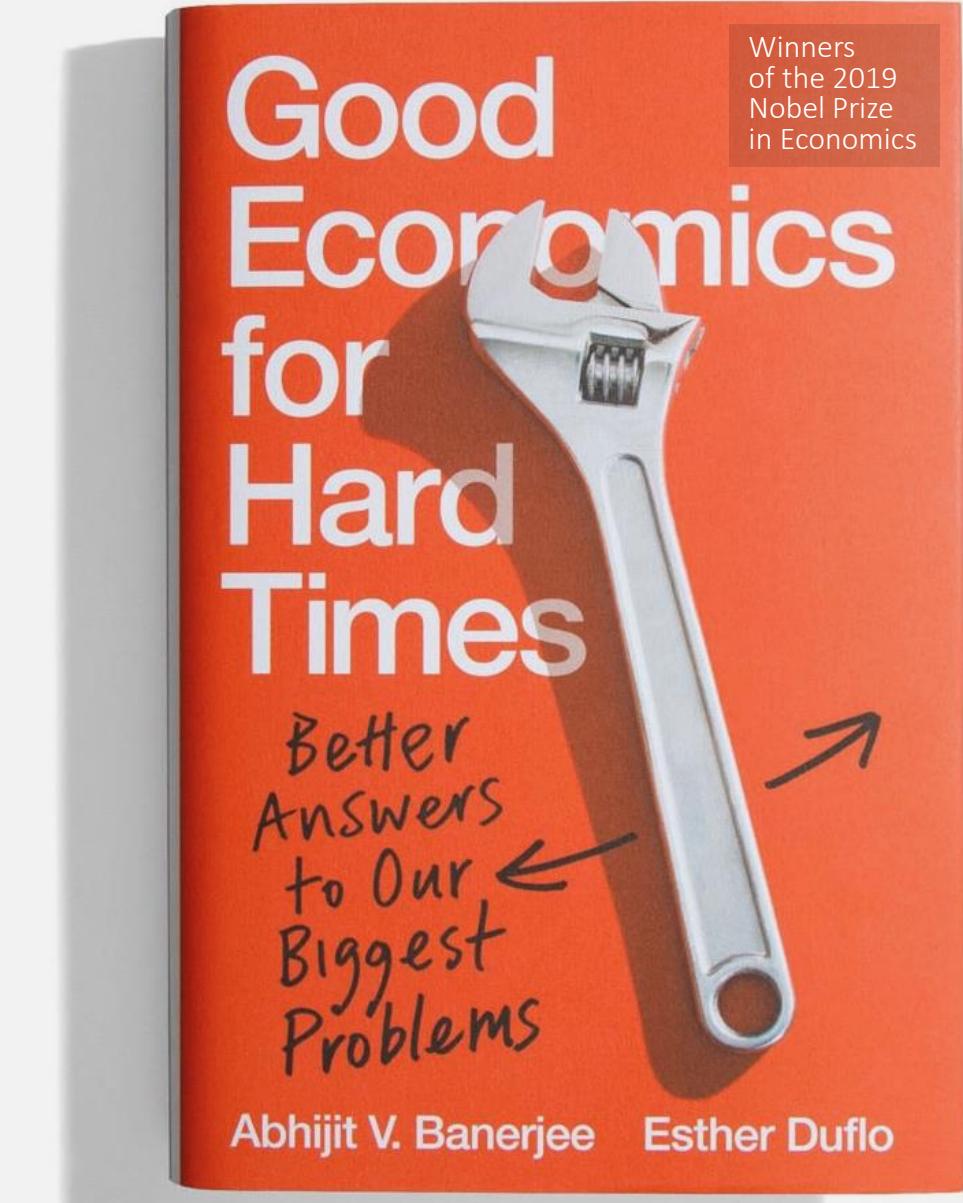




Good Economics For ~~Hard Times~~ ~~Harder Times~~ More Hopeful(?) Times

A course by Abhijit Banerjee
and Esther Duflo



Lectures 12 and 13: In hot water

Thinking about climate change

Welcome!

COP26

China

Greta Thunberg

California fires

US leadership?

Worldwide equity

Rising Sea Levels

Gilets Jaunes

Droughts and Floods

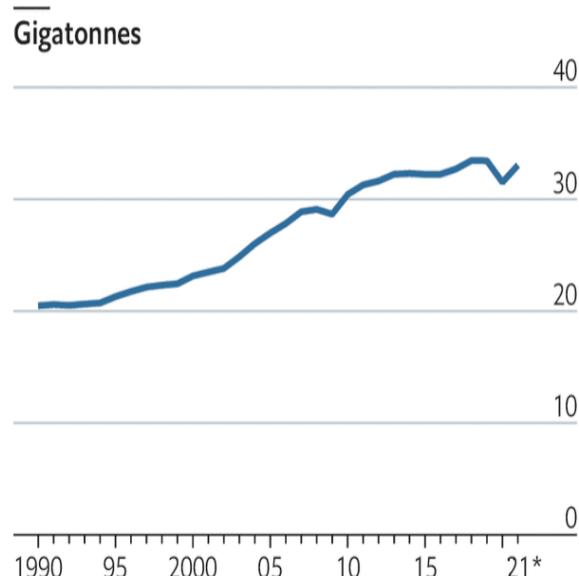
A new urgency on climate change?



The pandemic progress on emissions were short lived

One step forward, two steps back

Global energy-related CO₂ emissions

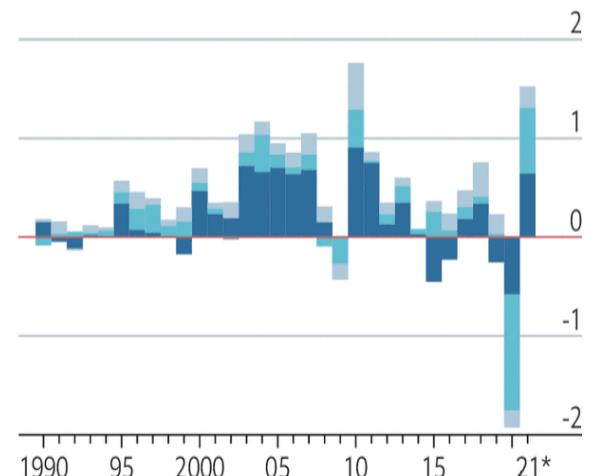


Source: International Energy Agency

The Economist

Change on previous year by fuel, gigatonnes

Coal Oil Gas



*Forecast

1. Emissions

The emissions responsible for climate change
are mainly due to the behavior of rich
country citizens

...And some rich citizens in poor countries

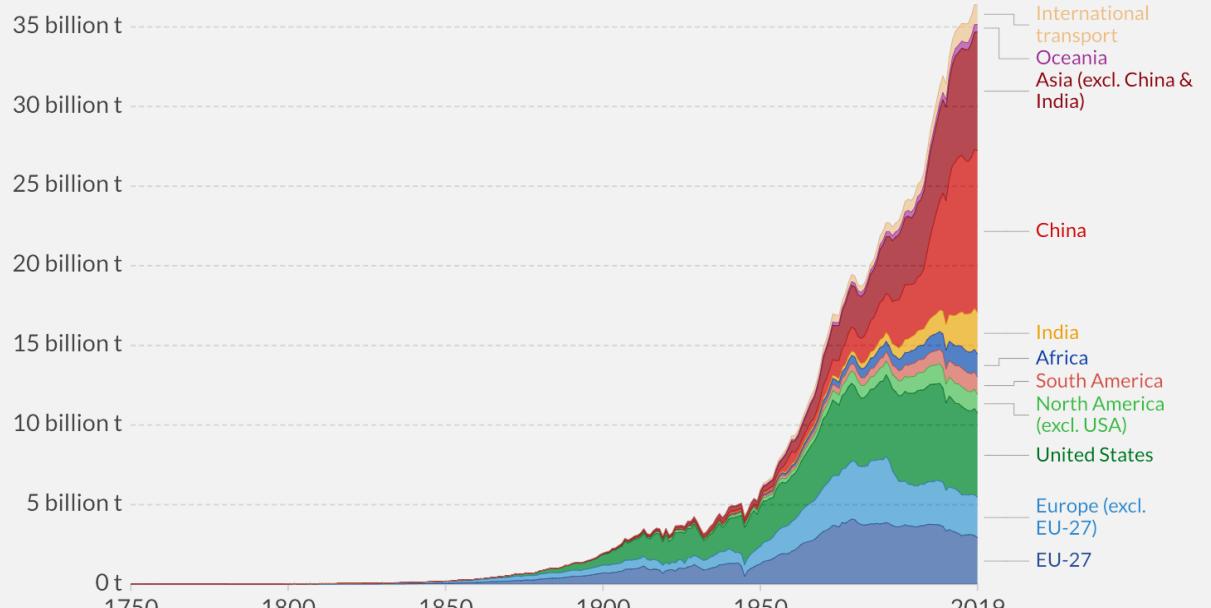
Emission location

Annual total CO₂ emissions by world region

Annual total CO₂ emissions, by world region

Our World
in Data

+ Add region Relative



Source: Our World in Data based on the Global Carbon Project
Note: This measures CO₂ emissions from fossil fuels and cement production only – land use change is not included. 'Statistical differences' (included in the GCP dataset) are not included here.

OurWorldInData.org/co2-and-other-greenhouse-gas-emissions • CC BY
Gavin Shaddick, Max Roser, Hannah Ritchie, Estelle Ralston, and Zeynep Tufekci

Historical emissions

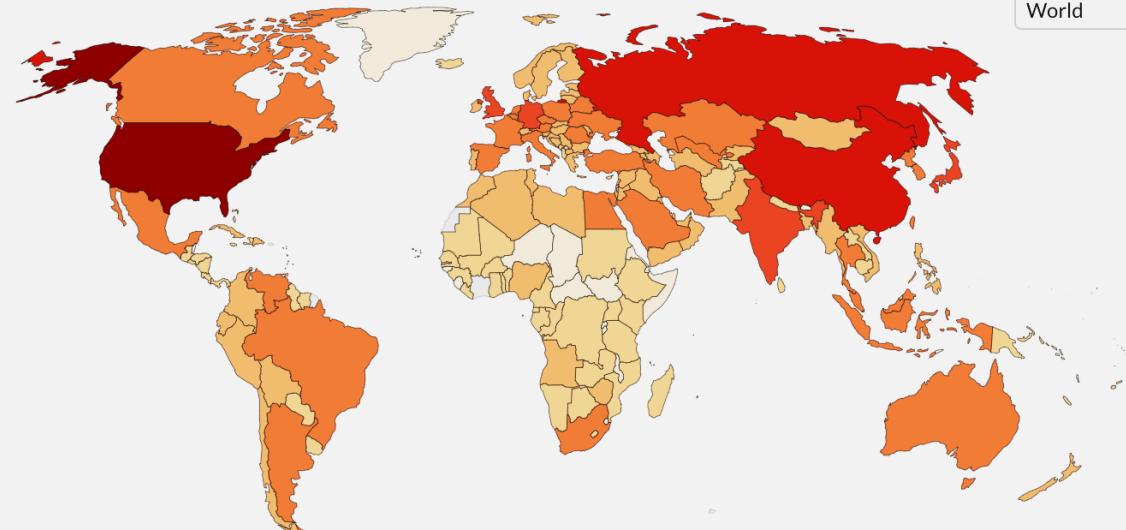
Cumulative CO₂ emissions, 2019

Cumulative CO₂ emissions, 2019

Cumulative carbon dioxide (CO₂) emissions represents the total sum of CO₂ emissions produced from fossil fuels and cement since 1751, and is measured in tonnes. This measures CO₂ emissions from fossil fuels and cement production only – land use change is not included.

Our World
in Data

World ▾

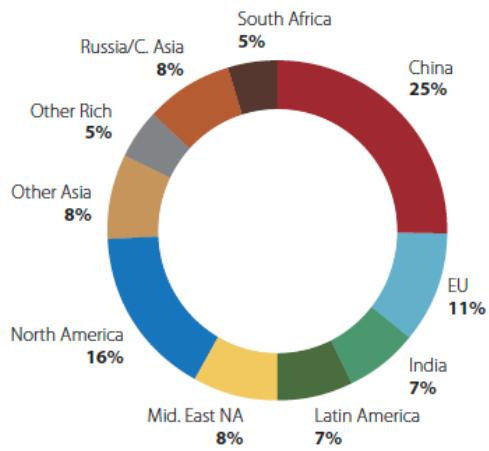


Source: Our World in Data based on the Global Carbon Project

OurWorldInData.org/co2-and-other-greenhouse-gas-emissions/ • CC BY

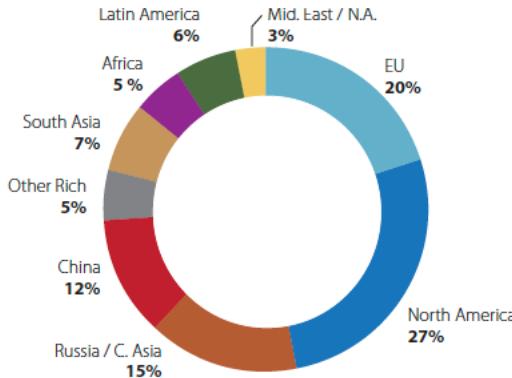
Production, historical production, and consumption

FIGURE 1.B. DISTRIBUTION OF CURRENT PRODUCTION-BASED CO₂e EMISSIONS



Source: authors based on CAIT (WRI, 2015). Key: China represents 25% of global CO₂e emissions when measured from a production base. Note: data from 2012.

