Innovation and Climate Change

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Who Am I?

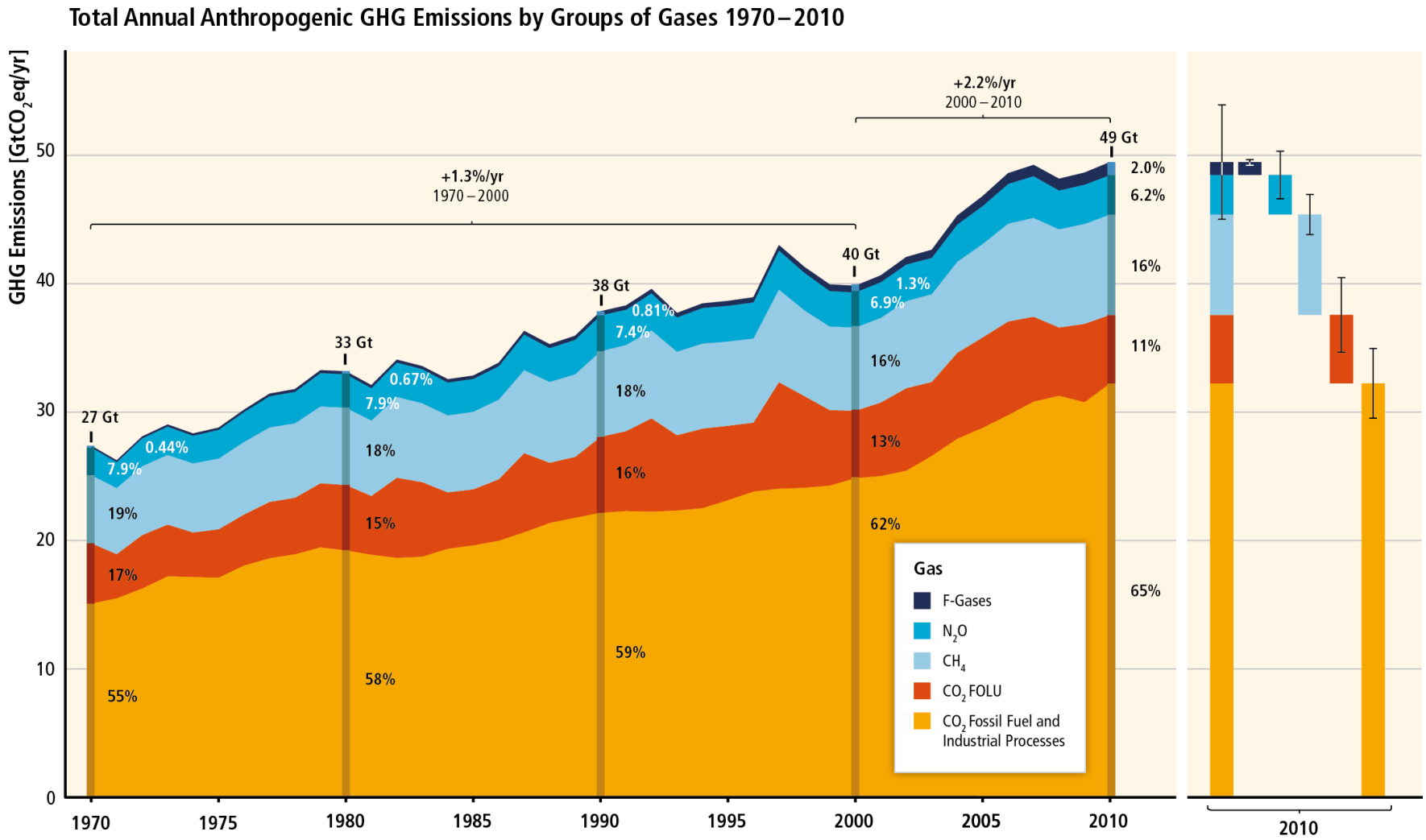
- Senior Researcher at CRIEPI
- Key area: climate & energy policy
- IPCC author/ coordinator (2007, 2014)
- Member of GOJ committees

✓ Global environmental committee of industrial structure council (METI)

✓ The platform for long-term strategy of mitigating climate change (METI)

