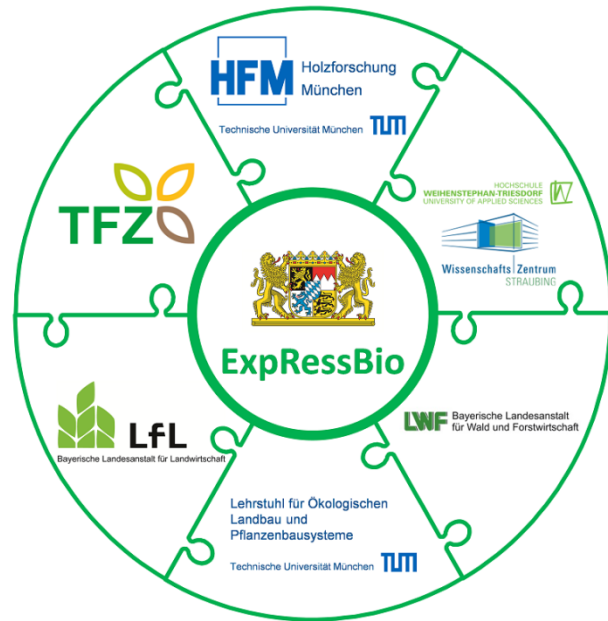




Holzforschung München



Technische Universität München



60th LCA Discussion Forum:
“ENVIRONMENTAL USE OF WOOD RESOURCES”

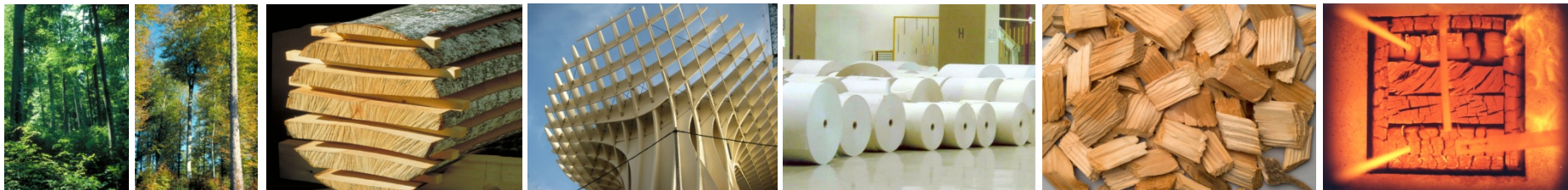
04.12.2015

ETH Zürich

Environmental Impacts of Shifting Energy Wood Utilizations in the Bavarian Heating Mix

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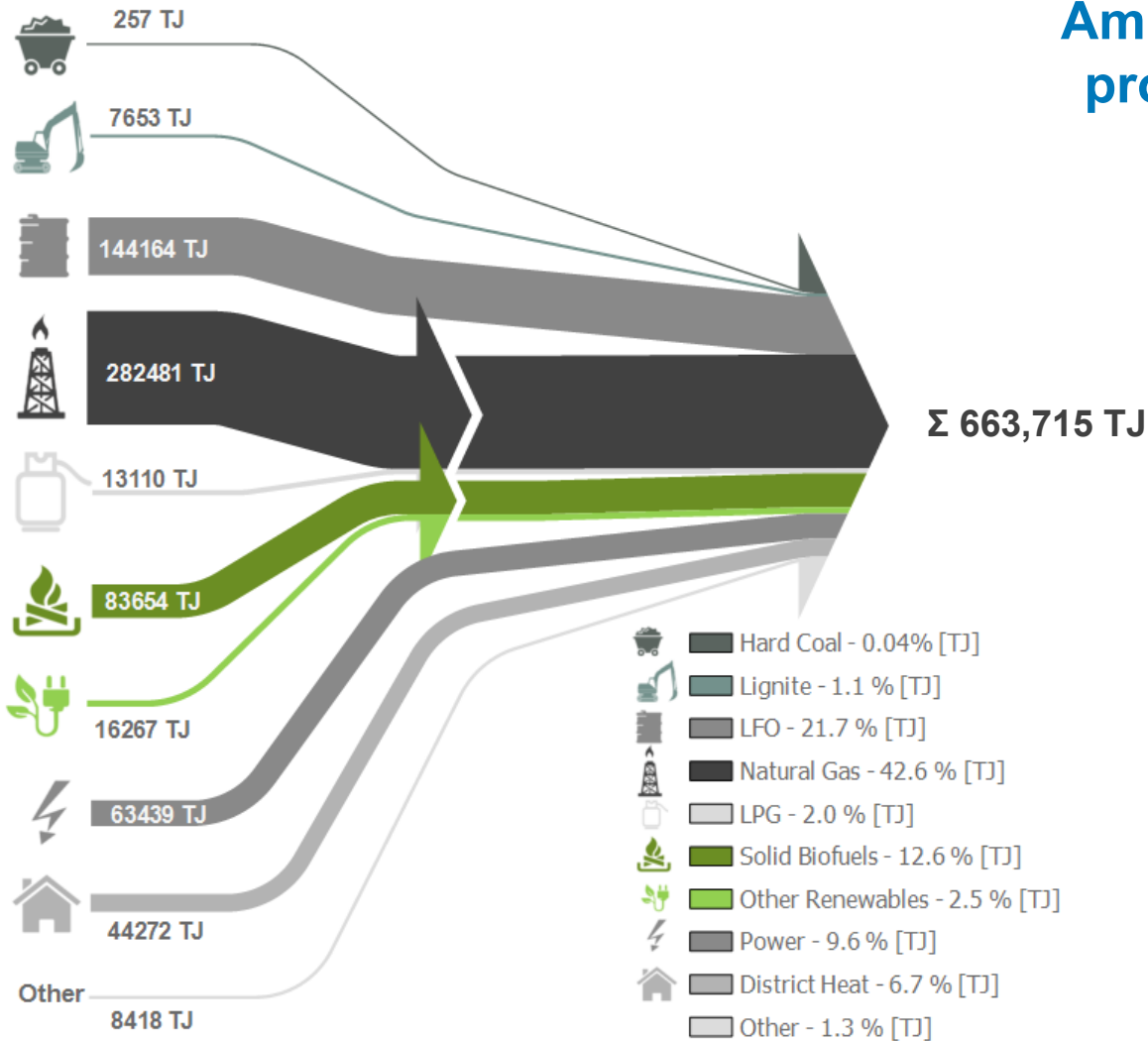
Research Questions

