Netherlands Environmental Assessment Agency

Co-benefits of Climate Policy

From physical to monetized impacts

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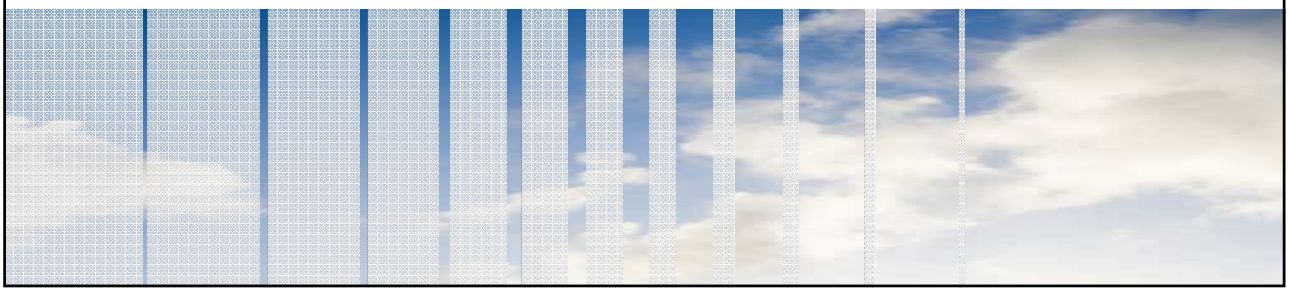
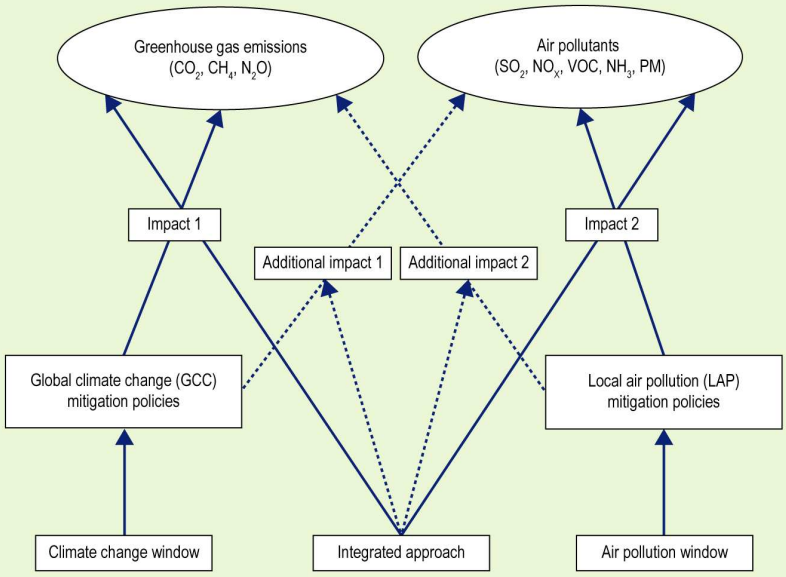


Different perspectives produce different types of co-benefits

Policy perspective on climate change and air pollution



Co-benefits of Climate Policy

- Prototype model: MERGE + air pollution in REE
- OECD working paper and PBL-report (www.pbl.nl)
- Conclusions
  - Climate policies → air pollution benefits,
    - *incentives South too small to join carbon coalition*
  - Air pollution policies →climate bonus
  - Balancing resources (climate & air) maximizes welfare

