

India's climate action must include warming short-lived climate pollutants (wSLCPs)

SLCPs considered: BC, CH₄, CO and NMVOCs (warming) | OC, SO₂ and NO_x (cooling)

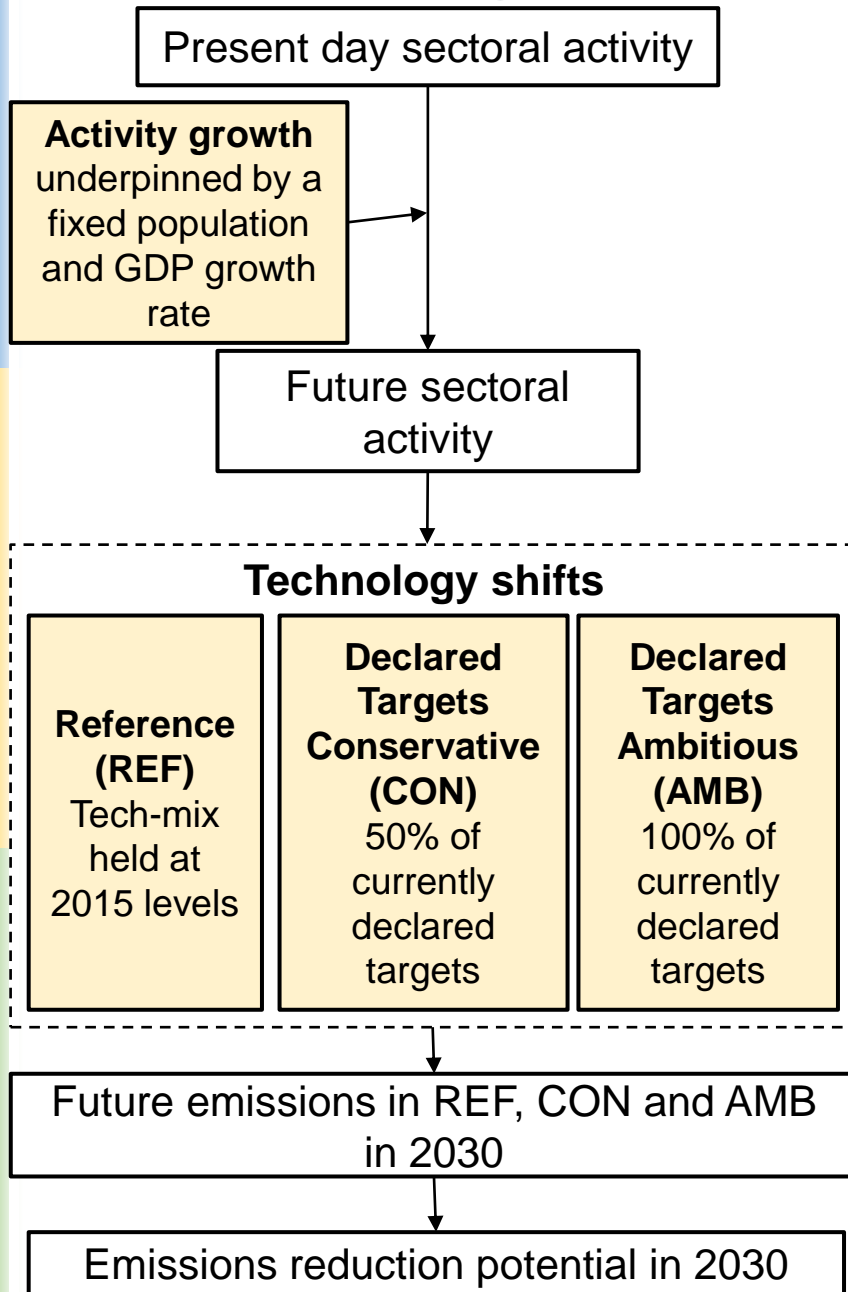
- **Emissions reduction potential of wSLCPs is 15-30% by Clean energy and 20-40% by Air quality interventions**
- **Current climate interventions do not contribute significantly to mitigating wSLCPs**
- **Specific sectors targeting wSLCPs must be included in climate reporting**
 - **Clean energy:- Residential**
 - **Air quality:- Agricultural residue burning**

Mr. Kushal Tibrewal
Prof. Chandra Venkataraman



Interdisciplinary Programme in Climate Studies
Indian Institute of Technology Bombay

