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BIOECONOMY

Providing Sustainable Energies: Key in the coming Bio- and Circular Economy

Our Common Present:
Energy, Economy, Environment and Ethics

March 30, 2017
University of South Bohemia; České Budějovice

Dr. Manfred Kircher
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Climate Protection is 1st priority
EU adheres a common GHG-Reduction Plan

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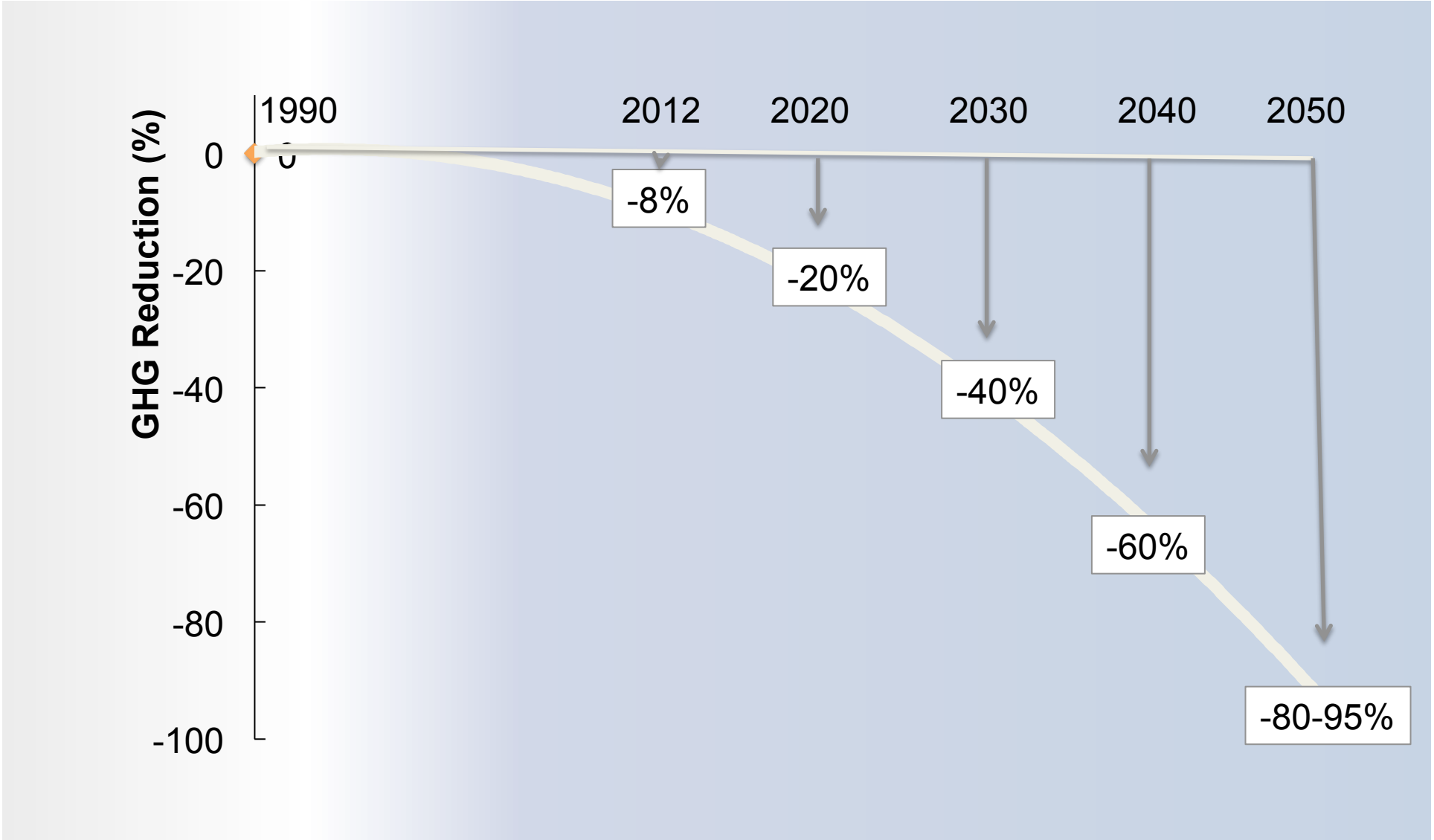

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Challenge	Fossile Energies to be replaced
Solution	Renewable Energies are the only alternative
Challenge	Regional nature, volatility, GHG-emission, limited availability and ethical issues of Renewable Energies
Solution	Broadening the spectrum of energy sources
	Integration of Renewable Energies
	Implications and Outlook

EU-Energy Consumption in heat, fuel, power

1.606 Mtoe oil-equivalents annually (2014, total)

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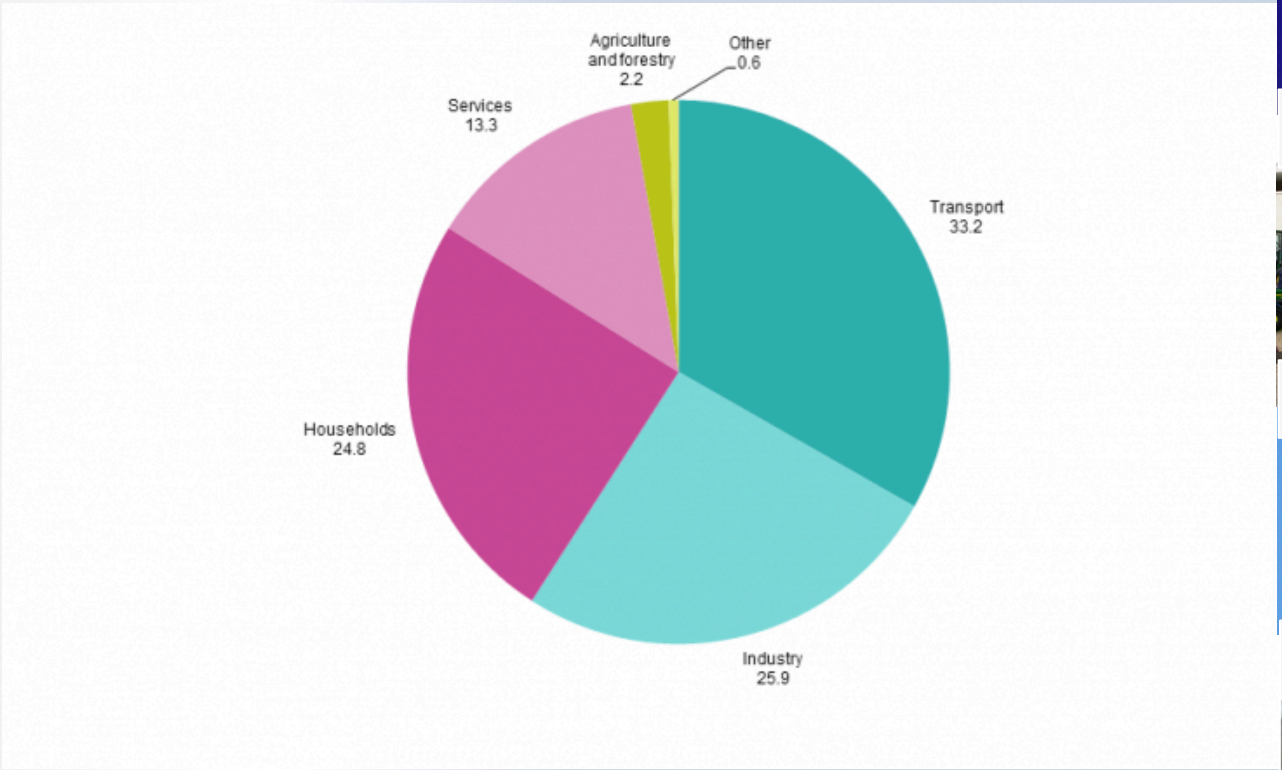
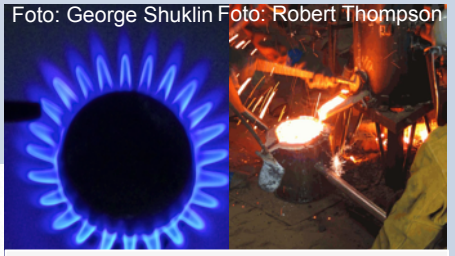
Final energy consumption
EU-28, 2014 (% of total, based on tonnes of oil equivalent)



http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Final_energy_consumption,_EU-28,_2014_(%25_of_total,_based_on_tonnes_of_oil_equivalent)_YB16-de.png