- **What is the total amount of final energy for heat in Bavaria and what distribution of energy carriers can be identified?**
- **What is the magnitude of emissions associated with the heating mix?**
- **What are current political goals and scientific assessments for solid biofuel development and what is their impact on heating mix emissions?**

Bavarian Heating Mix – Distribution

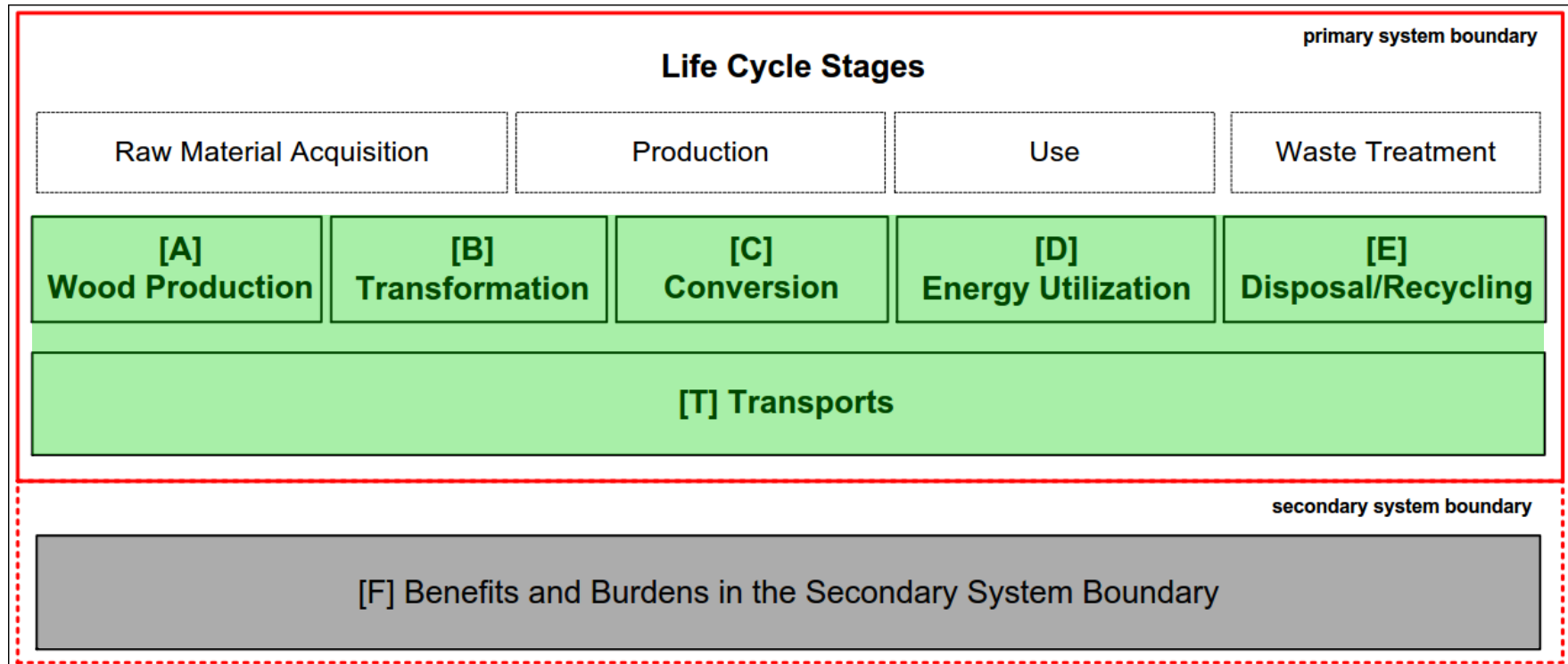
Amount of final energy for the provision of heat in Bavaria

[Basis: Bayerisches Landesamt für Statistik]



Solid biofuels, i.e. wood, are responsible for **83%** of the heat from renewables

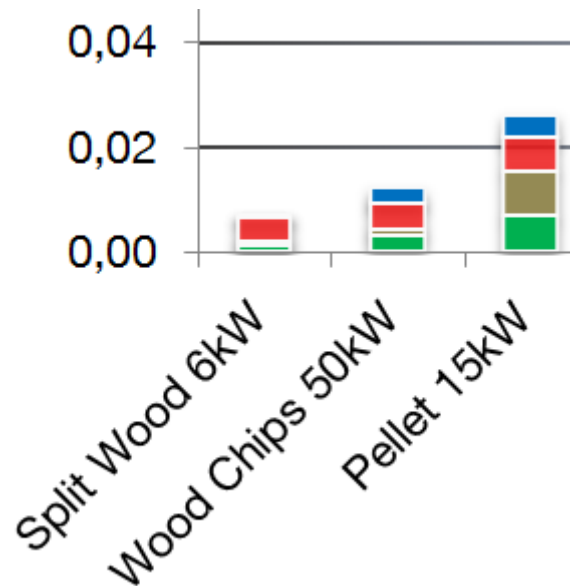
Bavarian Heating Mix – Emission factors



Bavarian Heating Mix – Emission factors

GHG Emissions,
without biogenic CO₂
(CO₂-Equiv. in kg * MJ⁻¹)

- [T] Transports
- [E] Waste Treatment
- [C] Conversion energy carrier
- [B] Transformation biomass
- [A] Wood production



Ratio of GHG emissions and C-storage in energy carriers:

- Split wood: **0.06**
- Wood chips: **0.11**
- Pellets: **0.24**

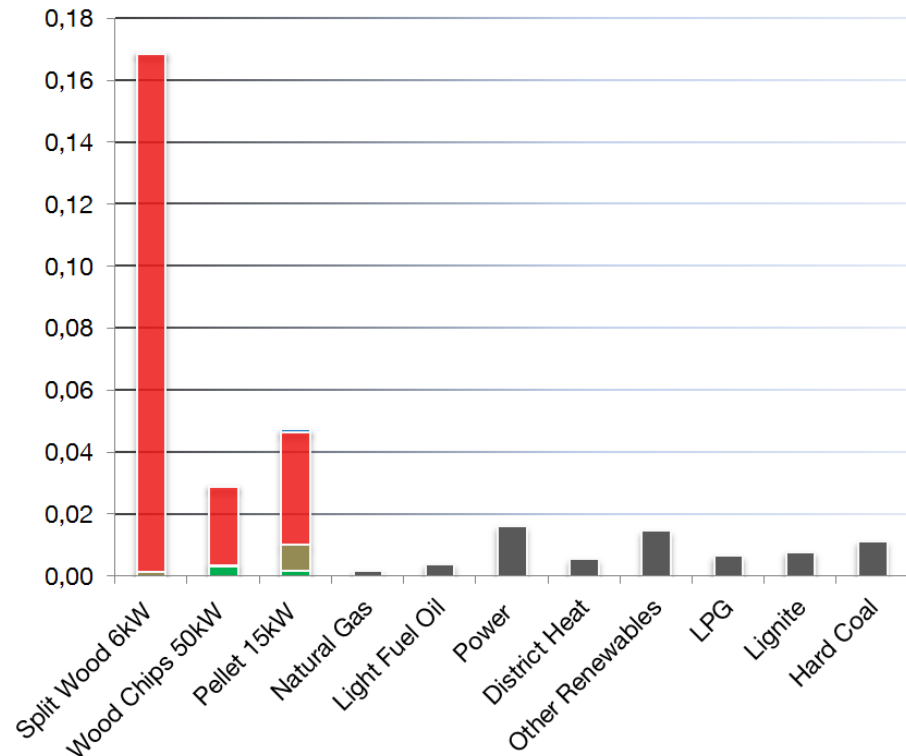
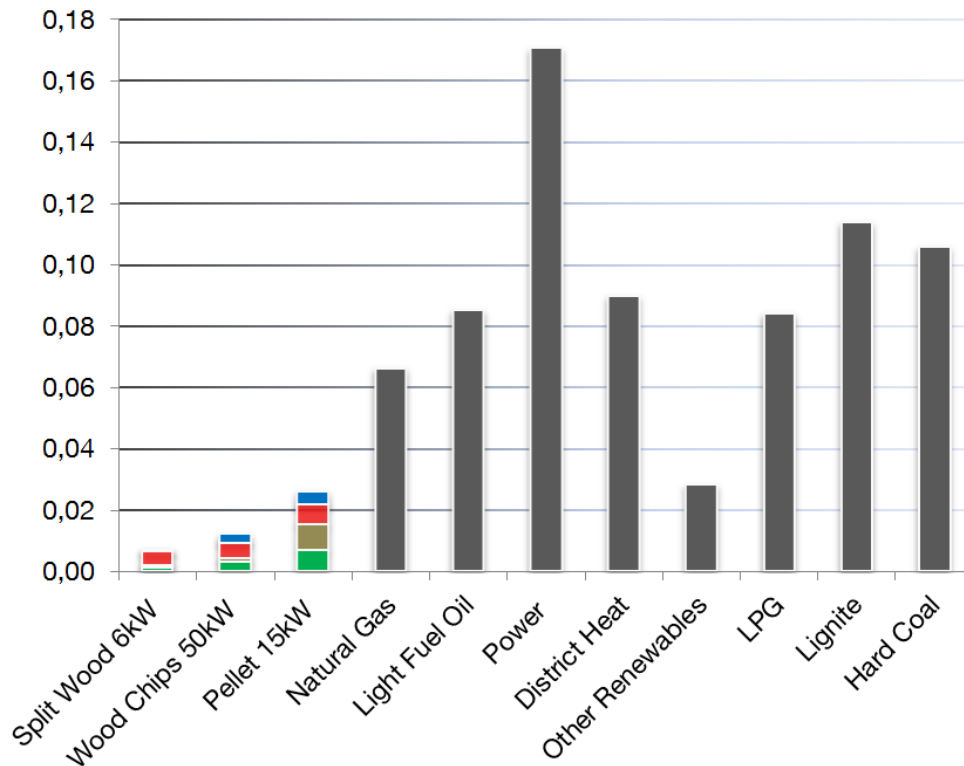
Heat from split wood, wood chips and pellets as well as heat from conventional energy carriers

Bavarian Heating Mix – Emission factors

GHG Emissions,
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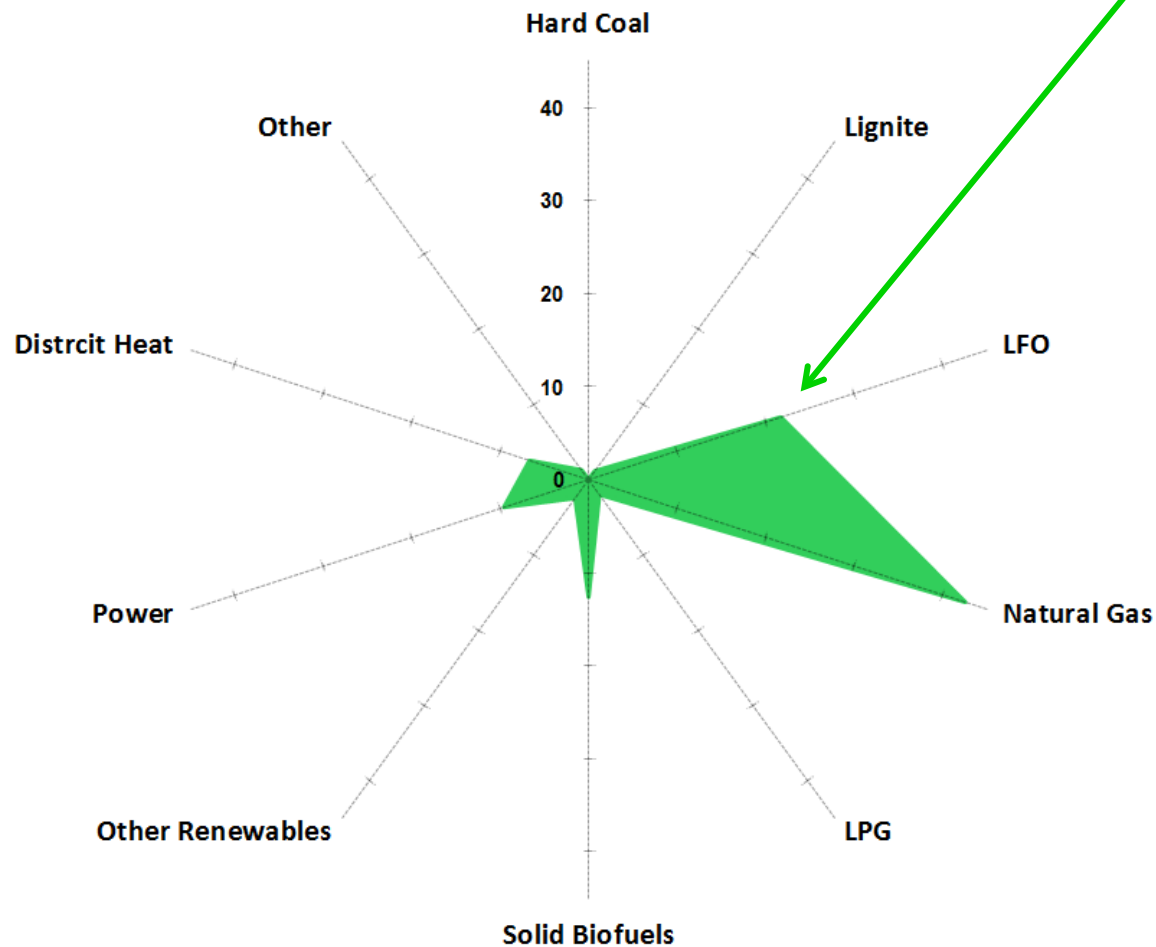
Emissions of
Particulate Matter
(PM_{2,5}-Eq.uiv in g * MJ⁻¹)