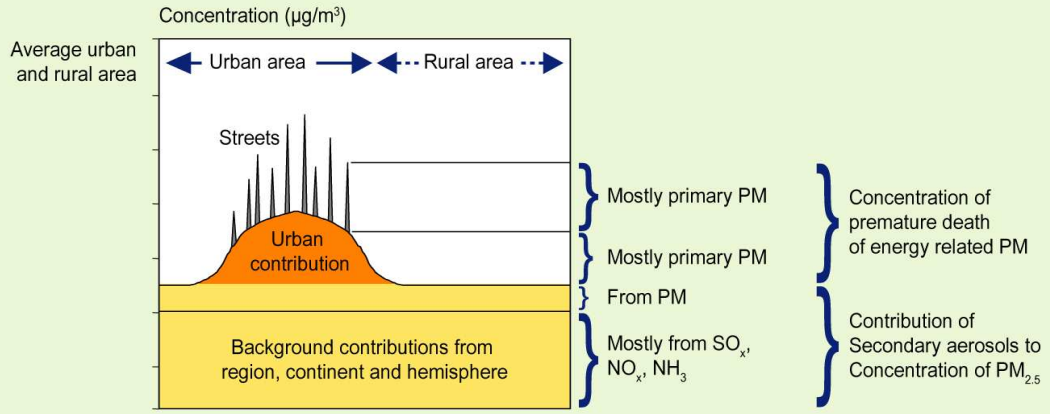
Main characteristics MERGE

- Optimization of long-term economic growth
- Intertemporal
- Nine regions, cases restrict to (weakly) Pareto-efficient
- Top-down production
- Bottom-up energy perspective

- Optimal emissions maximize discounted utility
- Abatement "where", "when" and "what" flexibility

Modelling Local Air Pollution (LAP)
Urbanization and greying population important

Various contributions to the outdoor concentration of $PM_{2.5}$



- weighted sum of SO_x, NO_x, NH_3, $PM_{2.5}$ (de Leeuw, 2002)
- translate concentrations to premature deaths (Pope et al, 2002)
- 1 mn €/premature death in Europe (CAFE), income elasticity 1 (Viscusi&Aldy, 2003)

Emission coefficients of energy technologies

Non-Electricity sector						
		Cost	Emission coefficients (global average)			
Date of availability	Technology	Cost in 2000 $/GJ	Carbon t/GJ	SO_2 t/GJ	NOx t/GJ	PM t/GJ
Available	Coal direct use	2.5	0.024	0.34	0.22	0.12
Available	Oil production	3.0-5.3	0.02	0.15	0.035	0.017
Available	Coal production	2.0-4.3	0.014	0	0.35	0
Available	Renewable	6	0	0	0	0.011
2010	Carbon free	14↓6	0	0	0	0
Electricity sector						
		Cost	Emission coefficients			
Date of availability	Technology	Cost in 2000 Mills/kWh	Carbon Bn tons/TWH	SO_2 Mt/TWh	NOx Mt/TWh	PM Mt/TWh
Available	Hydroelectric and geothermal	40	0	0	0	0
Available	Existing nuclear	50	0	0	0	0
Available	Existing gas	36	0.14	0	0.26	0
Available	Existing oil	38	0.21	1.87	0.40	0.01
Available	Existing coal	20	0.25	0.99	0.42	0.01
2010	New gas	13	0.09	0	0.23	0
2020	Advanced gas-fired with CCS	30	0	0	0	0
2010	New coal-fired	41	0.2	0	0.35	0
2050	Advanced coal-fired with CCS	56	0.01	0.029	0.01	0
2030	IG combined cycle with CCS	62	0.02	0.04	0.23	0
2010	Carbon free technology	100↓5	0	0	0	0

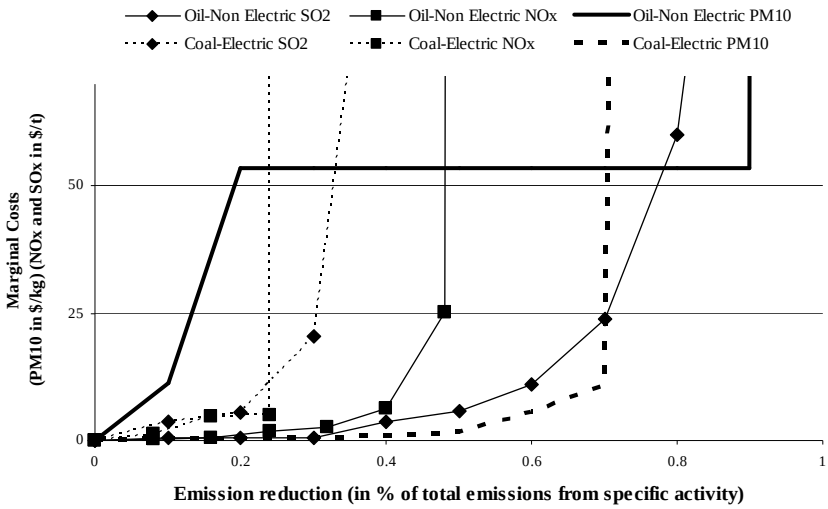
Emissions in 2000 in Europe
Global inventory from EDGAR/GAINS

