off4firms

The Current Climate and Energy Policy in the EU and in Switzerland

Joschka Gerigk
Katja S. Halbritter
Michel J.J. Handgraaf
Johannes Manser
Markus Ohndorf
Renate Schubert

ETH Zurich

December 2012

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

south pole carbon

WAGENINGEN UNIVERSITY
WAGENINGEN UR

eit Knowledge & Innovation Community
Climate-KIC

The Current Climate and Energy Policy in the EU and in Switzerland

Working Paper

Joschka Gerigk, Katja S. Halbritter, Michel J.J. Handgraaf, Johannes Manser, Markus Ohndorf, Renate Schubert

ETH Zurich
December 2012

Off4Firms
Climate-KIC Innovation Project
Reference Number: APIN0021
Work Package WP1
Deliverable D1.3

Off4Firms

Chair of Economics
Institute for Environmental Decisions (IED)
ETH Zurich
Weinbergstrasse 35
8092 Zurich, Switzerland

http://www.off4firms.com

Table of Contents

Off4Firms in a Nutshell

Off4Firms – Employer-led incentives for households' reductions in CO_2 emissions and energy consumption

Off4Firms is an applied research and innovation project aiming at reducing greenhouse gas emissions and energy consumption of private households. The project is led by ETH Zurich (Chair of Economics, Prof. Renate Schubert) and involves project partners from academia and business: Wageningen University, South Pole Carbon, Swiss Re, and EWZ. Partially financed by EIT Climate-KIC, the project runs from April 2012 until March 2014.

Being one of the world's largest emitters, households in aggregate bear an enormous potential for reducing emissions and energy consumption. Off4Firms starts from the premise that one effective way of triggering change in households is through household members' employers. Off4Firms creates a win-win situation for households and firms: both profit from employees saving energy and reducing CO_2 in their households. Employees benefit because they change their energy-related behaviour with the support of their employer. This change pays for – for example through lower energy costs. Companies, on the other hand, benefit from reputation gains as employers and in the public. In addition, under specific conditions – they may profit from offsetting their emissions by their employees' emission reductions.

Off4Firms develops a comprehensive programme for firms to use this great potential in an efficient way. This project enables firms to evaluate measures aiming at reductions in energy use and CO_2 emissions in their employees' private lives. Evaluation criteria are the effectiveness, cost efficiency, verifiability and acceptability of measures for the employees. Best practice measures will be identified and a tool kit will be provided, enabling the development of company-tailored CO_2 or energy reduction measures. These measures will be brought to scale by a dedicated business unit. In addition, the policy framework making such measures a win-win strategy for households and for firms will be depicted.

Introduction

Up to the present, employer-led incentive schemes to induce voluntary emission reductions and to foster energy efficiency in employees' households have been limited to a few cases. The main reason for companies to implement such schemes is to assume responsibility for environmental issues beyond the boundaries of the firm. Hence, currently, such activities are to signal Corporate Social Responsibility (CSR). The gains for firms implementing such programmes are purely of reputational nature, in particular on the labour market. The reliance on reputational gains of such programmes has however some drawbacks with respect to a scale-up over a large set of employers. As it is in the very nature of positive reputational gains that their value decreases with the number of firms that actually implement such measures, the potential of employer-led incentive schemes to foster energy efficiency in their employees' private lives seems limited when relying solely on voluntary corporate action. Thus, when investigating into opportunities for a scale-up of such measures, it is useful to examine opportunities to incorporate employer-led incentive schemes into existing mandatory policy instruments. This is the main objective of this document.

In principle, any type of policy instrument involving financial incentives to make private households behave in a more energy efficient way might be channelled through a company, instead of being paid out to households directly. It is one of the main hypotheses of Off4Firms as a research project (see BOX 1) that incentive payments provided within the work context of an individual will lead to a higher rate of diffusion of cleaner end-user technologies than direct subsidies. This assumption seems particularly plausible, as individuals tend to spend a significant part of their life at work, where socio-psychological effects (like group norms, social network effects, adherence to role model behaviour, social competition, etc.) are likely to increase the adoption of new end-user technologies. In this case, well-designed employer-led schemes could significantly increase the effectiveness of policy instruments involving financial transfers.

This working paper is to discuss policy instruments which would, in principle, lend themselves for a scale-up of employer-led incentive schemes. Given that such an implementation requires financial transfers, our focus is on project-based CO_2-markets and direct subsidy schemes to end-consumers.[1] In terms of economics, both instruments place a price on the per unit reduction of emissions or on the per unit increase in energy efficiency. This is a useful quality when it comes to incorporating employer-led schemes: A firm would receive payments for aggregated emission or energy use reductions and pass the necessary financial incentive through to its employees. The requirements for household activities to be eligible for such payments, i.e. to meet additionality requirements of different stringency levels are discussed in Off4Firms Working Paper D1.1, referenced as (Manser, Schubert, & Ohndorf, 2012).

A blueprint for the implementation of such a pass-through of incentives is provided by international credit-based mechanisms, like the Clean Development Mechanism (CDM). More precisely, the current CDM-rules include the possibility to implement so-called Programmes of Activity (CDM PoAs), which allow for pooling of small-scale reductions and certification of the aggregated amount of emission reductions achieved. As transaction costs for verifying and securitizing reductions in each household individually would be prohibitively high, pooling these emissions under one programme

[1] While it is theoretically conceivable to also adjust the well-established policies based on tax exemptions to integrate employer-led programmes, we refrain from a discussion of such instruments, as this would require some major overhauls of a country's tax system.

represents a viable option to tap into the vast reduction potentials which exist in the smaller scale. In order to reduce the risk of non-additionality, PoA eligibility criteria lay out the parameters that project activities need to fulfil in order to be included into the overarching programme. This facilitates the scale-up of the programme and can again serve as a model for future Off4Firms-type programmes.

The close analogy between CDM PoAs and Off4Firms-type regimes calls quite naturally for analysing the possibility to extend existing credit-based schemes so that PoA-type employer-led incentive schemes could be integrated. If appropriately designed, household reductions incentivized within such a scheme could indeed be used as a basis for tradable emission/energy reduction certificates attributed to the employer. Such certificates could then be used by firms to offset their own corporate carbon emissions (meeting voluntary or mandatory reduction targets) or for complying with energy efficiency targets. Alternatively, such securitized offsets could also be sold on the secondary market for reduction certificates.

Given the close structural relationship between CDM PoAs and Off4Firms-type regimes, this working paper will look into credit-based mechanisms implemented within the EU and Switzerland that might be eligible for an extension towards pooling of small-scale greenhouse gas emission reductions. An interesting potential case for such an extension is the domestic Swiss offset regime which is expected to be gaining in volume in the coming years. Furthermore, in some EU-countries, credit-based schemes also exist to foster energy efficiency—the so-called markets for White Certificates. Such schemes are not yet including provisions for PoA-type pooling of small-scale efforts, but might indeed have the potential for such extensions. There also exist certificate schemes designed to foster the implementation of renewable energy production (Green Certificates) which will be discussed in this working paper.

An alternative for pooling via a credit-based system could be the channelling of subsidies for households through their employers. Compared to direct support of households, such a setup might gain from the above-mentioned additional socio-psychological effects on participation. For this reason we also discuss subsidy schemes within Switzerland and the EU that might be potentially eligible for a channelling-through via employer-led incentive programmes. It is likely that implementing such a pass-through would not be easy to implement, as it would require a change in legislation. This working paper is structured as follows: In Part A we provide the general regulatory context by depicting the energy and climate policy framework established within the EU and Switzerland. Part B describes the different credit-based schemes within the EU and Switzerland that might be eligible to integrate employer-led incentive schemes for households in analogy to CDM PoAs. In Part C we delineate different incentive and subsidy programmes for households that might be eligible for a pass-through via employers. Part D concludes with a discussion of the insights gained by our analyses.

Part A: Climate and Energy Policies

Global climate change may cause serious damages and repercussions on people all over the world. Two major international agreements have been adopted to address and mitigate climate change: the United Nations Framework Convention on Climate Change (UNFCCC), which encompasses the most general principles of international climate policy (e.g. (IPCC, 2004)), and the Kyoto Protocol, which lays down country-specific legally binding emission reduction targets for industrialized countries—referred to as Annex I countries[2].

The Kyoto Protocol was ratified by 184 Parties to the Convention and came into force in 2005. The Parties to the Kyoto Protocol specified the rules on how to abate greenhouse gas emissions at COP7 in Marrakech in 2001. The agreement established that Annex I countries should account for an overall reduction of 5.2% below 1990 levels (the "baseline") during the first commitment period from 2008 to 2012, and that no emission targets would be set for developing countries (e.g. (European Commission, 2003)). Yet, the effectiveness of the Kyoto Protocol has been significantly reduced by the refusal of the USA to ratify in 2001 and Canada's withdrawal in 2011. Both, the EU and Switzerland have signed and ratified the United Nations Framework Convention on Climate Change and the convention's Kyoto Protocol.

International abatement measures enabling countries to offset emissions at places where the marginal costs of abatement are the lowest would be most cost-efficient. However, the general consensus prevails that countries should primarily meet their emission reduction targets through national measures. Accordingly, both the EU and Switzerland allow for a partial fulfilment of their climate targets through offsetting mechanisms that take into account emission reductions achieved outside their national boundaries.

At COP18 in Doha in December 2012, a follow-up agreement to the Kyoto Protocol was reached setting out a second commitment period starting on January 1, 2013 and running until the end of 2020. Both the EU and Switzerland, together with non-EU European countries and Australia, have already committed to participate in this new commitment period. Yet, Canada, Japan, Russia, and the US are not participating in a second Kyoto commitment period, with the latter not even having ratified the Kyoto Protocol. In addition, and possibly in view of missing its Kyoto target by a significant margin, Canada withdrew from the Kyoto Protocol shortly after the 2011 COP (Environment Canada, 2011; UN News Center, 2011).

1 Climate and Energy Policy in the EU

1.1 Climate Policy and Targets in the EU

The EU, responsible for around 11% of world GHG emissions, has conceded the topic climate policy quite an important role on its agenda and agreed to binding emission reduction targets up to 2020, with a roadmap of further emission reductions laid out until 2050. In the Kyoto Protocol, the EU (EU-15) pledges a collective EU-wide emission reduction by 8% below 1990 levels by the years 2008-2012.

[2] The UNFCCC defines industrialized member countries of the OECD plus countries with economies in transition as ANNEX I countries.

In addition, the EU already pledged itself to participate in a second Kyoto commitment period, and has committed to cutting overall EU emissions by 20% by 2020 (baseline: 1990), with the possibility to increase the target to 30% under the condition that other major economies set themselves similarly ambitious objectives. Until 2050, the EU plans to reduce its emissions to 80-95% below 1990 levels (European Commission, 2012b).

The EU climate protection strategy for the period until 2050 is laid out in its Roadmap 2050, with the overall aim to move towards a competitive low-carbon economy by 2050 (European Commission, 2011a). For reaching this goal, the efforts hitherto have included

(i) establishing the European Climate Change Programme (ECCP), whose duty it is to explore further cost-effective options for reducing GHG emissions in line with the EU's Lisbon strategy for increasing economic growth and job creation, and which to lead to the implementation of manifold new policies;

(ii) adopting legislation to raise the production of energy from renewable sources;

(iii) setting energy-efficiency targets for 2020;

(iv) setting binding emission targets for new cars and vans; and

(v) supporting the development of carbon capture and storage technologies.

Beyond its regional (EU-wide) policies, the EU is a strong advocator for a global climate agreement that should ideally be legally binding and cover all countries and aim at keeping global warming below 2°C compared to pre-industrial times. At the Climate Change Summit COP17 in Durban it was agreed to finalize such agreement by 2015, with its implementation starting in 2020 (European Commission, 2012g).

On its way towards a highly energy-efficient, low carbon economy, the EU has conceived a roadmap outlining the necessary measures and transformations. For the middle-term, it adopted a package of binding legislation, which aims at ensuring that the EU reaches its objectives for the year 2020, the so-called "20-20-20" climate and energy targets:

- 20% reduction in EU GHG emissions compared to 1990 levels;
- 20% proportion of renewable energies in the energy mix consumed in the EU;
- 20% improvement in energy efficiency in the EU

(European Commission, 2011b).

Four concrete cornerstone pieces of legislation, the so-called "Climate and Energy Package", aim at reaching these targets, namely (the reform of) the EU emissions trading scheme (EU ETS), national targets for non-EU ETS sectors, national renewable energy targets, and carbon capture and storage (CCS) (European Commission, 2012e). In the following, we briefly introduce the legislation that is of particular interest in the Off4Firms context, namely the EU ETS and the national targets for non-ETS sectors. National renewable energy targets are covered in the following Section 1.2 on Energy Policy and Targets in the EU. This study does not cover CCS since it is not of relevance in the context of households' GHG emissions and energy consumption.

The EU emissions trading scheme

The EU ETS has been the European Union's main instrument for cutting industrial GHG emissions the last eight years, covering around 11,000 industrial and power plants in thirty countries (EU-27 plus Norway, Liechtenstein, and Iceland). The EU ETS is a cap-and-trade scheme, applying a total emissions cap to the industries regulated under it and allowing for trade of the corresponding emission allowances (EUAs) among these industries and external parties. More specifically, the regulated industries under the EU ETS are power stations, combustion plants, oil refineries, iron and steel works, paper mills, glass, cement, and pottery and bricks. The EU ETS will be further expanded to the petrochemicals, ammonia and aluminium industries and to additional gases in 2013. Emissions trading shall guarantee that emissions are cut where it is least costly. In the first two phases (test phase from 2005-2007, second phase from 2008-2012), emission allowances were mainly allocated to the emitters for free. A third trading phase (2013-2020) will be dominated by auctioning permits destined at utilities, which are jointly the largest emitter within the EU ETS. For industry and heating sectors, allowances will be allocated for free according to benchmarks (European Commission, 2012a). The EU is strongly advocating towards launching similar cap-and-trade systems in non-EU countries, with the possibility to link them up with the EU ETS, thus ultimately leading towards a global carbon market (European Commission, 2012d).

National targets for non-ETS emissions

Households belong to the sectors that are not covered by the EU ETS. Sectors not covered by the EU ETS jointly account for approximately 60% of the EU's total emissions. National binding targets, informally known as the "effort-sharing targets", have been assigned collectively to the majority of these sectors for the period 2013-2020 and are laid out in the Effort Sharing Decision.[3] These targets include emissions from the majority of sectors that are not included in the EU ETS, such as transport (except aviation), buildings, agriculture and waste. In contrast to the sectors regulated under the EU ETS, the responsibility of setting up and implementing appropriate policies and measures to reach the joint emission reduction targets of these sectors lies with the Member States. Possible measures include, for instance, the electrification of transport and the promotion of public transport, the introduction of energy performance standards for buildings, incentive schemes for the refurbishment of the building shell, heating systems based on renewable energy and more efficient heating systems, and reducing GHG in the agricultural sector. See Figure 1 below.

The EU is assisting EU Member States in their efforts to reduce emissions and energy consumption by introducing energy labelling systems. Such systems aim at informing consumers and mandating eco-design requirements for energy-using products, for instance. This information allows consumers to e.g. choose electric household appliances on the basis of their energy efficiency. Other EU-wide environmental and climate standards and policies helping Member States to achieve their national targets for the non-ETS sector include emission performance standards for new passenger cars and light commercial vehicles, and regulations in the fields of fluorinated GHG and waste (European Commission, 2010).

[3] 406/2009/EC, Annex II

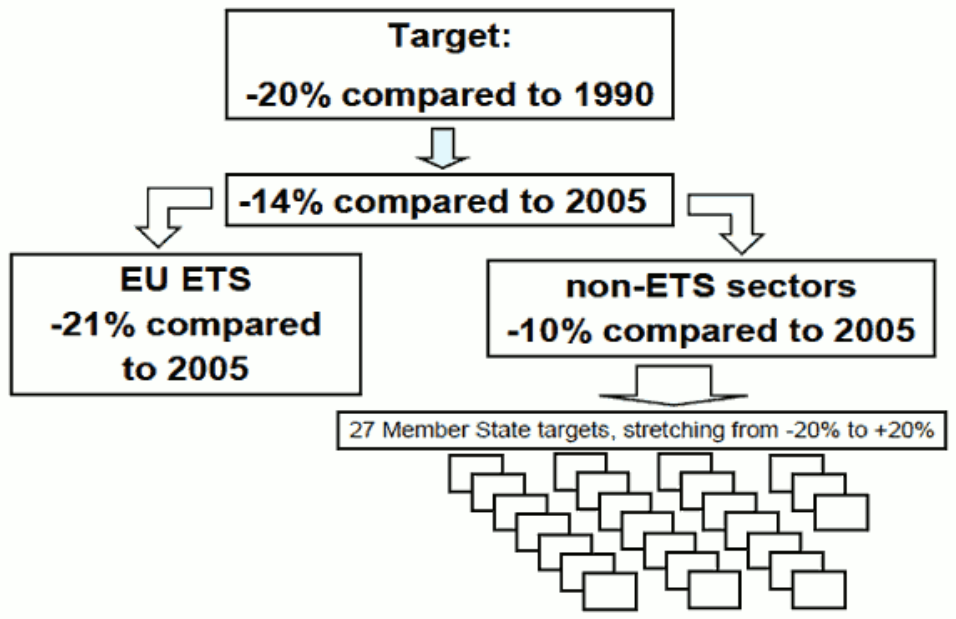

Figure 1 – Emission reduction targets in the EU. Source: (European Commission, 2012c)

1.2 Energy Policy and Targets in the EU

The overarching objectives of EU energy policy are to achieve a low energy consumption economy based on a more competitive, more sustainable, and more secure energy supply.[4] A broad mix of market-based and non-market-based tools, together with EU financial instruments, and the development of energy technologies should help reaching the aims of the policy (European Commission, not dated).

European energy policy – though being at the heart of the idea of a unified Europe with the European Coal and Steel Community Treaty in 1951 and the European Atomic Energy Community Treaty in 1957 – has for a long time been a rather marginalized policy area in Europe.[5] Interestingly, it is only since the adoption of the Treaty of Lisbon, signed by EU Member States in 2007, that energy has taken on a more significant and independent role in EU policy-making. This implies a new legal basis, which it lacked. Yet, EU Member States still retain the right to negotiate bilaterally on energy issues with non-EU countries, thus yielding a "shared ownership" of EU energy policy between the EU institutions and the Member States. Being a horizontal policy issue, EU energy policy is furthermore a component of other policy areas, such as foreign policy, environmental and climate change policy, and competition (Braun, 2011).

For the period until 2020, the EU's energy strategy is structured around five priorities:[6]

- Limiting energy use in Europe;
- Building a pan-European integrated energy market;

[4] COM(2007) 1 final – Not published in the Official Journal, Communication from the Commission to the European Council and the European Parliament of 10 January 2007, „An Energy Policy for Europe"
[5] Ibid.
[6] COM(2010) 639 final – Not published in the Official Journal, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee of the Regions of 10 November 2010, „Energy 2020 A Strategy for competitive, sustainable, and secure energy"

- Empowering consumers and achieving the highest level of safety and security;
- Extending Europe's leadership in the development of energy technology and innovation;
- Strengthening the external dimension of the EU energy market.

In its Energy Efficiency Action Plan (EEAP) of 2006, the EU set itself a primary energy savings target of 20% below the 2007 projections for 2020. As described in the previous section, this 20% energy saving target is one of the EU's three key energy and climate targets, together with a 20% reduction in GHG emissions and a targeted 20% share of renewable energies of the final energy consumed within the EU. In the following, some of the most important policies contributing to reaching the "20-20-20" target are outlined.

Specific EU policies contributing to reaching the "20-20-20" target

As part of its "20-20-20" target, the EU adopted its Renewable Energy Directive[7], which sets forth binding national targets for increasing the share of renewable energies in the energy consumption of EU Member States by the year 2020. Individual national targets vary between targets of 10% in Malta and 49% in Sweden. Further objectives are to raise the share of renewable energies in the transport sector up to 10% together with a reduction of dependence on imported energy (European Commission, 2012e).

In view of a possible failure to reach the 20% primary energy savings goal set for 2020, the EU Commission put forth a new Energy Efficiency Plan (EEP) and proposed the enactment of a new Energy Efficiency Directive[8] that was adopted in October 2012. While it does not set binding energy efficiency targets at national levels, it introduces binding measures.[9] After controversial discussions between Member States, it finally requests Member States to set up national schemes that

(i) oblige utilities to reduce energy sales by 1.5% annually among their customers, to be achieved through improved heating systems, fitting double-glazed windows, or insulating roofs;
(ii) obliges the public sector in each country to lead by example and renovate 3% of the building "owned and occupied" by the central government;
(iii) requests EU Member States to define a roadmap to make the entire buildings sector (including commercial, public and private households) more energy efficient by 2050, and
(iv) requires energy audits and management plans for large companies, with cost-benefit analyses for the deployment of combined heat and power generation (CHP), as well as public procurement (EurActiv, 2012).

[7] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.
[8] Directive 2012/27/EU on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC.
[9] These binding measures are to be implemented on national level. The implementation of these measures, and reaching their associated targets, is binding on national level.

