



**The mobility turnaround**  
Interview with Christian Hochfeld

**Actively  
managing  
change**

# Exnovation

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# Better a fresh horse ...

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Handlooms, leaded fuel, cassette recorders, incandescent lightbulbs – a glance back at the last 100 years of industrial history shows that out-of-date technologies have been replaced by new ones time and time again. Today, we call this “exnovation”, but it is not a new phenomenon: industrial societies have always evolved in this way, constantly reinventing themselves and their technological bases. From an environmental and sustainability perspective, a key issue for us here at the Oeko-Institut is to play an active role in shaping exnovation processes, both present and future. When the time comes to change existing technologies, it is vital to choose the right – the environmental – pathway early on, to replace climate-damaging with sustainable technologies, and to develop economically viable concepts that have good prospects of becoming established. My personal view is that by clinging to outmoded technologies, it is very easy to fall behind. Take Nokia: at one time, it was one of the world’s leading mobile phone manufacturers, but it failed to capitalise on the smartphone trend. To use a figure of speech, it is better to switch to a fresh horse than ride the old one to death. This issue of eco@work shows how we can embrace exnovation – and explains why phasing out climate-damaging electricity production from coal is a good example.

I hope you enjoy this issue of eco@work and send you best wishes from the Oeko-Institut.

Yours,

Michael Sailer

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# “We need an oil and gas consensus”

**Transport and climate protection? These are not terms that you would necessarily mention in the same breath – for even though the transport sector will have to be almost completely decarbonised by mid-century if Germany is to achieve its climate targets, transport emissions are currently still hovering around 1990 levels. What can be done to reverse this trend? We talked to Christian Hochfeld, Director of Agora Verkehrswende and a former member of the Oeko-Institut’s Executive Board. In this interview with *eco@work*, he explains which opportunities he sees for a phase-out of fossil fuels in the transport sector and describes some of the changes that lie ahead for the economy, politics and society.**

**Mr Hochfeld, how can the transport sector finally contribute to protecting the climate?**

We need a mobility turnaround and an energy turnaround for the transport sector. A mobility turnaround means making use of digitalisation to avoid unnecessary use of transport, promote a shift to green modes of transport where travel is unavoidable, and boost efficiency throughout the system without restricting mobility. Multimodal transport behaviour, especially in cities, is essential as well. In addition, an energy turnaround is required in order to avoid residual emissions. At present, we rely on fossil fuels and the relatively inefficient combustion engine to power 95 per cent of our road transport. What we need for the future is an oil and gas consensus on phasing out fossil fuels, along with a switch to electromobility based on renewables.

**Multimodal mobility behaviour – what exactly does that mean?**

It means linking public transport with active mobility. It includes new mobility services such as car- and bicycle-sharing and above all ridepooling. It’s all about sharing transport. This can radically reduce the number of private cars in cities.

**What can be done to steer this process?**

At present, we live in car-friendly cities which encourage ownership of private vehicles, so it is important to provide attractive alternatives which enable people to leave the car at home without any inconvenience to themselves. The use of public space must also be priced realistically. Car parking is a good example: where I live, on-street residents’ parking costs 20 euros a year, but a few blocks along, there is an underground garage where a parking space is sold for 40,000 euros. If the prices were harmonised, many car owners would surely consider getting rid of the car.

**And what about rural areas?**

People living in rural areas will undoubtedly still be reliant on private cars for the next 20 years, although there is now scope to create more flexible options through the use of digital technologies, for example. But generally, we are focusing more on climate-neutral mobility based on electric vehicles here.

**What do you expect from the car industry?**

The car industry’s business model is radically changing. For a hundred years and more, it was dominated by private cars powered by combustion engines. But in future, the companies which are

likely to maintain their successful position are mainly those which adapt their business model and evolve into mobility service providers. We are already seeing competitors from other industries pushing into this market. The question is whether car-makers can move fast enough – they have been standing on the brakes for far too long. But policy-makers also need to step up the pace of the transformation at last.

**Could you explain?**

Structural change in the transport sector is coming – it will happen in any case because it is market-driven. The question is how well we prepare for it. There needs to be a discussion, early on, about a whole range of issues. How can products and services evolve? How do we manage this structural change? What kind of enabling environment do the new mobility services need? What can be done to provide social policy support for the transformation? Germany has to align its policies to this restructuring process; otherwise, there will be negative consequences for companies, for Germany itself as a business location and, not least, for the climate.

