



CHP Goes Green

From biomass to gas in urban areas examples from Frankfurt, Germany

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Cogen Europe annual Conference 2013

IEE/09/948/SI2.558325, 07/2010 - 06/2013



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Frankfurt am Main – who we are

680,000 inhabitants
5th biggest city of Germany
Financial and transportation centre
Internet hub
Frankfurt trade fair
Industry



Town hall



Frankfurt center of city



Trade fair



Airport

IEE/09/947/5/255820_07/2010_06/2013



History of biomass use in Frankfurt



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- > 1957 Municipal sewage sludge
- > 1967 Urban waste to energy
- > 1990 Landfill gas for district heating
- > 1999 Urban biogenic waste to gas
- > 2005 Biomass use in a CHP plant for industrial facility
- > 2007 Industrial sewage sludge and co fermentation to gas - upgrade to biomethane
- > 2010 Biomethane for district heating

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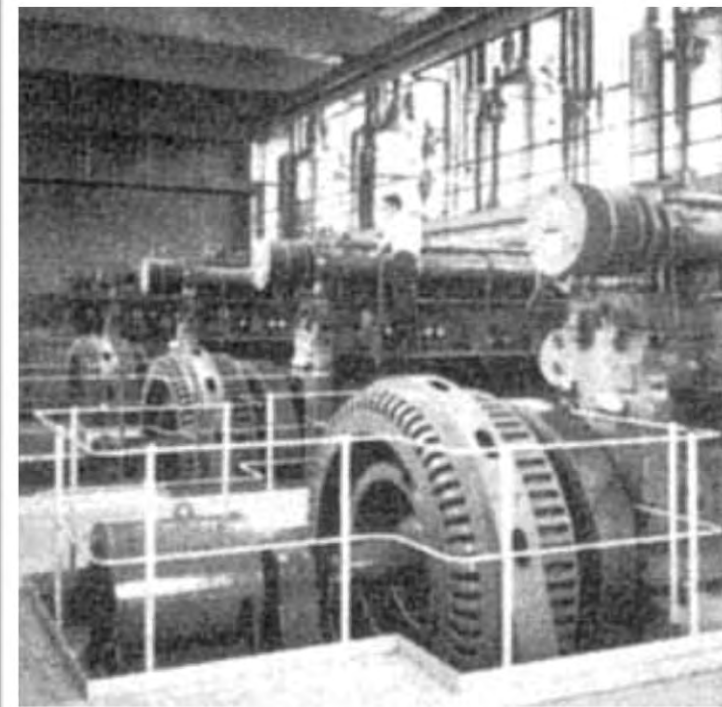
1957 – 1981 sewage sludge fermentation



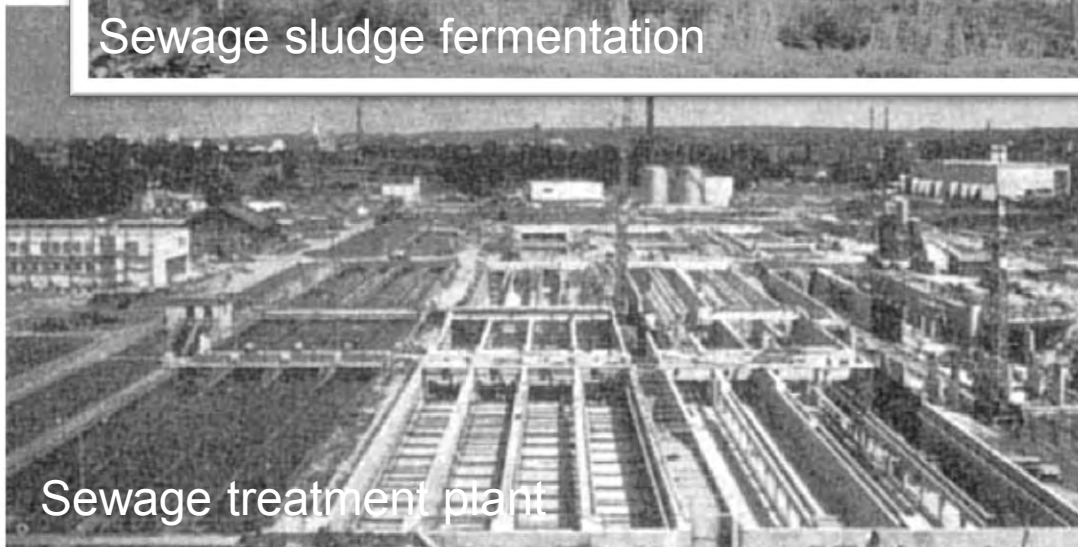
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Sewage sludge fermentation



