Personal carbon card: prospects and challenges for ICT

Sandrine Rousseaux

Personal carbon card: prospects and challenges for ICT

Sandrine ROUSSEAUX
CNRS (DCS – UMR 3128), University of Nantes
Nantes, France

ABSTRACT

The carbon card is a generic notion which includes several categories of programmes aiming at limiting the environmental impact of the individuals. Carbon compensation cards and green loyalty cards are offered by the private sector and municipalities. Issuing a carbon credit card to all the eligible inhabitants of a country (personal quota system) is also considered.

The purpose of this paper is to emphasize the major role of ICT for implementing individual carbon card schemes. The different functions to be fulfilled by ICT are underlined from a detailed analysis of the way each scheme is electronically managed. This analysis enables to identify potential prospects for the ICT sector, as well as the technological challenges to take up.

Keywords: climate change – individuals – personal emissions control – carbon card – personal carbon trading – ICT.

1. INTRODUCTION

Rapid and substantial reduction of greenhouse gas emissions is needed to contain the global warming of the Earth surface below the threshold of dangerous and irreversible disturbance of the climate system, estimated at approx. 2°C by the end of the century relative to pre-industrial values [5]. The world emissions, expressed in carbon dioxide equivalent (CO_2 eq.), must be reduced by at least 50% in 2050 relative to their 1990 level, and those of the industrialised countries by at least 80% at that time. The necessity of this reduction is again emphasised by a recent state of the art of climate science, which indicates that climate change is accelerating more rapidly than the most pessimistic scenarios of the last report of the Intergovernmental Panel on Climate Change adopted in 2007 [15]. The quite radical proposal of personal carbon rationing is in keeping with this context of ecological emergency. Indeed the individuals contribute significantly to climate change, directly by the consumption of non-renewable energy for housing and transport, indirectly by purchasing products whose life cycle is energy-intensive.

Reducing the individuals' emissions requires far-reaching change in habits and behaviours. The necessity for this change was mentioned by the Intergovernmental Panel on Climate Change for the first time in its last report [6]. Two economic instruments, taxation and tradable quotas, may be used to encourage to adopt low-carbon behaviours by sending a price signal. The main difference between both these instruments lies in the choice of the uncertainty, which may be put either on the environmental result (taxation) or on the price of pollution (quotas). A tradable quotas system may be preferable when the certainty of the environmental result is needed [17], which is the case of climate change considering the 2°C threshold that should not be exceeded.

A cap and trade system is gradually being established by the most emitting countries in order to limit the emissions from the energy and industry sectors, and sometimes from other economic activities. Engaging the individuals with such a system proves increasingly interesting at international level, on the politics and research and development plane. Personal carbon trading was initially developed by English researchers at the end of the 1990s [2], before to be taken into consideration by political institutions in the United-Kingdom [1] [4]. Other countries and a few international organisations are also showing an interest in this instrument. It has never been established as yet, apart from certain pilot experiments in the United-Kingdom.

The personal carbon trading system consists in capping the global quantity of CO_2 eq. emissions which may be generated by the households, then in apportioning among them the authorised emissions by individual allowances. These allowances – or carbon budgets – would be fractioned into carbon credits[1]. The credits would be stored on a carbon account, and surrendered by bank card or direct debit according to the carbon content of the purchases covered by the system. These emission rights would be traded on an open and organised market between those who have exceeded their carbon budget, and those who have not used it up. The carbon budget – or ration – is thus flexible. It would be gradually reduced so as to cut the emissions to the level required. The participation of the eligible individuals in the system would be compulsory. Their direct CO_2 emissions, associated with home energy use and (surface and air) transport, would be covered first. Extending the coverage of the system to indirect emissions, associated with the consumption of products such as foodstuffs, depends in particular on the capabilities for measuring the emissions released during their life cycle.

Pending the possible introduction of personal carbon trading systems by public authorities, numerous carbon card programmes have been launched since the beginning of the 2000s by the private sector and local authorities. Banks are offering their clients to compensate for the carbon footprint of the purchases made with their bank card, by financing emission reduction projects. Loyalty cards aiming at supporting sustainable consumption and behaviours are also offered by private bodies or municipalities, in partnership with retailers. The carbon card is therefore a generic notion which includes several schemes that may obey different logics.

