

**Impacts World 2017,  
Potsdam, 11 October 2017**

# **Avoiding the Unmanageable, Managing the Unavoidable: A Slogan Revisited**

*Professor H. J. Schellnhuber*

*Director, Potsdam Institute for Climate Impact Research;  
Senior Research Fellow, Stockholm Resilience Centre;  
Member, Pontifical Academy of Sciences*



### Nobel Prizes and Laureates

Physics Prizes < 2017 >

- ▼ About the Nobel Prize in Physics 2017
  - Summary
  - Prize Announcement
  - Press Release
  - Advanced Information
  - Popular Information

- Rainer Weiss
- Barry C. Barish
- Kip S. Thorne

All Nobel Prizes in Physics  
All Nobel Prizes in 2017



The Nobel Prize in Physics 2017  
Rainer Weiss, Barry C. Barish, Kip S. Thorne

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## The Nobel Prize in Physics 2017



© Nobel Media. Ill. N. Elmehed  
**Rainer Weiss**  
Prize share: 1/2



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**Barry C. Barish**  
Prize share: 1/4



© Nobel Media. Ill. N. Elmehed  
**Kip S. Thorne**  
Prize share: 1/4

The Nobel Prize in Physics 2017 was divided, one half awarded to Rainer Weiss, the other half jointly to Barry C. Barish and Kip S. Thorne "for decisive contributions to the LIGO detector and the

Watch the 2017 Nobel Prize Announcements **LIVE**

**2017 NOBEL PRIZE ANNOUNCEMENTS**  
*Full schedule*

2017 PHYSICS PRIZE QUESTION

**Did you know that gravitational waves were predicted by Albert Einstein a hundred years ago?**

### First Solution of Einstein's Equations

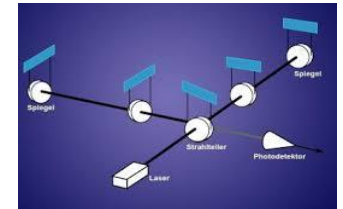
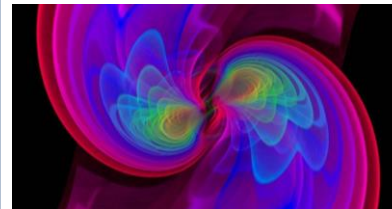


Albert Einstein  
1879-1955



Karl Schwarzschild  
1873-1916

### 11 February 2016: Gravitational Waves Detected, Confirming Einstein's Theory



# Geniuses loci

Field Equations

$$G_{\mu\nu} = \kappa T_{\mu\nu}$$

$$R_{\mu\nu} - \frac{1}{2} g_{\mu\nu} R = \frac{8\pi G}{c^4} T_{\mu\nu}$$

Black-Hole Solution

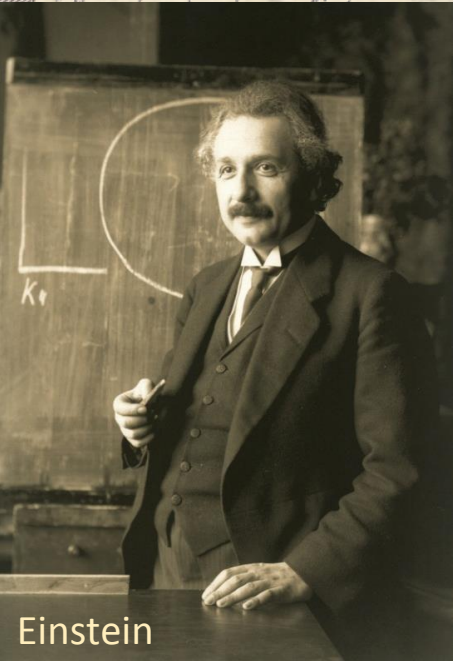
$$ds^2 = \left(1 - \frac{2GM}{r}\right) dt^2 - \left(1 - \frac{2GM}{r}\right)^{-1} dr^2 - r^2 d\Omega^2$$

$$\text{with } d\Omega^2 = d\theta^2 + \sin^2 \theta d\phi^2$$

Radiative Transfer Equation

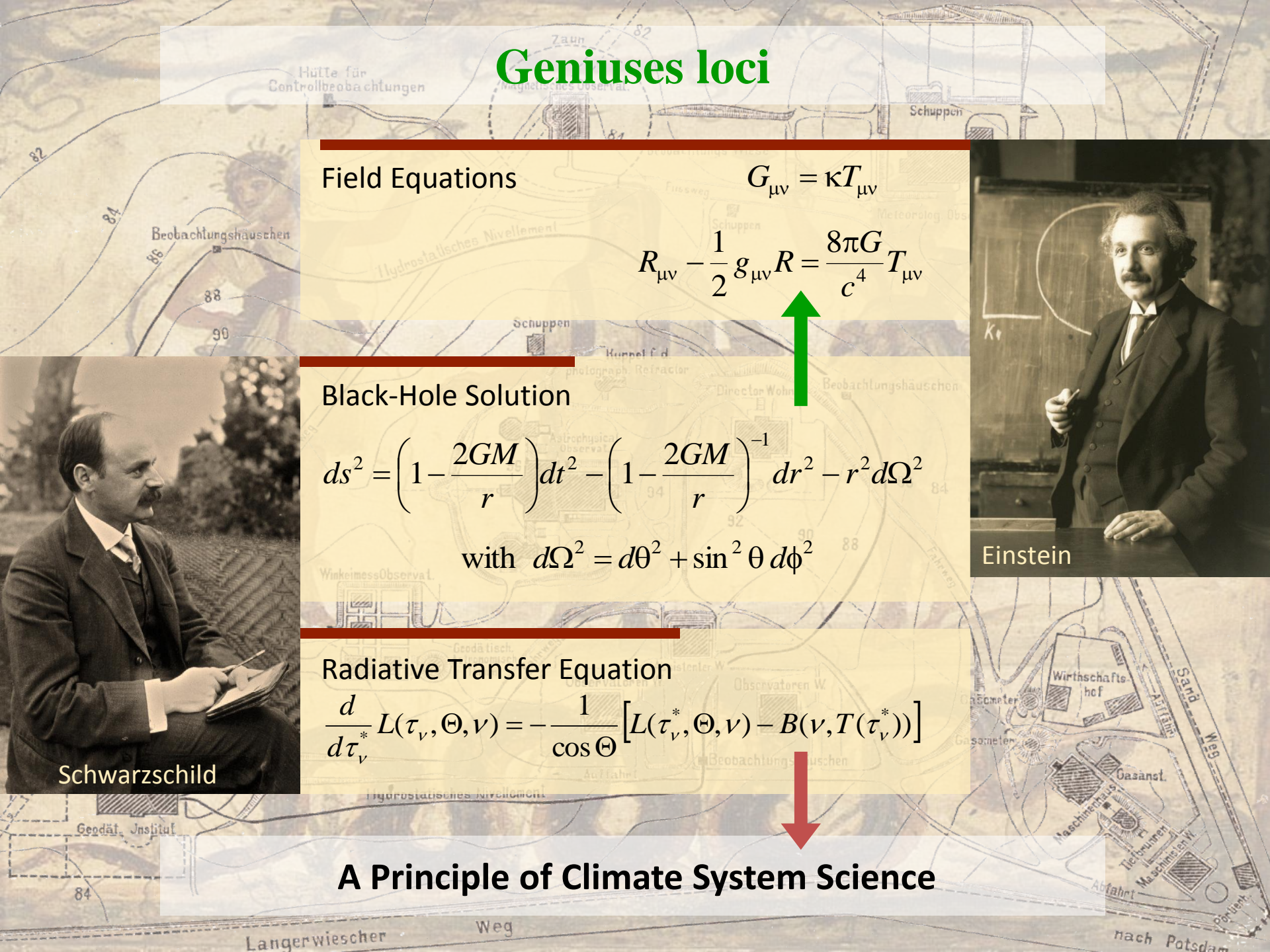
$$\frac{d}{d\tau_\nu^*} L(\tau_\nu, \Theta, \nu) = -\frac{1}{\cos \Theta} \left[ L(\tau_\nu^*, \Theta, \nu) - B(\nu, T(\tau_\nu^*)) \right]$$

