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Climate Economics Dilemmas: The Hope for Low-Carbon Growth

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Summary
Today, both the left and right wings of mainstream economics agree on the introduction of a carbon tax. The reason for the agreement on the left is obviously that the tax must be collected in any case, and it is better if those with a larger carbon footprint pay more. On the right, the consensus is explained by the fact that, although the right is generally opposed to taxation, if taxes must be paid, it is better to tax activities that are harmful, i.e. environmental pollution, rather than employment, the increase of which is in the interest of not only the individual but also society. A carbon-free economy must be global to be effective, requiring unprecedented international cooperation. Developing countries need access to clean technologies and financing to avoid the carbon-intensive development paths followed by rich countries. Technology transfer, climate finance and capacity building are essential elements of a successful global transition. The way forward requires recognising that this transformation represents one of the greatest challenges and opportunities in human history. If we embrace the opportunities while honestly facing the obstacles, we can build an economy that is not only carbon-free, but also more prosperous, fairer and more resilient than the one it replaces. A carbon-free economy is not a return to the past, but a leap towards a more advanced and sustainable future. A carbon-free economy represents both the greatest market correction in history and the greatest opportunity for economic transformation. Economic theory suggests that, with the right institutional design and policy implementation, this transformation can increase rather than decrease economic prosperity and create a foundation for sustainable prosperity that previous generations of economic growth have failed to achieve.

The infamous carbon dioxide

When I was training to be a chemistry teacher in the late 1960s, I learned that the concentration of carbon dioxide in the atmosphere is constant, although it does vary in certain areas. We can read about this in the 1964 book by none other than the distinguished Hungarian professor and educator József Öveges. "What exactly is air? Until the 18th century, it was considered as uniform substance, although Leonardo da Vinci already had a different view at the end of the 15th century. It was only Lavoisier who proved experimentally that air is a complex substance, a mixture of several gases. Its composition is practically constant near the Earth's surface, and whether we take a sample at the equator or at the North Pole, we find approximately 21% oxygen, 78% nitrogen and 1% various noble gases. More accurate analysis reveals between one hundredth and one tenth of a percent, averaging 0.03% carbon dioxide and varying amounts of water vapour. This depends on the location of the sample, as CO_2 levels are higher above primeval forests and water vapour content is higher above oceans than in the atmosphere of the Sahara. Finally, our civilisation also contributes with various possible components, such as sulphur dioxide from the combustion of sulphur-containing coal, dust from metallurgical plants, urban smog, and countless other types of pollution. Unfortunately, the latter has now reached

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such proportions that it is being combated with strong official measures. Air, as a source of oxygen, is practically inexhaustible, but separating oxygen is not a cheap operation. [2]

The quote shows that the harmful environmental effects of civilisation were already noticed in the 1960s, but no one had yet put carbon dioxide in the dock. In fact, the authors correctly stated that the atmosphere, as a source of oxygen, is inexhaustible. This is still true today, so when people talk about the importance of oxygen production in rainforests, it has little to do with science. Protecting rainforests is still very important, but not because of oxygen production, as is commonly believed.
When the authors wrote the above educational work, the world had not yet emerged from the spell of the industrial revolution. In Great Britain, coal was the main source of energy, as shown in the figure below.

