The role of energy in the mitigation of climate change

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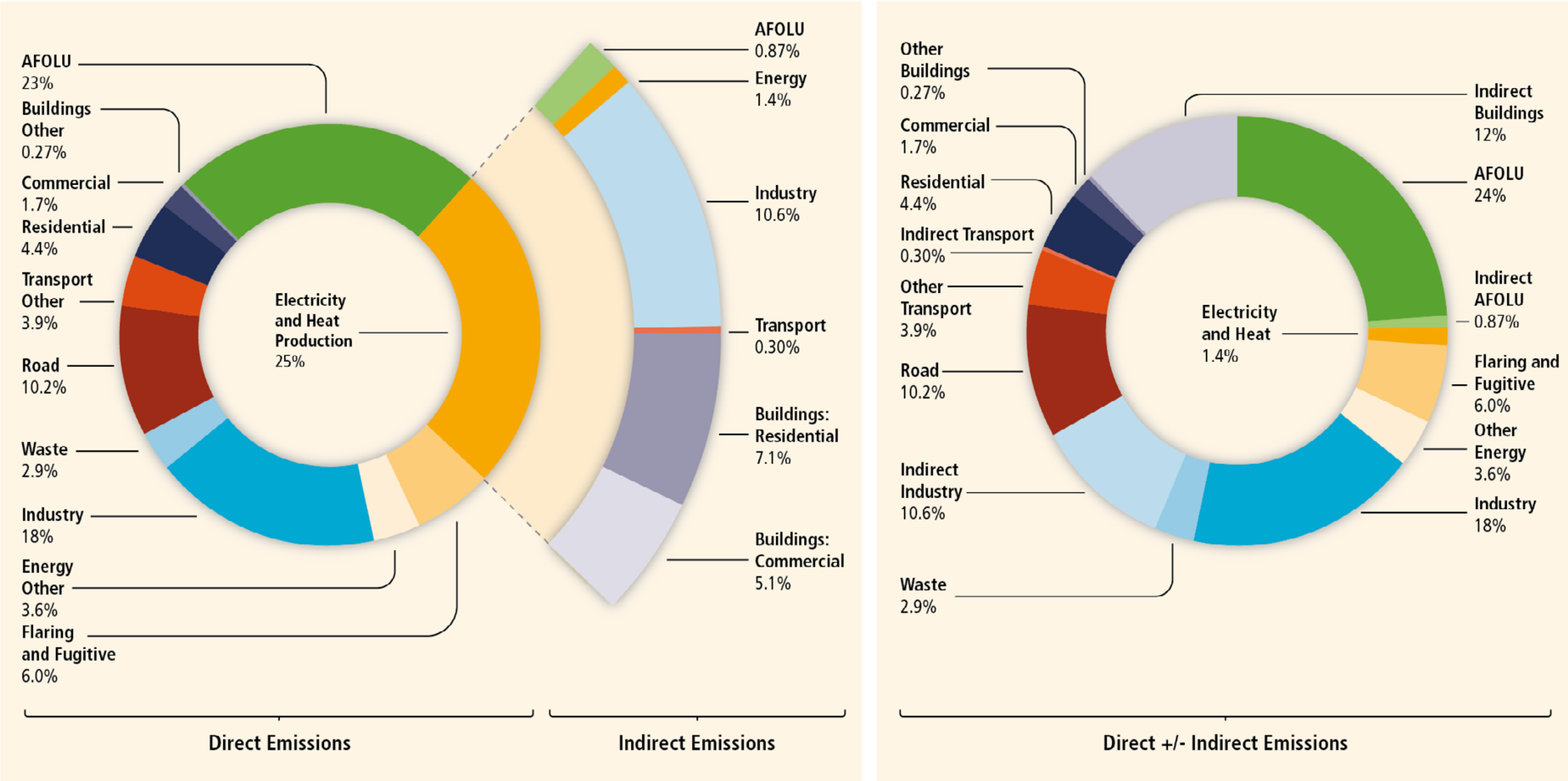
BC3 Summer School