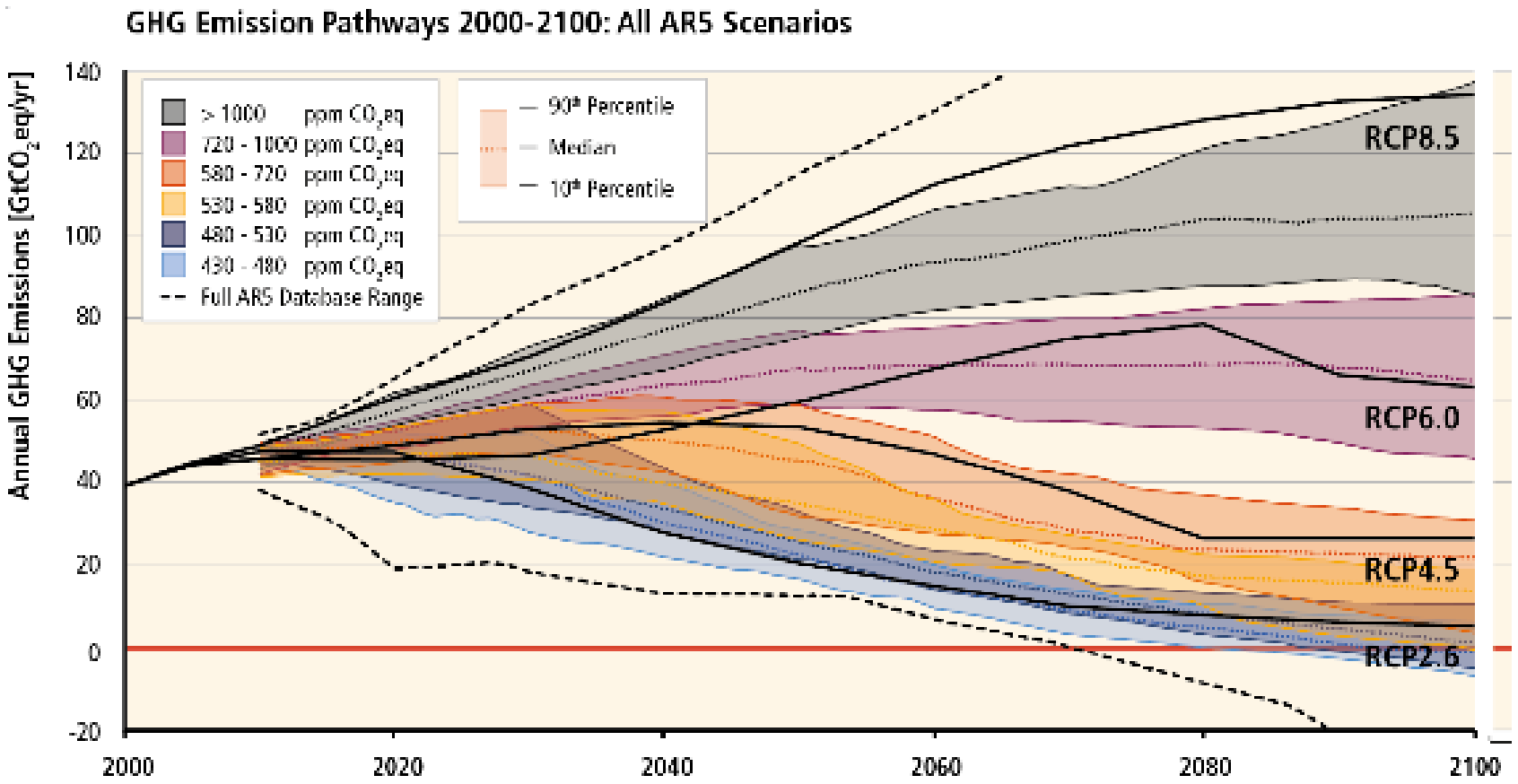
Etc.

