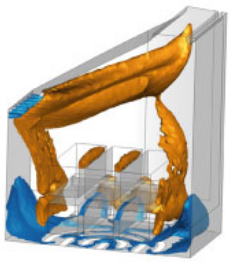
WoodCFD

Clean and efficient wood stoves through improved batch combustion models and CFD modelling approaches



Newsletter 1-2018

Introduction

The WoodCFD project is proceeding as planned, focusing on achieving the overall objective, which is development of clean and efficient wood stoves through improved batch combustion models and CFD modelling approaches through:

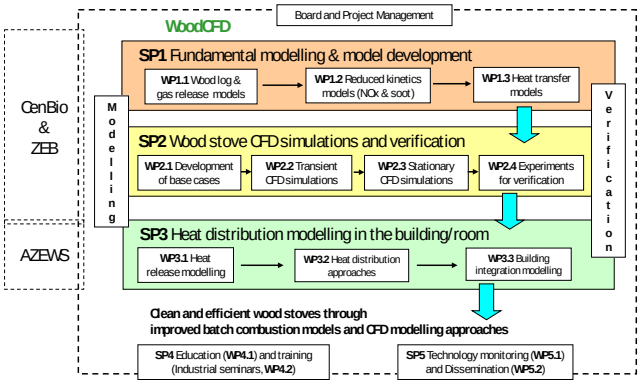
- Model development: improved transient wood log and gas release models, transient heat transfer and storage models, reduced kinetics models (NOx and soot), and transient models and approaches for heat distribution in the building; and verification of these
- Simulations: transient and stationary CFD simulations of wood stoves, and room and building integration simulations; and verification of these

The sub-objectives are:

- Develop improved sub models to be included in the CFD simulations
- Develop a numerical tool that is suitable to study concept improvements for wood stoves and to recommend new improved concepts with respect to high energy efficiency and low emissions based on simulation results
- Develop improved transient heat distribution models - giving reliable prediction of the effect of various heat transfer concepts in buildings and providing design guidelines for optimum wood stoves for tomorrows (energy efficient) buildings
- Education of highly skilled candidates within this area and training of industry partners
- Monitoring of activities and state-of-the-art within this area and dissemination of knowledge to the industry partners, and other interested parties when applicable

The anticipated results of the project are clean and efficient wood stoves through improved batch combustion models and CFD modelling approaches. Improved models and modelling approaches, in combination with targeted experiments, are keys in the development of future's downscaled clean burning and energy efficient wood stoves. This will have a potentially huge impact on the most important bioenergy value chain in Norway today, targeting key bottlenecks in the value chain, i.e. reducing today's still relatively high emissions from wood stoves and improving their energy efficiency, especially in low load wood stoves, as well as ensuring optimum room and building integration.

The Work Breakdown Structure of WoodCFD is:



WoodCFD will run for four years (2015-2018) and has a total budget of 17.5 million NOK which is 80% financed by the Research Council of Norway through the ENERGIX program and 20% financed by the industrial partners Jøtul AS, Dovre AS, Norsk Kleber AS, Morsø Jernstøberi A/S.

Progress in 2018

In **2018**, det final year of WoodCFD, the focus is on transient CFD simulations with heat storage, wood stove optimization, NOx reduction and building integration via dynamic and CFD simulations. A handbook will sum up the project and give recommendations.

- a Knowledge-building Project for Industry (KPN) co-funded by the Research Council of Norway through the ENERGIX-programme.
Contact: oyvind.skreiberg@sintef.no

SINTEF

In **2017** the work focused on testing and use of developed sub-models in CFD simulations, and the PhD candidate focus on further development of the decomposition model for wood logs, and has now several publications on this. The thermal comfort work in 2017 focused on experimental activity to provide detailed data for further development and validation of models.
The work with the sub-models, also for stationary CFD simulations, was continued in **2016**. The employed PhD candidate in the project focus on development of a thermal decomposition model for wood logs. In parallel work is ongoing regarding improvement of models and tools used for simulation of thermal comfort in energy effective buildings with wood stoves.
In **2015** the scientific focus was on initial studies and establishment of sub-models for use in transient CFD simulations, as well as modelling of heat transfer in stoves and analysis of heat distribution to other rooms in a building.

