MCC

Mercator Research Institute on
Global Commons and Climate Change gGmbH

Using carbon pricing revenues to finance infrastructure access

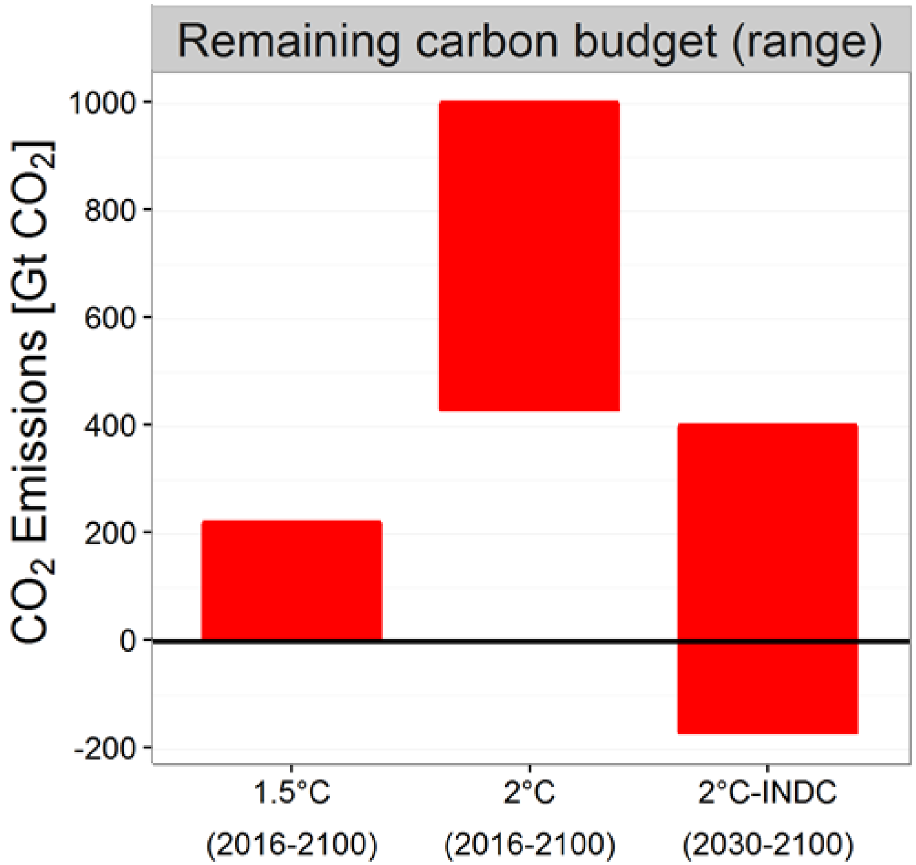
Prof. Dr. Ottmar Edenhofer

Based on work conducted at the Mercator Research Institute on Global Commons and Climate Change, Berlin

Climate Justice Conference, Cornell University

24 May 2016

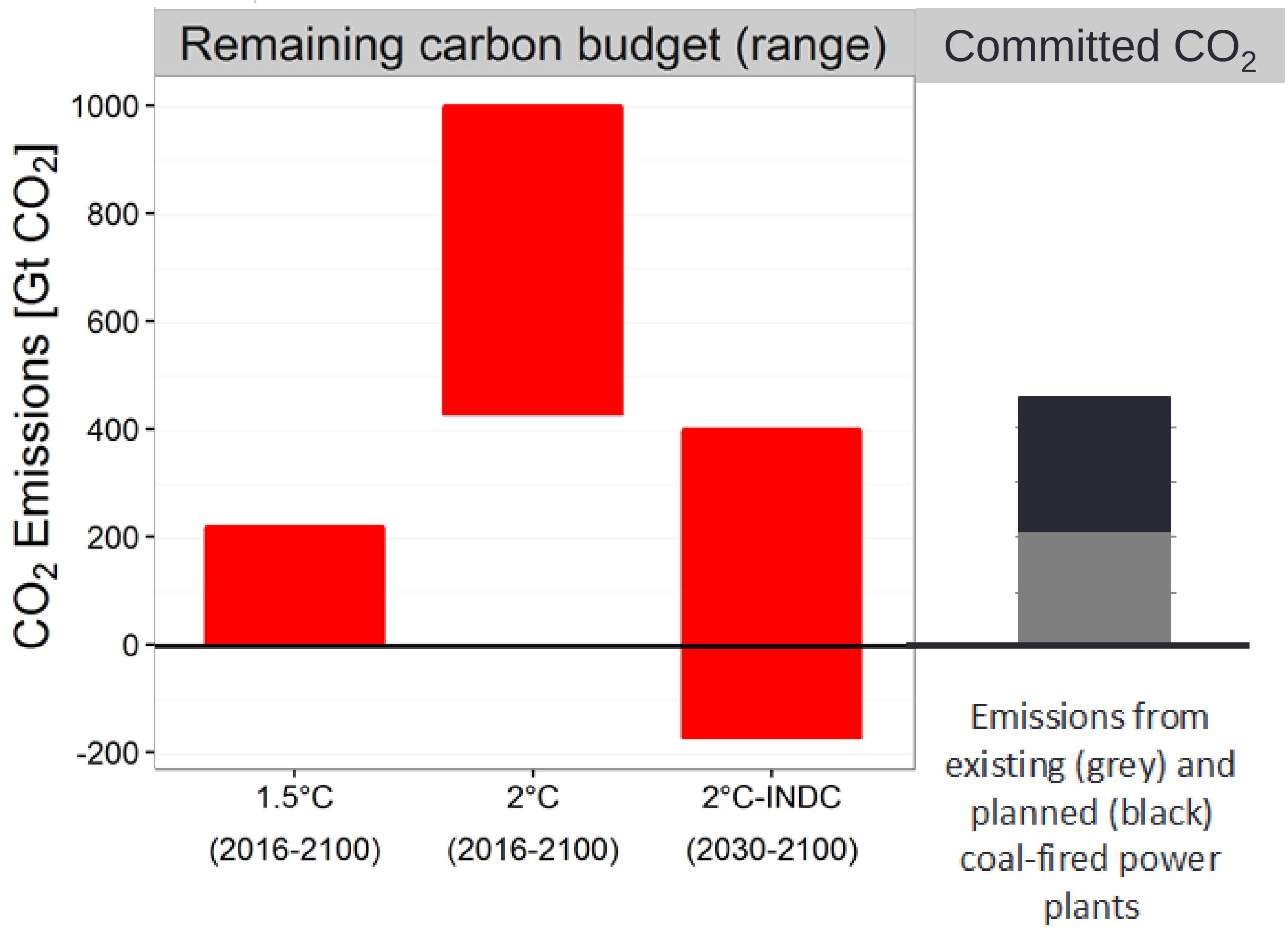
The Paris Agreement: INDCs



Intended Nationally Determined Contributions are inconsistent with the temperature target.

