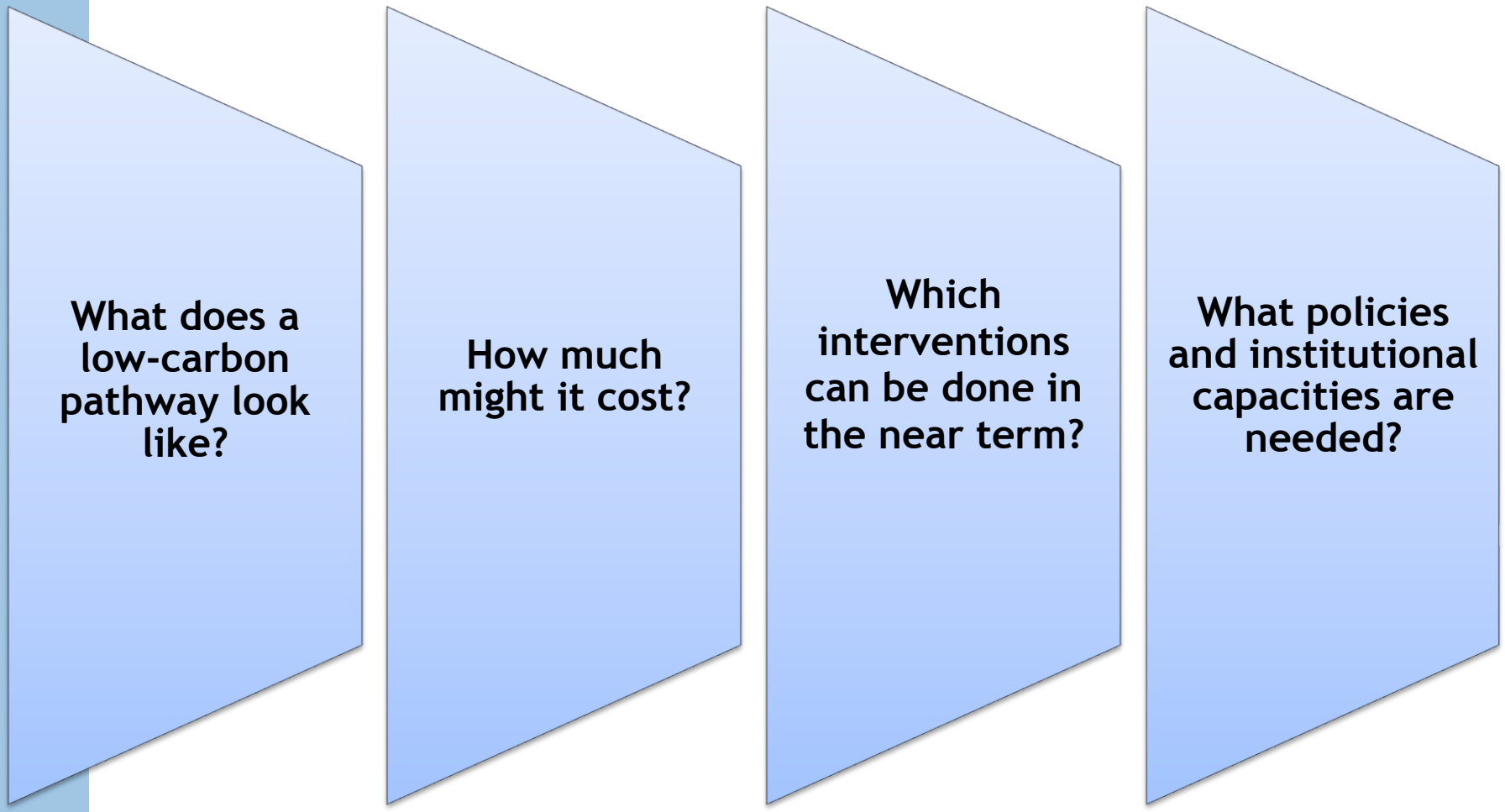
Low-Carbon Development for Mexico (MEDEC)

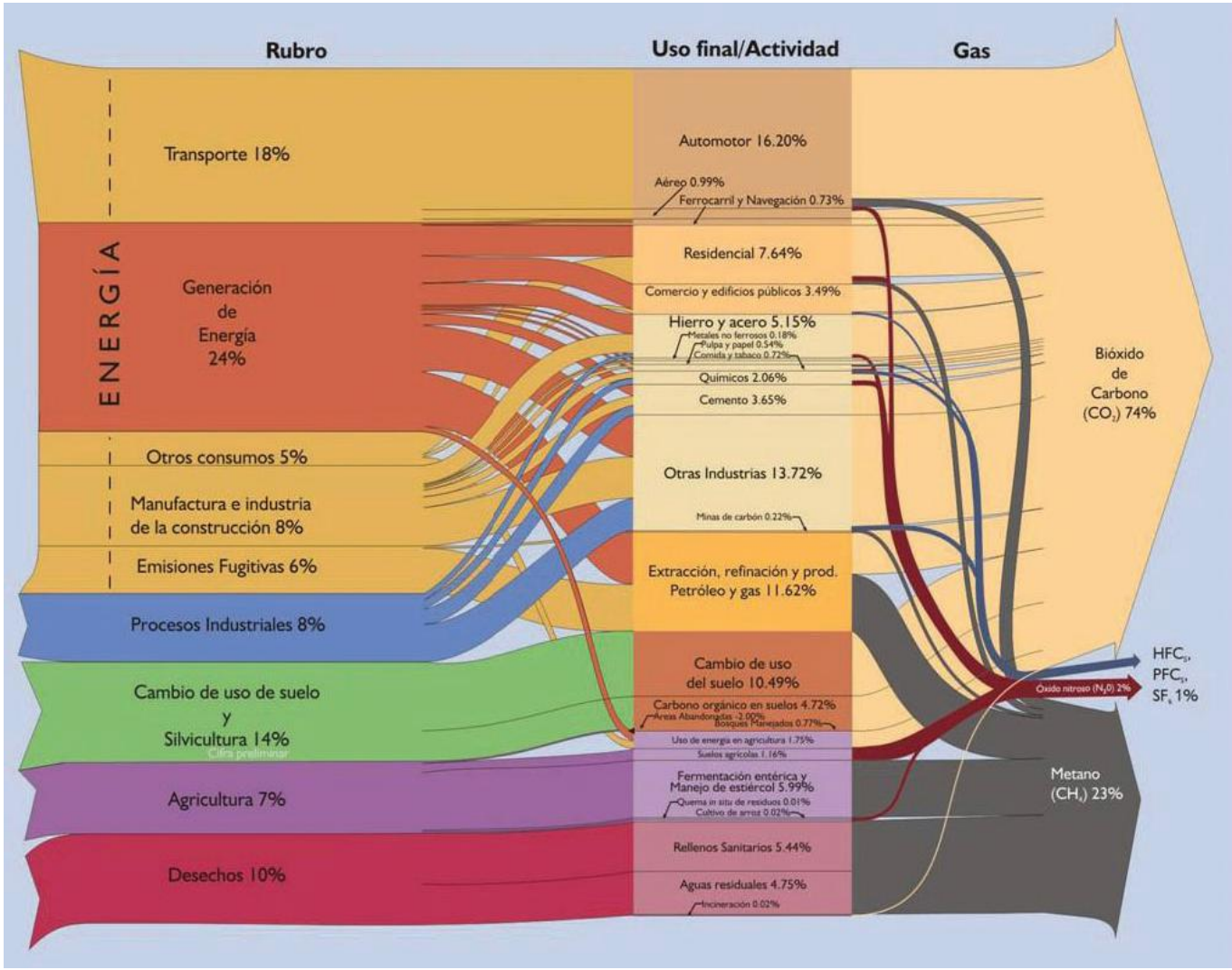
MEDEC – México: **E**studio sobre la **D**isminución de **E**misiones de **C**arbono

