The Monetary Cost of the Non-Use of Renewable Energies

– A first study –

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Abstract

It is often claimed that renewables are still too costly and not yet competitive with conventional energy sources. But what costs are incurred when renewable energies are *not* used? Every day during which potential renewable energy sources are not utilised but exhaustible fossil fuels burnt instead speeds up the depletion of these non-renewable fuels. Using burnt fossil fuels for non-energy related purposes (e.g. in the petro-chemical industry) in the future is obviously impossible. Thus, their burning – whenever they could have been replaced by renewables – is costly capital destruction. This study concludes that, estimated conservatively, the future usage loss resulting from our current oil, gas and coal consumption is between 3.2 and 3.4 trillion US Dollars per year.[1]

[1] Throughout this paper the American numerical scale (rather than British English) will be used.

Introduction

Previous studies to assess the costs of the non-use of renewable energies consist mostly of attempts to ascertain the costs arising from expected climate damage caused by burning fossil fuels. By internalising these costs the apparent competitive advantage of fossil fuels often disappears. More challenging is the question of how to monetise future damages,[2] with previous studies often criticised for their methodology.[3] This study raises a different, hitherto ignored issue. Externalised costs from burning fossil fuels are incurred not only through damages from climate change but also through the lack of future availability of fossil raw materials consumed to meet our current energy demands, although alternatives exist. This study is a first attempt to calculate the costs of this loss.

1. Framing the problem

The sun and the winds are free. Thus the costs of renewable energy are almost exclusively fixed extraction costs, whilst the use of fossil fuels incurs significant variable costs (reflecting the value of the fuels burnt). The difference between renewables and fossil fuels is not only the zero cost of renewables but also that they will never be exhausted.

How can the value of a commodity be measured, whose usage is free and inexhaustible? This can only be done indirectly through calculating the costs incurred when the use of a free and never-ending commodity is supplanted by the use of a finite commodity, which is destroyed, and thus unusable in the future, through its one-time use as energy. In contrast, it is the wind which blows and sun which shines but is <u>not</u> used today which is lost forever.

The renewable energy not used today thus cannot replace fossil fuel raw materials that, having been burnt as energy, are lost forever. This means that the use these raw materials *could* have had in the future is lost and additional costs will be incurred to replace them.

To calculate the loss incurred, the alternative use value of the burnt fossil fuels must be estimated. It is increasingly clear that, by remodelling our energy-systems, fossil fuels can be substituted by renewables. Every entity of fossil raw material that can be replaced by renewable energy retains its value as a raw material to be used in the future for non-energetic uses. For the energetic use of fossil raw material there is the alternative of using renewable energies, whose current usage, unlike that of e.g. oil, does not exclude further usage.

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[2] The breadth of studies ascertaining the external costs of human-induced CO2 emissions ranges from 14 to 300 Euro per ton CO2. See „Agentur für Erneuerbare Energien (Hrsg.); Kosten und Preise für Strom, Fossile, Atomstrom und Erneuerbare Energien im Vergleich“, Renews Spezial, Edition 52, September 2011, p. 28

[3] See e.g. the discussions around the Stern Report: Stern, N.; Stern Review on the Economics of Climate Change, London 2006

The lost value of under- or unutilised renewable energy therefore consists of the future lost value of burnt fossil fuel raw material, which is no longer available for non-energetic uses. The aim of this introductory study is not to make a full cost comparison between current renewable energies and fossil fuels in which all external benefits of renewable energies are internalised. Our aim is only to estimate the future lost usage value of burnt fossil raw materials in order to be able to establish the costs of the current under-usage of available renewable energy potential.

2. The methodology to measure non-usage

The burning of finite fossil resources for energy consumption forfeits their usage in the future. As costs equal benefits in a market economy, the costs equal the monetary losses that are created through future usage loss.

The usage of a commodity must be at least as high as the costs of procuring the commodity otherwise it would not have been bought. In the real market economy this value is usually higher than the cost as only then can the buyer make a profit. Calculating by how much the usage value exceeds the cost is methodologically very difficult, so this study uses the conservative assumption that the usage value is at least as high as the price of procurement.

