Economic growth and development with low-carbon energy

Sam Fankhauser and Frank Jotzo

EEG Conference
Washington DC, 3/4 November 2016
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)

\[
\text{carbon} = \frac{\text{carbon}}{\text{energy}} \times \frac{\text{energy}}{\text{GDP}} \times \text{GDP}
\]
Energy emissions: changes over time

Change in energy intensity and carbon intensity of energy, annual average 2001-2011

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
- Facilitate redirection of capital
- Provide social safety nets

Address rigidities and frictions related to structural change
Address market / regulatory failures in the financial sector
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
Annex slides
The climate context: Over 800 climate laws worldwide

Number of laws doubling every 4-5 years

Source: Global Legislation Database, Grantham Research Institute, London School of Economics
Energy emissions: current performance

Energy intensity and carbon intensity of energy, 2011

- High income countries
- Low and mid income countries
- Global avg CO2 intensity of GDP

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

Source: Deep Decarbonisation Pathways Project, 2015.
The spread of carbon pricing