From energy efficiency to carbon conservation

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1. SYNOPSIS

Domestic electricity consumption is rising too fast to achieve Kyoto compliance with foreseeable energy efficiency policies. A broader, carbon focus is needed.

2. ABSTRACT

Energy efficiency programmes cover an increasing share of domestic energy consumption in Europe, but still demand keeps rising. The paper provides an overview of existing trends and the likely impact of known policies. These are compared to Kyoto commitments and sustainability targets, to highlight the shortfall between where we are going and where we need to be.

The solution may lie in moving to a carbon market, with information for consumers, targets for energy companies, and a range of other policy initiatives designed to support a focus on carbon emissions. This would combine the effects of greater end-use efficiency with more efficient supply. A carbon reference scale also incorporates the benefits of renewable energy and low-carbon supply options, at both the household (solar thermal) and the national level (wind farms).

The wider effects on consumers and their perceptions are discussed, to explore the benefits of moving to a carbon economy in support of climate change policies. The proposed approach could extend to personal decision-making on private travel, leading to individual household commitments.

3. EUROPEAN ENERGY TRENDS

Both 1990 and 1997 had similar climatic conditions, across Europe, with similar numbers of degree days (Table 1). However, between these two years, total energy consumption increased by nearly 11%, with the tertiary-domestic sector contributing half of the increase in final energy demand and much of the rest coming from transport. Energy consumption, solely within the domestic sector, increased by 9% from 1990 to 1997, which was a slower rate of increase than the 14% growth in the commercial and public services (EC 2000, p51). Within the domestic sector, across Europe, electricity provides about a quarter of all the energy purchased. Total domestic electricity use has been growing faster than all domestic energy and in 1997 was 17% higher than in 1990.

Table 1. Indices of domestic energy use in Europe

	1990	1995	1996	1997
Total energy	100	106	115	111
Total domestic electricity	100	112	118	117
Domestic and tertiary energy per capita	100	104	112	107
Degree days	100	103	116	102

Note: degree days indicate the need for heating: colder years have more degree days

Source: EC 2000, p51

New household formation is an important driver of additional energy demand, but when energy is reduced to a per capita basis (Table 1), there is still a growth. We are demanding a higher standard of living. The extra demand results from both higher incomes and new appliances, as this is not offset by improved energy efficiency in the major existing appliance stocks (ibid, p52).

The use of electricity in lights and appliances has been subject to considerable political activity and almost all uses are now covered by market transformation initiatives, such as labels, minimum standards, voluntary agreements (Table 2).

Table 2. Summary of European policy instruments affecting domestic lights and appliances

Sector	Sub-sectors covered	Instrument	Direc-tive	Minimum efficiency level/ maximum power demand	In force†
Multiple		Framework legislation for energy labels	92/75		1.1.1994
		1st label	94/2		1.1.1995
		2nd label*	-		2002
		1st minimum standard	96/57	C except for chest freezers where it is E	3.9.1999
		2nd minimum standard*	-	Possibly additional 20% over 1992 baseline	2003
Wet	Washing machines	1st label	95/12		1.10.1996
		2nd label*	-		2002
		Industry agreement	-	D (with minor exceptions) C	1.1.1998 1.1.2000
		Industry agreement*	-	5% reduction from 1.04kWh per wash-load (1996 baseline)	2001
	Tumble dryers	Label	95/13		1.10.1996
	Washer-dryers	Label	96/60		1.1.1998
	Dishwasher	1st label	97/17		1.8.1999
		2nd label*	-		2004
		Industry agreement *	-	≥ 10 place settings: D; < 10 place settings: E ≥ 10 place settings: C; < 10 place settings: D	1.1.2001 1.1.2005
Consumer elec-tronics	TV and VCR	Industry agreement	-	Standby: max cons. 10W; fleet average 6W Standby: fleet average 3W	1.1.2000 1.1.2009
	Audio	Industry agreement*	-	Standby: 5W Standby: 3W Standby: 1W	1.1.2001 1.1.2004 1.1.2007
	Digital receiver decoders	Industry agreement*	-	Standby: 9W for stand-alone, 10W for integrated digital receiver decoder Standby: new targets to be defined in 2003	1.1.2003 2005
	External power suppliers	Industry agreement *	-	No-load: ≥ 0.3W and < 75W: 1W No-load: ≥ 0.3W and < 75W: 0.5 W No-load: 0.3-0.75 depending on power output	1.1.2001 1.1.2003 1.1.2005
Lighting	Lamps	Label	98/11		1.1.2001
	Fluorescent ballasts	Minimum standard		C B2 A3 or B1 depending on the market situation	1.1.2002 1.1.2005 1.1.2008
Cooking	Ovens	Label*	-	Electricity only – final early 2001? Gas – no test procedure	2001 or later

