

Chapter 4

Political Implications

The global energy problem is the result of our modern economy and of our basic style of living. We have to consider fundamental changes of our socio-economic systems to find a sustainable solution. A technical solution alone will not be sufficient. This book, written by a physicist, does not raise the claim to solve the socio-economic problems of our modern world. Nevertheless, the view of a scientist might be useful to emphasize a few things that go wrong in our society.

Our biosphere is a complex, fragile system which hosts an even more complex society of innumerable egos that like to divide the world into theirs and others. There are reasons to assume that—with the help of modern science and technology—it is in our hands to either destruct our living conditions within a few decades, or to use our talents and intelligence to organize the human society in a way, that it can happily live for many more future generations on a liveable and peaceful planet earth. To achieve the positive outcome, science and humanities, including philosophy and religion have to come together again in a cooperating fashion.

In general, complex systems can be stable, oscillating, or completely instable and diverging. When we look at the system design of our economic systems, we find that they are based on growing markets and on inequality, but there is nothing implemented, that would guarantee an inherent stability of the systems. In view of globalization, free capitalism, limited resources, overpopulation and powerful financial markets, it becomes unlikely that our economy remains stable. Instead, economic power will centralize, inequality will explode, and inner or outer warfare might be viewed as the only option to survive by all sides.

The energy market will be affected by the Energiewende in a particular manner, as it will decentralize the market and many consumers will become producers of energy at the same time. Storage capacities and the flexibility of production and consumption will define new business models. The whole energy market will have to be redesigned in many aspects to foster the transition to renewables.

4.1 One World

“Mother Earth” should not be regarded as an eternal base that was made to host the “creation’s crowning glory”. Instead, we are just a glimpse in an almost infinite and continuously evolving universe [1]. Life is not necessarily a uniqueness of our planet. From the scientific point of view it is likely that there are many other planets in our universe that host some kind of life, taking into account that there are about 10^{23} stars in the visible part of the universe and a lot of them have a planetary system. At the big bang 13.8 billion years ago, our universe exploded and it took only minutes before the first atomic nuclei were created. After that, stars and galaxies formed, and it took about 10 million years before the universe cooled down enough for the existence of molecules like water [2]. This is the earliest time at which life similar to our life on earth could have developed somewhere in the universe [3].

It took another 9 billion years before our sun and earth were formed. The standard theory says that primitive life developed on our earth half a billion years after the earth was created, which is a rather short time in the scale of the universe. However, in principle it could well be, that there was life in the universe long before there was life on earth, and there might have been conditions in the early universe where the genesis of first cells was much more favoured compared to the conditions on earth.

Some people consider the possibility that life on earth was initiated by a shower of meteors that contained protozoa from outer space. We know that it is possible that primitive forms of life, e.g. spurs of protozoa, survive long voyages in interstellar space when they are enclosed in rocks or frozen water. Recently it was found that even animals as complex as water bears (Tardigrades) can survive vacuum, frost and solar radiation in space [4].

Independent of the question if our life had its origin from outer space or from our own mother planet, we know for sure that evolution from primitive multicellular forms of life to highly intelligent primates took place on our own planet. This part of the biological evolution needed another 1.5 billion years. The findings of palaeontologists verified these basics of the Darwinian theory in great detail.

Nevertheless, the creation and/or development of the world, of life and of consciousness remain an enigma and a challenge for modern sciences, and it requires a certain level of abstraction to accept that traditional religions, philosophy and sciences are not contradicting each other in their different approaches to answer similar questions in different ways.

Since decades we are looking for signals from outer space to find signs of intelligent life somewhere else in our universe. All these attempts failed up to now, and there are two explanations for that: either there are no planets with intelligent life in reach of our scientific instruments, or intelligent life on all these planets in our reach has been extinguished already. If we imagine that we on our planet earth are able to send radio waves into space since only about 130 years, and that it is not clear that our sophisticated and technologically advanced civilization will survive

the next 100 years due to anthropogenic climate change or nuclear wars, we have a time span of 230 years compared to a development time of 2.5 billion years, which makes a chance of 1:10 million to find intelligent life on a planet like ours.

Of course this example is a bit overdrawn, but it should make clear how fragile our life as highly developed human being is and how short the lapse of time is that remains to bring our civilization back on track again.