**Thank you for talking to *eco@work*.**

The interviewer was Christiane Weihe.



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# Exnovation

## A planned phase-out

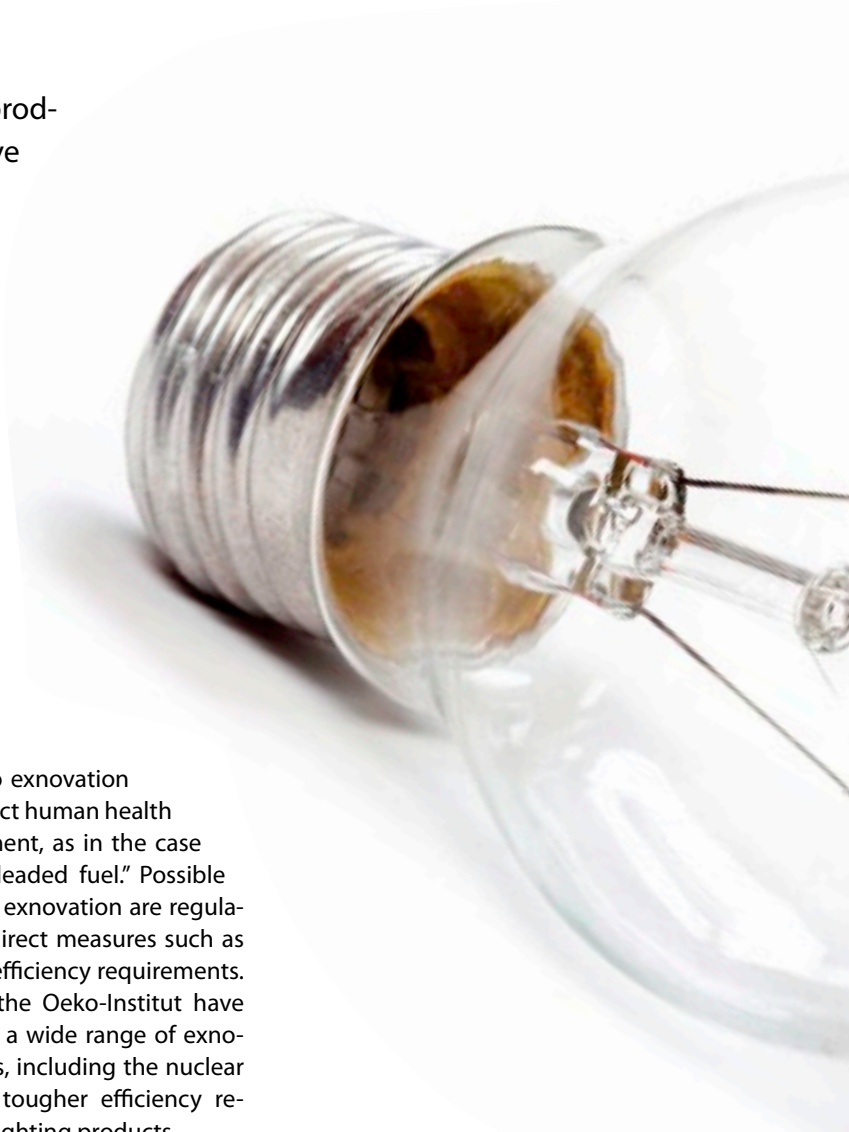
We know which ones they are – the materials, products and technologies that we should really leave behind because they are harmful to our health, the environment and the climate. But for many people and organisations, breaking the habit is very difficult for a variety of reasons – so they continue to rely on harmful chemicals, the combustion engine or climate-damaging electricity production from coal. Yet as the examples of incandescent lightbulbs, nuclear power plants and fridges that use CFCs show, phasing out unsustainable structures – known as exnovation – is a necessary but also a viable step. All it takes is forward planning.

“The term ‘exnovation’ has existed for some time but it is a relatively new concept in the context of the sustainability debate. It is the counterpart to innovation: in other words, it describes the process by which a product, behaviour or even an entire technology is removed from the system,” says Dirk Arne Heyen from the Oeko-Institut. “What we have seen is that innovations are often insufficient for a shift towards sustainability. In many cases, they are simply an addition to existing systems. For example, in Germany, the renewable energy share is increasing, but we have not seen a significant reduction in electricity production from coal.” Heyen, a Senior Researcher in the Environmental Law and Governance Division, has been working intensively on the topic of exnovation and has written a Working Paper on its governance and associated challenges, as well as various specialist articles, for the Oeko-Institut. “Some technologies become extinct because of a fall in market demand – the video recorder is one example, the Walkman another,” he says. “But it may also be necessary to give a

political steer to exnovation in order to protect human health or the environment, as in the case of asbestos or leaded fuel.” Possible mechanisms for exnovation are regulatory bans or indirect measures such as tough limits or efficiency requirements. Researchers at the Oeko-Institut have been looking at a wide range of exnovation processes, including the nuclear phase-out and tougher efficiency requirements for lighting products.

