12, where the Secretary of State is minded not to certify that a facility to which this agreement applies is covered by a climate change agreement (or where a certificate has already been issued, he is minded to issue a variation certificate), he shall serve a notice on the sector association and the operator of the facility stating that he is so minded and setting out his reasons.

7.11 Where the Secretary of State serves a notice under clause 7.10, the sector association or the operator may, not more than 10 working days following receipt of that notice, serve a notice on the Secretary of State (copied to the sector association or the operator, as the case may be) setting out why the server of the notice considers that the Secretary of State should certify that the facility is covered by a climate change agreement (or not issue a variation certificate) and, where such a notice is served, the dispute procedure set out in Schedule 4 shall apply.

7.12 Clause 7.10 shall not apply where -

(a) a termination notice has been served either under this agreement or under the relevant underlying agreement in relation to the facility; or

(c) the facility concerned is no longer a facility to which an underlying agreement applies.

8 CONFIDENTIALITY

8.1 The Secretary of State shall be entitled to publish, without the sector association's consent, this agreement and a list of the facilities in Part 1 of Schedule 1 which are certified under clause 7 as being covered by a climate change agreement.

8.2 The Secretary of State shall be entitled to disclose, without the sector association's consent, any other information relating to this agreement in the following circumstances -

(a) where the disclosure is made under and in accordance with the terms of any legislation;

(b) where the disclosure is made to a relevant authority for the purposes of-

(i) the Secretary of State's functions under Schedule 6 to the Finance Act 2000; or

(ii) the authority's functions; or

(c) where the disclosure is made in the course of legal proceedings.

8.3 In clause 8.2(a) "legislation" means primary or secondary legislation and includes legislation of the European Community.

8.4 The Secretary of State shall consult the sector association before making any disclosure under clause 8.2 where he considers it appropriate in the circumstances to do so.

8.5 Save as provided for in clause 8.1 and 8.2, the Secretary of State shall only disclose information relating to this agreement with the consent of the sector association.

8.6 The relevant authorities referred to in clause 8.2(b) are -

(a) either House of Parliament (including any committee);.Umbrella Climate Change Agreement for the Steel Sector PP2.02 11

(b) the European Commission;

(c) the Commissioners of Customs and Excise;

(d) the relevant environmental regulator for a facility under Part I of the Environmental Protection Act 1990 or regulations made under section 2 of the Pollution Prevention and Control Act 1999 or corresponding legislation for Northern Ireland;

(e) any person appointed by the Secretary of State under clause 6.11 to undertake an audit of information provided by the sector association; and

(f) the authorities charged with regulating under the Competition Act 1998.

8.7 The Secretary of State shall take steps to prevent any person, whom he appoints under clause 6.11 to undertake an audit, from disclosing information obtained in carrying out the audit to any one other than the Secretary of State, except to the extent needed to carry out the audit.

9 DURATION OF THIS AGREEMENT

9.1 Subject to clause 9.2, this agreement shall continue in force from the date on which it is made until 31 st March 2013.

9.2 This agreement may be terminated before 31 st March 2013 –

(a) by notice served by the sector association on the Secretary of State; or

(b) by a termination notice served by the Secretary of State on the sector association in accordance with clause 6.13 or 9.3 or paragraph 2.13, 4.13 or 5.12 of Schedule 6.

9.3 If state aids approval for the reduction in climate change levy in respect of taxable commodities supplied to facilities covered by this agreement is not granted by the European Commission or ceases to apply, the Secretary of State may terminate this agreement by serving a termination notice on the sector association.

9.4 A termination notice under clause 9.3 shall specify the date on which this agreement ceases to have effect (which shall be at least 10 working days after the date on which the notice is served) and this agreement shall cease to have effect on the date specified in the termination notice unless the notice is withdrawn before that date. Where this agreement ceases to have effect in this way, no new certificate will be given under clause 7 for any further certification periods and any existing certificates given under that clause will be terminated by a variation certificate

10 VARIATION OF AGREEMENT

10.1 Subject to clause 10.2, any provision of this agreement may be varied by agreement of the Secretary of State and the sector association in accordance with Part 1 of Schedule 6.

10.2 The sector targets and the currency of the targets shall be varied in accordance with Part 2 of Schedule 6 but, save as otherwise expressly provided in this agreement, no variation of the sector targets or the currency of the targets shall be made. Signed by authority of Signed on behalf of the the Secretary of State sector association

SCHEDULE 1

FACILITIES TO WHICH THIS AGREEMENT APPLIES AND CERTIFICATION PERIODS

PART 1
LIST OF FACILITIES

Facility number	Operator of facility	Address of facility	Description of facility (Eligibility form dated)
UKSA/ASW/00001	Allied Steel & Wire Ltd	Tremorfa Steel Works Site, PO Box 37, Tremorfa, Cardiff, CF24 5YX	26 October 2000
UKSA/ASW/00002	Allied Steel & Wire Ltd	Cardiff Rod and Bar Mill, PO Box 83, Castle Works, Cardiff, CF24 5XQ	26 October 2000
UKSA/ASW/00003	Allied Steel & Wire Ltd	Sheerness Steel Works Site, Wellmarsh, Sheerness, Kent, ME12 1TH	26 October 2000
UKSA/AVEST/1	Avesta Sheffield Ltd	Avesta Sheffield Ltd PO Box 161, Shepcote Lane, Sheffield S9 1TR	10 November 2000
UKSA/AVEST/2	Avesta Sheffield Ltd	Alloy Steel Rods, Stevenson Road, Sheffield, S9 3XG	2 November 2000
UKSA/AVEST/3	Avesta Sheffield Ltd	Precision Strip Meadow Hall Site, Trubrite Works, PO Box 54, Meadow Hall, Sheffield S9 1TR	10 November 2000
UKSA/AVEST/4	Avesta Sheffield Ltd	Precision Strip Stocksbridge Site, PO Box 402, Stocksbridge, Sheffield, S36 2JY	10 November 2000
UKSA/AVEST/5	Avesta Sheffield Ltd	Panteg Works, PO Box 1, Griffithstown, Pontypool, Gwent, NP4 5YH	10 November 2000
UKSA/BRID/001	Bridon International	Carr Hill, Doncaster, DN4 8DG	14 November 2000
UKSA/Foxw/1	Bridon Wire Special Steels Division	Sheephouse Wood, Stocksbridge, Sheffield, S36 4GS	13 November 2000
UKSA/BISC/01	Bromford Iron and Steel Co Ltd	Bromford Iron and Steel Co Ltd, Bromford Lane, West Bromwich, B70 7JJ	7 November 2000
UKSA/CORUS/001	Corus Plc	Corus Strip UK, Abbey General Offices, Port Talbot Works, Port Talbot, SA13 2NG	20 October 2000
UKSA/CORUS/002	Corus Plc	Corus Strip UK, Llanwern Works, Newport, South Wales, NP19 4QZ	20 October 2000