In addition, “soft” measures like labelling are perceived to contribute considerably to enhanced energy efficiency. In this context, seemingly, the EU labelling policy has played a significant role in the realisation of above average energy savings for electric appliances (ADEME, 2009). On a global level, the EU aims at reaching an international agreement on energy efficiency beyond the EU-level.[10] As a first milestone, the G8 signed the International Partnership for Energy Efficiency Cooperation (IPEEC) in 2009, providing a platform for exchanging and developing individual countries’ experience of energy-saving measures. The IPEEC’s current work includes identifying and documenting methods to overcome the multiple barriers that impede financing of energy efficiency projects, increasing the market penetration of highly efficient appliances through coordinated action and technical exchange by governments, and summarizing existing multilateral and international energy efficiency initiatives (Il Ministro dello Sviluppo Economico, 2009; IPEEC, 2012).

The status quo: On track towards reaching Kyoto targets

Emissions of the EU-15[11] have been below their joint Kyoto target already since 2009. Their joint emissions fell by 10.6% over the 20-year-period 1990-2010 (15.5% for EU-27), with the common commitment under the Kyoto Protocol amounting to an 8% in emission reductions between 2008-2012 (EEA, 2012). With the economy growing significantly within this time, it is evident that decoupling of economic growth from GHG emissions has been progressing steadily in this time. According to a recent draft report of the EU commission, the EU-15 is well on track to achieve its Kyoto target and likely to overachieve it by a few per cent. The report indicates though that more efforts will be needed to achieve the EU’s 2020 objectives, especially with regard to energy efficiency (European Commission, 2012f).

1.3 National policies, targets, and achievements: the cases of Germany, the United Kingdom, France, and Italy

In the following, we will throw a short glance at the four biggest emitters of the EU, namely Germany, the United Kingdom, France, and Italy, with a focus on their achievements and the policy instruments they have employed in their efforts.

Germany, the largest country in the EU in terms of total GHG emissions and inhabitants, has already exceeded its goal of 21% emission reductions by roughly 4%. They did so exclusively through domestic GHG emission reductions. Increased energy efficiency in power and heating plants and the economic modernization of the five new federal states[12] contributed to a large extent to this development (European Commission, 2012f). Over time, Germany has increasingly used economic instruments to bring about emission reductions, with the reform in energy taxation ("ecological tax reform”) helping reduce energy use and cutting GHG emissions by around 2%. In addition, Germany has relied heavily on the increased use of renewable energy sources and energy efficiency for reaching its climate and energy targets (OECD, 2012). With regard to transport, Germany achieved a

[10] COM(2007) 1 final – Not published in the Official Journal, Communication from the Commission to the European Council and the European Parliament of 10 January 2007, „An Energy Policy for Europe“

[11] Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom

[12] Bundesländer; due to German reunification

decrease in transport-related GHG in the 2000s through energy taxation, fuel efficiency, and improvement in logistics, aided by an increasing world oil price. Low emission zones in major cities and emission-based road tolls for heavy goods vehicles spurred the uptake of more fuel-efficient freight and passenger cars.[13] With regard to renewables, the German feed-in tariff (FiT) has been effective in promoting electricity generation from renewable energy sources and meeting the associated target of a share of 12.5% of electricity from renewable energy sources in total electricity generation by 2010. The share increased by ten percentage points between 2000 and 2010 (from 7% to 17%). Energy use decreased significantly, especially in the transport sector, with inherent emission reductions allegedly amounting to 2-3%. Overall emissions from the residential sector fell by more than 13% over the 2000s, mainly due to the eco-tax reform, support of residential energy efficiency, and rising energy and electricity prices (OECD, 2012).

In the United Kingdom, the situation is similar to Germany; the United Kingdom has already over-achieved its target of 12.5% emission reductions for 2008-2012 under the Kyoto Protocol, with emissions being nearly 23% below 1990 levels. The United Kingdom thus also attained its more ambitious national reduction target of 20% by 2010. The highest GHG reductions have allegedly been due to economic/financial instruments, of which the Climate Change Levy is probably the most important one. Further major contributing factors to the decrease in emissions were the liberalisation of energy markets, followed by fuel switches from oil and coal to gas, and nitrous oxide (N_2O) emission reduction measures in the production of adipic acid (ESDN, 2007; OECD, 2012). Significant emission reductions in the transport and residential sectors, accounting for 48% of total emissions, are still lacking (OECD, 2011).

France's GHG emissions fell by 6.6% between 1990 and 2010, thus exceeding their Kyoto pledge consisting in the maintenance of 1990 emission levels. France is on track to achieve its target domestically, having achieved major reductions in N_2O emissions from the adipic acid production. Yet, despite having the second-lowest average emissions in the EU for new cars sold, CO_2 emission from road transport and HFC emissions increased considerably (EEA, 2012; European Commission, 2012f; French Embassy in the United States, 2009). France adopted the "Grenelle 2" Law in 2010, including several policies that aim at reducing emissions, focusing on buildings, transport, and energy supply (Ministère de l'Écologie, not dated). The EU Climate Policy Tracker project partners claim that France should introduce more ambitious renewable energy and energy efficiency targets for industries and work on a strategy outlining how to achieve France's long-term emission reduction goal in 2050 (WWF/Ecofys, 2011a).

Italy pledged 6.5% emission reductions for 2008-2012. Compared to the achieved 3.5% of reductions in 2010, this leaves room for improvement. Italy is the only EU Member State not on track to achieve its national Kyoto target even when taking into account the planned use of Kyoto flexible mechanisms, use of unused allowances from the EU ETS new entrants reserve, and carbon sinks plus additional policy measures (European Commission, 2012f). Emissions rose mainly in the transport sector (road transport), electricity and heat production, and petroleum refining (EEA, 2012). In the energy sector, fossil fuels (mainly natural gas) are to be substituted by renewable sources and through the development of nuclear power, the latter being a highly contested issue among citizens.

[13] This led, for instance, to the scrapping (deregistration) of approximately 70% of cars of the highest emission category and 50% of commercial vehicles registered in Berlin.

In general, Italy still lacks a comprehensive climate strategy for moving towards a low-carbon economy, with a general lack of coordination and push from the national level (WWF/Ecofys, 2011b).

2 Climate and Energy Policy in Switzerland

2.1 Climate Policy and Targets in Switzerland

The first Kyoto commitment period 2008 to 2012 and the Swiss CO_2 Law

As a signatory state to the Kyoto Protocol, Switzerland committed to reduce its GHG emissions by 8% below the 1990 level between 2008 and 2012. This overall target was split up into sectoral targets. With fossil fuels used in the heating and transport sectors contributing a major part to Swiss national GHG emissions, policies in general focus on the building sector (including refurbishment of the building shell and installation of renewable energy) and on transport. Hence, in its national CO_2 law of the year 2000, Switzerland adopted a joint CO_2 emission reduction target for heating and process fuels and transport fuels of 10% below 1990 levels in the period 2008-2012. This target was further split up into a reduction target of 15% for heating and process fuels, and 8% for transport fuels (Swiss Confederation, 1999).

After roughly eight years in force, it became obvious that the CO_2 Law's reduction target could not be reached with voluntary measures alone. A revenue-neutral tax on stationary fossil fuels (heating and process fuels, not power fuel) was introduced in 2008 at a rate of CHF 12 per ton of CO_2. In 2010, the tax was increased to CHF 36 per ton of CO_2 and its revenues were partially earmarked (one third, at most CHF 200 mio) for the building refurbishment programme, a programme that additionally benefits from financial support from the cantons. Refurbishment of building projects had hitherto been supported with 10% of the costs by the Climate Cent foundation[14], with total investments on the part of the foundation of CHF 185 million (IEA, 2012a).

The above-mentioned tax on stationary fossil fuels has included the option of exemptions for energy-intensive firms and other large consumers of stationary fossil fuels. Depending on a firm's nature, it is either

(i) obliged to fully compensate its emissions, which applies to all fossil-fired power plants;
(ii) obliged to participate in the Swiss emissions trading system (CH ETS), or
(iii) allowed to either opt-in for the CH ETS or undergo formal and binding emission reduction commitments (FOEN, 2012c).

These commitments are worked out and tailored individually to the specific firm – for relatively small emitters in collaboration with EnAW[15] and with the possibility to apply for subsidies offered by the Swiss Climate Foundation[16]. These commitments need formal approval by the Swiss Federal Office for the Environment (FOEN) (FOEN, 2010). In the case firms overachieve their commitments, a

[14] The Climate Cent foundation [Stiftung Klimarappen] is a voluntary initiative by the Swiss industry aimed at efficient climate protection by implementing emission reduction projects, and financed through a 1.5 Rp per liter levy on petrol and gasoline imports. http://www.klimarappen.ch/

[15] The EnAW, Energy Agency of the Economy [Energieagentur der Wirtschaft], is a trade association that was founded to implement the environmental targets of the Federal Council as laid out in the Energy Law (EnG) and the CO_2 Law. It was founded in 1990 by important trade associations. http://www.enaw.ch/

[16] The Swiss Climate Foundation [Klimastiftung Schweiz] is a non-profit foundation that directly champions the cause of climate protection in Switzerland and Liechtenstein. It supports small and medium enterprises (SME) that are proactive in their approach to reducing CO2 emissions. http://www.klimastiftung.ch/

contract with the Climate Cent foundation stipulates that the foundation will purchase the corresponding domestic emission certificates (Climate Cent Foundation, not dated; DETEC, 2007).

The voluntary private-sector Climate Cent foundation proposed a surcharge of 1.5 Rp per litre of gasoline or diesel imported into Switzerland and for crude oil imports destined at the transport sector. This aimed at avoiding a carbon tax on transport fuels. The revenues of the levy are used for emission reduction activities under the auspices of the Climate Cent foundation. The mitigation obligations of the foundation are negotiated and agreed with the Swiss government. The main emission reduction activities are building refurbishments; financing energy efficiency and renewable energy projects in transport, space heating, process heat, and waste heat; and purchasing domestic allowances from those companies that have exceeded their obligation (IEA, 2012a).

A major instrument to enhance energy efficiency and the deployment of renewable energies has been the SwissEnergy programme[17]. Some measures initially introduced by SwissEnergy meanwhile became mandatory. Governmental feed-in tariffs (FiT) are an example (IEA, 2012a).

Despite these efforts, Switzerland has fallen short of its (domestic) reduction commitments by four million tons of CO_2 for this first Kyoto commitment period, corresponding to 0.8 million tons annually. Switzerland's domestic emission reduction target is to limit annual CO_2 emissions to 36.7 mio tons, corresponding to an emission reduction of 10% below 1990 levels. Its Kyoto target consists in limiting GHG emissions to 48.6 mio t CO_2eq annually in the period 2008-2012. Government authorities announced to close this emission reduction gap by the acquisition of foreign emission certificates. The failure to reach the envisioned target is mainly due to an increase in emissions of the transport sector. GHG emissions in this sector account for a third of total Swiss emissions. In order to further tackle and possibly curtail this undesired development in future, the Swiss Confederation introduced an obligation for fuel importers to partly and domestically offset emissions from the transport sector from 2013 on.[18] Up to now, emission offsetting in the transport sector has mainly taken place through the purchase of international emission reduction certificates (CERs). The unexpectedly fast and strong recovery of the economy after the crunch in 2009 further contributed to a slower decrease in industry emissions than predicted and thus to the failure to reach Swiss (domestic) reduction commitments. In contrast to this, emissions of the sectors industry and households, amounting each to roughly 20% of Swiss total emissions, decreased slightly by 1-2% each in the period 1990-2009 due to higher insulation standards of buildings, building refurbishments, and fuel switching from fossil fuels to gas and renewable energy sources (DETEC, 2011a; FOEN, 2011b, 2011c, 2012b; Swiss Confederation, 2011).

[17] The SwissEnergy [EnergieSchweiz] programme is the central platform for connecting, coordinating, and information and know-how exchange between the several actors in the fields energy efficiency and renewable energies in Switzerland. It supports both mandatory regulations and voluntary initiatives in households, municipalities, and business & industry (DETEC, 2012).

[18] The Federal Council can set the share of emissions that needs offsetting to 5-40%, in accordance with the progress made towards achieving the envisioned emission reduction target. More information is provided in the following section.

The second Kyoto commitment period 2013 to 2017/2020 and the "new" Swiss CO_2 Law

In line with the next (tentative) Kyoto commitment period, Switzerland has passed the new CO_2 law, which is entering into force in the beginning of 2013. In contrast to the former CO_2 law, it covers all Kyoto GHGs and sets a target of 20% emission reductions below 1990 levels until 2020 to be reached exclusively *domestically*.[19] In general, the Swiss Law is based on the subsidiarity principle, stipulating the priority of private-sector measures over government intervention (IEA, 2012a).

In accordance with the previous CO_2 law, the domestic emission reduction target should largely be achieved through measures in the buildings and transport sector, specifically, through

(i) the support of building refurbishments, including the replacement of oil space heating;
(ii) a limit on CO_2 emissions for new passenger cars; and
(iii) an obligation for fuel importers to partly (5-40%)[20] and domestically offset the emissions from the transport sector (Swiss Confederation, 2011). For the time being, a reduction path from 0% in 2013 to 10% in 2020 is stipulated in the corresponding regulation (FOEN, 2012f).[21]

In addition, the CO_2 tax as one of the main instruments in Swiss climate policy will be kept. An elevation of the CO_2 tax to 60 CHF per ton of CO_2 will be mandated in case the stationary fuel related emissions of the year 2013 exceed 80% of 1990 levels. Likewise, the tax can be increased to up to 120 CHF per ton of CO_2 in case the sectoral intermediary targets for stationary fuels are not achieved (FOEN, 2012g).

With regard to implementation, Switzerland continues with its most important and well-tried measures, like the CO_2 tax and the building refurbishment programme. Similarly to its set-up in the years 2010-2012, the building refurbishment programme shall be financed through a portion of the CO_2 tax on heating and process fuels earmarked for this purpose. These revenues are capped at CHF 300 million annually. The programme consists of two components: firstly, the improvement of the building shell, that is, energy efficiency, which receives the main part of the earmarked CO_2 tax revenues, and secondly, the promotion of renewable energy, the use of waste heat, and the optimisation of energy systems, with at most one third of the earmarked CO_2 tax revenues designated to these three measures (FOEN, 2010).

Obviously, as is the case for the EU and EU Member States, Swiss climate and energy policy are closely intertwined and linked. Hence, in the following, we briefly outline the relevant Swiss energy policy and its objectives, and how Switzerland plans to put them into practice.

[19] The text provides for the possibility of enhancing this target to a 40% reduction, in case an international agreement had been achieved. Remarkably, these additional reductions also need to be partially (25%) achieved in Switzerland. Hence, there is an increased focus on domestic efforts in climate change actions to be noted (FOEN, 2012g).
[20] The new CO_2 Law provides that the Federal Council can set the share of emissions that needs offsetting to 5-40%, in accordance with the envisioned emission reduction target (Swiss Confederation, 2011). Switzerland might increase its overall emission reduction target in case other countries pledged more ambitious emission reduction targets (FOEN, 2012f).
[21] This reduction path can be tightened in case Switzerland increases its overall emission reduction target, which might happen in case other countries pledged more ambitious emission reduction targets (FOEN, 2012f).

2.2 Energy Policy and Targets in Switzerland

Since 1990, energy policy has been enshrined in the Swiss constitution, mandating a sufficient, broad, safe, economic and environmentally friendly energy supply and economic and rational energy consumption. Both the Swiss CO_2 law and the Energy Law form part of Swiss energy policy (SFOE, 2012b). Since 2007, the Swiss energy policy is based on the four pillars energy efficiency, renewable energies, the replacement and new construction of large-scale power plants, as well as foreign energy policy. This policy is operationalized by action plans that foresee to decrease the consumption of fossil fuels by 20% and to increase the portion of renewable energies of the total energy consumed by 50% until 2020 (from 16.2% to around 24%).[22] The action plans envisage limiting the increase in energy consumption between 2010 and 2020 to 5%, with a stabilisation of energy consumption thereafter. They consist of a set of comprehensive incentive measures, direct subsidies, and regulations and minimal standards, which fall into the responsibility of either the Swiss Federation, or the Parliament, or the cantons. In the latter case, the Federation assists in harmonizing the independent cantons' efforts (SFOE, 2008, 2012a).

After the incident at the Fukushima Daiichi nuclear power plant in spring 2011, the Swiss government and parliament decided to completely phase out nuclear power, possibly until 2034. As a direct consequence of this decision, the "Energy Strategy 2050" [23] was adopted, laying out a roadmap towards a significant reduction in final energy use and a stabilization of electricity use. The medium-term policy measures will focus on improving energy efficiency, increasing renewable energy generation – especially hydro power but also other renewable sources –, and natural gas. The corresponding legislative proposals are currently being prepared by the government and due for public and parliamentary consultation in fall 2012 and spring 2013, respectively. The new legislation should then enter into force in the beginning of 2015 (IEA, 2012a; SFOE, 2012c).

The necessity of further baseload energy and thus the construction of a few gas-fired power plants to supplement baseload generation is quite controversially discussed (IEA, 2012a). In this context, the Swiss Federal Office of Energy (SFOE) assumes that the construction of at least one gas-fired power plant will be necessary to assure security of supply. Yet, given the current regulation that foresees full compensation of CO_2 emitted for all fossil fuel power plants, it remains unclear whether there remain enough financial incentives for utilities to invest into the construction of such a power plant (SFOE, 2012e). This is further discussed in Part B, Chapter 4.

Based on the European Energy Efficiency Directive[24] recently adopted, the new Swiss Energy Law introduces binding energy efficiency targets for energy utilities with an annual overturn of at least 30 GWh. The utilities that fall under the scheme need to effect energy savings of a certain percentage of their energy sales, to be stipulated annually and individually and amounting to up to 2%. These energy efficiency improvements can be fulfilled by implementing standardized or non-standardized measures[25], with the latter requiring prior examination and approval (Swiss Confederation, 2012a).

[22] This includes hydro power.
[23] Energiestrategie 2050
[24] 2012/27/EU
[25] The proof of evidence for the efficiency gains attained is done through a measures-based approach, similarly to the emission reduction target agreements between the Federal Office for the Environment (FOEN) and firms that wish to be exempted from paying the CO_2 tax. The Federal Government provides a broad catalogue of standard measures for which the efficiency gains can be calculated ex-ante, with no need for monitoring. Non-standardized measures are subject to a prior examination and approval by the Federal Government and need to fulfill of energy and investment additionality. The provision of evidence for non-standardized measures rests with the utilities (Swiss Confederation, 2012b).

White certificates[26] are planned to be issued for all verified energy efficiency gains and are supposed to be tradable among the obligated utility companies (Swiss Confederation, 2012b). They will be discussed in Part B, Chapter 1.

With regard to the longer-run energy policy, a motion for a gradual overhaul and introduction of CO_2 and energy taxation, respectively, is tabled by government authorities. This is in line with the Swiss Federal Council's longer-term objective to introduce an "overall energy tax" in the sense of an ecological tax reform with a steering effect on energy demand. The respective public consultation is planned for summer 2014 and will be based upon an analysis of the possible designs of the tax, for instance with regard to revenue recycling (SFOE, 2012d; The Swiss Federal Council, 2012b).[27]

3 Conclusion and relevance for Off4Firms

The EU as a whole (EU-15) seems to be on track towards achieving its joint Kyoto target, and most of the Member States will also fulfil or even overachieve their Kyoto pledges, with Italy slightly lagging behind. Switzerland has not achieved its domestic reduction commitments and is to close this emission reduction gap with foreign emission certificates. Yet, the Kyoto targets are far from being ambitious enough to limit the global average temperature rise to not more than 2°C above pre-industrial levels (IPCC, 2007). Given that efforts towards reducing emissions and energy consumption need to be ramped up drastically in order to stay on track towards reaching future targets, new and innovative ways of further reducing emissions need to be developed. Individual countries are responsible for defining their own additional national policies and measures to limit their emissions that are not covered by the EU ETS (European Commission, 2012f). Finding solutions for lowering emissions from the private sector (households), which accounts for roughly 40% of total CO_2 emissions in the EU and in Switzerland, becomes more and more urgent (Eurostat, 2009; FSO, 2009).

In the following two Parts B and C, we will describe the policy instruments that governments and public authorities have used up to now in the context of tackling small-scale emissions from disperse sources, especially households. We will analyse which role firms could play in this context in order to increase private household energy savings and GHG emission reductions.

[26] White certificates are documents certifying that a certain reduction of energy consumption has been attained. White certificates are sometimes tradable and mostly combined with an obligation for energy producers/suppliers to achieve a certain target of energy savings among their end customers.

[27] A best-practice example in this context could be the city of Basel that levied a special tax obligation on electricity bills, the revenues of which are earmarked for projects in the fields of renewable energy, energy efficiency, energy consciousness, and "ideas of the future". Furthermore, there is an incentive or steering tax on electricity (Amt für Energie und Umwelt. Basel-Stadt, 2012). Due to historic reasons, competences in Switzerland are split between the government, cantons, and municipalities, and especially cantons have an important say in daily political life in Switzerland, in line with the Subsidiarity Principle (EFV, 2012).

Part B: Credit-based schemes

Credit-based schemes seem to be an appropriate policy instrument for integrating emission and energy reduction activities in private households into employer-led emission reduction initiatives. Employer-led emission reductions in households might form the basis for emission/energy reduction certificates. Such certificates would potentially have a real value on the market for emission/energy reductions and could hence either be used by companies to offset their own corporate carbon emissions (meeting voluntary or mandatory reduction targets) or for complying with energy efficiency targets. In addition, certificates could also be sold to other firms that would use the certificates for meeting their respective emission reduction or energy efficiency targets. Thus, carbon offsets and energy efficiency certificates generated by households' emission/energy reductions, and initiated by firms, could serve as a means to facilitate corporate compliance to existing or future climate and energy policy regulation. They would hence be of interest for companies.[28]

Due to their small size and spatial distribution, the aggregation of emission offsets from households typically suffers from high transaction costs due to e.g. the need for monitoring, reporting, and verification (MRV) of the emission/energy reductions achieved. This can be well observed in the context of Programmes of Activities (PoAs) under the Clean Development Mechanism (CDM), where individual small-scale project activities that would reduce GHG emissions in developing (non-Annex I) countries were for a long time quasi excluded from their possible implementation under the CDM due to their high transaction costs. Thus, programmes of activities (PoAs) were conceived to pool such small-scale emission reduction projects (project activities) under one "umbrella", referred to as the programme. PoAs generally benefit from a streamlined and leaner validation and registration process, and the small-scale methodologies that lay out baselines and monitoring for these programmes are often significantly less intricate than is the case for larger-scale stand-alone CDM projects.