WoodCFD at IConBM 2018

Three WoodCFD or connected works were presented at IConBM 2018 in Bologna, Italy, 17-20 June, 2018:
1) Øyvind Skreiberg, Morten Seljeskog. Performance history and further improvement potential for wood stoves.
2) Øyvind Skreiberg, Laurent Georges. Transient heat production profiles for wood log combustion in wood stoves.
3) Alexis Sevault, Jerol Soibam, Nils Erland L. Haugen, Øyvind Skreiberg. Investigation of an Innovative Latent Heat Storage Concept in a Stovepipe. Co-presentation with PCM-Eff.
Corresponding full papers will be published in Chemical Engineering Transactions.

WoodCFD at RoomVent 2018

Two WoodCFD works were presented at RoomVent 2018 in Espoo, Finland, 2-5 June 2018:
1) Laurent Georges, Martin Thalfeldt, Øyvind Skreiberg, Per Sahlin, Patrik Skogqvist. Validation of an unsteady zonal model to capture the thermal stratification in a room heated by a stove.
2) Martin Thalfeldt, Laurent Georges, Øyvind Skreiberg. Characterization of the free plume created by stoves using laboratory measurements.
Corresponding full papers have been published in the conference proceedings.

WoodCFD at EUBCE 2018

Two WoodCFD or connected works were presented at EUBCE 2018 in Copenhagen, Denmark, 14-17 May, 2018:
1) Mette Bugge, Nils E. L. Haugen, Morten Seljeskog, Øyvind Skreiberg. Hysteresis in wood log combustion, demonstrated through transient CFD simulations and experiments.
2) Alexis Sevault, Nils Erland L. Haugen, Øyvind Skreiberg. A comparison of selected latent heat storage configurations for wood stoves. Co-presentation with PCM-Eff.

WoodCFD at 14th International Conference on Energy Storage

One WoodCFD connected work was presented at 14th International Conference on Energy Storage, 25-28 April 2018, Adana, Turkey:
Alexis Sevault, Jerol Soibam, Nils Erland L. Haugen, Øyvind Skreiberg. Numerical modeling of a latent heat storage system in a stovepipe. Co-presentation with PCM-Eff.
A corresponding full paper has been published in the conference proceedings.

WoodCFD at Cold Climate HVAC 2018

Two WoodCFD works were presented at Cold Climate HVAC 2018 in Kiruna, Sweden, 12-15 March 2018:
1) Validation of a zonal model to capture the detailed indoor thermal environment of a room heated by a wood stove
2) Assessment of the effects of using wood stoves on indoor air quality in two types of Norwegian houses
Corresponding full papers will be published in Springer Proceedings in Energy.

WoodCFD in Energy & Fuels

The WoodCFD PhD candidate published her 3rd major work entitled "Combustion of thermally thick wood particles: A study on the influence of wood particle size on the combustion behavior" in Energy & Fuels. The abstract is given below.

"A one-dimensional (1D) comprehensive combustion model for thermally thick wet wood particles, which is also applicable for studying large wood logs, is developed. The model describes drying, devolatilization, and char gasification as well as char oxidation. Furthermore, CO oxidation is modeled, in order to account for the fact that exiting gas products can be oxidized and therefore limit the oxygen transportation to the active sites. The challenges for model validation are outlined. Model validation was done against experimental data for combustion of near-spherical wood particles. Furthermore, the validated model was up-scaled and the effect of wood log diameter on the thermal conversion time, the extent as well as the position of drying, devolatilization, and char conversion zones were studied. The upscaling was done for cylindrical wood logs with an aspect ratio of 4. The thermal conversion time significantly increased with the size. It was also found

that the relative extent of the drying, devolatilization, and char conversion zones decreased as wood log size increased. The paper concludes with recommendations for future work."

WoodCFD in Scientific Reports

A WoodCFD connected work entitled "Cooling aerosols and changes in albedo counteract warming from CO_2 and black carbon from forest bioenergy in Norway" was published in Scientific Reports. The abstract is given below.

