The Honest Broker - Stuck Half Way Through

Comment on Pielke et al. in *Nature* 452, 531-532 (2008)

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In their recent Nature article Pielke et al. (2008) convey as a their key message that the IPCC dramatically underestimates the socio-economic effort it would take to transform the 21st century non-policy - high emission path into a policy-induced low-emission path. Thus, the core statement of working group 3 in the Fourth Assessment Report of the IPCC seems to begin to totter – that an ambitious climate policy can be pursued with the already existing technologies. What the article of Pielke et al. does not explicitly say but suggests implicitly is that the cost estimates of the IPCC would then also be just as unrealistic as the estimation of the technical and economic challenge. Is the optimistic message that the IPCC announced in 2007 to the whole world finally unfounded? Is the challenge greater than assumed, is climate policy now more expensive than alleged? Did the IPCC finally mislead policy makers? Is the IPCC eventually not the "honest broker" between science and politics and pursues own politics with the authority of science?

With their comment "Dangerous Assumptions", the authors further fostered the suspicion that the IPCC did not provide a down-to-earth analysis of the options and limits of climate policy. The bomb that the authors seemingly drop can however be easily deactivated.

A down-to-earth verification of the facts needs to be done indeed. In their commentary, the authors take up a thought experiment that was made by the IPCC itself. The IPCC wanted to know how much technical progress will be necessary to reach ambitious climate-political targets. Hence, the IPCC needed to clarify how much CO_2 needs to be mitigated worldwide. It calculated the necessary mitigation targets as the difference between the so-called business-as-usual-scenario and the policy scenario. The so-called business-as-usual-scenario describes the increase of emissions if there will be no climate policy. If this scenario already suggests that the emissions will significantly increase, climate policy will face greater challenges than in a world economy in which emissions would reduce even without climate policy. To estimate the whole range of potential mitigation efforts, the IPCC presents among others an extreme business-as-usual-scenario that they themselves consider to be hypothetic – solely on which the whole argumentation of Pielke et al. is built upon.

1. The historical trend

Technical progress plays above all a decisive role regarding the question how much will presumably be emitted. This progress can be separated into two components - in the low-

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ering of the energy and the carbon intensity. Figure 1 shows the historical trend of the last three decades.

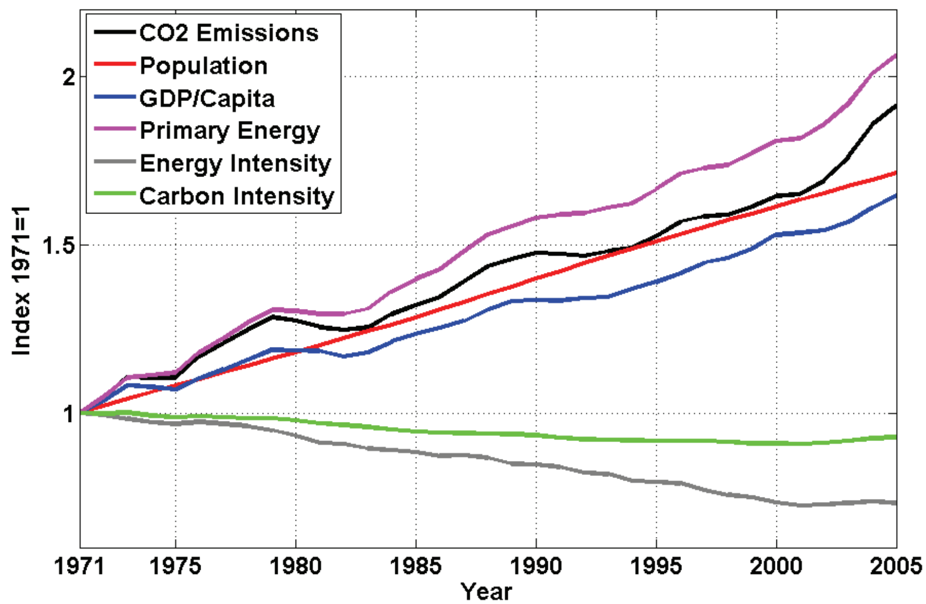


Figure 1: The historical trend of economic growth, population development, energy and carbon intensity. IEA 2007

