Health impacts of the transport transition

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1. Abstract

It is an inconvenient truth that the twin issues of climate change and oil scarcity imply a widespread energy transition with profound effects on transport and health, amplifying existing inequalities and health risks. On the other hand, it is a convenient truth that there are also health co-benefits. This paper briefly reviews the evidence for climate change, fossil fuel scarcity and health co-benefits of change. The transition will occur during the lifetime of all projects and policies started today and should be considered in all impact assessments.

2. Introduction

This paper builds on a theme introduced at IAIA'09 [1] and elaborated at HIA'09 [2]. Fossil fuel use may reduce rapidly and this has consequences for the practice of Health Impact Assessment. One of the priority areas for analysis is the transport sector.

Our civilisation has become uniquely dependent for its transport on a cheap, high density, light weight, liquid fuel. The energy density of oil is extraordinary. One small barrel does the work of an army of human slaves. Yet the resource is finite and has been squandered. There is no practical replacement. Burning oil for transport is a significant contributor to greenhouse gas (GHG) concentrations and these threaten to destabilise the climate and consequently our health. At the same time, overdependence on private cars for transport is also detrimental to our health.

It is now considered normal to use a car to travel distances of less than 1km. Many children do not know how to walk to school. An increasing percentage of the population are overweight or obese. Some 50% of urban car journeys in the UK are less than 5 km [3].

Our transport system is unsustainable for three major reasons: climate change, oil scarcity, and health.

2.1 Climate change

The estimated current annual human health impacts of climate change are as follows [4].

- 300,000 people are dying;
- 325 million are seriously affected;
- $125 billion economic losses are caused;
- 500 million people are at extreme risk;
- 4 billion people are vulnerable.

The future health impacts, and the requirements for managing them, have been discussed extensively [5].

The figures above represent averages based on projected trends and carry a significant margin of error. The real numbers could be lower or higher. The figures may represent the visible "tip of the iceberg". In any case, the figures should be sufficient to ensure that HIAs of transport plans include this issue. The health and well-being of a large number of people will depend on climate stabilization and adaptation.

2.2 Oil scarcity

We face a catastrophic loss of transport fuel, yet have nothing with which to replace it. Renewable energy and nuclear energy can provide a percentage of our total electricity needs. But we have no method of storing electricity at the same energy density as oil. None of the batteries available today, or the hydrogen storage systems, provides a similar energy density. Electricity alone probably cannot power our road transport fleet.

Figure 1 illustrates the probable timeline of global oil supply depletion. The future shape of the global oil production curve is not known with any accuracy. But there is good evidence, based on national production curves, that it will peak [6]. The peak may occur within the next two decades, and may have already occurred [7]. There is a 30-40 year lag between discovery and production so information about past discovery is used to predict future production. Discovery peaked about 30-40 years ago so we are currently somewhere near the peak.

The curve has two components: gross and net. The gross curve, illustrated as a solid line, is slightly skewed and with a broad base. This represents the annual rate at which oil is produced at the well-head. The net curve (dotted line) indicates the amount of available oil when the energy cost of production is included. This curve is narrower and has a much faster descent. The difference is stark and requires explanation. During the ascent, the easy oil is produced first (e.g. from shallow wells). During the descent, only the more difficult to extract oil remains (e.g. deep cold water, tar sands, bitumen). According to this theory, the descent will be very rapid.

Figure 2 illustrates the growing difference between gross and net oil production [8]. It indicates the total GHG emissions required to deliver one barrel of oil to an American refinery from different sources. The conventional oils from Saudi Arabia, Kuwait and elsewhere require relatively low energy investments in order to extract, clean and deliver. The unconventional oils, such as the heavy bitumen from Venezuela or from the Canadian oil sands require far more energy and production generates up to 10 times more GHGs. The energy return on energy invested (EROEI) falls from about 10:1 to about 2:1, or even less than 1. In consequence, the net supply of oil diminishes rapidly and the gross GHG emissions increase rapidly, contributing to climate change. (Nigeria is an exception because the high GHG emissions are attributable to the flaring of produced gas.)

The timing and breadth of the oil peak (Peak Oil) is partly determined by demand and this may continue rising exponentially, ensuring an earlier peak. As supply and demand must remain equal, the price will have to increase. Rapid increases in price may trigger economic recession leading to a reduction in demand. We can expect extreme volatility in price and availability. Our civilization is not well prepared for this and the plans in preparation today are nor designed for these stresses and may not be resilient.