Schwarzschild



Einstein

A Principle of Climate System Science



# The „Climate Year“ in Germany



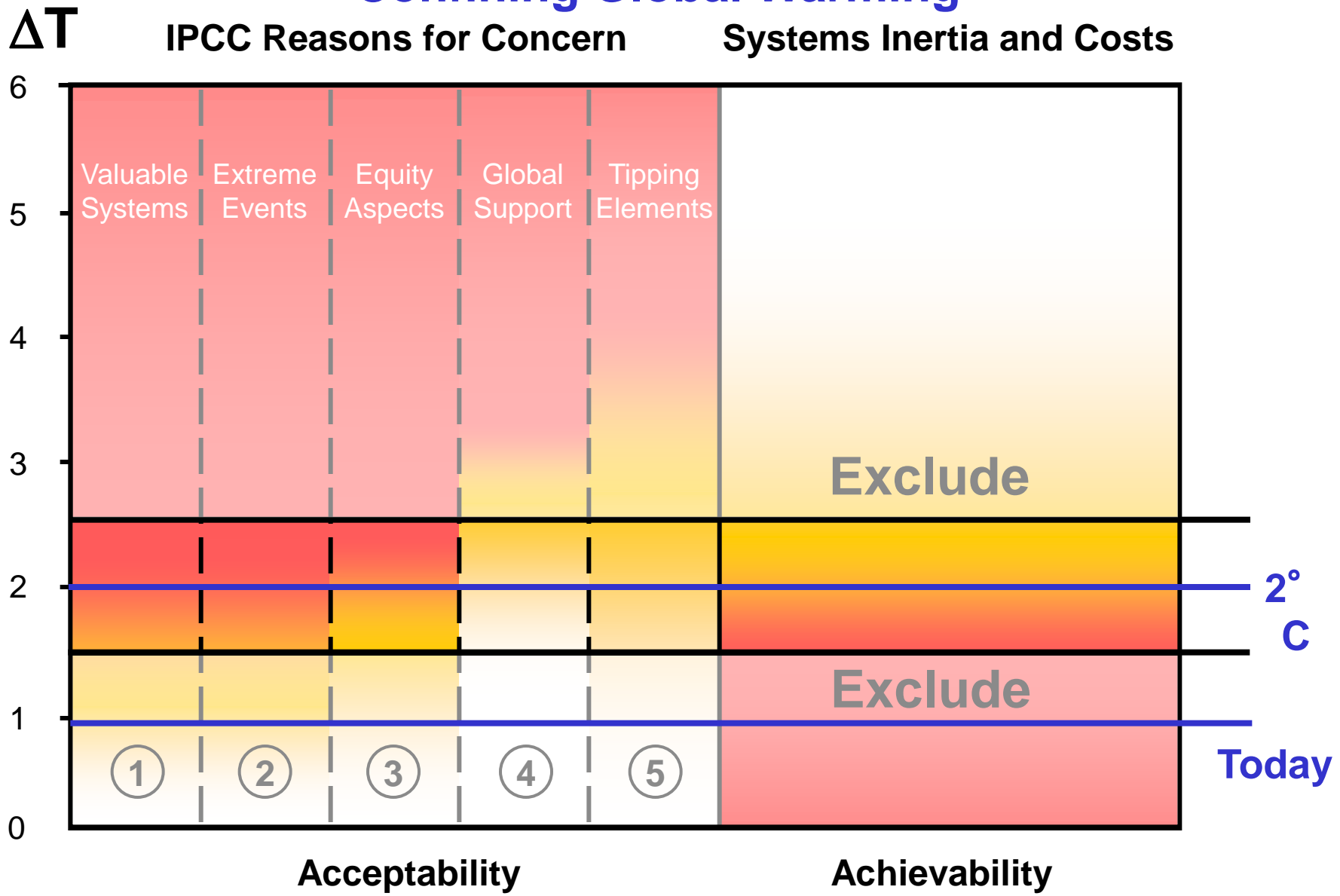
Joint Statement by Chancellor Merkel  
and the Academies of Sciences,  
Berlin, May 2007



G8 (+ 5),  
Heiligendamm, June 2007

# Sherpas Meeting G8 + 5: German Chancellery, Berlin, May 2007

## Confining Global Warming



# The Paris Agreement

Nations Unies

Conférence sur les Changements Climatiques 2015

COP21/CMP11

Paris France



Limiting global warming “well below”

2 degrees Celsius

Net-zero emissions of greenhouse gases by mid-21st century

National emission targets regularly reviewed and tightened

Developed countries provide 100 billion USD per year between 2020-2025

# **Managing the Unavoidable**

# Hurricane Maria: Devastation in Puerto Rico





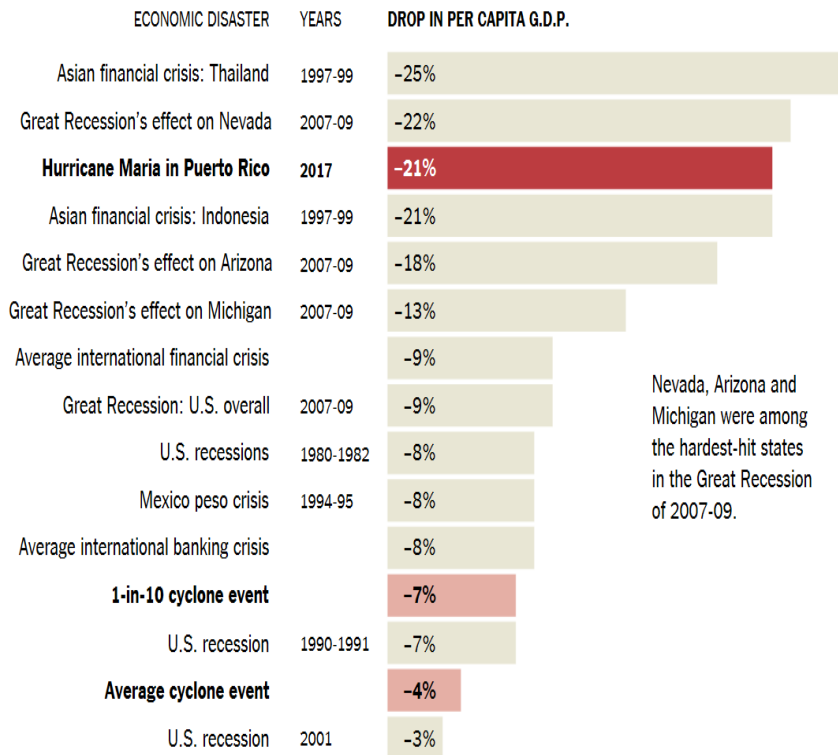
# Hurricane Maria's Impacts

Opinion | OP-ED CONTRIBUTORS

## Don't Let Puerto Rico Fall Into an Economic Abyss

### In Just 12 Hours, an Economic Wipeout

Hurricane devastation in Puerto Rico is expected to have much worse economic effects than many other recent crises that unfolded over months or years.