"Climate impacts of forest bioenergy result from a multitude of warming and cooling effects and vary by location and technology. While past bioenergy studies have analysed a limited number of climate-altering pollutants and activities, no studies have jointly addressed supply chain greenhouse gas emissions, biogenic CO_2 fluxes, aerosols and albedo changes at high spatial and process detail. Here, we present a national-level climate impact analysis of stationary bioenergy systems in Norway based on wood-burning stoves and wood biomass-based district heating. We find that cooling aerosols and albedo offset 60–70% of total warming, leaving a net warming of 340 or 69 kg CO_2e MWh^{-1} for stoves or district heating, respectively. Large variations are observed over locations for albedo, and over technology alternatives for aerosols. By demonstrating both notable magnitudes and complexities of different climate warming and cooling effects of forest bioenergy in Norway, our study emphasizes the need to consider multiple forcing agents in climate impact analysis of forest bioenergy."

WoodCFD blog article

A blog article entitled "Drying firewood logs – just how dry can a research topic get?" related to the PhD candidate work has been published by SINTEF Energy Research.
Norwegian version: Tørking av vedkubber – Hvor tørt kan et forskningstema egentlig bli?

WoodCFD in Energy & Fuels

The WoodCFD PhD candidate published her 2nd major work entitled "Drying of thermally thick wood particles: A study of the numerical efficiency, accuracy and stability of common drying models" in Energy & Fuels. The abstract is given below.

"The primary focus of this paper is on studying different numerical models for drying wet wood. More specifically, the advantages and disadvantages of the models, with respect to numerical efficiency, stability, and accuracy, are investigated. The two basic models that are studied in detail are the thermal drying model and the kinetic rate drying model. The drying models have been implemented in an in-house simulation tool that solves for drying and devolatilization of a one-dimensional cylindrical wood log. It is found that the choice of drying model can significantly influence the computational time associated with the thermal conversion. Furthermore, the occurrence of numerical pressure oscillations in the thermal drying model has been found and investigated. The numerical oscillations are reduced by introducing an evaporation fraction, f_{evap}. When the thermal drying model is applied, the drying zone is very thin, commonly only including one grid point, which can result in numerical instabilities. The evaporation fraction allows the smearing of the drying zone by reducing the heat flux used for evaporation of liquid water and using the residual heat flux for heating the grid points. Reducing the evaporation fraction also resulted in reduced CPU times. It was found that model accuracy was not significantly influenced by the choice of drying model."

WoodCFD in EERA Bioenergy News

An article entitled "Computational Fluid Dynamics for improving micro- to large-scale woody biomass and municipal solid waste combustion units" presented WoodCFD and also GrateCFD (Enabling optimum Grate fired woody biomass and waste to energy plant operation through Computational Fluid Dynamics) in an EERA Bioenergy newsletter.

WoodCFD in Progress in Energy and Combustion Science

A comprehensive review paper with the WoodCFD PhD candidate Inge Haberle as first author has been published in Progress in Energy and Combustion Science:
Inge Haberle, Øyvind Skreiberg, Joanna Lazar, Nils Erland L. Haugen. Numerical models for thermochemical degradation of thermally thick woody biomass, and their application in domestic wood heating appliances and grate furnaces. Progress in Energy and Combustion Science 63(November 2017):204-252. The abstract is given below.

"This paper reviews the current state-of-the-art of numerical models used for thermochemical degradation and combustion of thermally thick woody biomass particles. The focus is on the theory of drying, devolatilization and char conversion with respect to their implementation in numerical simulation tools. An introduction to wood chemistry, as well as the physical characteristics of wood, is also given in order to facilitate the discussion of simplifying assumptions in current models. Current research on single, densified or non-compressed, wood particle modeling is presented, and modeling approaches are compared.

