People. Nature. Economy.

COMPENDIUM

for a sensible energy policy

Germany's Energiewende – where we really stand

In March 2017, the German Federal Ministry of Economics and Energy published a brochure announcing that the Energiewende, its renewable energy revolution, was ‘a success story’.

Nothing could be further from the truth.

The Energiewende has the goal of making Germany independent of fossil fuels in the long term. Coal, oil and gas were to be phased out, allowing drastic reductions in carbon dioxide emissions. However, these goals have not even begun to be achieved.

The Energiewende was only driven forward in the electricity sector, which, accounts for only one-fifth of energy consumption. There were hardly any successes in the heating/cooling and transport sectors.

And so carbon dioxide emissions in Germany have been rising since 2009, even though well over a hundred billion euros have been spent on the expansion of solar and wind energy over the same period. The financial obligations undertaken in the process will continue to burden taxpayers for another two decades and will end up costing German consumers a total sum of around 550 billion euros.

Despite this enormous effort, security of supply is increasingly under threat. At the same time, people and the biosphere are suffering; wildlife protection has become subordinated to climate mitigation, even though the possibility of achieving the goals of reducing carbon dioxide emissions is becoming increasingly distant and the measures for the energy transition seem to become more and more questionable from a constitutional point of view.

In this review we would like to inform a public debate and set out a reasonable course for energy policy in Germany.

'But where should the electricity come from' is usually the immediate question to someone who takes a critical position on the expansion of wind and solar power plants. Our **problem description in section 1**. focuses on this simple question. It shows that wind and solar energy, which seem to promise a quick fix, are not simple alternatives to fossil fuels. Indeed, they are not even part of the answer; as their deployment becomes widespread, they become a problem in themselves and make it even more important to find sensible solutions.

It is often claimed that all that is needed is a sufficiently large and sufficiently widely distributed network of wind farms (*'the wind is always blowing somewhere...'*); 'smart grids' and grid-scale energy storage will then compensate for the intermittency of the power supplied. **Section 2. on the techniological aspects** shows that these hopes are unrealistic.

A widespread view is that if a measure is designed to protect the climate or the environment, then we should see no sacrifice or technical challenge involved in putting it in place as too great. In fact, however, this attitude is based on false premises, as section **3. on the ecological aspects** of the renewable energy question shows. Instead of delivering the promised protection of the climate, current energy policy is causing a biodiversity disaster. The protection of nature and wildlife is suffering, and populations of endangered wild animals have been decimated. These sacrifices are all the more tragic because they are completely pointless. There are easier, and much less painful ways to reduce carbon dioxide emissions.

The energy transition is a *'blessing for rural regions'*, claimed the former head of the German Chancellery, Peter Altmaier, a few years ago. Poorer regions would be given a new boost through their involvement in renewable energy production. There were also high expectations that Germany would take the lead in developing many of the new technologies and would benefit from a 'green jobs' boom. **Section 4. on the economic aspects** measures these expectations against reality. It reveals that renewables are being given perverse economic incentives, giving rise to undesirable developments that pose considerable risks to economic growth and prosperity in Germany.

The social effects and the losses in health and quality of life that the expansion of 'green electricity' facilities will have, are hardly noticeable in the large cities. Dramas are taking place in the countryside that remain hidden from the Energiewende enthusiasts, most of whom live in the cities. Our **section 5. on social and health aspects** examines these negative impacts.

A great deal needs to change in energy policy. We therefore conclude this paper with **a list of demands**, addressed to the future German Federal Government – whoever they may be.

In the last section of this paper you will find contact details for some of the supporters of the Vernunftkraft initiative who are experts the topics considered. These people are happy to share their expertise with journalists, decision-makers and others.

In the interest of the more than 800 citizens' initiatives represented in our regional associations and the federal initiative, we hope that this paper will be widely read and that it will help bring about a reconsideration of Germany's energy policy. In place of the Energiewende, we need an energy policy that sets sensible goals, pursues them consistently and that is constantly verifiable. Only in this way can we be sure that it is providing a benefit to man and to nature as a whole.

Dr. Nikolai Ziegler
Bundesinitiative VERNUNFTKRAFT.

Matthias Elsner
VERNUNFTKRAFT. Niedersachsen

Dr. Andreas Dumm
Landesverband gegen Windkraftanlagen in Natur- und Kulturlandschaften Baden-Württemberg

Claudia Kühn-Sutiono
VERNUNFTKRAFT. Bayern

Uwe Anhäuser
Bündnis Energiewende für Mensch und Natur Rheinland-Pfalz und Saarland

Norbert Schumacher
Freier Horizont Mecklenburg-Vorpommern

Michael Eilenberger
Bundesverband Landschaftsschutz Sachsen

Rolf Zimmermann
VERNUNFTKRAFT. Hessen

Gerti Stiefel
Bündnis Mensch Natur Baden-Württemberg

Holger Sehr
Landesverband Energiewende mit Vernunft e.V. Thüringen

Volkmar Pott
Vernunftwende Nordrhein-Westfalen

Dr. Susanne Kirchhof
Gegenwind Schleswig-Holstein

Waltraud Plarre
Volksinitiative Rettet Brandenburg

'...but where will the electricity come from?'

A reliable supply of electricity around the clock is taken for granted by citizens of the Federal Republic of Germany. But only those who have taken a closer look will appreciate the importance of a reliable power supply for our highly complex, high-tech society. It is not just about comfort and convenience. It is not only a matter of maintaining an essential input for important manufacturing processes; it is about nothing less than the functioning of civilised community life.

Electricity accounts for about one-fifth of total energy consumption. As a result, the actual contributions that wind power and photovoltaics make as supposed *'pillars of the energy transition'* are rather small: renewables delivered just 3.1 % of energy demand in 2016 (Figure 1). In the course of the so-called 'sector-coupling', this share is to be increased by pushing ahead with electrification of various sectors of the economy. The question of where our electricity will come from in future is therefore of fundamental importance.[1]

A fundamental characteristic of electrical current must be taken into account when answering this question: it must be produced, to the millisecond, at the moment of consumption, giving an exact balance between power supply and demand. Stable power grids are based on this principle.

This balance can be guaranteed with conventional 'dispatchable' power plants. At present however, coal-fired power plants are all to be shut down by 2030, a move which will seriously jeopardise grid stability. The shutdown of the nuclear power plants is to happen even sooner: by 2022. Politicians believe that wind power and photovoltaic systems will take over the main load of the power supply.

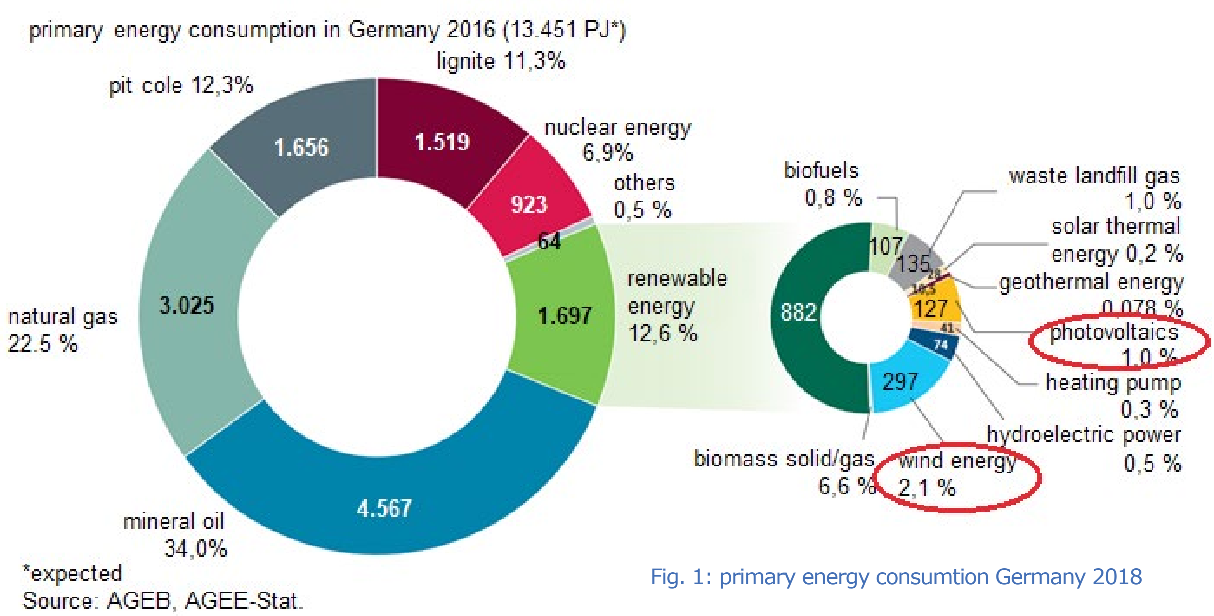


Fig. 1: primary energy consumtion Germany 2018

Physics, however, is unimpressed by this idea. At the end of September 2017, more than 27,000 wind turbines with a rated output of 53,374 MW were installed in Germany. Nominal power is defined as the highest power that can be provided permanently under optimum operating conditions (strong to stormy wind conditions). In Figure 2, the dark blue areas represent the delivered power from the German wind turbine fleet during September 2017. A total of 6,380 GWh (1 GWh = 1 million kWh) was sent to the grid, corresponding to just 16,6 % of what was theoretically possible. The red limit line indicates the installed nominal power capacity of all the wind turbines in Germany at that time.

For approximately half of September 2017, the power delivered by the wind fleet was less than 10 % of the nominal capacity. Values above 50 % were reached only 5.3 % of the time, in essence only on 8 and 13–15 September.

Figure 3 shows the power consumption curve (the 'load'), and the delivery curves of the wind energy and PV systems. Peak electricity consumption in September 2017 was 72 GW, and the average value was 54 GW. In the background of the diagram, the installed capacity of all wind turbines and PV systems in Germany can be seen as a light-blue area with a boundary line (red). Total capacity is 96 GW. Electricity consumption in September 2017 was 39,000 GWh. Wind turbines delivered for 6400 GWh of this and PV systems another 3100 GWh. The minimum power input by all of the PV and wind energy systems was below 0.6 GW, representing less than 1 % of the installed capacity of 96 GW.