RAINS activities	MERGE indicator	Emissions			
		Mt PM10	Gt SO_2	Gt NO2	Gt NH3
Coal					
Existing power plants	Old power plants	0.10	2.48	1.11	0.00
Direct use	Heating	0.50	0.43	0.30	0.00
Oil					
Existing power plants	Old power plants	0.02	0.76	0.17	0.00
Direct use	Transport	0.54	1.50	4.58	0.00
Derived products	Heating	0.02	0.02	0.37	0.00
Gas					
Existing power plants	Old power plants	0.00	0.00	0.22	0.00
Direct use	Transport	0.00	0.00	1.78	0.00
Derived products	Heating	0.00	0.00	0.82	0.00
Other					
Prim. to sec. energy	Total prim. En.	0.01	0.85	0.56	3.58
Producing sectors	BBP	0.33	0.00	0.00	0.00
Households	Consumption	0.10	0.00	0.00	0.00
Total		1.61	6.04	9.91	3.58

BAU

- Adjusted OECD Environmental Outlook
  - Higher long term economic growth Asia
  - IMAGE-TIMER-Phoenix
    - *Population: (migration, fertility, mortality, urbanization)*
    - *LAP emissions (also GAINS-Asia)*

Abatement Cost Curves: OECD Europe



MACC's move: Technological progress: →→
Income growth: ↑↑

How does CBA work?

Welfare (W) = C - external losses from GCC&LAP

$$Y = C + I + EC + EOP$$

$GCC \Leftarrow CO_2$ *emissions* $\Leftarrow$ *Fossil Energy*

$EC \Uparrow \Rightarrow C \Downarrow$, $GCC \Downarrow\Downarrow \Rightarrow W \Uparrow$

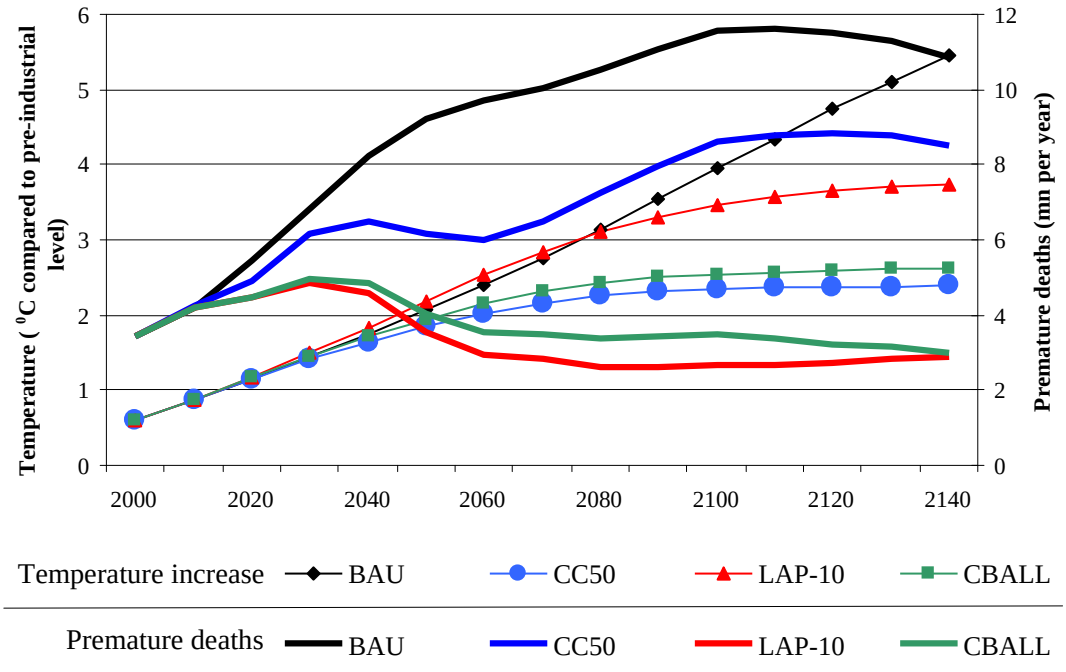
$LAP \Leftarrow$ *premature deaths* $\Leftarrow PM_{2.5}$*-concentration* $\Leftarrow$
abatement of air pollutants and CO2 $\Leftarrow$ *fossil energy, end-of-pipe costs*

