

# Radical CO<sub>2</sub> reductions: modelling global decarbonisation with E3MG

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A presentation to the Radical Emission Reduction Conference,  
11<sup>th</sup> December 2013, Royal Society.

The exercise reported here draws on the modelling undertaken for the chapter on “The economic feasibility of decarbonising the world economy” co-authored with Annela Anger and Hector Pollitt in Terry Barker and Doug Crawford Brown (forthcoming) *Decarbonising the World Economy*, Imperial College Press, London.

# Objective of the exercise

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- **To assess the macroeconomic feasibility of radical reductions in CO<sub>2</sub> emissions**
  - “radical”: >8%pa reduction 2020-30, Annex 1 economic area
  - with a mix of policies, including ETS schemes for energy-intensive sectors and demand-side regulation
  - adapted from International Energy Agency’s (IEA) 450 scenarios (e.g. IEA Energy-Climate Map, 2013)
  - with similar but weaker policies in China and other regions
- **Using the large-scale E3MG model**
  - a global 20-region, simulation, Post Keynesian, econometric model, projecting annually to 2050, covering the economy and the energy system

# Supply-side vs. demand-side action

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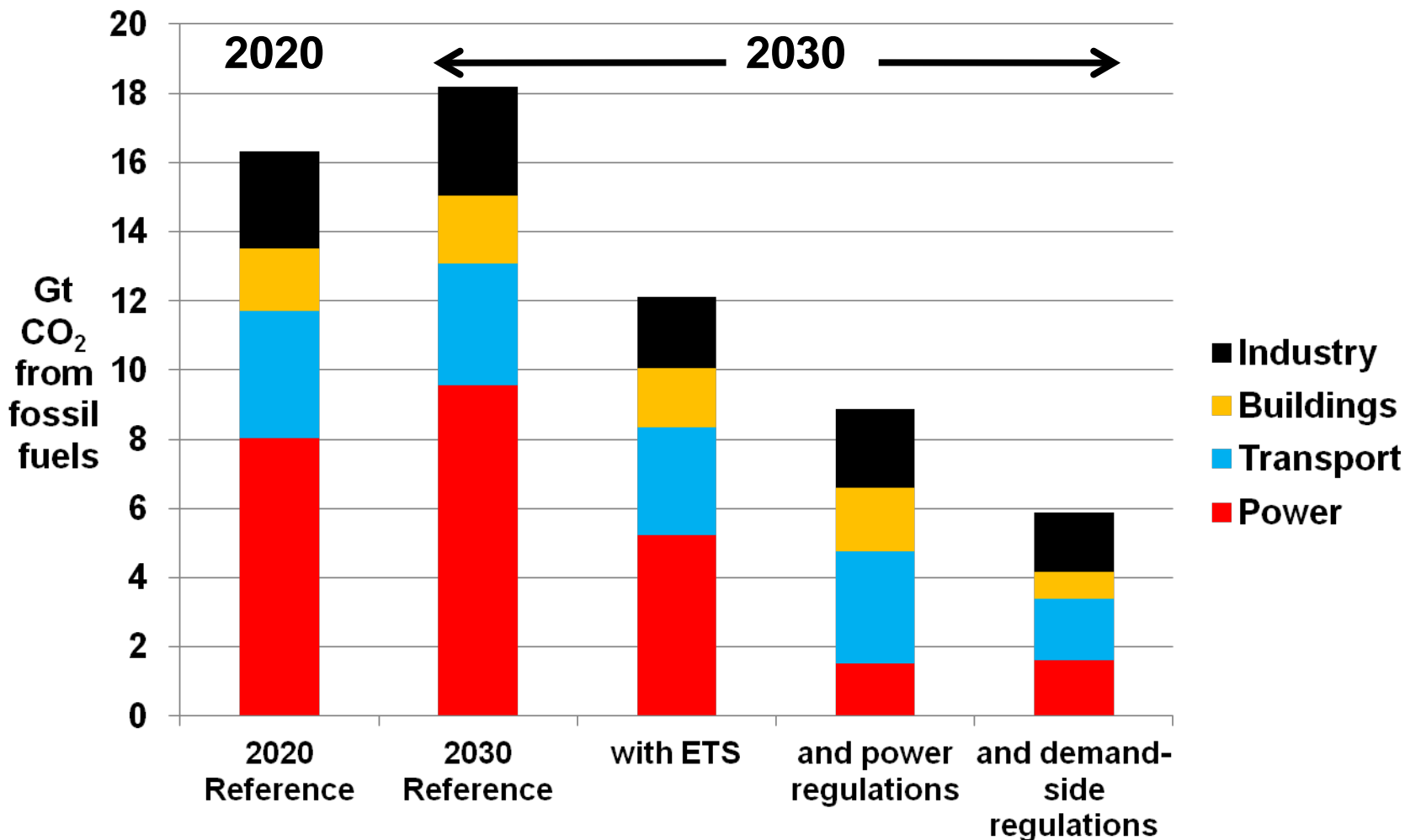
- **Supply-side (electricity generation)**
  - if electricity is not decarbonised first, any demand-led switch from fossil fuels to electricity could increase emissions
  - substitution from fossil fuels towards renewables is at lower cost and more effective in the power sector compared to final demand sectors
  - higher electricity prices support demand-side regulation and prevent rebound effects
  - electricity is an alternative energy carrier to fossil fuels in many final demand uses (cars, heaters)
- **Demand-side (buildings, transport, industry)**
  - action is diffused and less price sensitive
  - many barriers to overcome (infra-structure, ownership, access to capital)