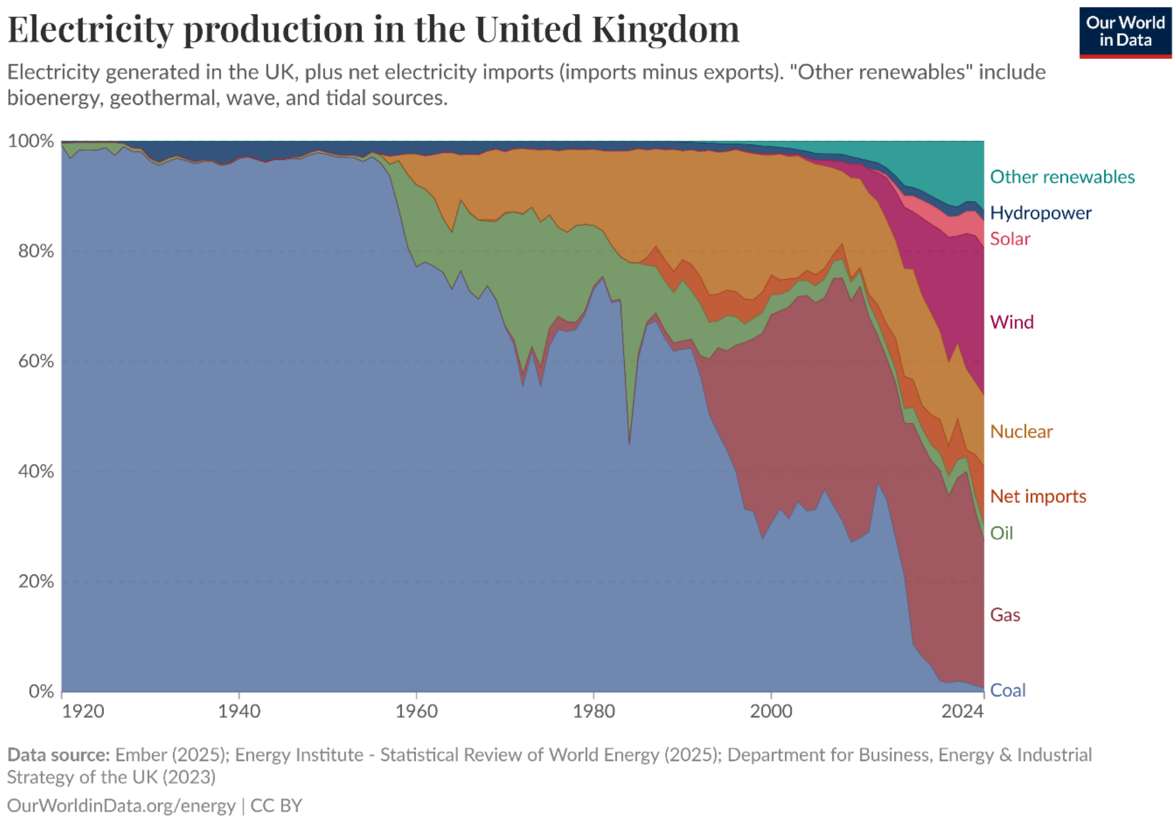

Figure 1. Electricity generated in the United Kingdom and net electricity imports [3]

Source: https://ourworldindata.org/grapher/electricity-mix-uk

The figure shows that until the end of the 1960s, electricity in the United Kingdom was generated using coal, but from 1979, when Margaret Thatcher came to power, coal mines were closed and coal was quickly pushed out of the energy market, replaced by oil, natural gas and nuclear energy, and more recently by renewables. The rapid transition required the decisive political

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[2] Dezső Králik, József Öveges, Róbert Forbáth (eds.): The World of Culture, Supplementary Volume 1 – Mathematics. Physics. Chemistry (Budapest, 1964) Chemistry / The realm of inorganic chemistry / Oxygen, our lifeblood and our enemy Inorganic chemistry, page 912. https://adt.arcanum.com/hu/view/KulturaVilaga_6_Potkotet1MatematikaFizikaKemia/?query=a+leveg%C5%91+k%C3%A9miai+%C3%B6sszet%C3%A9tele&pg=929&layout=s

[3](Net imports = imports minus exports). Other renewable energy sources include bioenergy, geothermal energy, wave energy and tidal energy.

involvement of the "Iron Lady", but it was also economically and environmentally rational. The "Iron Lady" pursued the interests of capital. Workers hated her because many lost their jobs. At the time, coal combustion was highly polluting due to high fly ash and sulphur dioxide emissions, but the policy's goal was not to eliminate pollution; it was to solve economic problems, and the reduction in harmful emissions was a beneficial environmental "side effect". We have slowly forgotten about acid rain, and economic problems are now of a different nature, but the issue of carbon dioxide and greenhouse gases in general has become a pressing environmental and climate policy issue today.

We talk a lot about carbon dioxide, but it is not certain that it deserves so much attention among greenhouse gases. A significant part of the carbon dioxide cycle in the atmosphere is of natural origin. Most of the biomass formed by photosynthesis decays through "slow combustion". Trees shed their leaves in autumn, and the decomposition of the leaves begins. At the same time, trees bind carbon dioxide through assimilation. In a polytunnel or greenhouse, increasing the concentration of carbon dioxide helps biomass formation, so there are not only negative but also positive feedback loops. "In terms of the biosphere, the increase in atmospheric CO_2 directly increases the amount of carbon fixed during photosynthesis and also improves the efficiency of photosynthesis (Goosse 2015). Overall, the increase in atmospheric CO_2 concentration results in positive feedback for the biosphere (which is limited, for example, by the availability of nutrients) but ultimately leads to a decrease in atmospheric CO_2 concentration, resulting in a negative net effect. The role of individual processes in climate change remains unclear, mainly due to the significantly oversimplified biogeochemical sub-models of climate models (Újvári and Topál 2025 pp 985).

As a result of these efforts, the amount of carbon dioxide entering the atmosphere has decreased significantly in Hungary, as shown in Figure 2. The decrease in the concentration of other GHGs is not as spectacular, even though their greenhouse effect is often more powerful, as in the case of methane. Ruminants are not the only source of methane emissions; significant amounts can also be released into the atmosphere during composting or when permafrost thaws, and only climate modellers suffering from "fatal conceit" believe they can map the effects this has on the climate.