Sector	Sub-sectors covered	Instrument	Direc-tive	Minimum efficiency level/ maximum power demand	In force†
Water heating	Boilers	Minimum standard	92/42	eliminated the least efficient boilers on the market. Label being considered	1.1.1998
	Electric storage heaters	Label*	-	Finalised early 2001?	2001 or later
		Industry agreement *			2000-2002
Air cond-itioners		Label		Finalised early 2001?	

† In force indicates the date on which the provisions should be in force in the member states, e.g. the date from which energy labels should be on the appliances in the shops.

* = under negotiation or development; provisional details given where available

Source: Fawcett *et al.* 2000 and updated

Obviously, demand for electricity in the domestic sector could have been considerably higher, in the absence of these policies from the European Commission and Member States. However, domestic electricity consumption across the EU is still rising and is expected to continue to do so, at least until 2010 (Table 3). By then, demand is expected to be 22% above the 1990 level. There are substantial energy savings and carbon reductions to be made through the introduction of more efficient lights, appliances and home-office equipment, reducing electricity consumption by 156 TWh, below what it would otherwise have been in 2010. This would only bring demand to 4% below the 1990 level. Therefore, the substantial anticipated growth in domestic electricity use by 2010 (particularly in consumer electronics and home-office equipment) cannot be offset sufficiently by the proposed policies to meet the Kyoto target in this sector: a further 23TWh would need to be saved by 2010.

Table 3. EU domestic electricity use and potential savings through improved efficiency (TWh)

	Consumption 1990	Consumption 1995	Consumption 2010 BaU/ 2010 policy scenario	Savings 1990/2010 policy scenario	Savings 2010 BaU vs 2010 policy scenario
Refrigerators and freezers	123.6	118.4	96.2/80.7	42.9	15.5
Washing machines	40.0	33.4	23.7/17.1	22.9	6.6
Dishwashers	12.8	14.1	17.6/15.6	-2.8	2.0
Dryers	8.2	10.6	14/11.4	-3.2	2.6
Lighting	80	89	112/84	-4.0	27.4
Consumer electronics: stand-by	15	20	26/4	11	22
Consumer electronics: on mode	15	25	50/40	-25	10
Home-office equipment	2	10	65/32	-29	33
Electric ovens	15.1	16.2	16.5/16.1	-1.0	0.4
Miscellaneous	26.0	29	39/39	-13	0
Electric storage water heater	72	68	68/65.2	6.8	2.8
Room air-conditioners	1.6	2.5	7.5/6.7	-5.1	0.8
Heat pump/domestic electric heating	150	150	150/125	25	25
Central heating circulation pumps	30	32	37/30	0	7
Total	591.3	618.2	722.5/566.8	24.5	155.7

Source: ECCP JSWG 3 paper

The European Climate Change Programme (ECCP) consists of a series of workshops that have collectively assessed the best opportunities for common and co-ordinated policies to ensure that the EU does make realistic attempts to achieve its international obligations. The proposed policies are based on achieving the economic and technical potential (ETP) by 2005. This in itself is ambitious, but has been agreed with industry representatives. The ETP is based on least life-cycle costs, as this gives the greatest saving to the consumer. More efficient appliance targets would be justified if the benefits were based on some other definition, for instance if the benefits to the consumer are equivalent to present levels (no money savings) or were calculated to include a carbon-trading premium. Additional savings are possible, for instance as a result of improved insulation standards in buildings, but these were covered by a different working group.