Figure 1 Sketch of global gross (solid) and net (dashed) oil production

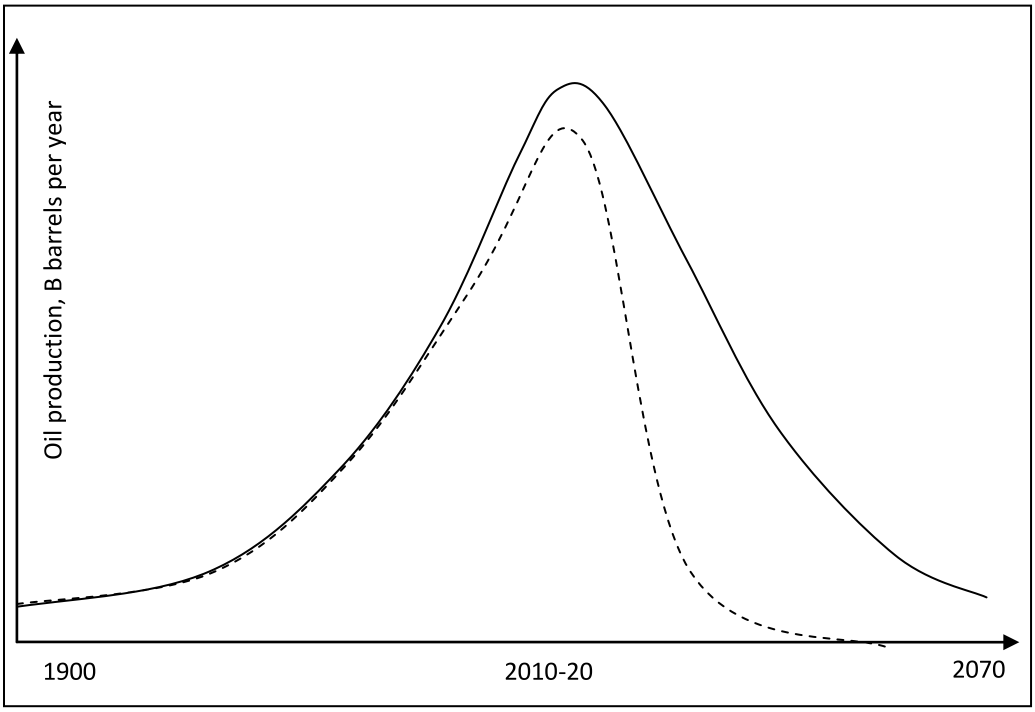
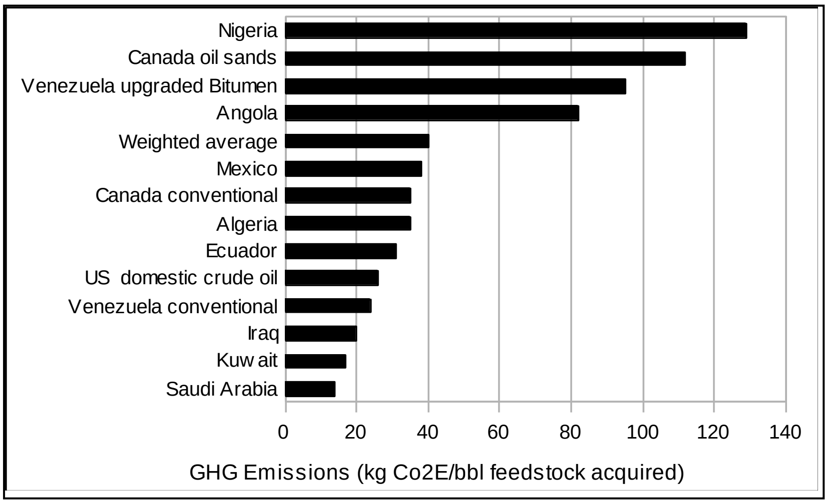


Figure 2 GHG emission hierarchy by feedstock source



Taken together, climate change and oil scarcity could amplify existing health risks and increase health inequalities [5].

3. Barriers to action

The facts about climate change and energy scarcity suggest the need for urgent and drastic action. Yet that action is not forthcoming, as the Copenhagen Summit in December 2009 amply demonstrates. There is inaction at personal, local, national and international levels. The inaction can be analysed by considering the emotional and attitudinal response to the facts. There are two main emotional responses: fear and hope. These, in turn, produce four main attitudes: denial, despair, magical rescue and transition. The magical rescue is the “deus ex machina” response; the belief that science, technology, or a supreme being will rescue us from catastrophe. The first three responses lead to inaction. The fourth response is to hope that a transition is possible from the present way of life to a more positive future in which energy consumption is much lower than today. This leads to action at a personal and professional level.

But how is such a transition to be promoted? Recent research on normal behaviour suggests that the majority of people wish to behave like their neighbours and to do whatever is considered normal [9, 10]. In this analysis, the objective is not to persuade people to abandon the norm and adopt a new and different way. Rather, the objective is to change what is believed to be the norm. Impact assessment and the IAIA conference on transitioning to a green economy both contribute to changing the norm. For example, urban transport plan designs can normalize walking, cycling and the use of public transport.