Gas engines and generators



Sewage treatment plant

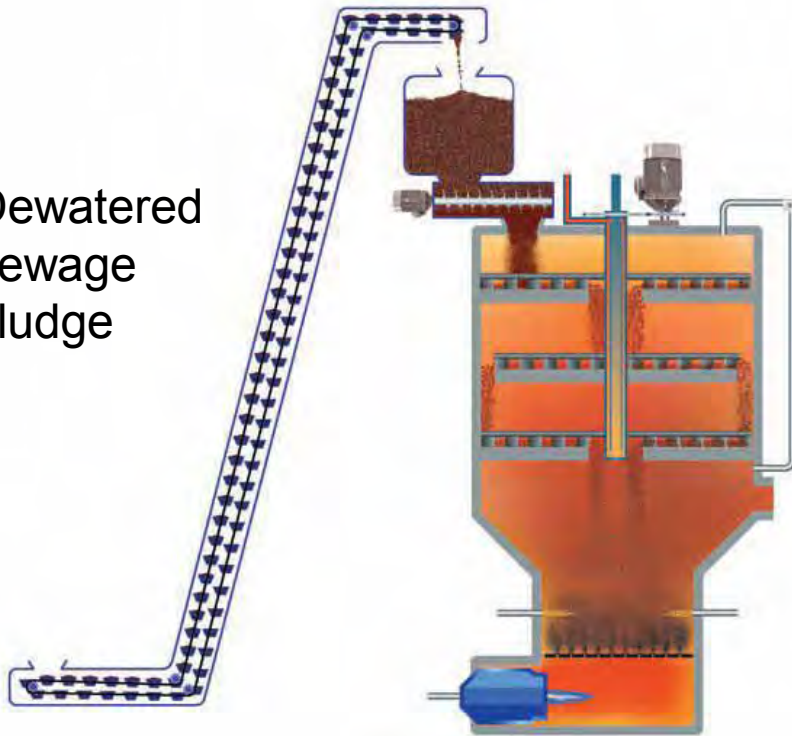


Since 1981 sewage sludge incineration – since 1995 steam turbine



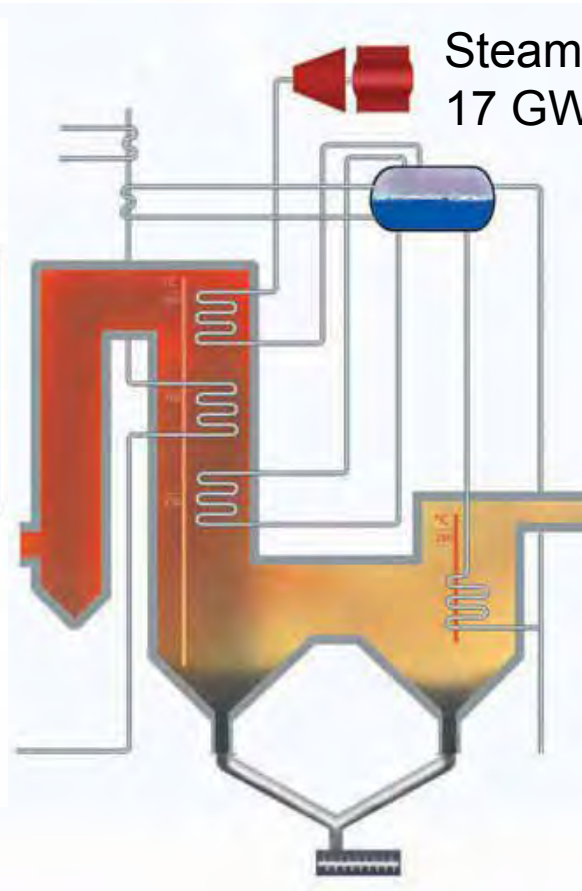
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Dewatered sewage sludge