4.2 Capitalism in a Global Market

From the empirical point of view, the capitalistic, or free market approach has proven to be a very efficient and fast method to promote technical progress, to maximize productivity and to exploit natural and human resources. From the systemic point of view, this economic paradigm is comparable to the Darwinian biological system, the “survival of the fittest”, where thousands of different species optimize and accommodate their interaction with the environment such that they survive better than competing species. Darwinism can be characterized as a “win-lose” system on the level of individuals and individual species. But it is a “win-win” system for life in total, as it evidently generated a great variety of ecosystems with highest forms of life.

Capitalism can be characterized as a “win-lose” system on the level of individual people and companies. But can it be regarded as a “win-win” system for the global human community?

How Evolution Avoids Centralization

There is a crucial difference between biological systems and today’s economy as illustrated in the following comparison: Biological systems require very long timescales for changes compared to the lifespan of individuals. Significant changes take many generations of individuals, and the repetition rate is even slower for more complex (i.e. “strong”) animals compared to more simple living beings like bacteria.

Imagine, at some time a species develops that is a “winner” of the “Darwinian Game-of-Life” in the sense that it dominates all the other species. This forces the concept of “eating others and being eaten” out of balance, and the ecosystem will either accommodate or break down. In the extreme case the winner species will eat all the loser species and will die from starvation afterwards.

How come, that evolution has been progressing over billions of years without a breakdown of the whole system? The key of stability are the slow changes and the limited spatial influence of the individuals. The impact of genetically caused changes is usually very limited in space, as certain races occupy usually only a certain niche of the global biospheres. If a certain species kills its own biosphere, life will continue somewhere else. Also mankind will not change that, as independent of global warming or nuclear wars, life on earth will continue—possibly not for most of the mammals, but certainly for cockroaches, ants and mushrooms.

Global Capitalism of Today is Instable

Today's global economy is different compared to biological evolution. Technical progress and economic changes become more and more rapid, without principle limits and without a natural regulation or damping system. The stronger a company is, the faster it can develop. It is like in any non-linear system with feedback loops: if the parameters run out of a limited stable range, if amplification increases, damping decreases, then values typically grow exponentially until they hit boundaries and the system breaks down or becomes static.

About 50 years ago, there were rich and poor countries, and many rich countries had a large, educated and wealthy middle class. To become rich, companies had to make inventions, get resources, e.g. from undeveloped countries far away, and build infrastructure and factories. In many countries companies had to pay a significant amount of taxes which was invested in infrastructure and education. A large number of educated and well-paid craftsmen were needed that produced and consumed the goods. The process to become a rich company usually took many years or even generations. Today the situation is different. The technical progress is more rapid and the global market allows for a fast exchange of huge resources. New business models sometimes have life cycles of only months between the first ideas, the realization and being outworn again.

Most children (at least in Germany) know the game *Monopoly* [5] that was invented in 1903 by Elizabeth Magie Phillips with the intention to educate people about economic systems. Anybody who has played it has experienced that the game is designed in a way that sooner or later all but one will be insolvent and the game is over. In the real world in a global market, there is no second chance once the game is over.

The Financial Capitalism

The main economic revolution of the last decades is the step from a capitalism based on the creation and organisation of production and service facilities to a capitalism based on the exchange of financial resources and the evaluation of credit ratings. The financial capitalism created a virtual world in which it is possible to create money from money without affecting any goods, manpower or resources. The value of a share or of a currency is not necessary related to "physical" values. A "rumour" (i.e. a virtual entity) is enough to change their values. In the language of a physicist, the Stock Exchange is a strongly coupled complex system, and those systems tend to show chaotic behaviour, which means that small fluctuations in one corner of the system can propagate and cause amplified reactions somewhere else in the system. In our "Modern Times" such a small initial fluctuation can be for example a simple madcap tweet on twitter. In principle, any company at any time can be claimed to be a looser, and this self-fulfilling prophecy can cause so much disturbance in the credit ratings that the competing company can take over their business before the first company is able to recover. A similar, recent example is the exchange rate of the British Pound GBP on the day when the English and Welsh people voted for Brexit. That day, the "physical capacities" of the British industries did not change, and the vote had no direct legal impact, but still people could make millions of Euro on that day using the drop in the currency exchange rate. If a few

months later the Brexit would be cancelled, the same people could make money again from the opposite currency exchange.