$EC \Uparrow \Rightarrow C \Downarrow$ & $GCC\&LAP \Downarrow\Downarrow \Rightarrow W \Uparrow$
$EOP \Uparrow \Rightarrow$ *consumption* $\Downarrow$ & $LAP \Downarrow\Downarrow, \Rightarrow W \Uparrow$

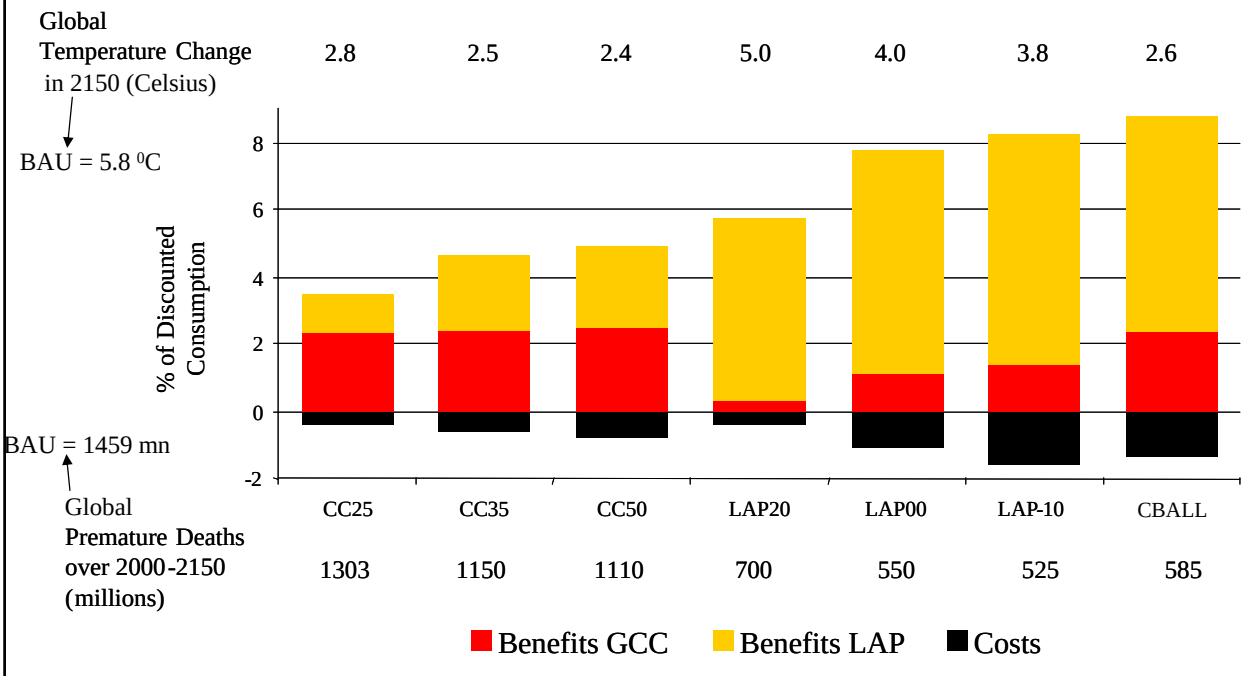
CBA: Balance between EC+EOP and C such that W maximal!!!!

