



Global Trade Analysis Project

Energy Policy, Carbon Emissions and Global Trade

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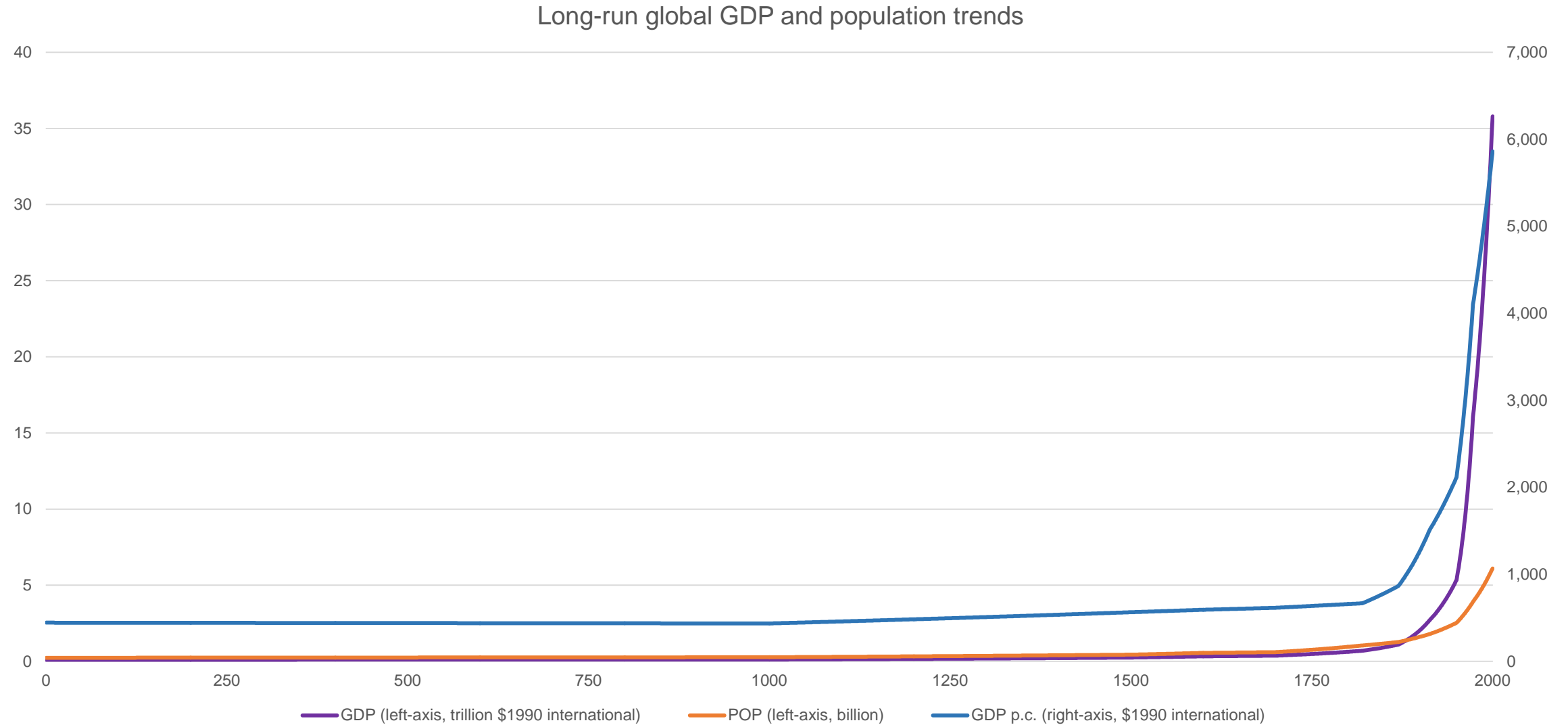
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Beck Agricultural Center, Purdue University

Outline

- **Energy needed for growth and economic well-being**
- **Conventional energy use is leading to rising atmospheric concentrations of greenhouse gases and is *very likely* leading to global climate change**
- **Global energy policies are highly distortionary**
 - Vary significantly across countries, end-users and energy carriers
 - Affect competitiveness and trade
 - And have macro-economic consequences
- **Taxes on commodities should have clear objectives**
 - Local and global emissions, health, congestion, other externalities
- **Cooperative solutions lead to efficient outcomes**

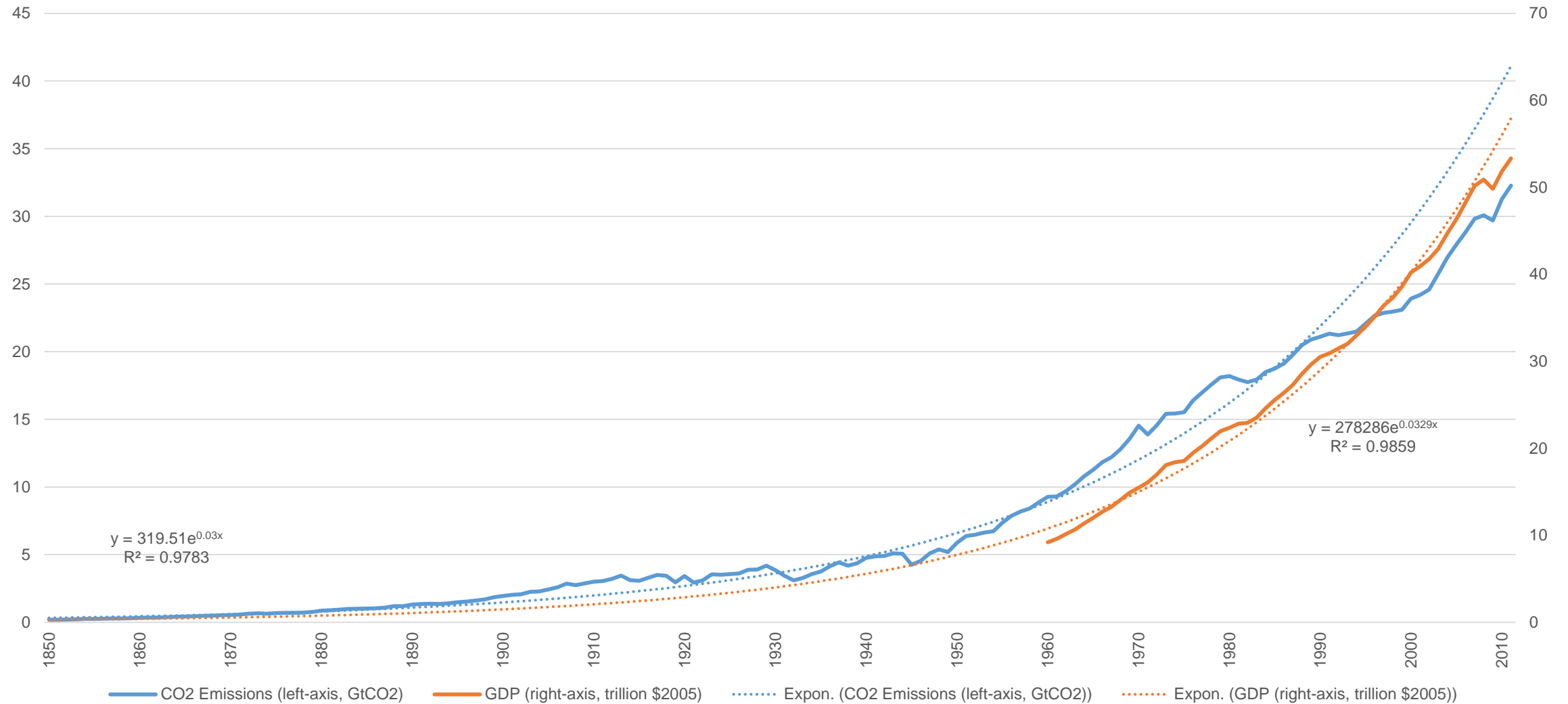
Industrial revolution ended a lengthy period of dismal growth



Source: Maddison, Angus (2001). The World Economy: A millennial perspective. OECD, Paris.