Heat from split wood, wood chips and pellets as well as heat from conventional energy carriers

Bavarian Heating Mix – Total Emissions

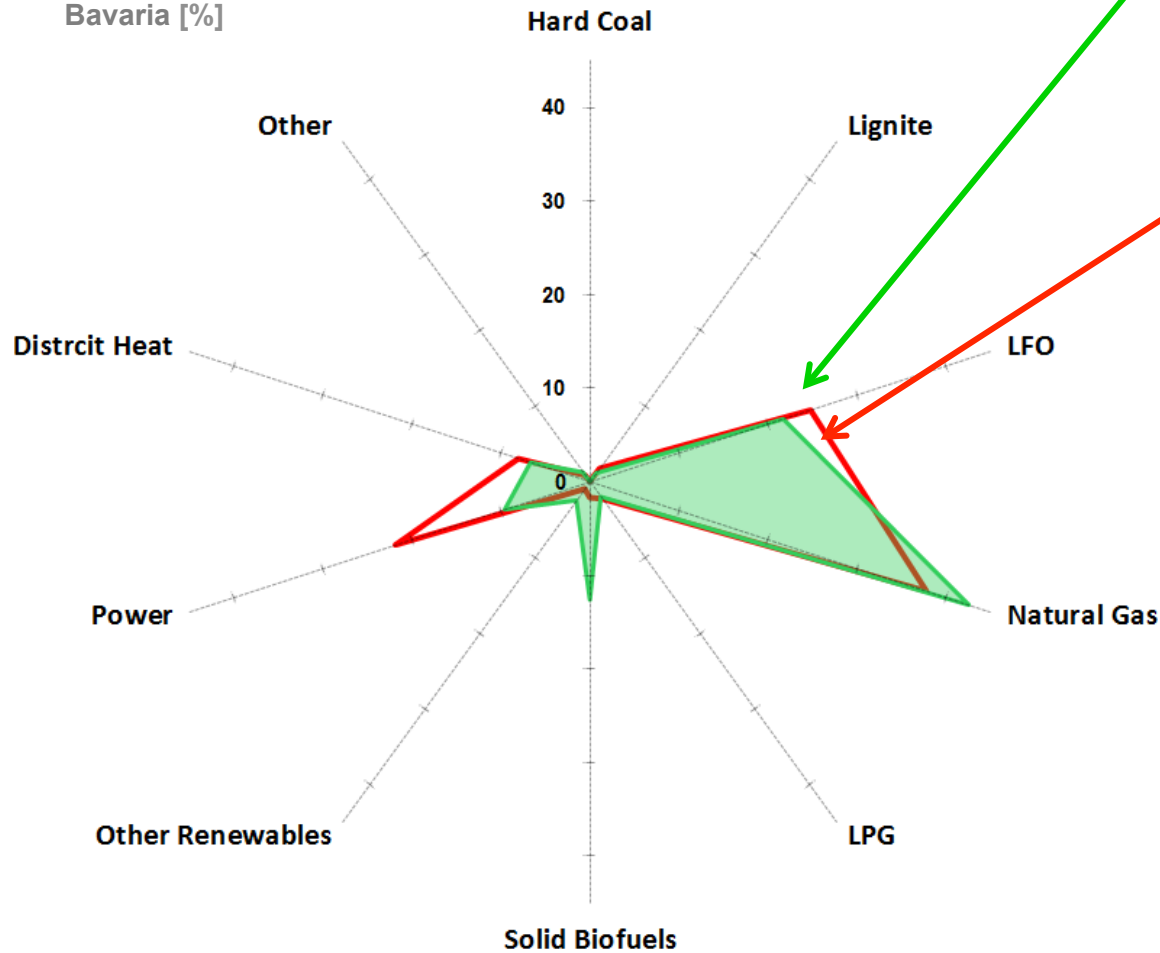
Shares [%] per energy carrier of the baseline heating mix



Amount of final energy
for heat in Bavaria:
663,715 TJ

Bavarian Heating Mix – Total Emissions

Shares [%] per energy carrier of the baseline heating mix and the impact on Global Warming and particulate matter emissions for the provision of heat in Bavaria [%]



