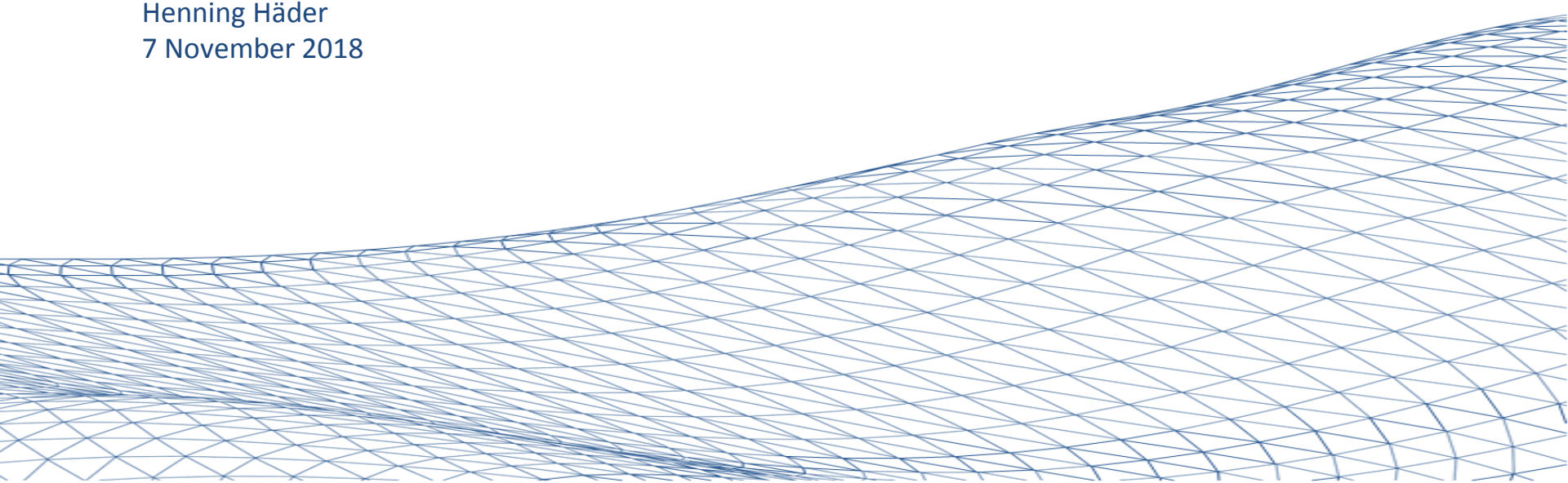
# Decarbonization pathways

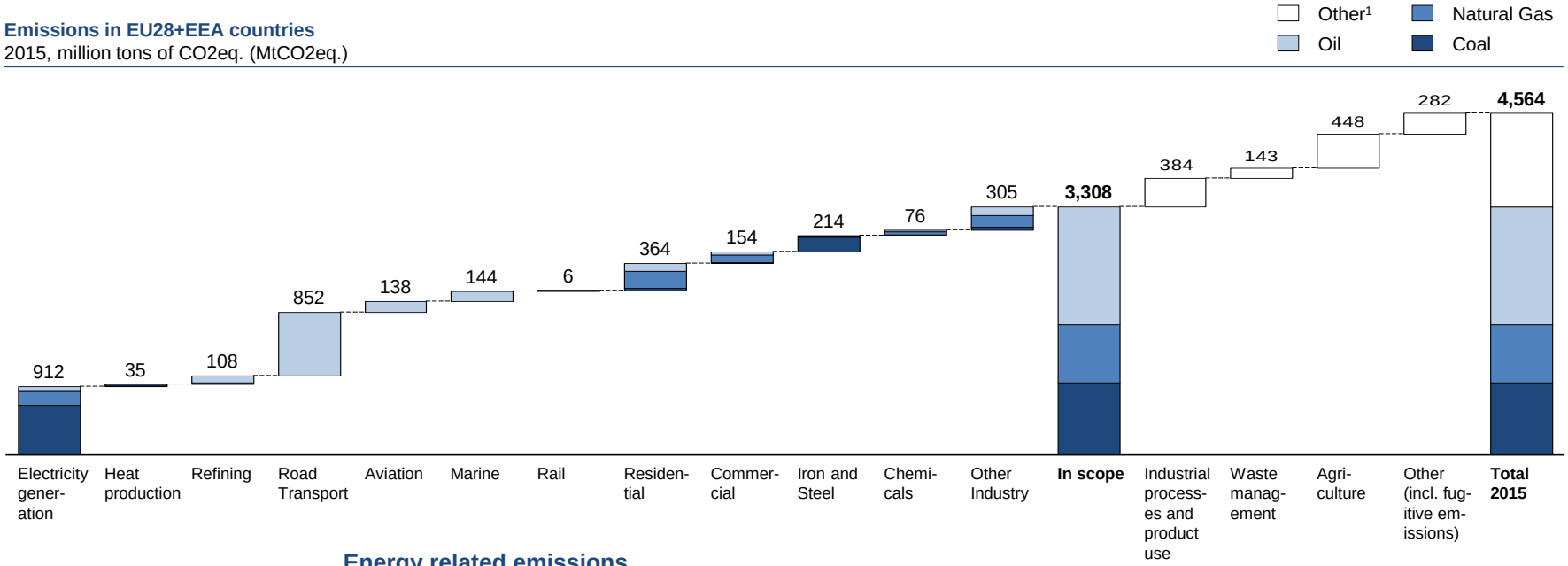
## The roadmap towards a CO2 neutral Europe

