

## Systemic Strategies for a Complex Transition

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**T**his post summarises my talk on 11 July 2025 at the Summer Course of the University of Cadiz, Remedies for a Planet in Crisis. The talk was entitled Strategies for another possible energy model for other possible worlds. It came after those of Antonio Turiel, Alicia Valero, Ferran Puig, Antonio Aretxabala and José Luis Yeltes, who had already clearly defined the problems of energy, material and ecosystemic limits. This presentation aimed to identify solutions, and I used system dynamics tools to do so.



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### System Dynamics

Systems dynamics is a fantastic tool that should be studied in all universities, because our culture has a huge deficit of systems thinking. Society has become very complex, but our minds still work with simple, linear reasoning: A implies B, non-A implies non-B. This is the systemic way of thinking. This is the way of thinking of logic, which originated in Greek culture and is the basis of mathematics, but we have outgrown it to cope with an increasingly complex world.

As in Figure 1, political and academic debates are full of people trying to prove that A is the cause of B. In contrast, others try to counter by saying that this is a lie because the cause of B is C, but in reality, B is caused by A and by C: the first people are right, and the second are right. And often there are many more causes and effects involved, which often overlap, creating closed loops in which a variable ends up being both its own cause and effect. This

creates vicious or virtuous circles, 'fish that bite each other's tails' that we call feedback loops. Feedback loops create structures that are difficult to change unless addressed systemically.

The complexity of the world versus the simplicity of our thinking makes most political and many intellectual debates sterile. Debates turn into fights between people who want to prove their cause-and-effect relationship but are unable to solve the problems.

There are two basic feedback structures: reinforcing and stabilising loops. Reinforcing loops arise when all cause-and-effect relationships are direct: the increase of one variable causes the increase of another (and vice versa, the decrease of one variable decreases the other). Stabilising ones arise when there is an inverse relationship in the loop (an increase in one variable causes a decrease in the other). Note that two inverse relationships in the same loop cancel and become a direct relationship.

For example, the more it rains, the more trees grow, but the more trees there are, the more it rains. This creates a reinforcing loop that makes the forest grow ever larger, accelerating until the territory's limits are reached (Figure 3). However, these same direct relationships can create the opposite behaviour. If there starts to be less rainfall, there will be fewer trees and less rainfall and fewer trees... until the forest becomes a desert. The reinforcing loop can be either a growth or a decline loop (which is why it is mistaken to call reinforcing loops' growth loops' or 'positive loops,' as is often done).

When there is an inverse relationship in the feedback loop (or an odd number of them), a stabilising behaviour is created: increases in one variable lead to a decrease in that same variable (Figure 4). These feedbacks are what control engineers look for, for example, to regulate the temperature of a room with a thermostat. Moreover, this is a tremendously common behaviour in nature; in fact, it is one of the characteristics of life. Our bodies constantly use stabiliser loops to keep body temperature, blood pressure, blood pH, and other parameters stable.

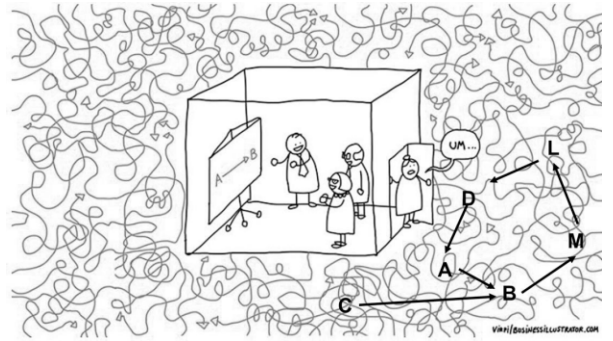


Figure 1: Academic reductionism in the face of a muddled

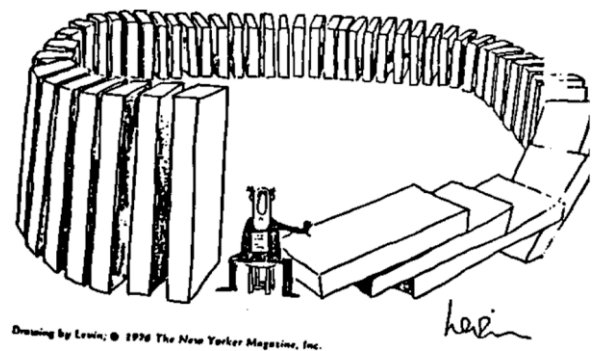


Figure 2: Reality is full of feedback... and it is often not a good idea to ignore feedback.



Figure 3: Reinforcing loop. Relationships are represented by arrows, with a + sign indicating a direct relationship and a - sign indicating an inverse relationship between two variables.

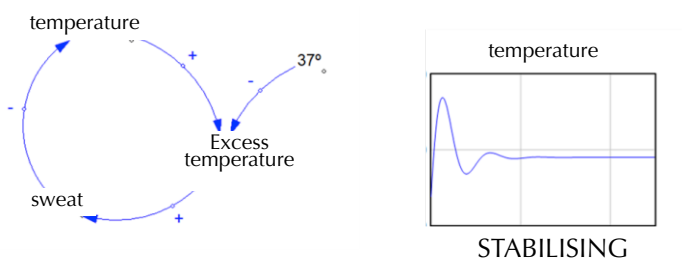


Figure 4: Stabilising loop. Relationships are represented by arrows, with a + sign indicating a direct relationship and a - sign indicating an inverse relationship between two variables.

