Economic growth and development with low-carbon energy

Sam Fankhauser and Frank Jotzo

EEG Conference
Washington DC, 3/4 November 2016

Grantham Research Institute on Climate Change and the Environment
Centre for Climate Change Economics and Policy
E·S·R·C Economic & Social Research Council
The Grantham Foundation for the Protection of the Environment
University of Leeds
LSE The London School of Economics and Political Science

Overview

- The climate change context
- Carbon emissions and energy use
- Policies to reduce emissions
- Areas for future research

The climate change context

- **Paris Agreement comes into force today**
  - Temperature target “well below” 2°C, with efforts for 1.5°C
  - Net zero emissions in 2nd half of the century
  - Contributions from all countries
- **Additional agreements on aviation and HFCs create a sense of momentum**
- **Paris requires a sharp reduction in global emissions**
  - Remaining carbon budget of less than 1,000 GtCO2, compared with annual carbon emissions of ca 40 GtCO2
  - Decarbonisation of energy is at the core of all climate strategies

Carbon emissions and economic growth

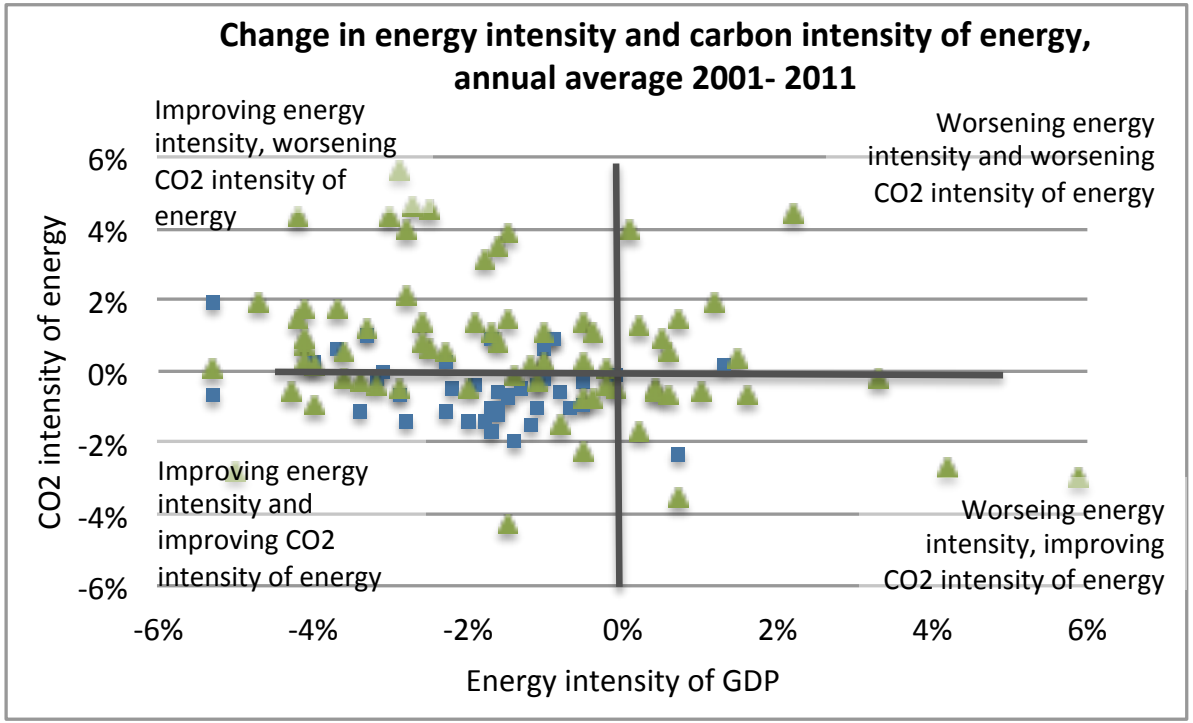
- Fossil fuel-based energy has driven economic growth, but emissions and growth can be decoupled
  - There are opportunities for low-carbon growth (strong knowledge spill overs from innovation)
  - Higher energy efficiency leads to productivity improvements and growth
  - Clean energy is often already competitive (e.g. off-grid solar for rural electrification)
- However, for high-carbon industries and carbon- intensive power grids there are adjustment costs
  - Particular problems for countries with large indigenous fossil fuel reserves

Reducing energy emissions

- **Reduce the carbon intensity of energy (*carbon/energy*)**
  - Switch from high-carbon fuels (coal) to low-carbon fuels (gas)
  - Replace fossil fuels with low-carbon energy (wind, solar, hydro, sustainable biomass)
- **Reduce the energy intensity of GDP (*energy/GDP*)**
  - Increase the energy efficiency of appliances, industrial processes
  - Structural change in the economy (e.g. from industry to services)
  - Change behaviour (e.g. on space cooling)

$$\text{carbon} = \frac{\text{carbon}}{\text{energy}} * \frac{\text{energy}}{\text{GDP}} * \text{GDP}$$

Energy emissions: changes over time



Grantham Research Institute on Climate Change and the Environment

Centre for Climate Change Economics and Policy

Notes: Energy intensity of GDP: Energy use in kg of oil equivalent per $1,000 GDP (constant 2011 PPP). CO2 intensity of energy: kg per kg of oil equivalent energy use.
Data: World Development Indicators 2016.