In the Oeko-Institut’s view, policy measures, mainly to steer a phase-out of the climate-damaging burning of coal and fossil fuels, are needed in the near future. “As coal is strongly linked to jobs and value creation – and the combustion engine even more so – the issue of structural change must be approached by consensus and, above all, at an early stage. Alternative structures cannot be put in place overnight.” Otherwise, as Dirk Arne Heyen explains, the process could lead to structural collapse in regions whose economies rely on the obsolete technologies – and that is

something everyone is keen to avoid. “The experience of many East German industrial regions right after German reunification shows the potentially serious economic and social consequences of abrupt change.” Governance of structural change also features in his work as leader of a new research project commissioned by the German Federal Environment Agency (UBA), entitled “Strategies for the Ecological Structural Change towards a Green Economy”. The research team from the Oeko-Institut and the Fraunhofer Institute for Systems and Innovation Research (Fraunhofer



ISI) will analyse experience gained with previous restructuring processes, carry out an in-depth study of the forthcoming structural change in the chemical and transport sectors and consult with industry representatives.

In the case of exnovation processes with potentially serious socioeconomic effects, it is entirely appropriate for policy-makers to

example is the German Business Declaration on Climate Policy initiated by Foundation 2°, whose signatories include Siemens, Deutsche Telekom and even E.ON. It's about creating the stability needed for long-term planning." There are some signs of movement from businesses on the issue of combustion engines as well: for example, Volvo has said that from 2019, all its new models will be pure-electric or hybrid cars. "It's an important step, as companies also need to act at the right time and change their business models," says Dirk Arne Heyen.

#### MOBILE BADEN-WÜRTTEMBERG

The urgent need for transformation of the transport sector as well – and with it, a phase-out of the combustion engine – is demonstrated by another project, entitled "Mobile Baden-Württemberg – Ways of Transformation towards Sustainable Mobility". In Baden-Württemberg, the transport sector currently produces 28 per cent of greenhouse gas emissions, with emissions from this sector still above 1990 levels. In addition, there are the harmful health effects of noise and air pollution, road traffic fatalities and the appropriation of large amounts of land.

Together with the Institute for Social-Ecological Research (ISOE), IMU Institut GmbH and the Fraunhofer Institute for Industrial Engineering (Fraunhofer IAO), the Oeko-Institut has analysed how pathways towards sustainability can be created within the transport sector without losing sight of the mobility and automotive industries' key significance for jobs and prosperity. "A transformation is both necessary and expedient for economic reasons as well," says Dr Wiebke Zimmer, Deputy Head of the Oeko-Institut's Resources and Transport Division. "We are seeing a worldwide trend towards electromobility, and German carmakers risk falling behind."

On behalf of the Baden-Württemberg Foundation and at the initiative of the Baden-Württemberg branch of Friends of the Earth Germany (BUND), the re-

searchers developed three scenarios showing how transformation of the transport sector is possible and which pathways should be pursued. "The results of our analysis show that mobility can only be safeguarded within environmental and health guard rails if there is a significant reduction in the number of cars on the road and maximum electrification of vehicles – of course based on renewables," says Dr Zimmer. "Germany can only achieve its climate targets if we move away from the combustion engine towards e-mobility based on renewables. For that to happen, we need clear policy frameworks, such as e-vehicle quotas and ambitious CO<sub>2</sub> standards for private cars." In her view, policy-makers have a responsibility to start planning for and supporting deep structural change early on. But the transformation needs the public's backing as well – based on a new mindset, a reversal of the trend towards ever-larger private cars, and a change in general mobility behaviour. "We all know that it's time we said goodbye to the combustion engine," says Dr Zimmer. "And the amount of pain associated with the separation will depend on when we start embracing and preparing for this change."