UKSA/CORUS/010	Corus Plc	Corus Construction & Industrial, Teesside Cast Products Headquarters, Redcar Works, Redcar, TS10 5QW	23 October 2000
UKSA/CORUS/020	Corus Plc	Corus Construction & Industrial, PO Box No 1, Brigg Road, Scunthorpe, DN16 1BP	23 October 2000
UKSA/CORUS/021	Corus Plc	Corus Construction & Industrial, Immingham Bulk Terminal, Humber Road, South Killingholme, North Lincolnshire, DN40 3LZ	23 October 2000
UKSA/CORUS/024	Corus Plc	Corus Construction & Industrial, Dalzell Works, Part Street, Motherwell, Lanarkshire, ML1 1PU	23 October 2000
UKSA/CORUS/025	Corus Plc	Corus Construction & Industrial, Clydebridge Works, Cambuslang, Glasgow, G72 7TX	23 October 2000
UKSA/CORUS/030	Corus Plc	Corus Engineering Steels, Rotherham Works, PO Box 50, Aldwarke Lane, Rotherham, South Yorkshire, S60 1DW	23 October 2000
UKSA/CORUS/031	Corus Plc	Corus Engineering Steels, Stocksbridge Works, Stocksbridge, Sheffield, S36 2JA	23 October 2000
UKSA/CORUS/032	Corus Plc	Corus Engineering Steels, Tinsley Park Mill, Shepcote Lane, Sheffield, S9 1US	23 October 2000
UKSA/CORUS/040	Corus Plc	Corus Rail, Moss Bay, Derwent Howe, Workington, CA14 5AE	6 November 2000
UKSA/CORUS/050	Corus Plc	Corus Special Strip, Plated Strip International, Wharfdale Road, Tyseley, Birmingham, B11 2DL	16 October 2000

UKSA/CORUS/051	Corus Plc	Corus Special Strip, Brinsworth Strip Mills, PO Box 69, Sheffield Road, Rotherham, S60 1SZ	17 October 2000
UKSA/CORUS/060	Corus Plc	Corus Packaging Plus, Ebbw Vale Works, Gwent, NP23, 6XD	24 October 2000
UKSA/CORUS/061	Corus Plc	Corus Packaging Plus, Trostre Works, Llanelli, Carmarthenshire, SA14 9SD	23 October 2000
UKSA/CORUS/070	Corus Plc	Corus Colors, Shotton Works, Deeside, Flintshire, CH5 2NH	19 October 2000
UKSA/CORUS/071	Corus Plc	Corus Colors, Cookley Works, PO Box 13, Brockmoor, Brierley Hill, West Midlands, DY5 3UT	19 October 2000
UKSA/CORUS/072	Corus Plc	Corus Colors, Bryngwyn Works, Gorseinon, West Glamorgan, SA4 2JA	19 October 2000
UKSA/CORUS/073	Corus Plc	Corus Colors, Consumer Products (Tafarnaubach Works), Tafarnaubach Industrial Estate, Tredegar, Gwent, NP2 3XX	19 October 2000
UKSA/CORUS/074	Corus Plc	Corus Colors, Aluminised Products, Glamorgan Works, Pontardulais, Swansea, SA4 1SB	19 October 2000
UKSA/CORUS/075	Corus plc	Corus Colors, Firsteel Coated Strip, Brockhurst Crescent, Bescot, Walsall, West Midlands, WS5 4AX	19 October 2000
UKSA/CORUS/080	Corus Plc	Orb Electrical Steels, Orb Works, PO Box 30, Newport, South Wales, NP19 0XT	16 October 2000
UKSA/CORUS/100	Corus Plc	Corus Foundry, New Stevenson Works, Stevenson Street, Motherwell, Lanarkshire, ML1 4LS	27 October 2000
UKSA/CORUS/101	Corus Plc	Corus Special Profiles PO Box 1 Skinningrove Saltburn by the Sea TS14 4ET	10 November 2000
UKSA/CORUS/102	Corus Plc	Corus Special Profiles Corus Trailers Whessoe Road Darlington DL3 0RG	14 November 2000

UKSA/CORUS/103	Corus Plc	Corus Special Profiles, Metal Services Division – Foundry, PO Box 1, Salterbeck Trading Estate, Moorclose Road, Workington, CA14 5DY	8 November 2000
UKSA/CORUS/110	Corus Plc	Corus Construction & Industrial, Shapfell Limestone Quarries, Shap, Penrith, Cumbria, CA10 3QG	20 October 2000
UKSA/CORUS/120	Corus Plc	Corus Tubes, Corby Tubeworks, PO Box 101, Weldon Road, Corby, Northants, NN17 5UA	19 October 2000
UKSA/CORUS/121	Corus Plc	Corus Tubes, Hartlepool 20" Pipe Mill, Brenda Road, Hartlepool, Teesside, TS25 2EG	19 October 2000
UKSA/CORUS/122	Corus Plc	Corus Tubes, Stockton 84" Mill, Marston Road, off Portrack Lane, Stockton-on-Tees, Teesside, TS18 2NF	18 October 2000
UKSA/CORUS/123	Corus Plc	Corus Tubes, Broadwell Works, Birmingham Road, Oldbury, West Midlands, B69 4DA	18 October 2000
UKSA/CORUS/131	Corus Plc	Corus European Market Unit, Badminton Road, Trading Estate, Yate, Bristol, BS17 5JU	27 October 2000
UKSA/CORUS/132	Corus Plc	Corus European Market Unit, Farningham Road Station, South Darenth, Nr Dartford, Kent, DA4 9LD	26 October 2000
UKSA/CORUS/133	Corus plc	Corus European Market Unit, Spittlegate Industrial Estate, Grantham, Lincs, NG31 7UP	26 October 2000
UKSA/CORUS/135	Corus Plc	Corus Service Centre Lisburn, Moira Road, Co Antrim, Northern Ireland, BT28 2SN	29 November 2000
UKSA/CORUS/136	Corus Plc	Corus European Market Unit, Steelpark Way, Wednesfield, Wolverhampton, WV11 3SQ	27 October 2000
UKSA/CCCL/1	Frederick Cooper plc	Cooper Coated Coil Ltd, Greatbridge Street, West Bromwich, West Midlands, B70 0DJ	24 November 2000