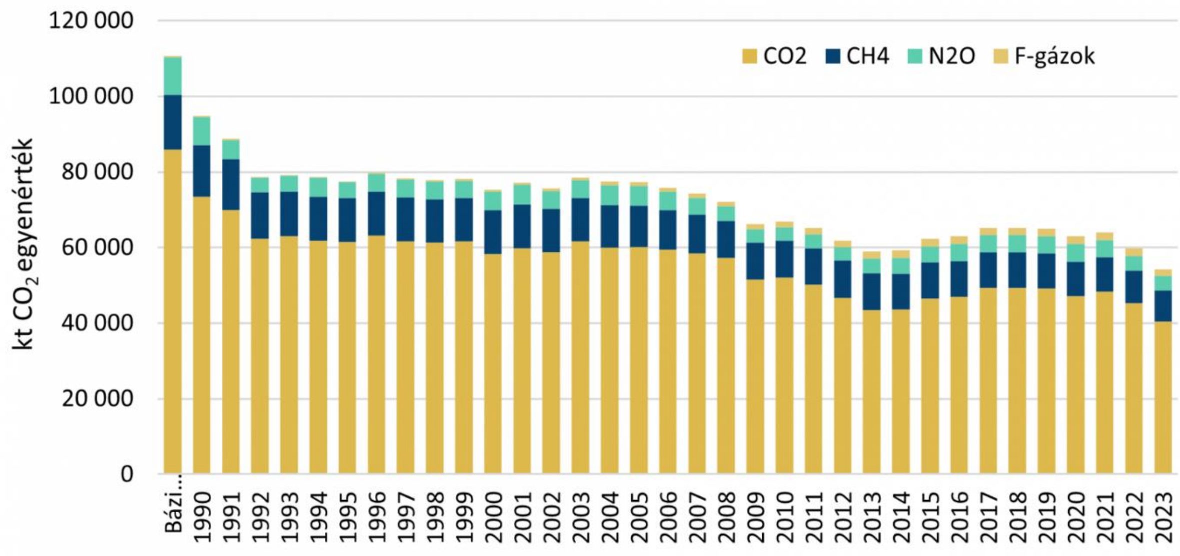

Figure 2. The amount of carbon dioxide entering the atmosphere in Hungary

Source: https://legszennyezettseg.met.hu/kibocsatas/trendek/uveghazhatasu-gazok
(Greenhouse gases n.d.)

The distinguished atmospheric chemist András Gelencsér, who considers sustainable development to be more of a myth than a possibility, summarises the complexity of the climate problem well in the following lines: "A drastic reduction in greenhouse gas emissions is definitely justified. There is no doubt that the climate system is extremely complex, interactive and highly non-linear, often involving little-known feedback processes. Therefore, climate models, which always contain only highly simplified elements of natural processes, can only provide forecasts for the middle to end of the century with a high degree of uncertainty. However, as the topic of climate change has become highly politicised and is the subject of intense public interest, this extremely complex system had to be condensed into a simple marketing message. This became the "CO_2-global warming" combo, which continues to shape public opinion and guide policy to this day. In this narrowed communication space, there are no probabilities, uncertainties or gaps in knowledge, which are essential components of science. Yet the very fact that none of the global ozone models that existed at the time and formed the basis of the Montreal Protocol were able to predict the sudden formation of the ozone hole over Antarctica in 1982 should prompt us to exercise caution. Although high-altitude ozone is an order of magnitude simpler natural formation than the climate system, the models that were believed to be reliable failed without exception (Gelencsér 2023).

As for the "wooden spoon", it is perhaps worth considering that an efficient economy works wonders not only in „Iron Lady's" time, but also today. According to endogenous growth models, the transition to a carbon-free economy can have a positive impact on long-term economic growth. If clean technologies show increasing returns through learning and action effects, early investments in green technologies can create self-reinforcing growth dynamics. The spillover of knowledge from green research and development can offset the short-term costs of the transition through increased productivity. Economic jargon refers to the phenomenon where economic growth is not accompanied by a proportional increase in pollution (relative decoupling) as 'decoupling', which is even more encouraging as it means that absolute reductions in pollution can also be achieved in many cases. The table below lists some of the countries that achieved significant economic growth between 2005 and 2019 while reducing their CO_2 emissions.

Table 1. The phenomenon of decoupling. The countries listed increased their GDP between 2005 and 2019 while reducing their CO_2 emissions.