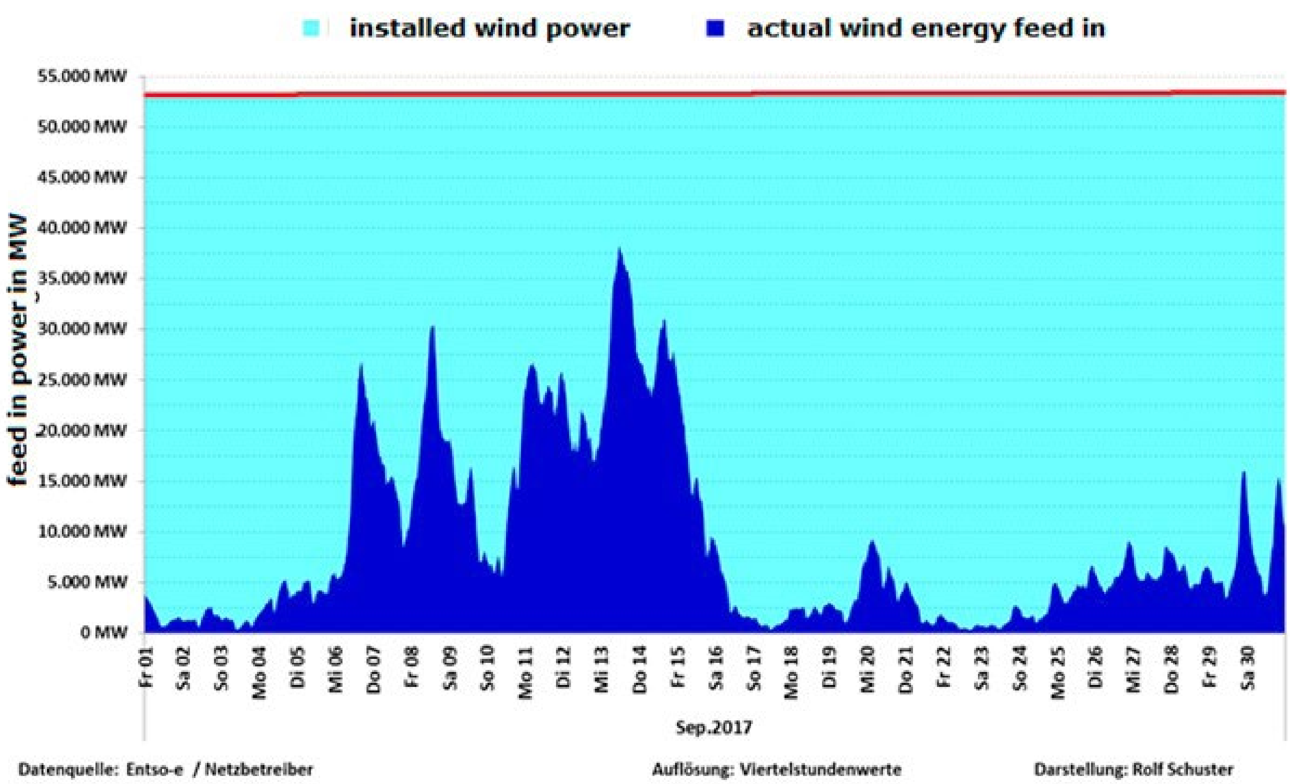


Fig. 2: Wind data Sep. 2017 - Installed capacity and production

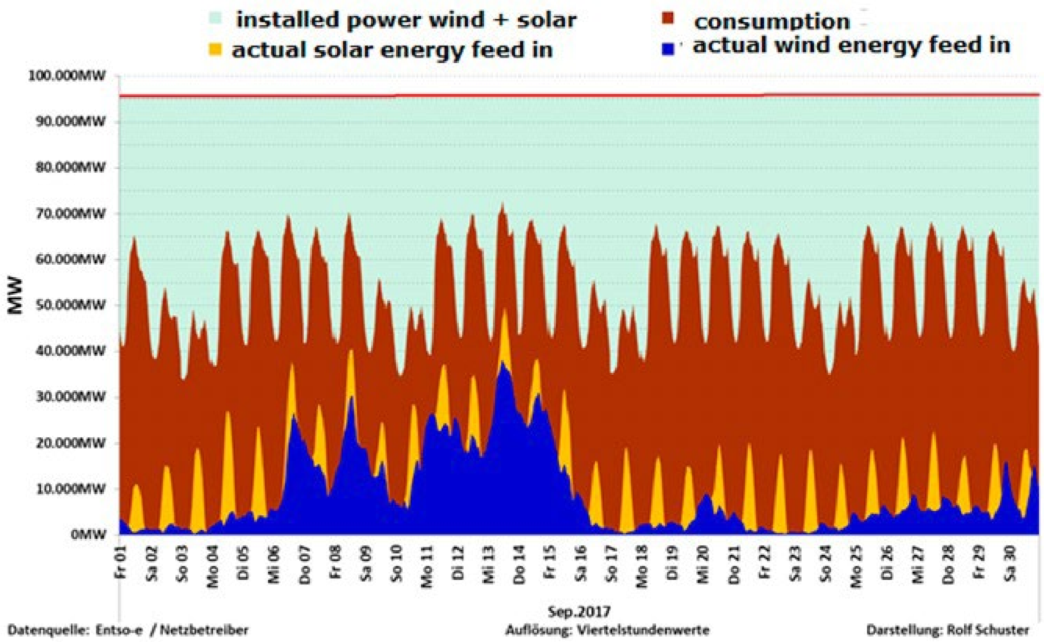


Fig. 3: Electricity production and consumtion in September 2017

Conventional power plants were therefore needed to ensure grid stability at all times - partly over longer periods - at times, their full capacity of 60 GW was required. From 10 to 15 September hurricane 'Sebastian' pushed the output of the wind turbine fleet up towards its maximum level. However, this also put the security of electricity supply at considerable risk, and to keep the grid in balance, it was not enough to switch off conventional power plants; wind turbines had to be switched off too.

Consumers pay for the costs of maintaining two parallel generation systems with a sharp increase in the number of emergency interventions via EEG contributions and network charges (see section 4 on the economic aspects).

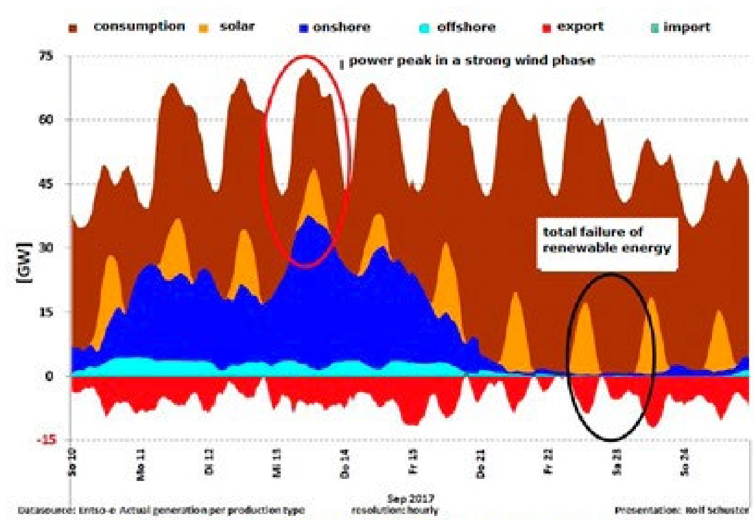


Fig. 4: Extreme situations in Germany in Sep. 2017

Figure 4 zooms in on the power supply situation for 10–15 September and 21–24 September, illustrating the problem: **a safe power supply with an acceptable 'socket' of feed-in power is not available.** If no wind blows, almost all turbines are affected. The same applies to photovoltaics at night or on dark, cloudy winter days

Figure 5 documents the output of German wind turbines and PV systems **between 2011 and mid-2017**. There is a background of a rapid increase in capacity (light blue background). The peak power supplied to the grid by renewables systems (yellow PV, dark blue wind) is also increasing. However, despite the increased capacity and the increasing peaks, the guaranteed output of all 27,000 wind turbines and the 400 million m² of PV systems remains close to zero because of their weather-dependency. This is a particular problem in the winter months, when electricity consumption is high.

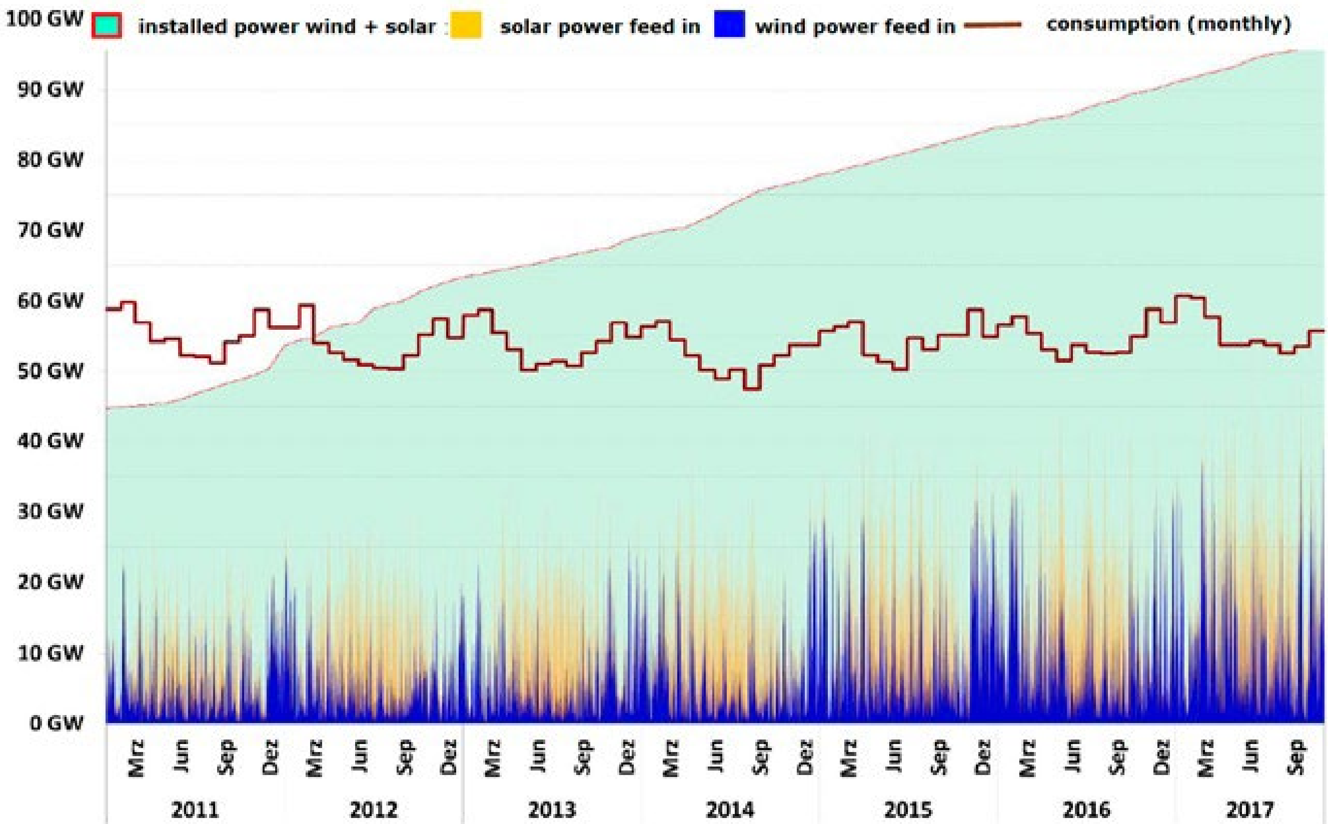


Fig. 5: Diagram of the power output of the WTG and PV systems with curve of the installed nominal power

In other words, there is no discernable smoothing effect from the size and geographical spread of the wind fleet: the argument that the wind is always blowing somewhere is not true, at least for Germany: the fluctuations in output simply increase as generation capacity is added.

As can be seen, peak renewables output is now approaching the minima of electricity demand. However, this should not be seen as progress, because it reduces the controllability of the overall system, which must always be guaranteed by conventional systems.

Figure 5 also plots electricity consumption for each month. The curve shows the annual increase in electricity consumption in the winter months and the reduction in demand in the summer. Over the years, electricity consumption has remained relatively constant at around 600,000 GWh.

The gap between demand and what is supplied by priority 'green electricity' plants has to be met by conventional power plants. After the last nuclear power plant shuts down in 2022, only coal-, gas- and oil-fired power plants will remain to do this. If there is no 'wind and sun' feed-in power, the entire conventional power plant capacity is required to secure electricity consumption. If necessary, these plants can be supplemented with standby power plants abroad. However, as the supply from renewables plant increases, this will no longer be possible and a real threat to grid stability will develop. **After all, power plants cannot take back electricity in the event of power oversupply.**

Even the 'dumping' of electricity abroad to reduce the surplus energy will become increasingly difficult, since neighbouring countries are closing themselves off with electricity barriers in order to protect their own grids.

In addition, the reserve of flywheel mass of turbines and generators of large conventional power plants, which is absolutely necessary to stabilize the power grids, is dwindling. This poses an additional threat to the network.

With further increases in feed-ins of wind energy and PV systems, which will increasingly reach the minimum electricity consumption, e.g. at night and at weekends, the control capability of conventional power generators will be severely limited. <u>The constancy of frequency and voltage in the power grid will be endangered or no longer guaranteed</u>.

Anyone who studies the feed-in characteristics of electricity generation from wind power and PV systems thoroughly must realize that **sun and wind usually supply either far too little or far too much** - and that one cannot rely on anything but chance.

A snapshot does full justice to the facts. (The name of the company 'Zufall' literally means 'chance')

Fig. 6: Lorry of a north-hessian forwarding company

When asked where the electricity should come from, 'wind and sun' cannot be the answer if one wants to have a secure supply.

There is no sunshine at night and electricity cannot be stored in bags

The problems outlined in the section above are rarely raised in the public debate, and if they are, it is usually claimed that they are only transitional.

A faster grid expansion, technologies for electricity storage, and expansion of the wind turbine fleet over vast areas are the standard remedies that are generally offered. However, none of this stands up to critical scrutiny.

The wind energy statistics reveal the absurdity of wanting to tackle the problem of intermittency through construction of additional power lines and extensive wind power expansion.

Figure 7 shows the expansion of wind energy with currently approximately 54 GW installed capacity and the volatile power feed-in with growing power peaks and regular drop to power values close to zero. In other words, only the peaks have risen. Even a Europe-wide wind power expansion in conjunction with a perfectly developed electricity grid would not solve the problem of the fluctuating wind energy generation. As Figure 8 shows, it is quite possible for there to be no wind anywhere in Europe. So even with a European electricity grid based on wind turbines, a 100 % replacement system would always have to be available to ensure the security of electricity supply.

The effects of European large-scale weather conditions are documented by the power hydrographs of the approximately 100,000 wind tur-

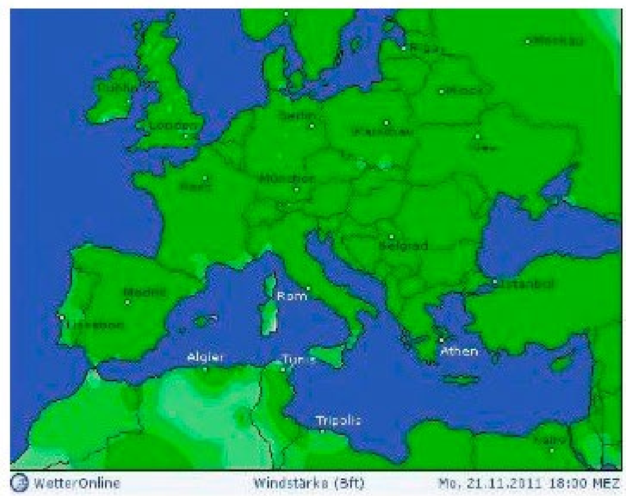


Fig. 8: Wind map from 21.11.11, wind speeds <3 m/sec are dark green

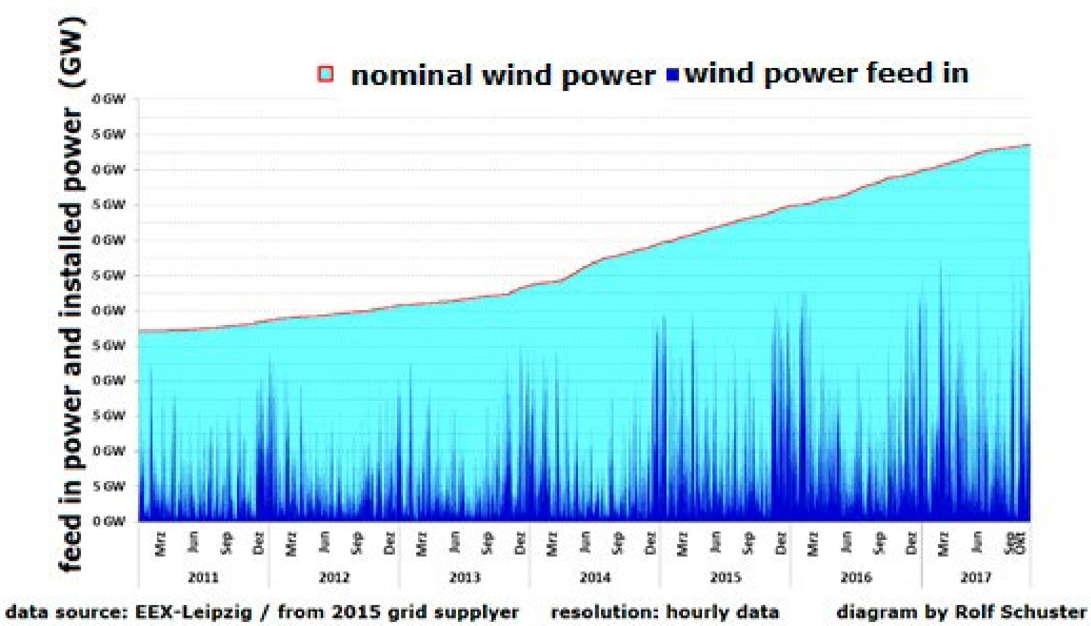


Fig. 7: Power input of all German wind-turbines, march 2011 to oktober 2017.