Henning Häder
7 November 2018



# Our project focuses on all energy related emissions for all EU28 and EEA countries

**Emissions in EU28+EEA countries**
2015, million tons of CO2eq. (MtCO2eq.)




**Energy related emissions**

**Non-energy related emissions**

| | Energy | Transport[2] | Buildings | Industry | |
|---|---|---|---|---|---|
| Share of emissions | 23% | 25% | 11% | 13% | 28% |

1. E.g. methane emissions from land-fills or agriculture and GHG emissions from waste burning
2. Includes international aviation and marine for consistency purposes

SOURCE: Energy Insights, EuroStat, EU inventory, team analysis

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▼ % $CO_2$

▲ electrification

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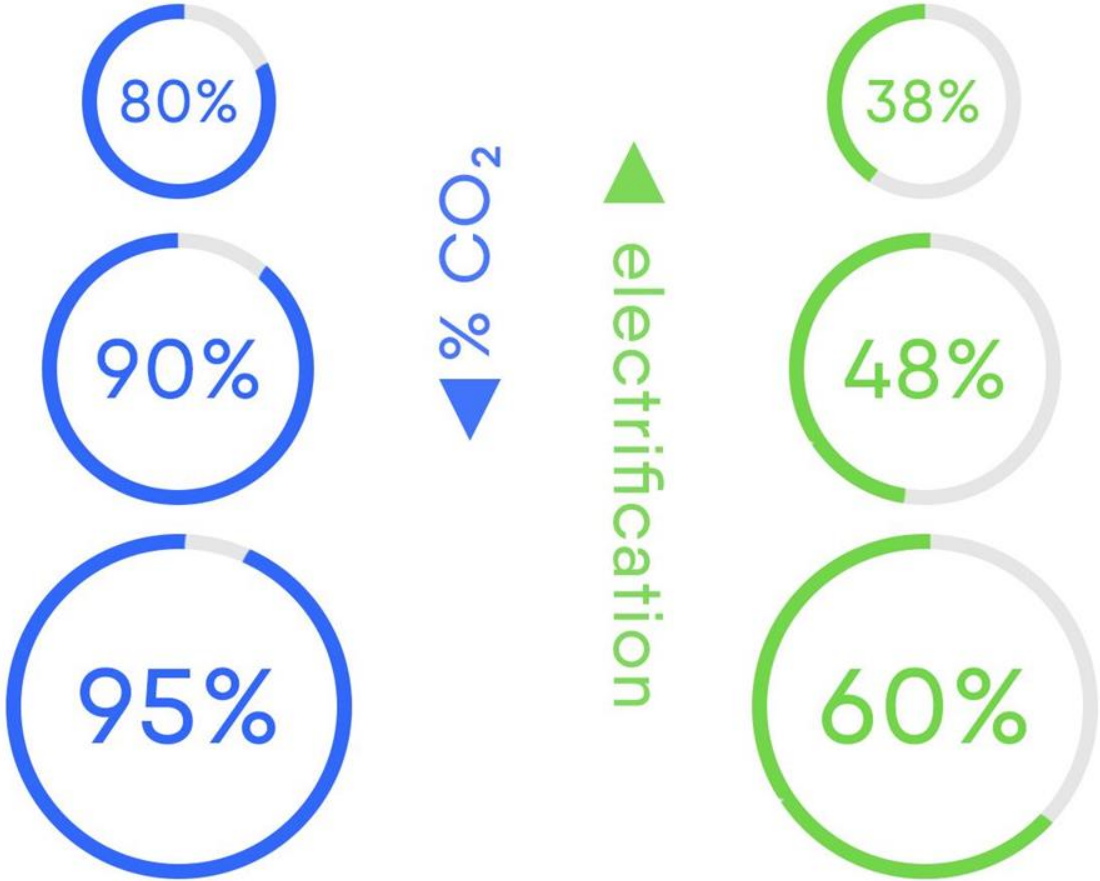
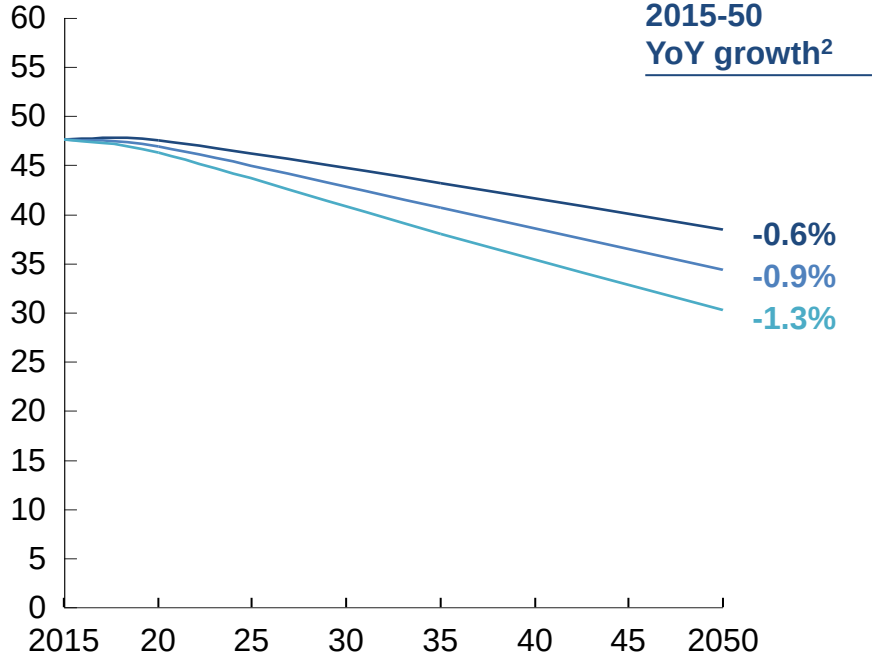


# Energy efficiency drives down final energy consumption significantly, while yearly direct electricity consumption increases by 1.0 to 1.5%