Countries	GDP growth rate %	Reduction in CO_2 emissions %	Countries	GDP growth rate %	Reduction in CO_2 emissions %
Ireland	81	42	Estonia	37	21
Portugal	10	38	Sweden	32	21
Spain	16	35	Cyprus	31	19
Denmark	19	29	Singapore	96	19
UK	22	28	Hungary	29	16
Romania	62	26	Japan	9	16
Croatia	16	25	USA	28	15
Finland	14	23	Mexico	33	10
Netherlands	22	23	Czechia	41	5
France	18	22	Latvia	30	4
Germany	24	21	Slovenia	31	4

Source: (Roser 2021)

The global nature of climate externalities causes further complications beyond traditional externality theory. Unlike local pollution, greenhouse gas emissions incur costs that are time-shifted, spatially dispersed, and characterised by threshold effects and irreversibility. Climate stability is a global public good, which causes classic "free rider problems". Individual countries or companies are encouraged to profit from the emission reductions of others while continuing their own emissions. Despite this brief digression to defend our profession, I largely agree with András Gelencsér's perfect assessment of the situation, with the caveat that neither politicians nor science will ever be able to resolve the contradictions caused by the complexity and uncertainty of such wild problems. Unfortunately, science only operates within the limits of its own competence, while the climate problem is multidisciplinary, and the unpleasant nature of such problems is that we cannot even define the problem itself precisely, yet, as the figure shows, we still need to take action.

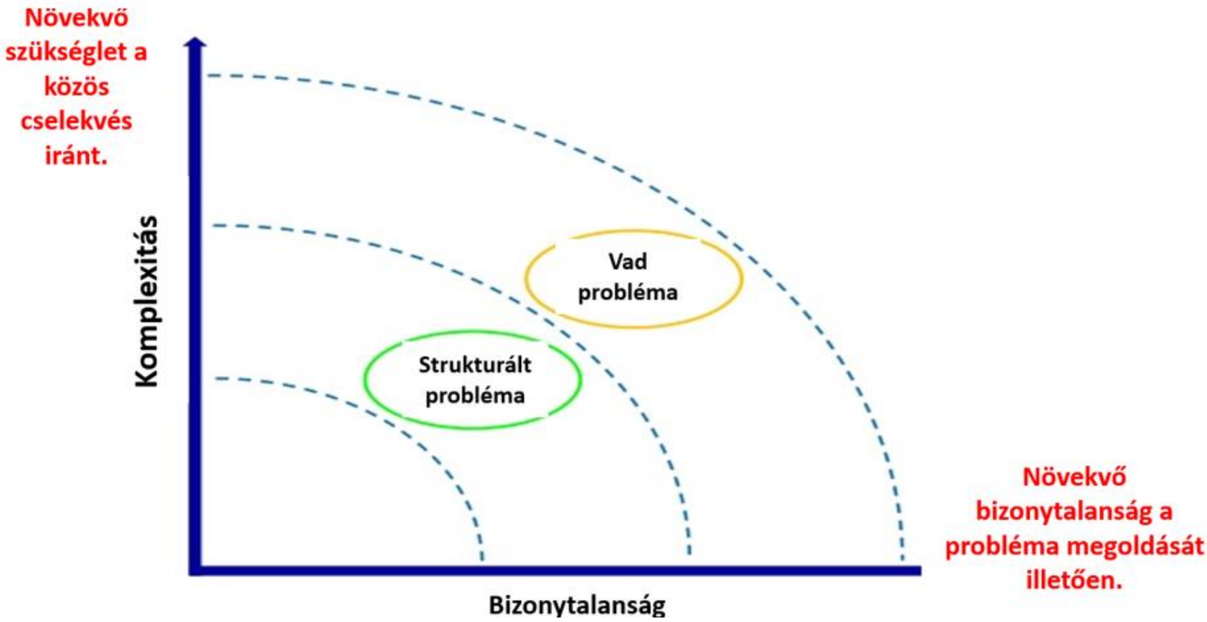

Figure 3. Due to uncertainty and complexity, problems are largely "wicked".

Source: (Rittel and Webber 1973)

Unfortunately, this is true for politicians, economists and scientists alike. But what should we do, who should we listen to, who should decision-makers listen to? The author's negative bias towards politics and economics is understandable and perhaps justified, but it is nevertheless unfortunate. In the following, I will show that it is not advisable to listen to "anointed" science either, because it seems to be talking nonsense, but this nonsense may be normal. If we were to believe, if we dared to believe, that no one possesses the philosopher's stone, then the "many kinds" of science could inspire us and decision-makers alike to take different actions. German politicians believed the environmentalists and shut down the nuclear reactors. Now the Germans produce the electricity used to charge electric car batteries in coal-fired power plants. Fortunately, the French did not follow the German example and export the electricity produced by nuclear reactors to Germany, among other countries.

There are those who think they know who is right about banning nuclear reactors and are looking for the optimal solution. But there is no optimal solution; we can only know whether a solution is useful or harmful once someone has tried it. It may not seem like a scientific approach to encourage experimentation and action rather than the collection of facts and the organisation of scientific analyses and conferences. Of course, these should not be reckless experiments, but rather careful ones, with strict adherence to the precautionary principles. Diversity can make even the most complex systems resilient, and only diversity can help us deal with uncertainty. Unfortunately, uncertainty is not the same as probability. Probability is calculable, uncertainty is not. They are related concepts, but the difference between them must be understood. Unfortunately, colloquial language uses vague terms. Insurance can be taken out against risks because risks are calculable. Insurance cannot be taken out against uncertainty because the "probability" of occurrence cannot be estimated in cases that are not mass phenomena. András Gelencsér's warning is worth heeding: "If we also take into account the risks arising from natural processes that are on a huge scale and, by human standards, uncontrollable, then we can compare the global climate change currently taking place to a runaway train that is accelerating by continuously shovelling coal into its boiler, while it has already reached a downhill track, has no brakes at all, and the driver has his eyes blindfolded.