Fluidized bed combustion

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Steam Turbine, 4 MWe
17 GWh/a

Heat recovery boiler



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Waste incineration plant - 1967



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MHKW Nordweststadt

P_{el} : 37 MW

P_{th} : 99 MW

Biogenic share of waste:
50%

Electricity production
related to biogenic share:

125 GWh/a



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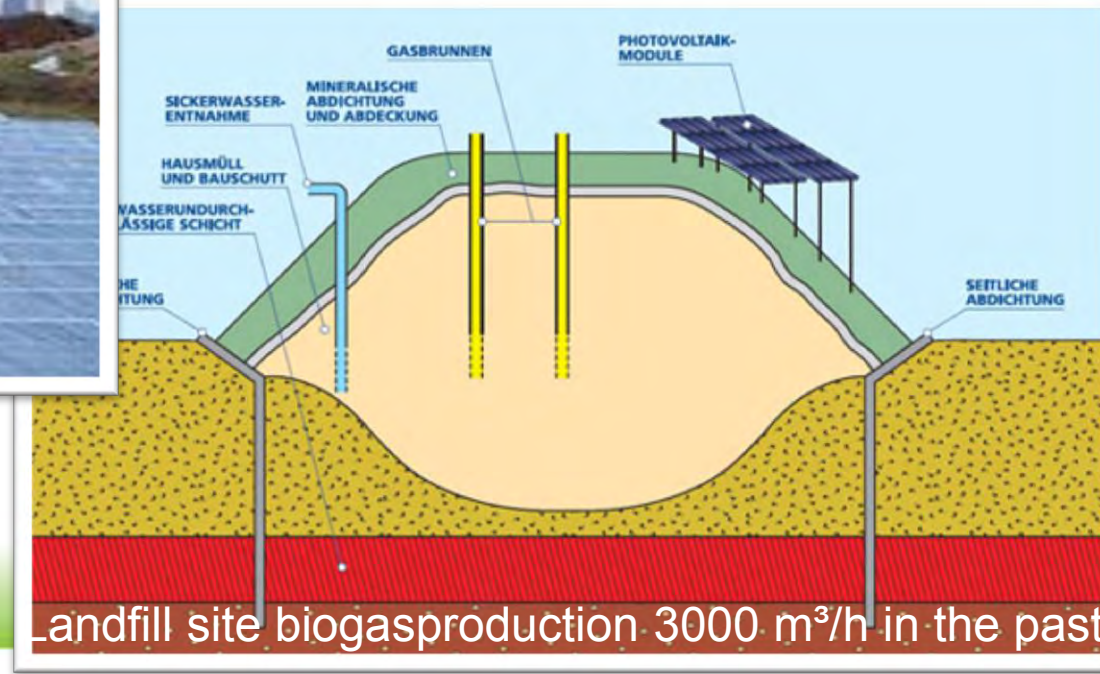
Landfill gas used for co-firing district heating – 1990 - 2000



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2011: PV-plant on landfill site 8,2 MW – public plant




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Landfill site biogasproduction 3000 m³/h in the past



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Co-firing of landfill gas 1990 - 2000



