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Development of Application-Related Emissions in the Course of the German Energy Transition

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2019

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Motivation

- Germany's Climate Action Plan:
 - Reducing total greenhouse gas (GHG) emissions by 55 % (in comparison to the base year 2030) until 2030
 - Reducing GHG emission by 80 95 % until 2050
- Slow decrease in the last decade

- What are the reasons for the slowly progressing energy turnaround?
- Which applications are to be focused so that the energy turnaround picks up speed?

Historic Development of Energy-Related CO₂ Emissions in Germany



Source: National Trend Tables for the German Atmospheric Emission Reporting. Dessau: Umweltbundesamt (UBA)



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Methodology and Input Data

Methodology and Input Data





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Results Development of the Emissions and Results for 2016

Results: Development of the Application-Related Emissions Balance



Development of CO₂ Emissions by Application

- Slowly declining total emissions in Germany
- Most of the emissions arise from the applications mechanical energy, process heat and space heating
- Emissions from mechanical energy have risen in recent years
- As a result of the economic crisis, the industry experienced a decline, which can be seen in the emissions of mechanical energy and process heat



Results: Development of the Application-Related Emissions Balance

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Change of CO₂ Emissions by Application

- Emissions from space cooling have risen sharply in recent years due to rising energy demand (very small share of total emissions)
- No significant reduction in CO₂ emissions in the emission-intensive applications mechanical energy and process heat
- Emissions due to the provision of space heating are reduced due to a combination of progressive renovation and new construction as well as improvements in heating technologies



- Most of the emissions from energy supply in 2016 are due to the provision of electricity
- The combustion of lignite and hard coal accounts for more than two thirds of the emissions of the energy supply sector

Energy Carrier	Emission Factor
Electricity (public)	491 g CO ₂ / kWh
Electricity (industry)	791 g CO ₂ / kWh
District heating	267 g CO ₂ / kWh

CO₂ Emissions in the Energy Supply





- The industrial sector accounts for a large share of the emissions from energy supply
- Due to high electricity consumption, the sectors private households and service are each responsible for more than 80 mio. t CO₂
- A positive export balance leads to an export of 25 mio. t $\rm CO_2$
- The transport sector is responsible for only a small part of indirect emissions (mainly due to the provision of fuels)

Distribution of CO₂ of the Energy Supply





- The greatest reduction potential is offered by mechanical energy and process heat
- Reducing emissions from space heating would lead to lower emissions in the sectors private households and service
- Electricity intensive applications such as lighting, ICT, process cold and space cooling are defossilized by the energy turnaround in the energy supply









If possible, it is reasonable to shift from direct emissions to indirect emissions. The constantly decreasing emission factor of electricity would lead to decreasing emissions.

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Summary and Conclusion

Beispielfolie: Strukturelemente

- **Summary** Total emissions in Germany stagnate in the period under review
 - The largest emitters are mechanical energy, process heat and space heating
 - In many application, a progressive energy turnaround in electricity supply can lead to a significant reduction in CO_2 emissions

Conclusion • It appears dangerous that the two most emission-intensive applications in particular will stagnate in the years under consideration

In addition to energy efficiency measures, both electrification and synthetic fuels could lead to a reduction in both direct and indirect emissions



Thank you for your attention!







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BACKUP: Germany's Energy Balance

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BACKUP: Weighted emission factor development



BACKUP: Emission factors



Emission factor in g CO ₂ /kWh	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Electricity (public)	576	592	557	551	535	550	555	553	536	500	491
Electricity (industry)	883	923	885	762	811	768	736	741	741	790	791
District heating	266	287	274	270	273	280	277	277	279	273	267

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