bines installed in Europe. In Figure 9, the power input of German wind fleet (light blue) is superimposed on the power generation of the combined wind fleets of 15 neighbouring EU countries. Even on a European scale, due to the meteorological conditions, it cannot be expected that the power supplied by the European wind

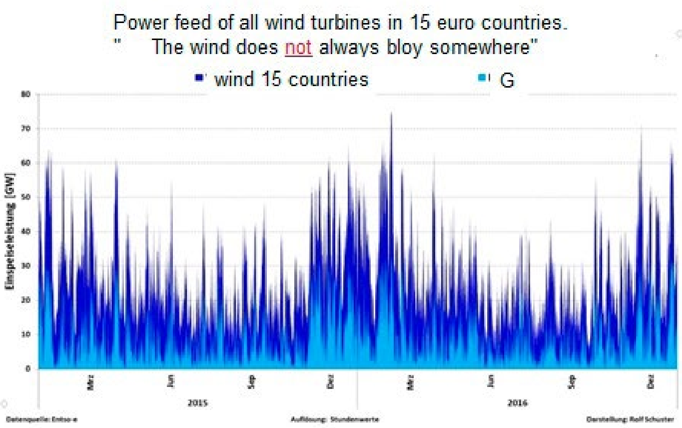


Fig. 9: Power feed of european wind turbines

fleet will be smoothed. Therefore, an expansion of production capacity over a larger area does not smooth production.

Figure 9 also includes offshore wind farms, which generate higher yields but also come to a standstill if there is no wind. Figure 10 shows

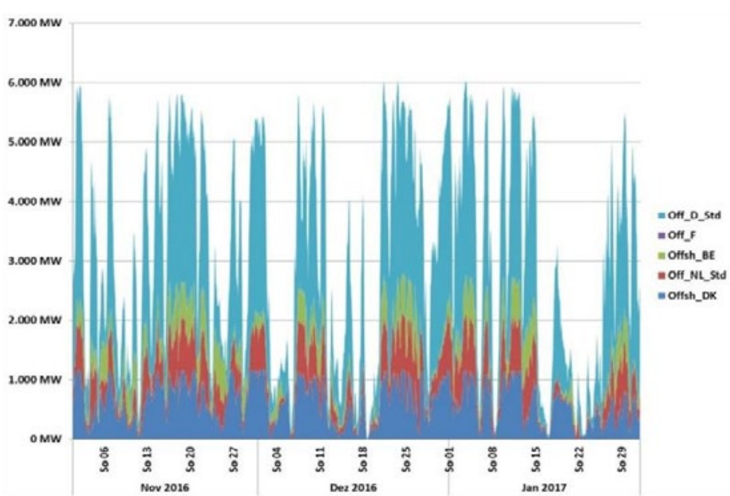


Fig. 10: power input offshore installations from 5 EU-states

the pattern of generation of offshore wind farms, with clear alternating peaks and troughs; they are clearly not contributing to the smoothing of electricity production.

With PV systems, the lack any smoothing of electricity over the diurnal and seasonal cycles is even more evident. It is obvious that the generation peaks in Germany occur at the same time as the peaks in the other European countries. This is due to the size of the low pressure areas, which results in a positive correlation of wind power generation levels across the continent: if too much electricity is produced in Germany, most of our neighbours will be over-producing too. **This calls into question the sense of network expansion a priori.**

It was clear from the outset that the fluctuations in output would increase with further capacity additions: a coherent power grid would bring together the production of many individual, ultimately random power generators. The random fluctuations of renewable power plants are correlated, and therefore add up according to a mathematical law known as the equation of Bienaymé, which states that the volatility of a sum of positively correlated random variables can only ever increase. **Any expansion of renewable generation capacities therefore must increases overall volatility.**

The hypothesis of the smoothing of power generation by an extension of the area is one of the central errors and misjudgements of the Energiewende. All known problems such as the export of electricity, the dumping of surplus electricity for a disposal fee and the control of plants are further exacerbated by the extension and the resulting increase in peaks in output.[2]

No, Mrs. Weiss – electricity storage facilities are not in sight or unaffordable.

Advertisements for a large energy company claimed that a *'battery for green electricity'* was available to provide a buffer against the fluctuations of wind power.

Fig. 11: Advertisement by EON (2013)

This message is highly misleading. **No such 'battery' is available; nor has one of the required size even been designed.** As an indication of what would be required to deliver grid-buffering on this scale consider the following. Conservatively, a minimum storage reserve of 10 days of demand would be needed; this is what would have been required – in the absence of conventional power sources – in January 2017, when there was a prolonged period with no wind and no sun.

Net electricity consumption in Germany in recent years has been around 600 TWh (see Figure 3). This means that 16 TWh of storage would be needed to see the country through a lull of 10 days.

Pumped storage?

Pumped storage is the most effective large-scale technical solution for storing electrical energy. In Germany more than 30 large and small pumped storage facilities are available. The latest and most efficient power plant is Goldisthal, a **600 million euros** facility, with a rated output of 1 GW derived from a reservoir of 12 million m³ of water stored behind a dam 3,370 m long. Germany's pumped storage plants can deliver around 7 GW of power to the grid.

However, Goldisthal's storage capacity is only 8 GWh. At 1650 GWh, the average daily electricity requirement in Germany is 200 times this value. Around 2000 Goldisthal-class facilities would therefore be needed to cover a ten-day slack period. Even facilities the size of the 'Three Gorges Dam' in China, the largest hydro-

Fig. 12: Three Gorges Dam

electric power plant in the world, could provide only a quarter of the required electrical power.

At a conservative estimate of 600 million euros per plant, the construction of this quantity of pumped storage would need cost a minimum of 1 trillion euros. This clearly shows that the storage of surplus power generation from wind power and PV via pumped storage as a failure backup for regenerative plants can never be economic. What is more, even if the financial constraints were ignored, there are not enough suitable locations in Germany that could be flooded. The idea that pumped storage plants could compensate for the fluctuating output in Germany is a delusion.

Batteries

At its peak, a wind turbine with a rated output of 5 MW delivers 5 MWh in one hour. A battery store of dimensions 5 MW/5 MWh – like the one that started operation in Schwerin (Germany) in 2014, the largest in Europe, installed at a cost of 6.5 million euros – can thus store the energy generated by such a wind turbine in one hour.

Between 2014 and 2016, the largest battery storage facilities with feed-in capacities/energy storage capacities of less than 10 MW/10 MWh were built in Germany at costs of approx. €1000/kW or kWh. In May 2017 work started on the world's largest battery store, rated at 50 MW/300 MWh, in Japan. In August 2017, a 16 MWh plant was inaugurated in Chemnitz (Germany). The cost was €10 million, which corresponds to €625/kWh. These examples show that very large power storage units can be made available by means of a modular design. Their specific costs over the last two years have been around €1000/kWh, but with a downwards trend. At €1000/kWh, the cost of storing one terawatt hour is €1 trillion. This would only be enough to cover the average electricity demand in Germany for 15 hours. To deal with a 10-day lull in the wind in winter, when light levels are low, batteries would be needed to store 16 TWh.

To do this, the worldwide annual production of such batteries (35 GWh in 2013) would have to increase by a factor of 450. Even the Tesla Gigafactory, which produces 500,000 lithium-ion batteries per year, could meet only a fraction of this demand when operating at full capacity, even assuming – somewhat implausibly – that

Fig. 13: sketch of a 'battery farm'

the necessary raw materials were available.

The cost of storing 16 TWh would be around 16 trillion euros. Even with efficiency gains of 500 % in battery technology, trillions of euros would still be necessary. Moreover, the durability of lithium ion battery systems is quite poor – typically around 10 years – so this level of spending would have to be repeated on a regular basis.

The use of batteries to absorb the fluctuating output of renewables plants is thus far removed from any economic and physical reality.

Power to gas?

No less illusory is the production of 'wind gas' as a storage method for these enormous amounts of energy. The technology involves using electricity to power the conversion of carbon dioxide and hydrogen to methane. This can be used to generate electricity again in gas-fired power plants when required. The process is wildly inefficient, and results in enormous conversion losses: even under the most favourable conditions, only about 30 % of the original electrical energy is ultimately regenerated. To compensate for these losses, even more wind turbines and PV systems would be required: capacities would have to more than double Even without taking into account the immense effort involved in building the extra wind turbines, solar farms and gas-fired power stations needed, the energy losses alone double the cost of the energy produced.

The German natural gas network has a storage capacity of 20 billion m³. Storing 1 TWh of

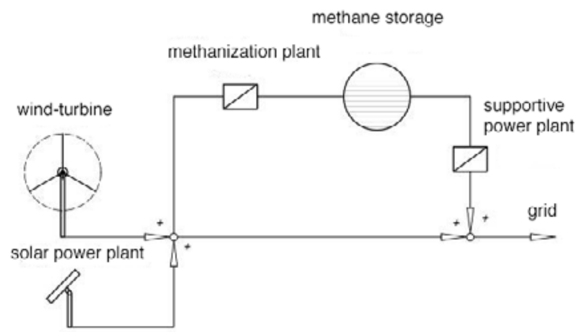


Fig. 14: sketch of the 'power to gas' concept

hydrogen with a specific energy content (calorific value) of 3 kWh/m³ means a volume of 333 million m³. With a storage requirement of 50 TWh, the storage volume increases to 23 billion m³ (taking into account the 70 % efficiency of electrolysis). This figure exceeds the storage capacity of the existing natural gas network.
Further losses result from the conversion of hydrogen into methane. The electricity production costs would be approx. 2 €/kWh.

Some municipal utilities are currently pursuing storage projects in the range of a few megawatt hours. That's 100,000 times too little to solve the problem.

Other options?

There are regular reports of supposedly groundbreaking new ideas in the field of energy storage. New types of pumped storages, spheres on the seabed, and similar fantasies appear again and again in the media. All of these 'concepts' are at the level of 'student research.' Since they usually cannot withstand simple plausibility checks, there is no need for further analysis. However, they are suitable for reaching uncritical and uninformed sections of the public and nurturing the illusion that the energy storage question can be answered.

'A veritable political-economic complex has grown up around the renewable energy sector…All the actors in this complex share an interest: the problems of the Energiewende must appear solvable, so that the wind and the solar industry can be further subsidised.'

From the newspaper ZEIT of 4.12.2014

Given the costs and technical restrictions, storage is definitely not the solution to intermittency problem. The necessary capacities are not economically feasible. And they are even less feasible if transport is to be switched from internal combustion engines to electrical power and if the introduction of heat pumps is to be strongly promoted in the heating sector. German energy consumption is particularly high in the winter months, especially during inversion weather conditions, when PV systems barely supply any electricity due to clouds and wind turbines are usually at a standstill. The weather-dependency of electricity generation would thus have direct and fatal effects on the transport sector. It would not be possible to heat electrically either. In other words, 'sector coupling' does not solve the problem of weather dependence; it reinforces it.

Climate protection: a bad joke with deadly undertones

No discussion about the construction of wind turbines and no energy policy document of the last federal government can avoid the suggestion that the Energiewende might help avert the dangers of climate change. This is why the last German government continually described the EEG as a central instrument of climate protection. The thesis – often presented in a shrill, moralizing tone – is that the expansion of 'renewable energies' is a human obligation in view of the impending global warming apocalypse. Particularly perfidious forms of this thesis even suggest that not expanding wind power plants in Germany would mean that we would soon be dealing with 'billions of climate refugees'.

But regardless of the intensity, frequency and variety of ways in which the thesis of 'climate protection through wind power' is presented, the idea remains fundamentally wrong. The reasons are as follows:

1. Germany contributes approximately 2.1 % of global CO2 emissions. No matter what policy is pursued in Germany, this share will fall to well below 2 % by 2030, because growth in China and India alone will exceed our total CO2 emissions. The total annual CO2 emissions in Germany are roughly the same as the volume that is added every 19 months in China. If Germany ceased to exist tomorrow, China alone would compensate for the loss of CO2 emissions after just 1.5 years. In other words, it is impossible to materially influence the global climate by reducing CO2 emissions in Germany.

2. Wind power is only effective in the electricity sector; it is largely irrelevant for transport and heating. However, the climate does not care whether a CO2 molecule comes from the exhaust of a car, a wood-burning stove or the chimney of a power station. The total energy consumption is decisive. This means that a maximum of 3.1 % (see Figure 1) of 2.1 %, i.e. 0.06 % of global emissions can be influenced by German wind energy and PV systems.

