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Kyoto, Bali, Copenhagen, … Back to Washington

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Human induced Climate Change (CC) is now widely recognized by a majority of peoples all over the world (BBC, 2007). Politicians must address the problem. The world agrees that "drastic and urgent change" is necessary, so why is progress so slow? This is a global commons problem and requires the perspectives of all the social sciences. Economists occupy many voices in the choir, as architects of the post-war consumption society fed by ever increasing flows of fossil fuels and grid electricity. For a long time economists did not understand that CC creates the need for drastic measures. The standard tools of benefit-cost analysis have been applied (Nordhaus, 2007), but they fall short of comprehending the many unknowns and uncertainties (Stirling, 1999; Weitzman, 2008), and the global scale and very long-term horizons (Portney and Weyant, 1999) beyond imagination and capacity of even the most sophisticated modelers and clever Nobel prize winners. Economics should shelve its hubris, before economics is shelved by society. The latter would be a nightmare for climate policy, because as this article shows, Adam Smith's findings are the basic key to a workable global climate policy.

This article is divided into four sections. The first section highlights the drivers of carbon emissions. The second section reviews low-carbon energy options. The third section argues that cutting energy use intensity is a prerequisite to make the full transition to renewable energy affordable. The fourth sections sketches the headlines of an alternative post-Kyoto policy.

1 Drivers of Carbon Emissions

Total Carbon Emissions are often expressed as the product "number of people x wealth per person x energy intensity of wealth x carbon intensity of energy used" (IPPC, 2007):

$$TotalCarbonEmissions = \sum_{P} Populations_{P} x \frac{\$GDP}{Person} x \frac{kWh}{\$GDP} x \frac{CarbonEmission}{kWh}$$

The first and second factors are highly personal, cultural, political, and social driven. Population is intertwined with demographic structure, cultural heritage, religious beliefs, migration policies, etc. Since the 1960s, global population growth has been high on the agenda, but our diverse world cannot settle on quantitative birth targets. Reducing wealth or wealth growth is not attractive either, because the poor majority wants a better life and the rich minority does not want to give in. Some economies export a lot of their production, e.g. 23% of China's carbon dioxide emissions in 2004 result from goods made for export (Wang and Watson, 2007). A climate policy implying limiting growth or free trade will find little support.

Kyoto followers want an agreement on quantitative targets and timetables on Total Carbon Emissions of various nations (the left hand side of the formula). Such approach drags in all the complexity of the first and second factors on the right hand side, making

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their efforts futile. Except for global emission trajectories obeying a ceiling concentration of e.g. 450 ppm greenhouse gases in the atmosphere (IPCC, 2007), it is not possible (neither intellectually nor politically) to split and assign the global target to the various UN member states (Nordhaus, 2007).

Prins and Rayner propose ditching Kyoto and "radically rethink[ing] climate policy. Not least, this is because today there is strong public support for climate action, but continued policy failure 'spun' as a story of success could lead to public withdrawal of trust and consent for action" (2007, p.975). The fear of wasting public willingness to contribute to the common good is valid. Public economics teaches that policies should be effective, efficient and fair to keep the public rallied behind it. The Kyoto Protocol falls short of these goals, as argued by many scholars. But what is the alternative? Mixtures of disperse trial and error voluntary initiatives can be instructive for some time (Pizer, 2007), but "the economic and scientific consensus points to the need for a credible international approach" (Stavins, 2004).

Therefore, cutting emissions depends on cutting carbon and energy intensities.

2 Cutting Carbon Intensity of Energy Use to (Almost) Zero

Four contenders compete to cut carbon dioxide emissions: fuel substitution, atomic power, carbon capture and storage, and renewable energy.

Fuel substitution is familiar. After coal had driven out wood as a fuel in the industrializing economies, fossil fuel use steadily progressed. Substituting oil for coal, natural gas for oil, and hydrogen for natural gas, raises the hydrogen content and lowers carbon/hydrogen ratios. However, the substitution to carbon-free hydrogen (solving the emission problem) contains a circular reference because hydrogen does not exist as a gas on earth. It is only derived from fossil fuels or biomass, or from water by electrolysis.