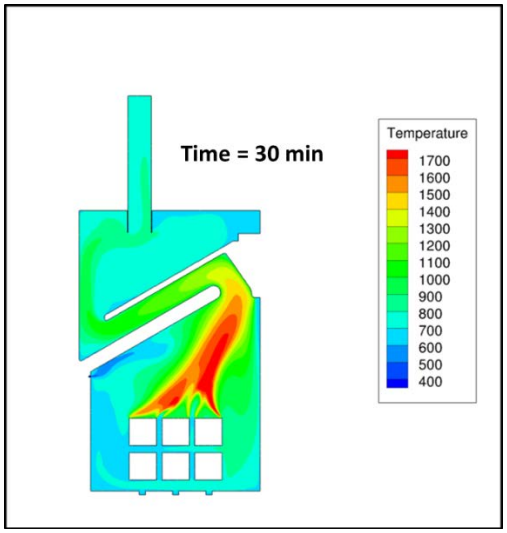
The different modeling approaches are categorized by the dimensionality of the model (1D, 2D or 3D), and the one-dimensional models are separated into mesh-based and interface-based models. Additionally, the applicability of the models for wood stoves is discussed, and an overview of the existing literature on numerical simulations of small-scale wood stoves and domestic boilers is given. Furthermore, current bed modeling approaches in large-scale grate furnaces are presented and compared against single particle models."

WoodCFD at ICAE 2017. Papers now published in Energy Procedia

Three WoodCFD or connected works were presented at the 9th International Conference on Applied Energy in Cardiff, UK, 21-24 August 2017:
1) Øyvind Skreiberg, Laurent Georges. Wood stove material configurations for increased thermal comfort.
2) Inge Haberle, Nils Erland L. Haugen, Øyvind Skreiberg. Comparison of numerical efficiency of the thermal and the kinetic rate drying model applied to a thermally thick wood particle.
3) Alexis Sevault, Roger Khalil, Bjørn Christian Enger, Øyvind Skreiberg, Franziska Goile, Liang Wang, Morten Seljeskog, Rajesh Kempegowda. Performance evaluation of a modern wood stove using charcoal.
These works have now been published in Energy Procedia.

WoodCFD at 25th European Biomass Conference & Exhibition

Four WoodCFD or connected works were presented at the 25th EUBCE conference in Stockholm, Sweden, 12-15 June 2017:
1) Mette Bugge, Nils E. L. Haugen, Øyvind Skreiberg. Transient CFD simulations of wood log combustion in a wood stove.
2) Inge Haberle, Øyvind Skreiberg, Nils Erland L. Haugen. Numerical simulation of devolatilization of wood logs and pressure generation in the wood log center. Published in proceedings, pp. 561-565.
3) Alexis Sevault, Roger Khalil, Bjørn Christian Enger, Øyvind Skreiberg, Franziska Goile, Liang Wang, Morten Seljeskog, Rajesh Kempegowda. Performance evaluation of a modern wood stove when using charcoal.
4) A. Cablé, L. Georges, P. Peigné, Ø. Skreiberg, K. Chetehouna. Coupled ventilation system and wood logs-stove for use in low energy dwellings: an investigation using dynamic energy simulations. Published in proceedings, pp. 611-617.



Transient CFD simulations of wood log combustion

WoodCFD at CenBio Final Conference

Øyvind Skreiberg gave a presentation at the CenBio Final Conference in Ås, Norway, 13-14 March 2017. The title of the presentation was "The ultimate wood stove".

WoodCFD at ICAE 2016. Papers now published in Energy Procedia

WoodCFD related work was presented at the 8th International Conference on Applied Energy in Beijing, China, 8-11 October 2016. Two papers were presented by Morten Seljeskog, with the titles "Variables affecting emission measurements from domestic wood combustion" and "Recommended revisions of Norwegian emission factors for wood stoves". The papers have now been published in Energy Procedia.

PhD work

The PhD work "Numerical simulations of the transient behavior of wood log decomposition and combustion" is progressing. The candidate, Inge Haberle from Austria, has very good progress in her research work, focusing on modelling of the thermal decomposition of thermally thick biomass particles. Several publications have already resulted from her work. The PhD defense is scheduled this autumn.

WoodCFD publications

Inge Haberle, Nils Erland L. Haugen, Øyvind Skreiberg (2018). Combustion of thermally thick wood particles: A study on the influence of wood particle size on the combustion behavior. Energy & Fuels 32(6):6847-6862.

