‘Something for Nothing’

(or, as your parents taught you: ‘Waste Not, Want Not’)
The Search for a Sustainable Resource Strategy

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1. Introduction

1.1 Some Questions

What value do we put on our resources, possessions and environment? What can we do to make our lifestyle more sustainable? Must an increasing standard of living result in greater damage to our environment? Is the only way to protect our environment to accept a lower standard of living? These are difficult questions which we must strive to answer if we are to find a sustainable resource strategy. We all have a part to play in protecting our environment; minimising the depletion of natural resources; minimising waste; and preventing unavoidable waste from being wasted. And the part each of us can play might make a greater contribution than you think.

1.2 Some Definitions

This presentation focuses mostly on energy, although there are many other aspects to sustainability that are equally important to society. Our goal should be ***sustainability***, not renewable energy *per se*, and sustainability in terms of ***society as a whole***, not simply the environment.

By **sustainable development**, we mean ‘a dynamic process which enables all people to realise their potential and improve their quality of life in ways which simultaneously protect and enhance the Earth’s life support systems.’[1] By **sustainable** or **renewable energy**, we mean ‘energy which is produced from fuels that are renewable in the short term, as opposed to fossil and nuclear fuels, stocks of which are rapidly diminishing and require the passage of millions of years in order to “renew” themselves.’[2]

The Collins Dictionary[3] gives nine different definitions for the noun ‘**waste**’, but for the purpose of this presentation it is ‘anything rejected as useless, worthless, or in excess of what is required’. However, this presentation will consider how we should extend this to include ‘anything unused or not used to full advantage’, for what society often considers useless can, in fact, be a valuable resource.[4]

1.3 Some Qualifications

This is not intended to be an exhaustive treatise on the subject matter; these are jottings to provide the source of information in the presentation and some supplementary ideas which time will prevent from being aired during the presentation.

2. What’s the Problem?

2.1 Some Environmental Issues

Many human activities have been detrimental to the environment. Amongst other things, we have destroyed forests, allowed top soil to be eroded, contaminated waterways, depleted the ozone layer, caused acid rain, and increased the greenhouse effect. This presentation

focuses largely on the increasing greenhouse effect, and power generation which emits more than half the emissions that are causing the damage.

We should be encouraged by the success of the **1987 Montreal Protocol** which addressed substances that deplete the ozone layer and came into force on 1 January 1989 ratified by 29 countries and the EU, representing 82% of the world's consumption. The Protocol was far tougher than anyone had thought possible, and now 165 countries are parties to the Convention of the Protocol, of which well over 100 are developing countries. Perhaps the same will happen with the Kyoto Agreement, which addresses greenhouse gas emissions. But the issues will need to be taken much more seriously than they are at present if this is to be the case.

The 'greenhouse effect' makes the average temperature of the earth's surface more than 30°C higher than it would otherwise be. Without it, life as we know it would not be possible. However, emissions of CO_2 due to human activities since the industrial revolution, largely electricity generation, are causing the temperature of the atmosphere to rise. Atmospheric CO_2 levels are more than 32% higher than in 1850 and is increasing 0.4% per year on average.[5] The Royal Commission on Environmental Pollution states 'there is now broad scientific consensus that the climate is changing as a result of burning fossil fuels.'

The Intergovernmental Panel on Climate Change, a body representing 2,500 of the world's leading scientists from 99 countries, reported in January 2001 that 'greenhouse gases are increasing substantially as a result of man's activities, and this will warm the world's surface with serious consequences for all of us.' Global temperatures rose by around 0.6°C over the 20th century but by 2100 they could be up to 5.8°C above 1990 levels, which will cause a rise in sea levels by up to 0.88 m, the impact of which will be increased flooding, drinking water shortages, failing crop yields, and increased disease levels.[6] Thirty of the world's largest cities lie near coasts; a one-metre rise in the oceans would put an estimated 300 million people directly at risk.[7]

Already, 460 million people live in countries with serious water scarcity, and industrial activity destroys 15 million hectares of tropical rainforest each year and is causing 13 of the world's 15 major oceanic fisheries to decline.[8] Since the mid-eighteenth century, more of nature has been destroyed than in all prior history. In the past half century, the world has lost a quarter of its topsoil and a third of its forest cover. While technology keeps ahead of depletion, providing what appears to be ever-cheaper metals, they only appear cheap, because the stripped rainforest and the mountain of toxic tailings spilling into rivers, the impoverished villages and eroded indigenous cultures – all the consequences they leave in their wake – are not factored into the cost of production.[9]

And in the UK? Around 50% of what little remained of the UK's ancient woodland in 1930 has been destroyed mainly due to the conversion to conifer plantation, as well as clearance for agriculture and development. These are "our rainforests" – irreplaceable links with thousands of years past.'[10]

The UK waste management industry deals with 450 million tonnes of waste a year[11] and has a turnover of £400bn, i.e. 0.5% of GDP[12]. Despite considerable efforts to reduce the production of waste, waste generation in the UK is increasing at the rate of 3% per year and is expected to continue to do. 11% of the waste generated is household and commercial waste (known as municipal solid waste or MSW), 85% of which is dumped in landfill sites.[13] At present, enough waste is landfilled in the UK every nine months to fill a hole the size of Lake Windermere.[14]

'We must learn to acknowledge that creation is full of mystery; we will never clearly understand it. We must abandon arrogance and stand in awe.'[15]

2.2 Some Security Issues

In addition to the environmental concerns, there are issues of national security, energy poverty, and many other social issues. Werner Muller, the German Energy Minister, said on

