

2580–4

**Joint ICTP–IAEA College on Identification and Assessment of
Nationally Appropriate Mitigation Actions (NAMAs) in Energy
System Development to Help Combat Climate Change**

5 – 9 May 2014

Energy Technologies for Mitigating Climate Change

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ICTP 2014 04 05

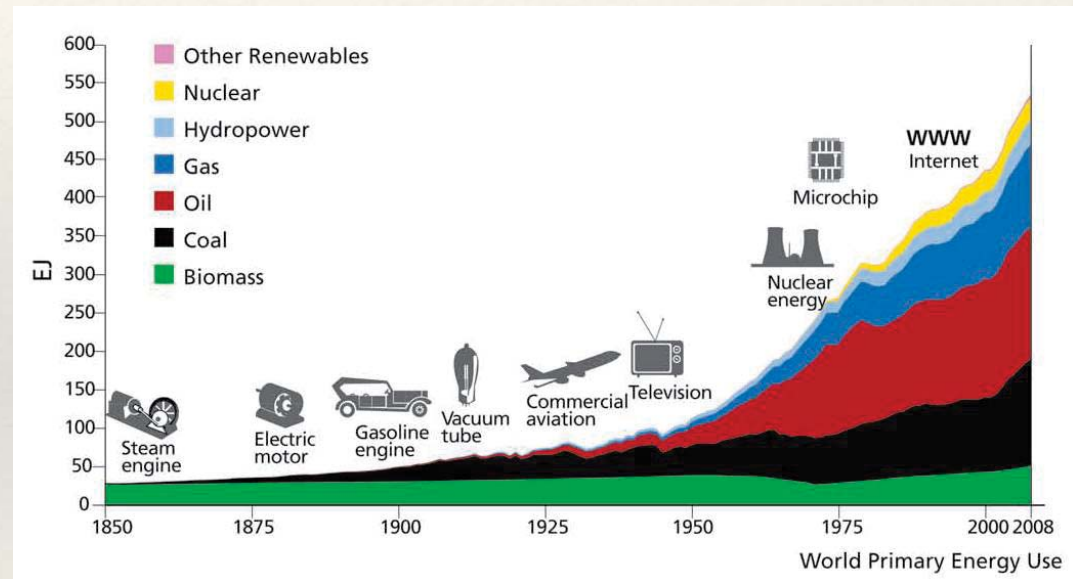
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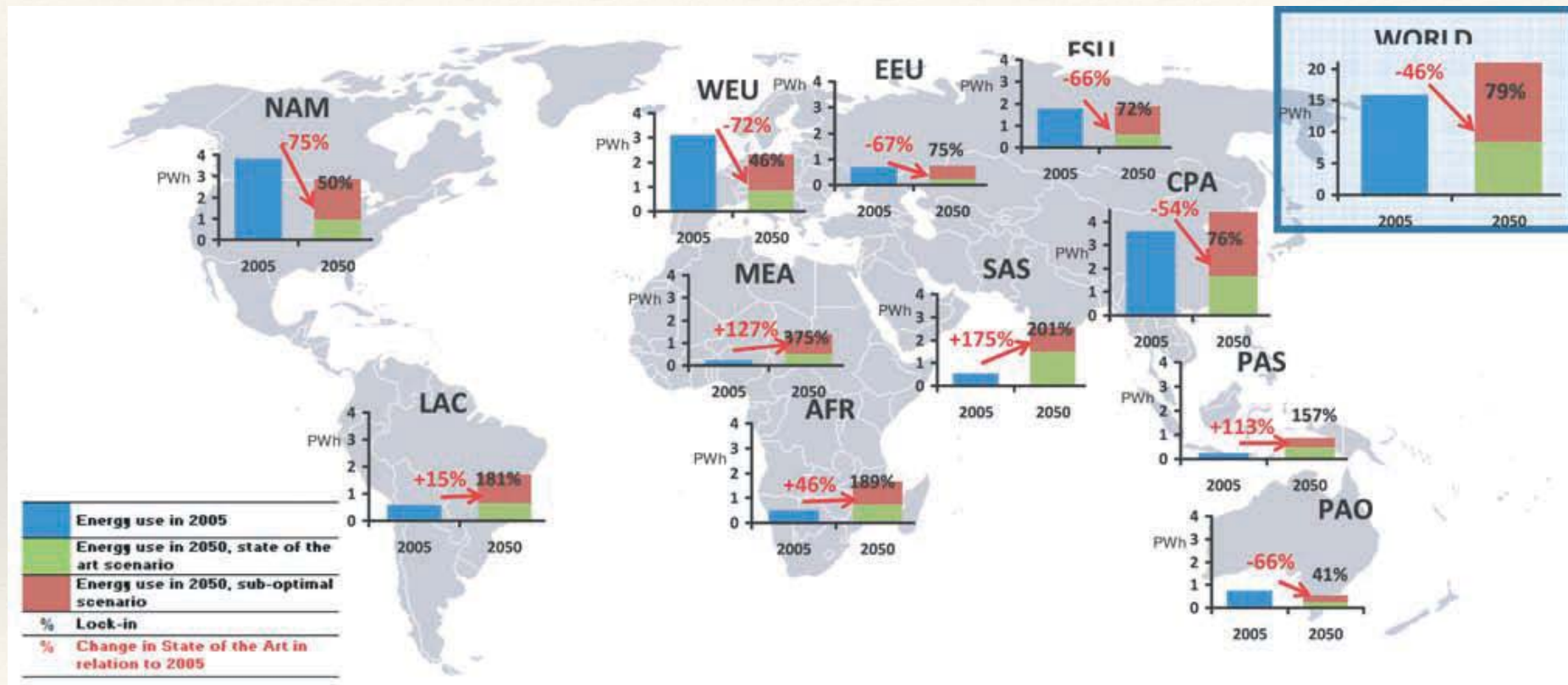
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Energy development

- ❖ Energy is needed for development
 - ❖ Societal
 - ❖ Economic
 - ❖ Environmental
- ❖ All services require energy
- ❖ Fossil fuels:
 - ❖ Cheap and plentiful
 - ❖ Emit GHG emissions

