Wood energy – heating with wood – interview with Stefan Pelz, HFR

Wood: a cornerstone in energy transition

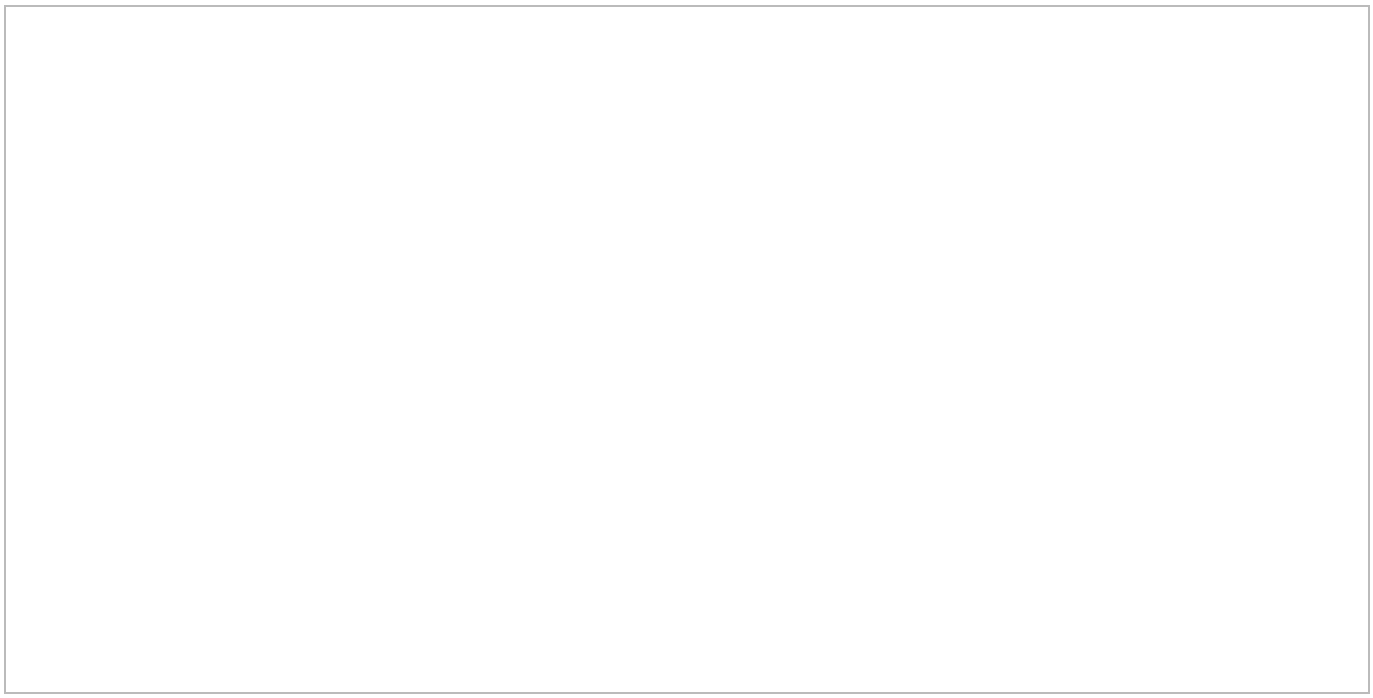
While a good third of the electricity in Germany now comes from renewable energy sources, the production and supply of heat from renewables has stagnated at around 11.5 percent. Energy from biomass, mainly wood and biogas, accounts for over 80 percent of the renewable energy produced[1]. Bioenergy municipalities such as Mauenheim on the Swabian Alb or Büsingen on the Swiss border show how locally available, renewable raw materials and solar power can be intelligently combined for supplying energy. Photovoltaic systems, solar thermal energy, biomass and wind power are stronger when combined. Wood plays a particularly important role in Baden-Württemberg, which is a heavily forested state.

