Pathways to a Low Carbon Economy

Version 2 of the Global GHG Abatement Cost Curve

UNEP SEF Alliance
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Full report available at
http://climatedesk.bymckinsey.com

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Setup of the research

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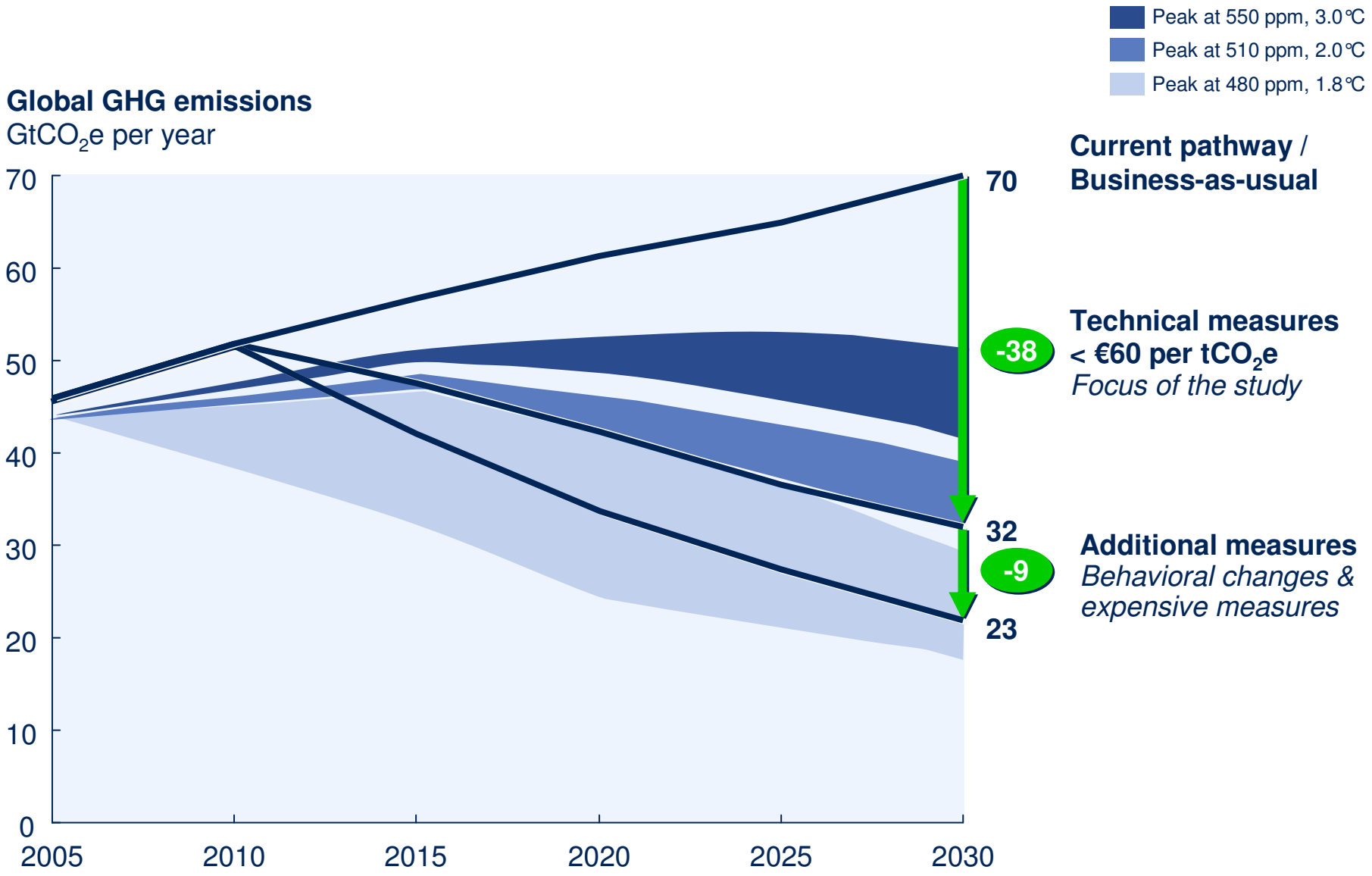
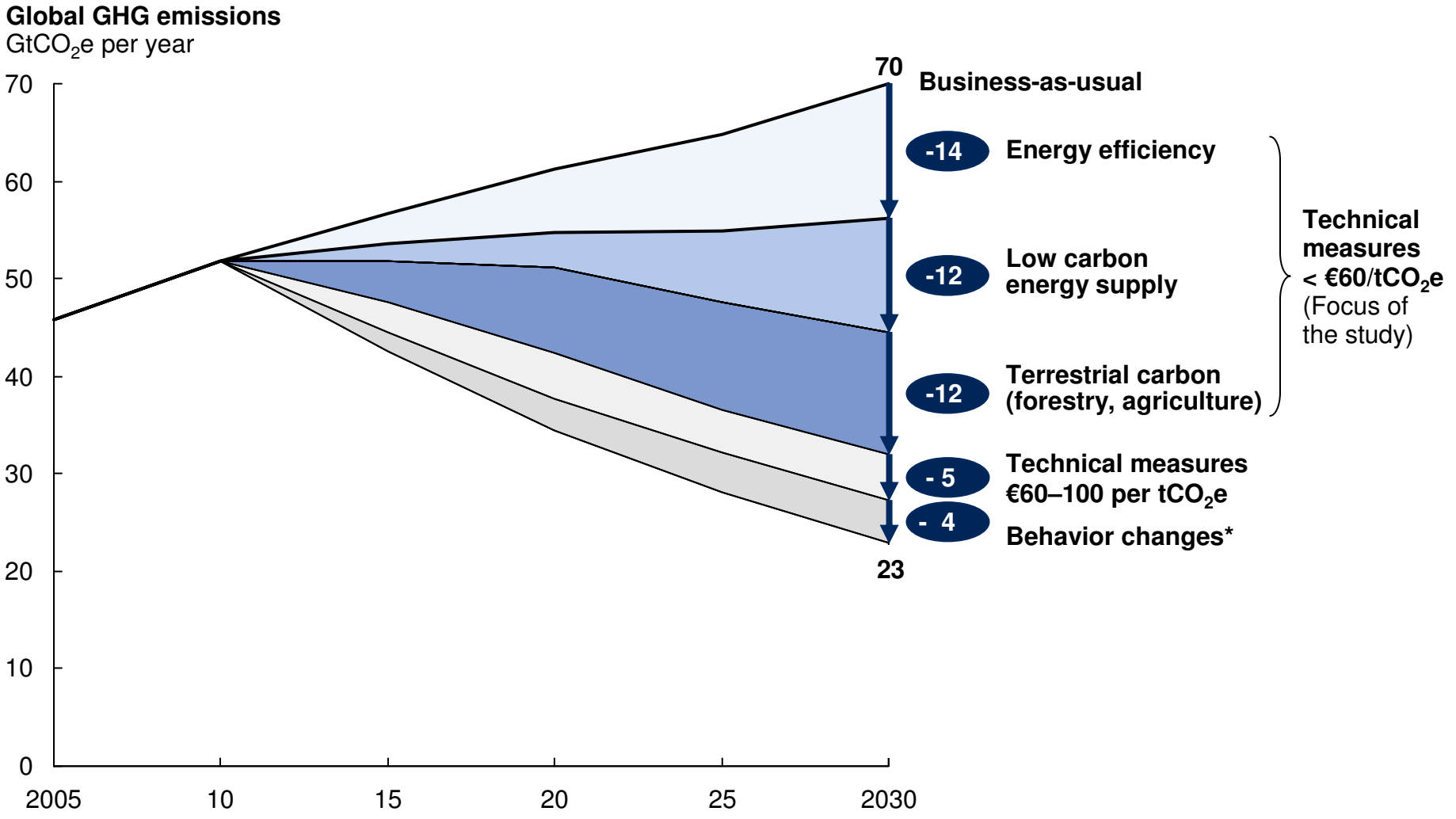
Key findings global GHG abatement cost curve v2.0