Heat

Fuel

Power

75% of EU-Energy Sources are fossil

1.200 Mtoe oil-equivalents annually (2014)

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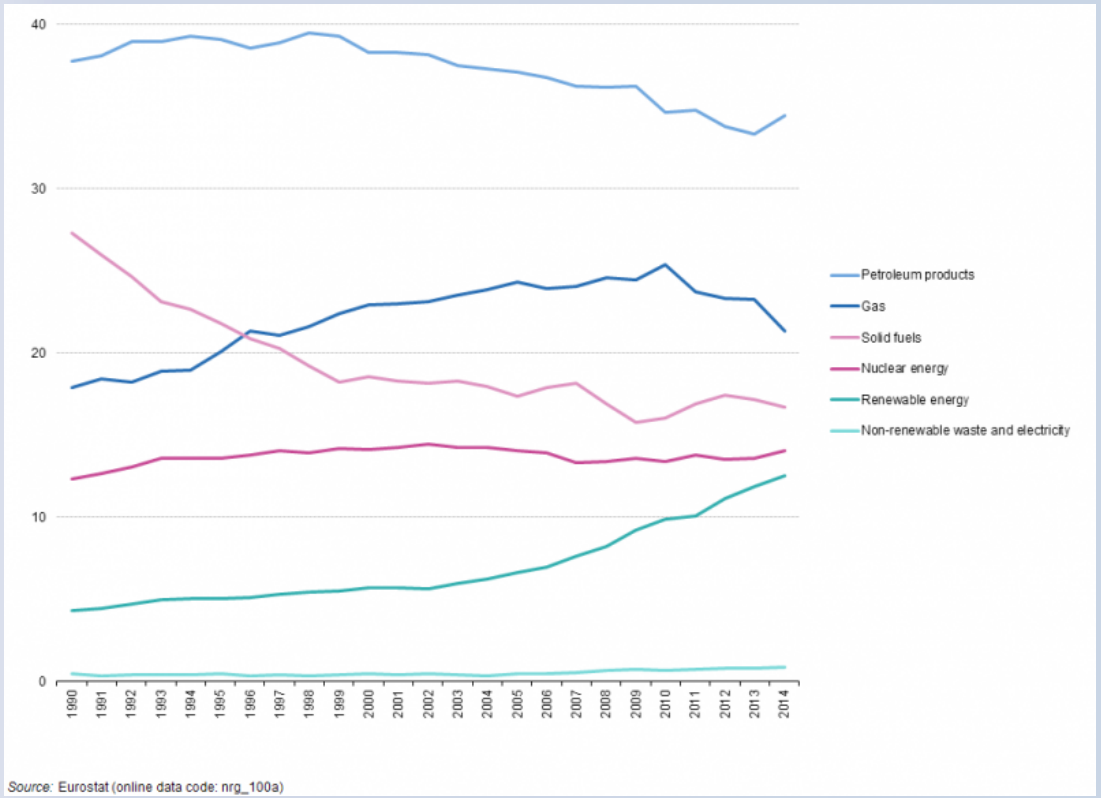
Gross inland consumption
EU-28, 1990–2014 (% of total consumption)



http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Gross_inland_consumption,_EU-28,_1990–2014_(%25_of_total_consumption)_YB16-de.png

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16% of Gross Final Energy comes from renewable sources (264 Mtoe)

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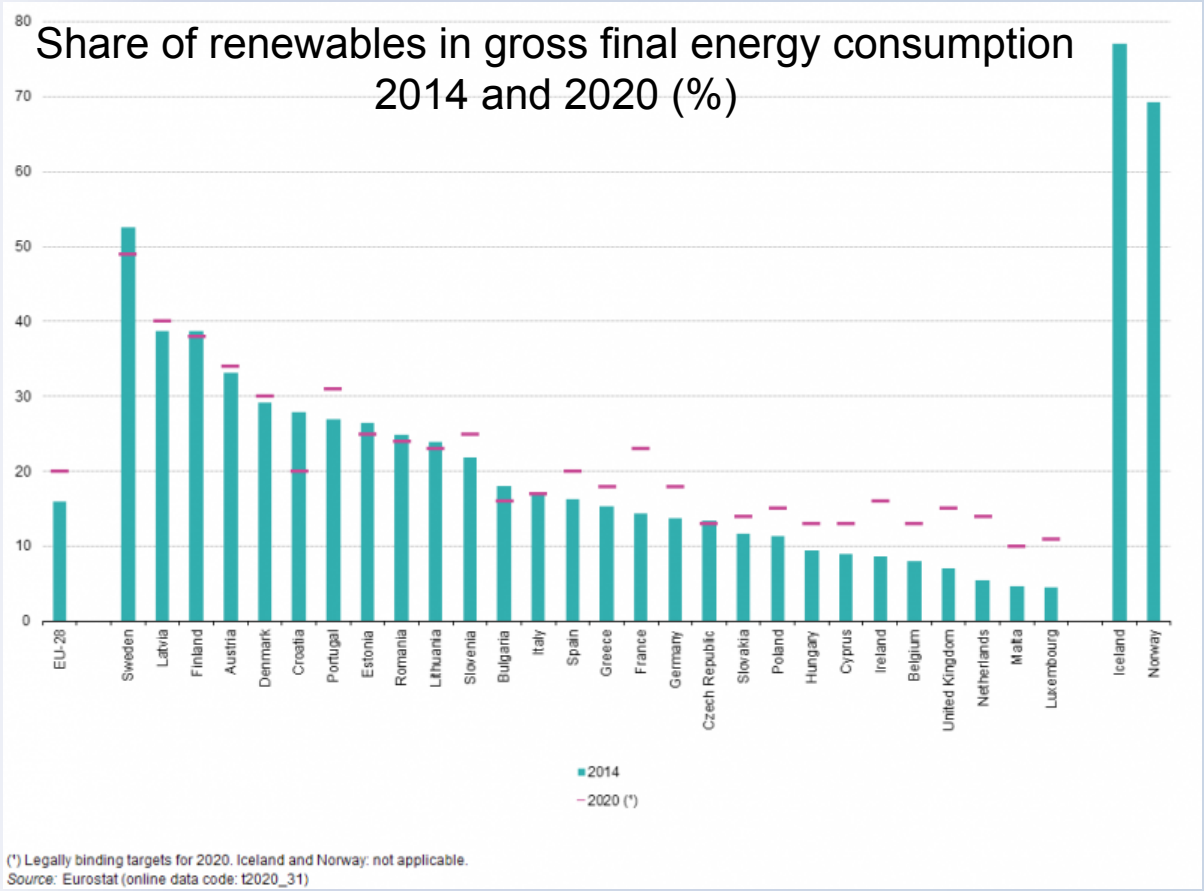
Fotos: Wikimedia



http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Share_of_renewables_in_gross_final_energy_consumption,_2014_and_2020_(%25)_YB16.png

Renewable Energy goes at 1st in heat, 2nd in power, 3rd in fuel

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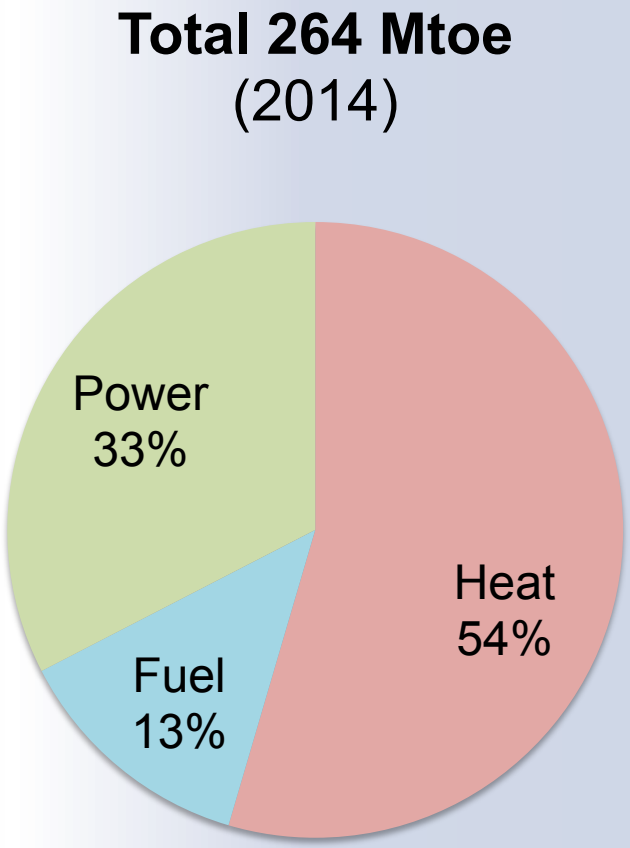

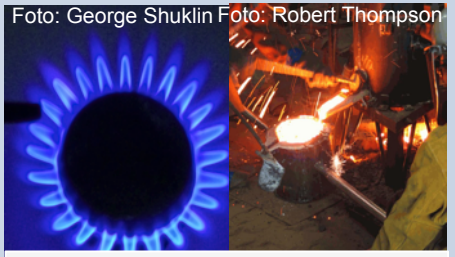

Heat

Fuel

Power

18% of Heating & Cooling comes from renewable sources[1] (144 Mtoe)

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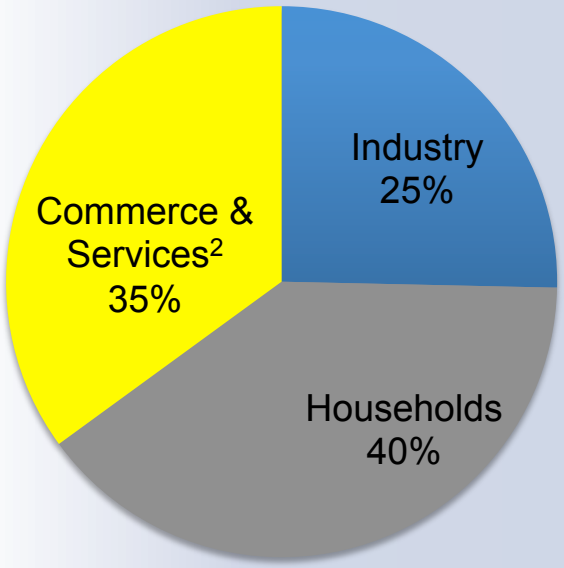
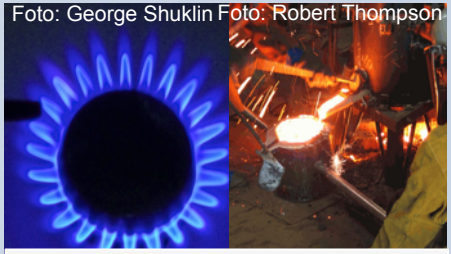
Heating & Cooling consumes 50% of total energy