Atomic power has enjoyed unprecedented support by the scientific, business and political communities during decades. There has been an effort during the last 50 years to use nuclear power as much as possible. Some believe that a new atomic wave can save the world, but nuclear power is part of the problem not of the solution (Verbruggen, 2008a). Instead of bringing the needed changes, a continued focus on nuclear power contravenes sustainable options. The risks of atomic power (accidents, waste, proliferation) nullify its own sustainability score. There is no future in substituting nuclear risks for climate change risks.

The hope of Carbon dioxide Capture and Storage (CCS) is that it can keep the vast coal resources usable for energy supply in the future (IPPC, 2005). When successful, centralized conversion of coal will remain a part of the energy system.

Renewable energy covers a wide range of sources and technologies. The sustainability characteristics of centralized hydro-power and biomass are often critical. Decentralized renewables, apart from their sustainability appeal and near zero carbon intensity, will have a hard time fitting into the present energy structures and habits. Many do not deliver at command but only intermittently, are not centralized but distributed, not concentrated but diffuse, not cheap to mine, but expensive to collect. As they stand now, these renewable energies are not ready to respond technically and economically to the exigencies of the energy intensive (obese) practices of the industrialized and industrializing societies.

But what is true today is not necessarily true tomorrow. Renewable energy surfs on technological innovations like micro-electronics, new materials, bio-technology, nanotechnology. Progress in performance and cost reductions is significant. But even then, we cannot change the universal laws of the daily rotating earth circulating the sun on a particular ellipse. An almost fully renewable energy economy will be clean but not cheap. The cost is such that the world cannot afford to meet the past and present energy intensive habits. When decentralized renewable energy use has to take over, cutting energy intensity is a prerequisite.

3 Cutting Energy Use Intensity is a Prerequisite

Energy use intensity is best measured as energy used in appliances, buildings, transport engines, industrial equipment, etc. There are two main final energy commodities: fuels (oil products, delivered gas, coal) and grid electricity. Energy intensity is a composition of technical efficiency (energy used per unit of activity) and of structure[1] (the mix of activities making up domestic product):

$$Energy\ Intensity = \sum_A \frac{kWh}{Activity} x \frac{Activity}{\$}$$

In OECD economies average intensities are composed of 80% efficiency and 20% structure (Geller and Attali, 2005).

Figure 1 shows 2003 electricity intensities for a panel of wealthy industrialized nations, singling out the price effect because panel countries are comparably wealthy with equal access to electricity end-use technologies. In climate policy jargon, the least-squares fit $I = \alpha.P^{\beta}$ (I = Intensity; P = Price) is a marginal cost curve of mitigating electricity intensity. It proxies an orthogonal hyperbole because price x intensity ~ constant; the long-run price elasticity β equals -1.03. The constant α is the GDP share countries pay for the supply of grid electricity.

There are multiple lessons. First, intensities diverge a lot between otherwise similar countries. If US intensity were to equal that of the Japanese, half of the US power generation complex could be mothballed.

Second, the relationship between end-use price and intensity is strong without short-cuts. When prices are high, so is efficiency. This brings intensity down. When prices are low, efficiency is also low, pushing intensity up. People are uncommitted to energy efficiency but economically rational. Personal preferences, adopted customs, cultural heritage, and even passion may reside in the end-uses we employ energy for, but no one is interested in energy for energy's sake. Barriers exist to attain first-best efficiency optimums (as they do in most markets) but consumers re-optimize swiftly and effectively once price signals are clear. That people decide on energy efficiency in a neutral, economic way is

[1] Structure covers the diverse activities in an economy and ranges from sector composition (how much industry, what type of industries, etc.) to lifestyles (housing, traveling, recreation, etc.).