Scenario 1
Scenario 2
Scenario 3

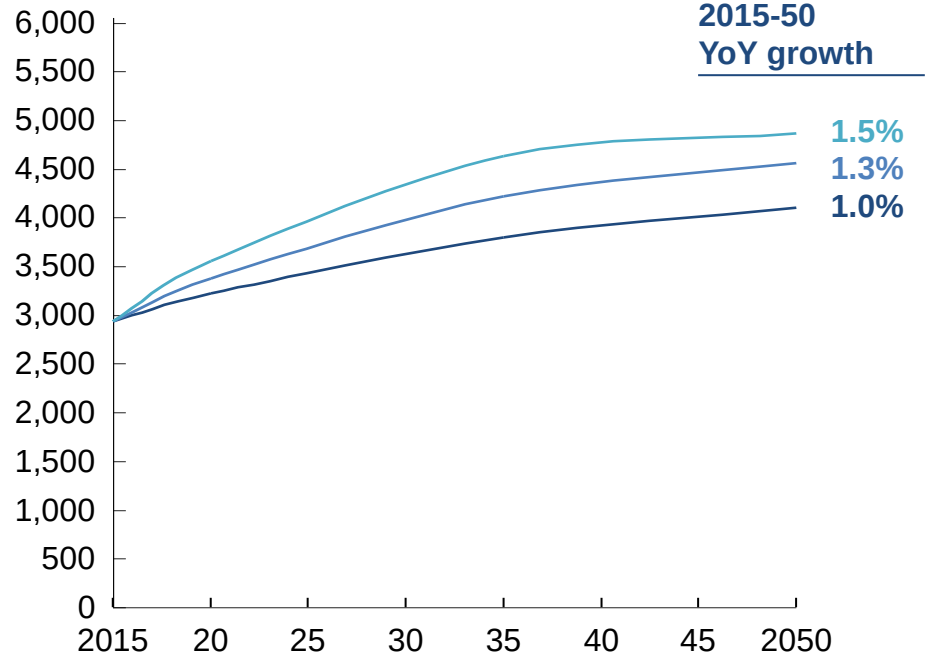
## Total Final Energy Consumption (TFC[1])

Exajoule




## Direct electricity consumption in TFC[1]

TWh




1 Includes 32 countries in scope: EU28 + EEA; ENTSOE report additionally includes Turkey and other Eastern European countries adding up to a total of ~3,300 TWh
2 Annual YoY TFC reduction adjusted to total GDP growth (as a proxy for increase in energy productivity) varies between 2% and 2.8% depending on scenarios

# Direct electrification results by scenario

| | | 2015 Baseline | 2050 Scenario 1 | 2050 Scenario 2 | 2050 Scenario 3 |
|---|---|---|---|---|---|
| **Total EU economy** | EU economy decarbonization vs 1990 | 22% | 80% | 90% | 95% |
| | Direct electrification rate | 22% | 38% | 48% | 60% |
| **Total transport** | Direct electrification rate | **1%** | 29% | 43% | 63% |
| **Total buildings** | Direct electrification rate | **34%** | 45% | 54% | 63% |
| **Total industries** | Direct electrification rate | **33%** | 38% | 44% | 50% |

# Total electricity demand is expected to increase beyond envisioned direct electrification

## Total electricity demand

| | Definition | YoY increase in total electricity consumption in TFC | | |
|---|---|---|---|---|
| | | Scenario 1 | Scenario 2 | Scenario 3 |
| Direct electricity demand | Direct use of electricity as an energy carrier (e.g. power consumed by households, road transportation, etc.) | 1.0% | 1.3% | 1.5% |
| + Indirect electricity demand for power-to-X | Power demand to produce hydrogen (via electrolysis), gas and other synthetic fuels which can then be used to decarbonize certain industry processes or as a fuel for transports | 0.3% | 0.4% | 0.5% |
| + Additional electricity demand for other decarbonization | Power required for CCS[1] and to produce other clean fuels/feedstock (e.g. biofuels) | 0.1% | 0.1% | 0.1% |

1 Total CO2 abated through CCS: <200 Mt Co2; CCS may require technology improvement as well as increasing acceptability, e.g., for underground storage