# Main assumptions and results

World region	Reference scenario		CO <sub>2</sub> reductions scenario	
	Annex 1	World	Annex 1	World
	<b>Assumptions</b>			
Oil price in 2030 \$(2012)/bbl	123.4	123.4	117.2	117.2
ETS average price 2030 \$(2012)/tCO <sub>2</sub>	1.7	0.5	82.8	40.6
Additional investment 2030 %	0.0	0.0	6.3	6.2
	<b>Results</b>			
CO <sub>2</sub> 2030 GtCO <sub>2</sub>	18.9	62.0	6.1	20.4
CO <sub>2</sub> 2020-30 %pa	0.6	1.9	-8.5	-7.3
GDP 2020-30 %pa	2.0	2.6	2.2	2.9
Consumers' exp. 2020-30 %pa	1.7	2.1	1.8	2.2
Gross investment 2020-30 %pa	2.8	2.9	3.3	3.4
Employment 2020-30 %pa	0.5	1.0	0.7	1.0

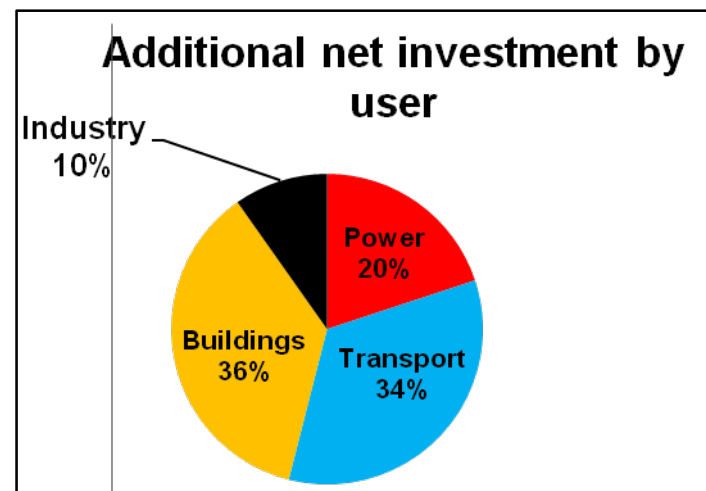
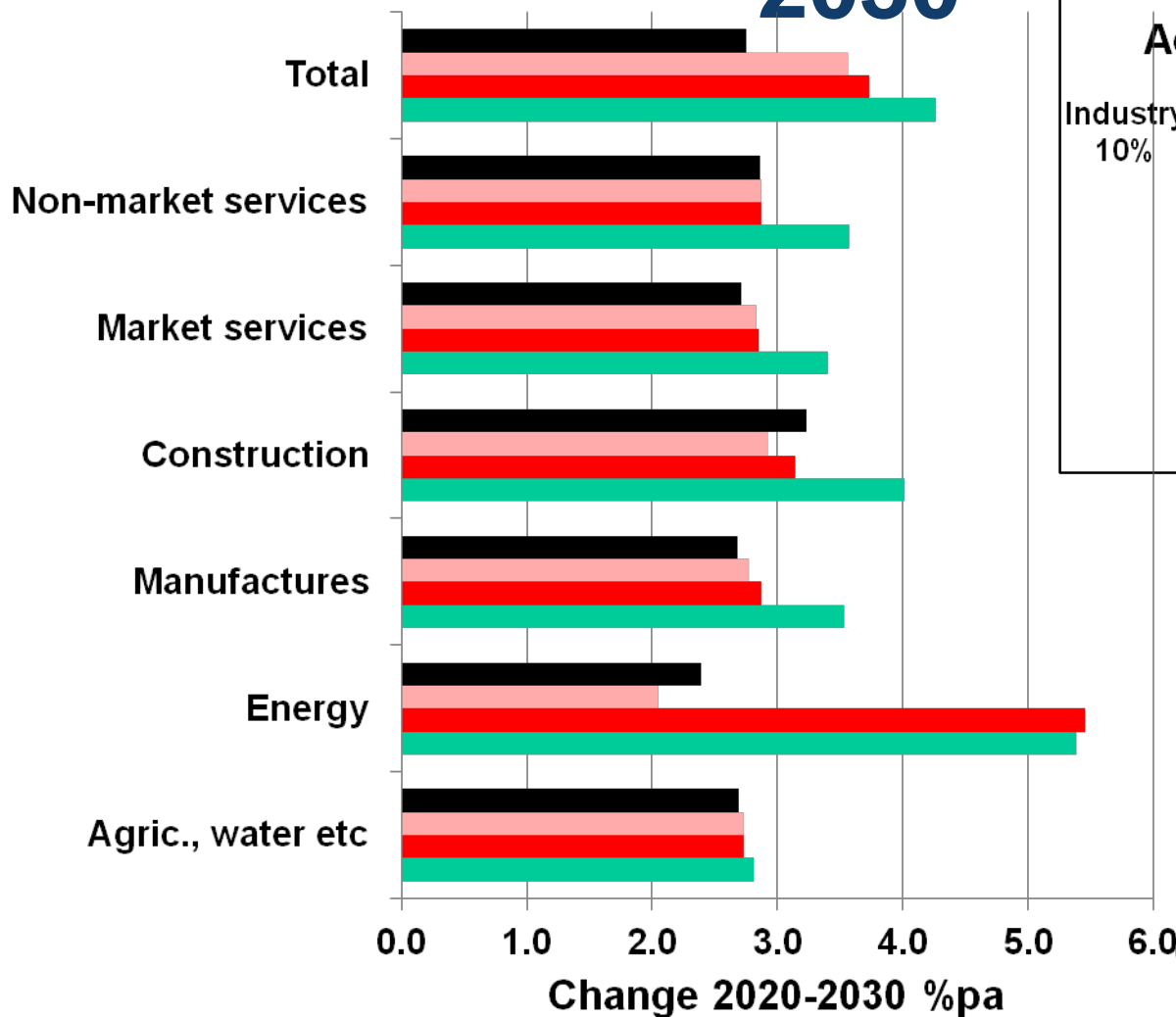
- oil demand falls when transport converts to electric/hybrid, so oil price is lower
- several ETS with different rising prices
- extra investment is only part of the costs of mitigation
- Annex 1 emits c 1/3 world CO<sub>2</sub>
- GDP and employment are higher with radical cuts