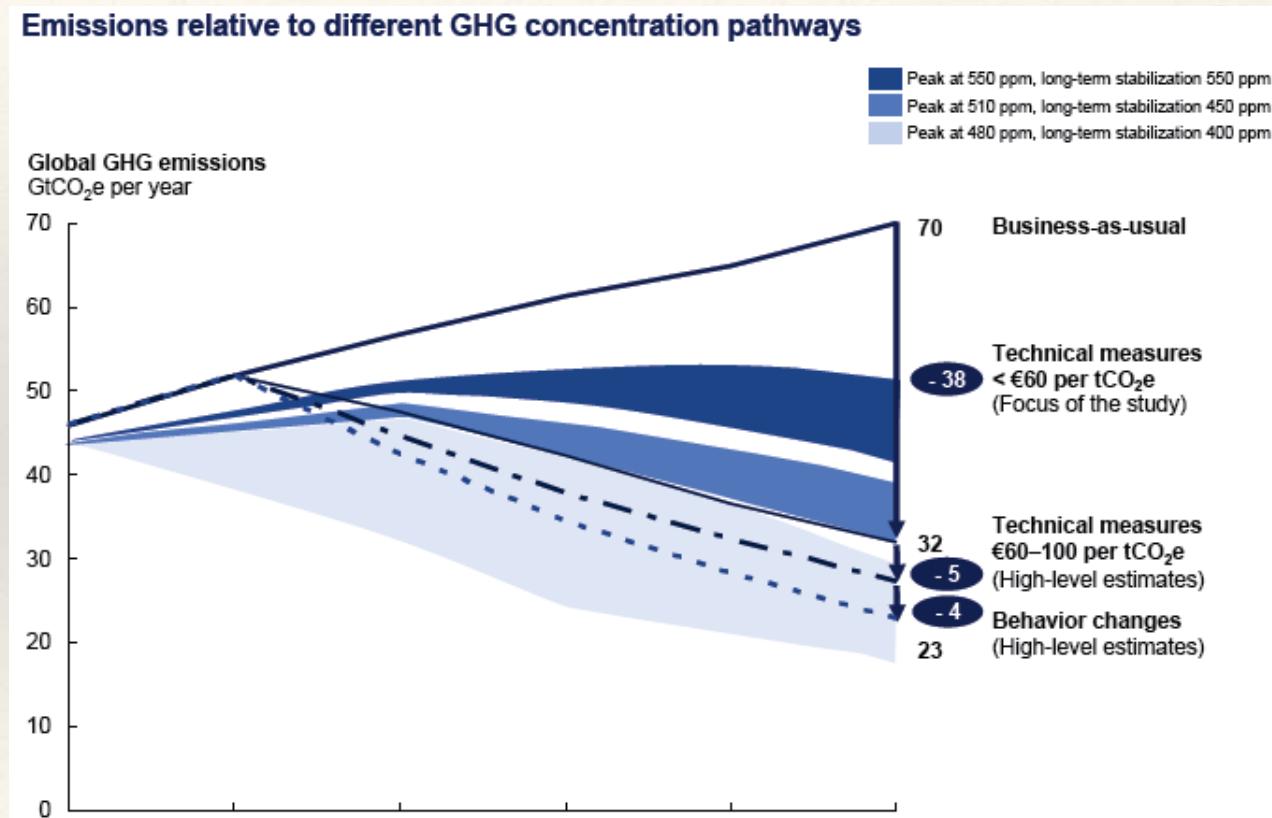


Growth in primary energy demand and potential



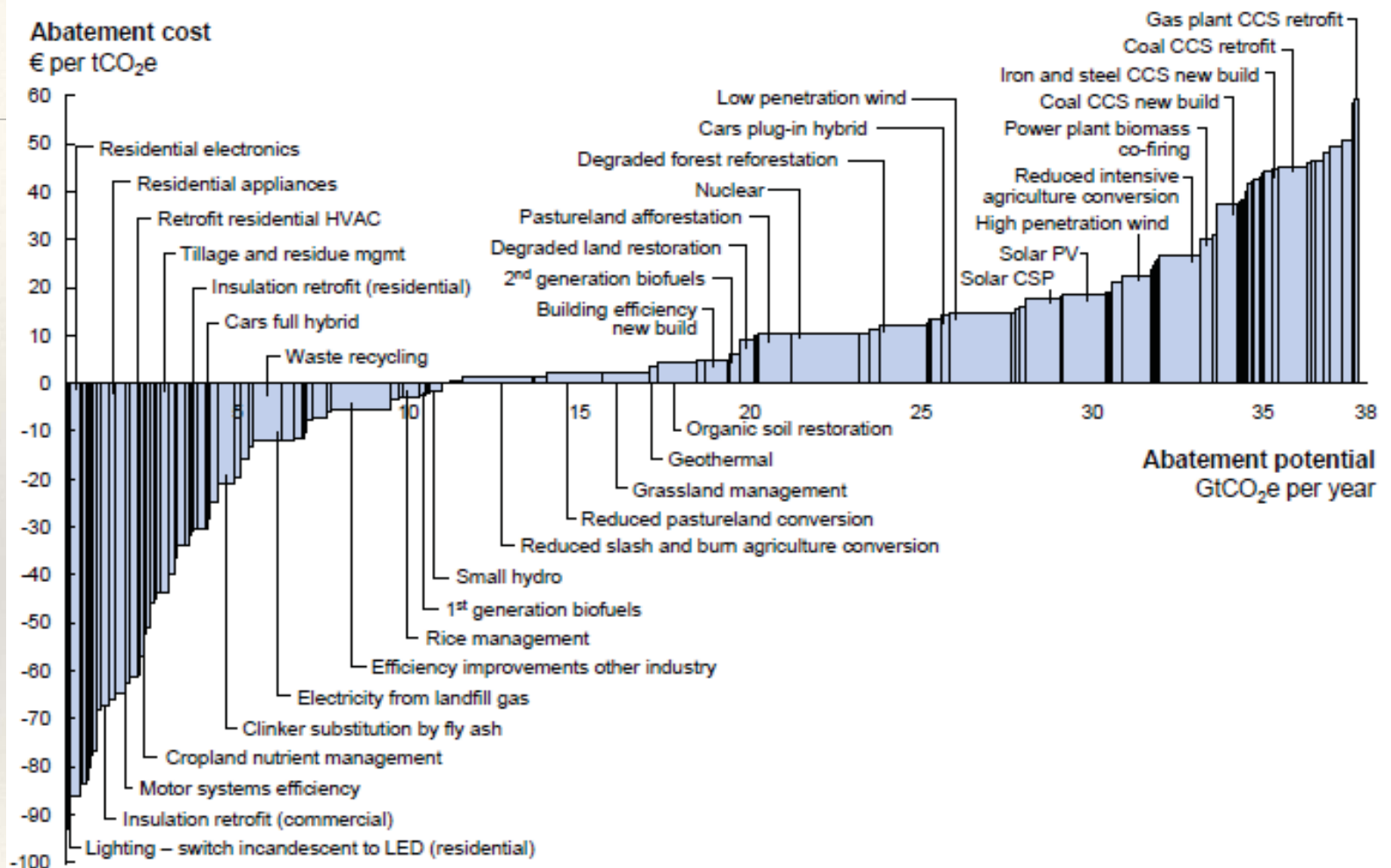
Scenarios of GHG mitigation potential

- ❖ Our emissions are on the increase
- ❖ What pathways are considered 'safe'
- ❖ What are the options to reduce GHGs
 - ❖ Technical
 - ❖ Behavioural
- ❖ What is acceptable?
- ❖ What is nationally appropriate?



- ❖ All the options
- ❖ Cost on the y-axis
- ❖ Reduction potential on the x-axis
- ❖ Combination of supply and demand

Global GHG abatement cost curve beyond business-as-usual – 2030

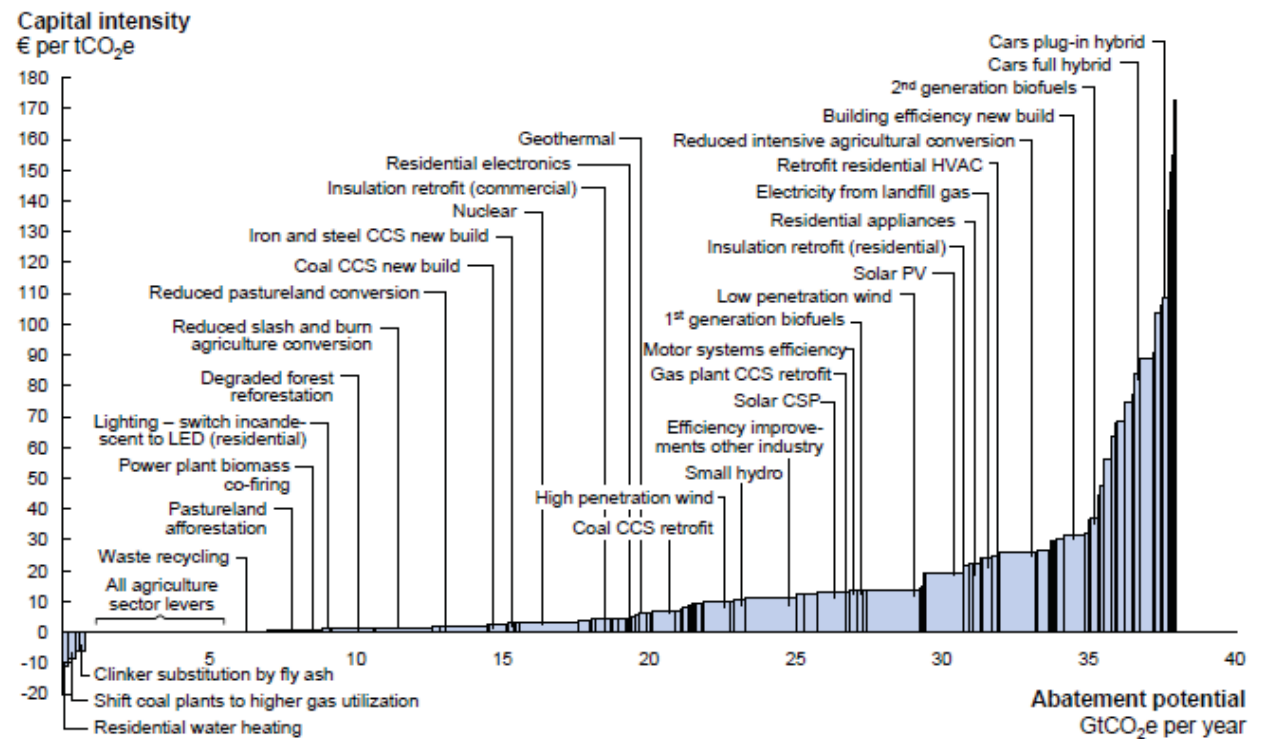


Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €60 per tCO₂e if each lever was pursued aggressively. It is not a forecast of what role different abatement measures and technologies will play.
Source: Global GHG Abatement Cost Curve v2.0