21 March 2002: 'Europe only remains oversupplied [with fossil fuel] until 2005.'[16] The DTI believes that by 2020, 70% of our electricity will be generated from gas, and our gas import dependency could be as high as 90%.[17]

Not only might there be **political** and **terrorist** threats if we are dependent on primary energy sources from the Middle East, Former Soviet Union and North Africa, but we are also threatened by **natural disasters**. 'All long-distance gas pipelines have to go through earthquake zones.'[18] A disruption to this supply, for example by a terrorist attack or earthquake, could therefore leave us with a national power shortfall of up to 63%. Yet the recent Energy Review concluded: 'Although some actions are needed in the short-term, there is no crisis of energy security for the UK'.[19]

2.3 Some Social Issues

Energy poverty is increasing in the UK, and if environmental protection means that energy costs will rise, we must ensure that the least fortunate in our society do not in fact bear the greatest (proportional) burden. 'A "fuel poor" household is one that cannot afford to keep adequately warm at reasonable cost.'[20] The Government launched its UK Fuel Poverty Strategy on 21 November 2001 which is intended to mitigate the effect of changes in policy which are made for environmental reasons.

2.4 The Needs for Truth

Given a holistic approach, the Royal Commission on Environmental Pollution's proposed target of cutting greenhouse gas emissions by 60% by 2050[21] is technically feasible without harming prosperity, according to a study commissioned by The Carbon Trust and DEFRA.[22] Indeed, Shell estimates that 50% of the world's energy needs could be met by renewables by 2050.[23] But how can this be achieved? It requires new ways of thinking.

Conventional wisdom is mistaken in seeing economic, environmental and social priorities as competing. 'The best solutions are based not on tradeoffs or "balance" between these objectives but on design integration achieving all of them together.'[24] 'In the standard industrial model, the creation of value is portrayed as a linear sequence of extraction, production, and distribution: Raw materials are introduced. (Enter nature, stage left.) Labour uses technologies to transform these resources into products, which are sold to create profits. The wastes from production processes, and soon the products themselves, are somehow disposed of somewhere else. (Exit waste, stage right.) This is not the case in nature.'[25]

We need to exchange the 'cradle-to-grave' mentality for a 'cradle-to-cradle'[26] one. Nothing in nature is exhausted in its first use. When a thing has served an end to the uttermost, it is wholly new for an ulterior service.[27]

We also need to know the whole truth. For example, the huge increase in the use of natural gas for power generation has helped the UK achieve its Kyoto targets because the combustion of natural gas produces about half the CO_2 of burning oil and about a quarter of the CO_2 of burning coal. However, the calculations of Britain's achievements in this respect fail to take into account that natural gas has a 3% leakage rate from production, transportation, distribution and use, which eliminates the advantages of the lower carbon intensity with respect to oil because natural gas is a far more potent greenhouse gas than CO_2.[28]

Another example: Kerbside collection of separated wastes is not recycling; waste is only recycled when a new product has been produced from it which will displace the production of that product from virgin materials. If we 'separate at source' but fail to put an adequate recycling infrastructure in place, the extra truck movements which separate wastes demands simply causes additional pollution and requires additional fuel which itself generates waste as a by-product.

3. Some Technical Solutions

3.1 Sustainable Energy Options

3.1.1 Wind – Onshore and Offshore

Wind turbines convert the almost boundless kinetic energy of the wind into mechanical energy; they are well-proven and being installed around the world at a frenetic rate. 4,500 MW of wind power capacity was added to Europe's electricity grids in 2001, a rise of 35% on 2000, which brings the total to more than 17,000 MW. By the end of 2001, wind power capacity totalled:[29,30]

- 8,754 MW in Germany;
- 3,337 MW in Spain;
- 2,417 MW in Denmark;
- 4,258 MW in the USA; but only
- 474 MW in the UK despite the UK having more than one third of Europe's wind.[31]

In 2001, nearly 1,700 MW of wind turbine capacity was installed in the USA (compared with the previous record year of 1999 with 732 MW) which will power 475,000 homes and displace the emission of 3 million t/y of CO_2.[32]

Offshore wind energy is being heralded as one of the best bets for sustainable energy. The UK has already installed 3.8 MW capacity offshore of Blyth Harbour. But compare this to:[33]

- 23 MW offshore Sweden;
- 19 MW offshore the Netherlands;
- 50 MW offshore Denmark with plans for another 160 MW to come on-stream in 2002;
- and plans approved by the Irish Government on 11 January 2002 to build 520 MW on Arklow Bank in the Irish Sea, south of Dublin, rated at 520 MW to produce 10% of the country's electricity needs.[34]

BP and ChevronTexaco plan to build a 22.5 MW wind farm at their jointly-owned Nerefco oil refinery near Rotterdam.[35] Why not in the UK where the wind strength is greater? The fiscal incentives are poorer and the planning process more difficult.

3.1.2 Water – Large-scale Hydro, Small-scale Hydro, Wave, Tidal and Current

Most opportunities for large hydroelectric schemes in the UK have already been exploited; in any case, concerns about the social and environmental damage caused by flooding large areas means that no more are likely to be built. However, there is considerable scope for small schemes which do not have these negative effects. The recovery of energy from waves has been investigated for many years, particularly with 'Nodding Duck' wave energy collectors which have proven to be too expensive and insufficiently robust to be viable, but some new devices offer greater promise.[36] It is believed that under water current turbines offer considerable scope.

3.1.3 Solar – Thermal/Active, Passive and PV

In active solar thermal systems, mechanical means are used to collect, store and distribute solar energy in buildings to provide hot water or space heating. Passive heating relies on architectural design to heat buildings. In PV (photovoltaic calls) the heat and light is converted directly into electricity.

