Use of Emission Rights for Construction Machinery to Help Prevent Global Warming

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OVERVIEW: With measures being adopted around the world to reduce emissions of CO_2, use of carbon offsets has grown rapidly in recent years as a means of offsetting one's own emissions with the aim of complying with international commitments made through the United Nations Framework Convention on Climate Change. Against this background, Hitachi Construction Machinery Co., Ltd. has added environmental value to its products by using carbon offsetting for its construction machines that deliver a higher level of energy efficiency than previous models. Hitachi Construction Machinery is also contributing to the use of construction machinery to prevent global warming in the forestry industry, with emission rights able to be generated for highly energy-efficient electric-hydraulic excavators (domestic credit projects).

INTRODUCTION

AT the Third Conference of the Parties to the United Nations Framework Convention on Climate Change (COP3) in 1997, Japan made an international commitment to reduce its carbon dioxide (CO_2) emissions by 6% relative to 1990 levels. FY2012 is the final year of the first Kyoto Protocol period. The policy of the Japanese government was that, of that 6% reduction, 3.8% should be achieved by increasing CO_2 removal units from forests, and the Forestry Agency has managed forests as a resource for CO_2 removal through its *Kizukai-Undou* (wood products use campaign) program[1].

Hitachi Construction Machinery Co., Ltd. also supplies forestry machinery that is used for forest management work such as thinning and the removal of thinned material. Participants in the forestry industry have a strong awareness of the environment, and Hitachi Construction Machinery has since 2008 been operating a joint program of carbon offsets for forestry machinery with customers that is aimed at preventing global warming.

Carbon offsets were first proposed by private businesses in the UK in 1997 and their use in Japan has grown rapidly since about 2008. As carbon offsets were originally intended as way for organizations to offset their own CO_2 emissions, organizations could choose for themselves which emissions to offset. Hitachi Construction Machinery has established a carbon offset policy that it applies to machines that significantly reduce or minimize emissions of CO_2. The carbon offsets work as follows[2] (see Fig. 1).

(1) Identify how the activities being studied result in carbon emissions.

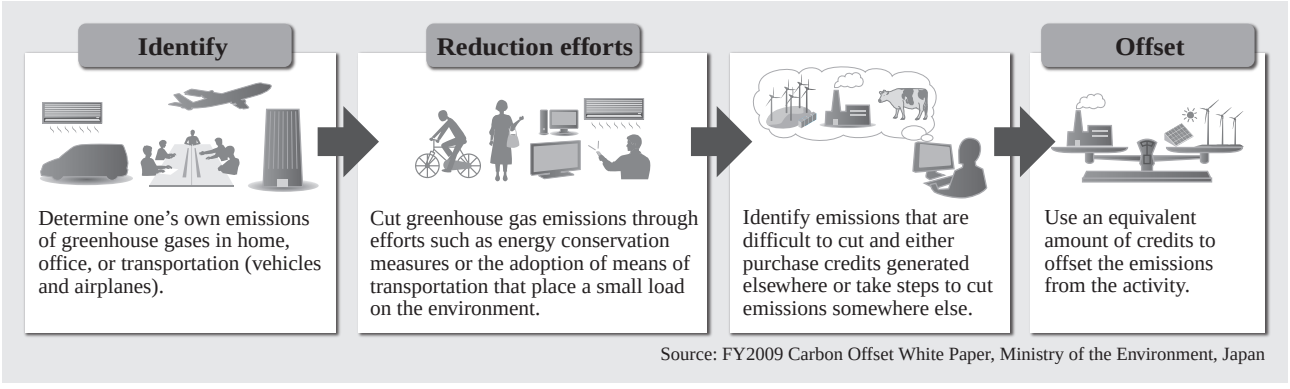

Fig. 1—Operation of Carbon Offsets.
The flowchart shows how carbon offsets work.