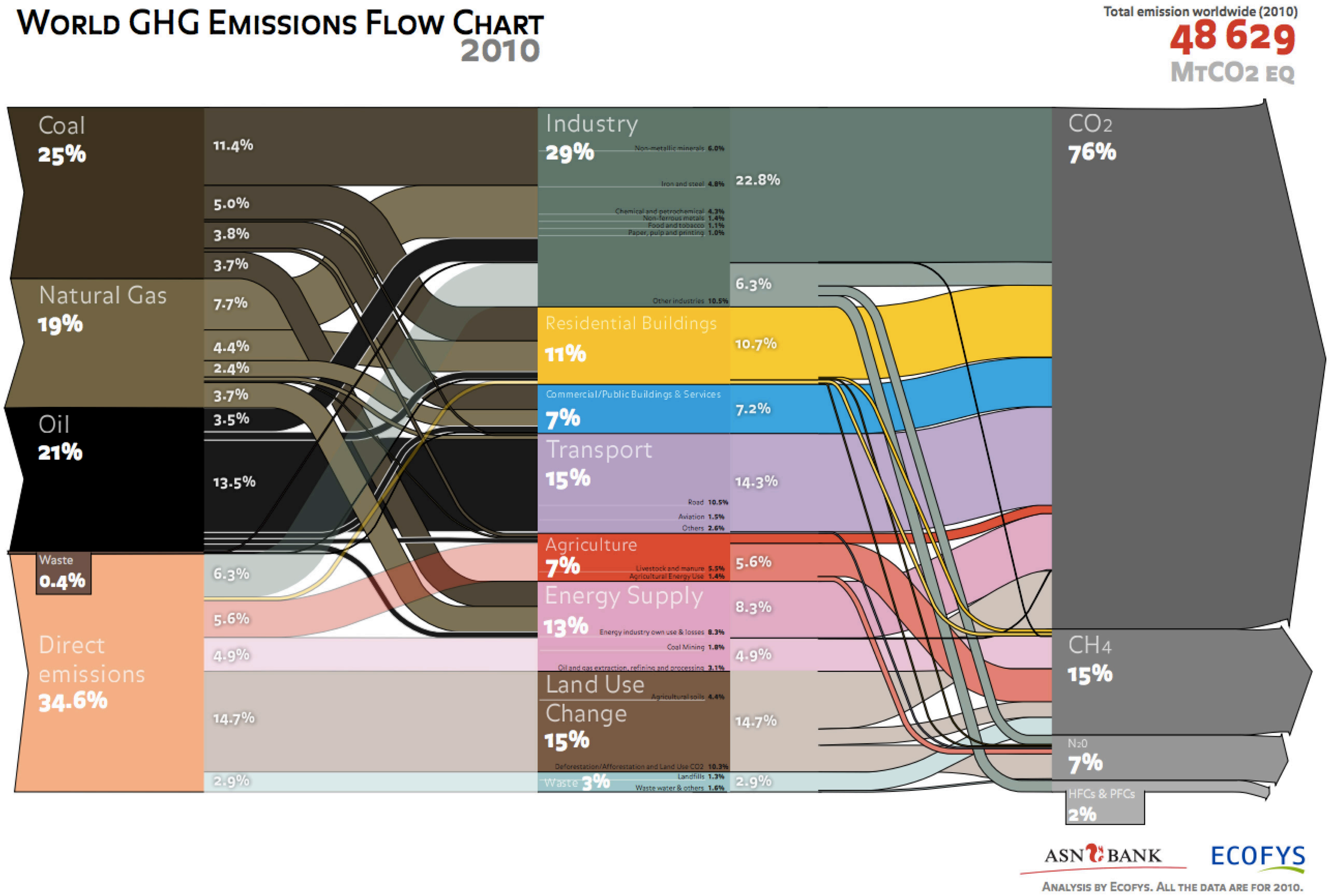
San Sebastián, July 16th, 2014

The role of energy in GHG emissions (I)

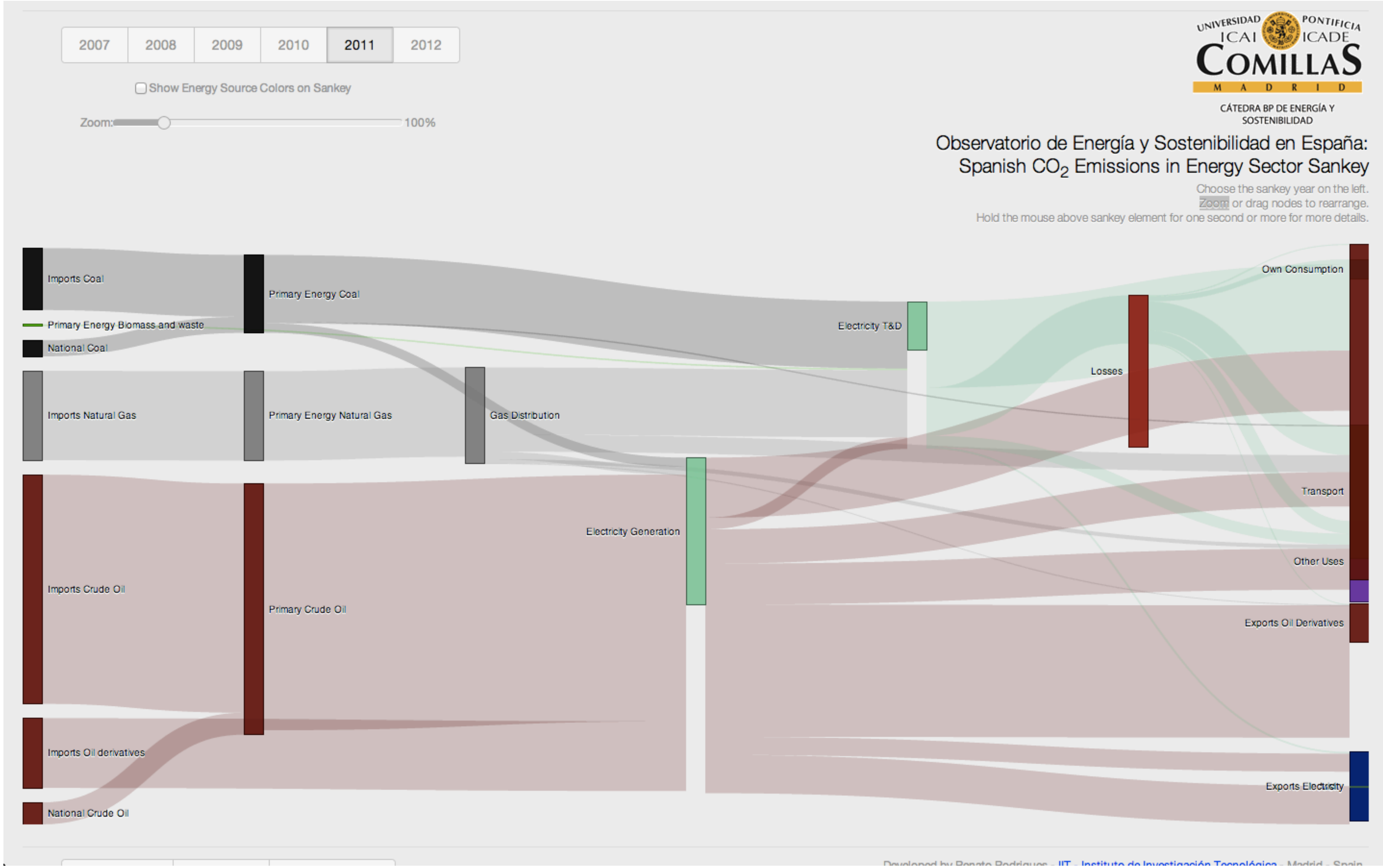


IPCC AR5, WG3 Technical Summary

The role of energy in GHG emissions (II)