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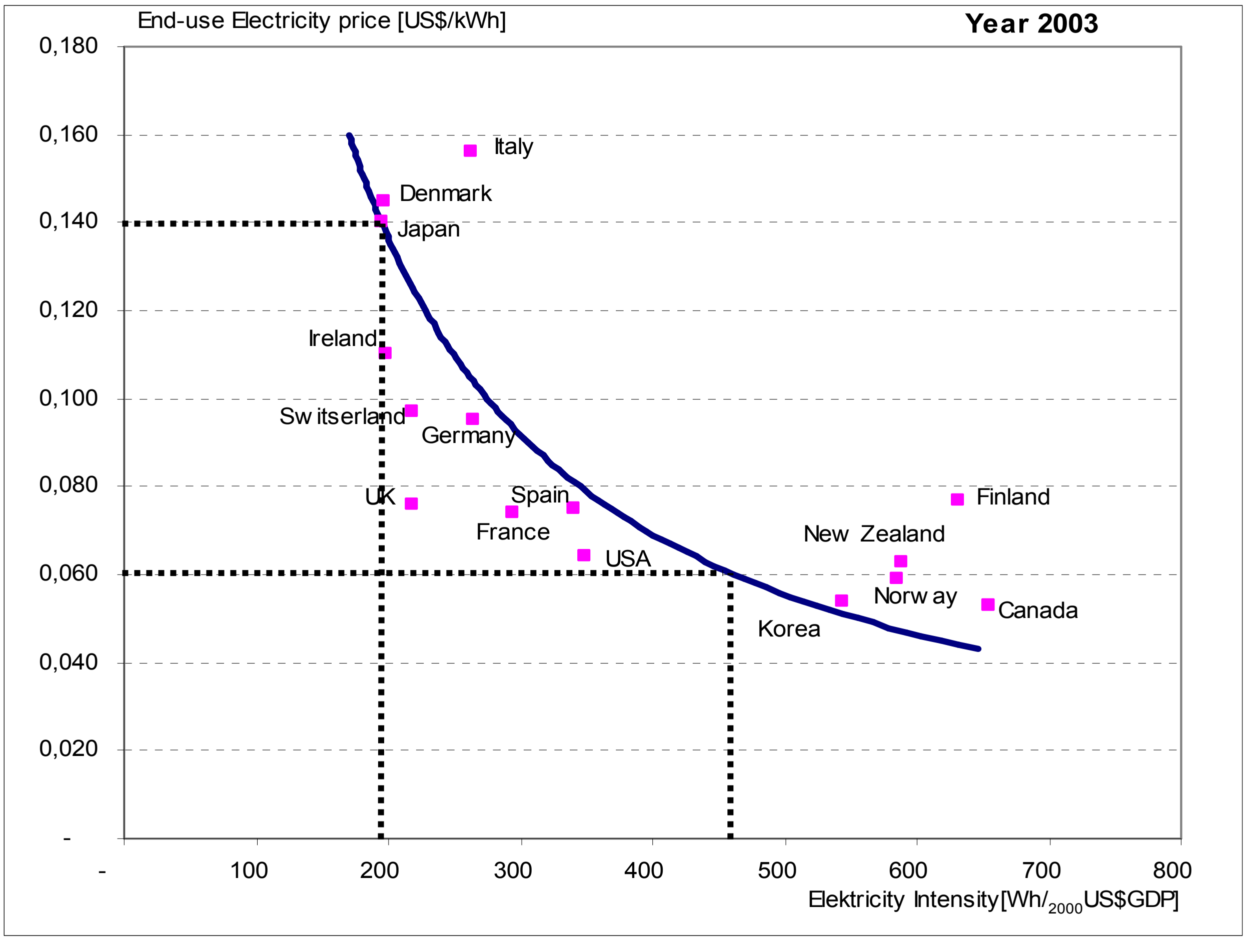
comforting: mankind must not excel above its nature (as Al Gore in The Inconvenient Truth asks the American people to do).