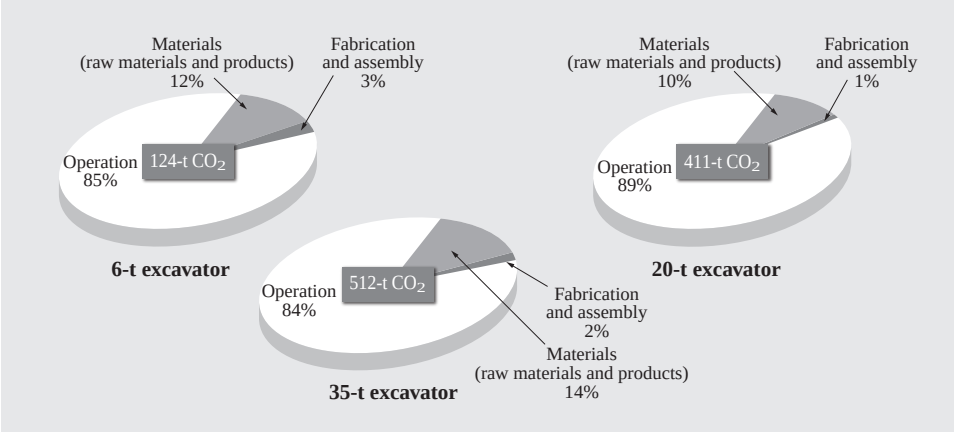

Fig. 2—Comparison of CO_2 Emissions over Hydraulic Excavator Lifecycles[3]. Between 85 and 90% of CO_2 emissions occur during operation, with materials accounting for 10 to 14%, and manufacturing only about 1 to 3%.

(2) Take steps to reduce emissions.
(3) Use credits to offset emissions that cannot be eliminated.

Use of carbon offsets starts with an awareness of CO_2 reduction. Using (redeeming) credits to offset emissions provides a means to collaborate with and support projects aimed at reducing greenhouse gas emissions.

The Clean Development Mechanism*1 (CDM) is one way of generating credits. CDM credits are a recognized mechanism under the Kyoto Protocol (to the United Nations Framework Convention on Climate Change) and grant credit for the CO_2 reductions that result from the use of advanced technology from developed economies in projects in emerging economies. This acts as an incentive for emerging economies to adopt energy-efficient technology.

The Ministry of Economy, Trade and Industry of Japanese government introduced a domestic credit system [CDM (based on a rule in Japan), domestic CDM hereafter]*2 in October 2008. The domestic CDM is a scheme for helping small and medium-sized companies in Japan to reduce greenhouse gas emissions, and it has greater energy saving benefits in Japan than CDMs that support overseas reduction projects as it makes a direct contribution to Japan's 6% reduction commitment under the Kyoto Protocol. Hitachi Construction Machinery has been participating in the domestic CDM since 2010.

*1 The Clean Development Mechanism is a scheme for awarding credits under the Kyoto Protocol (to the United Nations Framework Convention on Climate Change). For projects in which developed economies supply energy efficiency technology to emerging economies, it provides a mechanism for the managers of these projects to receive credit for the resulting reductions in CO_2 emissions.

*2 The domestic CDM is a scheme run by the Ministry of Economy, Trade and Industry whereby large corporations help small and medium-sized companies to reduce emissions. The credits generated by the scheme are called "domestic credits" and can be used for carbon offsets in Japan and to achieve voluntary reduction targets.

This article describes what Hitachi Construction Machinery is doing to use emissions rights to prevent global warming through construction machinery.

ACTIVITIES OF HITACHI CONSTRUCTION MACHINERY

Fig. 2 shows the CO_2 emissions over the lifecycles of hydraulic excavators. Between 85 and 90% of emissions occur during operation, with materials (raw materials and products) accounting for 10 to 14%, and manufacturing only about 1 to 3%[3]. Similarly, Fig. 3 shows a breakdown of the relative CO_2 emissions from construction machinery during operation in Japan. Total emissions are about 10-million-t CO_2, with hydraulic excavators responsible for approximately half of these. This means that developing energy-efficient construction machinery

