Basic economic concepts of Climate Change

Agnes Kelemen

16-17 March 2015
Tirana, Albania
ECRAN modelling workshop

Topics to be discussed:

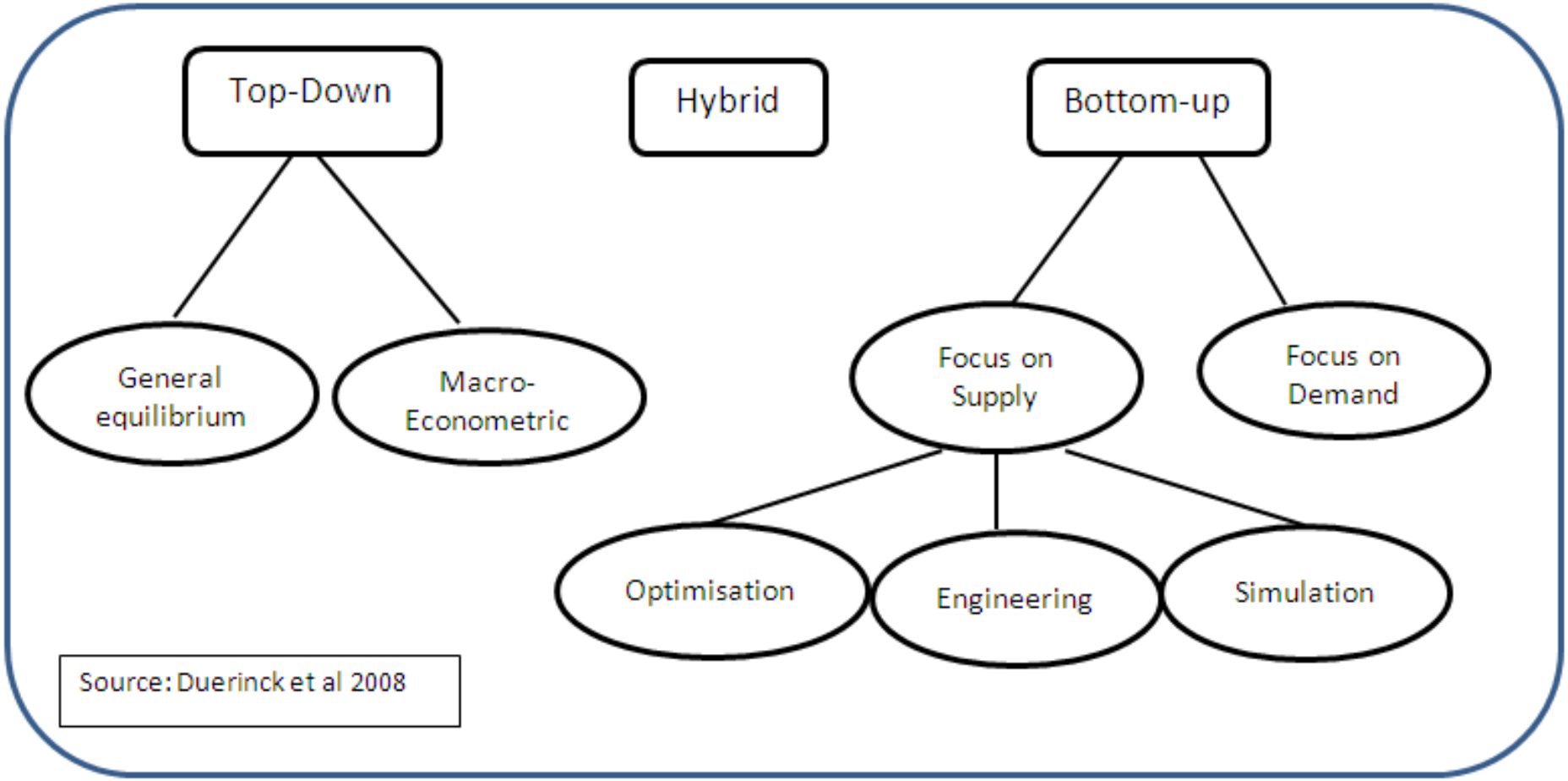
1. Modelling approaches
2. Basic energy economics (CBA, MACC)