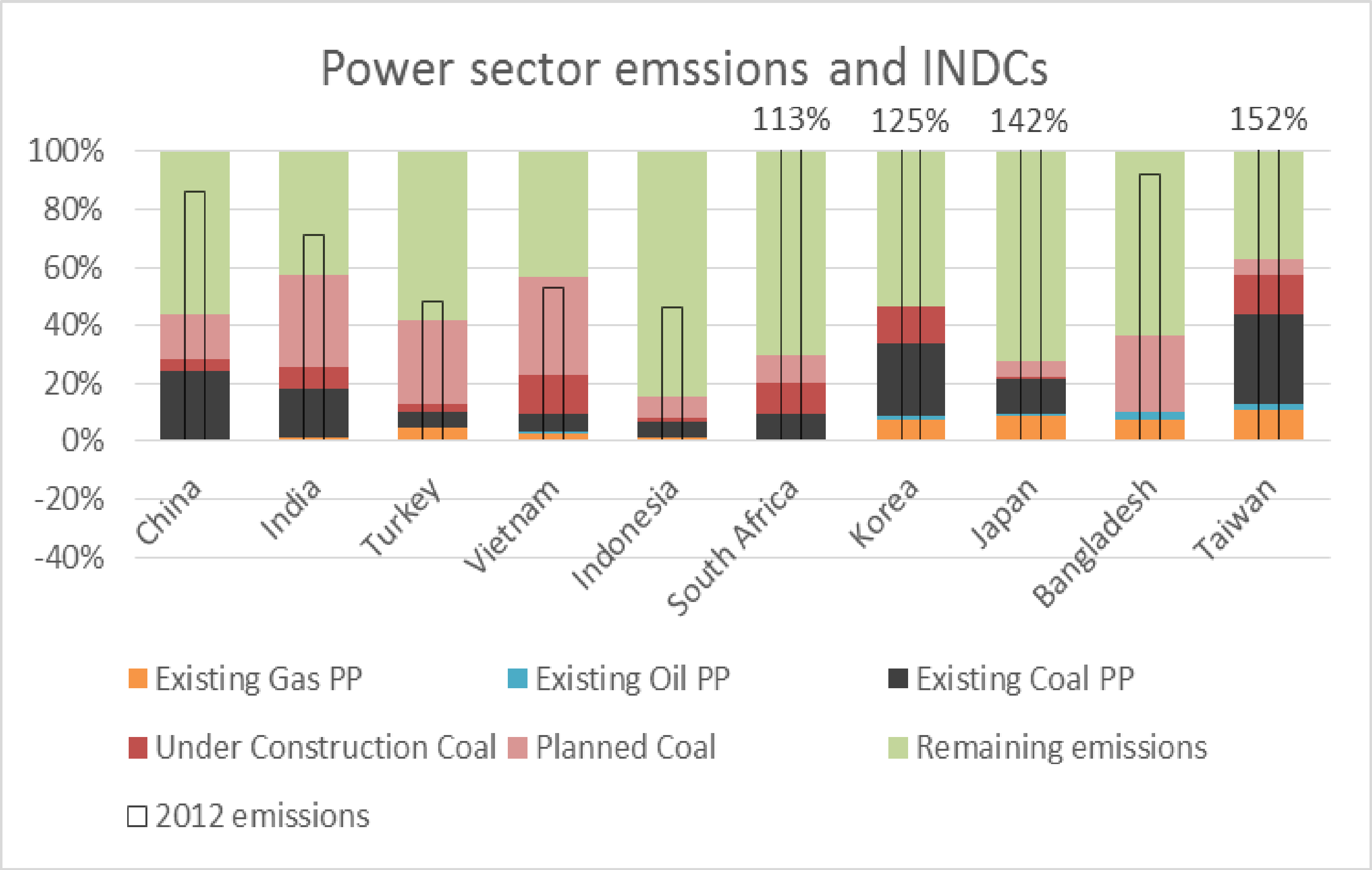
Data sources: IPCC (2014), Rogelj et al. (2015), Luderer et al. (2015); adapted from Jan Minx 2016

The Paris Agreement: committed CO_2



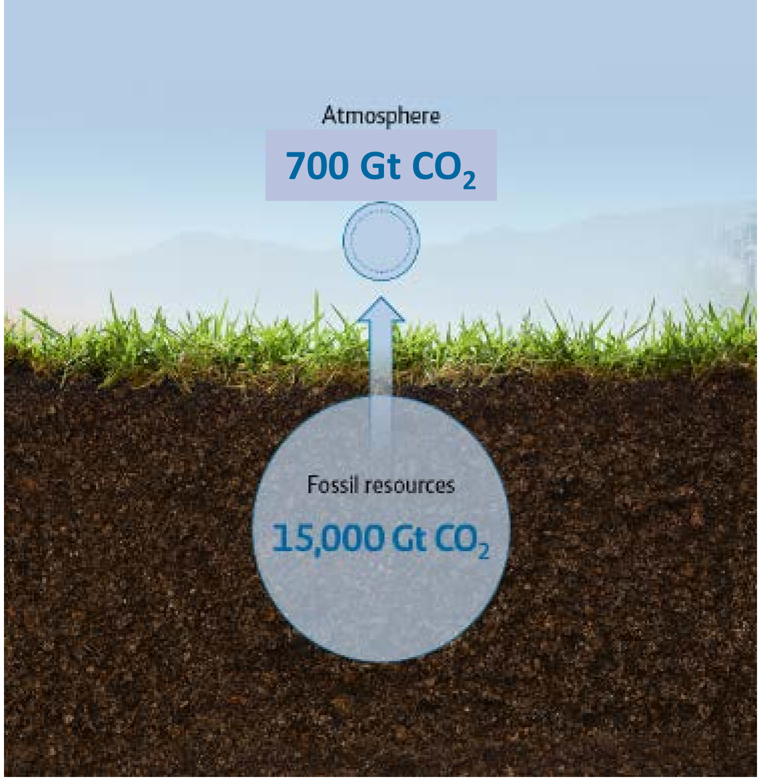
Additional data sources: Davis and Socolow (2014), Global Coal Plant Tracker