Heat

1: https://ec.europa.eu/transparency/regdoc/rep/1/2016/DE/1-2016-51-DE-F1-1.PDF
2: Report on biomass market segments within the transport, heat & electricity- CHP sectors for EU27 & Member States; Arturo Castillo, Calliope Panoutsou and Ausilio Bauen; November 2010

7% of Fuels comes from renewable sources (34 Mtoe)

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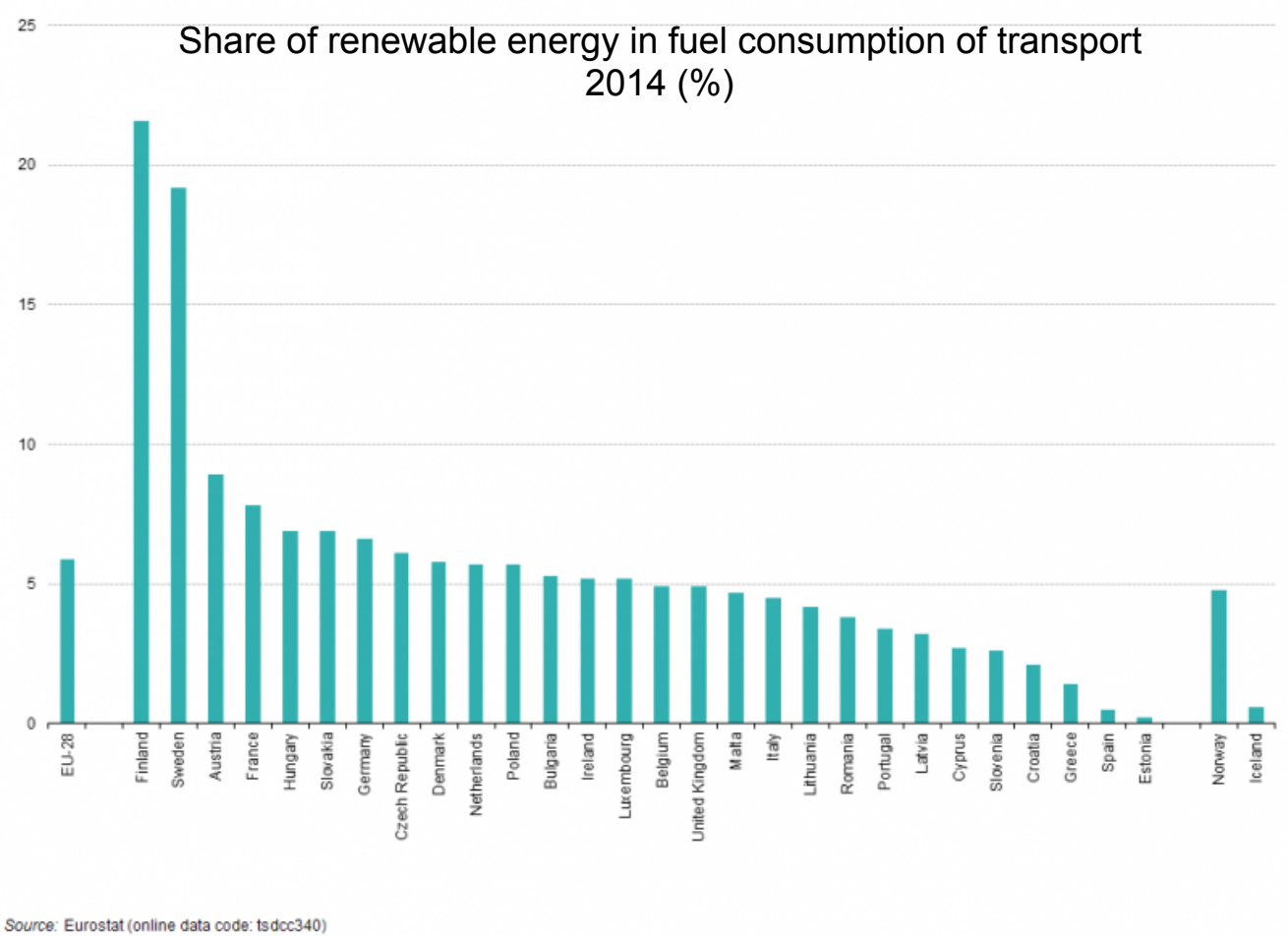

Fuel

http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Share_of_renewable_energy_in_fuel_consumption_of_transport,_2014_(%25)_YB16.png

27% of Power
comes from renewable sources (86 Mtoe)

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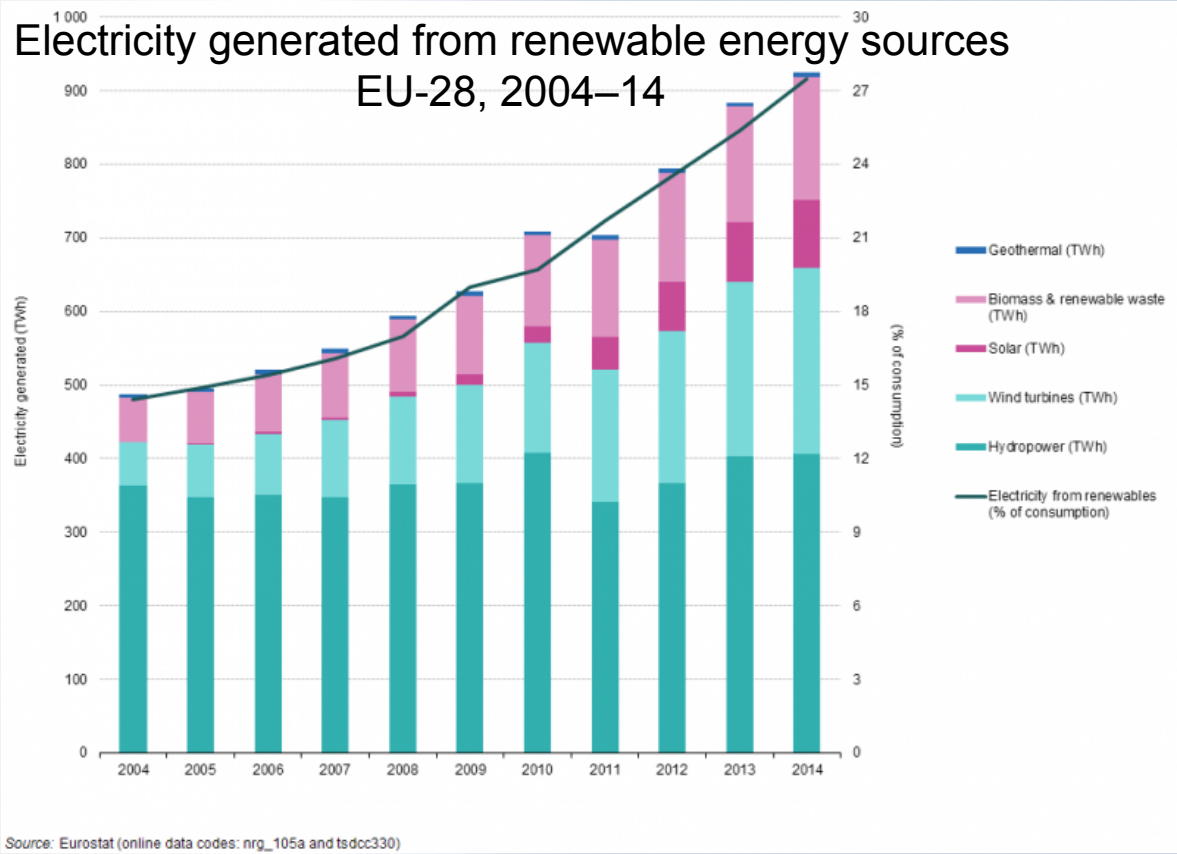

http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Electricity_generated_from_renewable_energy_sou

Power


Foto: Bran

Renewable Energies
- availability and primary output

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Fotos: Wikimedia Commons

Energy source	Available cross-regionally	Heat & Power & Fuel
Solar	✓	◎✓◎
Wind	◎	◎✓◎
Hydro	◎	◎✓◎
Geothermal	◎	✓✓◎
Biomass	✓	✓✓✓

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Challenge	Fossile Energies to be replaced
Solution	Renewable Energies are the only alternative
Challenge	Regional nature, volatility, GHG-emission, limited availability and ethical issues of Renewable Energies
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Availability of Renewable Energies depends on regional conditions