The energy intensity describes how much energy is necessary to produce one unit social product; the coal intensity describes how much CO_2-emission is produced per unit primary energy. If people find a lifestyle where they waste less energy, e. g. by better building insulation, energy intensity will decrease; if coal, oil and gas are replaced by renewable energies or by nuclear energy, carbon intensity will decrease. This technical progress is described as a "autonomous" technical progress, since it would even then have an effect if no climate policy was pursued. The majority (75 %) of the energy scenarios used by the IPCC assumes a 0.6% autonomous decrease of energy intensity per year in the next century. This is a low growth rate compared to the historical trend of the last thirty years. Since historically seen, the energy intensity has annually decreased by even 1.1% which can be derived from Figure 1. In this respect, the scenarios referred by the IPCC are much more conservative than the historical experience suggests.[2]

On the other hand, we can agree with Pielke et al. that there are definitely alarming developments in China that suggest that the autonomous technical progress may be slower in the future than the historical trend. Neither the carbon nor the energy intensity has for instance decreased in China in the years 2001-2004 (see Figure 2). Worldwide the development of energy intensity shows for the years 2001-2004 the same increasing trend as in China. This is due to the fact that China's CO_2-emissions trend seems to dominate

[2] IPCC, FAR, WG III, 219

the worldwide trend as they contribute to nearly half of the worldwide growth of CO_2-emissions. On longer time scales, however, the rapid growth of GDP in China and India is by far the most important reason for the growth emission in emissions, an issue that is not considered in Pielke et al.'s analysis.

The increasing use of brown coal in power plants with low levels of efficiency, the high economic growth and the increasing energy demand led in 2004 to the highest growth rates of CO_2-emissions that have been measured during the last 30 years. It is however not very likely that the growth of energy intensity will continue like this in China as it could have been expected since 2002 (see Figure 2), the energy efficiency e. g. already increased in 2005. Moreover, the Chinese government has formulated its target to reach a further increase of the energy efficiency by 20% until 2010.

In the light of Pielke et al. it needs to be discussed if there will be a break in the development of the worldwide energy system compared to the historical trend. On the basis of the data for the 5-year period 2000 to 2005 a trend reversal cannot be attested - neither in China nor worldwide. This implies that Figure 2 of their article cannot be reproduced with our data[3].

It is interesting to note that the other important emerging economy – India – does not show the decreasing trend of energy efficiency. Quite the contrary, the increase in energy efficiency seems to grow over the last years. For the USA and Europe, this trend of increase remains the same or slightly slows down, respectively.

Whereas we have shown that there are hints that the future development of energy intensity will be in line with the observed trend, there could be a trend reversal with respect to carbon intensity. Worldwide, carbon intensity is increasing similarly as in China in the period 2001-2005 (Figure 2). The same trend can be observed for India and the USA; for Europe, the decrease of carbon intensity is slowing down. In contrast to the analysis of the energy intensity, the year 2005 does in this case not bring it back on the track.

Analysing the different components of energy carriers that influence carbon intensity, it becomes obvious that on the world level the reason for increasing carbon intensity is mainly the use of coal (see Figure 3). As in the last four years, the use of oil already decreases. This could be a first hint that due to the high oil price, the energy system switches to coal instead of oil what brings about an increase in emissions. The trend to coal in the last years can also be identified for China and India. Whereas in Europe the share of renewables has been increasing since the late eighties, the share of renewable energy decreased in China and India nearly over the whole period 1971-2005, likely due to the decreasing significance of traditional biomass in the context of the general transformation of the energy system and the growing electrification of rural areas.

[3] For the decomposition we use IEA primary energy data and the IPCC conversion factors from the individual primary energy carriers to CO_2-emissions.

This decomposition analysis lets us conclude that, in order to achieve a decoupling of economic development and emission growth, the focus should be on both: the development of energy intensity and carbon intensity. Moreover, the decomposition of the different drivers of the carbon intensity gives a more sophisticated picture of the transformation of the energy system that is currently going on. The development of carbon intensity is therefore indeed worrying.