Inconsistency of INDCs



Countries with highest ongoing and planned coal investment

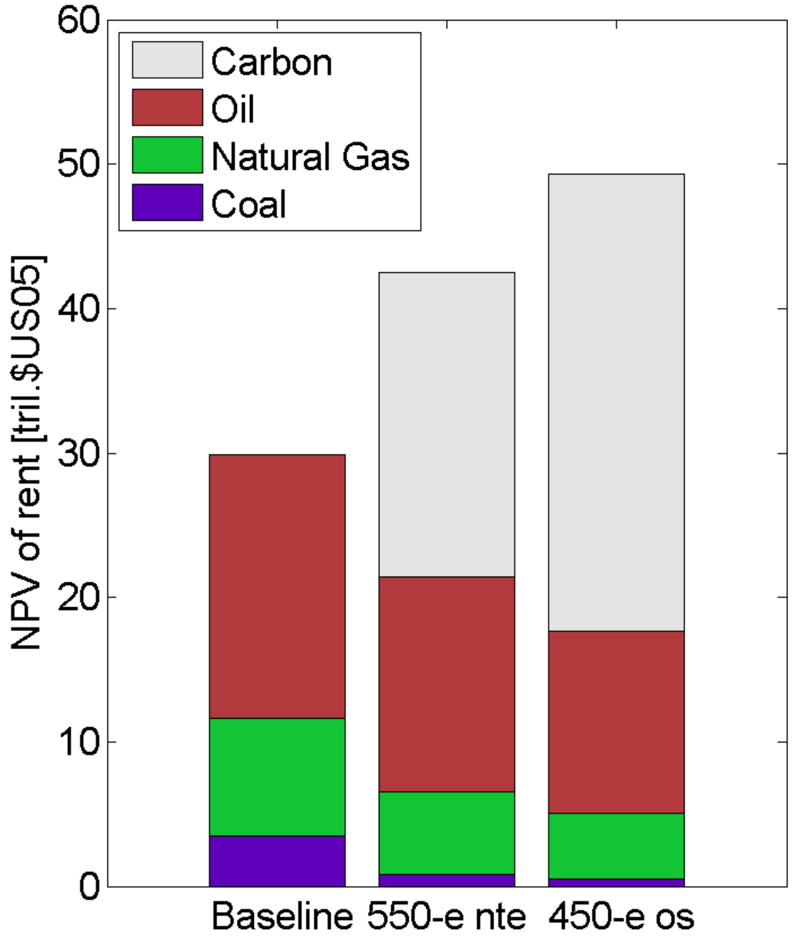
The climate problem at a glance



Resources and reserves to remain underground until 2100 (median values compared to BAU, AR5 Database)		
Until 2100	**With CCS [%]**	**No CCS [%]**
Coal	70	89
Oil	35	63
Gas	32	64

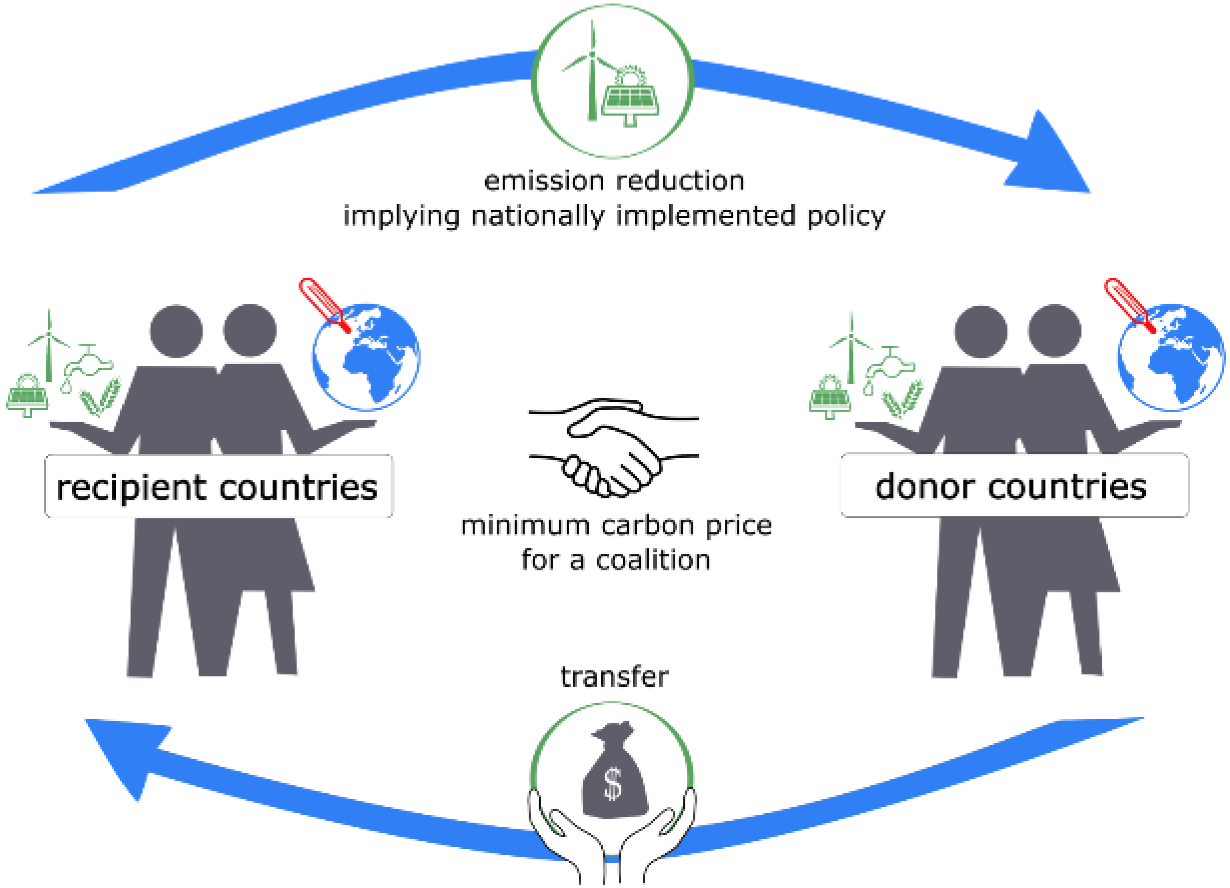
Based on: Bauer et al. (2014), Jakob and Hilaire (2015)

Overcompensating carbon taxes



- Fossil resource rents decrease with climate policy ambition
- Over-compensation by carbon rent (=permit price or tax * emissions)
- Carbon rent appropriated domestically via auctioned permits or tax
- The revenue can be invested: **climate policy and development are not a contradiction!**

Minimum carbon price and transfers



Reducing emissions and promoting development

- Revenues from carbon pricing could be used to advance human development objectives, e.g. access to basic infrastructure

- Limited access to basic infrastructures (e.g. > 2.4 billion people world-wide without access to sanitation in 2010)

- This analysis is hence related to the sustainable development goal (SDG) discourse

Jakob et al. (2016)

Relation to previous literature

- Emission pricing: prices vs. quantities debate (Goulder and Parry 2008), double dividend discussion (Goulder 2013)
- Infrastructure: investment needs for e.g. electricity (Pachauri et al. 2013), or water and sanitation (Hutton 2012)
- Our **contribution**: link revenues from emission pricing to infrastructure investment requirements on the country-level for a range of climate scenarios
- Can hence be regarded as an operationalization of *strong sustainability*, which emphasizes that some *natural and social thresholds* are not to be violated

The Approach

1. Project **access gaps** in 2030 for sanitation, water, telecommunications, roads and electricity. Objective is to reach 100% access.

2. Compute **cost** of closing access gaps.

3. Various integrated assessment models (EMF-27) for **revenues from carbon pricing**.

4. Divide total costs per infrastructure per country from step 2 by carbon pricing revenues for each country from step 3 to obtain the **share of revenues** needed.