Credit-based schemes, in analogy to CDM PoAs, may open up a great potential for the pooling of small and smallest-scale emission reduction projects. Therefore, in the following, the most important credit-based schemes that already exist are described and evaluated.

1 Tradable White Certificates

Tradable White Certificate (TWC) schemes are a relatively new and innovative policy instruments to promote end-use energy efficiency improvements. TWCs are designed to mend to a specific incentive problem on the energy markets: Without any policy intervention, utilities do generally not have an incentive to foster demand-side energy efficiency, as this would *ceteris paribus* reduce energy demand, and hence their revenues. White Certificates represent a credit-based scheme to provide such an incentive. A necessary precondition for such schemes is the implementation of so-called

[28] Employees would forego their right to claim emission reduction certificates or energy reduction certificates (white certificates) for the purchase of these energy-efficient appliances in exchange for the direct subsidies or discount price obtained by/through their employer. Firms could then aggregate these claims, obtain the respective emission reduction certificates from the issuing body, and either use them for their own compliance or sell them on the market.

Energy Saving Obligations (ESOs), which require suppliers to realize energy efficiency improvements within their clients' energy demand (e.g. households) up to a certain target within a given time frame (Harmelink, 2007). The securitization of the achieved reduction then results in White Certificates, with each certificate representing a per-unit reduction in energy demand. The calculation of the securitized reduction is analogous to other credit-based schemes, i.e. only those reductions that are "additional" to a predefined baseline yield a positive certificate flow.

Note that the demand on a market for White Certificates is driven by the stringency of the ESOs incurred by the electricity producers, which represent a cap similar to cap-and-trade emissions trading schemes. Electricity companies that do not meet their respective cap are then obliged to purchase White certificates on the market. The supply on this market is then generated by those utilities having achieved reductions in excess of their target. The tradability of TWCs theoretically ensures that energy efficiency improvements are realized at lowest possible costs, for which reason such schemes increase the economic efficiency of demand side reduction policies. (Giraudet, 2011; Pavan, 2011).

Currently, Tradable White Certificates are only issued in France (since 2006) and Italy (since 2005) and can be either traded over-the-counter (in Italy and France) or on a spot market (only in Italy). Other countries (Belgium's Flanders region, Denmark, and the UK) have introduced ESOs, which are however only tradable in the UK. Yet, extending these latter schemes towards full-fledged TWC regimes would be relatively easy to achieve. Furthermore, the introduction of TWCs is currently considered in Poland, Ireland, the Netherlands, Portugal, Romania, and Bulgaria (P. Bertoldi, 2011; ODYSSEE, 2011). As mentioned above, Switzerland has recently opted to introduce a TWC scheme and oblige utilities to effect energy savings of up to 2% of their sales in previous years. In Table 7 in the Annex, we provide an overview over the different schemes that are currently in place.

Interestingly, improvements in energy efficiency within the existing schemes are mainly achieved by incentive payments to the households for the use of "greener" technologies (P. Bertoldi, 2011). The preferred technologies, however, are highly country-specific. While insulation dominates energy efficiency improvements in Great Britain, heating device replacement dominate in France and CFLs (compact fluorescent lamps) in Italy (Giraudet, 2011).

An integration of employer-led incentive schemes into a TWC scheme would be a relatively simple extension of such markets. Analogous to CDM PoAs, employers could incentivize improvements in energy efficiency within their employees' households and receive in exchange the amount of White Certificates that corresponds to the aggregated improvements. These certificates, in turn, could be sold on the market, yielding financial revenues to cover for the incentive payments provided to the employees. Given that the integration of employer-led schemes would increase market volume, such an extension would increase both effectiveness and efficiency of TWC regimes.

2 Green Certificates and Renewable Energy Certificates

"Green" Certificates (GCs) and Renewable Energy Certificates (RECs) are tradable commodities guaranteeing that a specific amount of electricity has been produced from renewable energy sources.[29] Within the EU, the establishment of trading schemes for "green" certificates and renewable energy certificates has been propelled by the Renewable Energy Directive[30], which was adopted in 2001 and introduced Guarantees of Origin (GO) for renewable energy. Since then, several EU Member States have introduced their own tradable renewable energy certificate (REC) systems, specifically, Austria, Belgium, Czech Republic, Denmark, Finland, France, Ireland, Italy, the Netherlands, Slovenia, Sweden, the UK, and Romania. Often, renewable energy targets for utilities are linked to (sometimes already previously existing) quota policies (REN21, 2012). Quota policies are mandated by the government and obligate a utility, group of companies, or consumers to provide or use a certain minimum share of renewables of either installed capacity, electricity generated, or electricity sold. Usually, there is a minimum price for the certificates, which is set by the regulator and needs to be paid to the renewable power producer. In case the demand for certificates is too low, the government or another trustable body often acts as buyer of last resort (IEA, 2012b).

Yet, up to now, green certificate schemes are regionally scattered, and a harmonized common market for green certificates does not exist. In this respect, there are two trends to be observed within the EU. On the one hand, there are attempts by some countries to link their existing national markets by aligning the underlying trading principles. On the other hand, some countries have (partially) abolished or limited their certificates scheme in favour of the establishment or broadening of a feed-in tariff (FiT) scheme.[31]

The first cross-border green certificates scheme in Europe is the recently established Norwegian-Swedish green certificates scheme. It extended the existing Swedish green certificates scheme to Norway, thus establishing a common Swedish-Norwegian market for green electricity certificates. The scheme is supposed to run at least from 2012 until 2020. The largest share of certificates has so far been issued for biomass based electricity, wind power, and small-scale and refurbished hydro power. Both power suppliers and consumers are required to purchase green certificates for a specified share of the electricity they sell or consume. For the year 2012, this quota is set at 17.9%[32] (IEA, 2012b; Regeringskansliet - Government Offices of Sweden, 2012; Statnett, 2012). By contrast, Austria abolished its GC scheme, including the inherent quota obligation for operators, in 2003, establishing uniform FiTs and surcharges for the whole of Austria instead. The scheme had not really taken off, and Austria decided to mimic Germany's successfully operating FiT scheme instead (Frost & Sullivan Market Insight, 2002; IEA, 2012b). In Italy, a new incentive system based on FiT for all types of renewable energy shall apply from 2013 on. There will no longer be a market for GCs in Italy after 2015, the point in time when the binding quota of green electricity to be fed into the national

[29] The term "Green Certificate" predominates in Europe, whereas "Renewable Energy Certificate" is more widely used in the US. The general aim of GCs and RECs is to separate the attributes, especially its environmental benefits, of electricity generated from renewable energy sources from the actual commodity, the physical electricity, hence leading to the possibility of selling or trading them separately. This way, the certificates have the potential to serve as a "currency" on international markets for renewable energy, since they are no longer bound to the geographic and physical limitations of the underlying commodity. They can be traded on both voluntary and compliance markets, hence for reaching "green customers" or as a reaction to the corresponding legislation, for instance some type of obligation, mandatory renewable energy targets, or incentives/penalties system, respectively (REEEP, 2007).

[30] 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market.

[31] Feed-in tariffs set a fixed, guaranteed price over a stated fixed-term period when electricity from renewable sources can be sold and fed into the electricity network.

[32] The quota is an annual quota and has been decided for each calendar year until 2035 (Swedish Energy Agency, 2011).

grid by producers of energy from conventional sources will be eliminated, and the obligation of the state-owned Gestore dei Servici Elettrici (GSE) to purchase excess GCs will cease (EREC, 2009; GLS Brokers LTD, 2011). This situation depicts that one important challenge that needs to be overcome in the context of RECs is the uncertainty of demand. In many countries, the persistence of a stable market for RECs is not guaranteed, hence leading to insecurity for investors and thus their reluctance to invest into renewable energies. In order to incentivize more local and small-scale investments, an initiative was launched in Poland in 2010 to support the purchase and installation of a technology (in this case, solar thermal collectors) usable by private households. Poland's Certificates of Origin scheme that had been put in place before, together with a mandatory quota for renewable energy, had favoured big renewable energy projects and resulted in little to no locally owned renewable energy generation (NFEP&WM, 2012).

Our findings allow for mixed conclusions with regard to the question whether GCs/RECs could provide a suitable framework for pooling small-scale electricity generation from renewable sources. On the one hand, the Italian and Polish experiences indicate that certificates might not be the most appropriate measure for incentivizing the deployment of renewable energies among households, that is, on a small scale. Both countries abolished their certificates schemes, opting instead for a FiT scheme and subsidies, respectively. On the other hand, in principle, GCs/RECs and the inherent emissions savings, stemming from households, could be pooled and used by firms. Such pooling is not yet done but has the potential of lowering the inherent transaction costs.

3 Domestic small-scale emission reductions in the EU

In the EU, neither pan-European nor national credit-based schemes for small-scale emission reductions exist. Experience with credit-based schemes prevails in the context of the already mentioned credit-based schemes for energy saving obligations/tradable white certificates and green certificates/renewable energy certificates on the national level. These schemes trade units of energy reductions and units of renewable energy generated, respectively, rather than emission reduction units. In addition, they tend to be national rather than international or linked, with very limited trading activities of certificates involved.

Joint Implementation (JI) seems to be the first international mechanism awarding emission reduction credits to projects within the EU ("EU internal crediting"[33]). Under the Joint Implementation framework, developed countries[34] can invest in emission reduction projects in other developed countries as an alternative to reducing emissions domestically. Joint Implementation may be seen as role model for future types of EU internal crediting (IETA, 2012).[35] One of the future new types of EU internal crediting could include credits generated through private reduction activities. Activities reducing emissions of private households in the EU could be awarded emission reduction credits that

[33] According to Directive 2003/87/EC, EU internal crediting of credits (emission reduction units or ERUs) is possible, even for those activities that also lead to a reduction in emissions from installations covered by the EU ETS. In the latter case, an equal number of allowances should be cancelled from the registry of the Member State of the credit origin in order to prevent double-counting. In practice, there are around 233 JI projects in the pipeline hosted by Member States, most of them already registered and with another Member State buying the credits resulting from the activity. Examples include an N_20 abatement project in Uusikaupunki, Finland, with France being the buyer of the issued credits, and a wind power project hosted by Estonia with the Netherlands purchasing the credits issued (UNEP Risoe, 2012).

[34] More specifically, countries figuring in Annex I of the Kyoto Protocol, that is, countries with a binding emission reduction target under the Kyoto Protocol.

[35] Legally established under Art. 24a of the EU ETS Directive 2003/87/EC

could be fungible with AAUs[36]. They could be traded as compliance units in the EU ETS (similarly to certificates generated through the Clean Development Mechanism). They could also be counted towards emission reduction obligations of firms or sectors not participating in the EU ETS, thus making a case for employer-led activities under potential Off4Firms programmes. Small-scale projects within employees' households could be financially incentivized by employers and generate emission reduction certificates that would be eligible for offsetting their own corporate carbon emissions, hence meeting voluntary or mandatory reduction targets. In addition, certificates could also be sold to other firms that would use the certificates for meeting their respective emission reduction targets.

No trading scheme exists so far for emissions from sectors currently not covered by the EU ETS. Prevailing EU legislation already allows for and foresees emission allowance trading for activities and greenhouse gases which are currently not covered by the EU ETS, provided that the reliability of the planned monitoring and reporting system is assured and that inclusion of such activities and greenhouse gases is approved by the Commission. Emission trading for these activities shall not result in double-counting of emissions reduced and not impede the undertaking of other policy measures aimed at reducing emissions not covered by the EU ETS. Furthermore, Member States shall consider harmonizing the coverage of those emissions across the entire EU, thus potentially leading to an EU-wide scheme for trading emission allowances corresponding to these activities (European Union, 2009). Such a scheme might open up the opportunity for firms to trade pooled emission reductions of their employees' households.

4 Domestic small-scale emission reductions in Switzerland

In Switzerland, a credit-based scheme already exists in the Climate Cent foundation framework. Although projects that have been realized under the Climate Cent framework are rather large scale when compared to activities in households, there seems to be the possibility for pooling credits from smaller-scale project activities. Demand for such credits could be created by compensation obligations of various sectors, like, for instance, fossil fuel power plants or the transport sector.[37]

Demand for Swiss domestic reduction certificates

With respect to the demand stemming from fossil fuel power plants, the future number of gas-fired power plants[38] is relevant. To assure security of supply and grid stability, the SFOE recently announced that it deems the construction of one gas-fired power plant necessary until 2020 (SFOE, 2012e). On the other hand, the company in charge of the construction of what might become Switzerland's first gas-fired power plant, EOS Holding, reckons that most probably, one to four gas-fired power plants will be built, with a capacity of 400MW installed each (Volksblatt, 2012). Taking into account that the most efficient gas-fired power plants emit around 320 g CO_2eq/kWh_{el}, a gas-

[36] A country's Kyoto target translates into an amount of GHG that this country may emit in the first Kyoto commitment period (2008-2012). This amount of GHG is issued to each country in units of one ton of CO_2, the so-called Assigned Amount Units (AAUs).
[37] According to the new CO_2 law coming into force in the beginning of 2013, emissions stemming from fossil fuel power plants and the transport sector need to be partially compensated by domestic emission reduction measures. These portions to be offset domestically amount to 50% and 0-10% (target steadily ramped up over the years) between 2013 and 2020, respectively.
[38] More precisely, combined-cycle or gas-steam power plants [in German, Gas-und-Dampf-Kraftwerk (GuD)]

fired power plant of 400MW would possibly emit around 0.7 to 1.2 mio tCO_2eq annually, which would have to be compensated (FOEN, 2012e; Jansohn, not dated).[39]

Yet, it remains questionable if the emission compensation will have to be domestic. Given the fact that Swiss utilities are part of an internationalized and well-connected pan-European electricity market, emissions of fossil fuel power plants could be treated according to EU standards. This corresponds to an IEA recommendation (IEA, 2012a). In view of the on-going discussions between Switzerland and the EU about connecting their ETS, treatment to EU standards would possibly entail the inclusion of Swiss fossil fuel power plants into a joint EU-CH ETS (FOEN, 2011a, 2011d).

The earliest point in time for creating demand for domestic offsets by gas-fired power plants will probably be in 2018, when the construction of the first plant (in Chavalon/VS) could be finalised. Yet, it is questionable whether gas-fired power plants will be obliged to compensate their emissions – be it domestically or not. Hence, the demand for Swiss domestic reduction certificates from fossil fuel power plants is rather uncertain.

Further demand for domestic emission reduction credits might arise from the operation of cogeneration plants of an installed capacity of 350KW to 20MW. Under specific minimum requirements, operators of such plants can apply to grid operators for special cogeneration plant remuneration. Profiting from this remuneration entails the need to fully compensate these plants' emissions, minus the savings resulting from the substitution of fossil boilers, counted for as compensation. Such decentralised cogeneration plants have an overall technical potential of 5 to 7 TWh of electrical energy, the corresponding CO_2 emissions[40] of which would, as outlined, potentially need compensation (Swiss Confederation, 2012b).

Requirements for Swiss domestic reduction certificates

Emission reduction projects need to fulfil several requirements to be eligible for receiving Swiss domestic reduction certificates. Only emission reductions stemming from voluntary measures and reductions that have not been used for the achievement of other legally mandated emission reduction obligations can be taken into account. The rationale behind this requirement is to avoid double-counting of emission reductions achieved (FOEN, 2012g). Projects need to fall into the categories energy efficiency (demand and supply side), renewable energies, fuel switch, or mobility.[41] Small-scale projects can be bundled and considered jointly, thus opening up interesting opportunities for emission reduction activities in households. The Federal Office for the Environment (FOEN) issues credits for these domestic projects, and the project owner may sell these on the offset market. The rules for proving additionality of these credits are based on those that apply to international emission reduction projects (CDM and JI projects) (FOEN, 2012g; FOEN/SFOE, 2012).

Many emission reduction activities of firms directed towards private households will potentially fall into one of the eligible categories. The explicit permission to bundle small-scale projects helps.

[39] Although the gas-fired power plant could be put into operation as early as 2018 according to EOS Holding, it needs to be taken into account that a referendum might be initiated to prevent its construction (Neue Zürcher Zeitung, 2012; Volksblatt, 2012).

[40] Fossil power plants (including gas-fired power plants and cogeneration plants) in Switzerland are assumed to emit between 1.09 and 5.9 mio t CO_2 in the year 2050, depending on the respective future shares of electricity generated by gas-fired power plants and cogeneration plants (Ganz, Weiler, & Stahl, 2012).

[41] Projects that reduce methane, fluorinated greenhouse gases, or nitrogen oxides are also admissible but of lower interest in the Off4Firms context.

Potential revenues for firms

The price of Kyoto certificates (CERs/ERUs) is largely driven by the EU emission allowances (EUAs) price. Hence, in analogy, prices for potential credits generated through firms' activities may be roughly estimated, both for a purely Swiss and an internationally connected pan-European markets. In addition, with regard to possible prices for Swiss domestic emission offsets, it might be helpful to analyse projects that have generated domestic offsets under the Climate Cent programme and their costs. For instance, under the Climate Cent programme, CO_2 abatement costs for activities in the building sector amounted to approximately between CHF 10 and CHF 140 (TEP Energy, 2010).

Linking of national schemes

In order to guarantee high liquidity in the market for emission allowances, a linkage between the national and regional markets for emission allowances and/or certificates is useful. The Swiss government has voiced and reinstated its plans of linking the Swiss ETS with the EU ETS in the near future. As a first step, the Swiss government strives for a further development of the CH ETS towards a better compatibility with the EU ETS. One can argue that this might lead to a harmonization of Swiss with EU policies, and hence the possibility of an inclusion of all Swiss utilities into a combined CH-EU ETS. Currently, as opposed to the EU scheme, operators of Swiss power plants that are primarily destined at electricity generation, cannot opt for participation in the CH ETS but are obliged to fully compensate their emissions (FOEN, 2012c, 2012d).

An inclusion of these Swiss power plants primarily destined at electricity generation into a joint CH-EU ETS will have significant repercussions on the demand for Swiss domestic reduction certificates. Provided these power plants are not included into a combined CH-EU ETS, they are to compensate their emissions to a large extent domestically, as is further explained in the previous Chapter (Part B Chapter 4). Given that Off4Firms programmes will potentially generate Swiss domestic emission reductions eligible for receiving Swiss domestic reduction certificates, the political developments regarding the linking of the emission trading schemes should be taken into account and monitored.

Given the illustrated incompatibilities and thus potential hurdles for linking the CH ETS with the EU ETS, together with the need for the Swiss parliament to ratify a corresponding bilateral agreement between Switzerland and the EU Commission on the linkage of their respective emission trading schemes, it is not expected that a possible linkage of the two emission trading schemes will occur before 2014 (FOEN, 2012a, 2012d, 2012g; Point Carbon, 2012).

5 Conclusion and relevance for Off4Firms

Credit-based schemes are a policy instrument for integrating small-scale emission and energy reductions of private households into employer-led emission reduction initiatives. Employers would benefit from the generated credits through offsetting their own corporate carbon emissions (meeting voluntary or mandatory reduction targets) or use them for complying with energy efficiency targets. Markets for emission allowances and the several (potential) types of emission/energy

reduction offsets (certificates) are artificial markets, meaning that their existence merely depends on the respective climate and or energy legislation.

From the above analysis, some insights for the Off4Firms project can be derived. First, Switzerland already has a domestic crediting and offsetting scheme put in place that will potentially generate significant demand for domestic emission offsets. The feasibility of a mechanism that would pool several emission reduction activities under one programme, in analogy to CDM PoAs, needs to be investigated in the Swiss (and potentially EU) context. This will include discussions of appropriate methodologies and (standardised) baselines to be eligible within these programmes. Furthermore, cost-benefit analyses of potential emission reduction activities pooled under such programmes would be useful.

The same holds in principle for the EU, provided that appropriate policies are put in place that regulate (create) demand for this type of certificates. Note that currently, there does not exist a domestic crediting mechanism for small-scale emission reductions in the EU. Yet, EU internal crediting is legally possible. The introduction of policies generating demand for domestic emission reductions within the EU would lead to significantly higher demand for emission offsets, including those from the private sector and thus Off4Firms-type programmes. Linking existing or future Swiss and EU markets for allowances and credits will have a significant impact on the price of these certificates and hence the (financial) feasibility/profitability of the underlying emission reductions.

Tradable white certificates issued for energy efficiency activities at private households might offer further interesting opportunities for employer-led emission reduction activities at their employees' private households. Both the EU and Switzerland have enacted regulations for mandatory energy efficiency targets for utilities, which need to carry out energy efficiency measures at their customers' for their fulfilment. Up to now, this had only been the case to a very limited extent, for example, in the case of the public-owned utility company EWZ supplying the city of Zurich with electricity (Topten International Group, 2012; UnserStrom, 2012). These obligations for utilities can be as a chance for Off4Firms to take on the role of an intermediary for effectuating these measures. This is even more so when taking into account the success regional or municipality-based programmes have had so far (see also Part C). To employers not in need to reach energy efficiency targets themselves, again, the emissions savings stemming from energy efficiency measures carried out at their employees could be of interest and be used for their own compliance. Else, these employers might want to pool and sell the units of energy efficiency achieved at their employees' households to firms with a mandatory energy efficiency target.