World Bank – LCR Sustainable Development Department – March 17, 2011

Questions for Low-Carbon Studies



Mexico GHG emissions, 2002



Study methodology

Modeling the low-carbon scenario

- Construction of an economic and emissions model for Mexico to the year 2030
- BAU consistent with national income estimates and international energy forecasts and markets
- Bottom-up analysis of GHG reduction potential to 2030 from major sectors
- 3 selection criteria for reduction options: potential, cost, and feasibility

Cost methodology

- Economic cost-benefit analysis of interventions across sectors using a common methodology
- Not CDM analysis, but many interventions would qualify (carbon price=0)
- Focus is on existing technologies only – thus underestimates potential
- Calculate externalities where possible
- Excludes “transactions” costs

Electricity

Cost-benefit analysis

Key-word	Year	Positive investment costs	Negative investment and salvage	Energy costs	Other costs	Externalities	Emissions	MitCost without	MitCost with	Maximum annual mitigation
		US$	US$	US$	US$	US$	Ton CO_2	US$/Ton	US$/Ton	Ton CO_2
Wind	2009	$0	$0	$0	$0	$0	0			
	2010	$0	$0	$0	$0	$0	0			
	2011	$0	$0	$0	$0	$0	0			
	2012	$0	$0	$0	$0	$0	0			
	2013	$868,589,103	-$233,531,491	-$27,371,768	$6,147,171	-$2,320,887	-1,258,041			
	2014	$881,965,581	-$320,255,139	-$55,425,149	$12,389,010	-$4,677,517	-2,535,457			
	2015	$881,965,581	-$376,379,350	-$83,742,441	$18,630,849	-$7,034,146	-3,812,872			
	2016	$881,965,581	-$915,670,651	-$112,325,509	$24,872,688	-$9,390,776	-5,090,288			
	2017	$881,965,581	-$831,526,979	-$141,176,231	$31,114,527	-$11,747,405	-6,367,703			
	2018	$881,965,581	-$594,164,184	-$209,865,651	$39,929,585	-$12,738,557	-7,212,007			
	2019	$881,965,581	-$569,569,984	-$276,204,704	$48,571,484	-$13,821,596	-8,085,455			
	2020	$881,965,581	-$544,164,059	-$340,150,480	$57,037,628	-$14,997,899	-8,988,486			
	2021	$881,965,581	-$525,926,813	-$402,845,747	$65,402,405	-$16,227,992	-9,908,579			
	2022	$881,965,581	-$512,199,253	-$464,868,834	$73,703,414	-$17,491,924	-10,839,404			
	2023	$881,965,581	-$501,492,711	-$526,544,171	$81,961,705	-$18,778,524	-11,777,420			
	2024	$881,965,581	-$492,908,790	-$588,068,139	$90,189,982	-$20,081,051	-12,720,487			
	2025	$881,965,581	-$485,873,191	-$649,566,812	$98,396,366	-$21,395,196	-13,667,240			
	2026	$881,965,581	-$480,001,652	-$711,125,043	$106,586,289	-$22,718,076	-14,616,763			
	2027	$881,965,581	-$475,027,351	-$772,802,213	$114,763,525	-$24,047,688	-15,568,421			
	2028	$881,965,581	-$470,759,223	-$834,641,276	$122,930,776	-$25,382,598	-16,521,760			
	2029	$881,965,581	-$467,056,859	-$896,674,204	$131,090,027	-$26,721,754	-17,476,446			
	2030	$881,965,581	-$463,814,758	-$958,925,402	$139,242,769	-$28,064,364	-18,432,227			
	2031		-$2,037,851,910							
	IPV/TOTAL	**$4,932,178,644**	**-$3,093,158,527**	**-$1,728,573,737**	**$283,859,280**	**-$72,843,344**	**-184,879,057**	**$2.13**	**$1.74**	**-18,432,227**