UKSA/KPSWW/1	Kiveton Park Steel Ltd	Kiveton Park, Sheffield, S26 6NQ	13 October 2000
UKSA/LEGG/01	Legg Brothers Ltd	Legg Brothers Ltd, Spring Road, Wolverhampton, WV4 6JT	7 November 2000
UKSA/NIAG/1	Niagara Lasalle Hot Rolled Bar	Ductile Wesson, Victoria Steel Works, Bull Lane, Moxley, Wednesbury, West Midlands, WS10 8RS	6 November 2000
UKSA/NIAG/2	Niagara Lasalle Hot Rolled Bar	Gadd, Peartree Lane, Woodside, Dudley, West Midlands, DY2 0QS	6 November 2000
UKSA/NIAG/3	Niagara Lasalle Hot Rolled Bar	Dudley Port, Lower Church Lane, Tipton, West Midlands, DY4 7PL	6 November 2000
UKSA/FORGE/1	Sheffield Forgemasters Group	Sheffield Forgemasters Engineering Ltd, River Don, PO Box 286, Brightside Lane, Sheffield, S9 2RW	27 October 2000
UKSA/FORGE/2	Sheffield Forgemasters Group	Sheffield Forgemasters Rolls Ltd, Weston Road, Crewe, CW1 6DB	27 October 2000
UKSA/FORGE/3	Sheffield Forgemasters Group	Sheffield Forgemasters Rolls Ltd, Meadow Works, Calder Street, Coatbridge, ML5 4RR	27 October 2000
UKSA/Tim/0001	Timken Desford Steel Ltd	Kirby Muxloe, Leicester, LE9 2BJ	7 November 2000
UKSA/TWIL/001	Tinsley Wire Ltd	PO Box 119, Shepcote Lane, Sheffield, S9 1TY	30 October 2000
UKSA/UNSCO/1	UNSCO Steels Ltd	Manor Road, Kiveton Park, Sheffield, S26, 6PB	25 October 2000

PART 2
CERTIFICATION PERIODS

1 The first certification period for the facilities listed above is 1st April 2001 to 31st March 2003.

1 The subsequent certification periods for those facilities are –

(a) 1st April 2003 to 31st March 2005;
(b) 1st April 2005 to 31st March 2007;
(c) 1st April 2007 to 31st March 2009;
(d) 1st April 2009 to 31st March 2011; and
(e) 1st April 2011 to 31st March 2013.

SCHEDULE 2
SECTOR TARGETS AND CURRENCIES
PART 1
SECTOR TARGETS

1 Sector targets

1.1 The sector targets are set out in the following Table.

Target period	Sector target
1st January 2002 to 31st December 2002	388.3 PJ
1st January 2004 to 31st December 2004	376.6 PJ
1st January 2006 to 31st December 2006	368.8 PJ
1st January 2008 to 31st December 2008	365.0 PJ
1st January 2010 to 31st December 2010	360.8 PJ

1.2 The sector target for a target period shall be adjusted to reflect-

(a) any adjustments made under paragraph 1.3 of Schedule 2 to the relevant underlying agreements in relation to the facilities in the sector; and

(b) any adjustment made under paragraph 1.2A or 1.2B of Schedule 2 to the relevant underlying agreement.

1.3 For the purpose of determining whether a sector target has been met, the sector shall be treated as consisting of the facilities to which this agreement and the underlying agreements apply.

1.4 For the purpose of determining whether a sector target has been met, the units of energy used by the facilities in the sector, the units of carbon emitted from those facilities and the throughput of those facilities shall be calculated in accordance with the following paragraphs of this Part of this Schedule.

1.5 Where the target period for a target unit under a relevant underlying agreement is different from the target period for the sector targets but overlaps with that period, the figures for the target unit which are relevant to that overlapping period shall be used for the purposes of determining under those paragraphs whether the relevant sector target has been met and this agreement shall apply in relation to that target unit with appropriate modifications.

2 Calculation of units of energy used by sector

2.1 The total number of units of energy used by the facilities in the sector during a target period shall be the sum of the units of energy used by those facilities during that target period calculated in accordance with paragraph 2 of Schedule 2 to the relevant underlying agreements.

2.2 The units of energy used shall be measured in petajoules.

3. Calculation of carbon emissions from sector

3.1 The total number of units of carbon emitted from the facilities in the sector during a target period shall be the sum of the units of carbon emitted from those facilities during that target period calculated in accordance with paragraph 3 of Schedule 2 to the relevant underlying agreements. 3.2 The units of carbon emitted shall be expressed as kilogrammes of mass carbon (rather than carbon dioxide).

4. Calculation of throughput of sector

4.1 The total throughput of the facilities in the sector to which this agreement and the underlying agreements apply during a target period shall be the sum of the throughput of those facilities during that target period calculated in accordance with paragraph 4 of Schedule 2 to the relevant underlying agreements.

PART 2
CURRENCIES

5. Acceptable currencies

5.1 The acceptable currencies for the sector targets in Part 1 of this Schedule are –

(a) for an absolute carbon target, carbon emitted during the target period;
(b) for an absolute energy target, energy used during the target period;
(c) for a relative carbon target, carbon emitted during the target period per unit of throughput during that period; and
(d) for a relative energy target, energy used during the target period per unit of throughput during that period.

6. Conversion conventions for currencies

6.1 The conversion conventions for the currencies set out in paragraph 5 are as follows.

Converting an energy target to a carbon target

6.2 To convert an energy target to a carbon target multiply the energy target by the relevant carbon emission factors as follows: Carbon target = Energy target x ((assumed percentage of electricity x electricity carbon emission factor) + (assumed percentage of gas x gas carbon emission factor) + (assumed percentage of coal x coal carbon emission factor) + (assumed percentage of oil x oil carbon emission factor) + (assumed percentage of other fuels x relevant carbon emission factors for those fuels)).

Converting a carbon target to an energy target

6.3 To convert a carbon target to an energy target divide the carbon target by the relevant carbon emission factors as follows: Energy target = Carbon target / ((assumed percentage of electricity x electricity carbon emission factor) + (assumed percentage of gas x gas carbon emission factor) + (assumed percentage of coal x coal carbon emission factor) + (assumed percentage of oil x oil carbon emission factor) + (assumed percentage of other fuels x relevant carbon emission factors for those fuels)).

