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D8.6 Report Detailing Model for a Pilot of Emissions Trading

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1. Executive Summary

Europe has a stated commitment to reduce CO2 emissions by 20% by 2020, with an option of increasing the target to 30% if the US, India and China agree to emissions targets[1]. DEHEMS is designed to help Europe meet this target by supporting households to reduce their energy usage through better analysis and management of their energy consumption.

As part of Work Package 8 (Evaluation and Dissemination), initial desk research was undertaken, as well as discussions with UK government departments (i.e. Department of Energy and Climate Change [DECC] and Environment Agency [EA]), and contact with experts. This was followed by the setting up a Carbon Trading Working Group. This included a number of project Partners and external 'experts'. The stated objective of DEHEMS was "to establish a pilot model in Cycle 3 that enabled neighbourhood markets in emissions with households able to buy or sell according to pre-allocated emissions 'budgets' on the basis of actual (as opposed to estimated) emissions information.

There were two parts to the objective: the creation of a model; and then the testing of it within households as part of Cycle 3. The challenge, recognised at the outset of the Project was that a key barrier to household action on climate change is the sense that the issues are so large; individuals cannot make a meaningful contribution to tackle it[2]. Directly measuring the impact of an individual household is currently very difficult, making it hard to genuinely personalize the impact an individual can have. This is an equally important issue for the European Governments' perspective for policy around Personal Carbon Allowances and emissions trading for households. There would also be a clear benefit in producing a model that only allowed trade in an "eco positive currency", rather than pounds or euros, which can simply be used to burn even more carbon. Ideally an emissions trading system needed to be a closed cycle and include all buyers and sellers.

DEHEMS developed a pilot model in Cycle 3 for emissions trading at the household and neighbourhood level with the ability to allocate budgets and then allow for household and neighbourhoods buying and selling allocation according to their own usage. This model was based on the workings of the UK Carbon Reduction Commitment and was discussed with the CRC implementation team within the UK. Whilst it may have been possible to only include households in such a model, a wider neighbourhood or city scheme would open up greater opportunity for trading, particularly with corporate or other institutions that are part the UK Carbon Reduction Commitment.

In terms of implementing the model within a project the size of DEHEMS, then the challenge was to create a realistic trading system based on the principle that there is a market in a scarce resource, and that households would be prepared to trade money or something else for that ability. Alternatively, it can be viewed as a mechanism by which householders can be incentivised to reduce emissions by getting something of value, money or something else in return.

These considerations led to an implementation based on EcoPoints (ie. incentives) as outlined in Appendix I. This was successfully devised and implemented as a competition (ie. the Energy Team Challenge), and involved all 5 Living Labs, engaging with a total of 30 households over a 12 week period. Winners (ie. those teams reducing their electricity usage by the greatest percentage) were announced at the end of week 4 (ie. joint winners of Birmingham and Plovdiv 2); week 8 (ie. Ivanovo); and week 12 (and therefore the overall winners) the Municipality of Ivanovo. Questions about the relevance of the competition to behaviour have been included in the questionnaires for Cycle 3.

[1] European Commission Press Office, 09/03/07

[2] Jackson, T. (2005) Motivating Sustainable Consumption. A Report to the Sustainable Development Research Network.

2. Project and Cycle Objectives

The relevant objectives, as defined within the Description of Work, included:

- As part of Objective O3, the DEHEMS project is committed to producing a methodology for piloting emissions trading with live users, and disseminating the results as part of Work Package 8.
- *Emissions trading pilot model* - Localised emissions trading, at neighbourhood and household level, is a policy objective across Europe. This will be the first project to implement this objective. It will establish a pilot model in Cycle 3 that enables neighbourhood markets in emissions with households being able to buy or sell according to pre-allocated emissions 'budgets' on the basis of actual (as opposed to estimated) emissions information.

3. Activities to Achieve the Deliverable

As part of Objective 3 the project was tasked to devise a model for piloting Emissions trading with live users (ie. Living Labs). Then, as part of a contribution to Standards, the resultant emissions trading pilot model could be submitted to the European Local Authorities Network.

The approach taken was after initial research to establish a Working Party. Chaired by Vin Sumner of Clicks and Links (lead partner - Work Package 8), and supplemented by representatives from two other project Partners (ie. University of Salford and Birmingham City Council). In addition the team engaged the services of Michael King[3], a specialist consultant in the area of Carbon Trading and Emissions, as well as consulting with Professor Erik Bichard[4] and Bernard A. Lietaer[5], both international experts. Members of the team also met with representatives of the UK Climate Change and Environment agencies.

The Working Party met on several occasions throughout 2010, and recommended that for the purposes of an implementable model for emissions trading at the household and neighbourhood level the most pragmatic and practical solution would be to implement a solution that incentivises households to reduce emissions by getting something of value, whether financial remuneration or 'products'. However, such a model would require much wider adoption at say a City level, and be linked into other trading/taxation schemes such as the UK CRC.

