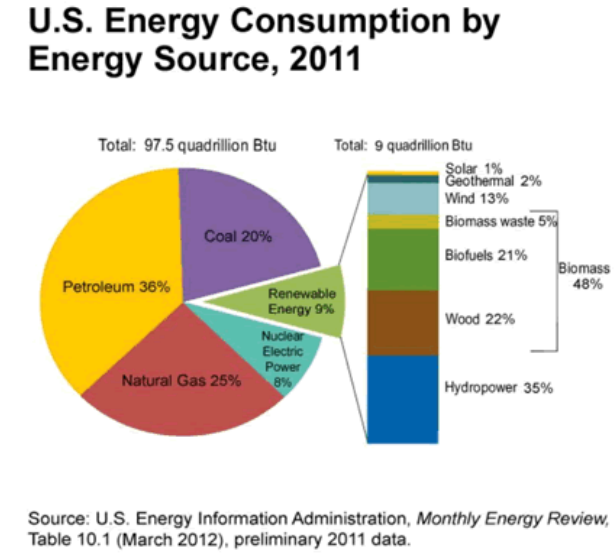
Should the provision of Renewable Energy be a Government Priority, or can it be provided by the free market?

First Prize – 2nd Year Undergraduate Category

By Daniel Sadler*

Practically without question, the most important issue the world faces today – and will continue to face – is the ever dwindling supply of fossil fuels, and, by extension, the alternatives offered by various renewable sources of energy, without which a global energy crisis is surely inevitable. The term 'renewable energy' is a broad one, and loosely encompasses wind power, solar power, hydro-electric power, tidal power, geothermal power and biomass power. Figure 1, for instance, showing the distribution of energy sources for the United States for 2011, makes clear the over-reliance on non-renewable power: petroleum contributed 36% of energy consumption, natural gas 25%, coal 20% and renewable energy only 9%.

Figure 1: US Energy Consumption by Energy Source, 2011[1]



Source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 10.1 (March 2012), preliminary 2011 data.

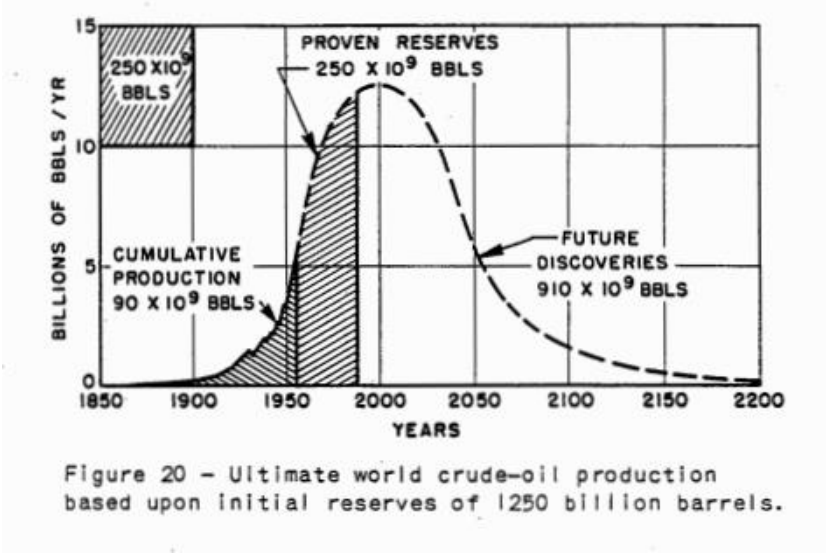
* BSc. Economics

1 Mills, Richard, *US Water Shortages to Impact Power Supply* 25/08/2012 http://www.marketoracle.co.uk/Article36193.html Accessed 17/02/2013

Peak Oil

The severity of the coming energy crisis is bound up inextricably with the concept of peak oil, something first highlighted by Marion King Hubbert, a geoscientist, in the 1970s. Simply put, it is the idea that oil production will reach an eventual maximum, and, past that point, the extraction of oil will become more laborious and so will decline. Hubbert initially estimated that peak oil would occur in 1995[2]; other estimates range from the 1970s to 2020s.

