The Rebound Effect, Sustainable Consumption and Electronic Appliances

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Introduction

Undoubtedly the world is rapidly changing under the growing influence of Information and Communication Technologies (ICTs), but whether for better or worse is the subject of much debate and controversy. Some argue that we will become an information society with the potential to substitute information and knowledge for material products. This process termed dematerialisation would consequently bring a big reduction in energy and material consumption without any cutbacks in economic growth. Others, such as protesters at G8 conferences, argue this change hastens the process of globalisation, and only encourages more transport of materials and people, with consequent increased energy use and environmental destruction.

The UK Labour Government is firmly of the former view, terming it the New Economy, and extolling the benefits of the internet and its economic opportunities - the e-commerce. One UK project examining these impacts and opportunities is the Digital Futures project (Forum for the Future 2001). Another UK exponent of the benefits of ICTs is Stephen Simmons, who believes teleworking has the potential to enhance the quality of life and reduce material consumption dramatically (Simmons 2000).

1. ICT use growing in the UK

It is estimated that in the UK service sector in 1994 IT equipment (computers, printers, fax, and telecoms equipment) consumed about 6% of electricity used in that sector - over two-thirds of this was in offices (Pout et al 1998). In the UK domestic sector in 1998 the DECADE project estimates IT equipment only used about 1% whilst other ICTs, such as TVs and videos, were much more significant, accounting for about 9% of electricity use (Fawcett et al 1998).

Electricity use in TVs is rapidly increasing due to the impact of cable and satellite decoders, which are on standby - that is drawing power even when the TV is swit-
ched off (Siderius 1998). DECADE estimates that decoders currently use about 1% of UK domestic electricity, a figure that will certainly increase as consumers switch from analogue to digital TV.

2. Indirect energy use with ICTs

Only about half of consumers energy use come directly through their purchases of electricity and fuel in the home and fuel for their cars, the other half comes indirectly through the purchase of goods and services (Noorman & Uiterkamp 1998). This indirect energy use, involved mostly in the manufacturing process, is particularly significant for ICTs. Studies estimate that the energy used in a PC for its production is about a factor of 10 higher than the energy consumed during its use (Hilty & Rudy 2000). The energy used in manufacture of appliances is considerable, when taken into account their world wide production in tens or even hundreds of millions. The (primary) energy used in the manufacture of a PC is about 10-12 GJ, and a colour TV 2.8 GJ, this compares to 13 GJ used to manufacture a refrigerator, and 83 GJ a car (Hilty et al 1999).

The internet, fax and phone are also not energy-free communication. The energy consumption per telephone line ranges from 90-144 KWh/year, about half for space heating at the exchanges, and the rest for running the exchange equipment, and operating air conditioning and ventilation systems (Hilty et al 1999). Given that their are tens of millions of lines in each country, the national energy use is significant. The true energy cost is much higher once indirect energy use is taken into account.

3. The energy costs of information and leisure

One important area affected by ICTs is leisure (or recreation) and information which are postulated as central themes in visions of the post-industrial or dematerialised society. A Finnish study of consumer energy use (Heiskanen & Pantzar 1997), taking into account both direct and indirect energy use, found that the ‘transport, information and leisure category’ had the largest energy consumption at 32% of total consumption (for a similar analysis for the Netherlands see Noorman & Uiterkamp 1998). Here energy is required for the production of goods, such as cars and television sets, for their operation, and for the construction and maintenance of infrastructure, such as roads and cables. Finnish time use studies indicate that the average time spent on leisure activities is about 6 hours a day, with watching TV accounting for about a quarter of that time, and reading about 15%. The survey found that these two most time-consuming activities are also the least energy intensive recreational activities (apart from perhaps just talking to family and friends, and some sporting activities such as walking). The most energy intensive recreational activity is anything that involves travel, either by car or long distance transport such as by plane.
Heiskanen & Pantzar (1997) estimate that reading a library book (that is read 100 times) is the least energy-intensive activity consuming only 0.5 MJ. However reading a newspaper or a purchased book consumes far more energy than just watching 3 hours of TV (2 MJ). Going out is very energy intensive because of the travel costs: they estimate a night at the theatre is 180MJ, a day at the race is 220 MJ, and even a game of golf is 216 MJ.