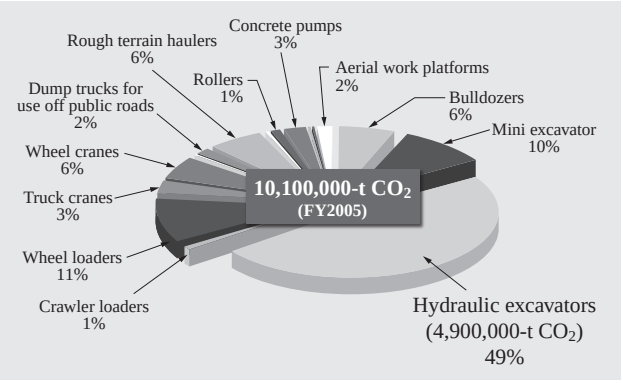

Fig. 3—Breakdown of CO_2 Emissions from Construction Machinery.
The figure shows a breakdown of the relative CO_2 emissions from construction machinery during operation in Japan. The figures were calculated based on data from surveys of construction machinery market trends and ownership costs conducted by the Ministry of Land, Infrastructure, Transport and Tourism.

capable of minimizing CO_2 emissions, particularly those associated with the operation of hydraulic excavators, will make a major contribution to preventing global warming.

While its conventional construction machines already feature a high level of energy efficiency, Hitachi Construction Machinery has also been working on the research and development of leading-edge, clean, and energy-efficient machines. These have included the development of an industry-first hybrid wheel loader in 2002, and also the release of a battery excavator powered by lithium-ion batteries in 2005, a hybrid rubber-tired gantry crane (RTG) in 2007, and a hybrid excavator that uses an electrolytic double layer capacitor, also in 2007. Hitachi Construction Machinery has also developed energy-efficient construction systems based on information-integrated construction that uses the Hitachi on-site screening & solution business for efficient operation of machinery at construction sites, and the global positioning system (GPS) and Global e-Service construction information management service for greater work efficiency. To encourage the wider adoption of these machines and systems, and to contribute to the prevention of global warming in conjunction with customers, their clients, and other stakeholders, Hitachi Construction Machinery has been promoting the use of carbon offsets and the domestic CDM. The domestic CDM provides the mechanism for generating credits, carbon offsets provide a way to use (redeem) these credits[*3], and construction machinery provides the model for utilizing credits through a product's lifecycle (see Fig. 4).

*3 Transferring carbon credits to a national management account at no cost prevents the credits from being subsequently onsold or transferred, and ensures that they count toward Japan's CO_2 emission reductions.

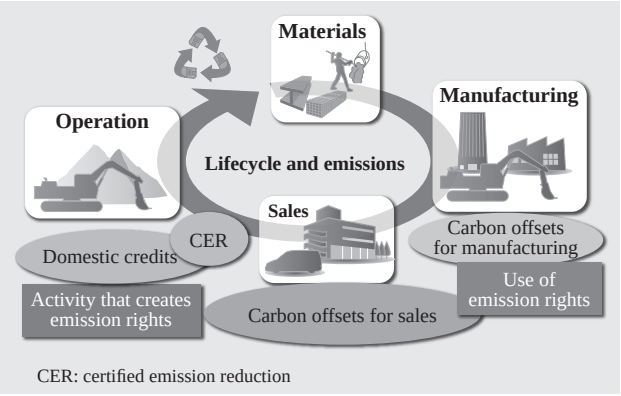

Fig. 4—Emission Rights over Construction Machine Lifecycle. The figure shows the model for the creation and use of credits in the case of a hydraulic excavator.

The forestry industry makes a major contribution to reducing CO_2 in its own right. Carbon offsets apply to machines used in forestry and for machines with significantly better fuel efficiency than conventional models.

The domestic CDM applies to electric excavators used in industry that have significant benefits for minimizing CO_2 emissions. Credits created through the domestic CDM are called "domestic credits," which means they are local credits that can only be used in Japan. Under this arrangement, Hitachi Capital Corporation is a provider of credits.

EXAMPLES OF CARBON OFFSETTING

Carbon Offset Policy

Hitachi Construction Machinery developed a joint carbon offset scheme with the Total Solutions Division (as it was then known) of Hitachi, Ltd. that has been operating since October 2008. Hitachi Construction Machinery carbon offsets are divided into three types: product offsets, event offsets, and voluntary action offsets[(4)]. These carbon offsets are marketable and mainly use certified emission reductions (CERs)[*4] to offset emissions.

