

Can  
electric cars  
reduce the  
energy consumption  
and the  
CO<sub>2</sub> emissions  
of our society?

# A school project

at Bundesrealgymnasium 16

Schuhmeierplatz 7

1160 Vienna Austria

by

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# Contents

- information about the students
- results of the project
- problems during the project
- additional information for the students at the end of the project given by the teacher

# Class: 6c

- high school in Vienna / Austria
- 10th grade
- 22 students: 16 girls, 6 boys
- 3 physics lessons weekly
- project duration: 8 lessons



Martina, Canan, Daniel, Maged, Danijela, Tamara

# Elektroautos

| Automarke  | Aufladedauer in h | Reichweite in km | Kosten/km | kWh/km   | Hoechstgeschwindigkeit in km/h | Leistung in PS |
|------------|-------------------|------------------|-----------|----------|--------------------------------|----------------|
| Smart      | 8 h               | 100 km           | 0.70 ct   | 0.12 kWh | 112 km/h                       | 71 PS          |
| Nissan     | 0.5 h             | 160 km           | 1.50 ct   | 0.15 kWh | 140 km/h                       | 109 PS         |
| BMW        | 3 h               | 241 km           | 3 ct      | 0.30 kWh | 145 km/h                       | 170 PS         |
| Mitsubishi | 7 h               | 160 km           | 2 ct      | 0.30 kWh | 130 km/h                       | 64 PS          |

Smart



Nissan



BMW



Mitsubishi



# Today electric cars have

- + no direct exhaust or soot
- + low energy consumption
- + low energy costs
- short range (  $10^2$  km )
- long time for recharge (1-10 h)
- high purchase price

# Energy density:

- Accumulators:

|    |                 |
|----|-----------------|
| Pb | ... 0.03 kWh/kg |
|----|-----------------|

|        |                 |
|--------|-----------------|
| Li-ion | ... 0.19 kWh/kg |
|--------|-----------------|

|      |                |
|------|----------------|
| Li-S | ... 0.5 kWh/kg |
|------|----------------|

- Fuel:  $\sim 11.9$  kWh/kg

# Electric cars are useful

- + for reducing air pollution
- + for reducing energy consumption
- for short trips

# Today electric cars need ...

- a long time for recharging
- additional car parks
- additional funds

# Impact of electric cars on

- + energy balance
- + CO<sub>2</sub> balance
- costs for new cars
- car parks
- price of electricity
- taxation of electricity



# Calculated results

- Reduction of CO<sub>2</sub> emissions in Austria:  
up to 24 %
- Reduction of energy consumption in Austria:  
up to 16 %

# Problems during the project

- understanding of physical quantities
- units and orders of magnitude
- combining statistical data from different sources
- selecting parameters
- time management

**IEA STATISTICS**

**CO<sub>2</sub> EMISSIONS  
FROM FUEL COMBUSTION  
HIGHLIGHTS**

**2009**  
EDITION



International  
Energy Agency



INTERNATIONAL ENERGY AGENCY

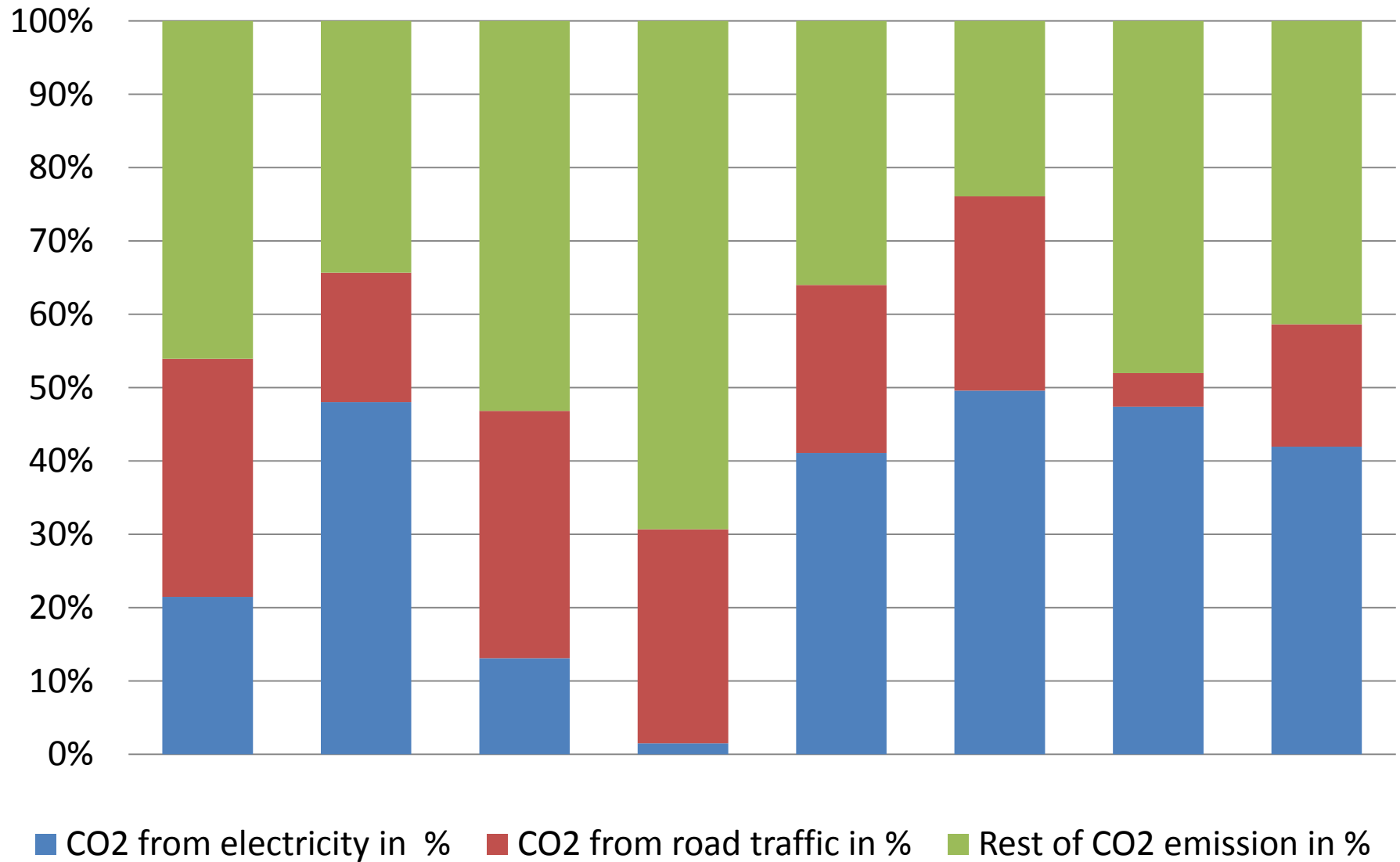
# KEY WORLD ENERGY STATISTICS

2009

# CO<sub>2</sub> emission of

- Austria
- China
- EU-27
- France
- Germany
- Norway
- USA
- World

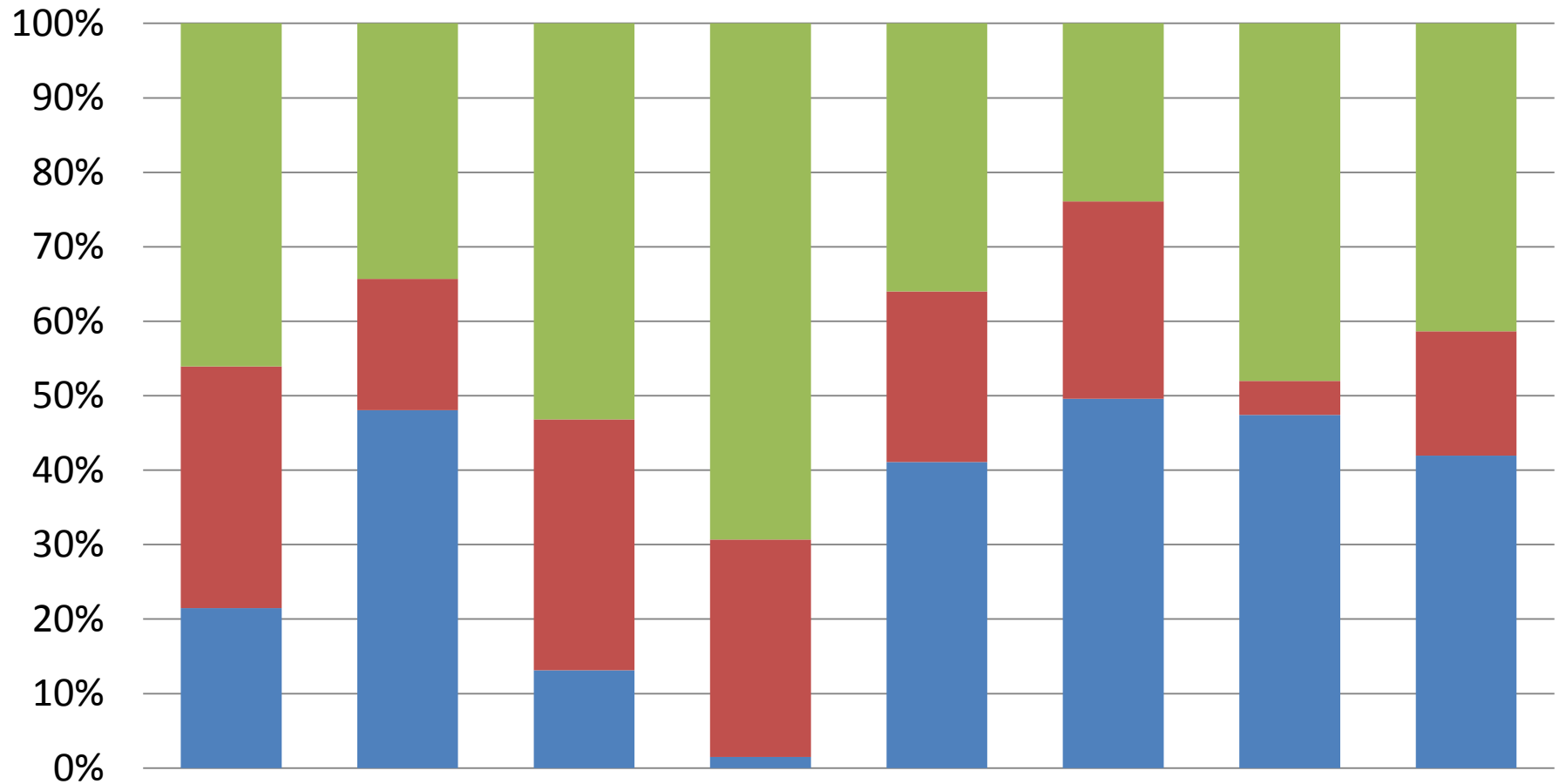
# CO<sub>2</sub> from ...