Modelling approaches

Climate/energy policy assessment

- Medium to long term outlook for analysing decarbonisation pathways
- Covering one or more sectors/entire economy
- Top-down/bottom-up/integrated modelling approaches

Different approaches



Bottom-up

- Detailed and physically realistic energy sector, explicit representation of technologies
- Uses disaggregated data
- Engineering philosophy
- Often only single sector and single country
- Partial equilibrium
- Useful energy demand, the drivers of demand (e.g. GDP) and prices are exogenous

Top-down

- Aggregate representation
- Uses aggregate data
- Economic foundations
- Focus on entire economy, single country, regional or global
- General equilibrium approach, macro-economic feedbacks
- Endogenous prices, quantities, GDP

LEAP

- Modelling platform/tool which enables flexible use depending on needs and data availability
- Energy and non-energy related GHG emissions
- Bottom-up methodology using physical accounting of energy (although if data is scarce then it may be highly aggregated on the demand side and may be based on an econometric rather than engineering relationship)
- Optimisation (only energy transformation) and simulation (all sectors)

Energy economics

Energy economics

“topics related to energy demand, energy supply, energy prices, environmental consequences of energy consumption and production, and various public policies affecting energy demand, supply, prices, and environmental effects”

(MIT course on energy economics)

Energy security

Economic growth and innovation

Energy poverty

Jobs

MARKET

Industrial competitiveness

EXTERNALITIES

Market

Equilibrium prices (often used in CBA for pricing of costs and benefits)

but prices are applicable within a certain framework:

- Market competition: perfectly competitive, oligopoly, monopoly
- Supply side technologies
- Legislative framework (taxes, emission limits, social policy, etc.)
- Infrastructural developments (electricity networks, gas pipelines, etc.)
- …..

Externalities

- Climate change
- Air pollution
- Water pollution
- Soil pollution
- …

The energy economics knowledge we need to use LEAP

For the purpose of doing a Cost-Benefit Analysis in LEAP you should be able to:

- Do a simple comparison of costs and benefits (Net Present Value)
- Understand the concept of Marginal Abatement Cost curves

But as policy makers don't forget about things happening outside the market!! In your analysis you can bring these in as restrictions, boundary conditions.