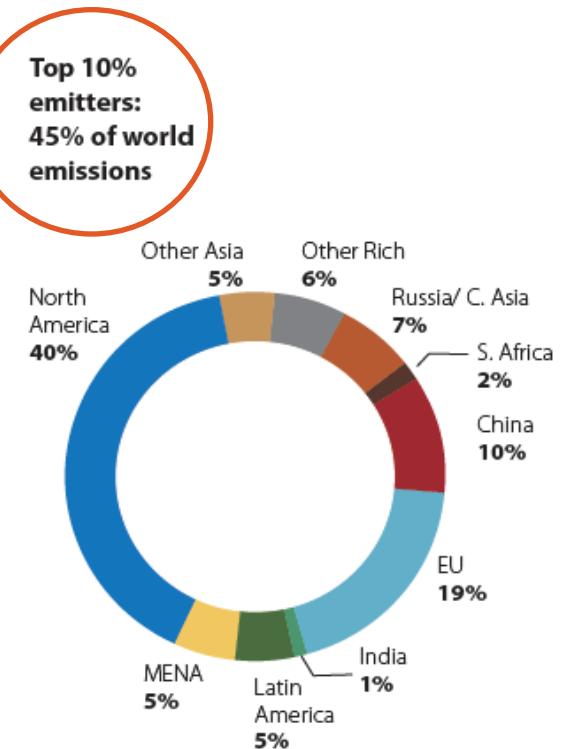
FIGURE 1.C. DISTRIBUTION OF CUMULATED PRODUCTION-BASED HISTORICAL CO₂e EMISSIONS



Source: authors based on CAIT (WRI, 2015) and CDIAC (Boden et al., 2015). Key: Emissions from North America represent 27% of all CO₂e emissions ever emitted since the industrial revolution. Note: these are production-based emissions estimates. Regions may slightly vary from those of other graphs, see Boden et al. (2015).

But production is not consumption! What if we attributed the CO₂e to the consumption that is helps fuel?

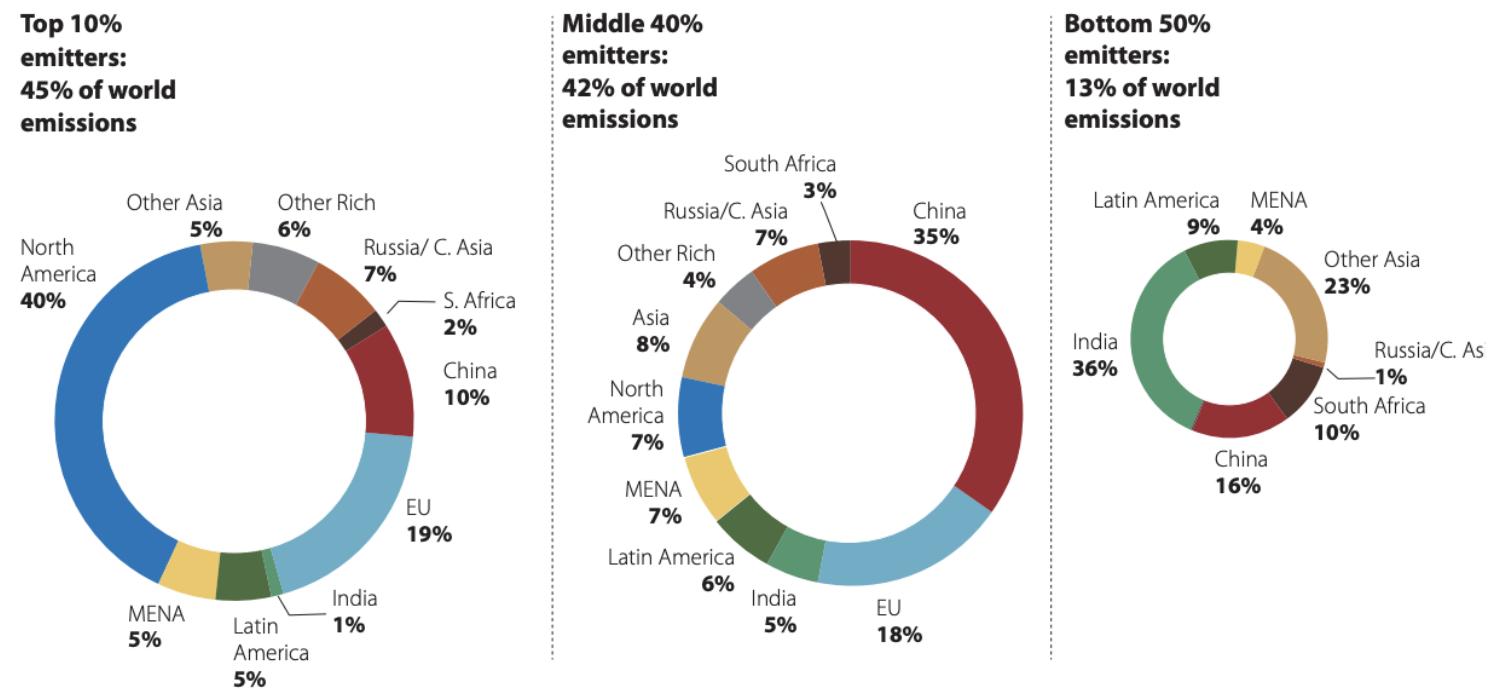
Piketty and Chancel compute income elasticity of consumption-based emission with respect to income: 0.9



CO₂e emissions based on consumption of their citizen

The “10-50 rule”

FIGURE 7. REGIONAL COMPOSITION OF TOP 10, MIDDLE 40 AND BOTTOM 50% EMITTER GROUPS



Source: authors. Key: Among the top 10% global emitters, 40% of CO₂e emissions are due to US citizens, 20% to the EU and 10% from China.

Sharing the burden of adaptation by country

Who should contribute to climate adaptation funds?

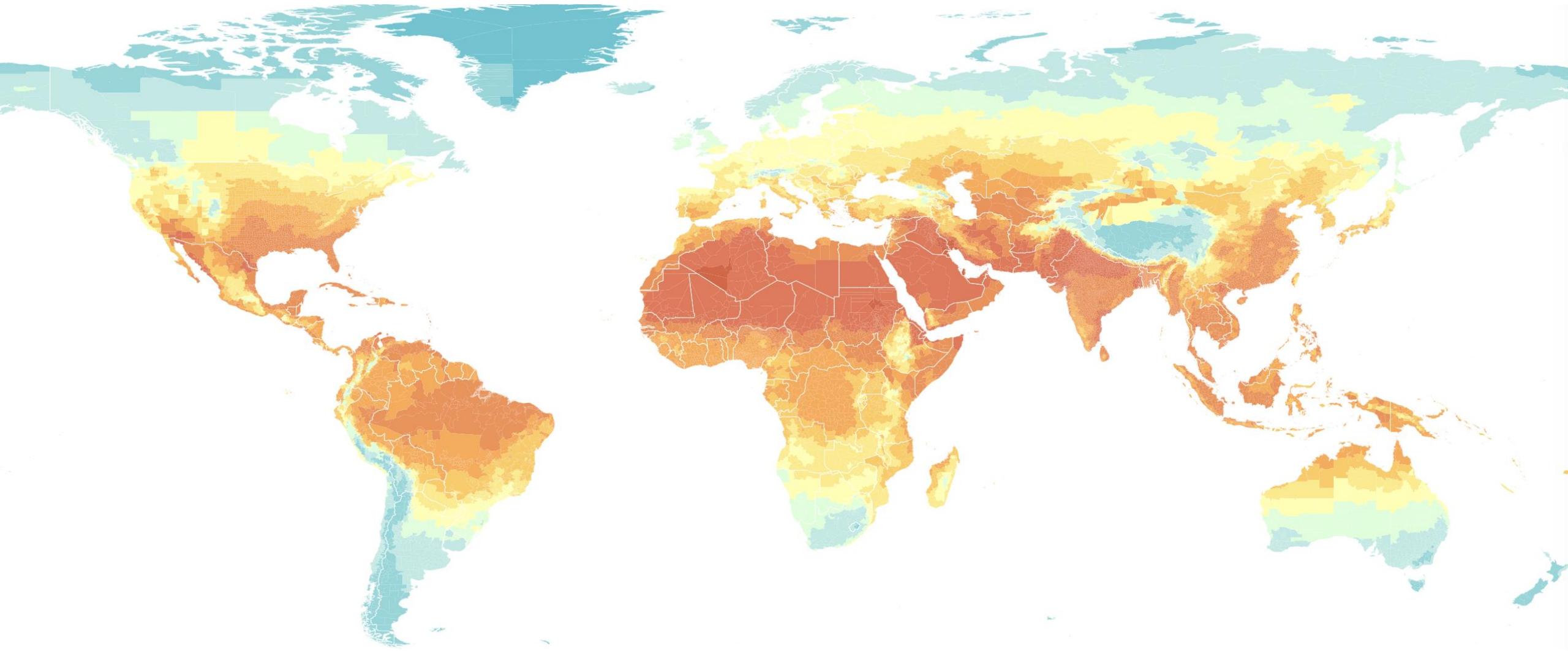
| Regions | Effort sharing according to all emissions (flat carbon tax) (%) | Progressive carbon tax strategies | | | Effort sharing according to a global tax on air tickets (%) |
|------------------|-----------------------------------------------------------------|-----------------------------------|------------|------------|-------------------------------------------------------------|
| | | Strategy 1 | Strategy 2 | Strategy 3 | |
| North America | 21.2 | 35.7 | 46.2 | 57.3 | 29.1 |
| EU | 16.4 | 20.0 | 15.6 | 14.8 | 21.9 |
| China | 21.5 | 15.1 | 11.6 | 5.7 | 13.6 |
| Russia/C. Asia | 6.0 | 6.6 | 6.3 | 6.1 | 2.8 |
| Other Rich | 4.6 | 5.8 | 4.5 | 3.8 | 3.8 |
| Middle East/N.A. | 5.8 | 5.4 | 5.5 | 6.6 | 5.7 |
| Latin America | 5.9 | 4.3 | 4.1 | 1.9 | 7.0 |
| India | 7.2 | 1.0 | 0.7 | 0.0 | 2.9 |
| Other Asia | 8.3 | 4.7 | 4.1 | 2.7 | 12.1 |
| S.S. Africa | 3.1 | 1.5 | 1.5 | 1.1 | 1.1 |
| World | 100 | 100 | 100 | 100 | 100 |

Source: Authors. Air passenger data from World Bank (2015). Key: North Americans represent 46.2% of global emissions released by individuals who emit 2.3 times more than the global average. Individuals who emit more than 2.3 times average emissions (14.3 tCO₂e per year) belong to the top 10% emitters. Note: 27% of individuals emit more than world average emissions (Strategy 1). These estimations focus on consumption-based emissions.