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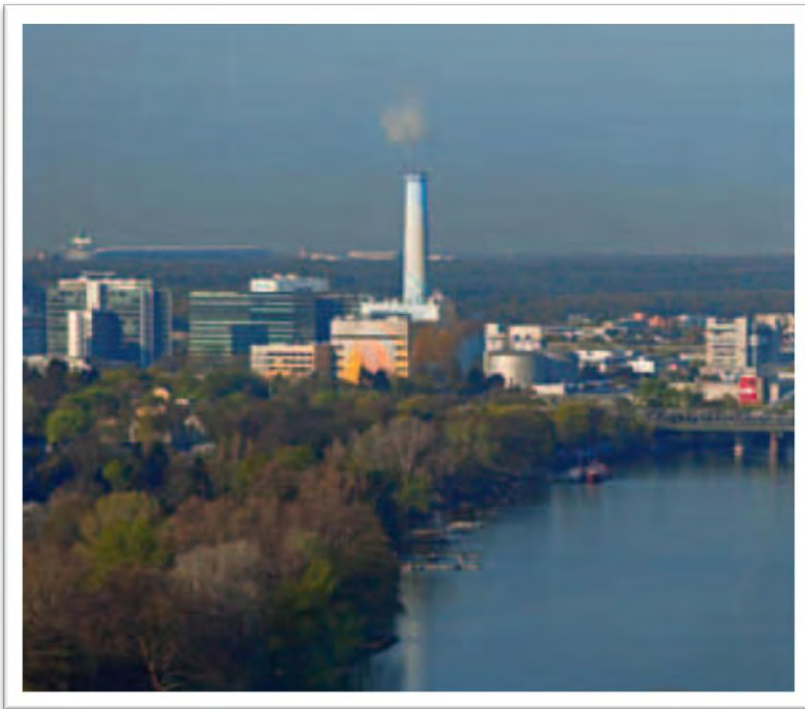
HKW Niederrad

P_{el} : 126 MW

P_{th} : 218 MW

Electricity production out of
landfill gas:

app. 88 GWh/a



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Biogenic waste from households to gas - 1999



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Rhein-Main-Biokompost

P_{el} : 680 kW

P_{th} : 625 kW

Electricity production :

6 GWh/a



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Biomass plant for industrial site - 2005



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Biomassekraftwerk Fechenheim

P_{el} : (3.8)12.4 MW

P_{th} : (27.2) MW

Electricity production:

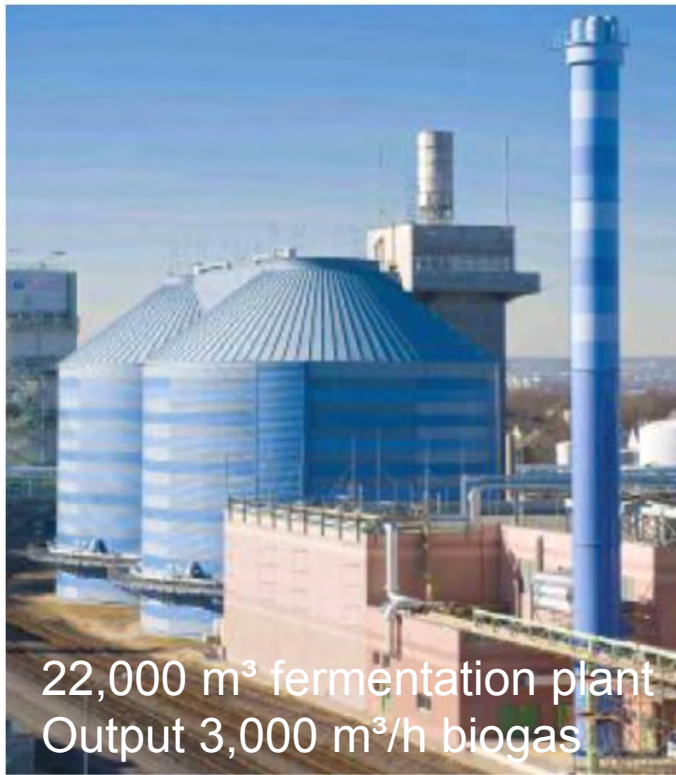
72 GWh/a

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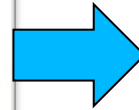
Industrial plant - Sewage sludge to gas - 2007