3.1.4 Geothermal – Geysers, Hot Springs and Hot Rocks

Geothermal energy uses heat from the Earth's interior, converting it into useful power using heat pumps. This is not sufficiently significant in Europe to warrant us dwelling on it, but even so, more than 3,000 GWh of electricity is produced annually from this source in Europe (equivalent to 375 MW).[37]

3.1.5 Biomass – See Table 1

Biomass can be converted to liquid fuels like gasohol and biodiesel, or energy extracted using combustion, gasification, or pyrolysis.

3.1.6 Waste – See Table 2

Most nations (now excluding Britain) consider waste as a renewable fuel. This does not encourage the generation of waste, but both solves the problem of its disposal and provides a renewable energy source. Modern technologies do not cause the pollution of former processes. Even gas recovered from landfills has a dual benefit: 120 MWe is generated from landfill gas in the UK; were this not recovered the methane, which is a potent greenhouse gas, would escape to the atmosphere. A typical energy-from-waste plant generates electricity for 50,000 homes.

Sustainable Biomass Fuel Sources	Waste Fuel Sources
Forestry and Arboricultural Residues	Municipal Solid Waste (MSW)
Timber Mill Waste and Sawdust	Gas from Landfill Sites
Short-Rotation Coppicing	Hazardous and Chemical Waste
Straw	Hospital and Clinical Waste
Sugar Cane Waste (Bagasse)	Sewage Sludge Combustion
Rice Husks and Coffee Husks	Sewage Digester Gas
Peanut and other Nut Shells	Vehicle Tyres
Palm Oil and Coconut Residues	Refinery and Process Plant Flare Gas / Off Gas
Poultry Litter	Stripped Crude Gas
Animal Carcasses and Meat & Bone Meal	Mines Gas
Livestock Slurry	Coke-Oven Gas

Table 1 'Sustainable' and 'Waste' Fuel Sources in Common Use

Material used as Fuel	Typical Calorific Value (MJ/kg)
Coal	23.0 - 32.0
Fuel Oil	40.0 - 45.0
Natural Gas	50.0 - 55.0
Plastic	27.0 - 34.0
Municipal Solid Waste (MSW)	8.5 - 11.0
Hospital and Clinical Waste	17.5 - 22.5
Chemical Waste	18.5 - 23.0
Sewage Sludge	7.0 - 13.0 (depending on dryness)
Vehicle Tyres	32.0 - 40.0
Sugar Cane Bagasse	8.0 - 12.5 (depending on dryness)
Wood	17.0 - 20.0
Rice Husks, Rice Straw	12.0 - 18.0
Straw	14.0 - 15.5
Meat and Bone Meal (MBM)	20.0 - 28.0 (depending on fat content)
Poultry Litter	13.0 - 14.0

Table 2 Calorific Values for Different Materials used as Fuel

3.2 Waste Reduction & Waste Utilisation

3.2.1 Reduction, Re-use and Recycling

For a number of years the 'waste hierarchy' Reduce, Re-use, Recycle has been commonly accepted. To encourage the practice, perhaps we should introduce 'pay-as-you-throw'. But even for the keenest 'waste reducers', just how aggressive is our waste reduction target? Womack & Jones advised firms not to judge themselves against their competitors, but to 'compete against *perfection* by identifying all activities that are *muda* and eliminating them.'[38]

Recycling cannot be bad, but how many people drive extra miles to deposit bottles in a bottle bank, not realising that the use of their car causes more harm to the environment than the benefit from bottle recycling?

In companies, individual initiatives can be defeated by bureaucracies. Many who propose changes discover that, because resource-saving equipment must be purchased from one budget, while its savings will benefit another budget, they can't get approval.[39]

3.2.2 Energy Recovery

Is waste a problem or an opportunity? If we use the term 'waste' and see it as inherently bad, we may miss an opportunity, particularly in the light of the imposing greenhouse crisis. For waste is a resource and should not be wasted. 100,000 tonnes of municipal solid waste (MSW) can produce 7 MW of electricity, enough power to meet the needs of 11,000 homes.[40] Britain's MSW could generate 1,700 MW – enough power for 2.7 million households. The USA has 103 plants burning approximately 15% of their MSW and generating more than 5,700 MW serving over 39 million people.

Gas can be gathered from landfills and used for energy generation. But compared with landfill gas, combustion using a modern technology[41] is a more efficient and environmentally friendly method of recovering energy from MSW, and it reduces the landfill needed by 85-100%.[42] A modern incineration plant produces 0.54 MWh per tonne of MSW compared with 0.29 MWh per tonne for landfill gas, i.e. 80% more electricity; it produces 850 kg of CO_2 per tonne of MSW compared with 1,680 kg of CO_2 per tonne of MSW for landfill gas (this can be compared with 3,800 kg CO_2 for a landfill without gas recovery); and it produces much less methane per tonne of MSW than a landfill gas site, and methane is 20 times more potent a greenhouse gas than CO_2.

There are useful by-products from an MSW incineration plant, as well as energy:

- slag is used in road and pathway construction;
- iron and steel are used in new steel making;
- non-ferrous metals are re-used directly;
- boiler and filter dust are used in brick-making;
- hydrochloric and other acids are sold into the chemical industry; and
- gypsum from the gas cleaning is used to make plaster.

A typical household has 5 kg of biofuel delivered free to the house per week in the form of paper, which is largely ash-free wood and could be used to generate 20 kWh or seven hot baths, saving the household £60/year.[43]

4. Some Case Studies

4.1 Wind Energy in Spain[44]

The view is often expressed that wind energy, though environmentally benign, cannot make a significant contribution to our power requirements. The following shows what can be done when there is the determination to produce a wind farm producing the equivalent output to a nuclear power station.