To make money from fluctuations in the stock market, one must have a good understanding and computer modelling of the market and a kind of early-warning system, but more efficient is insider knowledge and the possibility to generate one's own fluctuations in the market by significant transactions. From the point of view of the capitalist the ideal situation is, when the financial system has direct ties to the government of a country and can influence regulations and preferences. In that case making money from a fluctuating financial market is as easy as the task of an electric rectifier to extract electrons from an alternating current.

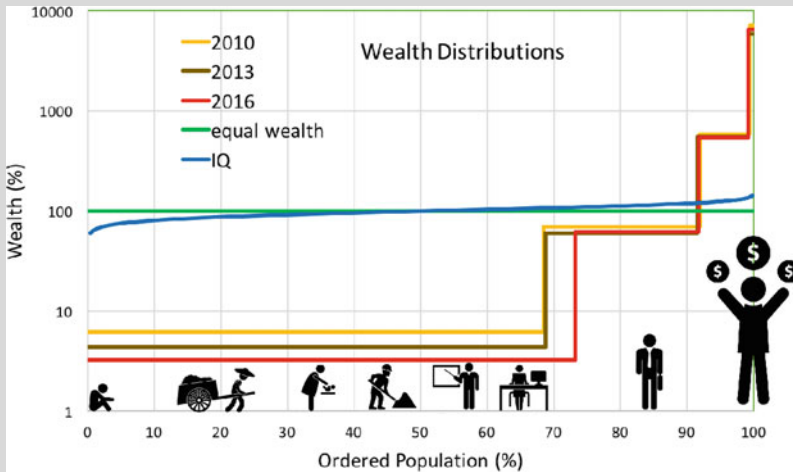
By creating financial bubbles and playing with oscillations of prices, these virtual games generate more and more money. This money must be matched with real values in order to have an impact in the real world. As the amount of values is limited, at some point the increasing amount of money cannot be matched with actual values any more, instead it is matched with debts. The debts are assigned to house owners, communities or whole states. In this game, the rich stakeholders have more opportunities than the poor ones, therefore the rich ones become richer and the power centralizes ultimately at a few people or companies. The tempo of the financial capitalism is not limited by the time it takes to build up infrastructure or to produce goods. It can be as fast as the information exchange in the stock market allows it. It can make companies, communities or even whole countries bankrupt from one day to the next.

For a mathematician, the global financial market may be a fascinating example of game theory with all the artificial feedbacks and bubbles that seem to appear from nowhere but actually are an inherent property of the system design. For a financial gambler it is the ultimate kick to satisfy his greed of gain. But for 95% of the population, this game of greed is a disaster. One example is the subprime mortgage crisis in the US in 2006 after which nearly 9 million people lost their jobs.

A look at the statistical numbers shows two aspects of today's world economy: One conclusion is that—despite the fast growth of the world population—the production of food, energy and goods grew even faster, so that the relative number of people below the poverty level decreased over the last decades [6]. A strong bonus on the world economic statistics comes from China, where the population increase was limited and the production and export has been strongly increased. In other regions of the world, especially in Sub-Saharan Africa, the situation is still desperate in many areas.

The second conclusion of the world statistics proves that, despite these achievements, the capitalism of today is a system that brought an extreme disparity into our world. The world's wealth is centralized in less than 1% of the population while the majority of the people have very little wealth. Box 4.1 shows the numbers [7–9]. If the total wealth were distributed equally (green line), everyone would have the same, i.e. everybody would have 100% of the average wealth. This would be the case of an “extreme socialism” which is of course neither realistic nor worth pursuing. In a realistic model of the world, one expects that some people have more and other people have less, but that the majority of the people have a wealth that is balanced around the 100% average line.

Box 4.1 Human Inequality Distributions [10]



The horizontal axis shows the world population ordered according to their wealth. The vertical scale shows the wealth in percent of the average wealth of the world population.

The green line corresponds to the case where everybody has the same, i.e. 100% of the average.

The three lines below show the distribution of wealth in the years 2010 (yellow), 2013 (brown) and 2016 (red). The crossing of these lines with the green line is beyond 90% of the population, which means that more than 90% of the population has less than the numerical average of the wealth.

Most the people have only a small fraction 6.1% (2010), 4.3% (2013), 3.2% (2016) of the average wealth. This means that in 2016, 73% of the people have a factor of 30 less than they would have if the wealth were distributed equally among all people. One interesting point is, that this number changes rapidly in the last 6 years, making the inequality of most people compared to the rest larger and larger.