Carbon-energy flows



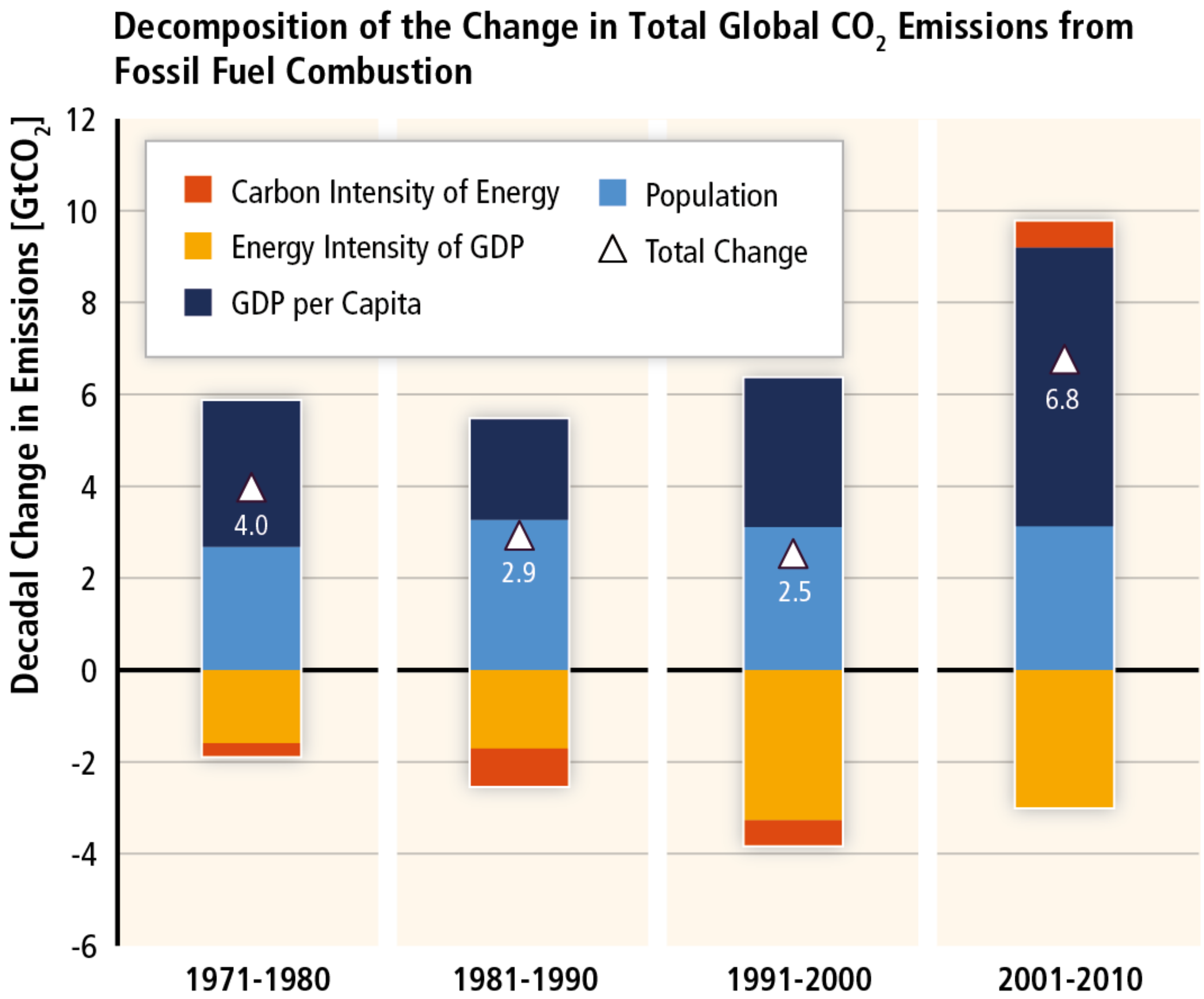
http://web.upcomillas.es/Centros/bp/D3_Sankey/sankey_co2.html

The role of energy in mitigation

- *Reaching atmospheric concentration levels of 430 to 650 ppm by 2100 will require large-scale challenges to global and energy systems over the coming decades [high confidence]*
  - *3x – 4x share low-carbon energy in 2050*
  - *2100 concentration levels unachievable if the full suite of low-carbon technologies is not available*
  - *Demand reductions on their own will not be sufficient*
  - *But will be a key mitigation strategy and will affect the scale of the mitigation challenge for the energy supply side*

(AR5 WG3 Technical Summary)

Drivers for GHG emissions (I)



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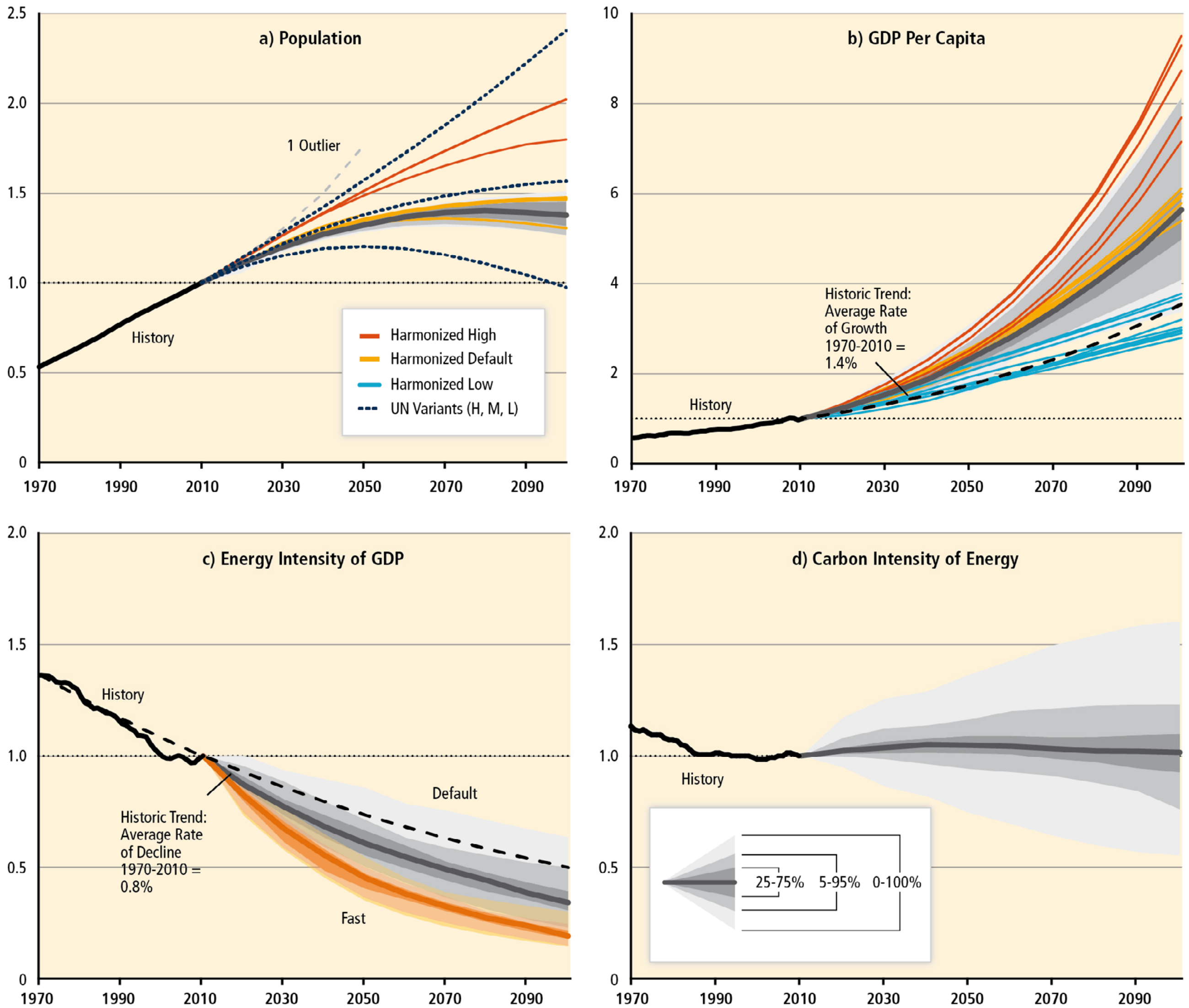
Drivers for GHG emissions (II)



IPCC AR5, WG3 Technical Summary

Access to energy?