Converting a relative target to an absolute target

6.4 To convert a relative target to an absolute target multiply the relative target by the

assumed throughput during the target period to get the absolute target.

Converting an absolute target to a relative target

6.5 To convert an absolute target to a relative target divide the absolute target by the assumed throughput during the target period to get the relative target.

6.6 For the purpose of this paragraph -

(a) the carbon emission factors for each fuel shall be the carbon emission factors for those fuels set out in the Table in paragraph 3.1 of Schedule 2 to the relevant underlying agreements;

(b) the assumed percentage of a fuel is the percentage of the total number of units of energy used by the facilities to which the target applies during the relevant target period which are assumed to be units of energy from that fuel and shall be agreed by the Secretary of State and the sector association before each application of the convention or, in default of agreement, specified by the Secretary of State in a notice served on the sector association; and

(c) the assumed throughput for the relevant target period shall be agreed by the Secretary of State and the sector association before each application of the convention or, in default of agreement, specified by the Secretary of State in a notice served on the sector association.

7. Co-ordination of currencies in this agreement with underlying agreements

7.1 The currency of the sector targets shall be co-ordinated with the currency of the targets in the underlying agreements as follows –

(a) if more than 50% of underlying agreement targets in a target period are absolute targets, the sector targets for the following target periods shall also be absolute targets;

(b) if more than 50% of the underlying agreement targets in a target period are relative targets, the sector targets for the following target periods shall also be relative targets;

(c) if more than 50% of the underlying agreement targets in a target period are carbon targets, the sector targets for the following target periods shall also be carbon targets; and

(d) if more than 50% of the underlying agreement targets in a target period are energy targets, the sector targets for the following target periods shall also be energy targets.

7.2 For the purposes of paragraph 7.1, the percentage of targets for a target period which are absolute or relative targets or carbon or energy targets shall be determined by reference to the total units of energy used by the relevant facilities in that period calculated in accordance with paragraph 2 of Schedule 2 to the relevant underlying agreements.

SCHEDULE 3
INFORMATION TO BE SUPPLIED TO THE SECRETARY OF STATE
PART 1
INFORMATION REQUIRED WHETHER OR NOT SECTOR TARGET IS MET

The information required by clause 6.5(a) is as follows -

1. The total number of units of energy used by relevant facilities during the relevant

target period calculated in accordance with paragraph 2 of Schedule 2 with a sufficient breakdown of that information to determine whether the currencies of the sector targets need to be changed under paragraph 7 of that Schedule.

2. If the sector target for the relevant target period is a carbon target, the total number of units of carbon emitted from the relevant facilities during that period calculated in accordance with paragraph 3 of Schedule 2

3. The total throughput for the relevant facilities in the sector for the relevant target period calculated in accordance with paragraph 4 of Schedule 2.

4. The adjustment to be made to the sector target for the relevant target period in accordance with paragraph 1.2 of Schedule 2.

5. For each target unit with an absolute target for the relevant target period, the throughput of that target unit during that period calculated in accordance with paragraph 4 of Schedule 2 to the relevant underlying agreement.

PART 2

INFORMATION REQUIRED ONLY IF SECTOR TARGET IS NOT MET

The information required by clause 6.5(b) is as follows -

6. For each target unit, the total number of units of energy used during the relevant target period by the target unit in relation to each type of fuel calculated in accordance with paragraph 2 of Schedule 2 to the relevant underlying agreement.

7. For each target unit with a carbon target for the relevant target period, the total number of units of carbon emitted from the target unit during that period calculated in accordance with paragraph 3 of Schedule 2 to the relevant underlying agreement.

8. For each target unit with a relative target for the relevant target period, the throughput of that target unit during that period calculated in accordance with paragraph 4 of Schedule 2 to the relevant underlying agreement.

9. For each target unit where the target is to be adjusted under paragraph 1.2, 1.2A, 1.2B or 1.3 of Schedule 2 to the relevant underlying agreement, the information needed to calculate the adjustment.

10. For each operator which relies on clause 7.4(a), a copy of its energy plan and a description of the steps taken to implement the plan.

11. For each operator which relies on clause 7.4(b), details of the relevant constraint or requirement and of its impact on the performance of the operator.

SCHEDULE 4

CERTIFICATION DISPUTE RESOLUTION 1.

1. Where the Secretary of State receives a notice under clause 7.11 he shall, not more than 10 working days after receiving the notice, serve notice on the sector association and the operator stating whether or not he intends to change his proposed decision and, if not, setting out his reasons..

2. Where the Secretary of State serves notice on the sector association and the operator under paragraph 1 that he does not intend to change his proposed decision and there is a dispute on the facts, the sector association or the operator may, not more than 10 working days after service of the notice, refer the dispute for adjudication to an

institution named on the list prepared under paragraph 1 of Schedule 5 and that Schedule shall apply in relation to the adjudication. A notice stating that there has been any such referral shall be served by the party making the referral on the other parties to the dispute.

3. Each party to the dispute shall have 20 working days from the date on which they receive notice from the nominated adjudicator of the address to which representations should be sent to make representations to the nominated adjudicator. Any such representations shall be copied by the party making the representations to the other parties to the dispute.

4. The adjudicator may request further information from any of the parties to the dispute. Any such request shall be in writing, shall specify the date by which the information is required and shall be copied to the other parties to the dispute. Any information provided in response to such a request shall be copied by the party providing the information to the other parties to the dispute.

5. The adjudicator will, on the basis of the representations provided to him and any additional information he considers to be necessary, make a finding on the disputed questions of fact and notify the parties of that finding. The adjudicator's finding on the disputed questions of fact shall be binding on the parties.

6. Not more than 5 working days after the receipt of the adjudicator's finding, the Secretary of State shall serve notice on the sector association and the operator stating whether or not he intends to change his proposed decision and, if not, setting out his reasons.

SCHEDULE 5
ADJUDICATORS

1. A person who wishes to refer a dispute on the facts to an institution for adjudication may refer that dispute to one of the institutions named in a list agreed by the sector association and the Secretary of State or, in default of agreement, prepared by the Secretary of State and served on the sector association.

2. Where a dispute is referred to one of the institutions named in the list mentioned above, that institution shall nominate a person to carry out the adjudication.

3. The nominated adjudicator shall notify the parties of his appointment and shall inform them of the address to which representations are to be sent..

