The Carbon Cost of Crime and Its Implications

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Secured by Design

SBD

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Summary

The report documents the failure to assess the carbon footprint of crime and responses to crime, both nationally and globally and speculates on reasons for this omission. It reviews relevant literatures and notes the absence of recognition of the nexus between crime and carbon-profligate lifestyles. The writers contend that such recognition would profoundly influence social and criminal justice policy. The precise quantification of the carbon costs of crime is beyond the scope of this report, to say nothing of the competence of its writers. While precision is not a realistic aim given the previous apparent neglect of the topic, and revision of the preliminary estimates contained herein inevitable and welcome, nonetheless it seems clear that the direct carbon costs of crime are substantial and the consequential costs more so, to the point where it is difficult to envisage a high crime society being a low carbon society. Recognition of this would lead to a major shift in policy favouring primary crime prevention through the design, implementation and maintenance of products and services less prone to crime.

The report tentatively and conservatively estimates the carbon cost of crime in England and Wales at an annual minimum of 6000000 tonnes of CO_2 equivalent. Estimates up to six times that amount could be justified if the carbon cost of moving home were factored in, given that crime is cited as the primary reason for moving home. The costs of crime, both fiscal and carbon, would be a matter for regret rather than action were it not for the demonstrable success of schemes to design out crime, for example from residential environments. At current domestic burglary rates (expected to rise in response to economic recession) the marginal carbon cost of building a home to Secured By Design standards would be recovered within four years, given the observed reduction in a mix of offences associated with the implementation of such standards, and recent evidence about the long duration and increased magnitude of the crime reduction gains afforded by SBD. General implementation of such standards alongside other developments in predictive patrolling could serve to reduce carbon costs further, through a variety of routes from the greater longevity of police vehicles by diminished instant response demands through to reduced court and criminal justice costs.

The scope for further improvement in designing out crime from environments seems considerable, and an intensive programme of research to explore

avenues for advance is advocated. This is not merely justified in itself, but is important for crime reduction to take its place in the greening of social policy generally. Ecological economics seeks to maximise the use of raw materials, and crime prevention through environmental design provides one means of giving effect to that principle whose promise has already been identified and partially realised.

Introduction

What is supposed to be sustainable in sustainable development?
Daly (2002) defines it as follows:

"…the entropic physical flow from nature's sources through the economy and back to nature's sinks, is to be non-declining. More exactly, the capacity of the ecosystem to sustain those flows is not to be run down. Natural capital is to be kept intact" (p1).

Perhaps the most significant change in economic thinking of the last decade has been the development of Daly's thinking into the discipline of eco-accounting (see for example Wackernagel 2006, Gray 2006, Owen 2007). This considers the earth's biological capacity against current consumption patterns, concluding that the current lifestyle of Western countries would require several earths to be indefinitely sustainable. Western countries have a particular obligation in achieving sustainability, since developing countries are understandably resentful that their citizens are to be denied comforts and facilities whose previous reckless use by the West has led to the global problem of climate change (see for example Chopra et al 2001).

There is now emergent scientific consensus that the consequences, particularly the climate implications, of current energy profligacy, are apocalyptic. This is even evident in the politically compromised prose of the 2007 synthesis report of the Inter-Governmental Panel on Climate Change (IPCC) and the (uncompromised) Stern Report on the economic implications of climate change. In the summary for policymakers of the 2007 synthesis report of the IPCC the matter is presented most directly. We read

"Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level" (p2)

and

"Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG [greenhouse gas] concentrations" (p5).

The Stern Report (2007) asserts the anthropogenic origin of climate change unequivocally, and argues that failure to address the issue now will require vastly greater expenditure later.

As time goes by, each science-based review of global warming trends seems more depressing than the last. In a public lecture given at University College London on February 4th 2009, the UK Government's Chief Scientific Adviser, Sir John Beddington, notes how (inter alia) Arctic ice extent and UK temperature projections are deviating increasingly from model predictions in the undesirable direction.[1] On June 18th 2009, the UK Climate Impacts Programme published a report (amended slightly the following month) [2] produced a range of estimates which The Times (18th June 2009 p3) summarised as "the bleakest official assessment yet of the impact of climate change in Britain over the rest of this century". In August, United Nations Secretary-General Ban-Ki Moon noted that 'The loss of ice in the Arctic ...is happening at a rate 30 years ahead of schedule. "Our foot is on the gas pedal, and it is time we put it off," he said. "We must stop this from further happening," the Secretary-General stressed. "Unless we fight climate change, unless we stop this trend, we'll have devastating consequences for humanity." [3]