Capital investment required

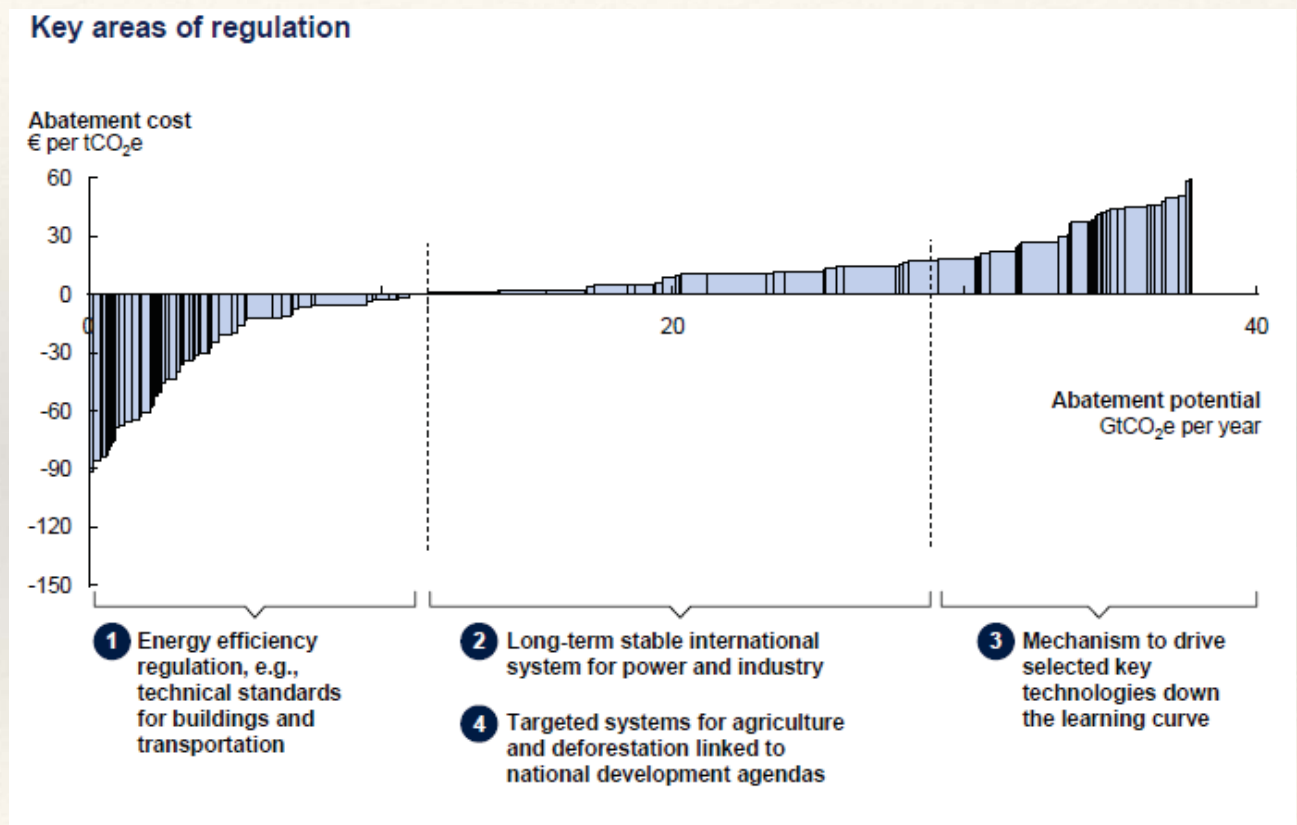
- ❖ Funding and access to capital can be clear barrier
- ❖ Can influence the choice of technology that might fit
- ❖ Can form the basis of a NAMA application

Capital intensity by abatement measure



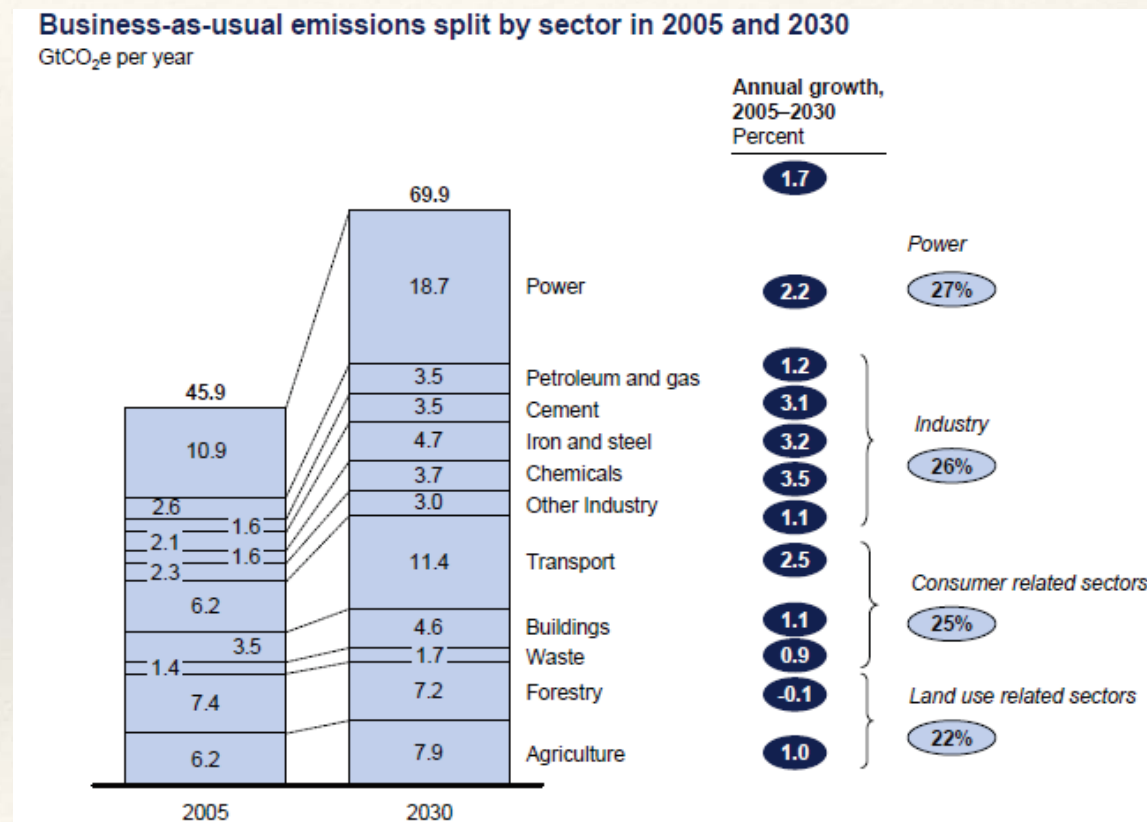
Technology and policy

- ❖ Technology deployment
 - ❖ Cost
 - ❖ Applicability
 - ❖ Ease of use
 - ❖ ...
- ❖ **Policy**
- ❖ Fits well with the concept of NAMAs...



GHG Emissions - where they are (1)

- ❖ Sectoral split is important
- ❖ Determines where to focus
- ❖ Each sector has special characteristics
 - ❖ GHG / Energy
 - ❖ Sustainable development
 - ❖ Appropriate PAMs etc

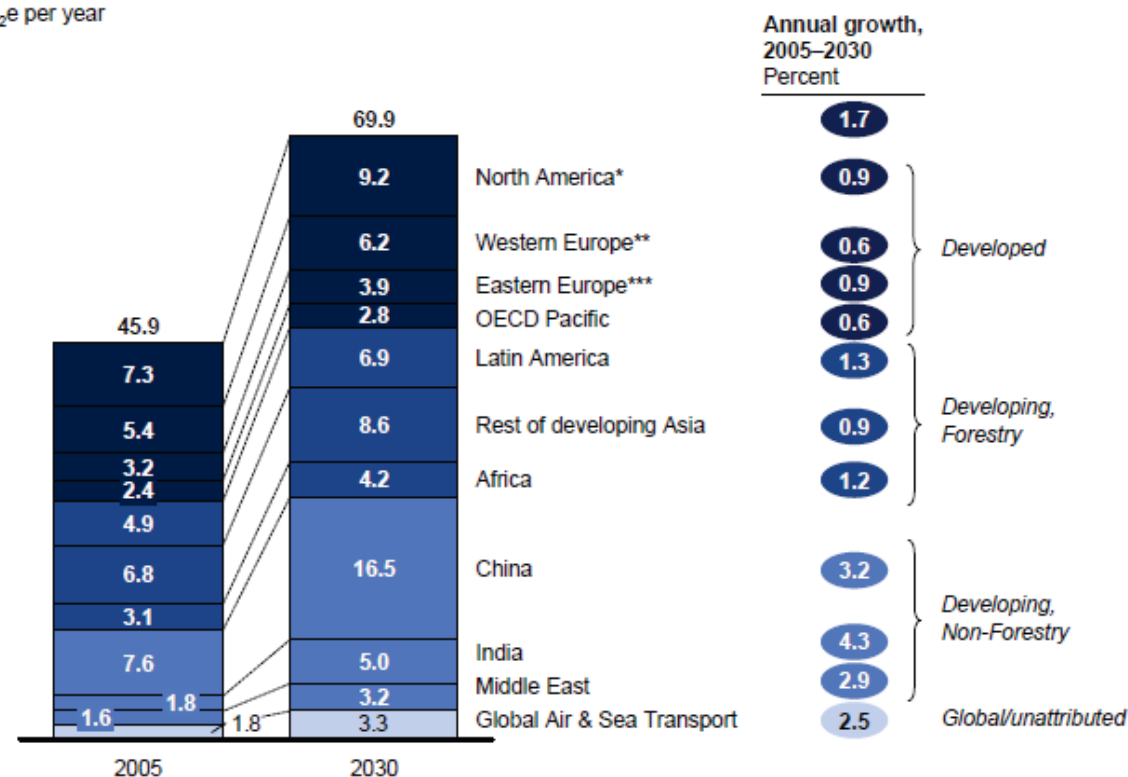


GHG Emissions – Where they are (2)