The question is, would we get on such a train? Obviously, no normal person would, but humanity is currently sitting on just such a runaway train. (Gelencsér 2023). Yes, we are on the train, but there is only one thing we can do: encourage humanity to try to slow down. If we slow down in many different ways, we may be able to avoid the precipice. Fortunately, many people believe that change is necessary. "Immediate action is needed to avoid, or at least mitigate, the significant economic, social and other problems caused by global warming. Based on the above figures, current emissions should be halved.

In 2022, the average Hungarian citizen emitted 4.95 tonnes of CO_2 per year (in 2005, this figure was 5.98 tonnes per capita; Crippa et al. 2022), roughly double the 2.3 tonnes of CO_2 per person per year considered sustainable, calculated for 2030 (Újvári and Topál 2025 pp 991). I fully agree with the renowned authors on the need for immediate action, but I do not know, and I think neither do others, what should be "halved". According to the authors, the problem is that "the effects of climate change are only being felt in a mitigated form for the time being, and the increasingly frequent extreme weather events (flash floods, droughts, heat waves) experienced in recent decades may not yet have reached the threshold of the average person's perception. In the near future, there will be a need for further widespread presentation of the scientific facts related to climate change, their rational consideration and social debate, where the attention of the average person and the political elite is not focused solely on the present" (Újvári and Topál 2025 pp 992).

The problem is that there are no clear scientific facts that, if taken into account by politicians and the general public, could be solved. Climate change is a real phenomenon, and there are committed advocates. Some predict the end of the world, others want to make a living from the climate business, and there are ordinary citizens who no longer believe anyone. We should not be outraged by the attitude of the "general public", as even scientists do not believe each other. László Szarka, for example, writes the following "The question is whether the +1.6 ºC, most of which (about 1.2 ºC) we have already exceeded, should be considered fatal. According to William Nordhaus, winner of the Nobel Prize in Economics (2018), it should not. In his opinion, the UN's climate policy goals would unjustifiably impoverish humanity, and it would be better to do nothing about climate change, but simply adapt to it (Nordhaus and Sztorc, 2013, and Szarka 2024 pp 339).

This comment is noteworthy because a natural scientist calls on a social scientist economist to support his argument. It is true that this economist is a Nobel Memorial Prize winner, but we must value the exchange of ideas between different disciplines, as this is precisely the key to addressing the problems of wicked. So far, we have agreed with the natural scientist experts but now comes the sticking point. According to László Szarka, "Whether the Earth system approach or the enhanced CO_2 effect hypothesis describes reality is a matter for science to decide. However, for science to fulfil its role, clear and unambiguous definitions are needed" (Szarka 2024).

Since the nature of wild problems is such that it is not yet possible to define precisely what the problem is, we have reached the trap of 22. "Since the Industrial Revolution, the rapid increase in atmospheric CO_2 due to human activities has prompted numerous international scientific research programmes to analyse the role of individual components of the Earth system in the global carbon cycle. Our knowledge of the carbon cycle in the oceans, terrestrial ecosystems and the atmosphere is extensive enough to conclude that, although natural processes have the potential to slow the rate of atmospheric CO_2 increase, there is no natural 'saviour' that will absorb all anthropogenic CO_2 over the next century. Our knowledge is insufficient to describe the interactions between the components of the Earth system and the relationship between the carbon cycle and other biogeochemical and climatological processes. Overcoming this limitation requires a systems-based approach (Falkowski et al. 2000). It does indeed require a systems approach, but there is no precise and accurate definition, natural science can throw up its hands, and there is no acceptable solution. The attempt that I repeatedly recommend is unacceptable to serious scientists.

It is also worth taking a closer look at what William Nordhaus said and did not say. Not all climate researchers welcomed Nordhaus's Nobel Prize with enthusiasm, and of course they quote those statements that support the position they themselves represent, according to their temperament. One of them is economist Robert Murphy, who naturally likes the last sentence of the quote the most, and this is what László Szarka also highlights: "Both fans and critics of William Nordhaus's computer model of the global economy and climate recognise that it is a crude approximation that ignores many important real-world considerations. Nevertheless, it is certainly significant that the work for which Nordhaus received the Nobel Prize clearly states that the UN's special report on climate change is full of proposals that are ridiculously expensive. In an interview after receiving his prize, Nordhaus diplomatically handled the situation by saying that the 1.5 °C target is currently impossible to achieve.