The Spanish regions of Navarre and Castilla-La Mancha have installed 1,022 MW of wind energy capacity since 1994; a further 1,000 MW will be installed by 2004. With the capacity factor achieved by wind turbines, the annual power generated will be similar to that of Sizewell 'B', and estimated emissions of over 11 million t/y CO_2 will be avoided. Navarre now produces 51% of its electricity from clean energy sources and intends to make this 80% by 2005 and 100% by 2010, even allowing for a 4% growth in electricity demand. Castilla-La Mancha already produces 70% of its electricity from wind energy.

As well as the environmental benefits achieved by this programme, it has considerably improved the industrial fabric of the communities, giving rise to a new high tech sector that employs more than 3,600 people. Some notable developments by local companies supported by the scheme are:

- two wind turbines with in-house technology of 1.3 MW and 1,5 MW respectively;
- a variable speed and synchronous generation system for wind turbines;
- a system to stabilise the grid voltage of the electricity company;
- studies on the radio-electrical interference from wind farms on TV signals;
- studies on the impact of lightning on wind turbine structures; and
- the incidence of gusts of wind on wind turbine structures.

This was achieved by the local Government establishing a clear strategy and bringing both public and private interests together to realise it. In 1989, 25 companies formed a new electricity company Energía Hidroeléctrica de Navarra SA (EHN) to develop sustainable energy sources. EHN led a programme of information, education, social participation and awareness, following which 85% of the local population favoured the implementation of wind farms, with only 1% against. To date, 54% of the population of Navarre have visited a wind farm. EHN also raised 80% of the cost of the installations. The confidence of the financial entities was reflected by the underwriting in June 2001 of the largest loan ever granted in the world in the field of sustainable energy for €914 million by 53 banks from 13 countries.

In addition to the wind power, 181 MW of other sustainable energy capacity has been installed in the regions, mainly small hydro.

4.2 Solar PV in Germany[45]

Like wind, the capture of solar energy for power generation is often considered to be of marginal real value. However, by the end of 2000, domestic dwellings in Germany had a combined solar PV capacity of more than 100 MW.

4.3 Mongolia[46]

Nor is it only rich nations that can afford sustainable energy. In Mongolia, more than 5,000 solar home systems have now been installed and the government has approved a programme to facilitate the electrification of 100,000 rural homes with PV. With only 142 out of the 314 regions connected to the national grid and 43% of the population being nomadic, this is often a means of *increasing* the standard of living. Sustainable energy doesn't cost them; it pays them.

4.4 Biomass in Finland[47]

The Alholmens Kraft power station commissioned in December 2001 at Jakobstad, Pietarsaari, Finland is fuelled by forest residue, bark, sawdust, wood chips, and cut peat, with coal as a reserve, and produces 240 MW of electricity, 100 MW process steam and 60 MW district heat. This makes it the largest biomass power plant in the world and demonstrates that such facilities can produce a substantial output. Whilst it may be claimed that the size of forestry operations and the pulp and paper industry in Finland provide a unique opportunity for such a plant, it should be borne in mind that all pulp and paper factories burn as much bark, wood residue, black liquor sludge and waste paper as possible

to raise the steam they need for processing and to produce electrical power for on-site use and sale.

The €170 million project cost was raised by 70% domestic financing and an EU THERMIE grant. The plant provides 450 jobs in its operation, maintenance, fuel production and transport.

But plants don't have to be large to make an impact. For every 1,000 litres of fuel oil replaced by wood, 3.4 tonnes of CO_2 emission is avoided; for every 1,000 m^3 of natural gas replaced by wood, 2.5 tonnes of CO_2 emission is avoided.[48]

4.5 Poland[49]

The plants don't have to be big to make a significant contribution. In Poland, thousands of old coal-fired steam boilers used in rural towns and villages to provide district heat are being converted to run on biomass such as straw or forest residue. This not only avoids large investment costs by extending the boiler working life from 30 to 45 years, but also reduces emissions, provides increased revenue for the farmers, and generates additional employment. By this means, Poland will increase the proportion of power generated from sustainable energy sources from 2.4% to 7.5%.

4.6 Biomass and Other Sustainable Energy Sources in Upper Austria[50]

In 1993 Upper Austria, one of the nine Austrian states, passed its first Energy Plan which defined concrete goals to reduce fossil fuel consumption by increasing both energy efficiency and the use of sustainable energy sources by 2000. Less than 10 years on, 30% of the primary energy consumption comes from sustainable sources, including 14% hydro-electric and 14% biomass. All new domestic buildings have an energy consumption 30% less per m^2 than the 1993 average, and industry has a 2% lower specific energy consumption than in 1993. The following have been installed:

- 550,000 m^2 of thermal solar collectors;
- 15,000 modern automatic wood heating systems;
- 200 biomass district heating networks;
- 450 grid-connected PV systems;
- 14 wind farms;
- 5 geothermal plants;
- 30,000 heat pumps; and
- more than 30 biogas and sewage gas plants.

In total, the sustainable energy sector has created or secured employment for over 10,000 people. Austria contributes 3% to EU environmental funds, yet receives 15% of the total funds because of its proactive approach to sustainable energy technology development and project implementation.[51]

To continue the strategy of the successful first phase of the energy plan (1994-2000), the Upper Austrian Government unanimously passed the 'Energy 21' strategy. The goals to be achieved by 2010 are:

- doubling the share of modern biomass heating systems and of thermal solar collectors;
- additional 350 MW capacity from sustainable energy sources;
- increasing overall and specific energy efficiency by 10%;
- reducing energy consumption for heating and hot water supply by 20%;
- creating 30 new companies and 1,500 new jobs; and
- 15 new energy research and demonstration projects annually.

