

# **Power-to-X and other alternatives for passenger cars – life-cycle efficiencies and carbon footprints**

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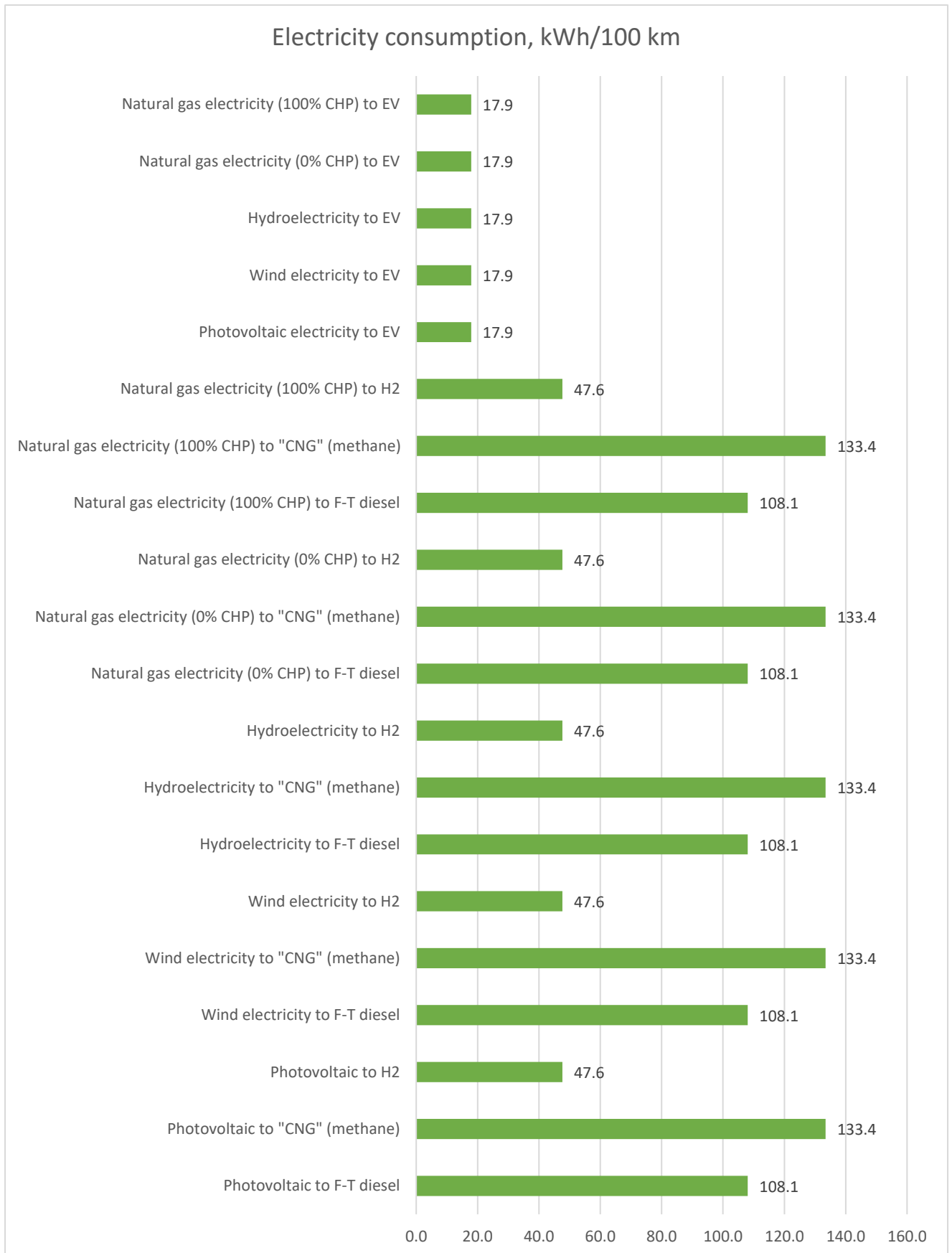
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## Shortly

-Direct electrification most efficient by far (Transport & Environment, 2020)