4. Health co-benefits of transport change

A major change in the way we live has benefits of many kinds. A recent paper compares the health effects, measured in disability adjusted life years (DALYs), of changes in urban land transport in two settings: London and Delhi [11]. For each setting, a business as usual projection to 2030 was compared with introduction of lower carbon emission motor vehicles, increased active travel, and a combination of the two. The analysis focused on the direct effects of pollution, physical activity and kinetic energy. Evidence was available from a number of systematic reviews and a range of key assumptions are made explicit. The study looked at the distribution of travel patterns between different modes under the three scenarios. The majority of the DALYs saved in both cities was associated with active transport rather than with low emission vehicles. The overall reduction in the burden of disease was estimated to be substantial as Table 1 indicates. Reductions in disease burden of 10-20% were estimated for ischaemic heart disease, cerebovascular disease, dementia, breast cancer, diabetes and depression. In London, an increase in the percentage of road traffic crashes could occur as a result of a substantial increase in the number of pedestrians and cyclists. In Delhi, reductions in road traffic crashes could be 27-69%. Differences between the two cities are the result of differences in current rates of air pollution and motorized transport.

Table 1 Estimated reductions in disease burden when lower emission vehicles are combined with active travel

Disease burden	London	Delhi
Ischaemic heart disease	10-19%	11-25%
Cerebovascular disease	10-18%	11-25%
Dementia	7-8%	
Breast cancer	12-13%	
Road traffic crashes	increase 19-39%	27-69%
Diabetes		6-17%
Depression		2-7%

This paper adds to a growing literature on the health co-benefits of reducing GHG emissions [12], changing diet and other measures summarised in Table 2.

Table 2 Examples of health co-benefits of transition

Intervention	Effect
Reducing GHG by 50% [13]	Reduce premature death from air pollution by 20-40%
Reduce car transport [11]	Reduce morbidity from traffic injury and lack of physical activity
Reduce obesity [14]	Save 0.4-1B tonnes CO2 per year per billion people associated with transporting overweight people
Reduce oil reliance	Reduce injury from oil wars
Contract and converge [15]	Reduce global inequalities

Not only is reduction in transport emissions beneficial for health, but reductions in obesity lead to reductions in transport emissions [14].

5. Health Impact Assessment of transport plans

There are many different settings in which Health Impact Assessments (HIA) are made of travel plans. These range from new highways, airports, ports, and railways to the regeneration of urban streets. Plan proponents are usually concerned with the rapid movement of goods and people for trade and leisure, inter-modal transfer, traffic assessment, safety, noise and other pollution and consumer satisfaction. Up to now, a "business-as-usual" model has been assumed in which oil based road vehicles are the dominant transport mode.

The HIA, on the other hand, may emphasise the direct health benefits of active transport such as walking, cycling and using public transport. As a consequence of the discussion above, HIAs also need to emphasise the cumulative impacts of fossil fuel use, the consequences of fossil fuel scarcity, and the health co-benefits of transition. The way in which this will be accomplished remains undetermined. This paper simply seeks to frame the question for discussion in a conference workshop.

We need scenarios to draw upon. The twin issues of climate change and peak oil imply a widespread energy descent transition: there will be less transport fuel available or it will be much higher priced. This will have profound effects on many aspects of modern life including: the way we travel, the food we eat, our social interactions, our leisure time activities, our work practices, the design of our homes and our urban spaces. To-date, only one country has had a positive experience of a sudden and massive restriction in fossil fuel availability: Cuba [16]. The consequence was a reduction in food supply and motorised transport. Average body mass fell and innovative solutions were introduced.

The transport transition may involve substantial reductions in the use of private, fossil fuel powered cars. There may be substitution by public transport, walking, cycling and low-range electric powered cars. This may lead to a substantial rise in physical activity and social interaction. This in turn, may lead to improvements in physical and mental health and well-being with reductions in adult and child obesity and the associated diseases such as cancer and diabetes. Social interaction may increase as communities become more localised and people encounter each other more often on the street. The widespread use of public spaces may increase security and thereby decrease fear of crime. Mental health and well-being may improve. Substantial reductions in private car use may to correspond to substantial reductions in traffic related injuries. Roads may become a safer place for bicycles and more people will use them. Commuting large distances to work using private transport will be even less practical than it is today. Social mobility will be affected and more people will work from offices in or near their homes. Conferences, such as the IAIA, will use virtual networks and video systems.

The travel miles associated with the food we eat may reduce and more of that food may be produced without inorganic fertiliser. Urban and peri-urban agriculture [17] may expand and more people may grow more of their own food on public and private land. There may be a modal shift in the distribution of trade goods from trucks to trains, with local distribution using electric vehicles. Developing economies that airfreight their agricultural produce to developed economies may suffer, unless they can demonstrate substantial co-benefits, such as the benefits associated with the Fairtrade movement [18]. Holiday travel may reduce substantially with most people choosing to take their vacations at home or in the region where they normally live. As air transport decreases, the economy of holiday destinations will be seriously affected.

Fossil fuel-based energy projects and policies that are designed to provide transport fuels will be under ever increasing public scrutiny. Unconventional energy projects such as gas to liquids, tar sands, and deep-sea cold-water oil production will be affected. As the price of oil rises, these projects will look increasingly financially attractive, but environmentally unattractive. The outcome will depend on the strength of climate change legislation, political commitment, carbon pricing, and public protest.

Change will occur during the lifetime of all projects and policies started today. Impact assessments will need to take account of them in order to understand, mitigate and enhance health gains. This is the challenge.

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