In contrast, the upper 0.7% of the richest people have a wealth that is at a value of 6500%, of the average, i.e. far above the 100% line. Note that the vertical scale is logarithmic. The steps come from the binning of the input data, in reality the curve is a steep, but smooth curve.

The blue line is shown for comparison. It shows the distribution of the intelligence quotient (IQ). 50% of the people have an IQ lower than 100, 50% higher than 100. Few people have a very high or a very low IQ. However, the broad majority of the people has a value that would allow them to be productive when they would have the financial means for it.

The blue line shows the distribution of the intelligence quotient (IQ) as an example for such a distribution, where some have more, others have less, but the majority of the people have an IQ around the average [11].

In our modern world today the economical distribution of wealth shows a completely different trend. Not only that more than 90% of the population has less than the average, most people (68%) actually have so little (4% of the average wealth per person) that their share on the society as a whole is marginalized. On the contrary, the major part of the wealth is concentrated at a few percent of the richest people. It is the mechanism of exponential growth in the global financial system that produces these unnatural, huge differences. The comparison of the years 2010, 2013 and 2016 (yellow, brown, red line in Box 4.1) shows the trend that the gap between the poor and the superrich is growing. Within 6 years, the share of the “poor majority” decreased by a factor of 2 from 6.1 to 3.2%. If the trend continues, it is likely that the system will break down already in a few years.

It is useless to blame the superrich for the global economic situation. As long as the governments of most states accept the existence of an instable economic system, one will always find numerous more or less irresponsible and more or less intelligent people that fill the positions that the system offers them. It is the task of the politicians and their voters to decide which system is preferable for the human society and which system violates basic human rights.

Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary social services, and the right to security in the event of unemployment, sickness, disability, widowhood, old age or other lack of livelihood in circumstances beyond his control.

Universal Declaration of Human Rights; Article 25.1, Paris, 1948 [12]

The End of Economic Creativity

What are the consequences of such a financial capitalism for the future? Education and decision-making abilities of the general public, as well as mass purchasing power and usable manpower in general will diminish when the funding of the large majority of the people is marginalized. There is no market mechanism for which the welfare of people in certain regions of the world with high population but low productivity is of any interest. Important long-term communal projects as well as long-term global changes like global warming are also not necessarily on the agenda of the super-rich companies.

It seems that our capitalistic system has been so successful and superior compared to the centrally planned economy because of the apparent collective intelligence and creativity of the free markets or rather their numerous stakeholders. This supremacy can obviously break down as soon as the market is centralized and reduced to a small number of decision makers.

It seems likely that such a capitalistic system with a free market but a centralized power of only few super-rich companies in each commercial sector will have the same deficiencies as a simple state monopoly capitalism, where also few decision makers have to control a whole complex system.

The Dilemma of the Politician and the End of Democracy

There is a global market, but there is no global government. Therefore, multinational companies are decoupled from political influence and democratic control to a large extent. Trading agreements make sure that international companies can rely on their investments and on their long-term plans and no government can interfere significantly.

If for example a political party in a country wants to fight poverty by increasing the salary for the workers, and it wants to fight pollution by sharpening the environment protection laws, any economist will explain them that this leads to a drift of industry away from this country with the consequence of unemployment and impoverishment. Most multinational companies today can move their places of production to the countries of cheapest labour, cheapest energy prices, worst/best industrial laws and smallest taxes. This way, any politician that wants to improve the situation of the people in his country is in a dilemma and realistically, the political power of local governments in a global market is basically neutralised.

Economic power today means also power in politics, research and education. Private universities are the best examples for that. In many of the 206 sovereign states on our earth one has the impression that the political leaders are the floor managers of the financial world, which have the task to care about the human capital of a specific country, but they have no control on basic economic decisions any more.

Today, some political leaders take advantage of this inequality in the population. They promise unrealistic short-term goals, where the own country will be protected and becomes rich to the cost of other countries or to the cost of minorities. This trend is well known from history and has always been a big danger for all democratic countries.