Source: Hsiang/Houser, NYT 29<sup>th</sup> September 2017

POLITICS

## An Exodus From Puerto Rico Could Remake Florida Politics

By MICHAEL TACKETT OCT. 6, 2017

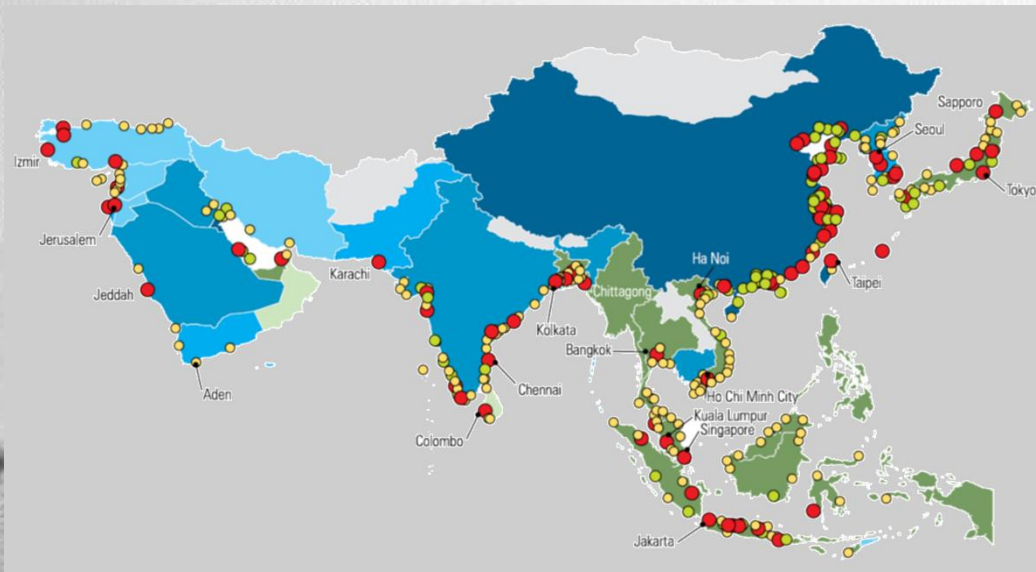


Esteban Garces, state director of Mi Familia Vota, has been working in Florida since 2012 and said his group had registered more than 65,000 voters since then.

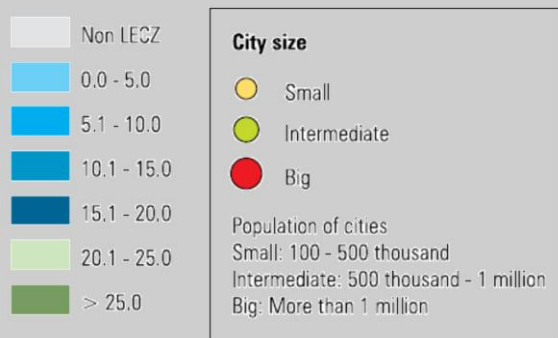
ORLANDO, Fla. — Every day dozens of Puerto Ricans straggle into the Orlando area, fleeing their homes and lives ravaged by Hurricane Maria. In the months to come, officials here said, that number could surge to more than 100,000.

Source: Tackett, NYT 6<sup>th</sup> October 2017

# Rising Seas Could Affect 1.4 Billion People by 2060



## % of national urban population in urban LECZ



**LECZ: Low Elevation Coastal Zones are land areas that are contiguous with the coast and ten metres or less in elevation.**



Source: Daesung Lee, *On the shore of a vanishing island 13, 2011*

See also Geisler & Currens 2017, Land Use Policy



# A REGION AT RISK

## THE HUMAN DIMENSIONS OF CLIMATE CHANGE IN ASIA AND THE PACIFIC

ASIAN DEVELOPMENT BANK



### Project Syndicate

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English



## Asian Cities' Endless Summer

Sep 11, 2017 | HANS JOACHIM SCHELLNHUBER , BAMBANG SUSANTONO

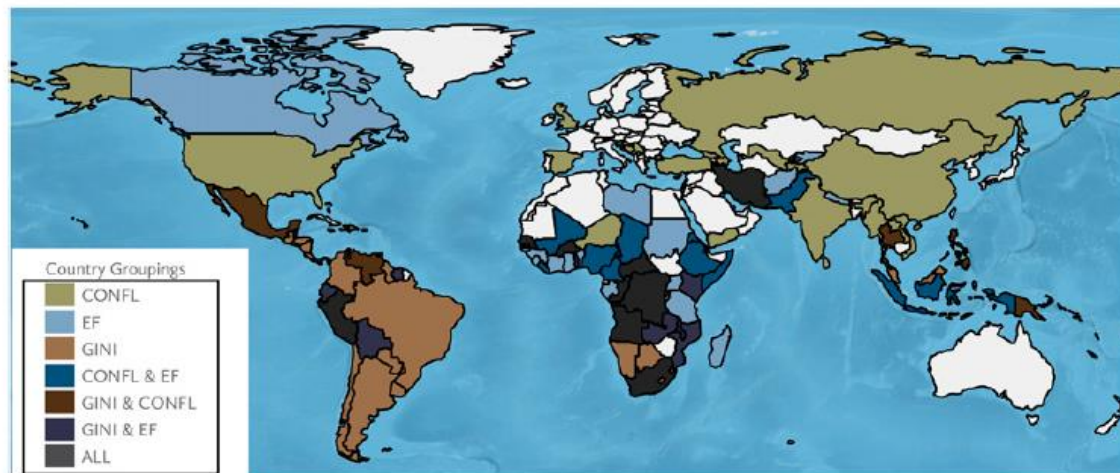
*Asia's urban areas already experience twice as many hot days as its rural areas do – and could experience ten times as many by 2100. And so far, governments have not done nearly enough to assess Asia's exposure to climate impacts, much less to strengthen protections for vulnerable areas or reduce greenhouse-gas emissions.*

**P**OTSDAM/MANILA – It's monsoon season in Asia – marking an end to months of scorching temperatures. But the extreme heat will return, with cities facing particularly brutal conditions. Already, Asia's urban areas experience twice as many hot days as its rural areas do – and could experience ten times as many by 2100. At that point, there will be no reversing the trend.