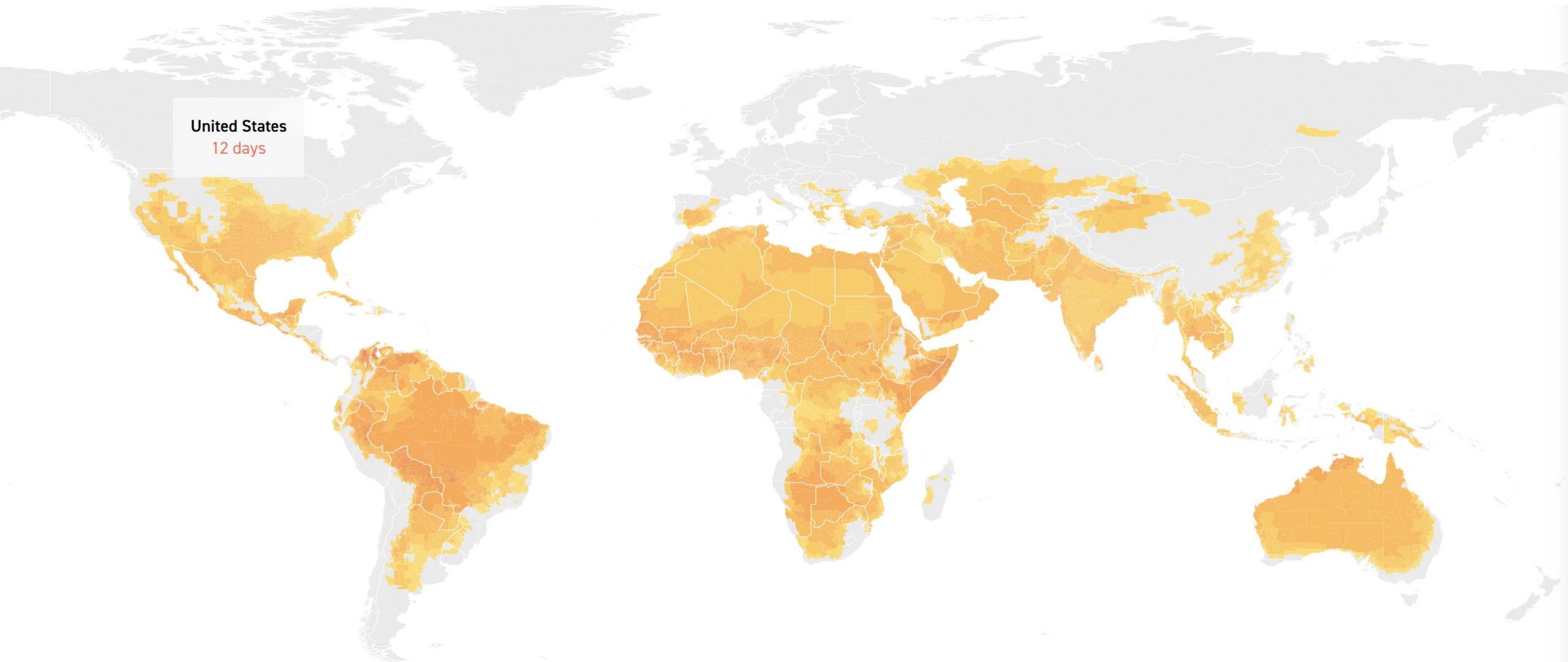
2. Costs

The Costs of Climate change are going to be felt in the poorer part of the world

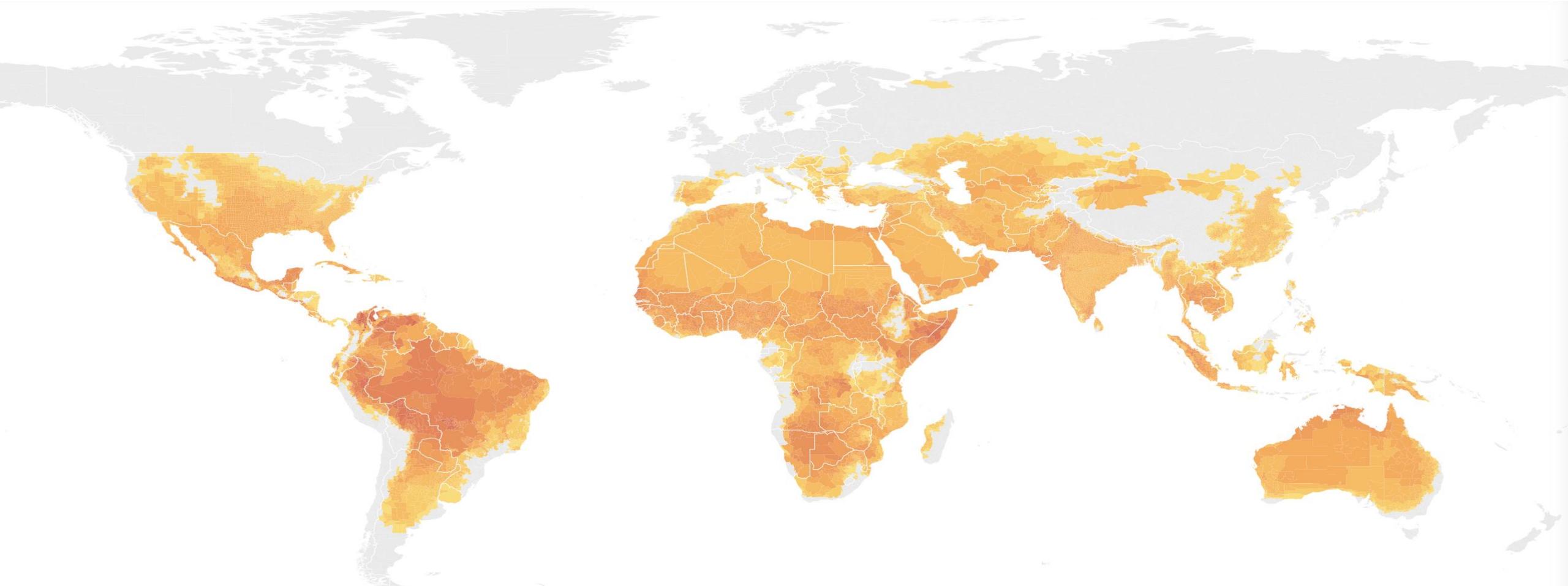
Poorer countries tend to be in warmer places



**In the next 20 years they will add many more very hot days
(>32 degrees)**



And even more so by 2050



Poor countries suffer more from same heat

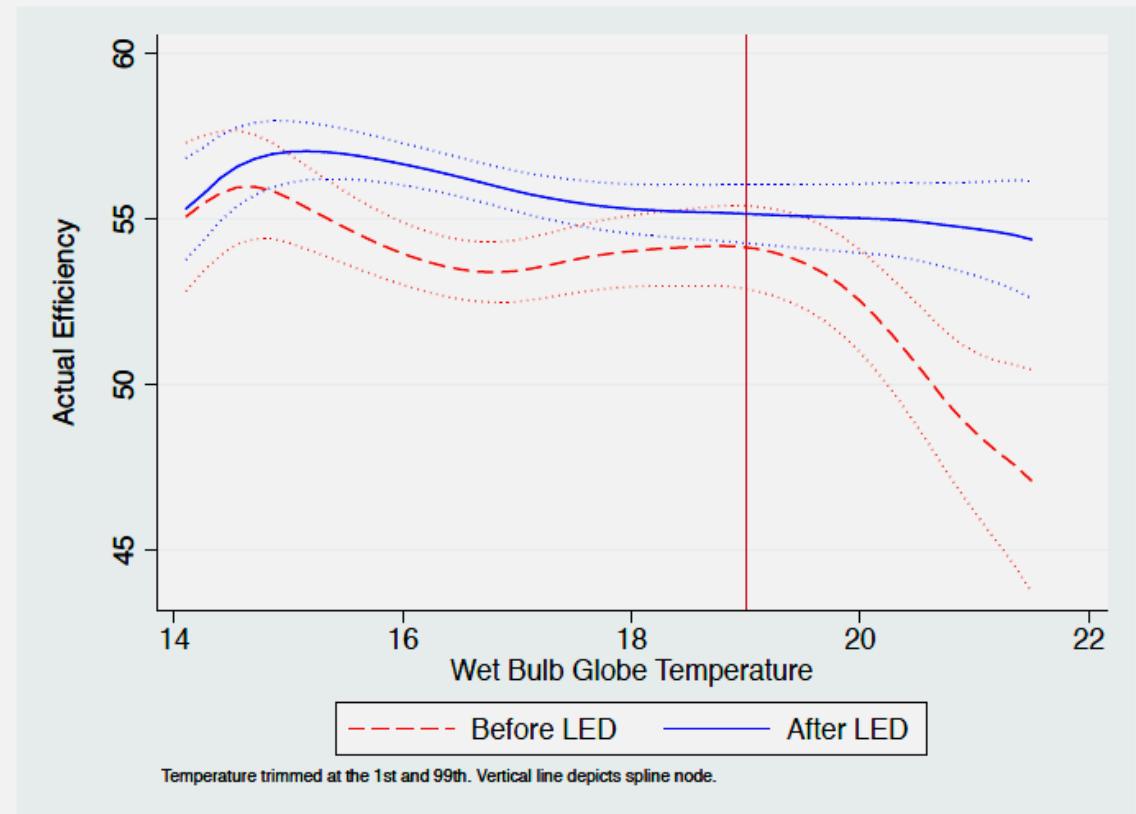
More agriculture

More work outside

Less mitigating technology
(AC and others)

LED mitigates the impact of heat on productivity in Indian textile manufacturers

Figure 3: Efficiency Against Temperature by LED

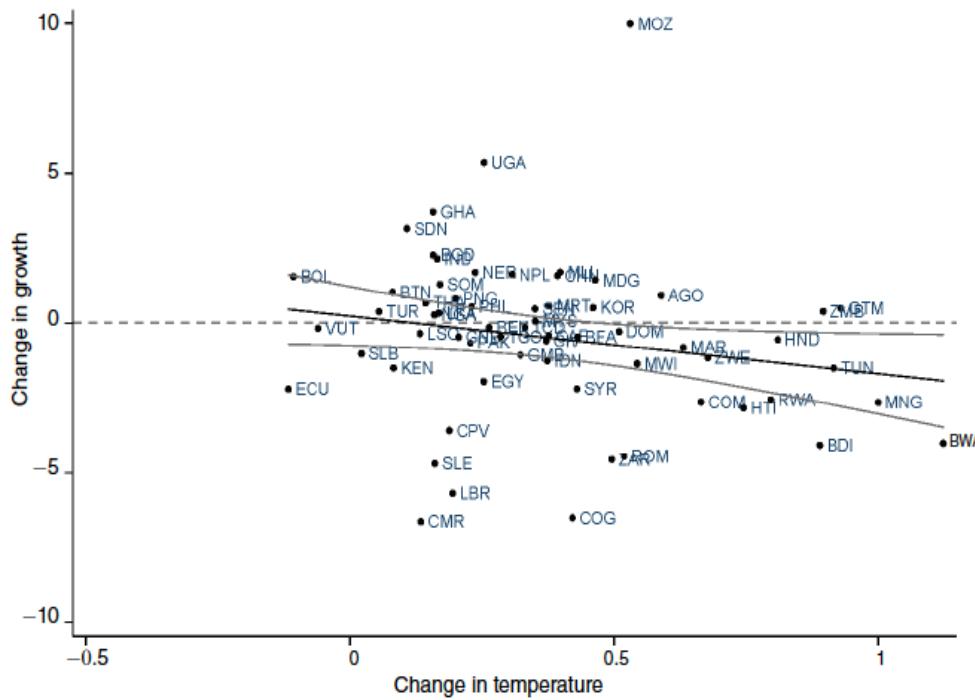


Source: Adhvaryu et al.

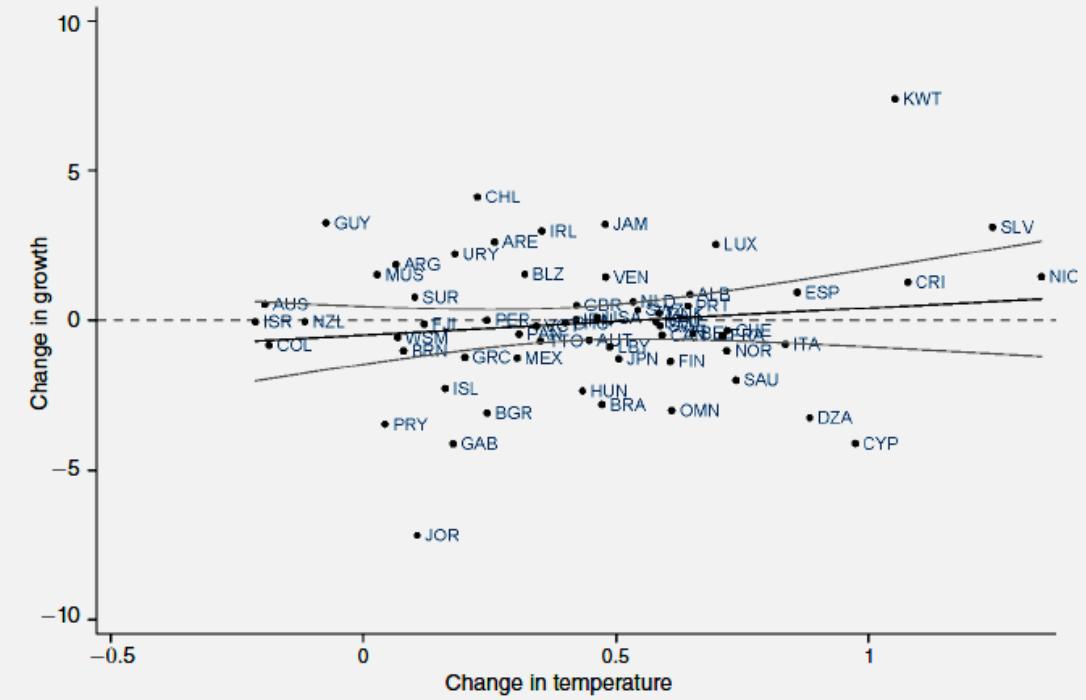
Impact of temperature on growth in poor countries...