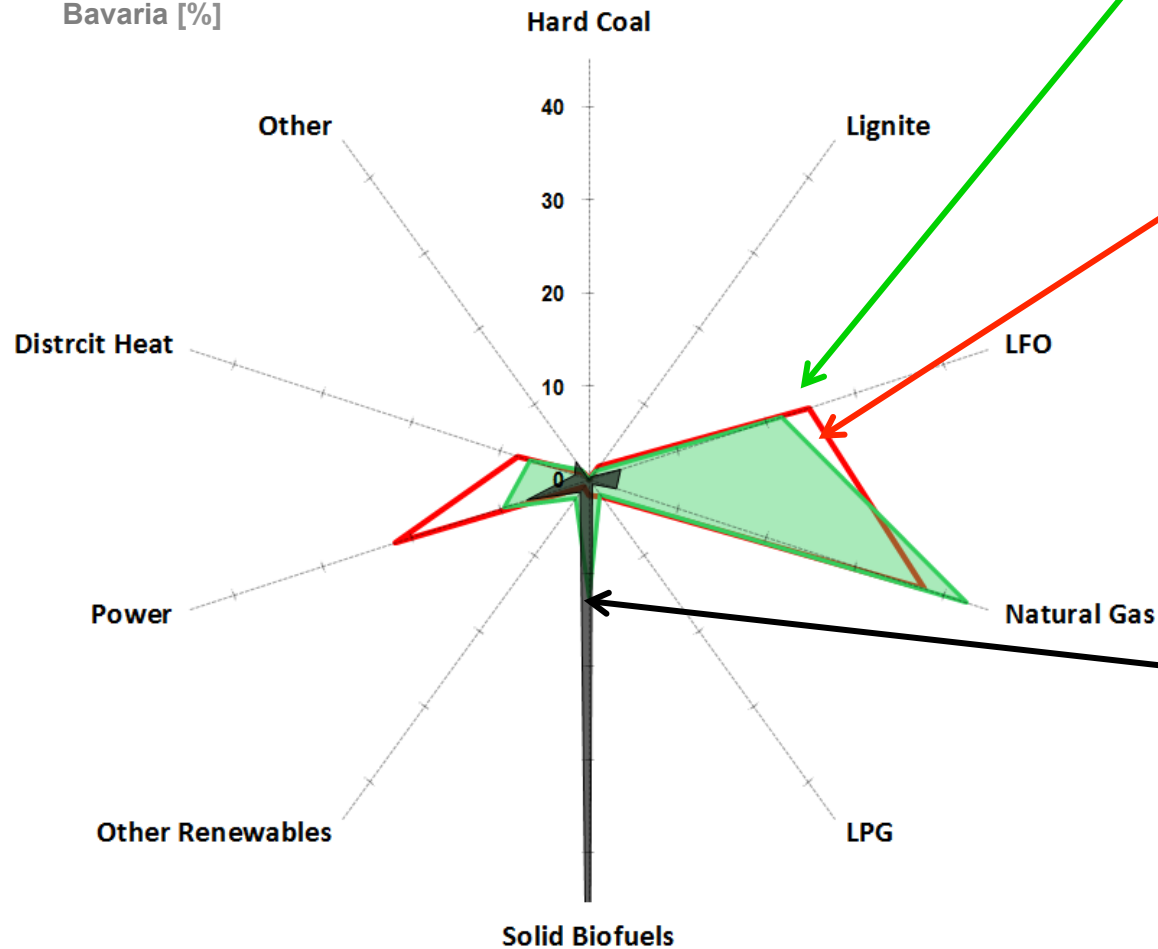
Amount of final energy
for heat in Bavaria:
663,715 TJ

GHG – Emissions
for the provision of heat:
49.59 Mt CO₂-Equiv.

→ **1.7%** of
GHG – Emissions are caused
by solid biofuels

Bavarian Heating Mix – Total Emissions

Shares [%] per energy carrier of the baseline heating mix and the impact on Global Warming and particulate matter emissions for the provision of heat in Bavaria [%]



Amount of final energy
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663,715 TJ

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49.59 Mt CO₂-Equiv.

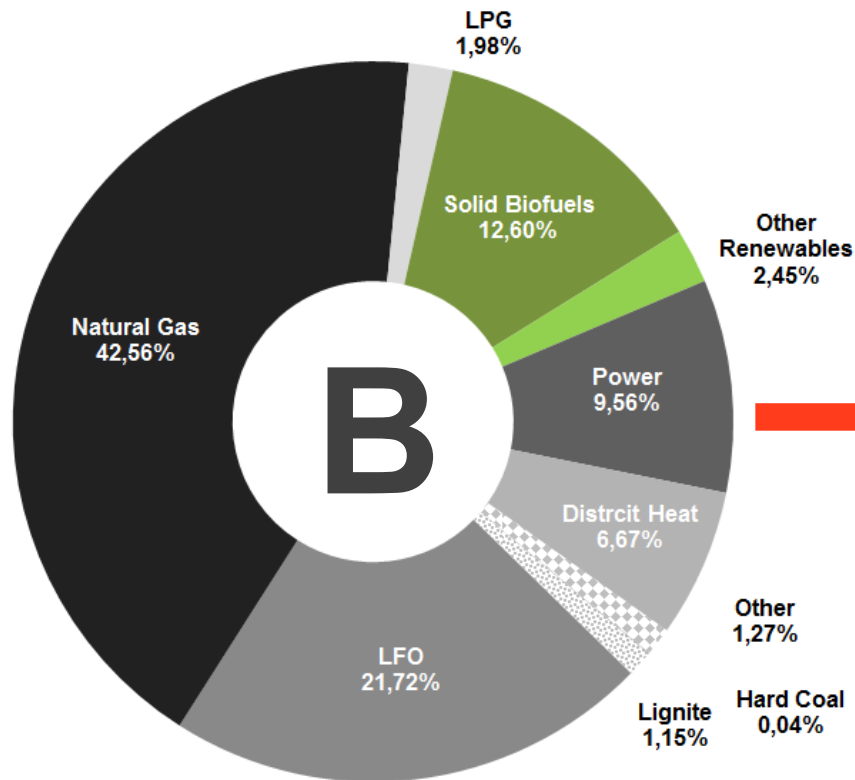
→ **1.7%** of
GHG – Emissions are caused
by solid biofuels

Emissions of particulate matter
for the provision of heat:
14,555 t PM_{2,5}-Äq.