Data sources

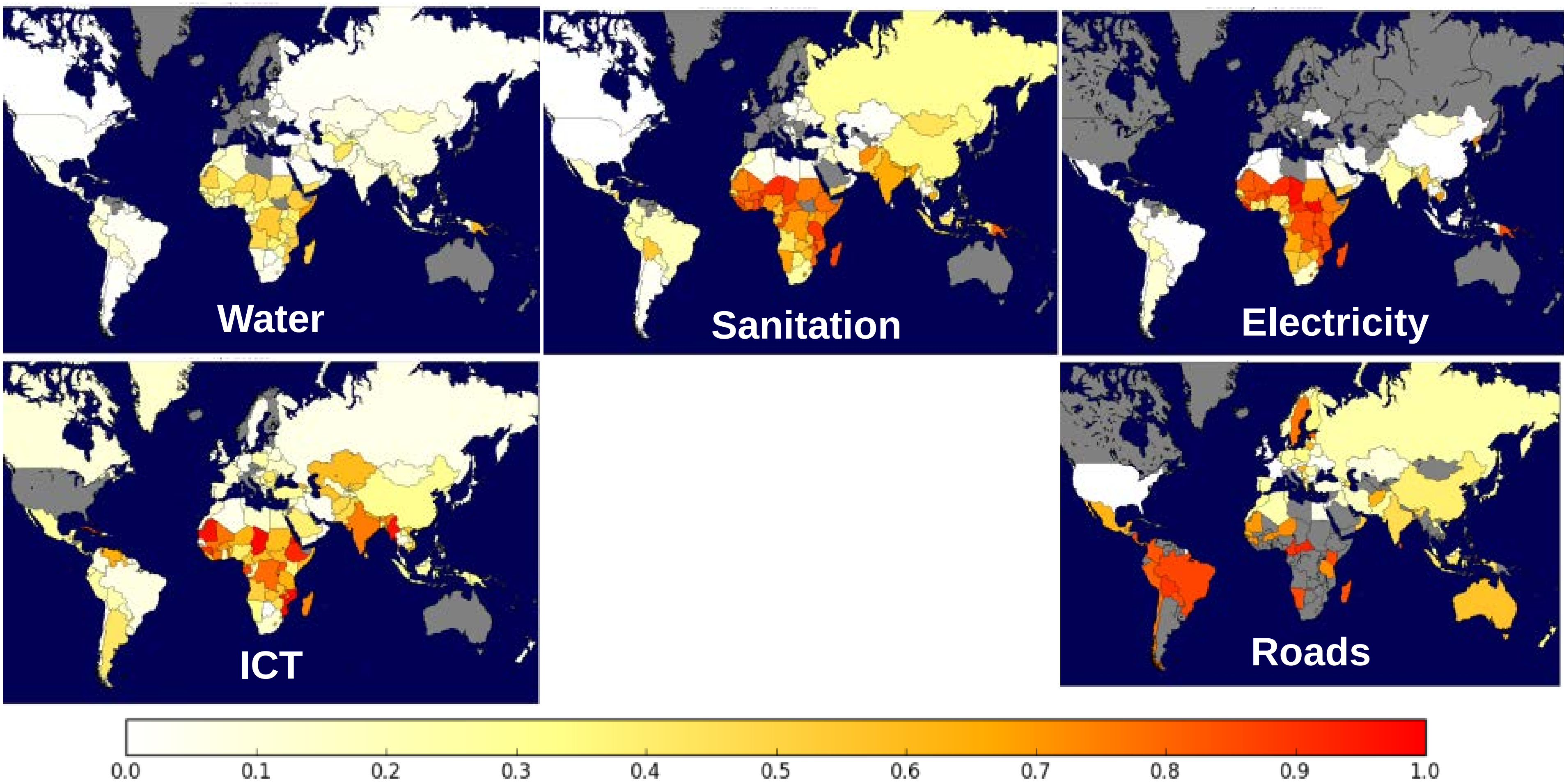
- 2012 UN forecast (medium fertility) for **population** in 2030
- World Development Indicators (**access gaps** for electricity, water, sanitation, roads). For **communications access gaps** (max of fixed and mobile connections): ITU. 2014. World Telecommunication/ICT Indicators Database
- For **electricity access costs**: Pachauri et al. (2013), for **water & sanitation access costs**: WHO/Hutton et al. (2012), for **road costs**: IEA (2013) Global Land Transport Infrastructure Requirements
- For **revenues from emission pricing** for 7 IAMs: EMF27 model comparison (Blanford et al. 2014) database, use regional growth rates to project emissions on country level

Assumptions

- Current share of people with access assumed constant to 2030
- Investments undertaken over a 15-year period, as envisaged by SDG process
- Unpaved roads as indicator for paved road demand
- ICT: 150 US$ fixed costs, air time of 10 minutes, cost per minute at 2 cents
- Annual recurrent costs averaged over 15 years
- Missing data for countries: regional averages or similar population density

Jakob et al. (2016)

Share of population without access



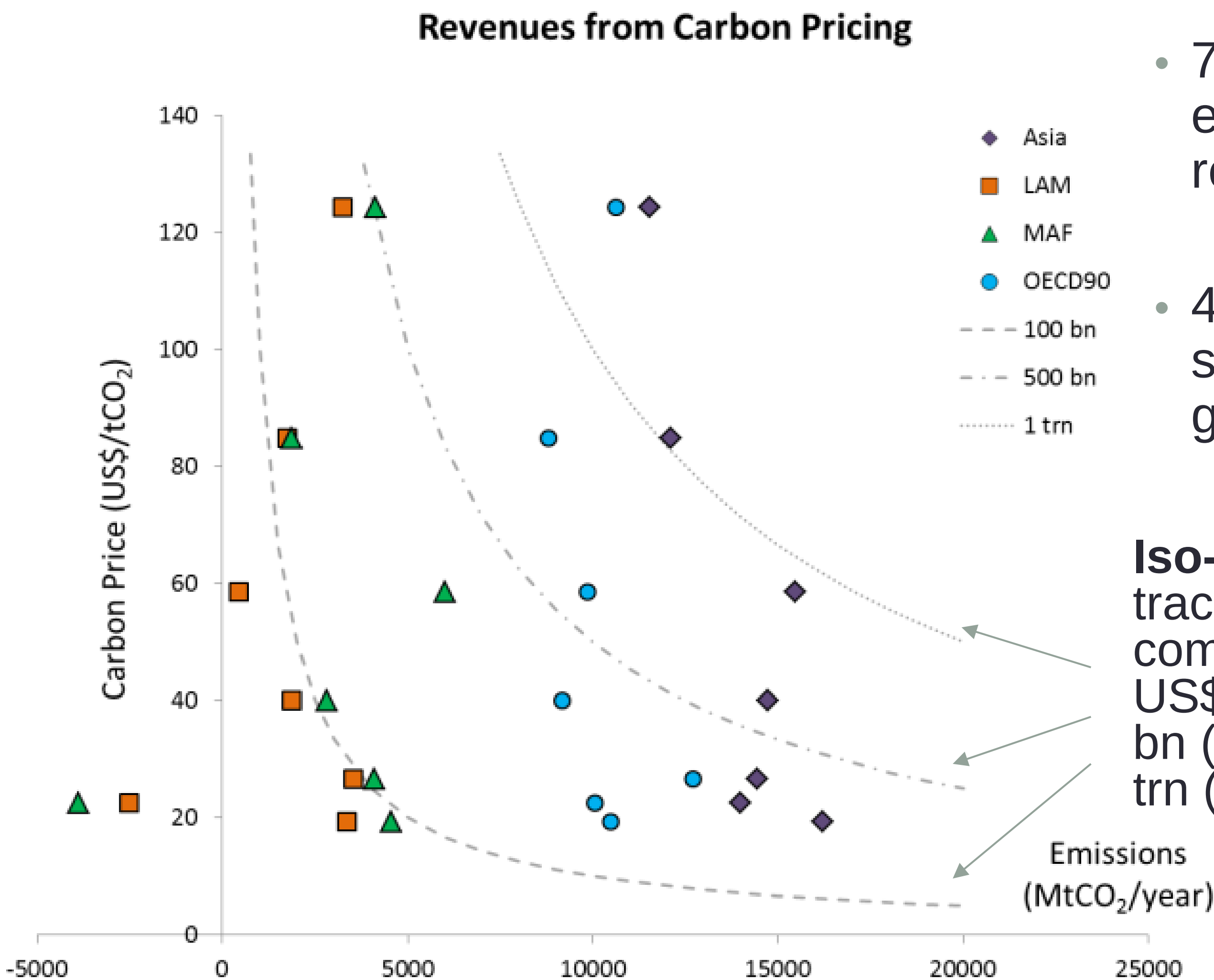
Jakob et al. (2016)