LAP	= local air pollution,	GCC	= global climate change,
C	= consumption,	EC	= energy costs,
EOP	= end-of-pipe costs		

Co-benefits from both policy windows



Global Welfare changes from mitigation
Integrated CB strategy superior; LAP dominates

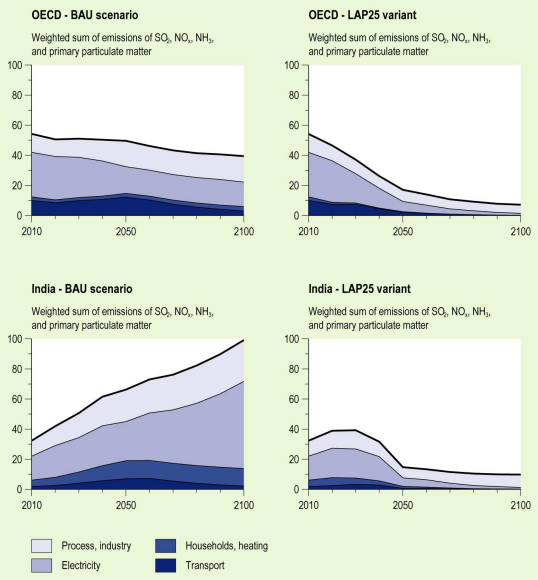


Co-benefits are not large enough to have non-OECD join a climate regime

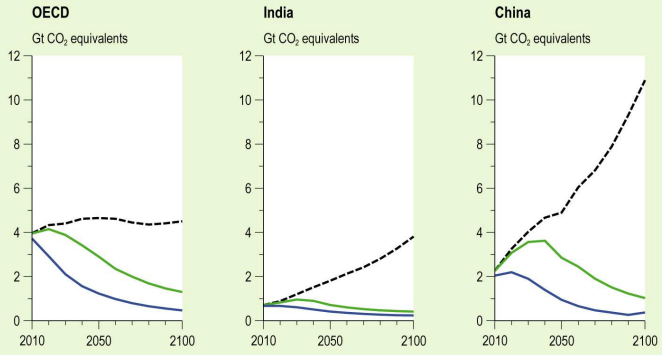
		World	OECD	China	India
Climate change window					
climate policy	CO_2 eq mitigation (%)	73	74	81	77
	PM-death reduction (%)	42	34	45	40
	GDP (%)	-2.2	-0.8	-6.4	-3.6
	GCC benefits (% GDP)	0.1	0.2	0.0	0.0
	LAP benefits (% GDP)	1.8	1.4	4.6	3.5
	benefits – GDP loss (% GDP)	-0.2	0.8	-1.8	-0.2
alternative air policy	benefits – GDP loss (% GDP)	1.1	1.0	2.8	1.8
Incentive power	climate policy – alternative air policy (% GDP)	-1.3	-0.2	-4.5	-2.0