Methodology



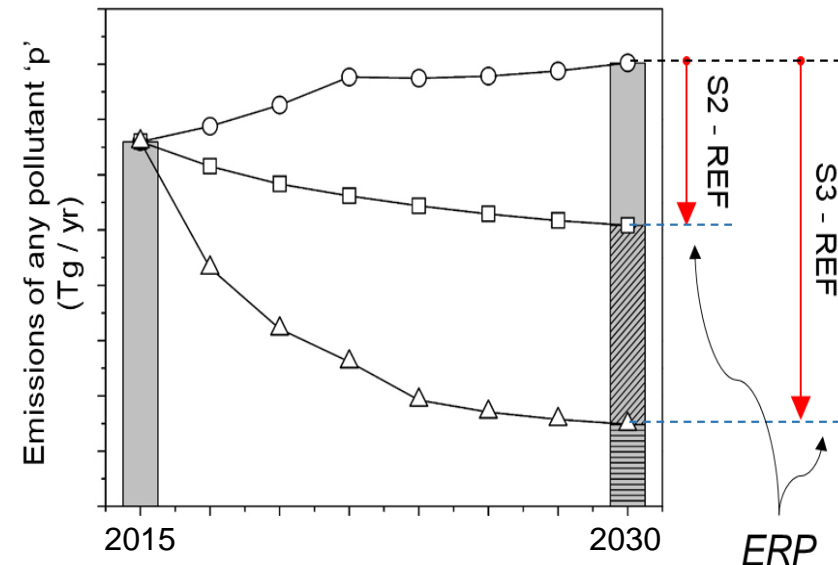
Estimation of climate impacts (CO₂-eq / yr)

$$GWP(T)_i = \frac{\int_0^T a_i c_i(t) dt}{\int_0^T a_{CO_2} c_{CO_2}(t) dt}$$

$$E_{CO_2-eq} = E_p \times GWP_p$$

a_i = radiative efficiency
 $c_i(t)$ = time decaying concentration
 T = time horizon
 E = Emissions
 p = pollutant

- Single horizon GWP is limited in capturing impacts at different timescales
- Thus, a combination of multiple metrics (such as GWP20 and GWP100) are used to analyse impacts (Ocko et al., 2017)