Figure 2- Bell shaped distribution curve as suggested by Marion King Hubbert[3]



Walter Youngquist, in his article 'The Post-Petroleum Paradigm: And Population', splits the impact of peak oil into two broad categories: the effect it has on countries which are almost entirely dependent on oil income, and the role of oil in world agricultural productivity.[4] The impact of dwindling oil reserves, for example, is already being felt in Gulf countries; 'The era in which ruling families could use seemingly endless oil revenues to buy the loyalty and silence of the population is coming to an end. Cash-strapped governments are cutting back on social services while the stream of rich contracts which helped oil the economy dwindled to almost nothing.'[5] Citizens in oil-rich countries have come to expect a growing standard of living in proportion to the vast money generated within their country from oil production; however, once the oil reserves start to dry up, citizens of such nations will suffer and civil unrest will likely ensue.

2 David Room *1976 Hubert Clip* 6/03/2007 http://www.youtube.com/watch?v=ImV1voi41YY&feature=channel_page Accessed 18/02/2013

3 Hubbert, M.King *Nuclear Energy and the Fossil Fuels* 1956 http://www.hubbertpeak.com/hubbert/1956/1956.pdf Accessed 18/02/2013

4 Younquist, Walter 'The Post-Petroleum Paradigm: And Population', *Population and Environment*, Vol. 20, No. 4 (March 1999), pp. 297-315. Accessed 18/02/2013

5 Ibid

On its own this potential for civil unrest will drive up the price of oil which will have a substantial negative impact on developing, and already developed, economies that rely on oil.

The production of food, and the extraction of clean water, are without a doubt the most important determinants of human existence. Agriculture in every developed country relies heavily on oil, and is gravely affected both by rising oil prices and increased depletion of reserves. Firstly, the most obvious use of non-renewable fossil fuels in agriculture is the use of agricultural machinery that requires the combustion of oil/petroleum in their engines. Due to rising prices, farms either have to cut costs to maintain the profits on their goods, or increase the price of their produce to maintain profits. This will have a negative impact on the wider community as either they are receiving a lower quality good for a similar price as before, or they are receiving the same good as before but for a higher price. However, the agriculture industry relies on fossil fuels to a greater extent than just driving their machinery.

'Today, virtually all nitrogenous fertilizers are derived from synthetic ammonia,'[6] and figure 3 shows how natural gas, coal and other petroleum products are the primary feedstocks for ammonia. As fossil fuels become scarcer, fertilizer prices will rise, resulting in farmers either having to charge more for their produce or go to more organic, historical methods of agriculture. However, environmental scientists at McGill University and the University of Minnesota have found that 'overall, organic yields are considerably lower than conventional yields', thus implying that organic forms of agriculture will not be able to sustain the growing populations' demand for food. [7]

6 P, Louis *Feedstock and Energy Sources for Ammonia Production* International Fertilizer Industry Association www.fertilizer.org/ifacontent/download/5571/88112/.../1/.../76.pdf Accessed 18/02/2013

7 V. Seufert, N. Ramankutty & J. Foley *Comparing the Yields of Organic and Conventional Agriculture* Published 25/04/2012 http://www.nature.com/nature/journal/v485/n7397/full/nature11069.html Accessed 17/02/2013

Figure 3: 2000 Ammonia Capacity- World[8]

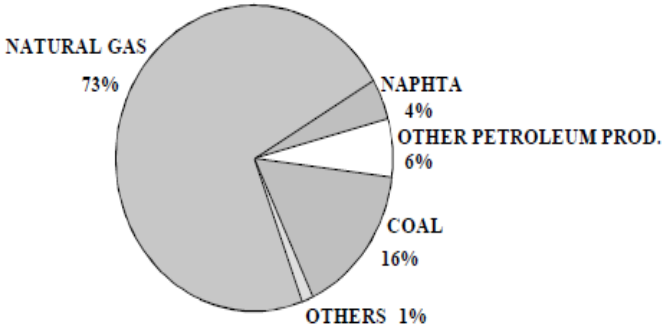
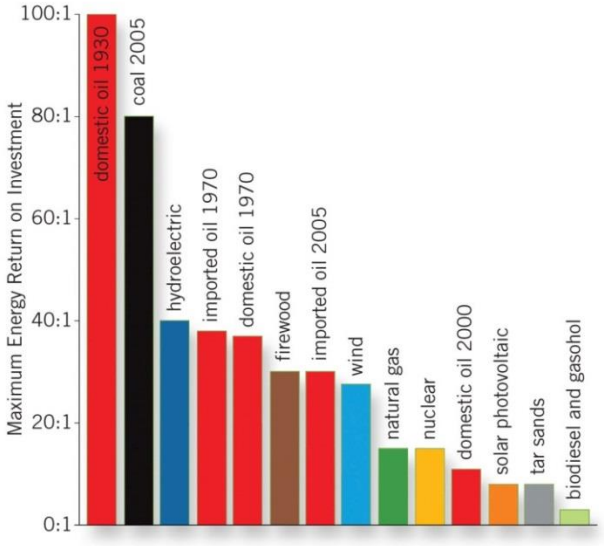