The climate change issue is so fundamental that it should permeate all policy areas. To anticipate a point which will be laboured a little later, the nexus between crime and climate change remains generally unacknowledged. The website of the UK Climate Impacts Programme contains the word crime just once, specifically "…includes consideration of climate change, alongside other threats such as crime, terrorism and global conflict.", representing crime and climate change as processes occurring in parallel, rather than closely linked, in part as cause and effect.[4]

Ecological economics is technically complex. However the central idea underpinning a green society is the minimisation of extraction of natural resources and the maximisation of use of those resources once extracted, to the point where extraction and renewal balance. All actions which deplete resources by reducing their longevity in use are inimical to sustainable

[1] http://www.ucl.ac.uk/environment-institute/News/Beddington.pdf, accessed July 12th 2009
[2] http://ukclimateprojections.defra.gov.uk/content/view/982/527/, accessed July 12th 2009.
[3] http://www.un.org/apps/news/story.asp?NewsID=31917&Cr=climate+change&Cr1=, accessed Sept 10th 2009.
[4] http://www.ukcip.org.uk/, accessed July 14th 2009.

development. Crime is one route by which the longevity in use of natural resources is reduced.

Herman Daly was senior economist in the environment department of the World Bank, and is a prominent writer and thinker about sustainability. He recounts (2008) his experiences there and contends that "the idea that economic growth should be constrained by the environment was too much for the World Bank in 1992 and still is today" (p46). He envisages (Daly 2002, 2007) a steady state economy in which the physical scale of our activities returns to and remains at a level which the planet is able to sustain. One interesting way in which he reckons this aim can be approached is by the shift of taxation to the point of extraction of raw materials. Making raw materials more expensive means that, once these are extracted, an incentive exists to husband these resources, to maintain and re-use them. The philosophy which this enshrines applies to crime reduction. In an e-mail exchange with the second author, Daly welcomes the application of his principles to designing out crime. "Value added by labour and capital to natural resources is what we want to encourage, so don't tax it. Depletion and pollution (resource throughput) is basically a cost to be minimized so tax it." Insofar as the protection of new buildings and products against crime features in their design, their longevity will increase and their embedded energy retained. The branch of criminology/crime science which emphasises avoidance of the criminogenic design of buildings, products and services is known as situational crime prevention, and in its application to the built environment as CPTED (Crime Prevention through Environmental Design).

The Crime-Carbon Blind Spot

In the writers' view, there is a blind spot in sustainability visions where the carbon cost of human conflicts, including crime, ought to be. Googling 'Carbon footprint of crime' yields effectively nothing. Limiting the search to Google Scholar does not improve matters. Crime does not appear in the index of the popular Carbon Calculator (Lynas 2007) nor in the index to the Stern Report (2005). A fuller discussion of the Stern Report and its implications will be undertaken a little later. Searching Criminal Justice Abstracts using the keyword 'carbon' yields much about suicide by carbon monoxide poisoning, but nothing about the carbon costs of crime. Searching on crime in the Carbon Trust website yields nothing. While the Commission on Sustainable

Development lists 123 mentions of crime on its website, its document 'Securing the Future' which details the 250 'promises, actions and challenges' of its delivery strategy, contains no mention of crime.[5] The Green Party has fourteen policy development groups, from agriculture to transport, but next to nothing directly on crime. Important texts on climate change and sustainable development do not index crime (e.g. Hoffman 2007; Rogers Jalal and Boyd 2008; Maslin 2009). The leading text on Environmental Science in Building (McMullan 2007) does not mention crime or security. Neither does the website of the Climate Outreach and Information Network.[6]
The Government's definition of a zero-carbon home does not mention crime and the contingent costs which crime would cause.[7] Examination of the websites of police forces and the Home Office reinforce the view that the carbon cost of security is not set against the carbon cost of preventable crime. For example, the Joint Annual Environment Report (2006/7) of the Metropolitan Police Authority/Metropolitan Police Service (MPS) discusses progress against environmental targets of MPS working, but does so simply in terms of (for example) operation of its own vehicle fleet, rather than in relation to the ecological footprint of crime itself. Likewise the Home Office's Sustainable Development Action Plan 2007[8] deals with energy expenditure in the Home Office estate, carbon offset schemes for Ministerial travel, and the like – as with the MPS document, not crime-contingent carbon. The document is however important for the recognition in its foreword that crime has a carbon footprint. Then Minister Meg Hillier writes