Tight link between GDP, energy and CO₂ emissions

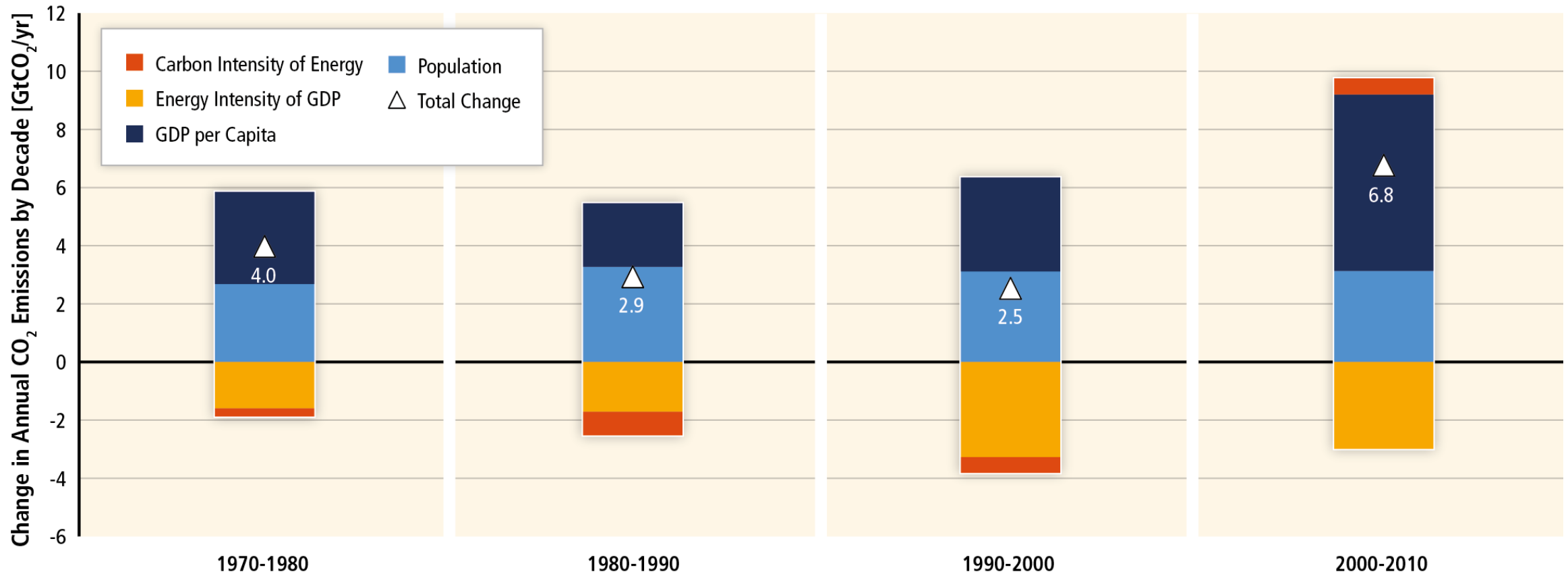
Global CO₂ emissions from fossil fuels and industrial processes and GDP



Source: World Resources Institute (WRI) (cait2.wri.org, accessed 4-Dec-2014.)

Population and GDP growth main drivers of emissions growth

Decomposition of the Change in Total Annual CO₂ Emissions from Fossil Fuel Combustion by Decade

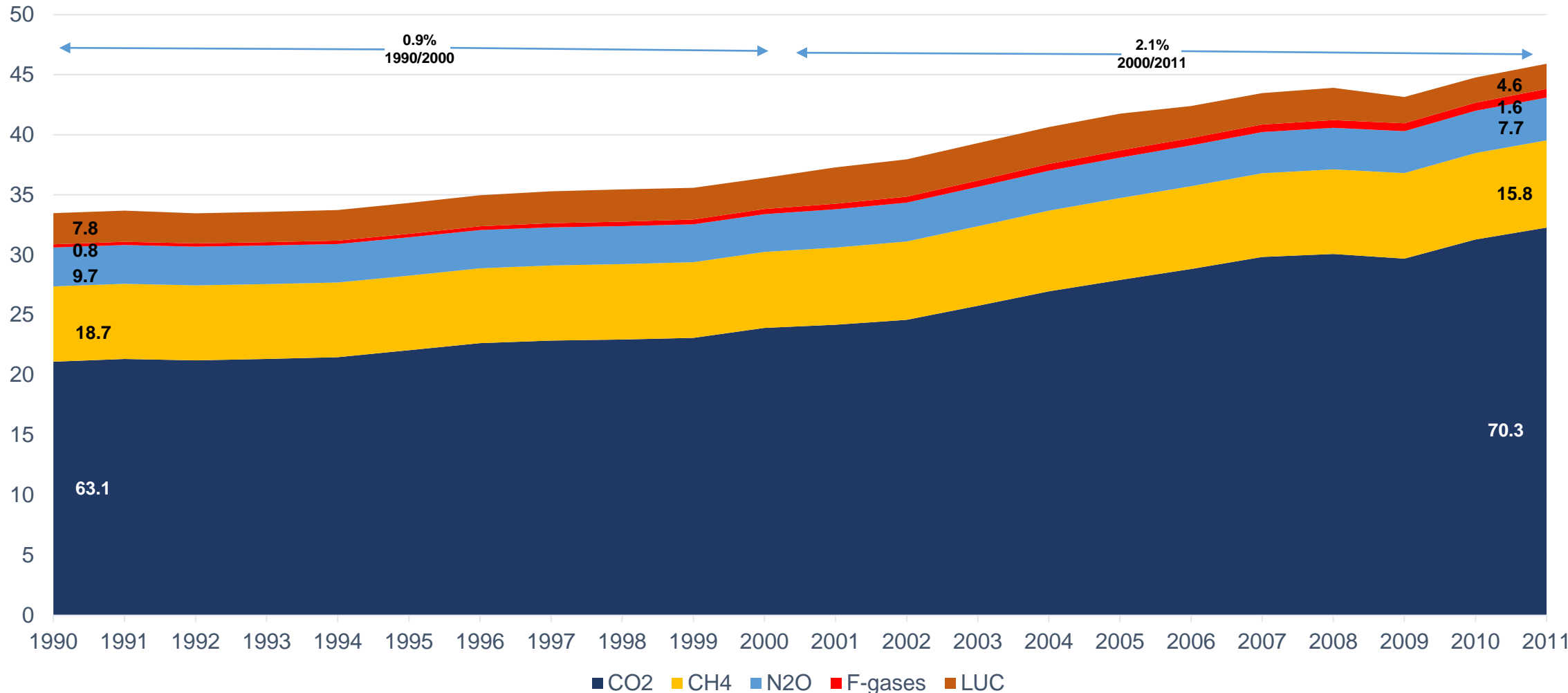


Source: Intergovernmental Panel on Climate Change (IPCC) 2014, WGIII, SPM
<http://www.ipcc.ch/report/graphics/index.php?t=Assessment%20Reports&r=AR5%20-%20WG3&f=SPM>, accessed 5-Dec-2014.)