# CO<sub>2</sub> emission of

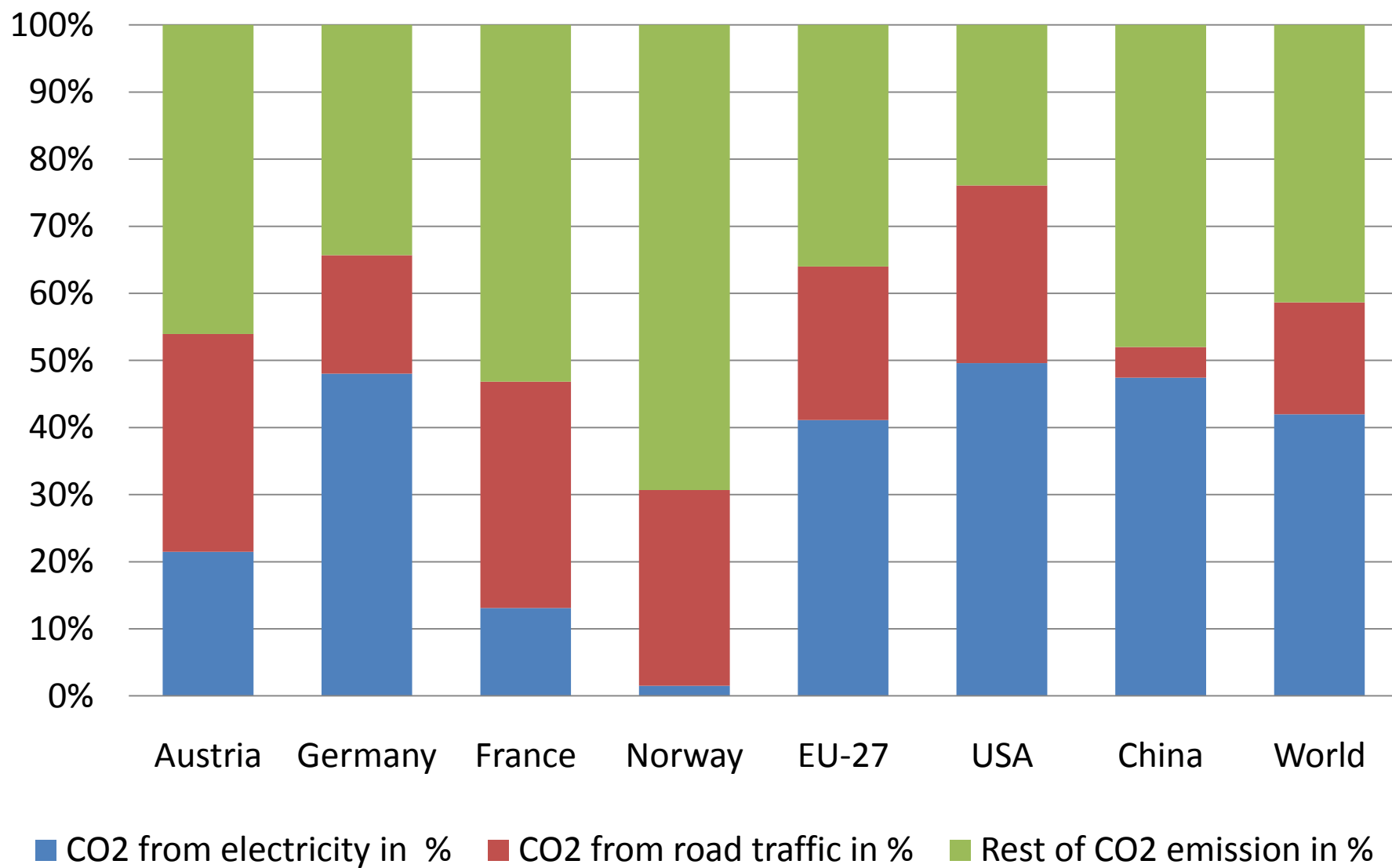
- Austria
- China
- EU-27
- France
- Germany
- Norway
- USA
- World

# CO<sub>2</sub> from ...

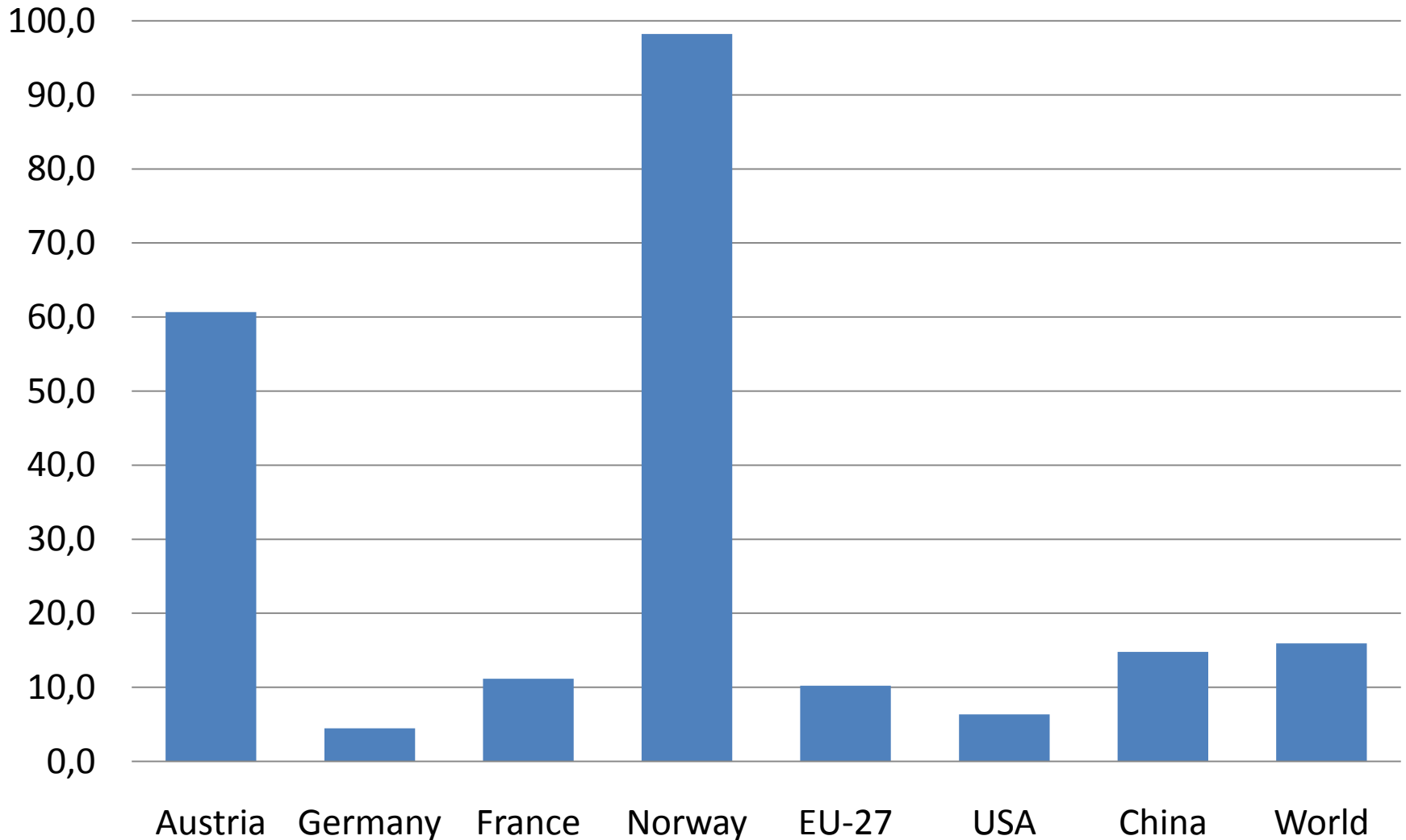


■ CO2 from electricity in % ■ CO2 from road traffic in % ■ Rest of CO2 emission in %

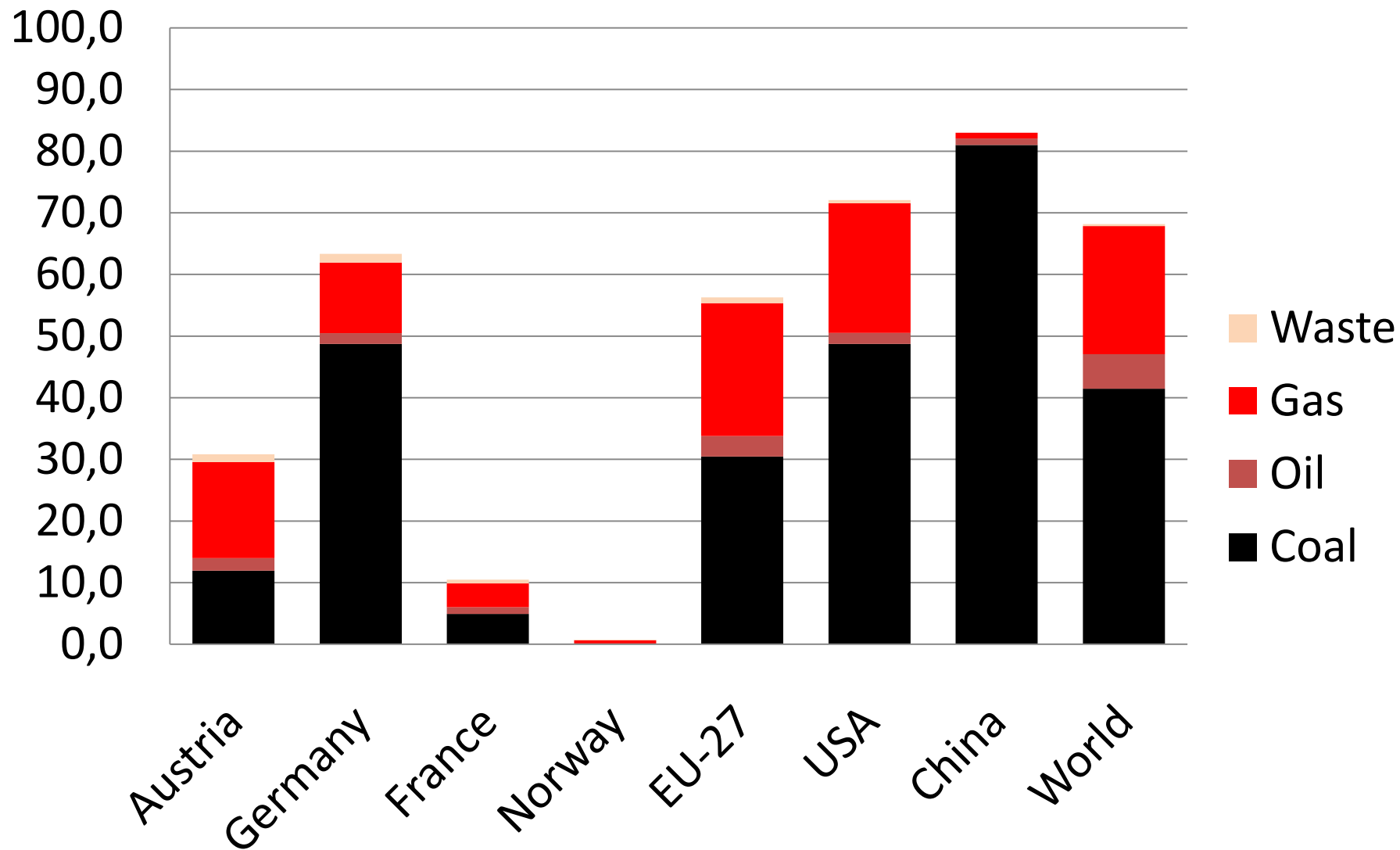
# CO<sub>2</sub> from ...