The effect of these policies would be to reduce average annual EU household electricity consumption for lights and appliances (including cooking, but not space and water heating) to 2125 kWh in 2010 and about 1930kWh in 2020.

The main emphasis continues to be on the more efficient use of electricity, partly because this is the more polluting fuel in most of the EU, but also because product-level policy is the easiest to implement. The powerful approach of market transformation strategies, if supported by strong EU commitments, can improve the efficiency of products with certainty and speed. Guaranteed savings are available, but depend on the Commission, Council and Parliament to be more active.

4. CARBON EMISSIONS

If the carbon intensity of electricity is declining, this will magnify the benefits of reduced electricity consumption, perhaps sufficiently to meet the Kyoto objectives even in this sector. The rate of reduction achieved between 1990 and 2000 is being replaced by a slower decline and may be replaced with a higher level of carbon intensity if the rate of renewables growth is insufficient to offset any nuclear phase-out.

In total, carbon emissions across the EU were at the same level in 1990 and 1997, so that the Rio commitment to return emissions to the 1990 level by 2000 could be achieved (Table 4). The obligation under the Kyoto Protocol is that carbon dioxide emissions (and five other greenhouse gases) within the EU are reduced in total by 8% by 2008-12 and this is considerably more challenging. The carbon intensity of energy use has been declining, because of a growth in gas use, both for electricity generation and for heating, whilst oil and solid fuel declined. The contribution of non-fossil fuels to electricity generation has been increasing: mainly nuclear together with some wind energy and biomass. The existing nuclear plants are operating at nearly full capacity and “the potential for new nuclear power is very limited” (EC 2000, p71). The contribution from renewable energy sources is increasing slowly and this is the main method by which future reductions in the carbon intensity of electricity will be achieved. It is clear that complying with the Kyoto Protocol in Europe will depend extensively on reducing energy consumption as well as renewable energy sources to achieve further reductions in carbon emissions.

Table 4. European carbon dioxide emissions

	1990	1995	1996	1997	1998
Carbon dioxide per capita, all energy tCO_2/capita	8.44	8.18	8.38	8.14	
Carbon dioxide per capita, all energy – index	100	97	99	96	97
Total population (m)	364.5	372.1	373.2	374.2	
Total emissions $MtCO_2$	3076	3043	3127	3047	
Total CO_2 – index	100	99	102	99	
Degree days	100	103	116	102	

Note: to convert CO_2 to C divide by 3.7. There are 44 units of weight in CO_2 (12+16+16), but only 12 in C.
Source: EC 2000, pp 51, 76, 77, 219

The recent limited level of improvements in carbon dioxide emissions per capita, from all sources of energy, is given in Table 4. The short-term effect of cold winters also demonstrates the need to compare similar climatic years.

The European Commission has recognised that the EU will fail to meet its international commitment to cut greenhouse gas emissions by a large margin unless it makes "substantial improvements" in climate policy measures (ENDS May 19, 1999). In a communication on implementing the Kyoto Protocol on climate change, the European Commission identifies a gap between "ambitious" EU international negotiating positions and practical actions to achieve its own targets:

> "Ambition...has to be complemented by concrete action and tangible results," it warns. "When assessing the current situation, the conclusions are not very positive".

Without further policy measures, the Commission points out, greenhouse gas emissions are projected to rise by 6% from 1990 levels by 2010. The EU is committed to cut emissions over the same period by 8%, leaving a huge 14% gap to be filled. The savings identified in Table 3, even in carbon terms, probably do not make sufficient contribution, particularly when the transport sector is still expected to grow.

5. TARGET FIGURES

Kyoto is recognised as an interim stage – the next international agreement should be substantially tougher if we are to really limit the threat of climate change. Various sources have defined targets that would represent sustainability – or appropriate progress towards sustainability. Some examples are listed in Table 5. The targets vary according to whether all energy use is divided by the population/ households; whether the number refers to just the energy used in the home, on a pro rata basis, or whether more is expected from the domestic sector to compensate for inadequate change with transport. In all cases, the challenge is formidable.