GHGs emissions increasing



(IPCC 2014)

Massive Cut Required



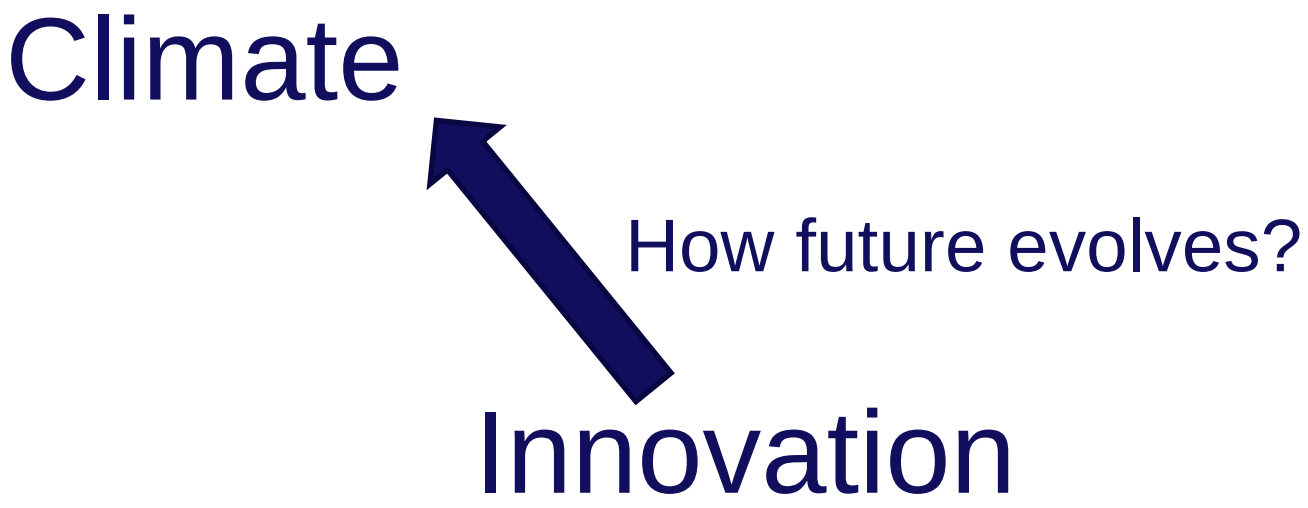
Top-down view

Climate

Policy Requirement

Innovation

Bottom-up view



Key Question

How can we get affordable

“Innovative Climate Technologies”

(PV, EV, etc…)

for massive GHG cut?

Definitions

Innovation =

Discovery/ Invention + Diffusion

(Ohashi, H. 2014)

Innovation plans & visions by Gov. of Japan

National Energy & Environmental Strategy for Tech. Innovation toward 2050 (NESTI 2050; Cabinet Office))

- R&D program for innovative climate techs
- Key techs:
  - ✓ Energy generation (PV, geothermal)
  - ✓ Energy storage (battery)
  - ✓ Energy efficiency (process, material)
  - ✓ Carbon Capture & Use (CCU)
  - ✓ ICT for energy systems (AI, big data, IOT)
  - ✓ Materials/devices for energy systems (superconductor, power electronics, censor)