MEDEC sectors

Electricity

Transport

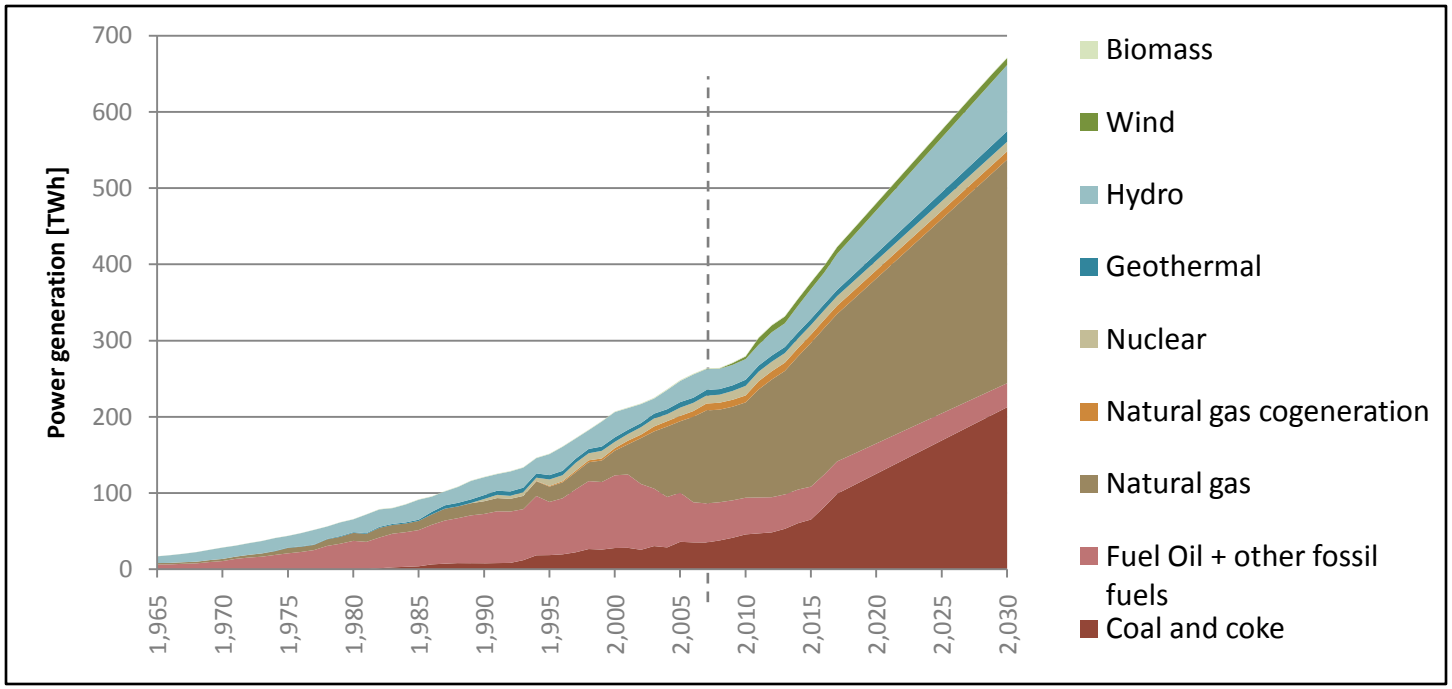
Oil and gas

Energy end-use

Agriculture and forestry

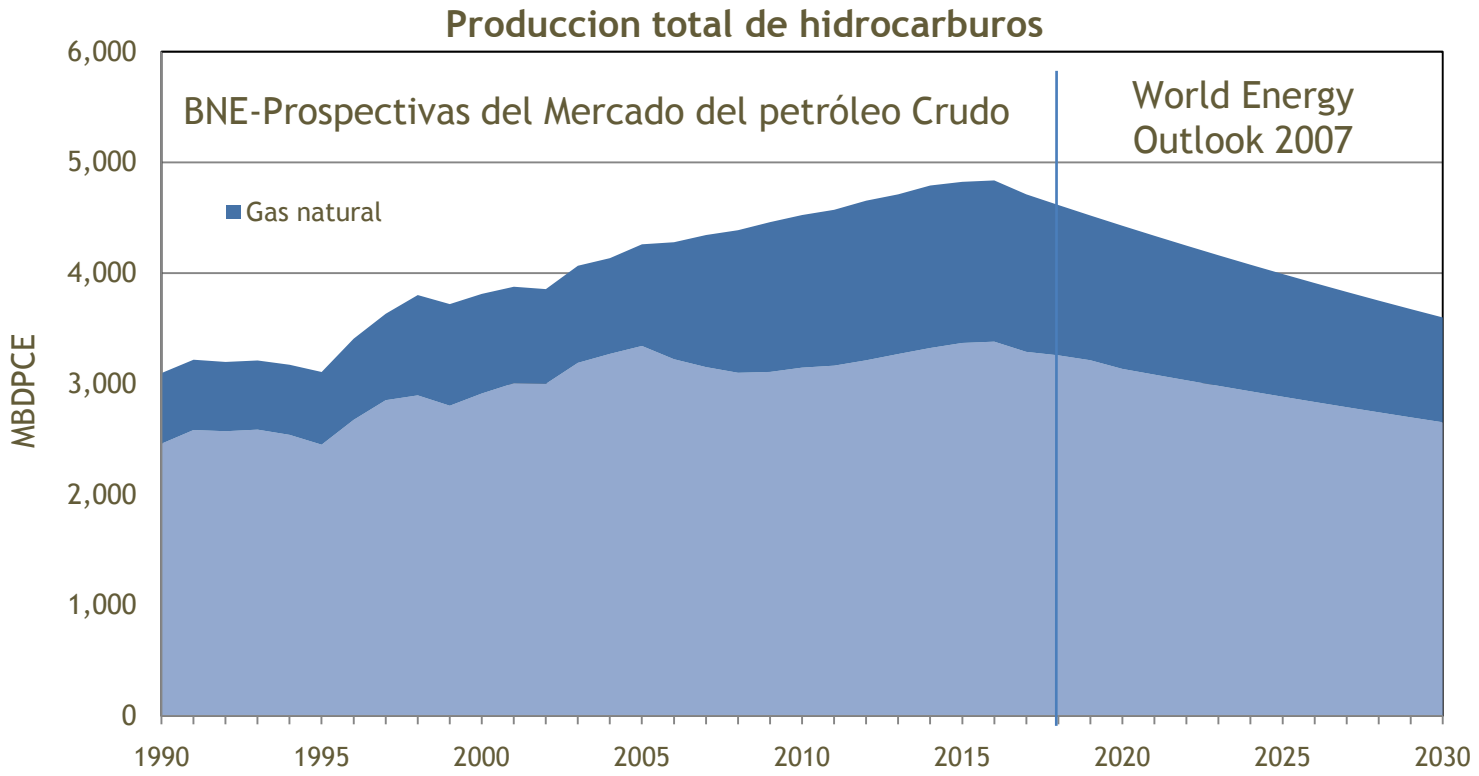
Baseline generation

- 2009 – 2016: Based on Mexico's official outlook (as of 2008)
- 2017 – 2030: Based on national and international estimates for least cost generation technologies
- BAU emissions increase from 142 Mt CO2eq in 2008 to 322 in 2030 (+230%)



Petroleum and Gas

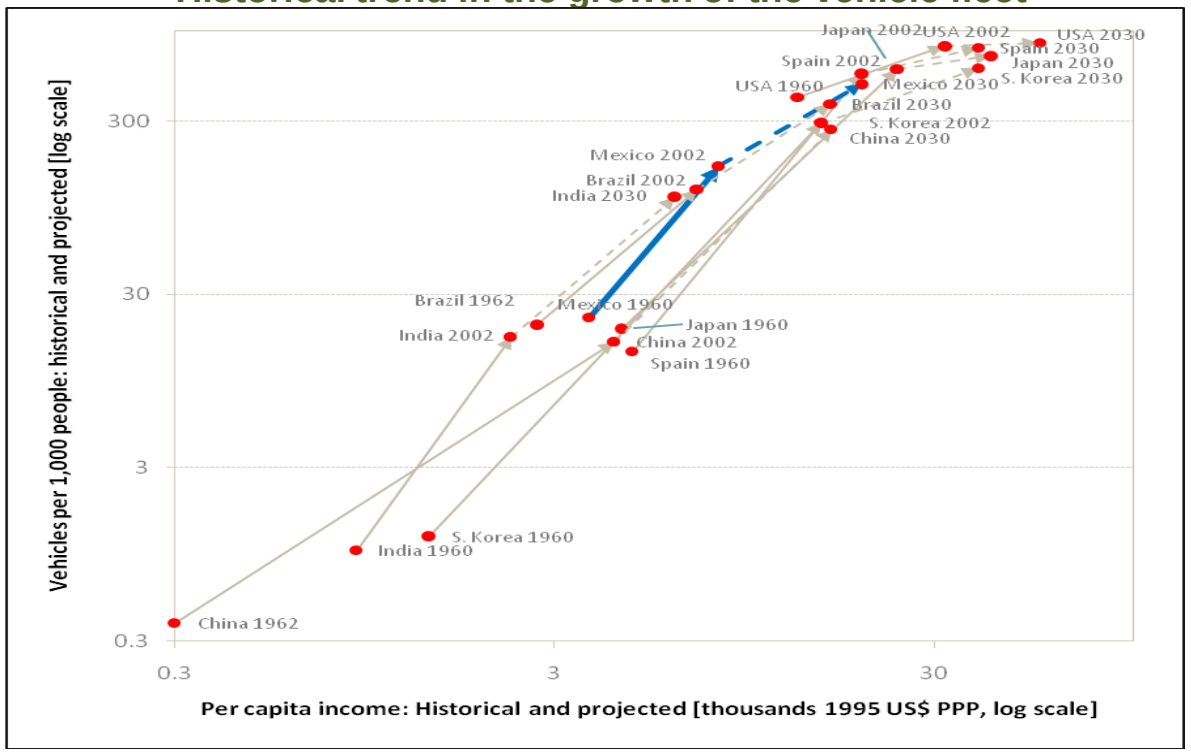
The production of oil and gas in Mexico is expected to decline over the medium to long-term



Baseline fleet growth

- The transport sector is the main consumer of energy, and responsible for the largest growth and absolute quantity of GHG emissions in Mexico
- Currently the sector accounts for 18% total emissions