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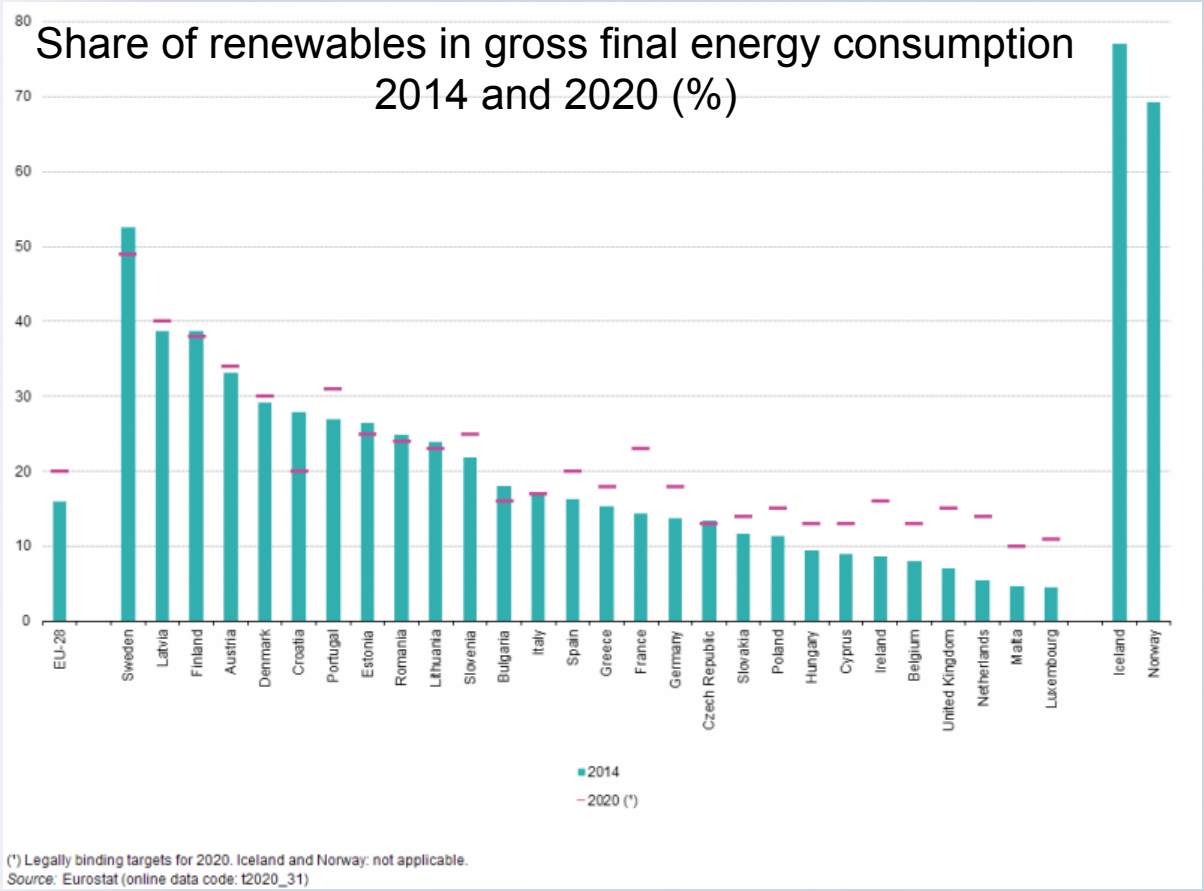

http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Share_of_renewables_in_gross_final_energy_consumption,_2014_and_2020_(%25)_YB16.png

Availability and Ethical Issues

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Fotos: Wikimedia

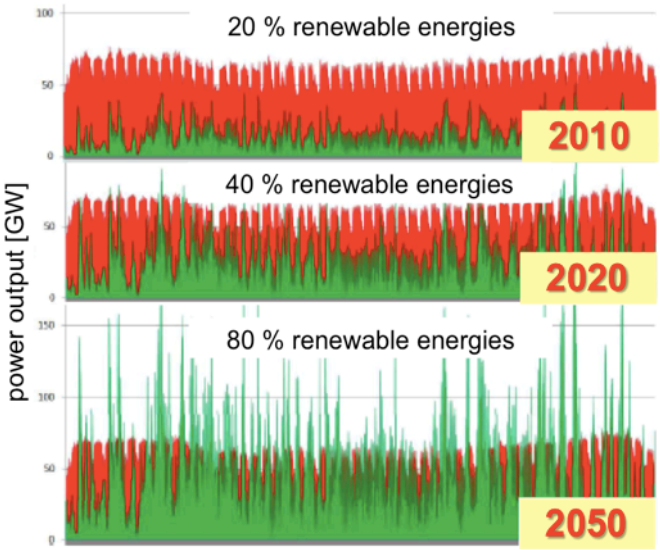
Solar Power day-, night-rythm

Wind Power highly volatile
land use conflict

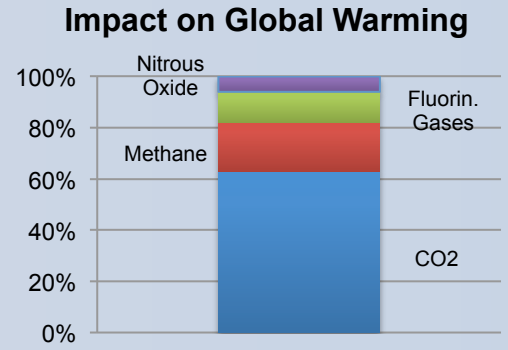
Hydro-Power slows rivers down
kills migrating fishes

Geothermal Energy CO_2-emission (Iceland
geological risks

Biomass food/feed conflict
trend to mono-cultures
reduces biodiversity
GHG-emission



Red: power demand; Germany 2010
Green: Solar and wind power supply
Source: Viessmann



Logistics of Biomass is limited

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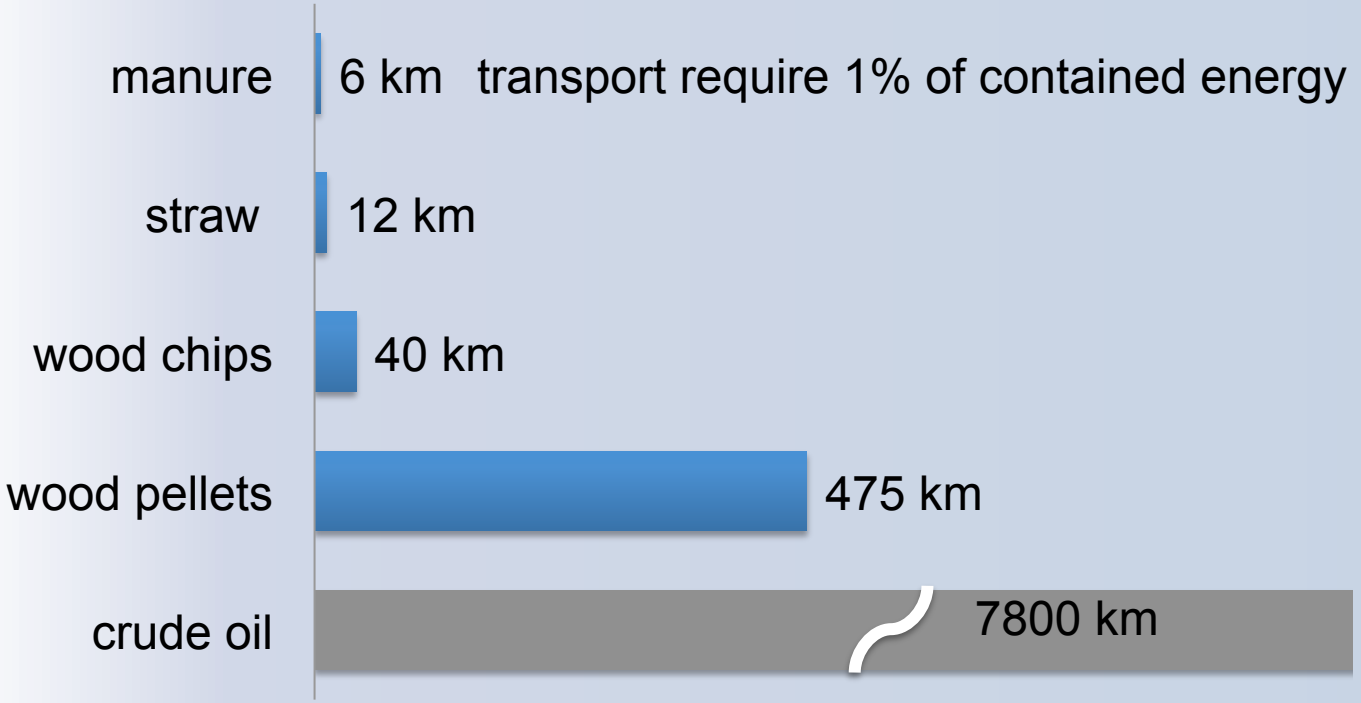
Fotos: Wikimedia



Renewable Energies

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Fotos: Wikimedia Commons

	Available cross-regionally	Heat & Power & Fuel	Baseload able	no GHG-emission	Un-exploited capacities available	no Ethical concerns
Solar	✓	◎✓◎	◎	✓	✓	✓
Wind	◎	◎✓◎	◎	✓	✓	◎
Hydro	◎	◎✓◎	✓	✓	◎	◎
Geo-thermal	◎	✓✓◎	✓	◎	✓	✓
Biomass	✓	✓✓✓	✓	◎	✓	◎