LAP more important than GCC, although both problems are mitigated

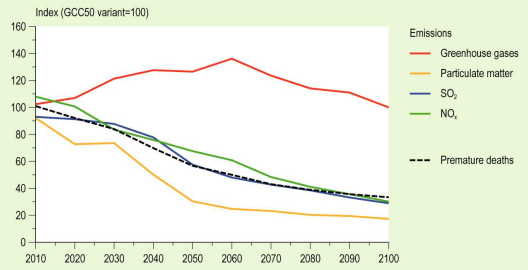
Air pollutant emissions by sector



Greenhouse gas emissions by variant



Global impacts of CBALL variant compared to GCC50 variant



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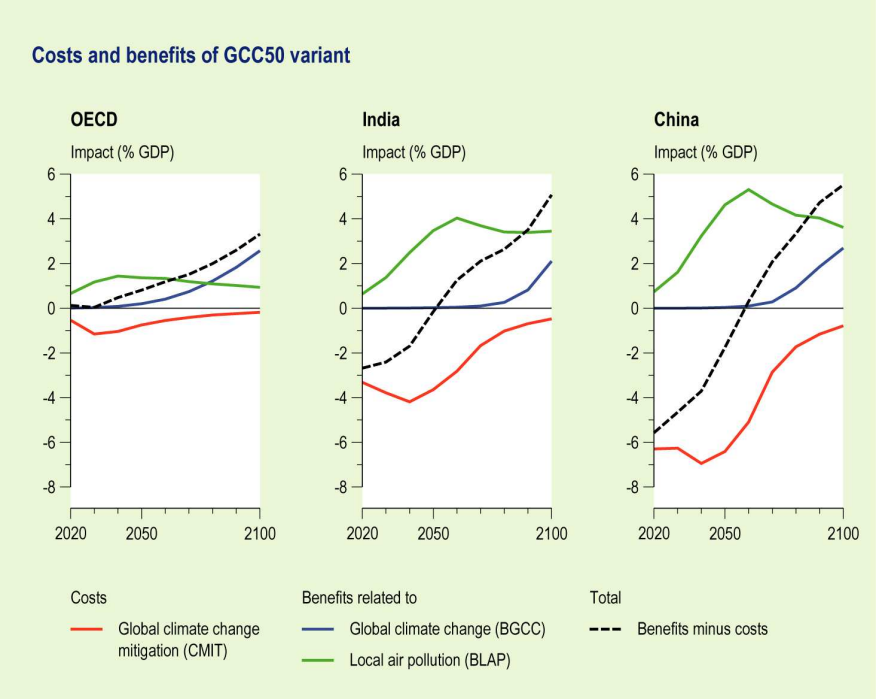
6-10-08

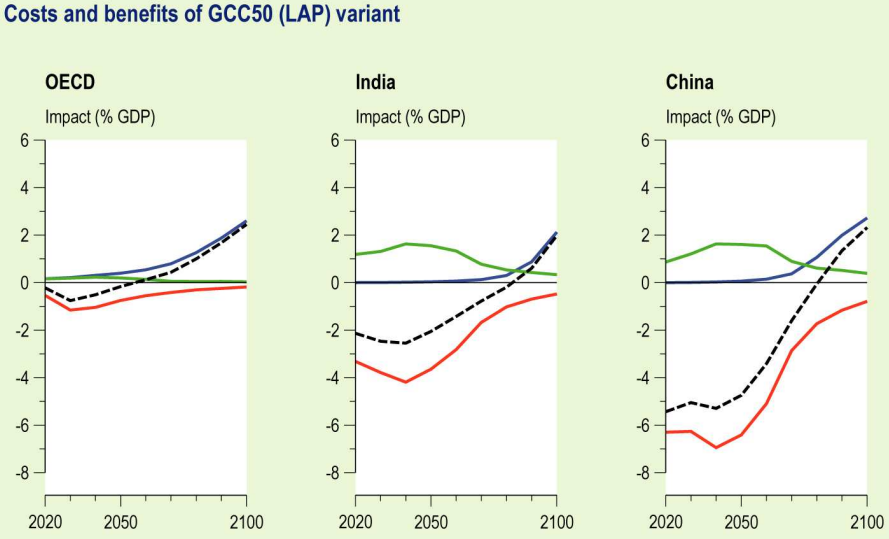
Co-benefits ⇑ from income growth and high CO2 prices



Air pollution policies -> CO2 ⇓ ,SO2 ⇓ → global warming →climate damages

		World	OECD	China	India
Air pollution window	CO_2 eq mitigation (%)	40	38	42	61
Air policy	PM-death reduction (%)	71	65	70	74
	GDP (%)	-2.3	-1.0	-6.9	-7.5
	GCC benefits (% GDP)	-0.1	-0.1	-0.1	0.0
	LAP benefits (% GDP)	3.2	2.5	7.3	6.8
	benefits – GDP loss (% GDP)	0.9	1.6	0.3	-0.8
alternative climate policy	benefits – GDP loss (% GDP)	-0.1	0.2	-0.7	-0.3
Incentive power	air policy - alternative climate policy (% GDP)	1.1	1.4	1.0	-0.5