Part C: Subsidy-based schemes

After looking at credit-based schemes, which so far find relatively few applications at the household level, this chapter looks at different financial incentives – in particular, subsidies and preferential loans – that support the implementation of energy efficiency activities in households. Unlike credit-based mechanisms, direct financial transfers and preferential loans are very common policy instruments in Switzerland as well as in the EU member states. Nevertheless, due to market failure and bounded rationality, many of these policies have yet to realise their full potential. While support schemes for households have so far been paid by government agencies, the question is whether letting employers administer these policies, providing both the necessary information as well as the monetary support, could increase their reach. Employers would possibly be better able to spread information, overcome perceived administrative burdens, and motivate a sense of collective responsibility. We will focus on subsidies and preferential loans, because unlike other financial incentive schemes, these could potentially be pooled and administered by firms. In doing so, we will concentrate on measures in the fields of transport, residential buildings, the production of renewable energy, and household appliances. More specifically, we will focus on electric vehicles in the field of transport, we will look at measures to improve the efficiency of heating and cooling in the part on residential buildings while the section on renewable energies will concentrate on solar power. Each of the following thematic subsections will provide examples of financial incentive schemes in EU member states as well as in Switzerland.

1 Transport: electric vehicles

Given that road transport is responsible for more than 20% of total carbon emissions in the European Union and more than 30% of Switzerland's CO_2 emissions, the need for environmental regulation in the automobile sector is obvious and has long been acknowledged (EEA, 2010; Swiss Statistics, 2012a; Tuchschmid, 2011). After a non-binding voluntary commitment by the automobile industry to reduce emissions failed to deliver the targeted efficiency improvement, the EU reviewed its CO_2 emissions strategy in 2007 and established stricter emission standards for cars. The Swiss government has followed this example. As part of this agenda, Switzerland and the EU are pushing the electrification of transport ((EU Commission DG MARKT, 2010) and (SFOE, 2011)). The ensuing reduction of emissions can be significant if the electricity to charge vehicles is produced from renewable resources. Billions of euros have thus been dedicated to research and development of electric vehicles – the EU has recently dedicated EUR 1 billion to the European Green Car Initiative, a research public private partnership (EU Commission DG RTD, 2011) – and while there are certainly other alternative fuels, we will focus on measures that aim to increase market deployment of electric vehicles. This is due to electric mobility being at the centre of attention of policy makers and the fact that other alternative modes of transport are usually not eligible for support through direct monetary transfers or preferential loans.

1.1 Financial incentives in the EU

Most EU member states have introduced (or plan to introduce) financial incentives to increase market uptake of electric cars. These policies include a variety of measures such as direct subsidies to buyers of electric vehicles and subsidized infrastructure, but also the reduction of road tolls as well as free parking. We only deal with the former two.

With direct subsidies being the most visible support for buyers of electric cars, they might be regarded as the most appropriate tool to change consumer behaviour and increase the market deployment of electric vehicles. For this reason, many EU member states have introduced such subsidies (see for example (ACEA, 2012) and (US Commerical Service - Global Automotive Team, 2010)). However, not only do these differ considerably between the Member States but sometimes even within member states. This is due to the fragmented support structure, which often includes a grant from the federal government plus support from regional or local government and possibly some subsidy from the power supplier. In Austria, for example, the federal government subsidizes electric cars with EUR 500 while several local authorities provide substantial additional subsidies that can reach up to EUR 3,000 (in Salzburg) (Intelligent Energy Europe, 2012). The range of subsidies between member states is yet much greater:[42] while countries such as Germany or Denmark do not subsidize the buying of electric cars directly, the Estonian government in 2012 introduced a scheme under which it pays 50% of the cost of an electric vehicle up to EUR 18,000 or EUR 1,000/kWh of battery capacity. Other countries that have a federal incentive scheme for purchasing electric vehicles find themselves in between these two extremes. For example, the governments of Cyprus (EUR700), France (EUR 7,000; see (Gouvernement de la République Française, 2012)), Luxemburg (EUR 5,000, see (Le Gouvernement du Grand-Duché de Luxembourg, 2012)), and the UK (25% of the price up to GBP 5,000 (EUR 6,200), see (Department for Transport, 2011)) offer support to the buyers of electric vehicles. An overview of subsidy schemes in EU member states is provided in Table 1.

Table 1 – Overview of electric vehicle subsidy schemes in selected EU member states

Countries with federal subsidies of EUR 5001 or more	Estonia, France, Portugal, Spain, United Kingdom
Countries with federal subsidies between EUR 2000 and EUR 5000	Ireland, Luxemburg, Malta
Countries with federal subsidies of up to EUR 2000	Austria, Cyprus
Countries without national subsidy scheme	Belgium, Bulgaria, Czech Republic, Denmark, Finland, Germany, Greece, Italy, the Netherlands, Romania
Countries offering subsidies for charging stations	Estonia (100% of installation cost), Malta (up to EUR 5,000), United Kingdom (50% of installation cost)

Sources: (CE Delft, 2011; Department for Transport - Office for Low Emission Vehicles, 2011; IEA, 2012b; MURE, 2012; US Commerical Service - Global Automotive Team, 2010)

[42] The description draws mainly on (IEA, 2012b; MURE, 2012; US Commerical Service - Global Automotive Team, 2010) unless otherwise stated.

1.2 Financial incentives in Switzerland

As recently as 2010, the Swiss Federal Office of Energy (SFOE) made it clear that it regards electric mobility as a technology of the future, not the present and does not believe in the imminent market success of electric vehicles (SFOE, 2010). Yet along with other private and public institutions in Switzerland, the SFOE has long financed pilot projects as well as research and development in this field. On the other hand, subsidies and other financial incentives for owners of electric vehicles do not exist on a federal level and only come from cantonal or local sources. These are usually either paid by regional governments or by electricity producers and vary significantly. Nevertheless, all these financial incentives have a remarkable feature in common, i.e. they are not paid as a direct subsidy for buying electric vehicles but rather take the form of exemptions from vehicle taxes, which are granted in all cantons (SFOE, 2012f). Additional incentives exist for the installation of charging stations at home. For example, in the canton of Zurich, charging stations in private households receive a subsidy of CHF 500 from the cantonal electricity provider EKZ (Stadt Zürich, 2010). The regional power company in St. Galle, SGSW, not only grants up to CHF 1000 for the installation of a charging station at home (50% of the total cost), but also provides 1.000kWh/year for free in the first two years after installation (SGSW, 2012).

1.3 Evaluation and lessons learned for Off4Firms

Table 2 – Electric passenger cars sold in selected European countries

	2008	2009		2010		2011	
Country	**EVs sold**	**EVs sold**	**increase**	**EVs sold**	**increase**	**EVs sold**	**increase**
Denmark	5	78	1460.0%	49	-37.2%	465	849.0%
France	4	12	200.0%	184	1433.3%	2629	1328.8%
Germany	36	162	350.0%	541	234.0%	2154	298.2%
Switzerland	27	58	114.8%	181	212.1%	345	90.6%
UK	220	181	-17.7%	255	40.9%	1204	372.2%

Sources: (Swiss Statistics, 2012b), (Department for Transport, 2012), (Federal Motor Transport Authority, 2012), (Ministère du redressement productif, 2012), (Statistics Denmark, 2012)

Maybe the most important lesson to be learned for Off4Firms is that subsidies of a few thousand euros per car alone do not seem to be sufficient to accelerate the market uptake of electric cars significantly. Instead, additional features like the provision of information and promotion of adequate infrastructure might be needed. While one case study on Ireland suggests that tax (and subsidy) policies may change the type of car consumers typically buy, the low number of electric vehicles sold implies that this finding is not fully applicable to electric cars given the current political framework (Gallachóir, Howley, Cunningham, & Bazilian, 2009). Of course, countries with higher subsidies show a higher deployment rate of electric vehicles. However, even in France, Sweden, Spain or the UK has the number of buyers by far not been sufficient to exhaust the allocated subsidy budgets and therefore the deployment rates seem to have fallen short of what had been envisaged by the respective governments (Germany Trade & Invest, 2012). Even with heavy subsidies for electric cars, consumers seem to prefer conventional vehicles and the market uptake of electric vehicles remains in similar ranges as in Germany, for example, where no direct financial incentive exists. While the relative increase in electric vehicles sold in the last few years has been tremendous in many countries and more so in the countries with substantial subsidies (see Table 2 for some

examples), their market share remains at very low levels. In 2011, electric cars only accounted for about 0.1% or less of newly registered vehicles in most countries, Denmark being an exception with a share of 0.27% (Department for Transport, 2012; Federal Motor Transport Authority, 2012; Statistics Denmark, 2012; Swiss Statistics, 2012b). In some countries like Belgium, Italy and Switzerland, this may be the result of the small and fragmented support programmes that neither seem economically efficient nor very effective as they may prove to be too complicated to offer appropriate incentives for consumers to change their behaviour (WWF Schweiz, 2011).

At the other extreme, there is the remarkable and unmatched effort of the Estonian government, which not only provides substantial financial support but also information as well as grants for the installation of the necessary infrastructure. Generally, this should improve the efficiency and impact of the support scheme, yet it is to be seen in the coming months whether this concerted programme will lead to electric vehicles reaching a much more significant share of the car market (IEA, 2012c). If the scheme is indeed successful, the potential for an employer-led electric mobility programme seems significant.

Finally, an additional aspect of the Estonian scheme is of interest in the Off4Firms context, namely that Mitsubishi Corporation received 10 million Assigned Amount Units (AAUs) in exchange for its support of the programme (Estonian Ministry of Economic Affairs and Communications, 2011). Therefore, the programme could serve as an example for future public-private partnerships that would enable firms to fulfil their emissions reduction targets by initiating or scaling up government-run subsidy schemes aimed at increasing the energy efficiency of households.

In addition to financial and information incentives, general behavioural structures play an important role, making drastic changes like from a fuel car to an electric car less probable. One of the most important factors that generally influence people's investment behaviour is the tendency to be *change averse*. This is likely caused by a deeper and hardwired *dislike of uncertainty* (Epstein, 1999): since change involves moving from a situation which is known to one that is less well known, change by definition introduces uncertainty. One well known consequence of this is the so-called *endowment effect* (Kahneman, Knetsch, & Thaler, 1991): Many studies have shown that when asked to give up a good that is in one's possession (i.e., to sell), people ask a much higher price than they would themselves be willing to pay for obtaining this good, had it not been theirs. This means that for people to invest in changing their current situation (for instance by changing from a fuel car to an electric car), there is quite a high threshold that needs to be crossed before people decide to change.

An emotion that that plays a role in this type of decision making is *(anticipated) regret*: people who are not certain about the outcome of making an investment may anticipate feelings of regret after change. This anticipated regret may lead to *inertia*, which means that people decide to postpone their decision. Furthermore, people feel more responsible for bad outcomes that are caused by their actions than for bad outcomes that are caused by inaction (termed the *inaction effect* (Zeelenberg, van den Bos, van Dijk, & Pieters, 2002), or *omission bias* (Ritov & Baron, 1990)). Thus, investing in an electric vehicle that turns out to be a bad choice (for instance because of limited radius or trouble finding recharging spots), they will feel much worse about this than they would when the consequences of not changing to an electric vehicle would be adverse (for instance because fuel prices skyrocket). Since people anticipate these feelings when considering their decisions, they are less likely to change.

All these psychological mechanisms lead to a general tendency called the *status quo bias* (Kahneman, Knetsch, & Thaler, 1991), which indicates a strong tendency for people to prefer the current situation over change. It should be noted that this does not always mean that people who do not invest have made a definite choice against such an investment. Many of these psychological factors merely lead to *choice deferral, indecision*, and *procrastination* (Anderson, 2003), which is not the same as making a definite decision against a certain investment option. Moreover, since sticking to the status quo usually means that all options remain open, this is actually a potential other reason for not investing: if a better alternative comes along, it remains an option to pick that alternative instead of the current ones. This is probably an important reason that many people are reluctant to invest in fast-developing technologies like electric vehicles.

Firms offer an excellent environment to tackle this uncertainty problem: since firms can easily reach their employees with information about potential investment options, and since employees can exchange information about and experience with such investments, firms offer an ideal context for mitigating these negative effects of uncertainty on investment behaviour. Moreover, because firms have a size advantage, it may even be feasible to further reduce uncertainty by investing in one of the potential options and let the employees experience this option. This is already done very successfully by some firms with electric vehicles that can be used by employees during work hours.

Since most people do not live in a social vacuum but are strongly influenced by their social context, the opinion of relevant others is a very important factor in many situations. Thus another type of norms, *social norms*, are also very important for predicting such decisions (Nolan, Schultz, Cialdini, Goldstein, & Griskevicius, 2008). People may lose or gain *social approval, status and reputation* by the choices they make. Especially in car purchases such processes are very important. In a recent article about green behaviour, (Griskevicius, Tybur, & Van den Bergh, 2010) showed, for example, that in some communities people who buy a Prius do so not out of care for the environment, nor to save money, but in order to gain status. Such *costly signalling* (Bird & Smith, 2005) can be an important factor in purchasing decisions, especially if the products are visible. Knowledge about the social norms within a group and the visibility of the product are thus important for tailoring interventions.

Again, firms offer an ideal environment for making use of these insights in creating successful interventions. Firms generally know their employees quite well (and if not, they have easy access to them to learn more), and are therefore able to tailor their intervention to specific (sub)groups of employees. Moreover, one of the most important social contexts that people operate in is the workplace. Firms therefore offer an ideal opportunity for adapting the interventions to social norms. It is even very likely that the norms of employees may be influenced by firms, which may also lead to more successful interventions.

The presented and arguments should motivate further analysis of ways to integrate an electric vehicle subsidy measure into an employer-led programme. Firms could provide the charging infrastructure at work, distribute information about the technology and available support schemes, and by establishing a “green” mind-set and rewarding sustainable behaviour, social recognition could add further incentives to sign up for such a programme. Whether such scheme would be based on subsidies for purchasing electric vehicles or went a step further by integrating car sharing concepts, aligned support measures combined with peer pressure by colleagues are likely to make employer-led programmes much more efficient than current government-run schemes.

2 Energy efficiency and sustainable heating in residential buildings

In light of the fact that residential buildings account for more than 40% of carbon emissions in both the EU member states as well as in Switzerland, governments have started implementing financial incentive schemes to motivate house owners to improve the energy efficiency of their property (EuroACE, 2010). EuroACE, an alliance of manufacturers of energy saving goods and appliances, estimates that energy saving activities in buildings could reduce annual carbon emissions in Europe by about one eighth or 450 million tonnes (EuroACE, 2009). In this section, we will look at the ways EU Member States and Switzerland are trying to bring about the necessary improvements in the residential sector.

2.1 Financial incentives in the EU

To promote energy efficiency activities in residential buildings, the European Union asks its member states in Directive 2010/31/EU to establish minimum efficiency requirements for new buildings and those undergoing major renovations. In addition, because the EU's ability to provide direct financing to private households is limited, the directive encourages member states to incentivize energy efficiency improvements in residential buildings financially (European Union, 2010). This subsection will look at the different ways in which EU member states have implemented these suggestions, differentiating between subsidies and preferential loans. Table 3 provides a first overview of how frequently different financial instruments are used throughout the EU.

Table 3 – Fiscal incentives for energy efficiency improvements in residential buildings in EU countries that have a national support scheme

	Subsidies for ...		Preferential loans
	…sustainable construction	…energy audits	
Austria	X	*	
Belgium	X		
Bulgaria	X	X	X
Czech Republic	X		
Denmark	X		
Estonia	X	X*	X
Finland	X	X	
France		X*	X
Germany	X	X*	X
Greece	X	X*	X
Hungary	X		
Ireland	X	X	
Latvia	X	X	
Luxemburg	X	X*	
Malta	X		
Netherlands	X	X	X
Poland	X	*	X
Romania	X		
Slovakia	X		
Slovenia	X	X	
Sweden	X	X	
UK	X		

***** energy audit is required to receive further financial support

Source: (Intelligent Energy Europe, 2012), (IEA, 2012b)

2.1.1 Subsidies

As Table 3 clearly shows, subsidies are by far the most common policy instrument in the EU to motivate investments in the energy efficiency of residential buildings. Almost all EU member states with national financial incentive schemes have introduced some sort of subsidy program, either for the energy efficiency activities themselves, for energy audits or for both. Energy audits are regarded as very important in many countries and are often a requirement – for example in Estonia, Germany, France or Luxemburg – to get access to preferential loans or to be eligible for subsidies (see e.g. (KfW Bankengruppe, 2012a)). Economically, this precondition seems reasonable as it ensures that primarily those activities that have the biggest savings potential are implemented. To not let this requirement discourage private investments, the energy audits are often subsidized or even for free: for example, Bulgaria and Sweden offer free consultations by energy experts while Finland, Germany, Latvia, and a number of other countries reduce the cost to the house owner by typically covering about 33-50% of the price of the energy audit (Intelligent Energy Europe, 2012).

When it comes to the subsidies for the construction activities that increase the energy efficiency of buildings, various additional requirements and restrictions apply in the different countries. For example, Denmark heavily relies on building standards to improve energy efficiency and only subsidizes the scrapping of old oil-fired boilers. Depending on the new heating technology, grants of DKK 10,000 to 20,000 (approximately EUR 1,350-2,700) are available. Slovakia on the other hand only subsidizes thermal insulation of walls (up to 50% of the cost or SKK 500/m^2, i.e. about EUR 16.70). Most other countries are less restrictive and incentivize various activities such as the installation of solar heating systems, heat pumps, thermal insulation of walls, new windows and doors or the insulation of the roof (EuroACE, 2009).

Given the fact that the subsidies in the different countries are sometimes based on price per square meter, sometimes have a total limit in terms of amount of money per project, and sometimes just cover a certain percentage of project costs, it is hard to compare and summarize the different schemes. Nonetheless, not counting Bulgaria and Malta, where subsidies are limited to EUR 850 and EUR 300, respectively, the subsidies typically amount to several thousand or even ten thousands of Euros and could thus offer a considerable incentive to invest in energy efficiency improvements.

2.1.2 Preferential loans

Preferential loans, which are offered by a number of EU member states to private house owners (see Table 3), are the second, frequently used policy instrument that we consider. Longstanding EU member countries such as France, Germany, Greece, and the Netherlands have established these schemes as did newer member states like Bulgaria, Estonia, and Poland. Some of the latter have done so with the support of the European Bank for Reconstruction and Development (Intelligent Energy Europe, 2012). These loans commonly not only offer an interest rate that is subsidized by the government and is thus considerably lower than going market interest rates (e.g. in France and Germany) or even zero (e.g., in Greece), but they also often include conditions that lead to partial waivers on the sum to be repaid (EuroACE, 2010). The case study on Germany's policy instruments provides some exemplary detail on the conditions that have to be met to be eligible for such waivers.

Case study: Improving the energy efficiency of Germany's residential buildings

According to Germany's Kreditanstalt für Wiederaufbau (KfW), a state-owned promotional bank, about 35% of Germany's energy demand comes from heating. As a result, Germany has been incentivizing renovation measures that increase the energy efficiency of residential buildings for more than a decade. Under the current scheme, both subsidies as well as preferential loans are offered by KfW, yet the house owner has to choose between the two options. Measures that are supported include, for example, the thermal insulation of the building's exterior walls, the roof or the ceiling of unheated floors as well as the installation of new windows, entrance doors or new heating systems (KfW Bankengruppe, 2012a). The amount of the subsidy depends on both the scale and scope of the renovation measures. Single measures receive subsidies of only 7.5% and up to EUR 3,750, while a broad set of renovation measures that increases the energy efficiency to the so-called "KfW-Effizienzhaus 55" standard (this standard is regularly updated to account for new technologies and materials) is granted 20% or up to EUR 15,000 per housing unit. Instead of applying for a subsidy, property owners may alternatively opt for a preferential loan – also provided by KfW but through the owner's commercial bank – that guarantees low interest rates and includes a partial waiver on the loan amount for comprehensive energy efficiency improvements (Intelligent Energy Europe, 2012). These waivers are between 2.5 and 12.5% of the loan and amount up to a maximum of EUR 9,375 (KfW Bankengruppe, 2012b). As a precondition for either program, the building's owner has to commission an energy audit by a certified expert. However, these energy audits are also subsidized, which reduces the cost of these audits to the consumer by EUR 400, thereby covering about half of the total cost (Federal Office of Economics and Export Control, 2012). Overall the programme has been relatively successful in that annually more than three per cent of property owners invest in at least one energy efficiency measure (Henger & Voigtländer, 2012). However, the share of owners who implement comprehensive renovation measures and try to bring their house up to the most efficient standard remains low. While the government is targeting comprehensive energy efficiency improvements in 2% of residential buildings annually, the current renovation rate is just below 1% and thus too low to meet Germany's carbon emissions reduction targets (BMWi/BMU, 2010; Henger & Voigtländer, 2012).

2.2 Financial incentives in Switzerland

To reduce carbon emissions from residential buildings, the Swiss government initiated the so-called building refurbishment programme[43] in 2010. The programme, which is planned to run for ten years and has undergone considerable changes in 2012 because high demand by house owners very quickly exhausted the available funds, now has an annual budget of up to CHF 300 million. It is partially funded by the federal government through the carbon tax and partially financed by the cantons (Das Gebäudeprogramm, 2011). Additional funds will become available once the Swiss carbon tax is increased. This increase is planned under the new carbon law, which will take effect in 2013 (Das Gebäudeprogramm, 2012a).