- ❖ Growth is occurring in emerging economies
- ❖ Opportunity to change direction now
- ❖ With long term gain
 - ❖ Cleaner growth (less adaptation)
 - ❖ Lower operating costs
 - ❖ Smaller infrastructure stock

Business-as-usual emissions split by region in 2005 and 2030

GtCO₂e per year



Abatement potential

❖ By sector and technology

❖ **Electricity**

❖ **Direct**

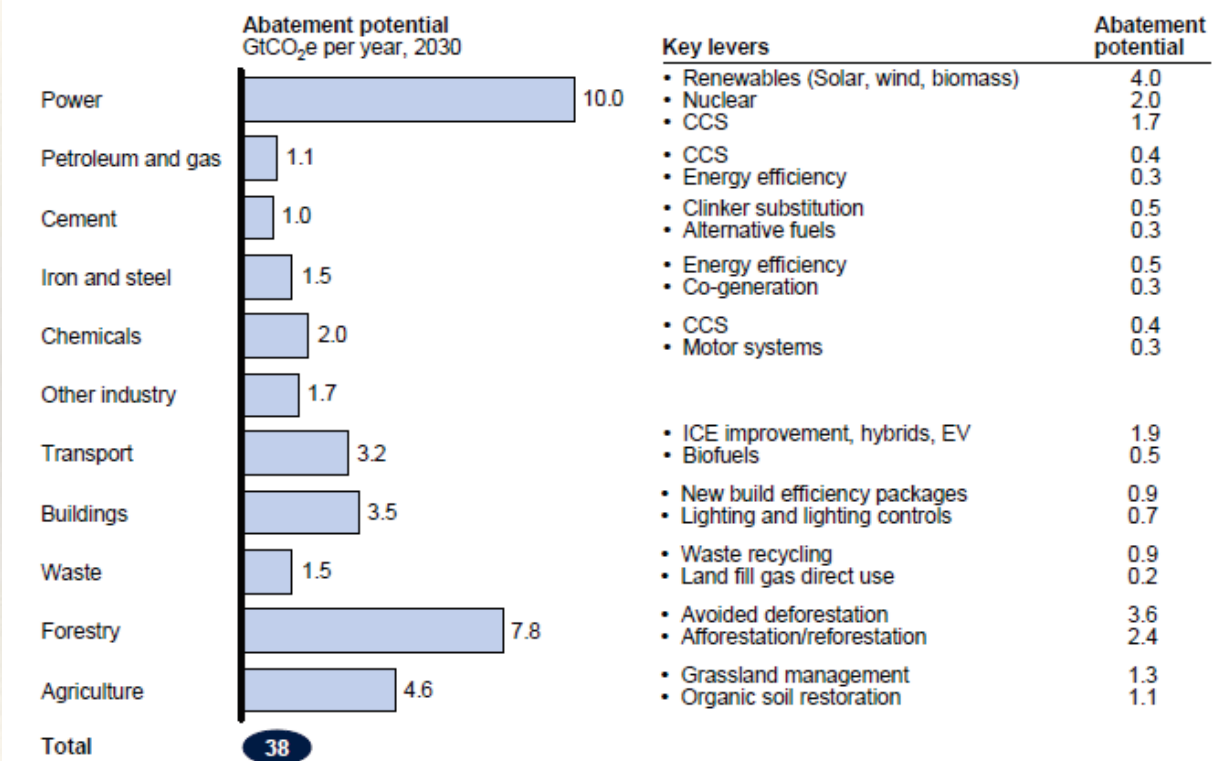
❖ **Indirect**

❖ **Industry**

❖ **Forestry**

❖ **Agriculture**

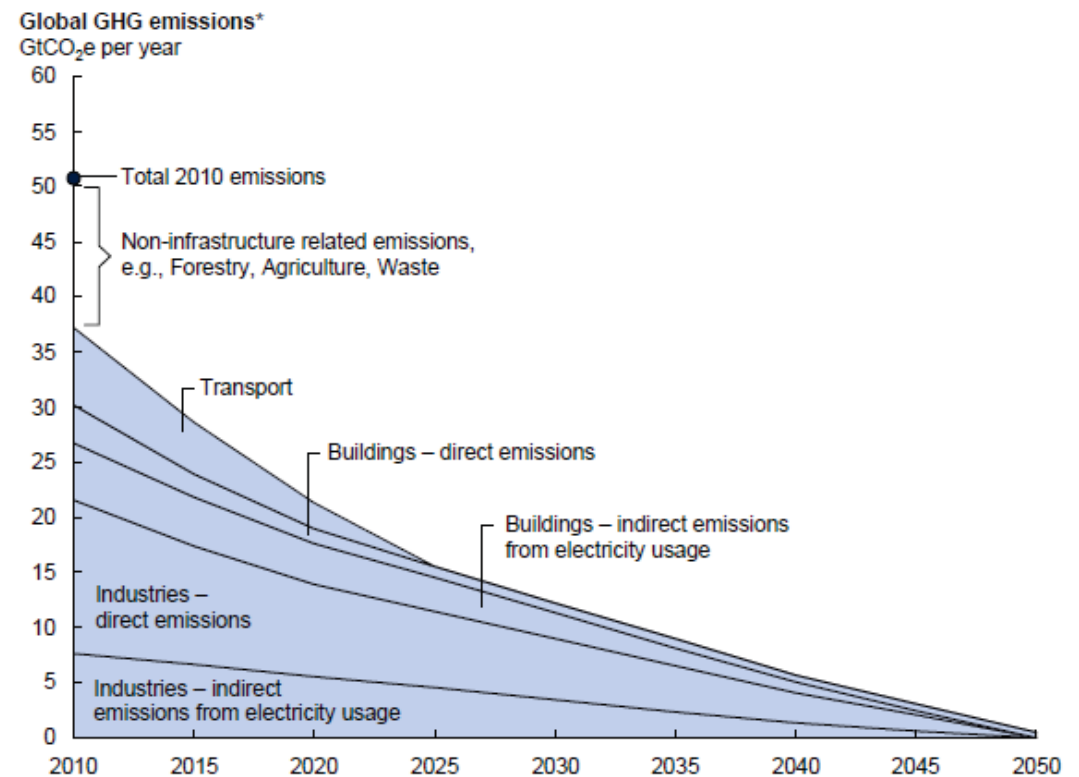
Abatement potential by sector and key levers



A note – why the opportunity is in emerging economies

- ❖ Infrastructure is long lived
- ❖ Patterns of production can be difficult to change