and in Rich countries

Panel A. Poor countries



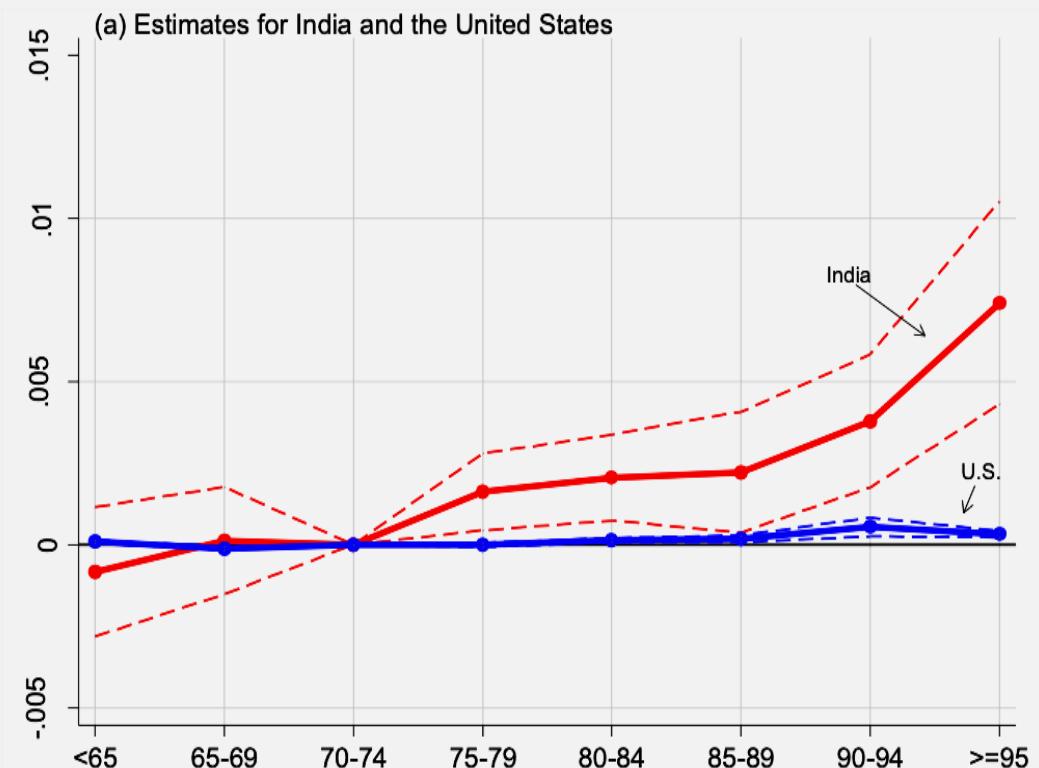
Panel B. Rich countries



Source: Dell, M., Jones, B. F., & Olken, B. A. (2012)

The human cost of a given hot day is larger in poor countries

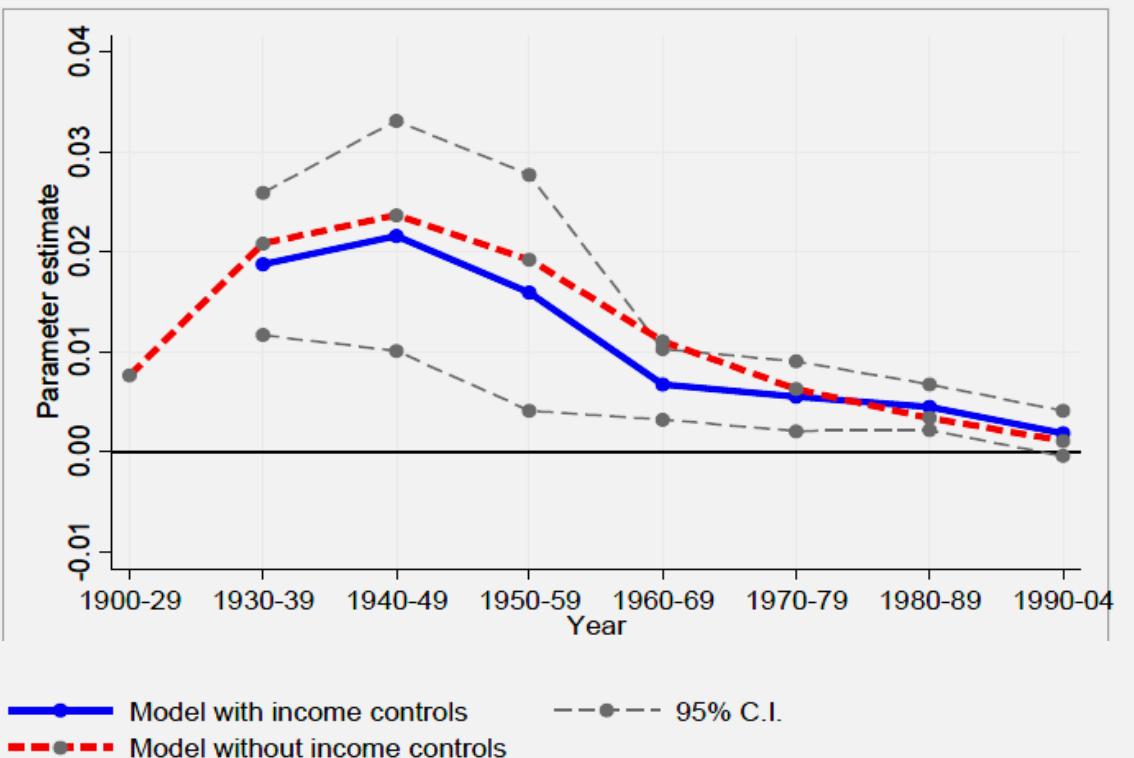
Impact of daily temperature log all-age mortality rates in India and the United States



Source: Burgess, R., Deschenes, O., Donaldson, D., & Greenstone, M. (2017)

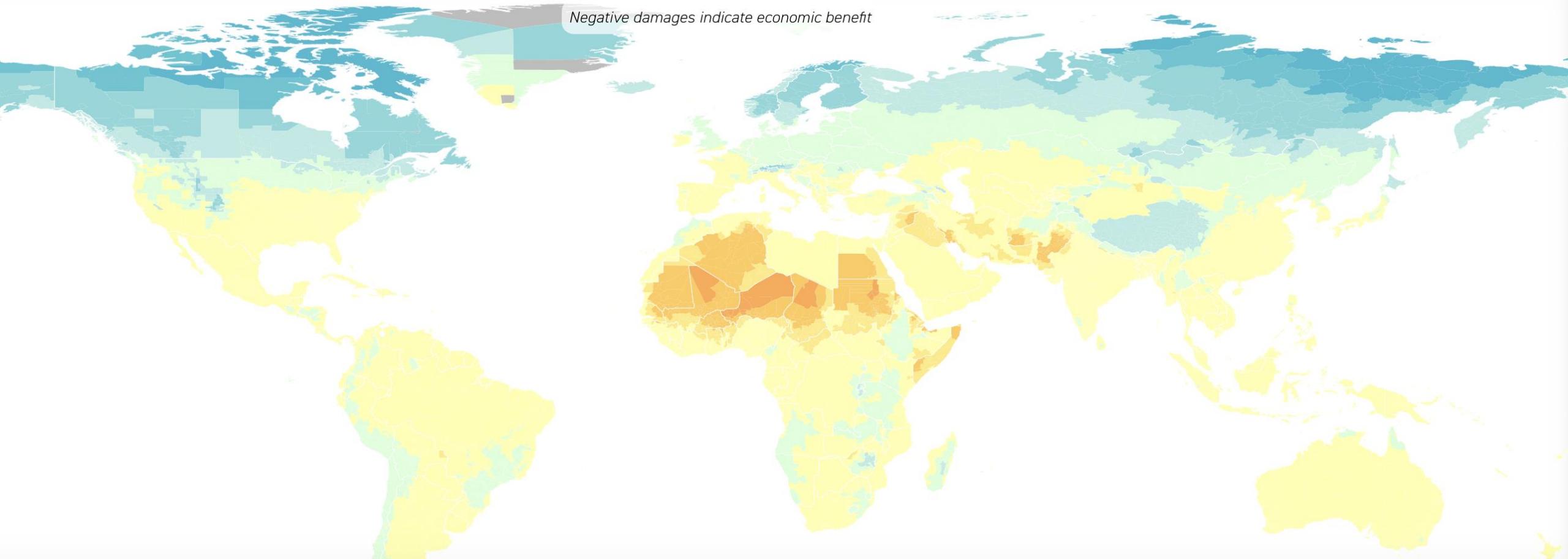
Historical relationship in the US

(a) Temperature-days above 90° F

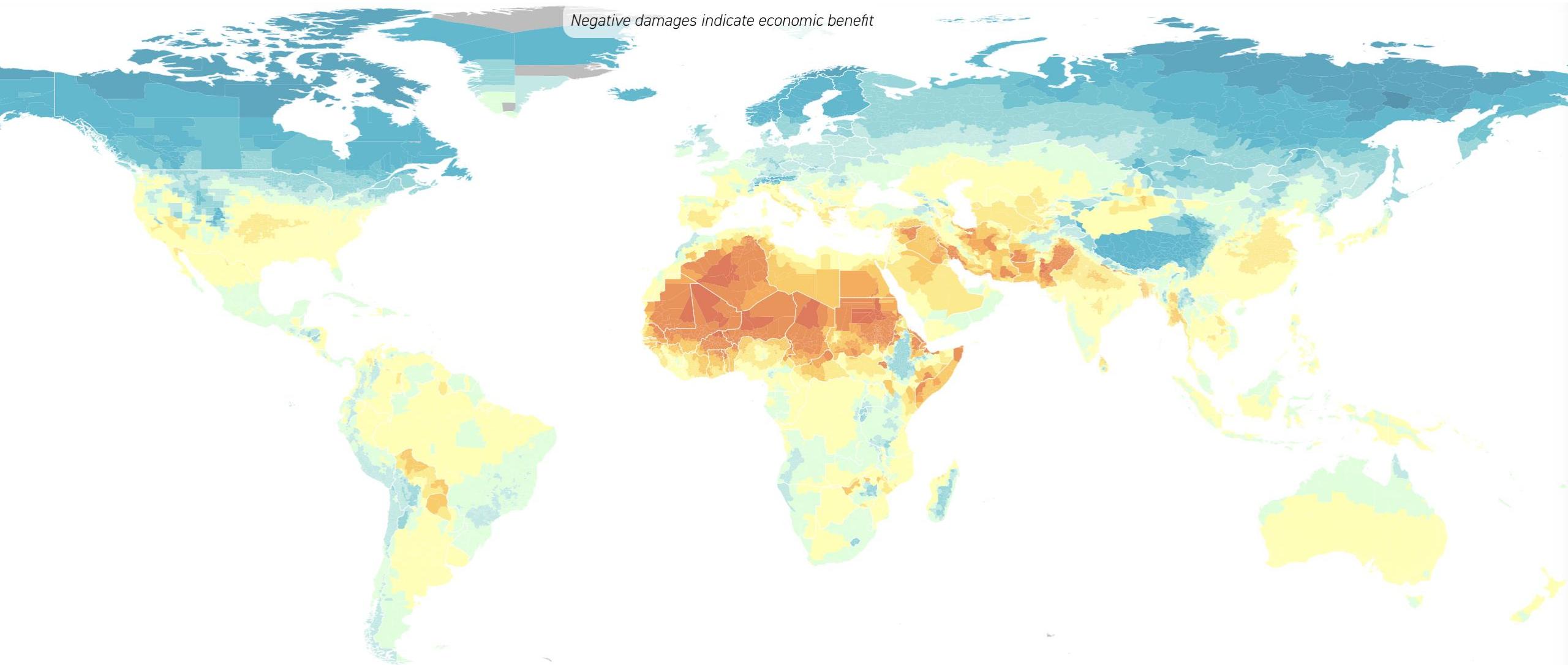


Source: Burgess, R., Deschenes, O., Donaldson, D., & Greenstone, M. (2017)

Mortality costs, next 20 years



Mortality costs, by mid-century



The dilemma of technology

Life saving technology now could make the problem much worse in the future...



Photo: Slawomir Kowalewski | Shutterstock.com

The Kigali agreement planned for phasing out HFC in 2019 in rich countries, 2024 in China and 100 other developing countries, and 2026 in India and Pakistan

3. Act Now

We need to act NOW to prevent
climate change

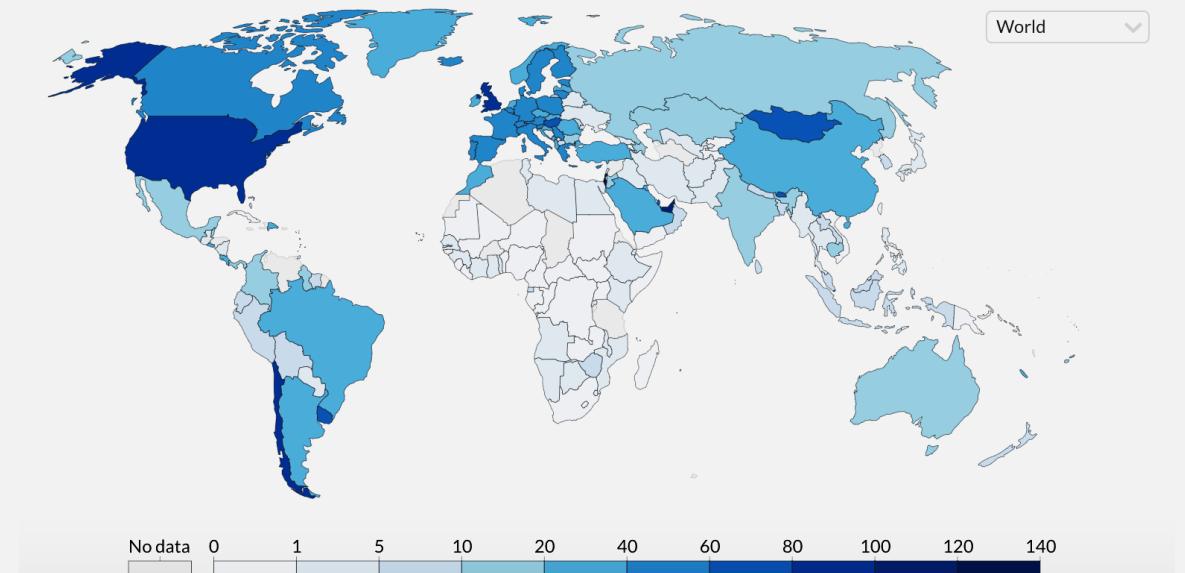
We don't seem to take the idea of a global public good too seriously

When faced with a serious crisis, it is every country for themselves....