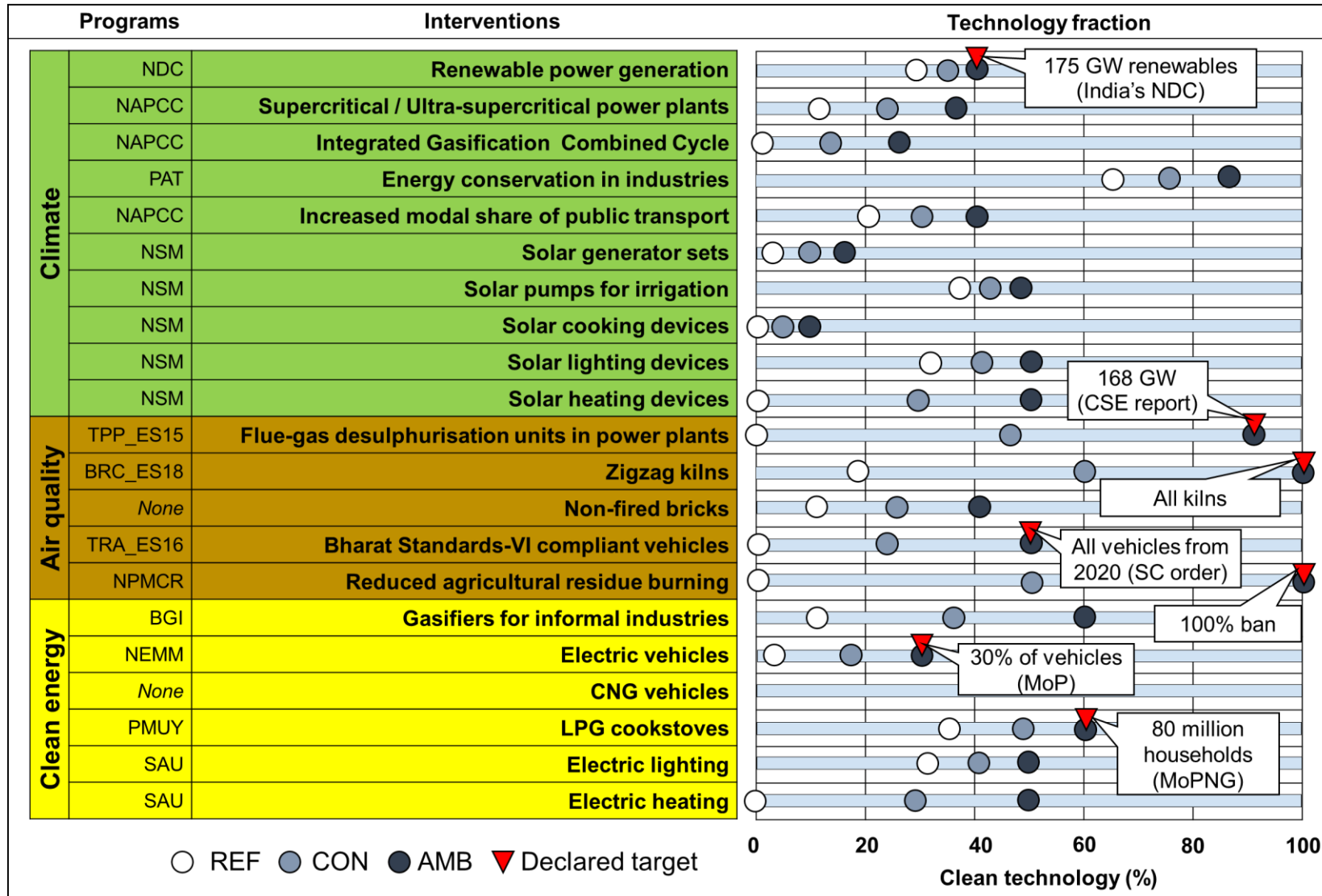


Emission Reduction Potential (ERP)

$$ERP_p = E_{p, S2/S3} - E_{p, REF}$$

(Halsnæs et al., 2007)

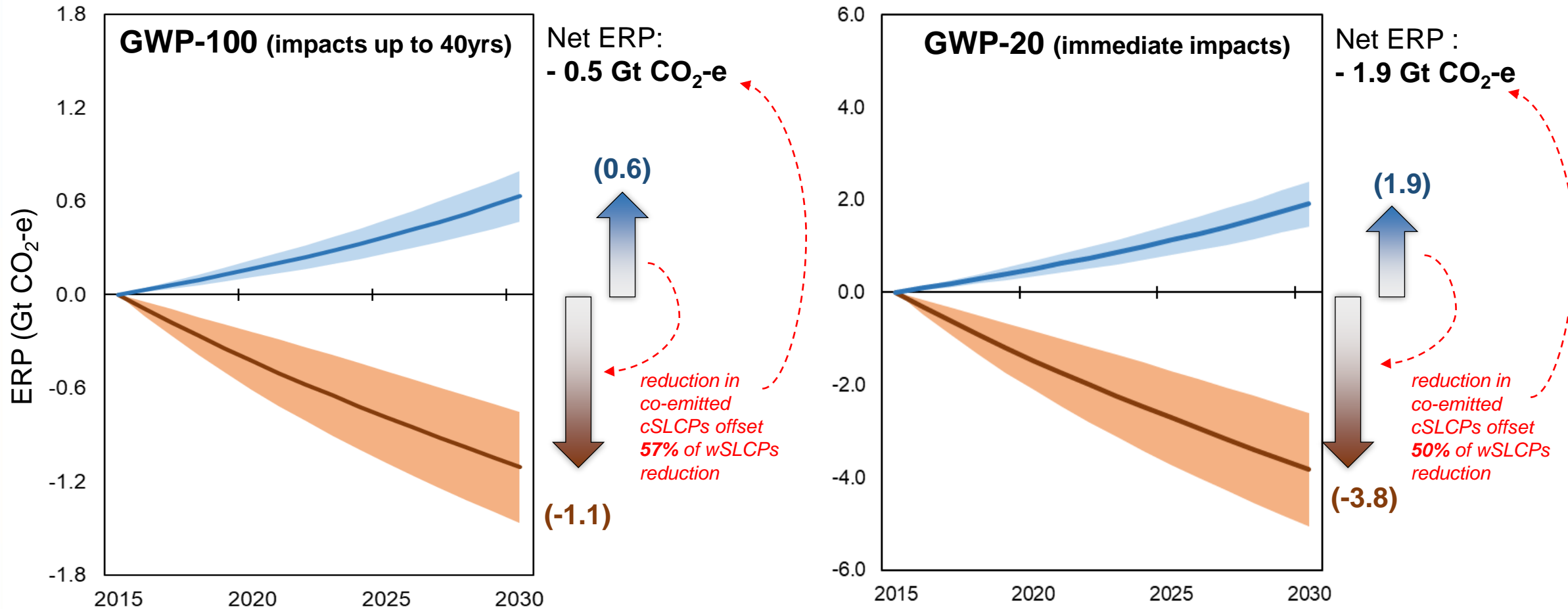
Implementation levels of interventions in 2030