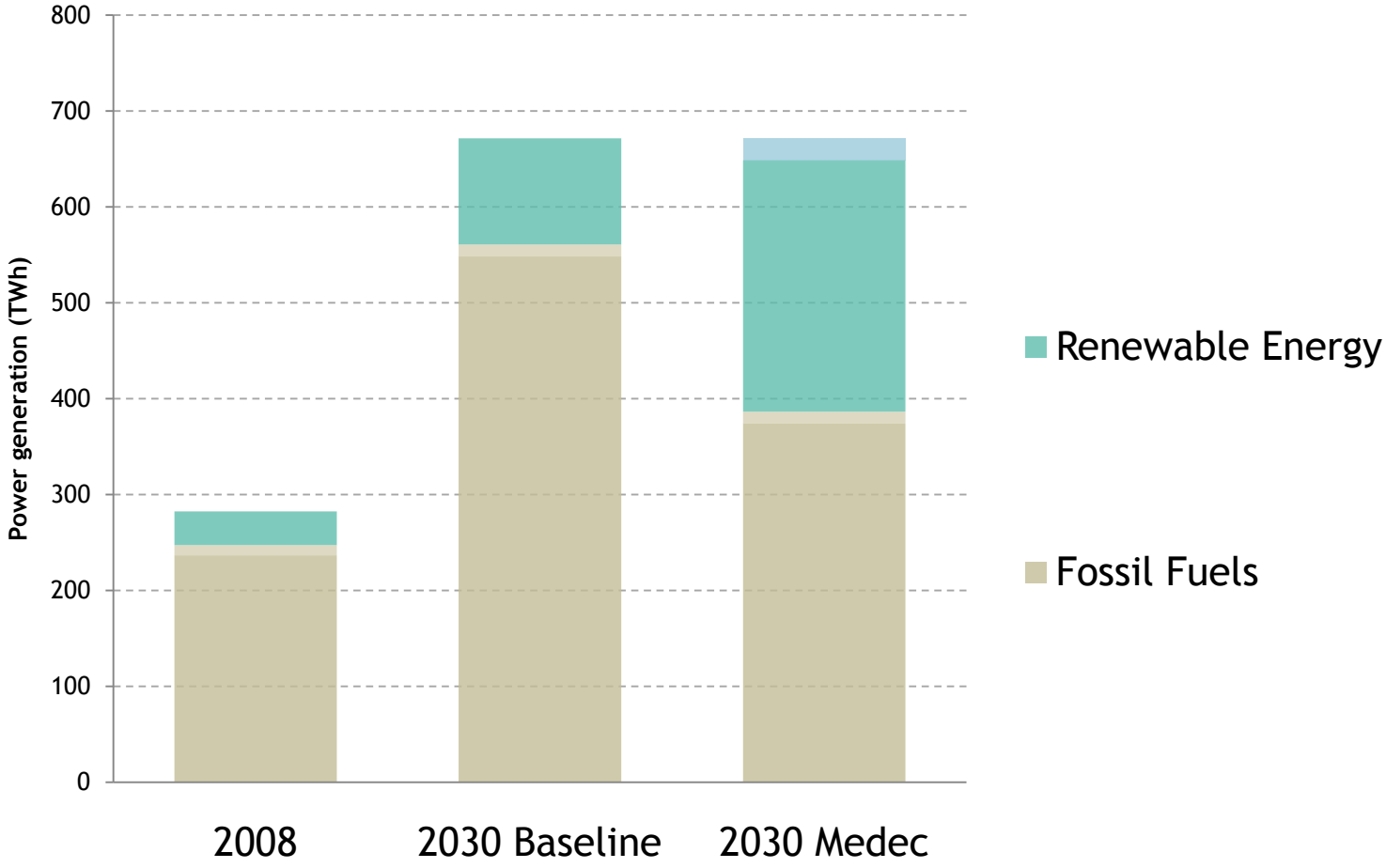
Historical trend in the growth of the vehicle fleet



MEDEC electricity interventions

			Maximum annual emission reduction ($MtCO_2e$/year)	Net cost or benefit of mitigation (US$/$tCO_2e$)
Utility efficiency		Utility efficiency	6.2	19.3 (benefit)
Electricity generation		Biogas	5.4	0.6 (cost)
		Windpower	23.0	2.6 (cost)
		Small hydropower	8.8	9.4 (cost)
		Geothermal power	48.0	11.7 (cost)
Electricity generation in other sectors	*Oil and gas*	Cogeneration in PEMEX	26.7	28.6 (benefit)
	Industry	Cogeneration in industry	6.5	15.0 (benefit)
	Ag and forestry	Biomass electricity	35.1	2.4 (benefit)
		20% fuelwood co-firing retrofitting	2.4	7.3 (cost)
		Bagasse (existing sugar mills)	6.0	4.9 (cost)
		Bagasse (new ethanol factories)	16.8	11.3 (cost)

Low-carbon power scenario



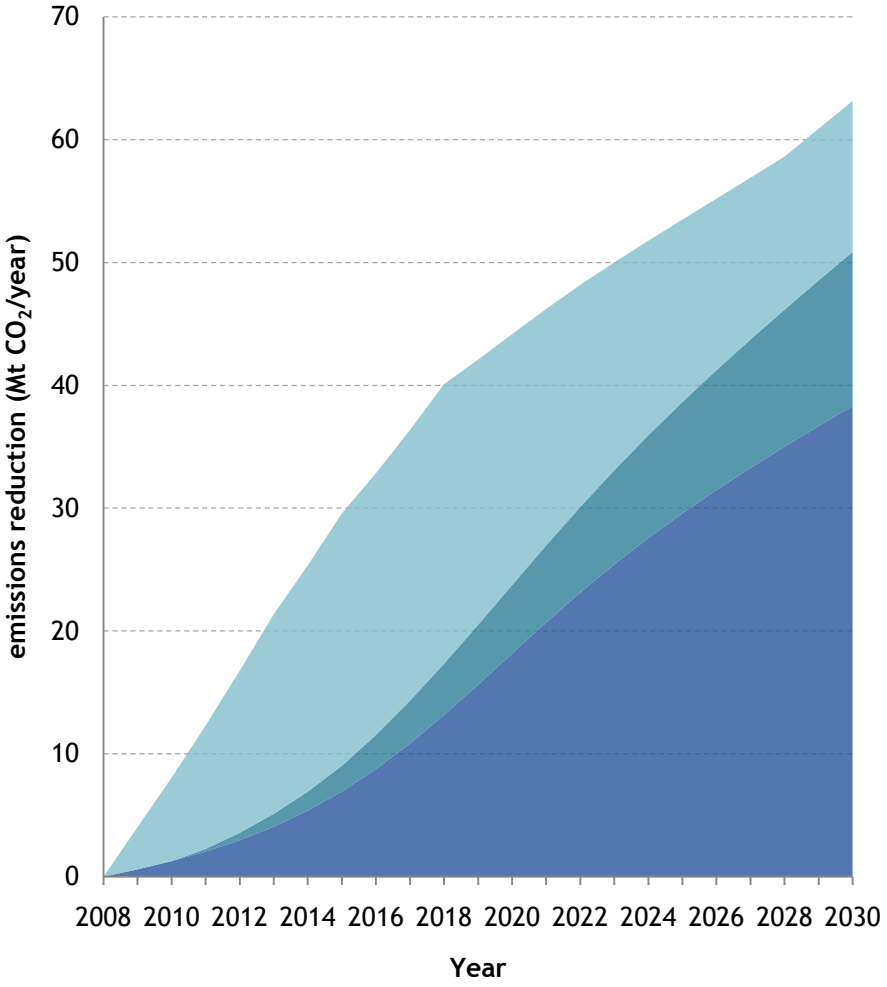
MEDEC oil and gas interventions

	Maximum annual emission reduction ($MtCO_2e$/year)	Net cost or benefit of mitigation (US$/$tCO_2e$)
Cogeneration in PEMEX	26.7	28.6 (benefit)
Gas leakage reduction	0.8	4.4 (benefit)
Refinery efficiency	2.5	16.6 (cost)

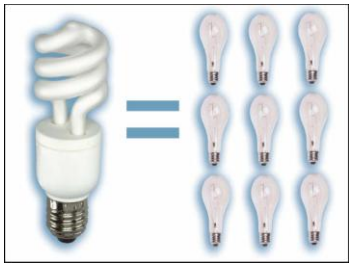
MEDEC energy end-use

		Maximum annual emission reduction ($MtCO_2e$/year)	Net cost or benefit of mitigation (US$/$tCO_2e$)
Electricity end-use efficiency	Residential lighting	5.7	22.6 (benefit)
	Residential refrigeration	3.3	6.7 (benefit)
	Residential air conditioning	2.6	3.7 (benefit)
	Nonresidential lighting	4.7	19.8 (benefit)
	Nonresidential air conditioning	1.7	9.6 (benefit)
	Street lighting	0.9	24.2 (benefit)
	Industrial motors	6.0	19.5 (benefit)
Cogeneration	Cogeneration in industry	6.5	15.0 (benefit)
	Bagasse cogeneration	6.0	4.9 (cost)
Renewable heat supply	Solar water heating	18.9	13.8 (benefit)
	Improved cookstoves	19.4	2.0 (benefit)