"Much of [the Home Office's] work makes a significant contribution towards sustainable development in the UK. Whether it is through reducing crime or the fear of crime, tackling the problem of alcohol dependency, or the measures it has introduced to tackle anti-social behaviour, the Department's work underpins key aspects of the UK Government's Sustainable Development Strategy 'Securing the Future'. The Strategy's goal seeks to enable 'people throughout the world to satisfy their basic needs and enjoy a better quality of life without compromising the quality of life of future generations'" (p2).

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[5] http://www.sd-commission.org.uk/publications/downloads/050307News%20-%20250%20Commitments%20in%20the%20Gov%20strategy.pdf accessed 8th Jan 2009
[6] http://coinet.org.uk/ accessed Sept 12th 2009.
[7] http://www.communities.gov.uk/documents/planningandbuilding/pdf/1101177.pdf accessed 8th January 2009
[8] http://www.homeoffice.gov.uk/documents/sustainable-dev-plan?view=Binary accessed 8th Jan 2009

In short, the core argument of this brief report is that considering crime and its reduction in terms of its carbon cost has not featured prominently, if at all, in the relevant literature.[9] What are the possible reasons for this, and are they defensible?

The primary putative justification for the omission is that the carbon costs of crime are contingent rather than intrinsic. Left alone, a place or person would not suffer any carbon costs beyond those incurred in its structure and legitimate operation. Destruction or theft of property requiring its replacement, and criminal harms to people requiring treatment, and the energy cost of both in emergency services and criminal justice response to crime events, taken together, represent the carbon cost of crime. There must be more to it than that, however, since almost all carbon costs are contingent on human behaviour in one way or another. Cars emit CO2 only because people drive them. Power stations do so because people heat and light their homes and workplaces. There are perhaps four factors which place crime outside the mainstream of carbon costing. These are:

1. The mental unavailability of alternatives which would be less carbon costly. The alternative to a high-emitting car is a zero-emitting car or the bus. This is the mentally accessible option when thinking about transport. When it comes to crime, the most accessible options (extra police, more prisons) are themselves carbon costly. Only when low carbon, demonstrably effective, methods of crime control spring readily to the political and public mind will the carbon cost of crime be seriously considered. A parallel can be drawn with war. War is hugely costly in carbon but that cost is not a central consideration. The Pentagon is the largest single consumer of oil in the world. Only thirty-five countries consume more.[10] Only if one could implement effective ways of preventing war would the carbon cost of war come fully into focus. Breathing is another activity bearing a carbon cost. Until an acceptable means of breathing less is devised, there is little ethical scope for thinking of breath reduction as a means of reducing one's carbon footprint.

[9] An interesting example of the incorporation of a range of costs in a context with some points of comparability, lead-safe window replacement and childhood lead poisoning, is to be found at Nevin et al 2007)

[10] http://www.nebraskansforpeace.org/globalwarming/carbonfootprintiraqwar.php, accessed 10th September 2009.