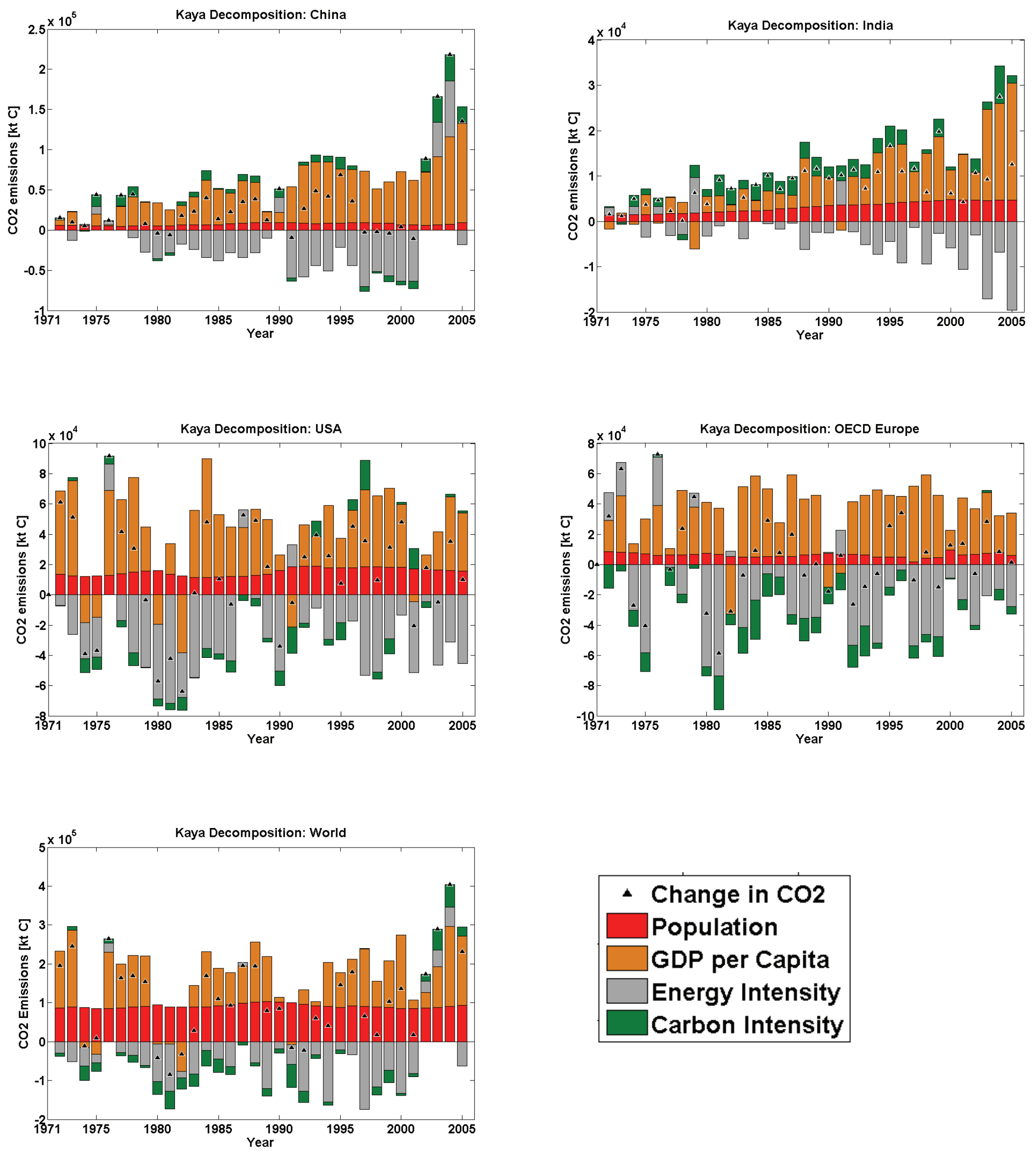


Figure 2: The development of the energy system for (a) China, (b) India, (c) USA, (d) Europe, (e) the World. The annual change of CO_2-emissions is attributed to the respective change of the driving forces population, GDP per capita, energy intensity and carbon intensity. Calculated by PIK 2008.