	Low		High	
	Optimistic	Pessimistic	Optimistic	Pessimistic
2009-2030: Energy poverty alleviation emissions (GtCO2)	2.9	2.9	17.8	17.8
2030-2060: Use of additional energy infrastructure (GtCO2)	7.9	7.9	48.5	48.5
2060-2100: Retirement of additional infrastructure (GtCO2)	5.3	10.5	32.3	64.7
2009-2100: Total emissions (GtCO2)	16.1	21.3	98.7	131
Additional temperature increase (degree C): mean and 10-90 percentile in square brackets	0.008 [0.004-0.011]	0.01 [0.006-0.014]	0.047 [0.027-0.067]	0.063 [0.036-0.089]

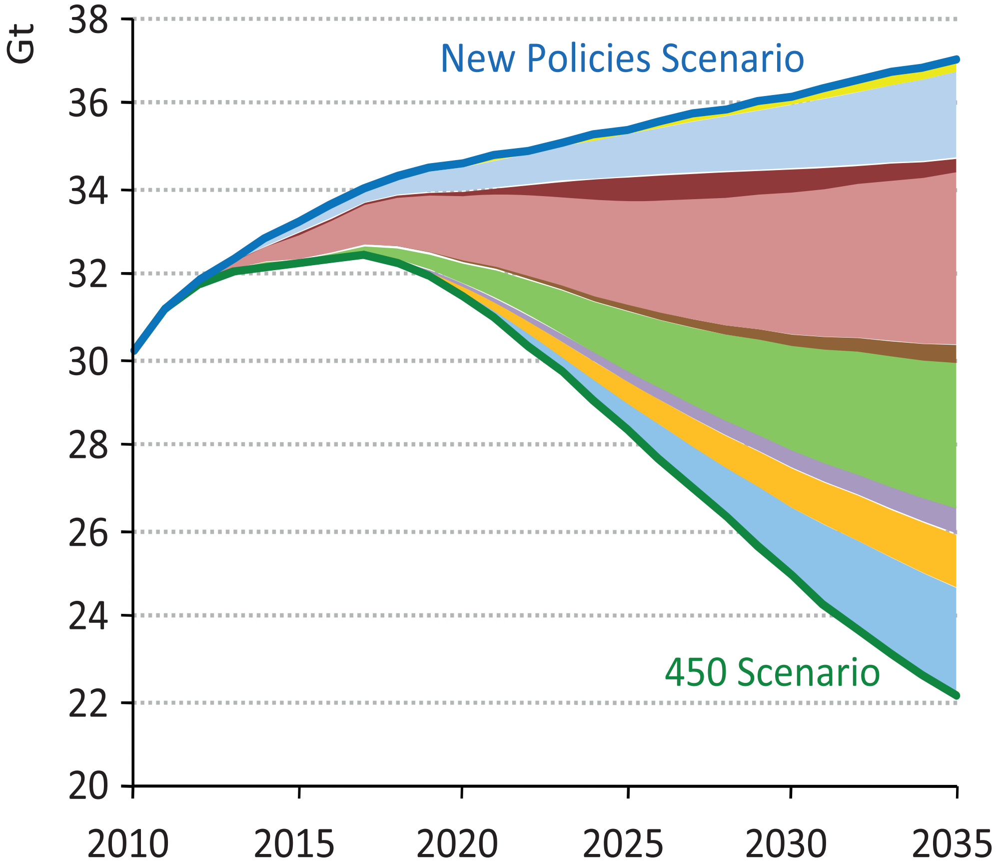
Table 3: Estimated additional emissions and temperature rise from an energy poverty alleviation program.

Chakravarty and Tavoni, 2013

Energy-related mitigation options

- Decarbonization of energy supply
- Final energy demand reductions
- Switch to low-carbon fuels
- Different by sector
  - Decarbonization of electricity generation is a key component: quicker and simpler
  - The transport sector is difficult to decarbonize, and opportunities for fuel switching are low in the short term
  - Large achievable potential in the building sector, but strong barriers

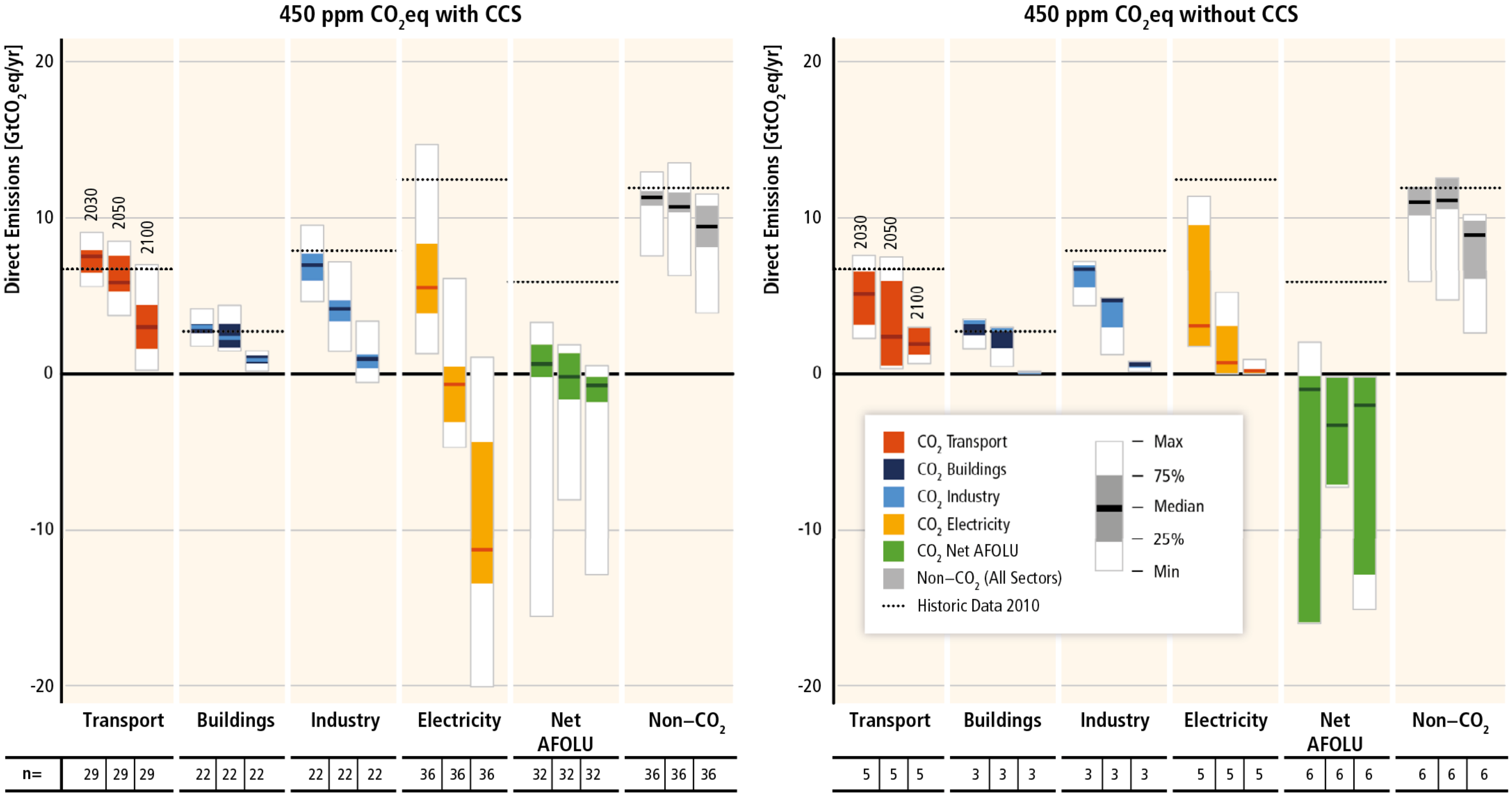
Mitigation potential (I)