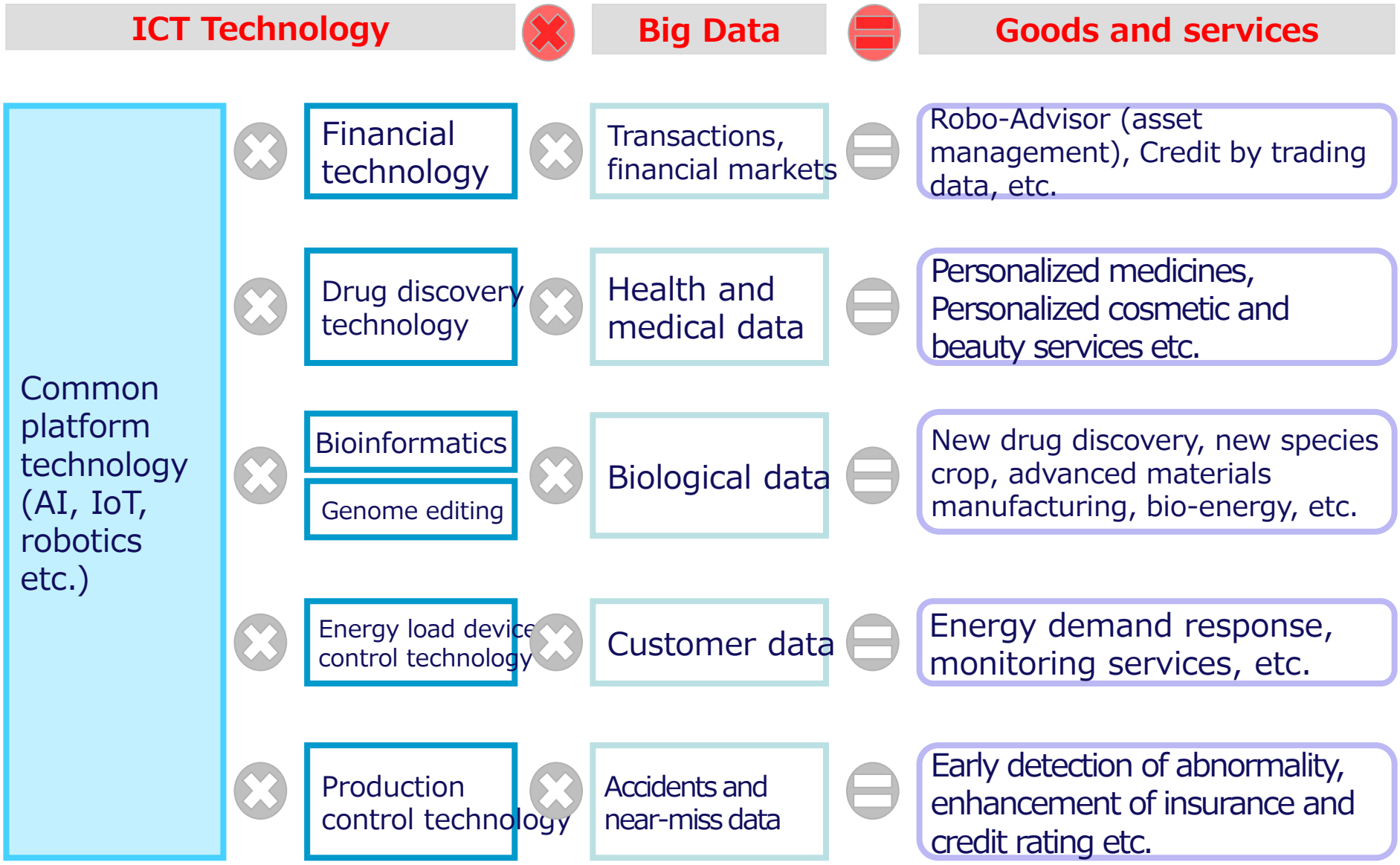
http://www.meti.go.jp/committee/summary/0004000/pdf/045_05_00.pdf

Society 5.0 (Cabinet Office)

Vision of “smart society” for *all* sectors

https://www.ntt-review.jp/archive_html/201604/images/fa1_fig08.jpg

New Industiral Structure Vision (METI)



http://www.meti.go.jp/committee/sankoushin/shin_sangyoukouzou/pdf/008_05_01.pdf

Vision for Prospective AI Technologies and Applications (NEDO)

- Vision of AI
- ✓ For three periods: -2020, 2020s, 2030-
- ✓ Many applications: machine learning, image cognition, robotics, self-driving, natural language, …

NEDO HP http://www.nedo.go.jp/content/100782828.pdf

Innovation formula

Innovation formula as of 2010s:

New techs = X * Y

X = ICTs

(IOT, AI, big data, digital technology, robot..)

Y = Industries

finance, health, biology, energy, manufacturing

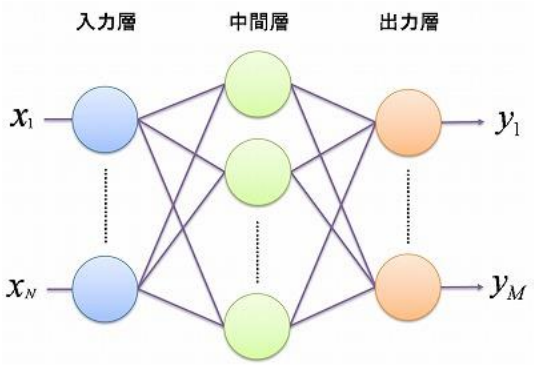
"*cognify*" (Kelly 2016)