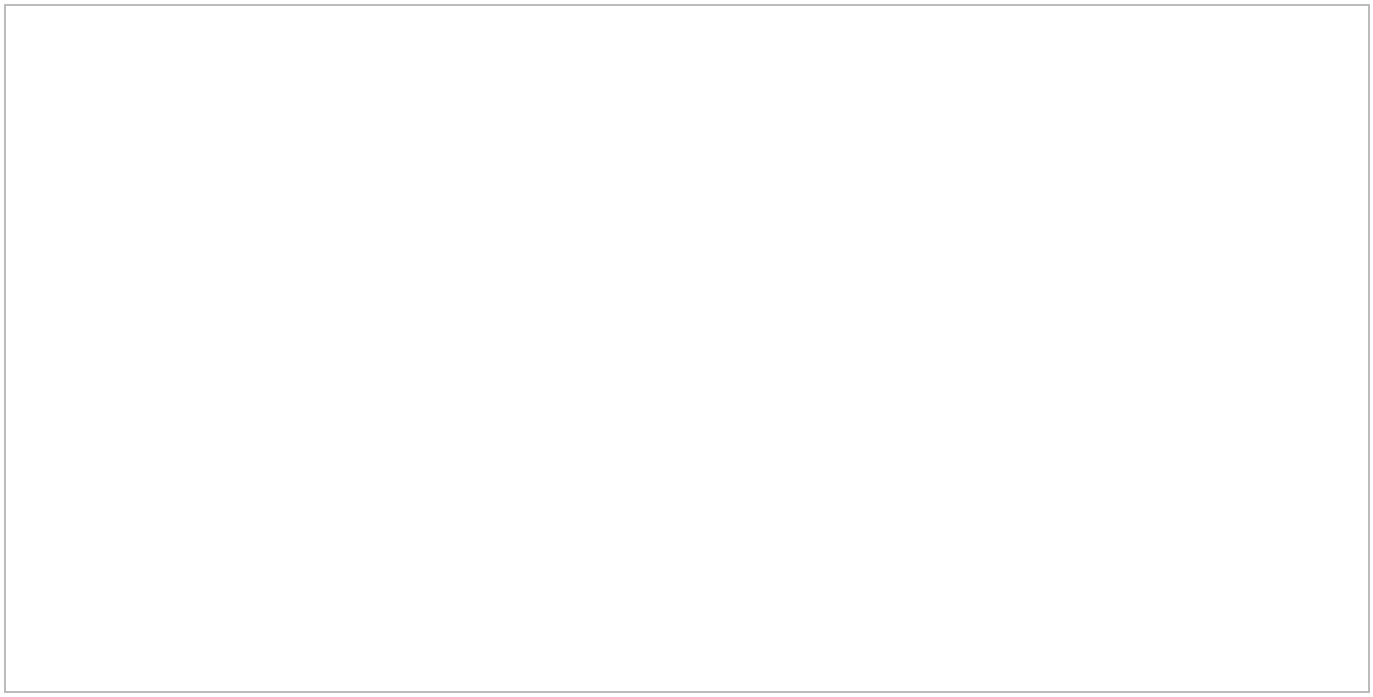
BIOPRO asked wood expert Prof. Dr. Stefan Pelz about the contribution wood can make to the energy transition. Pelz is the scientific director of the Institute for Applied Research (IAF) and professor for forest utilisation, wood technology and wood energy at the University of Applied Forest Sciences Rottenburg (HFR).

Stefan Pelz: We wood experts sometimes get annoyed that the focus of renewable energies is very often on electricity generation from solar and wind power. I think that the energy transition is primarily a heat transition. In private households in Germany, two thirds of the energy required is used for heating. And in the case of final energy consumption across all sectors, including households, industry, trade and transport, the heating sector accounts for over half[2] of the entire energy demand. However, when it comes to renewable heat, wood is unavoidable.

How is wood currently used for energy supply and where do you see room for improvement?

In private households, wood is mainly used as firewood. In urban areas, it is part of a "back to nature" trend and in rural areas, people have easy access to wood and pay significantly less for it than for gas or oil. For heating individual rooms with wood-burning stoves, fireplaces and wood central heating, consumption has doubled since the 1990s from ten million to over 20 million cubic metres of wood. Around half of the approximately 130 million cubic meters of wood that we use in Germany every year, i.e. including for the construction of houses, furniture, paper, pulp, etc., is used in energy production.