- **There is sufficient abatement *potential* to contain global warming below 2°C with high probability**
- **Global and cross-sector action is essential to capture the opportunity**
- **Costs and financing look manageable, but is likely challenging in some sectors and regions**
- **Time is of the essence, and the value of early investment is high**

Possible to contain global warming below 2°C



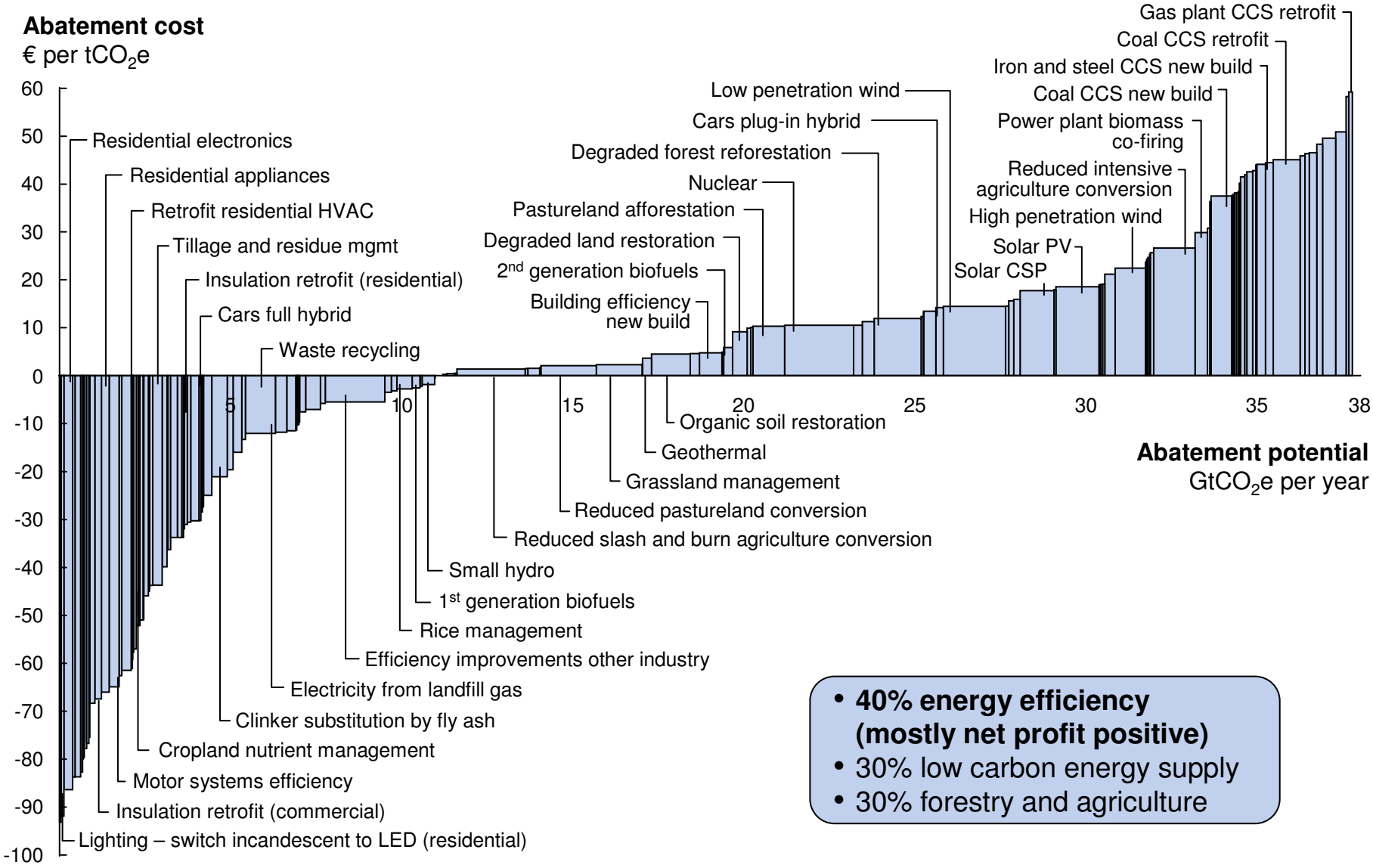
Three major categories of technical abatement opportunities complemented by behavioral change