Life is made of these two mechanisms that combine dynamically like yin and yang: regulation and growth, stability and drive, destruction and maintenance. Too much growth leads to explosive, uncontrollable behaviours, but too much stability stagnates systems; reinforcing growth allows systems to overcome adversities, but can also cause a prolonged decline leading to decay.

## What is energy transition?

To design energy transition strategies, the first question we should ask ourselves is what the goal of the transition is, the ideal to aspire to. The earth is a closed system materially and open energetically. We do not receive minerals from outer space, but we do receive a constant flow of energy from the sun that fuels photosynthesis and all the planet's metabolic cycles.

At the moment, humanity is basing its technology on fossil fuels (which are nothing more than solar energy accumulated over millennia) and uranium. We know that both will run out much sooner than we would like, and we should ask ourselves what a society would be like without these non-renewable energies.

A long-term sustainable energy model should have these four characteristics:

- ➔ Be 100% based on renewable energies, i.e. not rely on non-renewable energy sources such as fossil fuels or uranium.
- ➔ Recycle all minerals at rates close to 100%.
- ➔ Use the renewable resources of the biosphere at rates compatible with the regeneration and recycling rates of ecosystems.
- ➔ Have an acceptable Energy Return Rate ( ERR ).

The Energy Return Ratio is the ratio of the energy obtained from a source to the energy used to build and maintain it. An ERR of less than one means that our energy source is no longer an energy source and is, in fact, a sink. Energy sources should have a high ERR. Although this indicator is very difficult to measure, several methodologies exist that are not comparable and yield very different numbers. However, it is clear that energy sources with low ERR yield depleted societies with low returns for labour.

We know that pre-industrial societies were sustainable, or very close to it. We also know that today's industrial and globalised society is a long way from meeting these requirements. Is it possible to maintain an industrial society that meets these principles? Some people throw in the towel outright and claim that sustainability is only possible in simple agrarian-based societies. However, I honestly do not know, and I doubt anyone else does. We will only know when we experience it for ourselves.

Besides, I do not care so much about the final destination as I do about the path, because the transitional behaviour is often more important than the final destination. Depending on what we do in transition, we can make many futures possible or impossible.

Therefore, I would like to dive into the dynamics of energy and ecological transition and invite debate about these processes. Some dynamics trap us, preventing us from solving the problems for which we have known the solutions for decades. I would also like to talk about pernicious dynamics that can be unleashed during the transition and psychological mechanisms that can make things worse.

I would sum it all up in the following ideas:

- The technical problem: the transition is much more than renewable energies.
- The economic problem: economists, please come up with something!
- The dynamics of collapse.
- The feedbacks of fear, scarcity, guilt and the rules of the honourable harvest.
- Doing vs. not doing.

## The transition is much more than renewable energies

The idea that the energy transition is much more than simply replacing fossil fuels with renewable energy is a recurring conclusion across all the work we have done in the GEEDS-UVa.

In the first studies with the WoLiM model,<sup>1</sup> this conclusion already emerged very clearly. The most abundant renewable energy sources (solar and wind) generate only electricity. This energy is easy to transport, but very difficult to store. Hydro is much more stable and accumulable, but very limited. At the same time, energy from crops and forests (biomass and biofuels) is renewable, but only at very modest rates of extraction limited by the availability of fertile land.

We are used to cumulative, very versatile and powerful energy sources that allow us to shape today's society and industry. Oil, in particular, is a fantastic storehouse of energy, providing fuels such as petrol and diesel with 76 times the energy storage capacity per kilo than today's batteries.

Therefore, before we go madly installing solar panels and windmills, we should ask ourselves whether we are capable of electrifying energy uses that depend on fuels such as natural gas and diesel. Some sectors are challenging to electrify, such as transport and agriculture. Moreover, even if we can electrify, we still face the problem of renewable intermittency, which makes it very difficult to manage electricity grids.

We also face the problem of minerals, as renewables and electrification require more complex technical systems that rely on rare minerals we are not recycling. What if, by the time we realise we have to recycle minerals, we have already used up the reserves?

The territorial occupation of renewables is not negligible either, greater than that of fossil fuels. This is particularly serious for biofuels and biomass, but not negligible for solar and wind. Nor should we forget things like road asphalt, the chemical industry, plastics, synthetic fertilisers and so on. The problem is far-reaching. Technological change must touch all economic sectors. Energy is so essential that the technical characteristics of the energy sources we use shape all technology and a large part of social practices and customs.

The 5-axle trucks on our roads are designed that way because they have a power source that makes it easy to move those dimensions. If we were to move them with horses, it would be possible, but it would create so many animal management problems that we would stop doing it. The technology that is adapted for horsepower is the horse-drawn cart, whereas the truck is designed for diesel.

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<sup>1</sup>Capellán-Pérez, I., M. Mediavilla, C. de Castro, Ó. Carpintero, and L. J. de Miguel. 2014. "Fossil Fuel Depletion and Socio-Economic Scenarios: An Integrated Approach." *Energy* 77: 641–66. doi:10.1016/j.energy.2014.09.063 .