The three kinds of carbon card programmes (quotas, compensation, and loyalty) are not as environmentally efficient. The voluntary compensation and loyalty programmes contribute to making individuals sensitive to their contribution to climate change. But their purpose is not an absolute cut in emissions, contrary to a mandatory quota system.

The different carbon card schemes share however a common feature: they are ICT-based. Their implementation involves

[1] The carbon credits allocated to the individuals could be representative of the emission of one CO_2 eq. kilogram, while the credits currently in circulation on the carbon market are representative of the right to emit one ton of CO_2 equivalent.

electronic monitoring of the consumption of the goods and services covered. This monitoring consists in counting the quantity of emissions generated, or the amount of loyalty points earned, by the individuals. The data are sent to an electronic database that holds the accounts of the participants in the programmes. The accounts are debited or credited on the basis of these data, in conventional or in parallel currency (carbon credits, points).

The major role of ICT can be highlighted by explaining the design and the details of implementation of the different carbon card programmes[2]. The analysis of the precise functions devolved to ICT is based on a state-of-the-art of the programmes established or contemplated in Europe and in the United-States [11]. It helps to identify the technological needs, as well as the technical solutions tested or considered. The methods of electronic monitoring of the individual consumption are set out in the first instance. Then automated data processing in a database is examined. The conclusion stresses the main challenges that the ICTs should take up.

2. ELECTRONIC MONITORING OF THE INDIVIDUAL CONSUMPTION

The aim of individual consumption monitoring is to count the amount of CO_2 eq. emissions generated, or of loyalty points earned, by the participants in the carbon card programmes. Data are electronically collected and transmitted to a database.

Such a monitoring has financial consequences: payment for the emissions generated (purchasing offset credits, surrendering carbon credits), financial remuneration for the emissions avoided (selling or saving unused carbon credits, redeeming the loyalty points earned for gifts or discounts).

2.1. Measuring the individual ecological footprint

Measuring the individual ecological footprint consists in recording the environmental value assigned to each good and service covered by the carbon card programmes. This value may correspond to the carbon content of the products, or to a lump number of points. The products are consequently given a double value, monetary and environmental.

The environmental price is shown by means of labelling, with the aim of informing the consumers. It must appear on a medium enabling its electronic recording, for instance on a barcode. Implementing a quota system implies adding a carbon functionality to price calculation software packages for some products, such as the fuel purchased in petrol stations or the domestic energy use (heat and electricity), in order to determine their total carbon value.

2.1.1. Issues raised by measuring

Whereas counting the loyalty points earned is rather widespread and does not present any difficulty, measuring the individuals' emissions raises some technological issues.

The existing carbon compensation card programmes provide for a flat rate for emissions. This method for calculating lies in the fact that banks, which either manage or are in partnership with the programmes, are solely aware of the amount of the expenses made by electronic payment instruments (card, direct debit). Average emission values are therefore given to the expenses classed according to a list of economic activities.

Establishing a personal carbon trading system requires to accurately monitoring the individuals' emissions, by recording the carbon content of each of their purchases. The carbon content corresponds to the emissions released during the life cycle of the products. Though it can be quite easily determined as regards energy used for housing and transport (all fuels would be given carbon ratings), the process is more complex with regard to manufactured products. Methods for calculating their carbon footprint are being developed in several countries. They could forebode a future supranational standardisation.

The environmental effectiveness of a personal carbon trading system depends on a reliable and accurate measuring of all of the emissions covered. The emissions covered by the trials launched in the United-Kingdom are measured by the participants themselves. Expense statements, and carbon accounting computer software programs that give emission factors for the various budget items, are used for that purpose. Manual calculation is however tedious. Moreover it does not guarantee any effective monitoring of emissions associated with many daily life acts, contrary to electronic measuring. A first trial of electronic measuring was run during the second half of 2008 within the CarbonLimited programme, led in the United-Kingdom by the Royal Society for the encouragement of Arts, Manufactures & Commerce (RSA). The aim of this experiment carried out in partnership with Atos Origin was to capture by card the emission data associated with purchases of fuel at BP filling stations [12].

2.1.2. Measuring tools

The various carbon card programmes involve using a card. It is most often a bank card. A loyalty card and an electronic identity card are also used.

The carbon compensation card only records the price of the purchases, on the basis of which emissions are calculated. Conversely the loyalty card only records the environmental value of the purchases. An ecological accounting functionality is however added to the electronic identity card used by the participants in the 'De e-portemonnee' loyalty programme, implemented in Belgium (Flanders region)[3]. The loyalty card used in the trial of real-time calculation of personal carbon emissions, previously mentioned, is also fitted with carbon functionality.