* The estimate of behavioral change abatement potential was made after implementation of all technical levers; the potential would be higher if modeled before implementation of the technical levers.

Source: Global GHG Abatement Cost Curve v2.0; Houghton; IEA; US EPA

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

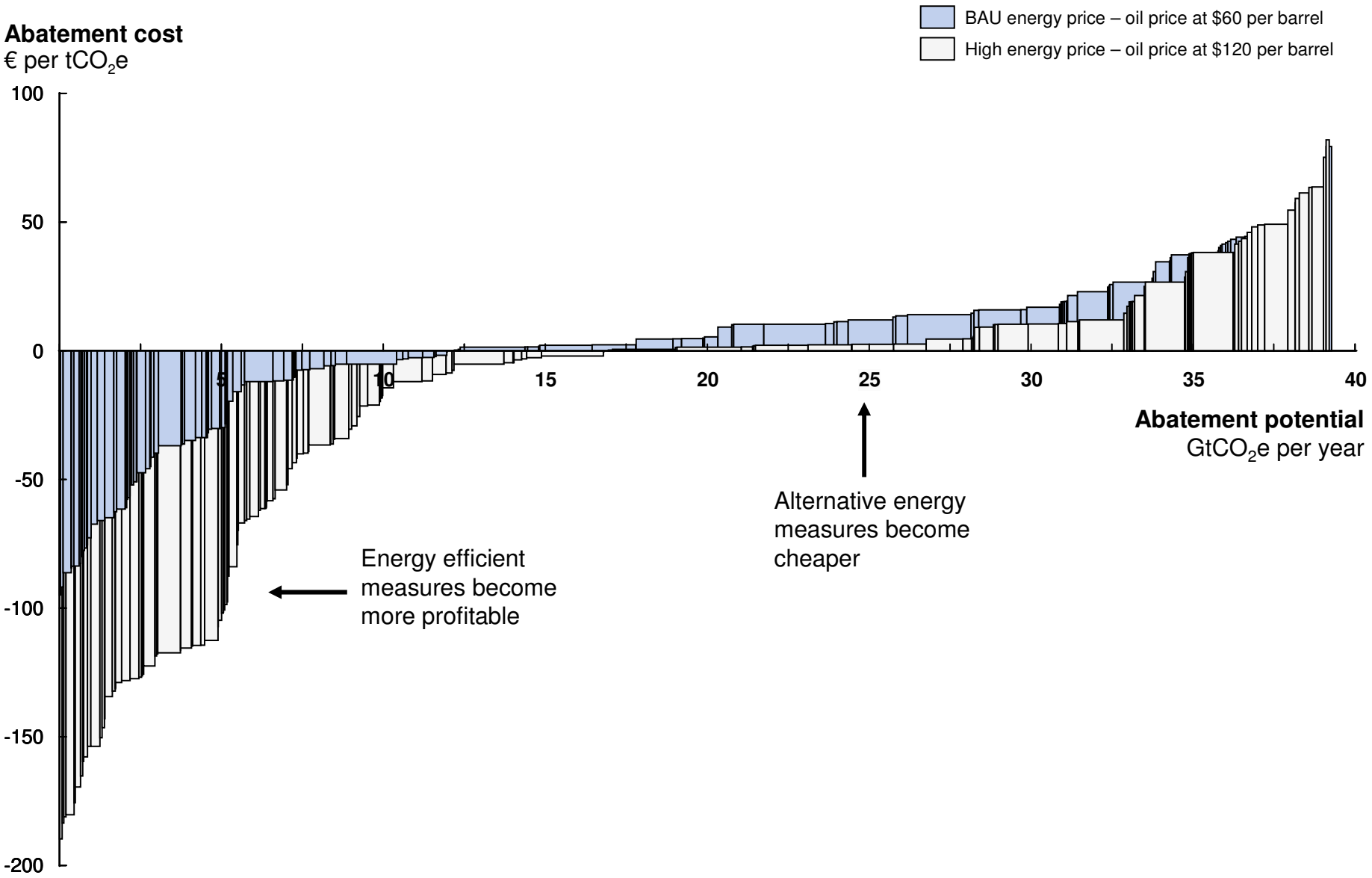


- **40% energy efficiency (mostly net profit positive)**
- 30% low carbon energy supply
- 30% forestry and agriculture

Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €60 per tCO_2e 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

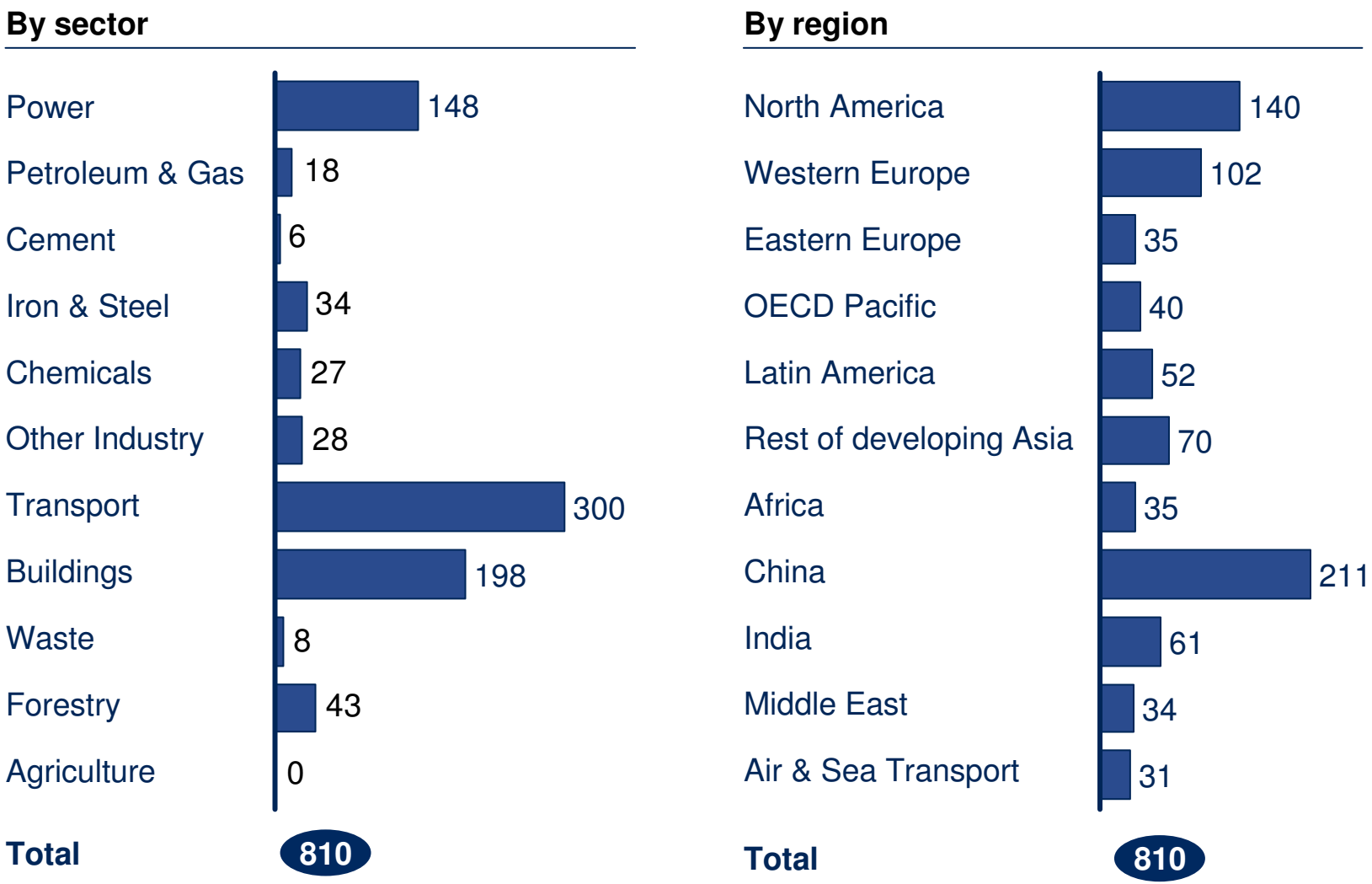
Effect of high energy prices (oil price at $120 a barrel)