The following section describes carbon offsets for products.

Applicable Machines for Carbon Offsets

The fact that carbon offsetting is voluntary makes its scope and applicability difficult to ascertain. Accordingly, Hitachi Construction Machinery set the following policies when starting the scheme.

(1) Seek to encourage wider use of environmentally conscious machines and systems.
(2) Actively support government programs, such as *Kizukai-Undou* and Challenge 25[(5)], as well as the −6% target.
(3) Help boost business activities and environmental branding of customers.

In accordance with these action policies, Hitachi Construction Machinery embarked on the progressive implementation of carbon offsetting on the basis that it would apply to the following four types of machines (the dates in brackets are the dates when carbon offsetting started).

(1) Forestry machinery (October 2008)
(2) Information-integrated construction machinery (October 2010)
(3) Electric excavators (April 2011)

*4 Credits created under the Clean Development Mechanism and recognized under the Kyoto Protocol.

Fig. 5—Forestry Machinery.
Carbon offsets can be used for forestry machines ranging from thinning machines designed for use in forestry to wood chippers used after thinning.

(4) Hybrid excavators (April 2011)

Carbon offsetting for forestry machinery extends from thinning machines designed for use in forestry, such as harvesters, processors, and swing yarders (which are based on Hitachi Construction Machinery excavators), to wood chippers used after thinning (see Fig. 5).

Carbon offsetting for information-integrated construction machinery covers road rollers and excavators fitted with machine guidance systems. Machine guidance systems display work drawings (input previously) and the position of the machine or bucket on a monitor located in the cab. A 24% improvement in work time has been reported[6], which indicates that the system also helps reduce CO_2 emissions (see Fig. 6).

Fig. 7 shows an electric and a hybrid excavator. These clean and energy-efficient construction machines utilize Hitachi's electrification technology. An electric excavator uses an electric motor instead of a diesel engine to drive the hydraulic pump using the commercial electricity supply. Up until 2010, nuclear power generation supplied approximately one-third of Japan's electric power. The amount of CO_2 emitted per unit of electric energy is low (0.36 kg-CO_2/kWh), and CO_2 emissions are reduced by around 60 to 80% compared to conventional machines[7]. The ZH200 hybrid excavator uses an electric motor and capacitor to boost system efficiency by capturing energy from swing braking and using it to assist with swing acceleration, for example. This provides energy savings of about 20% compared to conventional machines.

Fig. 6—Information-integrated Construction Machinery.
The photographs show a construction information display unit (left) and an information-integrated construction machine (right). The two masts are GPS receivers.

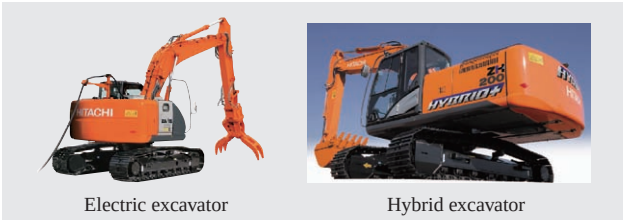

Fig. 7—Electric and Hybrid Excavators.
The ZX225USR (left) is an electric excavator and the ZH200-A (right) is a hybrid excavator.

Carbon Offsetting in Practice

For the four types of machines referred to above that are more effective than conventional machines for countering global warming, the total number covered by product carbon offsets reached a cumulative total of 253 in March 2012, with offsets exceeding 300 t (see Fig. 8).

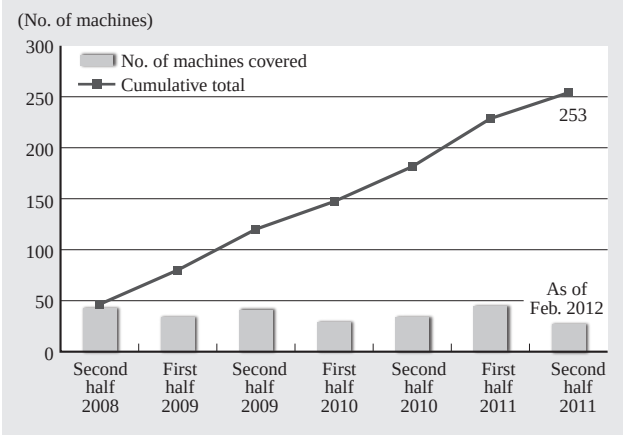

Fig. 8—Trend in Number of Machines with Carbon Offsets.
Carbon offsetting is used for four types of machinery: forestry machinery, information-integrated construction machinery, electric excavators, and hybrid excavators. The offsets range between 1 and 2 t per machine.