Net Present Value

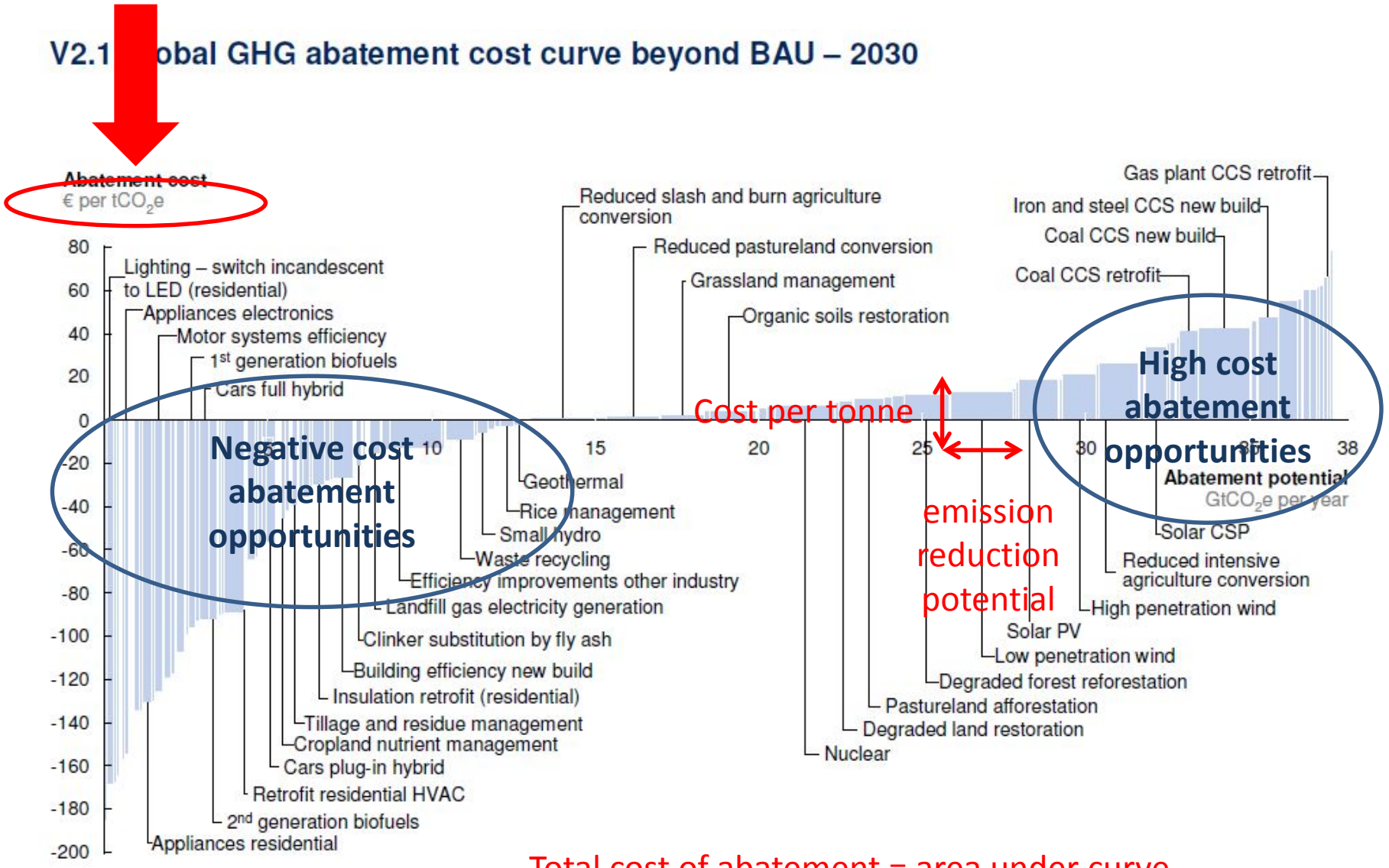
- Benefits – Costs
- But the timing of costs and benefits matters, need to discount future costs and benefits

$$NPV = \sum_{t=0}^{T} \frac{(Benefits_t - Costs_t)}{(1+r)^t} =$$

$$= B_0 - C_0 + \frac{B_1 - C_1}{(1+r)} + \frac{B_2 - C_2}{(1+r)^2} + \frac{B_3 - C_3}{(1+r)^3} + \cdots + \frac{B_T - C_T}{(1+r)^T}$$

- Use market prices for small impacts where available

MACC



Total cost of abatement = area under curve

Steps of calculating a MACC

1. Identify a baseline
2. Identify all GHG abatement options (e.g. energy efficiency, renewable energy, fuel switching, CCS, etc.) compared with the baseline
3. Calculate the GHG emission reduction for all measures
4. Calculate the annualised cost of the measures by including all relevant costs and benefits. These should include:
   a) Investment cost
   b) Operation and maintenance cost (including fuel costs)
   c) Energy savings
   d) Revenues
   e) etc.

   You may include only private costs and benefits or also externalities (social costs and benefits) depending on the aim of the analysis.

   Costs and benefits may change over time (technical development, resource scarcity, etc.) and will be sensitive to assumptions such as economic lifetime of investment and return on investment. Discount rate assumption also needed.
5. Divide annualised cost by emission reductions to arrive at cost per one tonne of CO2 reduced.
6. Rank the measures according to cost.

CBA and MACC in LEAP

- LEAP can be used in optimisation mode (only supply) or in simulation mode (both supply and demand)
- A simple MACC calculation does not take into account interactions between different mitigation options
- A MACC can also be generated as an output of modelling which takes into account these interactions, by running the model in optimisation mode and noting the CO2 price resulting from runs with different emission limits

Thank you for your attention!

agnes.kelemen@klimapolitika.com