Renewable Energies come at first from biomass

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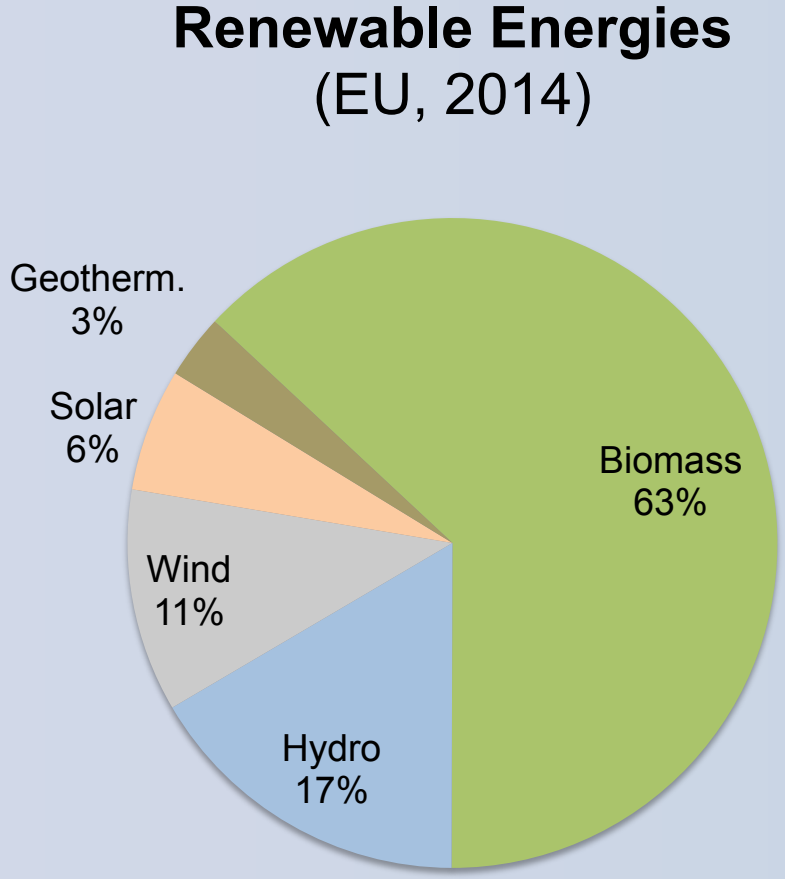
Fotos: Wikimedia Commons



http://ec.europa.eu/eurostat/statistics-explained/index.php/

Bio-Energy used at first for Heat, second for Fuel, and third for Power

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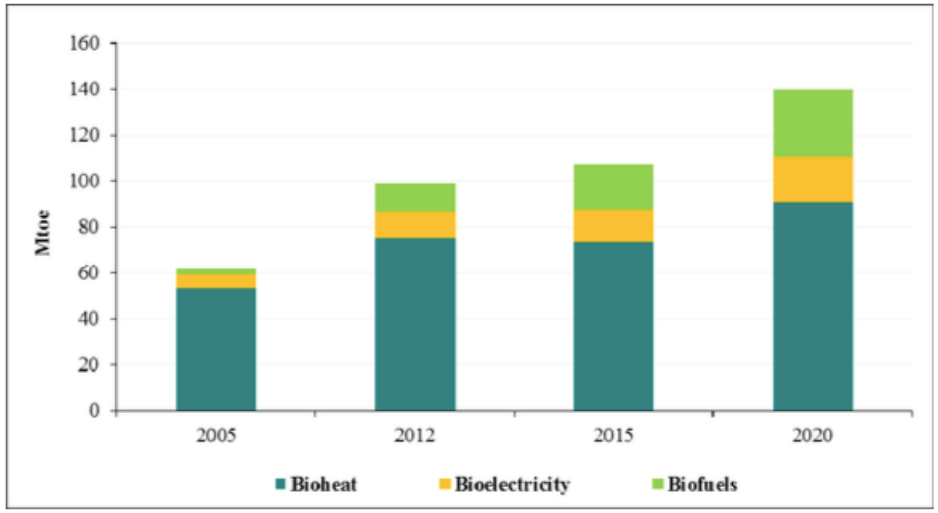

Figure 1: EU biomass consumption in electricity, heating, and transport (Mtoe, 2005-2020)
Source: National renewable energy action plans (NREAPs) and 2011 progress reports[23].

https://ec.europa.eu/energy/sites/ener/files/2014_biomass_state_of_play_.pdf

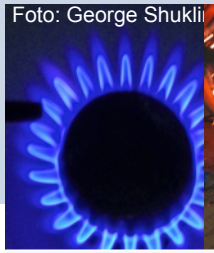
Foto: George Shukli


Foto: Robert Thompson

Heat


Foto: Andreas Praefcke

Fuel

Foto: Axwell

Power


Foto: Bran

Heat & Power: 51% Wood Pellets imported

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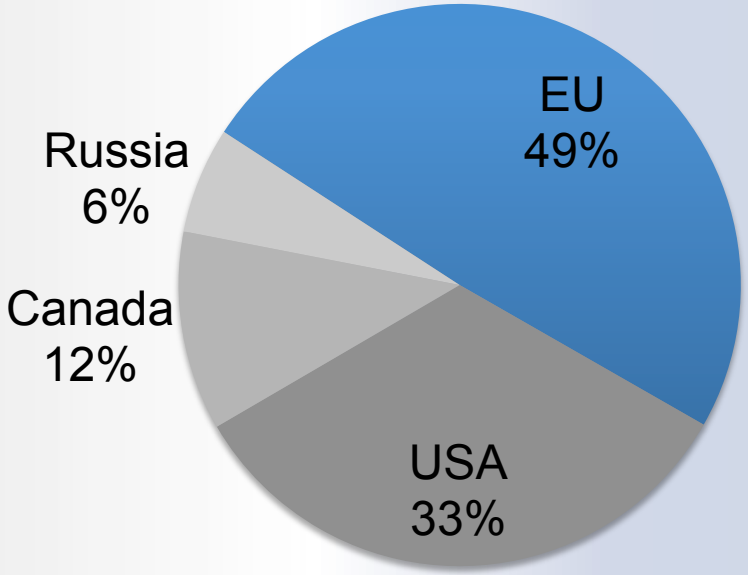
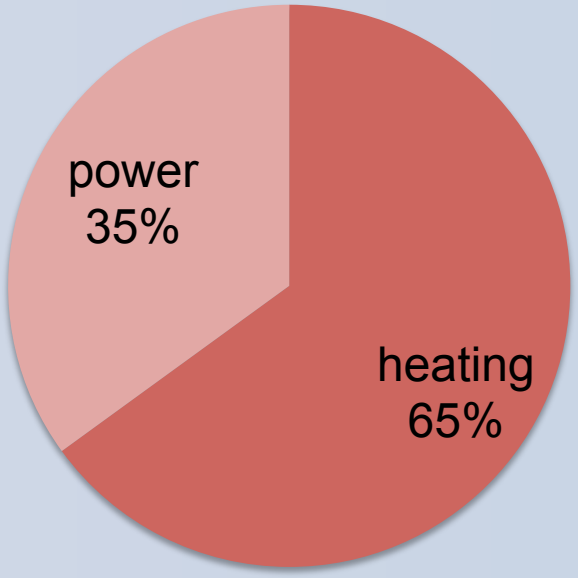
Origin of Wood Pellets
(total 14 mio MT; EU, 2015)

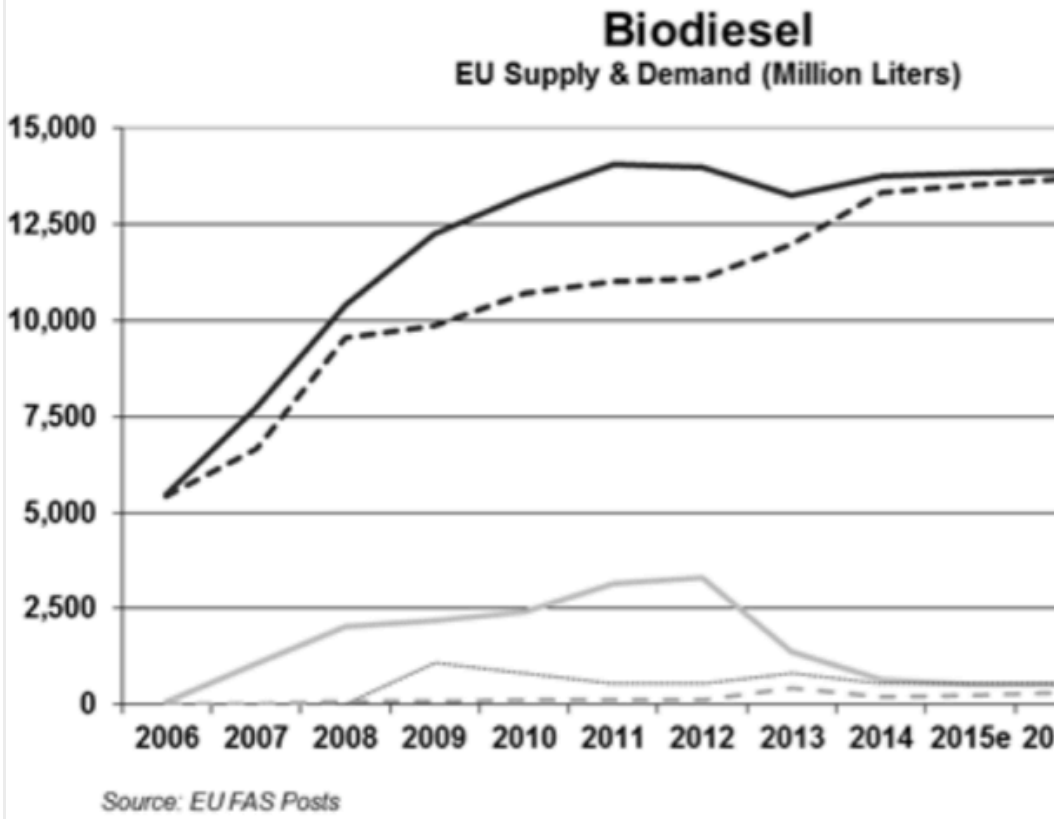


Utilization of Wood Pellets
(EU, 2015)