Product carbon offsets offset the CO_2 emitted during manufacturing (fabrication and assembly). The amount of CO_2 emitted during manufacturing is calculated from the production line electric power and fuel consumption for each model based on the "guidelines for calculating greenhouse gas (GHG)[*5] emissions of activities to be offsets." Offsetting is performed in 1 t increments for excavators of 7 t or more and 0.5 t increments for mini-excavators, with any remainder rounded up to the nearest increment. For example, if the calculated CO_2 emission for manufacturing are 1.1 t, application is made for 2 t of offset credits.

Fig. 9 shows an example of a carbon offset scheme for electric excavators. After a machine is delivered to the customer, Hitachi Construction Machinery requests Hitachi Capital Corporation (the credit provider) to provide carbon offsetting. Hitachi Capital Corporation then transfers the required amount of credits to the Japanese government at no charge in accordance with the written instructions (nullification). To verify the transaction, Hitachi Capital Corporation also produces a carbon offset certificate specifying the numbers of the nullified credits and details of the carbon offsetting (see Fig. 10). Hitachi Construction Machinery then forwards this certificate and a carbon offset sticker to the customer.

The main motors in electric excavators are alternating current (AC) induction motors from Hitachi Industrial Equipment Systems Co., Ltd. As Hitachi Industrial Equipment Systems performs carbon offsetting for the motors supplied for electric excavators, the above certificates contain details of two different offsets.

Benefits of Carbon Offsets

By using the machines covered by offsetting in their businesses, customers are contributing to preventing global warming and helping Japan achieve its

*5 Greenhouse gases. Six different gases are subject to government emission controls, including CO_2, methane (CH_4), and nitrous oxide (N_2O).