Energy end-use



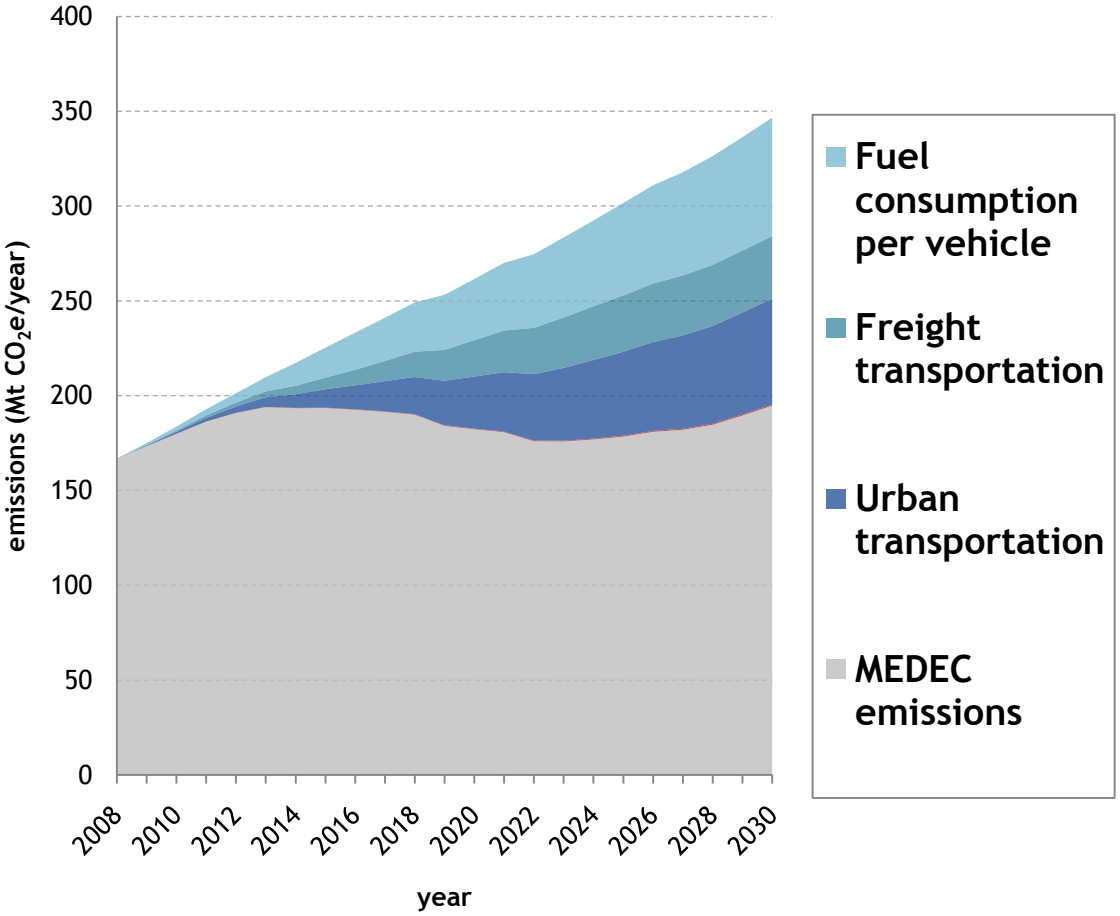
- Electricity End Use Efficiency
- Cogeneration
- Renewable Heat Supply



MEDEC transport interventions

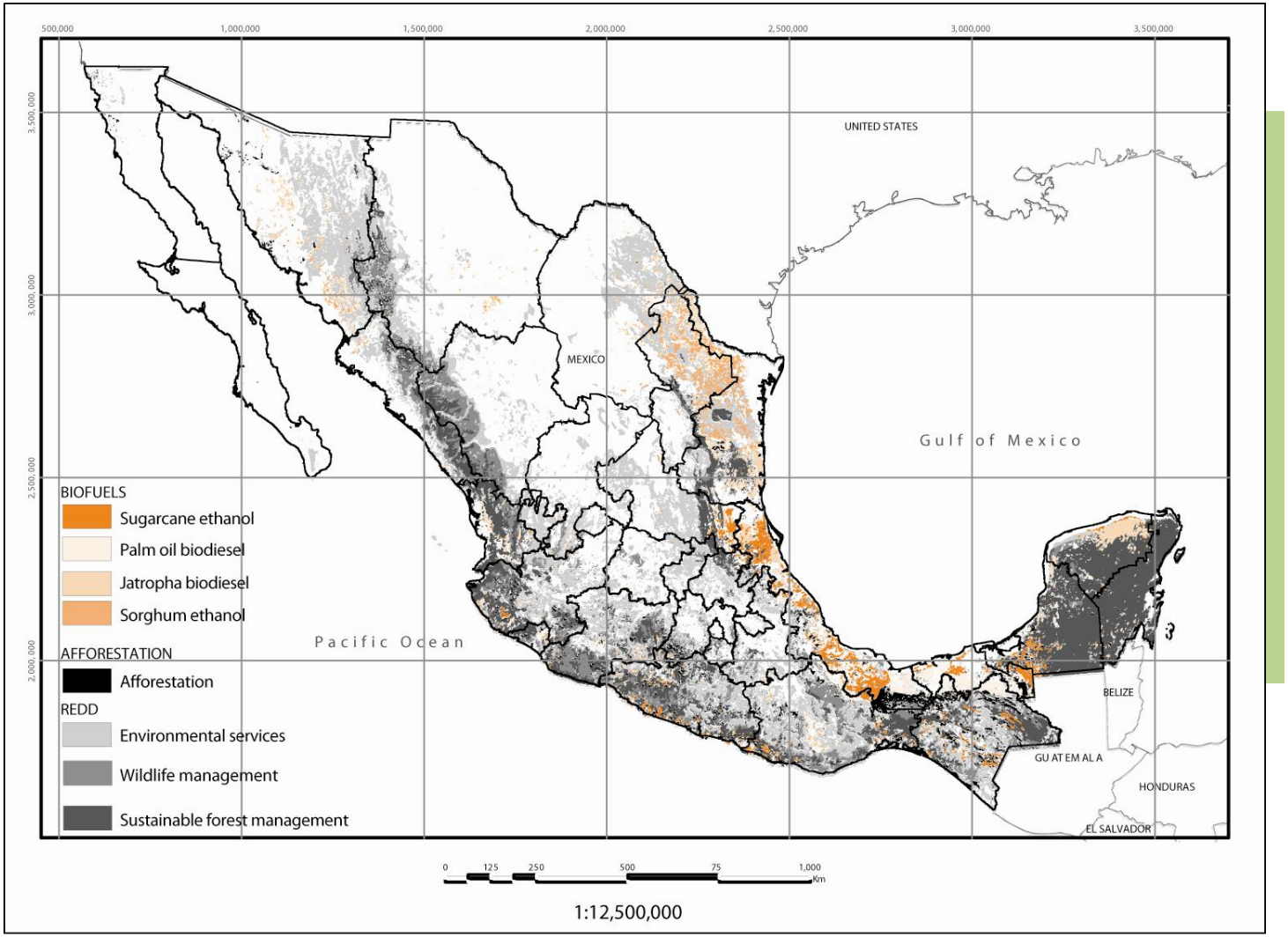
		Maximum annual emission reduction ($MtCO_2e$/year)	Net cost or benefit of mitigation (US$/$tCO_2e$)
Modal shift and urban development	Bus system optimization	31.5	96.6 (benefit)
	Urban densification	14.3	66.4 (benefit)
	Bus rapid transit	4.2	50.5 (benefit)
	Non-motorized transport	5.8	50.2 (benefit)
Technologies	Border vehicle inspection	11.2	69.0 (benefit)
	Inspection and maintenance in 21 cities	10.6	14.5 (benefit)
	Fuel economy standards	20.1	12.3 (benefit)
Freight	Freight logistics	13.8	46.3 (benefit)
	Railway freight	19.2	88.7 (benefit)