A multifunction card is more practical for the individuals, since it saves them keeping an additional card in their wallet. The same chip thus acts as a medium for processing various data, among which are carbon data.

Smart meters might also be used for monitoring the emissions associated with the home energy use. To this end, a carbon accounting functionality should be added to those tools in full expansion[4].

[2] Some schemes, which may be qualified as "greenwashing', are not taken into account. They consist in offsetting emissions or delivering points on an inclusive basis, according to the amount of the expenses paid for by credit card.

[3] http://www.bondbeterleefmilieu.be/milieuopdekaart (accessed 2 Dec. 2009).

[4] The Low Carbon Transition Plan of the United-Kingdom for instance, published in July 2009, foresees their installation in all homes by 2020.

The purchases may be recorded by mobile phones as well [16]. Like the other technical solutions, mobile phones must present guarantees in terms of accurate and reliable monitoring of emissions associated with the individuals' way of life so as to be used in a personal carbon trading system. The personal carbon accounts are indeed debited on the basis of the emission data collected.

2.2. Report

Once collected by the electronic monitoring tools, environmental data must be reported to a database holding the individuals' accounts. Issuing loyalty points, purchasing offset credits on the carbon market and surrendering carbon credits are based on this report.

The environmental integrity of a cap and trade system depends on the reliability of the emission data reported. The existing systems, applying to States and companies, provide for the emission data to be verified before their report. The emissions are monitored by the participants themselves, and then verified by third parties accredited by the regulation authorities. The auditors certify the compliance with the monitoring rules and the correctness of the data. As the personal carbon trading system would be electronically administered, the certification of the emissions monitoring tools might prove to be necessary. This certification would attest to the accuracy and the reliability of the tools used for implementing a policy instrument.

Data could be reported by a tool that simultaneously recorded the environmental and monetary values of the purchases, such as a bank card with carbon functionality. In such a case, this tool should be able to communicate at the same time with two accounts, one provisioned with conventional currency, the other with carbon currency. These accounts may be held by the same database, or by two different ones (see below).

When the emission data are reported on the points of sale at the time of payment for the purchases, a specific carbon card or electronic payment instruments fitted with carbon functionality must be used to communicate with the individuals' carbon accounts and debit them with an amount of carbon credits equivalent to the emissions associated with the purchases. If the need arises, the retailers would be responsible for the electronic report of their customers' emissions. They would have to comply with the obligation of surrendering carbon credits to cover these emissions. The retailers should purchase the necessary number of credits on the market and integrate their price in that of the products sold. This procedure is called 'pay as you go'. It might also apply in case of omission, loss or non-delivery of the carbon card (in particular for temporary residents who would not be subjected to a similar scheme in the State to which they belong).

3. AUTOMATED PROCESSING OF PERSONAL DATA IN A DATABASE

The data collected by the consumption measuring tools are sent to a database that holds the individuals' accounts. Recording these data entails movements into or out of accounts.

3.1. Movements on accounts

Reporting the data relating to individual consumption leads to credit or debit one or two accounts, provisioned with conventional or parallel currency.

The procedure is conventional within the framework of the compensation programmes, inasmuch as the price of the purchases is solely recorded. The individuals' account is debited for that price. An account provisioned with conventional currency is also debited following the purchase of offset credits on the carbon market. This account is held by banks, since they are bearing the cost of the carbon compensation service they are offering to their clients.

The loyalty programmes do not raise any particular difficulty either. Recording the number of loyalty points associated with the purchases involves crediting an account provisioned with this parallel currency.

The procedure would be more sophisticated with personal quotas programmes, as they would state a legally binding obligation of surrendering carbon credits to cover the emissions associated with the purchases of goods and services that fall within their field. The carbon credits would have to be surrendered to the authority in charge of their allocation (in the event of a system applying to individuals only), or to the emission producers (in the case of an economy-wide system). Surrendering carbon credits would take the form of a transfer between carbon accounts.