$$Emi = Pop \times \underbrace{\left(\frac{GDP}{Pop} \right)}_{\text{Per capita income}} \times \underbrace{\left(\frac{NRG}{GDP} \right)}_{\text{Energy intensity of output}} \times \underbrace{\left(\frac{Emi}{NRG} \right)}_{\text{Carbon intensity of energy}}$$

Other sources of greenhouse gas emissions are also prominent

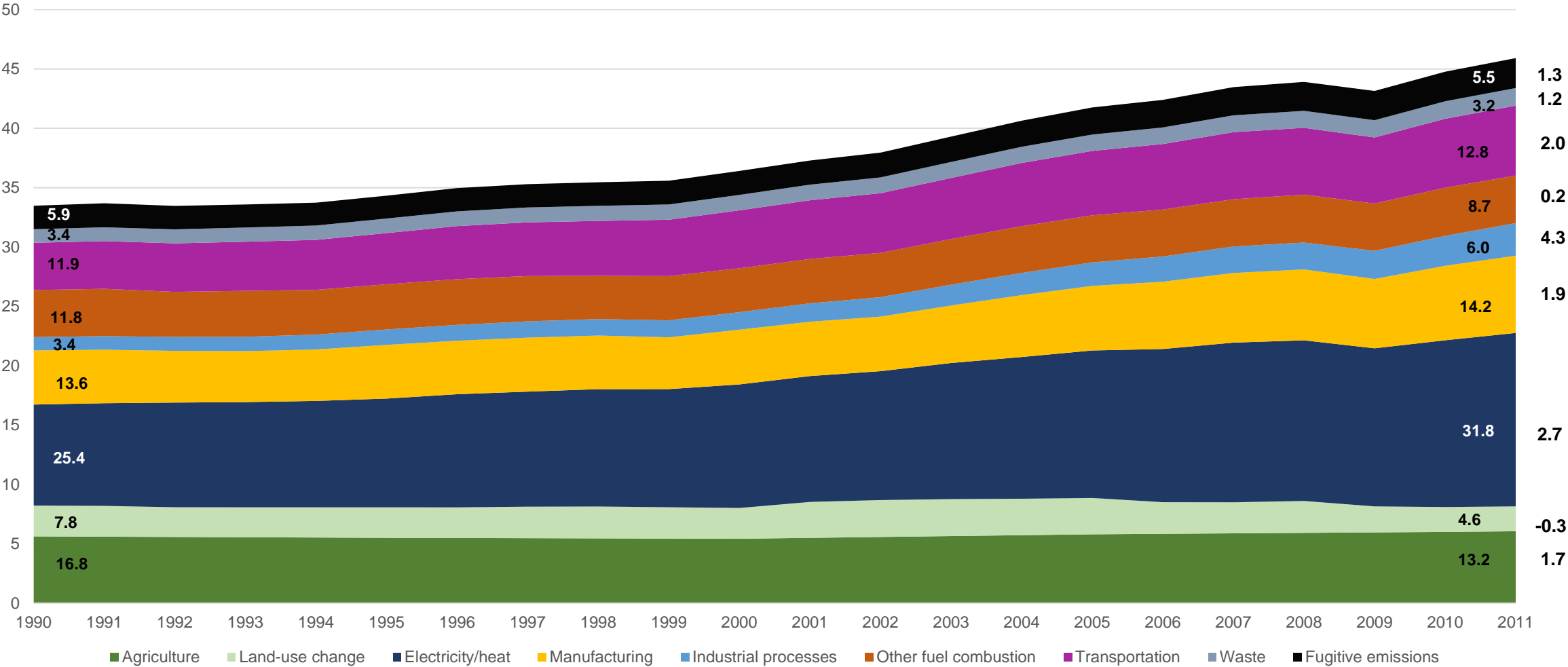
Greenhouse gas emissions, GtCO2e



Source: World Resources Institute (WRI) (cait2.wri.org, accessed 4-Dec-2014.)

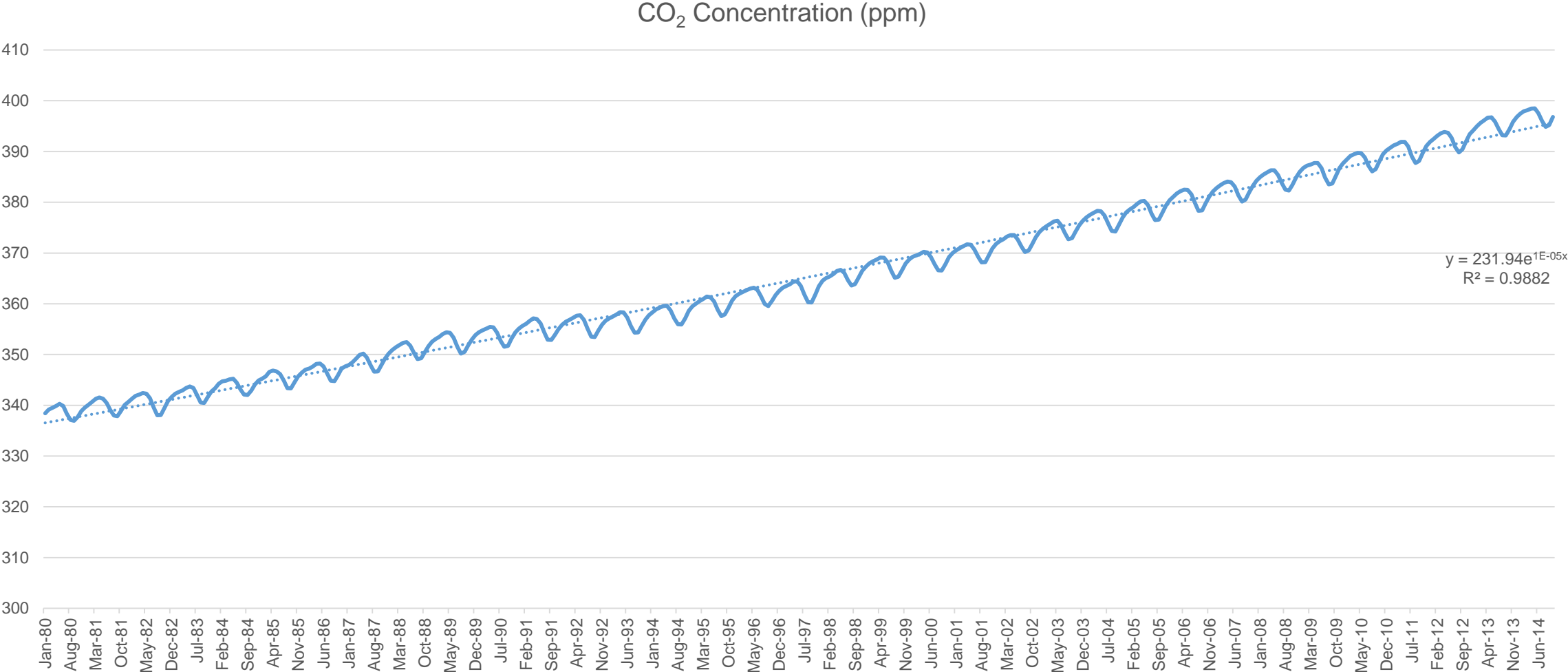
Rapid growth of emission for electricity, heat and industry