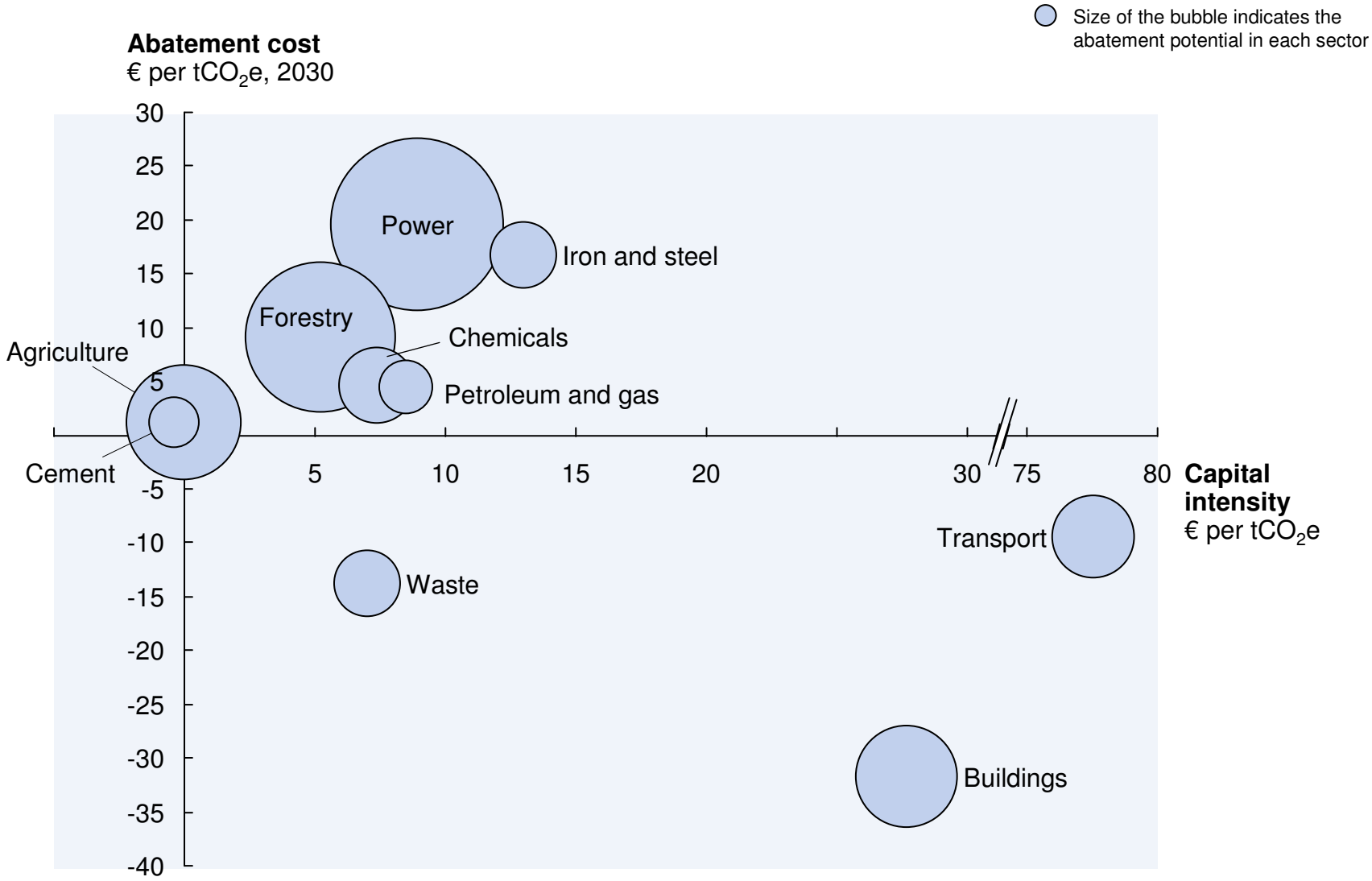
Source: Global GHG Abatement Cost Curve v2.0

Investments manageable at the global level, but could be challenging in some sectors

€ billions per year; 2030; in addition to current projected / business as usual investments