*Christiane Weihe*

attempt to negotiate, with the relevant sectors, detailed phase-out pathways which comply with climate guard rails, says Dirk Arne Heyen; one example is the consensus on coal. But most policy-makers are finding it hard to commit to a timely phase-out of coal and the combustion engine: "Most political parties avoid the issue – and the potential conflicts – like the plague. They fail to recognise that this has to be dealt with now, not in 2030 when we will have missed our climate targets," says Dirk Arne Heyen. "But even members of the business community are now calling for a coal phase-out; one



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**For the  
climate  
– no more  
King Coal!**



## The coal phase-out: facts, figures and strategies

Germany's goal was to be a role model: the inventor of the energy turnaround, a leader in renewables and a pioneer of ambitious climate targets. But now the Federal Republic risks falling short of its self-imposed mitigation targets for 2020 – and not by a miss but by a mile. Its target is to cut its CO<sub>2</sub> emissions by 40 per cent to 2020 compared with the 1990 baseline – but the latest estimates from the Oeko-Institut show that it will only achieve around 30 per cent. A key factor in this climate gap is the use of coal as an energy source: 76 per cent of CO<sub>2</sub> emissions from the German electricity sector comes from coal- and lignite-fired power plants, and the sector produces around 40 per cent of Germany's greenhouse gas emissions. For effective climate action and fulfilment of its ambitious climate targets, Germany has no option but to phase out coal. For some regions, this will mean radical restructuring, which needs to start now.

“The renewable energy share has noticeably increased here in Germany, but this does not mean that less electricity is being produced from coal,” says Charlotte Loreck, a Senior Researcher at the Oeko-Institut. “What we are seeing instead is a rise in exports of this climate-damaging electricity – 54 terawatt hours (TWh) in 2017, a new record. That amounts to around 9 per cent of Germany’s total gross electricity production.” The Oeko-Institut’s researchers are engaged in numerous projects on the coal phase-out, improving the data on the German coal sector and drafting strategies to manage the switch from coal towards alternative forms of power generation. Devising policy instruments to initiate and support the coal phase-out is a key focus of interest. “It is quite embarrassing that Germany will fall so far short of its 2020 climate targets, but at the same time, its international standing in this area will exert leverage, forcing those responsible to take action at last,” says Charlotte Loreck. “Of course, a great many lobby groups are resisting the coal phase-out. But by now, everyone should have realised that there is no other option.”

### THE LIGNITE INDUSTRY

Her colleague Hauke Hermann, also a Senior Researcher, has documented the current state of the German lignite industry in a study entitled “The German lignite industry. Historical development, resources, technology, economic structures and environmental impact”. “Previously, the information on this sector was patchy and confusing,” he explains. “This study is intended to

provide a basis for the necessary discussions about phasing out coal.” On behalf of Agora Energiewende and the European Climate Foundation (ECF), the Oeko-Institut has therefore compiled facts and figures on the history of the mining of lignite and its conversion into electricity, along with data on the number of industry employees, the carbon footprint of lignite-fired power plants and other environmental aspects. Lignite is the most climate-damaging fossil fuel: it currently accounts for approximately 19 per cent of Germany’s total greenhouse gas emissions, roughly a third of its sulphur dioxide emissions and half of its mercury emissions. The reconfiguration of the lignite industry – which produces more CO<sub>2</sub> emissions than the entire road transport sector – therefore has a key role to play in the energy turnaround. “We also looked in detail at the economic significance of the lignite industry,” says Hauke Hermann. “We found that it once played an important role in the German economy but now has only regional economic significance.” There are 18,000 workers and approximately 1,000 trainees employed across Germany in lignite mining, processing and public-sector power plants – as well as other employees whose jobs depend indirectly on the lignite industry. “These jobs are an important factor, so a step-wise phase-out of coal-based electricity production is essential.” What’s more, 50 per cent of lignite industry employees are now over 50 years of age. “Measures to promote structural change within the economy should therefore focus, in the medium term, on supporting sectors which offer future-proof jobs for the younger generations.” And financial aspects also come into play, as Hauke

Hermann emphasises: “It is no longer worth investing in old lignite-fired power plants; it is more economical to decommission power plants and mines when major investment – for example, in the expansion of mining capacities – becomes due. The investment costs for newer power plants can no longer be refinanced nowadays.”