Greenhouse gas emissions by sector of origin, GtCO₂e



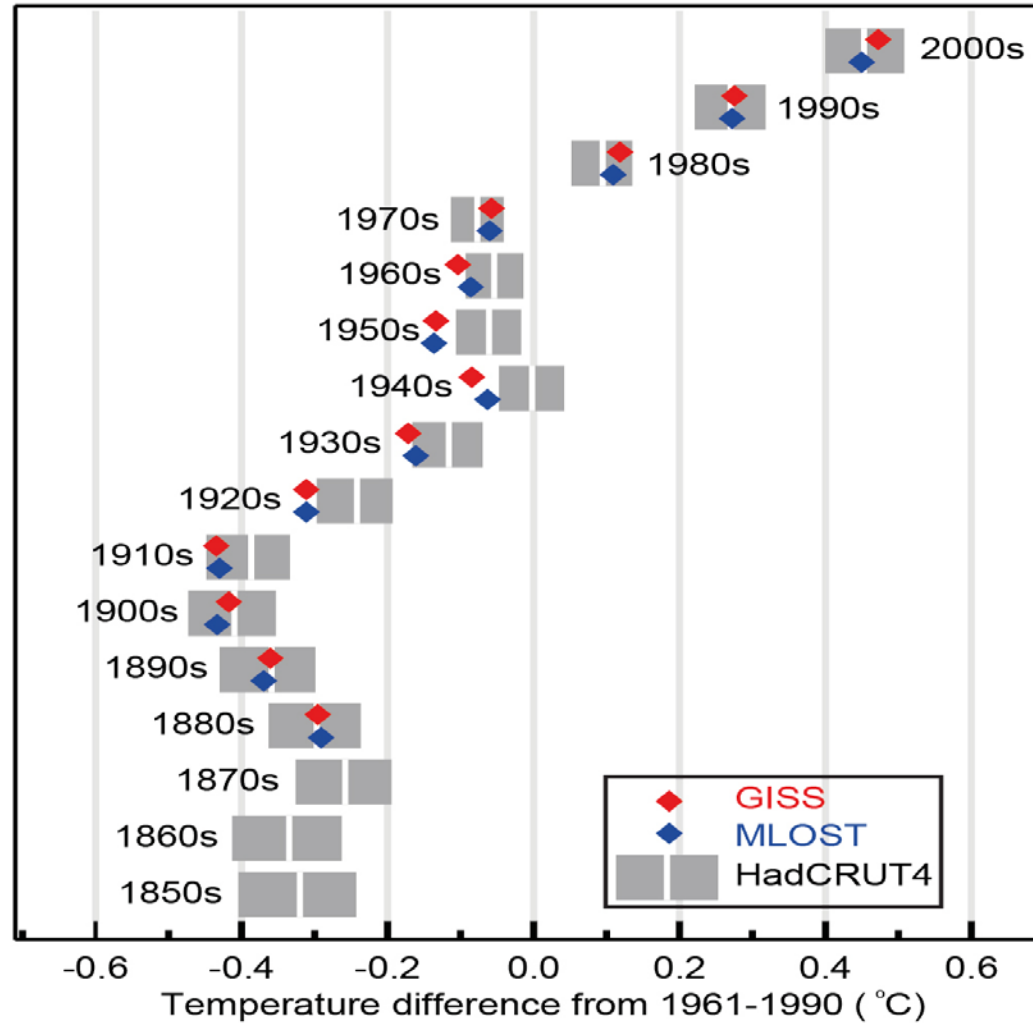
Source: World Resources Institute (WRI) (cait2.wri.org, accessed 4-Dec-2014.)

Rising measurement of atmospheric concentration of CO₂ (and other greenhouse gases)



Source: National Oceanic and Atmospheric Agency (NOAA) (ftp://aftp.cmdl.noaa.gov/products/trends/co2/co2_mm_gl.txt, accessed 5-Dec-2014.)

Recent decades warmest since the 1850's

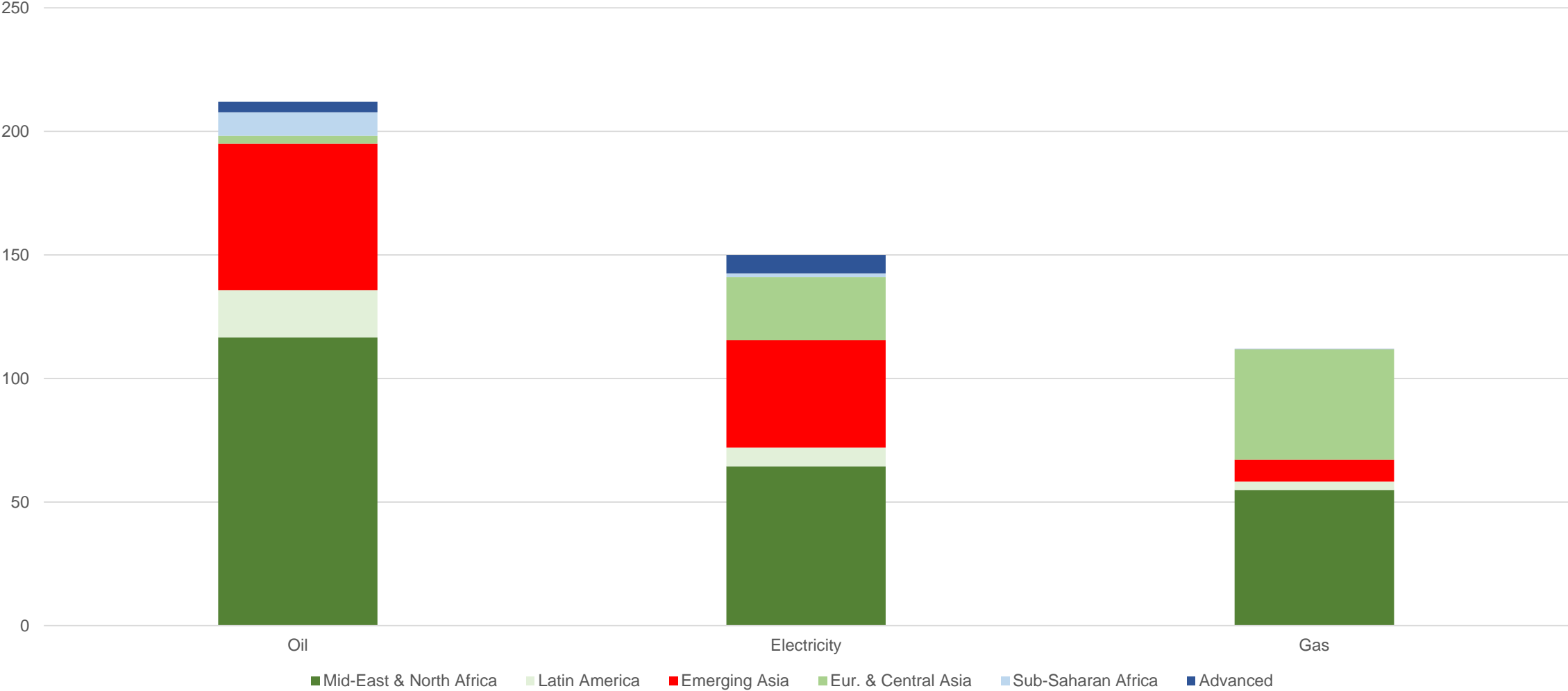


Source: Intergovernmental Panel on Climate Change (IPCC) 2014, WGI, Chapter 2, Figure 2.19

(<http://www.ipcc.ch/report/graphics/index.php?t=Assessment%20Reports&r=AR5%20-%20WG1&f=Chapter%2002>, accessed 5-Dec-2014.)