- Climate interventions mostly cover **electric generation** and energy conservation in **heavy industries**
- Even with current declared targets there is **still scope to shift towards cleaner technologies**

NDC: Nationally determined contributions; **NAPCC:** National action plan on Climate change; **PAT:** Perform, Achieve and Trade Scheme; **NSM:** National Solar Mission; **TPP_ES16:** Thermal power plants emissions standards 2015; **BRC_ES2018:** bricks emission standards 2018; **TRA_ES16:** Transport emission standards 2016; **NPMCR:** National Policy for Management of Crop Residue; **BGI:** Biomass Gasifiers for industries; **NEMM:** National Electric Mobility Mission; **PMUY:** Pradhan Mantri Ujjwala Yojana; **SAU:** Saubhagya scheme

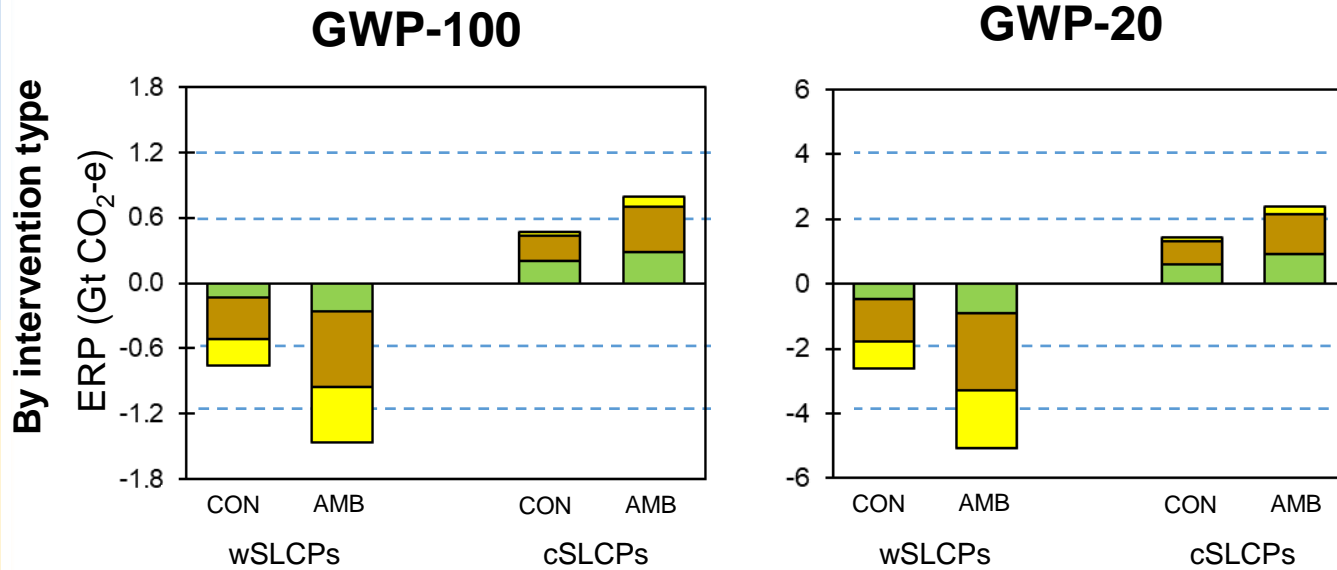
Results – Emissions reduction potential in 2030



The shaded area represents the bound between the ERPs in CON and AMB. The solid line is the mean ERP of CON and AMB.