Øyvind Skreiberg, Morten Seljeskog (2018). Performance history and further improvement potential for wood stoves. IConBM 2018, 17-20 June 2018, Bologna, Italy.

Øyvind Skreiberg, Laurent Georges (2018). Transient heat production and release profiles for wood stoves. IConBM 2018, 17-20 June 2018, Bologna, Italy.

Alexis Sevault, Jerol Soibam, Nils Erland L. Haugen, Øyvind Skreiberg (2018). Investigation of an Innovative Latent Heat Storage Concept in a Stovepipe. IConBM 2018, 17-20 June 2018, Bologna, Italy. Co-presentation with PCM-Eff.

Laurent Georges, Martin Thalfeldt, Øyvind Skreiberg, Per Sahlin, Patrik Skogqvist (2018). Validation of an unsteady zonal model to capture the thermal stratification in a room heated by a stove. RoomVent 2018, 2-5 June 2018, Espoo, Finland.

Martin Thalfeldt, Laurent Georges, Øyvind Skreiberg (2018). Characterization of the free plume created by stoves using laboratory measurements. RoomVent 2018, 2-5 June 2018, Espoo, Finland.

Mette Bugge, Nils Erland L. Haugen, Morten Seljeskog, Øyvind Skreiberg (2018). Hysteresis in wood log combustion, demonstrated through transient CFD simulations and experiments. 26th EUBCE, 14-17 May 2018, Copenhagen, Denmark.

Alexis Sevault, Nils Erland L. Haugen, Øyvind Skreiberg (2018). A comparison of selected latent heat storage configurations for wood stoves 26th EUBCE, 14-17 May 2018, Copenhagen, Denmark. Co-presentation with PCM-Eff.

Alexis Sevault, Jerol Soibam, Nils Erland L. Haugen, Øyvind Skreiberg (2018). Numerical modeling of a latent heat storage system in a stovepipe. 14th International Conference on Energy Storage, 25-28 April 2018, Adana, Turkey. Co-presentation with PCM-Eff.

Mathieu Hamon, Guangyu Cao, Øyvind Skreiberg, Laurent Georges, Morten Seljeskog, Roger Khalil, Alexis Sevault, Hans Martin Mathisen (2018). Assessment of the effects of using wood stoves on indoor air quality in two types of Norwegian houses. Cold Climate HVAC 2018, 12-15 March 2018, Kiruna, Sweden.

Martin Thalfeldt, Laurent Georges, Øyvind Skreiberg (2018). Validation of a zonal model to capture the detailed indoor thermal environment of a room heated by a stove. Cold Climate HVAC 2018, 12-15 March 2018, Kiruna, Sweden.

Anders Arvesen, Francesco Cherubini, Gonzalo del Alamo Serrano, Rasmus Astrup, Michael Becidan, Helmer Belbo, Franziska Goile, Tuva Grytli, Per Kristian Rørstad, Line Rydså, Morten Seljeskog, Øyvind Skreiberg, Sajith Vezhapparambu, Anders Hammer Strømman (2018). Cooling aerosols and changes in albedo counteract warming from CO_2 and black carbon from forest bioenergy in Norway. Scientific Reports 8, Article 3299.

Inge Haberle, Nils Erland L Haugen, Øyvind Skreiberg (2017). Drying of thermally thick wood particles: A study of the numerical efficiency, accuracy and stability of common drying models. Energy & Fuels 31(12):13743-13760.

Øyvind Skreiberg, Laurent Georges (2017). Wood stove material configurations for increased thermal comfort. Energy Procedia 142:488-494.

Inge Haberle, Nils Erland L. Haugen, Øyvind Skreiberg (2017). Comparison of numerical efficiency of the thermal and the kinetic rate drying model applied to a thermally thick wood particle. Energy Procedia 142:37-42.

Alexis Sevault, Roger Khalil, Bjørn Christian Enger, Øyvind Skreiberg, Franziska Goile, Liang Wang, Morten Seljeskog, Rajesh Kempegowda (2017). Performance evaluation of a modern wood stove using charcoal. Energy Procedia 142:192-197.