Table 5. Sustainability targets

Source	Target	Geographical area
IPPC	2% pa reduction compound, all GHG, starting as soon as possible, until 2100	World
GCI	1tC ($3.7tCO_2$) per capita annual emissions from all sources, by 2030. (This represents a 55% reduction for the EU, over 1997 levels.)	World
GCI	0.2tC ($0.73tCO_2$) per capita annual emissions from all sources, by 2100. (This represents a 98% reduction for the EU, over 1997 levels.)	World
ECI	43% reduction of all carbon emissions per household, by 2020, assuming that transport emissions are stabilised	UK
ECI	63% reduction of all carbon emissions per household, by 2020, if transport emissions continue to grow	UK
RCEP	60% reduction all GHG by 2050	UK

Notes: GHG = greenhouse gases

Sources: RCEP (2000); IPPC (1990); GCI (1998); ECI = Fawcett *et al.* (2000)

All these targets demonstrate the need for a much faster rate of reduction for the next round of the climate change targets. Whilst the policy effects given in Table 3 continue to be felt long after 2010 – as the stock is replaced – more and broader action is required.

6. DIFFICULT CHOICES

The scale of the challenges, both in relation to Kyoto and beyond, can be demonstrated by a recent UK study. The Royal Commission on Environmental Pollution is a powerful body and its reports have to be considered carefully by the Government, because it is a *royal* commission. The RCEP has recently recommended that UK carbon dioxide emissions should be reduced by 60% by 2050 (RCEP 2000). This is an important finding from such an august institution. The target can be achieved in a variety of ways and the RCEP has identified four scenarios (Table 6). These are:

Scenario 1: No reductions in demand, the greatest growth in both renewables and nuclear
Scenario 2: Considerable reduction in demand and growth in renewables, no new nuclear
Scenario 3: Similar reduction in demand, some growth in renewables and some new nuclear capacity;
Scenario 4: The greatest reduction in demand, reasonable growth in renewables and no new nuclear capacity.

Table 6. UK scenarios for 2050, aiming at 60% reduction in CO_2

	Scenarios			
	1	2	3	4
DEMAND (%) reductions from 1998				
Low-grade heat*	0	50	50	66
High-grade heat	0	25	25	33
Electricity	0	25	25	33
Transport	0	25	25	47
Total	0	36	36	47
SUPPLY (GW) annual average rate				
Fossil fuels	106	106	106	106
Intermittent renewables**	34	26	16	16
Other renewables	19	19	9	4
Baseload stations (either nuclear or fossil fuel with carbon dioxide recovery)	52	0	19	0

Notes: *only low-grade heat is used in the domestic sector; **intermittent renewables are wind, sun, tidal and wave; non-intermittent renewables are hydro, energy crops and waste.
Source: RCEP (2000) p173, 255

These scenarios identify the type and magnitude of the choices needed in the UK, if we are to achieve substantial reductions in carbon emissions and to head for sustainability. All countries have to decide on the balance between reduced demand, more renewables and increases in nuclear power (or fossil fuel with carbon dioxide recovery), if total carbon dioxide emissions are to be reduced. To reduce demand by 47% over 50 years is a decrease of slightly less than 1% pa, compound, in comparison with no decline over the seven years 1990-97 (Table 4). Europe has to try harder and achieve more.

7. HOUSEHOLD SCENARIOS

To bring together the sustainability targets in Table 6 and the level of action being proposed in Table 3, some indicative scenarios have been explored for UK households (Table 7). These cover just the use of energy in the home, no indirect consumption.