Key policies to reduce energy emissions

Put a price on carbon	Address the climate change externality
Support low-carbon technology	Address market failures related to research and innovation
Remove barriers to energy efficiency	Address market and behaviour issues related to energy use

Source: Stern 2007

Complementary policies to minimise frictions

Reduce effects on competitiveness	←	Address rigidities and frictions related to structural change
Facilitate redirection of capital	←	Address market / regulatory failures in the financial sector
Provide social safety nets	←	Protect the socially vulnerable (e.g. fuel poverty effects)

Areas for future research

Significant knowledge gaps persist on how low-carbon energy affects economic growth and development. For example:

- The economics of radical transformation (non-marginal change), as is required by “well below 2°C”
- Political economy (e.g. vested interests) and distributional aspects of the low-carbon transition
- The economic strategy of fossil fuel-rich countries, for which low-carbon growth poses particular challenges

Economic growth and development with low-carbon energy

Contact information:
s.fankhauser@lse.ac.uk

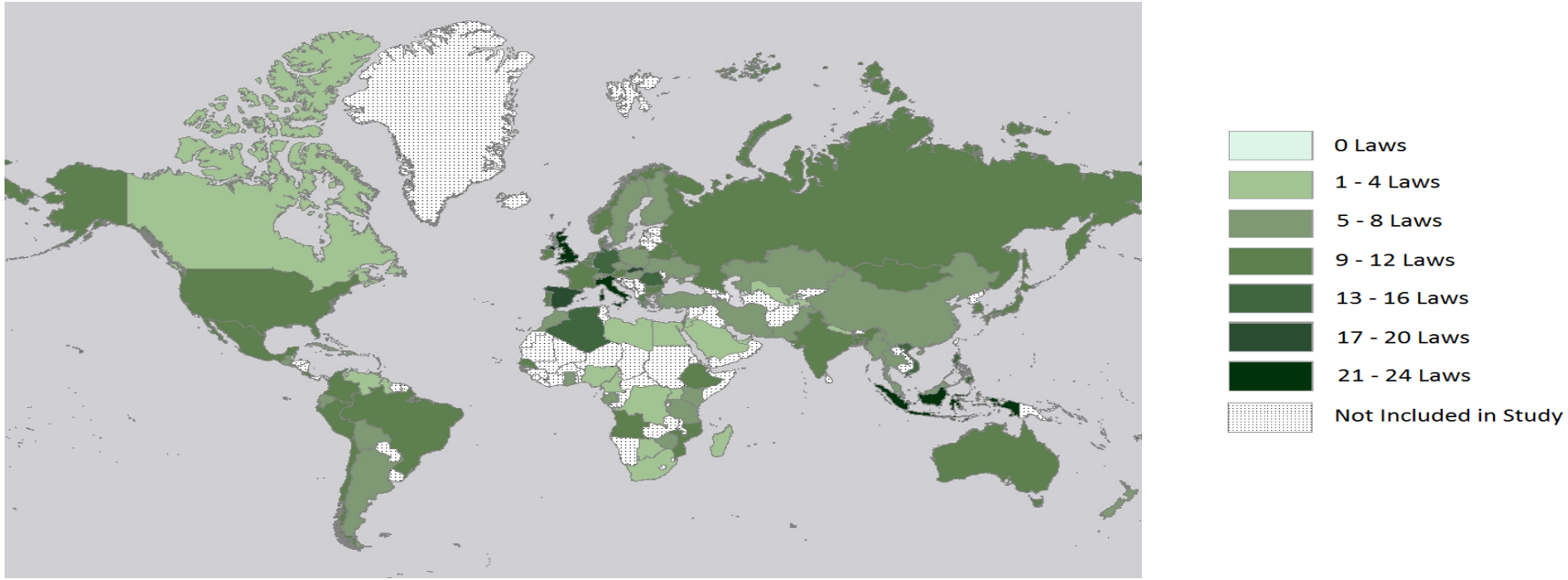
Grantham Research Institute on Climate Change and the Environment