What is the right technology for a world of renewable energy, similar to the wind and solar that we know now? I do not know, and I doubt anyone knows, but it would certainly be a world that does less nonsense in the distribution of goods, much more local, more austere. It would probably be a society that uses smaller vehicles, that returns to rail and ship for the transport of goods, based on organic agriculture, that adapts to the rhythms of the seasons and takes exquisite care in the recycling of minerals... It would not hurt if we started to remember what the technology of our great-great-grandmothers was like in the 19th century, just in case.

Also, many people advocate moving towards simple technologies that they call 'low tech', but I do not really agree with that term. The little I have experienced with technologies has made me realise that there are no simple technologies; they all require expertise, know-how and good professionals. It is the small details that make a technology work fantastically or not at all.

The complexity of technology, of all technologies, makes it very difficult for us to shift towards a more sustainable life. We are forced to use the technologies sold to us by the big multinationals, even though we know that many of them have a huge environmental and human cost. Yet, we do not know how to switch to alternative technologies. If we dare to experiment with 'home-made' alternatives, we end up with clumsy, crude technologies. In reality, it is not that the alternatives are clumsy - they can be just as effective as the technology sold to us by the multinationals - it is just that no one has invested enough time and money in developing them to bring them to technical maturity.

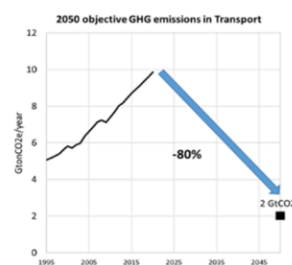
Again, we have a dynamic problem: we have gone down a path, and inertia makes it very difficult to get out, but this path is by no means the only or best one. For example, what would have happened if, at the beginning of the 20th century, it had been decided to treat human waste in cities dry instead of developing the sewage systems that create so many problems in rivers?

## Economists, create something!

The energy transition is much more than renewable energies; it is also much more than energy, because, although many do not want to see it, it is increasingly evident that we need profound social and economic changes.

To illustrate this, I would like to explain the study we published in 2020 on transport decarbonisation. This study used the MEDEAS model<sup>2</sup> to see what we would need to do to achieve an 80% reduction in global transport emissions by 2050 (Figure 5). To do this, we imagined two ideal scenarios: the techno-optimistic dream of the electric car (EV-high) and the environmentalist dream of 'everyone on a bike' (E-bike), and compared them with trends. We also designed a scenario that would work for us and achieve 80% decarbonisation of global transport, which we call Degrowth.

Figure 6 shows the percentages of private vehicles we proposed for 2050 in each scenario, compared with today's percentages. It can be seen that in the EV-high



### Scenarios:

1. Trends
2. EV high: strong electrification
3. E-bike: very light vehicles
4. Degrowth

Figure 5: Transport decarbonisation targets. The figure shows global transport CO<sub>2</sub> emissions (black) and the target of 80% reduction by 2050 (black square).

<sup>2</sup> De Blas, I., Mediavilla, M., Capellán-Pérez, Í., Duce, C., 2020. [The limits of transport decarbonization under the current growth paradigm](https://doi.org/10.1016/j.esr.2020.100543). *Energy Strategy Reviews*, 32. <https://doi.org/10.1016/j.esr.2020.100543>

scenario, all passenger transport is electric, either by cars or motorbikes, and in the E-bike scenario, most transport is by very light electric vehicles, similar to motorbikes.

Figure 7 shows the percentages of freight vehicles that we proposed. For freight vehicles, we did not dare to be as ambitious as for private vehicles, because that would put us into science-fiction territory. In the EV-high scenario, we proposed that trucks and heavy-duty vehicles should be hybrid or diesel; we did not envisage fully electric trucks. This generated significant criticism from the article's reviewers, but we kept it because a freight transport system based on electric trucks requires structural economic changes.

An electric truck cannot operate like a diesel truck; it requires many more stops, more time, and an extensive electrical distribution infrastructure for recharging batteries... A world of electric trucks requires structural changes in logistics and trade; it is not a simple technological change.

The results showed that global transport emissions under these scenarios were lower than expected from trends, but the reductions were very modest and fell far short of the 80% decarbonisation target (Figures 8 and 9). What was the cause of this? The main one was due to economic growth.

The EV-high and E-bike scenarios achieved higher economic growth than the baseline scenario because the shift to electric vehicles reduced their exposure to peak oil. With more economic growth, all sectors expand and demand more transport, which increases transport-sector emissions. To achieve 80% decarbonisation, we had to introduce changes that would profoundly affect the economic structure, which we grouped under the scenario we call Degrowth.

What is the 'Degrowth' scenario? This scenario also involves a shift to very light-duty vehicles, but GDP also falls to stabilise at \$5,000 per capita (current is \$6,500/person). It is also a scenario of relocalised economies: there is 60% less demand for freight transport and 85% less demand for air transport.

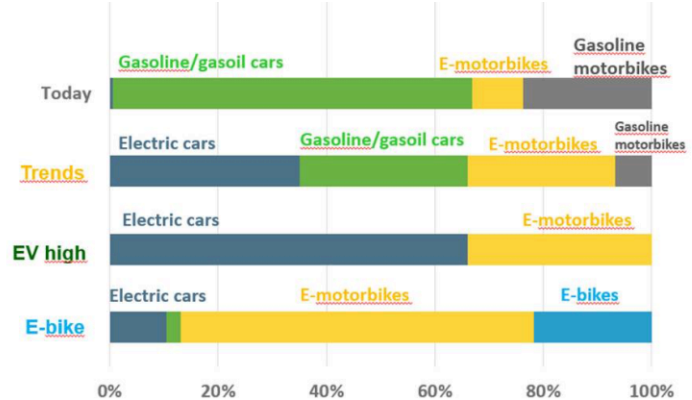


Figura 6: porcentajes de vehículos de pasajeros de cada tipo respecto al total de vehículos en 2050 para cada escenario.