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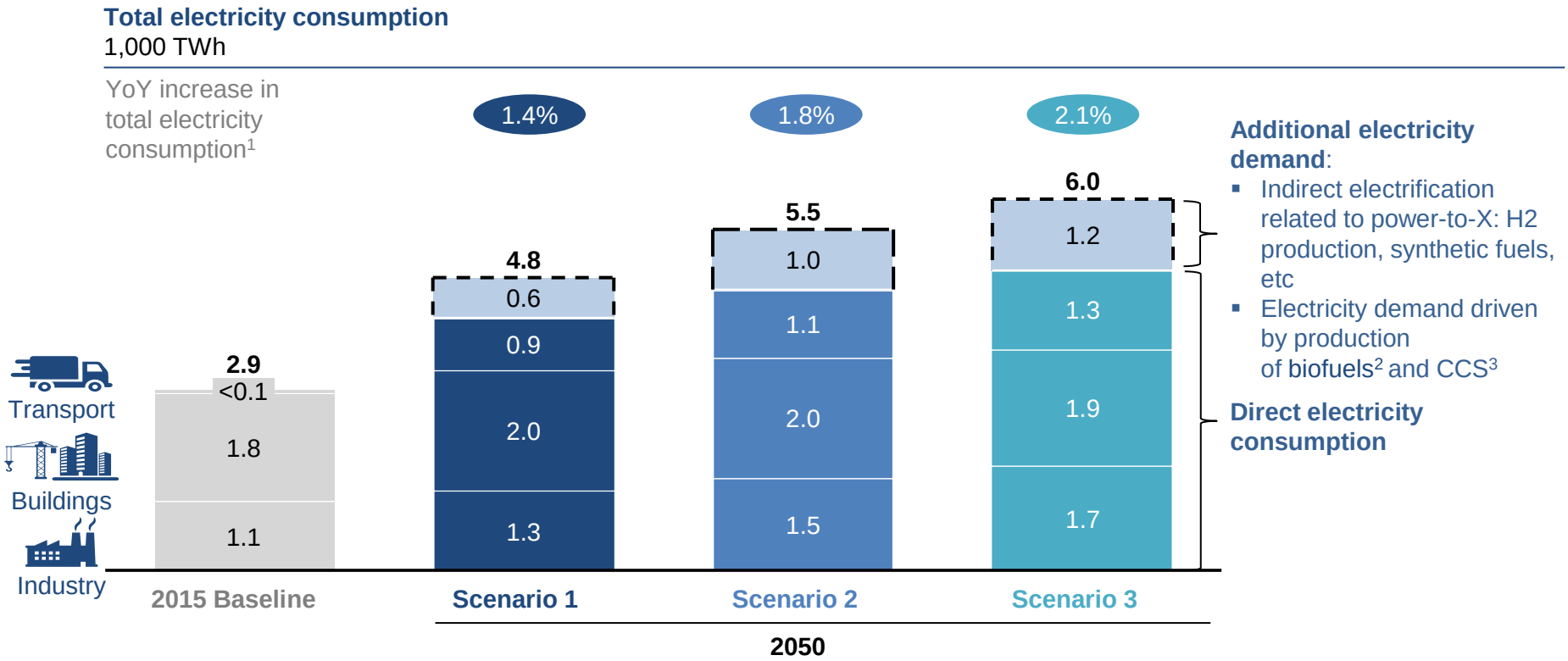
# Backup

# Strong electricity uptake in all sectors, with strongest increase in transport




1 Includes both direct and indirect electrification (power-to-X) as well as electricity demand driven by production of CCS and biofuels
2 Biofuels require feedstock as well as additional energy (either in form of thermal energy or power) for their production – see glossary
3 Total CO2 abated through CCS: <200 Mt Co2; CCS may require technology improvement as well as increasing acceptability, e.g., for underground storage