For Cycle 3 the Working Party considered a pragmatic interpretation of the model (see Fig. 1), as outlined to the EU Reviewers in Ruse in December 2010. This involved:

- Individuals and Groups would compete across Living Labs;
- EcoPoints would be allocated for Relative Reduction;
- League Tables representing individual users and teams/groups would be displayed on the DEHEMS website (www.dehems.org);
- There would be winners each month and at the end of the Cycle;
- The winning team(s) would receive suitable incentives recognising their achievement and contribution;

[3] Leader, RSA Personal Carbon Allowances, incl. three year study with the RSA to investigate Personal Carbon Allowances.

[4] Erik Bichard is Professor of Regeneration and Sustainable Development at the Salford University, in Greater Manchester

[5] http://www.lietaer.com/

- The competition would run for a 3 month period during Cycle 3.

Fig. 1. – Proposed Model – Stage 1

With the view that this could then easily lead to extending the model as outlined in Fig. 2.

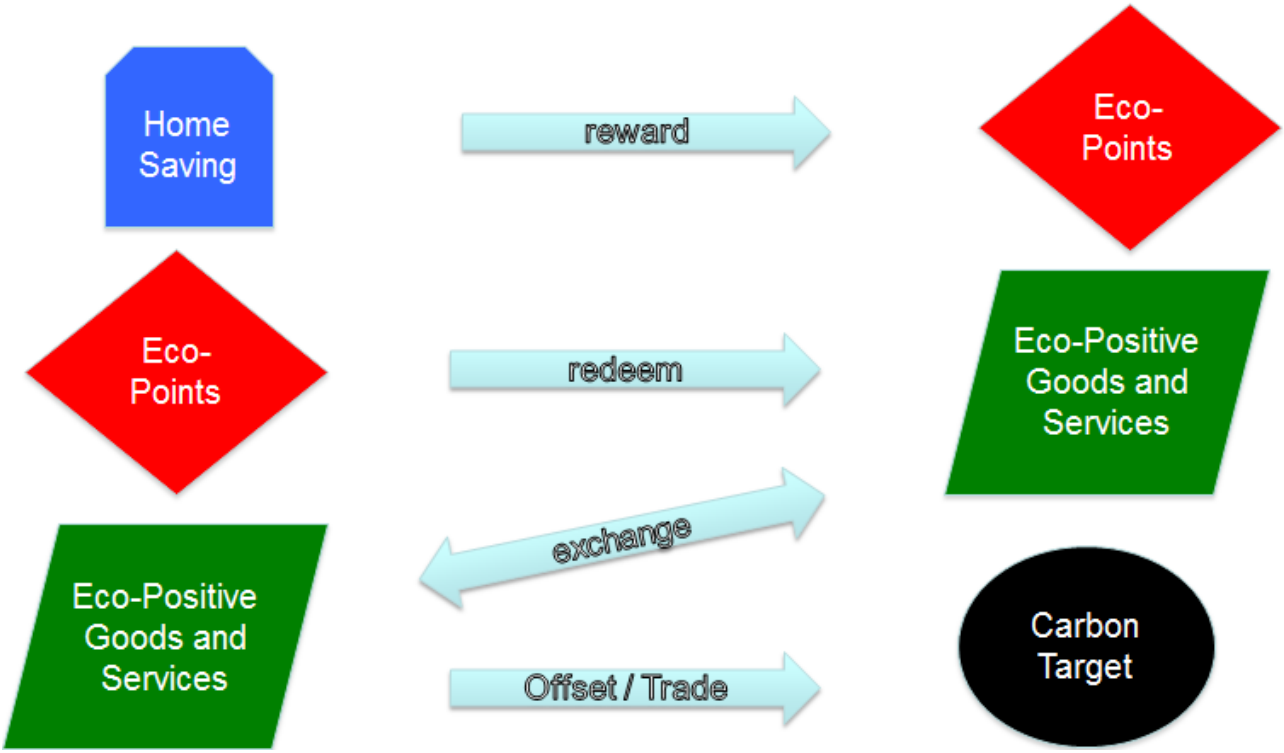


Fig. 2. – Proposed Model – Stage 2

As a result a scheme (see Appendix I – Discussion Paper) was devised whereby Living Labs would be incentivised to save energy, and thereby reduce (albeit not 'trade') carbon, by setting up a competition

between the 5 Living Labs. The system, branded 'Energy Team Challenge', involved each Living Lab submitting a team of 5 households, whose electricity usage would be measured over a 12 week period. The team saving the most relative energy each week were allocated a points value, and the team(s) with the highest points total at the end weeks 4, 8 & 12 recognised and rewarded accordingly.

The scheme was then handed over to Clicks and Links who used this as the basis for the Technical Specification (see Appendix II) for a 'Carbon Application'. This was developed, tested and successfully implemented ahead of 31st January start date. Note: all introductory text and team names were translated into Bulgarian text and translated to help ensure engagement and involvement from Ivanovo and Plovdiv households (see Fig 3. below).