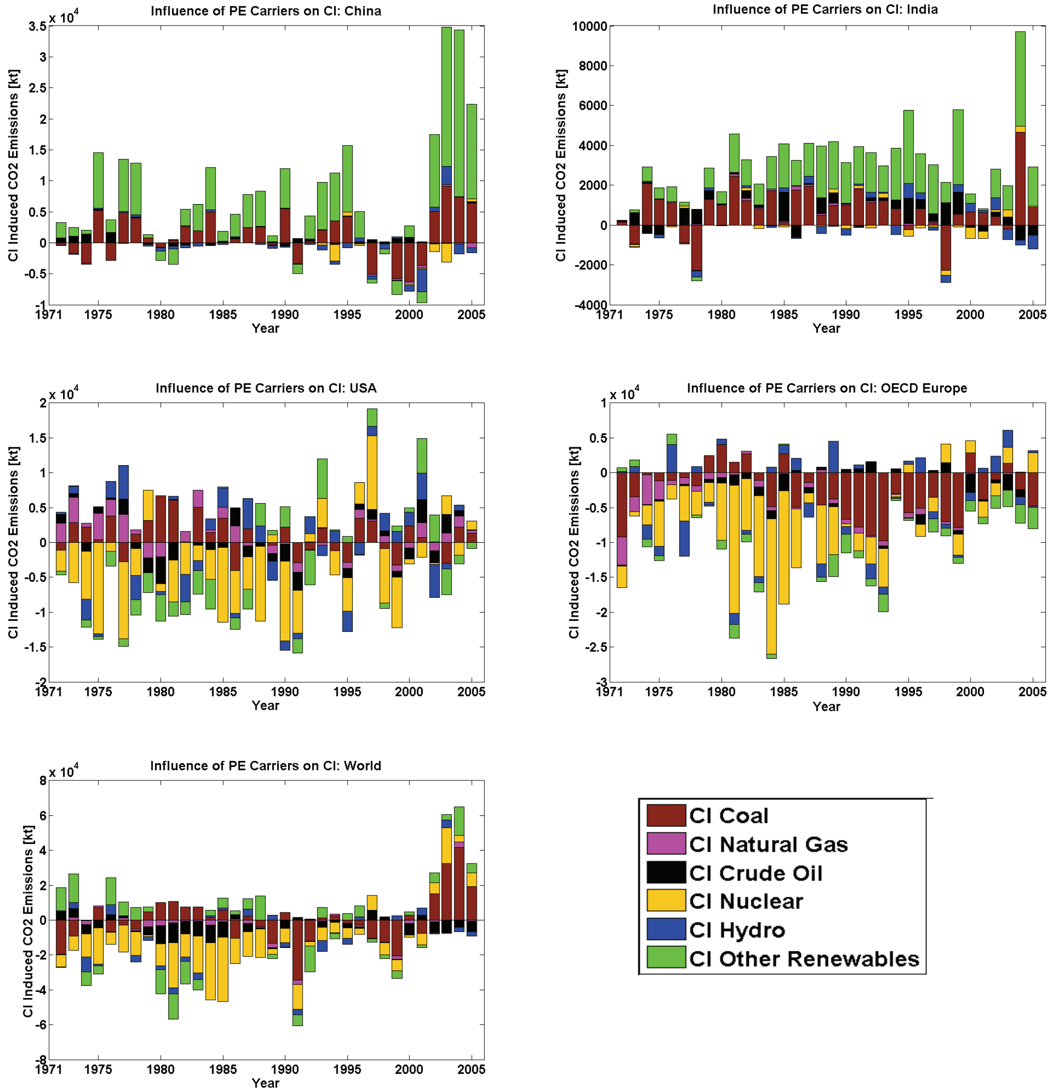
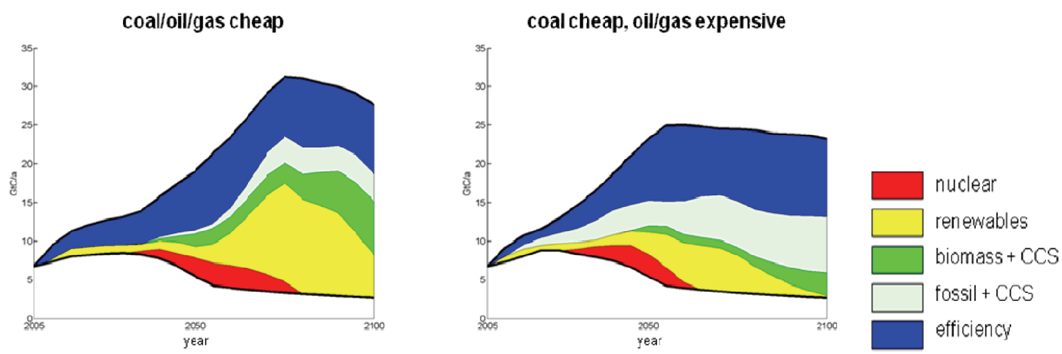


Figure 3: The development of carbon intensity for (a) China, (b) India, (c) USA, (d) Europe, (e) the World. The contribution of carbon intensity to the change in annual CO_2-emissions can be attributed to changes in the relative contribution of the energy carriers coal, natural gas, crude oil, nuclear, hydro and other renewables. Note that in case of decreasing shares of carbon-free technologies (renewables, hydro, nuclear) an increase of carbon intensity and thus CO_2-emissions is induced. Calculated by PIK 2008.