In 2018, gross electricity generation in Germany amounted to 646.8 billion KWh (646.8 TWh). Energy from renewable sources accounted for 35% of the energy produced. © FNR

Renewable primary energy consumption by source. © FNR 2019. Basisdaten Bioenergie Deutschland 2019, p. 2

More than 86% of renewable thermal energy production comes from biomass, primarily wood. © FNR 2019. Basisdaten Bioenergie Deutschland 2019, p. 6

Over half of the wood used in Germany is used for energy production although this figure also includes multiple uses. A great deal of waste wood is burned in larger biomass power plants. © FNR 2018. Basisdaten Bioenergie Deutschland 2019, p. 18

How expensive is wood compared to fossil fuels for energy production?

Wood is totally competitive. The cost of wood chips and pellets is currently around €25 and €50/MWh energy content, respectively. This is well below the price for natural gas and oil, which cost almost €70/MWh. It should be noted that fuel prices differ seasonally and regionally. Depending on the assortment, the price of firewood is between €55 and €70/MWh. Due to climate change, wood prices are more likely to fall in the short and medium term, since increased amounts of inferior wood are being produced due to increased beetle damage and damage caused by insufficient drying.

And what about the energy balance of wood?

An analysis of purely local supply chains, which is what is the most common here in Germany, shows that using wood as firewood is best. The proportion of "grey energy" is well below five percent. In practice, this means that a maximum of two to five percent of the energy content of the wood is used to produce ready-to-burn firewood, including harvesting, transport, sawing and cleaving. Pellets are almost as good. Producing wood pellets requires about three to ten percent grey energy. The way that raw material supply chains are structured makes a big difference. Pellet factories located directly on the site of a sawmill or a woodworking company, where the sawdust falls almost directly into the pellet production funnel, naturally have a far better energy balance than pellet factories that collect the raw material on trucks within a radius of 150 to 200 km. There are therefore big differences – of around 5 to 15 percent – in the pellet industry as far as the proportions of grey energy are concerned.

Is the use of wood for heating still appropriate, especially when considering the emission of pollutants?

Yes, it is. This is because a lot has changed technically. I am sure that we can use wood as an energy source in an absolutely environmentally friendly and sustainable way. However, there are of course different starting points that we have to work on, and that's one of our main research areas here in Rottenburg. Obviously, emissions such as carbon dioxide, carbon monoxide, hydrocarbons, nitrogen and sulphur oxides also arise from wood burning. As far as wood firing is concerned, fine dust, especially dust and soot particles ten micrometres and smaller are the emissions that are particularly relevant to health. They are problematic because they are respirable (≤ 10 µm), can be absorbed in the blood (≤ 1 µm) and can cause inflammation. Despite what is sometimes claimed, fine dust from burning wood is therefore no less harmful to health than the fine dust from traffic. However, the good news is that there is a lot we can do to minimise emissions from wood firing. The biggest problem

Thin spruce logs in the forest waiting to be removed. Wood that is used for long term purposes, such as furniture or construction wood, replaces fossil raw materials and stores the carbon bound in the wood.

with hand-fed small combustion systems such as wood-burning stoves is probably correct firing. We know from experience that it would be possible to reduce particulate emissions four to six times simply by renovating existing equipment and operating fireplaces properly.[3]

As part of a larger EU research project, we found that the type testing of such wood-burning stoves required for market approval does not in any way reflect the real operation of such an appliance, for example because there is no need to carry out measurements during the initial firing phase. However, most of the emissions arise at the start of the firing phase and at the end of the combustion phase. Many private stoves are used after people come home from work, so for a maximum of two to three hours a day. Under such circumstances, lighting a fire and leaving it to go out make up a considerable part of the operating time. EU approval regulations therefore need to be revised urgently. In cooperation with colleagues from six different EU countries, we have developed a proposal that could potentially make a significant improvement in the number of new plants constructed.