To conclude these thoughts, the global capitalism is designed in a way that most of the states strongly depend on it, but have no or only little control of it. The rate of change in our economy is much faster than the response of the global system, which makes the system unpredictable and instable. This instability is there at many timescales. There are the extremely short timescales of financial capitalism that can affect the economy of millions of people from one day to the other. Then there are the timescales of decades where the global economy is affected. The best example for an instability that acted on the timescale of hundred years is the use of fossil fuels and the response by climate change: The economic changes that lead to the extensive use of fossil fuels started 150 years ago, but the climate feed-back was delayed and starts to affect us only today.

Today's capitalism is based on growth and inequality, and it is inherently instable. We can replace it by an economic system that is sustainable and inherently stable.

We are accustomed to our economic values so much, that we accept them as God-given. But the basic economic laws are not laws of nature. They are constrained by mathematical and scientific relations, but they are designed by human egos and can be replaced by new rules any day. Let's hope our society manages to either stabilize and control the markets and their managers or replace early enough the concept of global free markets by something sustainable, so that the human race will not have a similar fate as the voracious dinosaurs in the times of prehistoric climate change.

4.3 Paradigm Change in Energy Economy

The transition from fossil and nuclear energy to renewable energies will have a direct impact on the economy. A few aspects are mentioned here.

Decentralization

The production of renewable energies is always more or less decentralized, as energies from sun, wind, water, biomass or others do not have the energy density as e.g. coal or nuclear energy, where the power of several Giga-Watt can be produced in one building. This argument, often brought up by engineers as being a structural drawback of renewables, is of course only half of the truth, as energy carriers like e.g. coal or uranium require vast fields of mining in remote areas. The real economical difference between renewables and conventional sources is twofold: While mines and the corresponding conventional energy carriers can be owned and sold and they lose their value when they are exhausted, renewable energy sources like wind and sun cannot be owned, and the harvesting and trading of the energy does not lead to a loss of value of the property: sun and wind will be back every day. This has an essential economic impact as illustrated in the following example: If a consortium dominates the oil market, it can reduce production to increase the fair market value and to save the oil for later when prices might even be higher. This way the profit is maximized and at the same time economic and political power is generated. In contrast, if a solar or wind power station reduces its power output, it will lose money and the earnings of that day are lost forever.

A second economical difference of renewables compared to conventional sources is that renewable energies typically require large initial investments while the "harvesting" of the energy is for free, except for maintenance costs and depreciation. In many cases, the dominating costs of renewables are banking costs

while for conventional fossil power generation the fluctuating, and over decades typically increasing fuel costs dominate.

The decentralized nature of renewables is intrinsically incompatible with monopoly-like business models of e.g. the traditional international oil companies where a few consortia own the major mines and oil fields. Instead, renewable energy companies try to get market dominance in technology, licenses, or distribution networks, which is much harder to achieve due to competition and regulation.

Democratization

Today, power production is feasible for anybody. This is especially true for PV, but also for wind, biomass, and small hydropower. It turns out, that a large number of individuals and communities favour the idea of producing their own power. These people invest a large amount of money for owning their own power generation for a feeling of being independent, environmentally friendly and sustainable. In many cases they invest more than they will ever earn back from the investment. This kind of behaviour is well known in the car market, where people spend a large amount of money for the feeling to own something which is a status symbol and that makes them independent, even if public transportation or getting a taxi is cheaper and more convenient in many large cities.

In Germany, the Renewable Energy Act (EEG) has been brought forward to support the energy transition [13]. The EEG is based on three pillars:

- i. Small and medium sized power producers are allowed to connect to the grid and sell their power with priority and for a guaranteed, stable feed-in tariff over 20 years. The tariff is technology specific. This enables the government to promote certain technologies, which are not necessarily the most suited ones for a given site and/or application.
- ii. The investments are private and do not charge the public purse. Instead, the costs are redistributed to all consumers over 20 years by a surcharge on the electricity price. This way, the costs of today's energy transition are effectively moved to our children and grandchildren. To avoid a migration of industry, many of the large power consuming companies in Germany do not have to pay the EEG surcharge. As a consequence, the surcharge on the electricity price for the private household is extraordinary high.
- iii. While feed-in tariffs for existing power producing facilities are constant, they decrease for new installations in regular intervals in order to foster innovations and price reduction.

Energy and Power Transition

Currently, energy economy is in a transition period and large parts of the energy debates are influenced by the concerns of fossil and nuclear industry that still have a dominant economic and political power in many countries. Renewable energies are publically propagandized, but at the same time fossil and nuclear energies are subsidized in a direct or an indirect way. In addition, industry antagonizes carbon trading and CO₂ taxes and also feed-in-tariffs and the priorities of renewables are disputed.