Previous goals have been achieved, and the future goals are expected to be achieved, by the creation of an energy agency to promote energy efficiency, sustainable energy sources and innovative energy technologies. The agency works in association with the energy

industry, environmental companies, consultancies, professional associations, and energy technology companies to deliver:

- information and awareness programmes;
- energy advice and auditing;
- sustainable buildings programme;
- energy technology programme;
- training;
- third party financing;
- management of a network of green energy businesses; and
- international co-operation, e.g. in the THERMIE, ALTENER, SAVE, SYNERGY, PHARE, INNOVATION, and FP5 programmes.

It is noteworthy in the light of the British Government's view on the subject[52], that the Upper Austrian Government considers the primary objective to be to ensure 'a secure and safe energy supply for Europe'. Secondly, but still considered of great importance, are 'contribution to climate and environmental protection, to economic development, job creation and cohesion in an "energy intelligent Europe"'.

4.7 Salad Waste in Switzerland[53]

A consortium comprising Erdgaszürich, a gas distributor, Kompogas, an equipment supplier, and Migros Zürich, a salad producer and distributor, collect waste salad products and process them into liquid fertiliser, compost and natural gas quality methane for vehicles which has been widely sold in Swiss petrol stations since April 2001. In fact there are now 17 processing plants in operation, each processing between 5,000 and 25,000 t/a of green waste. The production and use of the gas is carbon neutral, and results in emissions 72 times less harmful to the ozone layer than diesel, and produces less NO_X, CO, particulate and Lärm. The trucks are more expensive, but the engines run more efficiently, so the vehicles break even after 80,000 miles – which is a fraction of the lifetime mileage of a truck.

4.8 Rural Chile[54]

A five-year initiative to promote sustainable energy sources as a way to bring electric power to poor rural communities in Chile was announced in December 2001. The project will provide power for 10,370 households and pave the way for electrification of at least 100,000 homes with sustainable energy by 2020. Depending on the location, solar, hydro, biomass or wind sources will be used. The programme is receiving US$6 million from the UN Development Programme's Global Environmental Facility; US$17 million from the Chile Government; and US$1.5 million from local communities. The intention is to demonstrate that providing power in rural areas from sustainable sources is not only viable, of benefit to communities and the environment, but can also be a profitable business.

4.9 Zero Energy Housing in the UK[55]

Lastly by way of case studies, but by no means least, a zero-energy housing development in the UK. The Beddington Zero Energy Development, 'BedZED', is an environmentally friendly, energy-efficient mix of housing and workspace in Beddington, Sutton, UK, which has replaced a derelict sewage works into a community of:

- 82 one, two, three and four bedroom flats and houses for sale and rent;
- 1,600 m^2 of workspace;
- an on-site shop, café, information centre and sports facility; and
- plenty of green space, including private gardens.

In the construction of BedZED, where possible building materials were selected from natural, sustainable or recycled sources and brought from within a 35 mile radius of the site.

BedZED will not use more energy than it produces; because no fossil fuels are used to provide power or heat, it will have zero net carbon emissions. The site includes:

- energy-efficient buildings, facing south to make the most of the heat from the sun, highly insulating roof gardens, extra thick walls with excellent insulation, an 'overcoat' of super-insulation to the roof, walls and floors, triple-glazed windows with wood frames, well-sealed windows and doors, and a heat exchanger in the wind-driven ventilation system to recover 50-70% of the warmth from the outgoing stale air – expected to achieve a 90% reduction in heat demand compared to a typical suburban home;
- energy-saving appliances and low-energy lights – expected to achieve a 60% reduction in power demand compared to a typical suburban home;
- a CHP unit able to produce all the development's heat and electricity from tree waste which would otherwise go to landfill;
- solar PV panels which power recharging points for electric vehicles;
- a legally-binding transport plan as part of the planning permission which aims to reduce reliance on the car by using public transport and cutting the need for travel by having internet shopping links, on-site shopping, leisure and childcare facilities and a car pool – expected to achieve a 50% reduction in fossil fuel consumption compared to a typical suburban family;
- a water strategy including water meters in the kitchen, water-efficient appliances, low-volume baths, flow-restricted taps, and dual-flush toilets – expected to achieve a 33% reduction in mains water consumption compared to a typical suburban home;
- a waste water strategy including a biological sewage treatment system, the recycled water from which is stored with collected rain water in large tanks built into the foundations for flushing the toilet; and
- recycling bins in every home.

1.44 million 'zero-energy' homes could be built on brownfield sites in Britain. The homes are needed; the land is available; the environmental and social improvements are vital. But when receiving a Golden Globe Award for Sustainable Energy Developments on 6 March 2002 in Wels, Austria for BedZED, presented by Mikhail Gorbachev, the team said they had approached all UK property developers and house builders in an attempt to raise interest in another similar development but without success, so they do not expect further similar housing to be built.[56]

5. Some Ideas for a Political Strategy

5.1 The Political Response to Date

On 30 September 1997, John Browne of BP said: 'No single country or company can solve the problem of climate change. It would be foolish and arrogant to pretend otherwise. But I hope we can make a difference – not least to the tone of the debate – by showing what is possible through constructive action.' Mr Browne's initiative led to the development of the UK's **Emissions Trading Scheme** which came into effect on 1 April 2002 and is the first of its kind in the world to put a monetary value on carbon emissions.[57] The imminent EU Emissions Trading Scheme is expected to have even more teeth.

