Accelerating climate actions with AI: *can ITU experiences from SSC help?*

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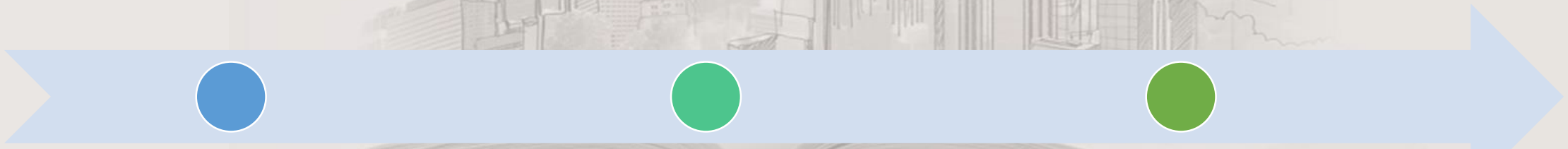
How can AI and emerging technologies help?

- In conjunction with the climate science:
  - Mitigation: measure/estimate/model
  - Adaptation: help society adapt to climate change
  - Alteration: reduce greenhouse gas emissions

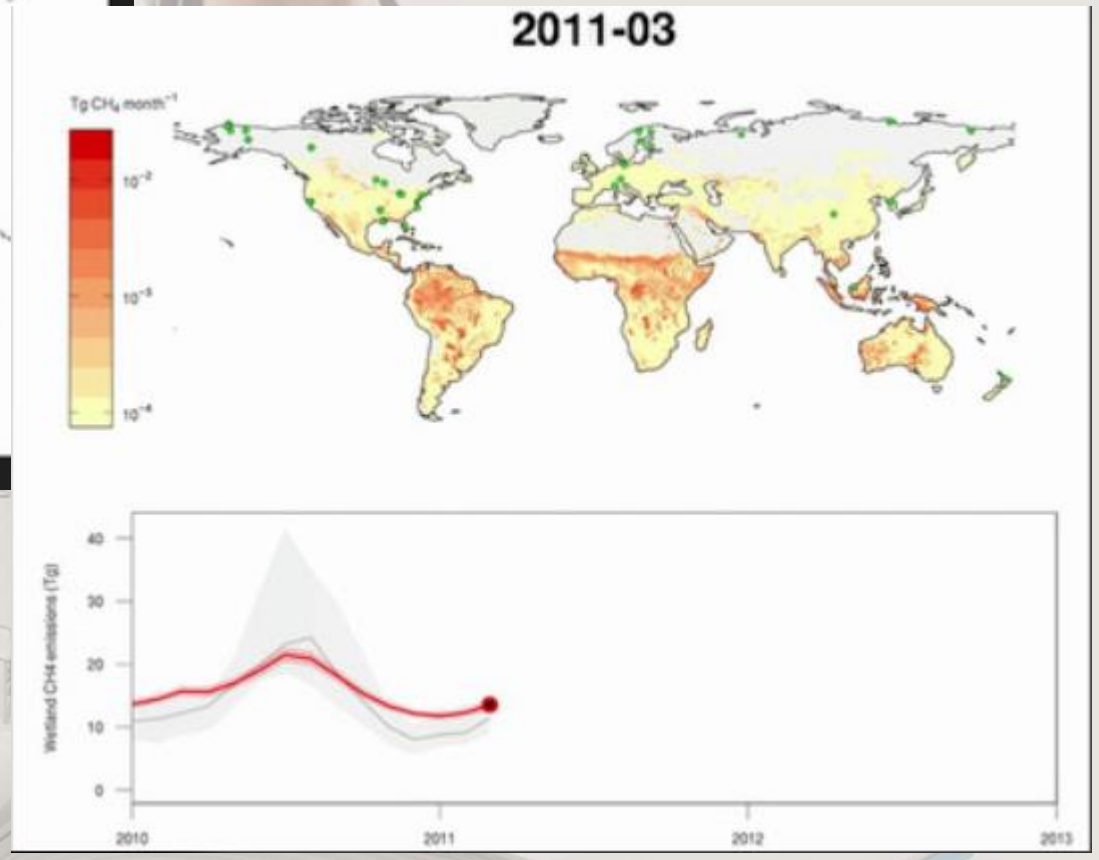
- Climate change is a complex problem

design smart electrical grids

Track deforestation in satellite images



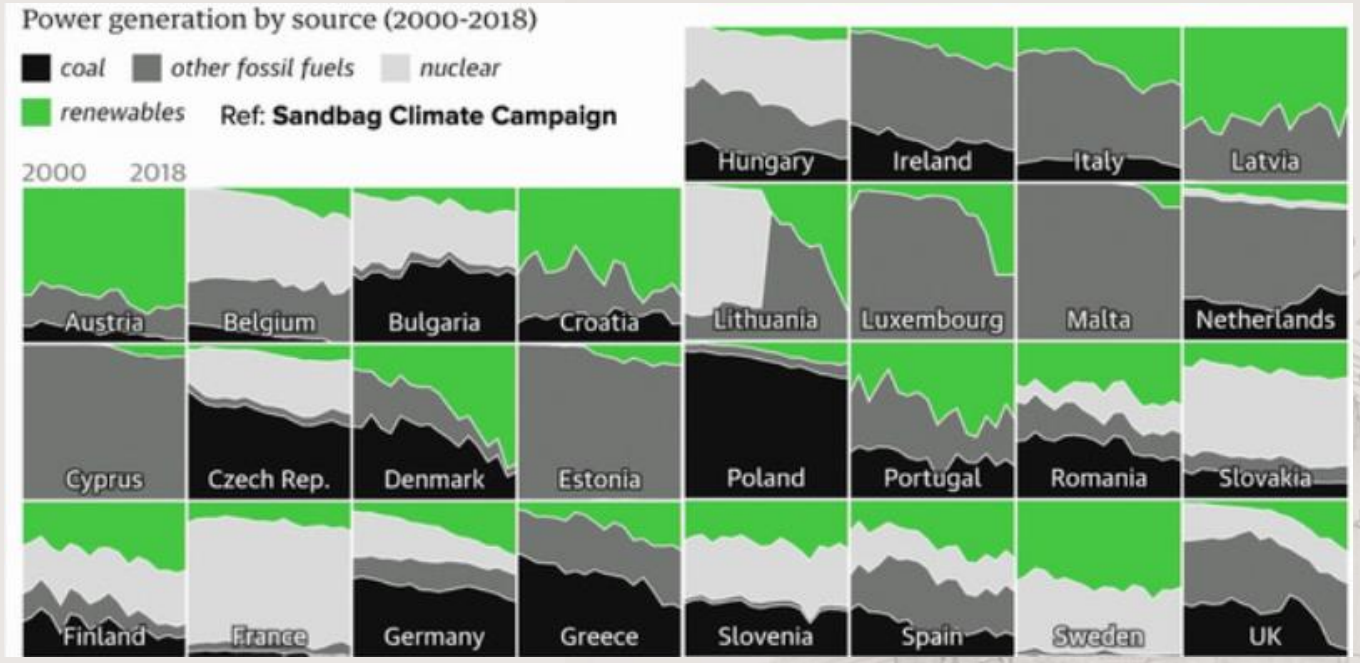
Mitigation: Can we use ML to predict methane?

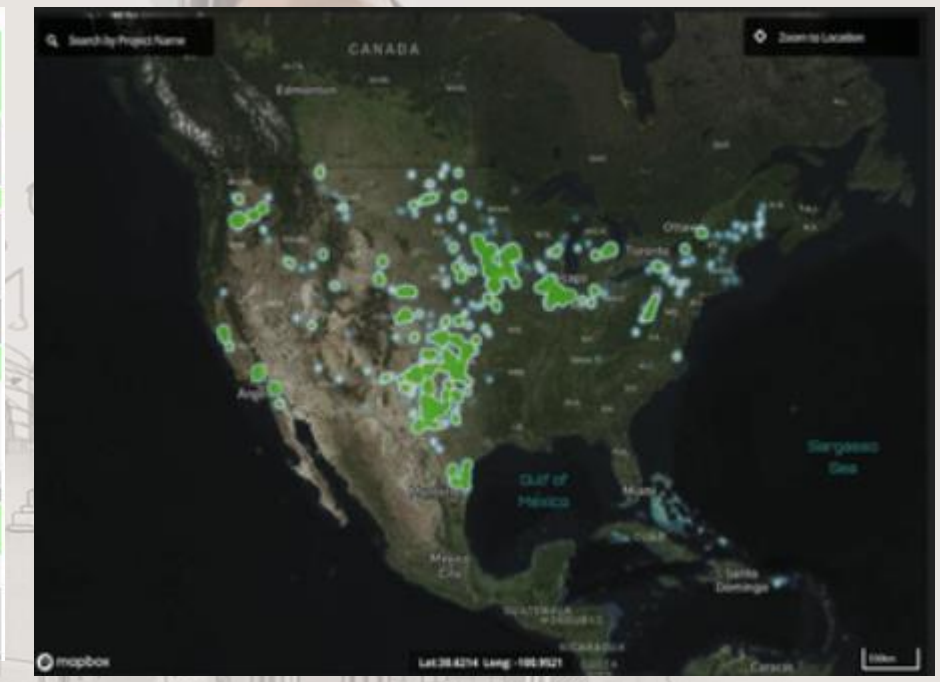


Upscale data analysis with AI

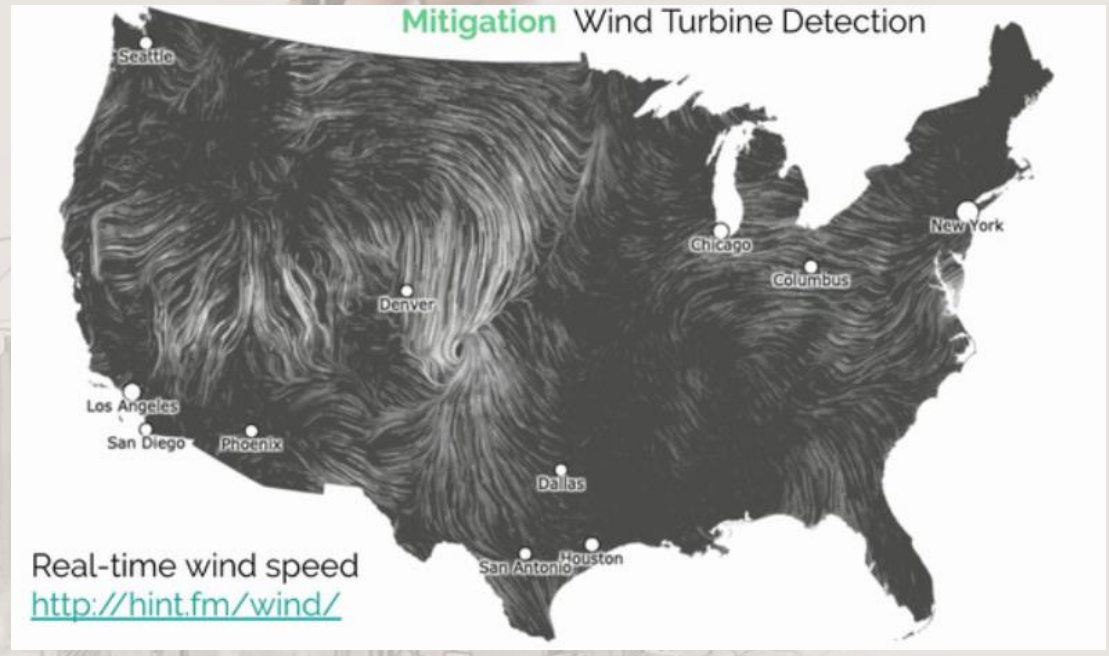
Ng, A. and Zhou, S. (2019). Tackling Climate Change Challenges with AI through Collaboration. *ICML Workshop*, Jan. 14, 2019

Mitigation: can we improve the view on turbines?





Mitigation: can we improve the view on turbines?