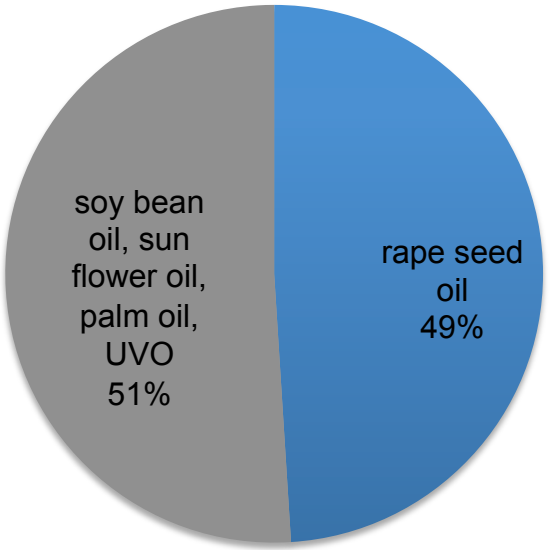


https://gain.fas.usda.gov/Recent/20GAIN/20Publications/Biofuels/20Annual_The/20Hague_EU-28_6-29-2016.pdf

Fuel: 51% Biodiesel Feedstock imported



Biodiesel Feedstock
(%, EU, 2015)



Bioethanol Feedstock

EU: Grain, Sugar beet
US, Ukraine: Corn

https://gain.fas.usda.gov/Recent/20GAIN/20Publications/Biofuels/20Annual_The/20Hague_EU-28_6-29-2016.pdf

30.11.2016 Renewable Energy Directive II Cap for Conventional Biofuel ´

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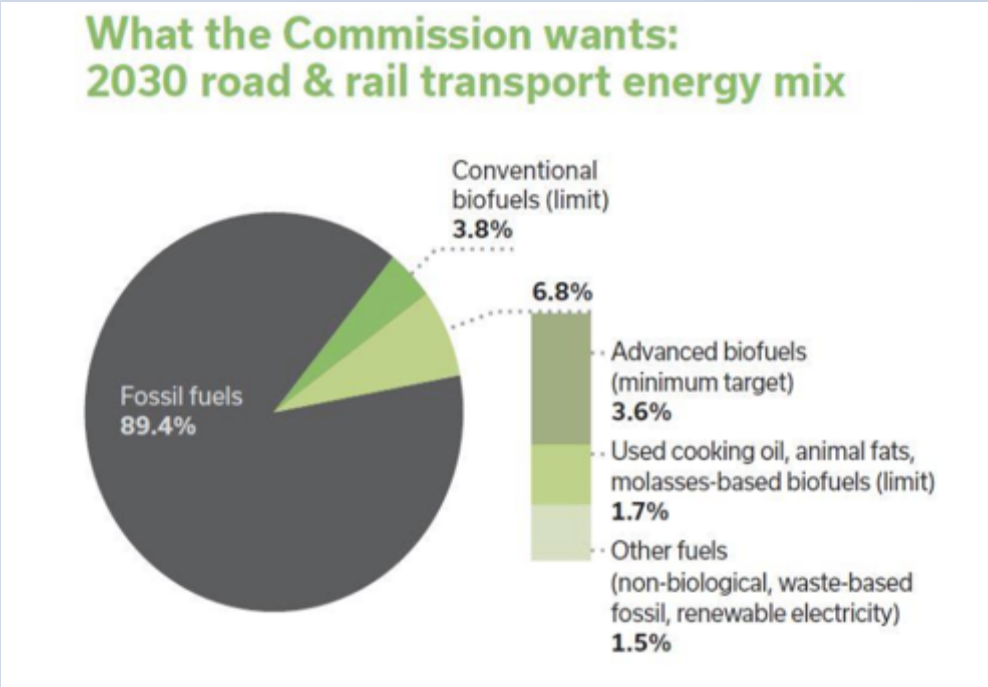
2030: Renewable energy consumption
at least 27% across the three sectors of
electricity
heating and cooling
transport

Renewable Energy Status 2014: 15,3%

Biofuels

Conventional biofuels , such as ethanol made from corn, wheat and sugar beet grown in Europe, to be reduced from 7 % of road transport energy in 2021 to **3,8% in 2030**.

Fuel Blending Status 2015
3,4% bioethanol
6,5% biodiesel
0,83% advanced ethanol, HVO



2050: Bioenergy Potential is limited

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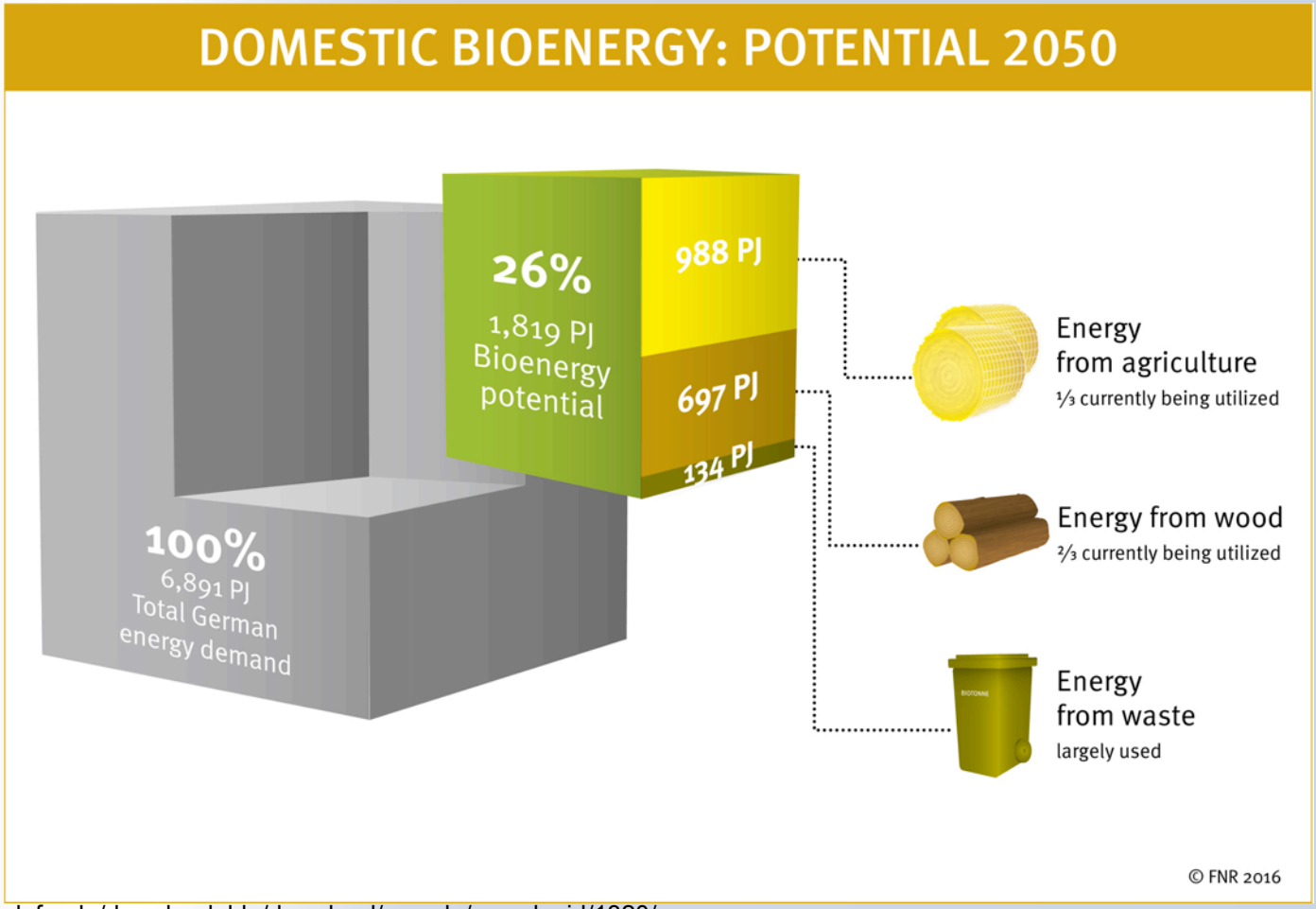

https://mediathek.fnr.de/downloadable/download/sample/sample_id/1320/

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Broadening the Feedstock Spectrum is Needed

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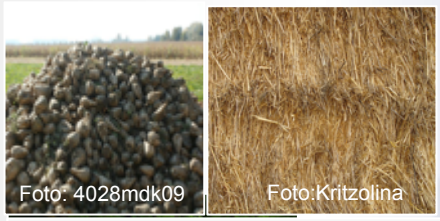


Agriculture

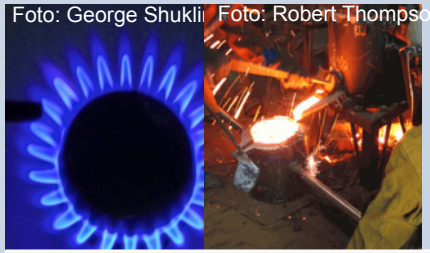
Forest. ‚Marine Cult.

