CLIMAT ACADEMY®
The Scientific Supplement

# Chapter Eight

## Tipping Points

## Physical Energy Transition and Rebound Effect


### Summary

This supplement challenges the comforting story that the world is moving smoothly from old energy sources to new ones. It argues that historical evidence shows not simple replacement, but "energy addition": coal, oil, gas, nuclear and renewables tend to accumulate rather than neatly displace one another. By looking at industrial history, the text shows that wood did not vanish when coal rose, and oil did not eliminate coal. Each new energy source often expanded the overall scale of energy use. The supplement also points toward the rebound effect, where efficiency gains or new technologies can stimulate greater total consumption instead of reducing it. This makes the phrase "energy transition" more problematic than it first appears. The chapter's wider warning about physical tipping points is therefore sharpened: without confronting absolute demand, infrastructure lock-in and material throughput, societies can mistake technological change for real climate progress while still driving the Earth system toward dangerous thresholds.



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# ENERGY TRANSITION AND THE REBOUND EFFECT

If there is one expression that we have all heard for many years, it is "energy transition". This expression is so deeply rooted in our daily lives that we have stopped questioning it, considering it either as a historical truth or as the solution to reducing greenhouse gas emissions. But what does this transition really mean and is it even underway?

To try to answer this question, it is necessary to look at the last two centuries from the perspective of energy sources. It is common to say that wood was followed by coal, which was itself replaced by oil, gas, then nuclear power and, more recently, renewable energies, which have finally decarbonised energy production.

A narrative in the face of historical reality

The industrial revolution is often described as the transition from human and wood-burning energy to coal-based energy. However, the reality of the volumes consumed is quite different: for example, 4.5 million tonnes of wood were used in 1913 in Great Britain for coal mining, far more than was burnt in the 18th century. Throughout Europe, the trend is the same. Wood consumption in Belgium increased so much that in the last 40 years of the 19th century, imports increased by a factor of six. The forests of the Congo provided ample supply for this considerable demand.

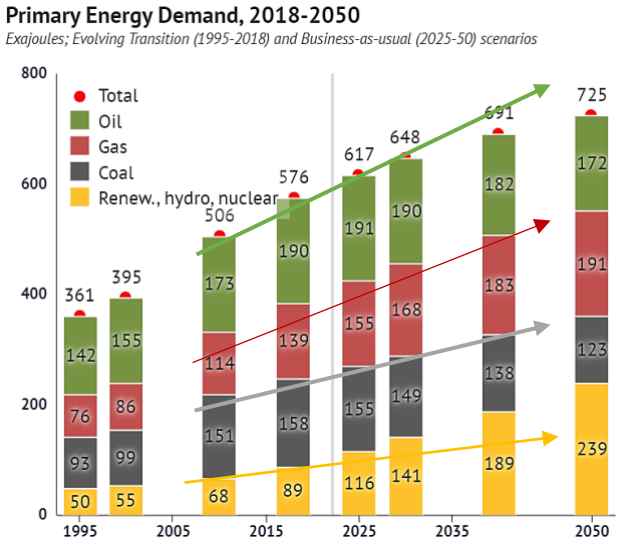
The development of the car industry led to the massive use of oil. This source of energy is added to coal rather than replacing it. Indeed, according to some studies, between the two world wars, the production of a car required as much coal as it used oil to run it. Moreover, since coal and oil do not have the same properties, the diversity of uses will lead to a concomitant increase in both resources.

With the oil shocks of the 1970s, the United States revived coal production, which peaked in 2008. Natural gas and shale gas also developed abundantly. The war in Ukraine that started in February 2022 dramatically illustrates the dependence of European countries on Russia for these fossil resources.

In 2019, 4 years after the Paris agreements, coal, oil and gas still represent 80% of the energy mix!

**There have therefore been no transitional energy technologies in history, but rather additions or symbioses.** [1]

The following document illustrates very clearly that there has been no transition from one form of energy to another since 1995, but rather a continuous increase in demand for all available energy sources.