Transport


400
350
300
250
200
150
100
50
0
emissions (Mt CO_2e/year)
2008
2010
2012
2014
2016
2018
2020
2022
2024
2026
2028
2030
year
Fuel consumption per vehicle
Freight transportation
Urban transportation
MEDEC emissions


Indios Verdes

Agriculture & Forestry

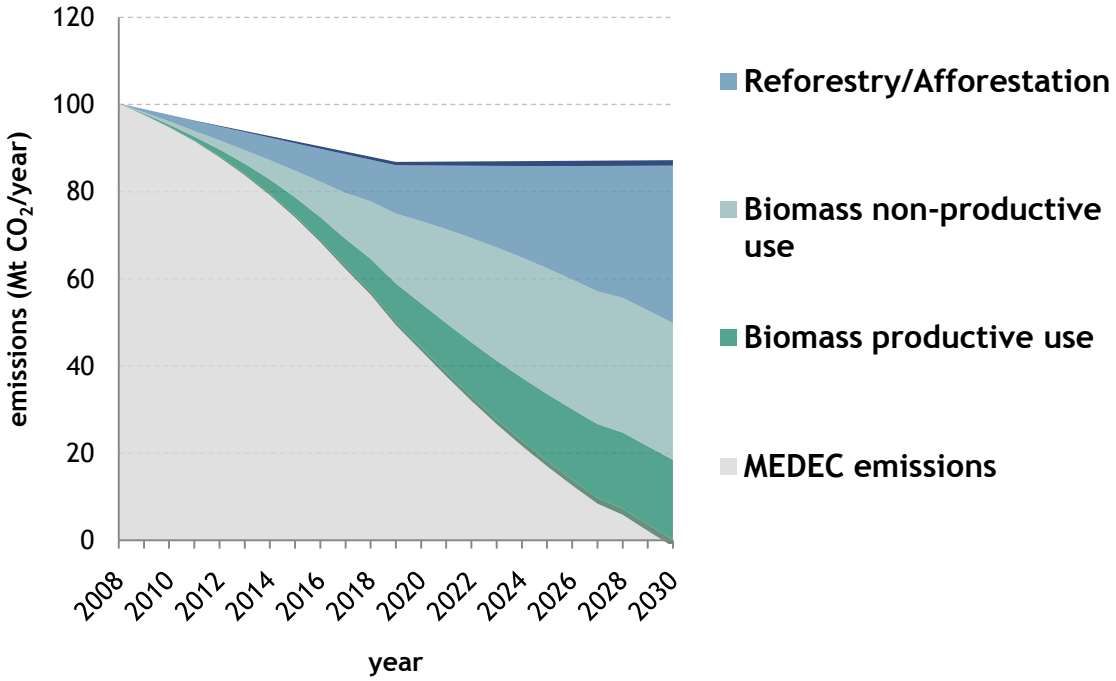


Source: Ghilardi and Guerrero 2009, based on REMBIO 2008; INEGI 1995, 2000, 2002.

Agriculture and Forestry interventions

					Maximum annual mitigation reduction [$MtCO_2e/yr$]	Net cost or benefit of mitigation [US/tCO_2e$]
Forestry	*REDD*	*Productive use of biomass*	*For energy purposes*	Biomass electricity	35.1	2 (benefit)
				Fuelwood co-firing	2.4	7 (cost)
				Charcoal production	22.6	20 (benefit)
			For other purposes	Forest management	7.8	13 (benefit)
		No productive use of biomass		Wildlife management	27.0	18 (cost)
				Payment for environmental services	4.4	18 (cost)
	Reforestation / afforestation			Reforestation and restoration	22.4	9 (cost)
				Afforestation	13.8	8 (cost)
Agriculture				Zero tillage maize	2.2	15 (benefit)
Liquid biofuels				Sugarcane ethanol	16.8	11 (cost)
				Sorghum ethanol	5.1	5 (cost)
				Palm oil biodiesel	2.4	6 (cost)