Centre for Climate Change Economics and Policy

Annex slides

The climate context: Over 800 climate laws worldwide

Number of laws doubling every 4-5 years

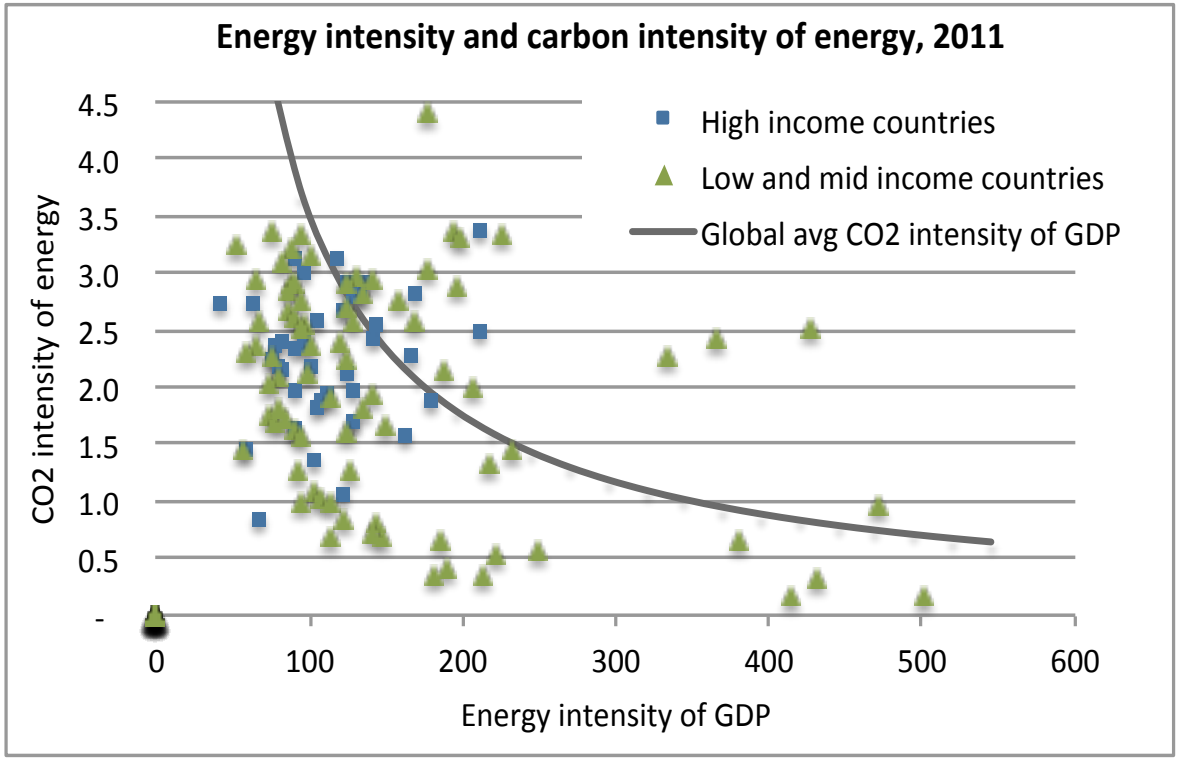


Grantham Research Institute on Climate Change and the Environment

Centre for Climate Change Economics and Policy

Source: Global Legislation Database, Grantham Research Institute, London School of Economics

Energy emissions: current performance

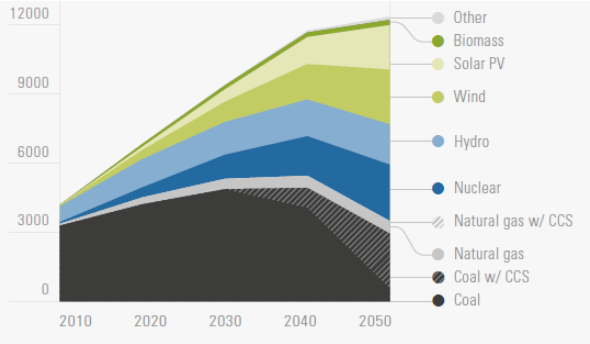


Grantham Research Institute on Climate Change and the Environment

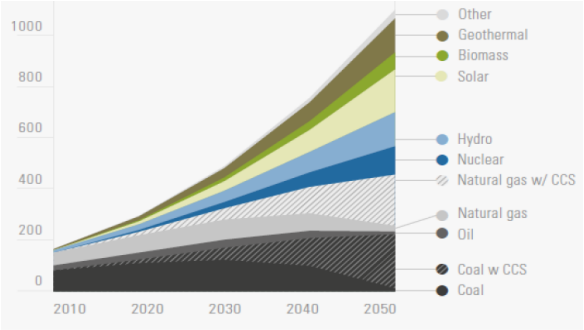
Centre for Climate Change Economics and Policy

Notes: Energy intensity of GDP: Energy use in kg of oil equivalent per $1,000 GDP (constant 2011 PPP). CO2 intensity of energy: kg per kg of oil equivalent energy use.
Data: World Development Indicators 2016.