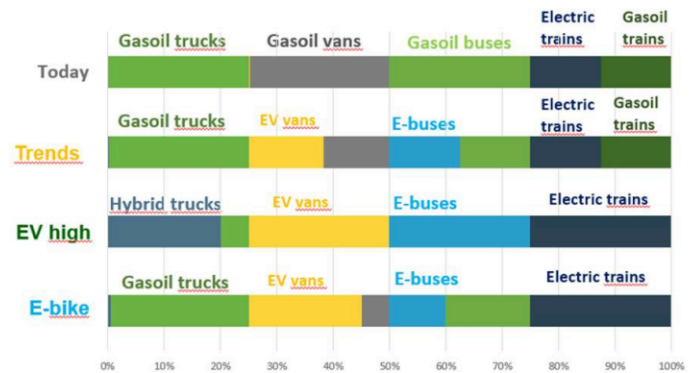


Figure 7: Freight vehicles' shares of each type in total vehicles in 2050 for each scenario.

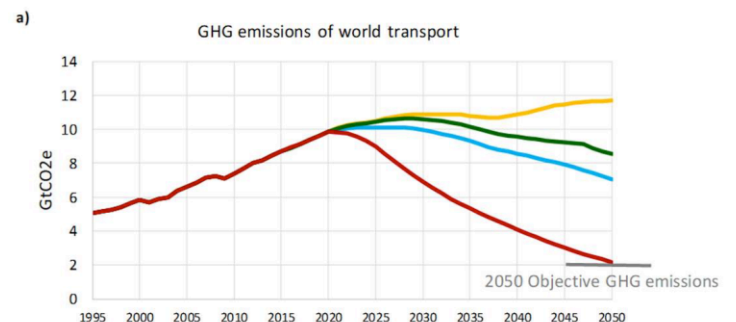


Figure 8: Greenhouse gas emissions from global transport under the four scenarios described. Emissions fall far short of the decarbonisation targets except in the Degrowth scenario.

All these things we had to do to achieve the decarbonisation target. Obviously, we could have chosen other combinations of numbers because this is just an exercise, but it gives us an idea of the magnitude of the changes needed.

The most relevant conclusion of the study is the GDP effect: the electric car and bicycle scenarios generate more economic growth than the baseline scenario and, paradoxically, increase consumption. This is represented in the diagram in Figure 10: both trends, the one that decreases energy consumption and the one that increases it, combine and end up giving a more mediocre result than expected.

In the end, all this shows us the futility of purely technological measures and the impossibility of reducing emissions without addressing the structural unsustainability of our society or touching the dynamics of economic growth. Even an environmentalist's dream of a world of bicycles is incapable of significantly reducing emissions, the dynamics of economic growth end up making energy that is not consumed by one sector consumed by another. The economic dynamics of growth underlie everything and have become an imperative of today's society: in order to 'get things right' we have to grow... Why? Why do we have to grow?

In theory, an economy does not have to be based on growth. We should have societies whose objective is to satisfy human needs, and as long as the population does not grow, those needs do not have to grow either.

We could represent this with a diagram like the one in Figure 11: human needs are compared with the production of material goods, and if there is a deficit, production would grow, but if there is a surplus, production decreases. In this way, a stabilising feedback would be created that would adjust production to needs. Traditional agrarian-based societies, to a large extent, behaved in this way because labour and energy were scarce, and society adapted to the energy that the environment could give it, trying to cover the needs of the population, but without trying to 'create more work'.

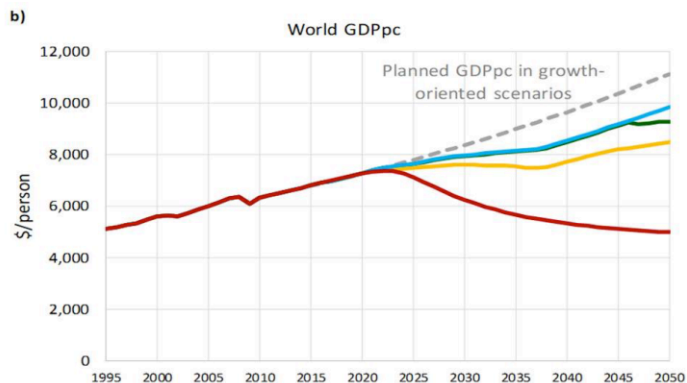


Figure 9: World GDP per capita under the four scenarios described. The dashed grey line represents the expected economic growth, which is higher than the others because the other scenarios are affected to a greater or lesser extent by the scarcity of liquid petroleum fuels. The EV-high and E-bike scenarios, which demand less liquid fuel, achieve higher economic growth. In the Degrowth scenario, GDP is forced down to stabilise at \$5,000 per capita (currently \$6,500).