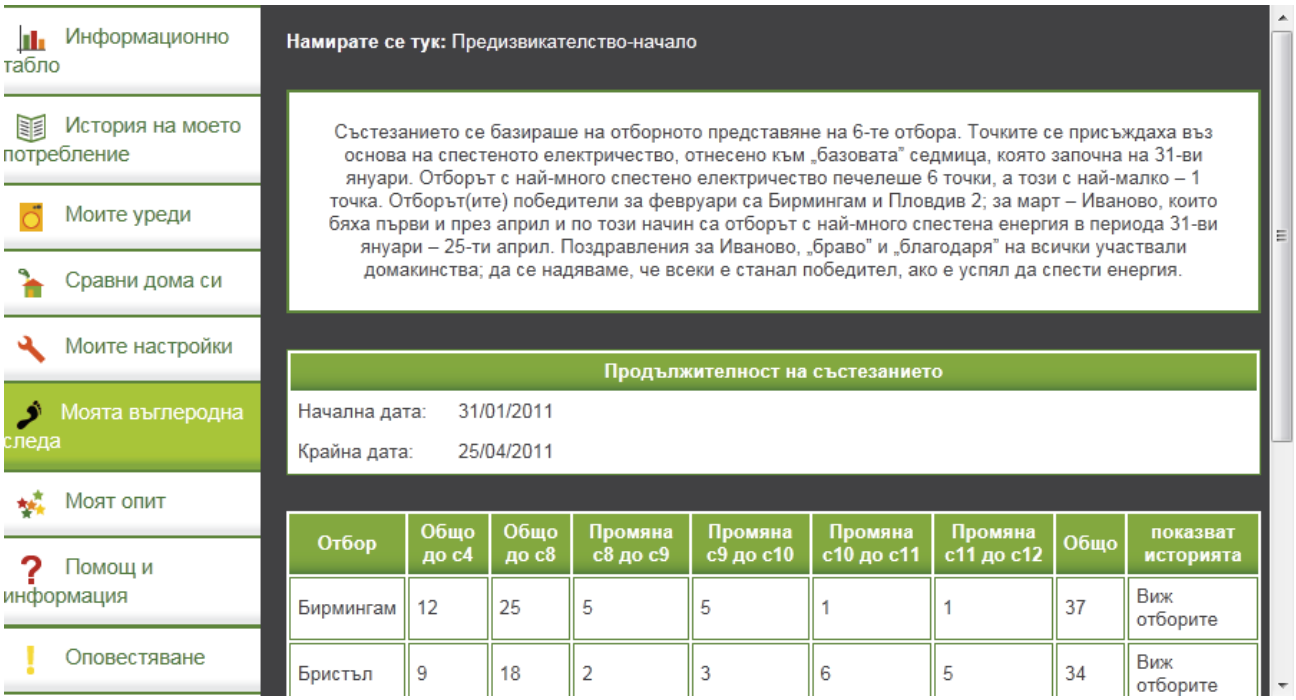


Fig. 3 - Translated text for the Carbon Application.

4. Implementation Approach

The approach taken was based on the model defined by the Carbon Trading Working Group and outlined in Appendix I Discussion Paper.

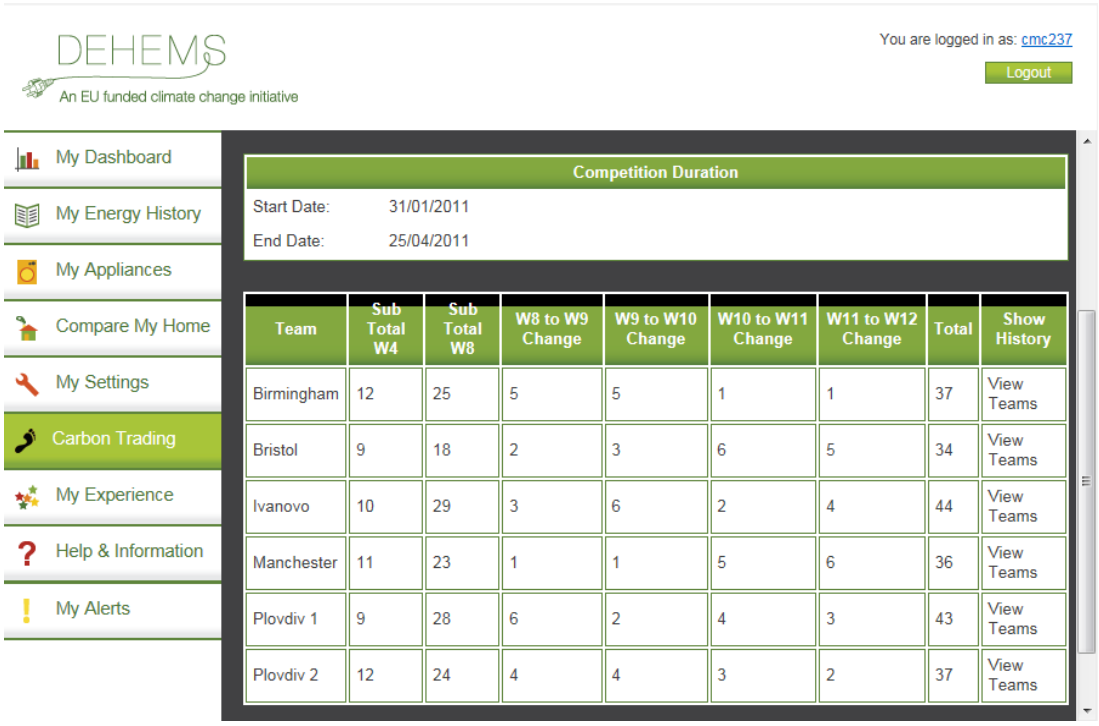
Each of the Living Labs (ie. Birmingham, Bristol, Ivanovo, Manchester and Plovdiv) were contacted and requested to submit a team of 5 households who were engaged with the DEHEMS initiative and committed to reducing energy and saving carbon. Due to significant householder interest, Plovdiv was allowed to enter a second team (ie. making a total of 30 households / 6 teams taking part).