Table 7. Household level carbon dioxide emissions, under different scenarios, UK

		tC pa per household
	Stock average	
A	2000	1.65
B	2020 – sustainability	0.81
C	2100 – sustainability	0.13
	House types	
D	2000 – all electric	2.4
E	2020 – all electric, efficient lights and appliances and renewables	1.1
F	- efficient lights, appliances and gas boiler	0.9
G	- new build and efficient equipment	0.7

The net effect of these proposed changes is that by 2020, for 28 million homes in the UK:

Lights, appliances and cooking use 1500 kWh (down from 3000 kWh in 2000)
2.8m homes have photovoltaics, to produce 1000 kWh of electricity pa
2.8m homes have solar thermal, to reduce electric water heating by 75%
90% of homes are on gas (up from 80% in 2000)
Average boiler is 85% efficient (up from 69% in 2000)
Building 250,000 new homes pa (up from 200,000 pa)
Demolishing 75,000 dwellings pa (up from <10,000 pa)

Average carbon emissions 0.88 tC

Not sustainable, but getting there.

The challenge of getting electricity consumption in lights and appliances (including cooking) down to 1500 kWh pa is considerable – the figures in Table 3 indicate a level of about 1930 kWh across Europe, by 2020. The UK traditionally has a higher level of consumption than the European average. This indicates the scale of the role for the ECCP and for common and co-ordinated policies. A further round of the Boiler Efficiency Directive is also implied. A wide range of other policies are needed to achieve sustainability targets, including the standards of new buildings, subsidies for household level renewables (PV and solar thermal), as well as controversial issues like demolition rates for older properties. In addition to the market transformation approach, there is a need to bring in the energy companies and consumers in a more proactive role.

As the above scenarios demonstrate, there are several options for fuel switching on the demand side. The more intensive and extensive use of gas is important in most EU member states, where this would displace a higher level of pollution from electricity (Boardman 2001). In addition, the choice could be for renewable energy rather than fossil-fuel based consumption. For instance, the switch could be to solar water heaters on the roof. Their adoption may depend upon the value placed on carbon saving – a rebate to replace electric with solar water heating would save more carbon than if the displaced fuel is gas. The installation of photo-voltaics on the roof can produce enough electricity to provide two-thirds of the consumption of domestic appliances. The size of the installation would vary with the geographical location of the house. These household-level renewable energy sources need to be supported through a market transformation approach, just as efficient appliances are being, and by the development of the domestic carbon market.

8. AUCH – AVERAGE UTILITY CARBON PER HOUSEHOLD

Many previous reports, including *Lower Carbon Futures* (Fawcett *et al* 2000; Boardman 2001), have demonstrated that there is plenty of technical potential to make energy and carbon savings. What is needed now are policy instruments that can effectively move the focus from energy efficiency to carbon reduction and incorporate behavioural and institutional attitudes as well.

AUCH is a simple but powerful concept which can help move the policy framework towards carbon savings, by engaging many different actors in the energy service chain. Each energy company has to reduce the amount of carbon produced annually by its average domestic customer. AUCH has other advantages in that it builds upon existing policy mechanisms, and would provide a conceptual (and actual) link between different areas of energy policy. Creating a carbon market via AUCH could be a powerful way of bringing together energy efficiency, renewable energy and fuel switching policies. Focussing on carbon reductions could help governments clarify the links between these sometimes disparate policy areas, and enable considerable carbon savings to be made. However, it would not do away with the need for a comprehensive policy environment in which to operate. One policy tool will not provide all the solutions.

AUCH is a policy which aims to work with the market, and make use of the innovative capacity that exists. To quote from the Northern Ireland Electricity Regulator (Ofreg 1999):

> "The industry must learn to be CO_2 smart. 'CO_2 smartness' should feed into its normal thinking process when it considers new investments, new markets, new products and how these can be enhanced by exploiting a CO_2 reduction opportunity".

AUCH would help to foster this "CO_2 smartness".

Options for carbon saving

In terms of saving carbon from the domestic sector (while supplying the same or greater level of energy services) there are two key strands of policy: increased energy efficiency and reduced carbon intensity of the energy supply. Increased energy efficiency refers to both the building shell and the energy using equipment within the building.