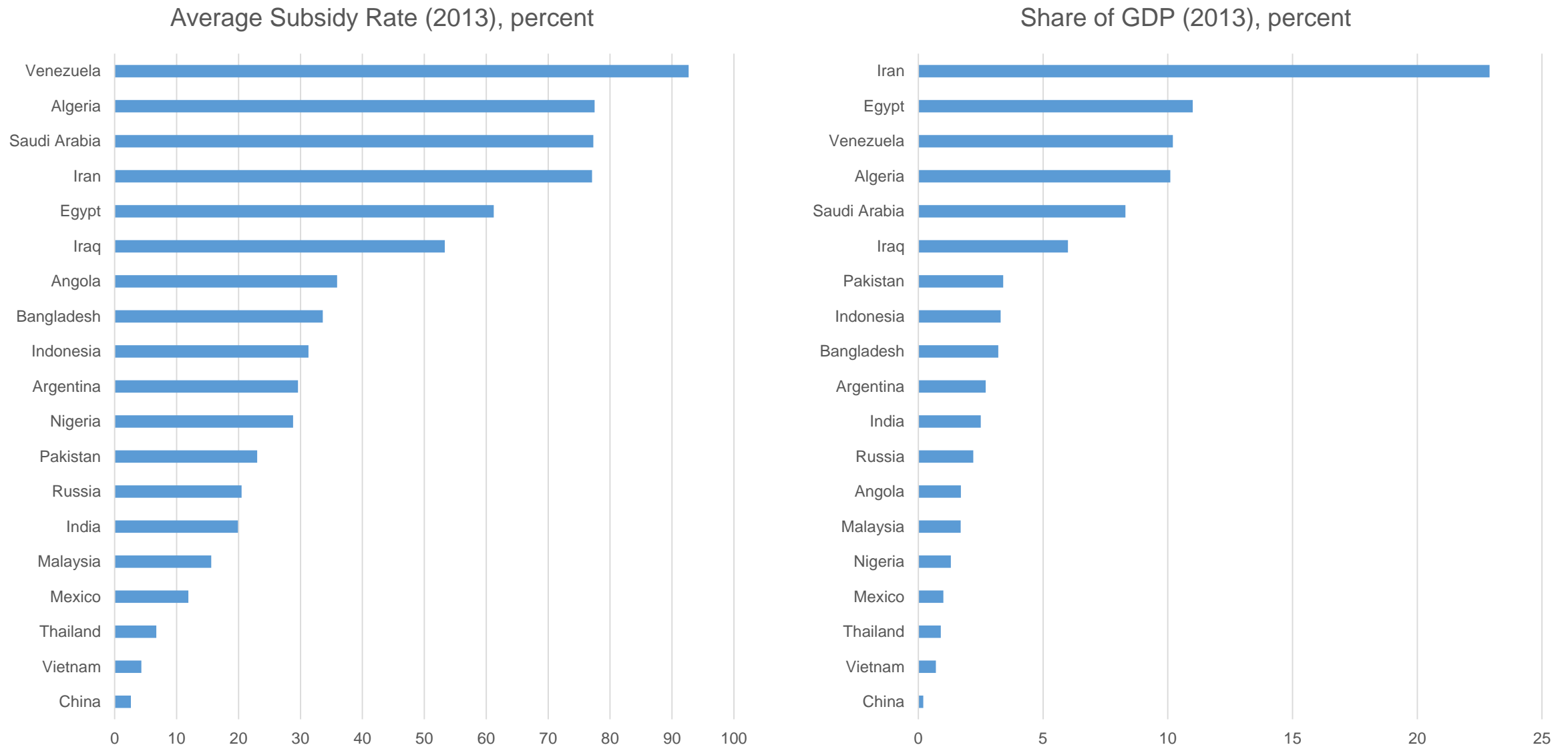
Energy subsidies high in developing countries

Energy subsidies by region, \$billion, 2011



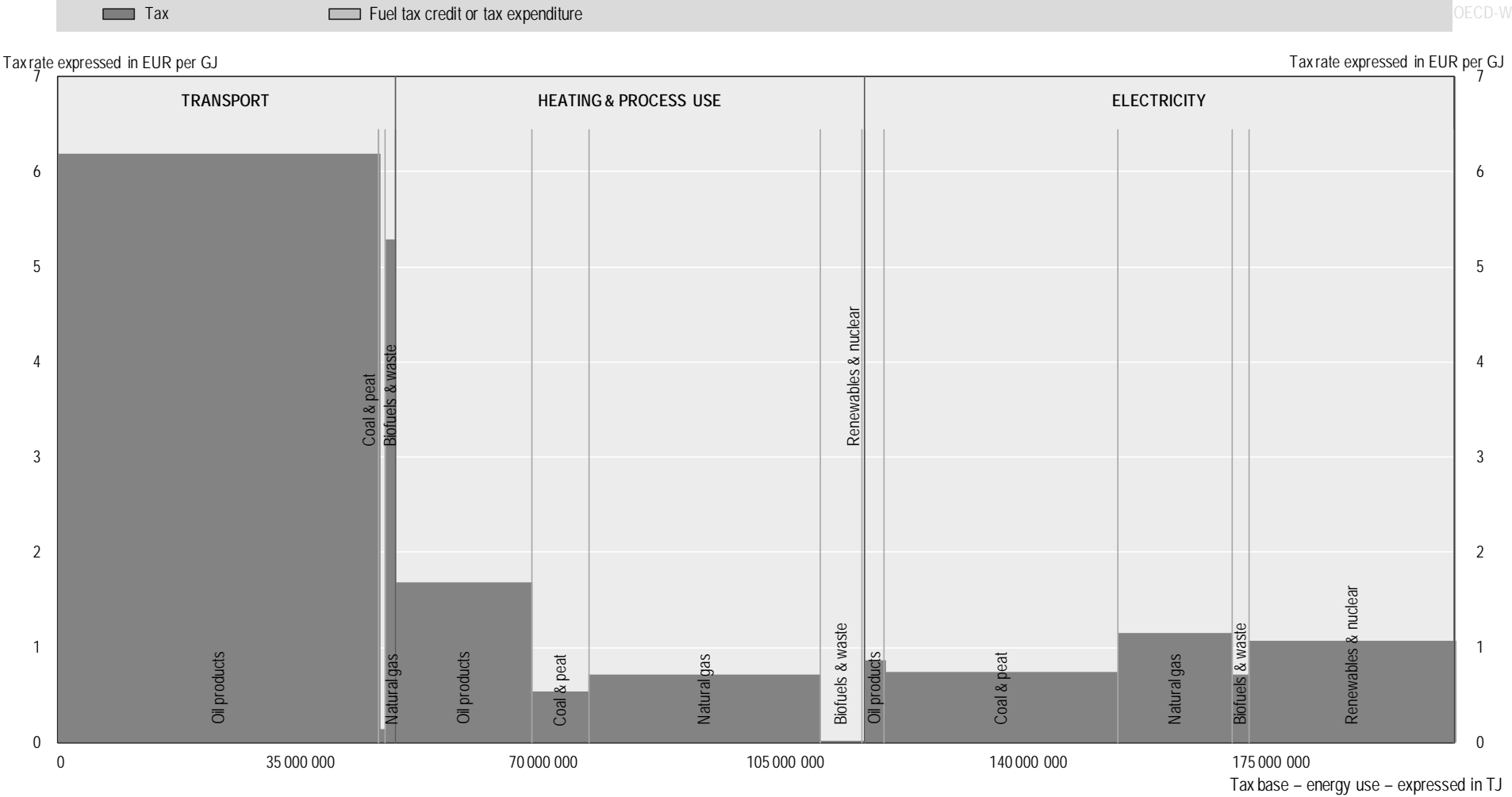
Source: IMF 2013. Energy Subsidy Reform: Lessons and Implications. (<http://www.imf.org/external/np/pp/eng/2013/012813.pdf>)

High fiscal costs and inefficient use of resources



Source: International Energy Agency (<http://www.iea.org/subsidy/index.html>, accessed 8-Dec-2014.)