2. Mitigation costs and strategies

The reason for increased energy efficiency and declining carbon intensity may be the same – rapidly increasing oil and gas prices on the one hand and a coal price increasing at a slower rate on the other hand. The increasing oil price is the reason for China's government to put emphasis on efforts to increase energy efficiency again. For the Chinese government high growth rates of resource consumption are a burden, for the Chinese economy in as much as the prices for coal, oil and gas will increase. At the same time an increasing oil price may lead to a substitution of oil and gas by coal. At prices of 40 $ per barrel, coal to liquid becomes an important option. The US and the Chinese government have invested in coal to liquid in order to become more independent from oil imports. The assumption that these substitution processes will not increase the coal price as much as oil and gas prices is especially due to the fact that the stocks of coal are very much larger than the stocks of oil and gas. As the comparison between Figure 4a and 4b shows, the business-as-usual-emissions will be lower in the case of high oil and gas prices. Pielke et al. therefore exaggerate immoderately if they assume that the hypothetic scenario of the IPCC, in which the carbon and energy intensity is frozen on today's level, is the most likely future scenario.



a) b)

Figure 4: Mitigation strategies under different assumptions about the development of fossil resource prices 4a and 4b. Calculated by PIK 2008.

The economically optimal mitigation strategies will thus also change: The increase of energy efficiency will become more important as well as carbon capturing and sequestration which supports the opinion that the development of fossil resource prices will make the energy system more efficient with lower emissions even without climate policy since the scarcity of fossil resources is more perceivable in their prices than in the last thirty years. The IPCC will do well to test its scenarios in the light of new experiences. Particularly the rapid economic development of emerging countries like China and India must be taken into account. If the authors had wanted to point out to this fact, this would have been much appreciated. The statement however that the IPCC is too optimistic on technological progress is unfounded since it is much more conservative than the historical trend suggests. Beyond this statement, the authors however mislead the readers if they pretend that the hypothetic scenario of the IPCC of a constant energy and coal intensity is also economically and technically plausible. The construction of business-as-usual-scenarios is anyhow only the first step; the more important step is the calculation of policy scenarios, since these can only clarify the question at which cost the worldwide energy system can be rebuilt.

3. The honest broker - Stuck half way through

And here the analysis of the authors is stuck half way through. As can be shown in 4a and 4b, the question how much technical progress can be induced by climate policy is more decisive for the estimation of emissions and thus their economic costs. Important research results were obtained here during the last years which the authors could have easily learnt from the IPCC report. This research work explicitly shows that a reasonable climate policy is definitely able to induce technical progress that is necessary to stabilise the atmospheric concentration on a level of 450 ppm CO_2 at moderate costs. It is therefore absolutely unquestionable that the assumptions about the autonomous technical progress considerably influence the mitigation costs. Figure 5 shows that different rates of technical progress are generated for different resource prices. If coal, oil and gas are cheap, investments in the increase of energy efficiency and the lowering of carbon intensity are relatively small; in the case of climate policy, relatively much needs to be invested which is reflected in higher mitigation costs. A model comparison however could demonstrate that mitigation costs are also then relatively low if a low autonomous technical progress is assumed.