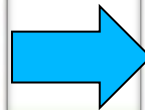
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22,000 m³ fermentation plant
Output 3,000 m³/h biogas



Biomethane plant
Input: 1,500m³/h biogas
Output: 1,000 m³/h biomethane



CHP-Plant
5.1 MW_{el},
40 GWh_{el}/a

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CHP – Biomethane – since 2010



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“Fuel change“ of older CHP –
plants:

plants which have exceeded the
period of funding by german
CHP-act (6-10 yrs) can get feed
- in tariff according to renewable
energy act - corresponding to the
year of installation

Total: 3 Plants : 2.4 MWe
plants are operated by mainova
energy services

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1,350 kWel – District heating
„Frankfurter Bogen“ – Primary
energy factor reduced to 0.5



422 kWel – Botanical
garden of Frankfurt
„Palmengarten“



611 kWel – District heating
Westpark/Lindenviertel



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Bioerdgas-Blockheizkraftwerke



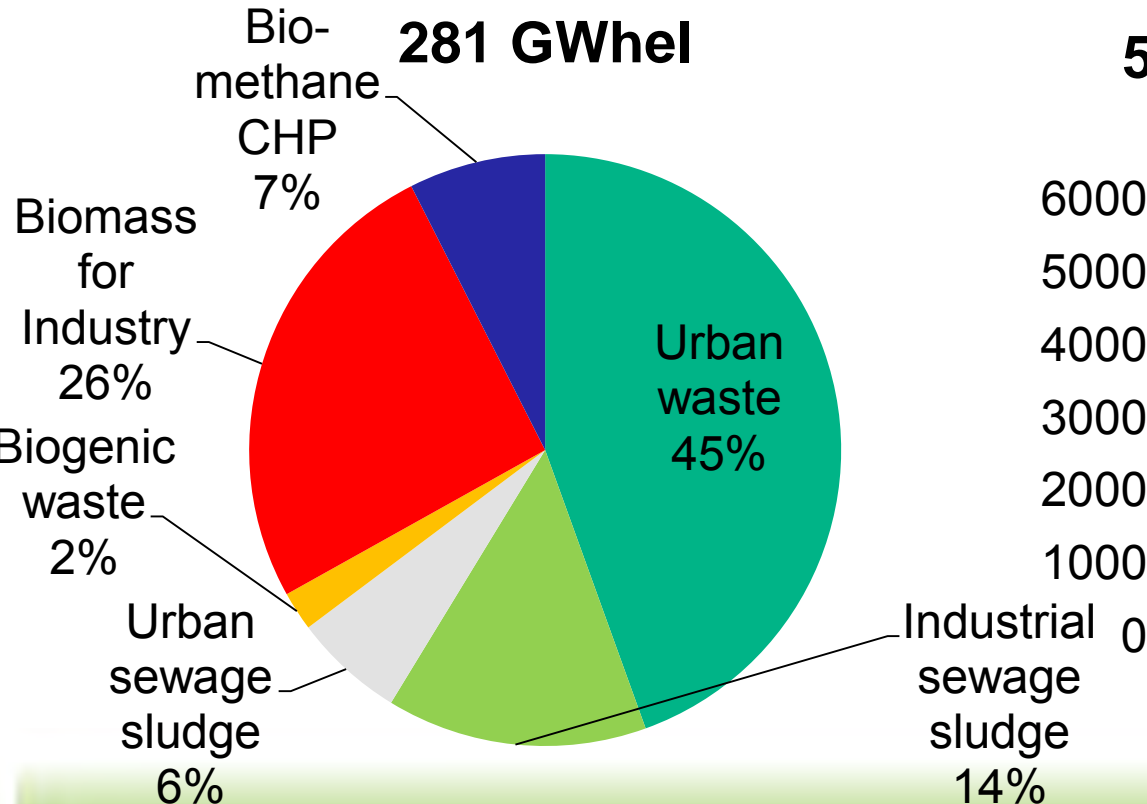
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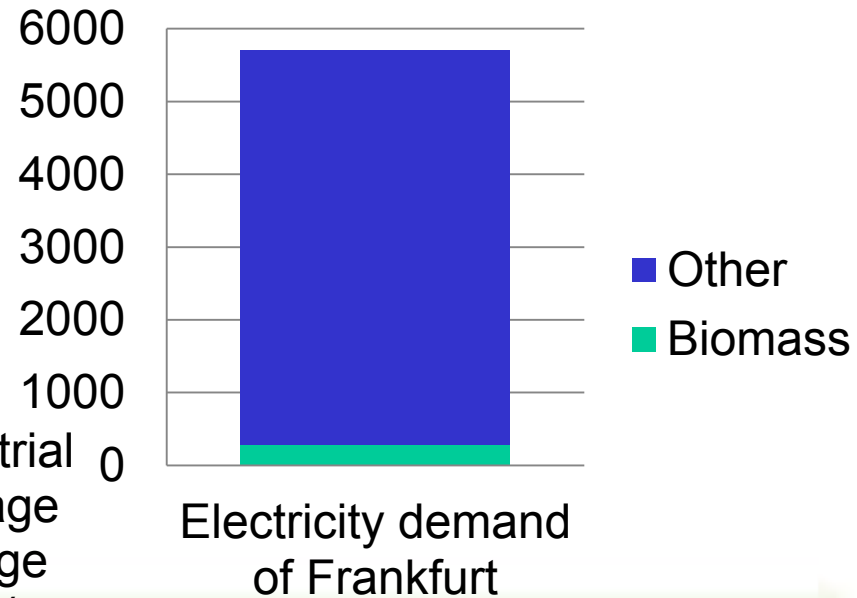
Status biomass use in Frankfurt - 2010