Thus how consumers choose to spend their leisure time is very relevant from an environmental viewpoint. Frequenting the public library could be very virtuous but not if one drives there! Here ICTs can make a big impact due to their ability to deliver information and entertainment to the home, eliminating the need to travel. But as Heiskanen & Pantzar (1997) ask:

will the information super-highway do away with the urge to travel?...Will consumers actually substitute one good for another, or will they want to have it all: the television on, the newspaper on the table, and electronic news pointlessly self-scanning as the consumer of all this information dozes on the couch?

They make the comparison with claims made in the early 1980s about the paperless office, which never happened and actually turned out to be the opposite.

However consumers only have a limited amount of time for consumption activities during the day - there has to be time-budgets. Mikko Jalas (2000) uses the concept of time-use rebound effects to analyse how time saved, such as through use of ICTs, is spent. Like Heiskanen et al (1997), he analyses Finnish household energy data and time use surveys to determine the energy intensity of selected household activities with very similar results. He argues that replacing activities with an above average energy intensity, such as driving or eating in restaurants, will (on average) result in activities with a lower energy intensity (and vice versa). Thus on-line shopping with home delivery will save energy (the time saved by driving to the shop will be spent on a less energy intensive activity) but replacing your DIY car repair by taking your car to a garage will result in increased energy use (as you indulge in more intensive activities). Thus use of the internet, a low energy intensive activity, could reduce overall energy consumption, but only if there is a shift away from other non ICT activities; not if it only replaces time spent watching TV.

4. Rebound effect and ICTs

Despite the continuing dematerialisation of digital electronics - a rapid trend to less power use per appliance - there has not been a reduction in their total energy use. As Lorenz Hilty and his colleagues comment (1999):

This apparent contradiction is a typical example of the rebound effect: the rapid dematerialisation has been compensated for - even definitely overcompensated for - by growth in the demand for computing and communication power.
The concept of the 'rebound effect' is well known and much debated amongst energy economists (Herring 1999). It has been further explored in a recent paper by Mathias Binswanger (2000) who has investigated the effect of substitutability of time for energy. As he remarks:

*Time saving devices usually require more energy as is most evident from transport where an increase in the efficiency of time use (faster modes of transport) tends to be associated with a larger input of energy....the overall effect of time-saving technological progress will be an increase in energy use.*

Hilty & Ruddy (2000) remark that ICTs have three effects: substitution, optimization and induction. The first two can reduce energy use but the induction effect arising from the globalisation of markets and distributed forms of production due to telecommunication networks offsets the other effects by far. Basically ICTs facilitates the world wide division of labour and thus causes far more transport energy use (particularly for long distance freight and tourist travel). A further problem, especially for waste disposal, is the short innovation cycles causing ICTs appliances to be disposed of long before the end of their technical service lives.

5. **Sustainable consumption**

So what can be done to lessened the environmental impacts of ICTs? There have been calls from environmental philosophers for a change in values, to change our lifestyle, towards what may be called 'voluntary simplicity' or 'sufficiency' (Rudin 1999). The desire by environmentalists (and religious teachers throughout the ages) to curb our material appetites has led to an upsurge of interest in the idea of 'sustainable consumption'. Laurie Michaelis, a researcher into the ethics of consumption, believes that we should aim to develop ideals of the good life that can be achieved without excessive material consumption (Michaelis 2000).

However sociologists Eva Heiskanen & Mika Pantzar, while sympathetic to such moral changes, see difficulties. They argue that if anything has been learnt from consumer research on environmental issues, it is that a change in beliefs, attitudes or values does not necessarily lead to lifestyle change. They comment: (1997):

*It is easy to agree that value change is needed, but new values are not swiftly taken up. Values are embedded in culture, both material and social... The dissemination of such ideas, and the setting in place of supporting institutions takes at least a hundred years. Obviously, we cannot wait that long for sustainable consumption.*

Scientists and engineers have instead of value changes emphasised the technical possibilities of a shift to less resource intensive types of consumption. One solution they advocate is the concept of service efficiency which may be defined as providing a maximum of useful end-services to consumers using the minimum of materials and energy use (Heiskanen & Pantzar, 1997). There is an extensive literature on this concept and many attempt to design new types of service-producing machines that
deliver energy services using innovative combinations of market goods and services and household labour (Roy 2000). Once such attempt is that by the Dutch Ministry of Environment in its programme *Sustainability and Quality Lifestyles for the Year 2000* which included such services as rent-a-car programmes, restaurant services, telecommunications and bulk delivery of goods to consumers.