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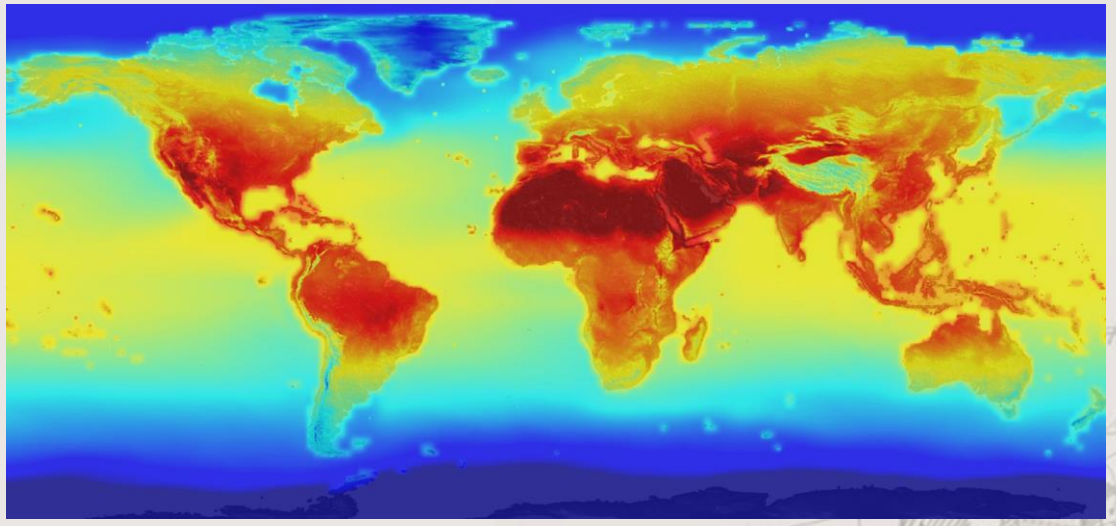

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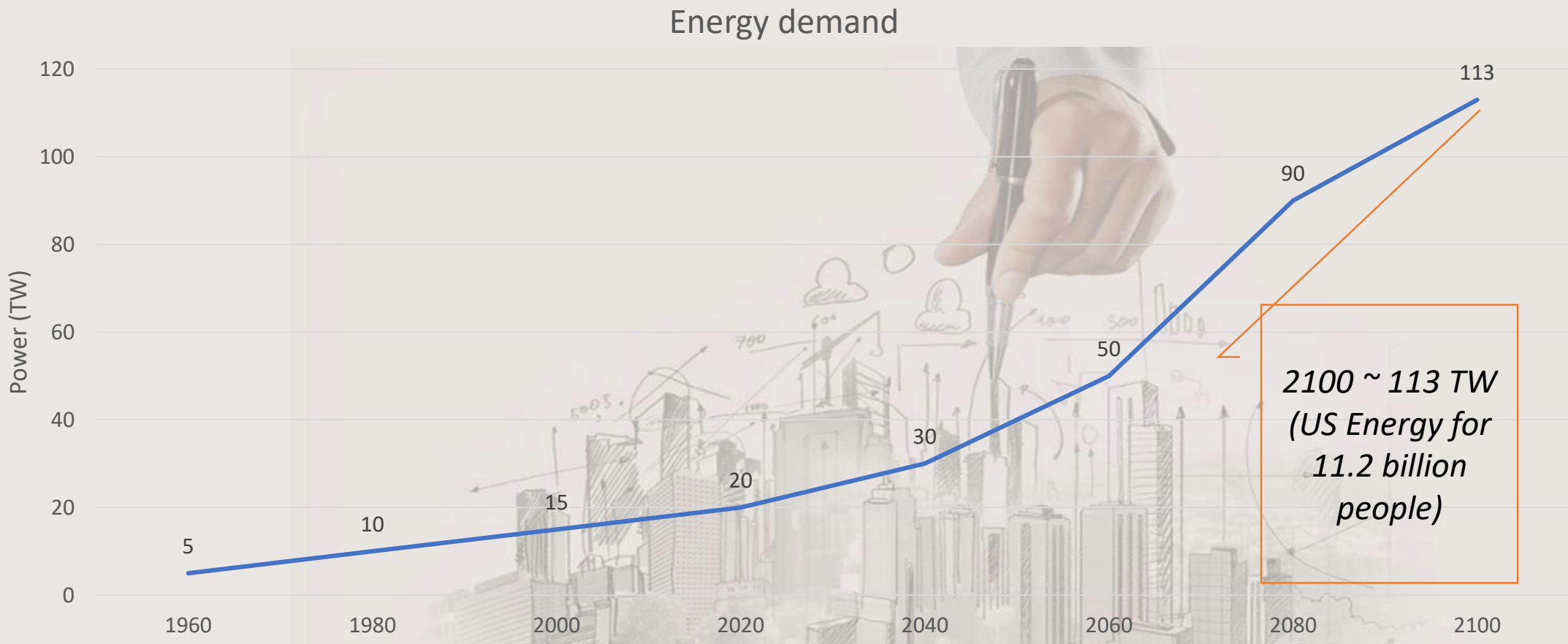
climate

energy

The energy problem

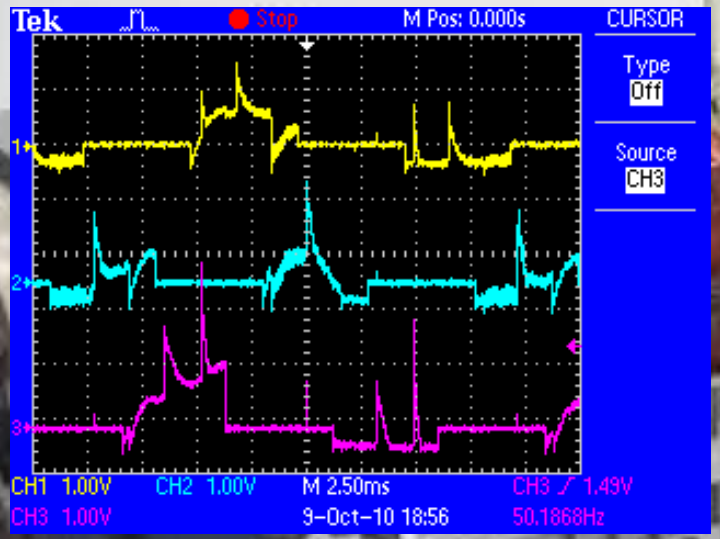


Platt, J. (2019). AI for Climate Change: the context. *ICML Workshop*, Jan. 14, 2019

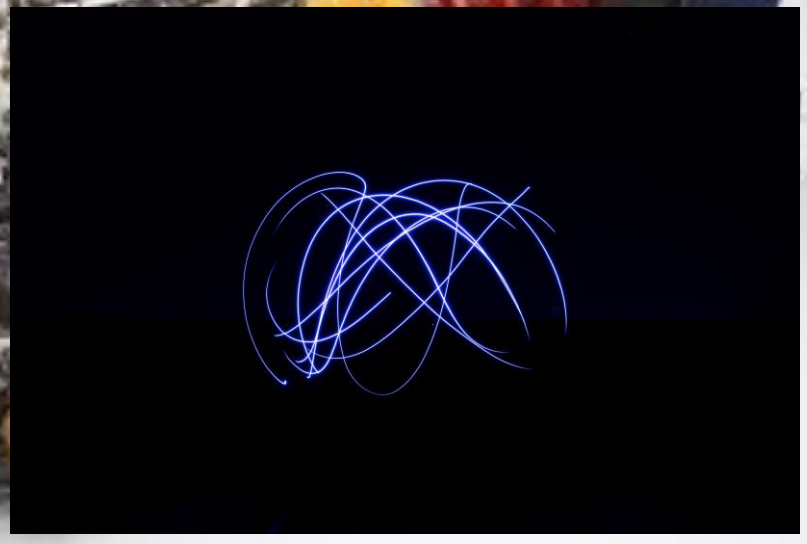
Ideal for ML/AI + new technologies

- Energy:
  - zero carbon
  - cheaper than fossil fuel
    - easier to diffuse energy types if they are cheaper
    - If energy is cheaper: global community will be more prosperous
- ML/AI can support inventing new technologies
  - Analysis/understanding
  - Optimization
  - Control
  - debugging

Can we use ML/AI to learn this mapping?