3. Anyone who thinks that a small reduction in 0.06 % of global CO2 emissions is worthy of any sacrifice must nevertheless note that even this prospect is deceptive: in fact, the expansion of wind power does not lead to any CO2 savings at all. The theoretical ideal conditions are not fulfilled (see Section 1). Conventional power plants must always be kept in reserve for when the wind is not blowing or the sun is not shining. These are forced into stop-go operations, and therefore become uneconomic and consume more fuel than they would have to. In addition, wind power pushes gas-fired power plants out of the market with their comparatively low CO2 emissions and thus indirect-

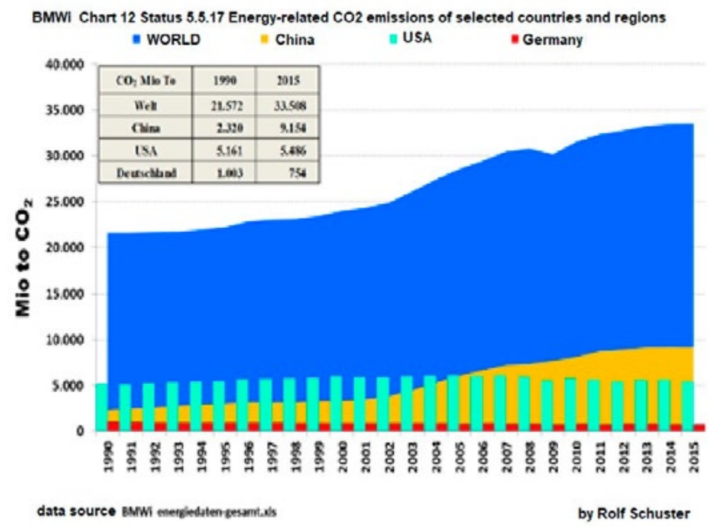


Fig. 15: CO2 emissions of selected countries.

ly increase the use of lignite. The upshot of all this is that wind power expansion does not yield any CO2 savings at all.

4. Anyone who dismisses these empirical facts as transitional phenomena must at least take note of the existence of the European Emissions Trading Scheme. It defines the total emissions of all EU countries - all potential CO2 emitters in energy-related industries must acquire emission rights within this capped quota. Power generation companies are fully covered and must provide proof of this for every gram of CO2 emitted. The certificates are freely traded on stock exchanges or between the plant operators, whereby the quota is gradually reduced. The system ensures that the CO2 reduction target is met and emissions are reduced where this is most cost-effective. Any savings in the German electricity sector would result in fewer certificates being required in the German electricity sector, i.e. the price of certificates would fall. This makes it less lucrative for companies in other sectors and regions to invest in emissions prevention. To put it bluntly:
Operators of Eastern European coal-fired power plants have no reason to install additional filters, as the savings on certificates are no longer worth the investment. However, this also applies to other branches of industry within Germany.

5. However, in the end, the EU-wide fixed quota of certificates alone determines how much CO2 is emitted in Europe. A

Fig. 16: Quote from the 'Neue Züricher Zeitung' 30.03.2015
The 'worlds most efficient turbine' has been mothbald.

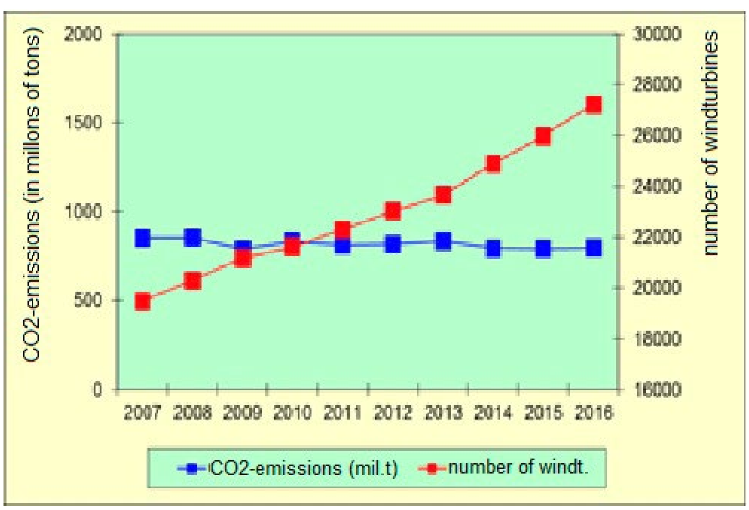


Fig. 17: WTG and CO2 emissions

Fig. 18: emissions trading cheme: The german 'energy revolution' undermindes an intelligent approach.

- anyway only fictitious - CO_2 reduction through further wind energy plants in Germany is definitely without effect on global emissions, but only increases the costs of emission avoidance.

6. Even if emissions trading is ignored and it is assumed that (fictitious!) CO_2 savings in Germany are actually reflected in an emission reduction throughout Europe, the reaction of global supply must be taken into account. Professor Hans-Werner Sinn already made this known in 2008 as the 'green paradox'.[3]

Fig. 19: 'Green paradox', demand-oriented cot-cutting policy accelerated the extraction of fossil resources.

European countries are spending a lot of money to improve energy efficiency, expand 'green' electricity, build ever more fuel-efficient cars and develop technologies to reduce their demand for fossil fuels. However, this demand policy is ineffective as long as other countries do not participate and resource owners do not cut off the supply. If 'green' policy becomes increasingly burdensome and pushes down the price of fossil fuels, it will actually accelerate the extraction of resources, as resource owners rush to realise their assets while prices are high. To put it bluntly: if Europe curbs its appetite for fossil fuels, prices will fall and fossil fuels will be consumed more in other parts of the world. If other parts of the world also curb their appetite, the sheikhs will turn their oil reserves into money and bring it to customers as quickly as possible. Figure 19

As long as the supply side is not included, any 'climate policy' restricted to the demand for fossil energy is either ineffective or counterproductive.

The forced settlement of wind power in the forest in the name of 'climate protection' is indeed **cynical**. Forests do not participate in emissions trading and do not influence world market prices for fossil fuels - their performance is therefore not counteracted by the mechanisms described under 4) and 5). At least one hectare of forest is cleared per wind turbine and is thus permanently destroyed. Afforestation elsewhere cannot make up for this, since old trees are in every respect much more valuable than new plantations. The negative effects of global warming predicted for Germany are more frequent floods and droughts, but forest is the best form of protection against soil erosion, cleaning soil and storing water.

In the light of all this, the assertion that we urgently need this kind of energy transition to stop climate change can only be understood as a bad joke. The latter receives a deadly applause when one also assesses the tangible ecological damage that the expansion of 'energy turning technologies' entails.


GRÜNEN-ABGEORDNETE ANGELA DORN

Frankfurter Allgemeine

„Wälder brauchen Windräder“

Fig. 20: (Translation: Green MEP Angela Dorn says: 'Forests need windmills'), title of an interview from FAZ of 10.4.13

The land consumption of 'renewable energies' causes biodiversity disasters

Whether it is forest destruction, cultivation of maize for biogas plants, the destruction of habitats or the direct killing of birds and bats - the massive expansion of 'renewable energies' has appalling consequences, ultimately the result of their low energy density and the resulting requirement for vast areas of land.

Besides intermittency, the core problem of wind and solar energy is that it is generated in a very diffuse form. Anyone who has ridden a bike against the wind will understand: a headwind of 3 m/s makes clothes flutter a little, but hardly makes it difficult to pedal. Water, on the other hand, flowing towards us at the same speed, will wash us away. This is because the power of water is comparatively concentrated, while the power of the wind is much more diffuse. In the case of hydropower, 'collecting from the surface' is done by a wide system of ditches, brooks, rivers and streams. If you want to 'capture' the power of the wind, you have to do the tedious work of concentrating the energy yourself - requiring a multitude of collection stations and power lines to connect them. Instead of ditches, streams, and rivers wind power required 200-m-high industrial installations, pylons and wires. Inevitably, natural areas become industrialised and opportunities for retreat in nature are gradually destroyed.[4]

The Energiewende leaves no room for nature

The doubling of the number of wind turbines since 2011 (see Figure 7) has caused considerable damage to flora and fauna. The Leibniz Institute for Zoo and Wildlife Research estimates that 250,000 bats are killed in Germany **each year**. On average, ten dead bats are found per wind turbine - among them many rare migrant species from Eastern Europe. German wind turbines are already endangering bats at the population level. In addition to deaths through direct collision and so-called barotrauma - differences in air pres-

Fig. 21: Nature reserves no longer protect nature

sure in front of and behind the wind turbines leading to internal organ injuries such as the rupture of the lungs – the siting of wind farms in forests has led to habitat losses and the loss of valuable living trees.

Not only are local populations threatened, but also migratory species, for which the wind farms on the peaks of the low mountain ranges often become a deadly barrier. Bats have a maximum of one, or in rare cases two, young ('pups') per year. High numbers of victims cannot therefore be compensated by an increase in reproduction, which is why some entire populations are threatened with extinction. With unchecked expansion and predominantly unregulated operation of wind turbines, bat populations could collapse dramatically in coming years. This would violate the EU's Fauna-Flora-Habitat Directive, which requires all bat species to be preserved in a 'favourable conservation status' and largely intact natural areas to be retained for them to live in.

The Michael Otto Institute has estimated that **100,000 birds are killed every year** by windfarms. Estimates of the number of unreported cases are many times higher. Under the title 'License to kill', the journal Naturpark dedicated a basic article to this topic.[5] This suggested that current expansion targets for renewable energy would mean the extinction of many species, especially red kites.

A field study undertaken at Bielefeld University, also estimated what the operation of more and more wind turbines would do to bird species, arriving at similarly dramatic conclusions. Remarkably, even common species such as the buzzard are killed so often by wind turbines that their survival can be threatened. Birds of prey are particularly affected because they are at the top of the food chain, have long lifetimes and low reproduction rates. The effects on the population therefore become visible only after a period of time.[6]

The risk of collision is particularly high when wind turbines are erected in the breeding and feeding habitats of birds of prey. In the so-called 'Heligoland Paper', the state working group of bird protection authorities drew up recommendations for the distances that should be maintained between breeding grounds and wind turbines. Unfortunately, these recommendations have not been adequately integrated into the energy policy of the federal states. The expertise of Germany's leading ornithologists has been ignored.

Fig. 22: red kite killed by windturbine

As early as 2011, in his award-winning article *'From the energy transition to biodiversity disaster'*, ornithologist Martin Flade described the fatal ecological effects resulting from the limited energy policy of expanding wind power, photovoltaics and biomass.[7] Biomass power plants sprout from the ground like mushrooms, rape and maize monocultures dominate fields and farmland, accompanied by drastic reductions in the populations of plants and animals. The decline of insects and other invertebrates deprives many birds of their food base; they barely breed in intensively cultivated maize fields. Partridge, quail, lapwing, skylark and yellowhammer are rarely seen. Poverty of species, water pollution and uncontrolled methane emissions are the results of excessive biomass electricity generation.

Offshore wind farms are little better than those built on land and damage marine mammals, birds, fish and communities on the seabed. Construction noise, particularly during driving of the piles for the foundations, can harm porpoises or drive them away. Migratory birds are also affected. Their travel routes are interfered with, their resting and feeding areas are lost and windmill collisions are always a threat. A few years ago, a wind turbine invasion of the many forests that have been managed for decades in accordance with the principle of sustainability was still unimaginable. But huge pits are now being dug and filled with thousands of tons of reinforced concrete, with considerable effects on the ecosystem. The effects on wildlife, soils and water as well as on the aesthetics and natural harmony of hilltop landscapes are catastrophic.

Dissection and deforestation change the function of forests as habitats and have further negative consequences. Particularly susceptible animal species suffer from this - from red deer to black storks and white-tailed eagles.

Sanctioned violations of law

The obvious infringements of German energy policy against European law, which have recently also been dealt with in legal terms, are playing an increasingly important role in connection with the planning and implementation of energy-transition projects. Environmental and species protection are precisely regulated there and exceptions are meticulously limited.

At the heart of the legal conflict that has now broken out, which could give Germany an infringement procedure with severe penalties, is the ban on the killing of *'particularly and strictly protected species'*. The relevant exemption of the Federal Nature Conservation Act, which was recently amended in view of the desires of wind power investors and aligned with vague 'climate protection targets', is already obsolete.

Fig. 23: sea eagle dead to windturbine, near Treuenbritzen, november 2017

Fig. 24: windpower constr. site in the Kaufunger forrest nature park (Hessen 2016)

Broken windows in the country, disappointed hopes on the scene

A. The economic dimension

The electricity price – a special location factor

The expansion of renewable energy was accompanied by the promise that price of electricity would remain manageable and even decrease in the long term. However, the levy on energy consumers to fund the Energiewende, which was 0.68 cents/kWh in 2005 has risen continuously since then. By 2017, it was approaching 8 cents per kWh, a more than tenfold increase. This was

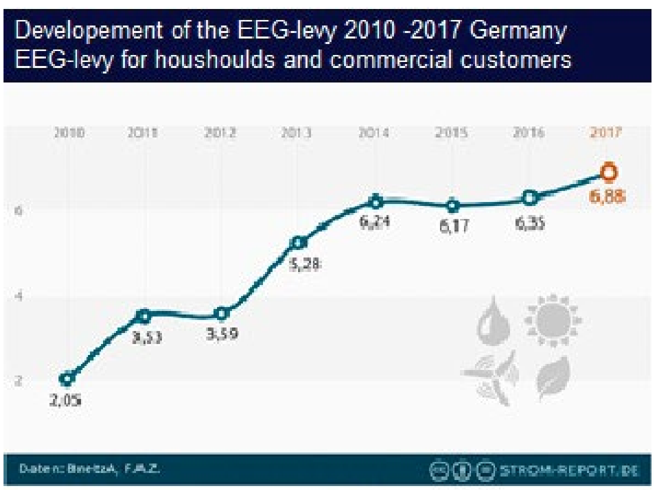


Fig. 25: Development of the EEG-levy

clearly foreseeable. It is equally clear that electricity prices will continue to rise with each additional wind, solar and biomass plant that is installed – the latest reforms and tenders will not change this.