Municipal Waste

ind.Sidestreams

Fotos: Wikimedia Commons

- ***Cascade use***
- ***Carbon recycling***



Heat

Fuel

Power

2.7.2014 Circular Economy
Reduce Landfills, Recycle

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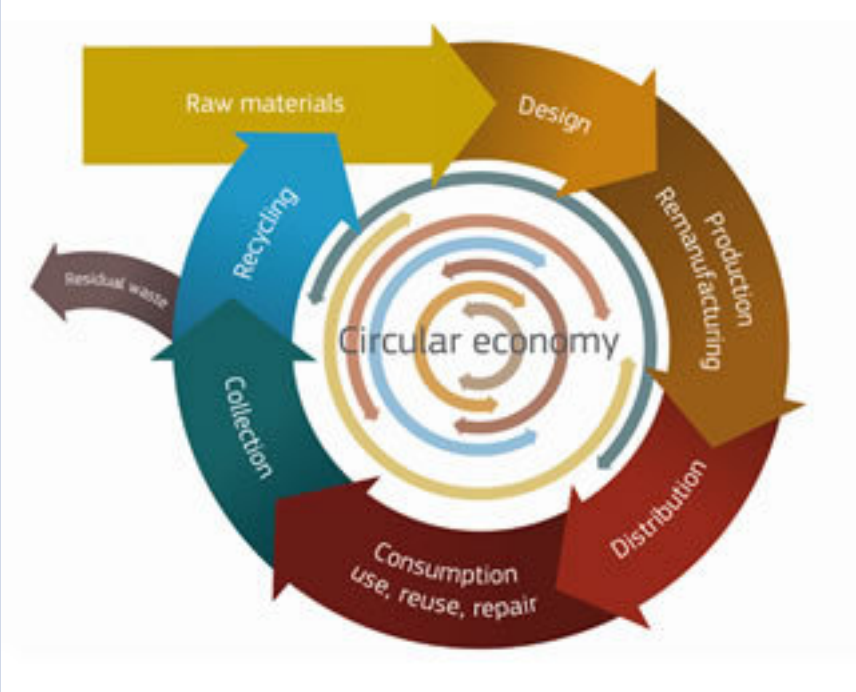
A common EU target for recycling 65% of municipal waste, 75% of packaging waste by 2030;

A binding landfill target to reduce landfill to maximum of 10% of municipal waste by 2030; no landfilling of separately collected waste;

Concrete measures to promote re-use and stimulate industrial symbiosis - turning one industry's by-product into another industry's raw material;

Economic incentives for producers to put greener products on the market and support recovery and recycling schemes (eg for packaging, batteries, electric and electronic equipments, vehicles).



http://ec.europa.eu/environment/circular-economy/index_en.htm

Cascading Material Streams & CO_2-Emission

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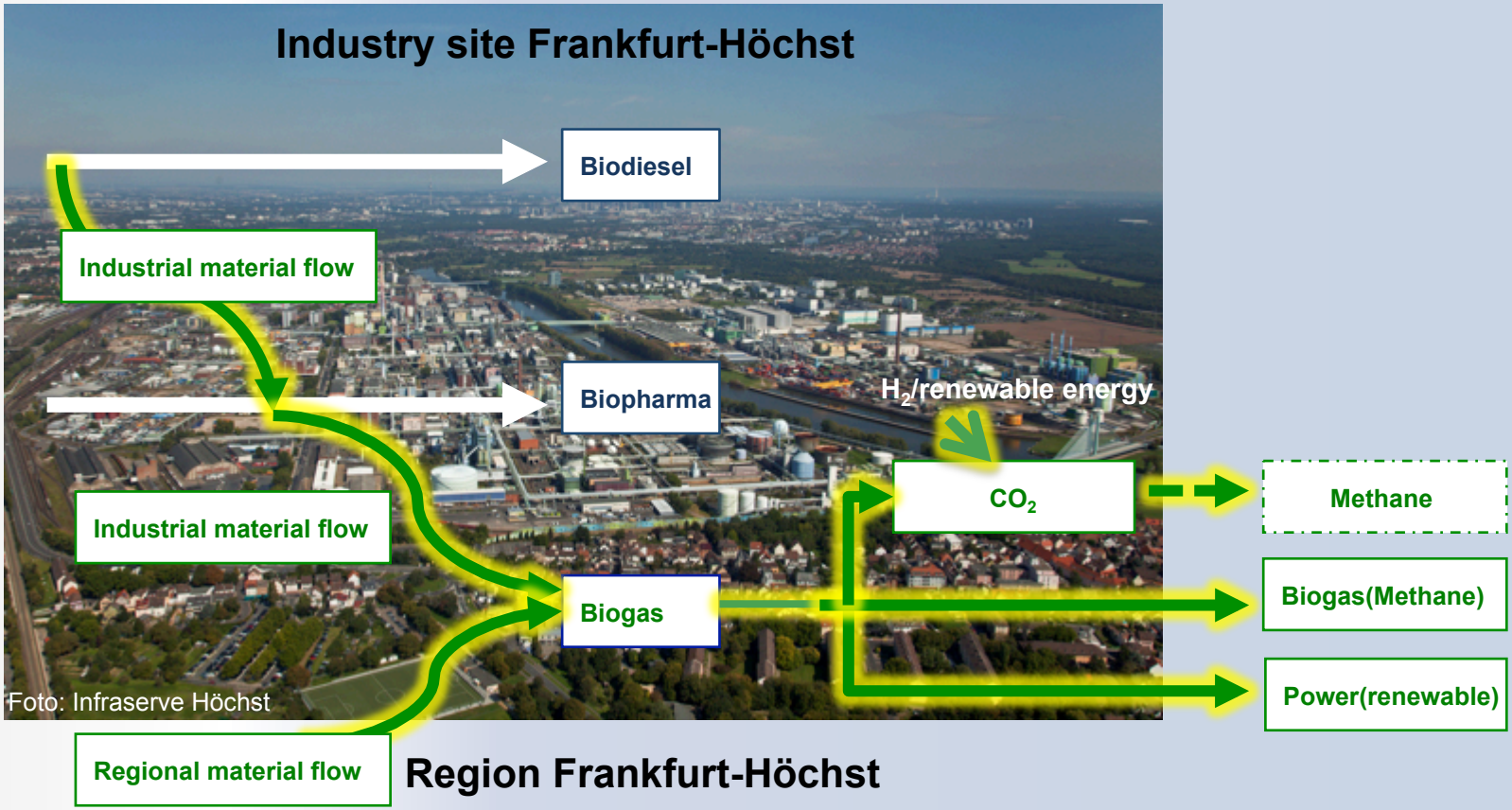

Cascading adds more options

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Fotos: Wikimedia Commons

	Available cross-regionally	Heat Power Fuel	Baseload able	no GHG	Unused capacities available	no Ethical concerns
Solar	✓	◎✓◎	◎	✓	✓	✓
Wind	◎	◎✓◎	◎	✓	✓	◎
Hydro	◎	◎✓◎	✓	✓	◎	◎
Geo-thermal	◎	✓✓◎	✓	◎	✓	✓
Biomass	✓	✓✓✓	✓	◎	✓	◎
Cascade to biogas	✓	✓✓✓	✓	◎	✓	✓
CO_2-emission to methane	✓	✓✓✓	✓	✓	✓	✓

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Power-to-Gas enables utilization of CO_2, energy storage, widens baseload capability

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Fotos: Wikimedia Commons

	Storable Energy	Heat Power Fuel	Baseload able	no GHG	Unused capacities available	no Ethical Concerns
Solar	✓	✓✓✓	✓	✓	✓	✓
Wind	✓	✓✓✓	✓	✓	✓	◎
Hydro	✓	✓✓✓	✓	✓	◎	◎
Geo-thermal	✓	✓✓✓	✓	✓	✓	✓
Biomass	✓	✓✓✓	✓	✓	✓	◎
Cascade to biogas	✓	✓✓✓	✓	✓	✓	✓
CO_2-con-version to methane	✓	✓✓✓	✓	✓	✓	✓

Replacement of fossil energies has implications on chemical sectors

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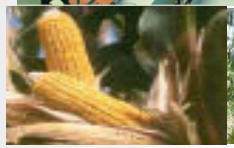
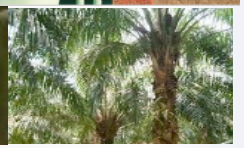
Foto:Tony Hisgett