Costs (millions of 2010 US$)

	Electricity	Water	Sanitation	ICT	Roads	**total costs**
East Asia & Pacific	22,590	93,145	79,269	564,210	2,486,253	**3,245,468**
Europe & Central Asia	0	5,501	11,011	105,887	676,624	**799,024**
Latin America & Caribbean	13,952	29,057	36,802	130,926	2,461,768	**2,672,505**
Middle East & North Africa	5,170	18,865	12,462	54,487	173,124	**264,108**
North America	0	0	0	3,419	0	**3,419**
South Asia	35,861	4,907	93,847	1,062,650	2,488,990	**3,686,255**
Sub-Saharan Africa	355,554	36,590	135,431	680,365	405,999	**1,613,939**
	433,127	**188,065**	**368,822**	**2,601,944**	**8,692,758**	**12,284,718**

Jakob et al. (2016)

Carbon prices and emissions in 2020



- 7 models from EMF27, each regional dot refers to 1 model
- 450ppm full tech scenario, assuming global carbon price

Iso-revenue curves: tracing all price-quantity combinations generating US$ 100 bn (dashed), 500 bn (dashed-dotted), and 1 trn (solid) revenues

Jakob et al. (2016)

Regression analysis

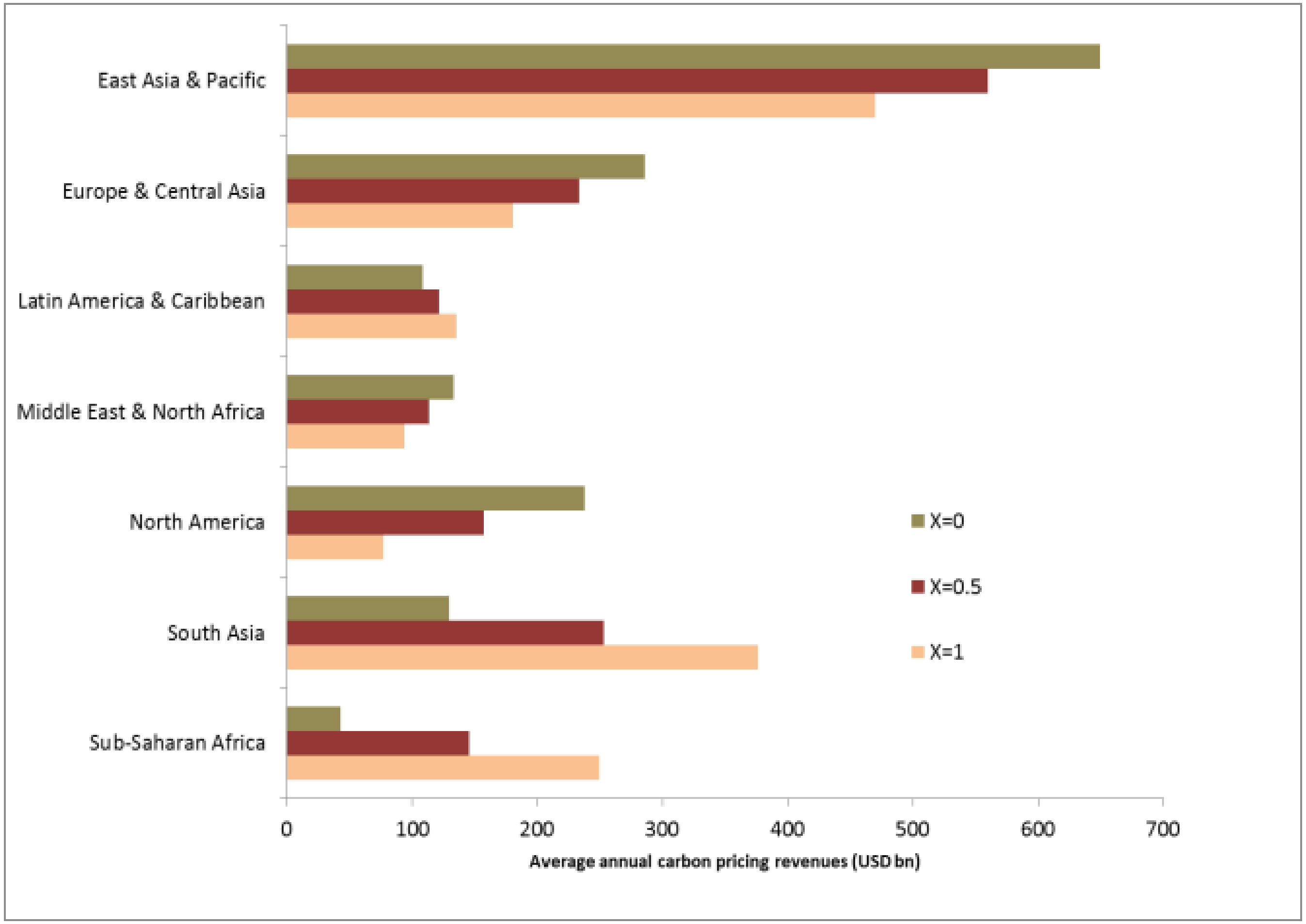
VARIABLES	(1) p2020	(2) p2020	(3) p2020	(4) p2020
ppm450	27.79	62.56**	27.79	63.67**
	(37.99)	(23.77)	(39.34)	(24.15)
noccs	8.422	52.08*	8.422	53.44*
	(37.99)	(28.94)	(39.34)	(29.57)
limbio	2.996	11.51	2.996	11.79
	(37.99)	(28.18)	(39.34)	(28.90)
ppm450_noccs	99.77*		100.9*	
	(56.90)		(58.36)	
ppm450_limbio	16.27		16.07	
	(55.10)		(56.79)	
aim	15.23	-0.213		
	(38.19)	(36.36)		
gcam	-8.103	-23.54		
	(38.19)	(36.36)		
image	22.79	1.050		
	(42.47)	(39.01)		
message	-2.054	-17.49		
	(38.19)	(36.36)		
poles	12.96	-2.475		
	(38.19)	(36.36)		
remind	95.60**	80.16**		
	(38.19)	(36.36)		
witch	14.87	-7.919		
	(39.92)	(37.31)		
Constant			21.61	3.673
			(27.82)	(23.40)
Observations	39	39	39	39
R-squared	0.625	0.577	0.292	0.220

Table 1: Results of regression analysis to explain carbon prices in the year 2020 in different stabilization scenarios. Standard errors in parentheses, *** $p<0.01$, ** $p<0.05$, * $p<0.1$

- Analyze differences between 450ppm and 550ppm, both for full tech, no CCS, and low biomass potential
- With full tech, carbon prices about US$ 30 higher for 450ppm than for 550ppm
- Much larger price difference if CCS is restricted (>100 US$)