Learning “climate innovation” with an example: AI

AI beats human at *Go* match

Deep learning of AI
by combination of existing techs

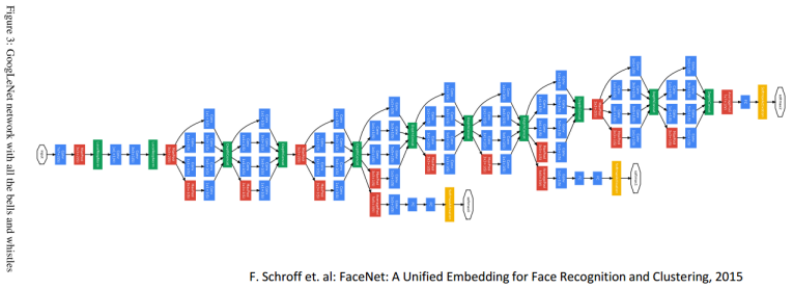
Kevin Kelly 2016 *Inevitable*



1. Percepton
(old AI)

2. Big data on Web
(to train AI)

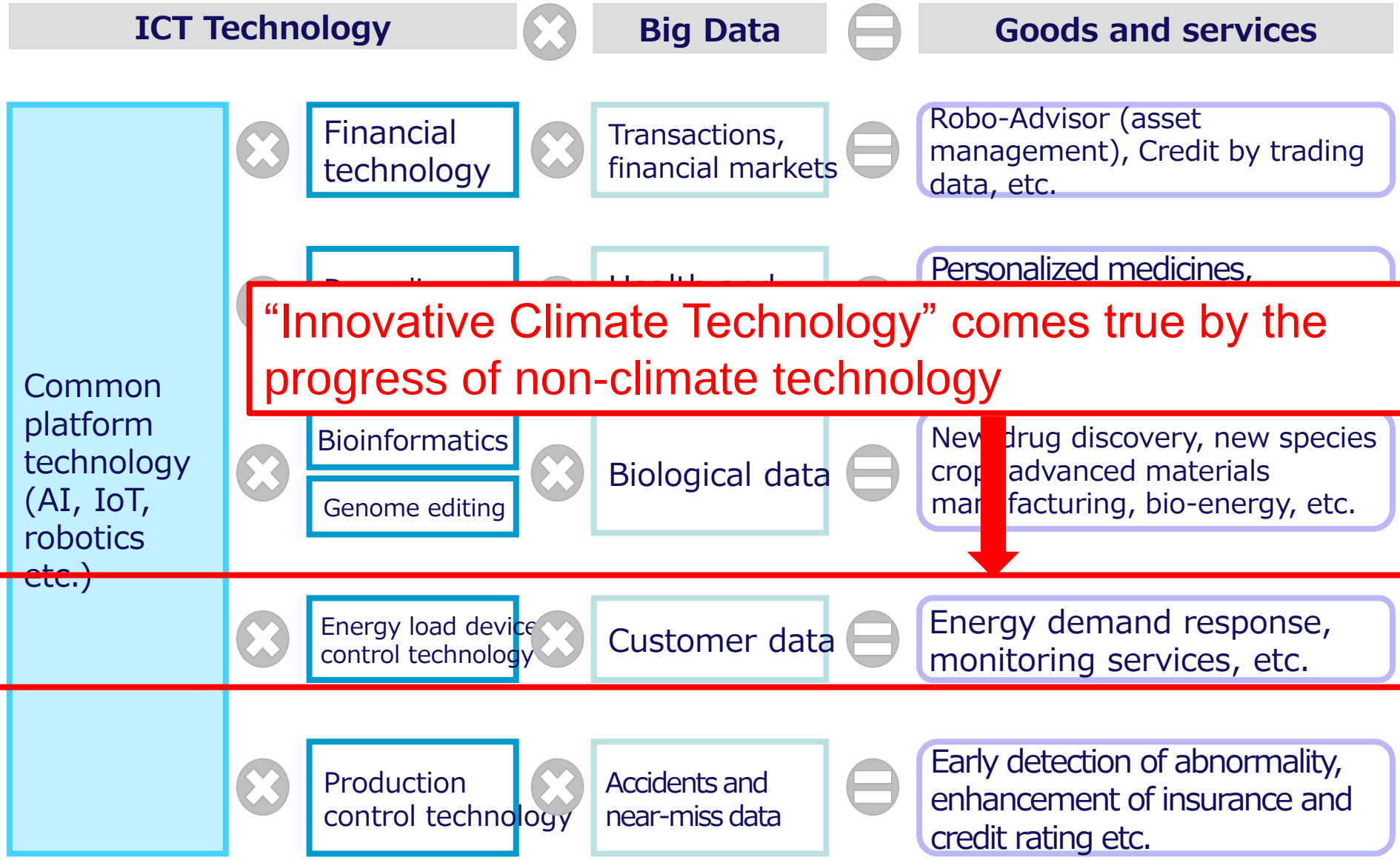
3. GPU
Graphic processing for games



Deep Learning (AI)

http://ifs.nog.cc/fishwin.hp.infoseek.co.jp/hp/etc/soft_computing/mlp.html http://matome.naver.jp/odai/2139450632745180701 http://tamagogohan.fool.jp/onlinegame/game/eternalcity2/eternalcity2.htr

New Industiral Structure Vision (METI)



新産業構造ビジョン http://www.meti.go.jp/committee/sankoushin/shin_sangyoukouzou/pdf/008_05_01.pdf (note addedd)

The Lesson from AI example

Climate tech

= combination of non-climate techs

You can not cut emissions by AI

without developing AI first

Different Time Span:
Chance to solve global warming

Progress of X (=ICTs..):

rapid & accelerating

… 2030? 2050?

Innovation time span << climate time span

(2020, 2030) (2050, 2100)