So we need to get ahead of it.

COVID-19 vaccine doses administered per 100 people, May 15, 2021
Total number of vaccination doses administered per 100 people in the total population. This is counted as a single dose, and may not equal the total number of people vaccinated, depending on the specific dose regime (e.g. people receive multiple doses).

Our World
in Data



A technological free lunch?

Initial investment can create market size effects

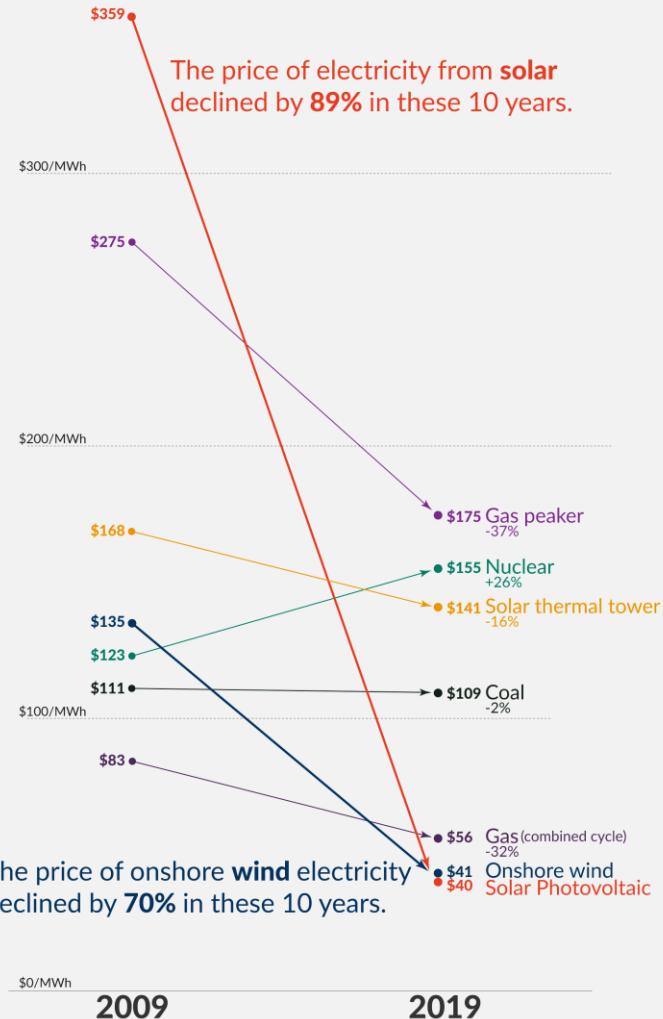
Old technologies would become unprofitable

And everyone will switch

Excitement around new technological solution that would have seemed pie in the sky before: carbone capture, sun dimming, etc.

The price of electricity from new power plants
Electricity prices are expressed in 'levelized costs of energy' (LCOE).
LCOE captures the cost of building the power plant itself as well as the ongoing costs for fuel and operating the power plant over its lifetime.

Our World in Data



The price of onshore wind electricity declined by 70% in these 10 years.

Data: Lazard Levelized Cost of Energy Analysis, Version 13.0
OurWorldInData.org - Research and data to make progress against the world's largest problems.

Licensed under CC-BY
by the author Max Roser.

The issue with technology

Randomized experiment on a weatherization program in the US

1. Demand was low
2. Impact on energy was much lower than expected even among those who took up
3. Energy gains were only half the money spent on weatherization

Figure 3 · Success Rate Across Groups

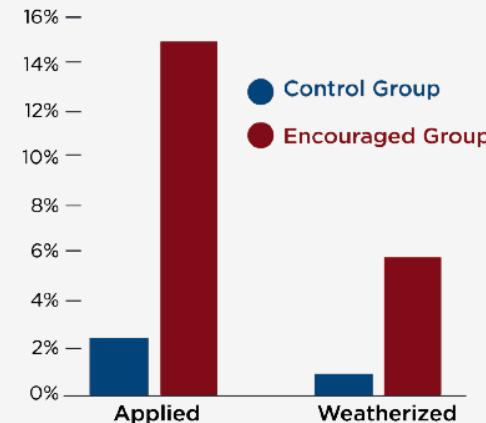


Figure 1 · Average Projected Household Energy Savings

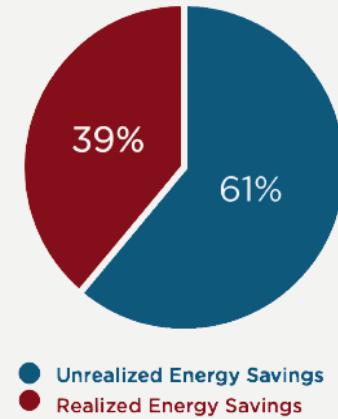
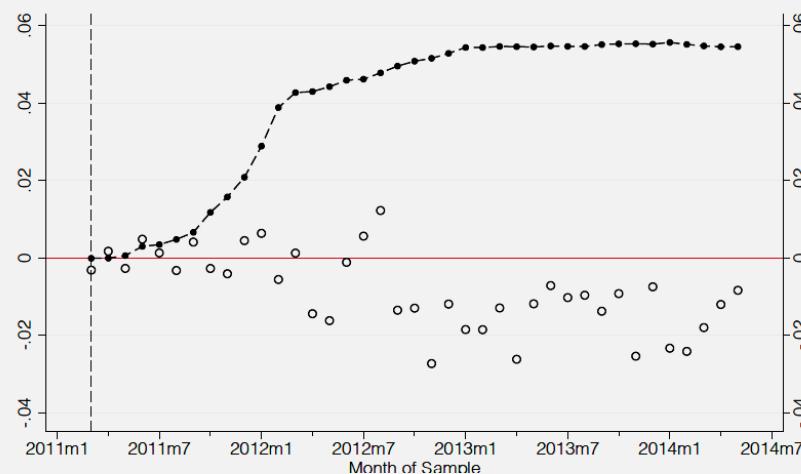


Figure 3: Effect of encouragement on participation and energy consumption

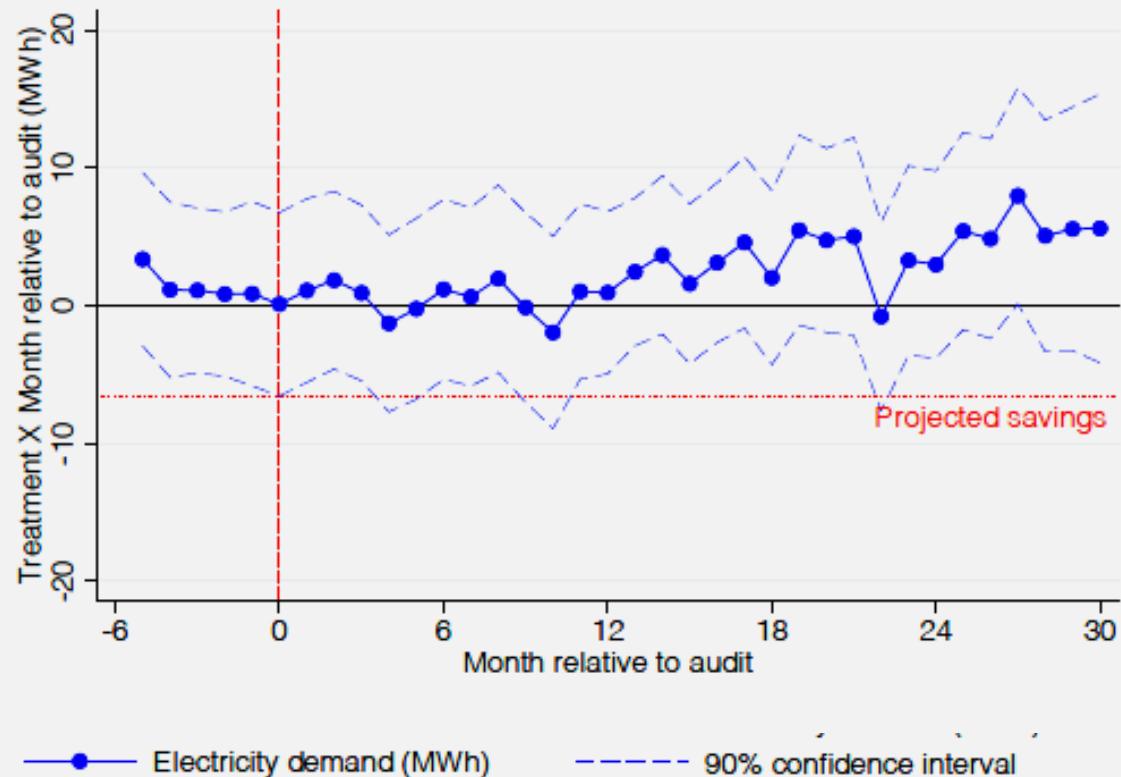


Source: Greenstone et al.

Backfiring effects

In India, free energy audits coupled with credit program to buy new more efficient equipment led to an **increase** in energy demand

Treatment effect on consumption in event time



Source: Ryan, et al.

4. Policy Efforts

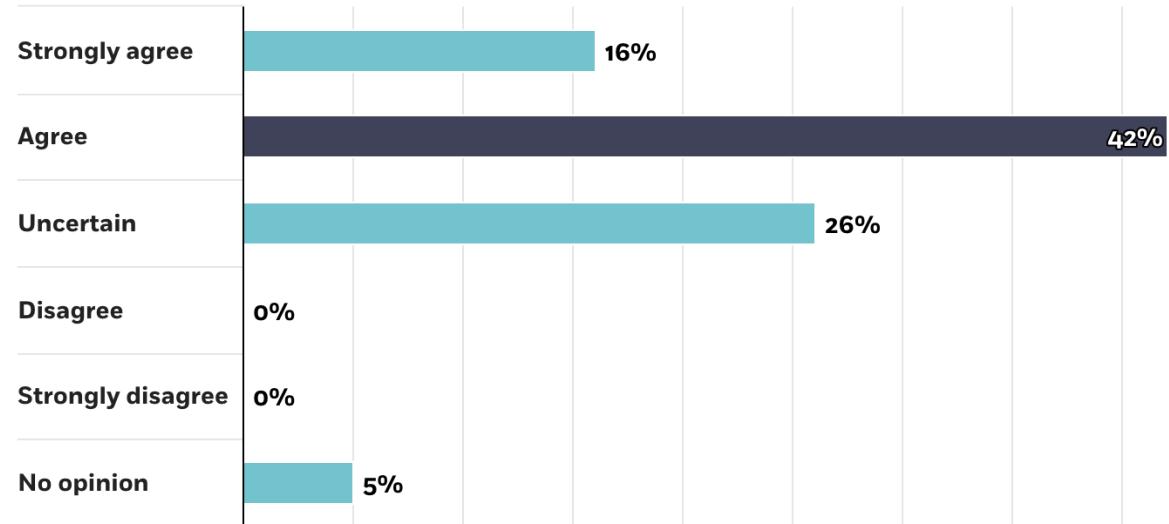
We cannot tackle climate change
without policy efforts

Pricing carbon

- Economists love carbon taxes
- A very natural idea: CO₂ emissions impose a negative externality
- By pricing it at the right level (the “social cost of carbon”), we would restore incentives for people to behave well
- And it is always better to use prices than quantities...

Statement before the panel: Carbon taxes are a better way to implement climate policy than cap-and-trade.

Responses as percentage of full US Economic Experts Panel



Rewarding conservation

| | Village boundaries | | | PFO-level land circles | | |
|-------------------|--------------------------|--------------------------|----------------------------|--------------------------|--------------------------|----------------------------|
| | Δ Tree cover (ha) | Δ Tree cover (ha) | Δ Log of tree cover | Δ Tree cover (ha) | Δ Tree cover (ha) | Δ IHS of tree cover |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Treatment group | 5.549* | 5.478** | 0.0521** | 0.245** | 0.267** | 0.0447* |
| | [2.888] | [2.652] | [0.021] | [0.110] | [0.106] | [0.023] |
| Control group | -13.371 | -13.371 | -0.095 | -0.349 | -0.349 | -0.073 |
| Control variables | No | Yes | Yes | No | Yes | Yes |
| Observations | 121 | 121 | 121 | 995 | 995 | 995 |

RCT in Uganda where people were paid to not cut their trees

Source: Jayachandran et al.