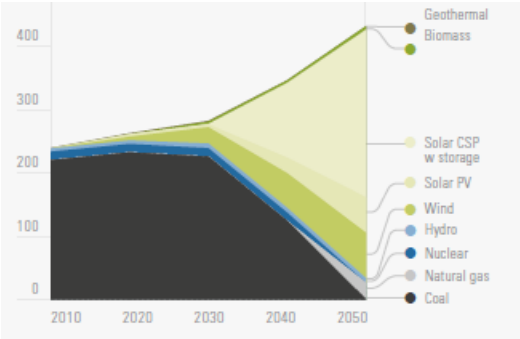
Illustrative decarbonisation pathways



China



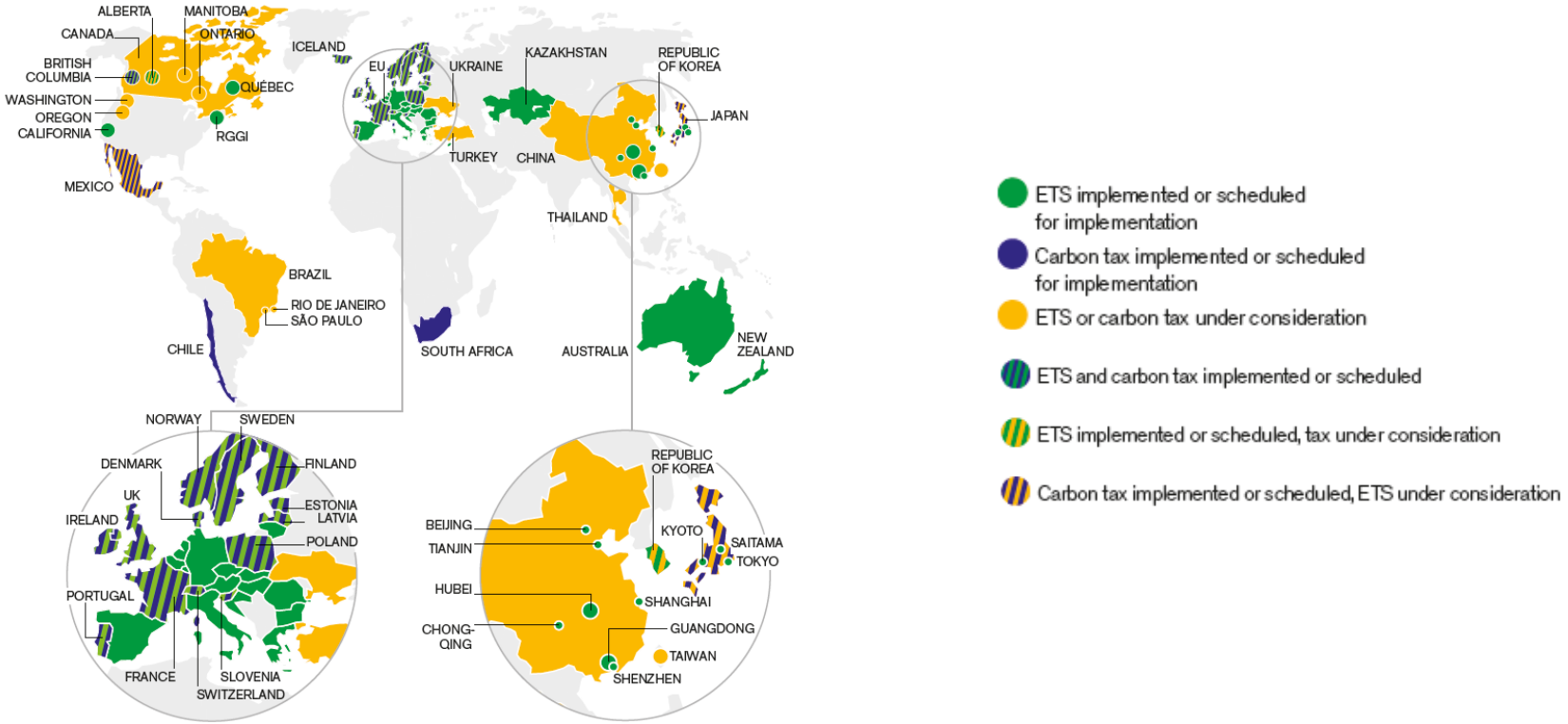
India



South Africa

Source: Deep Decarbonisation Pathways Project, 2015.

The spread of carbon pricing



Source: World Bank, Carbon Pricing Watch, 2016.