### Some parameters

- CNG vehicle
  - Natural gas to CNG efficiency: 80.6%
  - Transportation, storage and distribution efficiency: 93%
  - Consumption: 4.1 kg/100 km (57.0 kWh/100 km)
- Diesel vehicle
  - Natural gas to Fischer-Tropsch diesel efficiency: 40.7%
  - Consumption: 5.1 L/100 km (48.9 kWh/100 km)
- Fuel-cell hydrogen vehicle
  - Natural gas to H2 efficiency: 71.1%
  - Transportation, storage and distribution efficiency: 89%
  - Consumption: 0.8 kg/100 km (26.7 kWh/100 km)
- Diesel vehicle
  - Electricity to H2 efficiency: 63%
  - H2 to Fischer-Tropsch diesel efficiency: 72%
    - Including CO2 capture and Fischer-Tropsch synthesis
  - Consumption: 5.1 L/100 km (48.9 kWh/100 km)
- CNG vehicle
  - Electricity to H2 efficiency: 63%
  - H2 to methane efficiency: 73%
    - Including CO2 capture and methane synthesis
  - Consumption: 4.1 kg/100 km (48.9 kWh/100 km)
- Fuel-cell hydrogen vehicle
  - Electricity to H2 efficiency: 63%
  - Transportation, storage and distribution efficiency: 89%
  - Consumption: 0.8 kg/100 km (26.7 kWh/100 km)
- Electric vehicle
  - Transportation, storage and distribution efficiency: 94%
  - Battery charging efficiency: 89%
  - Consumption: 16.0 kWh/100 km



*Figure. Power-to-X alternatives with different electricity sources to fuel a typical passenger car (typically VW Golf, VW ID.3). Electricity consumption, kWh/100 km.*