# Armed-conflict risks enhanced by climate-related disasters in ethnically fractionalized countries

Carl-Friedrich Schleussner<sup>a,b,c,1</sup>, Jonathan F. Donges<sup>a,d</sup>, Reik V. Donner<sup>a</sup>, and Hans Joachim Schellnhuber<sup>a,e,1</sup>



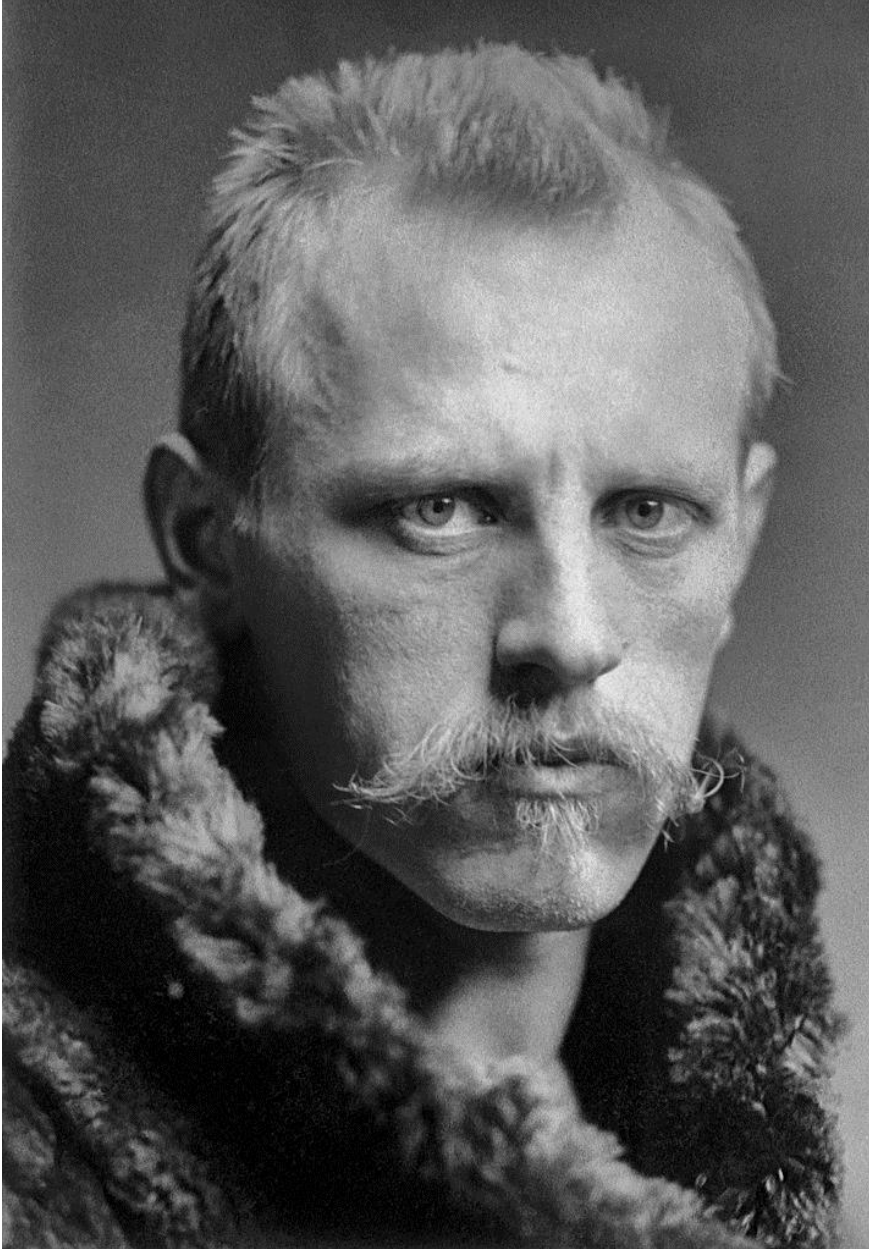
Mapping of countries according to different analysis criteria including countries with more than one conflict (CONFL), the 50 countries with the highest Gini coefficient (GINI), as well as the 50 countries with the highest ethnic fractionalization (EF).

9216-9221 | PNAS | August 16, 2016 | vol. 113 | no. 33

Picture: S. Salgado, Exodus

# Managed Global Migration in a +2°C-World?

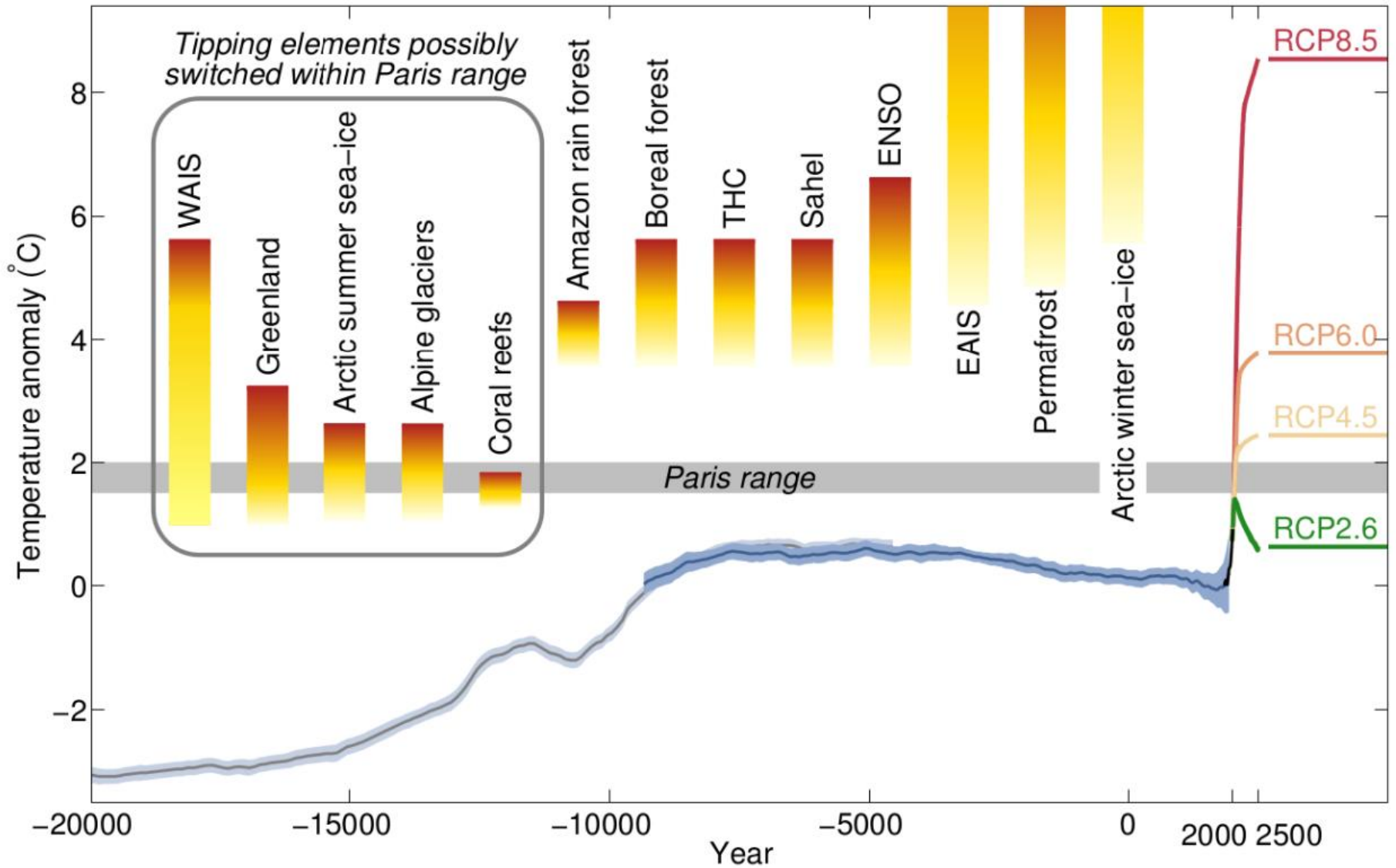
- **Immigration Quota**  
According to National Cumulative Emissions?
- **Nansen Passport** for Climate Refugees?
- **Global Green Card?**