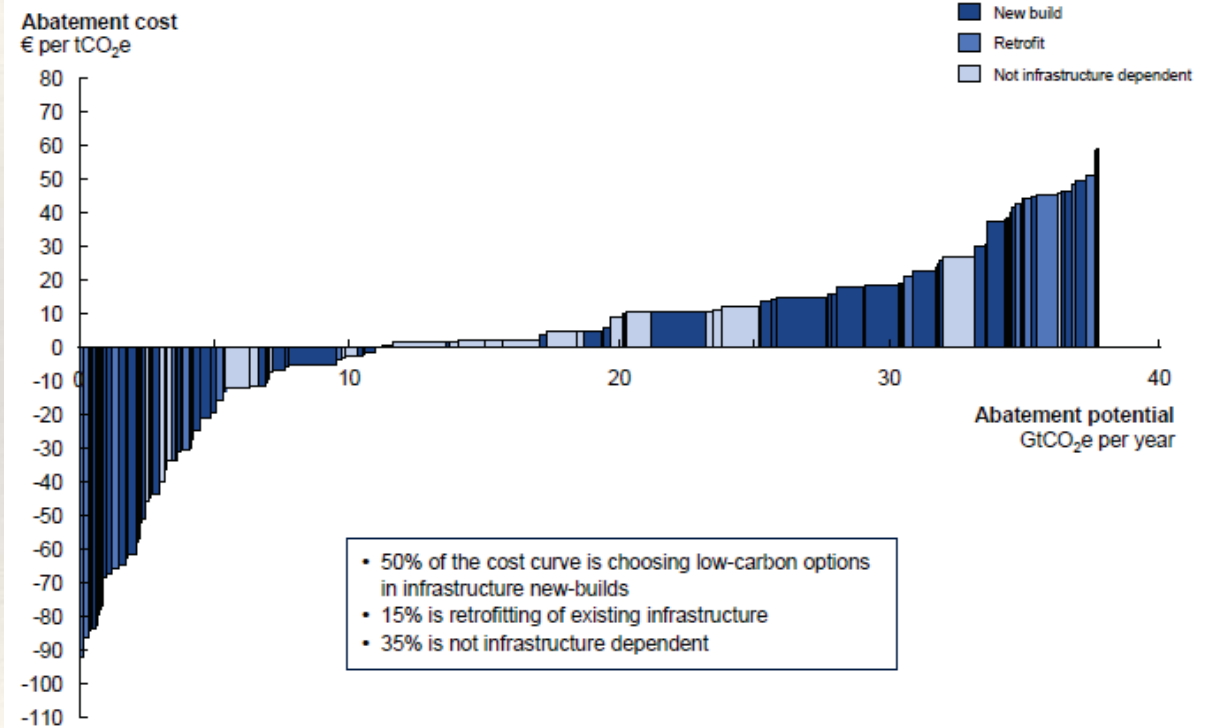
Existing infrastructure phase-out projection



Infrastructure dynamics

- ❖ Considering infrastructure
 - ❖ New build is 'best'
 - ❖ Retrofit
- ❖ Other

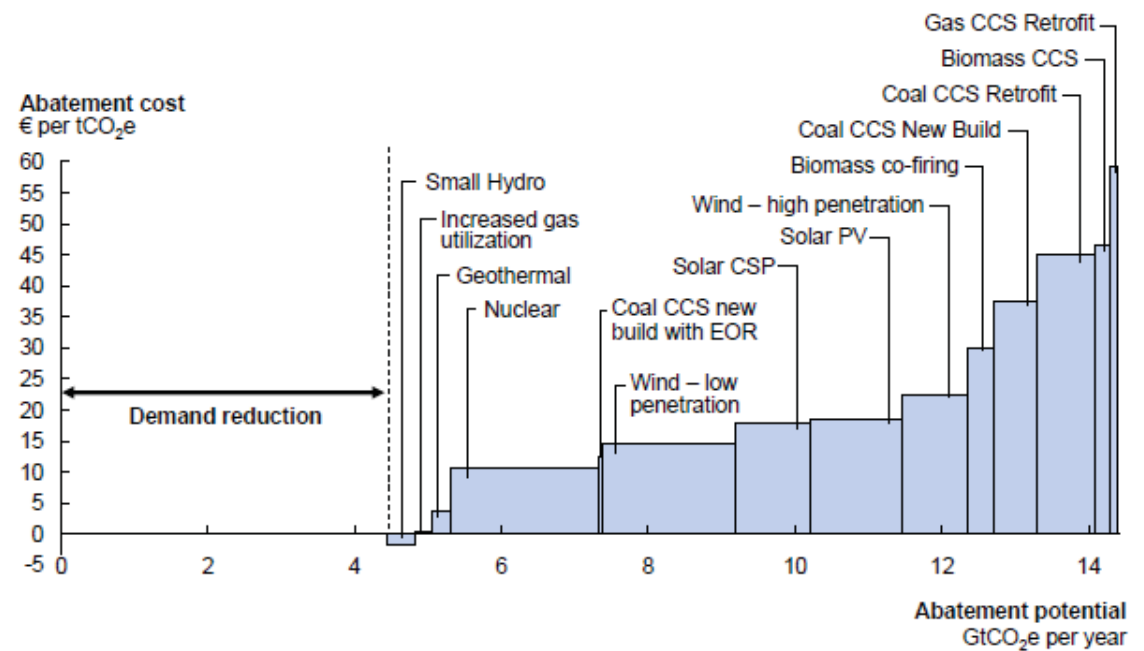
The role of infrastructure choices along the cost curve



Low Carbon Technologies – Power sector

- ❖ Energy efficiency
- ❖ Nuclear
- ❖ Renewables
 - ❖ Variable
 - ❖ Conventional
- ❖ Carbon Capture and Storage
- ❖ Higher efficiency

Global GHG abatement cost curve for the Power sector –
Scenario A: Maximum growth of renewables and nuclear energy
Societal perspective; 2030