Communication between the emissions measuring tools and the individuals' carbon accounts would consist in specifying the number of carbon credits to be surrendered. The accounts would be debited when the purchases are paid by card (on the points of sale, online or over the phone) or by direct debit. If the emissions data were reported on the point of sale, while the purchases are not paid for by electronic instruments, the seller's carbon account would be debited (see above section 2.2). Paying for emissions with carbon credits implies changes to be made to existing billing and payment infrastructures, so as to handle a new unit and to calculate the number of carbon credits to be surrendered [8].

The carbon accounts holders would not be allowed to go overdrawn [14] [8]. The electronic payment instruments would therefore check whether the accounts are sufficiently provisioned. Transactions ought otherwise to be made on other accounts. Surrendering the missing credits by the retailer is a first possibility. The credits would be purchased by the retailer on the carbon market, and then recorded on his carbon account before to be transferred onto the account intended for surrendering. The second possibility consists for the individuals who exceeded the carbon budget they were allocated in putting additional carbon credits into their account. They would have to trade carbon credits on the market. Trading would entail transfers between carbon accounts. Exchanges of emission rights could be made by mutual agreement between two people, for instance at the bank, online or over the phone. They could also be performed by market intermediaries, such as banks, who would be commissioned to acquire credits for their clients. Cash flows would mirror the transfers between carbon accounts when credits are exchanged against payment.

The storage of credits on the chip of the carbon card is sometimes mentioned. It has however to be taken into account that the credits would also be deduced from the carbon account when purchases are made by direct debit [17].

3.2. Database

Implementing loyalty and quota programmes requires an electronic database to be built and maintained, wherein accounts

provisioned with parallel currency (points, carbon credits) are open.

The database fulfils a bank function. This information system must be secured in order to prevent any risk of intrusion and fraudulent operation on the accounts. The risk is limited with loyalty programmes, since redeeming points illegally earned would involve a rather small financial loss. It is higher concerning the carbon credits allocated to the participants in a quota system, because their price should gradually rise as their scarcity is strengthened.

A major component of a personal carbon trading system is a central database, capable of holding a carbon account for all eligible participants and managing these accounts when the credits are issued, surrendered and exchanged. Setting up a central database should help the regulation authorities to oversee the implementation of the system, contrary to dispersed databases [13]. Building and maintaining such a wide and complex database would however entail significant costs. Two information systems could therefore be required for implementing a personal carbon trading system: one for enrolment, identity verification and allocation, the other for accounting and transactions [8]. The enrolment process must ensure that eligible individuals cannot fraudulently open more than one carbon account, which requires appropriate identity verification [14], whilst the allocation process must ensure that the credits are issued to the entitled individuals and stored on the right accounts. Besides, all participants in the system will need a carbon bank account for the receipt, payment and recording of carbon credits, and for their exchange.

The central database handling enrolment in the system and allocation of credits could be the responsibility of a government organisation [8]. It might be a new database, or an existing one that would also be used for that purpose.

Two possibilities are considered with regard to the database that would hold the carbon accounts: building and maintaining a government carbon bank or opening the accounts in banks. The most cost-effective way is to use the existing banking infrastructures [10] [8]. Banks could be commissioned by the governments to manage the carbon accounts in their own databases. Opening the individuals' carbon accounts in the national registries set up in accordance with the emission trading mechanism rules, such as those provided for under the Kyoto Protocol, is another possibility. State carbon assets should be issued to the individuals for this possibility to be conceivable. This would require changing the rules relating to the existing domestic tradable quotas systems, so that the consumers instead of the producers would be responsible for the emissions released during the lifecycle of the products purchased.

The carbon accounts could be managed by authorized bodies such as banks, irrespective of their location. Managing these accounts consists in providing current services: credit and debit transactions, inter-account transfer, monthly statements, access to the account balance and customer help services [8].

4. CONCLUSION

The individual carbon card opens up a vast area of applications for ICT. Many functions are devolved to them, as regards both software and hardware, for implementing new schemes aiming at controlling the CO_2 eq. personal emissions.

Among the three kinds of carbon card programmes analysed, the quota system should be considered more particularly. Indeed this policy instrument has the potential to gradually and substantially reduce the individuals' emissions.