What can users do to reduce emissions?

First of all, it is important to start the fire with comparatively small wood, and then it is important to only add more wood once a nice firebed has been created and there are no visible flames. Of course, the wood should have dried well and the logs should not be too big. The stoves themselves also play a role, e.g. the geometry of the combustion chamber and air circulation. In recent years, people have become more aware of the problem and are advised to seek information, appropriate recommendations and advice.[4]

But we can also make progress by installing filters and optimising the fuels. In a recently completed research project, we found that adding minimal amounts of kaolin to the sawdust moulding material during pellet production, meant that when the pellets were subsequently burned there was a significant reduction in fine dust of up to 60 percent. This was tested in very good stoves, which already produce relatively low levels of particulate matter. Kaolin ensures that the fine dust-forming salts that occur during combustion are kept in the grate ash. Kaolin is a natural clay mineral that is also used in porcelain manufacturing and in the paper industry. Another of our projects concerns the production of mixed pellets, i.e. pellets into which we mix inferior biomass, e.g. food industry waste, such as nutshells, cherry and olive kernels or stalks such as grain straw and Miscanthus grass. The goal is always to achieve the lowest possible emissions in combination with economical fuel production.

Where do you still see potential for wood energy?

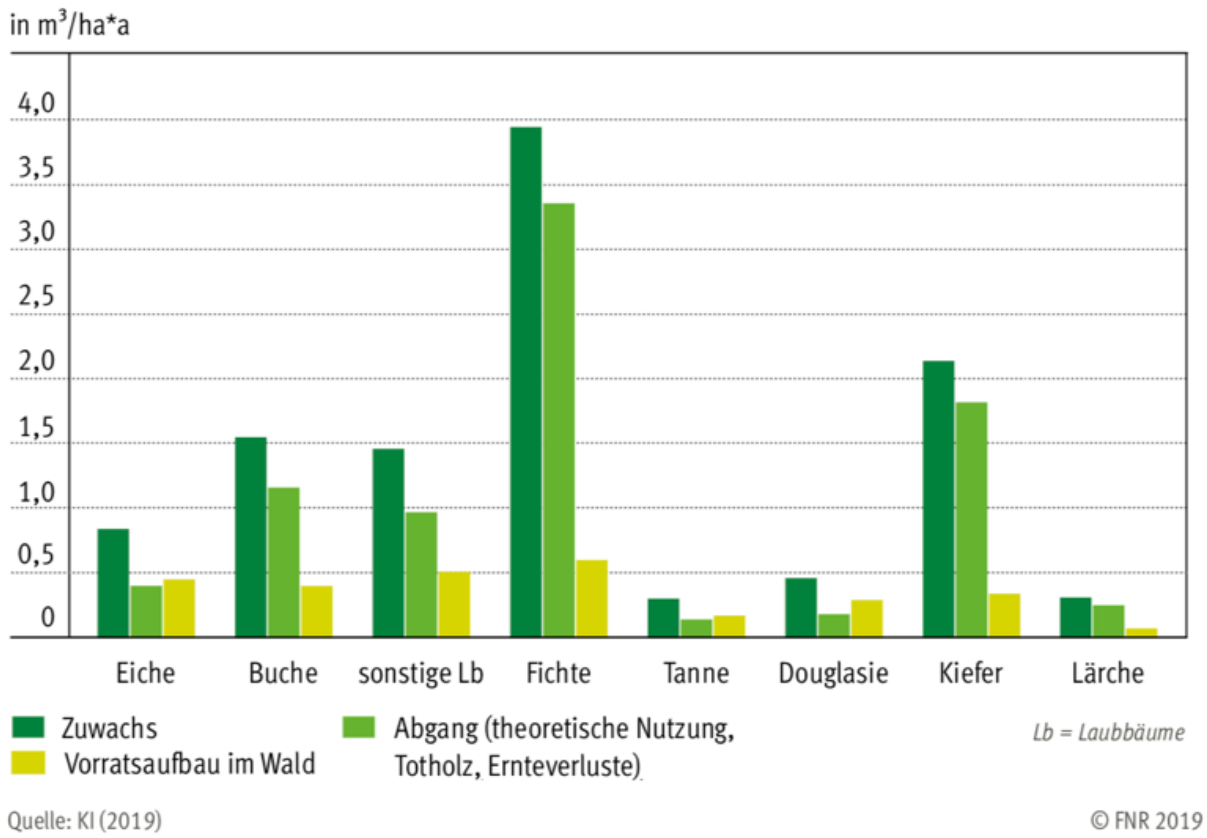
An old beech that has been felled in a private forest. Beech wood is often used as firewood for heating in private households. Wood consumption in private stoves and wood central heating has doubled since the 1990s.

