Aalto Universi
School of Eng

Role of forest industry transformation in energy efficiency and reducing CO_2 emissions

Timo Laukkanen

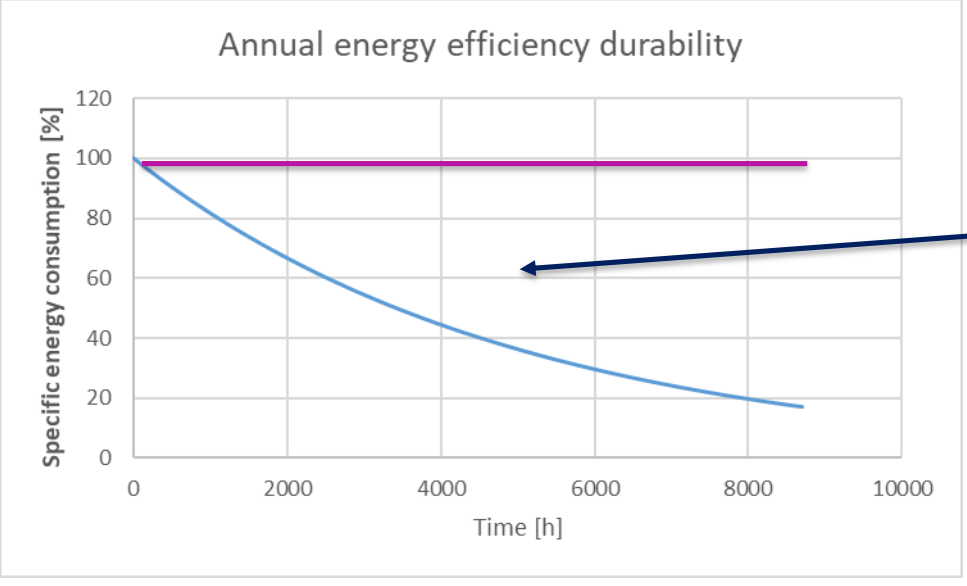
Background

- An Academy of Finland funded project
- Autumn 2018- Autumn 2022
- Costs 660 k€
- PI of LUT: Professor Esa Vakkilainen
- PI of Aalto: Staff scientist Timo Laukkanen

Background

- **Forest industry knows what is the specific energy consumption of their mills and processes, but don't fully understand**
  - Which parameters effect energy efficiency
    - *Which parameters are independent of the mill (outdoor temperature, raw materials, end-products, operational hours…)*
    - *Which parameters are dependent of the mill (chosen technology, condition of technology, operational practices, process integration…)*
  - How is energy efficiency related to quality of products
  - What is the relative effect of different parameters
  - How is different processes, production lines, mills and products compared to each other based on energy efficiency?

Objective



Try to explain the gap between the real energy efficiency and best energy efficiency

Objective

- **To develop an objective metering tool for analyzing the development of energy efficiency and CO_2 emissions of a mill and its process departments**
  - *making use of parametric models that are based on statistical analysis and AI tools*
  - *simulation models*
- **Mill energy usage and CO2 emissions will be used to study the role of mill closures and capacity upgrades to energy use and emissions**

Initial results

- Kähkönen, S., Vakkilainen, E., & Laukkanen, T. (2019). Impact of structural changes on energy efficiency of Finnish pulp and paper industry. *Energies*, *12*(19), 3689.
  - *20% of the Finnish pulp and paper industry energy efficiency improvement between 2011 and 2017 is caused by the major structural changes*
  - *80% mainly due to improved technology and more optimal operational modes.*
- A parametric model of a TMP process obtained by using the ANFIS method (Adaptive neuro fuzzy inference system)

Data-oriented energy efficiency business