



EXPONENTIALROADMAP.ORG

EXPONENTIAL CLIMATE ACTION ROADMAP

Johan Falk Exponential Roadmap
Stefan Henningsson WWF

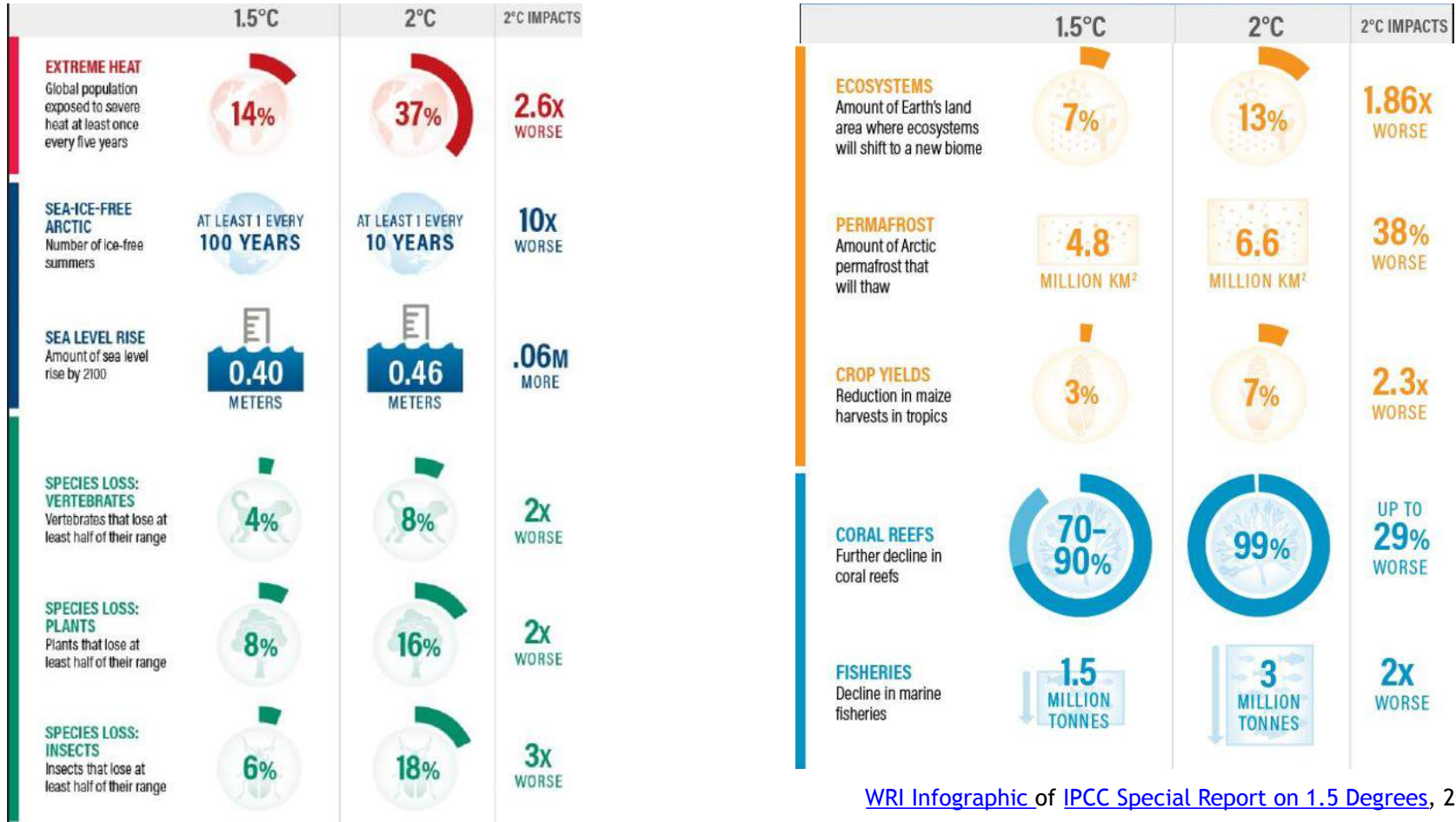


**WE ARE ENTERING
A CLIMATE CRISIS.**

**WE RISK
A HOTHOUSE EARTH FUTURE.**



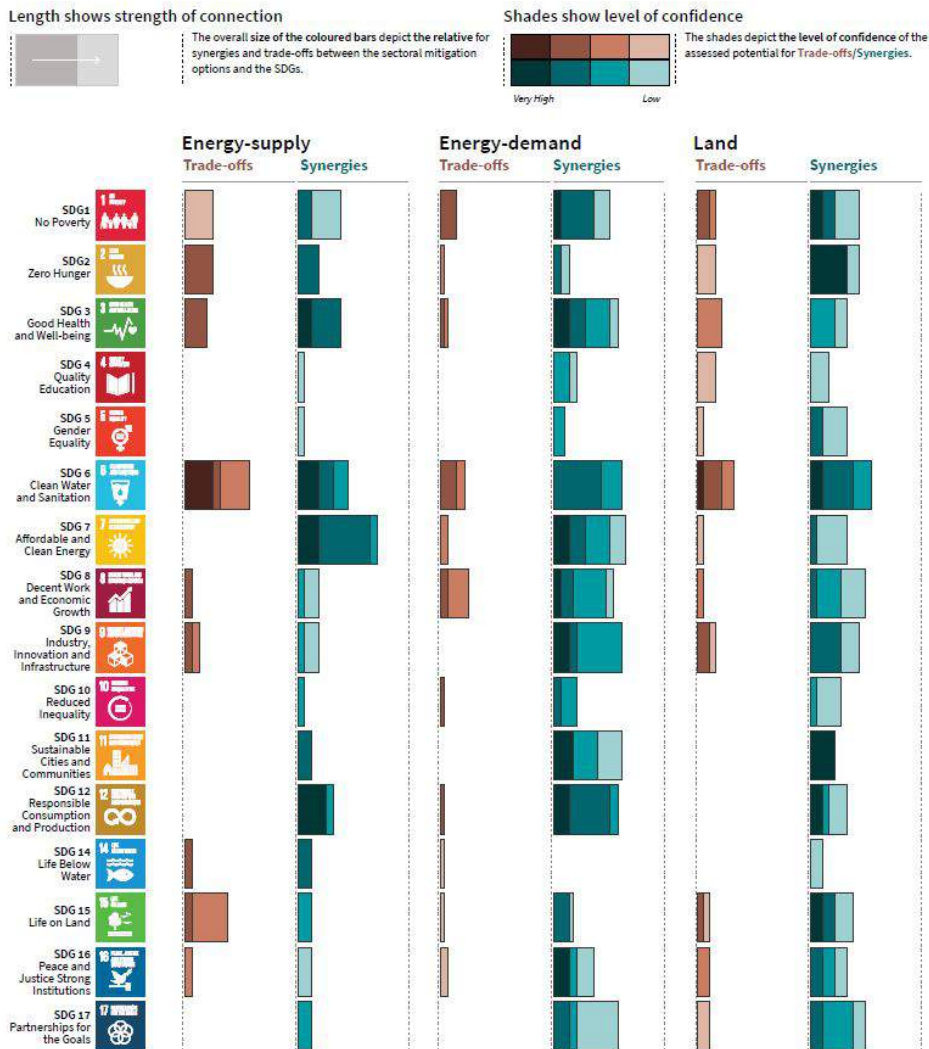
Half a degree makes a huge difference





Following a 1.5°C mitigation pathway has strong positive synergies with Sustainable Development Goals

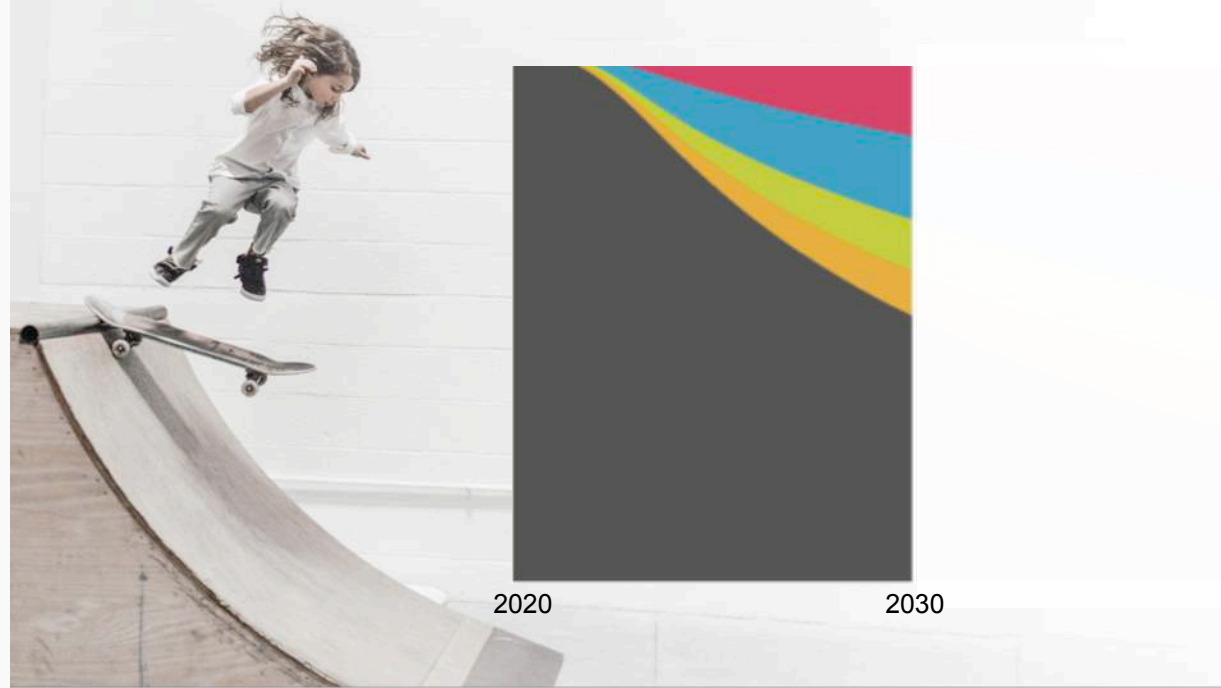
Much stronger synergies than trade-offs across SDG areas