Having sought various names for this competition, the consensus was that it would be branded as 'Energy Team Challenge'.

Week 1 (ie. 31st January to 7th February) was the 'baseline' week, whereby each participating household's electricity usage was assessed, and then used as the basis for future calculations of energy usage (ie. reduced or increased). During this baseline week each household was, by design, unable to access the carbon application so as to establish a realistic benchmark for all 30 households taking part.

At the end of the second week each household's usage during Week 2 was assessed against the baseline week. The household reducing their usage by the greatest percentage was allocated a score of 5 points, reducing to 1 point for the household securing the lowest reduction.

As the competition was designed and assessed based on team, rather than per household, a similar calculation was implemented so that team performance could be measured and team members rewarded (ie. the total electricity reduction per team would be calculated weekly, and the team reducing their combined usage by the greatest percentage would be allocated 6 points, reducing to 1 point for the team securing the lowest reduction). At the end of each week, the total points score was reported via the Dashboard – see Fig. 4.



Team	Sub Total W4	Sub Total W8	W8 to W9 Change	W9 to W10 Change	W10 to W11 Change	W11 to W12 Change	Total	Show History
Birmingham	12	25	5	5	1	1	37	View Teams
Bristol	9	18	2	3	6	5	34	View Teams
Ivanovo	10	29	3	6	2	4	44	View Teams
Manchester	11	23	1	1	5	6	36	View Teams
Plovdiv 1	9	28	6	2	4	3	43	View Teams
Plovdiv 2	12	24	4	4	3	2	37	View Teams

Fig. 4 – Weekly Team Scores

It was decided that rather than having 1 overall winning team at the end of the competition (ie. week 12), there would be interim 'monthly' winner(s) at the end of weeks 4 and 8, as well as an overall winner at the end of week 12 based on the team with the greatest points score.

In consultation with the Living Labs and the Carbon Trading working party it was agreed that an acceptable reward/Incentive would be that each winning team members should receive something that is (or can be used for purchasing) green/ethical goods. As such it was suggested that if any of the winning teams are in the UK, the respective Living Lab would purchase a gift voucher (say to the value of 20/25 euros) from the Green Shop (ie. www.greenshop.co.uk/gifts-115/gift-vouchers-203/?osCsid=eschn582r3klsv1ur69q38p805) for each winning team member, whilst acknowledging that Plovdiv and Ivanovo would need to seek a Bulgarian equivalent should any of their team(s) win.

Following implementation on 31st January, the system needed to be slightly modified to cater for service disruptions and situations whereby certain households for various reasons were not online at the time that energy usage figures were transmitted. In these circumstances weekly figures were averaged based on daily usage for the remaining days during that week.

5. Outcomes / Updated State of the Art

It became clear, especially at the outset of Cycle 3 and setting up the Carbon Trading Working Group that it would be unrealistic to fully achieve the objective contained within the Description of Work requiring DEHEMS to establish a model for piloting emissions trading in a Municipality area.

Nonetheless, as a first step, and recognising the large and active user base that DEHEMS had (ie. 250 households in 5 European locations), it was agreed to exploit the commitment and involvement of selected households by setting up a competition designed to encourage, by being part of a team, a reduction in electricity usage (nb. gas monitoring not implemented in Bulgaria). This would thereby contribute to a reduced carbon footprint.

Based on feedback from all 5 Living Labs, most of the selected households rose to the challenge and due to the competitive nature of the exercise were encouraging other households they knew who were taking part (nb. each household was allocated a pseudonym – e.g. Bristol 1, Bristol 2 etc, but due to DEHEMS being implemented in communities and ongoing dialogue brought about by Focus Groups, Community Champions etc, often participants in the Energy Team Challenge were aware who else was taking part).

The system holds the energy usage figures (see Fig. 5), which in turn can be used to calculate carbon emissions/savings, by converting kWh into tonnes of CO^2 saved.

Overall for the 30 households involved throughout the 12 weeks of the competition, there was a positive reduction in electricity usage (partially due to warmer external temperatures), and therefore an associated reduction in carbon emissions. By analysing the usage data maintained by the Energy Team Challenge application (see Fig. 5 example, below), an average saving of 26.03% across all 6 teams was evidenced.