Climate policies →air pollution benefits



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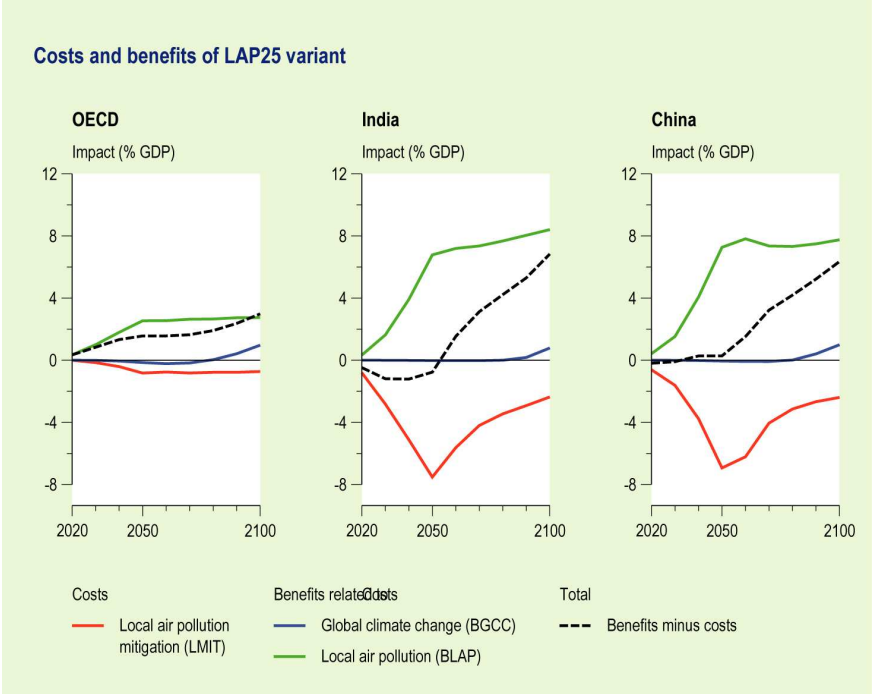
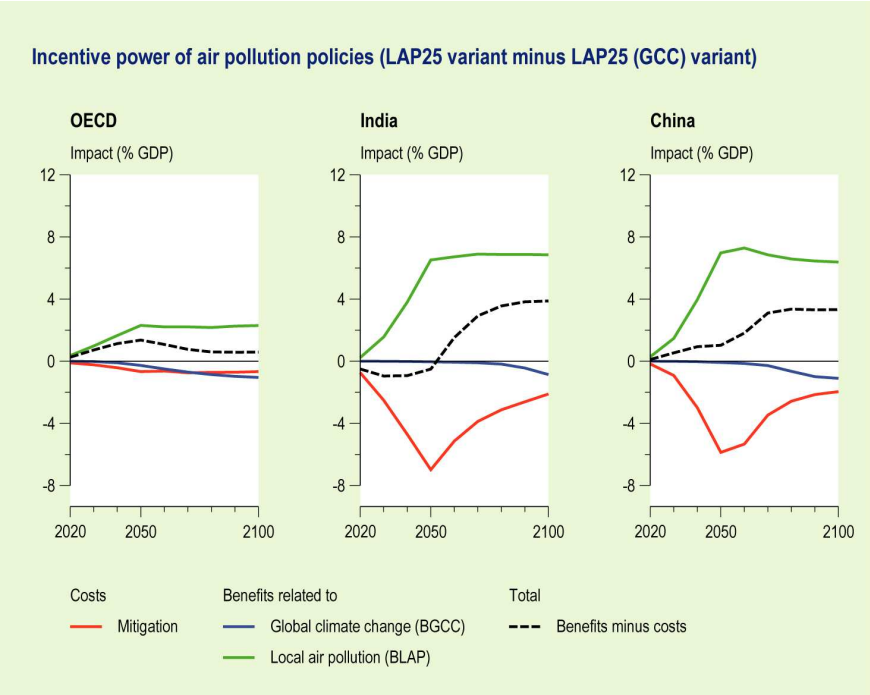


Climate policies →air pollution benefits



Climate policies →air pollution benefits