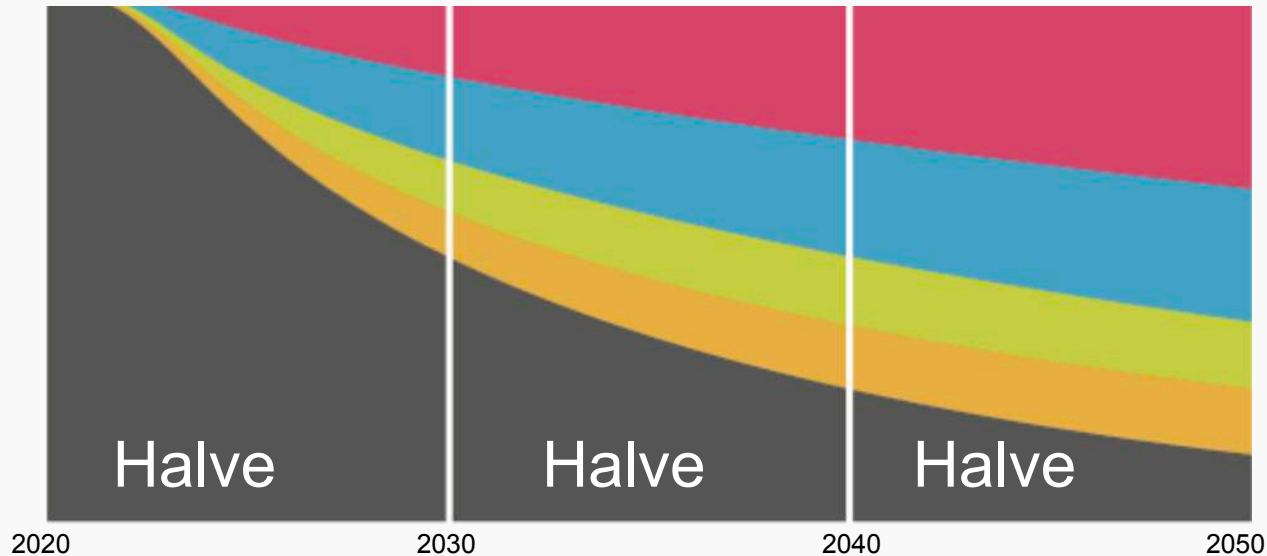
What is required
to save the climate?



We must halve carbon emissions by 2030



And every decade after that



the global carbon law

Opinion | OP-ED CONTRIBUTOR

Why the World Economy Has to Be Carbon Free by 2050

By JOHAN ROCKSTROM MARCH 23, 2017

The New York Times

In front of the financial district of Pudong amid heavy smog in Shanghai in 2015. Aly Song/Reuters



The road to glasscocktailshowersthat use renewable energy, as from those wind turbines in Germany, and improved transportation technology.

aligned with the trajectory of the past decade (see the figure, bottom left). All sectors (i.e., 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 CO₂ removal by technical means from zero to at least 10 GtCO₂/year by 2050, 2.5 by 2040, and 0.5 by 2030. CO₂ emissions from land-use must decrease along a nonlinear trajectory from a 100GtCO₂/year in 2000, to 0 by 2050. By 2040 and 0.5 by 2050 (see the figure, bottom right). The only way to bring back CO₂ emissions since 2017 to below 200 GtCO₂ by the end of the century (see the figure, top) and afterwards CO₂ concentrations to return to 200 ppm by 2100 (concentrations at 400 ppm).

Readings are planning instruments, linking short-term targets to longer-term goals. They help align sectors and organizations to anticipate technological and institutional breakthroughs to meet a collective challenge. An explicit carbon roadmap for halving anthropogenic emissions every decade, endorsed by and for all industry sectors, could help prevent disruptive, nonlinear technological advances toward a carbon-intensive world by 2050.

CLIMATE POLICY

A roadmap for rapid decarbonization

Emissions inevitably approach zero with a "carbon law"

By: Jonathan H. Christensen,¹ Owen Gaffney,²
Joost Rogali,^{1,3} Maïke Meindemaars,^{1,2}
Nikolay Nakhimovskiy,² Hans Joachims
E.ON Energy Research Center

As through the Paris Agreement goals (2) are all aligned with science (50-year aim), in principle, the technical and environmental challenges involved in achieving them are science-centric rather than science-based, urgent and national commitments. Despite progress during the 2008 Marshall Islands negotiations, long-term goals can be triggered by political short-termism. Following the Agreement, which became international law earlier than expected, several nations have adopted more aggressive climate business strategies, with more data used. Model-based decarbonization assessments (6) and scenarios often struggle to capture transformative change and the dynamics associated with it (European, innovative, and nonlinear change in human behavior). For example, in July 2019, the IEA said the meeting here (27-29 March 2019) was a defining moment in 2019 (6). To harness these dynamics and to continue for sustainable markets, we need

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land-use CO
zero emissions
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| Country | Percentage of global CO ₂ emissions (only 1990) |
|---------|--|
| USA | 25% |
| Canada | 15% |
| Mexico | 10% |
| Brazil | 5% |
| India | 5% |
| China | 5% |
| Russia | 5% |

...carbon
reservoirs

A bar chart comparing the number of people making Paris agreements in 2050 and 2060. The chart shows two bars for each year, with the 2060 bars being significantly taller than the 2050 bars. The bars are colored yellow and grey.

| Year | Number of people |
|------|------------------|
| 2050 | ~1.5 |
| 2060 | ~3.5 |