2. The degree of contingency and consequent mental accessibility of carbon reduction techniques. How direct is the perceived link between action and carbon? Driving a 4x4 fast has direct perceptible links with the emission of carbon. Chopping a tree down has a slightly less direct perceptible link, in that it requires knowledge of the carbon sequestration function of trees. Recycling requires a similarly slight level of awareness of links. Recycling avoids the energy-intensive extraction of raw materials. However thinking of crime or the importation of tropical fruit (for example) in terms of its carbon cost requires awareness of longer and more complex cause-effect sequences.
3. The costing of remedies but not problems. In carrying out a recent study of the perceived tensions between security and sustainability (Armitage et al. 2008), it became clear that such tensions arose because, while the carbon costs of security precautions were considered, the carbon costs of preventable crime were not. This is almost certainly because the relationship between crime and sustainability has been little studied and is attended by many imponderables. The writers attribute the current mindset to this absence. However, absence of evidence is not evidence of absence and the issue is too important to justify delay in addressing it. To restate, the crucial practical point is that effective preventive measures must be assessed not solely in relation to the energy they consume, but in relation to the energy saved by the loss and damage no longer incurred, and by the health, insurance and criminal justice expenditure no longer required. Until this is done, the danger remains that effective crime prevention may be forgone on the basis of the energy it consumes, even when its installation represents a substantial downstream net energy saving. This report does not claim to go beyond an initial demonstration that crime is carbon costly, and that a green policy should reflect that. (Incidentally, this one-eyed approach to the costs of greening policy is not limited to crime. On July 16th 2009, the Daily Telegraph (p4) headed a feature 'Going green could put £250 a year on bills' by ignoring cost savings consequent upon energy savings.)
4. The belief that effective crime prevention tends to a police state. If crime reduction relies on enforcement rather than proaction, this will be the case. However that belief is just a general paradox applied to the crime context. The general paradox is that green policies concentrate on individual behaviours which will have little effect, rather than collective pre-emptive behaviour which will. The knee-jerk response to

> sustainability will certainly feature the word 'recycling', for example. The distinction is made (Gardner and Stern, reported in The Psychologist, Nov 2008. See also Stern 2005) between proaction and curtailment behaviours. Curtailment behaviours (turning out lights, turning off air-conditioning) make only modest carbon savings. Gardner and Stern write "not only is efficiency generally more effective than containment, but it has the important psychological advantage of requiring only one or a few actions. Curtailment actions must be repeated continuously over time to achieve their optimal effect, whereas efficiency-boosting actions, taken infrequently or only once, have lasting effects with little need for continuing attention and effort.' Engineers refer to this kind of issue in terms of leverage effects, often depicted as graphs of see-saws with different pivot points relating to different phases of a project, illustrating how much effort needs to be expended at any stage in a project in order to achieve a stated goal. To restate the central point here, the fear of a police state is predicated on a mistaken view of effective crime reduction.

The Stern Report (2005) is the most encyclopaedic economic analysis of climate change available. Yet neither crime nor war appears in the topic index. Factors constituting social wellbeing (like health, education and the environment) are treated (p33), but crime and disorder are not. Large-scale population movements and their consequences in social upheaval are mentioned in places (e.g. page 331), those mentions generally in apocalyptic terms, rather than as the everyday undercurrent of crime and disorder as extant social problems. Close reading of Stern suggests to the present writers at least that three factors led to the exclusion of conflicts by crime or war.

First, margins of uncertainty in Stern's economic analyses were already high, and to add anticipated conflict would have been necessarily speculative and a hostage to fortune in his general analysis.

Second, there were basic arguments to be advanced concerning equitable distributions, and the economic convention of time discounting, whereby an increment in future consumption is deemed to be worth less than an increment in present consumption, on the basis that people are likely to be richer in the future and anyway they prefer jam today to jam tomorrow. When welfare crosses generations, Stern is dubious about this conventional practice,

and cites one commentator's dismissal of it as 'ethically indefensible' (p35, and see discussion in postscript, (p649-657). In the only apparent concession to humour (albeit dark) in the near seven hundred pages of the report, we read "we apply only a low discounting to the future simply because it is the future (we account for the possibility of extinction)" (p654). In more sombre vein, we read "Choosing a high rate of pure time preference to analyse a long term issue that affects the global environment is to make a profound ethical choice with, in this case, irreversible effects on future generations. It is as though a grandparent is saying to their grandchild, because you will live your life 50 years after mine, I place far less value on your well-being than I do on myself and my current neighbours, and therefore I am ready to take decisions with severe and irreversible implications for you" (p654). As in his discussion of discounting, Stern's treatment of equity is invaluable, and may be thought to leave little room for the specifics of crime and disorder.

Third, a core purpose of Stern's review was to lay down the parameters of a market in carbon, with the social cost of carbon agreed globally (p384 et seq). With an efficient market, much of the carbon profligacy would disappear. That said, Stern acknowledges the imperfection of the market, and makes suggestions which are directly relevant to issues of crime control.