# Contributions of policies to CO<sub>2</sub> cuts of 8%pa Annex 1 2020-2030



# Growth in gross investment with CO<sub>2</sub> reduction policies: Annex 1 2020-

## 2030



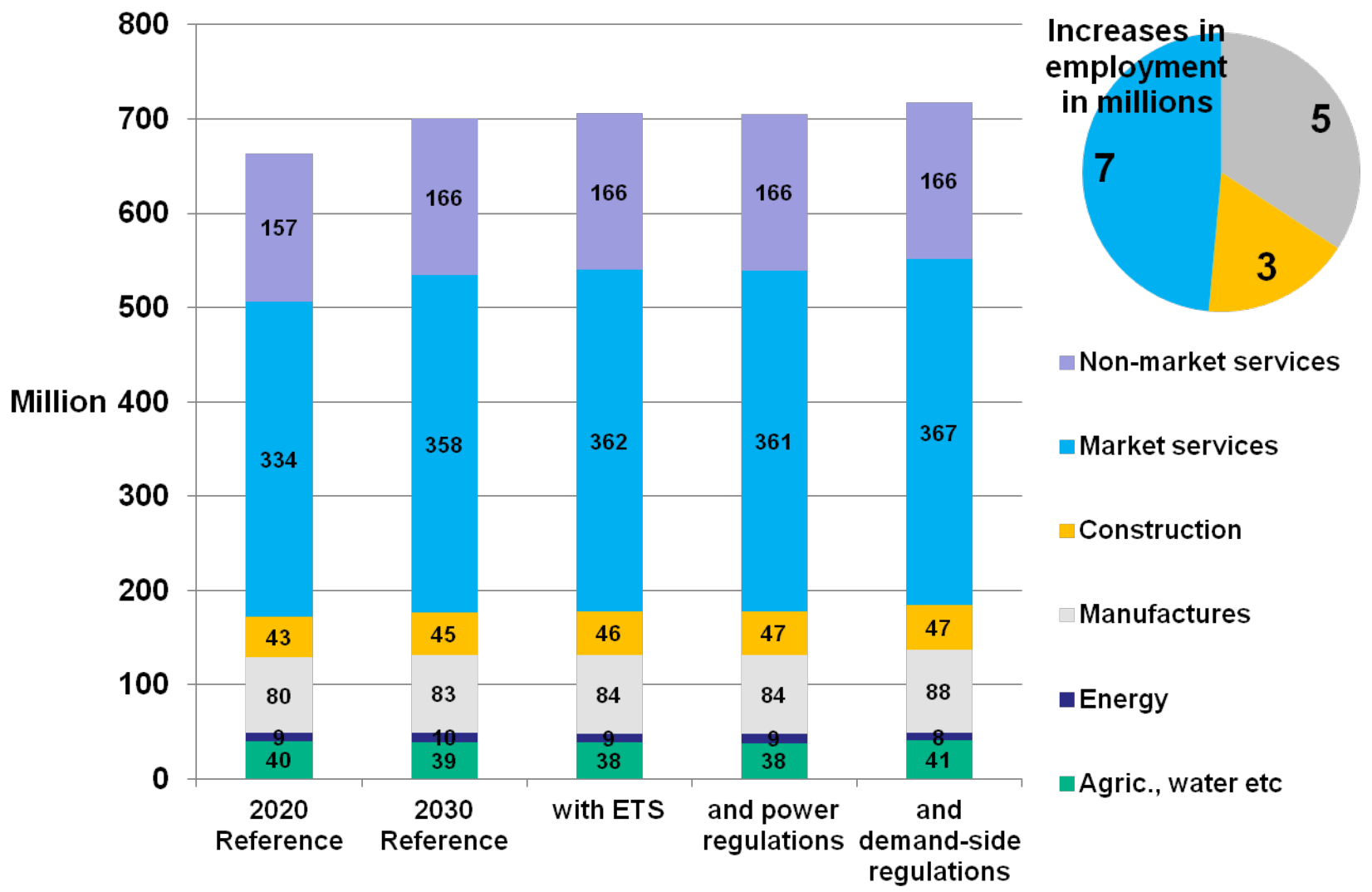
■ 2020-30 Reference

■ with ETS

■ and power regulations

■ and demand-side regulations

# Employment with CO<sub>2</sub> reduction policies Annex 1 2020-2030



# Conclusions on radical decarbonisation

- **Extremely challenging for political ETS coverage & price; unprecedented in recent history**
- **ETS allowance prices without regulation of  $> \$100/\text{tCO}_2$  by 2030 could yield  $\text{CO}_2$  -2.1%/pa 2020-30, in the range of other mitigation studies**
- **Supply-side regulation is a necessary complement to demand-side regulation**
- **Rapid action would require about 2-3 times the rate of extra investment estimated by IEA for energy efficiency to 2020 and much stronger regulation especially for power generation**
- **But it appears to be economically and technically feasible**



# Thank you

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