What is the price of the fossil raw materials used for non-energetic production? The standard global market prices of oil, gas and coal can be referred to as these are usually similar for energy and other product usages. The future value of fossil raw materials which could be (but are currently not) used for non-energy production purposes can be estimated by looking at the percentages of energetic and non-energetic use of different fossil raw materials. But current data on global non-energetic uses cannot be extrapolated into the future. Many less industrialised countries use fossil raw materials exclusively for energy as they do not have industries which can utilise these materials for other purposes. Therefore an extrapolation of current figures would severely underestimate the costs incurred by unnecessarily burning fossil fuels now, as future demand (and thus prices) for fossil raw materials for non-energy uses are likely to become much higher, as more countries industrialise.

To estimate the probable global demand and the prices of fossil raw materials for non-energetic uses in the future, the current demand and prices of an industrialised country should therefore be taken as a reference model.

Our estimates for rating non-energy use percentages of fossil raw materials are based on Germany, as a representative industrial country. We assume that the long-term global demand for commodities created from fossil raw materials will be similar to those of a mature industrialised country. As a reference model for future global usage-rates of fossil raw materials for non-energetic uses we therefore extrapolate current German usage-rates globally. To account for future uncertainties, we give two approximations, one 25% below and one 25% above current German usage rates. For example, future efficiency gains could decrease while the reality or fear of a peak in remaining supplies would increase the value of a finite resource and, by implication, the losses incurred by having burnt it instead of using a renewable, non-exhaustible alternative resource.

3. The model of assessment

3.1. Establishing the non-energetic consumption in the reference model country

According to the data of the AG Energy Balance[4] the non-energy usage consumption in Germany in 2009 was:

- 765,224 TJ[5] of crude oil
- 144,095 TJ of natural gas
- 10,318 TJ of hard coal[6]

Relative to the total usage of:

- 5,673,584 TJ of crude oil
- 3,508,024 TJ of natural gas
- 1,537,591 TJ of hard coal

resulting in a rate of non-energy usage consumption of:
- 13.5 % of crude oil
- 4.1 % of natural gas
- 0.7 % of hard coal

[4] AG Energiebilanzen e.V. (AGEB), Energieflussbild Deutschland 2009 (Detail in TJ), rate as of 31.03.2011.
[5] TJ = Terrajoule
[6] In this study only the value of hard coal will be considered, as there is no real market price for brown coal which could be used. There is no world market price for brown coal, as it is not internationally traded but rather used in proximity to the mine. Bundesministerium für Wirtschaft und Technologie, Arbeitsgruppe Energierohstoffe, Kurzbericht: Verfügbarkeit und Versorgung mit Energierohstoffen, 29.03.2006. The overall result is only marginally influenced by omitting the assessment of brown coal.

3. 2. The estimate of future global non-energetic uses at current market prices

The average annual global usage of crude oil[7] in the last 5 years

3,977 million tons

The average annual global usage of natural gas[8] in the last 5 years

2,987 billion m^3

and the average annual global hard coal production of the period from 2006 to 2010[9]

5,704 billion tons

If the respective rates of 13.5%, 4.1% and 0.7% for non-energy usages in the reference country are used, the middle reference path equals a global consumption for non-energy purposes of

- 537 million tons of crude oil and
- 122 billion m^3 of natural gas
- 40 million tons of hard coal

To account for the rough approximation, we are (as noted above) allowing a deviation of 25%. This results in a corridor of 10.1% to 16.9% for crude oil, of 3.1% to 5.1% for natural gas and of 0.5% to 0.9% for hard coal not burnt as fossil fuels.

The calculations for the non-energy usages are thus:

- Between 402 and 672 million tons of crude oil
- Between 93 and 152 billion m^3 of natural gas
- Between 30 and 50 million tons of hard coal

3.3 The assessment of future non-energy consumption at current market rates

This study does not attempt future cost projections. The valuations are based on current market prices. It is likely that the demand for and prices of fossil fuels will increase further in the near

[7] BP, BP Statistical Review of World Energy, June 2011 p. 11

[8] BP, p. 23

[9] EIA, U.S. Energy Information Administration, International Energy Statistics (http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=1&pid=9&aid=1&cid=ww,&syid=2006&eyid=2010&unit=TST).

future. Our decision to use cost/usage ratings based on current market prices can therefore be viewed as resulting in conservative estimates.