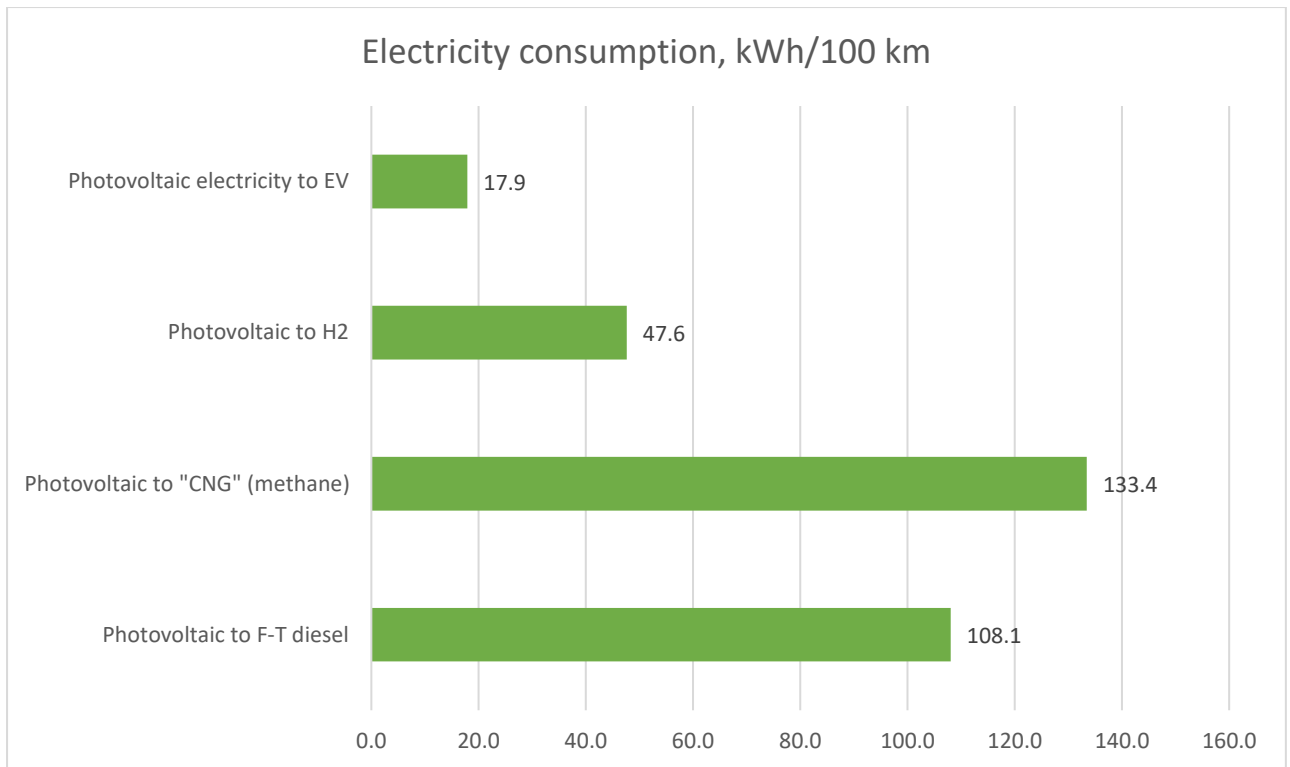


Figure. Photovoltaic-to-X alternatives to fuel a typical passenger car (typically VW Golf, VW ID.3). Electricity consumption, kWh/100 km.