CO_2 abatement	2020	2035
Activity	2%	2%
End-use efficiency	18%	13%
Power plant efficiency	3%	2%
Electricity savings	50%	27%
Fuel and technology switching in end-uses	2%	3%
Renewables	15%	23%
Biofuels	2%	4%
Nuclear	5%	8%
CCS	4%	17%
Total (Gt CO_2)	**3.1**	**15.0**

Source: IEA World Energy Outlook 2012

Mitigation potential (II)

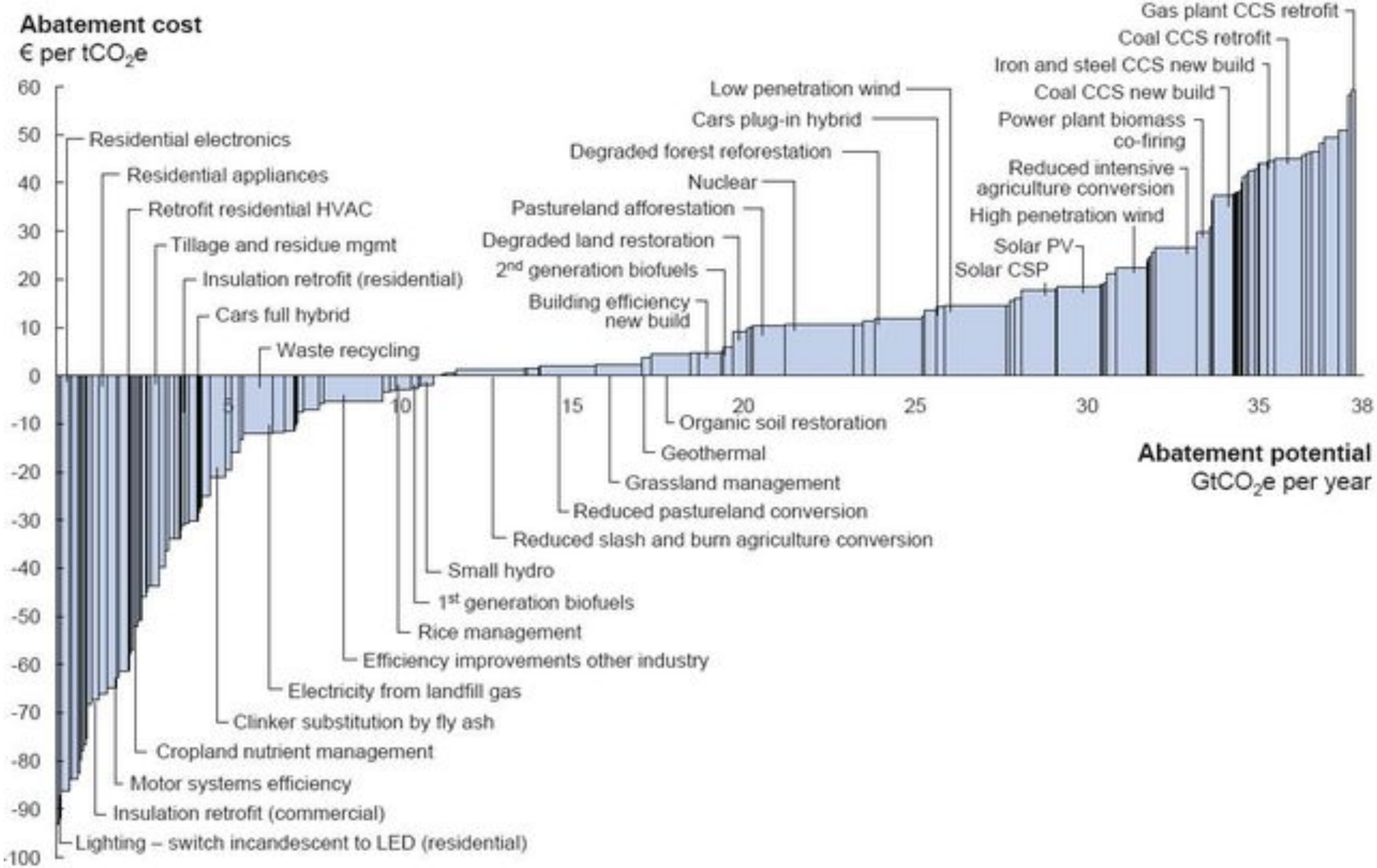


IPCC AR5, WG3 Technical Summary

Assessing costs and potentials

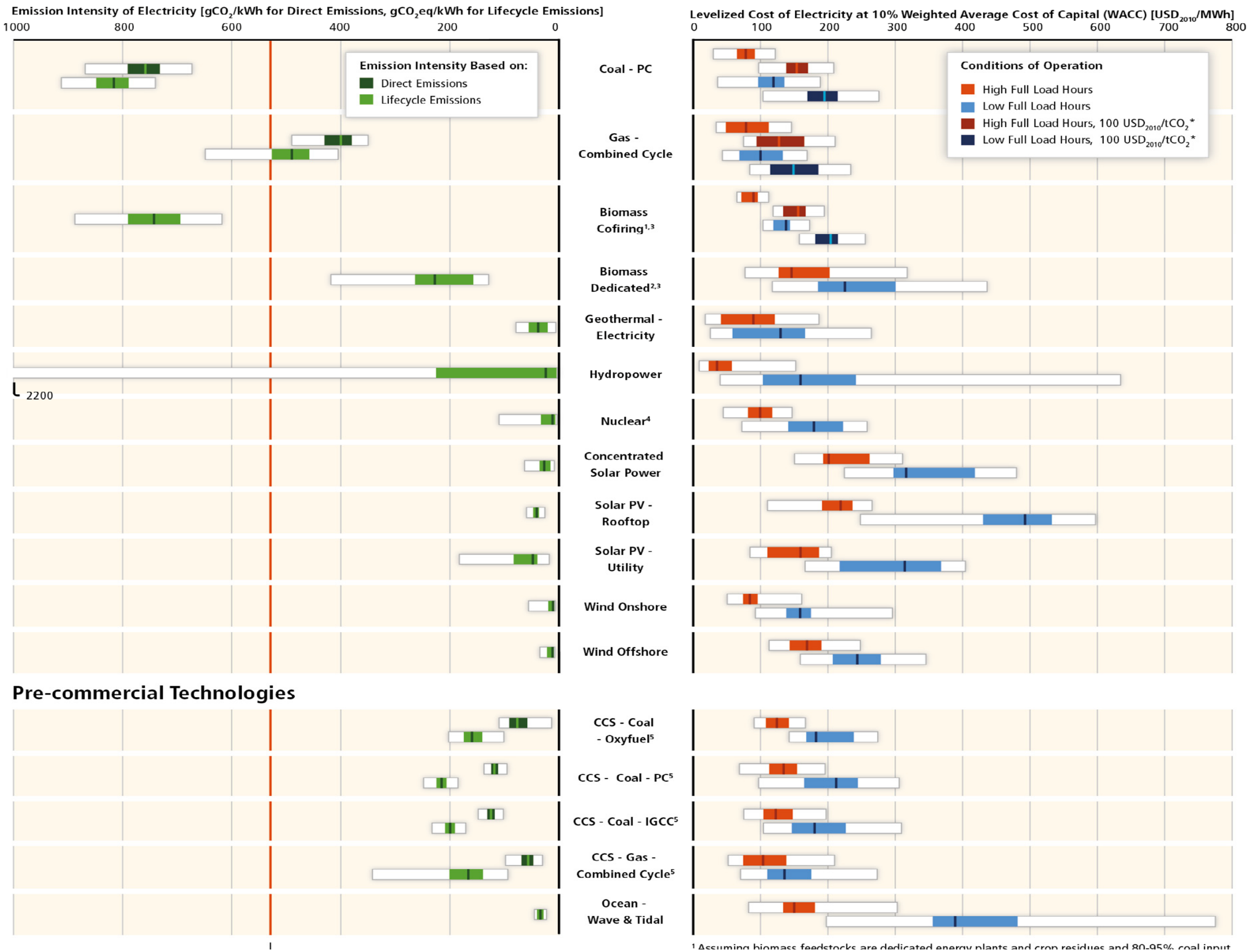
- It is easy to overestimate potentials and underestimate costs