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5 % of electricity is from biomass



According to a survey of the Government of Hesse (2008), Frankfurt uses 87% of biomass-potential

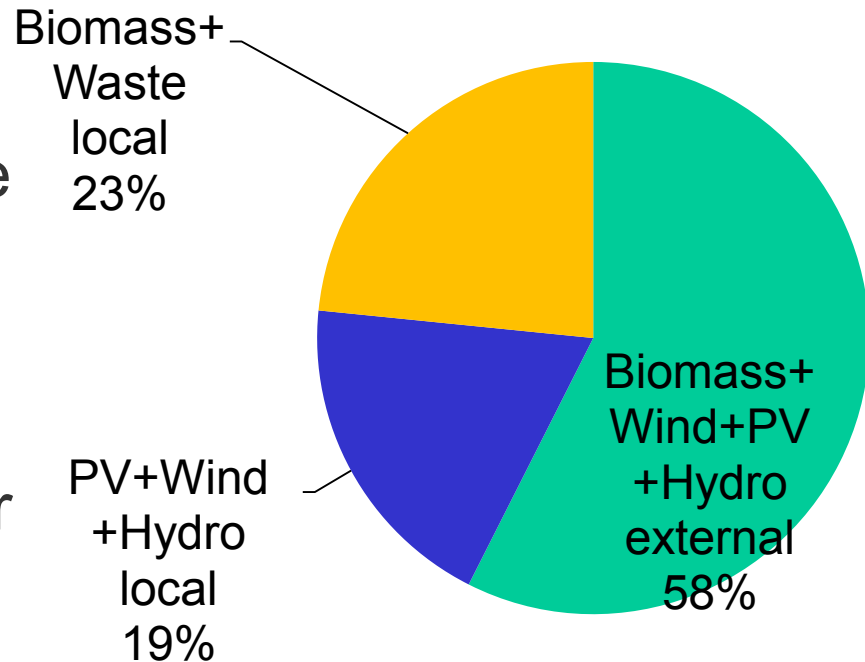
Future of biomass use in Frankfurt - 2050



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- > Energy efficiency has to increase at least 50%
- > The rest of demand will be covered by renewable energies
- > Biomethane will play a mayor role in the future for the energy supply of the city

Electricity demand Frankfurt



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