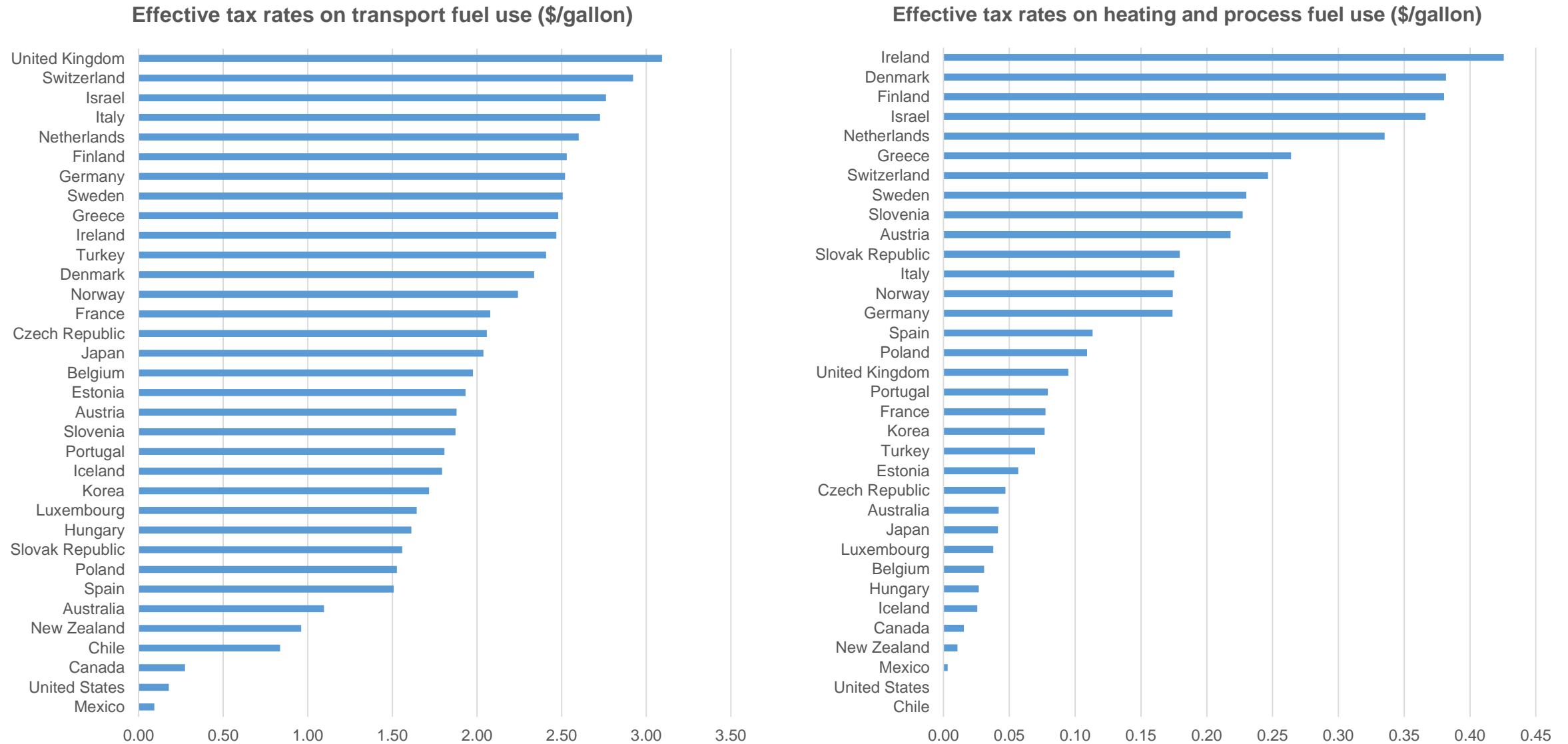
OECD countries tax mostly transport



Note: 6.12€/GJ ≈ \$1/Gallon

Source: OECD 2013. Taxing energy: a graphical analysis.

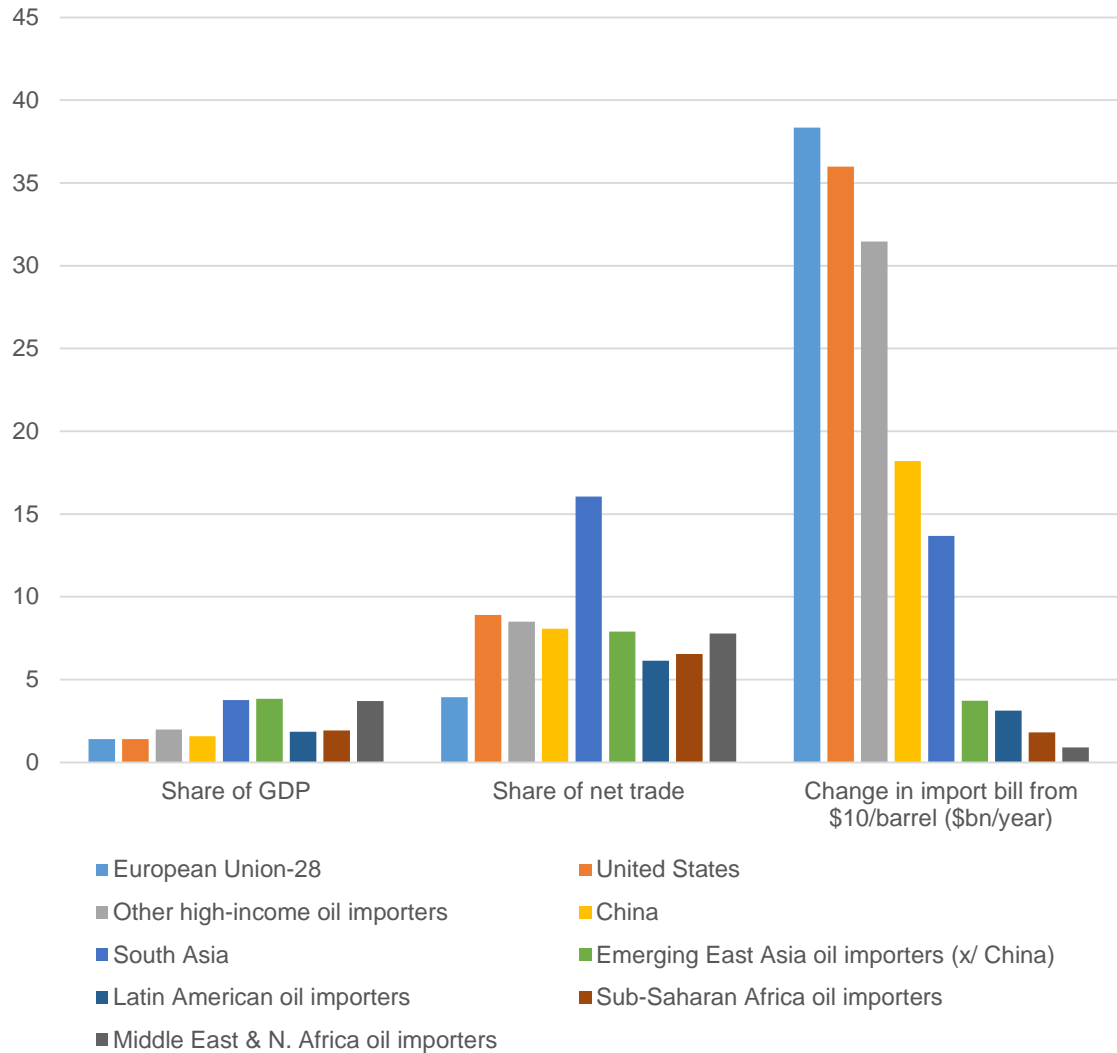
Wide dispersion in transport taxes, less on other energy uses