Jakob et al. (2016)

Revenues



We focus on 450ppm full tech

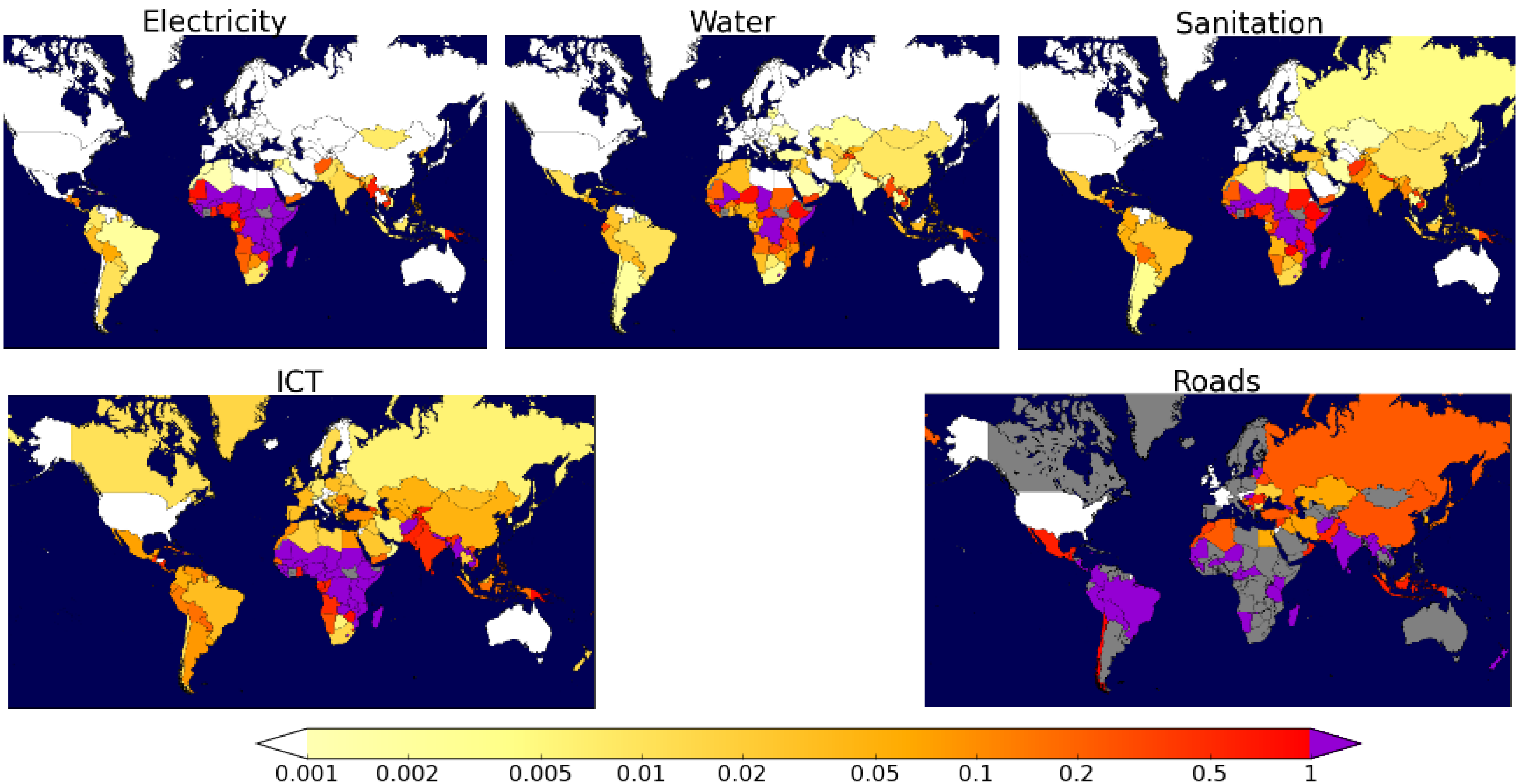
Median revenues from all IAMs (i.e. POLES)

Global revenues about 1.5 trn (in 2020)

Regional revenues depend on burden sharing scheme:

- X=0 → domestic carbon pricing
- X=1 → equal per-capita distribution
- X=0.5 → average between X=0 and X=1

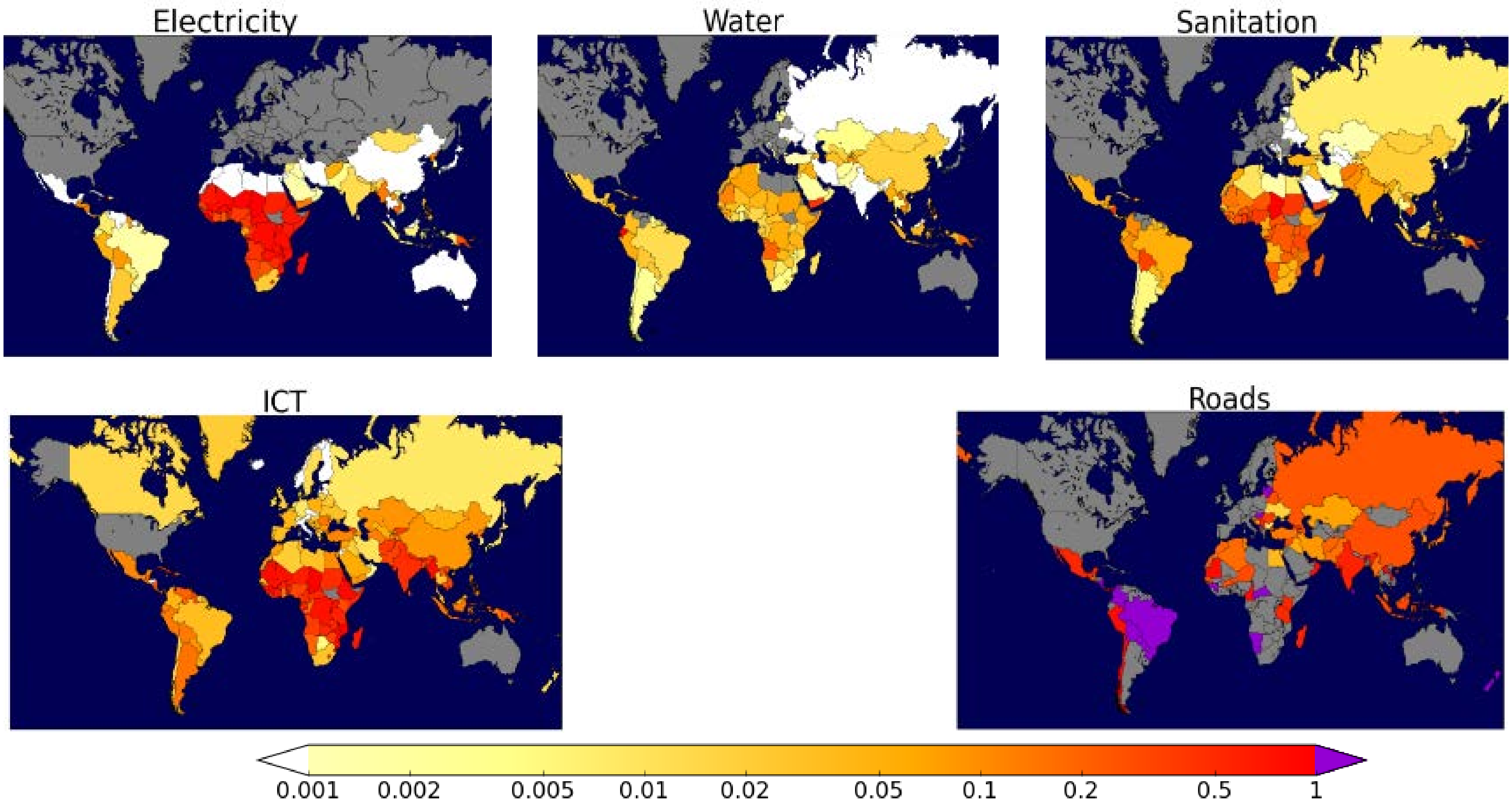
Ratio of costs to carbon pricing revenues (2015-30) with domestic carbon pricing (no redistribution)



Violet-colored countries do not have sufficient carbon revenues to cover the cost of closing the respective infrastructure gap (i.e. ratio of cost to revenue > 1).