On 24 October 2000, Tony Blair announced that £50 million from lottery funds would be available for renewable energy projects. However, on 23 October 2000 he allocated £15 billion from treasury funds for Railtrack. In other words, improving the safety of an incredibly safe system is 300 times more valuable than saving our planet for our children and grandchildren! Rail safety is of national importance to be funded from taxation, while renewable energy to prevent global warming is merely a 'good cause' worth a bit of lottery money![58]

On 6 March 2001, Tony Blair, in his seminal speech "Environment: the next steps", announced a further £100 million for renewable energy, this time from public funds and mainly to support 'off-shore wind' and 'energy crops'. So now improving the rail system is only 100 times more important than saving our planet for our children and grandchildren!

In February 2002, Tony Blair announced another £100 million to specifically help the UK to 'promote solar power and give a boost to offshore wind, kick start energy crops, and bring on stream other new generation technologies'.[59]

At the launch of **Renewables UK** on 4 March 2002, the Energy and Industry Minister Brian Wilson valued the renewable energy market for manufacturing industry at £500 to £1,500 billion globally.[60] (There are already 14,000 people employed in the wind energy industry in Denmark.)

In the UK, the **Renewables Obligation Order 2002** will come into effect on 1 April 2002, requiring 3% of electricity to come from sustainable sources from 1 April 2002, increasing to 10.4% by 31 March 2010.

One means by which the use of fossil fuel can be reduced is to install Combined Heat and Power (CHP) systems. Whilst the Climate Change Levy[61] was introduced to encourage CHP, NETA[62] and the recent increase in gas prices have caused almost all CHP projects to be shelved.[63] There is clearly a need for a holistic approach. The recent Energy Review was carried out by the Cabinet Office Performance and Innovation Unit rather than the DTI or DEFRA in order to achieve 'joined-up thinking' across Government. **The PIU Energy Review** confirms the government's commitment to a target of 10% of power being generated from renewables by 2010[64], which equates to approximately 5 GW capacity, and proposes a new target of 20% of power generation from renewables by 2020[65]. However, the Review also reports that the DTI projections for UK renewables show no increase between 2010 and 2020.[66]

The 2010 target might be achieved by 1 GW each of:

- onshore and offshore wind (turbines produce only 27% of their nameplate capacity);
- energy crops and other biomass;
- EfW (although this is now included in the UK government's definition of renewable energy);
- landfill gas, mines' gas, and process off gas; and
- hydro-electric.

But the Review focuses on wind. In order to achieve half the targets with wind, we need to install 925 MW of wind turbine capacity per year, i.e. 2.5 turbines of 1.5 MW capacity each working day for the next 18 years. At £1 million each turbine, this equals more than £11 billion. Isn't this a great opportunity for the UK manufacturing sector? No, because due to lack of political will to exploit this technology, UK industry has moved from world leader in wind turbine technology to nowhere, so all turbines will be imported from Germany and Denmark. Wind energy experience at 1.5 MW+ as of mid 2001 is:[67]

- Enercon (German): 550 installed;
- Enron Wind (German): 300 installed;
- Vestas (Danish): 300 installed;
- NEG Micon (Danish): 70 installed;
- British industry in total: 0 installed.

The Review makes reference to **coal seam methane** (mines' gas).[68] There are 100 potential sites in the UK, which together could produce 750 MWe from 300 kt/a gas. At present gas is collected and the energy recovered from six sites.[69] But there is no reference to power recovery from **blast furnace top gas, coke oven gas, stripped crude gas, refinery flare gas,** etc, despite there being successful UK installations of energy recovery

from all of these gaseous wastes. One industry expert commented: 'I perceive the PIU Energy Review[70] to be largely gas and wind – in the political sense!'[71]

5.2 The Cost of Sustainability

On 29 March 2001, US President George W Bush, said: 'The United States opposes the Kyoto Protocol because it exempts many countries from compliance and would cause serious harm to the American economy.' Given that one sixth of the world's population produces 55% of the world's CO_2 emissions, the relevance of the first reason is questionable. But what about the cost to industrialised nations including the US and the UK? It has been calculated that had the USA adopted in 1974 the energy efficiency practices of some other advanced industrial countries, and applied the savings to the national debt, the USA would not today have a national debt.[72]

The question must be asked: 'Can we afford sustainable energy?' The question presupposes that it is more expensive than generating power from fossil fuels – and with present cost structures it is. But a recent EU Commission study[73] suggests that if external environmental and health costs of power generation were taken into account, the cost of generating electricity from coal and oil would double and the cost of gas generation would increase by 30%. In fact, the external costs are estimated to be 1-2% of EU Gross Domestic Product, not including the cost of global warming. [74] If true costs were identified and fiscal policy ensured that they were properly allocated, sustainable energy would be economically viable.

The Met Office has calculated that the cost of action, though considerable, will be less than the impact of failing to take action, even ignoring the less quantifiable but nevertheless important costs of environmental disaster. [75]

5.3 The Need for a Holistic Approach

Nevertheless, perhaps we need a more radical approach to fiscal policy to take account of the true value of natural resources and the environment. What if there were a tax shift not intended to redefine *who* pays the taxes but only *what* is taxed, with work, business and personal income freed from taxation, and waste, toxins, and primary resources making up the difference? Shifting taxes towards resources creates powerful incentives to use fewer of them now. Simultaneously removing personal and employer taxes on labour creates new arenas of employment opportunity, since the cost of employment is reduced without lowering income.[76]

And saving electricity should have at least the same value as producing it. In the 1980s, when Central Maine Power Company started a trend of offering cash grants to those industrial customers that pledged to save the most electricity, i.e. where efficiency was allowed to bid against new supply, it almost always won, permitting valuable 'decongestion' of crowded grid capacity.[77]

Most people believe the alternative to cars is better transit – in truth, it's better neighbourhoods.[78] In the 1970s, Portland, Oregon, estimated it could cut petrol consumption 5% merely by resuscitating the concept of the neighbourhood grocery store.[79]

A UK haulier has a full-time job taking 20 tonne loads of laser-cut suit material from the UK to Morocco, where the suits are sown together, and bringing the finished suits back. This saves the clothes manufacturer 30p/suit.[80] But what does it cost the environment? Government has a role in developing policy which balances such issues.