With new techs, more will be happy to cut more emissions.

Understanding innovation in general

Characteristics of Innovation

- New techs = combination of existing techs

  “new combination (Schumpeter)”

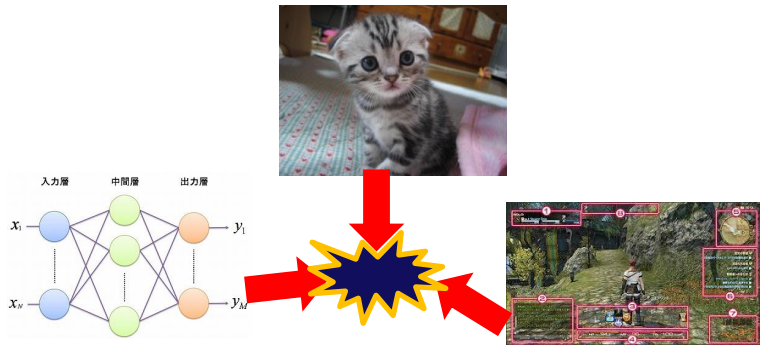
  “Ideas have a sex (Ridley)”

Innovation:

1) is cumulative
2) accelerates
3) occurs when “adjacent possible”

Adjacent Possibility

- An innovation emerges not out of thin air, but requires accumulation of other innovations
  - ✓ Eg.1 Deep-learning enabled by three techs
  - ✓ Eg.2 Youtube enabled by broadband
- A set of technologies makes it *adjacent possible* for a certain new technology to emerge



Simultaneous Inventions, Multiple Discoveries

Inventions/discovery/innovation are *inevitable* once they become adjacent possible

Thus they occur simultaneously and independently, often in competition

1. Newton and Leibniz both discovered differential calculous
2. Three mathematician invented decimals
3. At least 6 persons invented thermometer
4. Several inventors for typewriter
5. Five “original” inventors of steamship