*Credit : BP Energy Outlook 1995-2050, 2020 Edition*

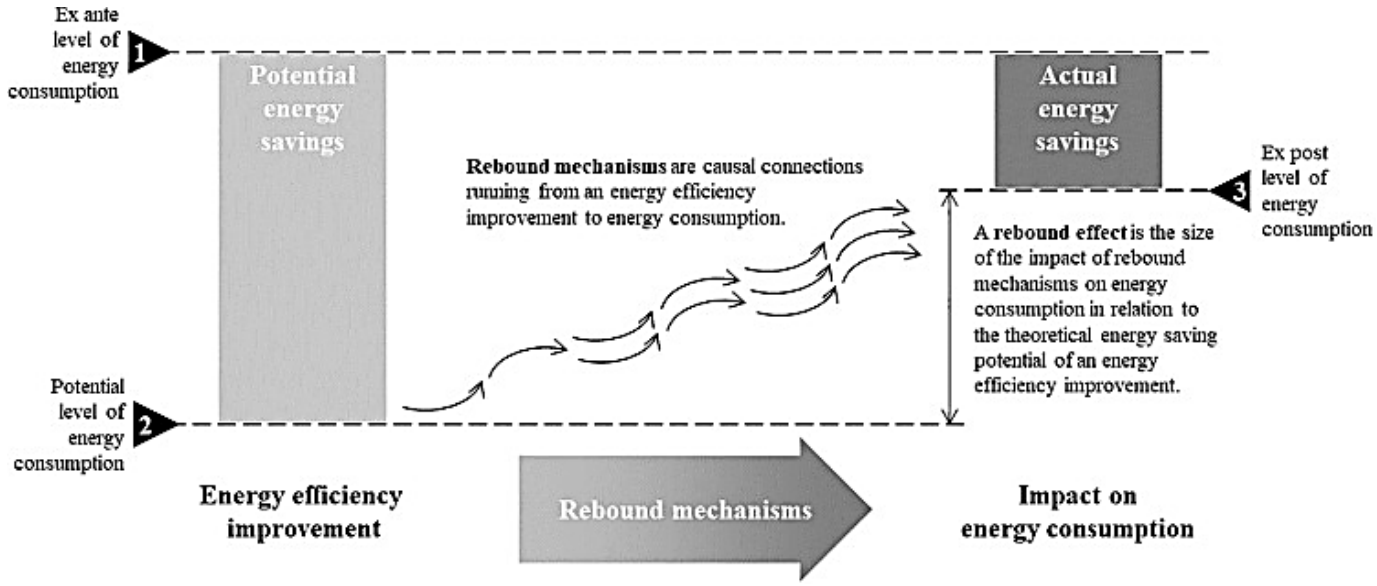
[1] Bonneuil, C., & Fressoz, J. (2013b). *L'Evénement Anthropocène : La Terre, l'histoire et nous*. Média Diffusion.

Today, the decarbonisation strategy needed to achieve carbon neutrality is based on the deployment of renewable energies. But rather than replacing them, these energy sources will be added to those already in existence.

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**A necessary ideological transition**

As early as the 19th century, William Stanley Jevons theorised about what is known today as the rebound effect: if the energy efficiency of a machine increases thanks to technology, the cost of the technology decreases, which leads to an increase in the number of these machines and inevitably to an increase in energy consumption. [1]




Source : https://www.sciencedirect.com/science/article/pii/S221462962100075X

Thus, while it is possible to hope that an improvement in energy efficiency will lead to potential energy savings, the rebound effect leads to an increase in energy consumption. This reduces the energy savings. It is even possible that it is no longer a question of savings but of additional expenditure.

So-called renewable technologies alone will not provide solutions for reducing GHGs. It is essential to adapt energy production and distribution infrastructures, to change behaviour, in a word: to reduce overall energy consumption.

The rebound effect is now widely documented beyond energy consumption.

In 2017, a study presented the effects of using rapeseed oil in Europe and soybean oil in the United States as biofuels, substitutes for hydrocarbons [2]. The conversion of agricultural land from food to energy has shown an unexpected rebound effect: that of driving up palm oil prices in Indonesia and encouraging local producers to produce more at the expense of the rainforest and peatlands. The agro-food use of rapeseed and soybean oils is thus competing with a new industrial outlet, which has the effect of increasing their price. Industries that are major consumers of these oils will have to diversify their supplies to try to maintain their profitability and will turn to palm oil. The latter will inevitably benefit from a price increase, encouraging the expansion of this environmentally damaging crop. While European and North American legislation prohibits the conversion of forest land into agricultural land, Indonesian legislation allows it.

Thus, although biofuels can reduce greenhouse gas emissions by up to 41% [3] compared to diesel fuel, the destruction of natural ecosystems acting as carbon storage sinks considerably reduces the benefits initially expected from these biofuels. But as the sustainability of fuels is not limited to an accounting of GHG emissions, the "ecological" rebound effect of the destruction of biodiversity and the damage to the natural contributions of these tropical ecosystems should be added to the "GHG emission" rebound effect.

(1) *Lange, S., Kern, F., Peuckert, J., & Santarius, T. (2021). The Jevons paradox unravelled : A multi-level typology of rebound effects and mechanisms. Energy research and social science, 74, 101982.* https://doi.org/10.1016/j.erss.2021.101982

(2) https://theicct.org/sites/default/files/publications/Oil-palm-expansion_ICCT-Briefing_27072017_vF.pdf

(3) https://doi.org/10.1073/pnas.0604600103

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