Agriculture & forestry



MEDEC low carbon scenario

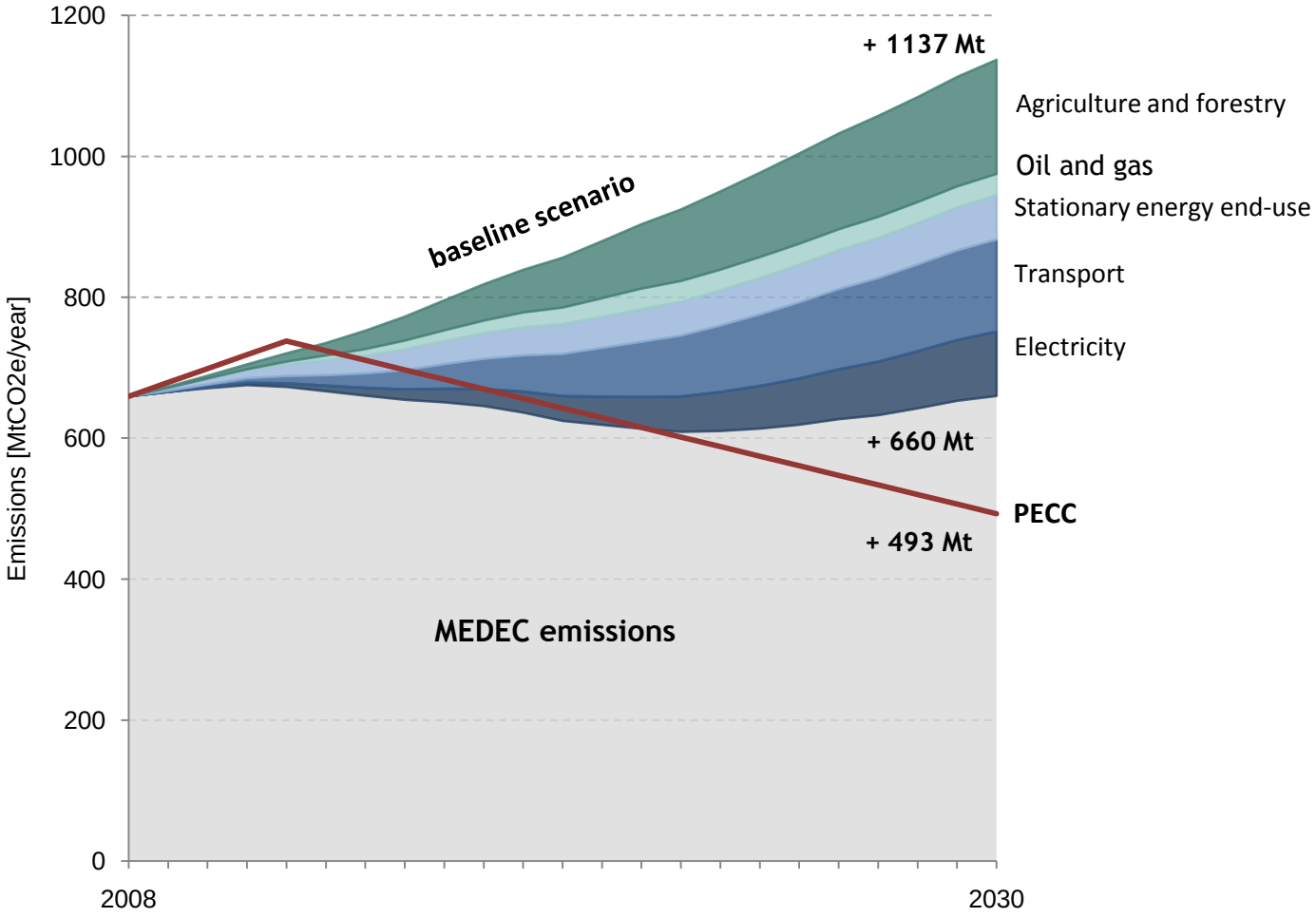
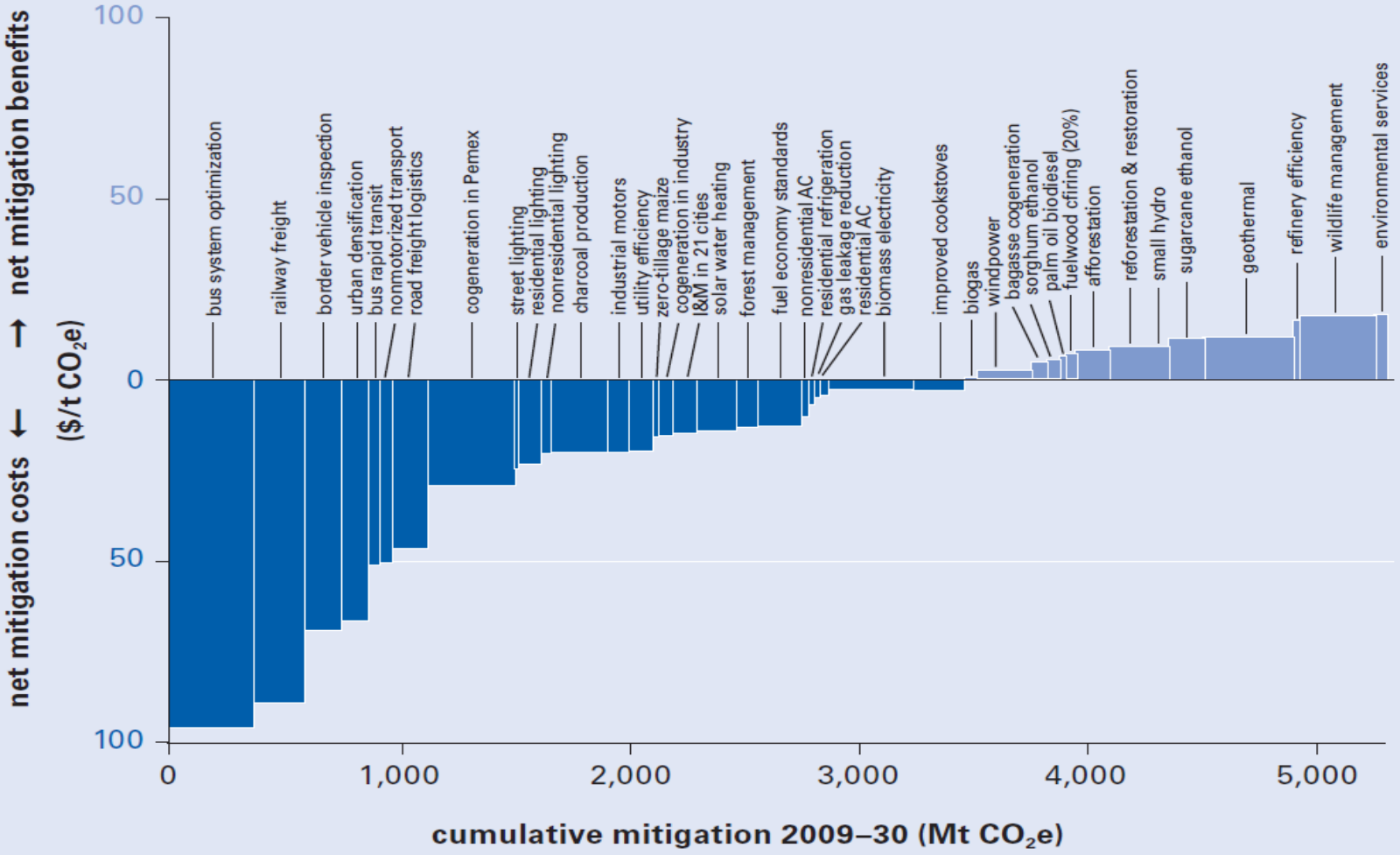
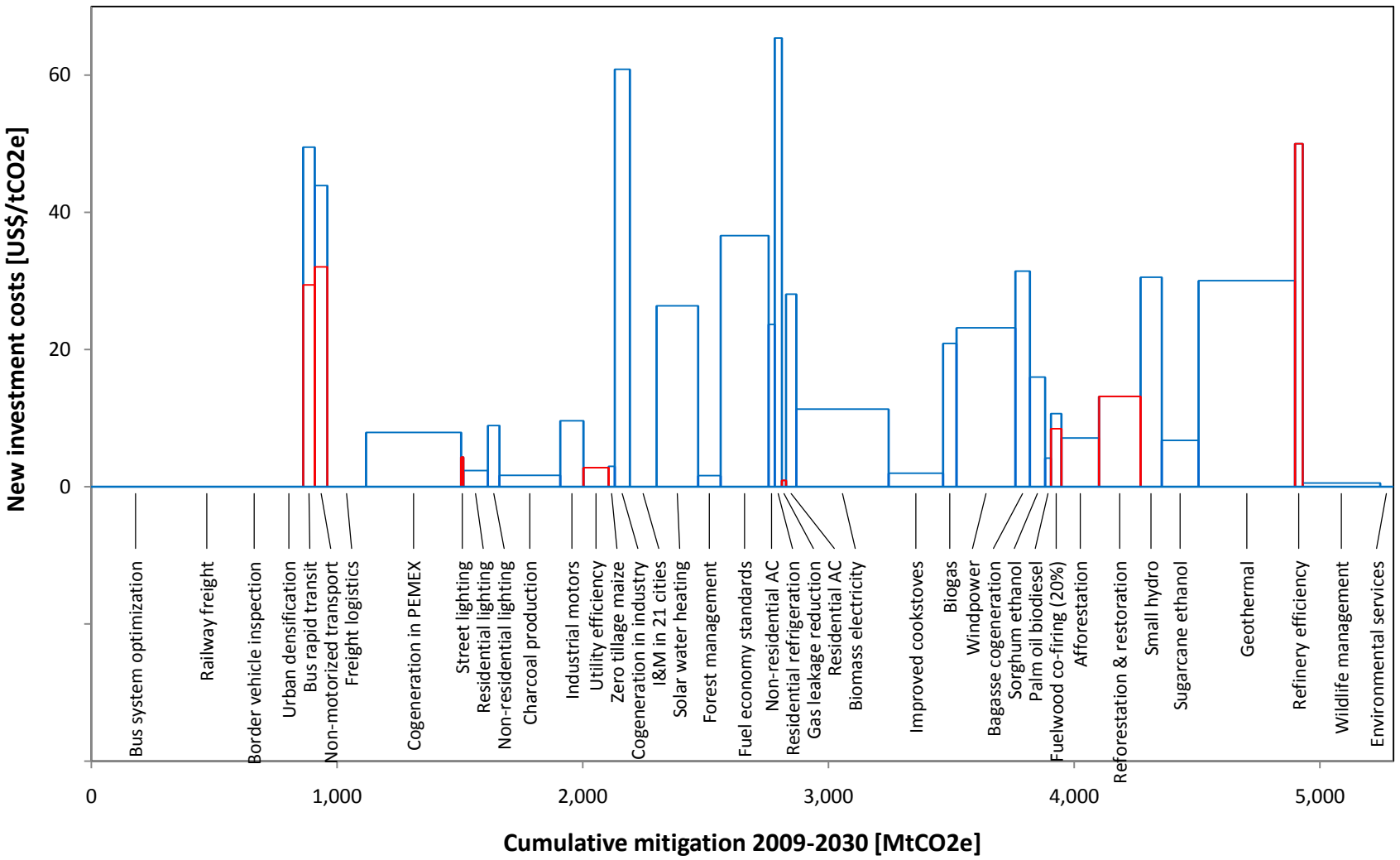