4. Subject to express provisions of this agreement on procedural matters in relation to the adjudication, it shall be for the nominated adjudicator to determine the procedure which is to be followed in relation to the adjudication but in doing so-

(a) he shall take account of the wishes of the parties;

(b) he may take expert advice, after consulting the parties, to assist him with the adjudication;

(c) he shall ensure that each party has an adequate opportunity to respond to any representations made by the other party, and any evidence, that he proposes to take into account; and

(d) he may impose or extend any time limit for any action to be taken by any party to the dispute and may proceed with the adjudication in such manner as he considers appropriate in the circumstances if a time limit is not complied with.

5. The parties to the adjudication shall bear their own costs.

6. The cost of the adjudication shall be shared equally between the parties.

SCHEDULE 6
VARIATIONS
PART 1
GENERAL VARIATIONS

1. General variations

1.1 Where a party to this agreement wishes to vary any of its provisions other than the sector targets or the currency of the targets, it may serve a notice on the other party setting out the variation and the reasons for the variation.

1.2 A party which receives a notice under paragraph 1.1 shall have 20 working days after its receipt to respond in writing.

1.3 Where the variation is agreed this agreement shall be varied accordingly.

1.4 Any notice served under paragraph 1.1 or 1.2 and any variation agreed shall be copied to the operator of every facility to which this agreement applies.

PART 2
VARIATION OF SECTOR TARGET PROVISIONS

2. Variation of sector targets due to inclusion or exclusion by agreement of a facility

2.1 Subject to paragraph 2.3(b), sector targets shall be varied in accordance with the following provisions of this paragraph where -

(a) in the case of relative and absolute targets, a facility is included in the list of facilities in Part 1 of Schedule 1 by means of a variation of this agreement in accordance with paragraph 1 and that facility is identified in an underlying agreement;

(b) in the case of relative targets, a facility has been excluded from the list of facilities in Part 1 of Schedule 1 by means of a variation of this agreement in accordance with paragraph 1 and that facility was identified in an underlying agreement.

2.2 Any variation of sector targets required by paragraph 2.1(a) or (b) shall be effected at the end of the first target period which ends after the inclusion or exclusion (the "relevant target period").

2.3 The sector targets for the relevant target period and for any subsequent target periods shall be varied to reflect -(a) in the case of absolute targets, all inclusions in the sector of facilities not previously taken into account; (b) in the case of relative targets, all inclusions in and exclusions from the sector of facilities not previously taken into account where these affect the overall product mix but not otherwise.

2.4 Where a variation to sector targets is required by this paragraph, the Secretary of State shall, not more than 5 working days after receiving the information mentioned in paragraph 3 of Schedule 3, serve a notice on the sector association and on all operators stating the variation that he proposes should be made to the sector targets.

2.5 The sector association and operators shall each have 5 working days after receipt of a notice under paragraph 2.4 to serve notice of its response on the Secretary of State.

2.6 If the Secretary of State and the sector association agree on a variation of the sector targets, the targets shall be varied accordingly.

2.7 If the sector association and the Secretary of State fail to agree on a variation of the sector targets within the period of 5 working days mentioned in paragraph 2.5 and

there is a dispute on the facts, either party may refer the dispute for adjudication to an institution named on the list prepared under paragraph 1 of Schedule 5 and that Schedule shall apply in relation to the adjudication.

2.8 Notice of any such referral shall be served by the party making the referral on the other party.

2.9 Each party to the dispute shall have 5 working days from the date on which they receive notice from the nominated adjudicator of the address to which representations should be sent to make representations to the nominated adjudicator. Any such representations shall be copied by the party making the representations to the other party to the dispute.

2.10 The adjudicator may request further information from either party to the dispute. Any such request shall be in writing, shall specify the date by which the information is required and shall be copied to the other party to the dispute. Any information provided in response to such a request shall be copied by the party providing the information to the other party to the dispute.

2.11 The adjudicator will, on the basis of the representations provided to him and any additional information he considers to be necessary, make a finding on the disputed questions of fact and notify the parties of that finding.

2.12 The adjudicator's finding on the disputed questions of fact shall be binding on the parties but it shall be for the parties to agree, in the light of such finding, on the variation required and if agreement is reached, the targets shall be varied accordingly.

2.13 Where, despite any finding made by the adjudicator, the Secretary of State and the sector association fail to agree the variation of the sector targets, the Secretary of State may terminate this agreement by serving a termination notice on the sector association.

2.14 A termination notice under paragraph 2.13 shall specify the date on which this agreement ceases to have effect (which shall be at least 10 working days after the date on which the notice is served) and shall be accompanied by a statement setting out the Secretary of State's reasons for not agreeing with the sector association on the variation required.

2.15 Where the Secretary of State serves a termination notice under paragraph 2.13, this agreement shall cease to have effect on the date specified in the notice unless the notice is withdrawn before that date. Where this agreement ceases to have effect in this way, no new certificate will be given under clause 7 for any further certification periods and any existing certificates given under that clause will be terminated by a variation certificate. Where a termination notice is withdrawn, the targets shall be varied to reflect any agreement reached between the Secretary of State and the sector association.

3. Variation of agreement and sector targets to reflect ineligibility exclusions

3.1 This agreement shall be varied in accordance with the following provisions of this paragraph-

(a) to exclude a facility (or part of it) which has been excluded from a relevant underlying agreement on the basis that it was not eligible for inclusion in that agreement; and

(b) to vary the sector targets to take account of the exclusion.

3.2 The Secretary of State shall serve notice on the sector association and the operators specifying the facility or part to be excluded and setting out the variations which he considers should be made to this agreement to take account of the exclusion,

including any variation of the sector targets, and inviting representations from the sector association and the operators within 20 working days.

3.3 After considering any representations made the Secretary of State shall serve a further notice on the sector association and the operators specifying the facility or part to be excluded and setting out the variations which he considers should be made to this agreement to take account of the exclusion, including any variation of the sector targets, and this agreement shall be varied in accordance with that notice without any further action being required. Where this agreement is varied in this way, a variation certificate will be issued if necessary to reflect the exclusion.

4. Variation of absolute sector targets due to fall of throughput

4.1 Where the annual level of throughput of the sector during a target period (the "relevant target period") calculated in accordance with paragraph 4 of Schedule 2 is less than 90 per cent of the annual throughput of the sector when the sector targets were set, the sector targets shall be varied to take account of that fall in throughput if they are absolute targets.

4.2 For the purpose of paragraph 4.1, the annual level of throughput of the sector when the sector targets were set is the level of throughput of facilities in the sector-

(a) if there has not been a relevant variation, in the year 1999; or

(b) if there has been a relevant variation, in the target period which immediately preceded the variation or, if there has been more than one such variation, the last one. "Relevant variation" means any variation other than one under paragraph 6 and does not include an adjustment under paragraph 1.2 of Schedule 2.

