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ScienceDirect

Procedia Computer Science 32 (2014) 665 – 672

Procedia Computer Science

The 4th International Conference on Sustainable Energy Information Technology (SEIT-2014)

IT-enabled Personal-level Carbon Emission Allowance

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Abstract

This paper presents an approach to personal carbon allowance trading with RFID tags or barcodes. It introduces RFID tags as certificates for the rights to claim carbon allowances so that it enables buyers, including end-consumers, that buy products or services with carbon allowances to hold and claim these allowances. It also supports the simple intuitive trading of carbon allowances by trading RFID tags coupled to the allowances. The approach was constructed and evaluated with real customers and real carbon allowances in a real supply chain. It can also be used to encourage industries and homes to reduce greenhouse gas emissions.

Keywords: Carbon emission allowance; Personal-level carbon emission trading; RFID;

1. Introduction

The reduction of greenhouse gases (GHGs), including carbon dioxide (CO_2), is one of the most important issues in the global world. There have been many approaches to reducing the amount of GHG emissions. In most advanced countries the amount of GHG emissions from the industrial sector has decreased or leveled off, but that from the home or end user sector has tended to increase. For example, this is 43 % of the national fossil fuel emissions in the U.S.A., 42 % in U.K., both countries have increased. The reduction of GHG emissions from home sector is a problem that we have to face.

To solve this, several countries, e.g., the U.K. and Ireland, have proposed schemes for carbon emission trading in the home/end user sector to Conferences of the Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC). *Personal Carbon Trading* (PCT) is a general term referring to personal versions of *carbon emission trading* in the home/end user sector. The original notion of *Carbon emissions allowances* is an economical approach to reducing the amount of GHG emissions in industrial sector. The allowances are limits, often called *carbon emission caps*, where a government authority first sets limits on the amount of CO_2 that companies are allowed to emit. If a company emits an amount of CO_2 below its limit, it can sell the excess capacity, which is the

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doi:10.1016/j.procs.2014.05.475

difference between the limit and the amount of CO_2 that has really emitted, as carbon allowances to companies whose emissions are over their limits. If a company emits an amount of CO_2 beyond its limit, it must pay a penalty or buy carbon allowances from someone so that it can comply with its allowances.

On the other hand, PCTs support carbon emissions allowances allocated to individuals rather than companies. If individuals emit at a level above that permitted by their initial allocation, they need to purchase additional carbon emission allowances from those using less, creating a profit for those individuals who emit at levels below those permitted by their initial allocation.

Several approaches to PCT have been proposed, e.g., Cap-and-Share[3], Tradable Energy Quotas (TEQs)[4], Tradable Consumption Quota[1], and Personal Carbon Allowances (PCA)[5], Although the concept of PCT was expected to reduce the GHG emissions from homes and individual sectors, existing PCT have several serious problems that must be solved before applying schemes can be applied to the real world.

Since existing PCT has aimed at reducing GHGs emitted from energy, i.e., their spending electric power from thermal power plants and refuelling their private cars, they have mismatches with existing carbon emission trading and carbon emission reduction schemes in companies, although reducing GHG emissions is a global issue. For example, suppose that a supermarket sells beverages or mineral water from room temperature shelves in addition to refrigerated shelves to reduce the amount of GHGs emitted from electricity for the latter and to obtain surplus carbon emission allowances. When customers intentionally select and buy beverages or mineral water from normal temperature shelves, they should share the surplus allowances with the supermarket.

Nevertheless, there is no way to share surplus allowances with supermarkets in existing carbon emission trading schemes, including PCT. Furthermore, the existing PCT does not encourage customers to buy products where the GHGs emitted from their manufacture and sale are reduced. As a result, customers may face a moral hazard in the sense that they intend to select and buy products according to the amount of GHG emitted in the use of the products rather than in their manufacture and sale. This paper proposes a low-cost approach for PCT based on an approach to enabling individuals, including end consumers, to receive carbon allowances from companies through their buying products or services and sells or pay the allowances to others or the governments. The approach aims at enabling a small amount of allowances attached to products to be transferred to end consumers who buy these products and carbon allowances to be easily traded. The approach was constructed and evaluated with real allowances in a real supply-chain system.

2. Background

The notion of carbon emission allowances has been useful in existing schemes such as the European Union (EU) Emissions Trading Scheme (EUETS) for EU countries or similar schemes elsewhere[2]. Several researchers and organizations have proposed different kinds of PCT in the last five to ten years.

- *Cap and Share* was originally developed by the Foundation for the Economics of Sustainability (Feasta)[3] and supported the use of fossil fuels. Individuals received certificates from the government and fuel suppliers required corresponding certificates equal to emissions from the use of fossil fuels to sell fuel.
- Personal allowance (PCA) was proposed by Hillman[5] and it was a proposed downstream carbon cap and trade policy instrument suggested for the U.K. There represented a mandatory policy whereby all individuals received an annual carbon emissions budget for their personal use. The PCA scheme only covered emissions under direct personal control, e.g., household energy use (electricity and gas) and private transport (not including public transport).
- Tradable Energy Quotas (TEQs)[4] assumed that individuals would receive certificates and if they used fewer certificates, they could sell their surplus. All fuels and electricity had *carbon ratings* in units. When individual buy energy, their certificates are deducted according to the amount of CO_2 emitted from the use of that energy.
- Household carbon trading[6] was a yearly carbon emission cap to set for residential energy use based on emissions reduction targets. Allowances are allocated to each household on an equal per household allocation basis via utility service providers who place the allowances in each user's account.
- Tradable transport carbon permit[7] was a cap that was set for emissions from private transport. Allowances were allocated to all individuals to comply for free, but these were not any equal basis. Allowances are transferred to