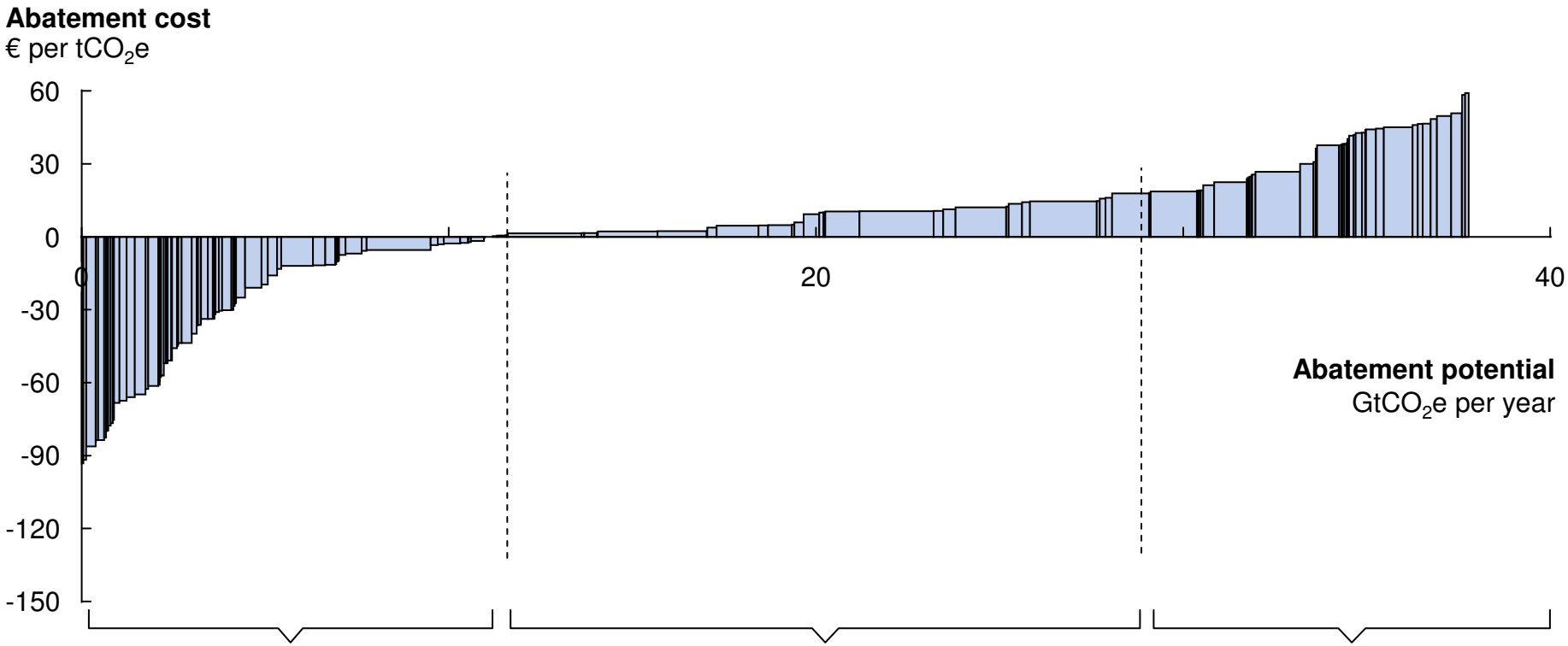


Capital intensity and abatement cost



Source: Global GHG Abatement Cost Curve v2.0

Key areas of regulation



1. **Energy efficiency regulation, e.g., technical standards for buildings and transportation**
2. **Long-term stable international system for power and industry**
3. **Mechanism to drive selected key technologies down the learning curve**
4. **Targeted systems for agriculture and deforestation linked to national development agendas**

Source: Global GHG Abatement Cost Curve v2.0

Thank you for your attention!

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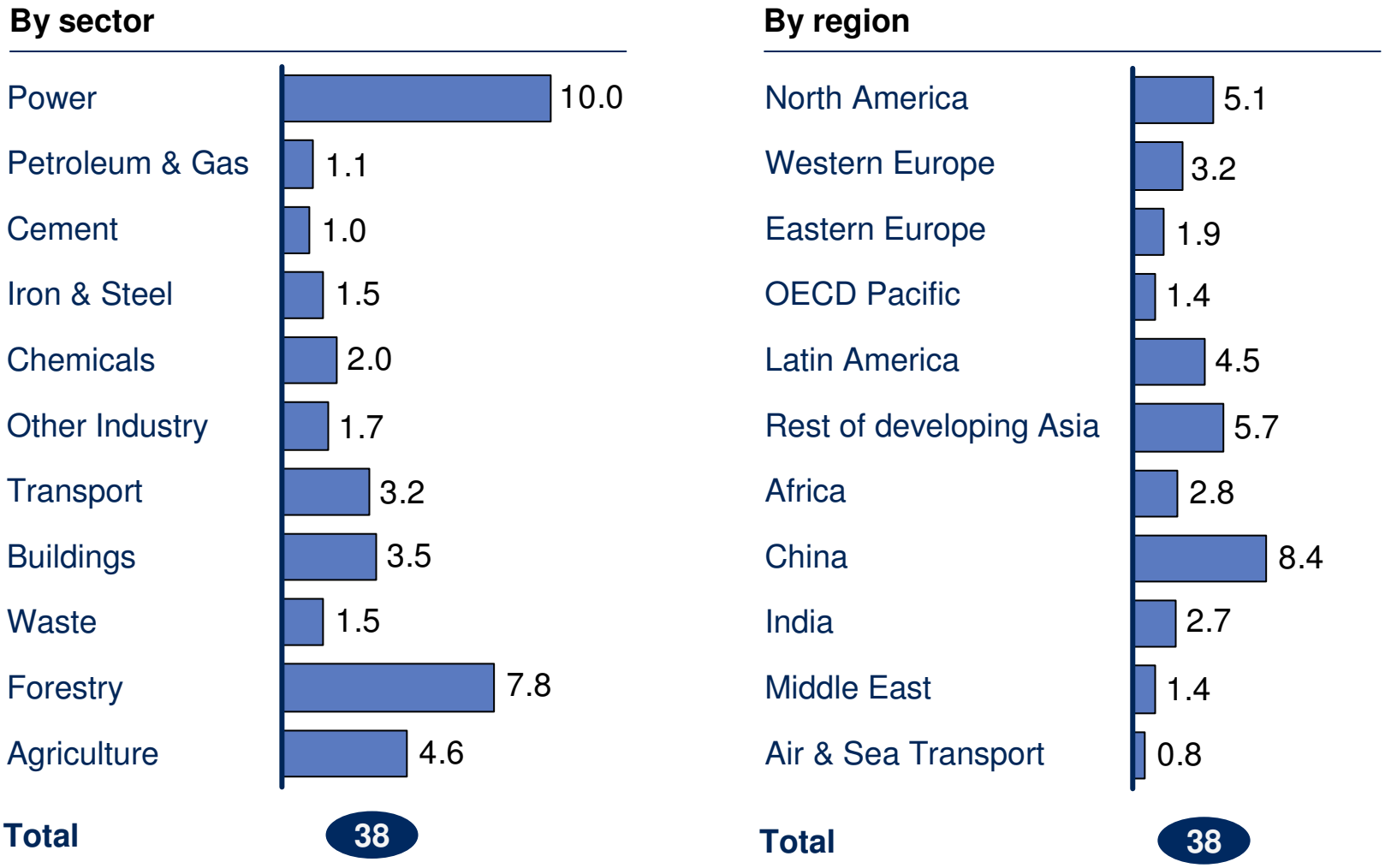
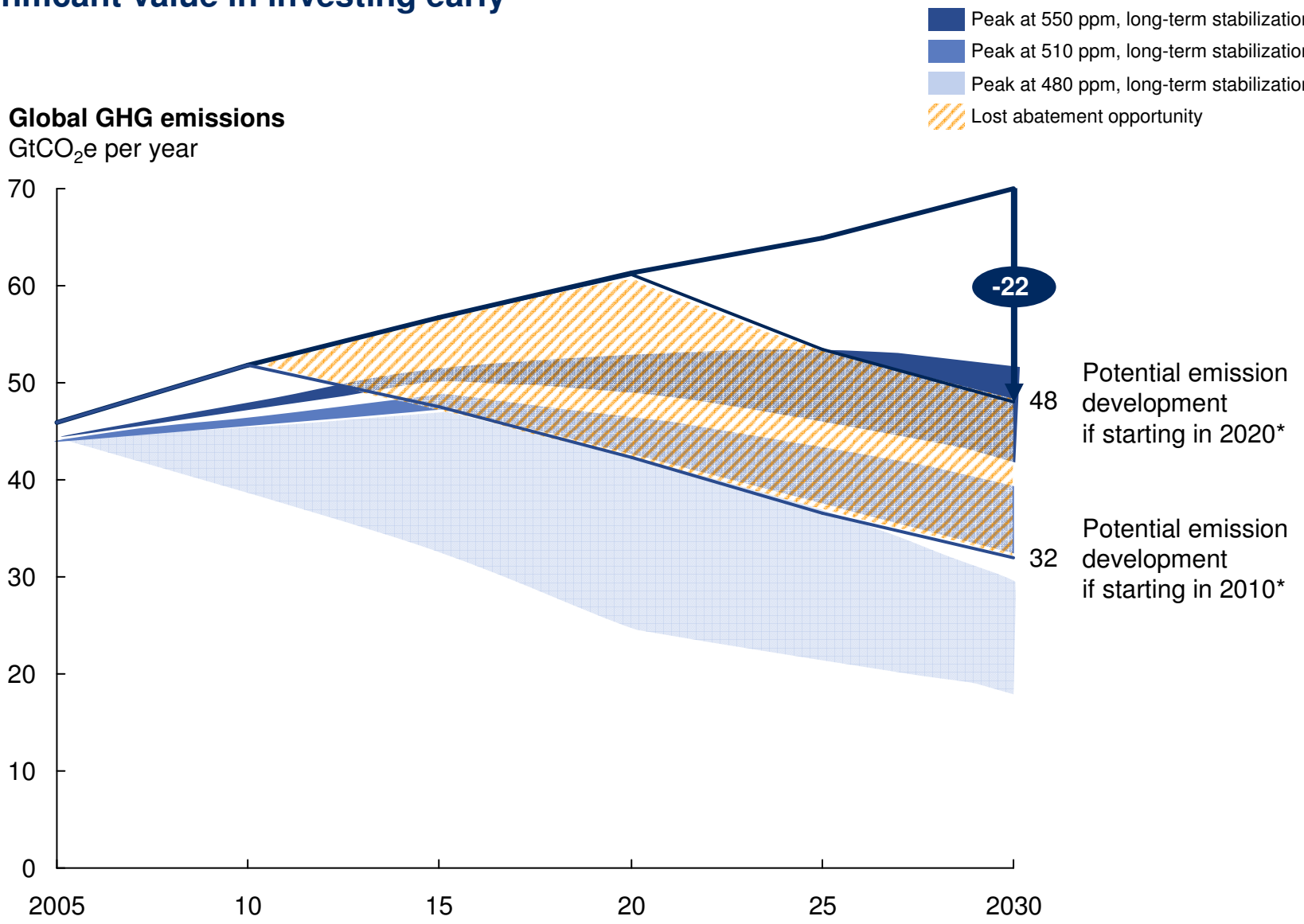
Global and cross-sectoral action required to capture full potential