[43] Gebäudeprogramm

The programme aims at reducing carbon emissions from the residential sector by a total of 1.5 to 2.2 million tons annually by 2020 (Das Gebäudeprogramm, 2012a), which seems quite sizable given that Switzerland's total emissions in 2011 amounted to just under 38 million tons (FOEN, 2012b). In order to reach this target, the scheme offers subsidies for both energy efficiency improvements of the building envelope (roof, exterior walls, and windows; paid with federal funds) as well as for renewable energy (paid for with cantonal funds), the latter of which we will deal with in the next section. During the first two years of the programme, about three quarters of the subsidized projects involved buildings that were still heated with fossil fuels and almost ninety per cent of the applications came from private owners. The latter shows that the scheme has been highly effective in reaching private households and the fact that the vast majority of subsidies (80% in 2010, 65% in 2011) amounted to less than CHF 5,000 also proves that even relatively small financial incentives make a difference when combined with adequate communication of information (Das Gebäudeprogramm, 2011, 2012b). Nevertheless, the share of residential buildings in Switzerland that undergo extensive energy efficiency improvements per year is just 0.9% and while the Swiss government does not define a target level in percentages, it does aim to increase this number significantly (The Swiss Federal Council, 2012b).

2.3 Evaluation and lessons learned for Off4Firms

Given the varying experiences in the different countries, it is difficult to draw a general conclusion regarding the effectiveness of the various support schemes. Studies find that comprehensive incentive schemes that are targeted at specific groups (e.g., owners of certain types of houses) and include both funding as well as information are most effective while the implementation of energy efficiency activities sharply decreases with a programme's complexity (EuroACE, 2010). At the same time, on the one hand, national schemes seem to be efficient because they ensure a level playing field for all house owners and make it relatively easy to access and understand information on the relevant subsidies and other available support measures. On the other hand, local actors also seem very important because information is much more easily and actively passed on and local schemes can take into account the local peculiarities and needs (The Regulatory Assistance Project, 2010). Therefore, greater involvement of local intermediaries could potentially increase the reach of these programmes further. In addition, some of the support schemes, for example in Switzerland, have shown that it only takes relatively small sums to make a difference and increase the share of houses that undergo energy efficiency activities.

The latter points should be quite encouraging for Off4Firms and further research in this field. If employers serve as the local facilitator, streamlined, firm-specific programmes appear to promise relatively high participation rates and therefore, potentially considerable reductions of carbon emissions. Such schemes would, for example, provide information and pool and pass on public funds to subsidize energy efficiency activities. They could also use a firm's good credit rating to pass on low interest rates to employees through preferential loans, which are generally regarded as a reasonably effective tool to motivate private investment (The Regulatory Assistance Project, 2010).

It is apparent that employers could also assume a role as financier, in analogy to what modern Energy Services Companies (ESCOs) do. The basic mode of operation of an ESCO is to provide upfront financing for investments in energy investments in exchange for some share in the resulting

monetary savings made over the subsequent years. As ESCOs can contract with landlords as well as tenants, ESCOs can overcome the principal-agent problem inherent in the refurbishment of rental homes. By providing the financing upfront, ESCOs typically assume the risk of a refurbishment project, while the landlord/tenant only commits to pay a percentage or fixed amount of the project's realized savings to the ESCO (Nexant, 2002). Yet, in the Off4Firms context and under an established credit-based mechanism that allows for the generation of emission/energy reduction certificates for such energy efficiency activities, a presumably more convenient framework would be that the employee concedes his right to claim emission/energy reduction certificates for the building refurbishment to his employer. This setting would enable the employee to fully benefit from the amount of (future) energy and electricity savings resulting from energy efficiency activities, while the employer's return on investment would stem from the monetary value of the certificates. In Switzerland, these certificates could be traded on the already existing market for domestic emission reduction certificates, whereas EU member states would need to establish such a market for domestic offsets, as outlined in Part B, Chapters 4 and 5.

To conclude, given households' response to existing support instruments, residential buildings seem to offer a great potential for employer-led programmes. The uptake of existing schemes by households has so far been strong – even with relatively small monetary support – and there is a broad range of activities that could be financed or subsidized by firms. Given that firms have an interest to use their funds most efficiently, i.e. to produce the greatest emission reductions with a given budget, such employer-led programmes might also be able to increase the economic efficiency of existing schemes if they are able to reduce administrative costs of such instruments.

3 Solar power production in private households

With global energy demand on the rise, satisfying this demand from renewable sources is becoming increasingly important, both for environmental reasons as well as to address energy security. Given the fact that several European countries (e.g. Germany, Spain and Switzerland) are phasing out nuclear power, advancements in the field of renewables are even more imperative. As a result, Switzerland has adopted new energy guidelines to 2050, aiming at a significant rise in the share of renewable energy (see also Part A). At the same time, the EU and its member states have committed themselves to increase the share of renewable energy from 8.5% in 2005 to 20% of the EU's total energy consumption by 2020 (European Commission DG ENER, 2011).

While there is no specific target for the power sector and the electricity mix varies greatly in the different member states, it is clear that electricity from renewable sources (RES-E) like wind, biomass, solar, etc. have to play a major role in this transition. Thus, this section will take a closer look at the policy instruments that are most commonly used throughout the EU and in Switzerland to reduce electricity's carbon intensity at the household level. This could be done either by motivating households to consume electricity from renewable sources or by incentivizing the production of renewable energy. We will focus on the latter as it is the production and not the consumption of "green" electricity that receives (financial) support through a number of policy instruments. While hydro and wind power have to date been by far the most important source of RES-E in Europe, their

production at the household level is negligible. Hence, our analysis will focus on financial incentives for the production of solar power, which receives substantial support in many European countries.

3.1 Financial incentives in the EU

In order to increase the share of electricity from renewable sources, in particular solar power, the EU and its member states apply a wide array of policies. For example, the EU itself has long been subsidizing research and development in the field of photovoltaic research and has handed out more than EUR 110 million in the last ten years to about 30 projects in this field (European Commission DG RTD, 2012). Direct financial support for the deployment of photovoltaic systems on the other hand, is the responsibility of the EU member states. While there exists a great range of measures to subsidize RES-E like, for example, preferential loans, tax rebates and investment grants, feed-in schemes are by far the most common policy instrument. The latter can take two forms: either the owner of solar panels receives a fixed price per kilowatt-hour, a so-called feed-in tariff (FiT), which is usually guaranteed for a period of 15 to 25 years, or the owner is offered a feed-in premium, i.e. a fixed price per kilowatt-hour that he receives on top of the revenue from selling the power on the market at the going market rate.

As figure 1 shows, almost all EU member states use one or the other at least as part of their policy portfolio if not their main instrument (note that Finland by now has also introduced a FiT for wind power, but not for solar power). According to a report for the German Federal Ministry for the Environment, 24 of the 27 member states are now using a feed-in scheme, 20 of which use it as their main policy tool (Ragwitz, Winkler, Klessmann, Gephart, & Resch, 2012). However, note that Spain and Malta have recently put their schemes on hold.

The following subsections will provide an overview of the different instruments that are used to support solar power in the EU countries, drawing on the member states' renewable energy progress reports as well as the work of the European Photovoltaic Industry Association and Squire Sanders (EPIA, 2011; European Commission DG ENER, 2012; Squire Sanders, 2011).

3.1.1 Subsidies for photovoltaic installations

Despite the households' preferences for financial support at the time of their investment and unlike in the fields of transport and residential buildings, direct subsidies for the installation of photovoltaic modules are rather uncommon. In fact, Finland is the only EU member state that relies solely on subsidies to incentivize the installation of photovoltaics (EPIA, 2011; Intelligent Energy Europe, 2012). This subsidy covers up to 40% of investment costs or up to EUR 3 million, thereby also aiming at large-scale installation. Yet coherent with its geographical location, Finland's overall efforts in the field of solar power are limited.

With the exception of Lithuania, Romania and Sweden, most other EU countries that run subsidy schemes for solar power are less generous because these subsidies are usually combined with other policy measures offering additional financial incentives. The subsidy schemes are typically run by local or regional governments and therefore may differ widely within the country. National subsidy programmes have largely been replaced by feed-in schemes, for example in Cyprus and Greece, and

only Lithuania, Luxemburg, Romania, and Sweden still pay subsidies from national funds. The investment support in these countries covers up to 70% (LT), 30% (LU; no more than EUR 1,650/kWp), 50% (RO), and 60% (SE) of the installation costs, respectively (EPIA, 2011). The sub-national schemes are beyond the scope of this working paper and will not be covered.

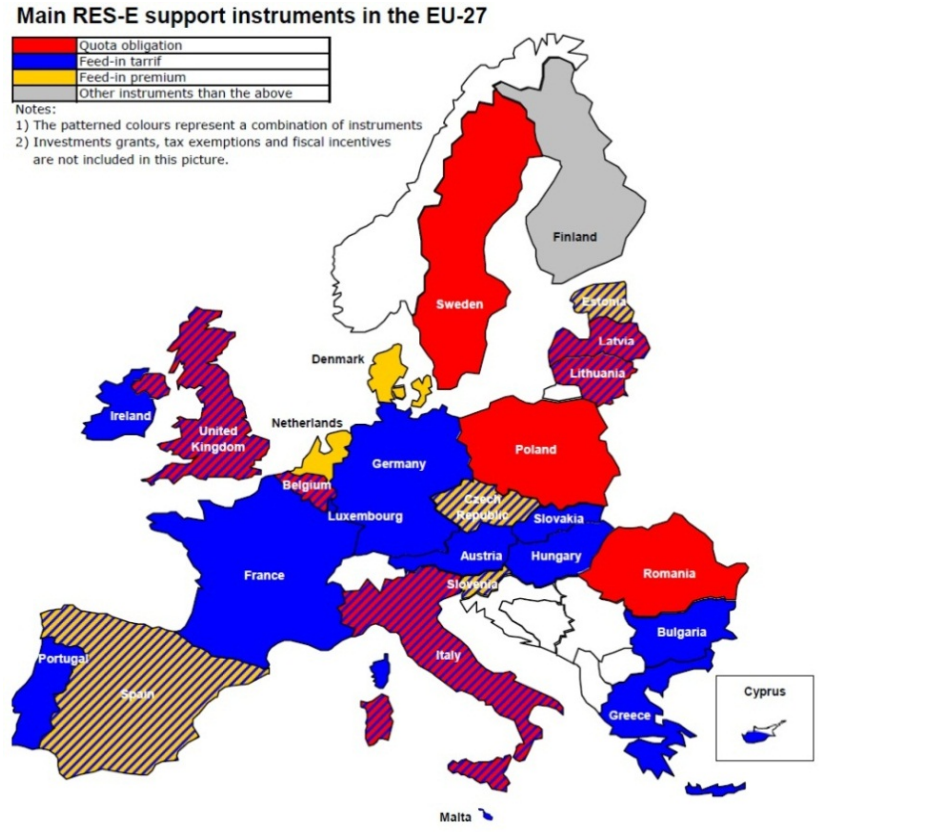

Figure 2 – RES-E policy instruments in the EU (Source: (Ecofys, 2011)).

3.1.2 Feed-in tariffs (FiTs) and premia

By far the most common policy instrument that supports solar power in the European Union is FiTs and premia. Based on a publication by the industry association EPIA, Table 8 provides an overview of EU member states that have a national feed-in scheme for photovoltaic installations on residential buildings (EPIA, 2011). Generally, feed-in schemes are quite effective in promoting solar energy given (European Commission, 2008b), yet effectiveness does not guarantee efficiency. Whether the (previously) existing feed-in schemes were in fact efficient in the recent past seems questionable given the experiences in a number of European countries. Given budgetary pressures, the governments in Spain, Italy, and Germany, for example, were forced to either sharply cut their tariffs or to stop their schemes entirely. These modifications came after very generous FiTs, which had not been adjusted to reflect the recent drop in the production costs of photovoltaic panels and thus made investment in solar power very profitable, had led to a sudden and strong increase in the installed capacity of solar power. As a result of the overly generous schemes, many European countries are redesigning their current policies and therefore, it seems unclear whether feed-in schemes will play an equally important role in the medium and long term as they do today.

Table 4 – National FiTs and premia in the EU in 2011 for building-mounted photovoltaic installations

	Size of installation to which scheme is applicable	Feed-in scheme (EUR/kWh)	Years guaranteed
Austria	5-20kWp	0.380	13
Bulgaria	≤5kWp >5kWp	0.404 0.371	25
Czech Republic	≤30kWp	0.300	20
Denmark	>6kWp	market price + 0.080 market price + 0.054	first 10 following 10
Estonia	≤100kWp	0.074	12
France	0-9kWp 9-36kWp	0.460 0.403	20
Germany	≤30kWp	0.287	20
Greece	≤10kWp	0.550	25
Hungary		0.105	20
Ireland	≤11kWp	0.090	unlimited
Italy	≤3kWp 3<P≤20kWp	0.391 0.360	20
Lithuania	≤100kWp	0.473	12
Luxemburg	≤30kWp	0.386	15
Malta	≤3kWp	0.250	8
Netherlands	≤15kWp	0.318	15
Portugal	≤3.68kWp	0.400 0.240	first 8 following 7
Slovakia	≤100kWp	0.388	15
Slovenia	≤50kWp	0.332	15
United Kingdom	≤10kWp	0.426	25

3.1.3 Preferential loans

A number of countries provide preferential loans in order to incentivize the production of solar electricity. According to the most recent renewable energy progress reports that member states are required to submit to the commission under Directive 2009/28/EC, national preferential loan schemes are currently available in Bulgaria, Estonia, Germany, Netherlands, Poland, Slovakia, and Slovenia (European Commission DG ENER, 2012). Unfortunately not all the progress reports specify the terms of these preferential loans. Typically, however, these support schemes finance – sometimes bound by a certain threshold – up to the entire cost of the photovoltaic installation. In Germany, for example, this threshold used to be EUR 50,000 for private households, but has recently been increased to EUR 25 million because the programme is now also open for institutional investors (KfW Bankengruppe, 2012c). Given that preferential loans generally seem to be a rather effective policy instrument, it is surprising that it is not used more frequently (The Regulatory Assistance Project, 2010).

3.2 Financial incentives in Switzerland

As a result of Switzerland's decision to phase out nuclear power, which currently accounts for more than 40% of electricity supply, renewable energy – in particular solar energy – will have to play a much greater role (see Part A). The main policy instrument to boost the deployment of renewable power in Switzerland is currently the so-called "*kostendeckende Einspeisevergütung (KEV)*", a feed-in

tariff. The FiT is lowered regularly to account for technological advances and decreasing costs of PV cells and currently varies between CHF 0.235/kWh (EUR 0.194/kWh) and CHF 0.428/kWh (EUR 0.354/kWh) for photovoltaic systems that are attached to or integrated into the roof. The applicable rate also depends on the size of the installation and is guaranteed for 25 years (The Swiss Federal Council, 2012a). The funds for the KEV are limited and due to fact that the demand for support through this scheme has been tremendous, there is now a long waiting list to receive the KEV. However, given that many cantons and/or local governments offer subsidies for the installation of photovoltaic cells, house owners who want to install photovoltaic systems are offered an alternative incentive scheme (Swissolar, 2012). These financial incentives vary greatly and are based on square meters covered, kilowatts peak (kWp) or are simply a lump-sum. The payment typically depends on kWp installed, but the amount varies between CHF 250/kWp (in the canton of Uri) and CHF 2,500/kWp (in the canton of Schaffhausen) while CHF 1,500/kWp is a common level of support in the remaining cantons. These payments and the KEV usually exclude each other so that the house owner has to decide which incentive scheme to apply for. In the medium term however, the coexisting programmes will be simplified as the future energy strategy (*Energy Strategy 2050*) foresees an end of the KEV for small scale photovoltaic systems (smaller than 10kWp). Instead, households that install those small-scale systems will receive 30% of the installation costs as a subsidy (The Swiss Federal Council, 2012b).

3.3 Evaluation and lessons learned for Off4Firms

When it comes to solar power, the conclusion seems obvious at first sight: feed-in tariffs and premia are widely used throughout Europe and have been very effective in increasing the deployment of photovoltaics, overcoming issues of insufficient information or credit-constraints. Yet the budgets allocated for the support of photovoltaic installations – in particular, for feed-in schemes – were often exceeded by a wide margin. Therefore, with the effectiveness in promoting solar power demanding enormous funds, the question whether these funds were used efficiently arises. Facing budgetary pressures, Spain and Malta have put their support for photovoltaics on hold, other governments have made significant cuts and long waiting lists to actually receive the FiT exist in countries like Switzerland and Austria. In short, experiences have been very mixed and what seemed to work in the initial phase may not be a long-term solution.

Nevertheless, one should recognize that thanks to private households being very responsive to the various support schemes, these have been very successful in the sense that electricity production from solar power has increased considerably.[44] Table 5 shows that, both in the EU as well as in Switzerland, the share of total electricity demand that is supplied by solar power has increased about sevenfold over the past decade.

For Off4Firms, households' high demand for photovoltaics installations could be promising as it is a declared policy goal to further increase solar power's share of total electricity supply. Against this background, a number of different employer-led carbon reduction programmes could help to increase the deployment of photovoltaic installations further. On the one hand, a firm could simply pool and administer available public support schemes and/or scale these up. On the other hand, a

[44] In Germany, about 40% of installed PV capacity is owned by private households (Wirth, 2012). In Switzerland, in 2010 private owners accounted for about 28% of newly installed PV capacity (DETEC, 2011b). Average figures for the EU are not available.

firm could offer its employees subsidized loans. A further alternative for an employer-led carbon reduction programme would be to use existing feed-in schemes whereupon the employee would only provide the space on his or her building while the employer would install photovoltaics and receive most of the tariff. Finally, if a firm was to receive reduction certificates for the use of domestically produced solar power, it could offer its employees an alternative to existing feed-in schemes: it would commit to buy the solar energy produced on the rooftops of its employees for a guaranteed price and time period. For the employees this would have the added benefit that they could invest in solar energy without having to put their project on a long waiting list – as they exist, e.g., in Switzerland and Austria – to receive public support.

Table 5 – Cumulative production of solar power and its share of total electricity demand in the EU and CH

year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Cumulative solar power production in EU (in TWh)	5.00	5.61	6.20	6.91	7.94	9.37	11.49	14.70	20.12	29.05	42.87
Solar power as share of total demand in EU (in %)	0.20	0.22	0.24	0.26	0.29	0.34	0.41	0.52	0.70	1.07	1.51
Cumulative solar power production in CH (in TWh)	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.05	0.08
Solar power as share of total demand in CH (in %)	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.05	0.06	0.09	0.14

Source: **(DETEC, 2011b; Eurostat, 2012, 2012b)**

A final point that seems to be of special relevance in the context of solar power production within private households is the importance of personal norms. *Personal norms* ((Schwartz, 1977), and in particular *moral norms* (Harland, Staats, & Wilke, 1999)), are an individual's felt obligations toward a certain behaviour. In the case of investment decisions in the environmental domain, one might think of attitudes toward caring for future generations, beliefs in the occurrence of climate change, etc. as determinants of these norms. Feeling an obligation to use only environmentally friendly produced electricity can be characterized as such a norm. These personal norms are important predictors of decisions and may differ between individuals, but also between groups of people and they may alter the effectiveness of interventions to promote investments. For example, some people who have a

highly pro-environmental personal norm may not be susceptible to any monetary incentive, since money is not the reason for their pro-environmental behaviour (see e.g., (Handgraaf, Van Lidth de Jeude, & Appelt, 2012)). In fact, such people may respond negatively to financial incentives for behaviour they would display out of their own accord anyway (Bowles, 2008). In contrast, people who do not have such pro-environmental personal norms will not respond to labelling some investment decisions as good or bad for the environment. It is therefore important to know the personal norms of the target audience before starting an intervention. In the context of firms it seems to be relatively easy to identify groups that are more susceptible to monetary incentives and those who react strongly to the labelling of actions. Hence, activities within firms open up opportunities to make household-directed interventions much more effective than interventions within a greater, much more anonymous group.

4 Household appliances

There are small electric appliances like computers, laptops, mobile phones, and stereos, and large electric appliances like refrigerators, freezers, washing machines, dishwashers, televisions, and dryers. The latter account for a share of 25% of total electricity consumption of households, with the total energy consumption attributed to commonly used large appliances still steadily increasing (Paolo Bertoldi & Atanasiu, 2006; IEA, 2008). In Europe, refrigerators and washing machines registered a decline in total energy consumption (the sum over the energy consumption of all appliances of a specific type) over the last twenty years, mainly due to higher energy efficiency of the appliances and saturation in the ownership levels of these appliances. In contrast, the total energy consumption attributed to freezers, dishwashers, TVs, and dryers increased in this period, due to higher penetration rates. Overall, the total energy consumption attributed to large electric appliances is still increasing (see Figure 3) (ADEME, 2012b; ODYSSEE, 2012). In view of this situation, governments in many EU member states and Switzerland have initiated financial incentive schemes that aim at substituting energy-inefficient old appliances by new and energy-efficient ones.[45,46]

[45] In some countries, the responsibility of implementing these schemes has been passed on to the regional or municipal administration or to utilities that need to fulfill energy efficiency targets among their end customers.