The direct cost drivers of electricity prices are the feed-in tariffs set out in the legislation: operators of wind farms, PV and biomass plants will receive a guaranteed price per kilowatt hour, fixed for 20 years after commissioning. This is set at a level that is many times higher than the market price. The difference is passed on to (almost) all consumers via the electricity price. In addition, producers are guaranteed to be able to sell electricity into the grid at that price, regardless of whether there is a need for it or not.

In the period 2000–2016, 176 billion euros were paid by electricity consumers to renewables companies, for electricity with a market value of just 5 billion euros. The **destruction of economic value** amounts to around 10 billion euros per year. What else could have been done with this money (in economic terms, what was the 'opportunity cost'). As examples, the St Gotthard tunnel opened in 2016 at a cost of 3.4 billion euros; the Hamburg Elbe Philharmonic Hall cost 0.8 billion euros. The refurbishment needs of all German schools are estimated to total just 34 billion euros.

It is often said that the levy scheme has too many exceptions; if energy-intensive companies were to bear their 'fair share', the burden would be much lower, or so the argument goes. This is wrong in two respects. On the one hand, the exemptions granted under the 'special compensation rule' are very small in terms of value; if they were completely abolished, the levy would only decrease marginally. On the other hand, it is irrelevant who bears these losses. Waste is always bad, no matter who has to pay for it.

The last federal government tried to curb the cost driver 'EEG payments' by introducing the tendering procedure.

The assessment that ‘renewable energies’ would thus become increasingly competitive and that the cost problem was an issue for the past is nevertheless wrong: the other element of privilege, the purchase guarantee, remains completely untouched. Although direct production costs will fall, the **systemic costs** of expanding wind power and the like will continue to rise:

The fact that electricity from wind and sun is randomly produced puts the power supply system under considerable and increasing stress. The task of transmission system operators to maintain a constant 50Hz alternating voltage becomes more difficult with each additional weather-dependent and privileged feeding system. In order to cope with increasing volatility, the generation output must be repeatedly intervened in order to protect line sections from overload. If a bottleneck threatens at a certain point in the grid, power plants on this side of the bottleneck are instructed to reduce their feed-in, while plants beyond the bottleneck must increase their output. The need for redispatching - so the technical term - will continue to increase. Figure 26 illustrates the connection between wind power production and the need to protect the cables.

Together with the expansion of wind power, the costs of these **redispatching measures** rose continuously. By 2015, grid operators had to spend a billion euros to protect the power grid from the blackout. Since this billion did not ‘fall from the sky’, the unreliability of EEG electricity is reflected in higher electricity prices. But that's not all:

In order to protect themselves from unwanted erratic electricity inflows and to prevent their grids from being endangered, our neighbours in the Czech Republic and Poland were forced to install phase shifters, i.e. to erect ‘electrical current barriers’. The costs of these self-defence measures are also borne by German consumers. A further effect of the expansion of wind power and the like is the costs of **grid expansion**.

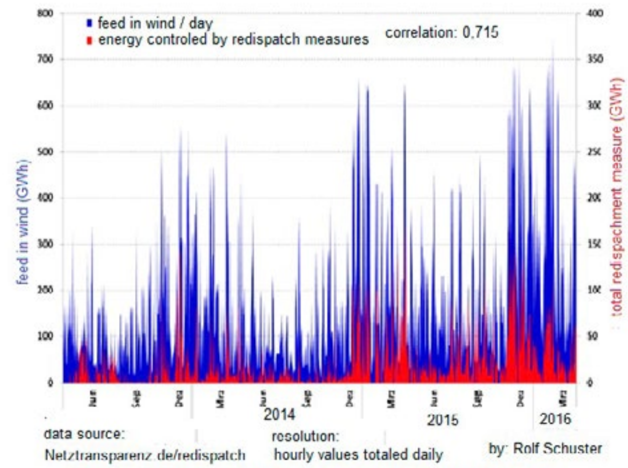


Fig. 26: windpower generation and redispatchment measures

Another rapidly growing cost driver is the phenomenon of **‘phantom power’**: consumers have to pay for non-existent electricity. According to §15 of the EEG, operators of wind power plants receive remuneration for electricity that has not been produced because it has no customers and would therefore jeopardise grid stability, so that the plants concerned have to be regulated down.

The costs of these processes, euphemistically referred to as ‘feed-in management’, have roughly tripled in the last three years. 643 million euros were due in 2016.

Finally, the further expansion of wind and PV will lead to an unprofitable, controllable electricity production that was previously calculable in a market economy and will incur ever greater losses, even if the expansion of renewable energies is supposedly ‘without subsidies’. However, supply security cannot be guaranteed without precisely this regulated electricity production - one kWh must be available as security for every kWh from wind and sun (see Chapter 2). The expansion of wind and PV systems is forcing this very safety performance into the loss zone - which is why these forms of energy can certainly be described as parasitic.

Bild

WINDRÄDER-IRRSINN

Phantom-Strom

Deutsche Verbraucher zahlten Millionen für Energie, die es nie gab!

26.10.2017 - 23:39 Uhr

Das ist doch Wahnsinn! Deutsche Verbraucher zahlten vergangenes Jahr 643 Mio. Euro für Wind-Strom, den es gar nicht gab!

Translation: windmills-insanity, phantom-power, german consumers paid millions for Energy that never existed! This is insane! German consumers paid 643 million euros last year for wind power, which did not exist!

Fig. 27: newspaper release from Bild 26.10.2017

All these factors lead to a development of electricity prices that knows only one direction: upwards. While in 1999 electricity prices were still in the European mid-range, the electricity prices to be paid by German households and companies are now the second highest in Europe. A social imbalance results from the fact that low-income households have to spend a particularly high proportion on electricity and are therefore most affected. This became a real problem for 330,000 households in 2016.

As far as companies are concerned, some are (partially) exempt from the EEG levy, but the overwhelming majority are negatively affected. In addition, the exceptions create new false incentives and uncertainties: to benefit from the exemption, companies must exceed certain energy cost thresholds. It is not uncommon that ecologically sensible investments are not made, because otherwise one would fall below these thresholds. In addition, the granting of exceptions has to be won over and over again. The sword of Damocles of deprivation always hangs over them.

Frankfurter Allgemeine

RECHNUNG NICHT GEZAHLT

22.10.2017

330.000 Haushalten wurde der Strom abgestellt

Translation: Invoice not paid? 330,000 households the electricity was turned off

Fig. 28: newspaper release from 22.10.2017

The misconception of technology leadership

The ‘energy revolution’ is often referred to as a modernisation and innovation programme. Germany will become a global leader in technology development, is the slogan. In green-inspired literature, ‘wind and solar’ should be celebrated as the ‘winners’. However, the real world is only partially impressed by this case: those technologies that prove to be economic will win, not those that bureaucrats and officials favour. Long-term economic gains can only be made through competition. However, with renewables, the competitive mechanism is switched off: prices and quantities are determined in a political process, the outcome of which is ultimately determined by the producers of renewable energy themselves.

If post-war governments had adopted the same approach for the automobile industry, it might have demanded that by the year 2000 every German must have a car. The Volkswagen Beetle – at the time, one of the most technically advanced cars in the world – would have been declared an industry standard and a purchase price that would deliver `cars for all' would have been determined in a biennial consultation process between government and manufacturers. As a result, we would still have vehicles of the technical standard of the VW Beetle, innovation would be irrelevant, and the German industry would never have achieved its position of global leadership.

Fortunately, when the Federal Republic of Germany was founded, the decision was made to pursue a market economy, uses competition to encourage generation of new ideas. This was to the advantage of both business and consumers, who were able to choose from a large number of good, inexpensive, innovative products that were constantly being improved, both from a functional and from an environmental point of view. Which products will be in demand in the future and which sectors of the economy will then flourish cannot be decided by law - especially not if this is strongly influenced by the producer interest.

The plight of the German photovoltaic industry, which rapidly lost international market share and had to cope with many insolvencies, is an example of this. The availability of easy money – subsidies – was the main reason for the sector's loss of competitiveness.[8] It is a harbinger of what can be expected in other artificially nurtured segments of the renewables sector.

Fig. 29: technology leader on the sidelines

In the long term, companies have to compete internationally. This is why German companies, with their competitive disadvantage in labour costs, must be at the forefront of technological development. Subsidies, however, take away their incentive to innovate. German PV companies invested only 2–3 % of their sales in research and development. In the highly competitive automobile industry, the equivalent figure is 6 %; in the pharmaceutical industry it is even higher, at around 9 %. Subsidies make businesses sluggish.[9]

It is often argued that 'renewable energies' need start-up financing in the short-to-medium term, seeing them through to the stage at which they can survive market competition. Such learning curves can be seen in other industries, but this is no reason for subsidies: the triumphant advance of the IT industry was not triggered by government support for the mass production of vacuum tubes (which the first computers used instead of diodes and transistors). There were no subsidy programs to ensure that by 1960 all inhabitants of the western world would have huge computers in their cellars. Nor were taxes introduced on typewriters to encourage the switch to new technology. The rapid progress was driven by enormous investment in research and development - driven by the space race - which paved the way for transistors, integrated circuits, hard drives and other important innovations. This enabled private companies - such as IBM, Nixdorf and Apple - to produce devices that consumers actually wanted to buy.

Subsidies are leading development in the wrong direction. The consequence is the constant enlargement of the old familiar. Wind power plants, which are already about 250 meters high today - even larger turbines, 300 meters high, are being designed - bear eloquent witness to this undesirable development. The Expert Commission on Research and Innovation of the Bundestag stated in 2014 that the fixed feed-in tariffs would not provide an incentive to develop new technologies. The EEG has not improved the competitiveness of German energy suppliers[10]; it distorts research and production decisions in favour of inferior technologies. It is not the discovery of the best idea, but the funding decisions, determined by lobbyists and bureaucrats, that determines which technology is used and which (perhaps ingenious) plans remain in the drawer.

Central state planners can never predict what resourceful entrepreneurs and scientists will develop in the future. At the end of the 19th century it was believed that the European metropolises would soon sink under the weight of horse manure in the streets, a view that seemed logical because of the increasing number of horsedrawn carriages. But with the discovery of electricity and the introduction of the tram, things changed.

The rapid progress of technology makes the presumption of knowledge particularly dangerous. There is a risk that our economy will miss the technological boat.

Green jobs?

On large posters and in advertisements in autumn 2015, the Energiewende congratulated itself for the creation of '230,000 sustainable jobs'. This myth of a 'job creating' energy transition is regularly disseminated. Of course, the energy transition is shifting purchasing power from traditional consumer and capital goods industries to industries that produce wind turbines, solar panels and other equipment. This shift generates gross jobs in the those sectors: wind turbines, solar parks and biogas plants must be built. The components have to be produced, delivered and assembled; the finished systems have to be maintained. The investments require financing and credit agreements. This creates employment in banks and law firms. Subsidies must be regulated and monitored, which leads to even employment in the bureaucracy and, once again, lawyers' offices. So far, so trivial.

However, a gross employment effect does not mean that the Energiewende creates jobs overall. Jobs are being lost in the sectors from which purchasing power is removed. There has been a drop in the number of people employed in major electricity suppliers for years. Declines in employment are also to be ex-

Translation: the energy transition - a good piece of work. Hats off: The energy transition is creating 230,000 new jobs. renewable energies are a job engine for Germany

Fig. 30: advertisement of the BMWi 2015

pected in the sectors upstream of conventional power generation. These lost jobs must be compared with the new jobs created. It should also be noted that were the money not spent on 'renewable energies', investments could have been made in other areas that would also have created employment. If, for example, the 178 billion euros mentioned above had been used to renovate schools, the order books of countless businesses would have remained full for many years to come.

Regardless of its empirical validity, the thesis of the 'green job engine' is also theoretically questionable. From an purely economic point of view, there is no reason to rejoice over supposed 'employment growth'. On the contrary, if the same number of kilowatt hours for which one had to employ 100 people 'in the old energy world' requires the deployment of 300 people in the 'new energy world', then 'innovation' is nothing more than a massive slump in labour productivity. Promoting employment figures cannot be a meaningful goal of energy policy. If it is, then power should be generated with rowing machines, treadmills and exercise bikes.

Sensible investments or broken windows?

The Energiewende has undoubtedly triggered considerable spending. Analagous to its effects on employment, however, those investments that were not made because of the Energiewende must also be offset here, whether due to the loss of purchasing power or the perceived poor quality of the location. Energy-intensive industries have been reluctant to invest for years. Visible bankruptcies are hardly to be regretted so far, but expansion investments are more likely to be made in the USA or France in case of doubt. This leads to creeping de-industrialization.

The Energiewende has caused visible damage in the energy sector: around €100 billion of capital was destroyed at EON and RWE alone. In 2010, these two companies had a combined value of €130 billion on the stock exchange; today they are worth only around €30 billion. The savings of hundreds of thousands of small investors are affected and stocks in equity savings funds and life insurance policies have been shattered. These companies are highly innovative enterprises that created jobs and prosperity, and on which thousands of small and medium-sized enterprises depend. The malinvestment means that our economy is missing growth opportunities and innovation potential.