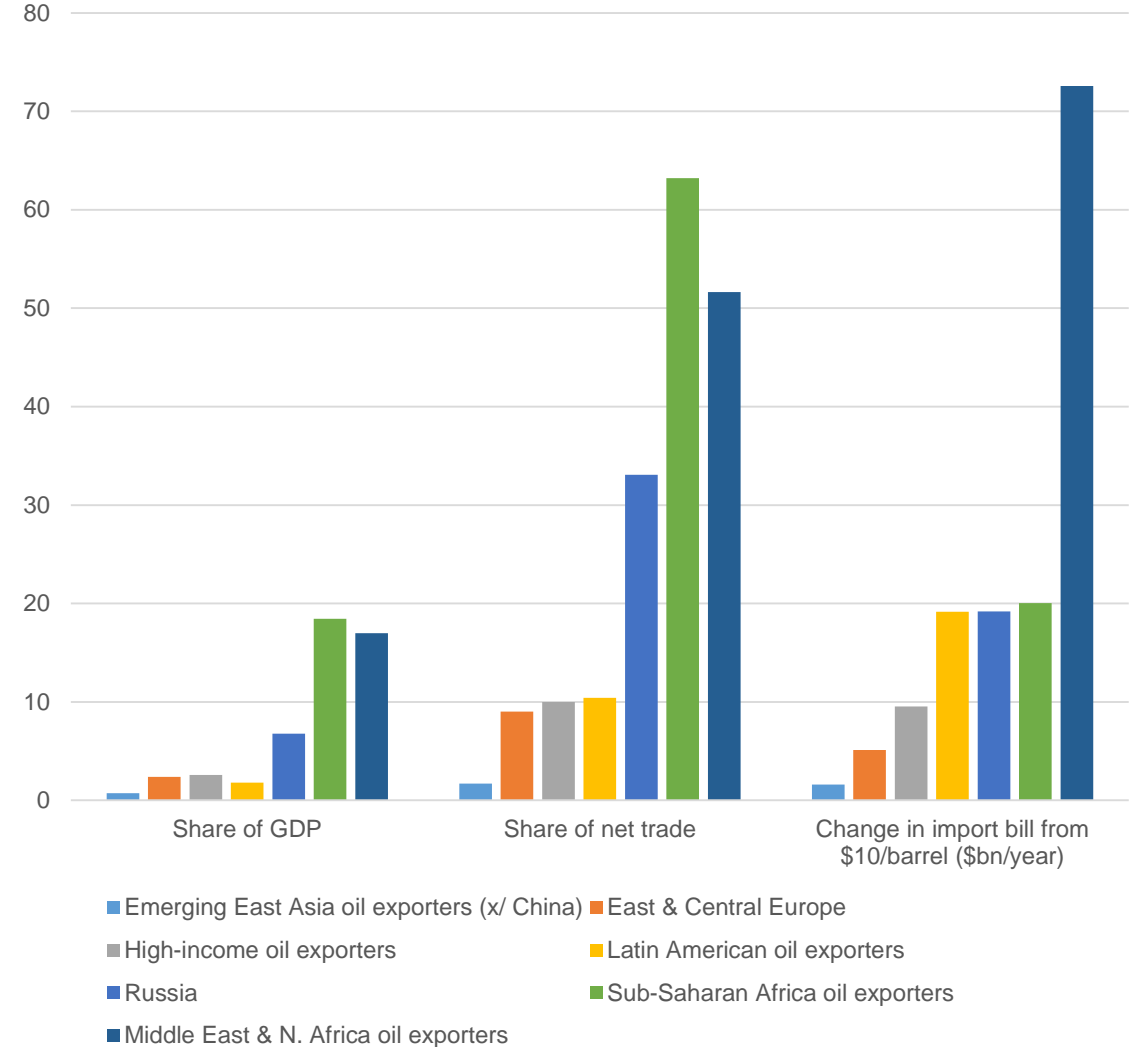
Source: OECD 2013. Taxing energy: a graphical analysis. (Data for figures 7 and figures 11, <http://dx.doi.org/10.1787/888932765655> and <http://dx.doi.org/10.1787/888932765731>)

Energy trade has macroeconomic impacts

Crude oil imports and trade, 2011



Crude oil exports and trade, 2011



Social cost of carbon

- **Emissions:**

- 2.88TCO₂/TOE (average for refined oil) → 0.00899TCO₂/gallon

- **Carbon tax implications**

- Carbon tax is an excise tax, percent impact depends on end-user price of energy, i.e. likely to have greater impact in the US than in Europe or Japan where energy prices are higher.
- Impact is higher on coal-based electricity (more emissions per unit of energy) and less on natural gas-based electricity.