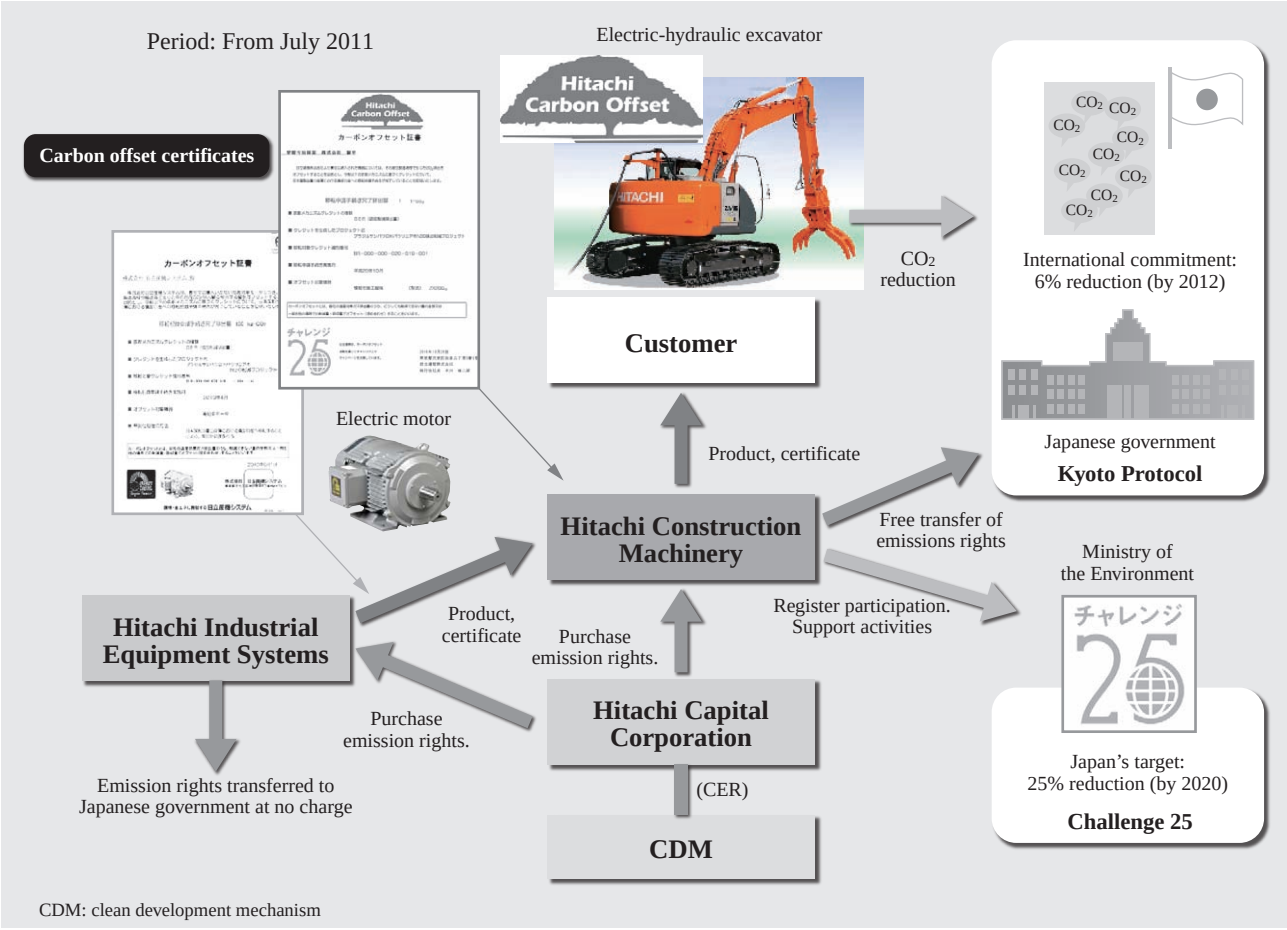

Fig. 9—Carbon Offset Scheme.
The figure shows the CO_2 offset scheme used for electric excavators and their main motors. Main motors are a major component of electric excavators.

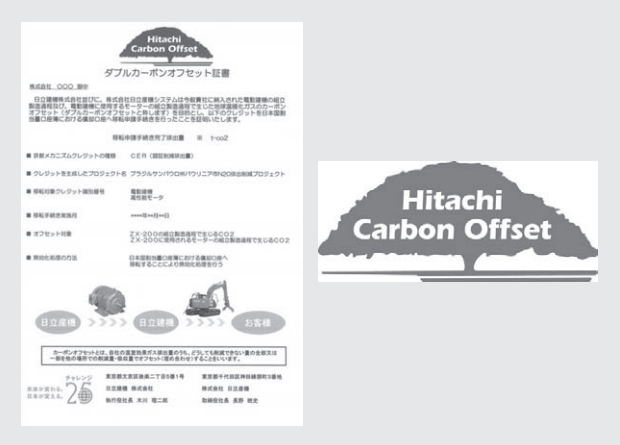

Fig. 10—Carbon Offset Certificate and Carbon Offset Sticker. The form on the left is a double carbon offset certificate covering both the electric motor and excavator. The carbon offset sticker on the right is affixed to the machine itself.

international commitment for the period of the Kyoto Protocol (a 6% reduction in emissions relative to 1990 levels) and the greenhouse gas reduction project. Carbon offsets raise awareness of environmental protection, not only among customers but also among staff and suppliers of Hitachi Construction Machinery, and provide an opportunity to make further progress on measures for preventing global warming.

In 2010, Hitachi Construction Machinery received a certificate of thanks from the Japan Wood-Products Information & Research Center that administers the *Kizukai-Undou* program, acknowledging the company's actions in promoting forestry machinery with carbon offsets. Together with the Total Solutions Division (as it was then known) of Hitachi, Ltd. and Hitachi Capital Corporation, Hitachi Construction Machinery was also awarded the special centenary prize as part of Hitachi's Inspiration of the Year 2010.