I don’t think there will be a big increase in the private sector because heating demand will tend to decrease in the future. Modern houses only have a fraction of the heat requirements of old buildings. And that's a good thing, because for climate protection reasons we urgently need to save energy and invest in the renovation of older buildings. In principle, however, wood is simply stored solar energy, i.e. a local energy source that we can use flexibly in decentralised energy systems, similar to biogas. Biogenic gases can also be obtained from wood. Wood chips or logs are converted in special reactors into carbon monoxide, methane and hydrogen. This gas can then be stored or converted into electricity directly via a gas turbine. The waste heat from the reactor and the turbine can feed a heating network. The key is always ensuring a smart mix of renewable energy systems. In summer, there is no need to burn any valuable stored solar energy, i.e. wood, if we have solar radiation. It makes more sense to construct the system so that appropriate solar thermal systems can be obtained. The wood boiler is only used when solar radiation decreases in autumn and winter or at times of peak load when more heat is required. There is still enormous potential, not only in new development areas, but also in urban neighbourhoods, where heating networks are already partially available. The Bioenergy Villages funding programme has some good best-practice examples. Crucial here is the communication between consumers and producers to connect and optimally balance energy supply and demand via control systems.

In addition to emissions, critics see increased wood use as a danger to forests. How sustainable is it to get bioenergy from forests?

Potentially, increased demand for wood can of course increase the pressure on forest use. But we are very well placed in Germany because so far not all available resources are being used. It is always important that raw material sources are available locally and regionally and that the wood comes from sustainable forestry.

Isn't there also a danger that wood will be imported from abroad to be burned here to generate electricity? What happens to the life cycle assessment then?



Inventory build-up in forests by tree species from 2012 to 2017.
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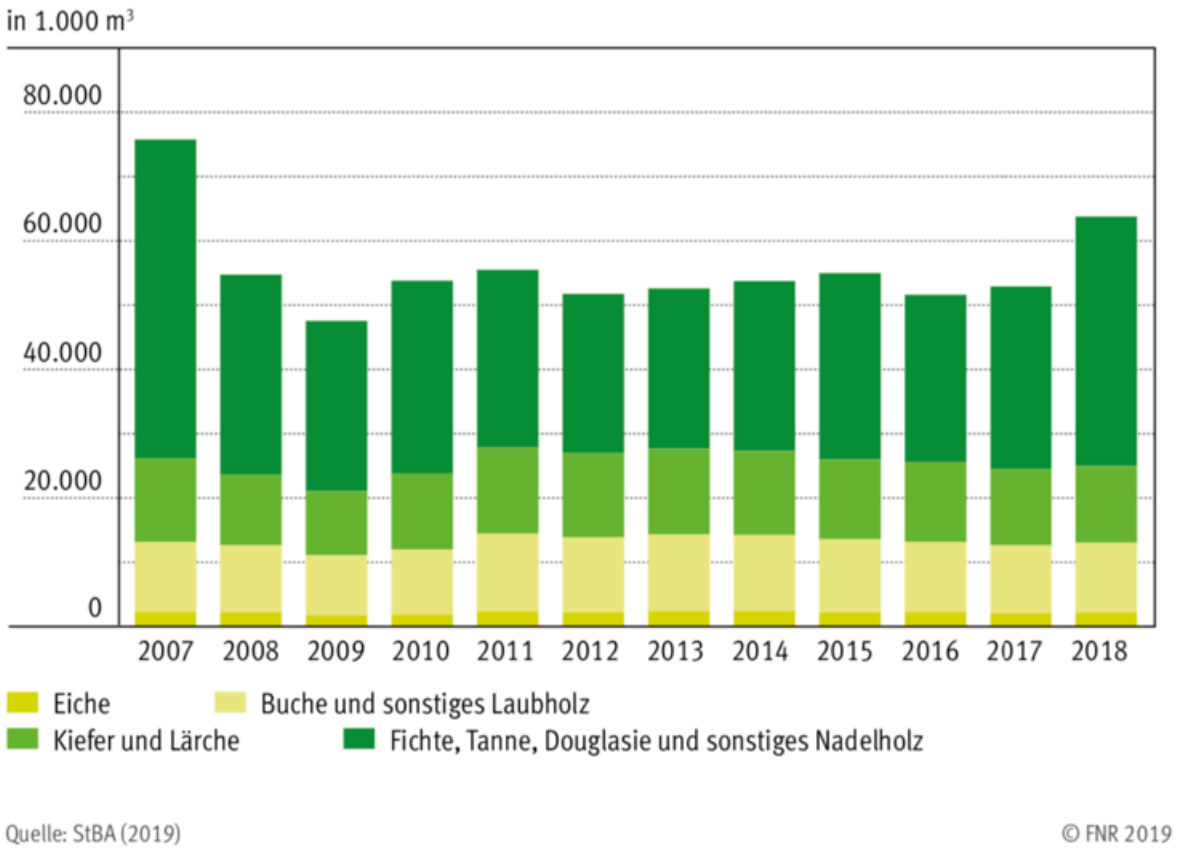