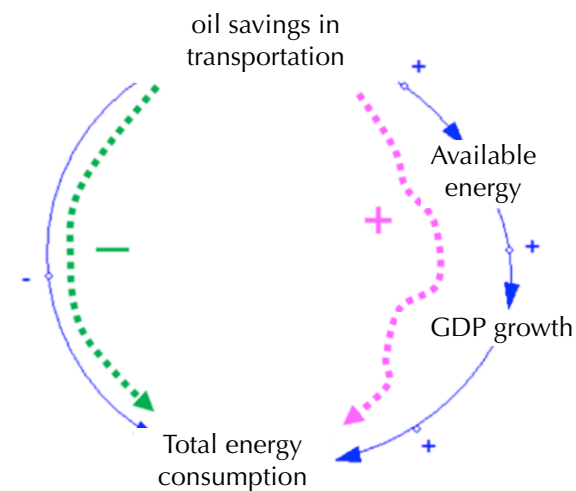


Figure 10: Representation of the effect of economic growth on the transport decarbonisation problem. On the one hand, energy-saving and electrification measures reduce energy consumption in transport, but on the other, they leave energy available for other sectors that grow and demand more transport, and thus more energy for transport.

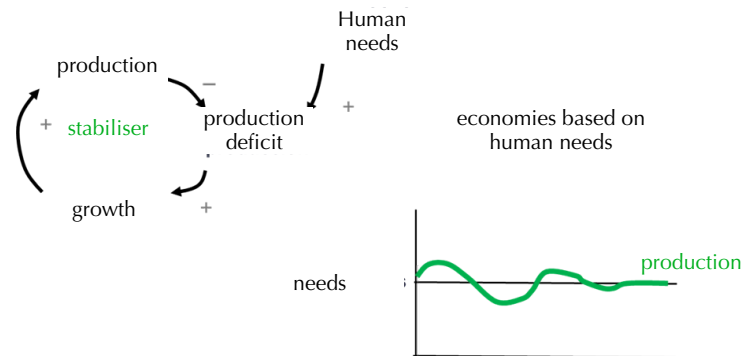


Figure 11: Diagram depicting an economy focused on meeting human needs.

But the capitalist economy does not follow this pattern, nor does it have a stable behaviour. In today's economy, two evident mechanisms tend to artificially inflate needs, as shown in Figure 12 with the red arrows. On the one hand, companies make profits proportional to the amount of product sold, so they have an interest in production growth and invest in advertising to increase consumers' perceived needs. This behaviour is self-reinforcing and creates a link with all the positive signs: the more production, the more needs, and the more needs, the more production. All this leads to an economy that constantly increases the impact of human activities on the biosphere.

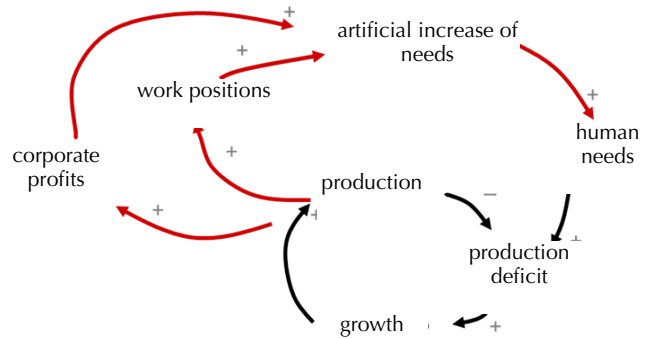


Figure 12: Diagram depicting an economy that artificially inflates human needs by creating two reinforcing feedback loops (red arrows combined with black arrows between human needs and production).

But another mechanism also creates this pattern, and it is more insidious. It comes from the need of the working classes to secure their livelihoods through paid employment. Since wages are also proportional to production, the working class is obliged to support increased production in order to secure their wages. Moreover, as automation decreases the number of jobs per unit of output, workers increasingly exert pressure to increase production and thus become enemies of any environmental measures that attempt to stabilise human impact within the limits of the planet.

This mechanism explains the usual conflict between environmental and trade union movements that causes a particular schizophrenia within left-wing movements. On the one hand, the left supports environmentalist demands. On the other hand, it defends maintaining jobs in companies whose activities are clearly unsustainable, such as automobile or coal mining companies. With very few exceptions, there are economic sectors that both create new jobs and reduce the impact on the biosphere, but this is not the general trend, which means the conflict between jobs and ecology remains unresolved or is artificially closed off with subsidies or hopes of finding 'green technologies'.

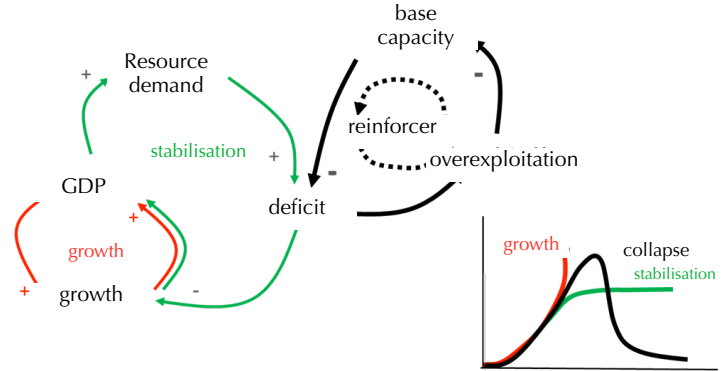
How do we solve this? The key to all feedback lies in the relationship between production and profits/wages. Could we imagine an economy in which corporate profits and wages were not linked to the quantity of products sold? Something like this is done in public services, for example. A doctor or a fireman is not paid more when there are more fires or more illnesses; they are paid to be there when needed.