Sensor output



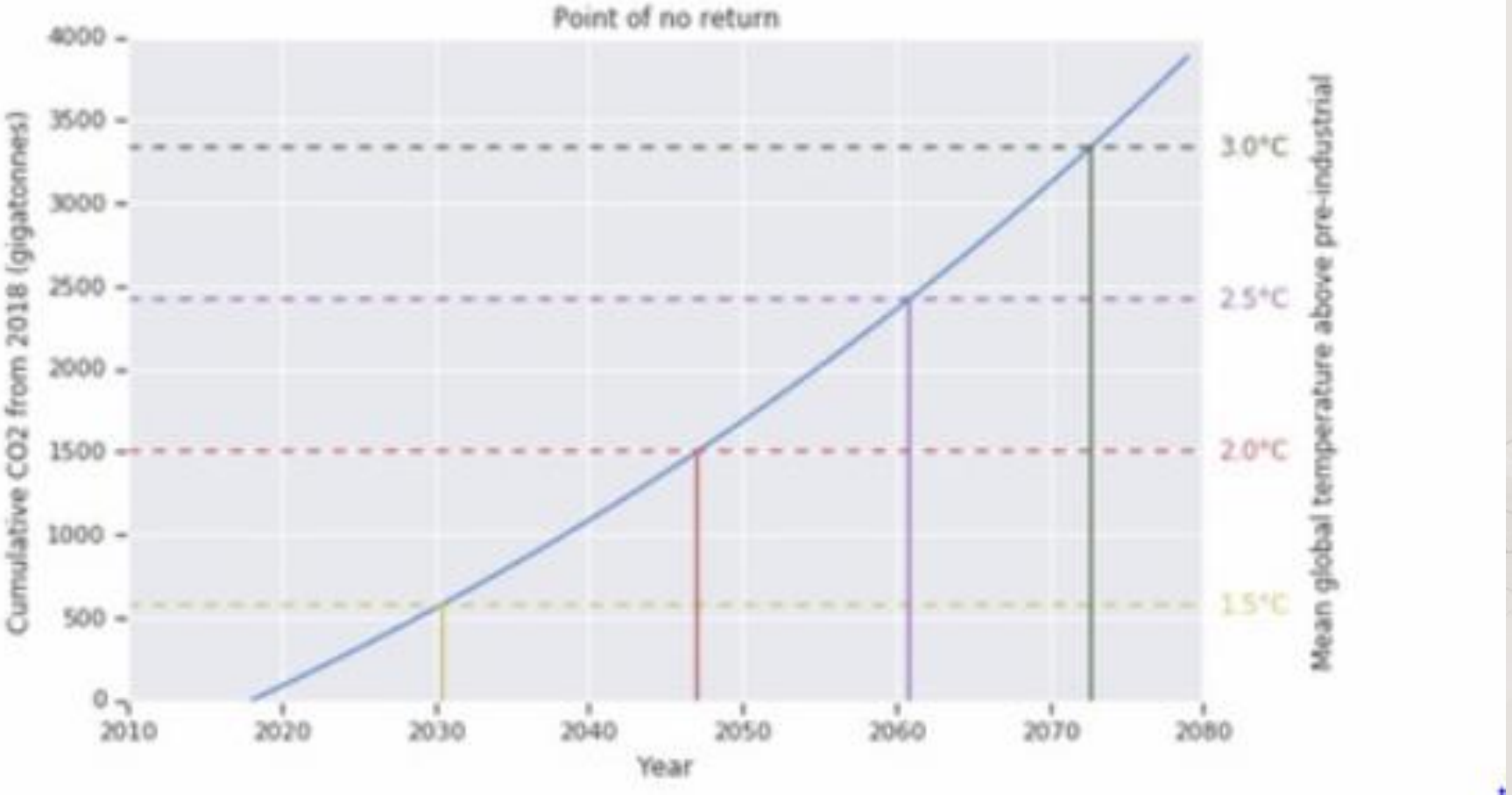
Plasma state

No large enough dataset

Use Bayesian inference

Climate crisis

- Reaching the planet's capacity for carbon



Climate crisis

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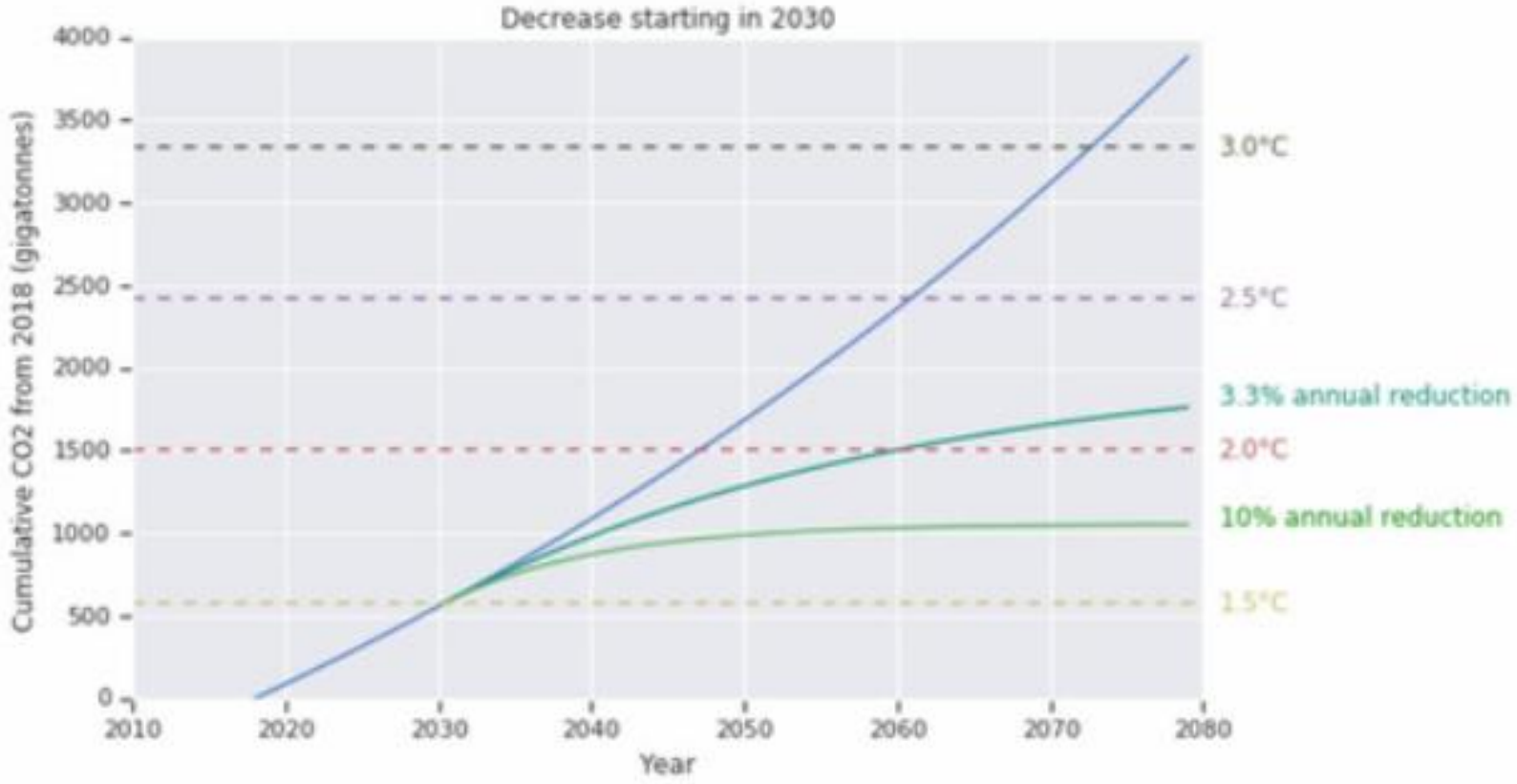
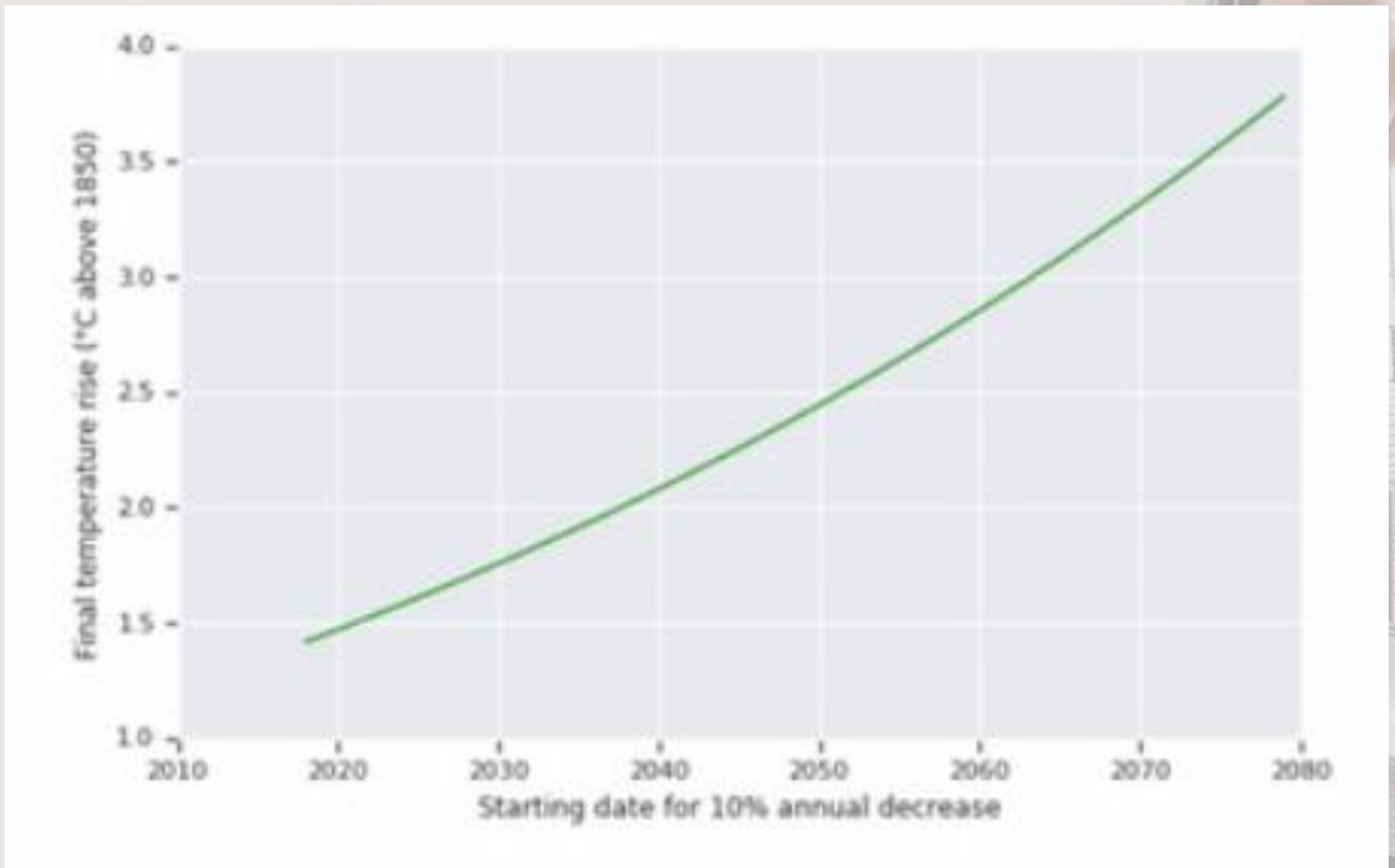


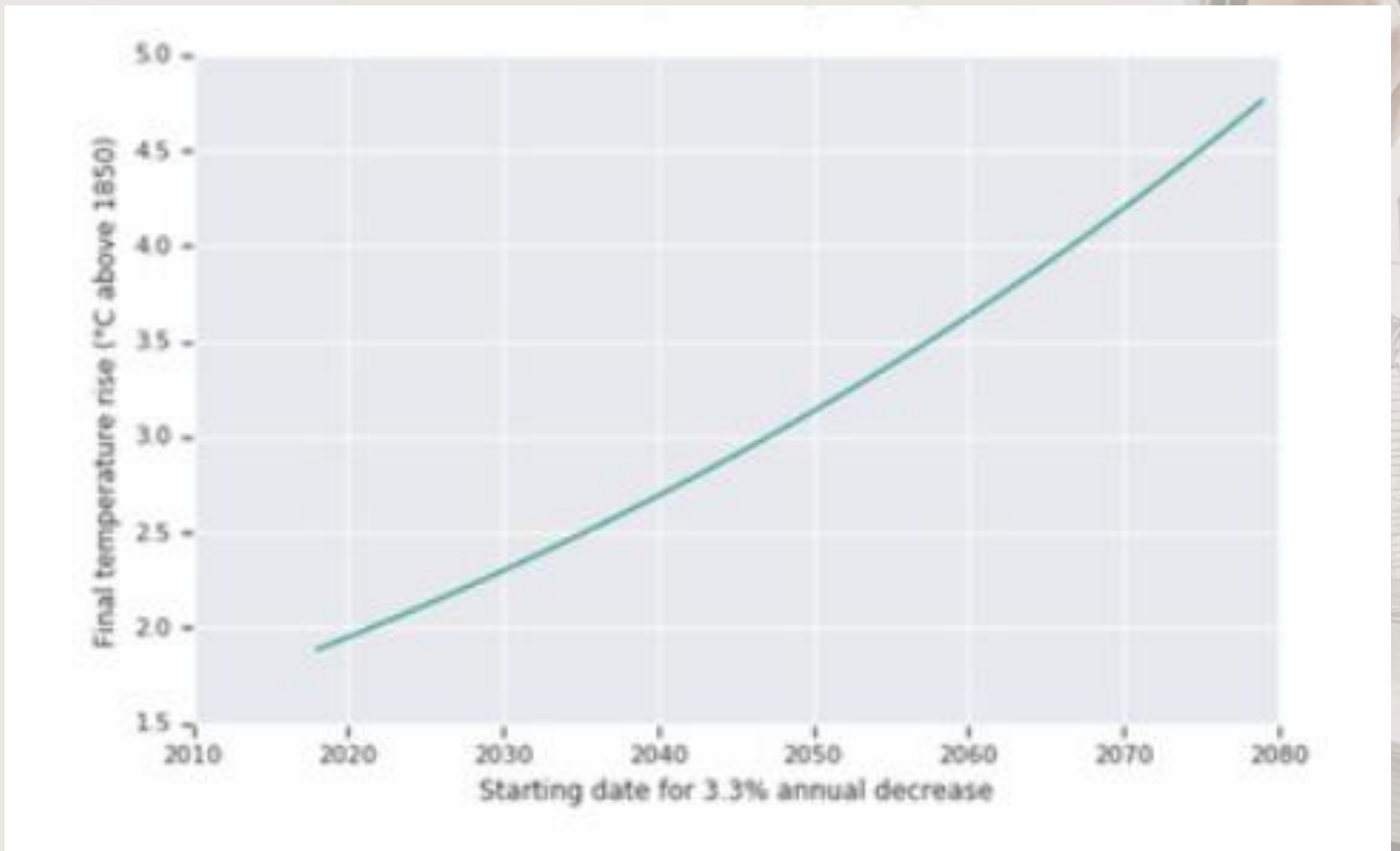
Temperature as a function of start date

- Assuming rapid decarbonization (10% per year)



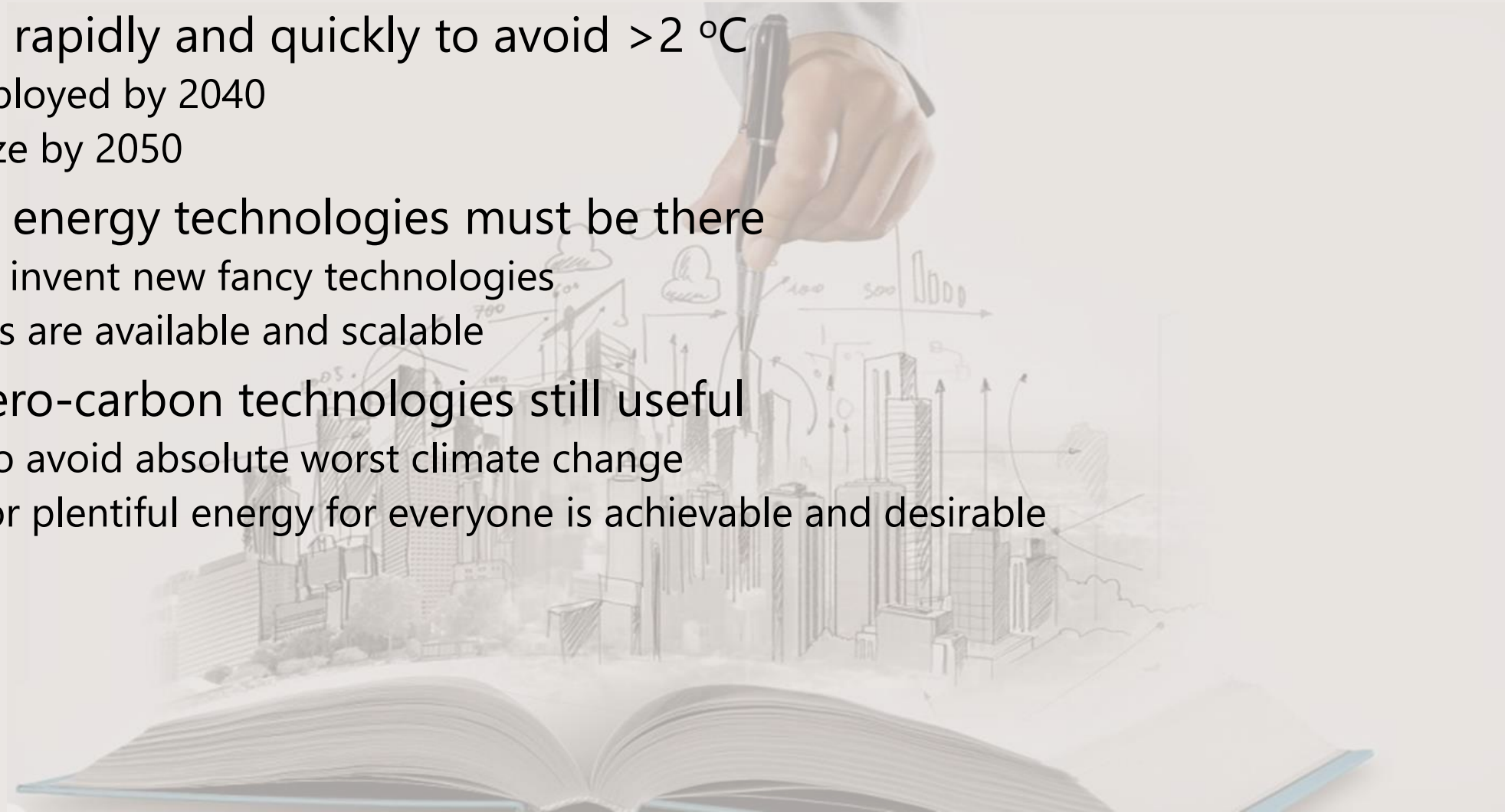
Temperature as a function of start date

- Assuming moderate decarbonization (3.3% per year)