- 2011-04-24: 3.26443147659302 kWh
- 2011-04-23: 4.36731338500977 kWh
- 2011-04-22: 5.07060289382935 kWh
- 2011-04-21: 4.68687105178833 kWh
- 2011-04-20: 4.31372547149658 kWh
- 2011-04-19: 4.85739994049072 kWh
- 2011-04-18: 5.40704774856567 kWh
- 2011-04-17: 4.83800983428955 kWh
- 2011-04-16: 2.93206286430359 kWh
- 2011-04-15: 4.09569644927979 kWh
- 2011-04-14: 3.93931889533997 kWh
- 2011-04-13: 3.66363716125488 kWh
- 2011-04-12: 4.0820255279541 kWh
- 2011-04-11: 4.90185022354126 kWh

Fig. 5 – Daily Readings of Electricity Usage For One Energy Team Challenge Household

6. Activities Implemented and Objectives Achieved

The objective, as defined in the Description of Work, was as part of Objective O3 to define and outline a Methodology for piloting emissions trading with live users.

Via the Carbon Trading Working Group a methodology was outlined and agreed (see Appendix I). This was implemented as detailed in Section 4 - Approach.

Basically the methodology was successfully proven by incorporating it within a team competition involving all 5 Living Labs (ie. participating households were incentivised on the basis that reducing energy usage results in less emissions/carbon implementation, and the households/teams who reduced their energy by the greatest percentage, should be deemed the winners and recognised accordingly).

The overall winners (ie. at the end of week 12) were the 5 households within the municipality of Ivanovo team.

Nonetheless, in terms of energy saved, and a reduction in carbon emissions, all participating households benefited.

But most importantly the environment benefits, and therefore everyone is a winner!!

7. Next Steps

Cycle 3 is the final phase of the DEHEMS project. As a result no further Emissions Trading activities are planned.

Nonetheless, the findings and lessons learned from DEHEMS are being factored into various other commercial energy management products, including Greenica (www.greenica.net) and Energyhive (www.energyhive.co.uk).

It is accepted that carbon footprint / emissions trading will become increasingly important in 2011 / 2012, and it is therefore important that products such as Greenica and Energyhive play an increasing role in recognising this, and reflecting on the contribution that DEHEMS Energy Team Challenge has made.

Appendix I - DEHEMS Discussion Paper : A Proposed Model for Personal / Neighbourhood Carbon Trading

1. Purpose of Document

This purpose of this document is to provide the start point for discussions on the development of a Greenhouse Gas (GHG) emissions trading model for DEHEMS and its implementation as part of Living Labs Cycle 3. The document will be reviewed and extended and once agreed converted to relevant deliverable structure.

Following on from partnership discussions an approach to implementation has now been included in section 5 for review and comment. This has now been reviewed further after discussions with Professor Erik Bichard at Salford University.

2. Carbon and Emissions Trading

Emissions trading6 (also known as cap and trade) is a market-based approach used to control "pollution" in this case carbon, by providing economic incentives for achieving reductions in the emissions of the pollutants.

A central authority would normally set a limit or *cap* on the amount of a pollutant that can be emitted. The limit or cap is allocated or sold to organisations in the form of emissions permits, which represent the right to emit or discharge a specific volume of the specified pollutant. Organisations are required to hold the relevant number of permits or credits equivalent to their emissions. Trade in permits, as a scarce resource is then encouraged, with those who can reduce emissions below their target selling the residual permits to those who are unable to, but who are prepared to pay. In this way, emissions trading seeks to encourage the most economically efficient emissions reductions.

The idea of neighbourhood or personal carbon trading takes the above principles and seeks to apply them in a way that will encourage behaviour change at an individual or group level. There are typically three approaches that can be pursued:

- (push) an **incentive** based approach where savings can be traded for some value, this tends to require some sort of subsidy or similar input into the system, unless a closed loop can be created.
- (pull) a tax based approach where the savings can be traded against some form of local tax or **penalty**, based on agreed target.
- (B2B) using savings as a basis for transactions between businesses , an approach pioneered in countries were the normal currency has been devalued.

One recent example of personal carbon trading was the RSA personal carbon trading project called Carbon Limited.[7] This was a three-year research study commissioned to look at the opportunity for personal carbon trading to engage individuals in the response to climate change. As part of this study a carbon trading system (CarbonDAQ) was created with notional values placed upon carbon derived from a trading group's baseline and emissions reduction targets.

[6] http://en.wikipedia.org/wiki/Emissions_trading

[7] www.thersa.org/projects/past-projects/carbon-limited

As a further example of this sort of approach, the attached paper (Annex A) by **Bernard A. Lietaer[8],** an international expert on currencies and founder of the ECU, provides an example of how to create a currency linked to emissions. One manifestation of this is the proposed SUCCESS[9] card funded under the EC Interreg programme.

3. DEHEMS Requirement

The DEHEMS Description of Work (DoW) states that the project will develop an:

"*Emissions trading pilot model - Localised emissions trading, at neighbourhood and household level, is a policy objective across Europe…being the first project to implement this objective. It will establish a pilot model in Cycle 3 that enables neighbourhood markets in emissions with households being able to buy or sell according to pre-allocated emissions 'budgets' on the basis of actual (as opposed to estimated) emissions information*".

The DoW goes on to say:

"*within Cycle 3, households will be allocated emissions 'budgets'. These will be based on Municipalities' policy objectives. An input into the recommendation process in the service demand layer will be whether to buy or sell emissions units based on whether the household is projected to be above or below its emissions budget for a given time period, and whether there are community-wide trading opportunities with other households in deficit/surplus*",

and

"*Anonymised emissions rankings for households will be published on the project website for each of the Living Labs. Users will be informed of their position with weekly updates, through the UI, on the community league tables*".

