

# General Purpose Technology and Global Warming: Solution to Global Warming through Innovation and a Role of Japan

Taishi Sugiyama  
The Canon Institute for Global Studies

ALPS International Symposium

Hosted by Research Institute of Innovative Technology for the Earth (RITE)

Tokyo

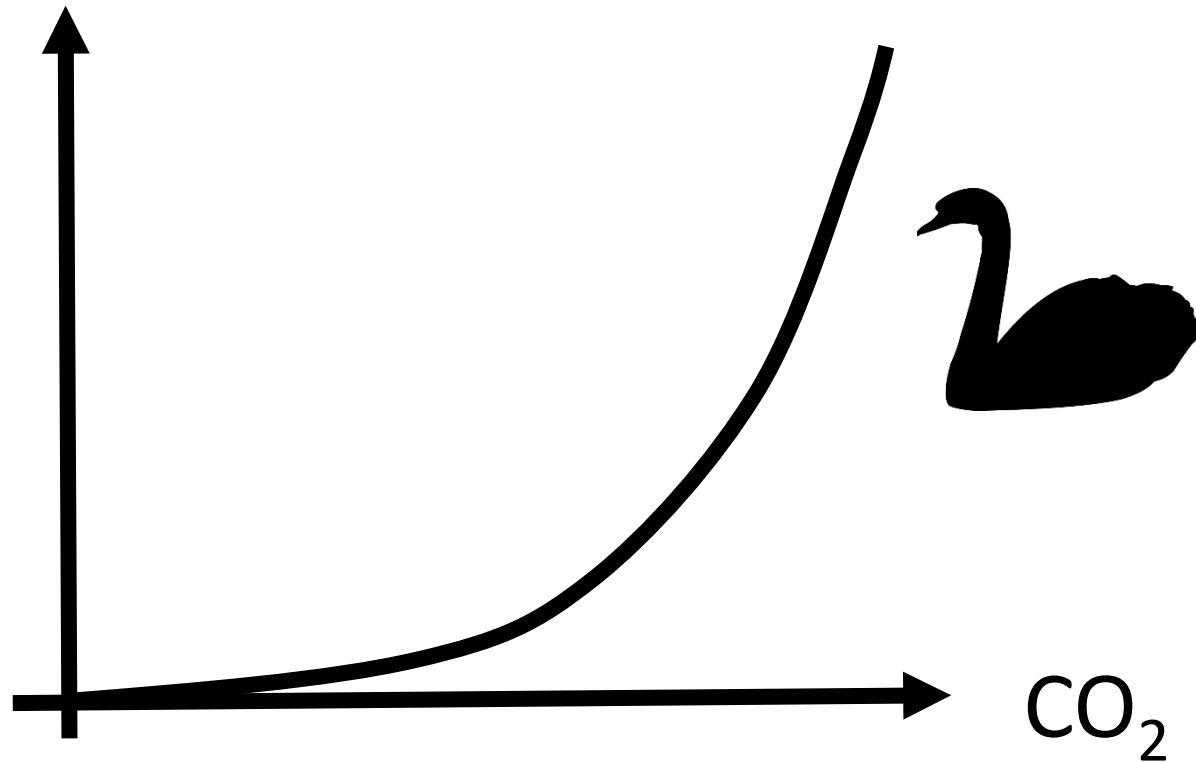
Feb. 19, 2019

(Views expressed are personal)