Think beyond Carbon taxes: Changing preferences is possible

While we over-estimate the miracles of technology, we underestimate the capacity of the human being for change.

Remember what we learnt about preferences

- Unclear : perhaps we care about future generations and people in Bangladesh?
- Changeable
- Affected by the social environment
- Susceptible to habits

That means that government mandates and policies can work too.

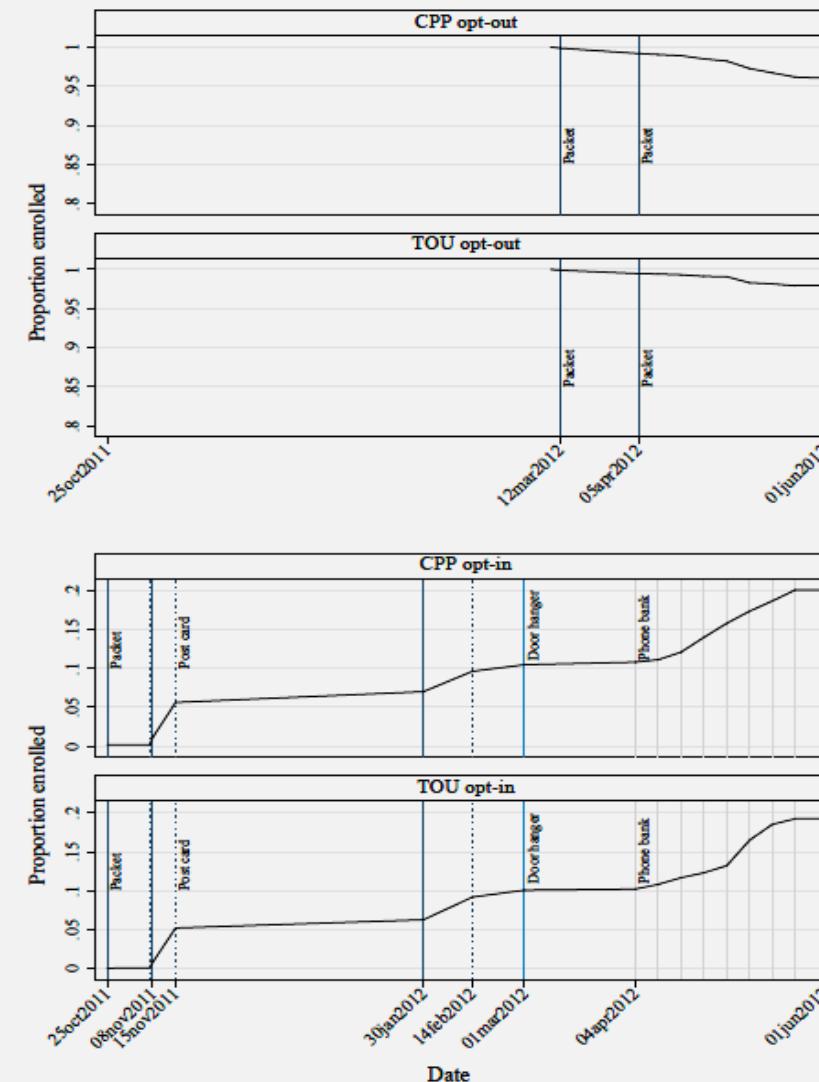
Remember cigarette bans in Italy.

Smart electricity plans in Sacramento

People show a lot of inertia
when opting in the plan...

Or opting out

Figure 3: Encouragement efforts



Reduced form impact of opt in and opt out

Treatment effect of the smart plan

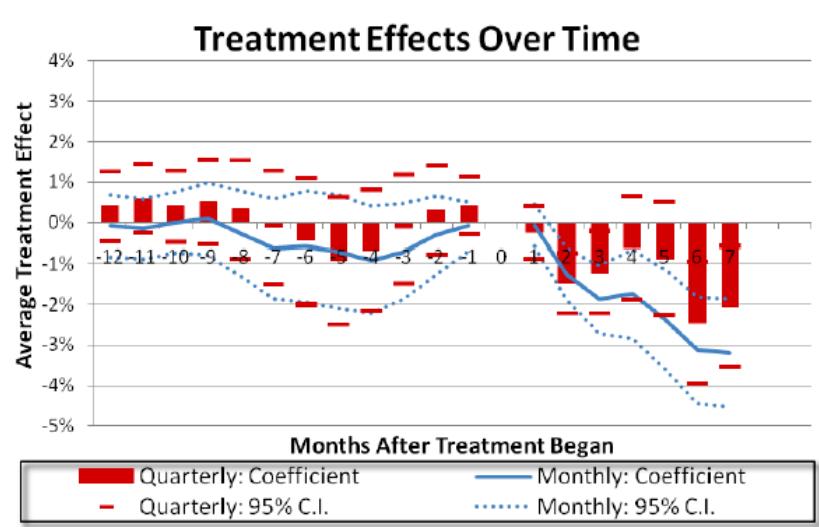
Table 3: Average effects for encouraged groups

| | Critical event | | Non-event peak | |
|---------------------|----------------------|----------------------|----------------------|----------------------|
| | Opt-in | Opt-out | Opt-in | Opt-out |
| Encouragement (CPP) | -0.129*** (0.010) | -0.305*** (0.037) | -0.029*** (0.006) | -0.094*** (0.020) |
| Mean usage (kW) | 2.49 | 2.5 | 1.8 | 1.8 |
| Customers | 55,028 | 46,684 | 55,028 | 46,684 |
| Customer-hours | 4,832,874 | 4,104,263 | 31,198,201 | 26,495,612 |
| Encouragement (TOU) | -0.091*** (0.008) | -0.130*** (0.019) | -0.054*** (0.006) | -0.100*** (0.013) |
| Mean usage (kW) | 2.49 | 2.49 | 1.79 | 1.79 |
| Customers | 58,573 | 48,245 | 58,573 | 48,245 |
| Customer-hours | 5,141,976 | 4,240,163 | 33,195,961 | 27,374,276 |

Table 4: Average effects for treated households

| | Critical event hours | | | Non-event day peak hours | | |
|-----------------|----------------------|----------------------|---------------------|--------------------------|----------------------|----------------------|
| | Opt-in (AJ) | Opt-out (AJ+PC) | Passive (PC) | Opt-in (AJ) | Opt-out (AJ+PC) | Passive (PC) |
| Treatment (CPP) | -0.658*** (0.051) | -0.330*** (0.040) | -0.242** (0.053) | -0.146*** (0.031) | -0.101*** (0.022) | -0.089*** (0.028) |
| Mean usage (kW) | 2.49 | 2.50 | 2.44 | 1.80 | 1.80 | 1.79 |
| Customers | 55,028 | 46,684 | 10,036 | 55,028 | 46,684 | 10,036 |
| Customer-hours | 4,832,874 | 4,104,263 | 880,075 | 31,198,201 | 26,495,612 | 5,679,023 |
| Treatment (TOU) | -0.480*** (0.044) | -0.136*** (0.020) | -0.051* (0.027) | -0.287*** (0.029) | -0.105*** (0.014) | -0.059*** (0.018) |
| Mean usage (kW) | 2.49 | 2.49 | 2.43 | 1.79 | 1.79 | 1.75 |
| Customers | 58,573 | 48,245 | 15,142 | 58,573 | 48,245 | 15,142 |
| Customer-hours | 5,141,976 | 4,240,163 | 1,325,077 | 33,195,961 | 27,374,276 | 8,555,447 |

Short and long run effects of o-power experiments



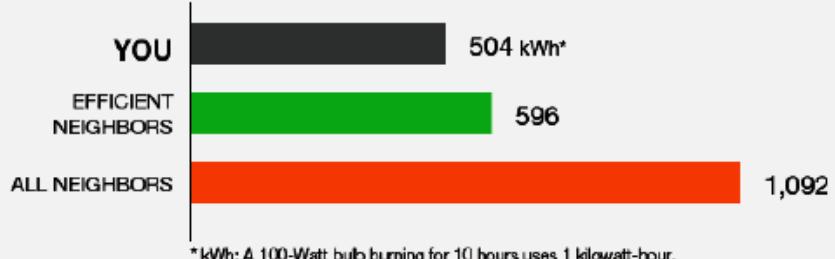
Source: Hunt Alcott

Last Month Neighborhood Comparison

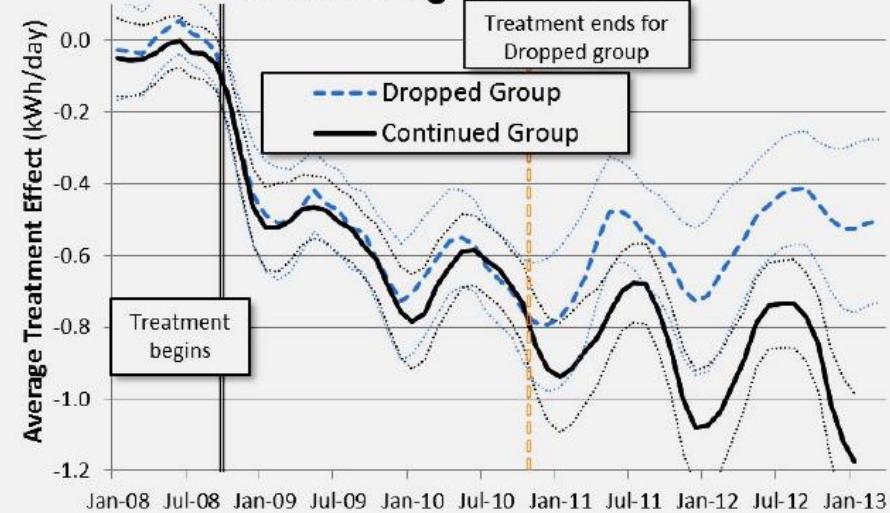
Last month you used 15% LESS electricity than your efficient neighbors.

YOUR EFFICIENCY STANDING:

► GREAT 😊😊
GOOD 😊
BELOW AVERAGE



Site 2: Long-Run Effects



The power of habits

Our tastes are to some extent a matter of habits

For example Indians like the food that was historically grown in their part of India

And migrants continue to like the food they grew up eating

So it seems hard to change...but it is possible! We need an impetus (Policy, incitation, price change) and then we will be fine



Photo: Shutterstock.com

6. Redistribution

We cannot tackle climate change without
tackling redistribution and trust in government

Great discontent around carbon taxes





Hindustan Times

Punjab govt's move to stop free power to farmers 'midsummer madness': Sukhbir

Shiromani Akali Dal core committee meet in Chandigarh on May 30 to consider party's strategy on congress govt's decision to replace it with direct benefit transfer subsidy