Figure 1. Electricity use intensity as a function of price (OECD data 2003).



Third, high end-use prices do not destroy economies but rather make them efficient. The GDP share that countries spend on electricity supply is similar regardless of which end-use price regime adopted. The main issue is what makes energy prices high: is it public policy using intelligent tax reforms that recycle the revenues in the domestic economy, or is it corporations and foreign interests that extract rents and monopoly profits from the economy for spending on the expansion of non-sustainable energy supplies or on wasteful consumptive projects? The first pays attention to welfare, the second runs contrary to the world's needs.

Fourth, transitioning from high intensity to low intensity electricity economies requires "rotating bills": remodel the flat horizontal rectangle towards a standing one (figure 1), up to an obelisk type when very low intensity is necessary to afford full renewable electricity supplies. Remodelling electricity bills requires price pressure, relentless and increasing, avoiding volatility.

Figure 1 shows electricity use. Similar results are observed for car fuels (Hammar et al., 2004). Price elasticity of energy demand at ~ -1 in the long-run is documented frequently (Sterner, 2003). The example illustrates the static case of 'frozen'2003 technology. High end-use prices induce technological innovation in efficiency and renewable energy that eases remodelling the bills (Newell et al, 1999; Popp, 2002; IPCC, 2007).

Summarizing: 1) Carbon emissions fall to zero if a full transition to sustainable renewable energy is successful. 2) The transition is affordable by a manifold reduction of end-use energy intensities. 3) The necessary thrust for the efficiency revolution is delivered by high end-use energy prices through tax reform.

"Setting the prices right" is widely accepted today (Stern, 2006), but the path is unclear and actual progress is slow. Economists favour a global unique carbon price by taxing (Cooper, 1998, 2005; Nordhaus, 2007) or by trading (Böhringer, 2002), because they assume technology is generic and equity is kept out of scope. But reality is too diverse for uniform instruments to be effective, efficient or fair. Economics should shelve abstract assumptions and accept complex realities. The quest for a harmonized global carbon tax is not politically pragmatic. The allegation that uniform taxation leads straight to cost-effectiveness hangs on comparability of mitigation cost curves of all emission sources. Comparability grows out of transparent competitive conditions (harmonization, leveled playing fields). "Equalized carbon tax rates will have significantly different cost implications for different economies, depending on their per capita incomes and energy intensity." (Kolstad and Toman, 2001, p.49). Installing a harmonized carbon tax globally seems to be a mirage similar to creating the global carbon permit market.
The search for a policy based on "sound science, rational economics and pragmatic politics" (Stavins, 2004) is still open.

4. A workable Climate Change Policy

Five basic attributes of a global CC policy and five components of a workable regime are described.

Attributes of a CC policy should be:

1. Change in energy use must be drastic and urgent for obeying the 450 ppm concentration stabilization trajectory, with the transition to renewable energy sources completed by 2050. Cutting energy intensities is a prerequisite. Intensity targets (as the US suggested in 2002) are criticized for not imposing absolute limits (Pizer, 2005). However, the context is different for energy intensity cuts that are designed to make a full transition to renewable energy affordable. Such policy implies immediate rejection and barring of all business-as-usual pathways.

2. Effective CC policies span the globe and are open to all UN members, but start at the main issues and players (Victor, 2004). "Until the US commits itself internationally, other nations will hide behind US unilateralism and inaction. The US has neither a sound climate foreign policy nor the right mechanism for creating one. Absent a fundamental change in the way the US makes and carries forward its climate diplomacy, the next president and Congress may fail to do what is necessary to stabilize the earth's climate system in time to avoid disastrous consequences for the US and the world." (Purvis, 2008, p.16). The US takes the lead while the EU evaluates the real performance of Kyoto and EU policies. A new agreement is attractive for poor nations to join because it offers economic development and transfers from the wealthy countries.
3. Sovereignty of citizens, organisations, and nations, is respected as diversity is important and as "it is necessary to locate the decision making at the political level that can internalize the spill-over" (Nordhaus, 2005). International agreements control free-riding and install transparent transfers to adjust differentiated responsibilities.
4. Common but differentiated responsibilities involve industrialized nations kick-starting and boosting energy efficiency and renewable energy technologies and practices. Emissions offsets are banned because they delay and deflect responsibility, spreading mostly business-as-usual solutions in developing nations. Second, industrialized nations transfer sustainable technologies to developing countries.
5. Quality management requires as good a design as possible (Aldy and Pizer, 2008), setting the true energy and carbon prices with consideration of nuclear risks along CC risks.