4.3 Any variation of an absolute sector target required by paragraph 4.1 shall be effected at the end of the relevant target period. The absolute sector targets for the relevant target period and for any subsequent target periods shall be varied.

4.4 Where a variation to sector targets is required by paragraph 4.1, the Secretary of State shall, not more than 5 working days after receiving the information mentioned in paragraph 3 of Schedule 3, serve a notice on the sector association and all operators stating the variation which he proposes should be made to the sector targets

4.5 The sector association or an operator shall respond, not more than 5 working days after receipt of a notice under paragraph 4.4, by serving a notice of its response on the Secretary of State.

4.6 If the Secretary of State and the sector association agree on a variation of the sector targets, the targets shall be varied accordingly.

4.7 If the sector association and the Secretary of State fail to agree on a variation of the sector targets within the period of 5 working days mentioned in paragraph 4.5 and there is a dispute on the facts, either party may refer the dispute for adjudication to an institution named on the list prepared under paragraph 1 of Schedule 5 and that Schedule shall apply in relation to the adjudication.

4.8 Notice of any such referral shall be served by the party making the referral on the other party.

4.9 Each party to the dispute shall have 5 working days from the date on which they receive notice from the nominated adjudicator of the address to which representations should be sent to make representations to the nominated adjudicator. Any such representations shall be copied by the party making the representations to the other party to the dispute.

4.10 The adjudicator may request further information from either party to the dispute. Any such request shall be in writing, shall specify the date by which the information is required and shall be copied to the other party to the dispute. Any information provided in response to such a request shall be copied by the party providing the information to the other party to the dispute.

4.11 The adjudicator will, on the basis of the representations provided to him and any additional information he considers to be necessary, make a finding on the disputed questions of fact and notify the parties of that finding.

4.12 The adjudicator's finding on the disputed questions of fact shall be binding on the parties but it shall be for the parties to agree, in the light of such finding, on what variation is required and if agreement is reached, the targets shall be varied accordingly.

4.13 Where, despite any finding made by the adjudicator, the Secretary of State and the sector association fail to agree the variation of the sector targets, the Secretary of State may terminate this agreement by serving a termination notice on the sector association.

4.14 A termination notice under paragraph 4.13 shall specify the date on which this agreement ceases to have effect (which shall be at least 10 working days after the date on which the notice is served) and shall be accompanied by a statement setting out the Secretary of State's reasons for not agreeing with the sector association on the variation required..

4.15 Where the Secretary of State serves a termination notice under paragraph 4.13, this agreement shall cease to have effect on the date specified in the notice unless the notice is withdrawn before that date. Where this agreement ceases to have effect in this way no new certificate will be given under clause 7 for any further certification periods and any existing certificates given under that clause will be terminated by a variation certificate. Where a termination notice is withdrawn, the targets shall be varied to reflect any agreement reached between the Secretary of State and the sector association.

5. Variations of sector targets following a review at end of 2004 and 2008

5.1 Where the Secretary of State carries out a review under clause 5.3 and he considers that it is appropriate to vary the sector targets reviewed to take account of the results of the review, he shall serve a notice of the appropriate variations on the sector association setting out -

(a) the revised sector targets in an acceptable currency; and

(b) his reasons for considering those variations to be appropriate.

5.2 The sector association shall, not more than 20 working days after receipt of a notice under paragraph 5.1, serve notice of its response on the Secretary of State.

5.3 If the Secretary of State and the sector association fail to agree on the variations and there is a dispute on the facts, either party may refer the dispute for adjudication to an institution named on the list prepared under paragraph 1 of Schedule 5 and that Schedule shall apply in relation to the adjudication.

5.4 Notice of any such referral shall be served by the party making the referral on the other party.

5.5 Each party to the dispute shall have 20 working days from the date on which they receive notice from the nominated adjudicator of the address to which representations should be sent to make representations to the nominated adjudicator. Any such representations shall be copied by the party making the representations to the other party to the dispute.

5.6 The adjudicator may request further information from either party to the dispute. Any such request shall be in writing, shall specify the date by which the information is required and shall be copied to the other party to the dispute. Any information provided in response to such a request shall be copied by the party providing the information to the other party to the dispute.

5.7 The adjudicator will, on the basis of the representations provided to him and any additional information he considers to be necessary, make a finding on the disputed questions of fact and notify the parties of that finding.

5.8 The adjudicator's finding on a disputed questions of fact shall be binding on the parties but it shall be for the parties to agree, in the light of that finding, what variations to the sector targets are required to ensure that the targets continue to.represent the potential for cost effective energy savings taking account of any changes in technical or market circumstances.

5.9 Where the Secretary of State and the sector association agree the variations to the sector targets, the sector association shall serve a notice on the Secretary of State setting out the variations that it proposes should be made to the targets in the underlying agreements to take account of those variations.

5.10 If the Secretary of State and the sector association agree to the variations that should be made to the targets in the underlying agreements to take account of the sector target variations, the Secretary of State shall serve a notice on each operator setting out the agreed variations to the sector targets and to the targets in that operator's underlying agreement and inviting representations on those variations from the operator within 20 working days.

5.11 If, having considered any representations made by the operators under paragraph 5.10, the Secretary of State and the sector association are in agreement on the variations that should be made to the sector targets and the targets in the underlying agreements, the sector targets shall be varied accordingly and the Secretary of State shall serve a notice on each operator setting out the variations to the targets in that operator's underlying agreement as agreed with the sector association.

5.12 The Secretary of State may serve a termination notice on the sector association terminating this agreement if -

(a) the Secretary of State and the sector association fail to agree on the variation of the sector targets or the targets in the underlying agreements; or

(b) the sector association fails to serve a notice under paragraph 5.9.

5.13 A termination notice under paragraph 5.12 shall specify the date on which this agreement ceases to have effect, which shall be at least 10 working days after the date on which the notice is served. A termination notice under paragraph 5.12(a) shall be accompanied by a statement setting out the Secretary of State's reasons for not agreeing with the sector association on the variations required.

5.14 Where the Secretary of State serves a termination notice under paragraph 5.12, this agreement shall cease to have effect on the date specified in the notice unless the notice is withdrawn before that date. Where this agreement ceases to have effect in this way no new certificate will be given under clause 7 for any further certification periods and any existing certificates given under that clause will be terminated by a variation certificate. Where a termination notice is withdrawn, the targets shall be varied to reflect any agreement reached between the Secretary of State and the sector association..