In short, reading Herman Daly and Nicholas Stern provided something of a shock to the present writers in showing how ill-fitted the assumptions and conventions of current economic analysis are to the unique challenges of climate change. It is no surprise and no criticism that the specifics of crime and disorder are not discussed directly. However, Stern makes suggestions which speak to crime and disorder control. For example, he sees a severe danger in continued investment in high carbon technologies in respect of long-lasting products. Such a danger has been realised, for example, in the recent UK vehicle scrappage scheme, which does not differentially reward the purchase of low-emitting new cars over high-emitting new cars, nor take account of the embedded energy of vehicle manufacture. In the emphasis taken later, the design of places without considering crime costs is an example of investment in high carbon technologies, albeit that the technology is high carbon in the sense of the costs of maintaining order.

In an imperfect market, Stern identifies a number of goals for government to create a suitable investment climate for new technologies (p561). They are

listed below, and those that are self-evidently relevant to place design are italicised. A case could be made for all the others, but they are omitted lest some be thought tendentious.

- *Removal of broad-based energy subsidies and tariff barriers.*
- *Establishment of credible legal and regulatory frameworks.*
- *Creation of market-based approaches such as emissions trading, energy performance contracts and credit guarantees*
- *Information dissemination regarding energy savings and clean energy options*
- *Including environmental costs in the price for energy services*
- *Strengthening intellectual property rights*
- *Developing product standards*
- *Making markets more transparent.*

Tentatively Carbon Costing Crime

The Home Office has already provided a financial cost breakdown of crime in 2003/4 (Dubourg and Hamed 2005) and this was taken as the starting point for estimation. The costs are separated into those in anticipation of crime and costs in consequence of crime. Only costs in consequence of crime are included in the analysis below, although it will be claimed that some costs deemed to be in anticipation of crime are equally properly regarded as being a response to previous crime suffered.

The Dubourg and Hamed costs are adjusted for inflation between January 2004 and June 2007 to correct for changes in the period between the data used by them and the point as which they were put alongside crime data. The 'lost output' component is omitted, as is the very substantial 'Physical and Emotional Impact on Victims' element. The lost output element is ambiguous as to its implications for carbon emissions. Lost output reduces emissions, but energy-consuming behaviour of those not working offsets it. The physical and emotional impact on victims is monetarised on the basis of QALYs (quality

adjusted life years)[11] whose carbon implications seem likewise ambiguous. The consequential costs of crime which remain are

- Value of property stolen
- Property damaged/destroyed
- Property recovered (negative value)
- Victim Services
- Health Services
- Criminal Justice System

On that basis, average consequential cost per offence in mid-2007 was as set out in the second column of Table 1 below.

The conversion to consequential cost in carbon tonnes is undertaken by a formula of the International Energy Agency, which calculates that every $1000 of goods and services produced using today's technology releases 0.5 tonnes of CO_2 into the atmosphere (IEA 2007). At the time of calculation, the US dollar bought .5173 £ sterling. Thus £1034.6 of goods and services yielded 1 tonne of emitted CO_2. The reader may wish justification of this approach. First, by using the Home Office's careful and systematic review of fiscal costs, criticism that costs were inappropriate or inflated will be bypassed. Second, the writers can think of no reason why the mix of crime-related goods and services should have different carbon footprints to goods and services generally. The uncertainty introduced by the second point seems more than offset by the confidence gained by the first.

It will be seen that, on this method of calculation, recorded crime costs 5.4 million tonnes of emitted CO_2. This conservative figure (see below) represents some 1% of total UK emissions.[12]

[11] Interestingly in this context, the section of the Home Office responsible for measuring costs of crime is currently inviting expressions of interest to research the crime costs of a QALY. This perhaps indicates some uncertainty about the QALY component of the crime costs measure as it stands.

[12] http://www.defra.gov.uk/news/2008/080131a.htm accessed 18th Nov 2008.