The main components of a workable CC policy are:

1. The G20 industrial nations have to identify enumerable large energy use activities by sector at the global level (Baron et al., 2007). Registers of such activities above a given size exist, e.g. power generation units, blast furnaces, cement kilns, oil refineries, international air and marine transport, etc. Sectors are regulated separately and can opt for stepwise increasing emission taxes or for regularly auctioned emission permits. Permit auctions are price driven, avoiding the unsolvable mess of quota assignments across sectors. Revenues of taxes and auctions are assigned to the countries where the activities are located with suitable rules for international air and marine transport.

2. Non-enumerable energy-uses are submitted to stepwise increasing taxing through a tax reform designed and implemented by country (with help by IMF, World Bank, ASEAN, LACEA, etc.). Countries enjoy degrees of freedom to adapt tax reforms and abolish subsidies for fossil fuel and grid electricity to national conditions and preferences. "Climate taxes," including auction revenues from enumerable activities, are earmarked to assess the yearly climate tax account. This account is expressed as a percent of GDP to monitor progress while avoiding exchange rate problems. Also commercial energy intensity and carbon intensity (neutralising the impact of nuclear power and adding the effects of forestation and land-use) are yearly assessed. The three indicators are derived from readily available statistics (national accounts and energy balances, complemented with land-use and forestry data).
3. Instead of Kyoto-like targets, the UNFCCC (United Nations Framework Convention on Climate Change) agrees on trajectories the above three indicators have to follow per country, taking into account starting levels and feasible paces and accelerations. Cutting energy and carbon intensities faster than population and wealth growth rates guarantees decreasing carbon emissions and will boost sustainable technologies.
4. Revenues from climate taxes and auctions represent the public's payment for using the earth's atmosphere as a public good and fall to the treasuries of the nations. Most of it will need allocation to energy efficiency and renewable energy investments, R&D and compensatory measures for people unevenly affected by the transition. Part of the revenues cashed by wealthy nations is transferred to developing nations.
5. The Global Climate Fund is funded by wealthy countries for providing drawing rights to poorer countries. Payments and receipts depend on the countries' GDP/capita and on their performance in tax reforms, energy and carbon intensity reductions. Self-regulating transfer mechanisms are adopted (Verbruggen, 2008b).

5. Conclusion

It is high time to denounce the prejudiced maxim that 'taxing energy is politically not feasible'. Breaking the locks on economic instruments is necessary to safeguard our common future against disastrous climate change and nuclear risks.

A growing majority of the public understands that personal longer-term interest is served by effective climate policies making higher energy prices necessary (BBC, 2007). Daily decisions are rooted in personal self-interest of billions of decision-makers that make their counts with the help of price signals (Adam Smith). Only end-use energy prices can convey the truth continuously to the billions of decision makers. Policy makers disregarding this basic law of economics are like engineers disregarding the basic laws of thermodynamics in designing machinery: both efforts are a waste of time and money.

When policy makers continue to resign their basic duty of climate tax reform, private companies and resource owners will deliver price pressure by cashing higher royalties and profits. This loads a double burden on citizens that also must finance the transition to

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low-carbon technologies and lifestyles. Rejecting climate tax reform is ‘the greatest and widest-ranging policy failure ever seen’.
A fresh, market economy based CC policy is ready for design by the UN with a leading role for the world’s largest economy. The ball is back in Washington waiting for the new president to score.

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