Figure 4: Maximum Energy Return on Investment[9]



Net Energy

Net energy is a term used in ecological economics that relates to difference between the energy input required to harvest an energy source, and the energy that can be created from the harvested product. The abundance and concentration of fossil fuels have allowed us to generate large amounts of energy with relatively little energy required for the harvesting of such fuels. It has been stated that early US production provided 100 barrels of oil for every barrel spent in getting that oil. However, as fossil fuels become depleted, other alternative energy sources must fill the gap, however, they have much worse net energy potential. Firstly, 'the idea that biofuels or coal to liquids will simply replace oil and gas the way oil and gas have replaced wood and coal shows an astonishing degree of ignorance of the concept of

8 P. Louis *Feedstock and Energy Sources for Ammonia Production* International Fertilizer Industry Association http://www.aspo-australia.org.au/References/Kingwell-Oil-in-Agriculture-2003.pdf Accessed 21/02/2013

9 Gulland, John *How Much Energy Does It Take to Get Our Energy?* December 2010/January 2011 http://www.motherearthnews.com/renewable-energy/net-energy-zm0z10zrog.aspx Accessed 20/02/2013

net energy'. [10] It's simple economics that it makes no sense exploring alternative forms of energy if such forms have a negative net energy. Figure 4 shows how oil and coal provide the highest energy return on investment. These figures paint a dark picture on the future of energy; if oil production is declining then other forms of energy are required to fill the gap. However, if other forms of energy have worse net energy, and more energy go into its harvesting, then is there a realistic alternative to the fossil fuels on which we have become so dependent?

Renewable Energy in the UK

According to the Department of Energy and Climate Change, the UK is in the advantageous position of having the 'best wind, wave and tidal resources in Europe[11].' The UK also leads the world in offshore wind, with '700 turbines already installed[12].' NATTA, the Network for Alternative Technology and Technology Assessment provides estimates for the potential energy output of renewable sources in the UK. They claim that both on-shore and off-shore windfarms could generate 20%- 50% of the UK's electricity requirements.[13] Additionally, wave energy could provide 20%[14] of the UK's electrical requirement, with a further 10%[15] coming from geothermal sources. If NATTA's figures are to be believed, then the UK is greatly underutilising its natural renewable energy advantage by only having 2%[16] of the UK's electricity coming from renewable sources.

One of the reasons behind these figures is the large logistical costs associated with renewable energy. Wind power is the most prominent renewable energy resource in the UK

10 Future Scenarios, *Net Energy Return* http://www.futurescenarios.org/content/view/24/37/ Accessed 20/02/2013

11 Department of Energy and Climate Change *UK Renewable Energy Roadmap* July 2011 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48128/2167-uk-renewable-energy-roadmap.pdf Accessed 21/02/2013

12 Ibid

13 *Renewable Energy in the UK: A NATTA guide for Newcomers* http://eeru.open.ac.uk/natta/natta-guide.html#options Accessed 21/02/2013