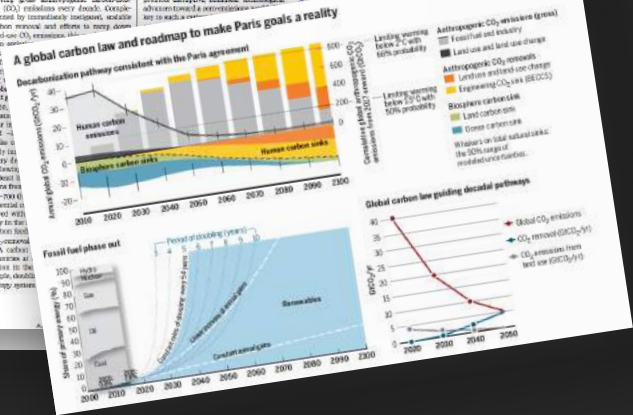
Global carb

warming with
 probability
 warming
 S₀ C with
 probability
 on law guiding

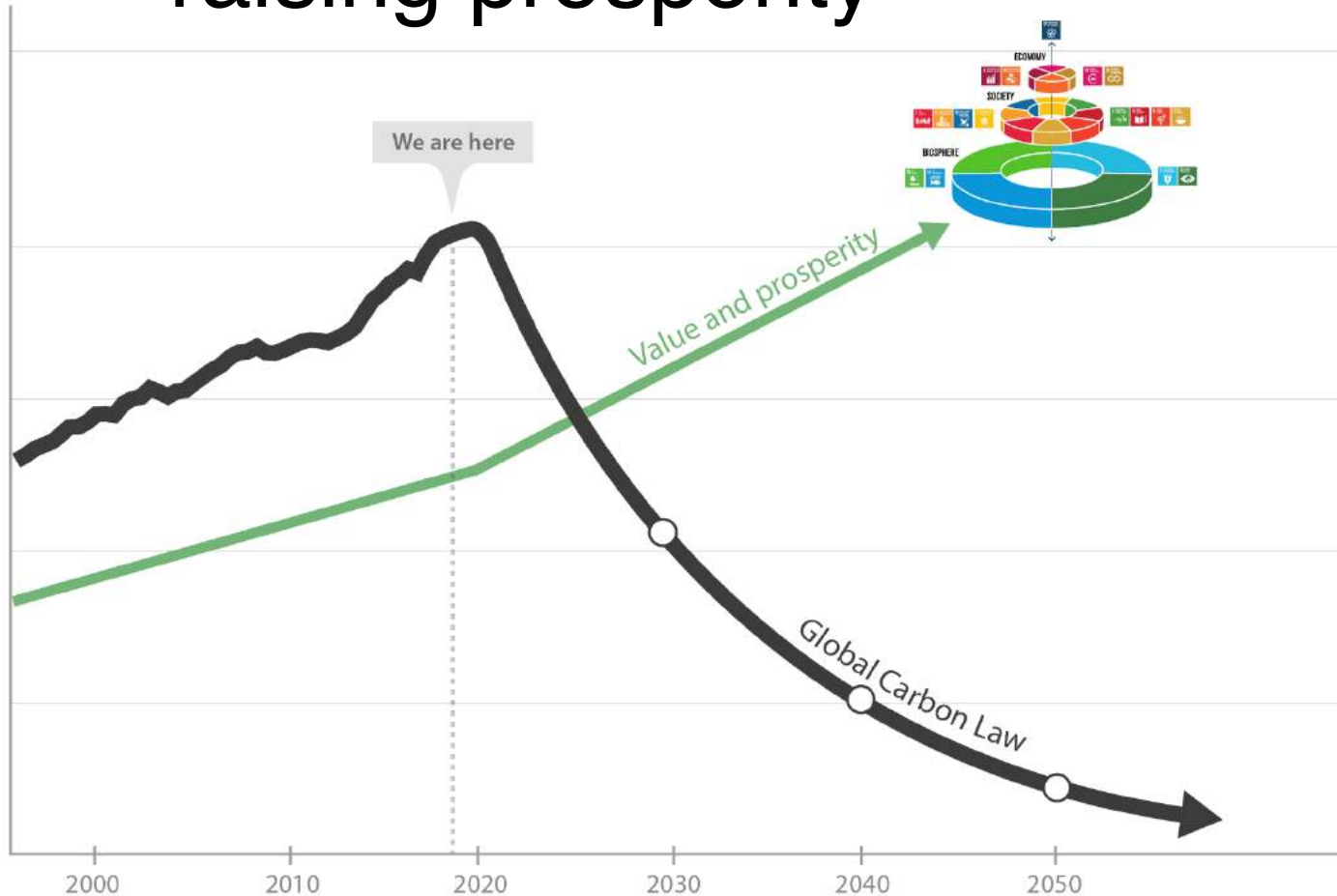
decadal pattern

[illegible]

SCIENCE 101/2017/1017

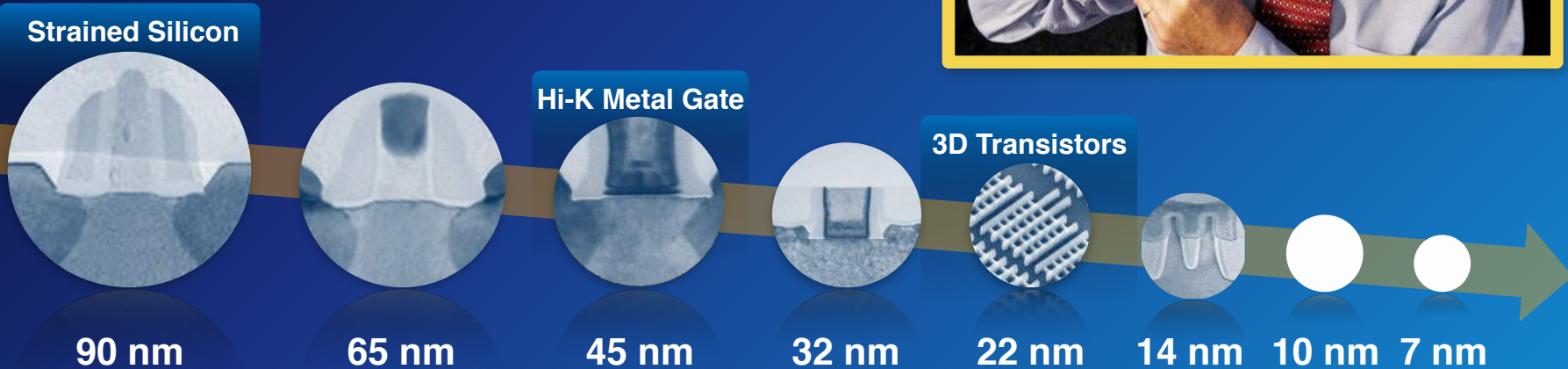
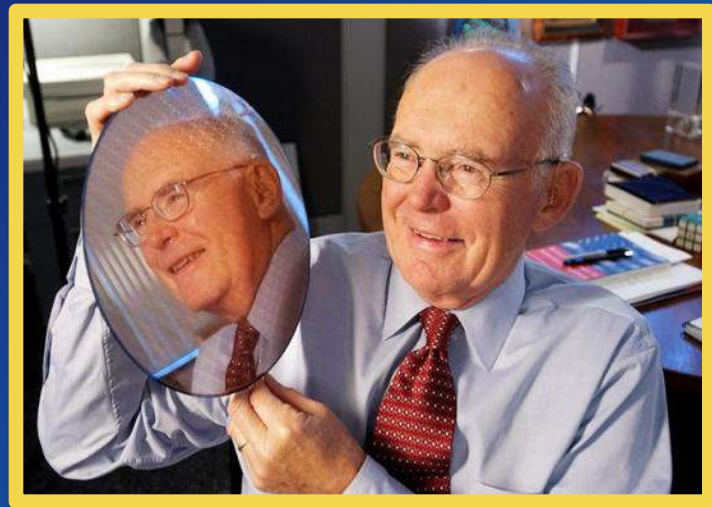


raising prosperity

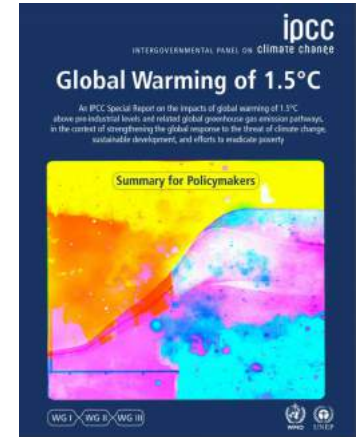
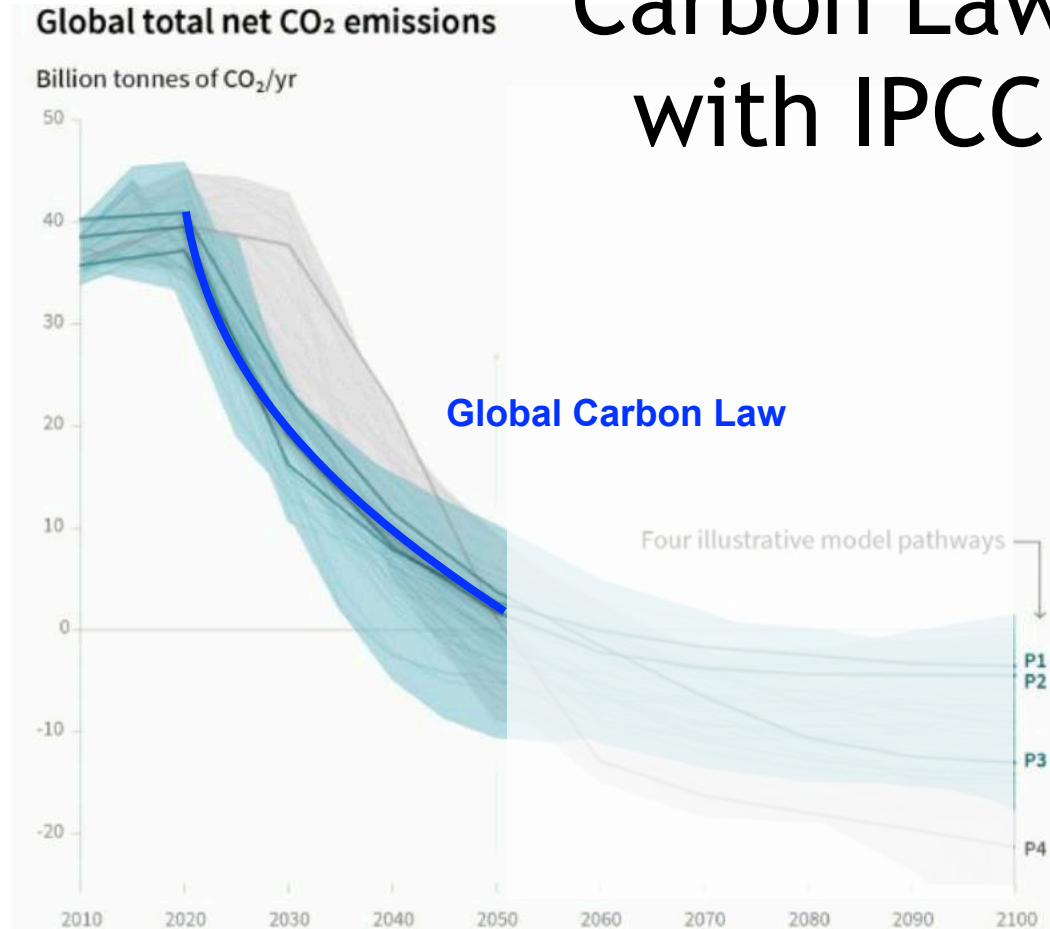


Inspired by Moore's Law

Enabling new devices with higher functionality and complexity while controlling power, cost, and size