Abatement potential; GtCO2e per year; 2030



Significant value in investing early



* Technical levers <€60/tCO2e

Source: Global GHG Abatement Cost Curve v2.0; Houghton; IEA; OECD; EPA; den Elzen; van Vuuren, Meinshausen

Methodology and scope of use

1. **Focus on abatement opportunities ("supply")** – no independent research into how much abatement is needed ("demand")
2. **External projections** (IEA, EPA, Houghton) for 2030 business-as-usual emissions
3. **Abatement volumes are "economic potentials"** based on full deployment rates of GHG-efficient technologies/measures per region and over time, with a focus on measures up to €60 per tCO_2e. It is not a forecast of what will actually happen in the future.
4. **Abatement cost defined as the incremental cost*** of a low-emission opportunity relative to activities that would otherwise occur in business-as-usual
   - Measured as € per ton of avoided CO_2e emissions
   - Excludes taxes, subsidies, transaction and program costs, and uses a "societal" interest rate equivalent to the rate of long term government bonds
5. **Investments are the yearly incremental capital expenditures** on top of BAU to implement the measures identified

The analysis **can** be used for:

- An integrated perspective on abatement potential and cost, to be compared with emissions target levels
- Order of magnitude evaluation and prioritization of abatement measures within and across sectors
- As fact base supporting the assessment of possible regulatory arrangements