For countries that own nuclear bombs or plan to become engaged in nuclear weapons in future, the “peaceful” use of nuclear energy is of special importance, as that allows them to share the costs for the whole chain of nuclear fuel production and expertise between the military and the civil applications.

An indicative example for the subtle discouragement of renewables is a plan of a European government to make private owners of PV modules subject to income tax even if the owners consume their self-produced power themselves. Many people object this proposal, they label it “sun taxes” and they compare it to paying taxes for tomatoes that you grow in your own garden. Possibly, it was not even seriously planned to realize this proposal, but by bringing it up, it achieved already the effect to unsettle and discourage potential small investors of PV modules and to delay the energy transition.

Major investments in fossil and nuclear industry and infrastructure will unavoidably lose their value in future, and some of the companies will face huge decommissioning and liability costs. Some energy companies are currently starting to separate the companies into an independent renewable sector and a deeply indebted conventional part, with the hope to recover the profit and to dispose the debt to the public. This is the commercial analogy to the invention of “bad banks” in the financial crisis.

4.4 The Global Union

It is beyond the scope of this book to design possible future economic or political systems. However, as a consequence of the scientific analysis, it seems clear that the political, economic and environmental system as of today is diverging and likely to approach a break down, which actually may mean the death of millions or billions of people or even a breakdown of major parts of the biosphere on our planet that is the basis for human food production. It also seems clear that especially the financial system needs further stabilizing elements. The global market may not continue to act without political control.

From the scientific point of view, it is likely that any uncontrolled complex system will collapse if the feedback loops are not well tuned. This is the case when the timescales of change are too fast compared to the response of the system or when the amplitudes of the changes, i.e. the power of the stakeholders are not well balanced. Therefore, from the humanistic point of view, the author sees no alternative to some general regulation of the markets:

Any agreement on tariffs and trade must be complemented with a political agreement that makes sure that economy is not only profit oriented but also serves the people and future generations.

It needs a kind of global government or global trade union that effectively incorporates the needs and concerns of the people and of future generations in the regulations of the market.

A viable option would be to add a new body to the organisations of the United Nations. This body—let’s call it the **Global Union**—would consist of a kind of parliament or commission that has direct binding legislative power over all the member states of the Global Union concerning certain global issues. In case a member state does not accept a majority decision of the Global Union, there is no “veto right” for certain privileged countries, but of course a country may leave the Global Union at any time. The “Global Union” could be set up in a similar way as the “European Union”. Any government on our planet would be allowed to join the “Global Union” if it accepts its basic rules. One might even think about expanding the membership to sub-states like Scotland or California and to geographical regions or even communities of NGO’s. By doing so, members could have great trade advantages while governments outside the “Global Union” could be sanctioned economically in case they violate certain standards of humanity or if they devastate the biosphere and the global resources.

It is not unlikely, that already in the coming decades millions of people will have to migrate due to climate change, water and food scarcity and/or the breakdown of domestic economy. This can boost xenophobia, nationalism and populism. Local political leaders will have to balance the right compromise between demarcation, integration and the promotion of global solutions. To the author’s opinion, the most important characteristic of any political party should be the following: It needs to have practicable visions for a future life on this planet. These visions must esteem the people and their work and must be compatible with their moral concepts. They must include the protection of the living condition of future generations. I believe, a lot of today’s power structures in politics and economy are far away from this basic footing.

Concerning the long-term effects of climate change a trial-and-error economy will be fatal. There is no reason to hope that the creative mechanisms of the free market will handle the energy transition by itself. Large parts of the energy transition will have to be carefully thought through. A global policy will have to set the right stimuli and penalties, and a coordinated international effort is needed in research and development. Energy flows in power lines or pipelines have to be coordinated and regulated by international agencies and cannot be left to companies or countries that only want to maximize their profit.

Finally, when it comes to the point that fossil fuels will be rationed and owners of fossil fuels will not be allowed to sell or use it, international conflicts will be inevitable, unless our society has reached the next level of human development by then. Let us hope that we do not have to go through another world war to reach it:

We are all in the same boat, sitting on the same powder-keg!