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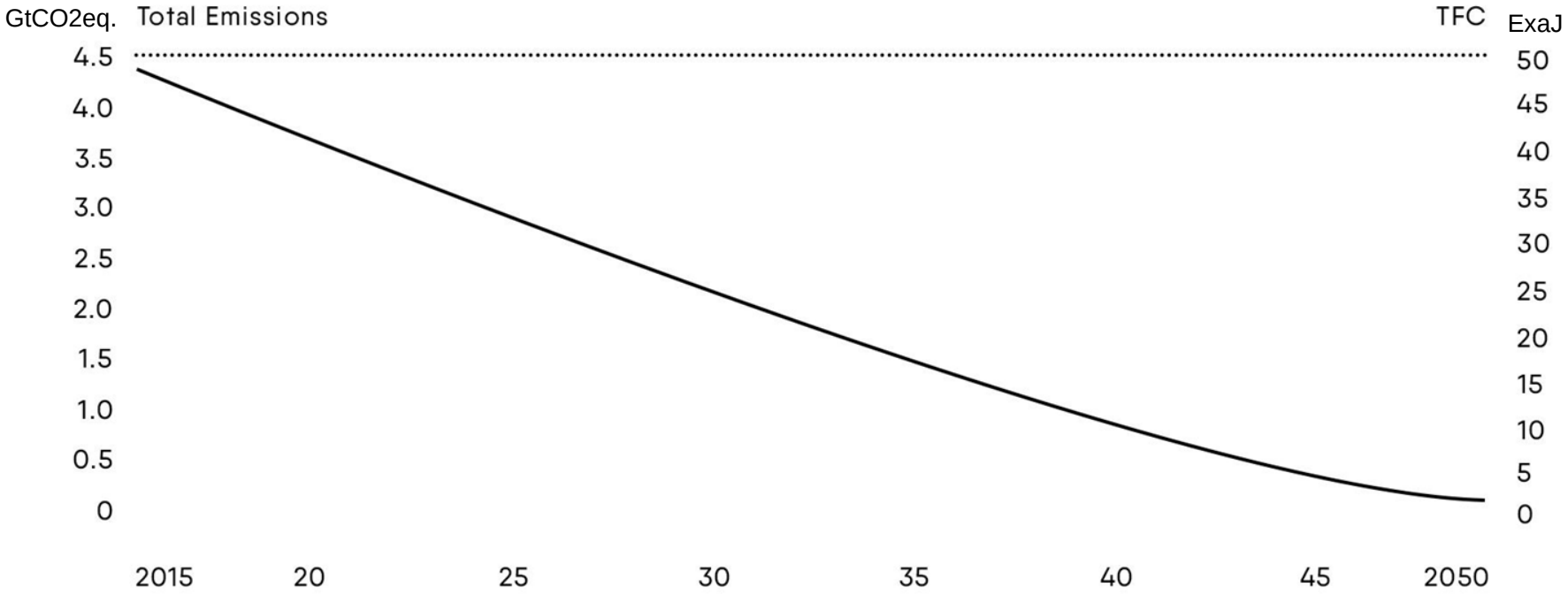
## Impact of electrification on EU economy emissions