Pollution and the difficulty of collective action

Pollution kills

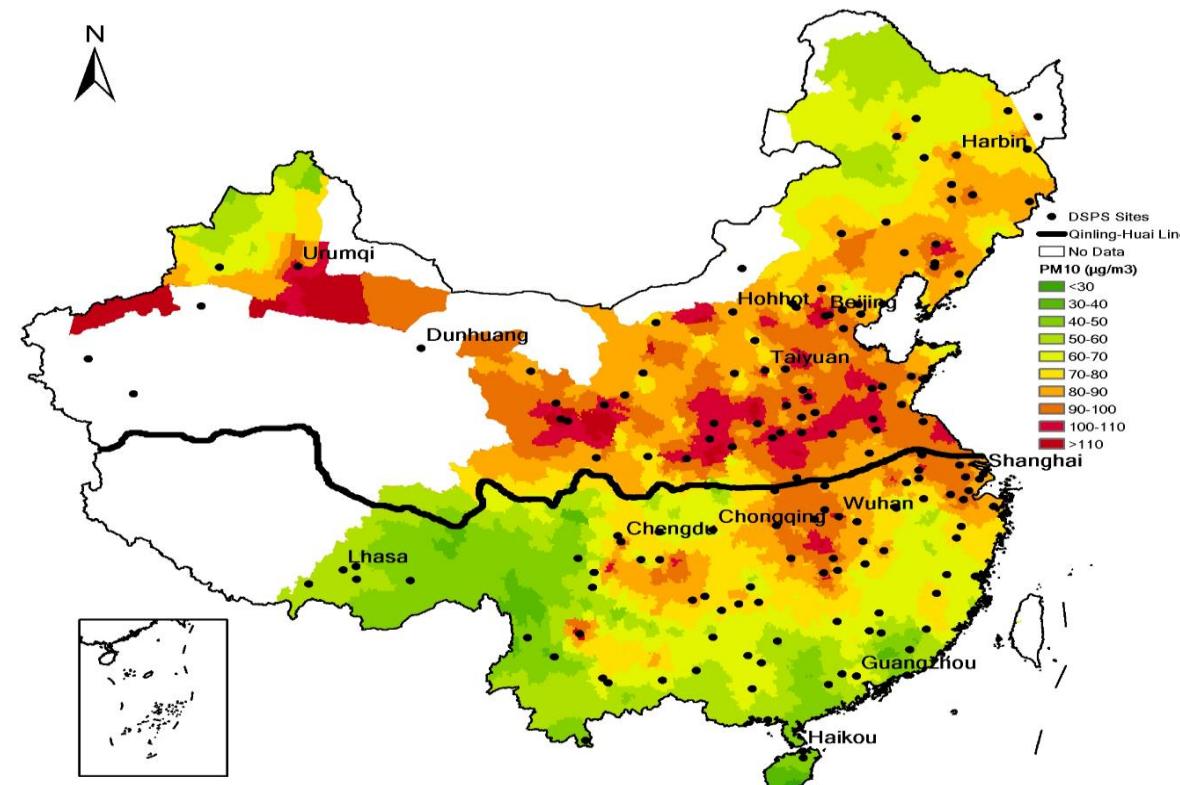
And reduces productivity

TODAY



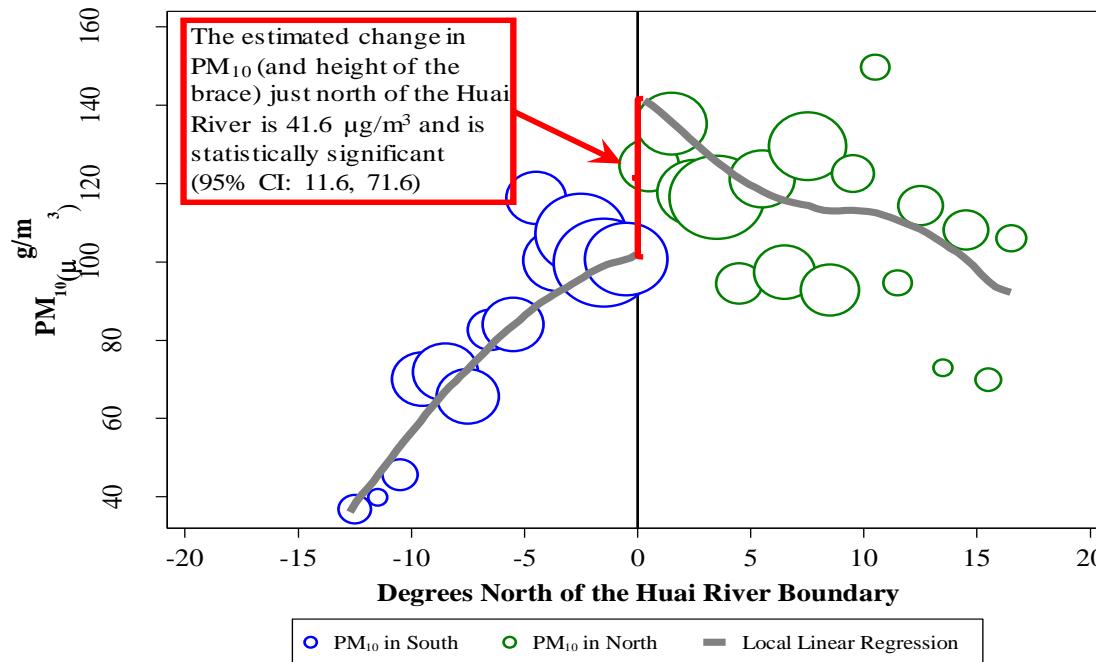
Photo: Saurav022 | Shutterstock.com

Pollution in China and the Huai River/Qinling Mountain Range



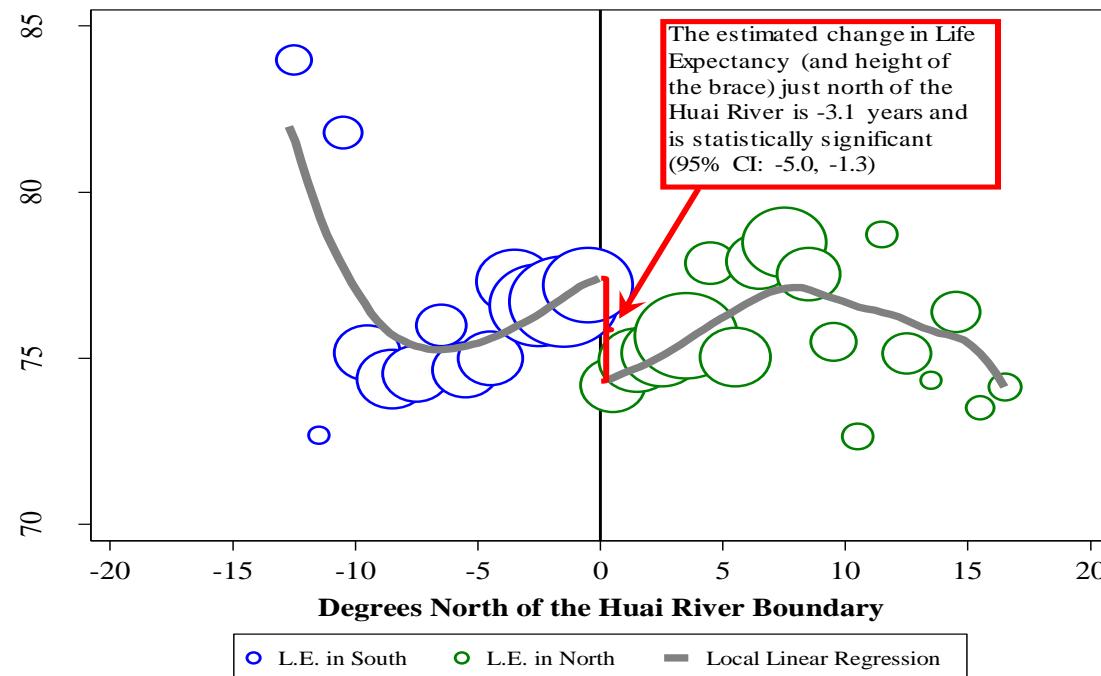
Notes : The cities shown are the locations of the Disease Surveillance Points. Cities north of the solid line were covered by the home heating policy. The figure coloring is generated by interpolating PM₁₀ levels at the 12 nearest pollution monitoring stations to create a high resolution grid of pollution throughout China (.1 degree latitude cell width). Areas are left in white which are not within acceptable range of a station.

Particulate Matter Levels (PM10) South and North of the Huai River Boundary



Notes : Each observation (circle) is generated by averaging PM₁₀ across the Disease Surveillance Point locations within a 1 degree latitude range, weighted by the population at each location. The size of the circle is in proportion to the total population at DSP locations within the 1 degree latitude range. The plotted line reports a local linear regression plot estimated separately on each side of the Huai River.

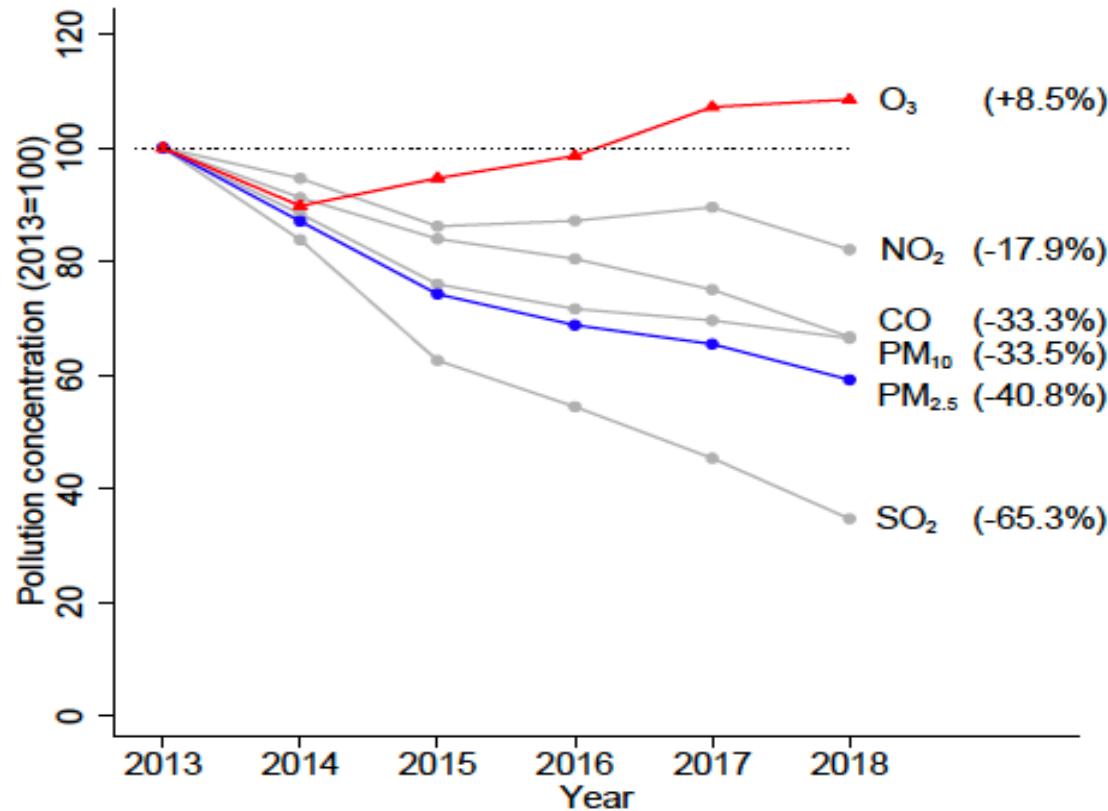
Life Expectancy South and North of the Huai River Boundary



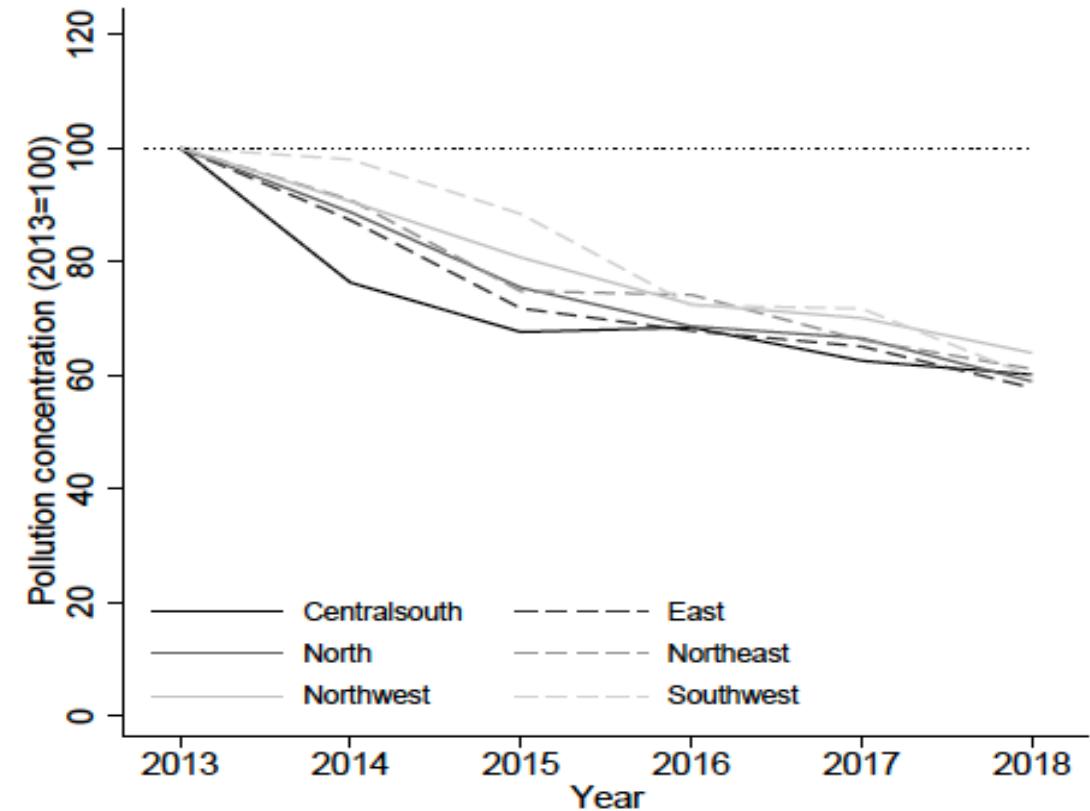
Notes : Each observation (circle) is generated by averaging life expectancy across the Disease Surveillance Point locations within a 1 degree latitude range, weighted by the population at each location. The size of the circle is in proportion to the total population at DSP locations within the 1 degree latitude range. The plotted line reports a local linear regression plot estimated separately on each side of the Huai River.