Fridtjof Nansen, 1897.  
Godfather of Polar Research;  
Peace Nobel Laureate

# **Avoiding the Unmanageable**

# Tipping Points Related to 2°C-Guardrail







## CLIMATE POLICY

# *A roadmap for rapid decarbonization*

Emissions inevitably approach zero with a “carbon law”

By **Johan Rockström**,<sup>1</sup> **Owen Gaffney**,<sup>1,2</sup>  
**Joeri Rogelj**,<sup>3,4</sup> **Malte Meinshausen**,<sup>5,6</sup>  
**Nebojsa Nakicenovic**,<sup>4</sup> **Hans Joachim Schellnhuber**<sup>1,5</sup>

pose framing the decarbonization challenge in terms of a global decadal roadmap based on a simple heuristic—a “carbon law”—of halving gross anthropogenic carbon-dioxide (CO<sub>2</sub>) emissions every decade. Comple-

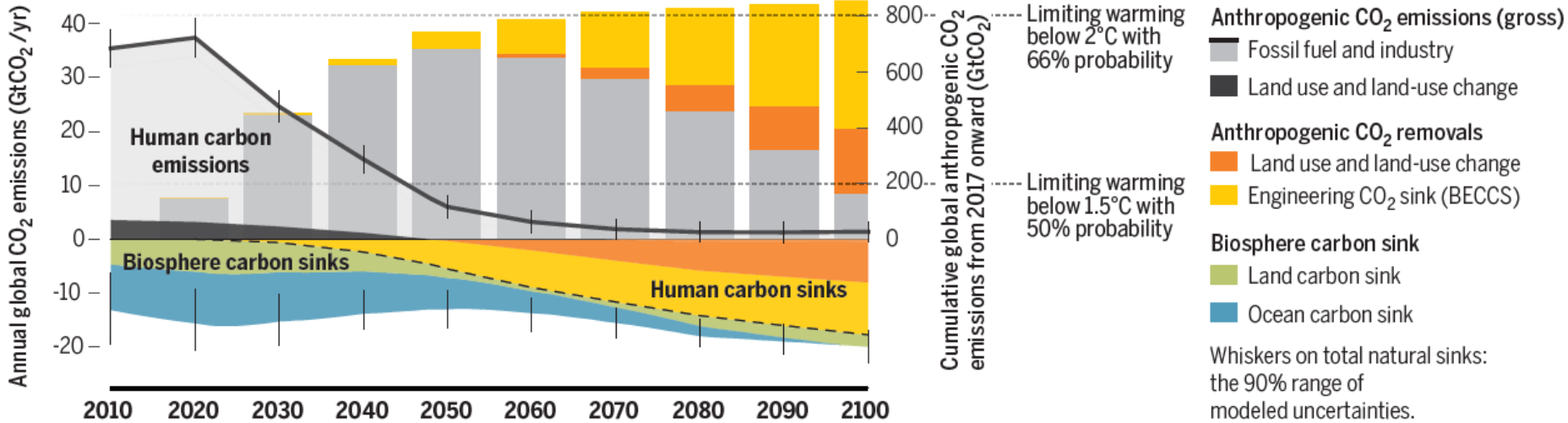
The road to global decarbonization must involve renewable energy, as from these wind turbines in Germany, and improved transportation technologies.

sistent with the trajectory of the past decade (see the figure, bottom left). All sectors (e.g., agriculture, construction, finance, manufacturing, transport) need comparable transformation pathways. In addition, in the absence of viable alternatives, the world must aim at rapidly scaling up CO<sub>2</sub> removal by technical means from zero to at least 0.5 GtCO<sub>2</sub>/year by 2030, 2.5 by 2040, and 5 by 2050. CO<sub>2</sub> emissions from land-use must decrease along a nonlinear trajectory from 4 GtCO<sub>2</sub>/year in 2010, to 2 by 2030, 1 by 2040, and 0 by 2050 (see the figure, bottom right). The endgame is for cumulative CO<sub>2</sub> emissions since 2017 to be brought back from around 700 GtCO<sub>2</sub> to below 200 GtCO<sub>2</sub> by the end of the century (see the figure, top) and atmospheric CO<sub>2</sub> concentrations to return to 380 ppm by 2100 (currently at 400 ppm).

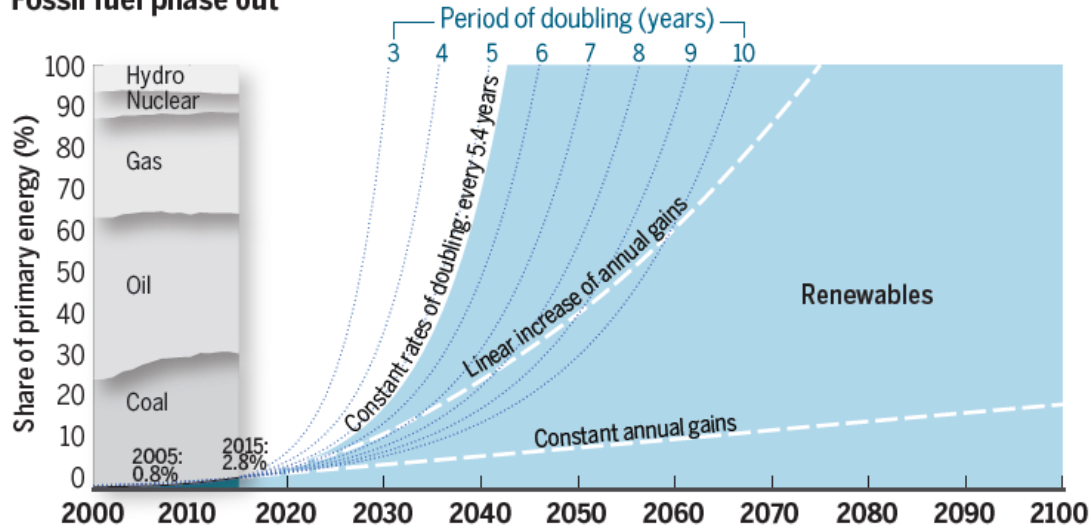
Roadmaps are planning instruments, linking shorter-term targets to longer-term goals. They help align actors and organizations to investigate technological and institutional breakthroughs to meet a collective challenge. An explicit carbon roadmap for halving anthropogenic emissions every decade, codesigned by and for all industry sectors, could help promote disruptive, nonlinear technological advances toward a zero-emissions world. The