Table 4.1 Examples for economic stimuli and penalties to foster a global energy transition. Some of them are taken from Germany as one of the pioneering countries

Aim	Measure	Function and Remarks
De-carbonization of energy industry	CO ₂ taxes	Taxes are imposed on the extraction, production, vending, import, export and/or consumption of fossil fuel (coal, oil, gas) according to the associated amount of CO ₂ during the combustion of the fuel. The advantage of taxes compared to other measures is that public money becomes available to reduce negative socio-economic side effects of the CO ₂ taxes and to foster further measures for the energy transition
	Carbon trading	Carbon Emission Trading and the Clean Development Mechanism were the measures of choice in the Kyoto protocol. Up to now these measures were not very effective because the allowed CO ₂ limits are too high, the prices too low, and many companies invented ways to circumvent or misuse the regulations
	Stop subsidies for fossil and nuclear energies	Direct or hidden subsidies for the conventional energy industry are widespread. This weakens the chance of renewables to compete in a common market. The money that is freed by stopping subsidies for the conventional market can be invested in sustainable technologies
Foster energy research	Coordinated global research	Increase public funding and international coordination for research of technical and socio-economic aspects of the energy transition. The constitution and funding mechanisms of CERN in Geneva can be used as blueprint for a dedicated research organisation with these goals
	Revision of rights on intellectual properties	Patents are rights to exclude others from using inventions and innovations. This aspect is inherently counterproductive for a fast technological development. Three examples: (I) Ten researchers at ten different companies have ten clever ideas, but they keep their invention secret over years and fail to make a profitable product from it. Bringing the ten ideas together might solve the problems of the developers immediately. (II) A company buys a patent not in order to use it but in order to stop competing companies from using the innovation e.g. because it endangers their

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Table 4.1 (continued)

Aim	Measure	Function and Remarks
		<p>own business model. (III) Two competing companies own a patent each and they stop each other from producing the ideal product that combines the two patents</p> <p>The rights on intellectual properties have to be revised such that research results and inventions are either public domain or can be licensed by paying a reasonable fee to an international organisation that handles these fees (e.g. similar to what GEMA in Germany does for musical performance rights). A reimbursement for the inventors and research institutes has to be guaranteed by this international organisation. Such a move could greatly improve the worldwide cooperation in energy research. Also here the example of the particle physics community at CERN is a reference for an open, well-working and productive research community with rapid progress. It is based on the finding, that real researchers are intrinsically motivated and money is secondary. Only businessmen need patents</p>
Transition of the power market	Priority of renewables	<p>The German renewable energy law grants priorities to renewable energy sources. This is a good move, however there is a side effect that grids are overloaded or electricity prices become negative. The law should be changed such that renewable sources can be switched off remotely in this case, however their owners still have to be reimbursed for this time by the causer of this situation (e.g. the conventional power station that could not be switched off in time or the grid operator that failed to provide the power lines that are necessary for a smooth operation)</p>
	Feed-in tariffs	<p>Feed-in tariffs are useful to foster investments in renewables. However, in Germany the money to finance the feed-in tariff mainly comes from private consumers. Large-scale industrial power consumers, companies that produce their own power, and consumers of fossil fuels are excluded from the feed-in surcharge. This perverts the original idea. It encourages the energy-intensive industry to continue with fossil fuels and with business as usual, while the average private user gets the</p>

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Table 4.1 (continued)

Aim	Measure	Function and Remarks
		<p>impression that the energy transition is really expensive</p> <p>Instead, the users or producers of conventional energies should finance the feed-in tariffs for renewable energy, because they are the cause for the environmental problem</p> <p>Paying feed-in tariffs may lead to the situation that renewables become profitable, that do not use the best suited technology or the best sites for this technology. Therefore feed-in tariffs have to be carefully chosen and should be valid only during very limited transition periods</p>
Transition of the heat market	Insulation and heat recovery	Investments in insulation and heat recovery must have highest priority and have to be regulated by law for (new) buildings and industrial products. Some of the current laws allow playing the quality of insulation off against the method of heating. That may be counterproductive on the long term
	Priority of heat pumps	Today, electrical heat pumps in Germany are burdened with large taxes and surcharges for feed-in tariffs of electrical power. In comparison, simple gas burners do not have these high surcharges. In future this has to be inverted and heat pumps have to become the standard for heating applications
	Power-heat cogeneration	The small-scale cogeneration of power and heat is strongly privileged in Germany. In many cases, there is no justification for that, because heat pumps and combined cycle gas power stations would be the better choice. Therefore power-heat cogeneration should be used only in exceptional cases where heat pumps are disadvantageous
Transition of the mobility market	Public transport	In many regions, public transport has many negative attributes: Not all locations are easily accessible, it is too infrequent, too expensive, and it has too little comfort. One has to realise that all these attributes are a consequence of the fact that individual motorcar traffic is the standard and public transport is the exception for large parts of the population. This has to be inverted and public long distance and local transport must have great political priority wherever it is suitable