Foto:Peabody Energy


Foto:Sasol





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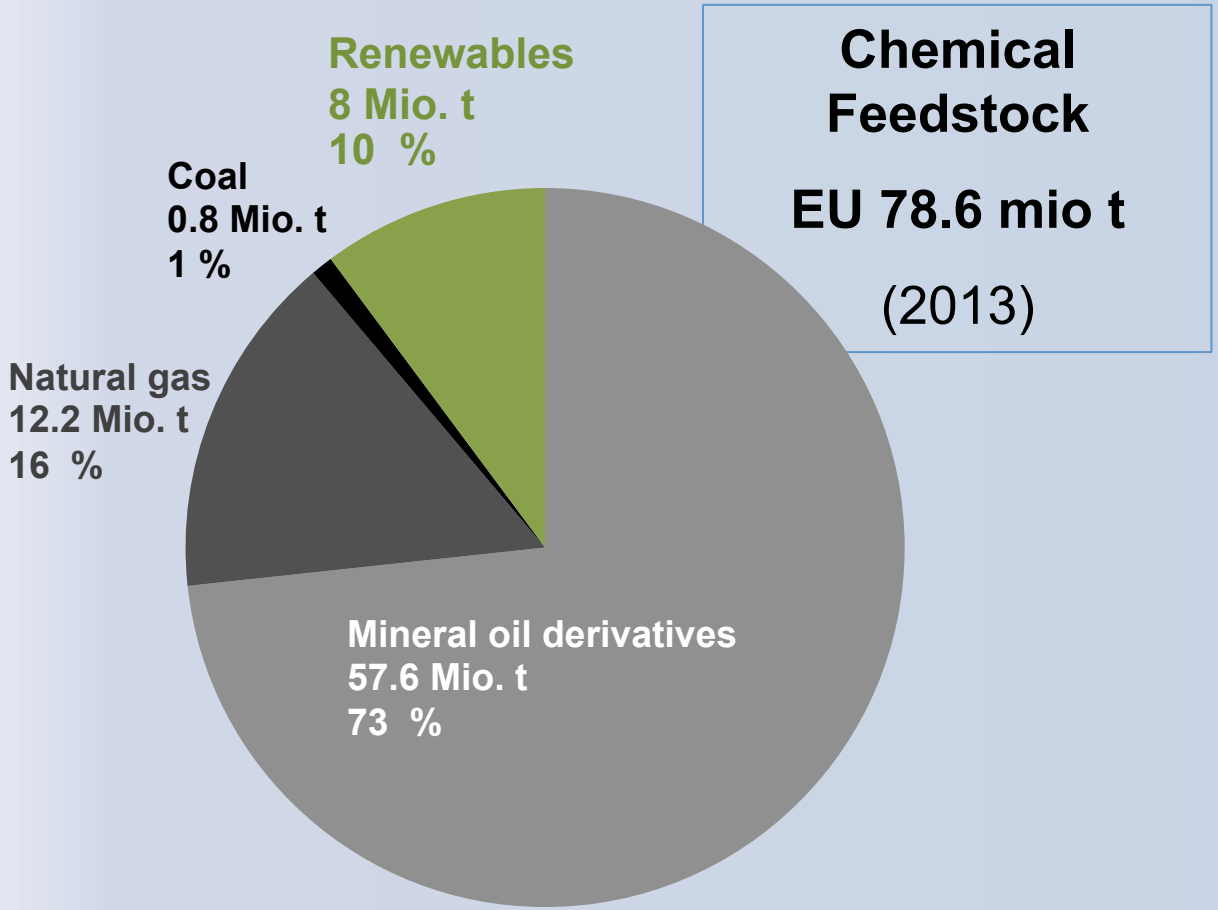

Chemical Feedstock

EU 78.6 mio t

(2013)

Data sources: Cefic, VCI, FNR.
Calculation base: Raw materials weight in tonnes

Paris Climate Change Agreement is effective
- GHG-emission capacity capped

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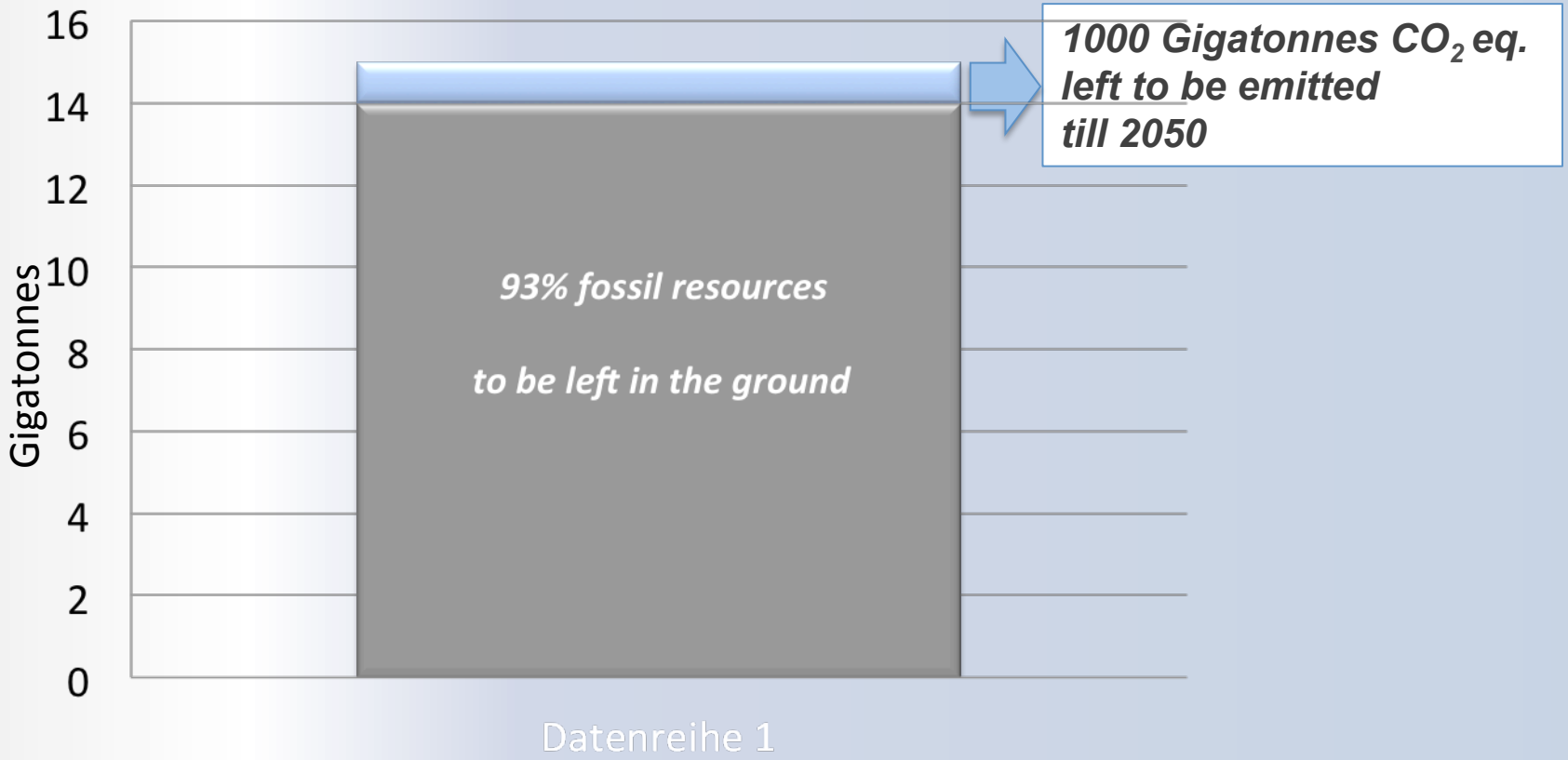

Replacement of fossil energies
- strong implications on financial sectors

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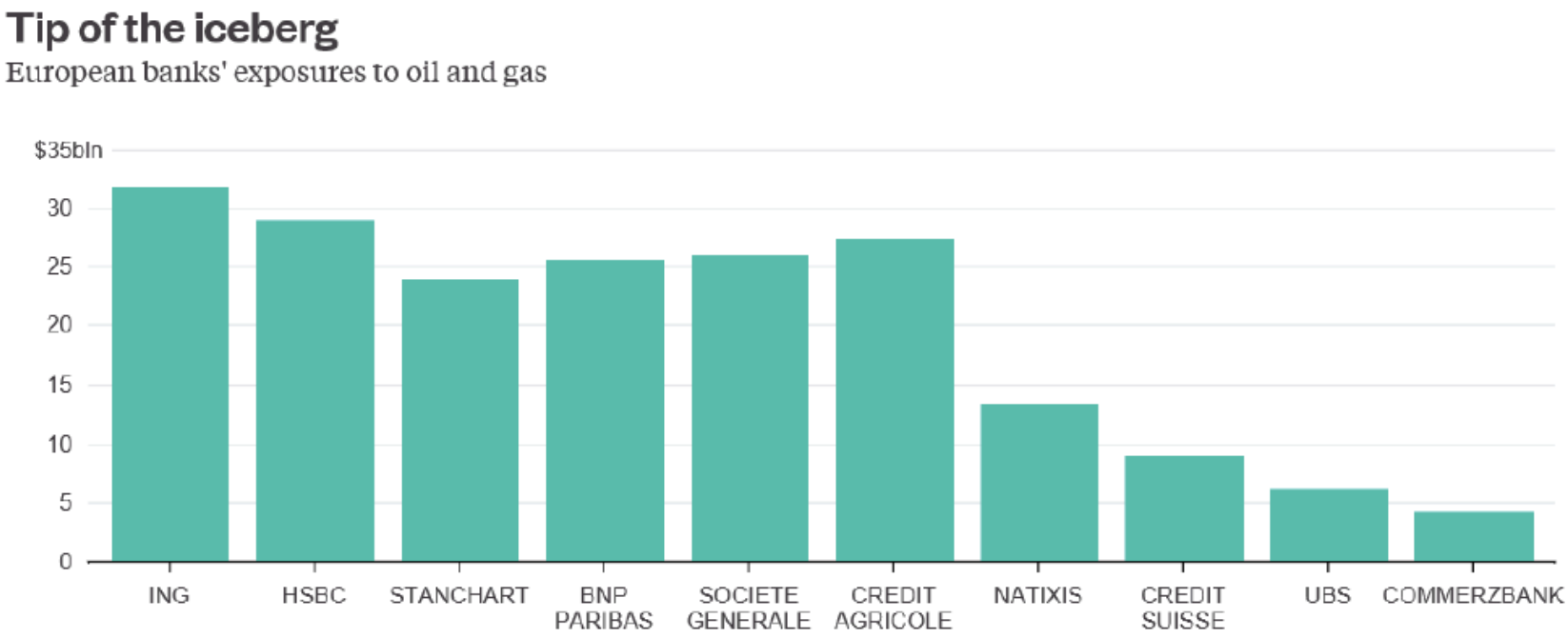

https://www.right-basedonscience.de

Summary and Outlook

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- EU on track in renewable energies
- Main load on biomass
- Biomass to serve energies & chemicals
- Increasing feedstock-efficiency by cascading necessary
- Integration of renewable energies necessary
- Methane going to play central role

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