Reducing the carbon intensity of the energy supply can be accomplished by many different means:
- Household level renewable energy (eg solar water heaters)
- Household level switching to lower carbon fuels (eg from electric to gas heating)
- Supply side electricity generation efficiencies
- Reducing electricity transmission and distribution loss
- Combined heat and power energy generation
- Electricity generation switching to lower carbon fuels, including renewables
- Reducing methane emissions from the gas transmission network

One of the interesting implications of AUCH is that the energy companies would have a strong interest in ensuring that appliances become more efficient, as this helps to reduce the annual carbon emissions per household. Discussions on industry agreements in Brussels would no longer be a debate between government and the appropriate trade association. The utilities would be alongside the government representatives trying to persuade the manufacturing industries to be more ambitious in their efficiency targets.

Creating a carbon market via AUCH would be a powerful way of bringing together energy efficiency, renewable energy and fuel switching policies. Focussing on carbon reductions could help governments clarify the links between these sometimes disparate policy areas, and enable considerable carbon savings to be made. But it would be important to make sure that the policy framework included the consumers directly, as well as the energy companies: it would be unrealistic for the energy suppliers to be given a firm target without at the same time having mechanisms to curb the growth in consumer demand.

9. SUPPORTING INITIATIVES

A complementary approach would involve giving individual consumers an allocation, that could be traded: Domestic Tradable Quotas (Fleming 1998). These could, eventually, cover all domestic energy use, including auditing the emissions that come from personal travel (Anable *et al.* 1997). Considerable research is needed to investigate how these would work, whether they would be acceptable to the public and so forth, but the need to constrain consumer demand in the EU indicates that these may need to be policy options.

In previous work (DECADE, 1997) it was demonstrated that the potential exists for electricity savings of almost 12% from UK domestic lights and appliances, by consumers making changes to the way they use their appliances without having to accept reduced service or incurring additional expenditure. However, beyond education campaigns, whose effect is uncertain and long-term, no mechanisms were identified to secure these savings.

At least 10% of savings can be achieved through effective advice, particularly if this involves feedback and reinforcement (Boardman and Darby 2001). In addition, it is now suggested that appliances themselves could provide better information and feedback to consumers. Current appliances give little information on how householders can be eco-friendly, or use their appliances in a less wasteful manner. Appliances that were designed to give more feedback, could themselves help to change behaviour. Some illustrations of this idea are given below:
- New houses could come with (low energy) intelligent metering, that explains where the energy comes from, and how much energy is being used and carbon emitted;

- ‘Informative bills’ which facilitate significant domestic energy savings. Even a 5% reduction in UK domestic energy use would lead to a 1.8MtC reduction (for all household energy, including space heating). It is particularly important for energy bills to include information about the carbon emitted as a result of the household’s consumption;
- Wet appliances could include sensors which tell the consumer by how much loads could be increased, and suitable water and detergent levels for the load. Some appliances are already approaching this level of sophistication;
- Ovens and electric kettles could be fitted with displays that shows the temperature inside, to avoid unnecessary re-heating or over-long warm-up times;
- Appliances on standby could switch off unless the consumer over-rides the automatic switch-off, or, more radically, stand-by settings on all appliances could be abolished.

Energy efficiency improvements can be more easily taken up where the consumer is supplied with a service and does not own the appliance. For instance, Electrolux is piloting a SAVE funded ‘pay as you use’ scheme for white goods using very efficient appliances, which will be replaced more frequently than usual to ensure the consumer always has access to highly efficient appliances. This sort of approach changes the economics of appliance purchase and usage, and may encourage the consumer to pay for a service which is delivered by a technology that more closely matches the ETP or least life cycle cost.

Household size

Energy use would not increase if households stayed larger. If the UK population in 2020 lived in households of 2.6 rather than 2.2 (as expected) people, then domestic electricity use would go down by more than 8%, gas use by more than 7%. Halting and possibly reversing the decline in household size would be a very significant contribution to energy saving. However, the change in household size is based on underlying social trends that are completely outside the realm of energy policy. Indeed, it is unclear that any government policy would be effective in affecting these trends to any significant extent.