Table 1. Estimated carbon costs of recorded crime

Offence	Consequential cost (£)	Consequential cost (CO_2 tonnes)	Number of recorded offences in 2007[1]	Aggregate carbon cost (tonnes)
Homicide	176533	170.63	772	131726
Serious Wounding	18840	18.21	18045	328690
Other Wounding	2800	2.14	446241	954956
Sexual Offences	5095	4.92	55531	273212
Common assault	461	0.45	200725	90326
Robbery	3842	3.71	93041	345182
Burglary in Dwelling	2591	2.50	286482	716250
Burglary non-Dwelling[2]	2591	2.50	316374	790934
Theft not vehicle	577	0.56	1150903	644534
Theft of Vehicle	2849	2.75	181763	499903
Theft from Vehicle	487	0.47	467514	219732
Attempted vehicle theft[3]	264	0.26	61485	15986
Criminal damage	408	0.39	1110643	433151
Total				5444582

Notes:

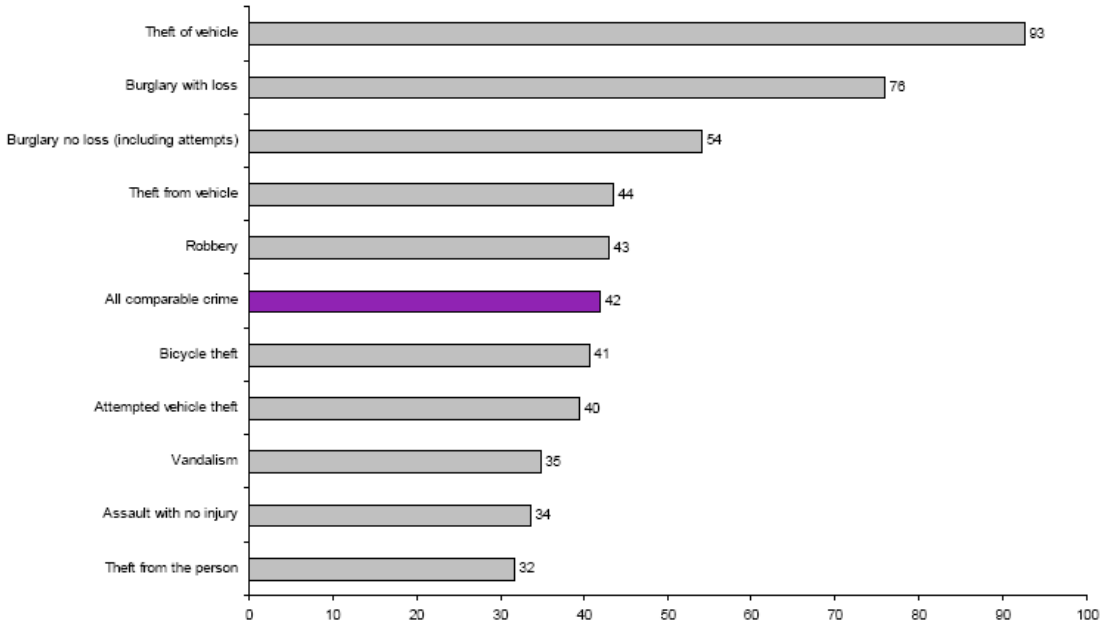
1. 2007 figures were taken as the average of 2006/7 and 2007/8 figures.
2. Costs taken to be equivalent to those for domestic burglary
3. Taken as 'Interfering with a vehicle'.

The above estimates are intended merely to demonstrate that crime is not carbon neutral. As for carbon (or cost) estimates of behaviour generally, they do not set the costs against what a person (in this case an offender) would be doing were they not committing the offence. There are many reasons to suppose that the estimates are in fact a gross understatement of the real carbon costs of crime. Some of these will be rehearsed.

Non-reporting/recording

Table 1 was based upon police recorded crimes. This was because only they incur criminal justice system costs. However, the consequence is to neglect the costs of the 58% of crimes not recorded by the police. Figure 1 shows the rate of report by offence type.

Figure 1. Reporting rates to the police 2007/8 (taken from Kershaw et al 2008)



Let us set aside the reporting-recording distinction, for the sake of simplicity.

To take one example, the reporting rate for robbery is 43%. Thus 57% of robberies and their associated losses are omitted from Table 1. Accepting that these will generally be the less serious instances of the offence, and arbitrarily assigning half the loss and damage figures in Dubourg and Hamed (2005) to

unreported crimes, the additional carbon costs calculable would be as in Table 2.