[46] In comparison to an energy class A appliance, on average, an energy class B appliance consumes 20-30% more energy and an energy class C appliance 40-65% more energy. Hence, the substitution of obsolete large appliances can bring about significant energy savings, especially when appliances are substituted that belong to very inefficient energy classes (CECED, 2012).

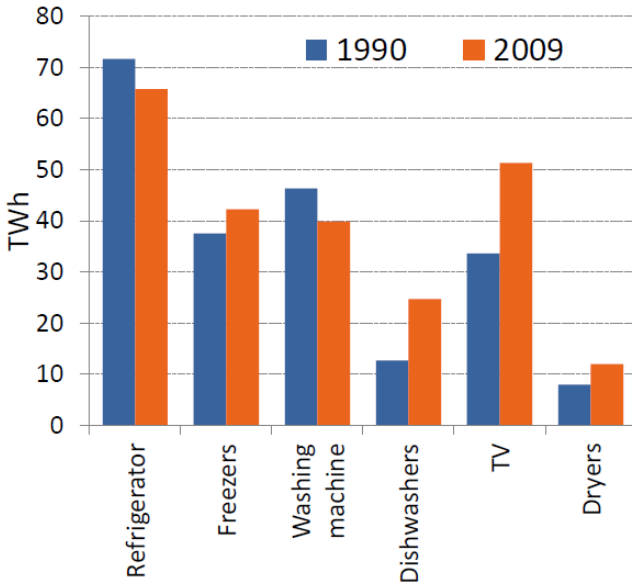

Figure 3. Energy Consumption of selected appliances, EU-27 (Source: (ODYSSEE, 2012)).

4.1 Financial incentives in the EU

4.1.1 Subsidies

Many EU member states have introduced programmes that subsidize the purchase of energy efficient large household appliances, like washing machines, refrigerators, and freezers. Some programmes also subsidize small appliances, like televisions and coffee machines. Typically, programmes for the purchase of energy-efficient appliances run between a few months and several years.

For the majority of programmes, eligibility criteria define the requirements or standards for receiving subsidies, and replaced old appliances need to be handed over for recycling.[47] In general, some restrictions apply to the amount of subsidized appliances a household can purchase. For instance, only one fridge and one freezer of A++/A+++ energy class, and one dryer of energy class A will be subsidized in five year period in Brussels-Capital Region, Belgium (EuroACE, 2009; IBGE, 2012). Table 6 below provides an overview of the subsidies paid for energy-efficient electric appliances in selected European countries and the minimum energy-efficiency requirements that apply for their obtainment. A more exhaustive table can be found in the Annex.

[47] These criteria change in some cases over the time the programme is running.

Table 6 – Subsidies for electric appliances in selected European countries				
Country	**Appliances**	**Minimum criterion**	**Subsidy**	**Period**
Belgium	Refrigerators, freezers, dryers	Energy class A++ or higher (refrigerators, freezers), energy class A (dryers)	EUR 50-200, 50%[#]	Since 2003 [on-going]
Greece	Air conditioners	High energy class	EUR 500 (max.), 35%[#]	July/Aug 2008
Malta	Refrigerators, freezers, washing machines, dishwashers, dryers, air conditioners	Energy class A	EUR 58-116 (max.), 20%[#]	2006-2008
Portugal	Large appliances	Energy class A+ or higher	EUR 50-100	Since 2008 [on-going]
Spain	Fridges, freezers, washing machines, dish washers	Energy class A or higher	EUR 50-125, 25%[#,48]	2006-2010; 2011-2020
Sources: (Fernandes, 2010), (IBGE, 2012), (IDAE, 2011), (IDAE, 2012b), (MURE, 2012), (ODYSSEE, not dated) [#] Maximum subsidy share (of retail price)				

A short-term programme running for a few months can be found in Greece. In 2009, Greece ran the "Changing air condition" programme, which provided for the purchase of new air conditioners a subsidy of 35% (max. EUR 500) of the retail price, paid to the retail store owner. As a result, more than 140,000 air conditioners were replaced and recycled, hence largely exceeding the envisioned replacement of 45,000 appliances. As a consequence, the initially allocated governmental funds of EUR 15 mio needed to be scaled up to more than EUR 45 mio, and the programme was terminated earlier than foreseen (CRES, 2009; Eleftherotypia, 2009; MURE, 2012).

Examples for long-term programmes, that is, programmes running for several years, can be found in Portugal and Spain. Portugal set up an Energy Efficiency Fund with a budget of EUR 30 mio/year in 2008. One of the programmes benefiting from this fund aims at replacing one million large electric appliances (white goods) in the residential and services sectors, providing a EUR 50 bonus for the replacement with an A+ appliance and EUR 100 for an A++ appliance (IEA, 2012b).[49] This corresponds to an estimated 20% share of subsidized appliances among the total amount of appliances sold (Statistics Portugal, 2012). Similarly, through its "Plan Renove", the Spanish government has subsidized the replacement of fridges and freezers, washing machines, dish washers, ovens and induction and gas worktops of energy class A or superior, depending on the appliance. The subsidy amount depends on the Autonomous Community of Spain where the subsidy is claimed, with the subsidy varying between EUR 50 to EUR 125 in 2011. Since its inception in 2006 until the end of 2010, the programme has led to a substitution of nearly four million electric appliances.[50]

This number is probably still too low for bringing about a general overhaul of the inventory of appliances in Spanish households within the next few years, given that the roughly 28 million households in Spain substitute some three million appliances annually without subsidies.[51] Yet, the

[48] This maximum share is not laid out in the general conditions of the programme „Plan Renove" but rather mandated by the Autonomous Regions.
[49] In the business sector, the purchase of energy efficient equipment is encouraged through fiscal measures, creating an accelerated depreciation regime for investments.
[50] In the next programme phase, running from 2011-2020, the Spanish government aims at substituting three million appliances (300,000 annually), and public support of EUR 800 mio have been budgeted for this purpose.
[51] This number includes fridges, freezers, washing machines, and dish washers.

Instituto para la Diversificación y Ahorro de la Energía (IDAE) claims that due to the programme, the percentage of citizens taking into account energy efficiency labelling and energy consumption when making a purchase decision increased from 43% to 84% and 16% to 48%, respectively (IDAE, 2011, 2012a, 2012b; IEA, 2012b; INE, 2012; MURE, 2012).

4.1.3 Other incentive schemes

In addition to direct subsidies for energy-efficient appliances, several EU member states have run awareness campaigns. The Danish Electricity Savings Trust, for instance, launched and ran a campaign in 2007 for spreading the usage of electricity saving sockets, so-called "standby-killers", in private households. Within this campaign, retail chains were asked to hand out the standby-killers for free upon the purchase of, for instance, a TV or a computer. In return, the Trust ran a TV infomercial informing customers which retailers were participating in this campaign. As a result, the demand for standby-killers rose significantly, and retail chains started offering them for individual purchase. As of 2006, 16% of Danish households had had at least one standby-killer for PC usage, and 6% of households used at least one standby-killer for TVs (MURE, 2012). In Germany, a consortium of public authorities and utility companies has been running an information campaign on energy efficiency of white appliances and brown goods, information and communication technology, and lighting since 2002. Utility companies participated in this campaign as part of their voluntary contribution to saving carbon, as agreed with the Federal Government. In contrast to the ban of refrigerators of energy classes lower than A+, comparable regulations for other power-guzzling appliances do not exist yet (Gutberlet, 2012). This, together with the fact that Germany, on the one hand, has no (public) subsidies for purchasing these appliances, and, on the other hand, registers one of the highest progresses in increasing the energy efficiency of large appliances in the country, indicates that information may play a key role in fostering sales of energy-efficient large appliances (ADEME, 2012b; MURE, 2012).

In the Netherlands, tax rebates were offered to purchasers of highly efficient appliances in 2001/2002. These tax rebates were applied primarily for the purchase of white goods and installed appliances accompanied by an energy tax to stimulate the purchase of energy-efficient products. Together with focused information campaigns, tax rebates for e.g. class A cold appliances, washing machines, and dishwashers brought about a rise in the respective market shares from less than 20% to 70-90% (IEA, 2012b; Klinckenberg, 2002).

In Hungary, a business association of domestic equipment manufacturers promoted the substitution of old refrigerators and washing machines for appliances of A, A+ or A++ energy class. Consumers handing in their old appliance at the time of purchase of a new one received a HUF 5,000 (approx. EUR 20) deduction from the retail purchase price. This campaign also announced public competitions for handing in and recycling the oldest still up-and-running refrigerator, washing machine, electric oven, and vacuum cleaner. More than 7,000 and 10,000 devices were replaced, respectively. In view of the fact that in Hungary, a high number of old appliances is still in use, these replacement numbers appear to be rather low.[52] But without financial support, no replacement of appliances would possibly have taken place (CECED, 2012; MURE, 2012).

[52] For instance, out of a total of approximately three million refrigerators in use in Hungary, an estimated one million refrigerators are older than 10 years.

These examples of national initiatives and programmes of EU member states show that, on the one hand, the demand for subsidies for the replacement of power-guzzling old household appliances by energy-efficient new ones has been significant among households within the EU, while the available funds have been quite limited. On the other hand, they indicate that information is likely to play a key role in propagating the purchase of energy-efficient white goods.

4.2 Financial incentives in Switzerland

In Switzerland, a large number of programmes exist that subsidize the purchase of energy efficient household appliances like refrigerators, freezers, and coffee machines. These programmes are run at a local level, for instance by utility companies and local governments. Several utility companies, for instance, city-owned power supplier EWZ in Zurich and city-owned EWB in Bern, have performance mandates[53] that include the promotion of the production and distribution of renewable energies and the promotion of energy efficiency. The subsidies provided to the customer take the form of an ex-post partial reimbursement of the purchase price of selected energy-efficient appliances. As a rule there is a maximum subsidy amount per appliance that cannot be exceeded. In general, only appliances that fulfil high energy efficiency standards are eligible for the partial refund (Topten International Group, 2012; UnserStrom, 2012).

In the canton of Zurich, for instance, the cantonal power supplier EKZ granted 25% of the purchase price and up to CHF 400 to buyers of new refrigerators and freezers in summer 2012. Similar programmes were launched by EWZ, subsidizing the purchase of energy-efficient coffee machines, refrigerators, and e-scooters with up to CHF 100, 400, and 1,000, respectively. These programmes have had a positive resonance among EWZ's customers; for instance, around 3,000 coffee machines, 26,000 fridges, and 75 e-scooters were subsidized between 1997 and 2011. The financial resources dedicated to the respective fond at EWZ, amounting to roughly six million Swiss francs for the purchase of these three goods, have constantly been (nearly) exhausted (EWZ, 2012). Yet, the number of subsidized appliances could possibly be increased when, for instance, considering that the average lifetime of a refrigerator in Switzerland is 10 years and that the number of households in Zurich reaches roughly 190,000 ((EKZ, 2012a; EWZ, 2010, 2012; Mieterverband, 2012; Statistik Stadt Zürich, 2012; Topten International Group, 2012); Table 9 in the Annex).

4.3 Evaluation and lessons learned for Off4Firms

For many countries, regions and municipalities, both long-term initiatives and shorter-term programmes providing subsidies for the purchase of energy-efficient household appliances – often combined with "soft measures" such as information and awareness campaigns or competitions – have seen high response rates by households. This has been even the case when these subsidies amount to only a relatively small share of the purchase price of the appliance, hence resulting to be a potential great lever for the mobilization of private investments into energy efficiency. These initiatives and programmes have possibly contributed to an increase in the share of energy-efficient household appliances in the inventory of appliances in households in the respective country or region

[53] Performance mandates [Leistungsaufträge] are based on a strategic business plan and are used by the Swiss Federal Council to manage certain groups, offices or parts of offices.

where the programme was run.[54] Similarly, (Klinckenberg, 2002) attribute increased market shares of energy-efficient appliances in the Dutch white goods market to the introduction of tax rebates for these goods (usually a fixed sum of EUR 50) in combination with information (EU and domestic energy efficiency labels), suggesting that also this type of intervention is an effective measure for influencing households' decision making when it comes to purchasing household appliances.

In many cases, either the budgets allocated for subsidizing appliances have been significantly exceeded, or subsidy programmes had to be terminated earlier due to the fast exhaustion of available funds. Both have been a result of unexpectedly high demand on the part of households. Hence, it remains questionable whether these funds were used efficiently. This question gains in importance in view of the fact that public funds for subsidizing energy-efficient appliances have been quite limited. The current economic situation in Europe will possibly worsen this already restricted availability of funds. This is where private firms could come into play. Firms could ramp up these funds with their own financial means. This would probably increase the number of households that can benefit from these subsidies, which, in turn, may be the factor tipping the scales towards the decision to substitute an existing appliance by a more energy-efficient one. In addition, employer-led programmes might be able to increase the economic efficiency of existing schemes, given that firms have an interest to use their funds more efficiently, that is, achieve the highest emission reductions with a given budget. This interest is likely to be even higher in a situation where crediting schemes provide additional incentives for firms to reduce emissions and energy consumption of their employees. Under an established crediting scheme, employers would benefit from the generated credits by offsetting their own corporate carbon emissions (meeting voluntary or mandatory reduction targets). They could also sell these credits to other firms with reduction targets (see Part B of this study). In Switzerland, these certificates could be traded on the already existing market for domestic emission reduction certificates, whereas EU member states would need to establish such a market for domestic offsets. Yet, firms could also, for instance, pool the purchase requests for energy-efficient appliances of their employees and acquire them all at once for a discount price, thus making use of their financial strength and exploiting economies of scale.

In addition to pooling/passing on public funds and providing (additional) funds, firms could also contribute significantly to the dissemination of information. This could include information with regard to both the energy-saving potential of energy-efficient appliances and existing (public) schemes for subsidizing these appliances. Furthermore, firms could help overcome their employees' uncertainty about the performance of and experience with such new appliances by purchasing one themselves and letting their employees use it during work hours.

Such possibilities might be also be important with respect to uncertainty affecting investment decisions through what is called the *disjunction effect* (Bastardi & Shafir, 1998). According to logic, someone who prefers A over B in situation X and also prefers A over B in situation Y, should also prefer A over B when it is unknown whether situation X or Y will materialize. So imagine a person who will buy certain electric appliances if a certain subsidy is available, but would also buy them when this subsidy is not given (because she thinks that with rising energy prices it will still be profitable in the long run). The sure thing principle prescribes that even when it is unclear whether subsidies are available, this person should decide to purchase the appliances, since she would do it

[54] However, due to the fact that windfall gains might play a role in this context, a clear-cut relationship between the response of households to subsidy programmes for energy-efficient appliances and the effectiveness of these programmes in incentivizing households to buy energy-efficient appliances cannot be established based on this information.

both when there is a subsidy and when there is no subsidy. Unfortunately, this is not how people reason: since people want to be able to explain (to themselves or others) why they make certain choices, they are inclined to wait for information on whether subsidies will be given, and refrain from buying or investing until this information becomes available. Perversely, after waiting for this information (that should not affect their decision), people then give this information a disproportionally large weight in their decision, and thus may decide not to buy the appliances, when it turns out that subsidy is not available, even though they would have done so had there never been the possibility of receiving a subsidy in the first place. Embedding purchase decisions in firms' contexts could be a way out of this dilemma.

Discussion

The overview presented in Part A reveals that the current portfolio of instruments to reduce CO_2 emissions such that global warming will not exceed 2°C is insufficient. New approaches to arrive at the required emission reductions seem necessary. A scale-up of employer-led programmes would, in principle, lead in the right direction. Furthermore, it will be in line with the declared policy goals in Switzerland, as well as the EU. Indeed, all activities proposed for Off4Firms-type projects as described in (Manser et al., 2012) would contribute to at least one objective specified in the EU's "20-20-20" target. The policy goals specified for Switzerland are of similar stringency and would hence also be in alignment with a scale-up of employer-led schemes. For both, the EU and Switzerland, allowing for employer-led schemes within their existing regulatory frameworks could represent an effective extension of the existing policy portfolio. The main findings of our analysis of the policy instruments eligible for such a scale-up, hence deserve further discussion.

Implementation within existing policy frameworks

As laid out in the introduction, Off4Firms-type projects could be easily integrated into a credit-based emissions trading scheme along the line of CDM Programmes of Activities (PoAs). Up to the present, only Switzerland has implemented a credit-based emissions trading scheme on the domestic level (see Part B of this report). Yet, currently, the Swiss scheme does not provide for a potential pooling of small-scale reductions. However, extending this scheme to include PoA-type projects seems straightforward and is likely to be associated with relatively low additional implementation costs. One of the most important requirements of such an extension is the development of baseline and calculation methodologies for pooling household reductions. In this area, the methodologies developed within the Off4Firms research programme could provide a valuable first step for further refinement of a regulatory PoA scheme in Switzerland.

The level of incentive payments that firms could pass through to their employees would then depend of the overall demand of the thus created reduction credits. Yet, as discussed in Part B, the level of demand is still uncertain. It remains hence to be seen whether such an extension of the Swiss system of reduction credits could actually lead to a successful large-scale implementation of employer-led incentive schemes. In principle, such a scheme could also be implemented within the EU, which already hosts the world's largest cap-and-trade emissions trading system. Such an extension would, however, require the introduction of a domestic credit-based system within the EU. Alternatively, a PoA-type extension might be implemented within the White Certificate programmes that are in place in different EU countries. Again, allowing for employer-led schemes would require elaborated methodologies of calculation, which could be provided by use of the output of the Off4Firms research programme.

It is to note that in Switzerland, as well as the EU, regulations targeting household reductions are dominated rather by incentives directly provided to households, like subsidies or preferential loans. As suggested above, such schemes would, at least in principle, lend themselves to a pass-through of funds via the employer. It is conceivable that firms provide information on reduction technologies and hand out financial incentive payments for realized investments within their employees'

households. The firm could then claim back the corresponding amount of overall subsidies from a government program. The realization such a framework is, however, likely to meet resistance in the realm of politics, as it requires a visible transfer from the state to firms, which could be easily perceived as a subsidy to the firm itself. Hence, such a redirection of subsidies via firms is unlikely to be politically realizable. Letting firms use the reductions in their employees' energy consumption and CO_2-emissions to meet voluntary or mandatory emission reduction obligations seems to be far more promising. Our analysis of the different incentive schemes established within different EU Member States and Switzerland, which is presented in Part C, yields some interesting insights that are useful for the implementation of employer-led schemes.

Learning from existing incentive schemes

As our discussion of subsidy schemes for electric mobility reveals, fostering the diffusion of electric cars via financial incentives alone requires the transfer of a significant monetary amount per car. Accompanying such incentive payments with the provision of information and the promotion of adequate infrastructure seems to be much more promising. In this area, employer-led schemes could, if well-designed, significantly increase the uptake rate. Firms complementing incentive payments with the provision of the charging infrastructure at work, as well as the distribution of information about the technology and additional support schemes available, are likely to increase the purchase rate of electric cars among their employees. This could be complemented with carefully managing "soft" factors of the purchase decision, e.g. by establishing a "greener" working culture and rewarding sustainable behaviour.

In contrast to electro-mobility, earmarked funds for subsidy programmes in other areas, like building refurbishment and household appliances were quite frequently fully exhausted. Similarly, in most countries, state-set incentives to improve the diffusion of small-scale photovoltaic systems were taken up extensively by households. This provides support for the presumption that, for these cases, financial incentives can considerably speed up switches toward the use of "greener" technologies within households. Interestingly, for some technologies, this seems to be even the case when the incentive payment amounts to only a relatively small share of the purchase price. This is surely a valuable insight when it comes to the selection of eligible activities within employer-led schemes.

Advantages of well-designed employer-led schemes

Given the tight budgetary situation of many EU countries, an effective and efficient use of existing funds is undoubtedly preferable. Here, employer-led schemes are likely to have an advantage to direct subsidization. In particular, a well-designed scheme could reduce the problem of households' capturing windfall gains. Indeed, a sensible additionality check, which is always required for a project-based approach, could significantly reduce the problem of over-subsidization associated with blanket subsidies. Furthermore, employer-led schemes would be complemented with a more focused information and communication strategy, as well as a sensible management of the above-mentioned socio-psychological factors. All of these advantages of employer-led schemes would increase the effectiveness of such policy instrument compared to the payment of direct subsidies for any given budget.

Of course, the above-mentioned advantages of employer-led schemes would be only realized if the use of soft factors and calculation methodologies are thought through and implemented with care. Hence, the findings derived within the Off4Firms research programme will provide valuable insights for the design of employer-led schemes as a potential future policy instrument.

Bibliography

ACEA. (2012). Overview of Pruchase and Tax Incentives for Electric Vehicles in the EU. Brussels: European Automobile Manufacturers' Association (ACEA).

ADEME. (2009). Energy Efficiency Trends and Policies in the EU 27 - Results of the ODYSSEE-MURE project. Paris: Agence de l'Environnement et de la Maîtrise d'Énergie (ADEME).

ADEME (Producer). (2012a, 11/09/2012). Certificats économie d'énergie. Retrieved from http://www2.ademe.fr/servlet/KBaseShow?sort=-1&cid=96&m=3&catid=15024#theme3

ADEME. (2012b). Energy Efficiency Trends in Buildings in the EU. Lessons from the ODYSSEE/MURE project. Paris: Agence de l'Environnement et de la Maîtrise d'Énergie (ADEME).

Amt für Energie und Umwelt. Basel-Stadt (Producer). (2012, 24/07/2012). Förderabgabe. Retrieved from http://www.aue.bs.ch/fachbereiche/energie/foerderabgabe.htm

Anderson, C. J. (2003). The psychology of doing nothing: Forms of decision avoidance result from reason and emotion. *Psychological Bulletin, 129*(1), 139-167.