However, we can go further than that. Nordhaus's work shows that such an aggressive target would put humanity in a much worse position than if we simply adapted to climate change without government intervention (Murphy n.d.). Murphy, of course, takes the DICE model's calculations further and adds: "The most alarming predictions of damage from climate change are based on naive assumptions about human adaptability. Even if we accept the basic predictions in the IPCC's latest assessment, 'unchecked' climate change will probably mean that our great-grandchildren's standard of living will rise less than it would have done if we had been able to remove some of the carbon dioxide from the atmosphere at no cost. Such a possible outcome is no cause for panic and does not justify massive government intervention in the energy or transport sectors (Murphy n.d. Saturday, 20 July 2019).

However, Nordhaus ran the DICE model again and published the results in 2024, which may be more relevant than the earlier data (Barrage and Nordhaus 2024). The results are interesting, but we must not forget that Nordhaus clearly argues in favour of introducing carbon taxes, although everyone can read whatever they want into the model. "The social cost of carbon (SCC) in the baseline scenario (if no extra efforts are made) is $66/t CO_2 for the 2020 period (in 2019 international dollars). This is higher than the SCC of $50/t CO_2 in the C/B optimal run, as the damages are lower in the C/B optimal run. It is far below the SCC of the 2 °C run, which is $76/t CO_2. The higher SCC in the temperature-limited run reflects the economic interpretation that a tight temperature limit corresponds to a damage function that bends sharply at the temperature limit and therefore results in a steeply higher damage function above 2 °C. One of the most important findings concerns the importance of discounting for SCC and other policy measures. The table shows alternative estimates of SCC in the DICE-2023 scenarios and highlights in particular the strong impact of discounting and climate damage on SCC.

A carbon-free economy entails costs for current generations for the benefit of future generations, raising fundamental questions about intergenerational welfare comparisons. The choice of discount rate, as evidenced by the DICE model, is crucial for assessing the net benefits of climate change measures. According to economic theory, discount rates should reflect pure time preference and the rate of economic growth, but ethical considerations of intergenerational equity may justify lower discount rates in climate change analyses than in typical investment projects. Declining discount rate approaches, proposed by many, including Stern, generally increase the present value of long-term climate benefits and strengthen the economic case for aggressive short-term action (Stern 2006).

Mainstream economists – William Nordhaus, Partha Dasgupta, Martin Weitzman – focused on technical issues such as discount rates, damage functions and the methodology used in the 2006 Stern Report. The alternative (heterodox economists) argued that Stern, as an orthodox economist, confined all questions and concepts to a narrow mathematical formalism, failed to address economic and social realities, and ignored the critical literature on ecological economics and environmental ethics. Science (Stern) and politics (British Prime Minister Tony Blair) had already stated twenty years ago that the costs of transition, although significant, pale in comparison to the costs of inaction on climate change, making a carbon-free economy not only an environmental necessity but also an economic one.

The message was clear, but neither mainstream nor alternative science wanted to hear it. Instead of action, the world chose inaction. Scientific papers have, of course, continued to be written since then. As can be seen from the relatively recent table below, a low discount rate (the version favourable to our grandchildren) results in an SCC that seems unbearable. A discount rate of around 5%, which is acceptable to the business world and favourable to current generations and the business world, roughly indicates what Murphy and many others would like to read from the Nobel Prize-winning economist's paper "Such a possible outcome is no cause for panic and does not justify massive government intervention in the energy or transport sectors" (Murphy n.d.).

Table 2. Social cost of carbon (SCC[4]), alternative scenarios (2019$/t CO_2)

Scenarios	2020	2025	2050
Cost/benefit optimal	50	59	125
T<2 °C	75	89	213
T<1.5 °C	3557	4185	16552
Alternative damage[5]	124	146	281
Paris Agreement	61	72	159
Baseline	66	78	175
R=5%	32	37	74
R=4%	49	58	107
R=3 %	87	102	172
R=2 %	176	207	302
R=1%	485	571	695

Source: (Barrage and Nordhaus 2024)

Natural scientists have given climate models a damning review, but the situation is no better with economic modelling. The assumptions are rather weak in both cases. However, they are better than nothing, but we should not take the models as seriously as we do. They help us understand complex systems, but we cannot place the responsibility on them. Let's try to see if we can slow down the runaway train. One such attempt could be the introduction of carbon taxes.