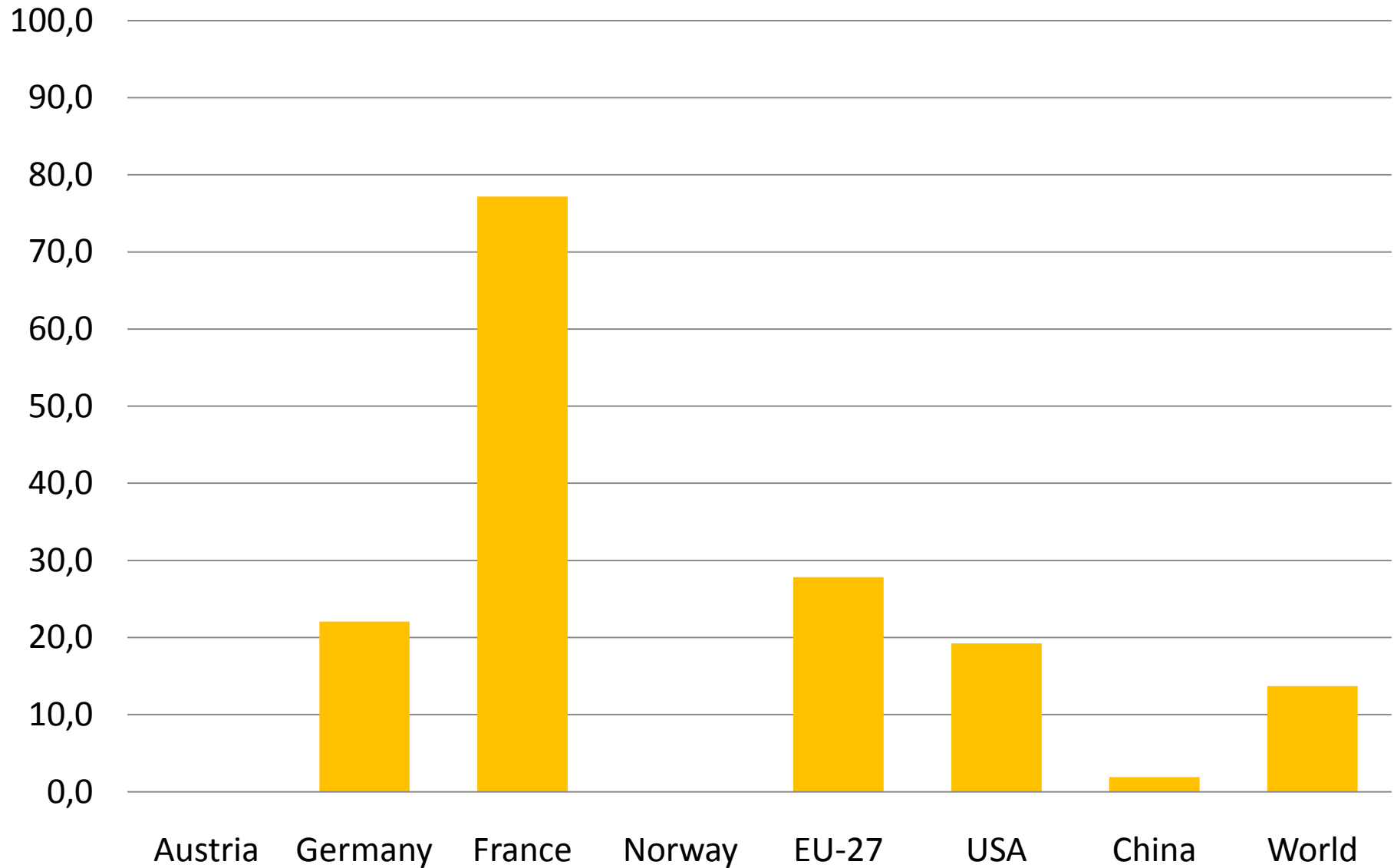
# Hydroelectricity



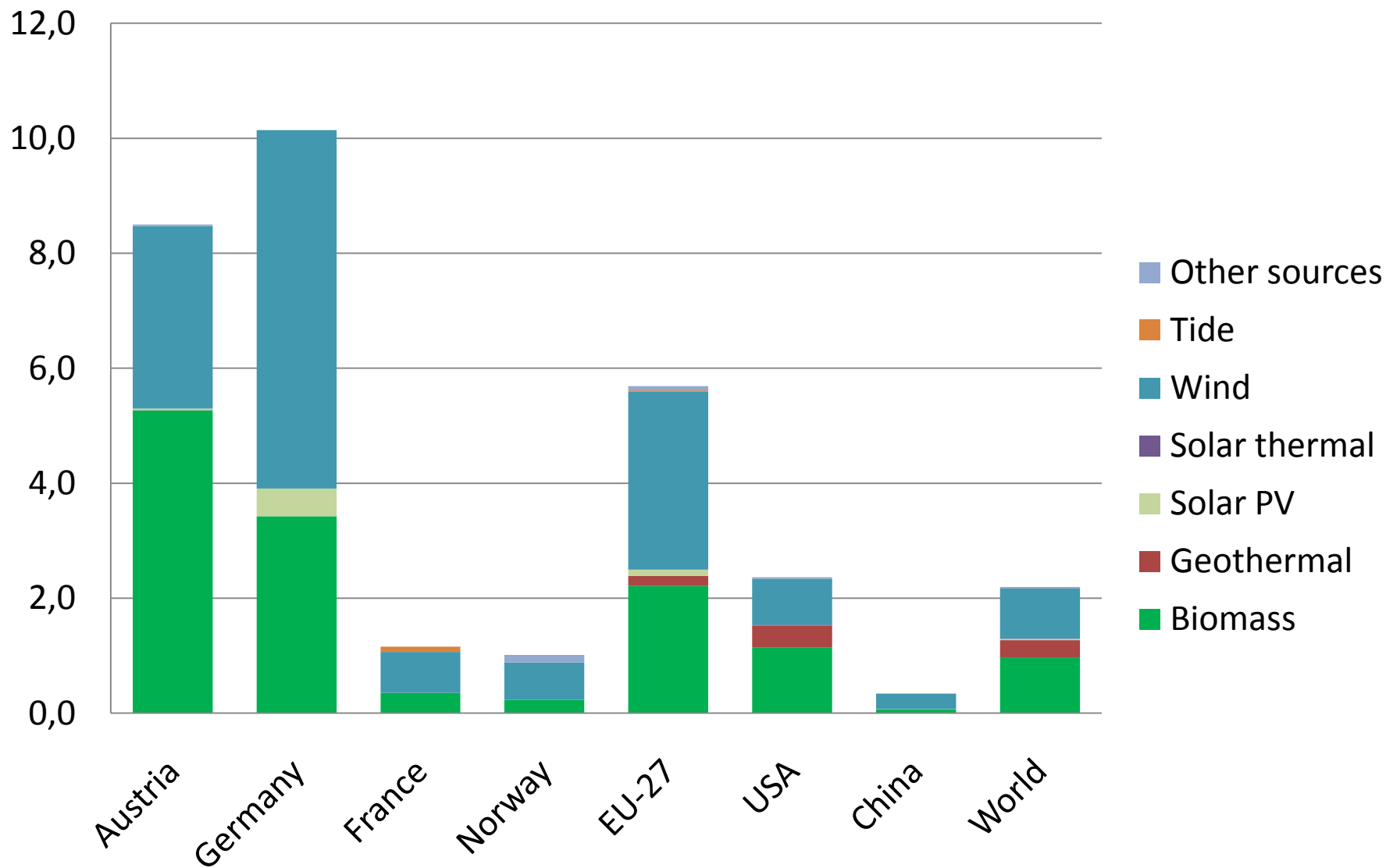
# Electricity from ...