Table 2. Estimated carbon costs of unreported crime (losses set as half of Dubourg and Hamed to reflect certain lower seriousness of unreported offences)

Offence	Consequential cost (£)[1]	Consequential cost (CO_2 tonnes)	Number of unreported offences in 2007	Aggregate carbon cost (tonnes)
Theft of Vehicle	1217	1.18	13681	16098
Domestic Burglary	567	0.55	90468	49757
Burglary non-Dwelling	567	0.55	99907	54948
Theft from Vehicle	199	0.19	595017	113053
Robbery	57	0.06	123333	7400
Bicycle Theft[1]	101	0.10	463000	46300
Attempted Vehicle Theft	86	0.08	92228	7378
Criminal Damage	119	0.11	2062623	226889
Theft from the Person[1]	101	0.10	575500	57550
Total				579373

Notes

1. All offences of these types are included here; both reported and unreported, being available from BCS tables and offences not featuring separately in Table 1.

Context

To put this into context, the report of the International Energy Agency 'CO_2 Emissions from Fuel Combustion 1971-2005', total UK emissions in 2005 were 529.9 million tonnes, of which the residential sector accounted for 79.9 million tonnes. These figures are not directly comparable with those calculated for crime, both because crime costs straddle sectors and the IEA data are UK rather than England and Wales based. It is nonetheless clear that the carbon costs of crime are not trivial in relation to national totals.

Unconsidered costs

As repeatedly stressed, the purpose of the present paper is to invite consideration of the carbon cost of crime, rather than to offer precision. Alternative sources will yield different numbers. For example, the carbon cost of arson alone is calculable on the same basis as 1.3 million tonnes, not including the direct emission of carbon.[13]

The Dubourg and Hamed work distinguishes costs in anticipation of crime and costs in response to crime. However costs in response to crime may be supplemented by costs in anticipation of the next crime. Thus some component of costs in anticipation of crime (defensive expenditure and insurance administration) may equally properly be considered as costs consequential upon crime. To that extent, they will elevate the figures above.

The second author worked near the infamous Hulme estate in Manchester, and saw it through its life-cycle, all the way from elegant architects' models, complete with trees and happy people, through its swift descent into effectively free student accommodation and subsequent demolition with the loss of the embedded energy in the still-serviceable building fabric.[14] Premature demolition is carbon-profligate, and is the common fate of crime-challenged housing developments.

One response to crime victimisation is to move home. A survey by the Abbey National bank in 2007 concluded "5.3 million people said their main reason for moving home in the last five years was due to crime levels in their area and a

[13] http://www.crimereduction.homeoffice.gov.uk/toolkits/an020304.htm accessed July 17th 2009.
[14] http://www.exhulme.co.uk/index.php accessed Nov 12th 2008.

desire to move to a location where they would feel safer."[15] The costs of moving home are very variable but are currently estimated at £5800 on a £200000 house.[16] This would equate to 5.6 tonnes of CO2 emitted per house move. If only one million of the 5.3 million claimed by Abbey National really moved because of crime, this would virtually double the estimated carbon costs of crime set out above.

The cost of manufacture, operation and disposal of a product is a complex set of elements whose totality is not captured in purchase and replacement costs. For example, an unpublished analysis of the whole life costs of a Volkswagen Golf shows it to consume an average of 113 MWh (MegaWatt hours) in primary energy, and to emit 27 tonnes of CO2 and 77kg of NOx over its lifetime. How much of that can be put down as a crime cost if stolen depends upon many factors, such as whether it is recovered, whether it is dismantled or used by thieves, whether the thieves would otherwise have purchased a car, and the replacement by the crime victim, to say nothing of the insurance and vehicle licensing implications.

Lest the discussion above seem too parochial, let us consider the costs of the trade in fake pharmaceuticals, taking the counterfeiting of anti-malarial drugs as an example. A treatment of choice for malaria is the drug artesunate. An increasing form of counterfeiting of the drug involves incorporating ineffective levels of active ingredients in artesunate tablets... [This] will greatly increase the risk for the selection and spread of malaria parasites that are resistant to artemisinin derivatives. That could lead to a loss of effectiveness for these essential medicines and an avoidable failure of malarial control." [17] The inclusion is small amounts of the active ingredient also fools the quality control test for the medication. The consequence would be the cost (fiscal and carbon) of the medical infrastructure to treat and manage the patients infected by artesunate-resistant malaria parasites. The scale of the cost is evident in the fact that between one third and half a billion people now contract malaria every year.

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[15] http://www.aboutproperty.co.uk/news/buying-and-selling-property/buying-and-selling-tips/crime-and-bad-neighbours-top-reasons-moving-$467498.htm accessed Nov 12th 2008

[16] http://www.alexanderhall.co.uk/mortgages/moving-home/cost-of-moving-home.html accessed Nov 12th 2008.