DOMESTIC CREDIT PROJECTS (DOMESTIC CDM)

Involvement with Domestic CDM

The domestic CDM program promoted by Japan Ministry of Economy, Trade and Industry is a CDM recognized by the Kyoto Protocol that has been revised to operate in Japan. It provides incentives for small and medium-sized companies making energy efficiency improvements by creating carbon credits that can only be used in Japan from the CO_2 emission reductions that result from large companies providing technical support to help small and medium-sized companies save energy (see Fig. 11). Adopting electric operation in the excavators used at factories and other plants not only significantly reduces CO_2 emissions, it also helps improve the workplace environment by reducing exhaust gas and heat generation.

The domestic CDM required a revision of the project design for use of construction machinery to reduce CO_2 emissions. Accordingly, Hitachi Construction Machinery worked with the Total Solutions Division (as it was then known) of Hitachi, Ltd. to create a project design for domestic credits for the replacement of engine-driven hydraulic excavators with electric excavators that was subsequently certified as an emissions reduction project design by the Domestic Credit Certification Committee in December

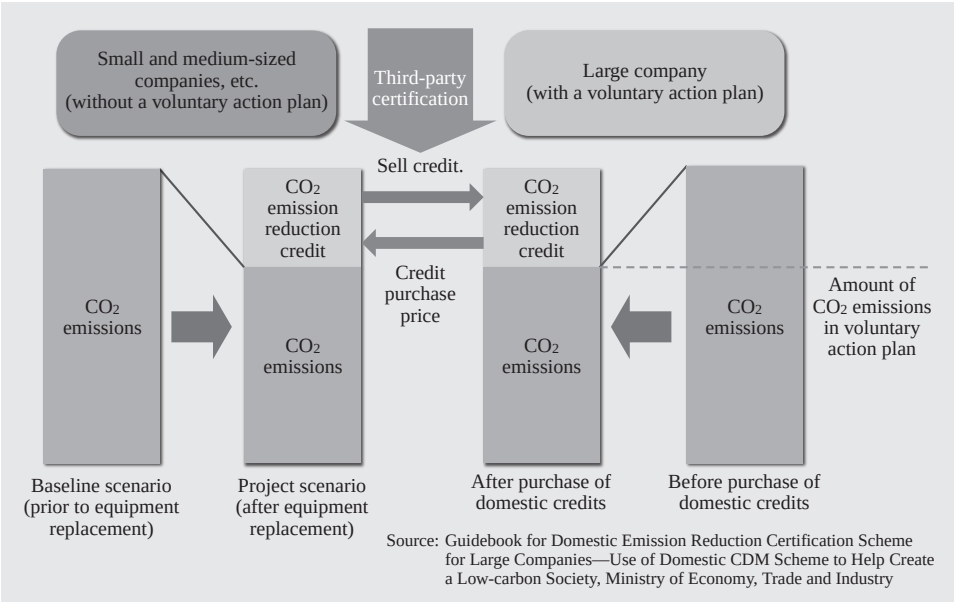

Fig. 11—Overview of Domestic CDM.
The domestic CDM turns CO_2 emission reductions into carbon credits that can only be used in Japan.

2010 under the title, "Replacement of Construction Machinery and Industrial Vehicles with Electrically Driven Machines" (Project Design Number 026). This was the first example anywhere in the world of a project design for using construction machinery to reduce CO_2 emissions.

Operation of Domestic Credit Projects

The initial emissions reduction project based on the project design described above was commissioned by Ishizaka-Group who operates a highly specialized recycling business for construction waste in Miyoshi in the Iruma District of Saitama Prefecture. An environmental leader with a strong awareness of environmental problems, Ishizaka-Group is already involved in numerous environmental protection activities, and factors such as the timing of its excavator replacements made it a suitable partner for collaboration.

The procedure for certifying domestic credits consists of (1) auditing and approval of a reduction project plan and (2) auditing and approval of reported reductions. The reduction project plan (1) requires auditing and approval of the size of CO_2 emission reductions, how the reductions are to be verified, and potential problems such as the project's economics and scope for expansion. The auditing of reported reductions (2) determines whether appropriate monitoring indicates that the level of emissions is in line with the plan. This involves auditing and approval of monitoring methods and of reported quantities such as emission volumes. Only after these two processes have been completed are the domestic credits created.