If one wants to focus not only on short-term economic effects, but also on long-term growth, one has to ask not only about the scope, but also about the type of investments made. Otherwise you run the risk of losing to 'Broken Window' fallacy. According to this, a large stone would have to be thrown through the nearest window as powerfully as possible as an immediate measure of economic policy. This would ultimately give the glazier a large order and thus income, of which he would spend a portion on the confectioner, for example, and thus generate income again. An income that he in turn would spend partly on the butcher, resulting in a virtuous circle that would ultimately benefit everyone and increase national wealth...

Whether this calculation will work out in the longer term, the reader may decide for himself.

Fig. 31: Not a good investment program

B. The business dimension - the Energiewende on the ground

All over the country, new, regionally focused players are engaging in energy generation. Laypersons in the energy industry, municipal energy suppliers, local authorities and cooperatives are using the opportunities engendered by the EEG and state laws to operate in a field that was previously characterized by high professionalism, high capital commitment and therefore high barriers to market entry.

Many fellow citizens see this as a 'democratisation of energy supply' and welcome the fact that allegedly abused market power is to be broken and an oligopoly replaced by a more broadly based market structure. The last federal government, for example, called a 'diversity of actors' the goal of its funding policy. The EEG contains passages aimed at providing special protection to 'citizen energy' initiatives.

This may be politically rational, but it does not make economic sense: there appear to be economies of scale in power generation, which therefore has an inherent tendency towards a natural monopoly. It is the task of regulators to ensure that producers do not abuse their market power. By trying to impose not only a certain market structure but also certain groups of actors against economic forces, the EEG policy undermines competition.

A priori it is not clear why a 'democratic deficit' in energy supply should be a concern. It would be equally justified to demand that the oligopolistic motor industry be broken up and placed in the hands of citizen motor manufacturers. It is clear that vehicles built by such citizens would be expensive and particularly in need of testing from a safety perspective. It is equally clear that the energy supply is made more expensive than necessary by having it delivered by a 'diversity of actors'.

By courting the alleged 'pioneers of the energy transition' and forcing wide participation in the energy supply market - i.e. ultimately not leaving production to those who can do it in the cheapest and best way, but to a politically determined collective - politicians hope for 'acceptance'. It is doubtful whether the results will confirm the political calculation.

Wind power – a licence to print money?

Anyone who produces electricity with the technologies mentioned in the EEG, wherever and whenever, will be remunerated at a guaranteed rate far above the market price for a period of 20 years. EEG beneficiaries do not need to worry about the needs of customers, the offerings of competitors, technical progress or other such 'banalities'.

The search for profitable locations is made easier for wind power producers insofar as the fixed prices per kWh are in essence higher at 'bad' locations than at 'good' ones. This principle – of incentivising the use of bad locations – can intuitively be recognized as foolish, but was nevertheless adopted in the tendering procedures of the 2017 revision of the EEG. This aburdity was justified with a claim the fact that an expansion of the area covered in windfarms would lead to a reduction in the volatility of the electricity supplied - a fundamentally wrong idea (see Section 2). In this respect, a statement by a municipal utility describes the incentive system correctly:

Fig. 32: production of 'renuable' cash

Wind turbines are a licence to print money, provided that the EEG remains in force.
Markus Lecke, Eschwege municipal utility

Source: Werra-Rundschau 2 March 2013

The EEG creates a comfortable environment for people who are willing to invest. Nevertheless: even in this comfortable environment and on a purely economic level, wind power very often does not keep its promises. This was pointed out by the DPA in November 2014 with a report taken up by FOCUS, among others, under the title *'Land of milk and honey has burned down: Wind power bleeds investors'*.

But even billions of subsidies do not help when the wind blows weakly, when companies plan badly and windy providers make money in the politically fanned green boom - at the expense of investors. Almost all affected funds, cooperatives and municipal utilities complain that the wind forecasts of experts have been far too optimistic in the past.

Source: FOCUS, 2014

This observation is in line with that of the tax consultant Daldorf, who analysed over 1600 annual financial statements of wind energy projects between 2005 and 2013.[11] They found that the vast majority of wind farms in Germany operate at a loss. With many local wind farms, investors are lucky to get their original investment back at all. Daldorf gives the following reasons for the poor performance of windfarms:

- poor wind assessments or no one-year wind measurements on site
- erroneous wind indexes as a basis for planning
- overly low margins of error in wind forecasts
- underestimates of plant downtime for maintenance and repairs
- 'planning optimism' of the project promoters as a strategy for maximizing profits

The latter is explained by the asymmetric distribution of risks and chances between the actors involved: planners, builders and landlords always get their money's worth. The operators and investors bear the full risk. Before they can make a profit, the following costs must be covered from the sales achieved:

- lease costs
- insurance premiums, fees
- maintenance costs
- repairs, reserves for dismantling costs
- management costs
- administrative and other costs
- interest-costs
- taxes

Wind farms therefore have a cost framework that is fixed even before the ground-breaking ceremony. The profit is almost solely determined by the annual electricity yield. No matter how clever the marketing may be, it cannot influence profitability, which depends on the whims of the weather. From the perspective of the operator, the investor and the lender, the expected electricity yield must be determined in advance by a procedure that is so well-understood and reliable that a profit and loss statement for the entire lifespan of the project can be generated before construction begins; after all, all costs are a priori fixed.

The expected power generation is mainly determined by the average wind speed, with a reduction of 1 % resulting in a 2 % reduction in electricity yields. The tighter the planned wind yields are calculated, the more critical the business profit and loss statement becomes already in the planning phase.

The cubic relationship between wind force and power generation is decisive for the frequent red numbers: a doubling or halving of the wind speed changes the generation by a factor of eight. The smallest deviations from the expected wind input are reflected in sharp deviations in power generation and thus in revenues. Measurements on wind masts are the most accurate method, but even here the typical error range is 2–8 %. The uncertainty of measurement alone causes an uncertainty of the expected yield of up to 16 %. Measurements with optical methods (LIDAR) or even wind assessments are even less accurate. Anyone who evaluates such measurements will find that the operation of wind farms entails considerable economic risks. These risks apply in particular to wind assessments, whose error rate is in the order of 20 %.

Investment in wind turbines on the basis of wind assessments is close to gambling. Anyone who does so is responsible for their own downfall. However, anyone who lives in a community whose elected representatives fall for the promises of windfarm promoters is virtually forced to the roulette table.

Clean electric power from trusted neighbours?

Municipalities have different economic incentives to private companies. Municipal decision-makers - most of whom are not personally liable for any resulting losses or waste - tend to incorporate considerations other than pure profit in their calculations. Status and prestige are often important factors. Moreover, conflicts of interest are the order of the day: municipalities are frequently not only investors in a project but also its landlord.

Fig. 33: Rien ne va plus - nothing works (anymore) without wind

An environment that promises high and secure lease income at zero risk when someone is found to make a politically motivated, high-risk investment creates a breeding ground for corruption and conflicts of interest.

'In November 2014, the FOCUS reported that *'many charlatans are on the move on the green ticket'*; This charlatanism is supported by the government of the federal state of Hessen, among others: by changing the local constitution, it has encouraged its communities to become involved in the field of 'renewable power generation'. In other particularly perfidious cases, highly indebted municipalities, which are under the financial protection of the state, are explicitly encouraged to take out further debts in order to set up wind power plants in state-owned forests together with citizens' energy cooperatives:

- plants that produce 'scrap electricity' that no one can use sensibly.
- facilities for the construction of which high-quality natural areas are partly destroyed.
- plants for which the 'Hessen-Forst' state company purchases leases.
- plants that are unprofitable right from the start.

The citizens of these communities, whose money is misused for such projects, can call themselves victims of organised white-collar crime.

The German Taxpayers' Association has not missed the pitfalls of supposedly clean 'local power generation'. A quote from the association newspaper describes a disaster that can also be observed elsewhere:

The Taxpayers' Association has included a project in the community of Waldfischbach-Burgalben (Southwest Palatinate) in the Black Book of Public Funds Wastage. The community caused a financial disaster by building and operating renewable energy plants...The municipality built four photovoltaic plants, a woodchip heating plant, a biogas plant and a straw heating plant. According to the Taxpayers' Association, almost 7.5 million euros were invested in this project...the total loss from 2008 to 2014 is 2.6 million euros. 'Waldfischbach-Burgalben not only burns straw and wood chips, but also a *lot of tax money,' sums up the position of the Taxpayers' Association. The municipality justified the losses with unexpectedly long approval and construction periods, increased construction costs, disruptions to operations and with the fact that there were fewer customers for the energy generated than expected. The Taxpayers' Association sums up: 'The community has probably miscalculated thoroughly'.* **It would have been better, it says in the black book, to have left these projects alone: 'That's why there are real professionals in the market'.**

Press Release of 'Bund der Steuerzahler 2016'

Citizen wind farms as acceptance procurers?

As many enthusiastic citizens and municipal utilities have found, the profitability of 'wind farms' is poor. It is obvious that the political calculation of creating acceptance in this way also only works to a limited extent. Such a calculation was recently implemented in Mecklenburg-Vorpommern: all investors in onshore wind turbines had to offer 20 % of their shares within a five-kilometre radius. In May 2017, NDR reported on the results:

One year after the new law on participation in wind farms came into force, municipalities and citizens have not yet made a single use of the regulation. If citizens and municipalities feel a positive effect of the development of new wind farms on their wallets, then the acceptance of the new, large wind turbines would increase, according to the state government. But so far this possibility has left communities and citizens completely cold. They have refrained from acquiring shares in new projects.

NDR 2017

The low response to this 'attractive offer' reveals good business sense. It can also be read as an indication of good economic intuition and an intact moral compass: ultimately, the law amounts to an attempt to motivate people to take part in a subsidy race that is harmful to the common good:

The all-dominating, rapid expansion of renewable power generation capacities is crucial to the problems of implementing the energy transition. (...) Here the motto 'the more and the faster the better' is pursued **at the expense of the common good.**

German Council of Economic Experts, 2012.

Anyone who participates in wind energy projects enriches themselves on the levies charged on the general public and sometimes also directly harms their fellow citizens in the surrounding area: in addition to the loss of quality of life, the devaluation of private homes, which often amounts to an attack on old-age provision, and the undermining of business models based on tourism/landscape enjoyment are worthy of mention. It is obvious that economically meaningless projects will not produce good results. An increase in acceptance is not to be expected; at best there will be complicity with the misguided objectives. In this way, peaceful village communities are divided into profiteers and victims.

The current energy policy destroys national wealth, hampers technological development and weakens Germany as a business location.

At the local level, it promotes gold rush and casino mentality.

Side effects and risks of 'energy transition technologies'

Our rural areas have changed considerably in recent years: there is hardly an area that is not already dominated by wind turbines or affected by plans for them. The massive land requirements of this type of power generation are increasingly transforming landscapes and habitats into inhospitable industrial sites.

The disastrous effects on fauna, flora and quality of life for those living in these areas aroused a steadily growing social resistance, which is now manifested in over 1000 citizens initiatives.

Fig. 34: A village in the Vogeldberg district. Photo: Hermann Dirr

Those who oppose these construction projects inevitably come into conflict with those who expect to gain lease income or other financial advantages. Thus, the Energiewende systematically brings discord to villages and towns. Good neighbours become adversaries, often even bitter enemies. Sometimes wind power even divides families and social clubs. Social togetherness - meaningful for many and a motive for choosing a place to live - is systematically undermined by the incentive system of the EEG. [13]

The burdens on residents due to the massive impairment of their home landscape are manifold. Their technical over-embossing leads to the loss of natural landscape proportions and of size and width, to horizon "pollution" and deformation of exposed terrain structures. Landscape-related tourism is also being damaged by the expansion of wind energy: although lobby groups regularly deny that wind turbines significantly reduce the attractiveness of landscapes to tourists, this has been clearly demonstrated by recent research and real experience. Villages in the Hunsrück region serve as an example: where the number of overnight stays has fallen sharply in parallel with the construction of wind turbines, while the number of guests has increased in neighbouring, less built-up areas along the Rhine and Moselle. [14]

Fig. 35: A village in southern Niederdsachen, 2015

In areas afflicted by wind farms, the nights are disturbed by permanent or temporary flashing lights and moving shadows. And all the time, they have to suffer the impact of noise pollution; not only audible noise, but also inaudible infrasound, which is an important effects of Energiewende, robbing people in the vicinity of their quality of life and potentially causing illness as well.

Infrasound – the boomerang of the energy transition

Residents living near wind turbines often describe the emission of infrasound in the form of a characteristic pulsing vibration. *'I feel what you can't hear."* Depending on the duration of exposure and an individual's constitution, these can cause far-reaching damage. Their quality of life is destroyed through brain-physiological processes: 'from within'.

What noise do wind turbines emit?

Wind turbines generate sound when air passes through the rotor blades (in current systems the rotor blade tips reach speeds of up to 400 km/h) and also through the noise of the moving parts of the turbine. This noise can trigger stress effects, such as an increase in the hormone noradrenaline during prolonged exposure, and this can in turn lead to high blood pressure and an increased risk of heart attack or stroke. Chronic exposure to noise always carries the risk of permanent hearing damage. Noise regulations set limits of 35 dBA (at night) and 50 dBA (during the day) for residential areas, and are intended to protect against these effects. The audible noise of wind turbines can be technically reduced, for example by optimal adjustment of the turbine and the rotor blades, or by structural measures.