Carbon Law is aligned with IPCC 1.5°C SR



30 SOLUTIONS FOR 2030

**EXPONENTIAL
CLIMATE ACTION
ROADMAP**

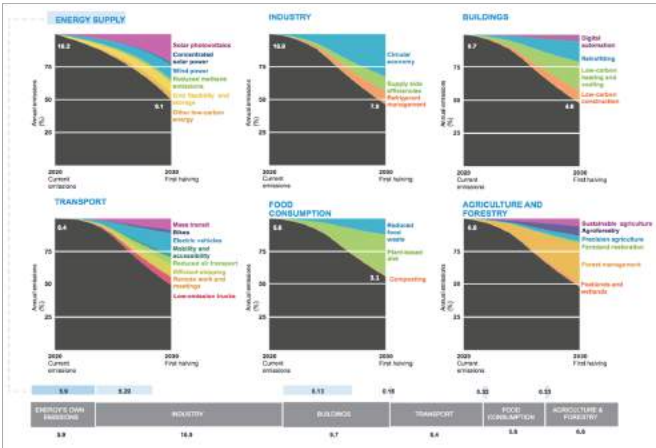


GLOBAL CLIMATE ACTION SUMMIT

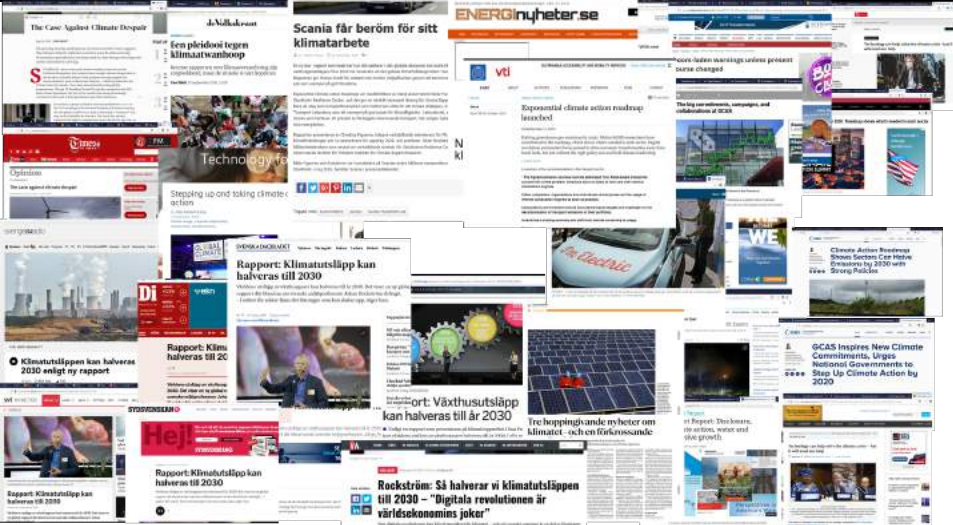
SEPT. 12-14, 2018 • SAN FRANCISCO



Trajectories for halving global GHG emissions by 2030

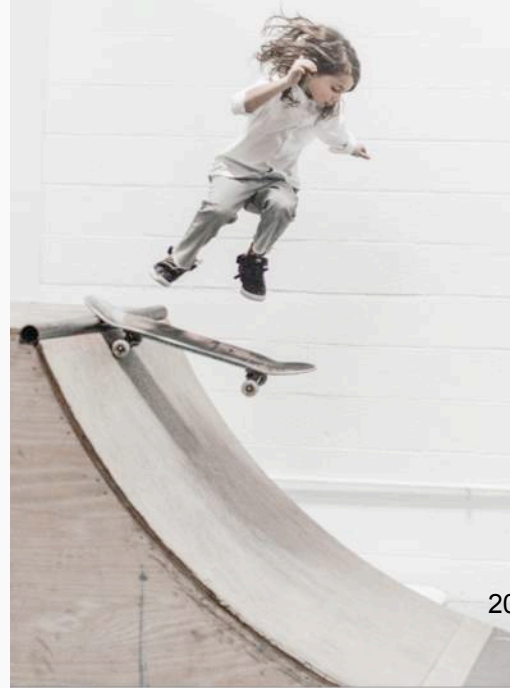


<http://exponentialroadmap.org/>



<http://exponentialroadmap.org>

focus on the first halving 2030



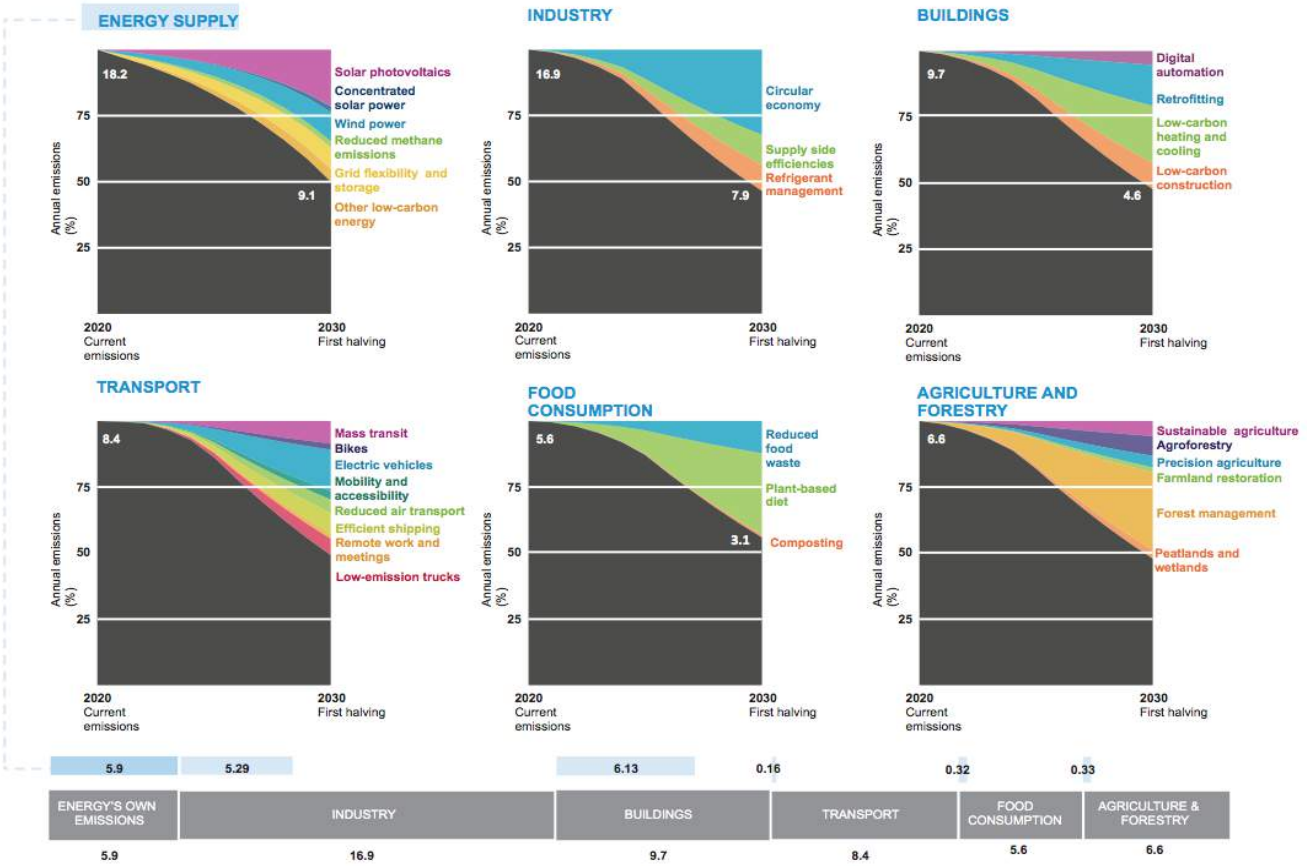
2020



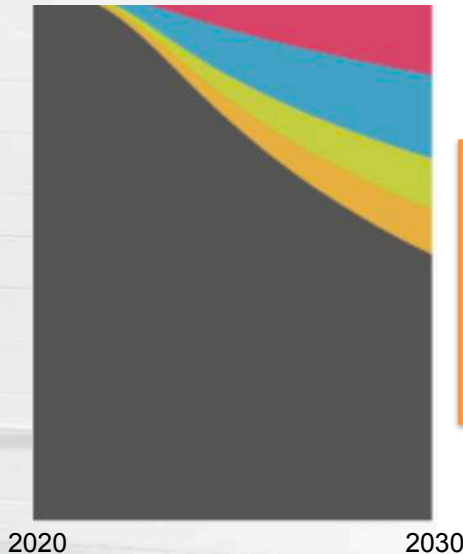
2030



solutions exist to halve CO2 in all sectors



but to scale they must be Accelerated by



- Climate Leadership
- Policy
- Finance
- Technology

Climate Leadership



A critical mass of
**companies, cities,
countries, citizens**
must start halve
emissions,
raise prosperity