To mitigate the energy price fluctuations in recent years the median market price of the last 5 years is used. For crude oil this equates to 75.2 US Dollars per barrel[10], for natural gas 8.79 US Dollars per million Btu[11] and for hard coal 83.6 US Dollar per ton.[12]

Taking into account the conversion rates, the following costs for the reference corridors have been calculated

Crude oil:
Lower reference path: 221 billion US Dollars
Upper reference path: 369 billion US Dollars

Natural gas:
Lower reference path: 31 billion US Dollars
Upper reference path: 51 billion US Dollars

Hard coal:
Lower reference path: 2.5 billion US Dollars
Upper reference path: 4.2 billion US Dollars

Added up this gives a value of:
- lower reference path: 254.5 billion US Dollars
- upper reference path: 424.2 billion US Dollars

It can thus be concluded that the minimal future usage value of fossil raw materials currently lost by burning for one-time use lies between 255 and 424 billion US Dollars per year.

Thus, the non-substitution of fossil raw materials by renewable energies causes a loss of future usage, i.e. a destruction of capital of between 255 and 424 billion US Dollars every year.

[10] BP, p. 15
[11] BP p. 27
[12] BP, p. 30. The value was calculated from the unweighted average of coal prices for Northwest Europe marker price and from the US Central Appalachian coal spot price index.

3.4. The assessment of the total alternative usage value loss caused by the one-time usage of fossil raw materials for energy production

These calculations relate only to the lost opportunity cost of the annual non-energy use of fossil fuels. With a relation between energy to non-energy usage of e.g. 10 to 1, in one year ten times the possible consumption for non-energy purposes is destroyed. The loss of usage thus stretches far into the future. Using current market prices the total usage loss can be estimated by subtracting the non-energy consumption from the total consumption of fossil raw material.

The average total consumption of crude oil between 2006 and 2010 was:
3,977 million tons/ 29,032 million barrels
At an average price between 2006 and 2010 of 75.2 US Dollars per barrel this equates to a total annual value of 2,183 billion US Dollars.

The average total consumption of natural gas between 2006 and 2010 was:
2,987 billion m^3 / 113 mmBTU
At an average price between 2006 and 2010 of 8.79 US Dollars per mmBTU this equates to a total annual value of 994 billion US Dollars.

The average total consumption of hard coal between 2006 and 2010:
5,704 billion tons
At an average price from 2006 to 2010 of 83.6 US Dollar per ton this equates to a total annual value of 477 billion US Dollars.

The values for the non-energy use in our projection corridor are:

Crude oil:
First reference path: 2,183 billion US Dollars – 221 billion US Dollars = 1,962 billion US Dollars
Second reference path: 2,183 billion US Dollars – 369 billion US Dollars = 1,814 billion US Dollars

Natural gas:
First reference path: 994 billion US Dollar – 31 billion US Dollar = 963 billion US Dollars
Second reference path: 994 billion US Dollar – 51 billion US Dollar = 943 billion US Dollars

Hard coal:
First reference path: 476.9 billion US Dollar – 2.5 billion US Dollar = 474.4 billion US Dollar
Second reference path: 476.9 billion US Dollar – 4.2 billion US Dollar = 472.7 billion US Dollar

After the total consumption of crude oil and natural gas is separated from the non-energy use, the total usage loss is established as:

First reference path: 1,962 billion US Dollar + 963 billion US Dollar + 474 billion US Dollar = 3,399 billion US Dollars

Second reference path: 1,814 billion US Dollar + 934 billion US Dollar + 473 billion US Dollar = 3,221 billion US Dollars

The total future usage loss that stems from current energy use of oil, gas and coal in one year, based on current market prices, can thus be estimated at between 3.2 and 3.4 trillion US Dollars. This means that, through the non-use of available renewable energies, every day a future usage loss (i.e. cost) of 8.8 to 9.3 billion US Dollars is incurred.

4. Conclusion

Protecting the use of increasingly valuable fossil raw materials for the future is possible by substituting these materials with renewables. Every day that this is delayed and fossil raw materials are consumed as one-time energy creates a future usage loss of between 8.8 and 9.3 billion US Dollars. Not just the current cost of various renewable energies, but also the costs of *not* using them need to be taken into account.

Based on the conservative estimates used, the actual costs are likely to be even higher than those that we have calculated.

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