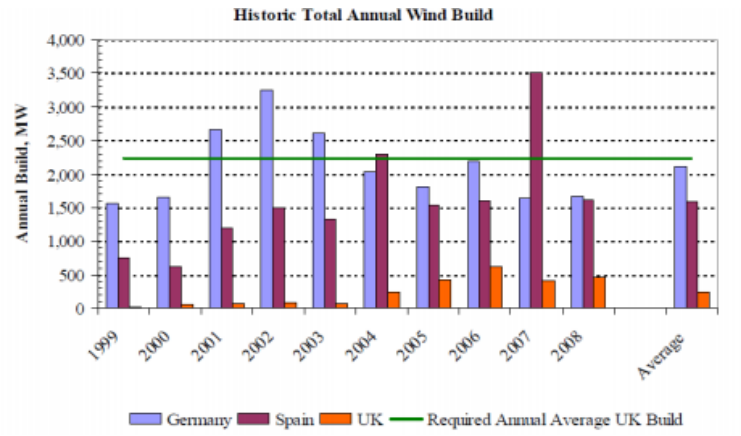
14 Ibid

15 Ibid

16 Ibid

currently. The manufacturing of wind turbines is not an issue in itself, as the Department of Energy and Climate Change have highlighted – 'turbines are available in sufficient quantity to supply existing demand.[17]' They also highlight that 'the UK grid is not considered a significant medium or long-term constraint to the deployment of wind to 2020[18].' However, the limitations of wind power come in the form of planning constraints, which will only be escalated with growing population, and the costs of replacing existing sub-1MW turbines[19], also the fact that the turbines themselves will most likely have to be imported in – as figure 5 shows, the manufacturing of turbines in the UK falls far short of the required annual average.

Figure 5: Historic Total Annual Wind Build[20]



The primary problem with tidal energy in the UK relates to the grid capacity in the primary areas for tidal power to be extracted. The areas best suited for tidal resources 'are located off the Western and Northern Isles of Scotland'.[21] However, currently the grip capacity in those areas is low. This means either large infrastructure improvements are needed around those areas for the

17 Department for Energy and Climate Change, *Review of the Generational Costs and Deployment Potential of Renewable Electricity Technologies in the UK* October 2011 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/42843/3237-cons-ro-banding-arup-report.pdf Accessed 21/02/2013

18 Ibid

19 Ibid

20 Ibid

21 Ibid

UK's tidal power to be affective, or, less desirable areas with better grid capacity will have to be chosen, which will result in a lower potential yield of net energy, and consequently it will take longer for the government or commercial companies to see an acceptable return on such endeavours.

Can Renewable Energy be provided by the market?

The growth of the oil industry over the last 100 years would suggest that the market is capable of supplying energy to vast numbers of people at reasonably acceptable price levels. However, due to generally lower net energy and generally higher production limitations, a similar trend is not assured to take place in the renewable energy industry in the future. If we are to believe that the stock of fossil fuels on this planet is decreasing rapidly, then in terms of simple economics the supply of fossil fuels drops and prices rise. Due to this price rise, people demand less oil, since there are now comparatively cheaper alternatives, which in turn leads to the price of oil dropping to an equilibrium price level similar to the one at which it started. However, this is not the case for oil, and the problem within the market relates to the price elasticity for fossil fuels, primarily oil. To say that the price elasticity for oil is inelastic would be an understatement; along with food and water it is one of the most necessary components for maintaining living standards on this planet.

In essence, there is no energy source that can replace the impact that fossil fuels have on our day-to-day life. Renewable energy sources may be able to compete with fossil fuels in the market for electricity, over the coming decades, and purely through market forces: fossil fuels will become more laborious to extract and energy companies may turn to relatively cheaper alternative energy sources. However, the impact fossil fuels have on our lives does not stop at electricity. I mentioned earlier about the potential impacts of dwindling fossil fuel reserves on fertilizers, but there are further reaching uses of fossil fuels that alternative energy will not currently be able to replace. Firstly, the transport industry is almost entirely dependent on fossil fuels. Gasoline, diesel and jet fuel are all derived from crude oil. While the numbers of electric cars in the UK is rising – expected to rise to 6,000 in 2013[22] – that is still a very small proportion of total car sales. Also approximately 7 gallons of oil is used to make every tyre. [23] This startling dependence on fossil fuels paints a bleak picture of the transportation industry in the future, which is vital to both the UK and the global economy. Also, the production of plastics is reliant on either liquid petroleum gases or

22 Urquhart, Conal *Electric Car Sales in UK Expected to Double in 2013 as Prices start to fall* 29/12/2012 http://www.guardian.co.uk/environment/2012/dec/29/electric-car-sales-prices Accessed 22/02/2013

23 Rubber Manufacturers Association *Rubber FAQs* http://www.rma.org/about_rma/rubber_faqs/ Accessed 22/02/2013

natural gas liquids.[24] Considering that plastics are used for a multitude of vital products, ranging from medical equipment to car parts, the potential lack of plastics could have frightening affects on the standards of living for everyone. Because of this over-dependence on fossil fuel products, the global demand for oil is incredibly inelastic.