### PHASE-OUT MECHANISMS

Which mechanisms can initiate and support the required phase-out? This question was investigated by Oeko-Institut researchers in two studies for WWF Germany. In one of the studies, entitled “Germany’s Electric Future: Coal phase-out 2035”, a research team from the Oeko-Institut and Prognos looked at various options for phasing out coal-fired electricity production by 2035. “The starting point was a calculation by the Intergovernmental Panel on Climate Change (IPCC) that global carbon dioxide emissions must be limited to around 890 billion tonnes from 2015 onwards if global warming is to be kept below 2° Celsius,” Charlotte Loreck explains. “According to our calculations, based on equitable distribution, this would produce an emissions budget for Germany of 10 billion t CO<sub>2</sub> maximum; the emissions budget for the German electricity sector would amount to around 4.0 billion t CO<sub>2</sub>.” In order to keep below this threshold, a rapid coal phase-out is essential. “This can be achieved by imposing an upper limit on greenhouse gas emissions once the plants have reached a certain age; from the 21st year of operation, they should not exceed annual emissions





of 3.35 tonnes of CO<sub>2</sub> per kilowatt of net capacity on average. This would be combined with managed power plant capacity reductions, with the shutdown of all coal-fired power plants older than 30 years starting in 2019." As she explains, this can be implemented by contractual arrangements, via legal regulation, or through pricing mechanisms for additional CO<sub>2</sub> emissions. "Electricity demand can be met through more rapid expansion of renewables and, for a transitional period, with gas-fired power plants," says Charlotte Loreck. With these measures, lignite mining can also be substantially reduced. In their study, the researchers also emphasise the need for investment in structural transformation in regions which rely on lignite production and the operation of coal-based power plants. "In some regions, the coal industry is currently the main employer, so something needs to be done for the young generation here," she says.

In an updated version of the study "Supporting European Emissions Trading – Opportunities and Limits to Unilateral Carbon Floor Pricing" for the WWF, the Oeko-Institut investigated another mechanism to support the coal phase-out: CO<sub>2</sub> floor pricing. "We looked at ways to achieve the 2020 climate target after all, so we compared the impacts of plant shutdowns, on the one hand, and carbon floor pricing, on the other," says Charlotte Loreck. "We produced calculations for a range of options, including the impact of various CO<sub>2</sub> floor prices per tonne in Germany and the introduction of a CO<sub>2</sub> floor price in a total of seven EU member states." The researchers also investigated the potential of additional power plant shutdowns.

If Germany is to reach its CO<sub>2</sub> emissions reduction target of 40 per cent by 2020, it will have to achieve maximum emissions of 200 to 250 million tonnes of CO<sub>2</sub> for the electricity sector. "But if the electricity sector only reduces its CO<sub>2</sub> emissions to 250 million tonnes, other sectors, such as transport and buildings, will have to save an additional 50 million tonnes of CO<sub>2</sub> – and in our view, that is not achievable by 2020," says Charlotte Loreck. "So we recommend a combination of a sufficiently high CO<sub>2</sub> floor price of 30 euros per tonne and, in addition, shutdowns in the range of 7 gigawatts (GW) of coal-fired power plant capacity." The experts are also calling for the implementation of rules on a coal phase-out in several European countries. "This reduces the risk of carbon leakage" – in other words, that emissions will simply be shifted elsewhere. The team is also advocating for action with a long-term impact. "What is needed are clear rules, not only to 2020 but well beyond that date. This could include a CO<sub>2</sub> floor price or a clear commitment to the shutdown of all coal-fired power plants that have run for more than 30 years."

#### THE CLIMATE LEVY

Another potential – and highly effective – mechanism is the national climate levy proposed by the German Federal Ministry for Economic Affairs and Energy (BMWi) back in 2015, based on calculations by the Oeko-Institut and Prognos. Hauke Hermann explains: "The idea was that each power plant unit in Germany would be allocated a fuel-neutral emissions allowance based on the age of the plant. This would force

the older emissions-intensive power plants in particular to reduce their CO<sub>2</sub> emissions." A climate levy would be paid once a given threshold was crossed and would entail the plant buying additional emissions allowances. "This type of mechanism has the potential to resolve several key challenges relating to the coal phase-out simultaneously: security of supply is not put at risk, the impact on electricity prices would be minimal, operators retain their flexibility and, not least, greenhouse gas emissions are reduced," says Charlotte Loreck. But regardless of which mechanism is chosen, Germany can only get back on track and at least meet its long-term climate targets if the old coal-fired power plants are taken offline as soon as possible.

Christiane Weihe



Before graduate engineer Charlotte Loreck joined the Oeko-Institut's Energy and Climate Division in 2010, she spent three years working in the Sustainable Energy Supply Section at the German Federal Environment Agency (UBA). Her research at the Oeko-Institut focuses mainly on electricity market modelling and current energy policy issues.  
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