6. Variations of sector targets on the basis of a significant difference in the terms of the state aids approval

6.1 If the terms of the state aids approval given in relation to the reduction in climate change levy are significantly different at any time during this agreement from the assumed state aid approval terms, then either party to this agreement who wishes to vary the sector targets to take account of that significant difference may serve a notice on the other party setting out the variation and the reasons for the variation.

6.2 A party which receives a notice under paragraph 6.1 shall have 20 working days from its receipt to respond in writing.

6.3 Where the Secretary of State and the sector association agree the variations to the sector targets, the sector association shall serve a notice on the Secretary of State setting out the variations that it proposes should be made to the targets in the underlying agreements to take account of those sector target variations and to any relevant trading limit.

6.4 If the Secretary of State and the sector association agree to the variations that should be made to the targets in the underlying agreements to take account of the sector target variations and to any relevant trading limit, the Secretary of State shall serve a notice on each operator setting out the agreed variations to that operator's underlying agreement and inviting representations from the operator within 20 working days on those variations.

6.5 If, having considered any representations made by the operators under paragraph 6.4, the Secretary of State and the sector association are in agreement on the variations that should be made to the sector targets and the targets in the underlying agreements and any relevant trading limit, the agreements shall be varied accordingly and the Secretary of State shall serve a notice on each operator setting out the variations to that operator's underlying agreement as agreed with the sector association.

6.6 In paragraph 6.1 "assumed state aid approval terms" means state aids approval for-

(a) the amount payable by way of climate change levy on a reduced-rate supply being only 20 per cent of the amount that would be payable if the supply were neither a half-rate supply nor a reduced-rate supply;

(b) the exemption from the climate change levy provided for by paragraph 15 of Schedule 6 to the Finance Act 2000 (supplies to combined heat and power stations);

(c) the exemption from the climate change levy of-

(i) coke, natural gas and coal used in blast furnaces in connection with steel making;.

(ii) coal and coke breeze used in sinter plants in connection with iron or steel making;

(iii) hydrocarbons used in electric arc furnaces in connection with steel making; and

(iv) coke and coal used in electric arc furnaces in connection with steel making.

(d) the exemption from the climate change levy provided for by paragraph 19 of that Schedule (electricity from renewable sources); and

(e) the provision of enhanced capital allowances for investment in energy efficiency measures.

7. Variation of the currency of a sector target following a change in the currency of underlying agreements

7.1 Where a change of the currency in underlying agreements results in the currency of the sector targets in this agreement no longer being co-ordinated with the currency of the underlying agreements in the way referred to in paragraph 7 of Schedule 2, the currency in the sector targets shall be varied to restore the co-ordination.

7.2 The Secretary of State shall serve a notice on the sector association setting out the variation of the currency of the sector targets required to bring the sector targets back into co-ordination with the targets in the underlying agreements. The variation shall be in accordance with the conversion conventions set out in paragraph 6 of Schedule 2.

7.3 The sector targets will then be varied in accordance with that notice on the date specified in the notice without further action being required.

8. Variation of sector targets where operator has failed to supply information needed to decide whether or not targets have been met

8.1 Where clause 6.7 applies and the Secretary of State proposes to vary the sector targets for the relevant period and subsequent periods, he shall serve notice specifying the proposed variations on the sector association.

8.2 Where the sector association receives notice under paragraph 8.1, it shall have 20 working days from receipt of the notice to make representations to the Secretary of State.

8.3 After considering any representations made in accordance with paragraph 8.2, the Secretary of State may serve a further notice on the sector association specifying the variations; and the targets shall be varied in accordance with that notice without any further action being required.

Appendix D. Spreadsheet Tool for the Annual Supervision Report for the Energy Conservation Voluntary Agreement Pilot Project: Hypothetical Example of a Steel Mill in China

SUPERVISION AND EVALUATION TOOL FOR ENERGY CONSERVATION VOLUNTARY AGREEMENT PILOT PROJECT

Ernst Worrell, Lynn Price
Lawrence Berkeley National Laboratory

Only fill in the white cells. Grey cells are copied or calculated, while green cells provide calculation end-result

This workbook consists of the following worksheets:

1. Energy Balance - Year n
Plant energy consumption and production data, as well as production data, for each process step have to be input here.
The sheet provides a energy balance by process, using standard Chinese statistical data collection definitions.
Do not input comparable energy consumption data !
There is a worksheet for each subsequent year covered by the VA. Please fill in the appropriate form for each year
Please enter the data in the first two tables. Other tables are used for calucaltions. Do not change other tables.

2. Results
This worksheet summarizes the results for the tracking of the progress of the VA.
In the Worksheet the EEI for each for the total plant are reported, as well as the EEI normalized to the year 2000.

Please enter the target for ease of comparison.

Sample Energy Input Sheet - 1

钢铁企业各工序耗能情况调查表

Survey of Energy Consumption by Process in Iron and Steel Enterprises - BASEYEAR (2000)