Carbon tax (\$/TCO ₂)	Cost per gallon
\$10	9¢
\$50	45¢
\$100	90¢

Carbon tax and trade

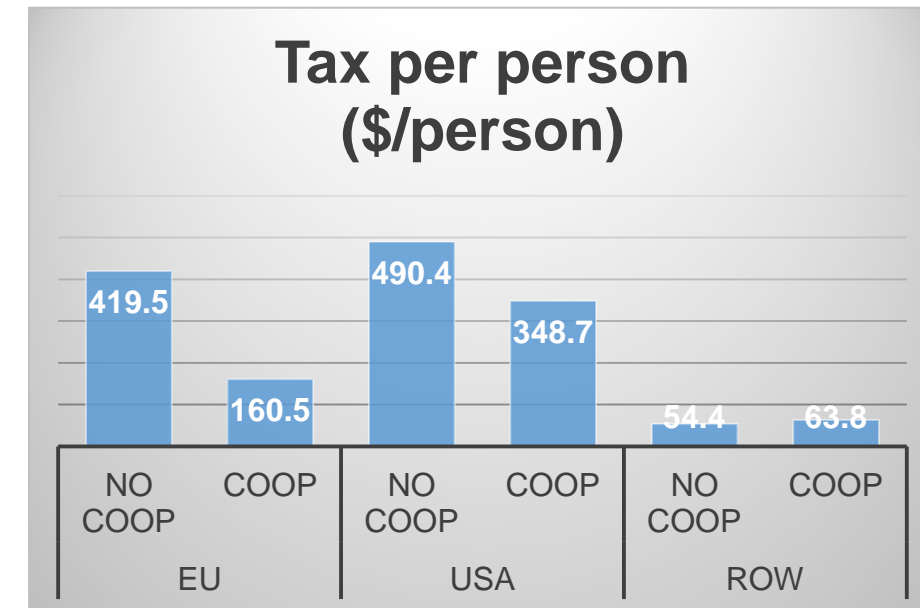
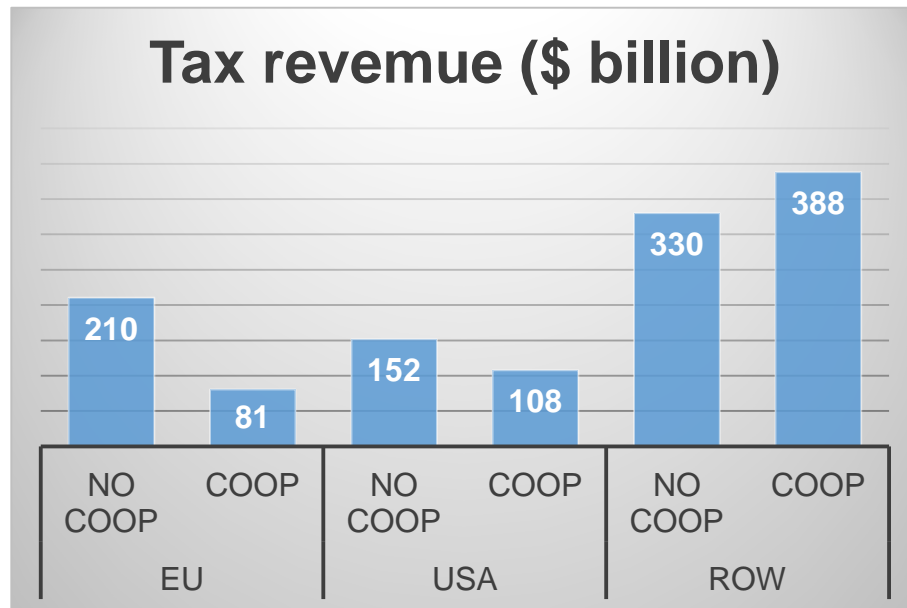
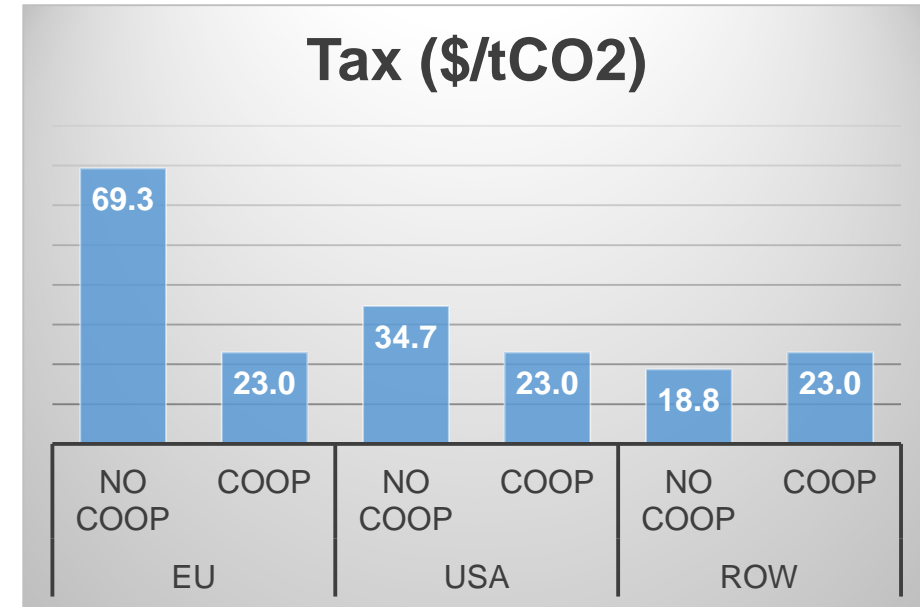
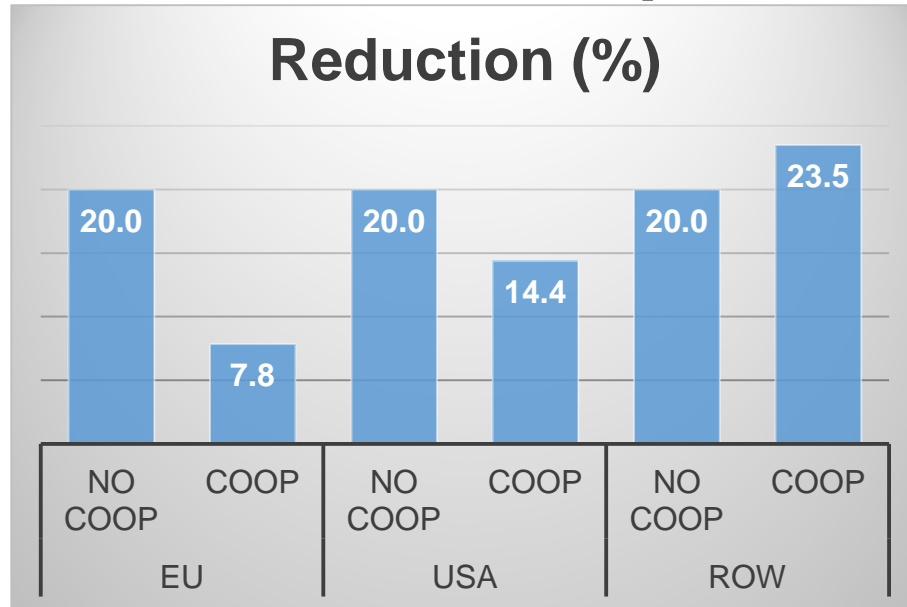
- The carbon tax rises with the level of ambition (R)
- The carbon tax is higher if initial energy prices are high (P)
- The carbon tax is higher if the initial energy system is clean (ρ)
- The carbon tax is higher if economy is less flexible (σ)

$$\tau = \frac{P}{\rho} \left[(1 - R)^{-1/\sigma} - 1 \right]$$

• Implications

- Carbon tax (for same level of ambition) will be higher in Europe/Japan than in the US, and will be higher in the US than in developing countries
- A uniform level of ambition with no 'carbon' trading, will lead to changes in relative competitiveness and therefore trade.

Carbon tax and cooperation



Implications of 'go-it-alone' on carbon tax policy

- **Emissions 'leakage'**

- Aggregate estimates are around 10%--can be higher by sector

- **Border tax adjustments**

- Raise tariffs on 'carbon embedded' in imported goods
 - Which technology to use? How to monitor?
- Can help with domestic competitiveness, may lower even further competitiveness on other markets

Conclusion

- **Energy and growth are tightly linked**
 - Strong role nonetheless for energy efficiency improvement
- **Energy markets are huge**
 - Taxes/subsidies influence efficient use of energy, competitiveness and investment decisions
 - Also influence macroeconomic indicators (for example exchange rates)
- **De-carbonization of energy use will be necessary to reduce emissions of greenhouse gases**
 - Will require an optimal mix of existing and new technologies
 - Will be less costly if it entails international cooperation