# The Transformation Roadmap

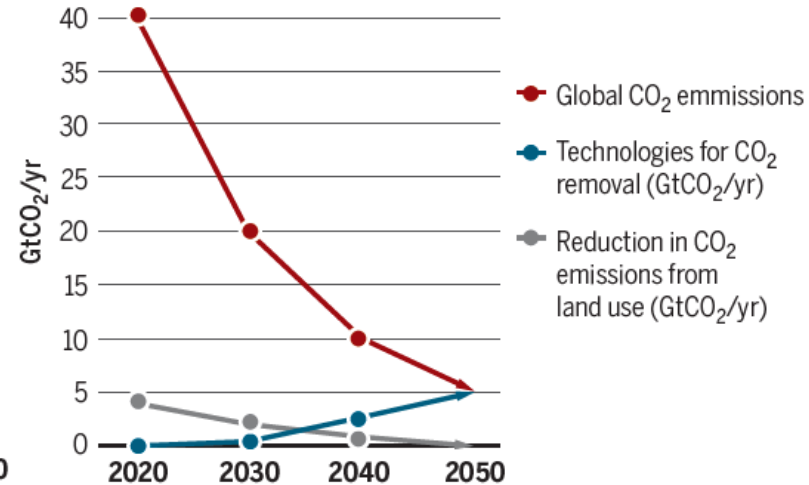
## Decarbonization pathway consistent with Paris agreement