- ERPs using GWP100 show greater offsets (~7% more) in wSLCPs reduction because of simultaneous reductions in cSLCPs, as compared to those using GWP20.
- Thus, identifying specific interventions targeted at wSLCPs are crucial to minimise the **unmasking in warming from reduction in co-emitted cooling SLCPs** (especially for longer term)

Results – Contribution to ERP of wSLCPs



Interventions:

Climate Air quality Clean energy

Sectors:

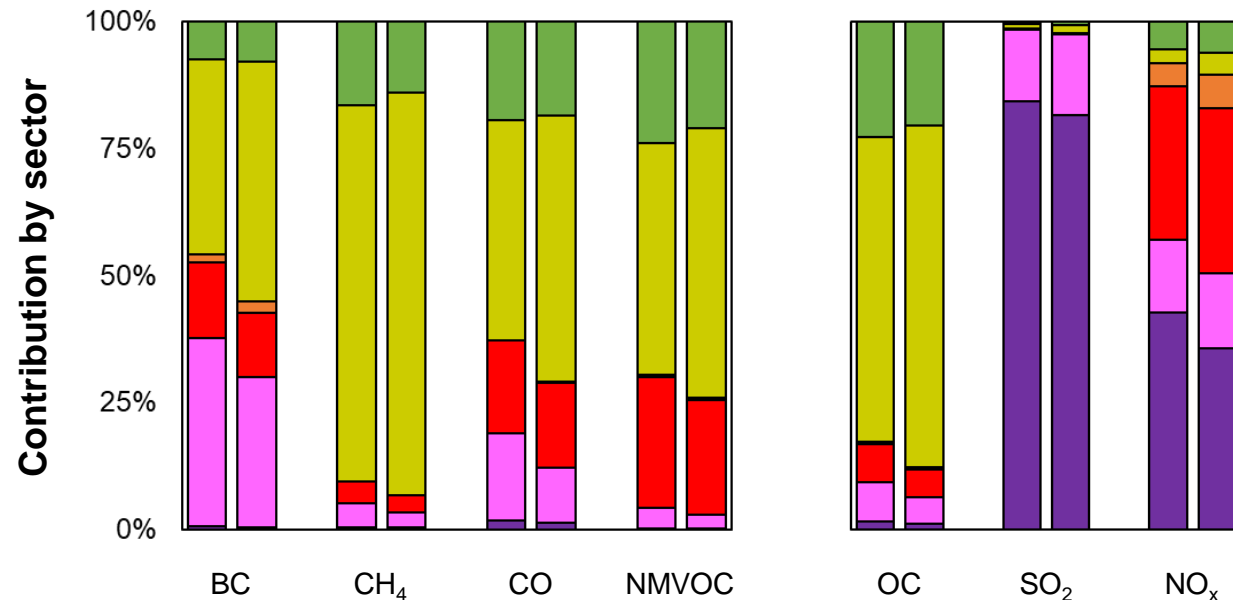
Agri. Residue burning Transport
Residential Industry
Dispersed diesel Power generation

➤ **Current climate interventions contribute just within 20% of the total ERP of wSLCPs. 80% reductions come from air quality and clean energy interventions.**

➤ **For mitigation of wSLCPs, target sectors must be residential sector and agricultural residue burning.**

⇒ *Least affected by co-emitted cSLCPs*

⇒ *Not covered in the current climate action plan*



Additional information

Global warming potentials from IPCC AR5 (Myhre et al., 2013)									
GWP	CO ₂	CH ₄	N ₂ O	Nox	CO	NMVOC	BC	OC	SO ₂
20	1	84	264	-40.7	5.7	27.8	3200	-160	-140
100	1	28	265	-25.3	1.8	8.8	900	-46	-40

References

1. Halsnæs, K.; Shukla, P.; Ahuja, D.; Akumu, G.; Beale, R.; Edmonds, J.; Gollier, C.; Grübler, A.; Duong, M. H.; Markandya, A.; et al. **Framing Issues. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change**; Metz, B., Davidson, O., Bosch, P., Dave, R., Meyer, L., Eds.; Cambridge University Press: Cambridge, United Kingdom and New York, NY, USA, 2007.
2. Ocko, I. B.; Hamburg, S. P.; Jacob, D. J.; Keith, D. W.; Keohane, N. O.; Oppenheimer, M.; Roy-Mayhew, J. D.; Schrag, D. P.; Pacala, S. W. **Unmask Temporal Trade-Offs in Climate Policy Debates**. *Science* (80-.). 2017, 356 (6337), 492–493. <https://doi.org/10.1126/science.aaj2350>.
3. Myhre G, Shindell D, Bréon F-M, Collins W, Fuglestvedt J, Huang J, Koch D, Lamarque J-F, Lee D, Mendoza B, Nakajima T, Robock A, Stephens G, Takemura T, Zhang H (2013) **Anthropogenic and natural radiative forcing**. In: Stocker TF, Qin D, Plattner GK, Tignor M, Allen SK, Boschung J, Nauels A, Xia Y, Bex V, Midgley PM (eds) **Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change**. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp 658–740.