Alternatively, if it proves impossible to encourage people to live in larger groups, governments could focus on policy to provide housing which is appropriately sized for these smaller households, particularly for one-person households. For instance in the UK, the average house is $80m^2$ and is occupied by 2.5 people, to give $32m^2$ per person. If, as predicted, the household will only be 2.2 persons by 2020, then perhaps new homes should be only be $70m^2$ ($2.2 \times 32m^2$). More research is needed to determine how large the energy savings from this sort of policy might be and whether they would be acceptable to the public.

Green consumerism

Going beyond the idea of changing peoples’ behaviour through their purchases is that of ‘green consumerism’: getting people to actively purchase products based on their eco-friendliness. Promoting green consumerism puts emphasis on providing suitable information to consumers to enable them to make the appropriate choice. Current market transformation policy approaches effectively expect consumers to behave in this way, by using the energy label to make efficient choices. A greater emphasis on the role of the consumer would tend to lead to policies such as:

- Energy labels on a wider range of appliances;
- Energy labels on electricity to identify what generating sources have been used;
- Labels that encourage energy conservation and downsizing, rather than energy efficiency;
- Promoting green electricity.

However, green consumerism is still a form of consumerism, albeit one where satisfaction comes partly from a reduced environmental impact.

Voluntary simplicity

The most eco-friendly form of behavioural change involves doing without, as a form of self-imposed constraint: “nothing is as efficient as appliances which are not purchased” (Sachs *et al*., 1998). Voluntary simplicity, or down-shifting, does not necessarily mean a reduced quality of life – the people who make these choices do so because they believe it will enhance their lives. Nørgård (1996) suggests that, if "lifestyle efficiency" equals satisfaction/(energy service) consumption, then the efficiency of Western lifestyles is declining to the point where consumption may no longer increase satisfaction at all. For instance, a new appliance could ostensibly increase utility, but the owner may not have enough time to enjoy it, or its use could mean less use of other

appliances. We are still far from any widespread acceptance of the need to reduce personal consumption, much less public willingness to do so. However the debate has started about the difference between quality of life and standard of living: more does not necessarily mean better.

Jorgen Norgard, at a previous ECEEE, declared that the target for a three-person household should be 750kWh electricity consumption pa and that he believed this would be possible with a combination of super-efficient appliances and lower levels of equipment ownership.

Fundamentally this way of thinking may need to become widespread if sustainable energy use (particularly in the longer term) is to be achieved. Appropriate policy on energy use and carbon emissions would only have a small part to play in the social revolution which would be needed to achieve voluntary acceptance of reduced consumption levels.

10. CONCLUSIONS

There are real fears that domestic electricity demand is about to escalate, particularly as a result of growth in consumer electronics and home-office equipment, and perhaps air-conditioning. By 2010, residential EU electricity demand could be 22% above the level of 1990, despite a wide-range of existing policies on labels, minimum standards, voluntary agreements and so forth. Additional policies could be implemented, based on the least life-cycle cost, but these would lower demand to only 4% below 1990 levels. Compliance with Kyoto requires greenhouse gases to be 8% below 1990 levels by 2010. Therefore, even the powerful market transformation approach to energy efficiency is proving insufficient, on its own, to combat the likely growth in consumer demand for domestic electricity use. The hopes and aspirations that many of us had for the contribution that domestic lights and appliances could make to reducing the threat of climate change are being negated by ever-increasing demand and new uses. A policy re-assessment is required that looks, for instance, at more challenging targets than least life-cycle cost.

The public have to be involved, together with other players such as the energy companies and industry, in changing perspectives and choosing a lower carbon future. Attitudes, behaviour, education and information have to be utilised in meeting the challenge and in order to begin to work towards sustainability targets. An annually-decreasing target for each utility, based on the Average Utility Carbon per Household (AUCH), would combine policies on renewables with energy efficiency. But this should be supported by initiatives aimed at the individual householder as well, for instance through putting the carbon content on the energy bill and, eventually, capping householder emissions. The magnitude of the climate change challenge is beginning to be clear.

Perhaps, in recognition of the changing political debate, our conference should change from being ECEEE to ECCEE - a European Council for Carbon Efficient Economies.

11. ACKNOWLEDGEMENTS

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