Bastardi, A., & Shafir, E. (1998). On the pursuit and misuse of useless information. *Journal of Personality and Social Psychology, 75*, 19-32.

Bertoldi, P. (2011). *Assessment and Experience of White Certificate Schemes in the European Union.* Paper presented at the Policies for Energy-Provider-Delivered Energy Efficiency (PEPDEE) Workshop Brussels.

Bertoldi, P., & Atanasiu, B. (2006). Consumption and Efficiency Trends in the Enlarged European Union. Ispra: European Commission - DG JRC.

Bertoldi, P., Rezessy, S. (2009). Energy Saving Obligations and Tradable White Certificates: European Commission, Renewable Energy Unit.

Bird, R., & Smith, E. A. (2005). Signaling theory, strategic interaction, and symbolic capital. *Current Anthropology, 46*(2), 221-248.

BMWi/BMU. (2010). Energiekonzept für eine umweltschonende, zuverlässige und bezahlbare Energieversorgung. Berlin.

Boardman, B. (2007). Home truths: a low-carbon strategy to reduce UK housing emissions by 80% by 2050 (U. o. O. s. E. C. Institute, Trans.). Oxford: University of Oxford.

Bowles, S. (2008). Policies designed for self-interested citizens may undermine "the moral sentiments": evidence from economic experiments. . *Science, 320*, 1605-1609.

Braun, J. F. (2011). EU Energy Policy under the Treaty of Lisbon Rules: Between a new policy and business as usual. *Politics and Institutions, EPIN Working Papers*.

CE Delft. (2011). Impacts of Electric Vehicles - An Overview of Electric Vehicles on the market and in development. Delft: CE Delft on behalf of the European Commission.

CECED. (2012). Energiakalkulator Retrieved 27/11/2012, from http://www.energiakalkulator.hu/en

Climate Cent Foundation. (not dated). Regeln zur Anrechnung von Emissionsreduktionen aus Brennstoff-Zielvereinbarungen. Online: Climate Cent Foundation.

CRES. (2009). Energy Efficiency Policies and Measures in Greece. Monitoring of Energy Efficiency in EU 27, Norway and Croatia (ODYSSEE-MURE). Athens: Centre for Renewable Energy Sources and Saving (CRES).

Das Gebäudeprogramm. (2011). Statistische Auswertungen - Jahresstatistik 2010. Bern: Das Gebäudeprogramm.

Das Gebäudeprogramm. (2012a). Das Gebäudeprogramm 2011 - Gesamtbericht. Bern: Das Gebäudeprogramm.

Das Gebäudeprogramm. (2012b). Statistische Auswertungen - Jahresstatistik 2011. Bern: Das Gebäudeprogramm.

DEFRA. (2009). Saving Energy Through Better Products and Appliances. A report on analysis, aims and indicative standards for energy efficient products 2009 - 2030. London: DEFRA.

DEFRA. (2012, 29/10/2009). ARCHIVE: Energy saving light bulbs Retrieved 2/12/2012, from http://archive.defra.gov.uk/environment/business/products/roadmaps/lightbulbs.htm

Department for Transport - Office for Low Emission Vehicles. (2011). Making the Connection - The Plug-In Vehicle Infrastructure Strategy. London: Department of Transport.

Department for Transport (Producer). (2011, June 30). Taking Charge. *Department for Transport*. Retrieved from http://www.dft.gov.uk/new/press-releases/dft-press-20110630

Department for Transport (Producer). (2012). Vehicle licensing - Statistics. *Department for Transport*. Retrieved from http://www.dft.gov.uk/statistics/series/vehicle-licensing/

Vollzugsweisung: Verpflichtungen und Zielvereinbarungen. Weisung des BAFU und des BFE

an die Energie-Agentur der Wirtschaft (EnAW) zu Handen der dort angeschlossenen Unternehmen über die Erarbeitung von Vorschlägen zur Emissions-begrenzung und zur Reduktion des Energieverbrauchs sowie über die Umsetzung der Verpflichtungen und Zielvereinbarungen (2007).

DETEC. (2011a). Bundesrat will Kyoto-Ziellücke mit Emissionszertifikaten schliessen. Retrieved 29/06/2012, from DETEC http://www.news.admin.ch/message/index.html?lang=de&msg-id=39555

DETEC. (2011b). Markterhebung Sonnenenergie 2010. Bern: Federal Department of the Environment, Transport, Energy and Communications (DETEC).

DETEC. (2012). Konzept EnergieSchweiz 2011 – 2020. Online: DETEC.

Ecofys. (2011). Financing Renewable Energy in the European Energy Market. Brussels: European Commission, DG Energy.

EEA. (2010). Monitoring the CO2 emissions from new passenger cars in the EU: summary of data for 2010. Brussels: European Environment Agency (EEA).

EEA. (2012). Annual European Union greenhouse gas inventory 1990-2010 and inventory report 2012. Submission to the UNFCCC Secretariat. *EEA Technical report*. Copenhagen: European Environment Agency (EEA).

EFV. (2012). Finanzausgleich Retrieved 21/12/2012, from http://www.efv.admin.ch/d/themen/finanzpolitik_grundlagen/finanzausgleich.php

EKZ (Producer). (2012a). EKZ Förderprogramm: Aktion für Kunden. Kühl- und Gefriergeräte A+++ gemäss topten.ch. Reglement. Retrieved from http://www.topten.ch/uploads/images/download-files/Reglement-Kuehlen-Gefrieren-v3.pdf

EKZ. (2012b, 2012). Förderung energieeffizienter Geräte Retrieved 27/11/2012, from http://www.ekz.ch/content/ekz/de/geschaeftskunden/Foerderprogramme/stromeffizienz-im-unternehmen/energieeffiziente-geraete.html

Eleftherotypia. (2009, 28/08/2009). Αντικαταστάθηκαν 140 χιλιάδες κλιματιστικά [140 000 air conditioners replaced] Retrieved 26/11/2012, from http://www.enet.gr/?i=news.el.ellada&id=76688

Environment Canada. (2011). A Climate Change Plan for the Purposes of the Kyoto Protocol - Implementation Act. Gatineau: Environment Canada.

EPIA. (2011). European PV Support Schemes - Photovoltaic Observatory Q1 2011. Brussels: European Photovoltaic Industry Association (EPIA).

Epstein, L. G. (1999). A definition of uncertainty aversion. *Review of Economic Studies, 66*(3), 579-608. doi: 10.1111/1467-937x.00099

EREC. (2009). Renewable energy policy review - Italy.

ESDN. (2007). Strategic Approaches to Climate Change in Europe: EU policies and strategies, provisions in SD strategies and overview of national climate change strategies *ESDN Quarterly Report September 2007*. ESDN Office: ESDN (European Sustainable Development Network).

Estonian Ministry of Economic Affairs and Communications (Producer). (2011, March). Electric Mobility Programme for Estonia. *Ministry of Economics Affairs and Communications*. Retrieved from http://www.mkm.ee/electric-mobility-programme-for-estonia/

EU Commission DG MARKT. (2010). Challenges for a European market for electric vehicles. Brussels: European Parliament.

EU Commission DG RTD. (2011). European Green Cars Initiative - Multi-annual roadmap and long-term strategy. Brussels: European Commission.

EurActiv. (2012). Energy Efficiency Directive: Completing an energy policy puzzle Retrieved 18/11/2012, from http://www.euractiv.com/energy-efficiency/energy-efficiency-directive-linksdossier-514483

EuroACE. (2009). Working paper: current financial and fiscal incentive programmes for sustainable energy in buildings from across Europe. Brussels: The European Alliance of Companies for Energy Efficiency in Buildings (EuroACE).

EuroACE. (2010). Making Money Work for Buildings: Financial and Fiscal Instruments for Energy Efficiency in Buildings. Brussels: The European Alliance of Companies for Energy Efficiency in Buildings (EuroACE).

European Commission. (2003). Kyoto Protocol. Reference: MEMO/03/154. Retrieved 5/10/2012 http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/03/154&format=HTML&aged=0&language=EN&guiLanguage=en

European Commission. (2008a). COM(2008) 11 final. Retrieved 5/09/2012

European Commission. (2008b). SEC(2008) 57: Commission Staff Working Document *The support of electricity from renewable energy sources*. Brussels: European Commission.

European Commission. (2010, 17/12/2010). Effort sharing decision, from http://ec.europa.eu/clima/policies/effort/index_en.htm

European Commission (Producer). (2011a). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - A Roadmap for moving to a competitive low carbon economy in 2050. Retrieved from http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52011DC0112:EN:NOT

European Commission. (2011b, 8/03/2011). Roadmap for moving to a low-carbon economy in 2050 Retrieved 27/09/2012, from http://ec.europa.eu/clima/policies/roadmap/index_en.htm

European Commission. (2012a, 9/08/2012). Benchmarks for free allocation Retrieved 6/10/2012, from http://ec.europa.eu/clima/policies/ets/benchmarking/index_en.htm

European Commission. (2012b). Climate Change factsheet. Online: European Commission.

European Commission. (2012c, 17/10/2012). Effort Sharing Decision. Questions and Answers on the Effort Sharing Decision (October 2012). Retrieved 12/12/2012, from http://ec.europa.eu/clima/policies/effort/faq_en.htm

European Commission. (2012d, 15/11/2010). Emissions Trading System (EU ETS) Retrieved 5/10/2012, from http://ec.europa.eu/clima/policies/ets/index_en.htm

European Commission. (2012e, 10/09/2012). The EU Climate and Energy Package Retrieved 26/09/2012, from http://ec.europa.eu/clima/policies/package/index_en.htm

European Commission. (2012f). Report from the Commission to the European Parliament and the Council. Progress towards achieving the Kyoto objectives. Brussels: European Commission,.

European Commission. (2012g, 10/09/2012). What is the EU doing about climate change? Retrieved 27/09/2012, from http://ec.europa.eu/clima/policies/brief/eu/index_en.htm

European Commission. (not dated). European energy policy Retrieved 7/10/2012, from http://europa.eu/legislation_summaries/energy/european_energy_policy/index_en.htm

European Commission DG ENER. (2011). Renewables make the difference. Brussels: Publications Office of the European Union.

European Commission DG ENER (Producer). (2012). Renewable energy 2011 Progress reports. *European Commission, DG Energy*. Retrieved from http://ec.europa.eu/energy/renewables/reports/2011_en.htm

European Commission DG RTD (Producer). (2012). EU Support for Photovoltaics. *European Commission - Research & Innovation*. Retrieved from http://ec.europa.eu/research/energy/eu/research/photovoltaics/support/index_en.htm

Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emissions allowance trading scheme of the Community (2009).

European Union. (2010). Directive 2010/31/EU of the European Parliament and of the Council of May 2010 on the energy performance of buildings. Brussels: European Union.

Eurostat. (2009). Final energy consumption, EU-27, 2009 (% of total, based on tonnes of oil equivalent). Retrieved from http://epp.eurostat.ec.europa.eu/statistics_explained/index.php?title=File:Final_energy_consumption,_EU-27,_2009_(%_of_total_based_on_tonnes_of_oil_equivalent).png&filetimestamp=20120112112000

Eurostat. (2012). Final energy consumption of electricity. Retrieved from http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=ten00097&plugin=1

Eurostat. (2012b). Renewable energy primary production: biomass, hydro, geothermal, wind and solar energy. *Eurostat: Tables, Graphs and Maps Interface (TGM)*. Retrieved from http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=ten00082&plugin=1

EWZ (Producer). (2010). Eine ewz-Stromsparfonds-Aktion. Förderbeiträge für Kühl- und Gefriergeräte der Klasse A++. Retrieved from http://www.topten.ch/uploads/images/download-files/SSF_Kuehlgeraete_GR_2010.pdf

EWZ. (2012). Jahresbericht 2011. 20 Jahre Stromsparfonds. Zurich: EWZ.

Federal Motor Transport Authority (Producer). (2012). Emissionen, Kraftstoffe - Zeitreihe 2005-2011. *Kraftfahrt-Bundesamt (KBA)*. Retrieved from http://www.kba.de/cln_031/nn_191064/DE/Statistik/Fahrzeuge/Neuzulassungen/EmissionenKraftstoffe/n__emi__z__teil__2.html

Federal Office of Economics and Export Control (Producer). (2012, 12/10/2012). Energiesparberatung. *Federal Office of Economics and Export Control (BAFA)*. Retrieved from http://www.bafa.de/bafa/de/energie/energiesparberatung/index.html

Fernandes, A. (2010). *Plano nacional de acção para eficiência energética. Resultados 2010.* Paper presented at the P3E - Seminário Políticas e Experiências em Eficiência Energética. http://www.uc.pt/org/inescc/P3E/p3e_PNAEE_AlexandreFernandes

FOEN. (2010, 7/01/2010). Das CO2-Gesetz Retrieved 27/06/2012, from http://www.bafu.admin.ch/klima/00493/00494/index.html

FOEN. (2011a). CO2-Emissionshandelssysteme: Verhandlungen Schweiz-EU fortgesetzt Retrieved 23/08/2012, 2012, from http://www.bafu.admin.ch/dokumentation/medieninformation/00962/index.html?lang=de&msg-id=41297

FOEN. (2011b). Kenngrössen zur Entwicklung der Treibhausgasemissionen in der Schweiz 1990-2009. Bern: Federal Office for the Environment (BAFU).

FOEN. (2011c). Treibhausgase: Ungenügender Rückgang des Ausstosses im Jahr 2009 Retrieved 19/11/2012, from http://www.bafu.admin.ch/dokumentation/medieninformation/00962/index.html?lang=de&msg-id=38662

FOEN. (2011d, 20/09/2011). Verhandlungsablauf mit der EU Retrieved 23/08/2012, from http://www.bafu.admin.ch/emissionshandel/10923/10926/index.html?lang=de

FOEN. (2012a, 03/08/2012). Anhörung zur CO2-Verordnung abgelaufen Retrieved 06/08/2012, from http://www.news.admin.ch/message/index.html?lang=de&msg-id=45520

FOEN. (2012b). Emissionen nach CO2-Gesetz und Kyotoprotokoll. Bern: Federal Office for the Environment (BAFU).

FOEN. (2012c). Faktenblatt: Entscheidungsdiagramm zu rechtlicher Grundlage für fossil-thermische Kraftwerke und Wärme-Kraftkopplungs-Anlagen.

FOEN. (2012d). Hintergrundinformationen Emissionshandel - Grundlage: Entwurf zur CO2-Verordnung gemäss Anhörung vom 11. Mai 2012.

FOEN. (2012e, 26/09/2012). Kraftwerk Chavalon: Bund und Betreiberin unterzeichnen Vertrag für CO2-Kompensation Retrieved 9/10/2012, from http://www.news.admin.ch/message/index.html?lang=de&msg-id=46103

FOEN. (2012f). Verordnung über die Reduktion der CO2-Emissionen (CO2-Verordnung) (Draft as of May 11, 2012 ed.). Online: Federal Office for the Environment (BAFU).

FOEN. (2012g). *Verordnung über die Reduktion der CO2-Emissionen (CO2-Verordnung). Erläuternder Bericht zum Anhörungsentwurf vom 11. Mai 2012*. Bern: Federal Office for the Environment (BAFU).

FOEN/SFOE. (2012). Klimaschutzprojekte in der Schweiz. Vollzugsweisung zur Durchführung von Kompensationsmassnahmen. Gemeinsame Mitteilung des BAFU und des BFE als Vollzugsbehörden. Aktualisierte Ausgabe. Stand: Februar 2012. Bern: FOEN/SFOE.

French Embassy in the United States. (2009, 3/12/2009). Where does France stand on greenhouse gas emissions? Facts and rationale Retrieved 19/11/2012, from http://www.ambafrance-us.org/climate/france-and-greenhouse-gas-emissions-facts-and-rationale/

Frost & Sullivan Market Insight. (2002, 12/08/2002). Austria Abandons Green Certificates Scheme Retrieved 21/11/2012, from http://www.frost.com/prod/servlet/market-insight-print.pag?docid=JEVS-5MZJGN

FSO. (2009). Treibhausgasemissionen nach Wirtschaftsakteur: Effizienzgewinne in der Wirtschaft. Neuchâtel: Federal Statistical Office (SFO).

Gallachóir, B. P. Ó., Howley, M., Cunningham, S., & Bazilian, M. (2009). How private car purchasing trends offset efficiency gains and the successful energy policy response. *Energy Policy*, 3790-3802.

Ganz, J., Weiler, W., & Stahl, S. (2012). GuD- versus WKK-Strategie. Ersatz von Öl- und Gasheizungen durch effizientere Technologien. *Study commissioned by BKW FMB Energie AG*. Zurich: awtec AG.

Germany Trade & Invest. (2012). Branchenbarometer Westeuropa: Automobilindustrie. Berlin: GTAI.

Giraudet, L.-G., Bodineau, L., Finon, D. (2011). The costs and benefits of white certificates schemes. *Energy Efficiency, 2012*(5), 179-199.

GLS Brokers LTD. (2011). The Italian Green Certificates regime and its future perspectives.

Gouvernement de la République Française. (2012). Le plan de soutien à la filière automobile. *Portail du Gouvernement*. Retrieved from http://www.gouvernement.fr/gouvernement/le-plan-de-soutien-a-la-filiere-automobile

Griskevicius, V., Tybur, J. M., & Van den Bergh, B. (2010). Going Green to Be Seen: Status, Reputation, and Conspicuous Conservation. *Journal of Personality and Social Pyschology, 98*(3), 392-404. doi: 10.1037/a0017346

Gutberlet, K.-L. (2012, 8/06/2012). Einstieg in die Energieeffizienzwirtschaft: "Was fehlt, sind marktwirtschaftliche Anreize". *VDI Nachrichten* Retrieved 6/12/2012, from http://www.vdi-nachrichten.com/artikel/Einstieg-in-die-Energie-effizienz-wirtschaft-Was-fehlt-sind-marktwirtschaft-liche-Anreize/59090/1

Handgraaf, M. J. J., Van Lidth de Jeude, M., & Appelt, K. C. (2012). Public praise versus private pay: Effects of feedback and rewards on energy conservation in the workplace. *Ecological Economics*, In Press.

Harland, P., Staats, H., & Wilke, H. A. M. (1999). Explaining proenvironmental intention and behavior by personal norms and the theory of planned behavior. *Journal of Applied Social Psychology, 29*(12), 2505-2528.

Harmelink, M. (2007). White Certificates Schemes in Europe: ECOFYS.

Henger, R., & Voigtländer, M. (2012). Energetische Modernisierung des Gebäudebestands - Herausforderungen für private Eigentümer. Köln: Institut der deutschen Wirtschaft Köln.

IBGE. (2012). Primes Énergie 2012 - Conditions techniques et formulaire (Version of 5/03/2012 ed.). Brussels: Institut Bruxellois pour la Gestion de l'Environnement (IBGE).

IDAE. (2011). Plan de ahorro y eficiencia energética 2011-2020 *2a plan de acción nacional de eficiencia energética en España 2011-2020*. Madrid: Instituto para la Diversificación y Ahorro de la Energía (IDAE).

IDAE. (2012a). Plan Renove 2011 para el Equipamiento Doméstico. Retrieved 9/07/2012 http://www.idae.es/index.php/mod.pags/mem.est/p.planrenove2011

IDAE. (2012b). Plan Renove de Electrodomésticos. Retrieved 9/07/2012 http://www.idae.es/index.php/idpag.58/relcategoria.1161/relmenu.68/mod.pags/mem.detalle

IEA. (2008). Worldwide Trends in Energy Use and Efficiency: Key Insights from IEA Indicator Analysis. Paris: OECD/IEA.

IEA. (2012a). Energy Policies of IEA Countries - Switzerland, 2012 Review. Paris: OECD/IEA.

IEA. (2012b). IEA's Policies and Measures Databases. from International Energy Agency (IEA) Available at http://www.iea.org/textbase/pm/index.html, accessed and information retrieved June/July 2012.

IEA. (2012c). Policies and Measures Databases - Energy Efficiency. Retrieved 11.09.2012, from International Energy Agency http://www.iea.org/textbase/pm/?mode=cc

IEA. (2012c). Improving the Fuel Economy of Road Vehicles. Paris: OECD/IEA.

IETA (Producer). (2012). CarbonExpo 2012 - Full Conference Program Overview. Retrieved from http://www.ieta.org/carbon-expo-2012

Il Ministro dello Sviluppo Economico. (2009). G8 Energy. Signing establishing IPEEC (International Partnership for Energy Efficiency Cooperation). SPEECH: Il Ministro dello Sviluppo Economico.

INE. (2012). Censos de Población y Viviendas 2001. Resultados definitivos., from INE (Instituto Nacional de Estadística) http://www.ine.es/censo/es/listatablas.jsp

Intelligent Energy Europe (Producer). (2012). MURE II - Database on Energy Efficiency Policies and Measures. *Mesures d'Utilisation Rationnelle de l'Energie*. Retrieved from http://www.muredatabase.org/index.htm

IPCC. (2004). 16 Years of Scientific Assessment in Support of the Climate Convention. Intergovernmental Panel on Climate Change Retrieved 5/10/2012, from http://www.ipcc.ch/pdf/10th-anniversary/anniversary-brochure.pdf

IPCC. (2007). IPCC Fourth Assessment Report: Climate Change 2007 (AR4). Working Group III Report "Mitigation of Climate Change". In O. R. D. B. Metz, P.R. Bosch, R. Dave, L.A. Meyer (eds) (Ed.). Cambridge, United Kingdom and New York, NY, USA.