Therefore, when reserves start to deplete and oil prices rise significantly people currently have no alternative but to continue to use oil-products but will have to pay a higher price, which means less money for the people to spend on other goods and services that both boost the economy and their personal welfare. Currently I would argue that renewable energy sources cannot be adequately provided by the market; in the future, this may change, as innovation may lead to lower costs for renewable energy producers and may increase the dexterity of renewable sources of energy to replace existing fossil fuels. Another change that may occur in the future that might enable renewable sources to be allocated more efficiently by the market would be a growing general negative perception of fossil fuels and growing positive opinions of more renewable alternatives. Today, given the choice people will most likely pick to use renewable energy over fossil fuels if they are both the same price, but, in reality, they are not. In the future, however, public perception of renewable energy ideally should turn more positive and consumer decisions may be less affected by price and more by a conservationist attitude.

Government Intervention

Currently it appears that government intervention in the renewable energy markets is the only option to increase the provision of renewable energy. Most would not argue for a nationalised renewable energy service, although it hopefully would limit price fluctuations and ensure energy prices remain low to maximise citizen welfare. Therefore, it appears the government's main role in the renewable energy sector is to encourage firms to invest in renewable energy sources in the long term in the UK, stimulate innovation and to make the energy created from renewable sources more competitive against fossil fuel energy.

One way the government could achieve the first role could be through corporation tax breaks for renewable energy producers and subsidies to encourage innovative foreign and domestic firms to move into the renewable energy market. In many ways the government has already enacted policy to aid renewable energy creation and usage. One way is through the policy of Renewable Obligations, which is 'making UK suppliers source a proportion of their electricity from eligible renewable sources'.[25]

24 US Energy Information Association *How Much Oil is Used to make Plastics?* http://www.eia.gov/tools/faqs/faq.cfm?id=34&t=6 Accessed 23/02/2013

25 Inside Government, *Increasing the use of Low-Carbon Technologies. 27/02/2013* https://www.gov.uk/government/policies/increasing-the-use-of-low-carbon-technologies Accessed 28/02/2013

The second role of stimulating innovation of renewable energy sources in the UK could be achieved through a number of different methods. One such method could be subsidising renewable energy companies that produce innovative advances in technology. However, it may be difficult to quantify innovation and the allocation of innovation subsidies may not be corresponding with actual innovation in the market. One way this may be overcame could be through the use of patent rewards, i.e. the government providing rewards to renewable energy producers who obtain patents of their innovations, this would serve to encourage innovation. However, as patents can potentially be maintained for 20 years this innovation that is encouraged may not be market wide and instead be firm-specific. If large amounts of innovative patents are issued for only a small amount of firms, this could give rise to an oligopolistic renewable energy market, where tacit collusion is prevalent, which has the potential for consumers to be over-charged for products and thus lose welfare.

Achieving the third role of making renewable energy more competitive against non-renewable energy could theoretically be aided by accomplishing the two previous roles. More firms in the renewables market should result in more competition in terms of prices, which should result in lower prices for the consumers. Similarly, innovation could provide renewable firms the opportunity to charge lower prices for their energy due to lower long-term costs, again making renewables more competitive against non-renewable alternatives.