Total logging in Germany in 2018 was 62 million cubic metres. The significant increase over previous years can be attributed to the large quantities of damaged timber due to drought.
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Fortunately, we do not have a funding policy that makes co-firing economically attractive, i.e. adding biomass to coal-fired power plants, as has been done in England, Denmark and the Benelux countries in recent years. This concerns such huge quantities that there is no way to avoid long transport distances. I am glad that this path was deliberately not chosen in Germany, although it was discussed at the time the EEG (Renewable Energy Sources Act) came into force. Austria has large biomass power plants that are now also dependent on the supply of wood from distant Eastern Europe. This clearly shows that from a certain biogas plant size it makes absolutely no sense economically and environmentally. In Germany, the largest biomass power plants are located in industrial areas where there are pulp and paper mills. Wood is broken down on site into its individual components, lignin, cellulose and hemicellulose, to produce pulp and paper. Lignin has a similarly high energy content to heating oil, is of no interest for paper production and delivers the process heat and electricity required on site through combustion in a biomass power plant. Such sites are almost self-sufficient in terms of energy.

Are you brave enough to take a peek into the future?

Energy storage, whether as heat or electrical energy, is a huge issue and it will become even more important in the future. Wood in its various forms is interesting as a quickly convertible and renewable energy source. Not all synergies with other renewable systems have been explored yet. Wood is a decentrally available natural energy store and the intelligent use of these advantages in the context of other renewable energy sources such as solar radiation or geothermal energy is an important task for the future. In addition to storage, I consider the intelligent coordination of demand and generation to be a key task in coming years. This is especially true for urban areas. And as far as using wood to heat private households is concerned, some research and development is still needed to increase efficiency and further reduce emissions.

References:

[1] www.waermewende.de/home.html

[2] https://www.bmwi.de/Redaktion/DE/Downloads/Energiedaten/energiedaten-gesamt-pdf-grafiken.pdf?__blob=publicationFile&v=38

[3] TFZ report, no. 61: Nutzereinflüsse auf die Emissionen aus Kaminöfen, www.tfz.bayern.de/service/presse/233377/index.php

[4] Information on recommended brochures on correct heating with wood can be found in the information section after the interview.

Article

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Gunther Willinger

The article is part of the following dossiers

Sustainable bioenergy

bioenergy | biomass | renewable energy | sustainability | waste | ground

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