## Fossil fuel phase out

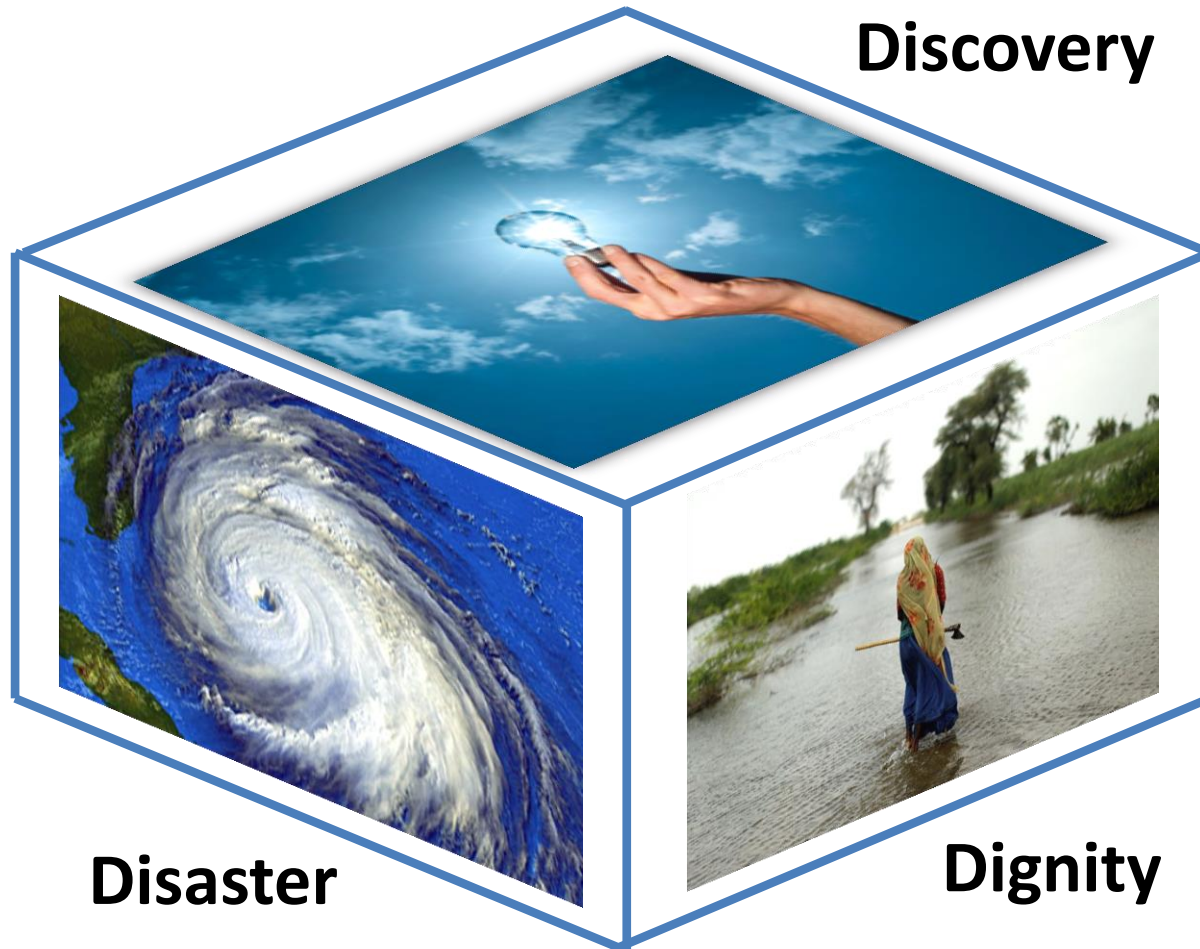


## Global carbon law guiding decadal pathways

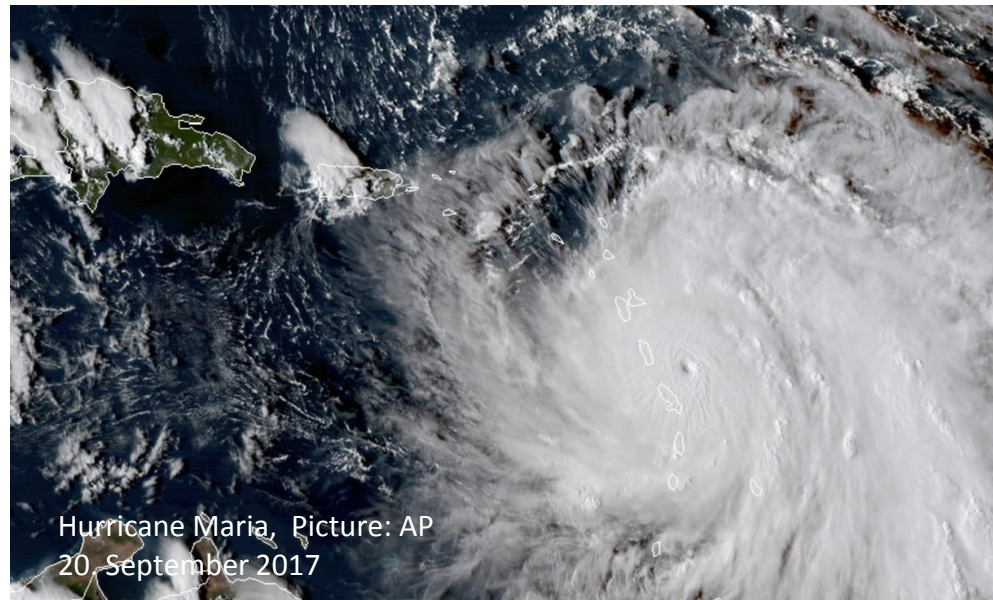
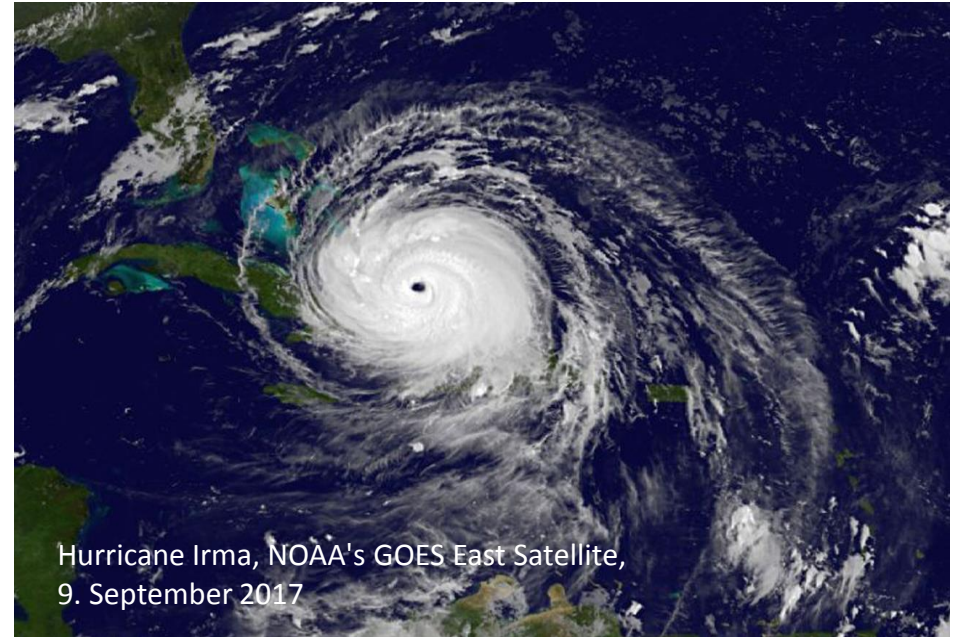
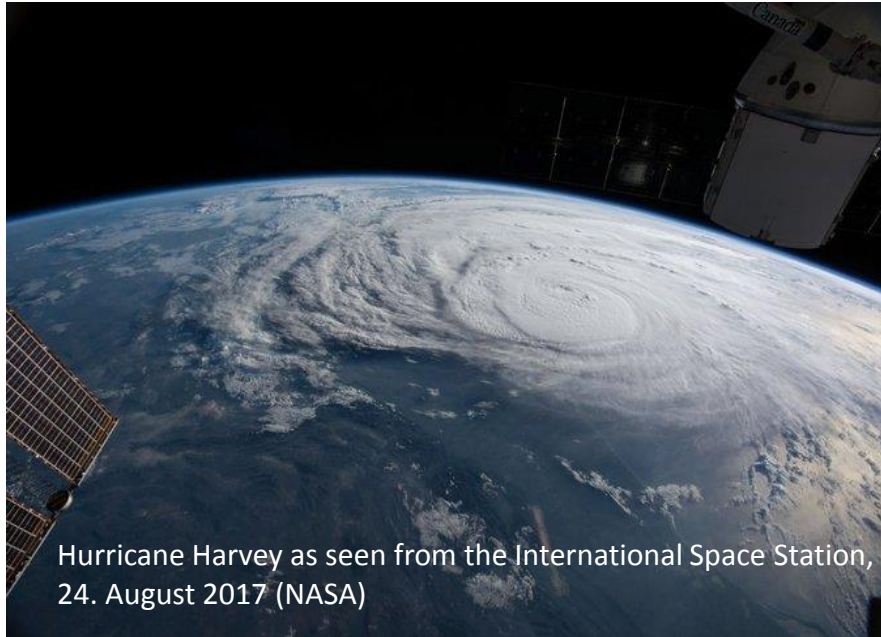


**Will It Happen?**

# 3D Perspective – The Great Transformation



# D1: Damaging Extreme Events (Harvey, Irma, Maria et al.)

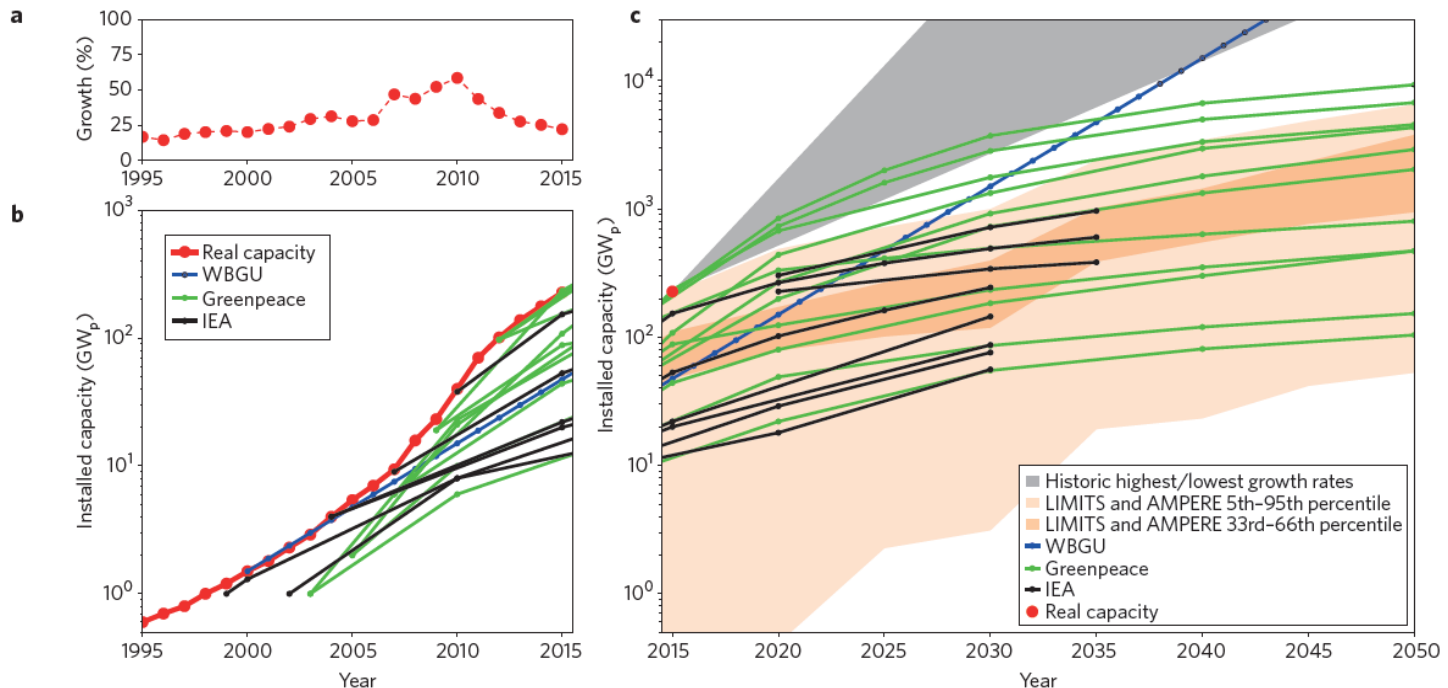


# D2: Disruptive Innovations

## The underestimated potential of solar energy to mitigate climate change

Felix Creutzig<sup>1,2\*</sup>, Peter Agoston<sup>1</sup>, Jan Christoph Goldschmidt<sup>3</sup>, Gunnar Luderer<sup>4</sup>, Gregory Nemet<sup>1,5</sup> and Robert C. Pietzcker<sup>4</sup>

The Intergovernmental Panel on Climate Change's fifth assessment report emphasizes the importance of bioenergy and carbon capture and storage for achieving climate goals, but it does not identify solar energy as a strategically important technology option. That is surprising given the strong growth, large resource, and low environmental footprint of photovoltaics (PV). Here we explore how models have consistently underestimated PV deployment and identify the reasons for underlying bias in models. Our analysis reveals that rapid technological learning and technology-specific policy support were crucial to PV deployment in the past, but that future success will depend on adequate financing instruments and the management of system integration. We propose that with coordinated advances in multiple components of the energy system, PV could supply 30–50% of electricity in competitive markets.