ENERGY

2020
Current Emissions

2030
First Halving

Solar
Photovoltaics

Concentrated
Solar Power

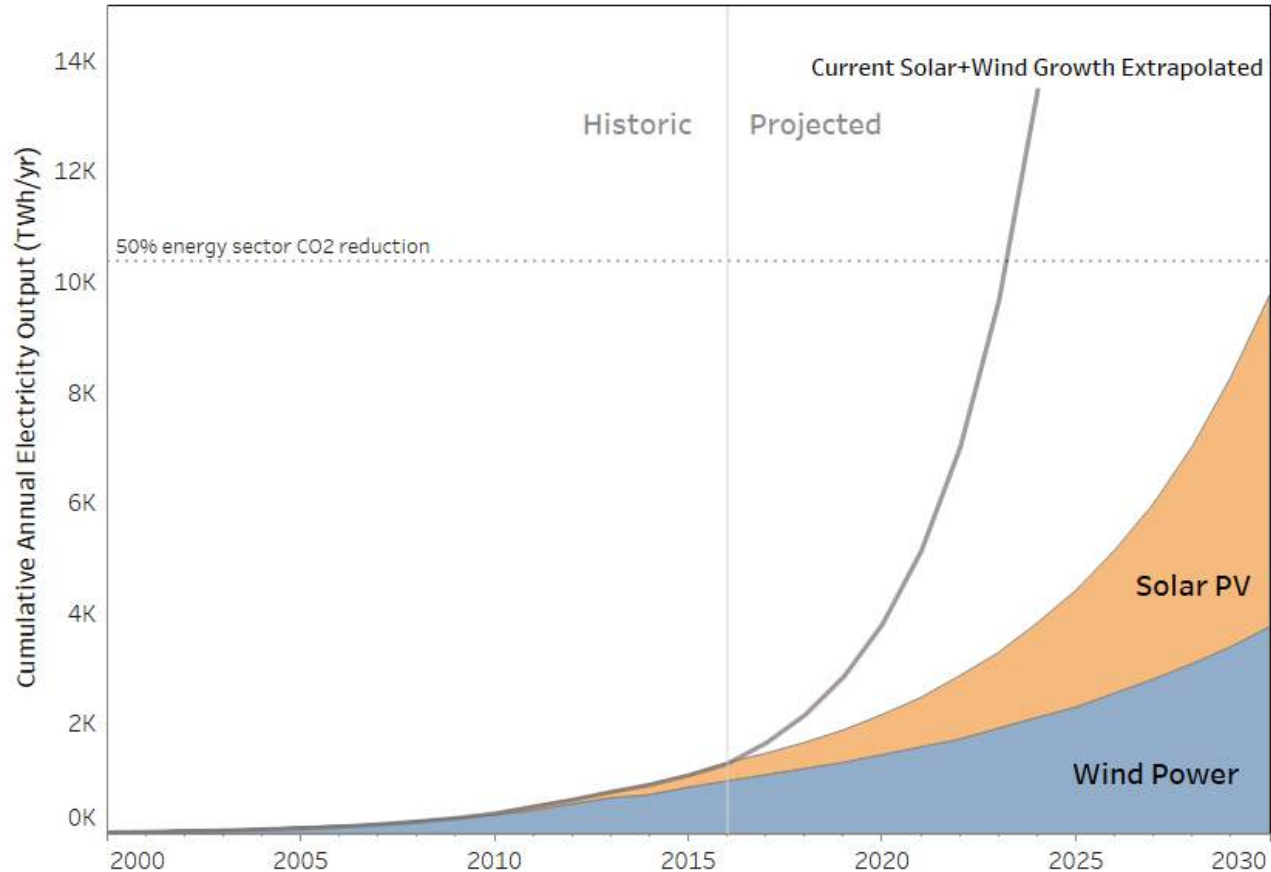
Wind Power

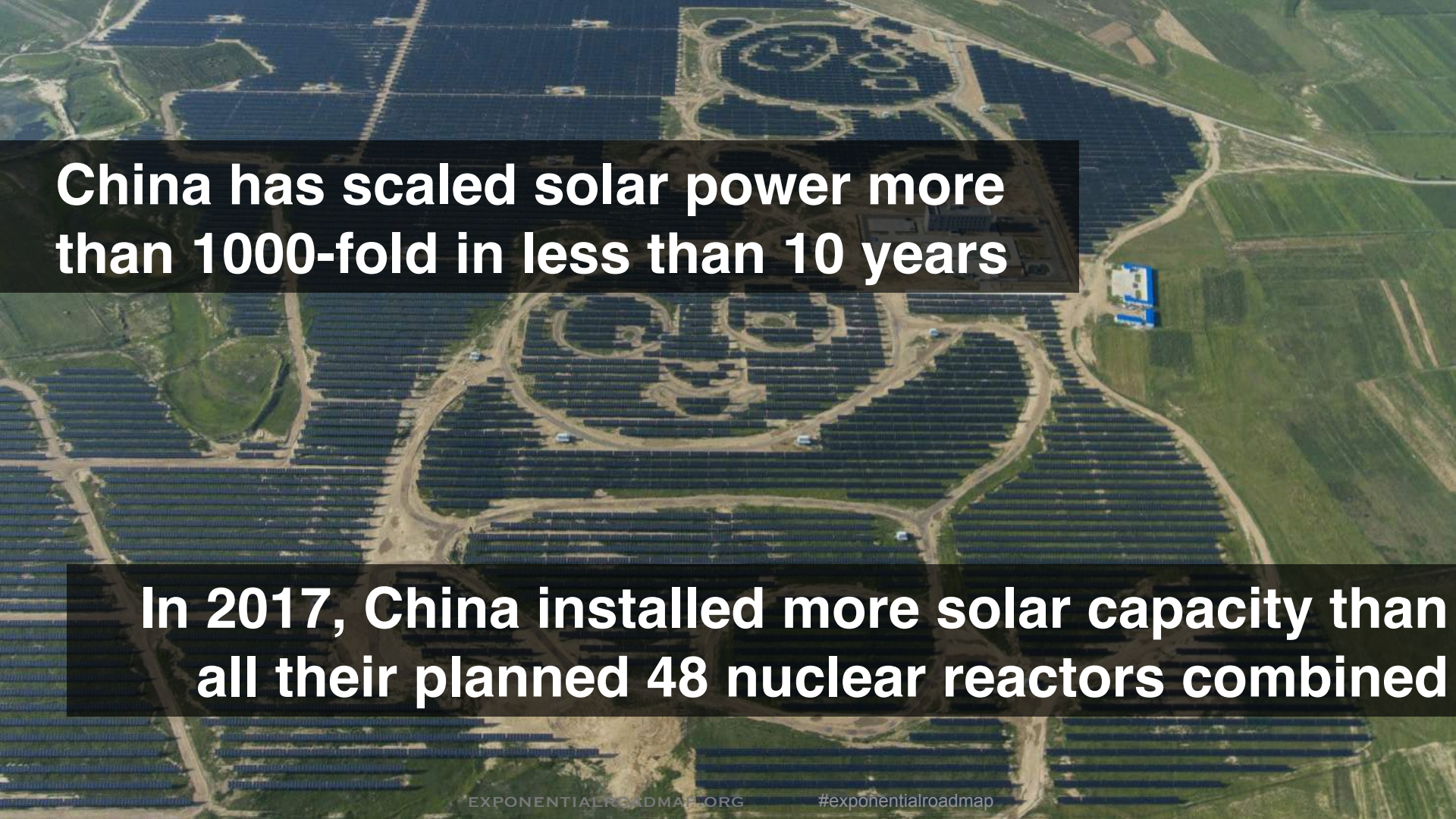
Reduced Methan
Emissions

Grid Flexibility
and Storage

Other Low-carbon
Energy

On path to 50% electricity for renewables



An aerial photograph of a vast solar farm. The landscape is covered with rows of dark blue solar panels, interspersed with dirt roads and some green patches. In the upper right, there is a small cluster of buildings, including one with a blue roof. The overall scene shows a large-scale deployment of solar energy infrastructure in a rural or semi-rural area.

China has scaled solar power more than 1000-fold in less than 10 years

In 2017, China installed more solar capacity than all their planned 48 nuclear reactors combined

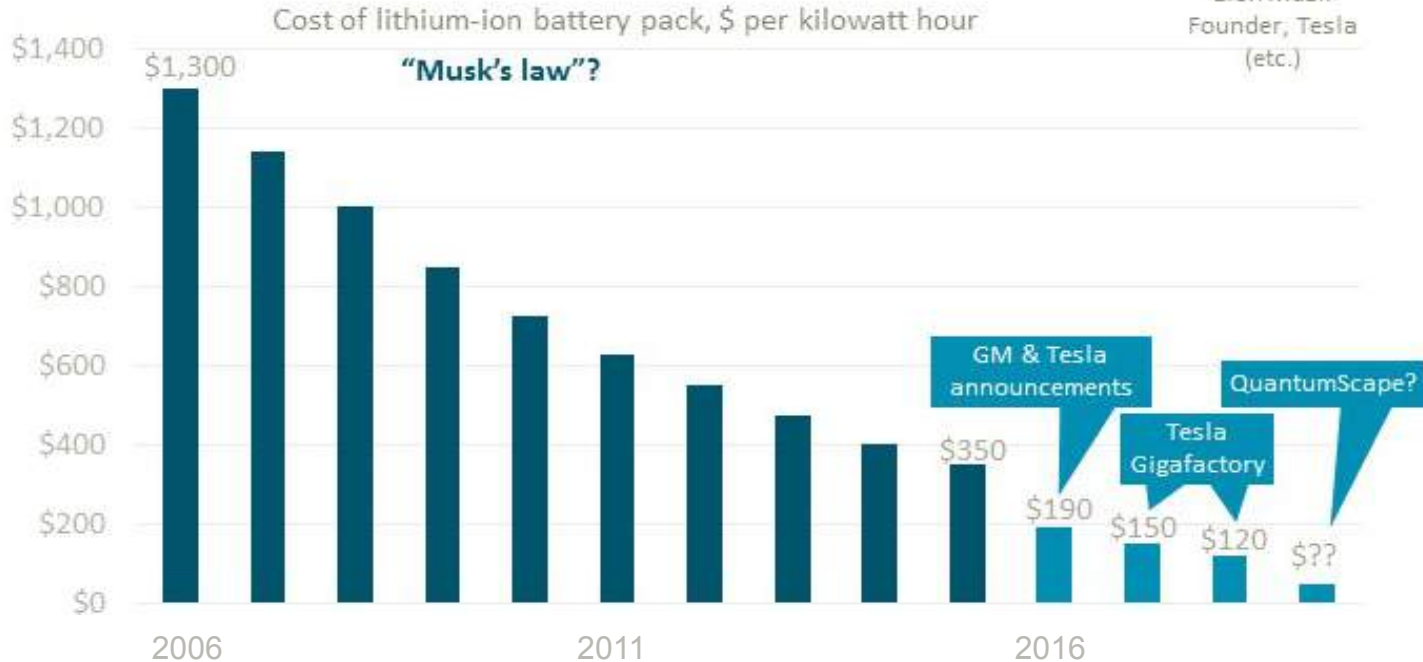
Exponential future of battery technologies

Declining cost energy storage

- Historical estimates
- Market leader forecasts



Elon Musk
Founder, Tesla
(etc.)