[17] http://www.sciencedaily.com/releases/2006/06/060619005440.htm accessed 17th July 2009.

But Does Anything Work?

A comparison was made earlier between crime and breathing. While seen as inevitable, calculating the carbon costs of crime and breathing are equally futile. However, there is much evidence that crime can be reduced,[18] and that the engineering of places may be a particularly fruitful means of achieving this. It is perhaps tedious to document the copious evidence for place design as crime reductive (see for example Eck and Weisburd 1995; Eck 1997; Felson 2002; Poyner 2005).

In the spirit of the Stern review's advocacy of government promulgation of standards in crime reduction, we focus below on the Secured by Design standards for residential developments. There have been four published evaluations of the effectiveness of the SBD scheme (Brown, 1999; Pascoe, 1999; Armitage, 2000, Teedon and Reid, 2009) each concluding that SBD confers a crime reduction advantage.

However two recent pieces of work take the debate forward. First, Armitage and Monchuk (2009) revisited and extended the work of Armitage (2000) to determine whether the crime reduction advantage conferred by SBD had endured a decade later. This of course is crucially important for carbon costing. They write:

- The evaluation also included an analysis of two randomly selected matched pairs taken from the original evaluation of SBD within West Yorkshire (1999). The aim was to establish whether the crime reduction effects of SBD had been sustained over a ten-year period.
- The results were extremely positive and revealed that for both matched pairs the SBD development was performing either the **same** or better than the non-SBD development for the two time periods 1999/2000 and 2007/2008.
- For matched pair one (Halifax), crime levels on both the SBD and non-SBD development were the same in 1999/2000, yet by 2007/2008 the SBD development was outperforming the non-SBD development with just one crime in the SBD development and eight in the non-SBD development.

[18] http://www.popcenter.org/ accessed 12th September 2009.

- For matched pair two (Leeds) the SBD development performed better than the non-SBD development for both time periods. In 1999/2000 there was one crime on the SBD development and five on the non-SBD development. In 2007/2008, there were three crimes on the SBD development and six on the non-SBD development.

The other aspect of Armitage and Monchuk (2009) which is particularly noteworthy is their analyses of developments built since the original Armitage (2000) work. It reinforces the view that SBD as an evolving standard confers ever greater crime reduction advantage. Using the figures from Armitage and Monchuk, and the costs of SBD compliance, fiscal and carbon costs would be recovered by crime reduction alone over some four years, to say nothing of other diminished costs such as health care as a result of more contented residents.

The second work of relevance addressed the hitherto vexed question of permeability and crime risk (Johnson and Bowers 2009). In contrast to all of the previous research, the approach to analysis takes into account the multi-level structure of the data analysed. Thus the effect of road segment type can be calculated independent of variables like household numbers, population density, ethnicity and so on. In short, the findings demonstrate that increased permeability is associated with elevated burglary risk, that burglary risk is lower on cul-de-sacs (particularly those that are sinuous in nature. The central data are presented as Table 3 below

Table 3: Risk of burglary by different types of road segment

	Burglary Rate	N (segments)
Major Roads	46.29	911
Minor Road	36.95	666
Local Road	29.17	8039
Cul-de-Sacs:		
Linear	24.50	884
Sinuous	18.03	2152
Private Road	15.38	246
Segments off Major Rds:		
Local	41.29	1223
Linear Cul-de-Sacs	23.89	236

(Johnson and Bowers, in press.)

The Johnson and Bowers work, in the writers' view, closes the book on the permeability debate in favour of the SBD characterisation, and adds some additional information about cul-de-sac sinuosity.

What Next?

There are two policy agendas, specific and general. The specific agenda is that, given the accumulated evidence about SBD efficacy and the role of permeability of street networks in crime, SBD should be mandatory in new developments and in refurbishment, and that SBD standards should continue to evolve, informed by the Johnson and Bowers research.

Alongside this, the more general policy approach requires that carbon costing of crime should be undertaken in a more refined way than was possible here, and disseminated widely. A local start to this process has been made by David Lancaster of Northampton Police who has devised an ingenious model for routinising these calculations. An integrated research programme to take forward place and product design with an emission reduction agenda is also essential.

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