But how do you impose this kind of draconian change with a highly centralised, state-run economy like the USSR's communism? Allow me, as a proponent of system dynamics, to doubt the capacity of this kind of top-down solution. A state-planned economy is something completely unidirectional and lacks feedback; yet everything that works well in nature does so based on feedback.

I would rather bet on the incentivisation of mechanisms that correct this insidious loop of growth based on feedbacks from below, which, in the end, is what we call democracy. But I am not an economist, nor do I know what such mechanisms might be realistic, so I beg the professionals in this field to please develop an economic system that does not tie us suicidally to growth.

## The dynamics of collapse

The fact that we have a growth-based economy greatly increases our chances of entering into the dynamics of social collapse. There are various definitions of collapse, but I like to think of it as the dynamic pattern depicted in the diagram in Figure 13, which produces a sharp, accelerating fall. This type of collapse can also be called collapse or crumbling: the loss of the base, the growth that forgets to build on its foundations.



In this diagram, on the one hand, we have the reinforcing loop of economic growth, in red arrows. On the other hand, we have demand for resources, proportional to GDP, confronting nature's capacity to provide them (what we call 'base capacity'). If demand exceeds availability, a deficit arises, which, in theory, should slow GDP growth and create a stabilising loop, as shown in green.

Figura 13: diagrama del patrón de colapso con sus tres lazos de realimentación: el reforzante del crecimiento económico, el estabilizante de los límites y el reforzante de la sobreexplotación.

The combination of these two loops, the GDP growth loop and the stabilising loop, should give an S-shaped behaviour like the one in the figure (in green) that starts growing, but stabilises when it reaches the limits. In today's economy, however, the green stabilising loop is not triggered, because the dynamics of capitalist economic growth are so strong that all attempts at stabilisation are futile. This sets in motion a third, particularly insidious loop: that of over-exploitation.

Overexploitation occurs when the deficit deteriorates the capacity of the resource base to provide resources. For example, if more wood is systematically removed from a forest than is regenerated each year, the forest becomes smaller and smaller and less capable of providing wood. Overharvesting also creates a feedback loop (the black loop in Figure 13) because it decreases the base capacity, and as it decreases, the deficit increases, leading to even more overharvesting (the two minus signs offset each other and become a plus). This is a reinforcing loop that progressively reduces the capacity of the base. The result of combining these three dynamics is a collapse pattern shown in black in the figure: an initial rapid growth that peaks and then falls very rapidly.

Since the 1980s, we have known that we have exceeded the planet's capacity to provide us with resources sustainably and are degrading its biocapacity. Yet, we have continued to grow, indicating that we have entered a loop of overexploitation. Since the 2008 crisis, it is also clear that we have continued to grow by overexploiting our social base with worsening working conditions, increasingly stressed families and increasingly precarious lives.

Faced with the evidence of the limits, society should have set in motion the green loop of stabilisation with good degrowth policies. This idea of voluntary degrowth, in one way or another, has been the central message of political environmentalism in recent decades. However, we are seeing that the measures take a long time to be implemented, because capitalism resists degrowth and is burdened by enormously powerful inertias and interests.

The delay in implementing the stabilisation loop means the pernicious black loop of overexploitation is beginning to activate. It is therefore vital that we understand that the most important action for the survival of human societies

at this time is to deactivate the degradation loop. This message adds a further nuance to the degrowth message, and the word that best describes it is the notion of care, applied broadly to the care of everything that reproduces life on the planet.

Because we can perfectly call well care policies all those that deactivate the relationship between deficit and overexploitation. The caring attitude inspires environmental protection policies and leads us to manage the territory, soils, forests, and people with care; it is the attitude that protects the reproduction of everything that feeds us.

## The feedbacks of fear, scarcity, guilt and the rules of the honourable harvest

Although the reality is harsh, we cannot ignore the fact that we are entering a dynamic of collapse, of breakdown, of what we can call the deterioration of our human and natural foundations. We must therefore confront the social dynamics and the feedbacks that can make things worse in order to be able to defuse them or at least keep them at bay. One of the ones that I find most pernicious is related to feelings of fear, guilt and scarcity and is depicted in Figure 14.

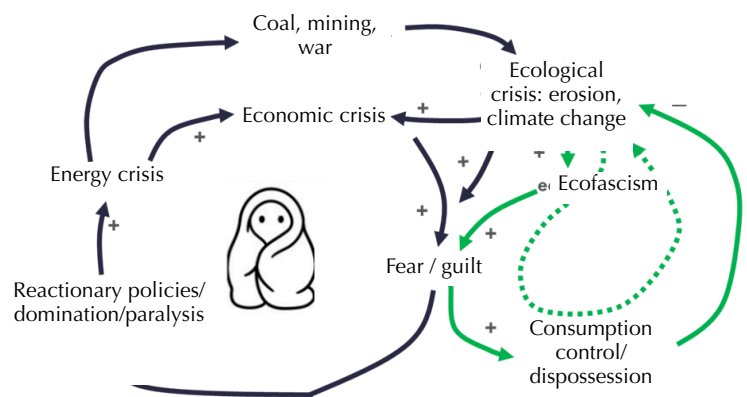


Figure 14: Reinforcing feedbacks of fear and guilt (black) and stabilising loop of eco-fascism (green).