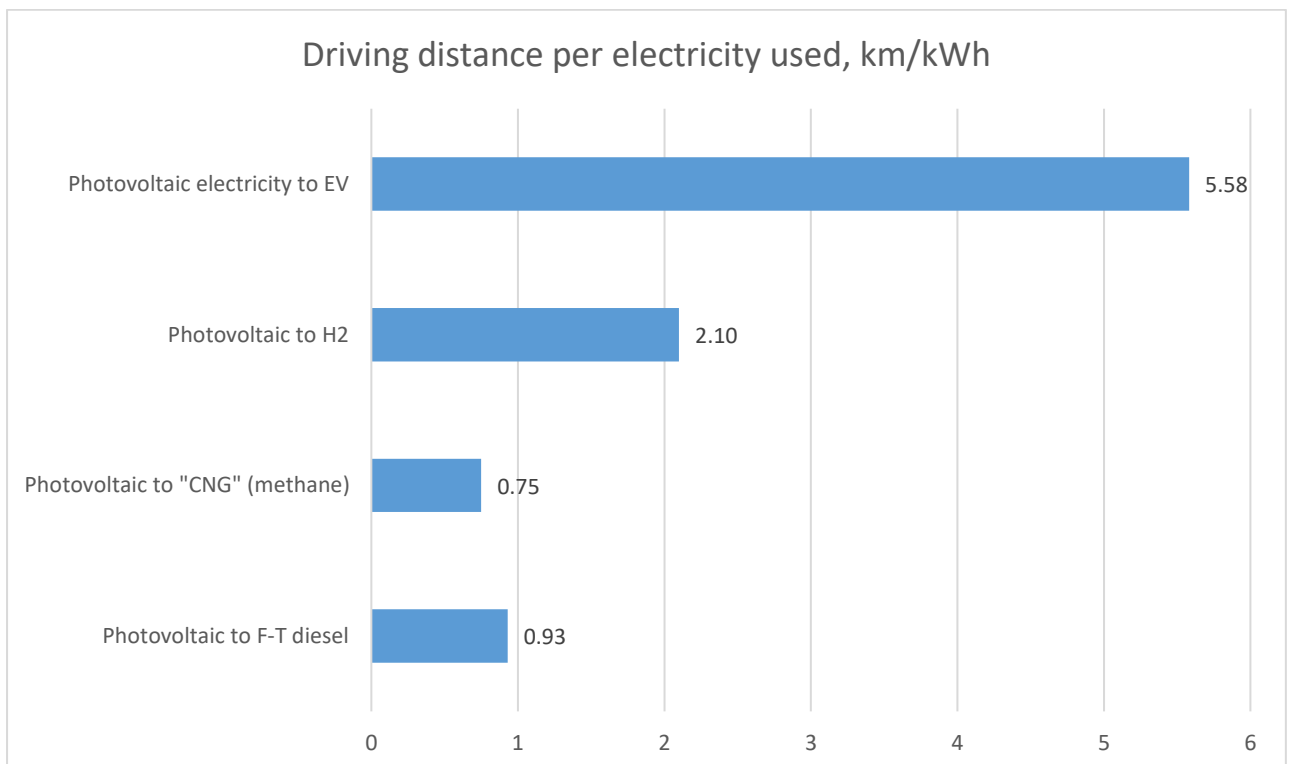
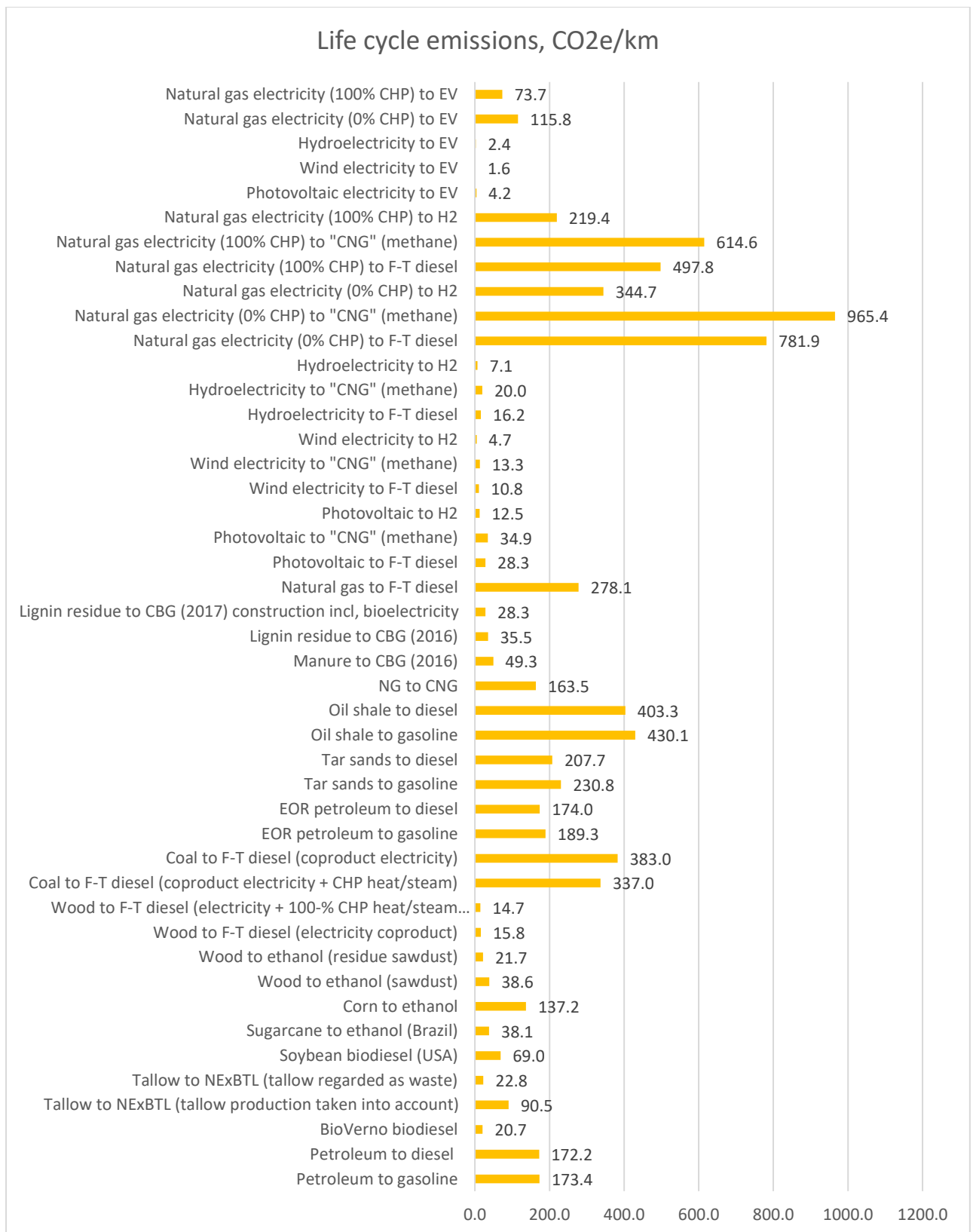