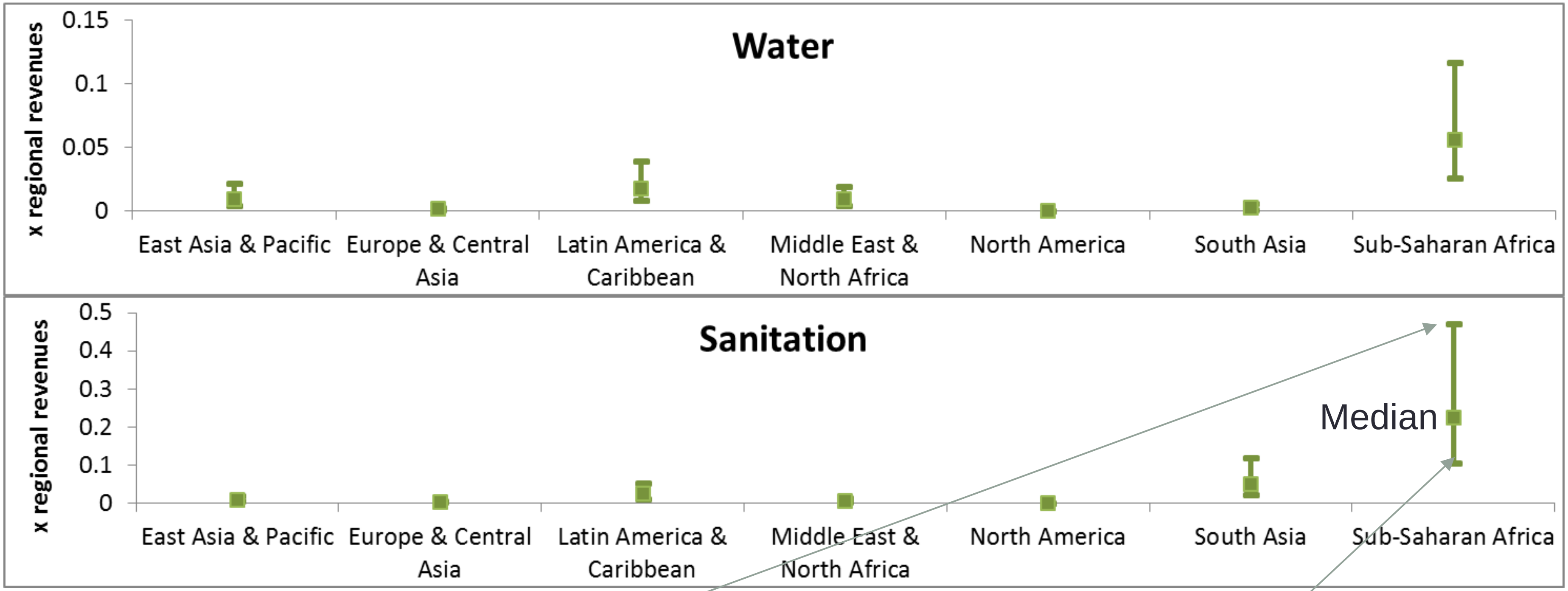
Jakob et al. (2016)

… and distributed by the average between ‘no redistribution’ and ‘equal per-capita’



With redistribution, revenues are sufficient to finance universal access to any single type of infrastructure except roads, where Africa’s & Latin America’s cost still partially exceed revenues.

Sensitivity analysis for domestic carbon pricing

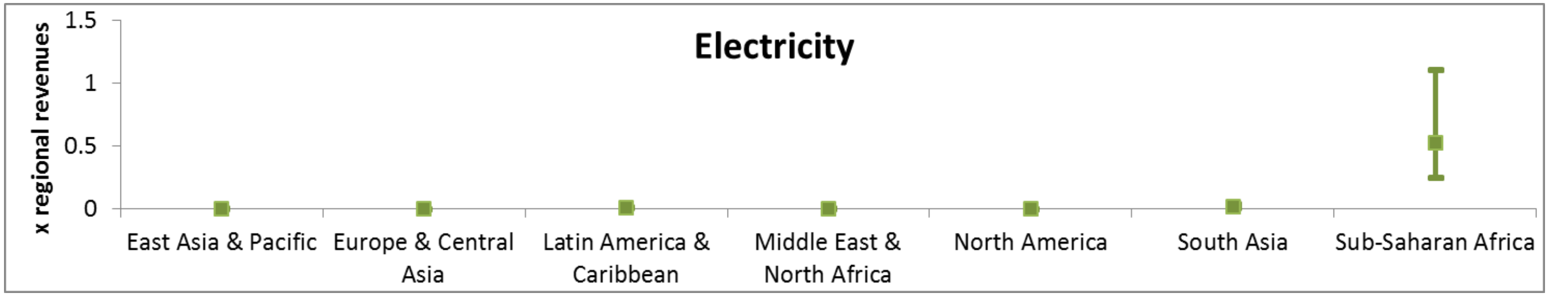


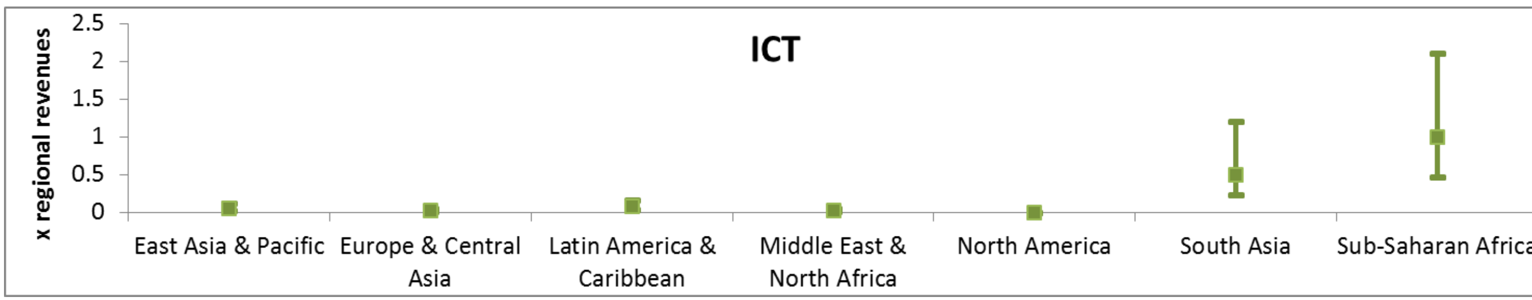
Worst case: > 40% of revenues needed if carbon revenues lower (550ppm, no techn. restrictions) and costs 50% higher.