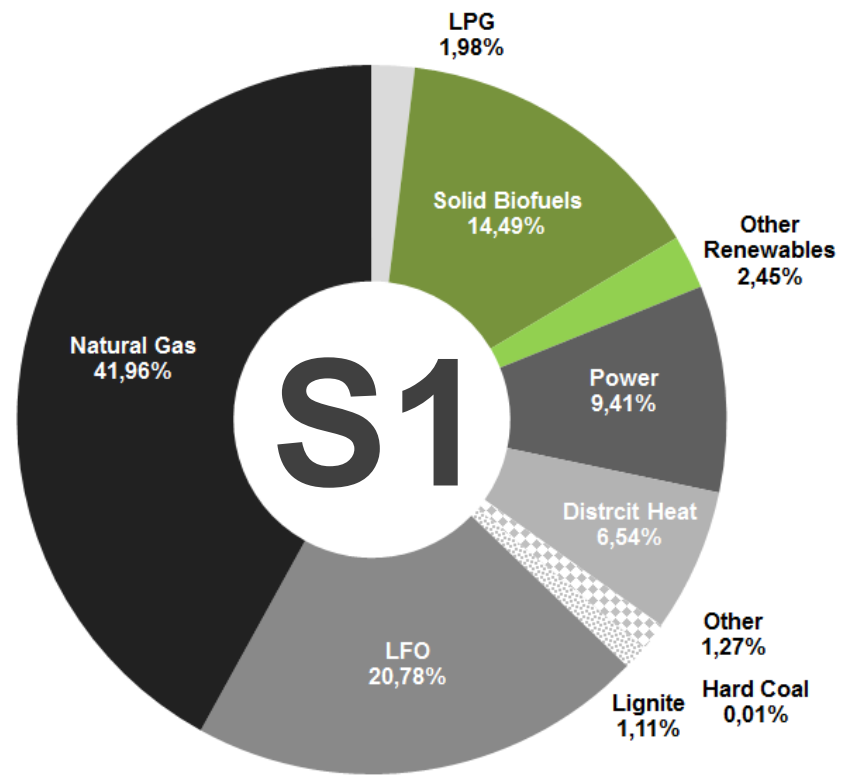
→ **80%**
of particulate matter
emissions are caused by
solid biofuels

Shifting Energy Wood Use – Scenarios

Baseline



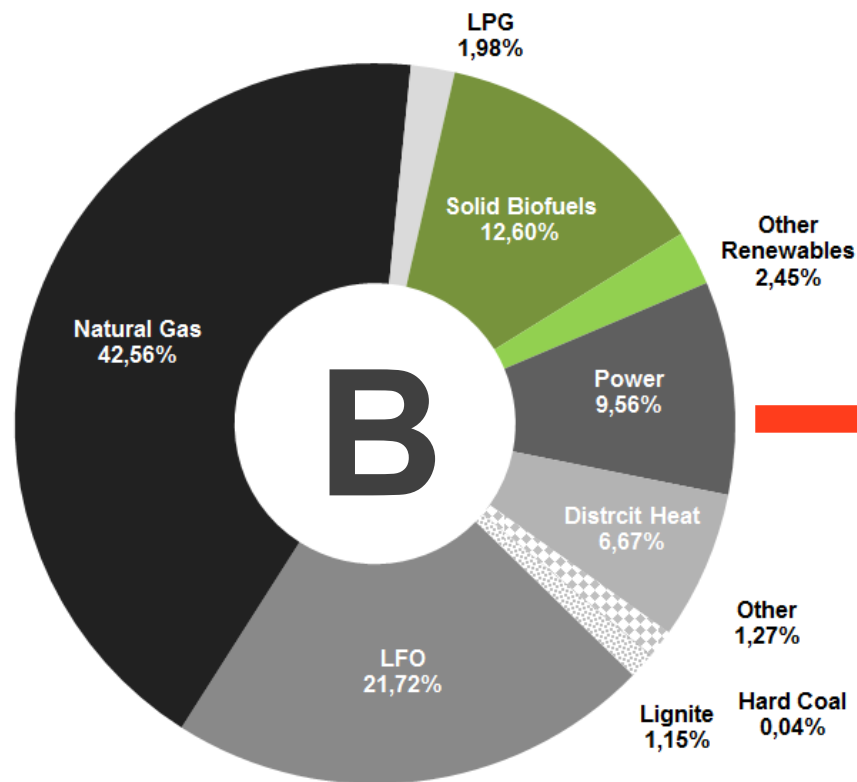
Bavarian Energy Concept (15% increase of energy wood)



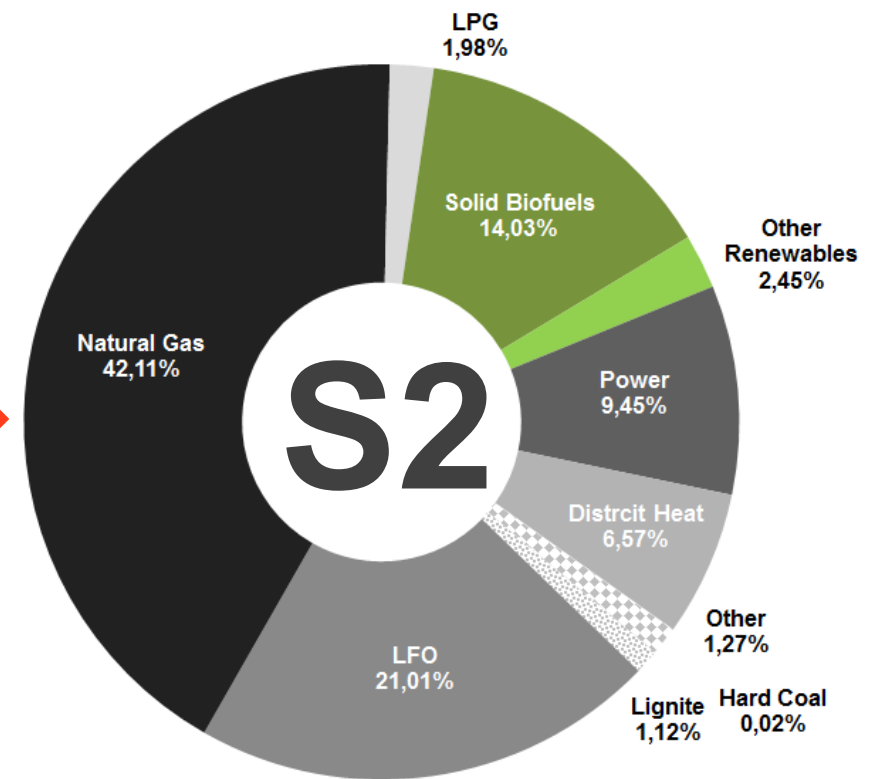
- Reduction of GHG- Emissions of 1 Mt CO₂-eq. * yr-1 (-2%)
- Increase in particulate matter emissions of 1690 t PM_{2.5}-eq. * yr-1 (+11.6%)