Pollution is related to industrial output. We do not wish our standard of living to suffer by stifling the availability of consumer goods, but a key variable in production levels is clearly *how long* the goods last. So we should incentivise design for longevity.

Utilities have traditionally been content to recover power-plant investments over 20 to 30 years. Incentivise society to consider energy saving investments in the same way.

5.4 Swapping Debts for Sustainable Energy Developments

Between 1992 and 2001 the EcoFund Foundation provided financial support for 80 energy efficiency projects, 72 sustainable energy projects totalling some 90 MWe capacity, and the closure of more than a thousand old and inefficient coal-fired boilers totalling 800 MWe capacity.[81]

5.5 Recognising Environmental Leverage

In Germany the hidden history of a product is called 'ecological rucksack'. For example, the amount of waste generated to make a semiconductor chip is over 100,000 times its weight; that of a laptop computer close to 4,000 times its weight.[82]

It is compounding savings that represent significant economic and environmental leverage. The *economic* importance of an energy-saving measure will depend on its position in the chain.[83] An example of environmental leverage is aviation efficiency. 10 tonnes of fuel transported from London to Tokyo costs 4 tonnes of fuel to transport.[84] So the benefit of increased aircraft efficiency is multiplied by the saving in fuel needed to transport the avoided fuel, which is further multiplied by the saving in fuel and energy during fuel production and transport to the airport.

5.6 Recognising the Value of Human Resource and Community

The industrial revolution has resulted in machines doing work humans once did or could do. This brings benefits when it relieves humans from conducting hazardous or demeaning tasks. But in our quest to reduce labour levels we have created the phenomenon of unemployment. With years of falling unemployment rates in the UK, this is no longer to the fore in our minds. Considering the global situation, however, there is still a problem to be addressed. Unemployment in Europe in 1960 stood at 2%; in 1998 it was nearly 11%. In many parts of the world it has reached between 20 and 40%.[85]

An overcrowded but undervalued workforce, outsourced parenting, the unremitting insecurity that threatens even the most experienced workers with fear of redundancies – these all corrode community and undermine civil society. It is people who have become an abundant resource, while *nature* is becoming disturbingly rare.'[86] We no longer call people 'personnel' but 'human resources', but apparently they are not a very valuable one. The true bottom line is this: A society that wastes its resources wastes its people and vice versa. And both kinds of waste are expensive.[87]

We are told that industrialised nations have experienced continued growth over the last decades, because growth is measured by the economic value of the GDP. But what about *net* growth, taking into consideration growth in the quality of life, in leisure and family time, in a better infrastructure, and in greater personal and economic security? 'Wasting resources to achieve higher profits is far from fair; wasting people to achieve higher GDP doesn't raise standards of living; and wasting the environment to achieve economic growth is neither economic nor growth.'[88] 'The result can be illusory gains in income and permanent losses in wealth.'[89]

6. Some Ideas for a Commercial Strategy

6.1 Design Integration

Solutions lie in understanding the interconnectedness of problems, not in confronting them in isolation.[90] Too few designers ask: 'What does this place require us to do? What will it allow us to do? What will it help us to do?'[91] A high level of design integration crossing traditional professional boundaries, and careful planning that takes the right steps in the right order, will create synergies that both reduce cost and enhance performance.[92]

'In manufacturing, about a quarter of the labour force is engaged in the fabrication of basic raw materials. The reverse is true of energy inputs: Three times as much energy is used to extract virgin or primary materials as is used to manufacture products from those materials.'[93]

We tend to design safe, thus producing uninspired, big, complex and costly equipment because 'there is no liability for in*eff*iciency – only for in*suff*iciency. The engineer won't be held responsible for the operating costs.'[94] A 'microwave drier' would take much less energy that a conventional clothes drier.[95] (And what about 'shared laundry facilities in apartment buildings which could improve energy efficiency by about fourfold and materials efficiency by about tenfold?'[96])

Dedicated product teams in direct dialogue with customers always find ways to specify value more accurately and often learn ways to enhance flow and pull as well.'[97]

6.2 Providing Solutions rather than Supplying Products

It has been said that 'mere product-sellers will become suspect.'[98] We should strive to become 'a solution provider, not a product supplier.'[99] For example, Dow's German affiliate SafeChem (a supplier of solvents for cleaning) moved from selling solvents to a service comprising delivery, help with its application, working with the client to recover the solvent, and taking it away. It has become a provider of the 'dissolving services'. It now plans to charge by the square inch degreased rather than by the gallon used – thereby incentivising itself to use fewer rather than more gallons.[100]

This approach will also encourage attention to detail, where the detail can have a seemingly disproportionate impact of the efficiency of the overall system. For example, poor attention to the mortar finishing inside cavity walls causes 'bridging' which results in 16% great heat loss, and inaccurate brickwork causing a 10 mm gap between the brick and insulation results in 10% greater heat loss.[101]

It is not uncommon for industrial premises to have heating and cooling systems operating simultaneously, fighting each other due to a poor control system.[102] Yet modern control technology is not only available but its cost is so low that when retrofitted to domestic, commercial or industrial buildings the payback is generally less than three years, without taking into account the environmental impact.