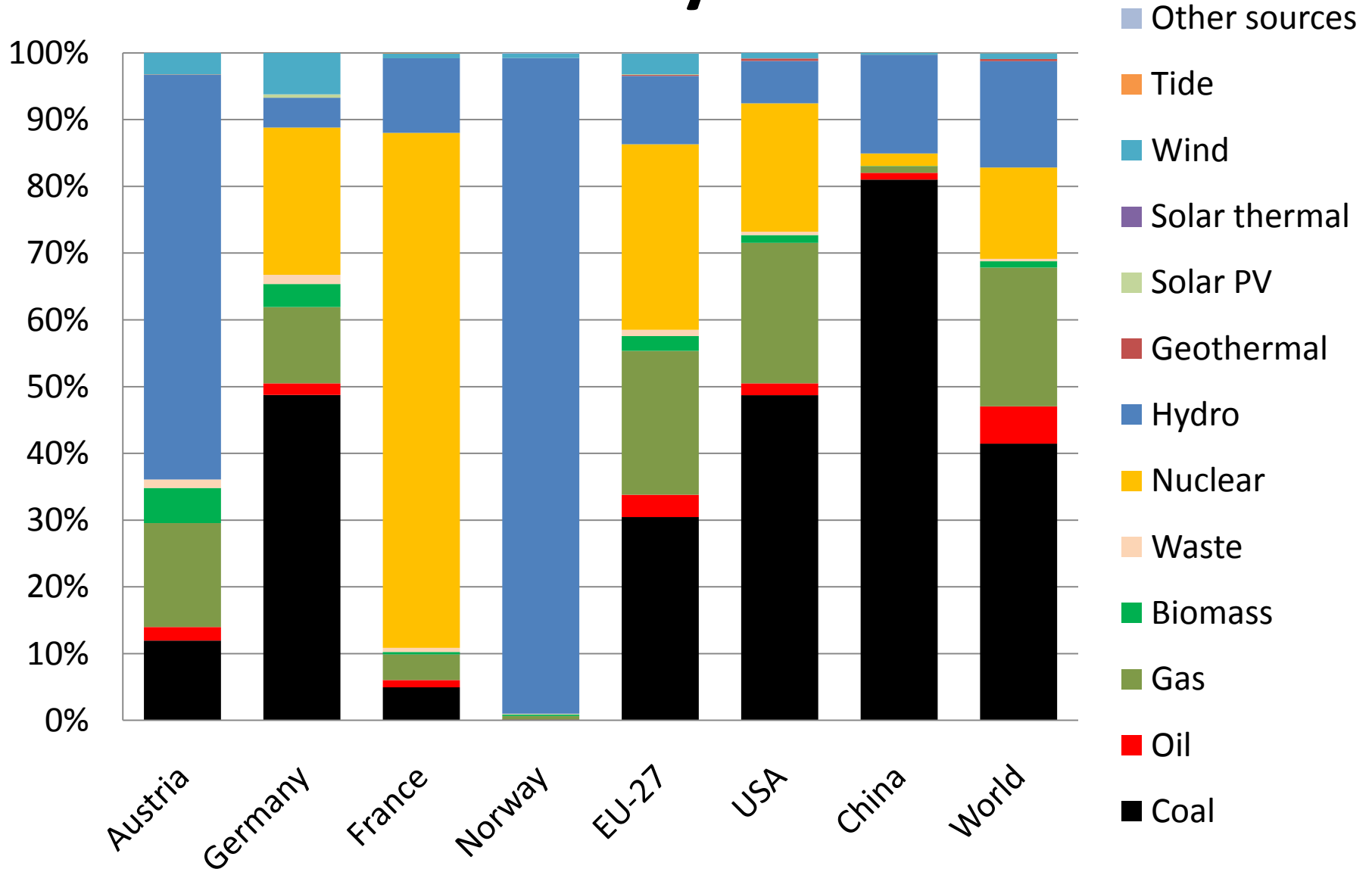
# Electricity from nuclear energy



# Electricity from ...



# Electricity from ...



# Parameters

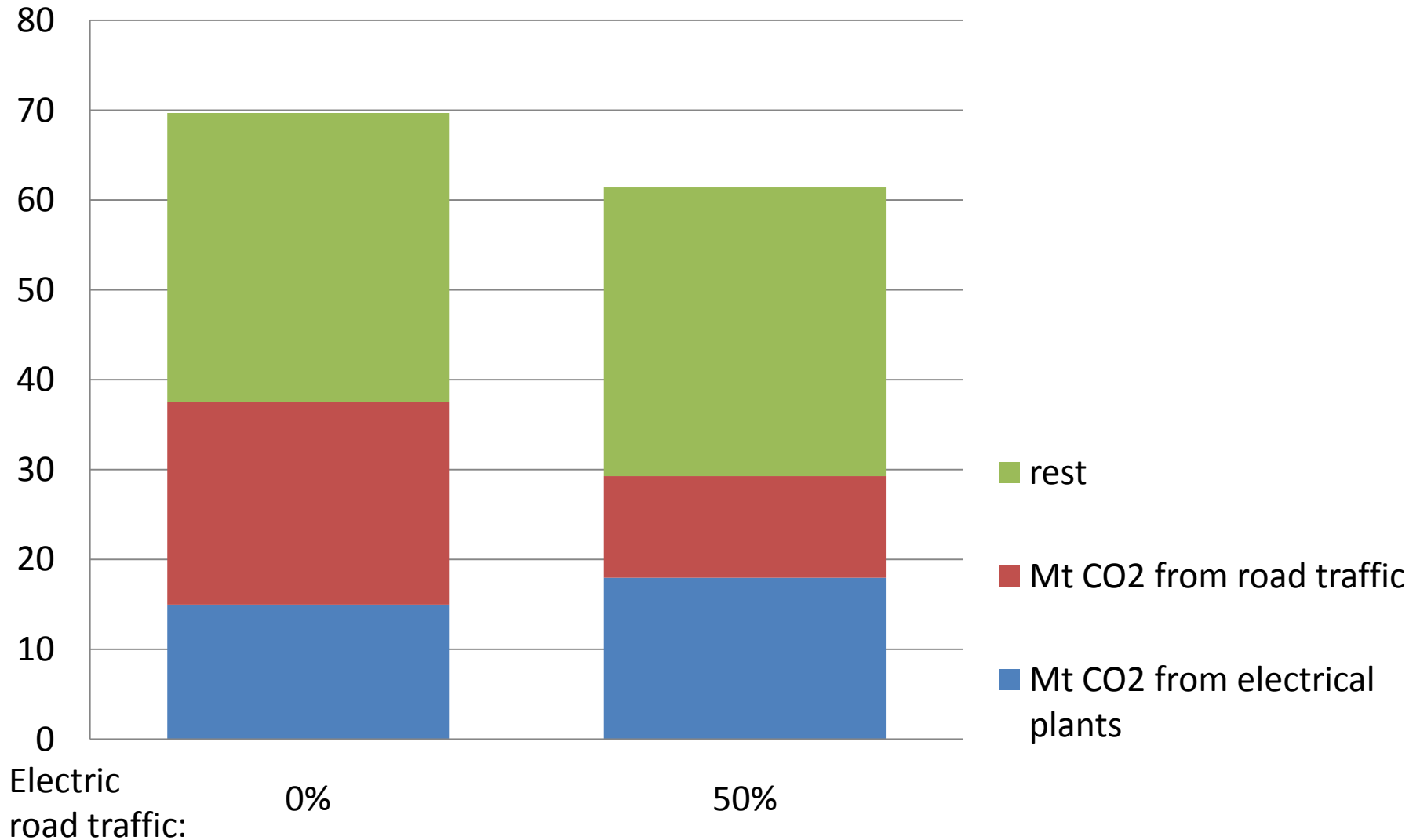
- demand of energy : 0.18 kWh/km
- emission of CO<sub>2</sub> : 2.4 kg/L
- fuel density : 0.8 kg/L
- heat of combustion : 11.9 kWh/kg
- emission of cars today : 160 g/km
- percentage of electric cars : 50 %

# Assumption

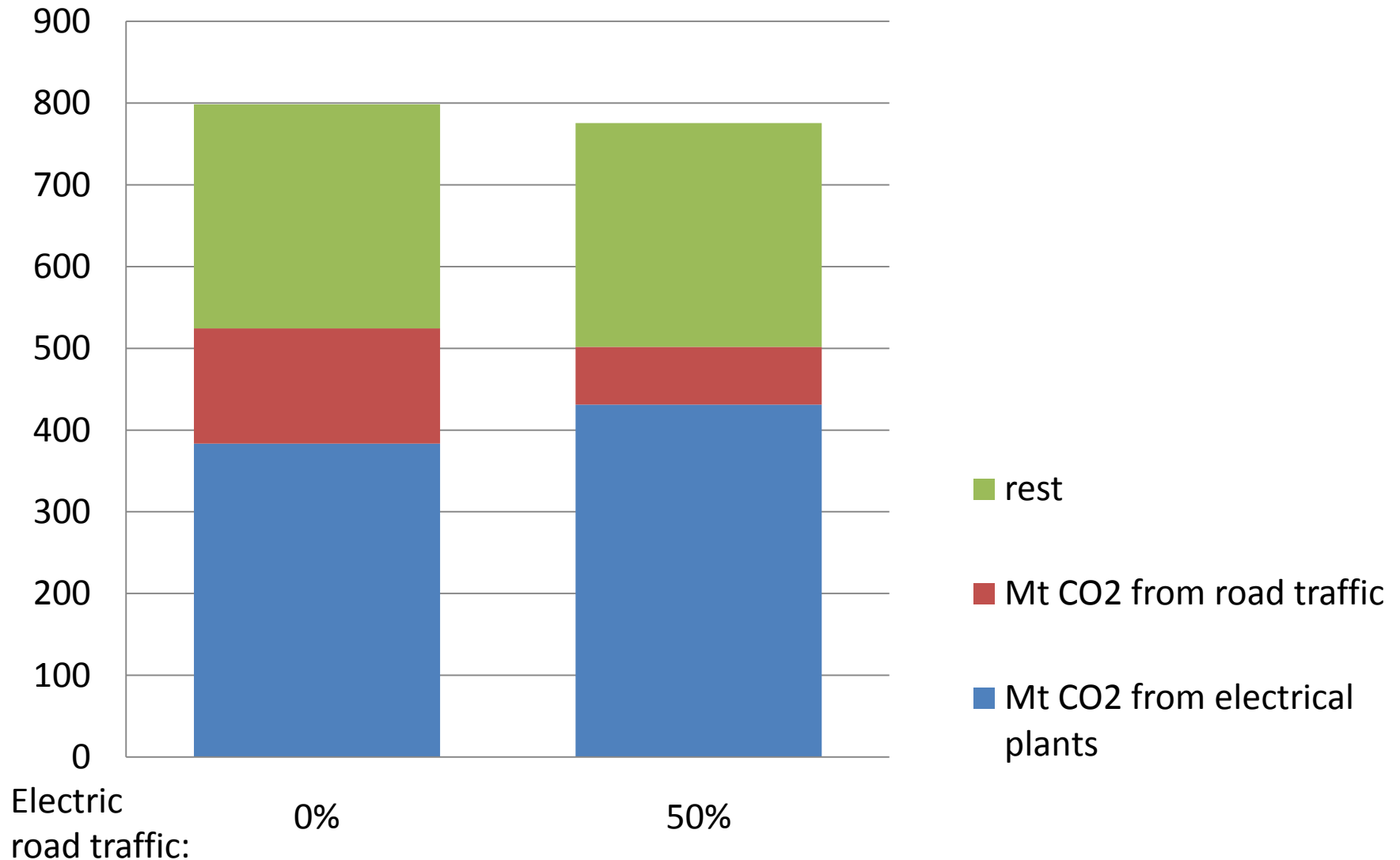
The structure of production  
of electricity does not change.

Data from 2007

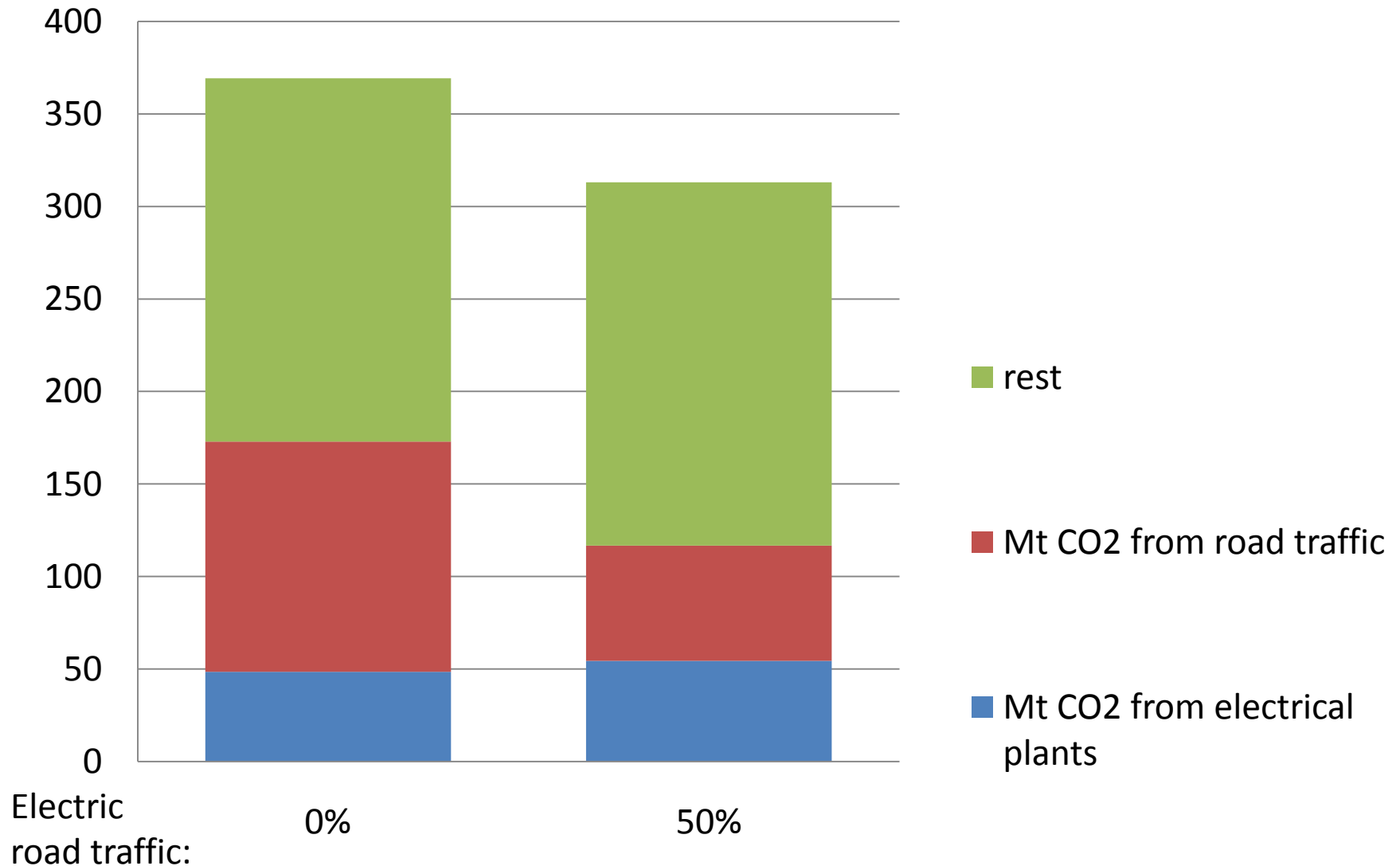
# Austria: CO<sub>2</sub> emissions in Mt/a without and with electric cars



