Energy
National Research Programmes 70 and 71

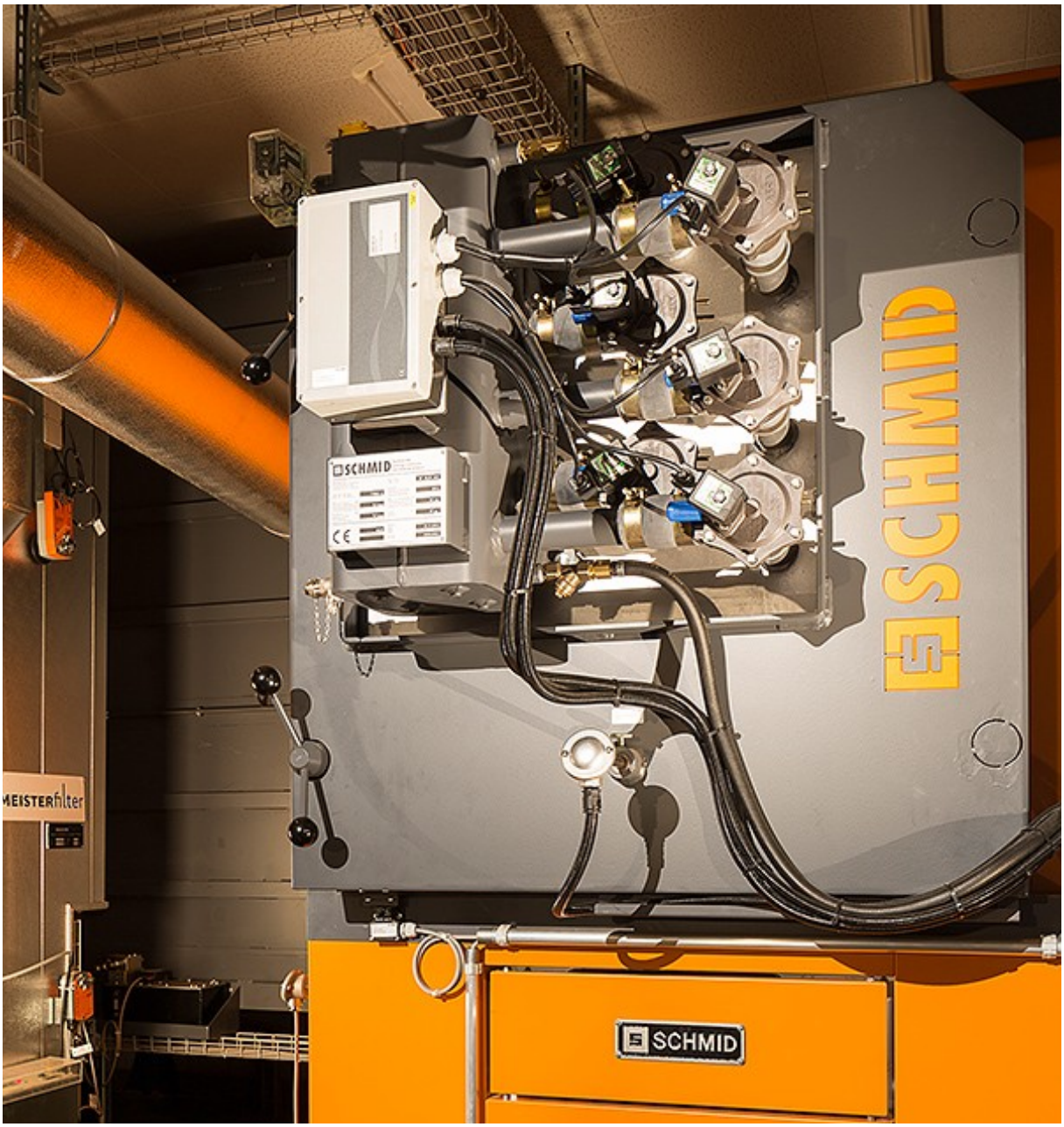
Project

Minimising pollutants in wood combustion

The clean burning of wood

The clean burning of wood

Wood is a renewable raw material that can contribute to fewer fossil fuels being used. Depending on the combustion system utilised, however, the burning of wood can lead to considerable air pollution. Researchers have therefore investigated under which operating conditions the fewest pollutants are released.