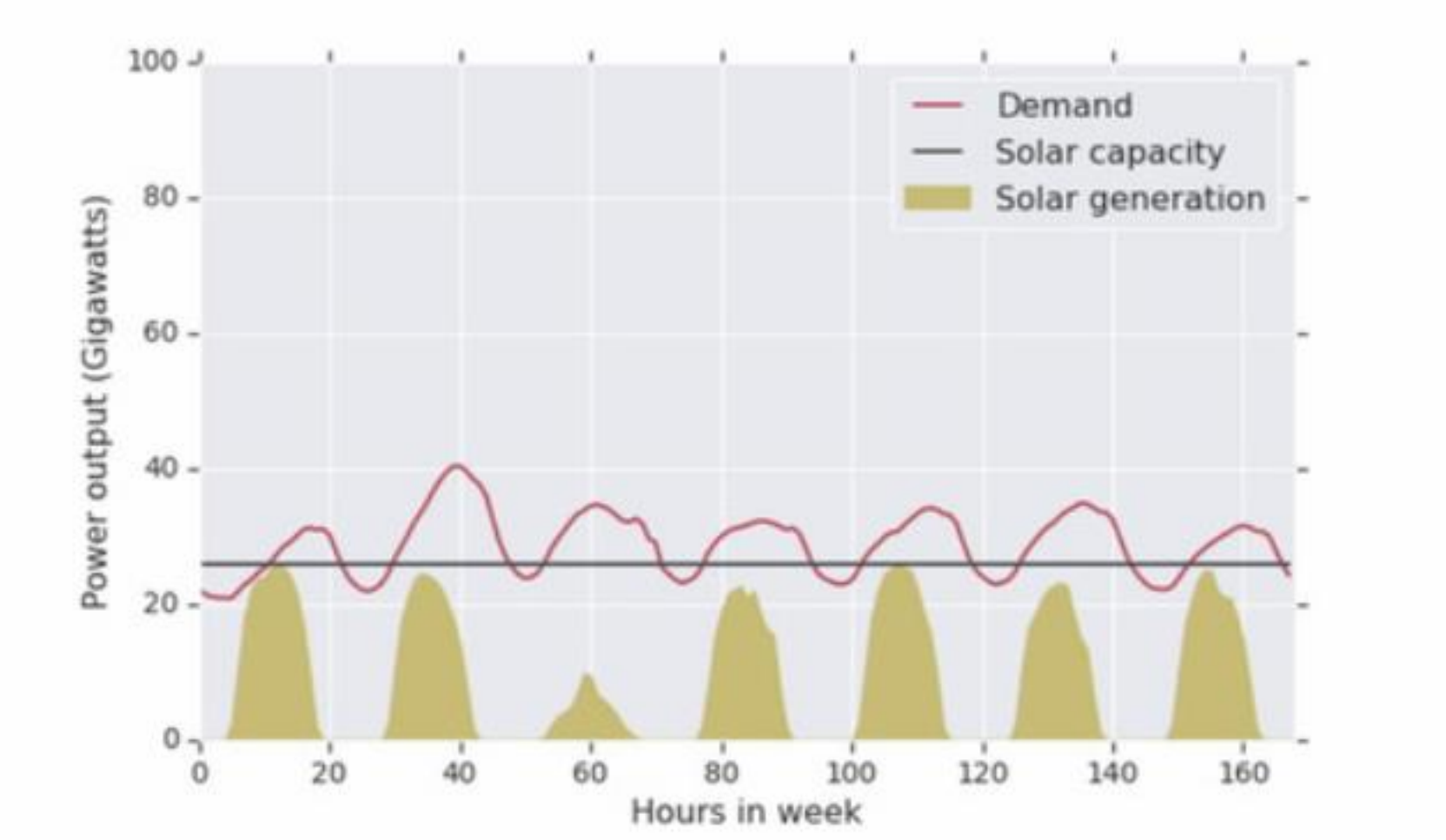


What needs to happen?

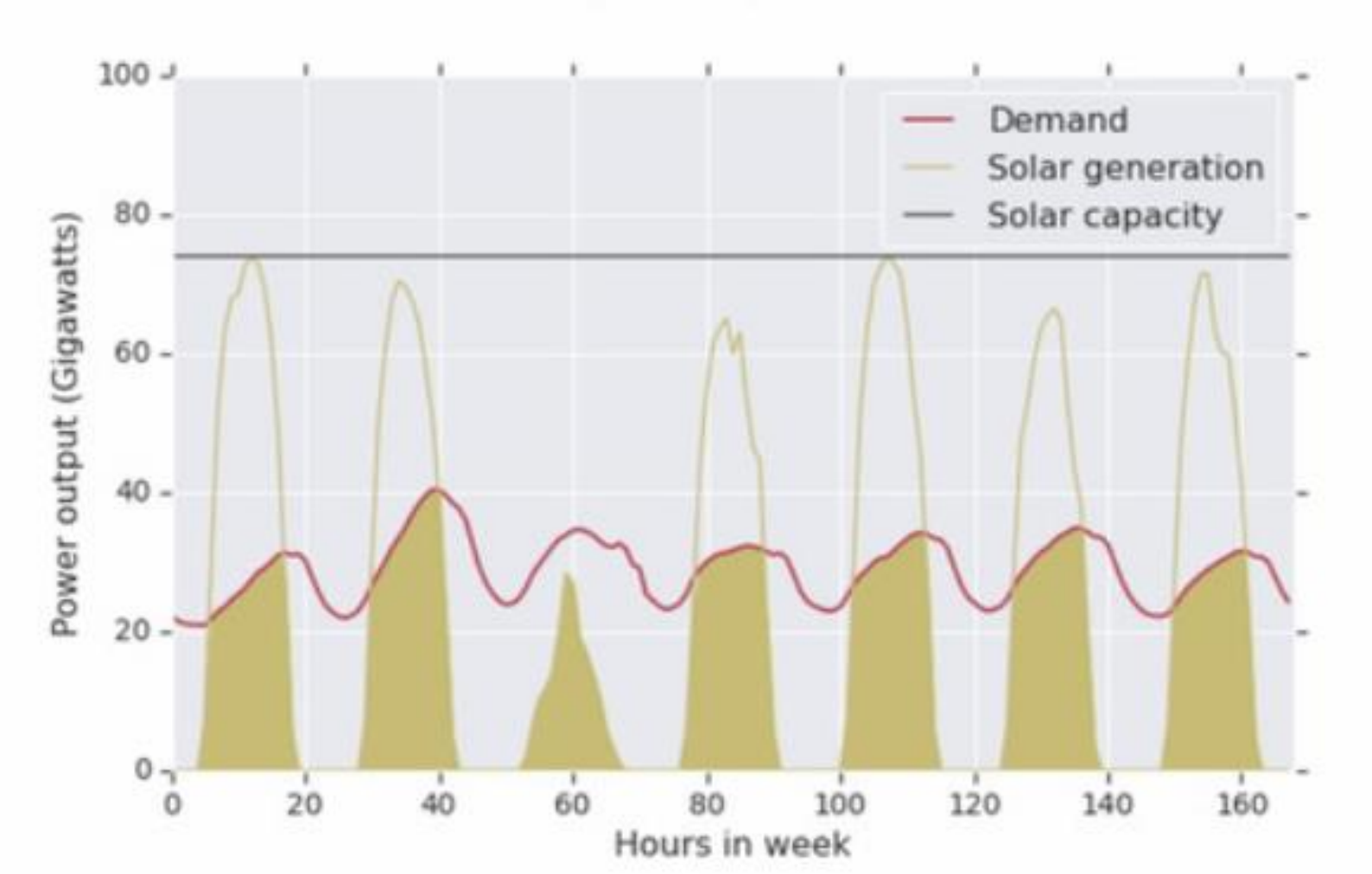
- Decarbonize rapidly and quickly to avoid >2 ^{o}C
  - Largely deployed by 2040
  - Decarbonize by 2050
- Zero-carbon energy technologies must be there
  - No time to invent new fancy technologies
  - Renewables are available and scalable
- Post-2040 zero-carbon technologies still useful
  - Backstop to avoid absolute worst climate change
  - Scenario for plentiful energy for everyone is achievable and desirable



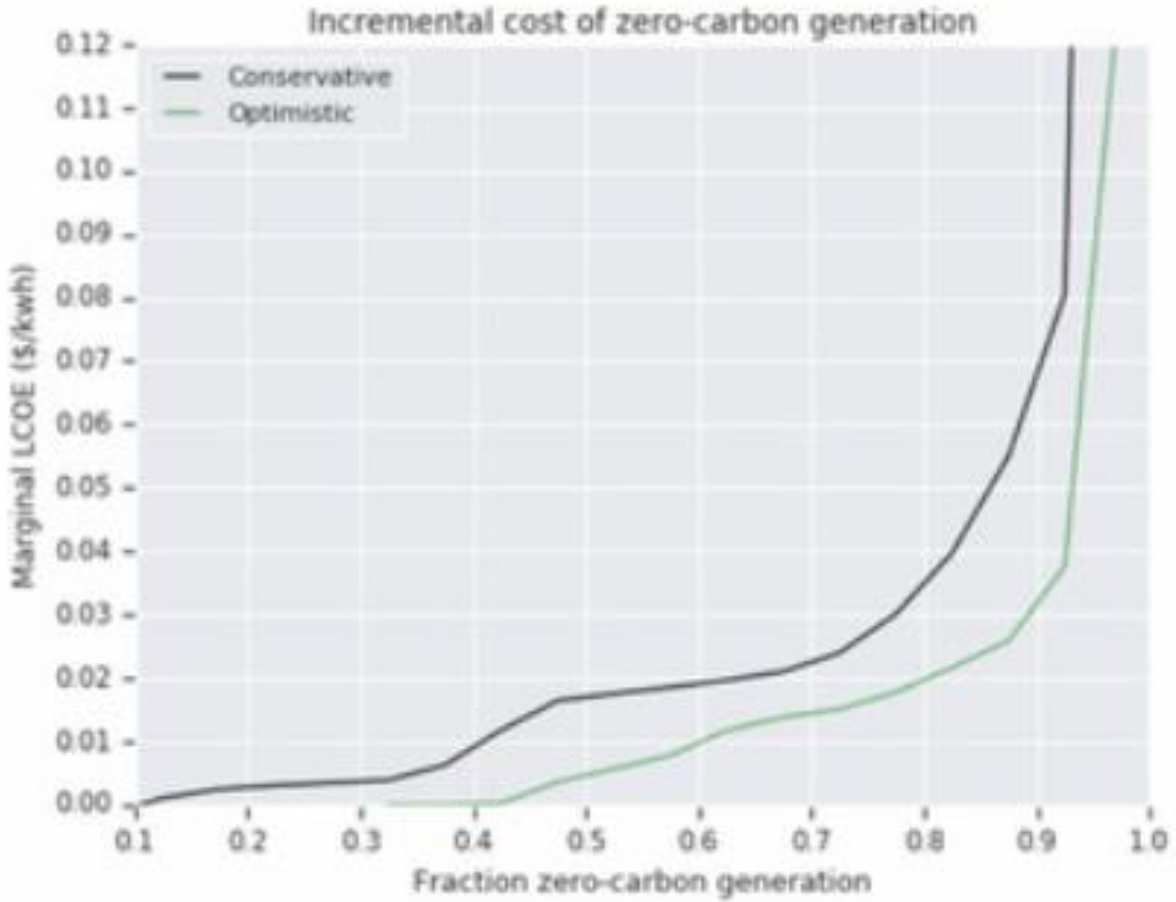
Moderate levels of renewables can work



High levels of renewables can get expensive



Getting the last of the carbon out will be expensive



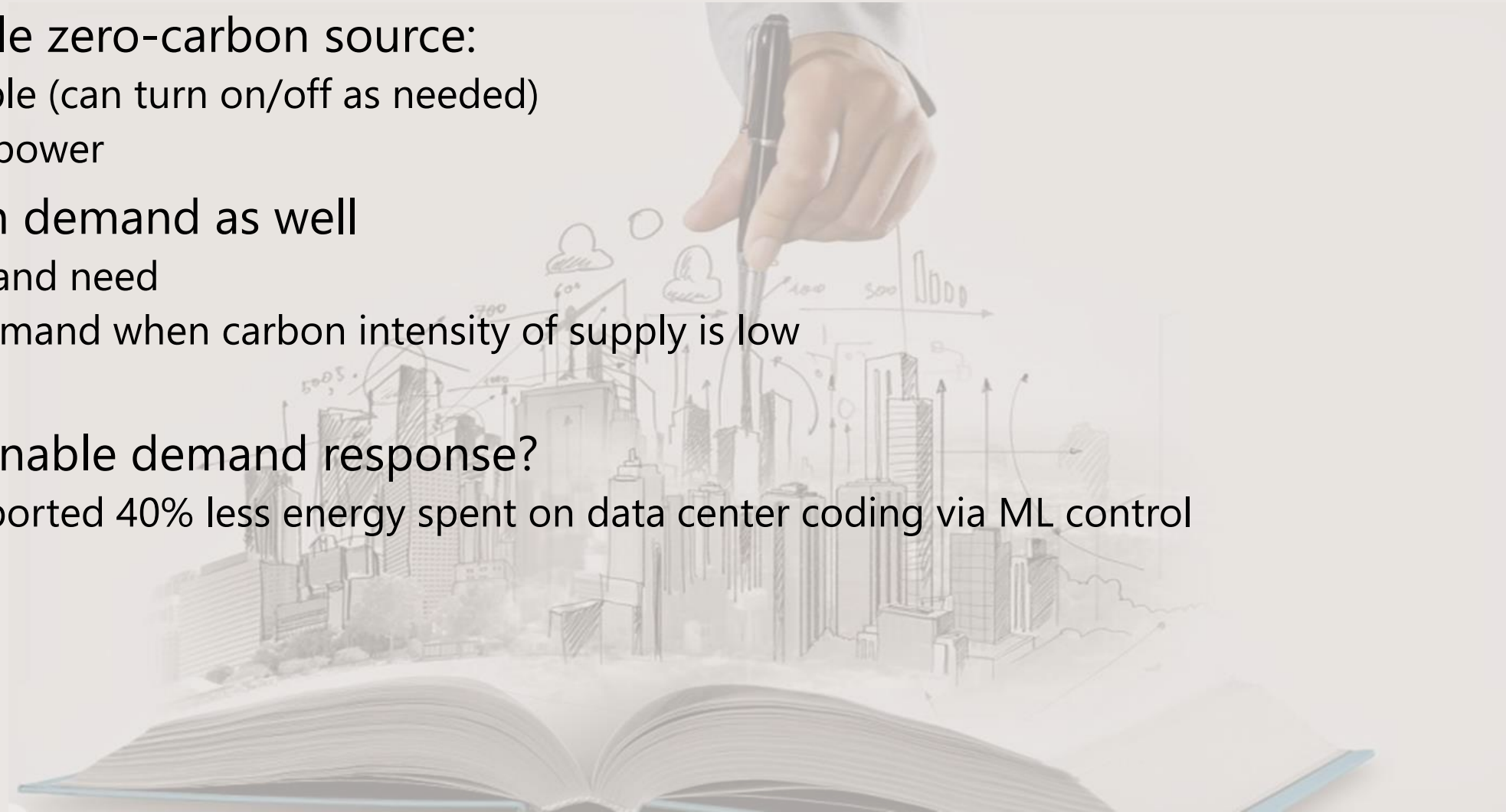
For method, see
Platt, Pritchard, Bryant (2015)
http://bit.ly/DOSCOE