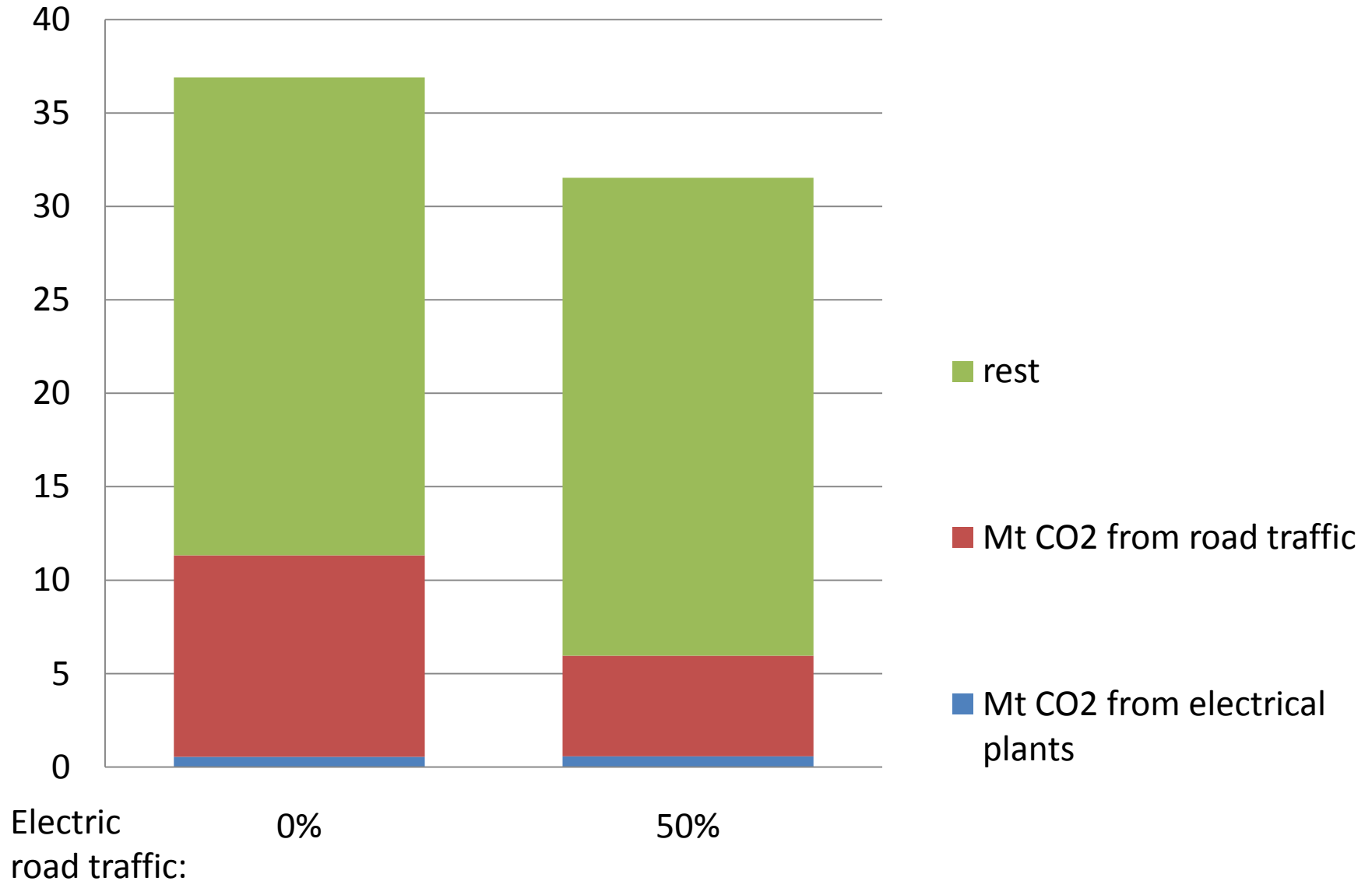
# Germany: CO<sub>2</sub> emissions in Mt/a without and with electric cars



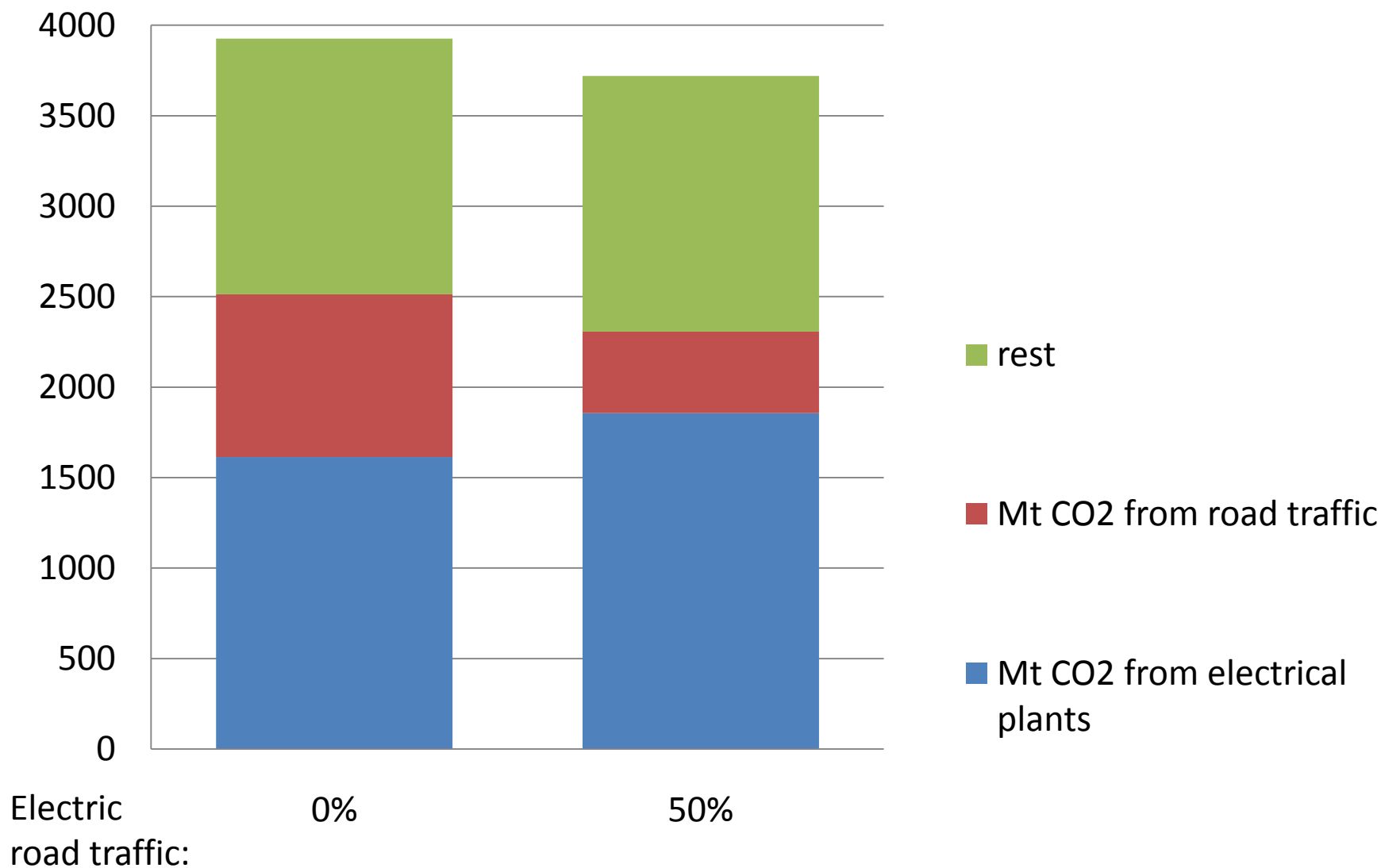
# France: CO<sub>2</sub> emissions in Mt/a without and with electric cars