There are 2 distinct but connected requirements, the creation of a model and its implementation on a pilot basis during Cycle 3. The scale of implementation is not specified but clearly needs to take place within the 5 Cycle 2 Living Labs, each of which has 50 homes.

4. Proposed Model

The DoW calls for the development of a pilot model for emissions trading at the household and neighbourhood level with the ability to allocate budgets and then allow for household and neighbourhoods buying and selling allocation according to their own usage.

The above approach works on the principle that there is a market in a scarce resource, that is - the ability to "emit" - and that households will be prepared to trade money or something else for that ability. Alternatively, it can be viewed as a mechanism by which householders can be incentivised to reduce emissions by getting something of value, money or something else in return. Ideally an emissions trading systems needs to be a closed cycle and include all buyers and sellers. Whilst it may be possible to only include households in such a system, a wider neighbourhood or city scheme would open up greater opportunity for trading, particularly with corporate or other institutions that are part of wider schemes such as the UK Carbon Reduction Commitment. There would also be clear benefit in producing a model that only allowed trade in an "eco positive currency", rather than pounds or euros, which can simply be used to burn even more carbon.

[8] www.lietaer.com/

[9] www.nweurope.eu/index.php?act=project_detail&id=3993

This leads to a potential model along the following lines.

1. Households are allocated a total energy target based upon their historical usage for the period of interest
2. On a weekly or monthly basis household performance against target is calculated and converted to EcoPoints.
3. EcoPoints will be allocated based on emissions reduction over the time period and will be allocated as follows:
   a. x% of total scheme points will be awarded for the performance of all our part of the Living Labs group
   b. The remaining (100-x)% of total scheme points will be allocated to individual households across all of the Living Labs.
4. The EcoPoints are there to incentivize emissions reductions at the group and individual level. These points will not be allocated in a winner-takes-all approach, but will using a sliding scale as shown in the table below:

Emissions reduction performance	**Share of EcoPoints**
Best performance – greatest reduction	50%
Second best	25%
Third best	15%
Fourth best	10%
Lowest reduction in emissions	0%

1. A worked example can illustrate this:
   a. if Living Lab group 1 achieves the largest emissions reduction as a group relative to the other Living Labs then the group as a whole would receive 40% (50% of the 80% for group performance) of the total scheme EcoPoints. The group can then decide how to allocate the points among their members
   b. If Mrs X in Living Lab 3 achieved the greatest personal reduction across all individuals, then she would receive 10% (50% of the 20% for individual performance) of the total scheme EcoPoints for her personal use.
2. EcoPoints are redeemable at a number of retailers within the defined neighbourhood in exchange for “eco positive” value. For example, a discount on a A++ fridge or washing machine.
3. In the future retailers would then able to trade any redeemed EcoPoints against a quota scheme such as the UK Carbon Reduction Commitment.[10] Essentially, the retailer would be able to buy out part of its CRC allowance by redeeming EcoPoints.
4. This type of model provides a way of both linking different types of stakeholders across the community – incentivizing emissions reductions in other parts of society, where there may be more economically efficient opportunities.

5. Implementation Cycle 3

The proposed implementation model of the above for cycle 3 is as follows:

[10] www.decc.gov.uk/en/content/cms/what_we_do/lc_uk/crc/crc.aspx

1. Members of the Living Labs are encouraged to form one or more EcoTeams consisting of a minimum of 10 Households. These teams will then compete over the period of cycle 3 (January 11 to March 11) to reduce their electricity usage and win EcoPoints.
2. Teams will chose a name for themselves and will become part of the DEHEMS EcoLeague. For Example we could have :
    - Chorlton Greens (Manchester)
    - Eastserve (Manchester)
    - Family United (Birmingham)
    - Aston North (Birmingham)
    - Knowle Rovers (Bristol)
    - Sporting Plovdiv (Plovdiv)
    - Dynamo Ivanovo (Ivanovo)

    Etc
3. The average daily kWh for each team over the month of December 2010 will be calculated and used as the baseline for each team. Allowance will have to be made for any circumstances where the equipment fails so as to adjust the data (eg. exclude any days which have periods of zero use)
4. Ideally allowance would be made for temperature anomalies. For example if one area experienced an exceptionally cold January relative to December then it would be disadvantaged, with a likely impact upon participation and motivation. Ideally external "uncontrollable" factors such as this would be factored into the incentives process, but for the purposes of this trial this will be ignored.
5. In each month January to March there will be a competition to see which team and individual households can reduce their electricity usage by the greatest percentage from previous month. Each month 2 league tables will be produced based showing the following, with greatest % reduction first :
    A. Absolute Performance of Teams
    B. Weighted Performance of Households

    League B will be based on a mix of Household and Team Performance, but weighted differently for different months. The objective is to see whether already "green" householders who are unable to make significant changes themselves, can be encouraged to contribute to the team effort.