With automatic combustion systems, energy can be generated from wood without the air being heavily polluted. *Source:* Schmid AG energy solutions

At a glance

- Energy from wood represents an alternative to fossil fuels. The burning of wood can, however, have a negative impact on air quality due to particulate matter and other harmful pollutants.
- Researchers therefore investigated how the fuel, combustion technology and operating method impact the emission of pollutants.
- The best results were achieved by automatic wood combustion systems. In particular, manual combustion systems must be operated correctly in order to minimise pollutant emissions. It was also shown that carbon monoxide can be used as a simple indicator of pollutants with adverse health effects.

At present, wood as an energy source accounts for around 4 % of final energy consumption in Switzerland. One objective of Energy Strategy 2050 is to increase this share to more than 7 % by, for example, heating residential buildings with wood chips rather than oil. During the burning of wood, however, pollutants such as particulate matter and nitrogen oxides are released into the air. The researchers of the Lucerne University of Applied Sciences and Arts investigated how emissions that are detrimental to health can be minimised.

Wood chips allow for clean burning.
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To this end, they examined nine different types of combustion system, including both automatic and manual variants. In doing so, the scientists varied the operating conditions and the fuels used, allowing them to measure a total of 51 combinations. In addition to normal operations, the different operating conditions included cold and warm starts as well as operations with a lack of air. The fuels included wood pellets, wood chips as well as dry and damp pieces of beech.

Automatic systems win

Wood pellets are a common fuel in wood heating systems.
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The measurements revealed that the emission of pollutants is much lower in the case of automatically operated wood combustion systems than for manually operated systems – depending on the setting, between three and 2,400 times lower. Not only this: manually operated furnaces also produced so-called secondary organic aerosols that are first formed in the atmosphere upon reacting with sunlight. For a wood furnace, these can reach high levels during the start phase and more than double the overall volume of particulate matter. However, under poor conditions, such as a lack or surplus of air, or during the start phase, automatic combustion systems also emit a similar level of pollutants. A low level of pollutant emissions can therefore be achieved with automatic systems that run as continuously as possible and ensure the complete combustion of the wood.

Simple control measurements

Comprehensive monitoring of the combustion quality and the emitted gases is very expensive. However, the researchers' analyses revealed that the measurement of carbon monoxide is a good indicator of the harmfulness of the waste gases – including the secondary organic aerosols. This is because the various gases and particles that are produced during the combustion process correlate with carbon monoxide. This knowledge allows for simple control measurements both during the development of new combustion systems and for monitoring purposes during operations.

The project shows that an expansion of wood energy in Switzerland is possible and that this can be done without a detrimental effect on air quality. The researchers write, however, that the authorities should develop incentive strategies to this end. This is because in addition to an expansion, the replacement of old furnaces with new, automated combustion systems will be required. Emissions can be reduced if the influence of people on the combustion process is minimised. With respect to further technical developments, special attention should also be paid to the ignition and smouldering stages as during these phases air pollutants can still be produced in automated systems.

The increased use of wood as a fuel would not only have a positive effect on air quality and the CO_2 load – the Swiss forestry sector would also benefit.

Produkte aus diesem Projekt

- A simple sampling method to analyze cell toxicity of nano¬particles and condensable compounds from biomass combustion
  Date of publication: 01.01.18
- Zytotoxizität von Abgas aus Holzfeuerungen
  Date of publication: 01.01.18
- Wood combustion for energy in buildings
  Date of publication: 01.01.18
- Primary and secondary particle and gas phase emissions from nine state-of-the-art wood combustion devices
  Date of publication: 01.01.18
- In-vitro cytotoxicity of nanoparticles and condensable compounds from biomass combustion determined by a simple sampling method
  Date of publication: 01.01.18
- Aerosols from biomass combustion
  Date of publication: 01.01.18
- Zytotoxizität von Abgas aus Holzfeuerungen
  Date of publication: 01.01.18
- The role of aerosols from biomass combustion
  Date of publication: 01.01.18

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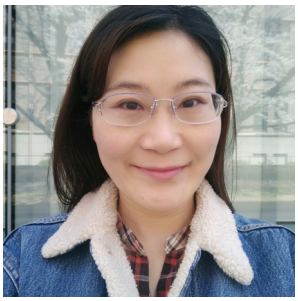

Jun Zhou

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Associated projects

Toxicity of pollutants in wood combustion

Harmful particles in the air originating from wood stoves

All information provided on these pages corresponds to the status of knowledge as of 10.05.2019.