and Total Final Energy consumption (TFC)



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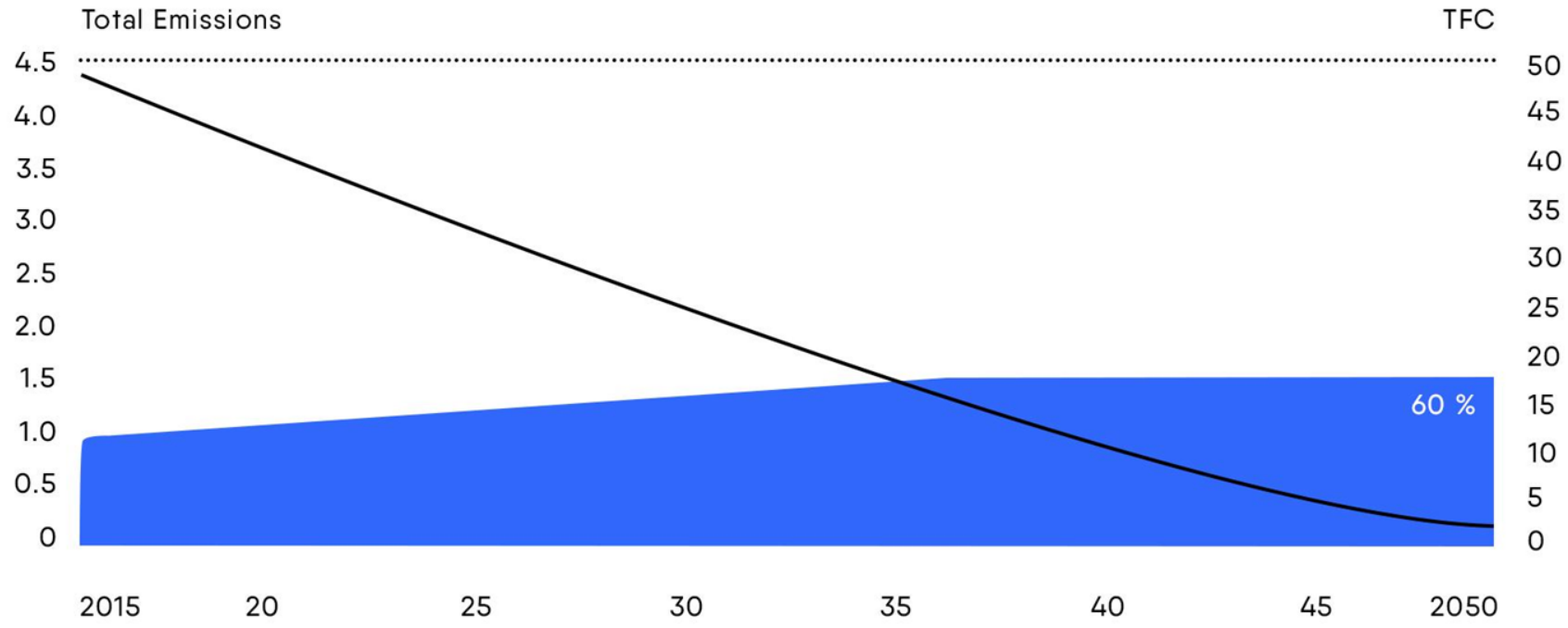