Assumptions	Solar capital ($/kw)	Wind capital ($/kw)	Battery capital ($/kwh)	Battery lifetime (years)
Conservative	790	1370	200	10
Optimistic	520	1290	100	15

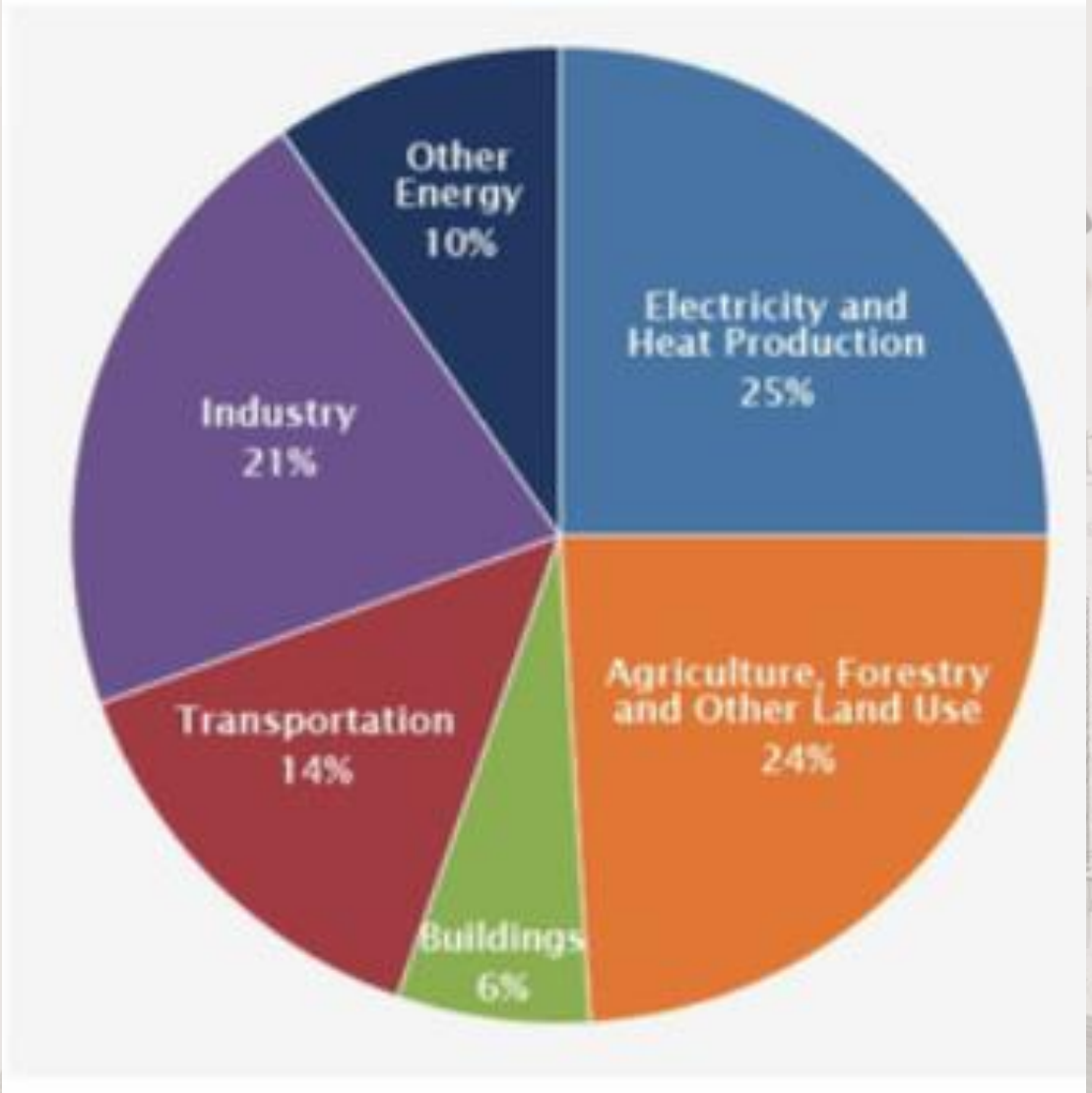
Can ML/AI help?

- Most valuable zero-carbon source:
  - Dispatchable (can turn on/off as needed)
  - Like hydropower
- Can dispatch demand as well
  - Meet demand need
  - Turn on demand when carbon intensity of supply is low

- Can ML/AI enable demand response?
  - Google reported 40% less energy spent on data center coding via ML control

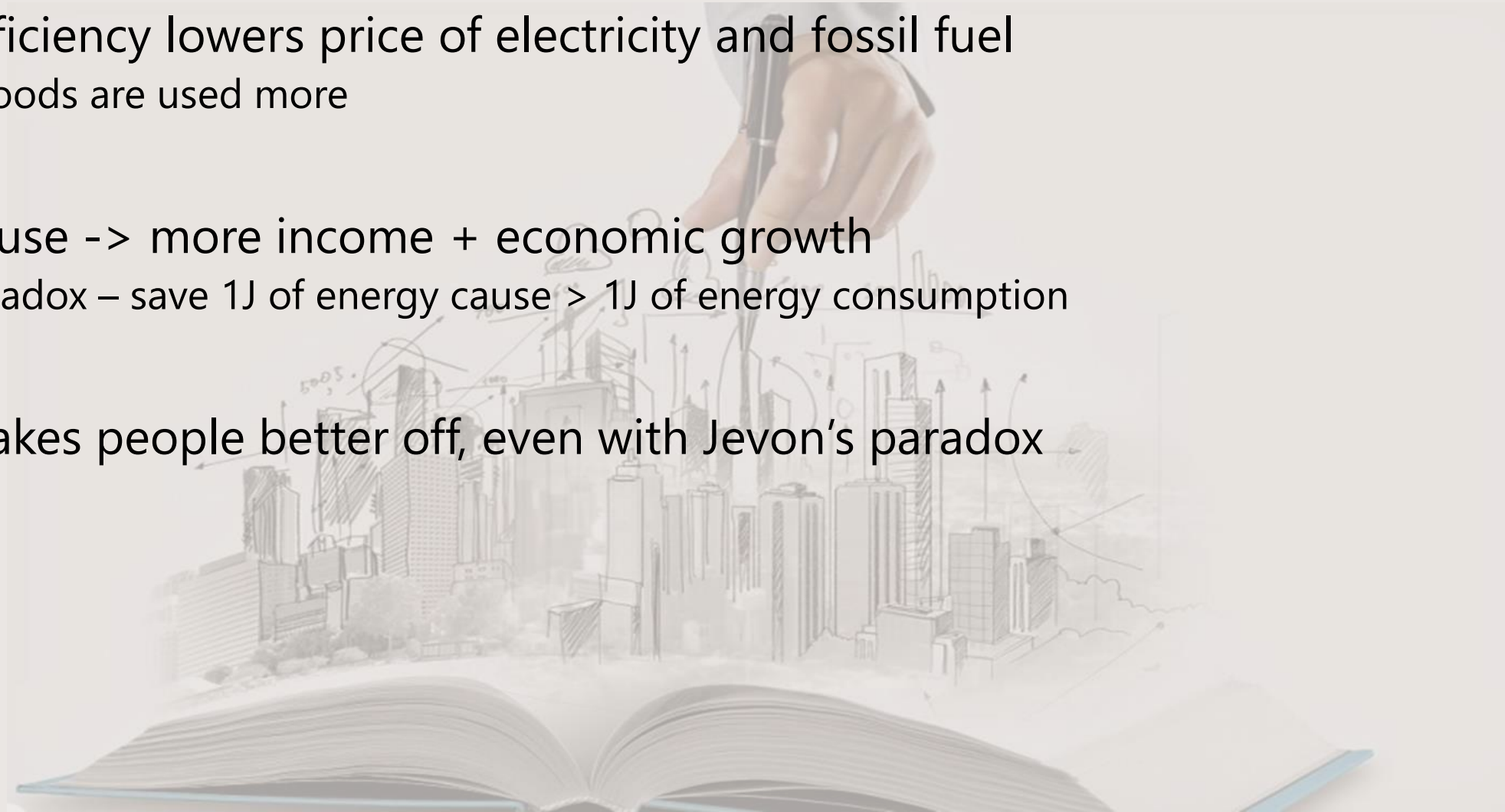


Many sources contribute to climate crisis

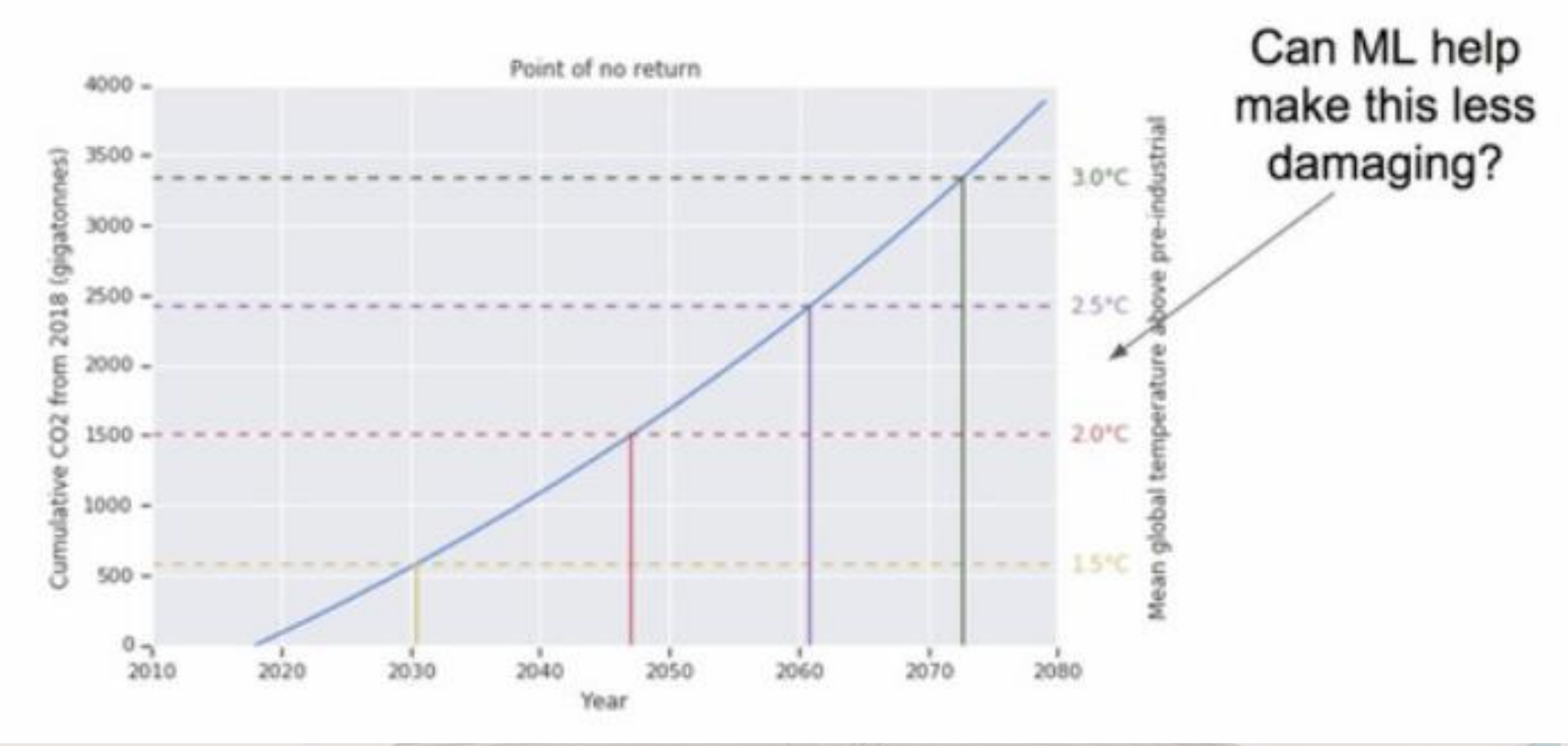


Carbon pressure is required

- Increased efficiency lowers price of electricity and fossil fuel
  - Cheaper goods are used more
- Less energy use -> more income + economic growth
  - Jevon's paradox – save 1J of energy cause > 1J of energy consumption
- Efficiency makes people better off, even with Jevon's paradox