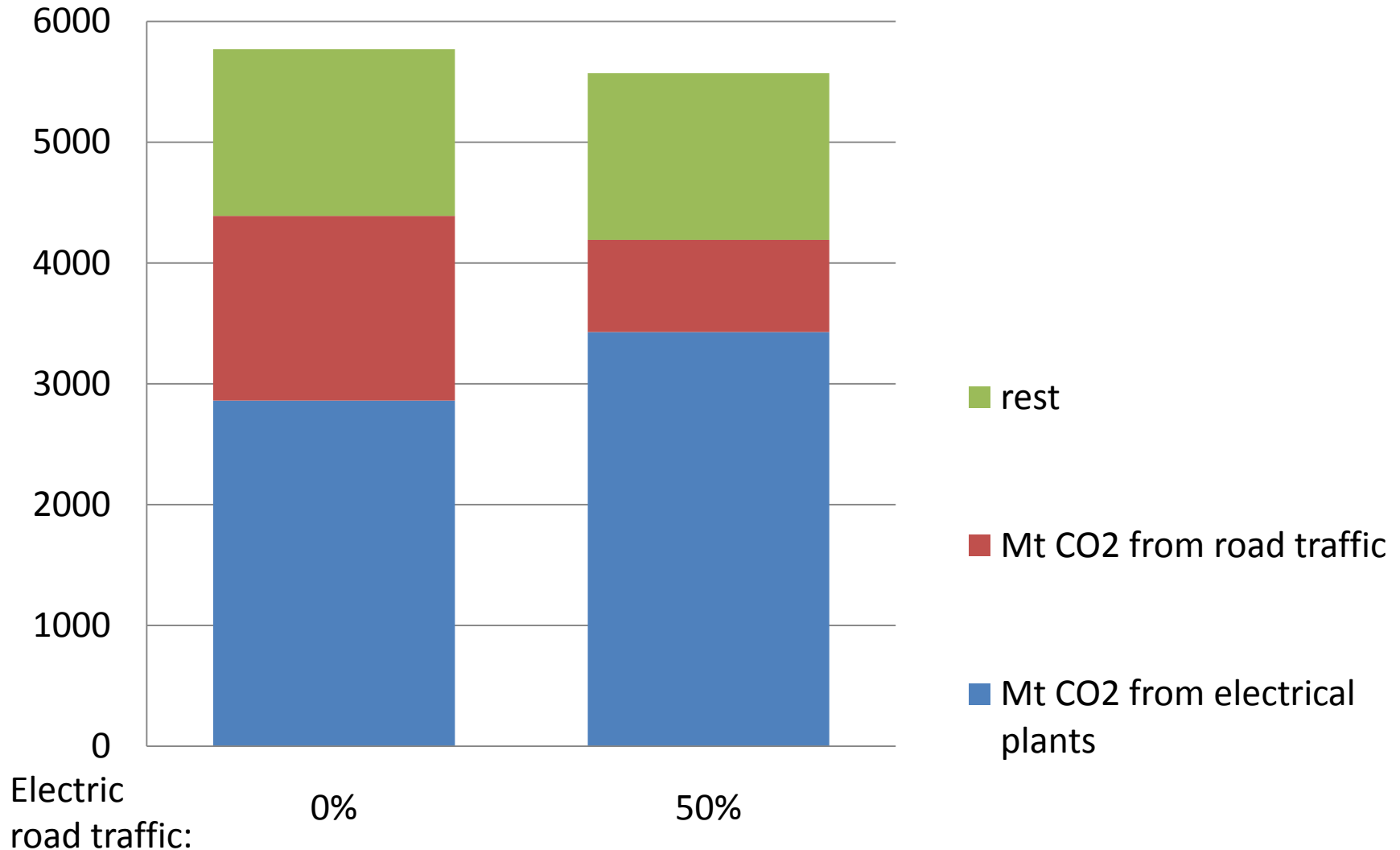
# Norway: CO<sub>2</sub> emissions in Mt/a without and with electric cars



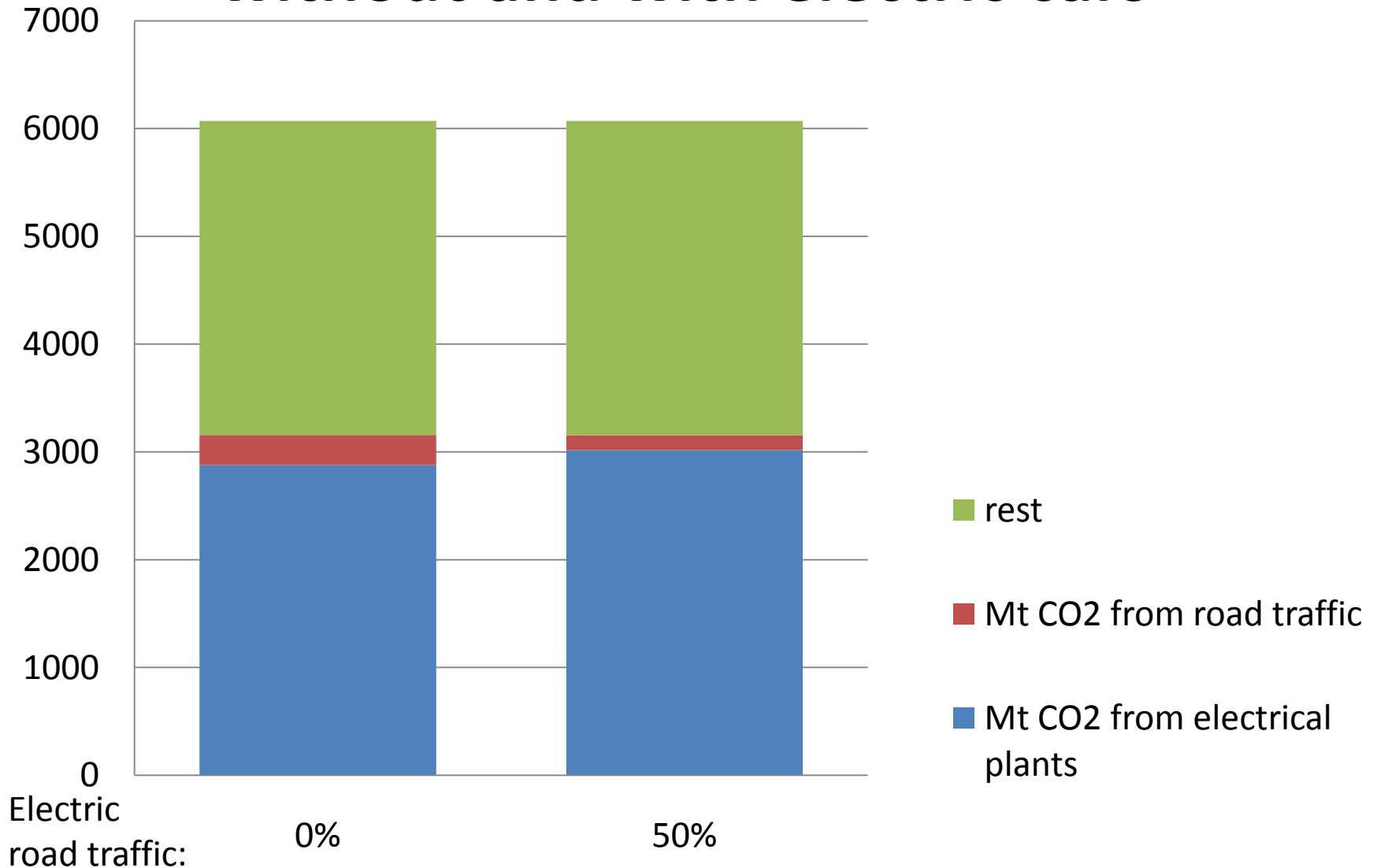
# EU-27: CO<sub>2</sub> emissions in Mt/a without and with electric cars



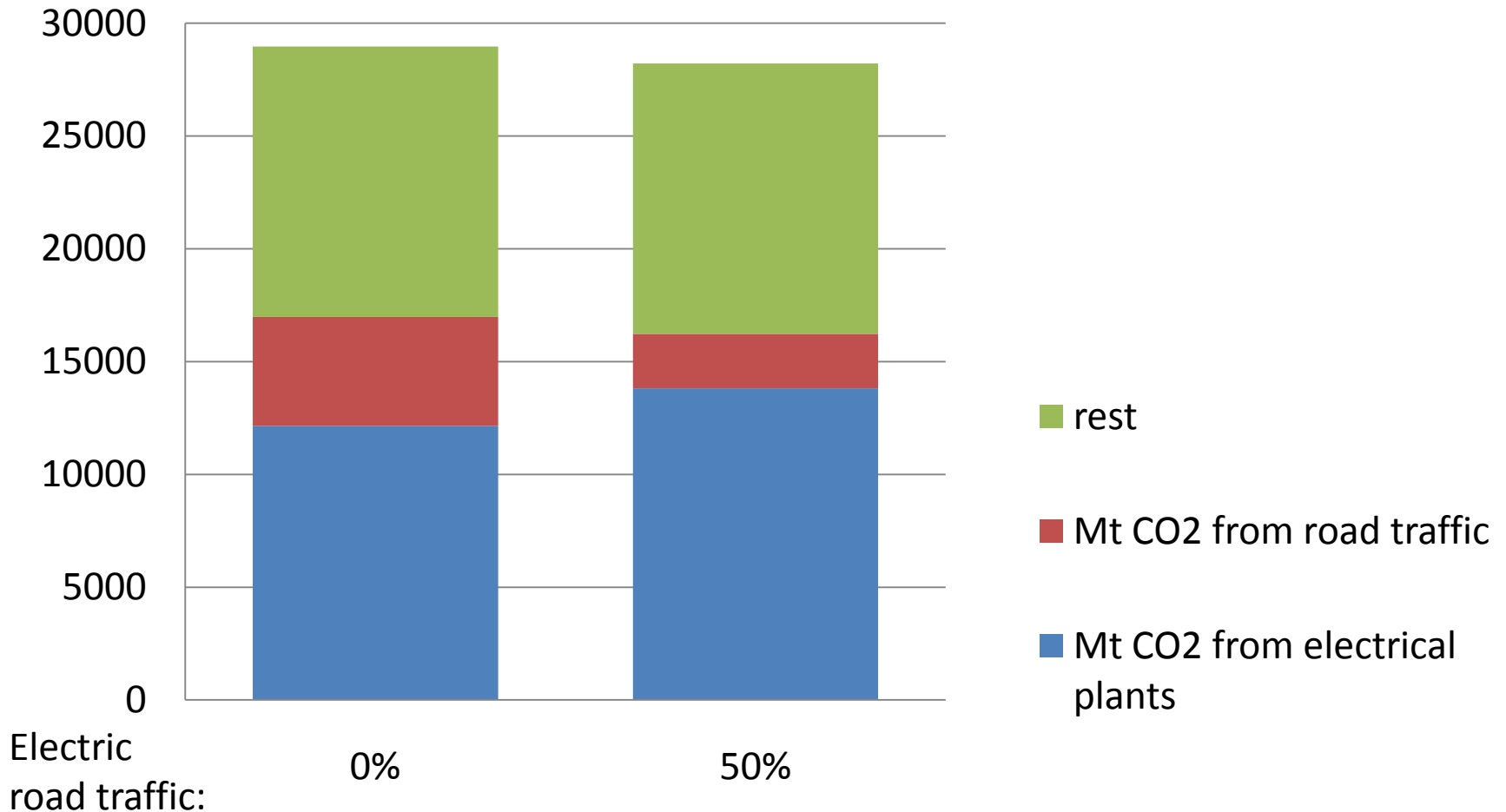
# USA: CO<sub>2</sub> emissions in Mt/a without and with electric cars