…

(Kelly 2014); https://en.wikipedia.org/wiki/Multiple_discovery

Power of Market for Innovation

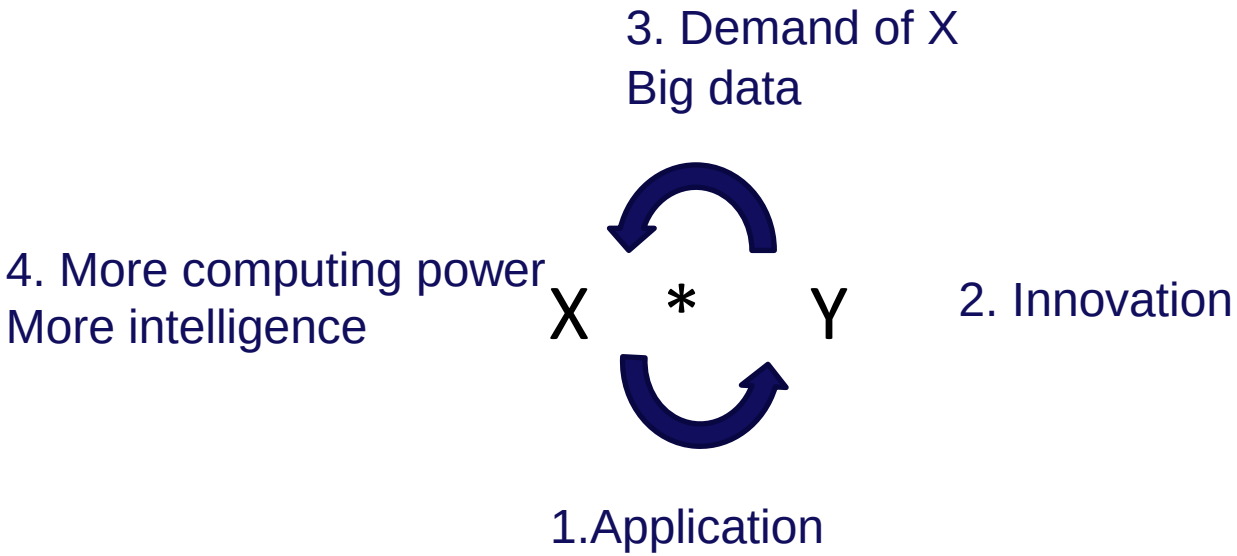
- "I, Pencil“(Read 1958)

  A pencil details the complexity of its own creation, listing its components (cedar, graphite, …), and the numerous people involved.

- Market has the power to combine fragmented information to produce, invent, and innovate, in unpredictable manner.

- Vigorous economic activities are the key to innovation

X-Y feedback loop in economy



1: X (=ICTs) are applied to Y(=industries),

2: Innovation of Y,

3: X is trained by Y, and

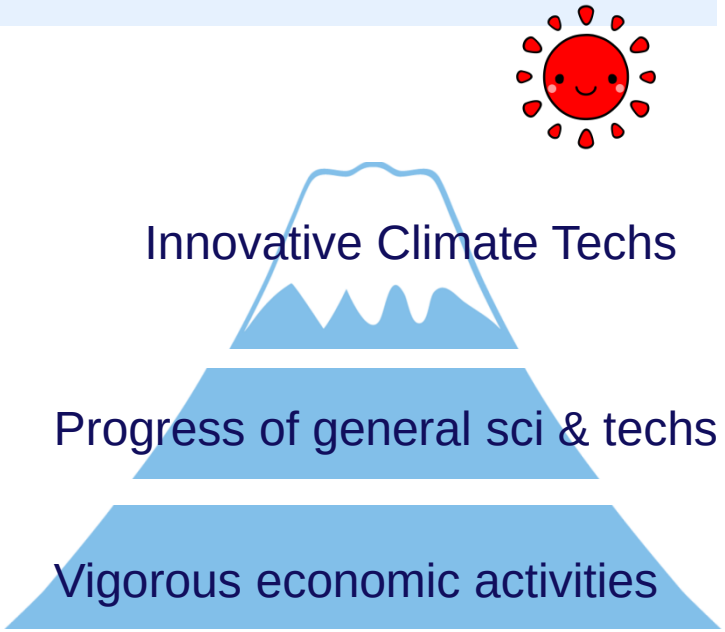
4: X improves,…

Players: industry, academia, and government

Conclusion

Conclusion 1

1. “Innovative climate technologies” are made available by progress of general science and technology
2. Progress of general sci & techs are enhanced by vigorous economic activities.



⇒ Climate policy must be compatible with economic growth – for the *climate* sake.

Conclusion 2

- Rapid development of general science & technology. Opportunity to solve climate problem.
- Role of the government for innovative climate techs
  - 1) Keep macro-economy good, 2)invest in basic research in general, 3) invest in dedicated climate tech programs.