  - Counterfactual scenarios
  - Public vs Private perspectives
    - Discount rates
    - Taxes
  - Interactions between options
  - Rebound effect
  - Bottom-up vs Top-down

The McKinsey curve



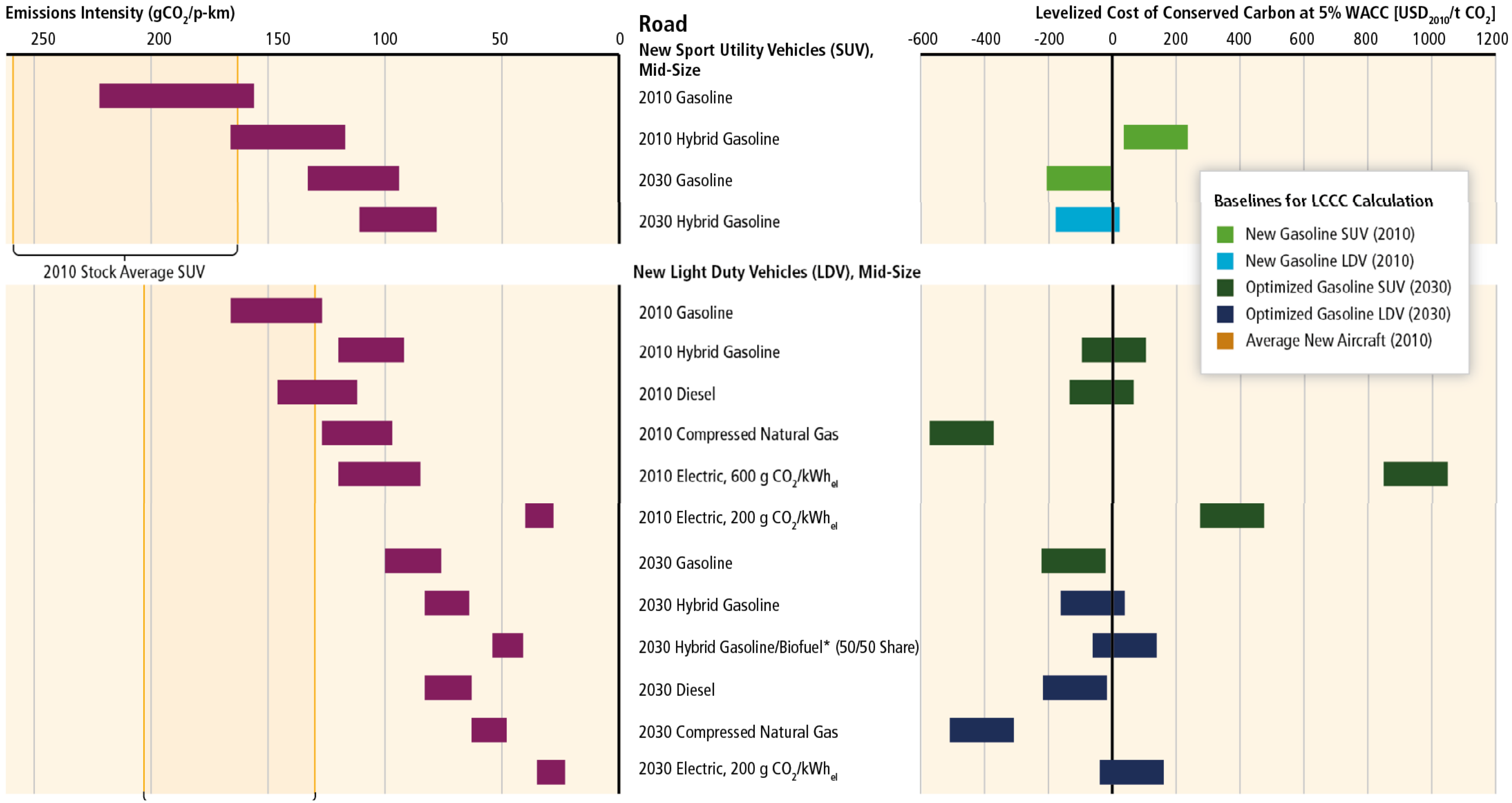
Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €60 per tCO_2e if each lever was pursued aggressively. It is not a forecast of what role different abatement measures and technologies will play.
Source: Global GHG Abatement Cost Curve v2.0