The introduction of a carbon tax is inevitable

Economic theory offers two main approaches to internalising the externalities of carbon dioxide emissions: the introduction of Pigou taxes and quantity-based regulation. The latter could take the form of a pollution rights market, more recently known in international practice as a cap-and-trade system. With certainty and perfect information, both regulatory approaches can achieve effective results. Carbon taxes provide certainty in terms of prices but uncertainty in terms of quantity, so they may be potentially better when the marginal costs of emission reductions are relatively low and uncertain, but the marginal damages are well known. Cap-and-trade systems aimed at regulating quantities provide certainty in terms of emission volumes, but on the other hand, they create uncertainty in terms of prices. This regulatory practice is more advantageous when marginal damage functions are steep and marginal abatement costs are better known. Weitzman's analysis suggests that when marginal abatement costs fall steeply relative to marginal damage costs, the use of price instruments (taxes) is more appropriate. Given the global nature of climate change and the relatively flat marginal damage function in moderate

[4] The social cost of carbon is an estimate, expressed in monetary terms, of the economic damage caused by each additional tonne of carbon dioxide emitted into the atmosphere. It is a measure used to quantify the long-term damage caused by carbon dioxide emissions, including the effects of climate change on agriculture, human health and infrastructure. Policy makers use SCC to evaluate the costs and benefits of regulations and policies that affect carbon dioxide emissions.

[5] Traditional climate-economy models often use simple damage functions to examine the effects of climate change. For example, the effect of temperature rise on economic output. These damage functions do not necessarily capture how climate change affects different sectors, regions or aspects of the economy. ‘Alt damage’ is based on estimates that take greater account of uncertainties and extreme events.

emission ranges, Weitzman's analysis argues in favour of carbon dioxide taxation rather than quantitative regulation (Weitzman 2018).

A carbon tax is a tax levied on all goods and services whose production generates carbon dioxide emissions. The price of carbon dioxide can be introduced in two ways: through a carbon tax or through a cap-and-trade system. In a Cap-and-trade system, the price of carbon dioxide changes over time. A maximum level of pollution (the 'cap') is set, and producers must apply for permits to emit carbon dioxide. The cost of these permits is determined by a trading system. The price of permits rises as the emission limit is approached. In both systems, the price of any product increases with the amount of carbon dioxide emitted during its production. As a result, low-carbon products (such as train travel or solar energy) do not become more expensive, while high-emission products (such as air travel or coal energy) do (Roser 2021).

"The argument, then, is that if taxes must be levied, it is better to tax things that harm people than things we want to encourage, such as work. There are big losers from the carbon price – the fossil fuel industry – but general taxes for citizens do not have to rise: the carbon price is government revenue, so it can cut taxes elsewhere" (Roser 2021).

By comparing fuel prices and per capita fuel consumption in 42 countries, we can gain some interesting insights. As a general economic correlation, we might expect that where fuel is more expensive, per capita fuel consumption will be lower. Unfortunately, this cannot be proven; the data show that there is virtually no correlation between fuel prices and how much people in certain countries drive. For clarity, we have only included a few countries in the figure.

It is surprising, for example, that an island country like Singapore, where distances are short and fuel prices are high, ranks ahead of France and Italy. Prices are exceptionally high in Switzerland, yet per capita consumption is high. In oil-rich Arab countries, fuel is cheap and per capita consumption is relatively high. Canada and the USA are relatively sparsely populated countries with low fuel prices and, naturally, high per capita consumption. However, we know that these are rich countries where even cities lack adequate public transport.

The vast and sparsely populated Kazakhstan is considered a relatively poor country, but with relatively cheap fuel prices and high per capita consumption, it stands out from the ranks of poor countries, which is obviously due to its abundance of hydrocarbon mineral resources. Many conclusions can be drawn from the data. Some will question the rationale behind fuel taxation, while others will argue in favour of higher taxes, saying that a radical increase in fuel prices would reduce consumption. The data show that this is a truly complex, real-world problem, and it is almost impossible to determine what effect a drastic price increase would have. However, we do know that fuel prices are not very elastic, but in the long run, prices do affect consumption. Today's cars consume a fraction of what they did twenty years ago. Many people choose electric and hybrid cars not out of environmental conviction, but out of thriftiness. The direct effect is not apparent from the figures, but through complex transfers, fuel prices do have an impact on consumption. Extensive research shows that short-term price elasticity for fuels is around -0.3, while long-term price elasticity is significant , with various studies indicating values around -0.6 and -0.7 (Liddle and Huntington 2020).