Figure 2 Marginal Abatement Cost Curve

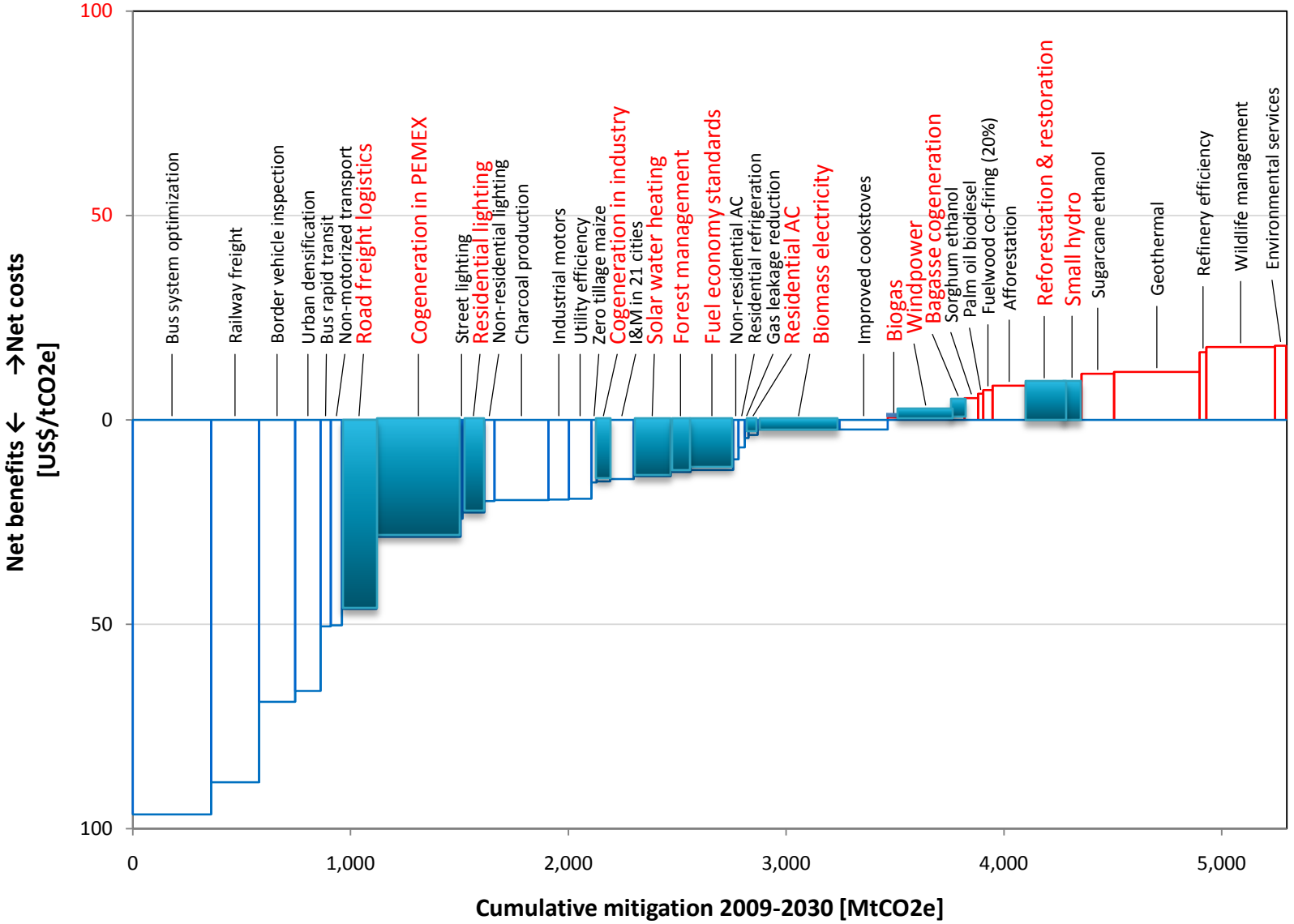


Source: Authors, based on MEDEC study results.

Investments required



MEDEC – México: Estudio sobre la Disminución de Emisiones de Carbono



Conclusions

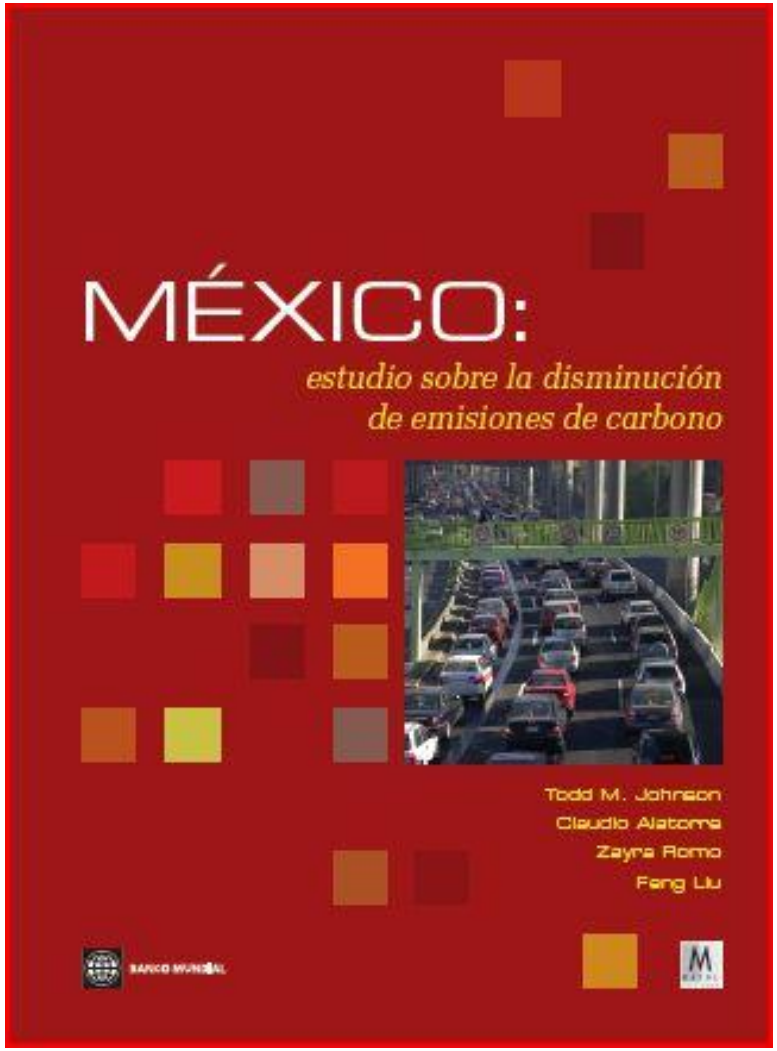
Some priority interventions will require changes in financing rules, government regulations, and institutions to be achieved

- ***Investment and Financing***. Higher up-front costs (MEDEC scenario -- ~$64 billion to 2030 ($3b/year) or less than 0.4% of GDP). Financing required from public and private sectors and households

- ***Regulatory***. Below-MC pricing of electricity (especially residential) and fossil fuels. Enforcement of environmental and efficiency standards and natural resource policies. Contracting issues

- ***Institutional.*** Governance reforms in CFE, LyFC, and PEMEX. Better coordination of Federal, State and Municipal government agencies, such as for public transport

However, there are dozens of "low-carbon" interventions with high economic and social returns without considering climate change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