Shifting Energy Wood Use – Scenarios

Baseline



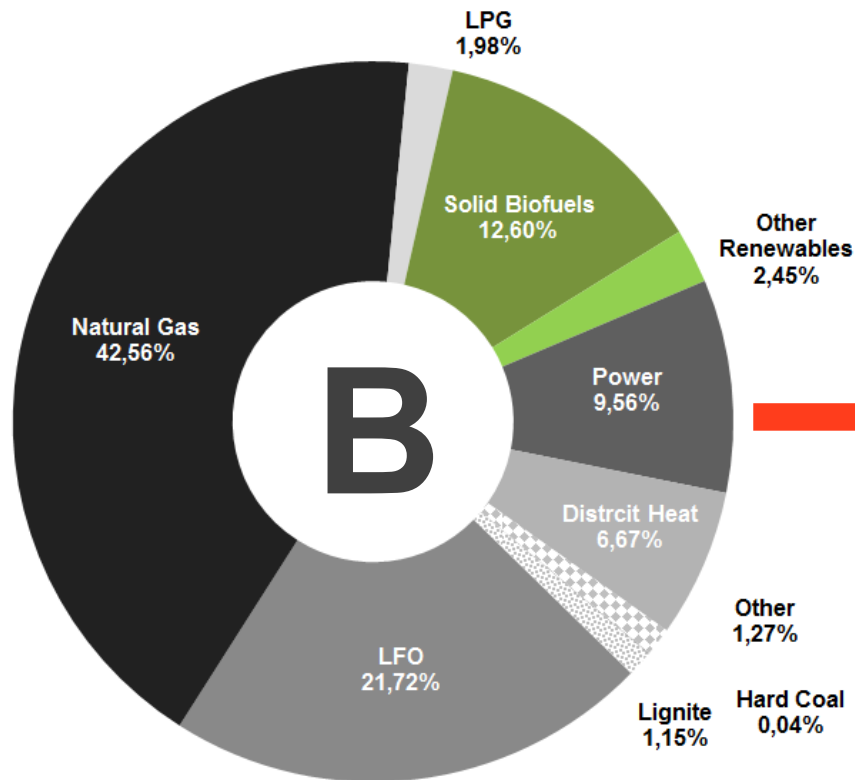
Wood Mobilization from Private Forests (+1.1m³/ha/a)



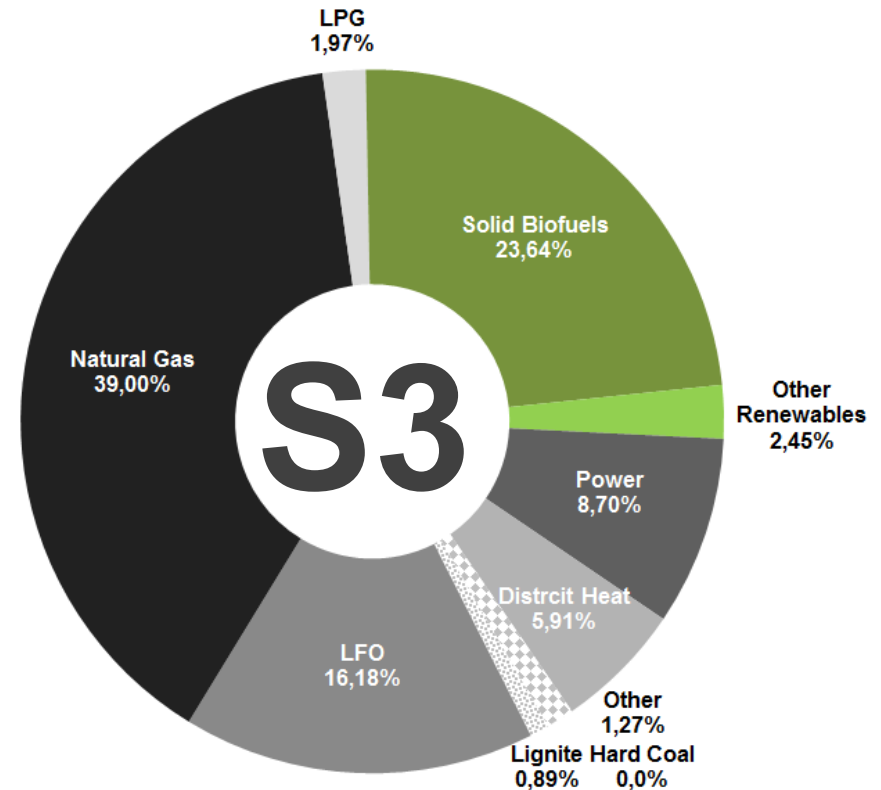
- Shows slightly more moderate changes in comparison to S1
- Confirms that scientific assessment and political target can be „comparable“