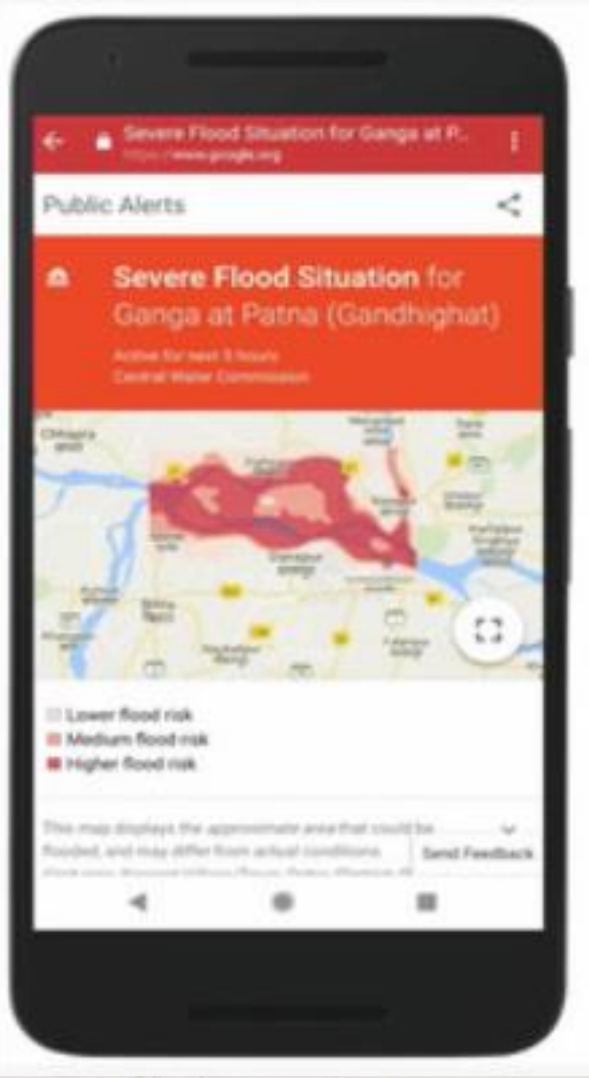


Adaptation

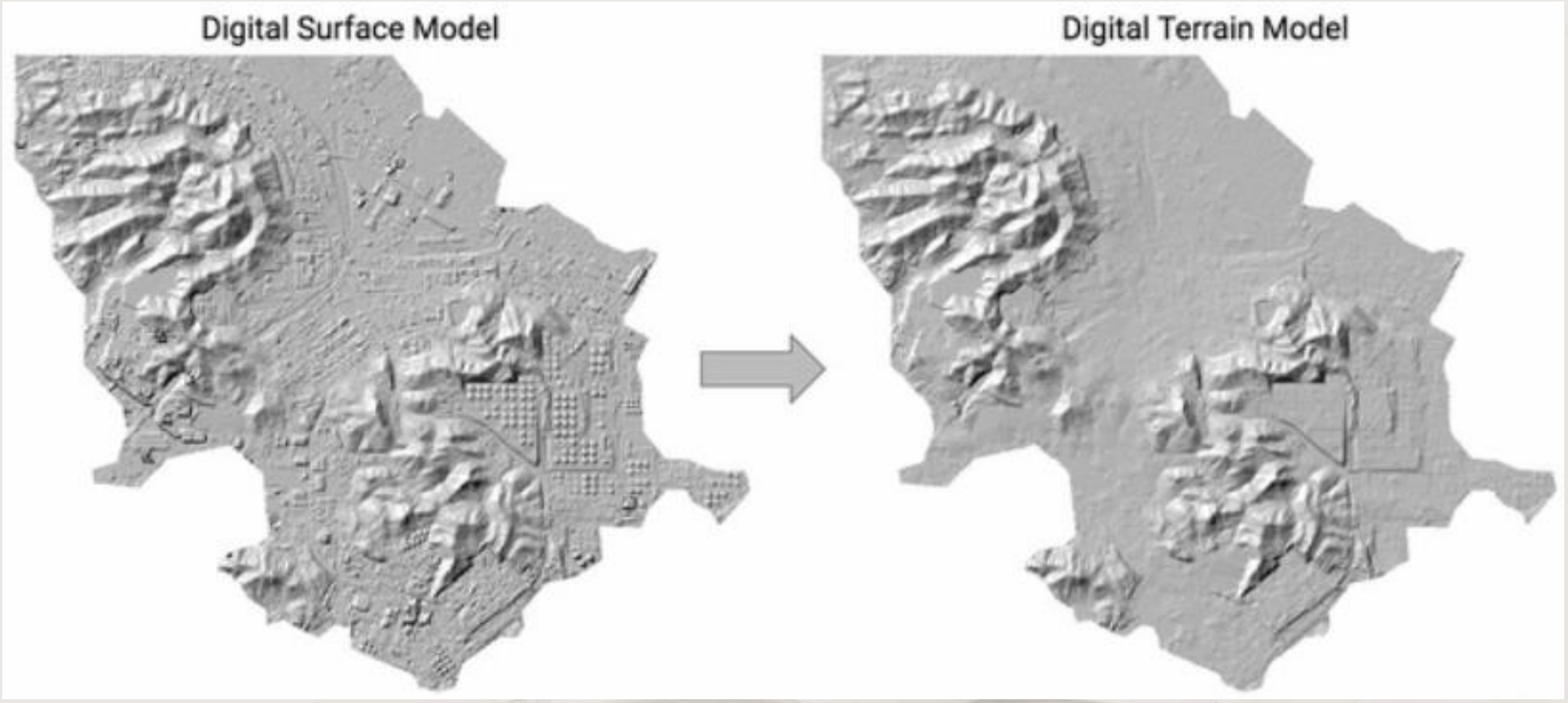

Point of no return
Cumulative CO2 from 2018 (gigatonnes)
4000
3500
3000
2500
2000
1500
1000
500
0
2010
2020
2030
2040
2050
2060
2070
2080
Year
3.0°C
2.5°C
2.0°C
1.5°C
Mean global temperature above pre-industrial
Can ML help make this less damaging?

Example: flood forecasting

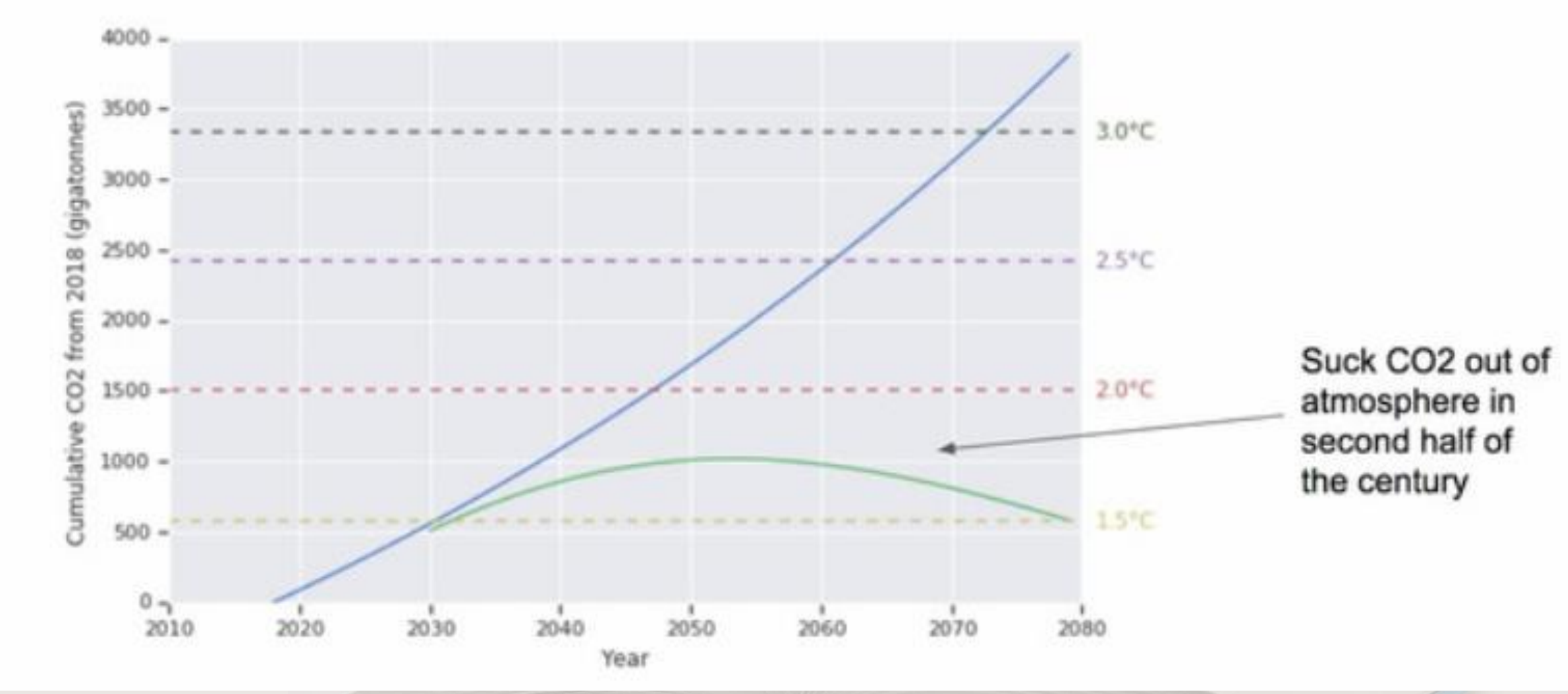
- Floods are bad now
  - US $9.8B annual damage
  - Affects 250M people/year
- Will get worse at higher temperature
- Use ML to better predict floods



Example: use ML to derive high resolution maps

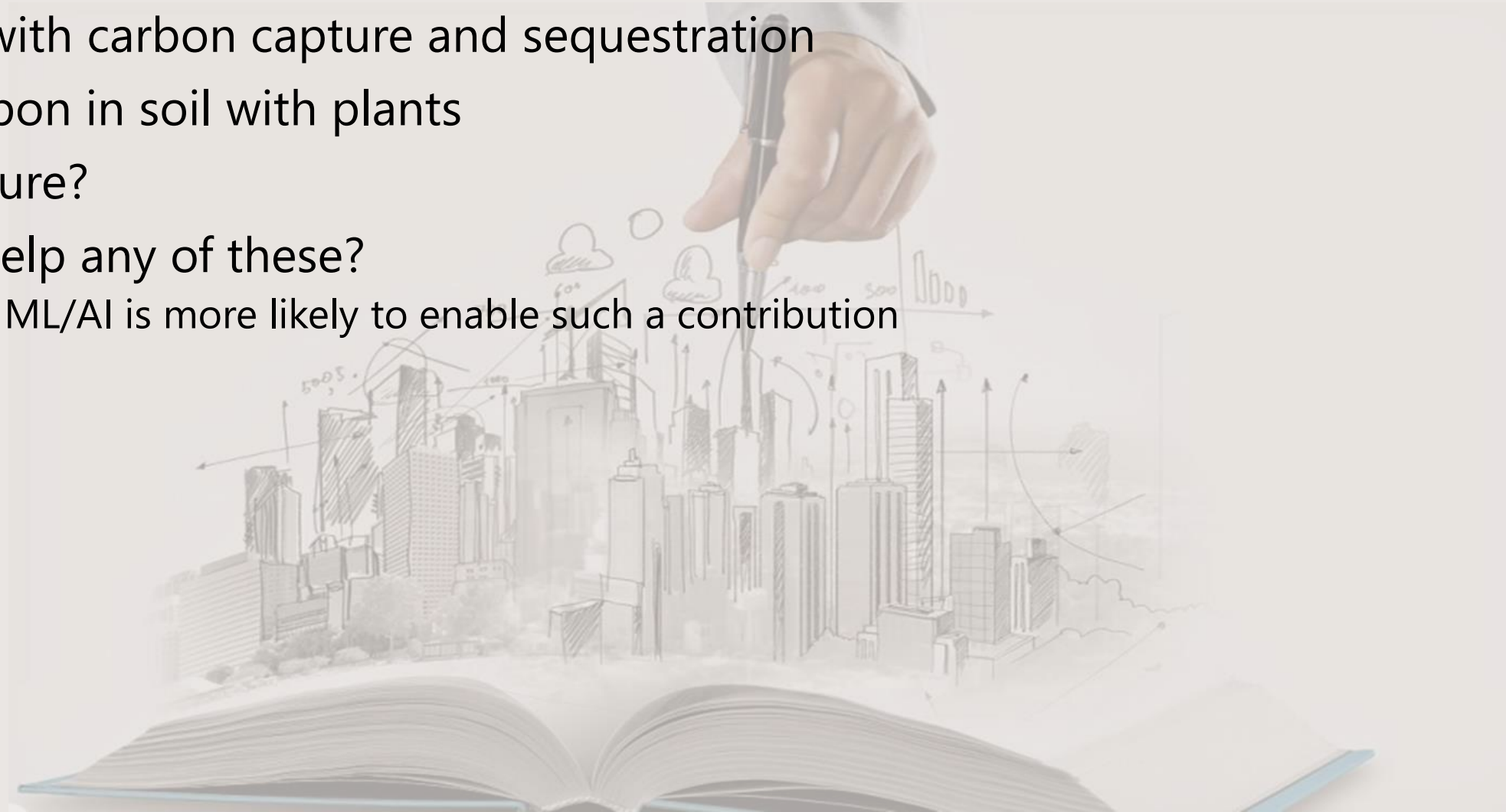


Reverse the damage?