While the prospect of the government increasing spending to encourage the use of renewable energy sources may sound foolish considering the governments burgeoning budget deficits and substantial levels of debt. Tim Jackson, in 'Prosperity without Growth', highlights that a 'green stimulus' offers the 'potential for direct financial returns to the economy.' Some of the returns he highlights are 'fuel cost savings' and 'savings in national expenditure as a result of reduced health costs, lower congestion and lower levels of pollution'.[26]

Conclusion

Whether or not the government acts, this energy crisis is coming and the effects will change both the quality of life of the global population and the make-up of most economies. It is easier to take a myopic view of current problems in the global energy market, and try to increase people's welfare in the short-run by implementing policies directly against the use of non-renewable energy sources, but until there is large-scale, long-term investment in the renewable energy sector in the UK there is no viable alternative to the use of fossil fuels. It's quite clear the market cannot be left to alleviate the crisis, especially considering it was the market that created the problem in the first place; the demand for current forms of energy is simply too inelastic and

26 *Tim Jackson,* 2009, Prosperity without Growth, UK, Earthscan.

too deep rooted in modern economies. There needs to be great innovation and investment firstly in the infrastructure necessary to achieve and ideally surpass the governments aims of 15% of the UK's energy demand to be met by renewable sources by 2020[27], and such innovation and investment is only possible through government intervention.

Bibliography

- Mills, Richard, *US Water Shortages to Impact Power Supply* 25/08/2012 http://www.marketoracle.co.uk/Article36193.html Accessed 17/02/2013
- David Room *1976 Hubert Clip* 6/03/2007 http://www.youtube.com/watch?v=ImV1voi41YY&feature=channel_page Accessed 18/02/2013
- Hubbert, M.King *Nuclear Energy and the Fossil Fuels* 1956 http://www.hubbertpeak.com/hubbert/1956/1956.pdf Accessed 18/02/2013
- Younquist, Walter 'The Post-Petroleum Paradigm: And Population', *Population and Environment*, Vol. 20, No. 4 (March 1999), pp. 297-315. Accessed 18/02/2013
- P, Louis *Feedstock and Energy Sources for Ammonia Production* International Fertilizer Industry Association www.fertilizer.org/ifacontent/download/5571/88112/.../1/.../76.pdf Accessed 18/02/2013
- V. Seufert, N. Ramankutty & J. Foley *Comparing the Yields of Organic and Conventional Agriculture* Published 25/04/2012 http://www.nature.com/nature/journal/v485/n7397/full/nature11069.html Accessed 17/02/2013
- P. Louis *Feedstock and Energy Sources for Ammonia Production* International Fertilizer Industry Association http://www.aspo-australia.org.au/References/Kingwell-Oil-in-Agriculture-2003.pdf Accessed 21/02/2013
- Gulland, John *How Much Energy Does It Take to Get Our Energy?* December 2010/January 2011 http://www.motherearthnews.com/renewable-energy/net-energy-zm0z10zrog.aspx Accessed 20/02/2013
- Future Scenarios, *Net Energy Return* http://www.futurescenarios.org/content/view/24/37/ Accessed 20/02/2013
- Department of Energy and Climate Change *UK Renewable Energy Roadmap* July 2011

27 Inside Government, *Increasing the use of Low-Carbon Technologies* 27/02/2013 https://www.gov.uk/government/policies/increasing-the-use-of-low-carbon-technologies Accessed 28/02/2013

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- *Renewable Energy in the UK: A NATTA guide for Newcomers* http://eeru.open.ac.uk/natta/natta-guide.html#options Accessed 21/02/2013
- Department for Energy and Climate Change, *Review of the Generational Costs and Deployment Potential of Renewable Electricity Technologies in the UK* October 2011 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/42843/3237-cons-ro-banding-arup-report.pdf Accessed 21/02/2013
- Urquhart, Conal *Electric Car Sales in UK Expected to Double in 2013 as Prices start to fall* 29/12/2012 http://www.guardian.co.uk/environment/2012/dec/29/electric-car-sales-prices Accessed 22/02/2013
- Rubber Manufacturers Association *Rubber FAQs* http://www.rma.org/about_rma/rubber_faqs/ Accessed 22/02/2013
- US Energy Information Association *How Much Oil is Used to make Plastics?* http://www.eia.gov/tools/faqs/faq.cfm?id=34&t=6 Accessed 23/02/2013
- Inside Government, *Increasing the use of Low-Carbon Technologies. 27/02/2013* https://www.gov.uk/government/policies/increasing-the-use-of-low-carbon-technologies Accessed 28/02/2013
- *Tim Jackson,* 2009, *Prosperity without Growth, UK, Earthscan.*