Inge Haberle, Øyvind Skreiberg, Joanna Lazar, Nils Erland L. Haugen (2017). Numerical models for thermochemical degradation of thermally thick woody biomass, and their application in domestic wood heating appliances and grate furnaces. Progress in Energy and Combustion Science 63(November 2017):204-252.

Øyvind Skreiberg (2017). Computational Fluid Dynamics for improving micro- to large-scale woody biomass and municipal solid waste combustion units. EERA Bioenergy News 2017 (7), p. 5.

Mette Bugge, Nils E. L. Haugen, Øyvind Skreiberg (2017). Transient CFD simulations of wood log combustion in a wood stove. 25th European Biomass Conference & Exhibition (**EUBCE**), 12-15 June 2017, Stockholm, Sweden.

Inge Haberle, Øyvind Skreiberg, Nils Erland L. Haugen (2017). Numerical simulation of devolatilization of wood logs and pressure generation in the wood log center.

Proceedings of 25th EUBCE, 12-15 June 2017, Stockholm, Sweden, pp. 561-565.

Alexis Sevault, Roger Khalil, Bjørn Christian Enger, Øyvind Skreiberg, Franziska Goile, Liang Wang, Morten Seljeskog, Rajesh Kempegowda (2017). Performance evaluation of a modern wood stove when using charcoal. 25th EUBCE.

A. Cablé, L. Georges, P. Peigné, Ø. Skreiberg, K. Chetehouna (2017). Coupled ventilation system and wood logs-stove for use in low energy dwellings: an investigation using dynamic energy simulations. Proceedings of 25th EUBCE, 12-15 June 2017, Stockholm, Sweden, pp. 611-617.

Morten Seljeskog, Alexis Sevault, Asbjørn Østnor, Øyvind Skreiberg (2017). Variables affecting emission measurements from domestic wood combustion. Energy Procedia 105(May 2017):596-603.

Morten Seljeskog, Franziska Goile, Øyvind Skreiberg (2017). Recommended revisions of Norwegian emission factors for wood stoves. Energy Procedia 105(May 2017):1022-1028.

Øyvind Skreiberg (2017). The ultimate wood stove. CenBio Final Conference, 13-14 March, Ås, Norway.

Øivind Lie, Simen Gjølsjø, Øyvind Skreiberg (2017). Maks varme av veden. Hytteliv 1/2017:46-48.

Kolbeinn Kristjansson, Erling Næss, Øyvind Skreiberg (2016). Dampening of wood batch combustion heat release using a phase change material heat storage: Material selection and heat storage property optimization. Energy 115:378-385.

Jacob Hadler-Jacobsen (2016). A model for pyrolysis of thermally thick wood particles. SINTEF Summer Job Project report. Supervisors: Nils Erland L. Haugen, Øyvind Skreiberg

Eivin Dyvik Sellevold (2016). Modeling of indoor environment of building heated using wood stoves. NTNU Master thesis. Main supervisor: Laurent Georges, Co-supervisor: Øyvind Skreiberg

Guangyu Cao, Laurent Georges, Øyvind Skreiberg, Morten Seljeskog (2016). An experimental study on how a wood stove affects the indoor air quality when used as the main source of heating in two representative Norwegian dwellings, one modern and one old. Indoor Air 2016, 3-8 July 2016, Ghent, Belgium.

Morten Seljeskog, Alexis Sevault, Birger Rønning, Magnus Rishaug, Asbjørn Østnor, Øyvind Skreiberg (2016). Variables affecting particulate emissions from residential wood combustion – simultaneous sampling on hot and ambient filter. 20th ETH-Conference on Combustion Generated Nanoparticles, 13-16 June 2016, Zurich, Switzerland.

Øyvind Skreiberg, Mette Bugge, Morten Seljeskog, Nils Erland L. Haugen, Inge Haberle, Laurent Georges (2016). Computational Fluid Dynamics as an Efficient Design Tool for Wood Stoves. 24th EUBCE, 6-9 June 2016, Amsterdam, The Netherlands.