IPEEC. (2012), from http://www.ipeec.org/

Jansohn, P. H., Stefan; Mazzotti, Marco; Neville, Andrew; Plüss, Christian. (not dated). Fossil-thermische Stromproduktion. Online: proclimweb.scnat.ch.

Kahneman, D., Knetsch, J. L., & Thaler, R. H. (1991). Anomalies - the Endowment Effect, Loss Aversion, and Status-Quo Bias. *Journal of Economic Perspectives, 5*(1), 193-206.

KfW Bankengruppe. (2012a). Energieeffizient Sanieren - Investitionszuschuss. Frankfurt: KfW.

KfW Bankengruppe. (2012b). Energieeffizient Sanieren - Kredit. Frankfurt: KfW.

KfW Bankengruppe. (2012c). Erneuerbare Energien "Standard". Frankfurt: KfW.

Klinckenberg, F. P., Linda; Kramps, Robert; Siderius, Hans-Paul;. (2002). Taking It EASY in the Netherlands: Refocusing Energy Efficiency Policy for Domestic AppliancesTeaming for Efficiency. Proceedings. Washington, D.C.: ACEEE. Retrieved from http://eec.ucdavis.edu/ACEEE/2002/pdfs/panel06/15_131.pdf.

Le Gouvernement du Grand-Duché de Luxembourg - Ministère de l'Économie et du Commerce extérieur. (2011). Second National Energy Efficiency Action Plan For Luxembourg under the EU Directive on energy end-use efficiency and energy services (2006/32/EC). Luxembourg.

Le Gouvernement du Grand-Duché de Luxembourg (Producer). (2012, 12/10/2012). Bonus CAR-e. *Ministère du Développment durable et des Infrastructures*. Retrieved from http://www.car-e.lu/prime-car-e.html

Manser, J., Schubert, R., & Ohndorf, M. (2012). Conceptual Analysis of Emission Reduction Activities Applicable in Private Households. Zurich: Off4Firms.

Mieterverband. (2012). Paritätische Lebensdauertabelle MV / HEV Schweiz Retrieved 21/11/2012, from http://www.mieterverband.ch/smv_lebensdauertab.0.html

Ministère de l'Écologie, d. D. d., des Transport et du Logement,. (not dated). Politiques climat ed efficacité énergétique. Synthèse des engagements et résultats de la France. La Défence: Ministère de l'Écologie, du Développement durable, des Transport et du Logement.

Ministère du redressement productif (Producer). (2012). www.industrie.gouv.fr. *Secteurs industriels - Automobile*. Retrieved from http://www.industrie.gouv.fr/enjeux/auto/auto.php

MURE. (2012). MUREII Database on energy efficiency measures and policies: ISIS [Institute of Studies for the Integration of Systems, Rome], Fraunhofer Institute for Systems and Innovation Research ISI (Germany), et al.

Neue Zürcher Zeitung. (2012). Gaskraftwerks-Vertrag heizt Debatte an. from NZZ http://www.nzz.ch/aktuell/schweiz/chavalon-muss-grossen-teil-des-co2-im-inland-kompensieren-1.17642562

Nexant. (2002). Model ESCO Performance Contracts - Sri Lanka *Prepared for: USAID-SARI/Energy Program, www.sari-energy.org*.

NFEP&WM. (2012). National Fund for Environmental Protection and Water Management Retrieved 13/10/2012, from http://www.nfosigw.gov.pl/en/priority-programmes/offer-for-an-individual-investor

Nolan, J. M., Schultz, P. W., Cialdini, R. B., Goldstein, N. J., & Griskevicius, V. (2008). Normative social influence is underdetected. *Pers. Soc. Psychol. Bull., 34*, 913-923.

ODYSSEE. (2011). Energy Efficiency Profile: Poland: Odyssee Energy Efficiency Indicators in Europe.

ODYSSEE. (2012). Odyssee - Energy Efficiency Indicators in Europe. Energy efficiency trends for the households in the EU-27. Retrieved 5/10/2012 Available at: http://www.odyssee-indicators.org/reports/ee_households.php

ODYSSEE. (not dated). Energy Efficiency Policies in the Household Sector: ODYSSEE.

OECD. (2011). Climate-change policy in the United Kingdom *OECD Economic Surveys: United Kingdom 2011*. Paris: OECD.

OECD. (2012). OECD Environmental Performance Reviews: Germany 2012: OECD Publishing.

Pavan, M. (2011). Tradable white certificates: experiences and perspectives. *Energy Efficiency, 2012*(5), 83-85.

Point Carbon. (2012). Switzerland sees EU ETS link in 2014. http://www.pointcarbon.com/news/1.1861881

Ragwitz, M., Winkler, J., Klessmann, C., Gephart, M., & Resch, G. (2012). Recent developments of feed-in systems in the EU - A research paper for the International Feed-In Cooperation. Berlin: Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit.

REEEP (Producer). (2007, 28/06/2012). Emerging market for Green Certificates. Presentation at the CSD15 in New York. Retrieved from http://www.un.org/esa/sustdev/csd/csd15/lc/reep_emgc.pdf

Regeringskansliet - Government Offices of Sweden. (2012). Renewable Energy. Retrieved from http://www.government.se/sb/d/16022/a/190026

REN21. (2012). Renewables 2012 - Global Status Report. Paris: REN21 Secretariat.

Rhiienergie. (2012). Förderprogramm 2012 Retrieved 24/07/2012, from http://www.rhiienergie.ch/Foerderprogramm.101.0.html

Ritov, I., & Baron, J. (1990). Reluctance to vaccinate: Omission bias and ambiguity. *J. Behav. Decis. Making, 3*, 263-277. doi: 10.1002/bdm.3960030404

Schwartz, S. H. (1977). Normative influences on altruism. *Advances in experimental social psychology, 10*, 221-279.

SFOE. (2008). Aktionsplan "Erneuerbare Energien". Faktenblatt 6. Bern: Swiss Federal Office of Energy (BfE).

SFOE. (2010). Faktenblatt zu elektrisch angetriebenen Personenwagen. Bern: Swiss Federal Office of Energy (BfE).

SFOE. (2011). E-Mobiltät aus Sicht des Bundes. Switzerland: Swiss Federal Office of Energy (BfE).

SFOE. (2012a, 8/02/2012). Aktionspläne 2008 für Energieeffizienz und erneuerbare Energien Retrieved 5/10/2012, from http://www.bfe.admin.ch/themen/00526/02577/index.html?lang=de

SFOE. (2012b, 8/2/2012). Energiepolitik Retrieved 5/10/2012, from http://www.bfe.admin.ch/themen/00526/index.html?lang=de

SFOE. (2012c, 02/05/2012). Energiestrategie 2050, from http://www.bfe.admin.ch/themen/00526/00527/index.html?lang=de

SFOE. (2012d, 28/09/2012). Energiestrategie 2050 und ökologische Steuerreform - Bundesrat eröffnet Vernehmlassung zur Energiestrategie 2050 Retrieved 1/10/2012, from http://www.bfe.admin.ch/energie/00588/00589/00644/index.html?lang=de&msg-id=46133

SFOE. (2012e). Fragen und Antworten zum Energiepaket 2050. Faktenblatt 2. Online: SFOE.

SFOE. (2012f). Kantonale Motorfahrzeugsteuern: Rabatte für energieeffiziente Fahrzeuge. Bern, Switzerland: Swiss Federal Office of Energy (BfE).

SGSW (Producer). (2012). Förderprogramme. *Sankt Galler Stadtwerke (SGSW)*. Retrieved from http://www.sgsw.ch/home/Mobilitaet/Elektromobilitaet/Foerderprogramm.html

Squire Sanders. (2011). Overview of European tariffs for electricity generated from solar energy. Frankfurt: Squire Sanders.

Stadt Zug. (2012). Energie-Förderprogramm 2012 Retrieved 27/11/2012, from http://www.stadtzug.ch/dl.php/de/0dy3z-uzya4y/Flyer-FP_2012a.pdf

Stadt Zürich. (2010). Mobilitätsstrategie der Stadt Zürich - Teilstrategie Elektromobilität. Zürich: Stadt Zürich.

Statistics Denmark (Producer). (2012). Cars - Hovedtal. *Statistics Denmark*. Retrieved from http://www.dst.dk/en/Statistik/emner/biler.aspx

Statistics Portugal. (2012). Censos 2011 - Resultados definitivos Retrieved 28/11/2012, from http://www.ine.pt/scripts/flex_definitivos/Main.html

Statistik Stadt Zürich. (2012). Statistisches Jahrbuch der Stadt Zürich 2012. Volkszählung. Zürich: Statistik Stadt Zürich.

Statnett. (2012, 8/02/2012). The first of several hundred million green certificates issued Retrieved 23/11/2012, from http://www.statnett.no/en/News/News-archive-Temp/News-archive-2012/The-first-of-several-hundred-million-green-certificates-issued/

Swedish Energy Agency. (2011). The Electricity Certificate System 2011. Eskilstuna: Swedish Energy Agency.

Swiss Confederation. (1999). Bundesgesetz über die Reduktion der CO2-Emissionen (CO2-Gesetz). In Swiss Confederation (Ed.), *641.71*. Bern: Swiss Confederation (Schweizerische Eidgenossenschaft).

Swiss Confederation. (2011). Bundesgesetz über die Reduktion der CO2-Emissionen (CO2-Gesetz). In Swiss Confederation (Ed.). Bern: Swiss Confederation (Schweizerische Eidgenossenschaft).

Swiss Confederation. (2012a). Energiegesetz (EnG) *730.0*. Bern: Swiss Confederation (Schweizerische Eidgenossenschaft).

Swiss Confederation. (2012b). Erläuternder Bericht zur Energiestrategie 2050 (Vernehmlassungsvorlage) *12.xxx*. Bern: Swiss Confederation (Schweizerische Eidgenossenschaft).

Swiss Statistics. (2012a). Bericht über die Nachhaltige Entwicklung 2012. Neuchâtel: Swiss Statistics.

Swiss Statistics (Producer). (2012b). Verkehrinfrastruktur und Fahrzeuge. *Statistik Schweiz*. Retrieved from http://www.bfs.admin.ch/bfs/portal/de/index/themen/11/03.html

Swissolar. (2012). Förderung - Förderbeiträge an private Investoren für Solaranlagen. *www.swissolar.ch*. Retrieved from http://www.swissolar.ch/fileadmin/files/swissolar/f%C3%B6rderung/Infodossier_Foerderung_PV.pdf

TEP Energy. (2010). Energetische Gebäudeerneuerungen – Wirtschaftlichkeit und CO2-Vermeidungskosten. Eine Auswertung des Gebäudeprogramms der Stiftung Klimarappen. Schlussbericht (pp. 215). Zurich: TEP Energy.

The Regulatory Assistance Project. (2010). A Comparison of Energy Efficiency Programmes for Existing Homes in Eleven Countries. London: Department of Energy and Climate Change, UK.

The Swiss Federal Council. (2012a). Energieverordnung (Stand 1. März 2012). Bern: The Swiss Federal Council (Der Schweizerische Bundesrat).

The Swiss Federal Council. (2012b). Erste Massnahmen Energiestrategie 2050. Faktenblatt 1. Bern: Swiss Federal Office of Energy (BfE).

Topten International Group (Producer). (2012, 5/09/2012). Retrieved from http://www.topten.ch/deutsch/foerderprogramme.html

Tuchschmid, M. (2011). Umweltfahrplan SBB. Zürich.

UN News Center. (2011). Canada's withdrawal from Kyoto Protocol regrettable – UN climate official. Retrieved 28/09/2012, from UN News Center http://www.un.org/apps/news/story.asp?NewsID=40714&Cr=climate+change&Cr1

UNEP Risoe. (2012). JI Pipeline. Retrieved 20/09/2012 Available at: http://www.cdmpipeline.org/

UnserStrom (Producer). (2012, 24/07/2012). Retrieved from http://www.unserstrom.ch/massnahmen/foerderbeitraege/foerderprogramme-ewb-oekofonds

US Commerical Service - Global Automotive Team. (2010). Electric Vehicles - Europe in Brief. Washington, DC: US Department of Commerce.

Volksblatt. (2012, 20/4/2012). Gaskraftwerk in Chavalon VS könnte im Jahr 2018 in Betrieb gehen Retrieved 8/10/2012, from http://www.volksblatt.li/nachricht.aspx?id=150101&src=sda

Wirth, H. (2012). Aktuelle Fakten zur Photovoltaik in Deutschland. Freiburg: Fraunhofer-Institut für Solare Energiesysteme.

WWF Schweiz. (2011). Fact Sheet Elektromobilität. Zürich: WWF.

WWF/Ecofys. (2011a). France *EU Climate Policy Tracker 2011*. Brussels: WWF (World Wide Fund for Nature).

WWF/Ecofys. (2011b). Italy *EU Climate Policy Tracker 2011*. Brussels: WWF (World Wide Fund for Nature).

Zeelenberg, M., van den Bos, K., van Dijk, E., & Pieters, R. (2002). The inaction effect in the psychology of regret. *Journal of Personality and Social Psychology, 82*(3), 314-327. doi: 10.1037/0022-3514.82.3.314

Annex

Table 7 – Overview of important elements of the existing energy saving obligation schemes in Europe (ADEME, 2012a; P. Bertoldi, Rezessy, S., 2009; Giraudet, 2011; IEA, 2012c).

	Great Britain	Italy	France	Denmark	Flanders region
Obligation period	2002-2005 (EEC-1) 2005-2008 (EEC-2) 2008-2012 (CERT)	2005-2012	2006-2009 2010-2013	2006-2013	2002 (amended 2003, 2007, 2008), still in force
Obligated parties	Electricity and gas suppliers with at least 50'000 domestic customers	Electricity and gas distributors (grid companies) with at least 50'000 customers two years previously	Suppliers with sales above 400 GWh/y for electricity, gas and heating/cooling, above 100 GWh/y for LPG, and no threshold for heating oil	All electricity and gas distributors (grid companies)	Electricity grid managers
Eligible Sectors	Residential	All end-use sectors plus small PV systems, new DH, small-scale CHP and some measures concerning intermediate natural gas users	All end-use sectors except ETS	All except transport (but internal company transport allowed)	Residential, service sector, non-energy intensive industry
Target size	185 $MtCO_2$ lifetime savings in 2012	Cumulative savings of at least 22.4 mtoe in 2012	54 TWh lifetime discounted in 2009 345 TWh cumac until 2013	2.95 PJ annual (first year savings)	Approx. 580 GWh (2008 target)
Trading mechanism	Trading of obligations among suppliers	Spot market and Over-the-counter trading	Over-the-counter trading	No trading	No trading

Table 8 – Overview of subsidy programmes for household appliances in the EU.[55]					
Country	***Subsidized appliances***	***Minimum criterion***	***Subsidies***	***Operating time***	***Budget***
Belgium (Brussels-Capital Region)	Refrigerators, freezers	Energy class A++/A+++	fixed value subsidy of EUR 50, 100, or 200 (depending on the income of the household, and not surpassing 50% of the purchase price)	Since 2003 [on-going]	n.a.
Belgium (Brussels-Capital Region)	Dryers	Energy class A	fixed value subsidy of EUR 50, 100, or 200 (depending on the income of the household, and not surpassing 50% of the purchase price)	Since 2003 [on-going]	n.a.
Cyprus	CFL bulbs	CFL bulbs	Distribution of six CFL bulbs per household for (nearly) free, 2m lamps in total	5 years	EUR 3.5m
Denmark	Electricity saving sockets, "standby-killers"	Not applicable	Hand out the standby-killers for free upon the purchase of a TV or a computer	2007-2008	EUR 1.2m
Greece	Air conditioning	Energy class high	35% (max. 500 EUR)	July - August 2009	EUR 46.9m
Hungary	Refrigerators, washing machines	Energy class A, A+ or A++	HUF 5000 (approx. EUR 20) deduction from the retail purchase price	2006-2008	n.a.
Hungary[56]	Washing machines, refrigerators	Energy class A, A+ or A++	For A: maximum gross subsidy of HUF 60,000 (approx. EUR 240); for A+, A++: HUF 70,000 (approx. EUR 280)	2009	HUF 1bn
Italy	Full kitchen renovations	Energy class A	Up to EUR 1000 (max. 10% of total cost)	Since March 2010	EUR 110m
Italy	White appliances	Energy class A	Up to 20% of the cost to replace dishwashers (up to EUR 130), electric furnaces (up to EUR 80) and hot water equipment (up to EUR 400)	Since March 2010	EUR 110m
Italy	Refrigerators, freezers, boilers, lighting systems	Energy class A+ or higher	tax incentives of up to EUR 200 for any A+ refrigerator and freezer and of up to EUR 30,000 for replacing existing boilers with condensing boilers	2007-2010	EUR 3m
Luxemburg	Refrigerators	Energy class A++	Payment of grants/subsidies	2008-2011	n.a.

[55] "n.a." meaning that the specific information was not readily available/could not be found.

[56] Only for socially disadvantaged people. Within this initiative, this includes elderly people, large families, disabled people, and registered unemployed persons.

Malta	Refrigerators, freezers, washing machines, dishwashers, dryers, air conditioners	Energy class A	Max. 20% of the purchase price and up to EUR 116 (refrigerators, freezers) and EUR 58 (all other appliances)	2006-2008	n.a.
Netherlands	Appliances	Energy class A	Tax rebates (usually a fixed sum of EUR 50)	2001-2002	n.a.
Portugal	Large electric appliances (white goods)[57]	Energy class A+ or higher	EUR 50 bonus for the replacement with an A+ appliance and EUR 100 for an A++ appliance	Since 2008	EUR 30m per year
Slovenia	CFL bulbs	Not applicable	Subsidize purchase of CFL bulbs	Since 1998	n.a.
Spain	Fridges, freezers, washing machines, dish washers, ovens, induction & gas worktops	Energy class A or higher	From EUR 50 to EUR 125 in 2011[58]	2006-2010; 2011-2020	EUR 250m; EUR 500m
Switzerland (Bern)[59]	Coffee machines, refrigerators	n.a.	n.a.	Since 2006	10% of the annual profit of EWB
Switzerland (Zurich canton)[60]	Refrigerators, freezers	Energy class A+++	Max. 25% of the purchase price and up to CHF 400	Several short programmes [on-going]	CHF 3m per year[61]
Switzerland (Zurich city)[62]	Coffee machines, refrigerators, e-scooters	Energy class A++ or higher	Max. 25% and up to CHF 100 (coffee machine), CHF 400 (refrigerator); max. 10% and up to CHF 1,000 (e-scooter)	1997-2011 [on-going]	CHF 6m[63]
Switzerland (local programme)[64]	Coffee machines, refrigerators, freezers	Energy class A++ or higher	Max. 25% of the purchase price and up to CHF 100 (coffee machine), CHF 150 (fridge, freezer, A++), CHF 250 (fridge, freezer, A+++).	2012 [on-going]	n.a.

[57] Subsidies are provided for the substitution of a maximum of one million appliances
[58] Subsidies depend on the Autonomous Community of Spain where the subsidy is claimed
[59] Implemented by publicly owned utility company EWB
[60] Implemented by publicly owned utility company EKZ
[61] Annual fund for all consulting services, subsidies, and discounts offered to EKZ's electricity customers (households, companies, and public sector) with the aim of saving end-use electricity
[62] Implemented by publicly owned utility company EWZ
[63] Spent exclusively for subsidies of appliances
[64] Implemented by public/privately-owned energy provider Rhiienergie near Chur/GR

Switzerland (Zug city)[65]	Washing machines, refrigerators, freezers	A+++	CHF 250 (lump sum per appliance)	2012 [on-going]	n.a.
Switzerland (Meggen)	Coffee machines, refrigerators, freezers, washing machines	Coffee machines: topten.ch label; refrigerators, freezers: A++; washing machines: A+	25% of the price or max. CHF 100 (coffee machines), max. CHF 200 (refrigerators, freezers), max. CHF 300 (washing machines)	Since 2010 [on-going]	CHF 1.5m
Switzerland (Erstfeld)	Coffee machines, refrigerators, freezers, dish washers, washing machines	Coffee machines: automatic switch-off required; refrigerators, freezers: A++; dish washers: A; washing machines: A+	CHF 100 (coffee machines), CHF 200 (refrigerators & freezers), CHF 200 (dish washers), CHF 200 (washing machines)	Since 2010 [on-going]	n.a.
United Kingdom	Refrigerators	n.a.	Appliance worth GBP 120 offered for only GBP 25[66]	Since 2008	n.a.
United Kingdom	CFL bulbs	Not applicable	CFL light bulbs for a special price or for free	2008-2011	n.a.
Sources: (Amt für Energie und Umwelt. Basel-Stadt, 2012), (Boardman, 2007), (DEFRA, 2009), (DEFRA, 2012), (EKZ, 2012a), (EKZ, 2012b), (EuroACE, 2009), (European Commission, 2008a), (EWZ, 2010), (EWZ, 2012), (IBGE, 2012), (IDAE, 2012a), (IDAE, 2012b), (IEA, 2012c), (Klinckenberg, 2002), (Le Gouvernement du Grand-Duché de Luxembourg - Ministère de l'Économie et du Commerce extérieur, 2011), (MURE, 2012), (ODYSSEE, not dated), (Rhiienergie, 2012), (Stadt Zug, 2012), (Topten International Group, 2012)					

[65] "Energie-Förderprogramm" (Energy Promotion Programme) of city of Zug
[66] Targeted at low income households

Off4Firms

Chair of Economics
Institute for Environmental Decisions (IED)
ETH Zurich
Weinbergstrasse 35
8092 Zurich, Switzerland

http://www.off4firms.com