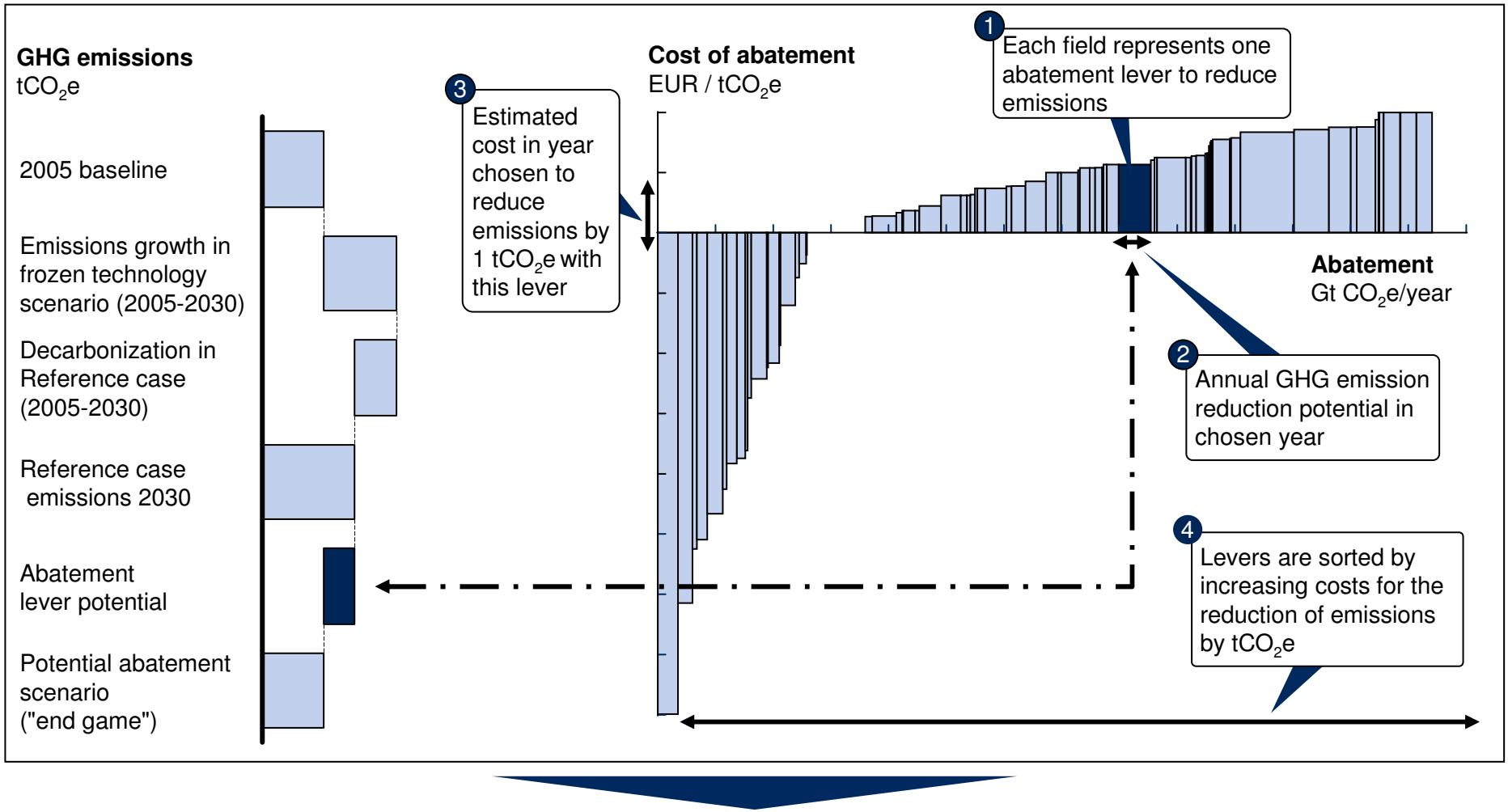
The analysis **cannot** be used for:

- Definition of a target CO_2e concentration level to solve climate change issues
- Forecasting exact CO_2 prices or CO_2 regulation.
- Forecasting detailed development of individual technologies

* Operational cost and savings + capital investment repayment

Source: Global GHG Abatement Cost Curve v2.0

Basic cost curve logic



- The cost curve displays abatement potential, and corresponding cost, for each abatement lever relative to a "business-as-usual" scenario
- The merit order is applied based on the cheapest measures in 2030 in EUR/tCO_2e

Source: Global GHG Abatement Cost Curve v2.0

The cost curve is powerful, when understood in the right context

The GHG abatement cost analysis . . .

. . . can be used for

- Construction of an **integrated perspective on abatement potential and opportunities** to be compared with a given target CO_2e concentration level
- **Order of magnitude** evaluation and prioritization of abatement measures within and across sectors
- Providing a **fact base** to support the assessment of possible regulatory arrangements

. . . cannot be used for

- **Definition of target CO_2e concentration level** to solve climate change issues
- **Forecasting exact CO_2 prices** or CO_2 regulation
- **Forecasting individual technologies** – while there is a view on learning rates and volume development for individual technologies, in the database, the value of this work is its comprehensive scope more than the depth in individual technologies

Source: Global GHG Abatement Cost Curve v2.0

Calculation logic and assumptions for the abatement cost

$$\text{Abatement cost} = \frac{[\text{Full cost of } CO_2\text{e efficient alternative}] - [\text{Full cost of reference solution}]}{[CO_2\text{e emissions from reference solution}] - [CO_2\text{e emissions from alternative}]}$$

Full cost includes…

- Investment costs calculated with economic amortization period and capital costs (like a repayment of a loan)
- Operating costs, incl. personnel/materials costs
- Possible cost savings generated by the actions (especially energy savings)

Full cost does not include…

- Transaction costs
- Communication/information costs
- Subsidies or explicit CO_2 costs
- Taxes
- Consequential impact on the economy (e.g., advantages from technology leadership)

Other assumptions

- Abatement cost for new technologies are consistently compared to the specific cost and emission intensity of displaced alternatives
- Full costs could be negative, i.e., indicating a net benefit deriving from the use of the solution

Source: Global GHG Abatement Cost Curve v2.0