More problematic is the inaudible component of the sound emission of wind turbines: when one of the rotor blades passes the mast (about 1-2 times per second), compression of the air creates a pressure wave. The operation of a wind turbine therefore generates periodic pulses with a fundamental frequency between 0.5 and 1 Hz. In addition, there are harmonics whose maxima occur in the range up to about 6 Hz. This results in wavelengths of approx. 50 m to 300 m. These emissions belong to the infrasound frequency range below 16 Hz. It is not therefore not consciously perceived by people and is therefore not considered a danger. However, infrasound reaches the brain in various ways and affects the subconscious. Only with extreme sound pressure levels of over 100 dB is infrasound directly perceptible, as vibration on the skin. Greater intensities will soon reach the level of the human pain threshold. Due to the long wavelength, buildings cannot be insulated against infrasound with sound insulation measures; infrasound passes through walls.

The range of infrasound from wind turbines

Infrasound has a much greater range in the air than audible sound. The Federal Institute for Geosciences and Natural Resources, for example, has recorded infrasound emissions from 1.5 MW and 5 MW plants more than 10 km away.[15] Infrasound is transported not only through the air but also through the ground over long distances. In buildings far from the sound source, infrasonic waves can occur as 'structure-borne noise', amplifying the airborne infrasound. Underground infrasonic signals are used in seismic measurements for earthquake warning and nuclear explosion detection systems. These are supposed to be built at least 10 km from any wind turbines to ensure that there will be no interference with the instrumentation.

Infrasound as a health risk

Infrasound is a normal part of our environment and is often emitted together with low-frequency audible sound. Natural sources include the sea and or the wind in grass or a forest. Such emissions are harmless because they occur as low-frequency noise. Technical civilisation has also created numerous artificial infrasonic generators, for example road traffic, aircraft engines, industrial machines and many household items. However, such emissions can pose a health risk if exposure to them is prolonged.

Infrasound from wind turbines differs from other sources in that it is emitted in the form of rhythmic pulses in the frequency range of approximately 0.5–6 Hz. Pulsed infrasound causes health problems in sensitive people far below the hearing or perception threshold. About 10–30 % of the population is sensitive to infrasound. These people develop a non-specific symptom picture that doctors are only gradually learning to identify.

The primary effect, which can already begin after a few days, consists of sleep and concentration disorders, reduced respiratory frequency, anxiety and dizziness, tinnitus and visual disturbances and is accompanied by changes in brain waves. When exposed for weeks or months, a permanent alarm situation develops in the brain; this can be detected as an increase in the stress hormone cortisol. It leads to psychological instability and measurable physical reactions (blood pressure increase, risk of heart attack, and so on).

Physiologically, the hair cells of the corti organ of the cochlea are damaged and certain areas of the brain are permanently irritated. Effects on the heart and blood vessels, including pathological changes of the connective tissue in the arteries of the pericardium, have been demonstrated in sound exposed individuals for many years and in animal experiments. [16]

No-nocebo – naive denial cannot be an answer

The wind energy industry and its pet scientists regularly claim that the discomfort felt by an individual exposed to wind farm noise depends on their attitude towards the turbines. These are 'imaginary diseases', they suggest, which do not have a valid medical cause (the so-called nocebo effect). This claim is, however, interest-led and wrong, because the symptoms affect all sensitive people equally (even wind power enthusiasts are not immune to it). Numerous international studies have been carried out in this regard in recent years. For example, the acoustician Steven Cooper, together with a wind farm operator in Australia, investigated the effects of infrasound on an affected population. The residents complaining about health problems but were not within sight of the wind farm. Cooper had them record the precise times they felt the symptoms, and checked the correlation with the activity of the wind turbines: the symptoms were most severe when the turbines were running very strongly.

How does infrasound affect the brain?

The path of audible sound into our brain is well known. In the inner ear it reaches the cochlea, where it stimulates the inner ear hair cells. This information is transmitted via the auditory nerves to the hearing centre in the cortex of the brain and is thus perceived by our consciousness. Infrasound, on the other hand, causes vibrations of larger areas of the brain, the inner ear (outer hair cells, cochlea) and the organ of balance, but does not excite the centres relevant for conscious perception. For this frequency range, therefore, there is neither a perception threshold oriented to hearing nor a habituation (desensitization).

In April 2017, scientists from the Charité Berlin, the Klinikum Hamburg-Eppendorf and the Physikalisch-Technische Bundesanstalt published new findings on the perception of infrasound in the brain. [17]

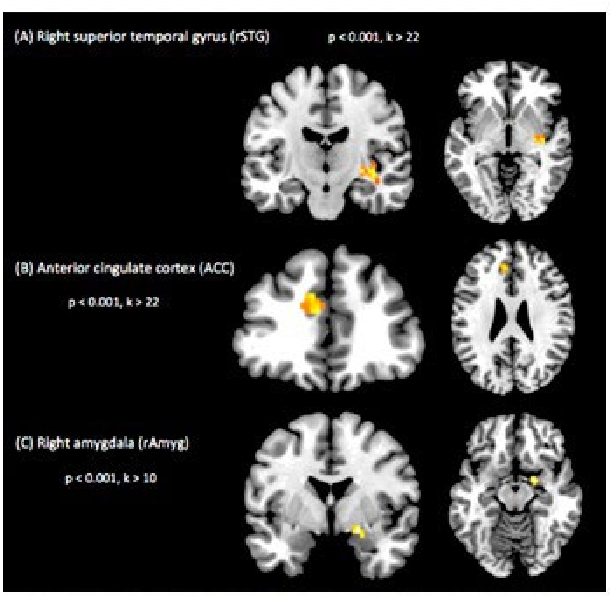


Fig. 36: Detection of infrasound-activated brain areas. Simplyfied representation according to Weichenberger et al. 2017

They used an imaging technique, functional magnetic resonance imaging, and visualized three areas in the brains of 14 subjects that were activated by infrasound (12 Hz, 200 sec.): These areas - shown in Fig. 36, yellow/orange - are located in the upper right temporal lobe (A), next to the hearing center (B) in the anterior cingulum (ACC), and C) in the amygdala. These areas were activated by infrasonic signals inaudible to the subjects. The upper area in Fig. 36 is close to the hearing centre, which suggests similarities to hearing sound processing. The other two areas are relevant for emotional reactions, such as mechanisms of conflict management and fear and flight reflexes, and autonomous control, such as blood pressure and heart rate. The activation of the three areas disappears when the sound signal exceeds the hearing threshold, i.e. the test person becomes aware of it. Apparently, infrasound works beyond the threshold of hearing and through a mechanism independent of consciousness. The functions of the brain regions activated by infrasound are in harmony with the medically verifiable stress situation of infrasound victims and explain, among other things, the known findings. This confirmed findings from the treatment of infrasound patients and experiments with experimental animals. [18]

'Protection regulations' grasp at nothing, authorities fail

All previously valid German protection standards such as the Technical Instructions on Noise and DIN 45680 assume that only noise that is perceived by the sense of hearing can cause damage. Other forms of sound perception are not considered. The measurement regulations are also not helpful, since only sound above 8 Hz is measured, although modern measuring instruments can also detect frequencies of < 1 Hz and the infrasonic range of 1–8 Hz causes particularly severe health problems. The application of these regulations therefore protects against the risks of infrasound just as well as the application of sunscreen against X-rays; that is, not at all.

Fig. 37: No effective protection against x.rays

The only thing that protects people is distance

The easing of health problems with increasing distance of wind turbines is well documented.[19] The regulation in Bavaria – distance = 10 x the height – where it is actually observed, represents a first attempt to do what is necessary in terms of health prevention.

The health risks of infrasound are played down by most federal state governments as well as the wind power industry. For example, TA Lärm continues to be applied even though its inadequacy is known and a large number of amendments to the law have been submitted. An example of official failure is the publication of the State Agency for the Environment, Measurements and Nature Conservation of Baden-Württemberg (LUBW) of February 2016.[20] It concludes – like similar so-called 'fact papers'–- that at a distance of 300 m, the infrasound from a wind turbine is significantly below the perception threshold and therefore no health effects are to be expected. Apart from the fact that the 'perception threshold' is not a relevant criterion – an impact threshold would have to be determined instead – these statements have already been scientifically refuted:

At a distance equal to ten times the height of a wind turbine, considerable infrasonic pressures still occur and it is possible to show that some brain areas are activated by infrasound below the hearing threshold (Figure 36). Moreover, the LUBW study is clearly using inadequate measurements; for example:

- the pulsed infrasound of the wind turbine is not clearly separated from the infrasound of the environment
- in most measurements, the critical range below 8 Hz is completely filtered out
- no measurement is carried out in buildings (infrasound is often even more effective there than outdoors)
- the propagation of infrasound over the subsurface was not properly measured.

Despite these errors, the LUBW study serves courts, politicians and the wind industry nationwide as the official 'facts'. With the exception of Bavaria, authorities and politicians have so far insisted on completely inadequate minimum distances (700–1000 m; sometimes even less). <u>And as justification, it is stated that with the medically justified minimum distance of ten times the plant height the ambitious expansion targets are not achievable!</u> This is cynical in view of the recently confirmed health risk that has been suspected for years. All experts believe that further research on the effects of infrasound is needed. The Federal Environment Agency noted this as long ago as 2014, and again in March 2017.[21] The German Medical Association also pointed out the research deficit in 2015.[22] In the same year, the Federal Physical-Technical Institute came to the conclusion that knowledge about the human hearing spectrum and thus about the medical effects of WTGs had to be improved.

'Basically, we're just at the beginning. Further research is urgently needed,' the project leader was quoted.[23]

Knowledge of the health risks among politicians and responsible authorities is growing much more slowly than installed wind power capacities. From a medical point of view, infrasound threatens to become the boomerang of the energy transition. A small leap of thought leads from this throwing device to further ill-considered health risks of Energiewende technologies.

Ice throwing

In certain weather conditions, the rotors of wind turbines can throw ice blocks weighing several kilograms, sometimes hundreds of meters away. Attempts have been made to prevent this happening. However, the sheer number of sources of danger - the current plans imply tens of thousands of wind turbines - suggests that serious harm cannot be permanently avoided. Catastrophic material failure is not alien to wind turbines either, as the various reports of broken masts and blades in early 2017 documented.[24] It cannot be expected that on all of the tens of thousands of three-rotor wind turbines all of the blade heating wires will always work and prevent ice formation.

Fig. 38: Burning wind power plants

Carbon-fibre reinforced plastics

Legislators would be expected to regulate risks that have been recognised in other industries where these also apply to wind turbines: asbestos has been banned since its carcinogenic potential became known. The carbon fiber-reinforced plastics (CFRP) used in wind turbine blades carry a potential risk comparable to that of asbestos: if wind turbines catch fire, they are virtually impossible to extinguish; you have to let them 'burn down in a controlled manner'. Fly ash consists of tiny particles that can penetrate the lungs and cause cancer.

With current energy policy, there will be large concentrations of wind turbines almost everywhere in the vicinity of human settlements, always tall and built at exposed locations. It is obvious that lightning strikes and therefore fires will become more frequent. But there are no plans to deal with the consequences.

All these topics reveal a pattern: risks are already ignored or downplayed if addressing them might threaten political plans.

Fig. 39: Offical practice in dealing with the health risks of the 'energy transition'

Elements of a sensible energy policy

The aim of the Energiewende was to redirect Germany's energy supply to 'renewable' sources. Wind power and photovoltaics were described as 'pillars of the energy transition', and were intensively promoted and protected.

However, anyone who measures the results of this policy against the energy industry objectives of affordability, security of supply and environmental compatibility will see significant deterioration in all three aress.

As explained in the preceding chapters, this is not surprising and also not temporary, because these miscalculations are based on a non-observance of physical laws and technical principles. So long as the policy is maintained, the undesirable developments will continue to intensify and the desired blessings of the 'energy turnaround' will fail to materialize.

- The idea of meeting our country's energy needs with wind power and solar energy has proven to be an illusion. At present, around 29,000 wind turbines and 1.6 million photovoltaic systems together account for just 3.1 % of our energy requirements. Although their share of electricity is higher, their direct and systemic costs are gigantic.
- The cardinal problems - weather-dependence and low energy density - are unsolved or unsolvable. The idea often put forward by the government that expanding the areas covered in renewable systems will reduce natural volatility contradicts mathematical laws and has also been clearly refuted empirically.
- To compensate for the lack of reliability of wind and sun and to be able to actually replace conventional power generation, gigantic amounts of electricity storage would be required. The replacement of controllable power generation with a fluctuating power supply is impossible without storage and unaffordable with it.
- As a result of the rapid expansion of 'renewable energies', electricity prices have risen steadily and further cost increases are inevitable. Germany as a desirable location for business is suffering. The social imbalance is getting worse and worse. There is a locational disadvantage for the manufacturing industry. At the same time, the redistribution from 'bottom' to 'top' is continuously increasing
- The present energy policy does not serve the alleged climate protection. CO_2 emissions are rising instead of falling. The 'dirty secret' of producing 'green electricity' is not a transitional phenomenon, but a systemic one. Through emissions trading, a (global) tax and open-technology research funding, the target of CO_2 reduction could be achieved much more cost-effectively. Instead of' climate protection', the incentive system of the EEG induces environmental crime, sows discord and causes unprecedented landscape damage and destruction of nature.