    The proposed weighting will be:

Month	Team Weight	Household Weight
January	80%	20%
February	20%	80%
March	50%	50%

6. During the month the league tables will be updated on a daily basis using cumulative averages to date and will be visible on the DEHEMS website to encourage households and teams.
7. Rewards will take a number of forms :
    - Peer competition and the opportunity to be the winning team or household.
    - A monthly EcoReward for each of the leagues and the overall winners (based on cumulative average position). Needs thinking about … maybe we could go for some A++ white goods for the households and maybe some low energy device that could be shared across a community (Ideas)

- Conversion of league positions to EcoPoints that can be traded with supermarket or similar. (We will continue to seek such an arrangement, but it is not a dependency).

8. In terms of timescale, then we clearly need to know the teams by the start of December, so recruitment will need to take place in late October/November.
9. A variant on the above would be to publish the performance of teams but not to provide any specific reward. This would then be followed up by an attitudinal survey to ask individuals and teams if they would have behaved differently if there had been a more specific reward. This would then provide the evidence for a larger scale implementation of carbon trading.

6. Activities - Cycle 3

Activity	**Timescale**	**Who**
1. Agree Approach	31st October 2010	CL
2. Select Teams	30th November 2010	CL/Birmingham/User Group
3. Record Base Data December	31st December 2010	CL/Salford
4. Design/Build Webpage	15th December 2010	CL/Salford
5. Moderate Competition	Jan to Mar 2011	CL/User Group
6. Attitudinal Survey	April 2011	CL/Salford

Annex

*The paper below was written by **Bernard A. Lietaer**[11], an international expert on currencies and founder of the ECU. It provides an example of how to create a currency linked to emissions.*

CLIMATE CHANGE: THE ECO2—A CONSUMER ORIENTED CURRENCY TO REDUCE CARBON EMISSIONS.

Could consumer behaviour towards carbon reduction be changed systematically with a specialized complementary currency?

The ECO_2 System:[4] How it Works

The ECO_2 system is a voluntary carbon reduction program whereby consumers receive electronic credits for purchases or investments that contribute to carbon emissions reductions. It mobilizes not only those people already converted (e.g. currently own a fuel efficient car or solar power generator), but also the much larger group of consumers who have adopted a "wait and see" attitude. Furthermore, it provides individuals and communities with a reliable way to track and compare their carbon emission reductions, as all transactions are recorded and verifiable.

Businesses providing goods and services that reduce carbon emissions or have formally engaged in sustainability activities ("green businesses") would accept ECO_2s as a loyalty currency in partial payment for additional carbon-reducing goods and services. Each business decides what percentage of an invoice or bill they are willing to accept in ECO_2s. An electric or hybrid car dealer, for example, could decide to accept 10% of the purchase of a new car in ECO_2s, whereas a shop selling energy efficient light bulbs or solar panels might accept 20% of their payment in this currency. It's their choice.

The participating businesses that sell the carbon-reducing goods or services to the customer provide the data relevant to the transaction, which automatically generates an electronic certificate. If this is a first carbon-reducing purchase by the customer, the retailer gives the customer an ECO_2 debit card, and the corresponding account is credited with their carbon savings in ECO_2 units. Subsequent transactions are performed with this card as any normal debit card transaction.

In turn, these businesses—the car dealership, hardware store, solar panel distributor—have two options for the use of the ECO_2s they receive. They can make purchases with other businesses participating in the program (B2B transactions); or sell the ECO_2s through the program's administrator to the funder of last resort.

[11] www.lietaer.com/

Final redemption of ECO_2 units would be at a fixed price previously agreed upon between the funder of last resort and the businesses. This funder of last resort could be any organization willing to pay for carbon reducing emissions. Given the additional sales tax generated by this program, it would be ideal that the tax authority of the particular municipality, county, state, or local government that has a mandatory reduction in carbon emissions, would play this role. With each transaction sales tax is generated.

For example, if sales tax is 8% in a given municipality with a business accepting ECO_2 for 20% of their sales price, and an ECO_2 is worth $20, the business owner would need 2.5 sales tax incomes to earn the $20 cost of redemption. So, by the third exchange (first a Consumer to Business (C2B) followed by one or more Business to Business (B2B) transactions), the sales tax accrued is greater than the cost of redeeming the ECO_2 units. They can then be counted as carbon reductions towards that area's Kyoto goal, and, it turn, could be traded on the international carbon markets.

For *homes*, an evaluation will be made of the carbon credit consumption of different types of dwellings by professional raters. In the U.S., many have already been trained and certified by the trade association called *Build it Green* (www.builditgreen.org), Residential homes are then rated on performing beyond their city/county's energy code minimum standards. If a house scores, for instance, 25% better than code that fact is logged, certified, and corresponding carbon savings are computed. Adding better insulation or double-paned windows, for example, is one way to reduce heating bills and carbon consumption.

For *transportation*, the type of car used, and any reduction in mileage driven compared to the State's average mileage driven, would similarly provide ECO_2s to the consumer. These would be credited to his or her ECO_2 account following a smog test or compared through the driver's previous annual mileage...