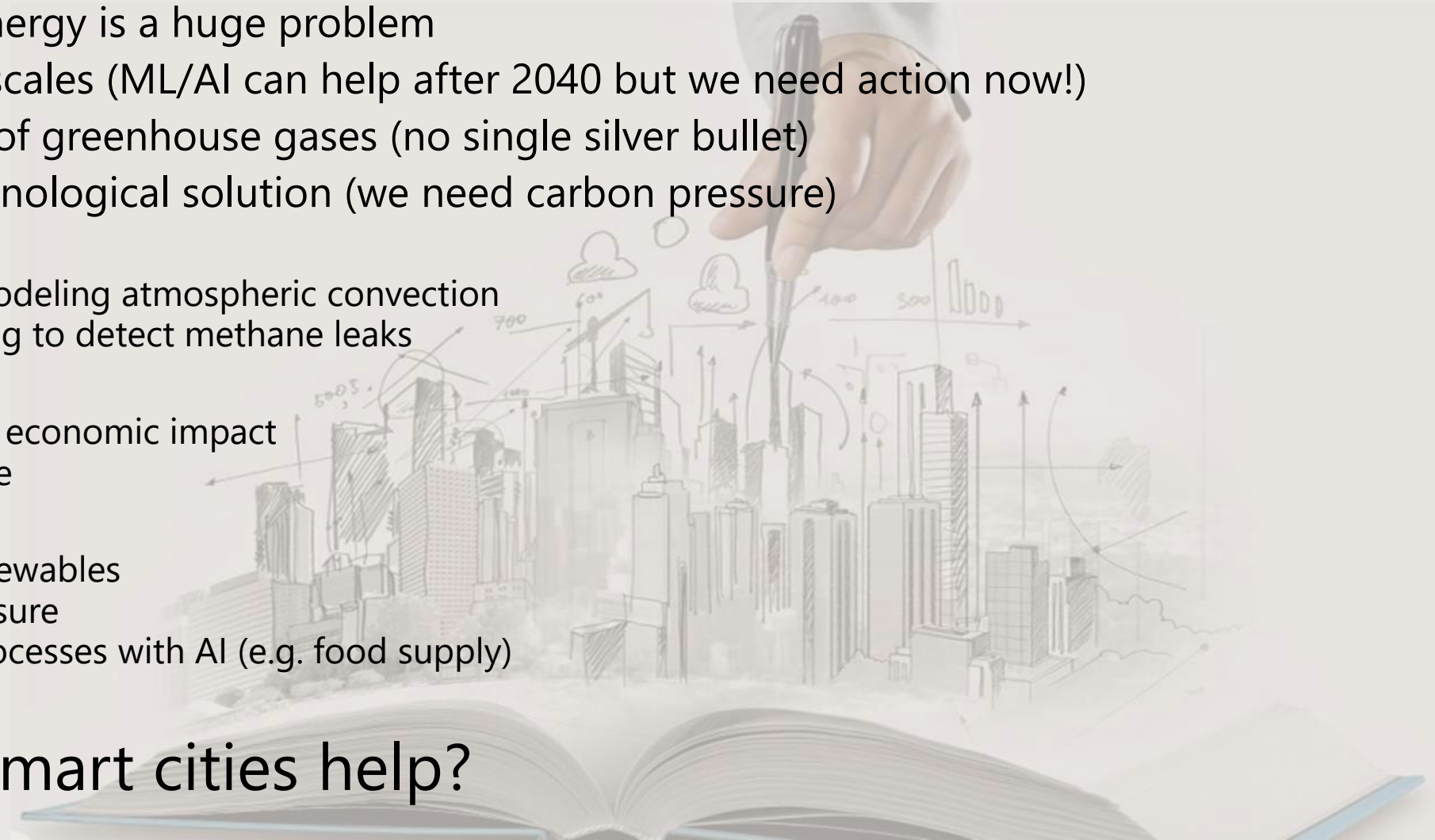
Methods?

- Bio-energy with carbon capture and sequestration
- Increase carbon in soil with plants
- Free air capture?
- Can ML/AI help any of these?
  - After 2040 ML/AI is more likely to enable such a contribution



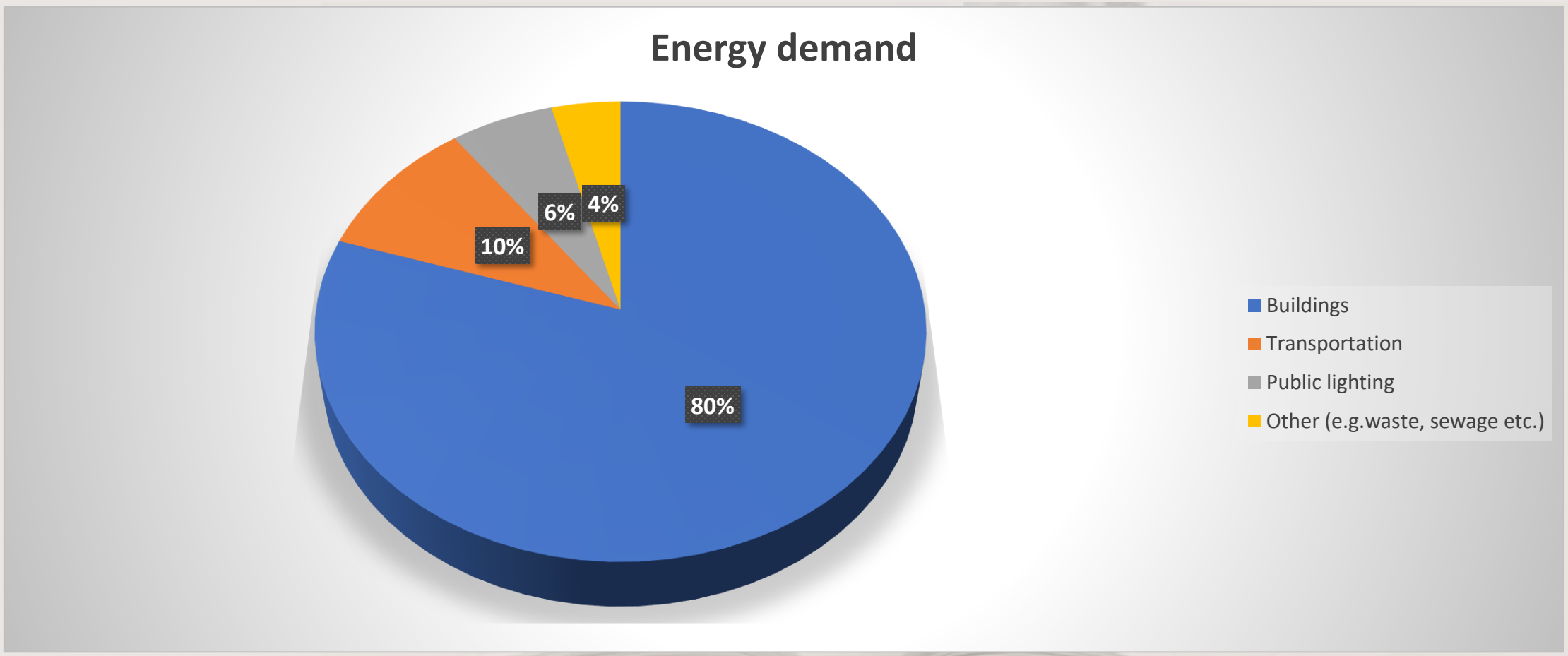
Discussion

- Climate and energy is a huge problem
- Multiple time scales (ML/AI can help after 2040 but we need action now!)
- Many sources of greenhouse gases (no single silver bullet)
- No purely technological solution (we need carbon pressure)
- Mitigation:
  - ML/AI for modeling atmospheric convection
  - Deep learning to detect methane leaks
- Adaptation:
  - Estimate the economic impact
  - Track wild life
- Alteration:
  - Enhance renewables
  - Carbon pressure
  - Optimize processes with AI (e.g. food supply)



So, could smart cities help?

City as energy system: findings from Trikala

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AION


SMART ENERGY

How can standards help cities?

- GDAŃSK (PL)
- KAUNAS (LT)
- KLAIPĖDA (LT)
- NANCY (FR)
- ŠIAULIAI (LT)
- STRASBOURG (FR)
- UTENA (LT)
- VILNIUS (LT)

"Hard" to collect KPIs

Economy

- Wireless Broadband Subscriptions/Coverage
- Intersection Control
- Tourism Sector Employment
- ICT Sector Employment
- Travel Time Index
- Shared Bicycles
- Shared Vehicles
- Integrated BMS in Public Buildings

Environment

- Air Pollution
- Solid Waste Treatment
- EMF Exposure
- Recreational Facilities
- Residential Thermal Energy Consumption (kWh)
- Public Building Energy Consumption (GJ / year / capita)

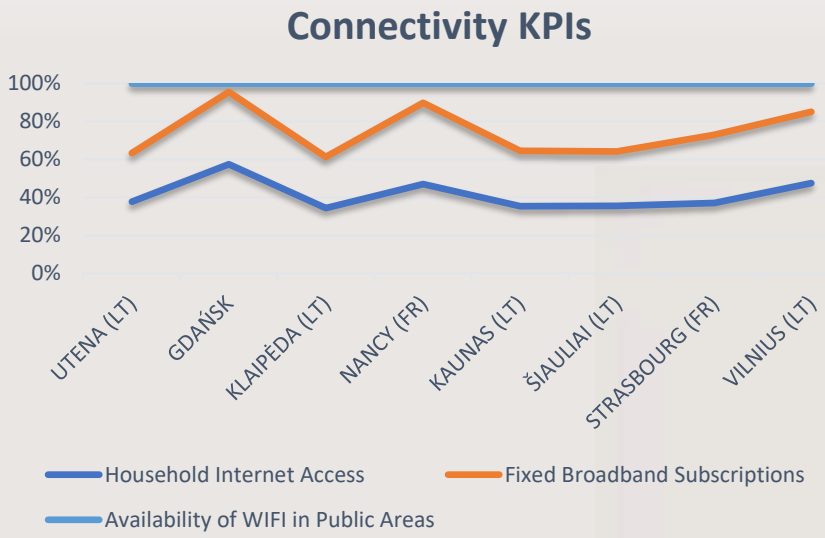
Society & Culture

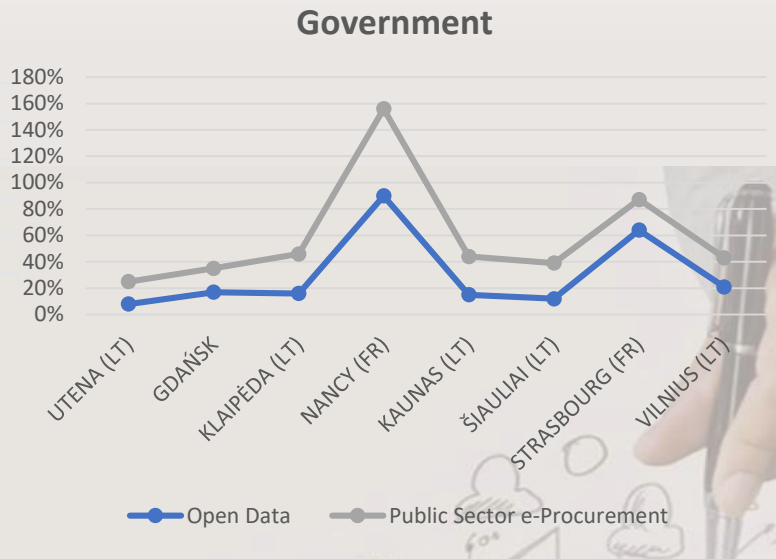
- Student ICT Access
- Higher Education Degrees
- Electronic Health Records
- Housing Expenditure
- Gender Income Equity
- Gini Coefficient
- Disaster Related Economic Losses
- Resilience Plans

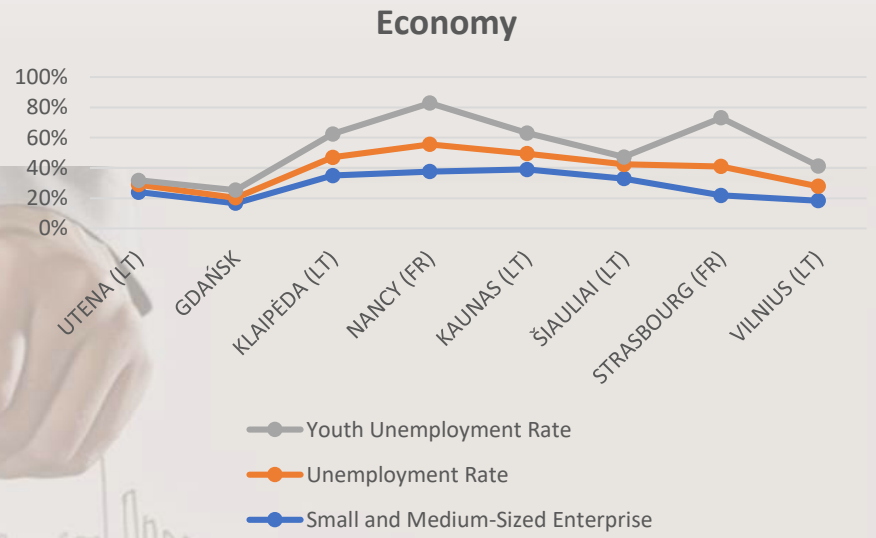
Relative KPIs

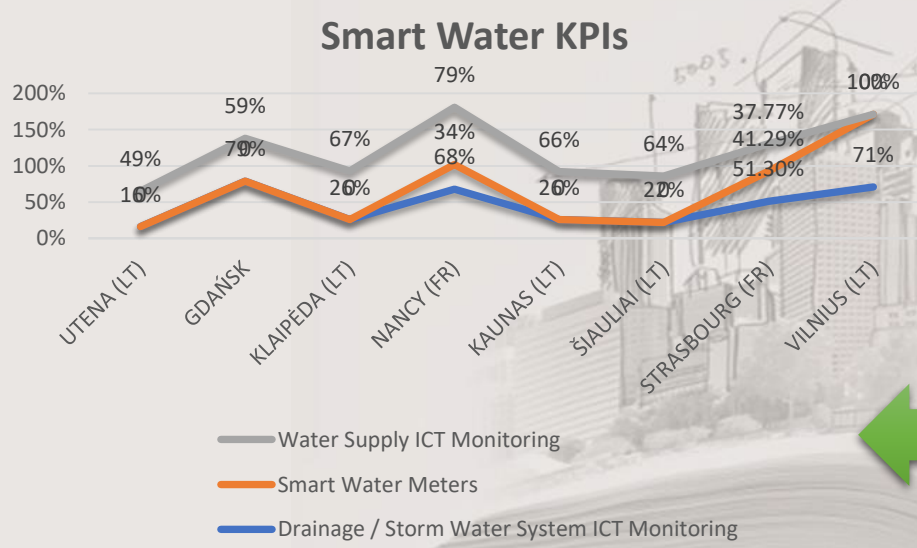
- Smart Water KPIs - Water KPIs
- Smart Energy KPIs – Energy KPIs
- Smart Transportation KPIs – Transportation KPIs