AR5 Energy supply



IPCC AR5, WG3 Technical Summary

AR5 Transport



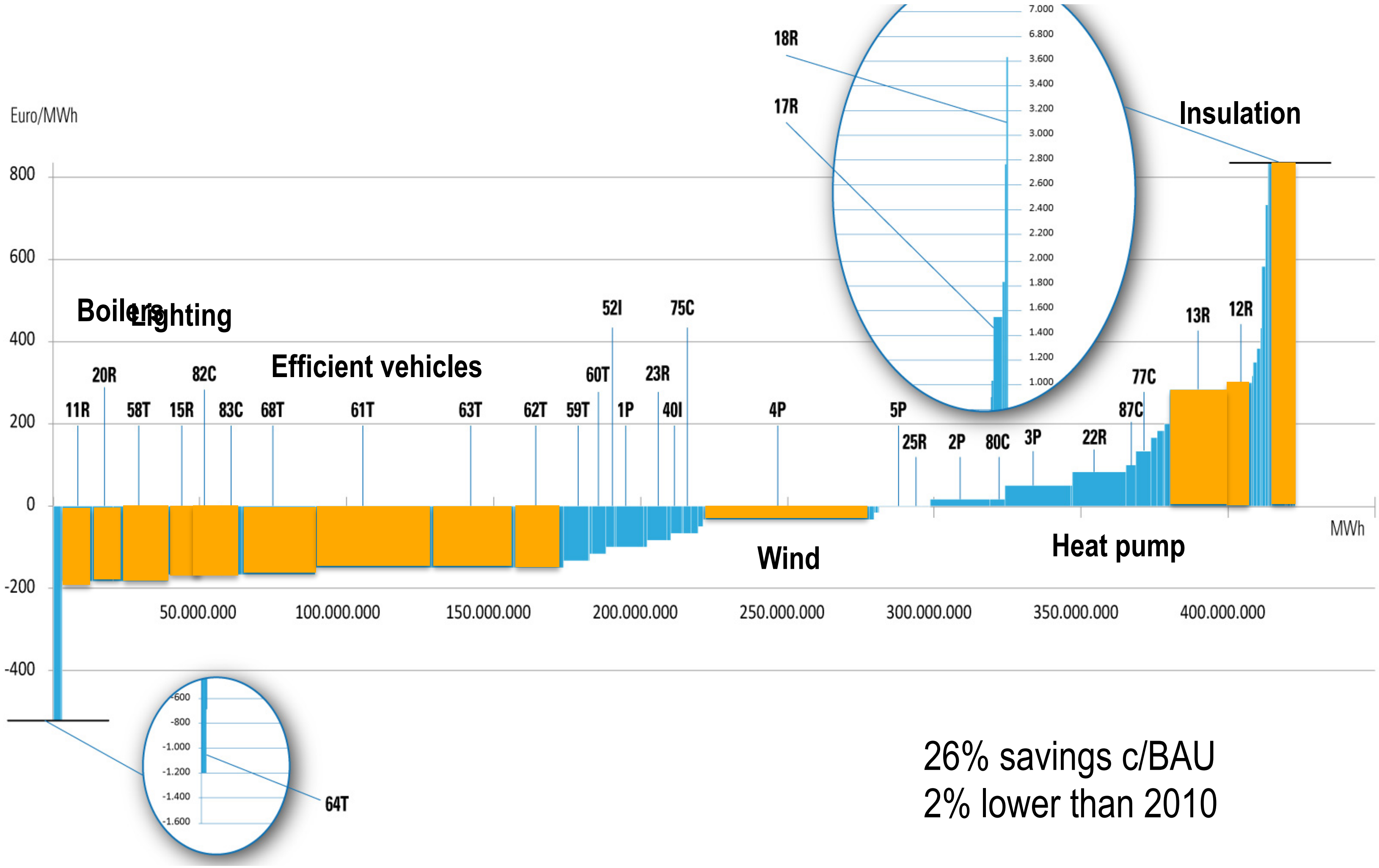
IPCC AR5, WG3 Technical Summary

The Economics for Energy curve

- Expert-based
- Only technological changes
- Interaction between options
- Public and private perspectives

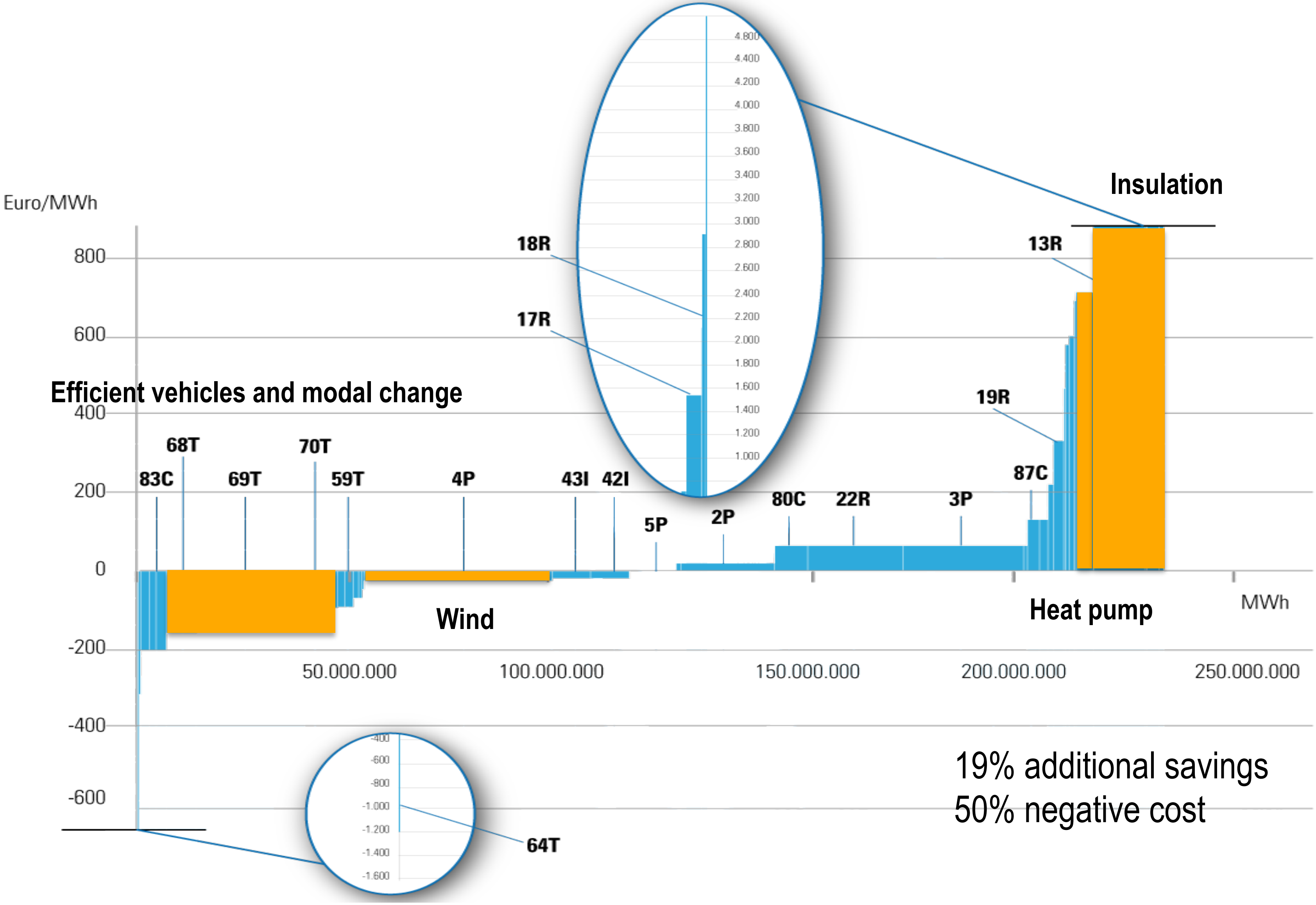
- Translating energy into GHG mitigation
  - Electricity: 0.3 tCO_2/MWh
  - Transport: 0.25 tCO_2/MWh