Keeping the System Honest

The burgeoning regulated international market for carbon credits is expected to more than double in size to about $68.2 billion by 2010, with the unregulated voluntary sector rising to $4 billion over the same period. Yet, companies and individuals rushing to go green have been spending millions on "carbon credit" projects that, on deeper inspection, yield few if any environmental benefits.[5]

A recent *Financial Times*[12] investigation has uncovered widespread failings in the new markets for greenhouse gases, suggesting some organizations are paying for emissions reductions that do not take place. Others are meanwhile making big profits from carbon trading for very small expenditure and, in some cases, for clean-ups that would have been made anyway.

[12] www.ft.com/cms/s/0/48e334ce-f355-11db-9845-000b5df10621.html

In contrast, the ECO_2 approach provides carbon savings that are locally certified, can be tracked within the vicinity in real time, and whose use can be electronically audited back to their origin. Each ECO_2 has its own electronic certificate, through which one can follow where and by whom it was created, for what specific purchase and at what time. This gives a much higher degree of verifiability than is typically available with the carbon credits traded under the Kyoto agreement. Finally, as the ECO_2 system is electronically integrated in real time, it enables each community to announce the carbon savings it has generated, providing an "on the spot" feed-back on how well it is doing compared to other communities. That way, everybody can participate through their own daily decisions.

Advantages Compared to Other Approaches

Besides the advantage of providing an instantaneous tracking system for carbon reducing activities and leaving an auditable trail of these carbon reductions, the ECO_2 leverages the efficiency of tax dollars to multiply carbon reductions. In most existing schemes, a consumer or business receives a tax credit or subsidy for a carbon reducing investment, but these tax dollars only have a one-time effect. In contrast, the ECO_2 units are used at least twice, and possible more, before they are cashed in. The sales taxes on these multiple transactions compensate for the cost of their redemption. As we have already noted above the cumulative sales taxes can even be larger than the redemption costs, changing the carbon reduction program from a cost item to an income producing one for the tax authority.

Appendix II - Technical Specification of Personal / Neighbourhood Carbon Trading

Introduction

This paper describes technical specification for the DEHEMS carbon trading specification based on the requirements document and DEHEMS API documentation.

Infrastructure and Integration

The carbon trading application will be developed as an independent web application and will be hosted by Clicks and Links. The application integrated with the main DEHEMS system:

1) Over DEHEMS API for all data used as part of the application
2) As part of the main DEHEMS dashboard utilising iframes.

Initial Setup

Clicks and Links will populate the application with the available living labs and the selected users supplied by the Living Labs.

One team of 5 participants will be created in each of the 5 Living Labs. Teams consist of a single living lab participant household. Households are anonymized and represented by the Living Lab name denoting their location (e.g. Bristol, Manchester…) and a number (from 1 thru 5).

Note : this 'model' can easily be revised should, for example, one Living Lab wish to submit two teams, or another Living Lab be unable to participate as they unable to get five households to participate.

Application User Flow

Users will be able to access the carbon trading application from the main menu of DEHEMS dashboard by clicking on the carbon trading icon.

The first screen displayed is the team performance table. The data on this table will build up while the competition progresses. The first screen will also display the competition start and end dates and the competition winners when available.

If the user selects a team from the table, the individual households table for the selected team will be displayed.

Competition Flow

The application goes live at the beginning of February and records data over the period of 4 weeks (nb. there will be a total of 3 x 4 week periods).

1. Week One is the baseline week (Feb 2011). During this week, energy consumption from each individual household is recorded. The energy consumption is used to rank participants in each living lab from 1-5 (based on five teams participating). Those consuming the lowest amount of electricity are allocated 5 points. Points are allocated on a sliding scale across each living lab with the household with the highest consumption of electricity receiving 1 point.

2. In Week Two the electricity consumed by participant households is measured and compared against the electricity consumed in Week One. The difference in electricity consumption between Week One and Week Two is compared and points are allocated according to the percentage reduction between the two weeks. The household with the largest reduction or least increase will get 5 points, the 2nd 4 points through to the least reduction/largest increase with 1 point. The overall percentage reduction or increase for each team is also calculated and the teams given in the same way as participants depending on number of teams, eg. for 5 teams then 5 points for the greatest reduction and 1 for least.

3. The information about team performance and the range of individual performances is published on the dashboard. Total points will be the baseline plus up to 3 scores for reduction/increase in subsequent weeks.

4. The scheme continues in the same manner each week with both households and teams competing to move higher up the league table. Individual results across all living labs could also be displayed on the dashboard.

5. At the end of each 4 week period 3 prizes (ecopositive) would be awarded as follows:

   - best Living Lab team

Based on the above, the league table might look like the following at end of a 4 week period:

Bristol

Household	Baseline Points	W1 to W2 Change	W2 to W3 Change	W3 to W4 Change	Total
Bristol 3	3	5	4	5	17
Bristol 1	4	3	5	4	16
Bristol 5	5	1	2	3	11
Bristol 2	2	4	1	2	9
Bristol 4	1	2	3	1	7

Team Performance

Team	W1 to W2 Change	W2 to W3 Change	W3 to W4 Change	Total
Bristol	4	5	3	12
Ivanovo	5	3	2	10
Manchester	3	2	5	10
Plovdiv	2	1	4	7
Birmingham	1	4	1	6