INDUSTRY

2020
Current Emissions

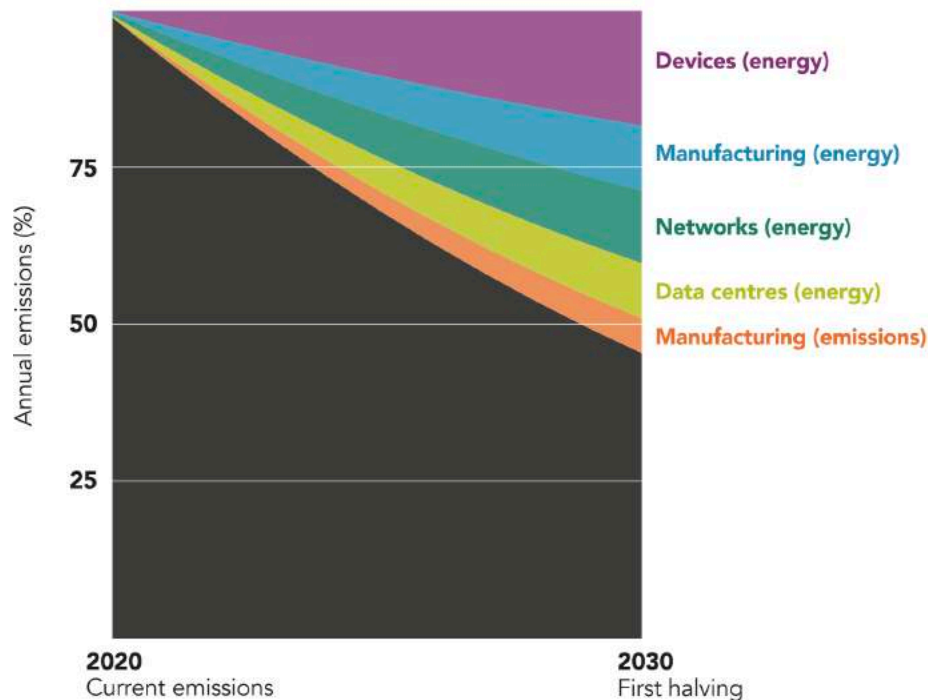
2030
First Halving

Circular
Economy

Supply Side
Efficiencies

Refrigerant
Management

ICT Industry sub- sector



A Zero-Carbon Data Centre

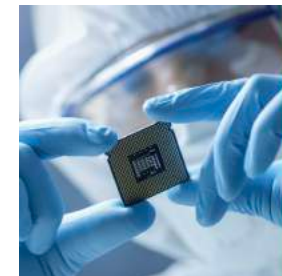
Google's data centre in Hamina, Finland is built in an old paper mill and uses water from the Baltic Sea to cool servers.

The data centre uses 100% wind power.

Mobile Network Efficiency

The energy performance of networks improves continuously through modernisation programmes and new product architectures.

Ericsson and Nokia have seen around 40% energy savings.



Halving Chip Manufacturing Emissions

Intel has quickly and drastically reduced the fluorinated gas emissions from its chip manufacturing plants.

From 1995 to 2010, Intel cut its chip production emissions by 50%.

TRANSPORT

2020
Current Emissions

2030
First Halving

Mass Transit

Bikes

Electric Vehicles

Mobility and Accessibility

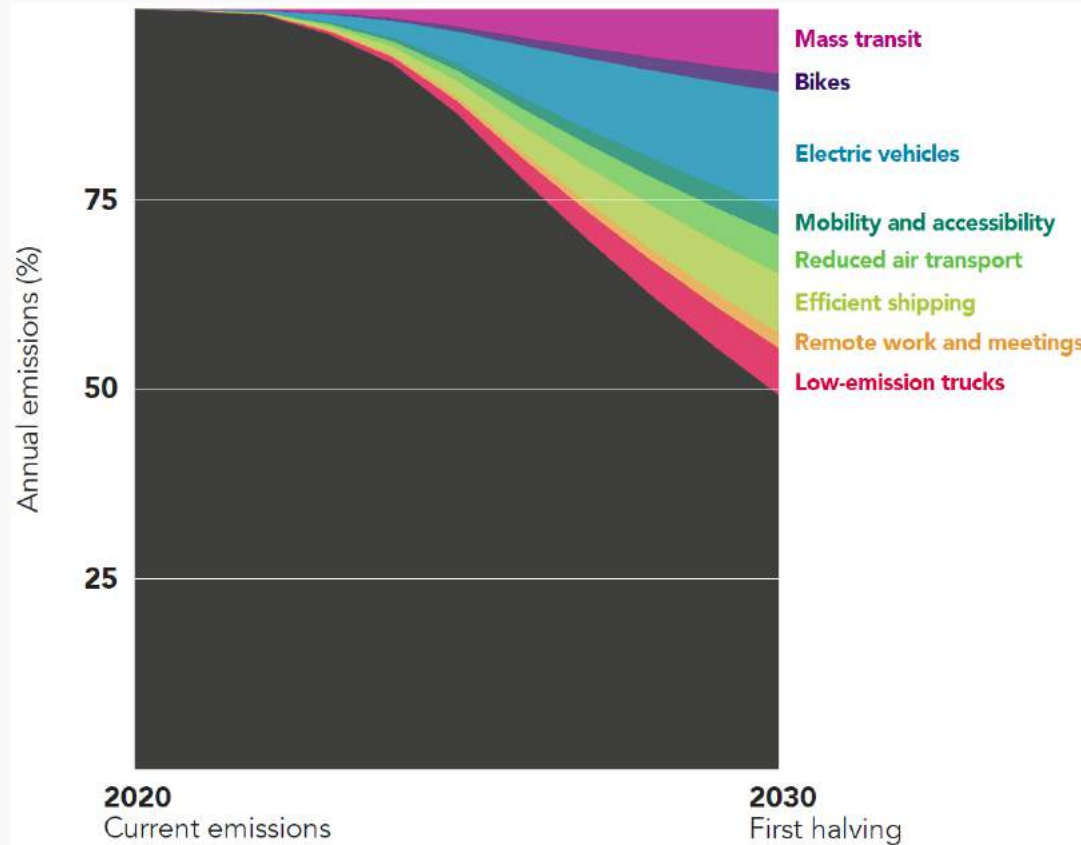
Reduced Air Transport

Efficient Shipping

Remote Work
and Meetings

Low-emission Trucks

Transport sector – Long journeys



1. Avoid



Less Business Travel

Telia has implemented measures to reduce business travel in favour of more video conferencing and online meetings.

Air travel at Telia has fallen by almost 79%.

2. Shift

Delivering Flowers by Sea

Maersk StarFlower is a system solution that makes it possible to transport cut flowers by sea rather than by air.

Delivering flowers by boat rather than plane cuts relevant CO₂ emissions by 98%.



3. Improve

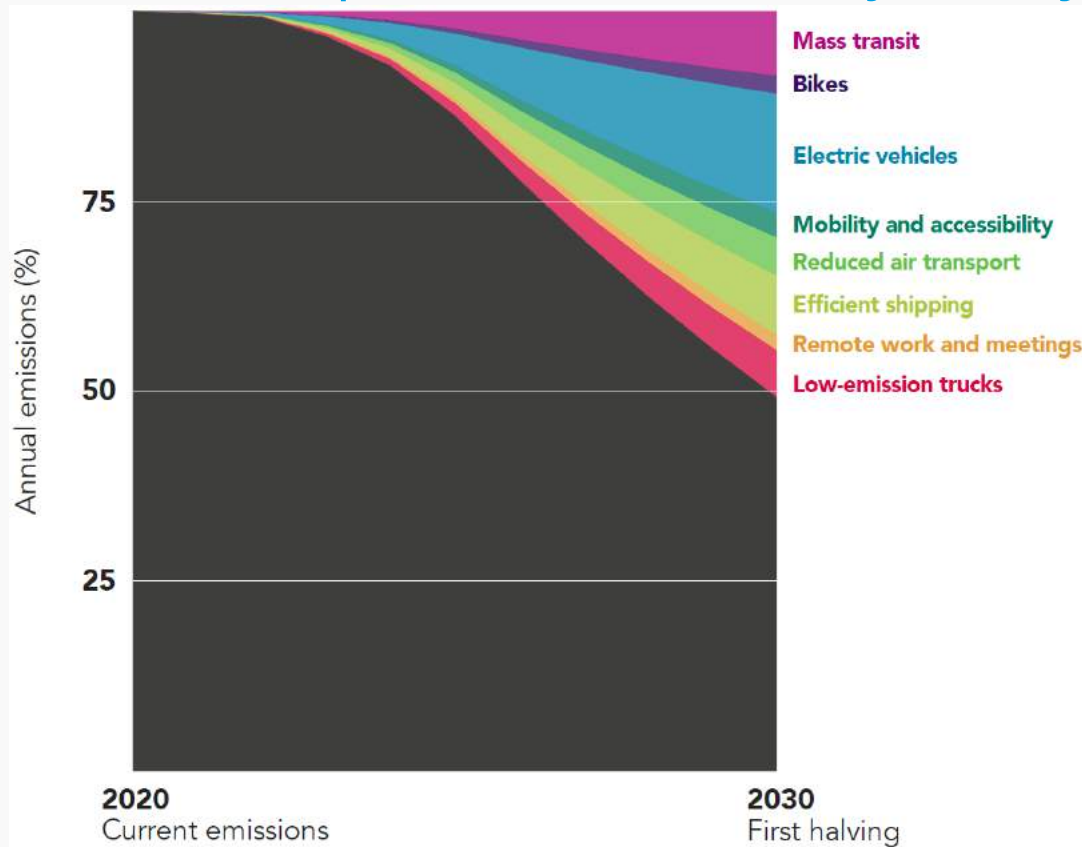
Reducing Truck Emissions

Scania's Transport Lab is reducing truck emissions through driver behaviour, smart maintenance, aerodynamics and fill-rate optimisation.