x 2050 direct electrification rate

Annual emissions

Emitting fuels

Other carbon-neutral fuels[4]

Other carbon-neutral fuels requiring power[3]

Electricity[5]

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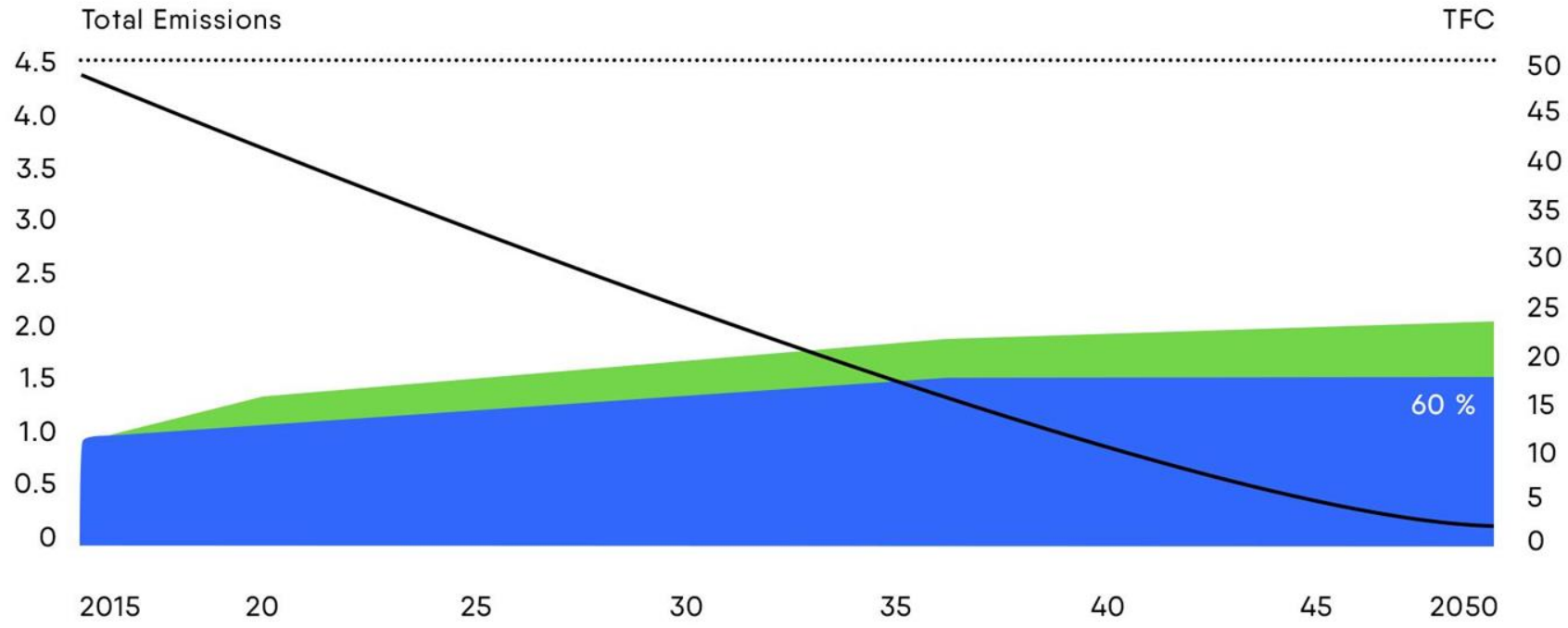