Independent scientific panels have long been calling for a change of course. Unfortunately, legislators do not appear to have been listening.
A sensible executive is required to recognize the primacy of physics and to reorient energy policy towards the well-being of man, nature and Germany as a business location.
The German Council of Economic Experts has repeatedly stated what is required from an economic point of view:[24]

Before a corresponding market design is found and established, a moratorium on the promotion of renewable energies makes sense, as the expansion of capacities has already exhausted the system's ability to integrate.
German Council of Economic Experts, 2013

Those who want to successfully implement the energy transition must overcome the political resistance of the biggest profiteers of the current subsidy system for the benefit of consumers.
German Council of Economic Experts 2014

Die National support for renewable energy should completely cease in the future or at least be technology-neutral if the political power in this policy area dominated by interest groups is insufficient.
German Council of Economic Experts, 2015.

The recommendations of the 'economic wise men' should be implemented immediately:
the integration capability of the system was exhausted in 2013, and it was overstretched by the end of 2017. **A moratorium is imperative.** The last EEG 'reforms' brought only the appearance of progress. Under pressure from those benefiting from the subsidy system, the fundamental design errors were retained and also transferred to the tendering procedures. **The EEG should not be reformed, but abolished and not replaced.** Renewable energy companies must hold their own against the competition and be subject to the same regulations that apply to other economic actors. In particular, their **legal privileges in planning and conservation law must be abolished**.

These measures serve to leave the wrong track and enable the search for orientation. After a pause for reflection, a new attempt is needed. All scientific findings must be taken into consideration and the physical and economic framework must be better taken into account than previously. If we want to abandon the use of coal, oil and gas by the end of the century, we must develop alternatives today. So far, they do not exist, because the sun and wind are too unreliable to supply modern economies with energy. The techniques for efficiently storing solar and wind energy or converting it into chemical energy have largely not even been researched.

What we therefore need is **a large-scale and generous energy research programme** that covers all aspects of energy efficiency, storage, transport and generation in a **technology-neutral** manner. It was a mistake to cut government research budgets in the 1990s. Many tal-

ented researchers have left Germany or changed professions. Reconstructing energy science research is a task that must begin with universities. The best scientists and engineers must once again be inspired by the energy sector. It will also be necessary to use the knowledge of older researchers. It is imperative that we take these steps. However, it requires a lot of determination.
Whoever strives for reasonable changes will find support and encouragement in our network of more than 800 citizens' initiatives throughout Germany. The road to a sensible energy policy is a long one. May this compendium accompany him. In addition, the contact persons listed below are happy to provide more detailed background information on their topics. Decision-makers, journalists and disseminators are invited to provide themselves with argumentative provisions. With this in mind, we wish everyone and us a good journey.

I would like to thank all those who have contributed to this compendium.

Dr. Nikolai Ziegler
Chairman Bundesinitiative Vernunftkraft e.V.
November 2017

The people listed below are happy to provide more detailed background information in their fields of expertise. Decision-makers and journalists are invited understand their arguments.

On the technical aspects

Dr.-Ing. Detlef Ahlborn	Detlef.Ahlborn@Vernunftkraft.de
Rolf Schuster	Rolf.Schuster@Vernunftkraft.de
Prof. Dr.-Ing. Hans Jacobi	Hans.Jacobi@Vernunftkraft.de
Prof. Dr.-Ing. Helmut Alt	Helmut.Alt@Vernunftkraft.de
Prof. Dr.-Ing. Lothar Meyer	Lothar.Meyer@Vernunftkraft.de
Prof. Dr.-Ing. Konrad Kleinknecht	Konrad.Kleinknecht@Vernunftkraft.de
Prof. Dr. Jürgen Michele	Juergen.Michele@Vernunftkraft.de
Dr. Björn Peters	bp@mail-peterscoll.de

On the ecological aspects

Prof. Dr. Martin Kraft	Martin.Kraft@Vernunftkraft.de
Dr. Friedrich Buer	Friedrich.Buer@Vernunftkraft.de
Dr. Gisela Decker	Gisela.Decker@Vernunftkraft.de
Harry Neumann	H.Neumann@Naturschutz-Initiative.de
Johannes Bradtka	Johannes.Bradtka@Landschaft-Artenschutz.de

On the economic aspects

Prof. Dr. Stefan Tangermann	Stefan.Tangermann@Vernunftkraft.de
Prof. Dr. Günter Specht	Guenter.Specht@Vernunftkraft.de
Prof. Dr. Gonde Dittmer	Gonde.Dittmer@Vernunftkraft.de
Prof. Dr. Tim Lohse	Tim.Lohse@Vernunftkraft.de
Dr. Hans Hönl	Hans.Hoenl@Vernunftkraft.de
Dr. Nikolai Ziegler	Nikolai.Ziegler@Vernunftkraft.de

On the social and health aspects

Prof. Dr. Werner Roos	Werner.Roos@Vernunftkraft.de
Dr. med Thomas-Carl Stiller	Thomas.Stiller@Aefis.de
Dr. med. Regina Pankrath	Regina.Pankrath@Vernunftkraft.de
Dr. med. Eckhard Kuck	Eckhard.Kuck@Innovib.de
Gerhard Artinger	Gerhard.Artinger@Vernunftkraft.de

LITERATURE

1) Thomas Petermann et al. (2011): Ein großräumiger und langandauernder Stromausfall: einenationale Katastrophe. Büro für Technikfolgenabschätzung beim deutschen Bundestag.

2) Detlef Ahlborn (2015): 'Glättung der Einspeisung durch Ausbau der Windkraft?', energiewirt-schaftliche Tagesfragen, Dezember 2015.

3) Hans-Werner Sinn (2012): Das grüne Paradox – Plädoyer für eine illusionsfreie Klimapolitik.

4) Wolfgang Epple (2017): Windkraftindustrie und Naturschutz sind nicht vereinbar. Denkschriftfür die NATURSCHUTZINITIA TIVE (NI). Das umfassende und aktuelle Standardwerk zu denökologischen Aspekten der Windenergie.

5) Wilhelm Breuer (2015): 'Lizenz zum Töten', in: Nationalpark (4/2015).

6) Oliver Krüger (2016) 'Wir haben eine potenziell bestandsgefährdende Entwicklung', in: DerFalke (3/16)

7) Martin Flade (2012) 'Von der Energiewende zum Biodiversitätsdesaster', in: Vogelwelt (133).

8) Handelsblatt (2013): 'Solarbranche vor der Sonnenfinsternis. Studie zum Niedergang.'

9) Quelle: Stifterverband für die deutsche Wissenschaft.

10) Bundestags-Expertenkommission Forschung und Innovation (2014): Jahresgutachten 2014.

11) Werner Daldorf (2013): Praxiserfahrungen mit der Wirtschaftlichkeit von Bürgerwindparks inDeutschland. Präsentation für den Bundesverband Windenergie.

12) Georg Etscheit (Hrsg.) (2016): Geopferte Landschaften. Wie die Energiewende unsere Umweltzerstört. Ein Debattenbuch. Heyne-Verlag.

13) Handelsblatt vom 11.11.2017: Windkraft entzweit Waldbesitzer. Der hier zitierte Brief kann auchals moralischer Kompass (vgl. S. 30) gelesen werden.

14) Tim Broekel, Christof Alfken (2015): Gone with the wind? The impact of wind turbines on tourismdemand. Energy Policy, Volume 86, November 2015. Auch: Statistisches Landesamt Rheinland-Pfalz, Daten von 2012–2015.

15) Lars Ceranna, Gernot Hartmann, Manfred Henger (2004) 'Der unhörbare Lärm von Windkraftan-lagen - Infraschallmes sungen an einem Windrad nördlich von Hannover, Bundesanstalt für Geo-wissenschaften und Rohstoffe (BGR).

16) Mariana Alves-Pereira, Nuno A.A.Castelo Branco (2007): Vibroacoustic disease: Biological effectsof infrasound and low-fre quency noise explained by mechanotransduction cellular signalling. Pro-gress in Biophysics and Molecular Biology, Vol. 93 (1-3).

17) Steven Cooper (2014); 'The results of an acoustic testing program Cape Bridgewater Wind Farm"The Acoustic Group.

18) Markus Weichenberger et al. (2017): Altered cortical and subcortical connectivity due toinfrasound administered near the hearing threshold Evidence from fMRI.

19) Alec N. Salt, Jeoffrey T. Lichtenhan(2012, 2014): 'Perception-based protection from low- fre-quency sound may not be enough"; InterNoise 2012. 'How does wind turbine noise affect pe-ople?" , Acoustics Today.

20) Claire Paller (2014): Exploring the Association between Proximity to Industrial Wind Turbines andSelf-Reported Health Out-comes in Ontario, Canada. University of Waterloo, Canada.

21) Landesanstalt für Umwelt, Messungen und Naturschutz Baden-Württemberg (2016):Tieffre-quente Geräusche inkl. Infra schall von Windkraftanlagen und anderen Quellen.

22) Umweltbundesamt (2014): Machbarkeitsstudie zu Wirkungen von Infraschall und (2017): Tief-frequente Geräusche im Wohnumfeld - ein Leitfaden für die Praxis.

23) Bundesärztekammer (2015): Beschlussprotokoll des 118. Deutschen Ärztetages in Frankfurt amMain vom 12. bis 15.05.2015

24) Physikalisch-Technische Bundesanstalt (2015): Presseerklärung vom 10. Juli 2015.

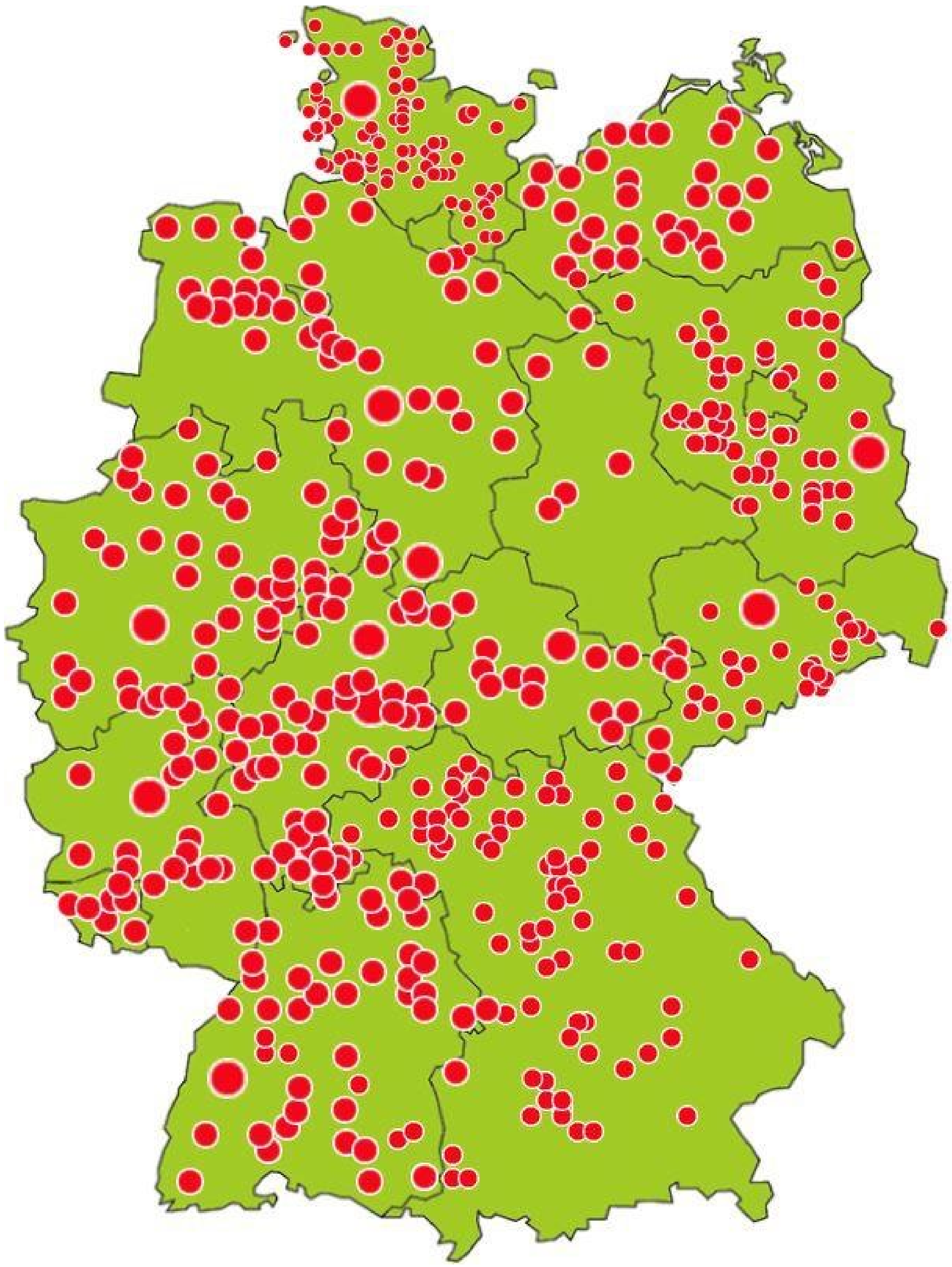
25) Eine Zusammenstelllung findet sich unter http://www.vernunftkraft.de/28-in-24-fuer-0/

26) Mehr zu diesem Thema unter http://www.vernunftkraft.de/cfk

27) Sachverständigenrat zur Begutachtung der gesamtwirtschafltichen Entwicklung, Jahres-gutachten 2014/15, 2013/14 und 2012/13.

NOTES

VERNUNFTKRAFT.



Nationwide for man and nature.

English translation of the German original version

IMPRESSUM
Bundesinitiative Vernunftkraft e.V.
Kopernikusstraße 9
10245 Berlin
www.vernunftkraft.de