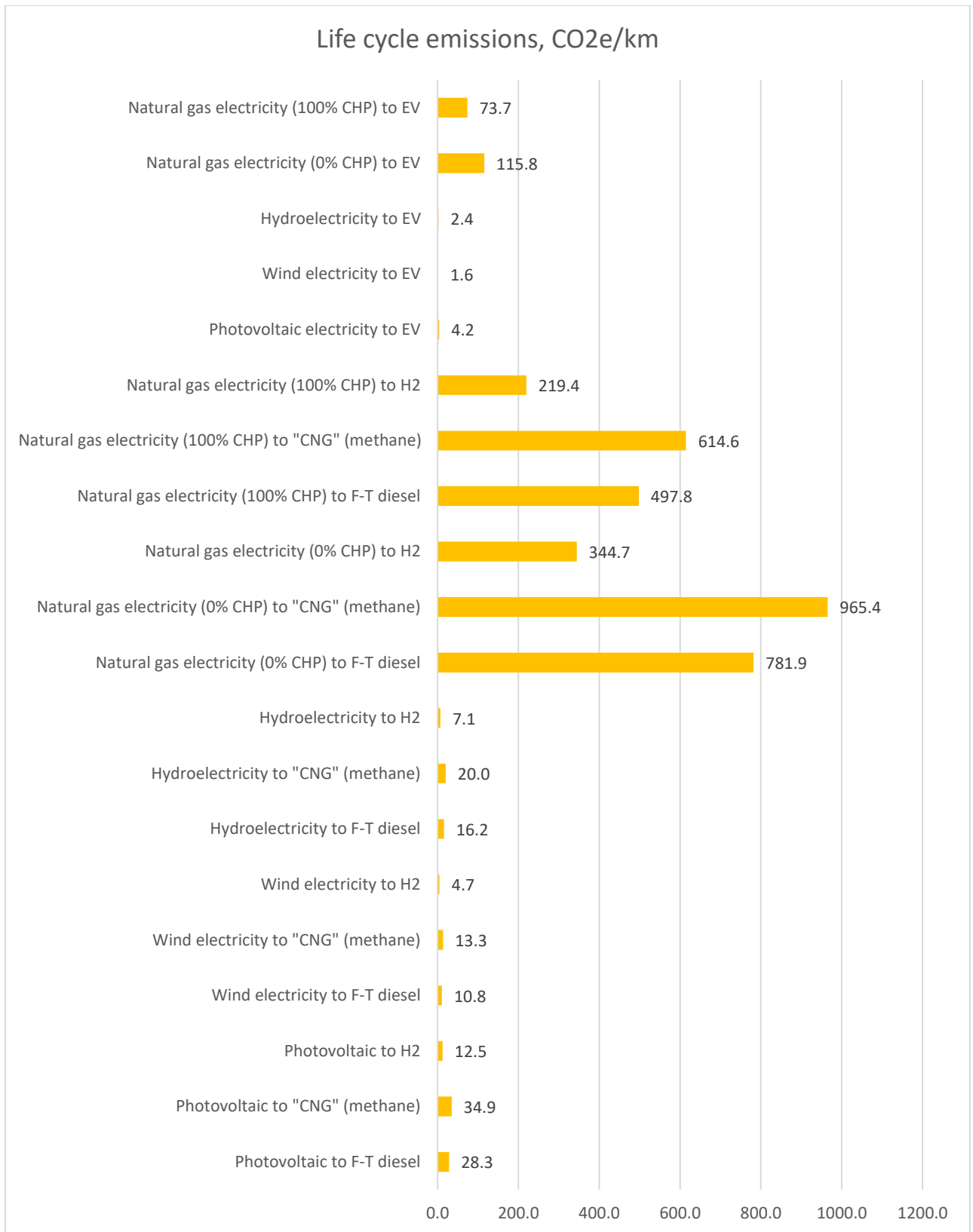