The effect of energy scarcity on the economy is not evident because they do not translate into a direct increase in fuel or electricity prices, but they create difficulties that gradually undermine all economic sectors, creating one-off and more or less long-lasting economic crises.

The economic crisis brings with it a social crisis. People find themselves in a more precarious situation every day and are easy prey to fear: fear of the poor who fear for their livelihood, and fear of the rich who want to continue with the business as usual of growing profits in increasingly uncertain markets. The feeling of scarcity leads to competition, eliminates the tendency to share and accentuates fear. Guilt can also add to this cocktail of insidious feelings, which is guilt derived from our poorly assumed responsibility for the ecological crisis.

Fear and guilt are usually not suitable for anything. On the one hand, fear often encourages conservative positions; on the other hand, it often supports far-right political options defended by 'strong men' who promise to bring back the good things of yesteryear. Poorly digested guilt leads to denial: faced with intractable guilt, the problem is denied. We are seeing this mechanism clearly at the moment with the rise of climate denialism.

Conservative options that look backwards are not the best company for facing the problems of this century, so different from those of past centuries, which were centuries of growth, not decline. The ultra-conservative political parties have no intention of investing in savings, alternative energies or even less in changing the economic system.

With them, we run the risk of entering a feedback loop, as shown in Figure 14: the energy and social crises cause the rise of the far-right, the far-right further aggravates the energy crisis, and the energy crisis further aggravates the social crisis, which drives the far-right vote even further....

Things can get worse if we try to get out of the crisis by squeezing even more from our exploited Mother Earth, creating another reinforcing feedback loop, as shown in Figure 14. The lack of oil can make us look for anything to satisfy our consumerist hunger: biofuels that ruin forests, biomass that leaves us without forests, electric cars that trigger mining, coal that accelerates climate change... All of this, moreover, leads us to war over resources, and war is also a huge energy consumer.

On the other hand, we also run the risk of the emergence of a pernicious stabilising loop, which we can call eco-fascism and which is represented in the figure in green. Faced with the ecological crisis, the elites may be tempted to impose strongly authoritarian systems that stabilise consumption by resorting to totalitarianism based on fear. Although, in theory, this system would solve the environmental problem, it would lead to highly undesirable social dynamics.

Feelings of guilt and scarcity are two key pieces of our psychology that we should carefully analyse.

When it comes to escaping guilt in our relationship with nature, I recommend reading Robin Wall Kimmerer's book *A Braid of Sacred Grass*, in which she describes the rules that Native Usonian peoples have when gathering fruits from nature. These rules of good behaviour seek to establish peace between our need to extract resources from nature to live and our need to respect it, which is vital to end the permanent sense of guilt and the feeling that humans are a cancer on the biosphere.

The rules of honourable harvesting, at their core, seek a symbiosis between humans and nature, an optimal relationship in which the benefits are mutual. They also address a very interesting aspect: abundance. When relationships are approached fairly and respectfully, as these rules propose, gratitude for what has been received and sharing occur, which stimulate others to adopt the same attitude of sharing, and this, if adopted throughout the community, ends up creating an abundance of well-distributed resources.

This sharing that creates abundance is the opposite of the attitude of scarcity, which encourages everyone to keep to themselves, leaving others without resources that may be sufficient but become scarce through misallocation. The rules of honourable harvesting can be summarised in the following rules (own translation):

- Take only what you need, take only what is offered to you.
- Ask permission.
- Leave something for others.
- Do not waste, use respectfully...
- Share and be grateful (abundance mentality).
- Give something back (reciprocity).

All these reflections can help us to deactivate the pernicious feedback loops in Figure 14. The most urgent dynamic to halt at this time is the one that leads to the deterioration of the biosphere. In times of economic crisis, it may seem to us that the protection of nature is an accessory, but it is not. It is a matter of eating or not eating. The overexploitation of nature intensifies the erosion of fertile land, the collapse of fisheries, and the depletion of

aquifers, which cause migrations, famines, and wars. Moreover, our only protection against the disastrous consequences of climate change is to maintain a biosphere in the best possible condition, which stabilises and slows the progression of climatic disasters. This is why the diagram in Figure 15 proposes the love-of-nature strategy to break the feedback loop between the energy and ecological crises.

Another relationship that needs to be severed is the one linking the economic crisis to the social crisis. Cutting this link requires a good dose of social policies that spread the crisis over all shoulders and ensure basic necessities. Care, putting life at the centre, something so important and so forgotten.

Finally, we must not forget the irresistible power of successes to convince. When 'less is more' solutions start to succeed, they will be much more convincing than reactionary promises of a return to the past. They will break the link between economic crisis and reactionary policies because society will trust in better policies.

## Doing versus not doing

I want to quote a great sage of this century who has made a valuable contribution to permaculture: Masanobu Fukuoka. Fukuoka, inspired by Taoism and Zen, speaks of the philosophy of not doing, the Wu Wei, of intervening as little as possible, leaving the forces of nature to act.

The capitalist world does the opposite of Wu Wei. The dynamics of self-interest encourage selling remedies and manufacturing solutions rather than addressing causes. Millions are invested in developing medications to cure cancer, but no one cares to look for its causes, to ban pesticides or to remove carcinogenic preservatives from food. New pesticides, genetically modified seeds and agricultural robots are developed, but no one cares about letting earthworms and mycorrhizae fertilise the soil.