Joanna Polak, Guangyu Cao, Laurent Georges, Øyvind Skreiberg (2016). Experimental study of the airflow distribution inside and between two zones with temperature differences with an air curtain system. Proceedings of CLIMA 2016, 22-25 May 2016, Ålborg, Denmark.

Laurent Georges, Øyvind Skreiberg (2016). Simple Modelling Procedure for the Indoor Thermal Environment of Highly Insulated Buildings Heated by Wood Stoves. Journal of Building Performance Simulation 9(6):663-679.

Joanna Lazar, Nils Erland L. Haugen, Jonas Kruger, Andrzej Szlek (2016). Numerical Study of Hydrogen Inhibition of Char Gasification Using Detailed Hetero- and Homogeneous Chemical Kinetics. Energy & Fuels 30(6):4411-4418.

Philipp Betchart (2015). Viscosity measurements. NTNU Project thesis. Main supervisor: Erling Næss, Co-supervisor: Kolbeinn Kristjansson

Eivin Sellevold (2015). Modelling the indoor thermal environment in passive houses heated by wood stoves. NTNU Project thesis. Main supervisor: Laurent Georges, Co-supervisor: Øyvind Skreiberg

Joanna Polak (2015). Experimental study of the airflow distribution in a room with heating equipment. NTNU Master thesis. Main supervisor: Guangyu Cao, Co-supervisors: Laurent Georges, Øyvind Skreiberg

Laurent Georges, Morten Seljeskog, Øyvind Skreiberg (2015). En balansert kombinasjon av stråling og konveksjon gir best komfort. Varmenytt 4-2015, p. 22.

Øyvind Skreiberg, Mette Bugge, Morten Seljeskog, Nils Erland L. Haugen, Laurent Georges (2015). CFD as an efficient design tool for wood stoves. Expert workshop on Highly efficient and clean wood log stoves, IEA Bioenergy Task 32, 29 October 2015, Berlin, Germany.

Laurent Georges, Øyvind Skreiberg (2015). Wood stoves for future's energy efficient buildings. Expert workshop on Highly efficient and clean wood log stoves, IEA Bioenergy Task 32, 29 October 2015, Berlin, Germany.

WoodCFD in the media

Øyvind Skreiberg (2018). Drying firewood logs – just how dry can a research topic get? SINTEF Energy Research blog 23 January 2018.

Øyvind Skreiberg (2018). Tørking av vedkubber – Hvor tørt kan et forskningstema egentlig bli? SINTEF Energi blogg 18 januar 2018.

Benjaminsen, Christina; Skreiberg, Øyvind; Seljeskog, Morten. Her er "vedfyringens ABC". Gemini 3 desember 2015. Reprodusert på forskning.no.

Benjaminsen, Christina; Skreiberg, Øyvind. Cheaper heating using environmentally-friendly wood-burning stoves. Gemini 9 February 2015.

Benjaminsen, Christina; Skreiberg, Øyvind. Miljøvennlig vedfyring gir deg billigere varme. Gemini 3 februar 2015. Reprodusert på Adresseavisen nett.

Skreiberg, Øyvind. Vi skal gjøre det mer effektivt og miljøvennlig å fyre med ved. blog.sintefenergy.com 2 februar 2015.

Selected **StableWood modelling publications:**

Øyvind Skreiberg, Morten Seljeskog, Laurent Georges (2015). Solutions and technologies for wood stoves in future's energy efficient residential buildings. Oral presentation at 23rd EUBCE, 1-4 June 2015, Vienna, Austria. (Co-presentation with ZEB).

Mette Bugge, Øyvind Skreiberg, Nils E. L. Haugen, Per Carlsson, Morten Seljeskog (2015). Predicting NOx emissions from wood stoves using detailed chemistry and computational fluid dynamics. Energy Procedia 75:1740-1745.

Øyvind Skreiberg, Morten Seljeskog, Laurent Georges (2015). The process of batch combustion of logs in wood stoves - Transient modelling for generation of input to CFD modelling of stoves and thermal comfort simulations. Chemical Engineering Transactions 43:433-438. (Co-publication with ZEB).