(continued)

Table 4.1 (continued)

Aim	Measure	Function and Remarks
	Railway infrastructure has to be financed	In many cases railways are the most sustainable mean of transportation due to the little friction resistance, the electrification without the need to transport heavy electricity storage and due to the high degree of automation. Today's economical hindrance of railways is the fact that the railway infrastructure has to be paid by the small number of railway customers, while the road infrastructure is paid by the community and/or a very large number of car and truck drivers. Also here the concept of financing has to be inverted: The railroad infrastructure should be paid by the community while the privilege to use expensive highways and to produce excessive noise and pollution in towns and landscapes should be discouraged by environmental taxes
	Car sharing, e-bikes, new communication technologies	Car sharing, e-bikes and new communication technologies provide a new market that is able to minimize transportation cost, time, and energy consumption. Many new ideas are emerging and have to be fostered by politics
	Video conferences; home offices; 3-D printing	Modern technologies allow for minimizing the need of transportation. Videoconferences and home offices, as well as home shopping are examples to avoid travel. 3-D printers and video-instructions allow for local repair shops and the local production of goods. A fast and area-wide coverage by high speed internet is required to allow for that
	EVs	The infrastructure for EVs has to be provided by the public. There should be economic stimuli or penalties that foster the use of EVs compared to cars with fossil fuels

(continued)

Table 4.1 (continued)

Aim	Measure	Function and Remarks
Capitalism and globalization	Revision of trade agreements	<p>The problem of global warming is too big and urgent to be handled by small adjustments of the current economic system. Global problems require global solutions, i.e. solutions that are agreed on by the majority of the countries. There are two general approaches:</p> <ol style="list-style-type: none"> 1. Strengthen globalisation and economic interdependency. This forces global thinking and makes any economic or conventional warfare unprofitable. <p>However, there must be a global political consensus about standards in human and environmental questions, otherwise the globalisation will be counterproductive</p> <ol style="list-style-type: none"> 2. Demarcation and protective tariffs. This allows for local changes in certain sectors of economy and certain groups of countries, even when there is no global consensus on questions that are regarded as important. It is probably easier to humanise economy on a limited scale by a “coalition of the willing” instead of finding free trade agreements that improve the human standards globally. This demarcation can be combined with fair trade agreements in the international domain <p>In today’s world with different ideologies and political systems there is no obvious solution, neither for approach 1 nor 2. Nevertheless, it is of eminent importance to find solutions where mankind is not divided any further and where it becomes possible to act together in the fight against a collapse of civilization</p>

4.5 Conclusions

Today, the global economy is largely decoupled from the political systems of the individual countries and there are hardly any political instruments to control world economy. By numerous agreements on tariffs and trade, global business competition was set-up in a way that it leads to a decline of taxes and to public debt. In the last decades, the classical capitalism converted to a financial capitalism, which trades large amounts of money in short timescales and allows companies and people to become super-rich, while the corresponding huge negative amounts of money are accumulated as public and private debts. A political counter force is needed that sets

up rules to stabilize the financial markets and to reinvest the profits of the companies in the communities.

Today's free economy maximises short-term profit regardless of its effects on future generations. To manage the global energy transition, a coordinated international research and planning is needed, as well concerning technologies and energy passageways as stimuli and penalties that regulate the market. Effective international agreements have to be negotiated to protect our climate and to pursue a global energy transition. Ways have to be found to enforce these international agreements. It seems clear that nationalism cannot solve global problems, instead we need strong international organisations as for example the proposed "Global Union".

It is beyond the scope of this book to re-design global economy, but as a basis for further discussions Table 4.1 lists a number of political measures that could help to foster a global energy transition. It is up to the reader to discuss the political pros and cons of these options. Let's take the climate change as a chance to redefine our living together on our planet!

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