Shifting Energy Wood Use – Scenarios

Baseline



100% Energetic Wood Use

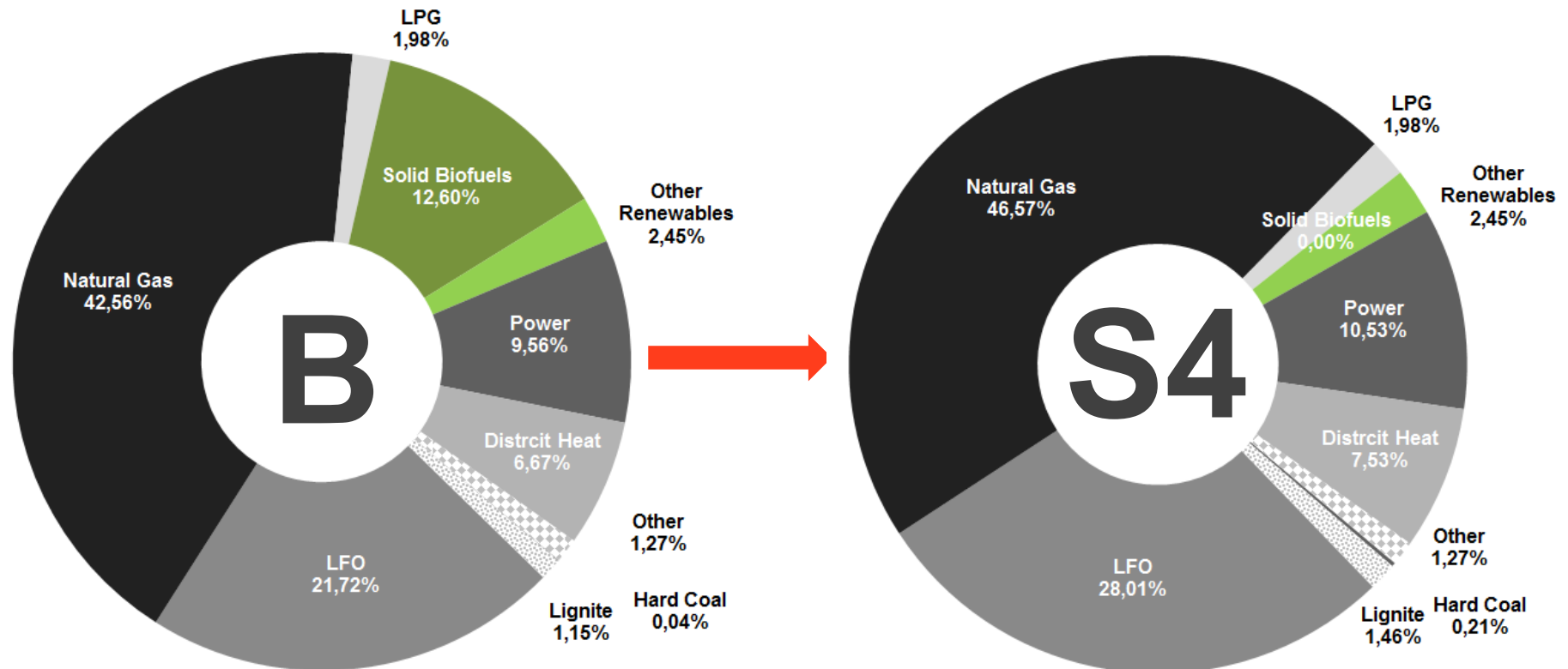


- **Maximum share of solid biofuels in Bavaria can not exceed 25%**
- **Maximum GHG reduction from solid biofuels: 5.6 Mt CO₂-eq. * yr⁻¹ (-11%) (PM_{2.5} + 68%)**

Shifting Energy Wood Use – Scenarios

Baseline

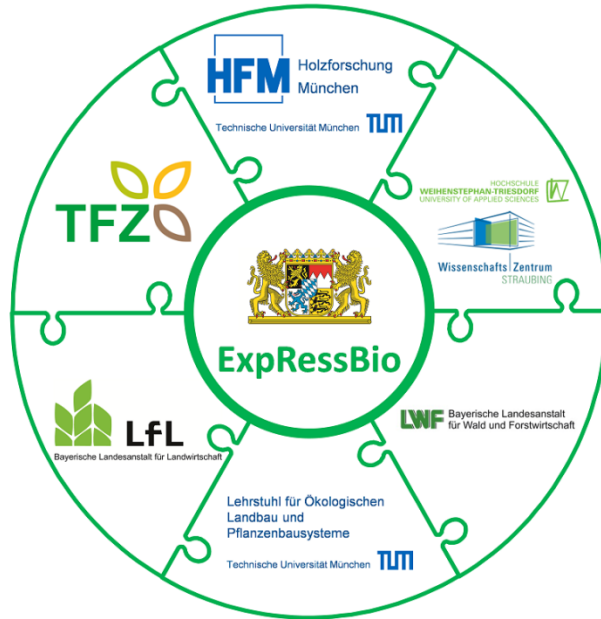
0% Energetic Wood Use



- Shows the current climate change mitigation performance of solid biofuels in Bavaria: 6.4 Mt CO₂-eq. * yr⁻¹ (total: 56 Mt CO₂-eq. * yr⁻¹)

Key Notes

- **Share of solid biofuels** in the heating mix is approx. **13%** and rising (**1.7%** of total **GHGs**; **80%** of total **particulate matter**)
- **80%** of wood is used in **split wood** stoves (^particulate matter)
- **Emissions of GHGs** alone are **insufficient** for the scientific assessment of environmental effects of wood energy
- Current **political targets show** a potential additional **reduction** of GHG emissions of approx. **1 Mt CO₂-eq. * yr⁻¹** (2%) with a current mitigation performance of – 6.4 Mt CO₂-eq. * yr⁻¹
 - 1% reduction of GHG emissions per % of increased share of solid biofuels in the mix
- **Already high saturation of wood heating** in the state. **Important to preserve** this installed capacity and mitigation performance in comparison to competitors (e.g. centralized heating services (district heat), natural gas)



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**Thank you for your
attention**





Literature

- **Wolf, C.; Klein, D.; Weber-Blaschke, G.; Richter, K. (2015a):** Systematic Review and Meta-Analysis of Life Cycle Assessments for Wood Energy Services. *Journal of Industrial Ecology*.
- **Wolf, C.; Klein, D.; Weber-Blaschke, G.; Richter, K. (2015b):** The provision of Heat on a regional Level - Environmental Effects of Developments in the Bavarian Heating Mix through Shifts in the Utilization of Solid Biofuels . Submitted to *Journal of Environmental Management*.
- **Joa, B.; Wolf, C.; Weber-Blaschke, G. (2015).** Einzelöfen verursachen die höchsten Emissionen – Forschungsprojekt untersucht regionale Verteilung und Emissionen von Holzfeuerungen in Bayern. *Holzzentralblatt* Nr. 30.
- **Klein, D.; Wolf, C.; Schulz, C.; Weber-Blaschke, G. (2015)a.** Environmental impacts of the provision of raw wood: An analysis of different biomass supply chains for the most relevant tree species in Bavaria, Germany. *Science of the Total Environment*.
- **Klein, D.; Wolf, C.; Schulz, C.; Weber-Blaschke, G. (2015b):** 20 years of life cycle assessment (LCA) in the forestry sector: state of the art and a methodical proposal for the LCA of forest production. *International Journal of Life Cycle Assessment*.