Implementing a personal carbon quota system raises several issues for the ICTs. Reliable and accurate emission monitoring is the first challenge to be taken up. It must be guaranteed by the electronic tools used for measuring the individuals' consumption. The second challenge is about handling two different currencies. It implies an adaptation of the existing billing and payment infrastructures. It also promotes the development of multifunction cards, such as bank cards with carbon functionality. The ability for these cards to not only debit but also credit several accounts at the same time might be useful in terms of practicability for individuals. In this case they could record loyalty points, should loyalty programmes supplement the implementation of quota systems to make access to low-carbon products easier for the individuals. The third challenge deals with computer security. Carbon credit cards need to be highly resilient to fraud, in order to prevent lost or stolen cards from being used, or their counterfeiting. Otherwise there is a risk for carbon accounts to be unduly debited, or for illicit emissions to be generated (without charging on carbon accounts). All carbon credits transactions could be protected through chip and pin, even if the purchases are made online or over the phone [14]. The carbon databases should be secured too. Intrusion into these information systems might involve the fraudulent debit with carbon credits or the creation of illicit carbon money. The last challenge relates to counting the individuals' emissions, providing they are within a jurisdiction where a personal quota system is introduced. Universally recognized communication technologies would make easier their acceptance and their connection to point-of-sale terminals [7], and allow their holders' accounts to be updated even if they are open in another jurisdiction. The issue of standards relating to interoperability and security of the technologies used for implementing domestic quota systems applying to the individuals might be raised as these instruments are introduced in different countries.

5. REFERENCES

[1] Department for Environment, Food and Rural Affairs (2008). **Synthesis report on the findings from Defra's pre-feasibility study into personal carbon trading**: London.

[2] Fleming D. (2007). **Energy and the Common purpose. Descending the energy staircase with tradable energy quotas**: The Lean Economy connection, 3rd ed., London.

[3] Hillman M., Fawcett T., Rajan S.C. (2008). **How we can save the planet. Preventing global climate catastrophe**: Thomas Dunne Books, New York.

[4] House of Commons, Environmental Audit Committee (2008). **Personal carbon trading**: Fifth report of Session 2007-08, London.

[5] Intergovernmental Panel on Climate Change (2008). **Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change**: Cambridge University Press, Cambridge.

[6] Intergovernmental Panel on Climate Change (2008). **Summary for Policymakers, Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report**: Cambridge University Press, Cambridge.

[7] Kampers van Hilten, in assignment of Belfast City Council and the Points Foundation (2008). **The City Carbon Card; a Feasibility study**: Amsterdam,

http://minutes.belfastcity.gov.uk/(S(1x0fqvurxwk1j5ayewmak555))/Published/C00000317/M00006507/AI00003097/CarbonRewardCardFeasibilityReport.pdf (accessed 2 Dec. 2009).
[8] Lane C., Harris B., Roberts S., (2008): **An analysis of the technical feasibility and potential cost of a personal carbon trading scheme. A report to the Department for Environment, Food and Rural Affairs**: Accenture & Centre for Sustainable Energy, London.
[9] Prescott M. (2008). **A persuasive climate. Personal trading and changing lifestyles**: RSA, London.
[10] Roberts S., Thumim J. (2006). **A rough guide to individual carbon trading. The ideas, the issues and the next steps**, Report to Defra: Centre for sustainable energy, London.
[11] Rousseaux S. (2009). **Etat des lieux international des programmes de 'carte carbone' pour les particuliers (Europe et Etats-Unis)** : Report to ADEME, Nantes, http://hal.archives-ouvertes.fr/hal-00368067/fr.
[12] RSA CarbonLimited (2009). **Practical solutions for personal carbon trading**: RSA, Atos Origin, London, http://www.atosorigin.com/NR/rdonlyres/02CEAC58-4198-48A4-A610-3A48E0B5BB38/0/cs_rsa_carbonLimited.pdf (accessed 2 Dec. 2009).
[13] RSA CarbonLimited (2007). **Technical requirements for Personal Carbon Trading**: RSA Working Paper, London.
[14] Starkey R., Anderson K. (2005). **Domestic Tradable Quotas: a policy instrument for reducing greenhouse gas emissions from energy use**: Technical report 39, Tyndall Centre for Climate Change Research, University of Manchester.
[15] United Nations Environment Programme (2009). **Climate Change Compendium**: Nairobi, Kenya.
[16] VATT (2009). **Climate Bonus Final Report**: Helsinki, http://extranet.vatt.fi/climatebonus/publications/2332%2031%2007_CLIMATE%20BONUS%20-%20Final_Report_kv_valmis090422.pdf (accessed 2 Dec. 2009).
[17] World Trade Organization, United Nations Environment Programme (2009). **Trade and climate change**: WTO, Geneva.