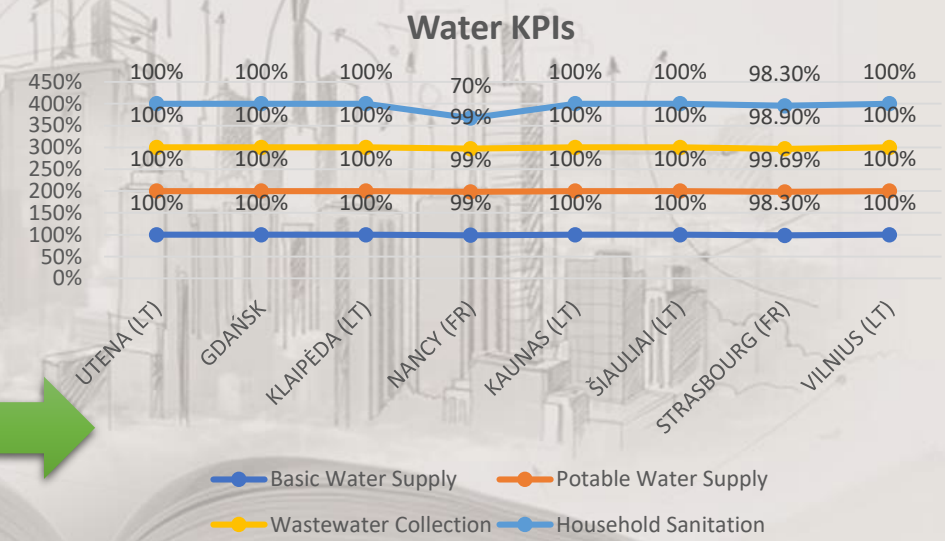
Some indicative comparative figures



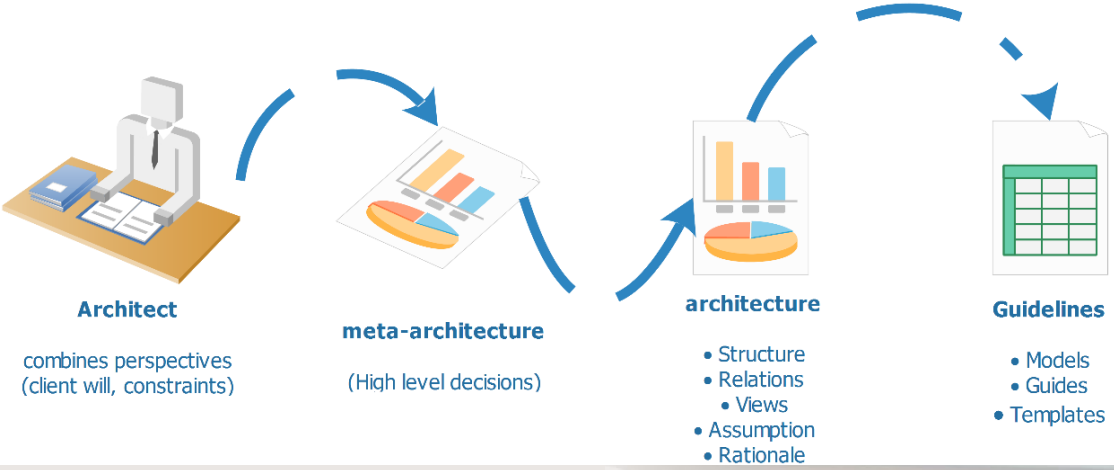


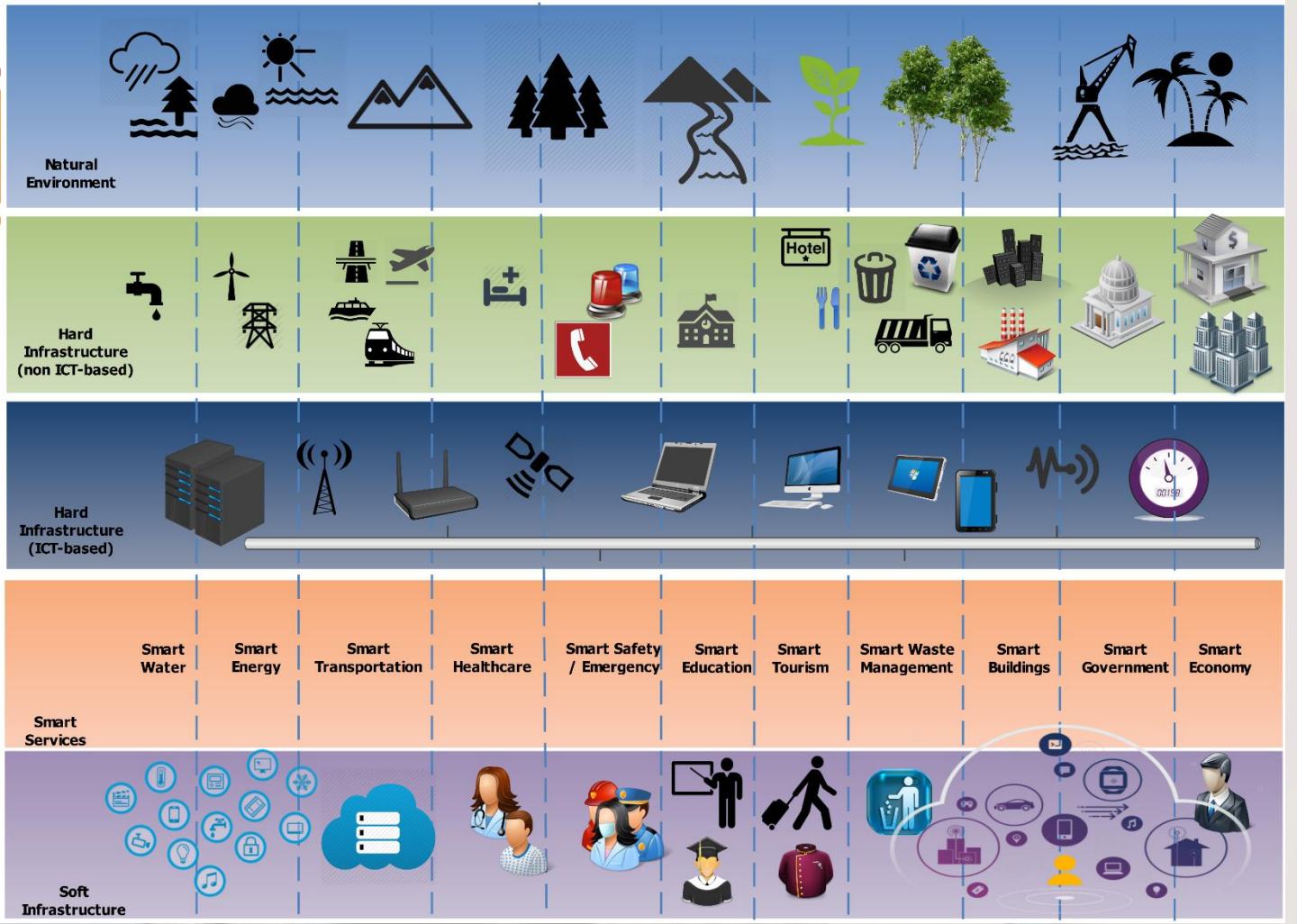






Adopting the ITU SSC definition and architecture framework

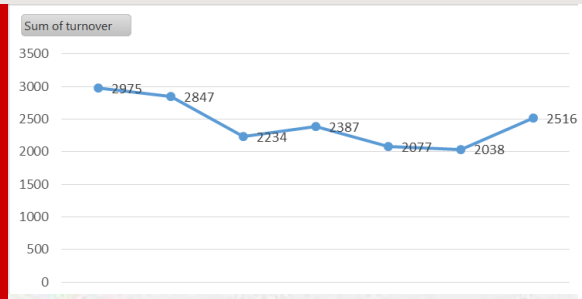


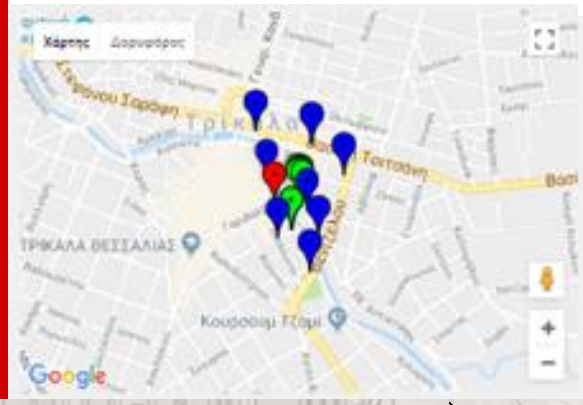


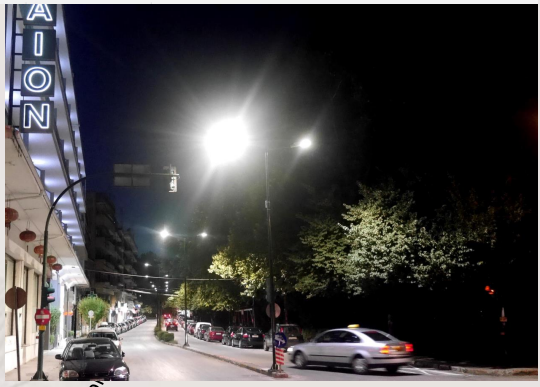
Can the city become more efficient? How can AI help?

4.854
requests
2017

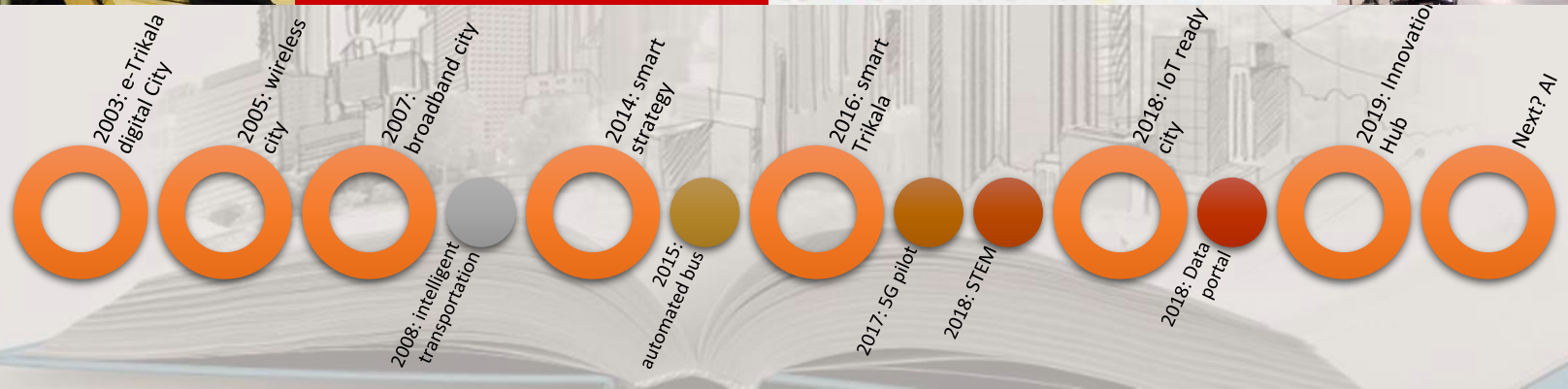
4.590
requests
2016



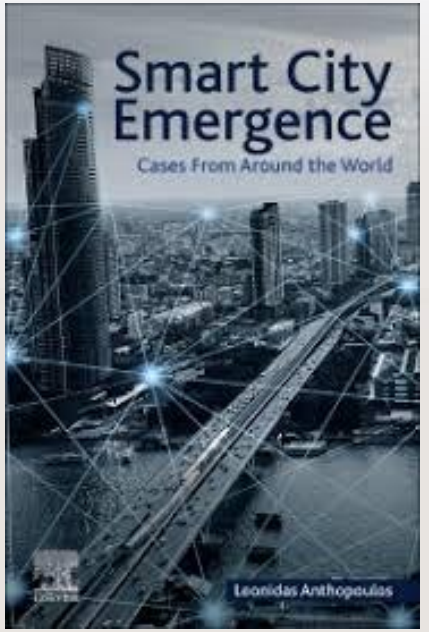




Smart Trikala timeline:



Please contact me for more information.



Thank you for your attention!

lanthopo@uth.gr

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