Success in China

(a) National Level by Pollutants



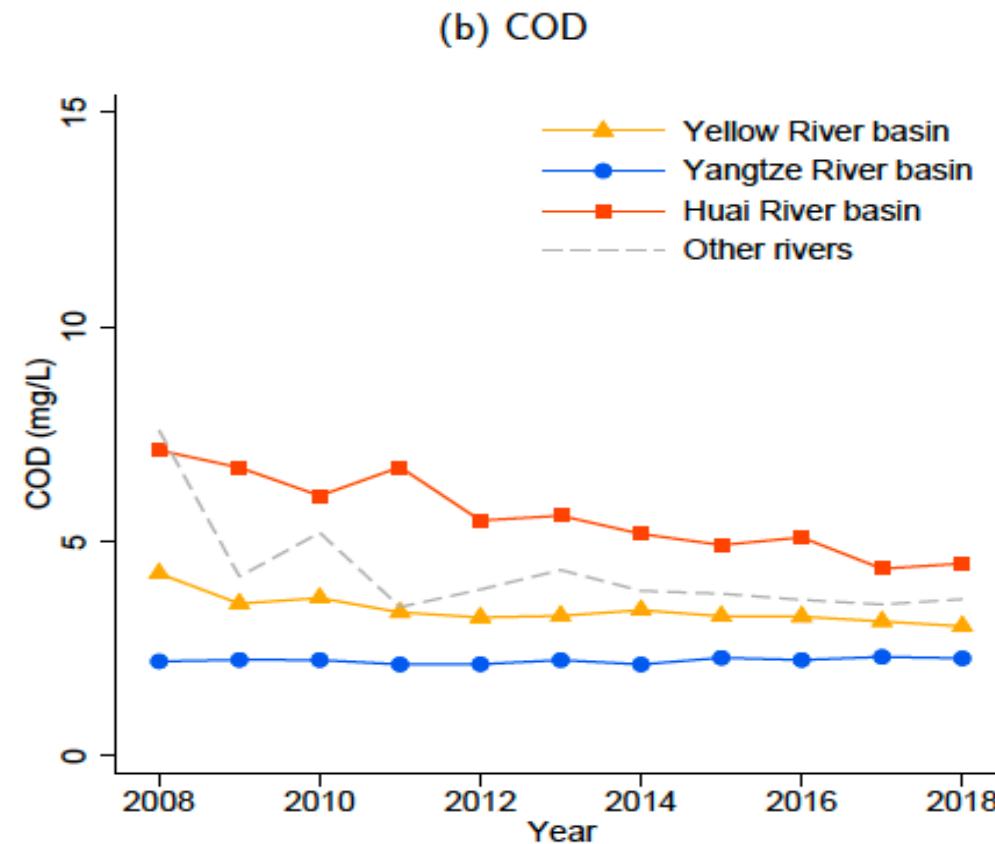
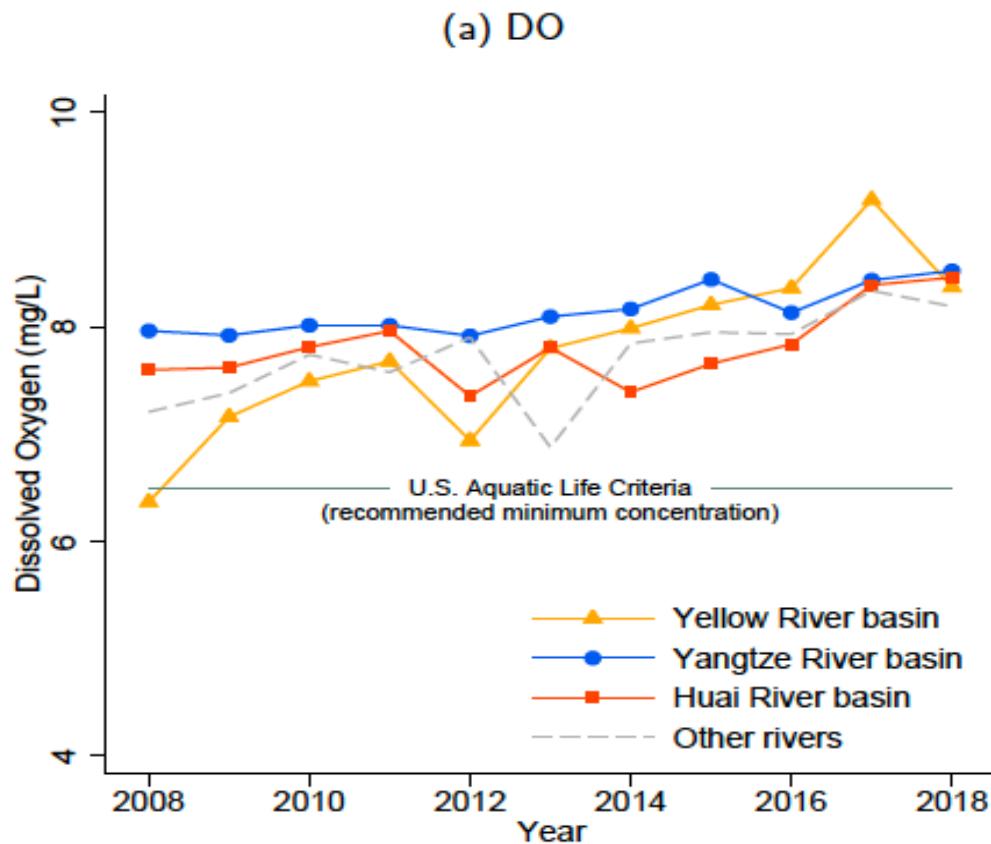
(b) PM_{2.5} by Region



Source: Greenstone et al.

Success in China

Figure 2. Trends in Surface Water Quality at Major River Basins, 2010-2018



Source: Greenstone et al.

Pollution and the difficulty of collective action

Not one silver bullet

But many silver pellets

That could reduce the Delhi
problem drastically

Yet, no progress: difficulty to
make it an agenda and to
share the gains



Photo: Saurav022 | Shutterstock.com

A green new deal? Climate change is unequal, solutions must be equitable

Inequality in the cost and causes of climate change tightly linked to inequality in resources and income

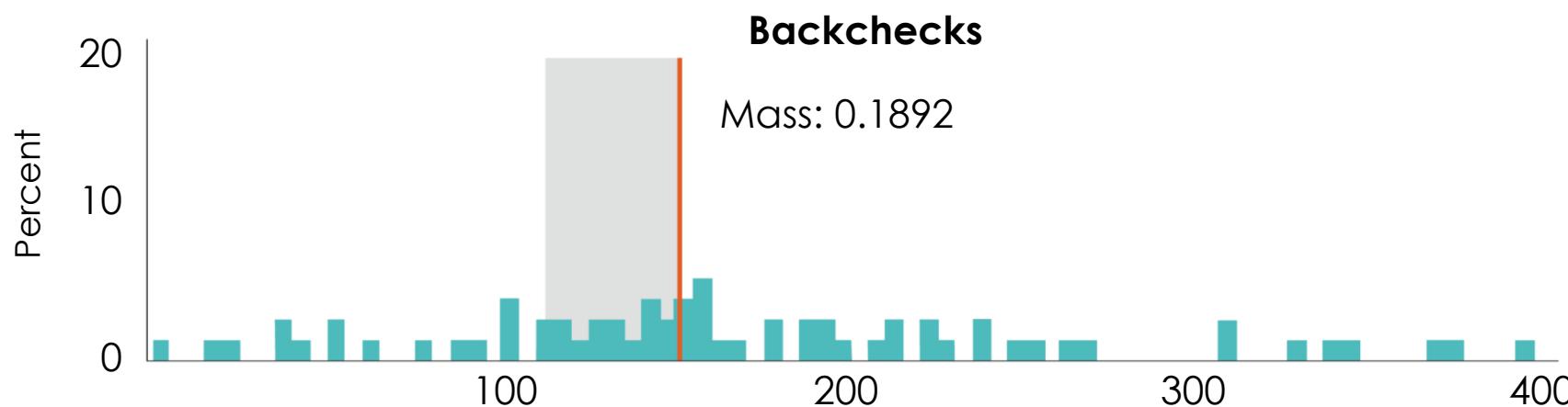
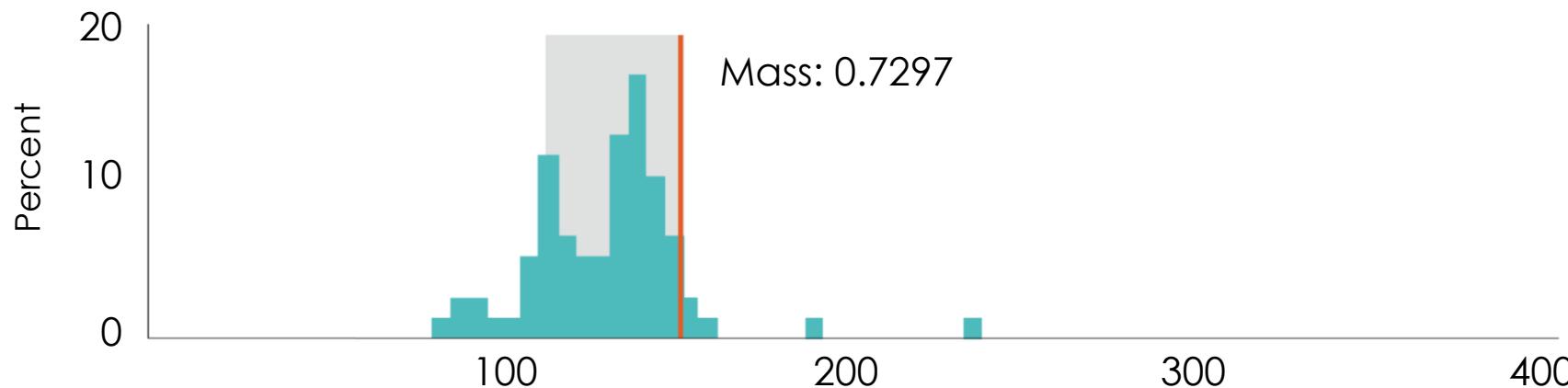
Yet all solutions involve some short run costs that may hit the poor harder

Carbon tax is OK! But it must be progressive. Unless financing is clearly linked to redistribution, it will be seen as an anti-poor program and has no chance to succeed

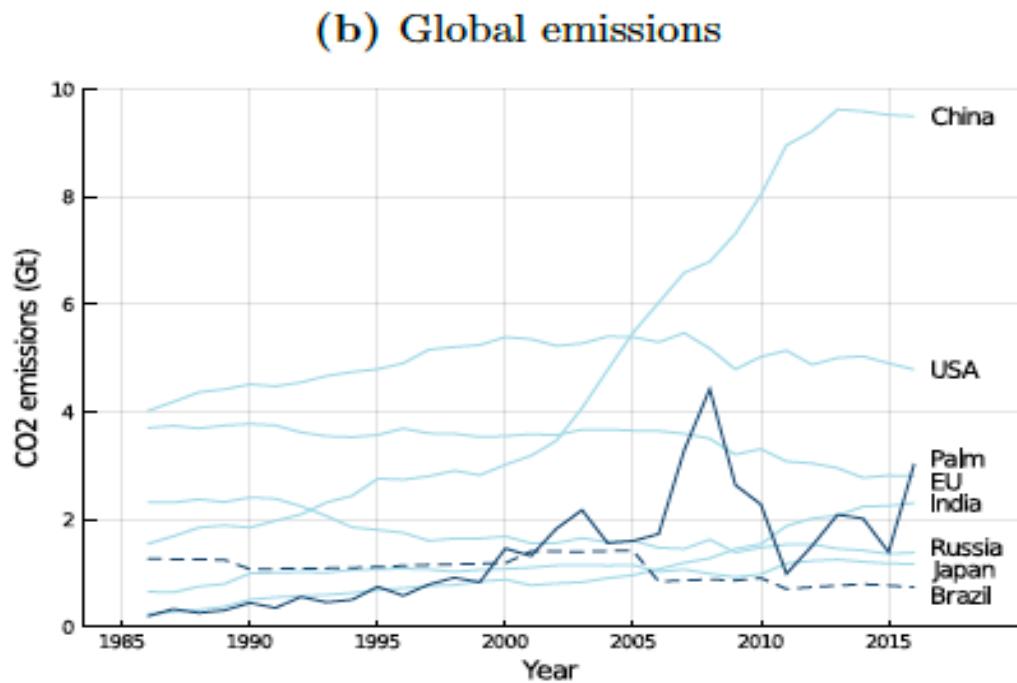
Belief and preferences: easy to think that climate change does not exist. But also that GDP is not the only thing that matters

Regulations must be enforced

Suspended particulate matter, mg/Nm³ | A. Control, Midline



Policies need to be coordinated



Palm oil is becoming a major Co2 emitter...
and Indonesia is a weak enforcer

The Nutella Tax

Can Europe fight Palm Oil production with Tariffs?



Photo: Shutterstock.com

Conclusion

The COVID-19 crisis is a big opportunity
and a big risk

An opportunity

It reminds us that some times, nature is just stronger than us. Some times, dire warnings by experts do come to pass...

It taught us to redistribute

It shows us that some times, we do need government to steer collective action

And it shows us that we can change our lifestyle without being so unhappy about it!



Photo: Shutterstock.com

An opportunity and a risk

For fairly little money, the rich world could do what it takes to vaccinate the world

It would do a lot to establish a common agenda and credibility

And encourage them to participate

But it does not seem to be rushing doing so



Photo: Valeriya Anufriyeva | Shutterstock.com