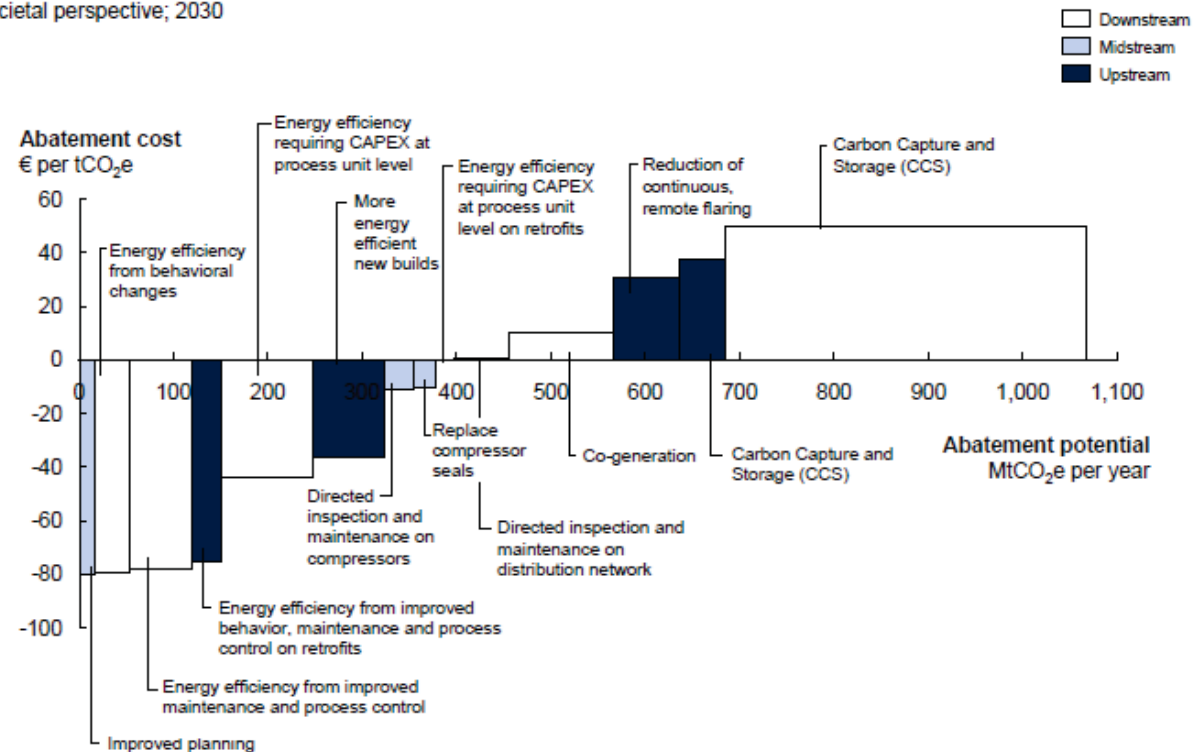


Low Carbon Technologies – Petrochemicals

- ❖ Efficiency
- ❖ Co-generation
- ❖ Flaring
- ❖ Carbon Capture and Storage

Global GHG abatement cost curve for Petroleum and Gas sectors

Societal perspective; 2030

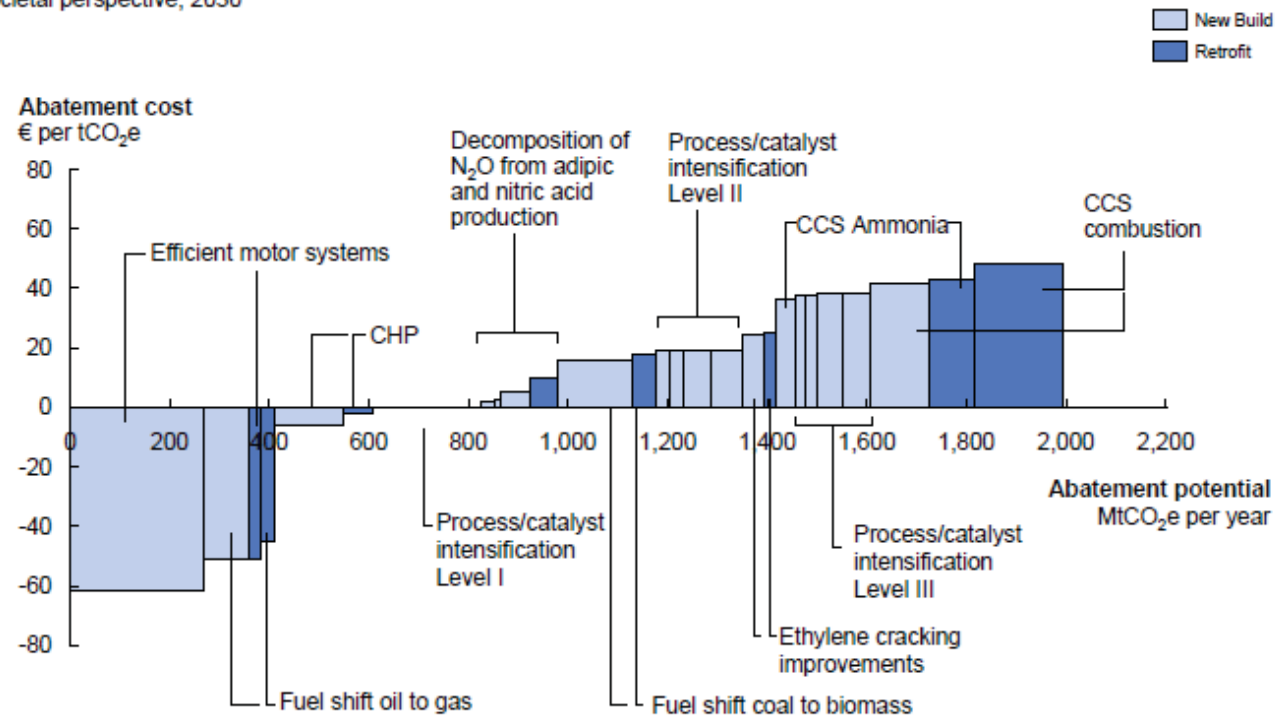


Low Carbon Technologies – Chemicals

- ❖ Energy Efficiency
- ❖ Fuel Switching
- ❖ Combined Heat and Power
- ❖ Process change
- ❖ Carbon Capture and Storage

Global GHG abatement cost curve for the Chemicals sector

Societal perspective; 2030

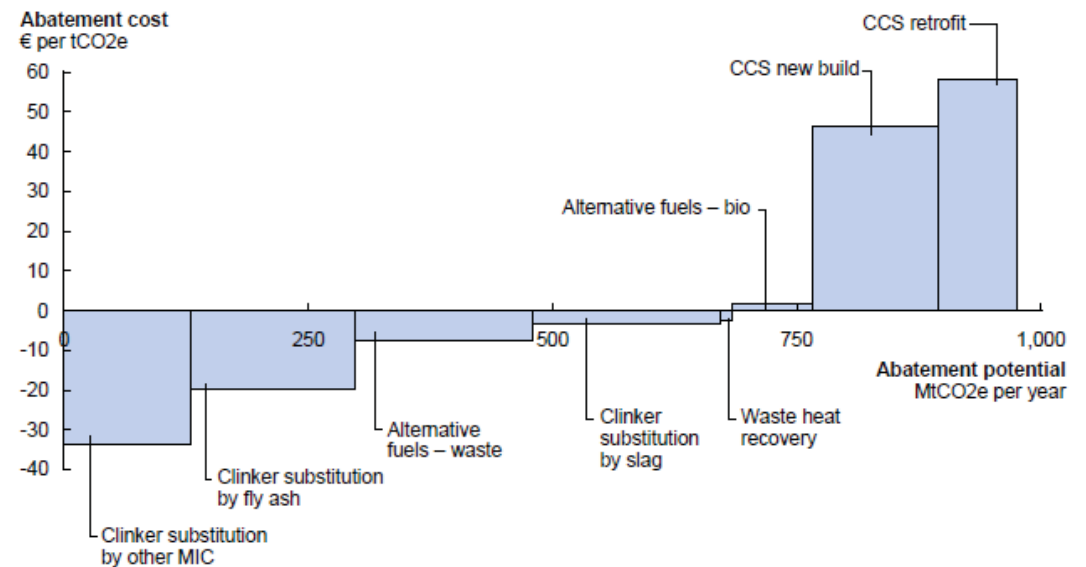


Low Carbon Technologies – Cement

- ❖ Process change
- ❖ Fuel switching
- ❖ Waste heat recovery
- ❖ Carbon Capture and Storage

Global GHG abatement cost curve for the Cement sector

Societal perspective; 2030

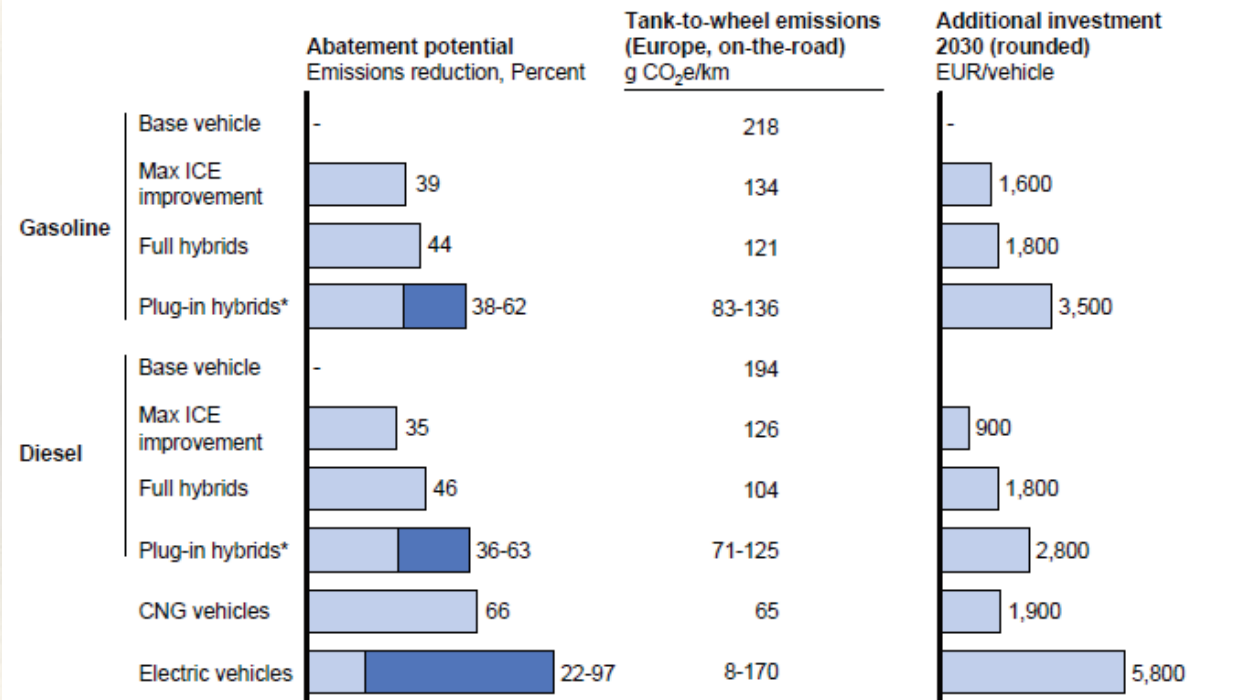


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Low Carbon Technologies – Transport (1)