Growth in PV capacity and scenario projections.

## D3: Divestment (e.g. by Catholic Church)

theguardian



“More than **40 Catholic institutions** are to announce the largest ever faith-based **divestment from fossil fuels**, on the anniversary of the death of St Francis of Assisi.”

A Catholic church spire against smoky coal power plants in North Rhine-Westphalia, Germany. Photo Alamy Stock Photo

**FOSSILFREE**



# The New York Times

Tuesday, October 10, 2017 | Today's Paper | Video | 50°F | Hang Seng +0.52% ↑



World U.S. Politics N.Y. Business Opinion Tech Science Health Sports Arts Style Food Travel Magazine T Magazine Real Estate ALL

## Wildfires Sweep Across Northern California; at Least 10 Dead

By THOMAS FULLER, DANIEL VICTOR and MAGGIE ASTOR 10:18 PM ET

- Firefighters were battling at least 15 fires in eight counties. The blazes are among the most destructive in state history.
- More than 20,000 people have evacuated, and in Santa Rosa, the authorities imposed a curfew.

327 Comments



Video by ROBIN LINDSAY. Photo by Jim Wilson/The New York Times

### Watch: Are All These Fires, Storms and Quakes Normal?

By HENRY FOUNTAIN and DAVID BOTTI

A climate reporter for The Times explains what you should know.

- Did the Fires Force You to Evacuate? Tell Us Your Story

## E.P.A. Says It Will Repeal Key Obama-Era Climate Plan

By LISA FRIEDMAN and BRAD PLUMER 8:51 PM ET

The rollback of the Clean Power Plan, which limits greenhouse gas emissions from power plants, sets up a bitter fight over United States climate policy.

887 Comments

### Your Tuesday Briefing

By PATRICK BOEHLER 12:27 AM ET

Here's what you need to know to start your day.



AUDIO

### Listen to 'The Daily'

Will the A.C.L.U. rethink its approach to free speech?



### Opinion

EDITORIAL

#### On Immigration, Mr. Trump Shows Congress It's on Its Own

Republicans need to craft a bill shielding young immigrants, since the president has proved he can't be trusted.



#### Lena Dunham: Harvey Weinstein and the Silence of the Men

The hush in Hollywood about the megaproducer reinforces a culture that keeps women from speaking up.



#### The E.P.A.'s Sleight of Hand on Climate

The Trump administration is using smoke and mirrors to justify rescinding one of the most significant climate rules of the Obama years.



- Editorial: The Republican's Guide to Presidential Etiquette
- Blow: Attacking Media as Distraction
- Leonhardt: Cohn and Mnuchin Risk Their Reputations
- Trump Is Going to Make a Huge Mistake on the Iran Deal
- I Miss the Old Megyn Kelly

TIMES INSIDER »

#### Trauma, and Red Tape, in Las Vegas

2h Can the United States repair its health care system while keeping its edge on innovation? Any harm to innovation in America could harm other countries, too.



THE CROSSWORD »

#### Play Today's Puzzle

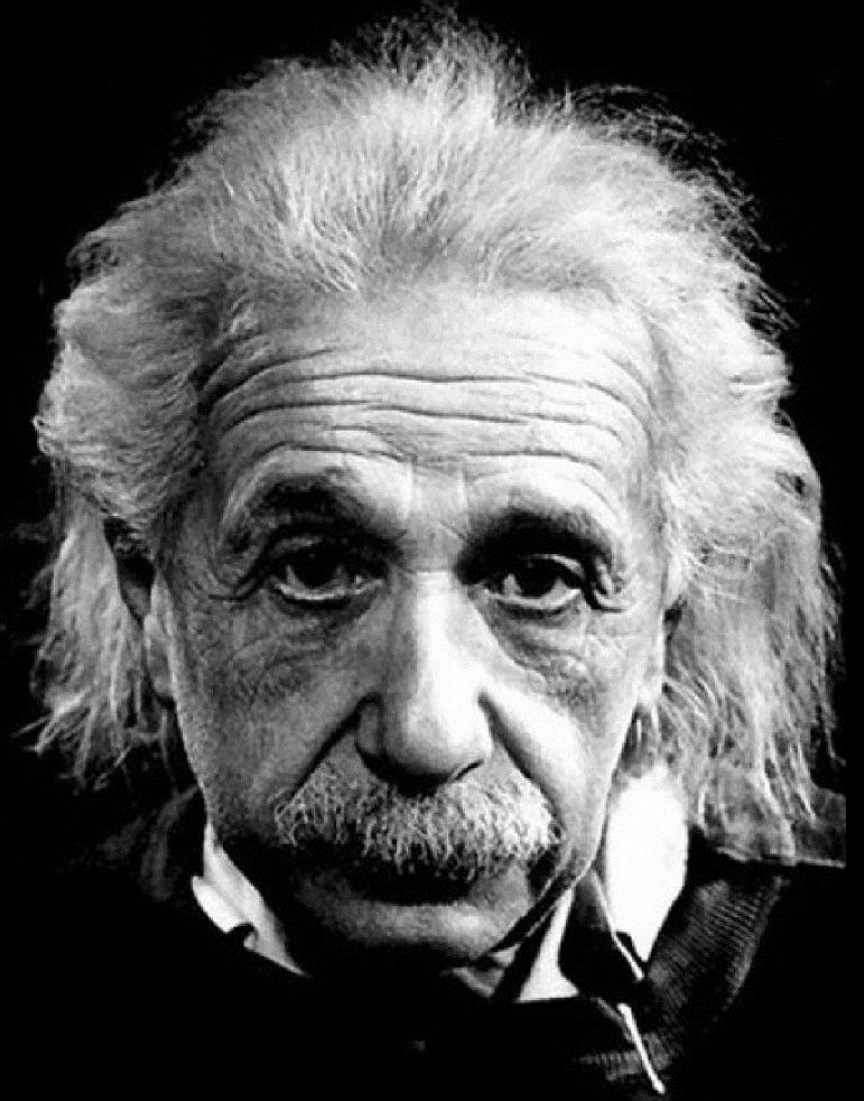


3h A college freshman **fatally shot a campus police officer** at Texas Tech University in Lubbock, the authorities said. The student was being questioned in a drug-related case.





“THE WORLD WILL NOT BE  
**DESTROYED**  
BY THOSE WHO DO EVIL,  
BUT BY THOSE WHO  
**WATCH**  
THEM WITHOUT DOING  
**ANYTHING”**



*Albert Einstein*