Unit: 10,000 tce

工序	Process	烧结 Sintering	球团 Pelleting	焦化 Coking	高炉炼铁 Blast- furnace iron smelting	转炉 BOF steelmaking	电炉炼钢 EAF steel making	炉外精练转炉 Refining	板坯连铸机 Slab continuous casting	小方坯连铸机 Small billet continuous casting	轧钢工序 Steel rolling	热轧：带钢 Hot rolling: strip steel	热轧：棒材 Hot rolling: bars	热轧：盘条 Hot rolling: wire	Cold rolling	Finishing	锅炉 Boilers	铁合金 Ferroalloys	非生产用能 Non-production energy use	其他 Other	TOTAL
	Production (Mt)	1.75	1.05	0.78	1.75	1.85	0.35	1.85	1.00	1.10	0.88	0.45	0.42								
能源品种	**Energy Type (10,000 tce)***																				**Million tce**
能源投入量 Energy Input: 煤	Coal	2.35		105.35	15.33		0.00				0.10						13.01				1.36
重油	Fuel oil										0.25										0.00
煤气	Coal gas	0.85	1.90	10.00	13.50	1.10			0.20	0.22	6.77	1.77	5.05				8.10				0.49
电	Electricity	3.25	0.90	0.85	2.48	0.17	9.10	1.50	0.16	0.19	5.06	1.61	3.25				1.00				0.30
天然气	Natural gas																				0.00
蒸汽	Steam	0.25		0.80	0.38	0.02				0.02	0.12	0.08	0.08								0.02
鼓风带入热量	Heat content of compressed air																				0.00
焦炭	Coke	10.70			93.00																1.04
水**	Water**	0.02	0.01	0.05	0.15	0.00	0.04	0.00		0.00	0.05	0.00	0.03				0.03				0.00
	Compressed air				6.52	3.20	0.79			0.05	0.02	0.00	0.02								0.11
	Oxygen					2.00															0.02
其他（风/氧气/柴油）	Diesel																				0.00
小计（吨标煤）	**Subtotal (10,000 tce)**	17.42	2.81	117.05	131.36	6.49	9.93	1.50	0.36	0.48	12.37	3.47	8.43	0.00	0.00	0.00	22.14	0.00	0.00	0.00	3.34
能源产出量（包括回收）Energy Output (including recovered energy): 焦炭	Coke			75.68																	0.76
煤气	Coal gas			21.01	35.00	0.00															0.56
蒸汽	Steam					0.00											16.98				0.22
电	Electricity																				0.00
粗苯	Crude benzene			1.29																	0.01
焦油	Tar			5.22																	0.05
**																					0.00
**																					0.00
其他	Other																				0.00
小计（吨标煤）	**Subtotal (10,000 tce)**	0.00	0.00	103.20	35.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.98	0.00	0.00	0.00	1.60
工序单耗	**Unit final energy consumption by process**	17.42	2.81	13.85	96.36	6.49	9.93	1.50	0.36	0.48	12.37	3.47	8.43	0.00	0.00	0.00	5.16	0.00	0.00	0.00	
	Total Final Energy Consumption (Million tce)																				**1.740**

注：*：可用实物量或吨标煤表示。（以上数据为标煤，单位：万吨）

Usable energy in physical units or tce. (Data above are in units of 10,000 tce.)

**：可根据贵企业的具体情况，增加能源的投入和产出品种或增加工序，并在表中注明。

These are to be filled in based on the specific condition of each plant. Insert energy type or process and data in the table as appropriate.

Sample Energy Input Sheet – 2

钢铁企业自发电情况调查表

Survey of Self-Generation at Iron and Steel Enterprises

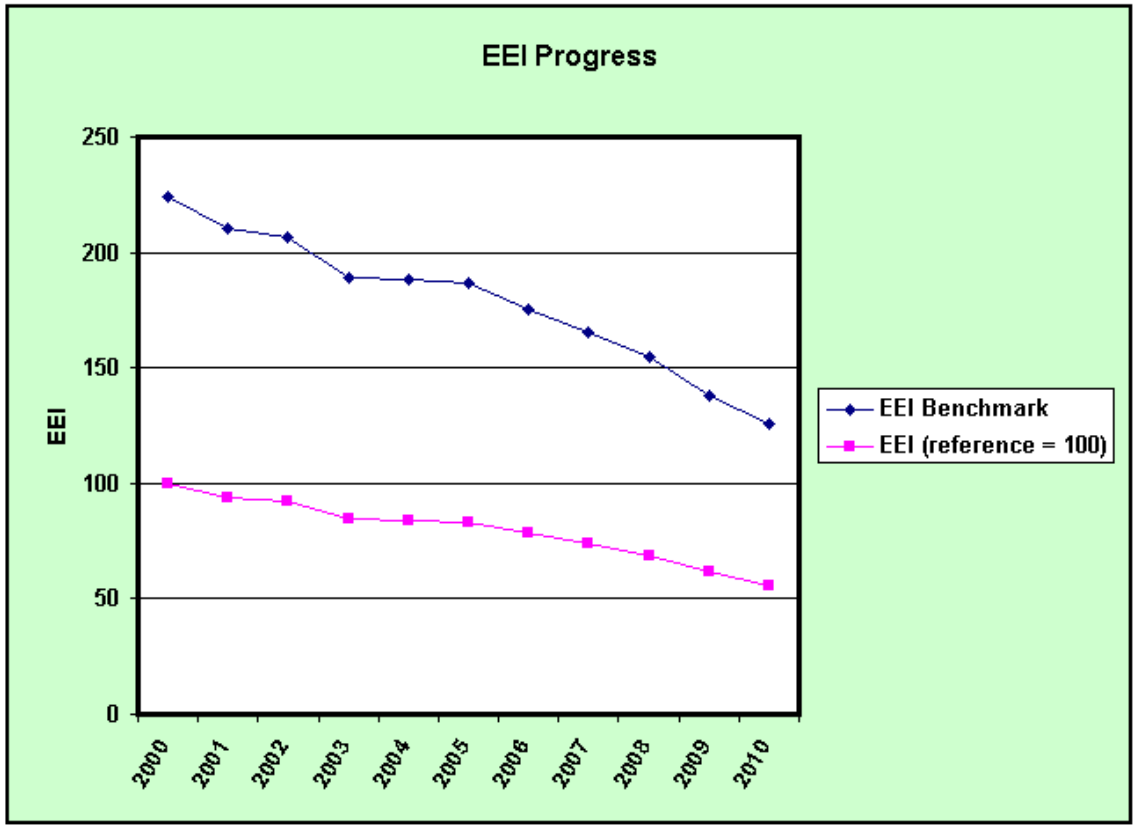
工序		Process	焦化 Coking	高炉炼铁 Blast furnace iron smelting	锅炉房电站 Power generation boilers	**	**	其他 Other	TOTAL
	能源品种 *	Fuel*							
转入自发电能源投入量 Energy Input for Self-Generation	煤	Coal			2.45				2.45
	石油	Oil							0.00
	煤气	Coal gas							0.00
	电	Electricity							0.00
	天然气	Natural gas							0.00
	蒸汽	Steam							0.00
	**								0.00
	**								0.00
	其他	Other							0.00
	小计（吨标煤）	Subtotal			2.45				2.45
发电量		Power generation (kWh)			50000000				50000000.00

注：*：可用实物量或吨标煤表示。

Usable energy in physical units or tce. (Data above are in units of 10,000 tce.)

**：可根据贵企业的具体情况，增加能源投入品种或增加工序，并在表中注明。

These are to be filled in based on the specific condition of each plant. Insert energy type or process and data in the table as appropriate.

Sample – Hypothetical Plant Results

	EEI Benchmark	EEI Normalized	Savings
Target	125	56	
2000	224	100	0%
2001	210	94	6%
2002	206	92	8%
2003	189	84	16%
2004	188	84	16%
2005	187	83	17%
2006	175	78	22%
2007	165	74	26%
2008	154	69	31%
2009	138	61	39%
2010	125	56	44%