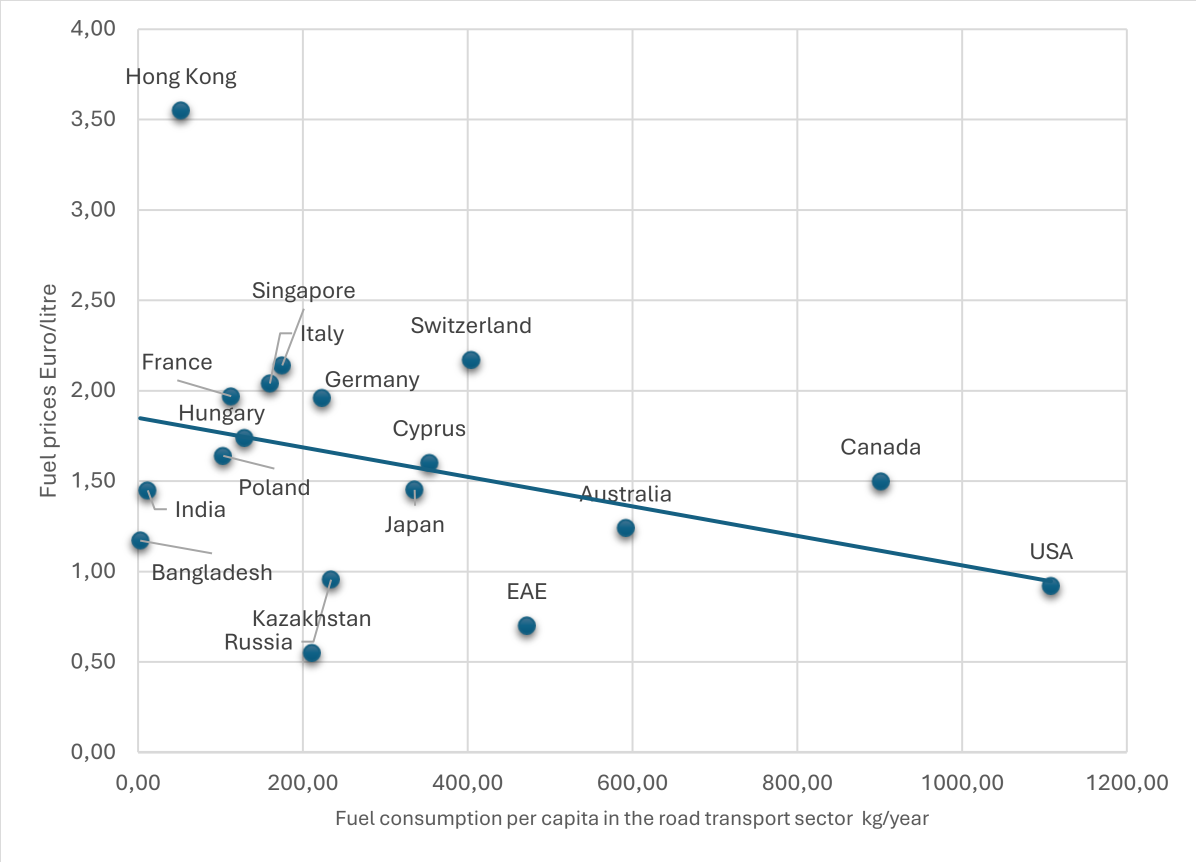

Figure 4. Per capita fuel consumption in the road transport sector and fuel prices in Euro (arbitrary selection, data for 2010 and 2025)

Source: Own compilation based on the following databases: https://www.globalpetrolprices.com/gasoline_prices/ https://static.nationmaster.com/country-info/stats/Energy/Gasoline/Road-sector-gasoline-fuel-consumption-per-capita/Kg-of-oil-equivalent#country

The possibility of a carbon-free economy

The concept of a carbon-neutral economy – one that operates without net carbon emissions – has evolved from an environmental aspiration into an economic necessity. A carbon-neutral economy does not necessarily mean that all activities produce zero carbon emissions, but rather that a combination of emission reduction and carbon removal strategies achieves net-zero emissions. This approach recognises that some sectors may continue to produce emissions, while others become carbon negative.

The transition will require fundamental changes in how we produce energy, manufacture goods, transport people and products, and design our built environment. The transition to a carbon-free economy creates significant economic opportunities on the other side. The clean energy sector already employs millions of people worldwide, and the number of jobs is growing at a rate that exceeds that of traditional energy industries. Green bonds and sustainable finance are directing trillions of dollars into low-carbon investments, as companies discover that sustainability often goes hand in hand with efficiency and profitability. The concept of the circular economy eliminating waste and keeping materials in use offers another path to reducing emissions and resource costs.

The biggest challenges are political and social rather than technical. Existing vested interests in current systems, political polarisation around climate policy and public resistance to change can significantly slow progress. Joseph Schumpeter's concept of creative destruction provides a framework for understanding the transition to carbon-free emissions as a process of economic renewal. The displacement of fossil fuel industries by clean energy represents a technological disruption that has historically been the engine of economic development. Existing companies and industries face obsolescence, while new sectors emerge. Resistance to the transition to carbon-neutrality may stem not from concerns about economic efficiency, but from the distribution of gains and losses.

Schumpeter's theory suggests that although the transition may reduce efficiency in the short term, it may increase dynamism and innovation capacity in the long term. The question is whether the process of creative destruction can take place quickly enough to meet climate constraints while managing the social and political disruption associated with significant economic restructuring (Bőgel 2008).

The challenge is not the theoretical feasibility of a carbon-free economy, but the practical design and implementation of institutions, policies and market mechanisms capable of coordinating the necessary transformation while managing distributional consequences and international coordination problems.

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