6.3 Measure and Manage

A business that ignores measurement will inevitably fall behind in making useful and cost-saving discoveries. As a colleague of mine says repeatedly: 'If you can't measure it, you can't manage it; and if you can't manage it, you can't improve it.' The following are examples of actions which can be environmentally and financially beneficial:

- minimise packaging, especially avoiding tin foil;
- replace incandescent exit signs with LED exit signs: they reduce energy consumption by about 80%;
- install energy efficient systems, e.g. lighting and CHP;
- mark light switches red for lights near windows and green for ones in the darker areas;
- reduce the room temperature;
- reduce commercial kitchen waste;
- develop an environmental strategy (with ISO 14001);
- take a long-term view in the strategy;
- implement 'green' designing;
- buy utilities from a 'green' source;
- educate employees regarding the issues; and
- influence government as far as possible.

'No matter how wonderfully efficiently we convert forests to logs to pulp to paper, it's all for nought if the result is junk mail that nobody wants and that is thrown away unread and sent to landfill.'[103]

6.4 Re-use and Recycling

We don't need to invent a sustainable world – nature's done that already.[104] In nature, there is no waste; one organism's waste is another's food.[105] If, for example, an entire building can't be recycled, the next best approach is often to reuse wood, bricks, and other materials from prior structures.[106]

Ohno defined waste as 'any human activity which absorbs resources but creates no value.'[107] Womack & Jones classify waste as 'mistakes which require rectification, production of items no one wants so that inventories and remaindered goods pile up, processing steps which aren't actually needed, movement of employees and transport of goods from one place to another without any purpose, groups of people in a downstream activity standing around waiting because an upstream activity has not delivered on time, and goods and services which don't meet the needs of the customer.'[108]

7. Some Ideas for a Personal Strategy

7.1 Be Prepared to Change your Habits

What can we as individuals do?

- use LPG in your car: it produces 95% fewer particulates than diesel and 90% less NO_X;[109]
- avoid buying heavily packaged foods;
- avoid the use of tin foil wrappers;
- buy food loose where possible;
- use refillable containers;
- use own shopping bags or boxes;
- cancel unwanted 'free' newspapers;
- eliminate junk mail;
- use scrap paper;
- re-use envelopes where possible;
- take unwanted clothes to charity shops;
- compost kitchen waste, egg cartons, newspapers, etc;
- collect and use rainwater for the garden;
- repair leaking water taps;
- control space heating better and reduce temperature;
- replace old thermostats with electronic programmable thermostats; this will reduce heating costs significantly by heating areas when they are actually being used;
- install better insulation for windows and walls;
- draft-proof windows and doors;
- redecorate less frequently;
- replace goods less frequently;
- use the white goods efficiency rating to select energy efficient appliances;
- check the temperature of your fridge and freezer: don't put them next to a cooker or in direct sunlight; ensure there's proper ventilation for them; and clean the coils regularly;
- install light sensors for infrequently used rooms: bathrooms and storage rooms; these can reduce energy consumption by up to 50%;
- replace incandescent bulbs with compact fluorescent bulbs, which use 66-75% less energy and last up to 10,000 hours compared with incandescent bulbs lasting 1,000-2,500 hours;

- turn lights off when not in use;
- turn off computers and printers, especially monitors, when not in use; put them on "sleep" mode when not in use for at least 10 minutes110 (a typical house in the UK incurs standby losses of 277 kWh/year);[111]
- plant trees: they absorb CO_2; shade your home and keep it cooler in the hot weather; and shield it and keep it warmer in cold weather;
- resist the 'rebound effect' – using greater efficiency for increased comfort;
- support companies and organisations that have a policy of buying renewable electricity, e.g. The Body Shop, The Co-operative Bank, B&Q, WWF-UK, and EMI; and
- encourage others to do all these things as well.

How many people have a motor mower to get the job done quickly so they've got time to go to the gym and keep fit? The raw materials and manufacturing of a mower have a negative impact on the environment; the electricity or petrol to power it has a negative impact on the environment.

7.2 Oppose Opposition: Encourage Action

This presentation has illustrated (albeit briefly) many technologies and practices that are available to us today. Yet too often we fail to do what we can because we would like to do better. We should use the best available technology, even if some people think it's not good enough. If we object to everything that might be harmful, we'll end up not doing anything, which is much more harmful. It was Edmund Burke who said: 'Nobody made a greater mistake than he who did nothing because he could only do a little.'

8. Conclusion

Ernst von Weizäcker, a Member of the German Bundestag, said: 'We are entering the century of the environment, whether we want to or not. In this century everyone who considers himself a realist will be forced to justify his behaviour in the light of the contribution it made toward the preservation of the environment.'[112]

Bill McKibben told a group of corporate executives: 'The laws of Congress and the laws of physics have grown increasingly divergent, and the laws of physics are not likely to yield.'[113] While there may be no 'right' way to value a forest, a river, or a child, the wrong way is to give it no value at all.[114] The best option for an uncertain future is the one that leaves the most options open. And as Darwin said: 'It's not the strongest species that survive, nor the most intelligent, but the ones most responsive to change.'[115]

So **'Something for Nothing'** can be viewed in one of two ways: if we seek to use what we currently waste, our environment will benefit significantly; but if we seek 'something for nothing' from a selfishness that's unwilling to pay for what we use, we will cause quite literally unimaginable damage to our environment. The choice is ours.

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