Counterfactual scenario

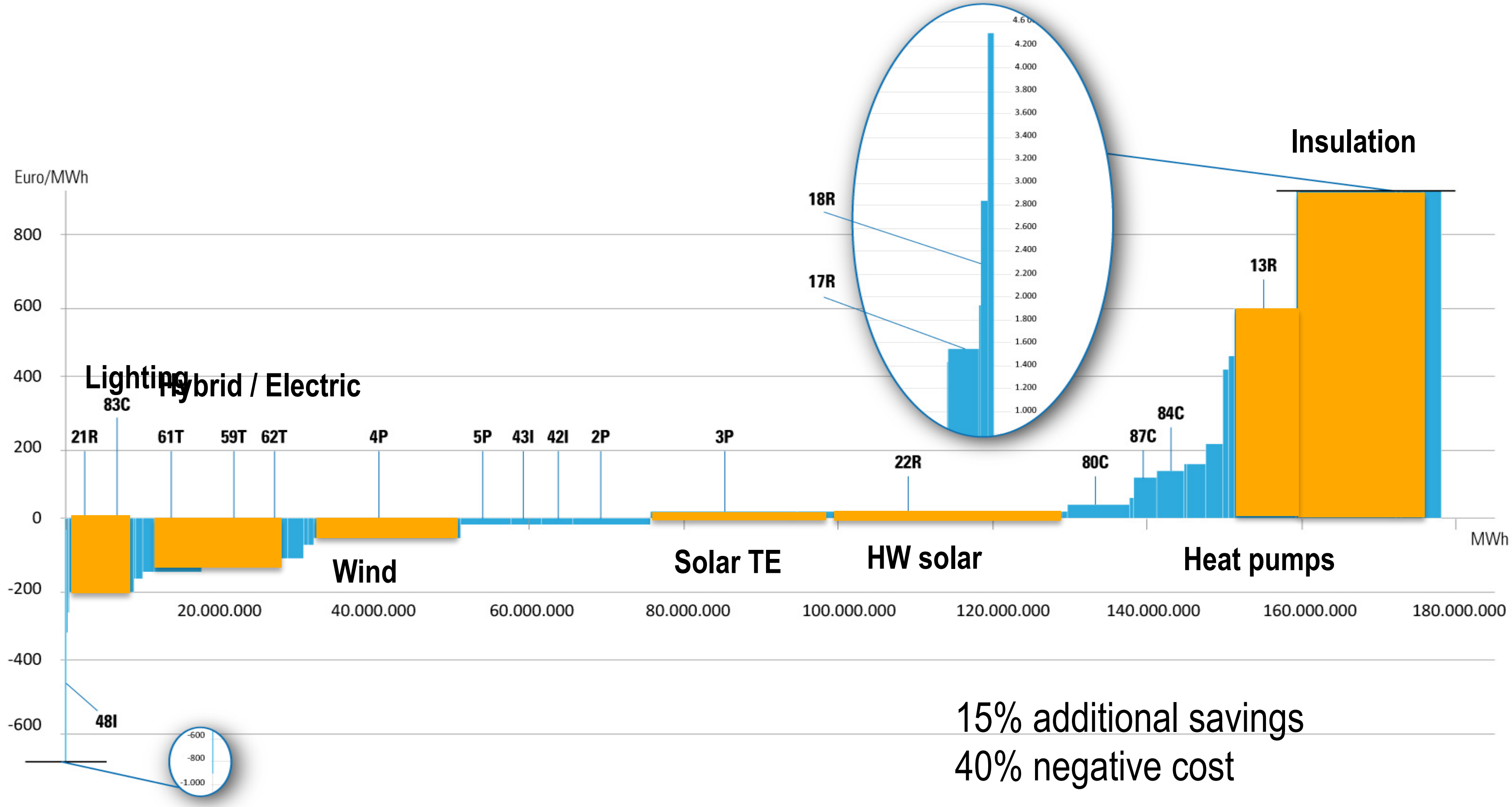


26% savings c/BAU
2% lower than 2010

“Aggresive policy” scenario



“Advanced technology” scenario



15% additional savings
40% negative cost

Why don't we use negative cost measures?

- The energy-efficiency paradox
- Non-monetary barriers
  - Hidden or transaction costs
  - Lack of awareness
  - Inertia
  - Risk premium
- In most cases, the problem is not economic
  - Subsidies may be useless

Why do some measures look so expensive?

- Lack of the right information
  - Very difficult to get reliable data (non-ETS)
  - Data aggregation: there may be niches
- Multiple objectives (e.g. Buildings)
  - How to allocate the cost?
- Interaction between measures

economics for energy

Low-carbon policies

- Carbon price
  - Auctioned cap-and-trade
  - Safety valve

plus

- Technology standards
- Technology policies
  - Market-pull
  - Technology-push
- Education policies
- Voluntary approaches

Energy efficiency policies

	Policy instrument
Low energy prices	Taxes; Real time pricing
Hidden and transaction costs	R&D; Institutional reform
Uncertainty and irreversibility	Information programs
Information failures	Information programs
Bounded rationality	Information programs, Education, Standards
Slowness of technological diffusion	R&D programs; R&D incentives
Principal-agent problem	Information programs; Institutional reform
Capital markets imperfections	Financing programs
Divergence with social discount rates	Financing programs

Conclusions

- We need all options
  - Low-carbon energy
  - Energy efficiency (technology & behavioral changes)
- The potential is huge
  - But must be estimated correctly
- The cost:
  - May be very low, even negative
  - Or very high
- Good policies are required
- Adaptation also needs to be factored in

Thanks for your attention

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