Laurent Georges, Øyvind Skreiberg (2014). Simulation of the Indoor Thermal Environment in Passive Houses heated using Wood Stoves: comparison between thermal dynamic simulations and CFD. 1st International Workshop on CFD and Biomass Thermochemical Conversion, 30th September, 2014, DBFZ, Leipzig, Germany, pp. 57-61. (Co-publication with ZEB).

Laurent Georges, Øyvind Skreiberg, Vojislav Novakovic (2014). On the proper integration of wood stoves in passive houses under cold climates. Energy and Buildings 72:87-95. (Co-publication with ZEB).

Laurent Georges, Øyvind Skreiberg, Vojislav Novakovic (2013). On the proper integration of wood stoves in passive houses: Investigation using detailed dynamic simulations. Energy and Buildings 59:203-213. (Co-publication with ZEB).

Other news

IEA Task 32 Biomass Combustion and Co-firing

The first IEA Bioenergy Task 32 meeting of the year was arranged in May in Copenhagen, Denmark, in connection with the EUBCE 2018 conference. The meeting was combined with a field trip to the Amagerværket CHP plant.

2018 is the last year of the current triennium, and plans for activities in the next triennium (2019-2021) have been made, yet to be finalized.

However, there will be significant focus on small-scale biomass combustion, including wood stoves.

In the current triennium, the deliverables connected to wood stoves are:

- Aerosols from biomass combustion
- Particle emission measurement techniques (ongoing)
- Consequences of real life operation on stove performance (ongoing)
- Workshop on Biomass Combustion Generated Nanoparticles
- Workshop on New Emission Measurement Methods

For information about IEA Bioenergy Task 32 activities, see the webpage and newsletters, and for IEA Bioenergy news, see this newsletter. Øyvind Skreiberg from SINTEF Energy Research is the Norwegian participant in IEA Bioenergy Task 32.

EERA Bioenergy – SP5 Stationary Bioenergy

The effort this year has been focused on revising the SP focus and the description of work, and this work is now soon finalized. For more info on EERA Bioenergy,

visit the brand new website, and see the newsletters. Berta Matas Güell from SINTEF Energy Research is leading SP5 Stationary Bioenergy in EERA Bioenergy.

RHC technology platform

The activity level of the RHC platform picked up after a period where new financing solutions were sought and the originally planned strategy documents had been delivered. The "new" European Technology and **Innovation** Platform on Renewable Heating & Cooling (RHC-ETIP) brings together stakeholders from the biomass, geothermal and solar thermal sector - including related industries such as District Heating and Cooling, Thermal Energy Storage, Hybrid Systems and Heat Pumps - to define a common Research, Development and Innovation strategy for increasing the use of renewable energy technologies for heating and cooling.

Previously concrete work has been carried out by the Biomass Panel in the RHC-ETIP connected to giving input to the SET-plan issues paper on renewable fuels and bioenergy, as well as work connected to the Implementation of the biomass technology roadmap of the Biomass Panel. The aim of the latter was to update the progress in R&I priorities identified by the Biomass technology roadmap.

This work continues through different efforts. The next Biomass Panel steering committee meeting is planned to be arranged after the summer vacation.

Øyvind Skreiberg from SINTEF Energy Research is a member of the Biomass Panel Steering Committee and the leader of Issue group 2: Residential/small scale heating devices and building integration.

As a continuation of the SET-plan work, workgroups were established to provide specific input to the SET-plan work, e.g. Action 5 Energy Efficiency in Buildings with the sub-action 5.2 Heating and Cooling Technologies for Buildings and Action 8 Renewable Fuels and Bioenergy. Two meetings connected to Action 5 have been arranged in 2018 to provide input to this implementation plan. The work is still ongoing, and Øyvind Skreiberg has been involved in the Action 5 work, representing the Biomass Panel. For Action 8, an endorsed implementation plan is now ready.

See the RHC newsletters for other news.

Links (click on the links or logos to get there)

StableWood
SKOG22
Energi21
Renewable Heating and Cooling technology platform
EERA Bioenergy
IEA Task32 Biomass Combustion and Cofiring