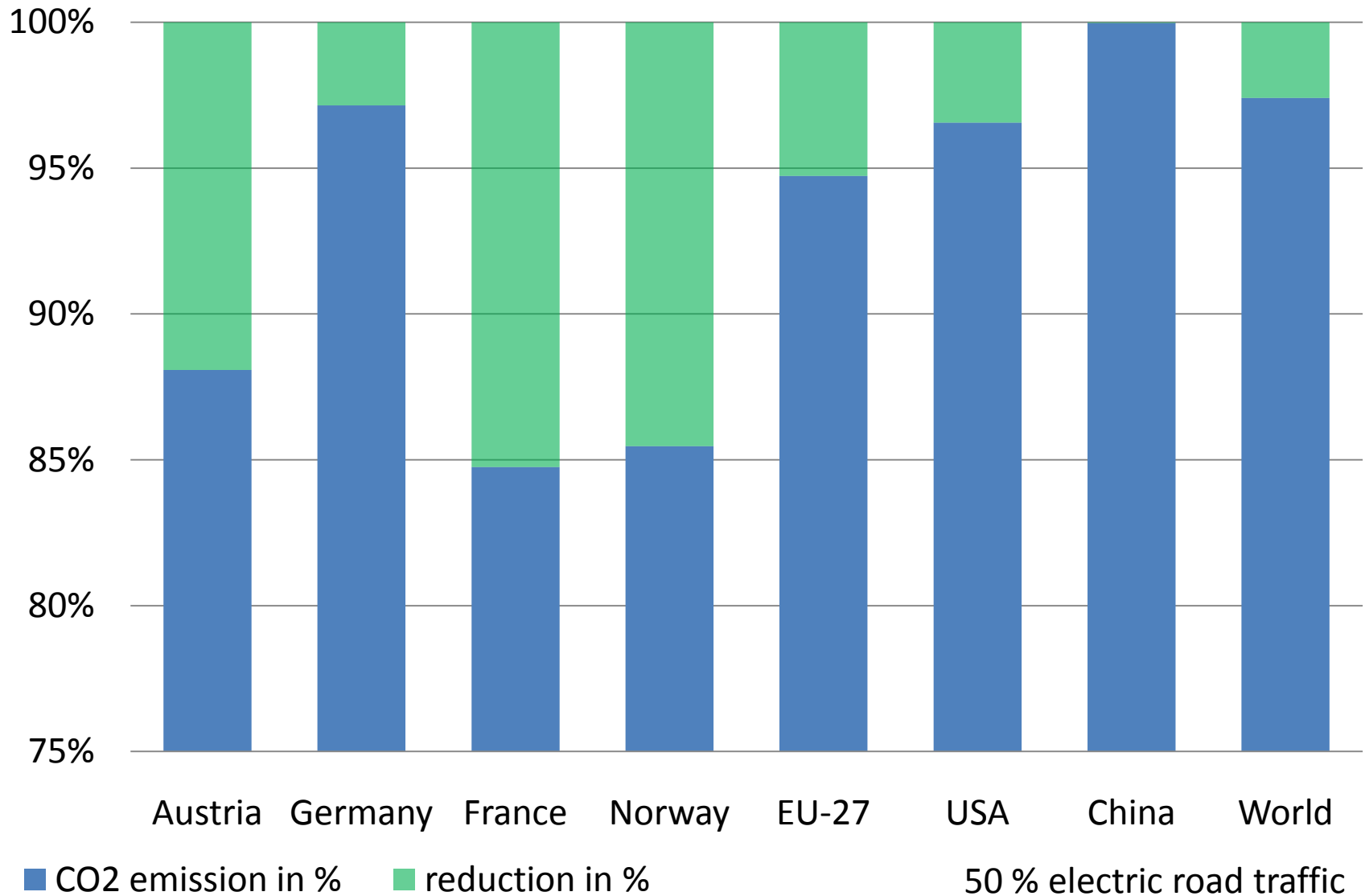
# China: CO<sub>2</sub> emissions in Mt/a without and with electric cars



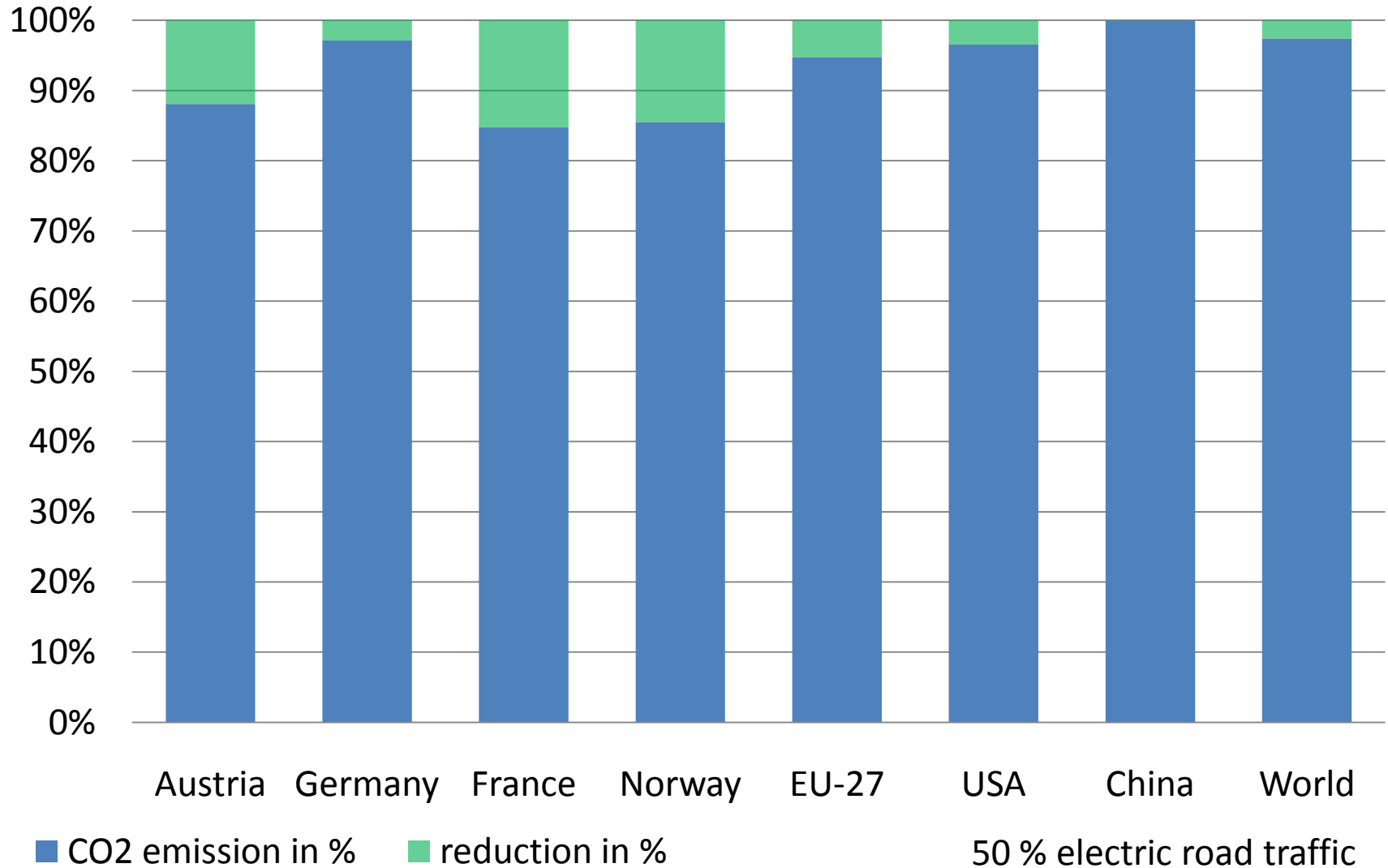
# World: CO<sub>2</sub> emissions in Mt/a without and with electric cars