But there is a major obstacle to this letting nature do its thing: our traditional disdain for all things natural and fascination with technology. We do not let nature do its thing because we consider nature crude and backward, while our technology is sophisticated and advanced. We do not realise how crude and elementary our technologies are compared to nature's technologies!

Imagine that you put a mobile phone in the ground, water it a little, and see how that mobile phone develops small solar panels to generate its own

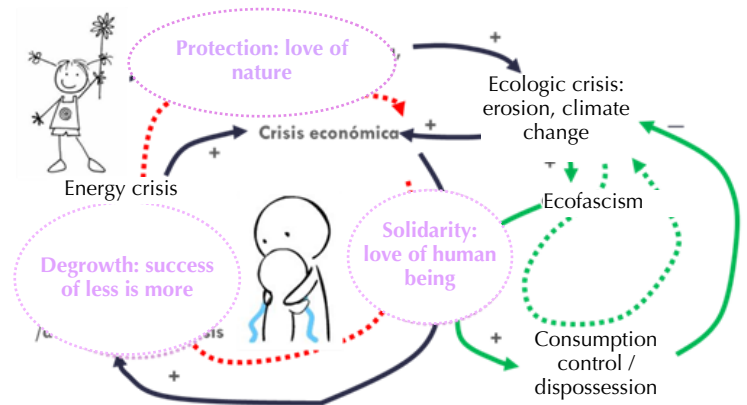


Figure 15: Strategies for breaking the feedbacks in Figure 14.



Figure 16: It would be great to get a plant that gives mobiles, wouldn't it?

energy, then, with that energy, it creates a mine to extract minerals from the earth and a few months later, it has created a mobile phone factory all by itself. Fascinating, isn't it? Well, that is what a simple seed does, let us say, for example, a tomato seed.

Our technology is light years away from coming close to doing something similar. Plants, animals, ecosystems and our own bodies do things that are unthinkable for human engineering: they recycle minerals at rates close to 100%, they are incredibly efficient in their use of energy, they have extraordinary stability and resilience... We do not know if Gaia is a super organism as Carlos de Castro says, but what we do know is that she is a 'great engineer'.

This respect for nature is essential if we are to move towards a society and technology that fulfils the basic principles of sustainability set out at the beginning of this paper. We need to stop being fascinated by technological mirages that make us invest ever scarcer energy and resources in technological fetishes that, in the end, are a burden on our lives.

Artificial intelligence, social networks, Google, the cloud are free for us as users (for the moment) but someone is paying for them. The cost of all these technological services is shared by society as a whole. This means that very basic things like housing, fresh fruit and vegetables or time to look after ourselves and others are so expensive that we cannot afford them. Research pays very little attention to some technologies that could be essential for us in a future of scarce resources, such as agroecology, while spending huge amounts on things that have very little social return. We could say that we are a society with a huge head and tiny feet that... collapses, plummets for lack of a base. We are a giant with feet of clay.

## Transcendence

This whole panorama speaks to systemic, intertwined problems with complex solutions. Faced with such complex problems, it is essential not to make things worse. The worst thing that can happen to us is to fall into the dynamics of social chaos, war and moral degradation that not only create horrible human problems, but also accentuate ecological problems. It is therefore essential to control fear, which turns us into manipulable masses and leads us to fall into the worst degeneration. But .... how can we not be afraid of fear?

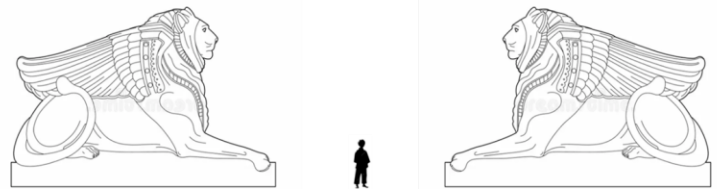


Figure 17: Atreyu and the sphinxes.

This situation is reminiscent of the story of Atreyu in the book *The Neverending Story*. The young hero of the novel has to find a solution to a terrible problem: the world of Fantasia is being annihilated by the most horrible destruction, nothingness. To find the solution, he must pass through the door flanked by two terrible sphinxes without them opening their eyes. If they detect his fear, they will open their eyes and stare him down with their gaze. How can you not be afraid of something that can strike you down on the spot?

The solution to the riddle lies in transcendence. Atreyu comes to believe that saving Fantasia is more important than his own life, that his life is at the service of something greater than his individual self. This sense of

transcendence, the feeling of being part of something greater than oneself, is essential to preserving a healthy psyche in times of crisis, as psychologist Ginie Servant-Miklos<sup>3</sup> and psychiatrist Viktor Frankl<sup>4</sup> also argue.

Keeping calm in the face of danger, maintaining serenity and doing the right thing simply because you have to do the right thing are essential to avoid falling into destructive spirals that can only make things worse.

I hope to have opened up avenues for reflection in this systemic post, so full of ideas that may or may not be right, but that want to encourage you to open the door, to leave behind the old schemes of the usual linear solutions and face the dance of this complex, multiple, variegated reality that needs open and broad minds to be understood.

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<sup>3</sup> Interview with Ginie Servant-Miklos at the World Adaptation Forum 2025. [https://www.youtube.com/watch?v=8m9mHOj\\_dnY](https://www.youtube.com/watch?v=8m9mHOj_dnY)

<sup>4</sup> El hombre en busca de sentido, Viktor Frankl. Editorial Herder, Barcelona 2004

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