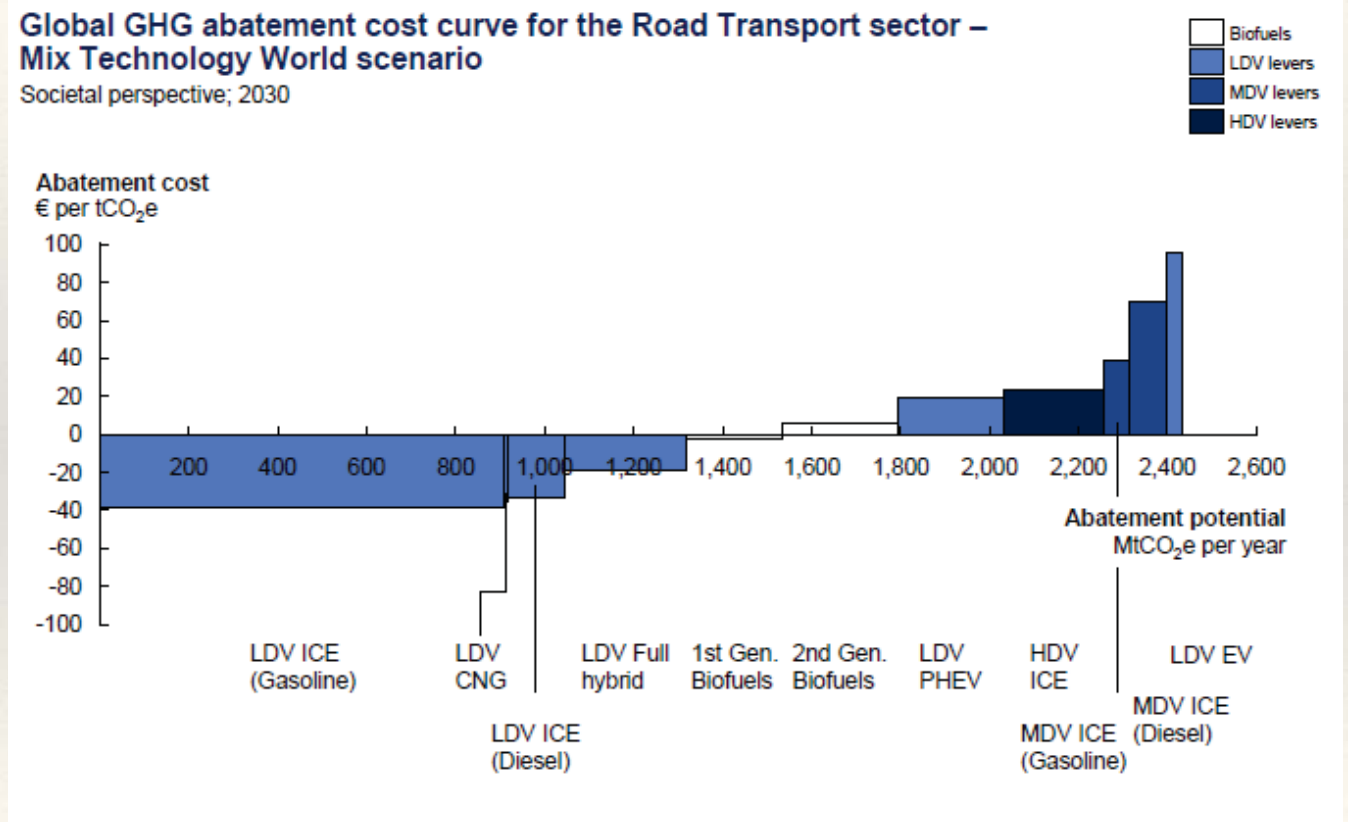
- ❖ Efficiency
- ❖ Hybrids
- ❖ Electrification
- ❖ Biofuel
- ❖ Mode switching

LDVs – Comparison of abatement measures



Low Carbon Technologies – Transport (2)

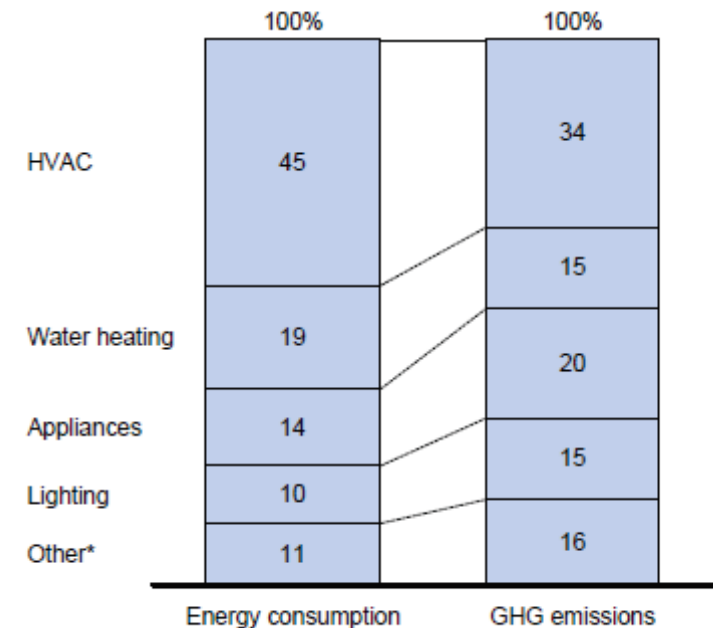
- ❖ Efficiency
- ❖ Hybrids
- ❖ Electrification
- ❖ Biofuel
- ❖ Mode switching



Low Carbon Technologies - Buildings

- ❖ Where is energy used?
 - ❖ Thermal comfort
 - ❖ Water heating
 - ❖ Appliances
 - ❖ Lighting
 - ❖ Other...

End-use energy consumption and emissions in the Buildings sector,

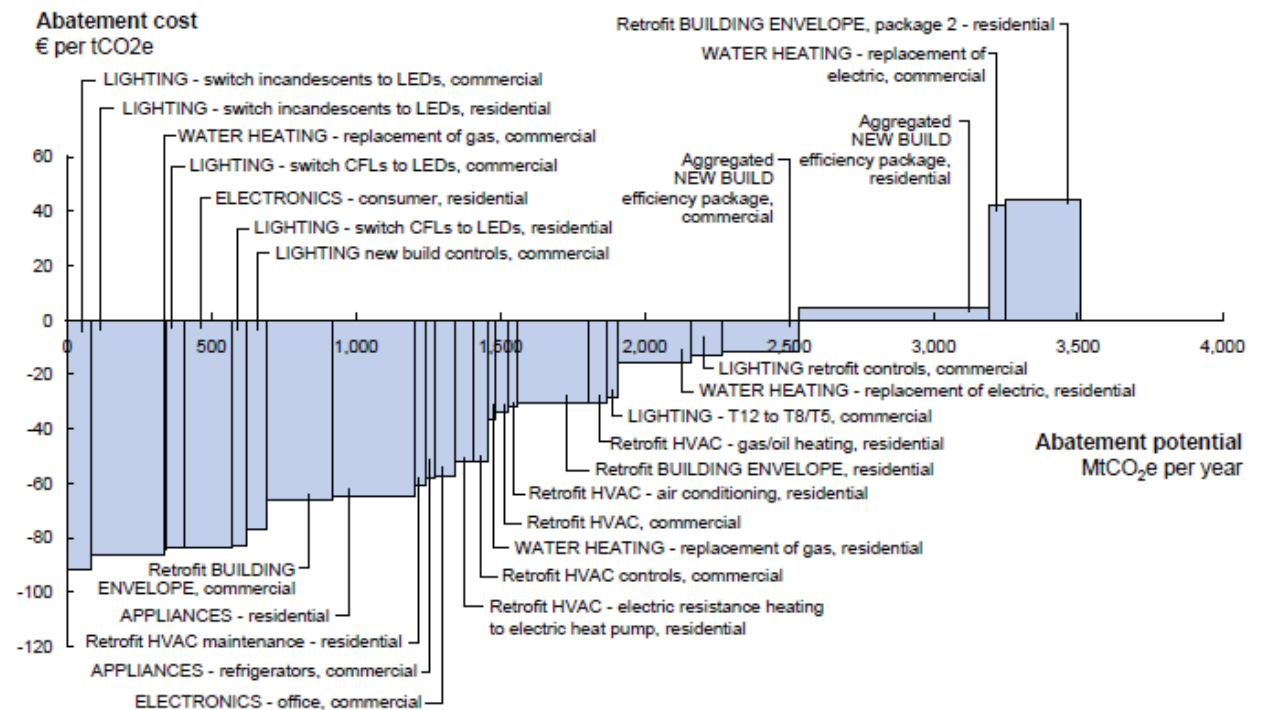


Low Carbon Technologies - Buildings

- ❖ Efficiency
- ❖ HVAC
- ❖ Water heating
- ❖ Appliances
- ❖ Building retrofit
- ❖ Building design
- ❖ Fuel switching