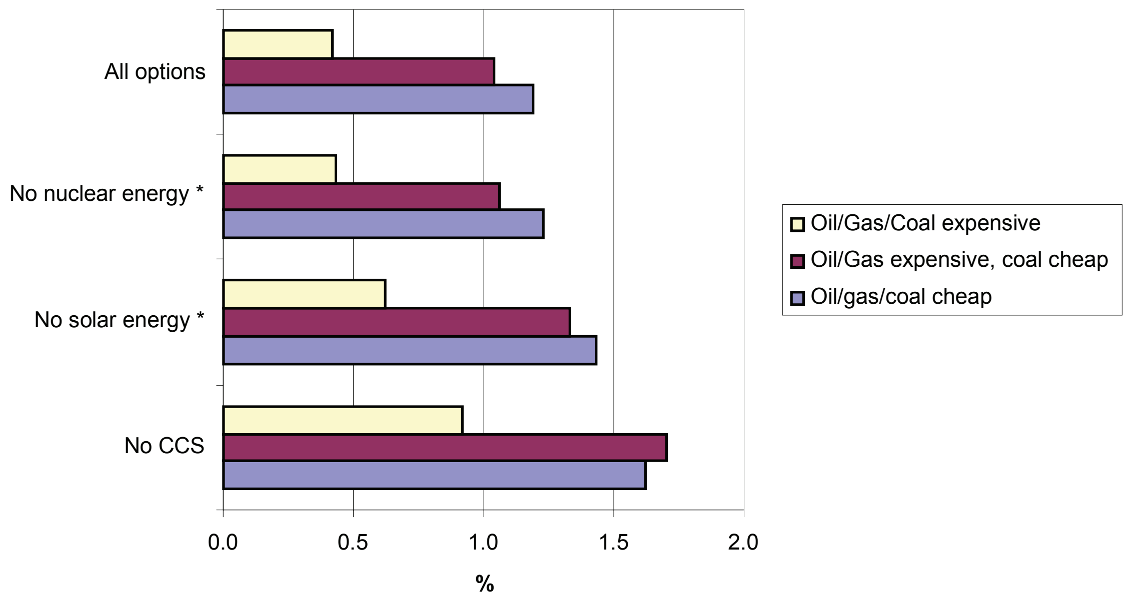


Figure 5 shows the economic costs - measured as percental losses in the world social product produced by climate policy. Different price paths are assumed here for coal, oil and gas. Moreover, those costs were calculated here that incur if different options are not available.

The fact that "much" technical progress needs to be induced by climate policy does nowhere near mean that this also needs to be expensive. Three economic effects primarily support this fact: First, many bottom-up-studies, as for instance the ones of McKinsey, show that substantial CO_2-savings can be realised at negative costs. This mainly concerns measurements to increase energy efficiency. Second, many mitigation technologies become cheaper by learning-by-doing. Third, and this effect has already been mentioned, climate policy does not become more expensive with increasing prices of fossil energy sources but cheaper which is also true if the price for coal increases slower than the prices for gas and oil. This is because declining fossil energy sources make a rebuilding of the energy system already inevitable which however needs to take place more rapidly due to climate policy reasons. Therefore, many cost estimates on the basis of different methods result in the fact that the mitigation costs amount to approx. 1-3% of the world national product if the atmospheric concentration should be stabilised at 450 ppm CO_2. The IPCC itself emphasizes how important the topic "Induced Progress" will be in the future. Their thought experiment to which Pielke et al. refer to should exactly show this. Most of the models of the IPCC, however, estimate that the autonomous technical progress is more conservative than this corresponds with the historical trend. Pielke et al. however allege something completely different: The IPCC is too optimistic measured against historical experiences. There could however be no question of it if the last decades were included in the consideration and not only the last five years. For the estimation of the future trend, it is however absurd to construct a business-as-usual-scenario that does not produce any technical progress: Business-as-usual-scenarios are only consistent if the economic growth, the development of resource prices and the price elasticity of the energy demand describe a consistent and plausible development. A world with high economic growth but without increasing energy efficiency is not conceivable. Quite the contrary, since there is much to argue for the fact that especially the increase of fossil resource prices triggered by high economic growth will lead to a higher autonomous technical progress which may lead to a trend reversal compared to the development so far. Admittedly, a possible increase of carbon intensity due to a renaissance of coal is indeed a worst-scenario for any climate policy. As it is shown in Figure 5, it increases mitigation costs and makes carbon capturing and sequestration more important compared to other mitigation options. A model comparison of the most important models (not only of one model as shown above) which shows the quantitative dimension of this effect on the induced technical progress and the mitigation costs would here be worthwhile. Pielke et al. instead use a thought experiment of the IPCC and pass it off as a plausible future scenario. If the authors had intended that the IPCC needs to revise its results in principle, they should have used a model comparison to demonstrate which factors change the dimension of the autonomous technical progress (e. g. an increase of fossil resource prices) and which influence these factors have on mitigation costs. These questions have not been answered by Pielke et al.

As honest broker scientists have to integrate scientific knowledge with stakeholder concern. The real question for scientists is: What are the implications for climate policy when the world economy is now facing a renaissance of coal. This debate is urgent and timely.

Literature:

Pielke Jr., R., T. Wigley, Ch. Green: Dangerous Assumptions. Nature 452, 531-532 (2008)