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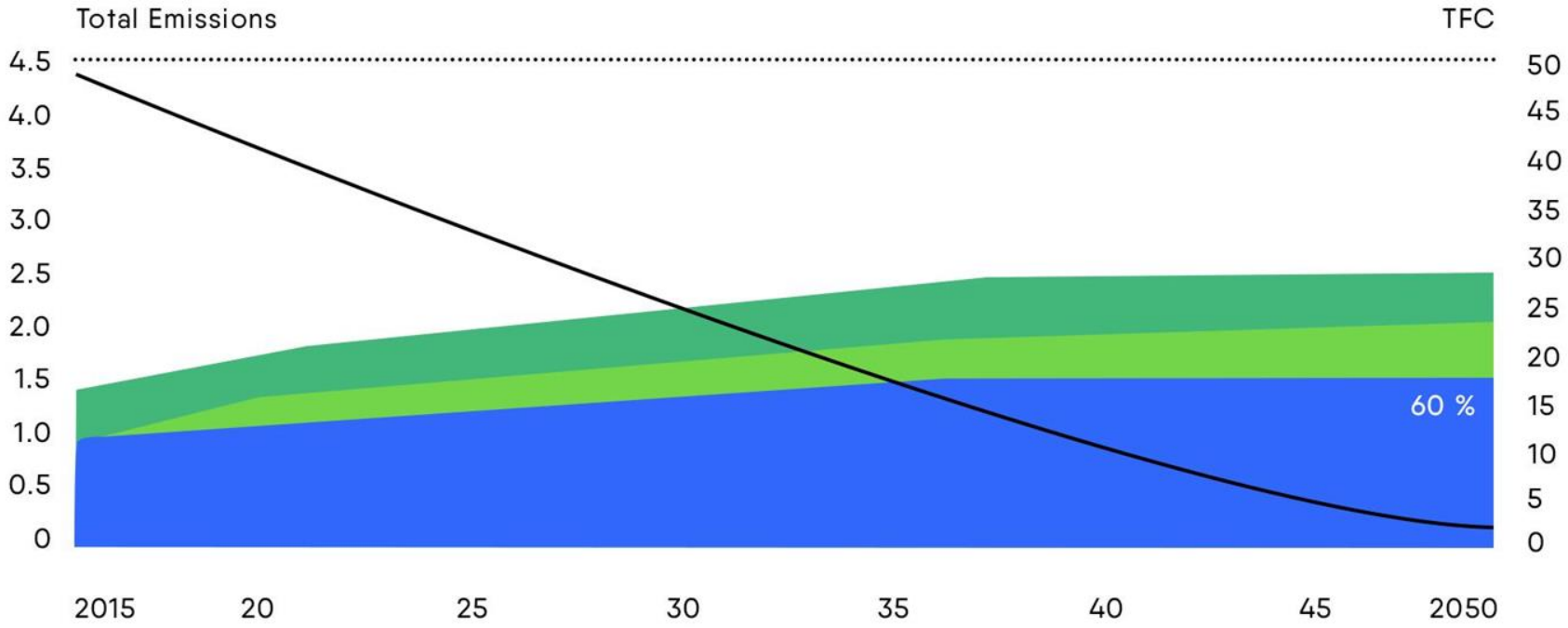


2050 direct electrification rate
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