Global GHG abatement cost curve for the Buildings sector

Societal perspective; 2030

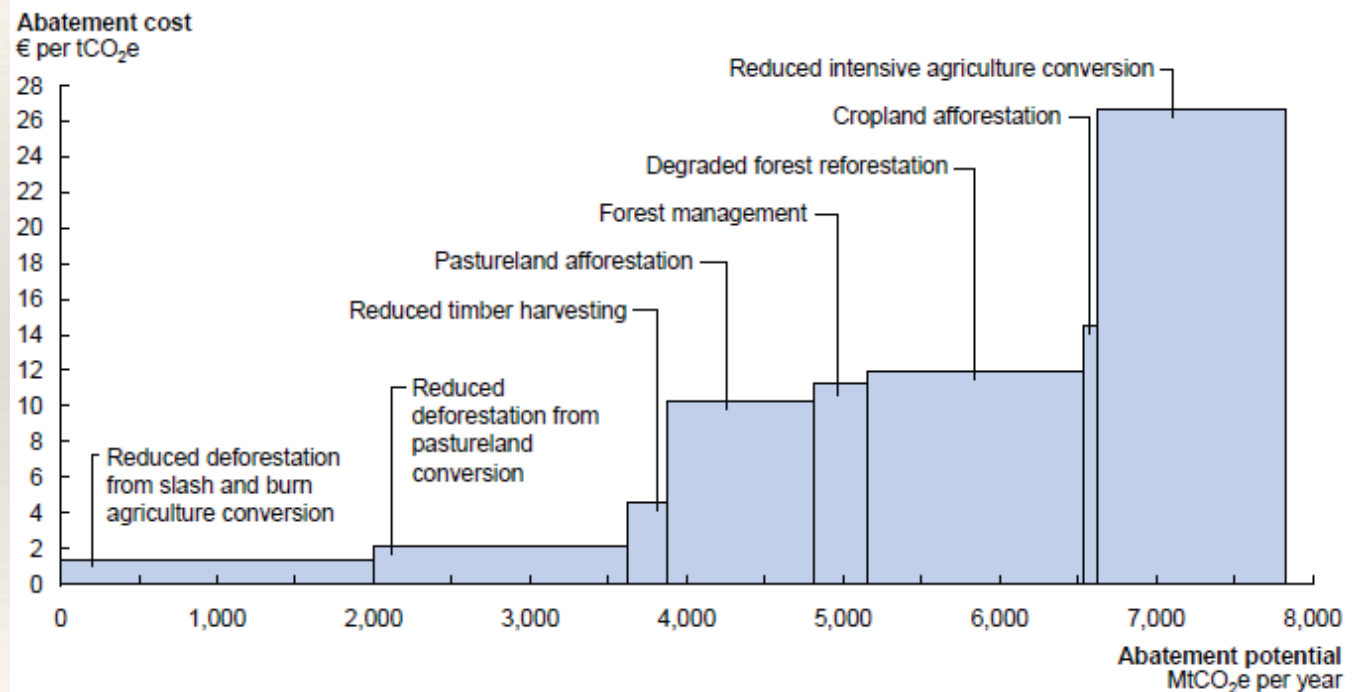


Low Carbon Technologies – Forestry

- ❖ Land use change:
 - ❖ Slash and burn agriculture
 - ❖ Pasture land
 - ❖ Timber harvesting
 - ❖ Afforestation
 - ❖ Forest restoration
 - ❖ Agriculture intensification

Global GHG abatement cost curve for the Forestry sector

Societal perspective; 2030

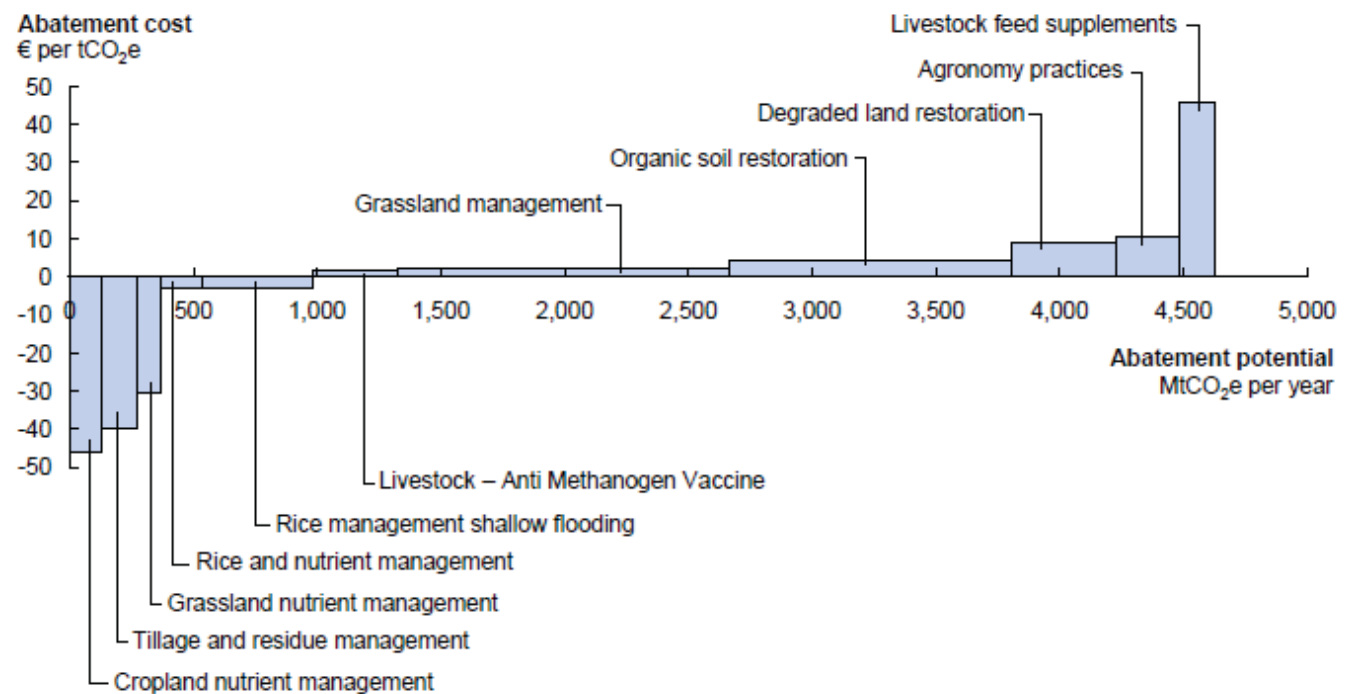


Low Carbon Technologies - Agriculture

- ❖ Nutrient (fertilizer) management
- ❖ Livestock and methane
- ❖ Grassland management
- ❖ Organic soil restoration

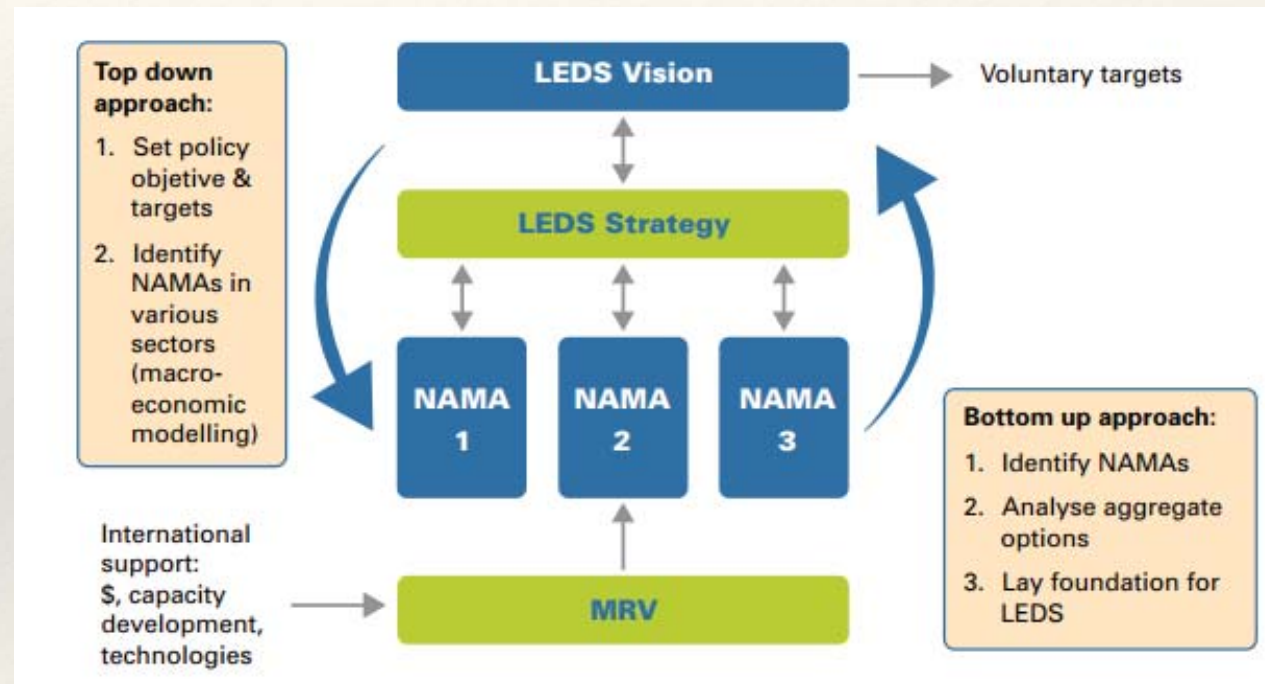
Global GHG abatement cost curve for the Agriculture sector

Societal perspective; 2030



Which of these could fit your NAMAs?

- ❖ Sustainable development
- ❖ Fits into current national development
- ❖ GHG mitigation potential
- ❖ Financing potential
- ❖ Transformative
- ❖ National economy links
- ❖ Develop data, scenarios and MVR





Many thanks

References:
Global Energy Assessment, IIASA
Pathways to a low carbon economy, McKinsey & Co