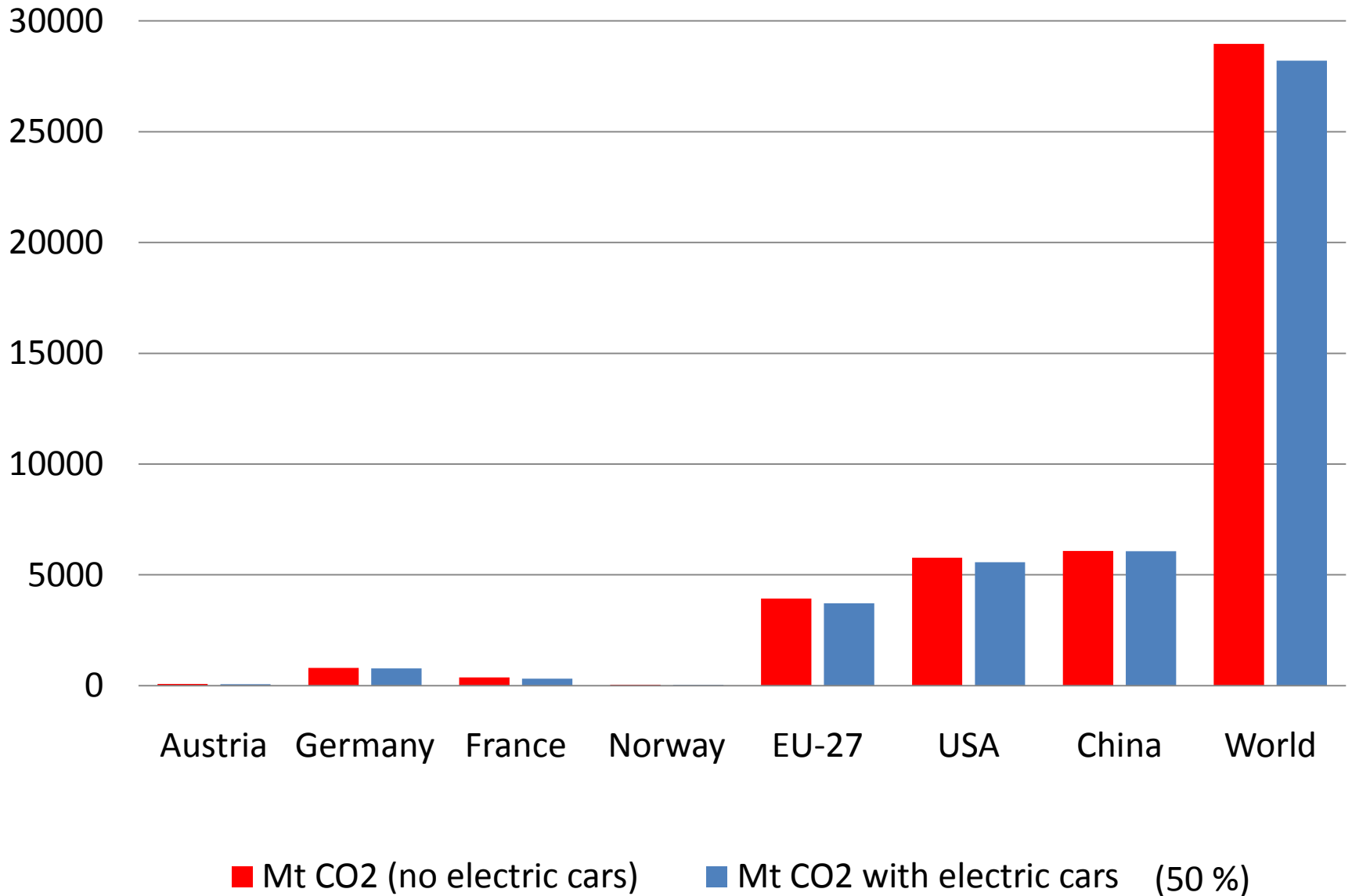
# Change of CO<sub>2</sub> emissions



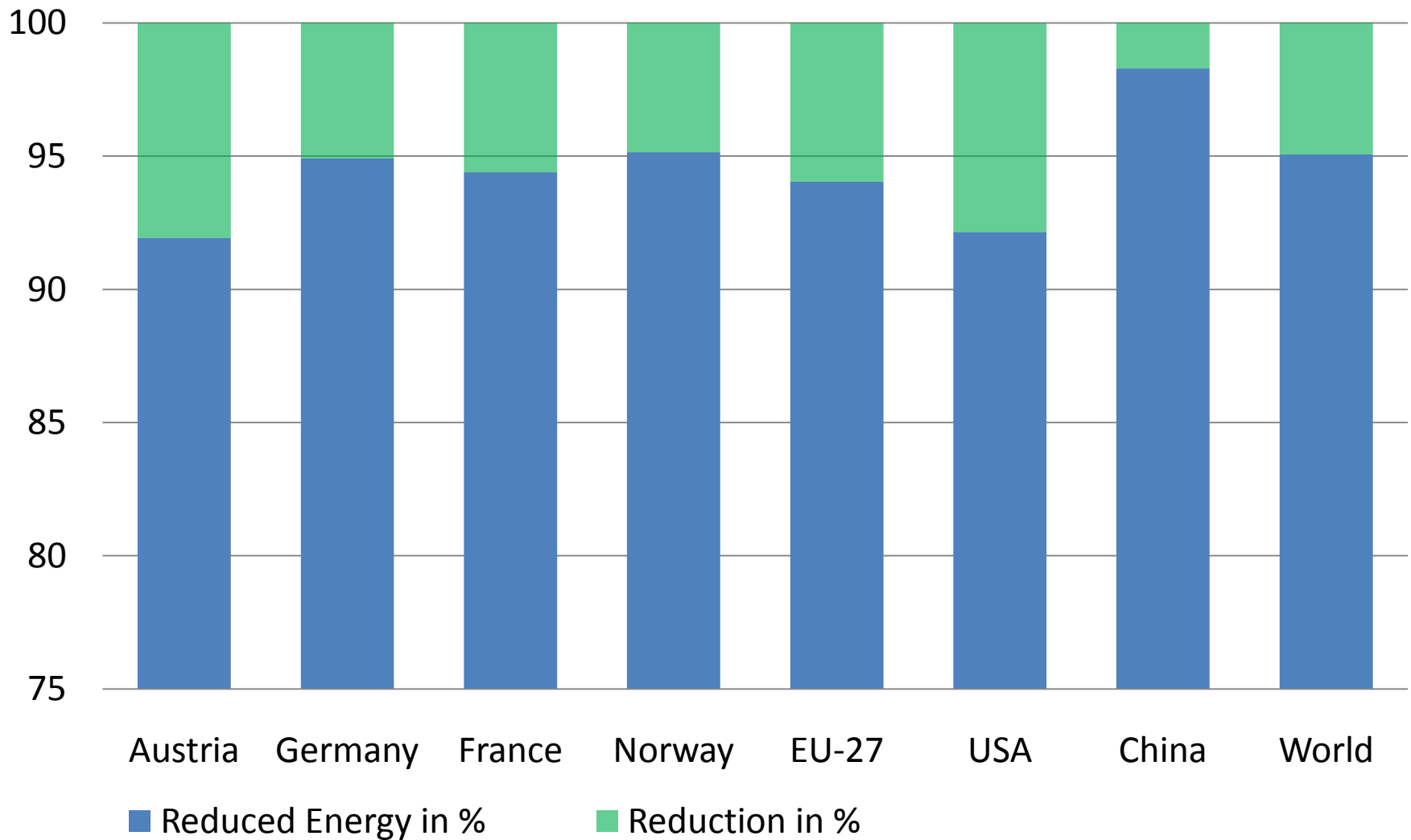
# Change of CO<sub>2</sub> emissions



# Total CO<sub>2</sub> emissions in Mt/a

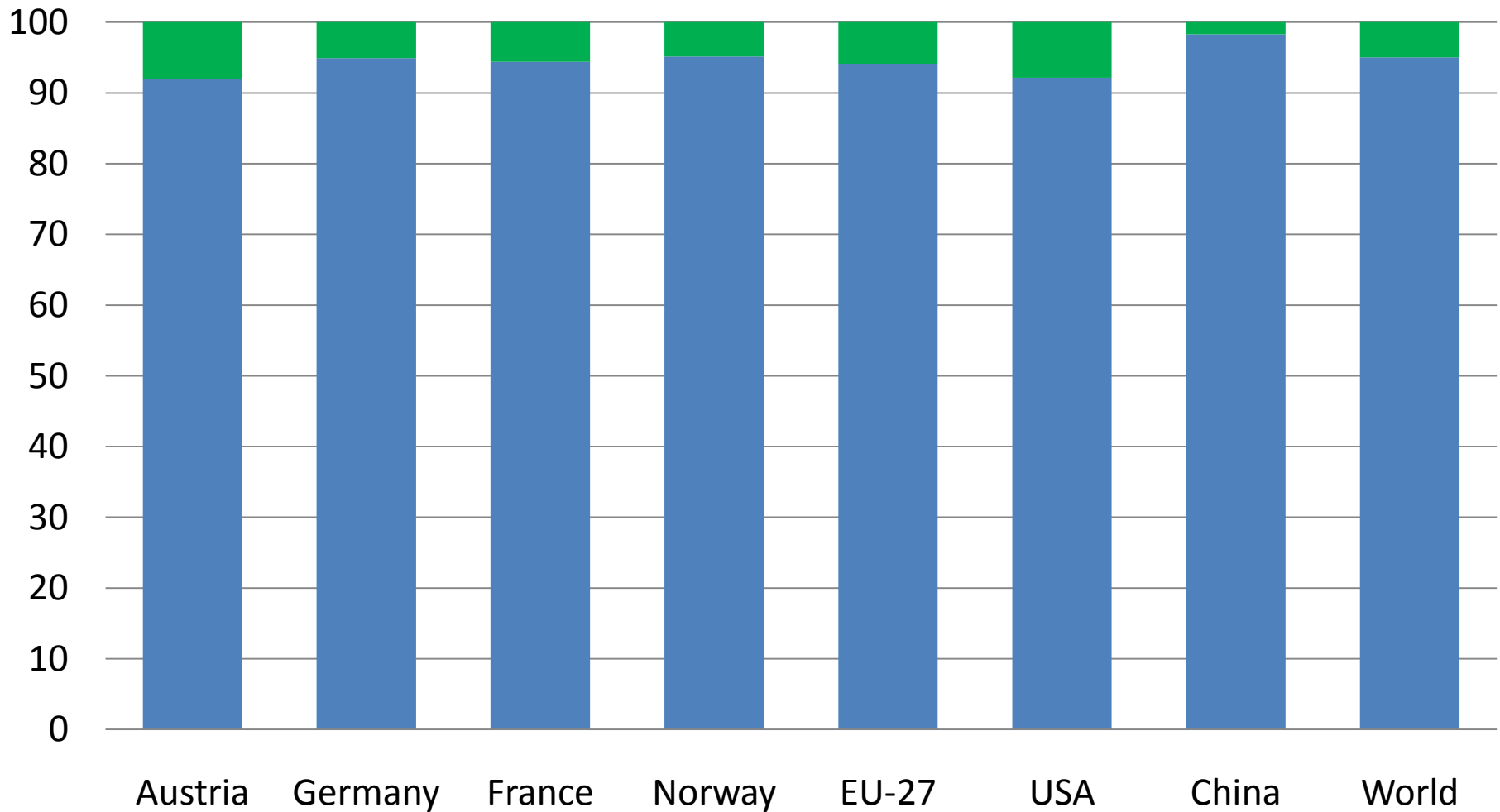


# Energy reduction



50 % electric road traffic

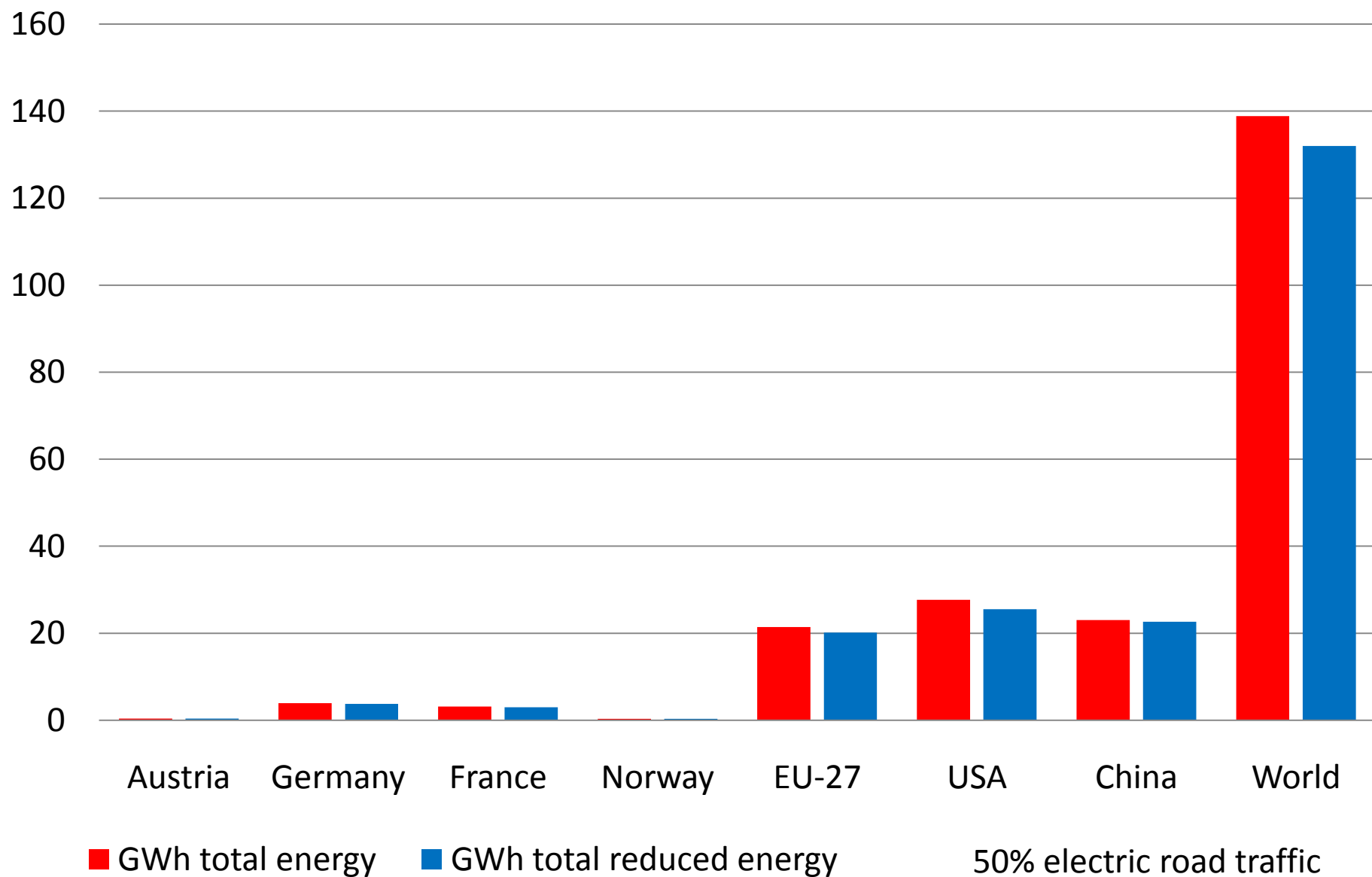
# Energy reduction



■ Reduced Energy in %   ■ Reduction in %

50 % electric road traffic

# Yearly used energy in PWh



# Without consideration:

- town or country
- car or truck
- time of recharging
- production of electric cars
- car sharing

Thank you for your attention!

Have a good time in Vienna!