6. **Open University factor 10+ Project**

For ICTs perhaps the most talked about is the internet, with its potential to transform the way information and services (like insurance, education, recreation and entertainment) are delivered to consumers. Research examining the claims of the internet to reduce material consumption was undertaken recently by the *Factor 10 Visions* project at the UK Open University (OU). This examined the potential for up to Factor 10 (90%) reductions in resource consumption and emissions (notably CO2) in higher education which has the potential for significant dematerialisation through distance learning and electronic delivery. Two techniques of distance learning are practised by the OU: one is a mainly print based courses, the other is courses delivered mainly via the internet.

For two similar environmental courses (internet based T171 and print based T172) it was found that the internet based course used (per typical student) about half the (delivered) energy use, and saved about a third of the CO₂ emissions, of the print based course. The main savings for T171 were due to reduced transport use - there being no (required) travel to tutorials and day schools- but this was somewhat offset by greater computer and paper use.

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<tr>
<th>T172 print based</th>
<th>T171 Internet based</th>
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<tr>
<td>Category</td>
<td>Energy MJ</td>
</tr>
<tr>
<td>Transport</td>
<td>672</td>
</tr>
<tr>
<td>Computer Use</td>
<td>51</td>
</tr>
<tr>
<td>Course material</td>
<td>243</td>
</tr>
<tr>
<td>Paper use</td>
<td>15</td>
</tr>
<tr>
<td>Home Lighting</td>
<td>31</td>
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<td><strong>TOTAL</strong></td>
<td><strong>1012</strong></td>
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The paperless office had definitely not arrived for T171 students who often printed out internet based material; however this was more than offset by the savings in not having printed course books. So it appears that the internet-based course did sa-
ve energy and materials, if only less than 0.5% of the total CO₂ emissions of a typical UK adult. However it is the indirect effects of doing the T171 course that may have the bigger impact. For many students the course acted as a catalyst, giving them basic internet literacy. As such, some felt that the course had reduced the amount they travelled - they could now shop or obtain information via the internet, work from home, or communicate with friends using e-mail. For others the same internet literacy had stimulated increased travel, for example by giving access to low cost flights or new contacts. There is also the (unresolved) question of whether doing the course stimulated the purchase or upgrade of computer hardware. The production of a PC, as mentioned earlier, does involve significant energy (5-12 GJ) and material costs, far more than is used during its operation (Hilty et al 1999).

7. Conclusion

Service efficiency in itself is not a panacea for sustainable consumption as the gains are easily offset by an increase in the number and variety of products consumed. Also as researchers into the cultural aspects of consumption have shown, it is necessary to understand how and why we consume. Products often transform the needs and services of consumers. This is why innovations that are meant to be efficient, and to reduce the need for resources, often have the opposite effect.

As F-J Radermacher remarked (quoted in Hilty & Ruddy 2000):

*The trap that we have fallen into again and again over the course of technical progress consists of our always using progress on top of whatever went before (the rebound effect). This effect predicts that market forces and humanity's apparently unlimited capacity for consumption will use new technology to convert more and more resources into more and more activities, functions, services and products.*

What can be done about the rebound effect? There are a variety of methods - financial, regulatory and voluntary - none of which are easy to implement in a 'free trade' world or popular with consumers. EU regulation may help to make appliances more efficient or to lower standby losses, but it cannot curb consumption. The simplest, and perhaps most urgent environmental goal, is to reduce CO₂ emissions. Here the strategy should be to shift away from fossil fuels, particularly coal, towards less carbon intensive fuels, such as gas, and ultimately towards non-fossil fuels, such as renewables and nuclear. In order to encourage this shift we need ecological tax reform and in particular a carbon tax.

However ultimately what is needed, to limit energy consumption, is a policy of energy sufficiency or energy conservation (Herring 2001). We need somehow to de-link economic growth from resource consumption, and to adopt a policy of 'sufficiency' which is *living well on less*. For this low energy future ICTs will be important and necessary but we must be aware that they may induce more material and...
energy throughput. What is needed is a change in lifestyles, a change in our culture, and a vision of new services to reshape that lifestyle.

References

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