The principal in this emissions reduction project was Ishizaka-Group, with Hitachi Capital Corporation acting as co-principal. The resulting emission rights formed part of the scheme run by Hitachi Capital Corporation (see Fig. 12). The details of the plan were formulated into a plan document by Ishizaka-Group and Hitachi Construction Machinery with support from the Total Solutions Division of Hitachi, Ltd.

Ishizaka-Group's emissions reduction project plan involved replacing a 20-t engine-driven hydraulic excavator used for sorting industrial waste with an equivalent electric excavator. This was estimated to reduce the annual CO_2 emissions of the engine-driven hydraulic excavator (approximately 137 t) by 64% (87 t). Other potential benefits included improving the workplace environment, eliminating exhaust gas from indoor work areas, reducing waste heat, and cutting running costs for fuel and engine maintenance.

An emissions reduction report approved in October 2011 stated that Ishizaka-Group had reduced emissions by 52 t over seven months, which was roughly in line with the plan.

Domestic credits created by the reduction project are to be used as carbon offsets by Hitachi Construction Machinery from FY2012 onward.

CONCLUSIONS

This article has described what Hitachi Construction Machinery is doing to use emissions rights to prevent global warming through construction machinery.

At COP17 held in Durban in December 2011, Japan decided it would not participate in the Kyoto Protocol post the Kyoto Protocol period.

With the falling price of CERs and the increasing volume of assigned amount unit[*6] trading since the onset of the global financial crisis, credit trading and the CDM are facing difficult conditions and the enthusiasm of a few years ago has disappeared[(8)]. Nevertheless, levels of greenhouse gases continue to

*6 Emission quotas assigned to countries with reduction obligations that have signed the Kyoto Protocol. Trading involves emission quotas from countries that have significantly reduced their CO_2 emissions relative to the base year, such as the Russian Federation and the nations of Eastern Europe.

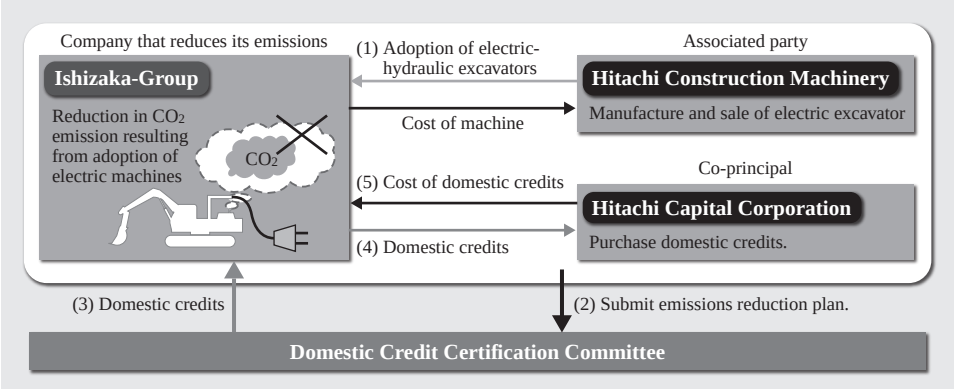

Fig. 12—Ishizaka-Group's Emission Reduction Plan. The figure shows an outline of the Ishizaka-Group's emission reduction plan.

rise and there is a growing need for energy-efficient and clean machinery.

How to engage with carbon offset policies, CDM policies, and other mechanisms is an important factor in encouraging the wider adoption of the leading-edge, energy-efficient machines developed by Hitachi Construction Machinery to help prevent global warming. Hitachi Construction Machinery would like to believe that this is a good opportunity for everyone to consider how the use of machines with excellent fuel efficiency can affect the level of carbon emissions, and how best to reduce these emissions.

Although the offset amount for a single machine is small, the total quantity of offsets to date is equivalent to 22,000 trees[(9)]. Hitachi Construction Machinery Co., Ltd. believes that patient environmental protection measures like this will help create a sustainable society and prevent global warming.

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