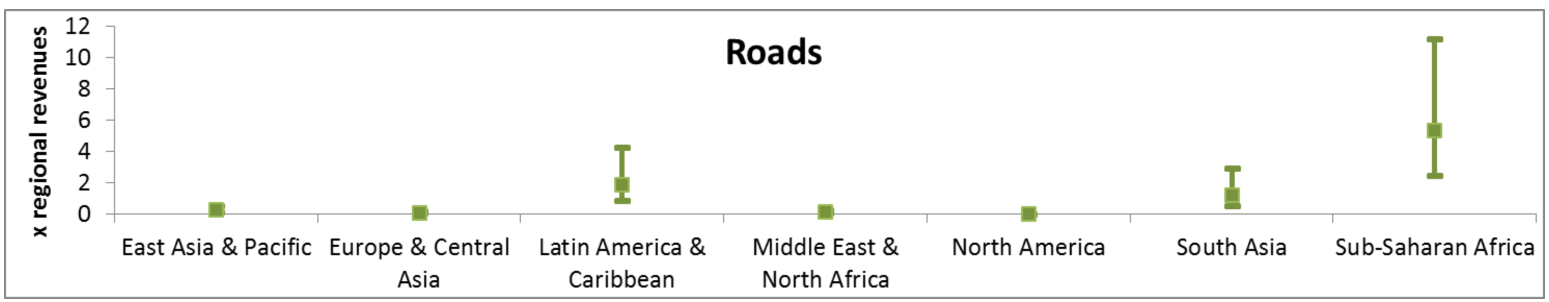
Best case: only 10% of revenues needed if carbon revenues higher (450ppm, techn. restrictions) and costs 50% lower.

Jakob et al. (2016)

Sensitivity analysis cont'd







Qualifications and Caveats

- Results highlight order of magnitude, no model taking into account e.g. general equlilibrium effects: building new infrastructure will also raise rents, e.g. land rents
- Economic growth likely to contribute to closing the gap: conservative estimates
- Front-loading of investment and compensation of adversely affected people
- Political economy: resistance of e.g. energy-intensive sectors could be counter-balanced by demand for infrastructure investments
- Earmarking of revenues for development purposes to increase political support of Pigouvian taxes (see Kallbekken et al. 2011)
- How to ensure that funds are well-used? Need sound institutions?

Jakob et al. (2016)

Concluding thoughts

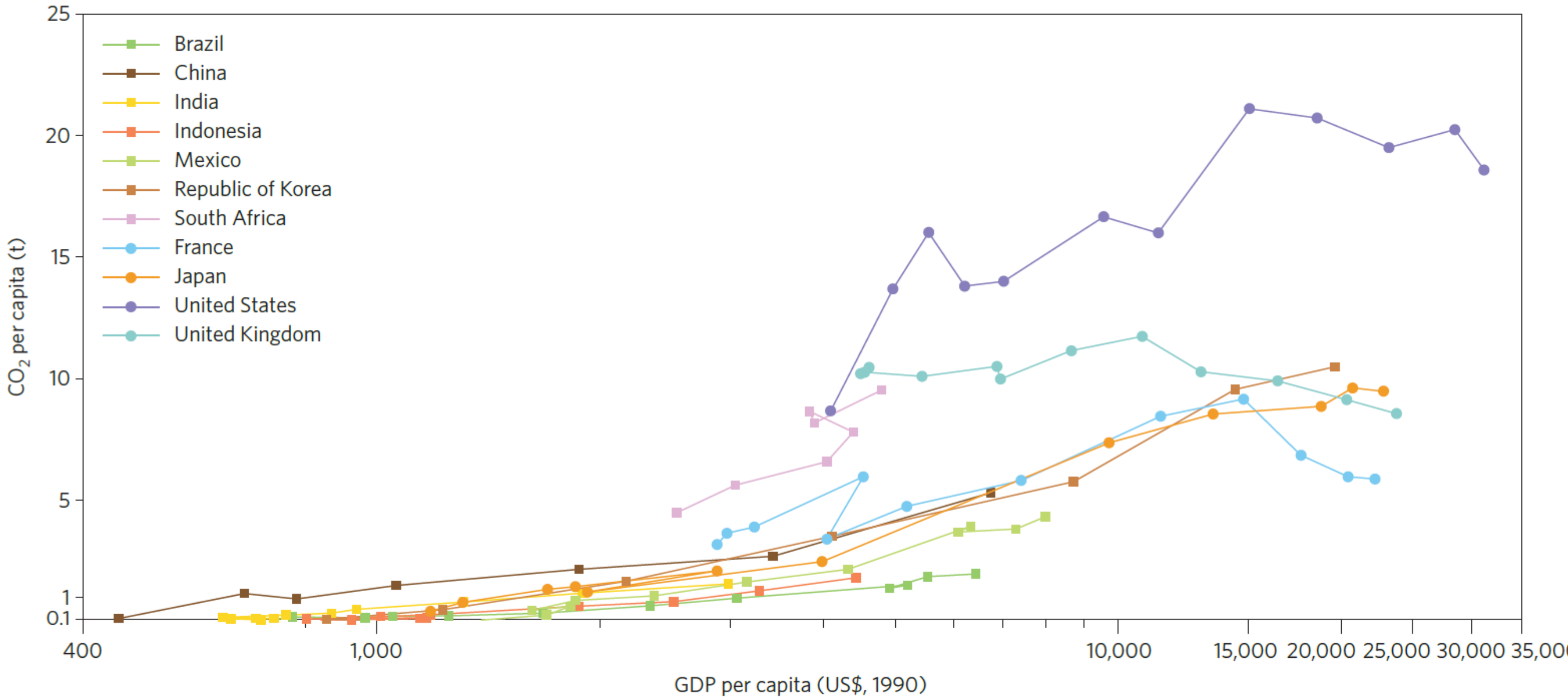
- Carbon pricing would generate substantial revenues, about US$ 1.9 trn per year in our benchmark scenario
- This could go a long way towards closing infrastructure access gaps
- Carbon price and hence revenues are sensitive to stabilization target, technological availability, model used and depend on allocation scheme
- Resource rent taxation (Fuss et al., accepted) would yield US$ 3 trn annually. Yet, our carbon pricing scenario with X=0.5 achieves more in terms of closing access gaps (redistribution!)
- Fossil fuel subsidy reform (Jakob et al. 2015) also an option. Lower revenues (550 bln per year), but high potential for a number of specific countries (mostly in Africa and South Asia)

Contact

Prof. Dr. Edenhofer, Director
Mercator Research Institute on
Global Commons and Climate Change gGmbH
Torgauer Str. 12–15 | 10829 Berlin | Germany
tel +49 (0) 30 338 55 37 - 101
mail director@mcc-berlin.net
web www.mcc-berlin.net

MCC was founded jointly by Stiftung Mercator and
the Potsdam Institute for Climate Impact Research

Motivation



Two of the most fundamental challenges in the 21st century: poverty reduction and climate change mitigation