CO₂ emissions per tonne-km halved between 2008 and 2012.



Transport sector – Short journeys



Urban Development in Portland

Portland, Oregon has an aggressive mass-transit-oriented urban development approach, focusing on "people, not cars".

Portland residents are 2x as likely to commute by public transport than the US average.



Copenhagen

Copenhagen has set a sharp goal for carbon neutrality, with programs for cycling, public transport, recycling and green space access.

Approximately 62% Copenhagen's population cycles to work or school.



Shenzhen

Shenzhen has 16,000 electric buses in operation and is targeting an electric taxi fleet by 2020.

Shenzhen's bus fleet is 100% electric.



Renting Electric Vehicles

EkoRent is a 100% electric car rental and sharing service, making it zero-carbon when electricity comes from renewables.

With a 30% market share, about 11 Mt of emissions would be avoided annually.



BUILDINGS

2020
Current Emissions

2030
First Halving

Digital Automation of
Temperature and Lighting

Retrofitting

Low-Carbon
Heating and Cooling

Low-Carbon
Construction

FOOD CONSUMPTION

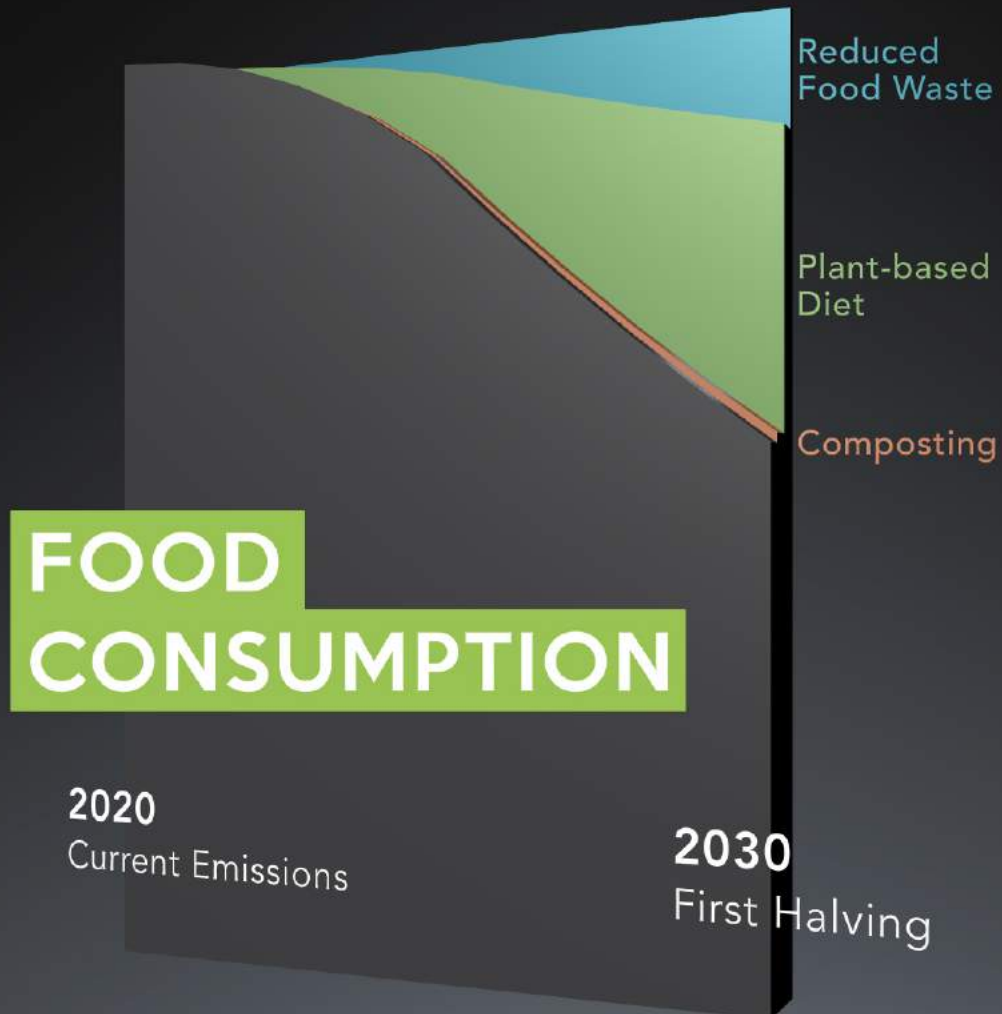
2020
Current Emissions

2030
First Halving

Reduced
Food Waste

Plant-based
Diet

Composting



LAND USE

2020
Current Emissions

2030
First Halving

Sustainable Agriculture
Agroforestry
Precision Agriculture
Farmland Restoration
Forest Mangement
Peatlands and Wetlands

SOLUTIONS EXIST IN EVERY ECONOMIC SECTOR.

BUT THEY MUST BE

SCALED UP

EXPONENTIALLY

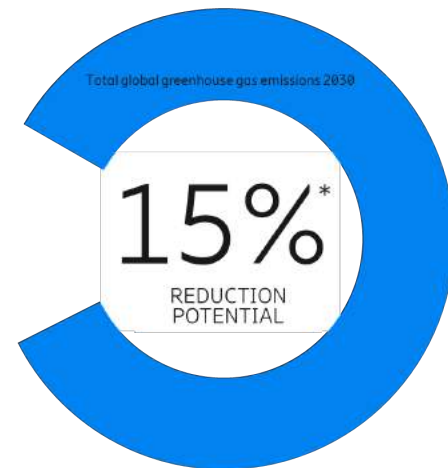
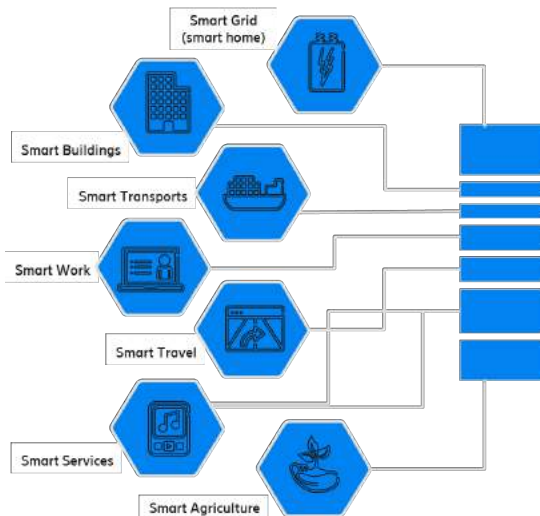


"The tech sector can influence whether we live on a 1.5-2°C or on a +3-4°C world"

ICT as an enabler of exponential climate action



- ICT is the wildcard of decarbonization
- Can enable 1/3 of the first halving with current technologies
- Influences the decisions of 3 billion producers and consumers every day.
- Additional potential of 5G, AI, IoT



* Potential GHG reduction by 2030 due to ICT in a high reduction scenario. Note: 7% in a medium scenario.