Figure. Photovoltaic-to-X alternatives to fuel a typical passenger car (typically VW Golf, VW ID.3). Electricity consumption, Driving distance per electricity used, km/kWh.



*Figure. Alternatives to fuel a typical passenger car (typically VW Golf, VW ID.3). Carbon footprint, gCO<sub>2</sub>e/km).*



*Figure. Power-to-X alternatives with different electricity sources to fuel a typical passenger car (typically VW Golf, VW ID.3). Carbon footprint, gCO<sub>2</sub>e/km).*

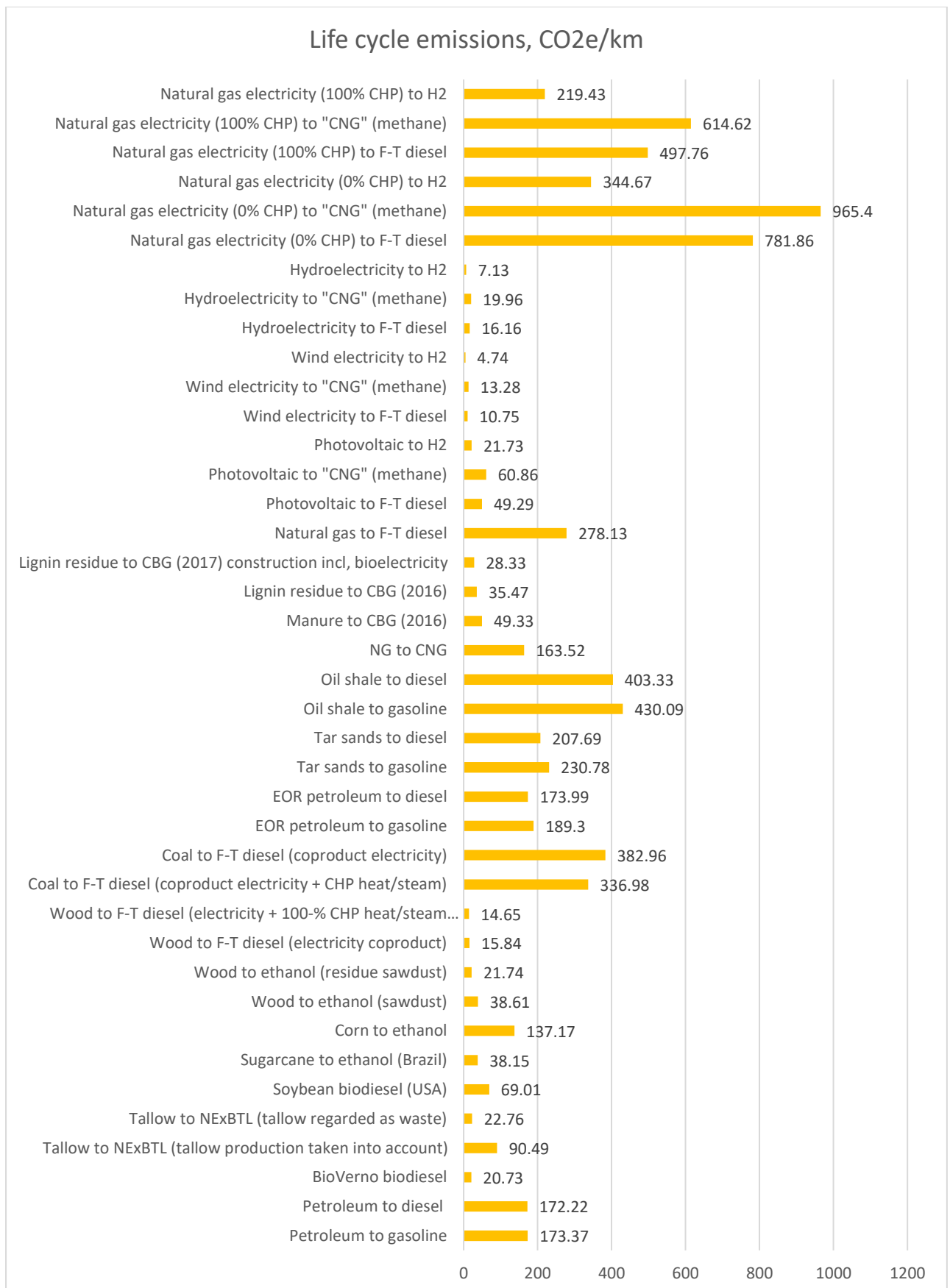


Figure. Combustion engine alternatives to fuel a typical passenger car (typically VW Golf). Carbon footprint, gCO<sub>2</sub>e/km).

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## ***Photovoltaic to F-T diesel***

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