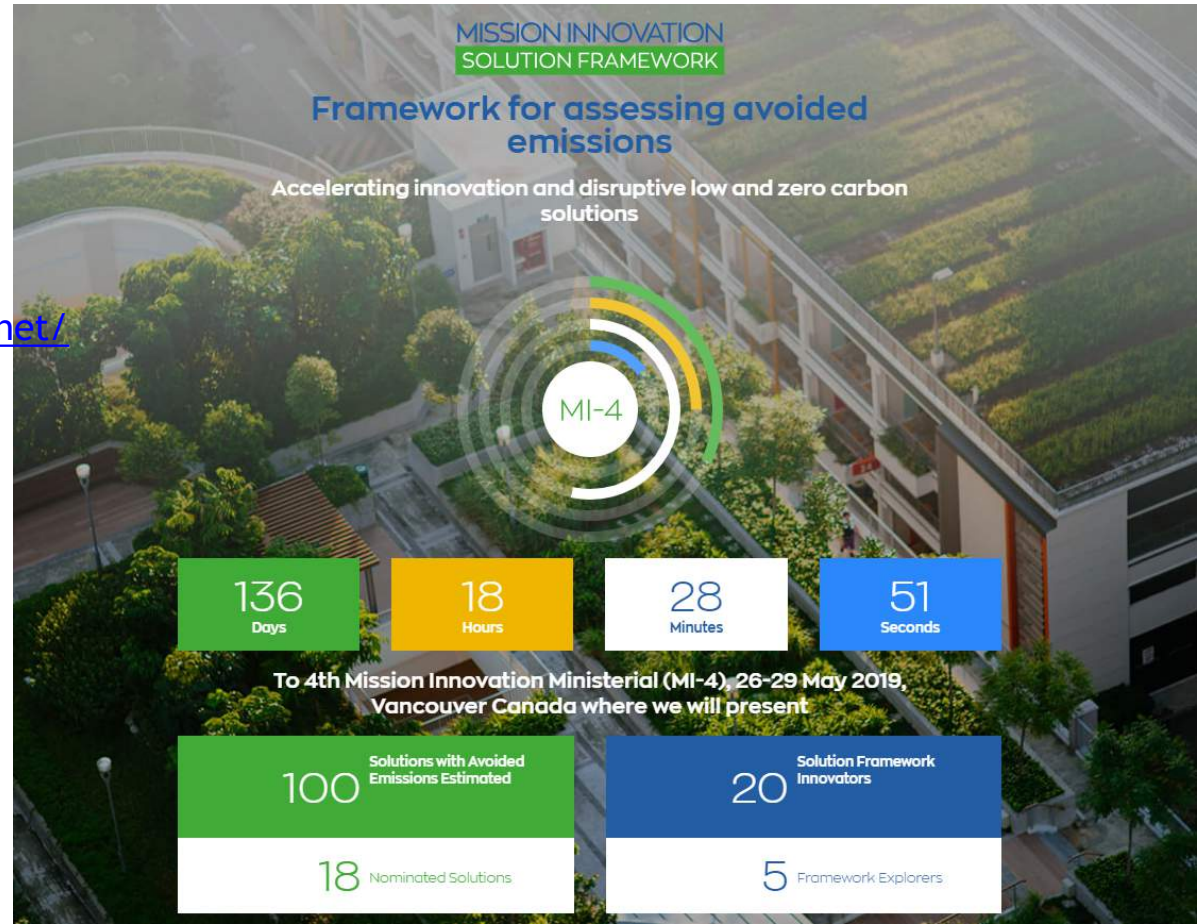
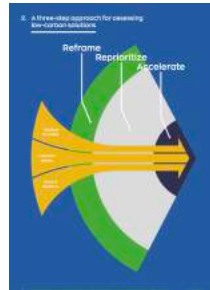


Support High Impact Climate Innovation

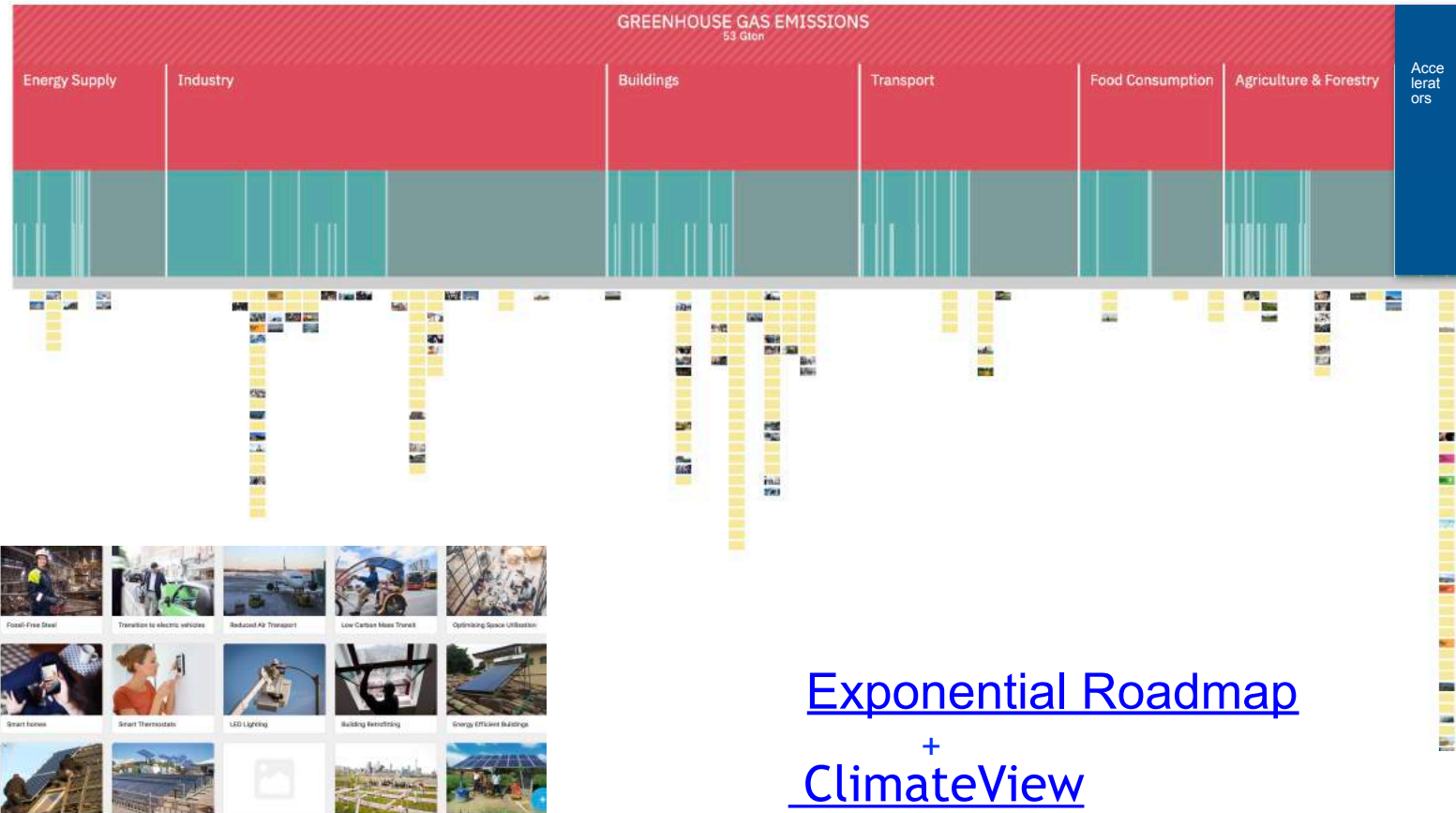
1. Nominate solutions
2. Become a Framework Explorer
3. Improve the Framework

At <https://www.misolutionframework.net/>

First 100 for MI4 in May 2019



Solutions/innovations mapping on high climate impact areas



Exponential Roadmap
+
ClimateView

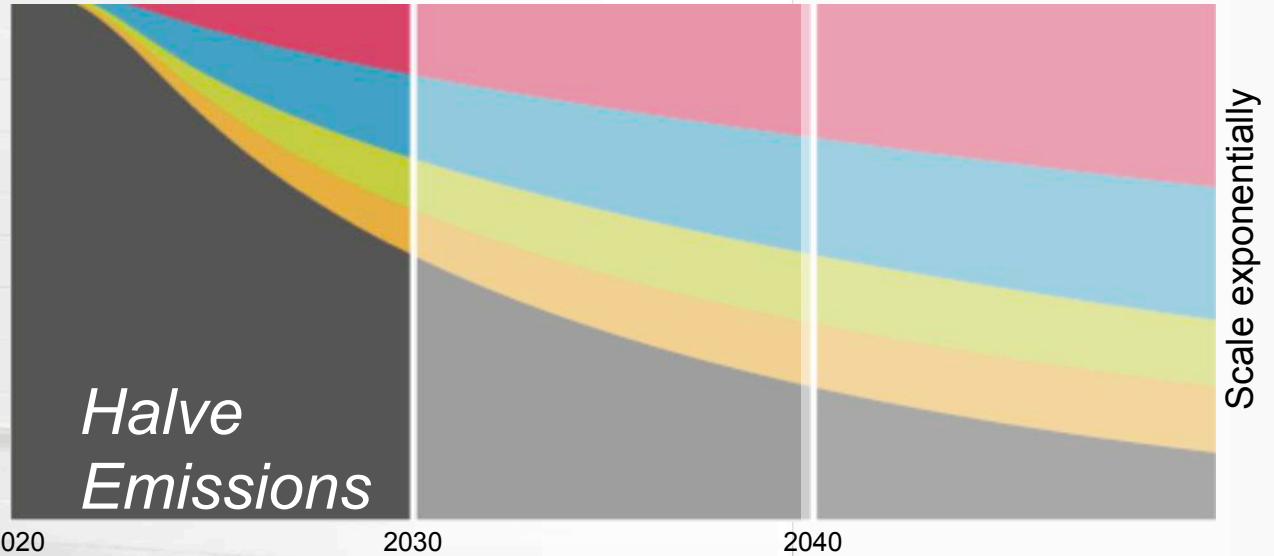
Halving GHG emissions 2030 is

- 1. Necessary*
- 2. Achievable*
- 3. Desirable*



Lets reach the **critical mass** companies, countries, cities individuals

Raise Prosperity



Call to Action

- Decide to shift all investments to 1.5°C world solutions (vs 4°C solutions)
- Scale high climate impact solutions exponentially
- Accelerate climate leadership on every level to drive global demand





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