# Risk of environmental impact

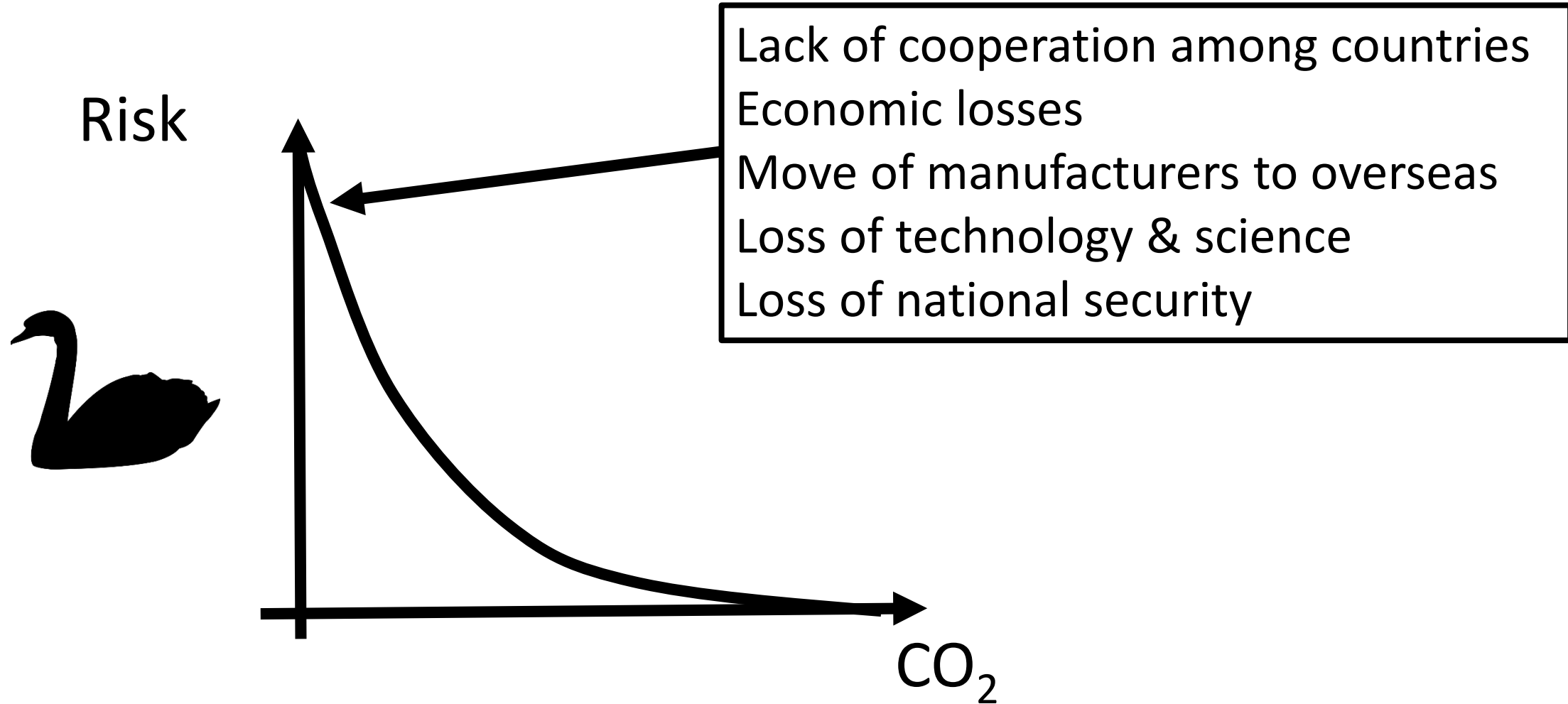
Risk



“Black Swan”  
= Events seldomly occur but possibly resulting in severe impact  
(Taleb 2006)

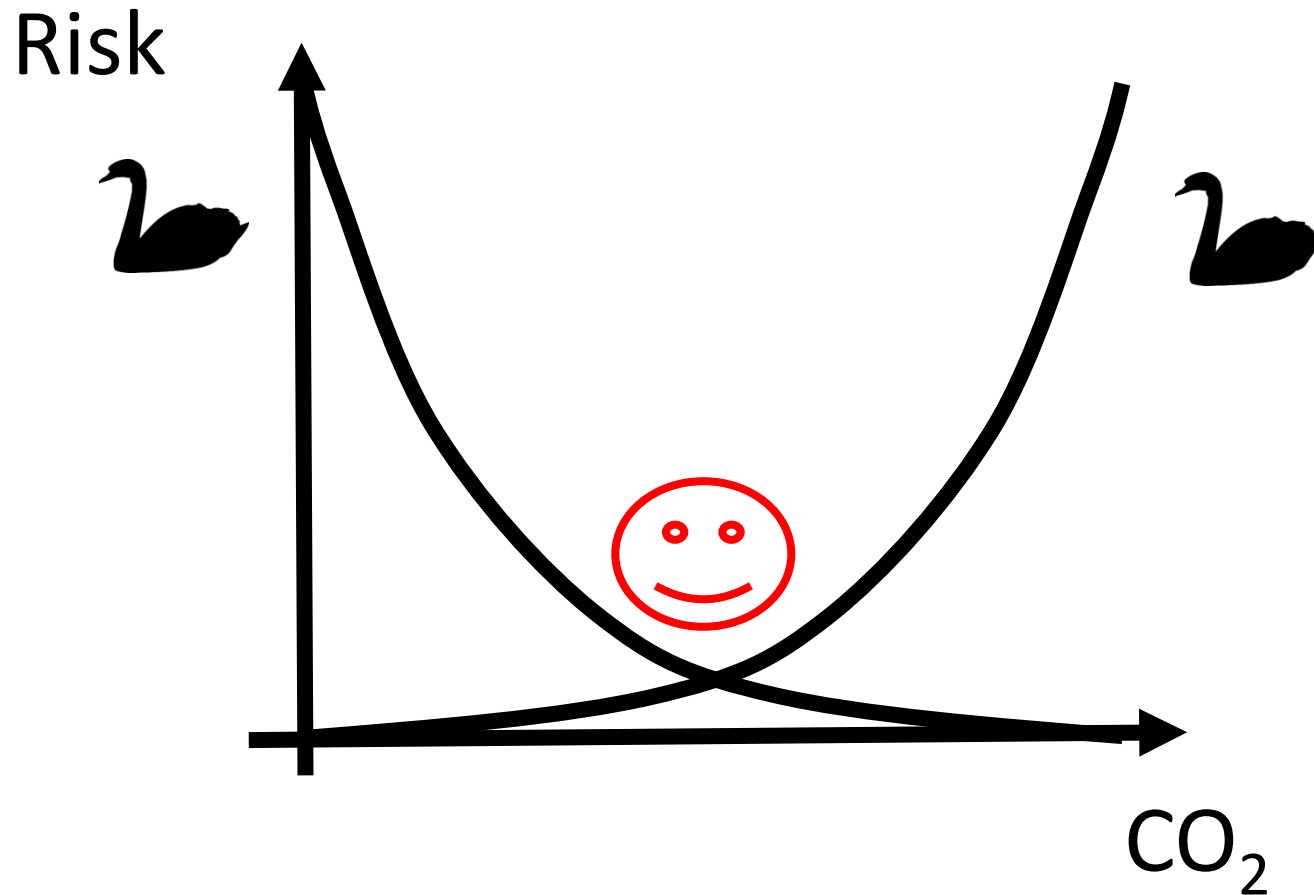
Should precautionary principles be applied?

# Risk of CO<sub>2</sub> emission reductions



# Balance is needed

Precautionary principles are not applicable when trade-off is crucial.



# Solution of environmental problems in the past

Development of **affordable technology**  
(=technology at acceptable cost) was the solution  
to environmental problems in the real world.

E.g., Air pollution by car (NO<sub>x</sub>): three-way catalyst

Air pollution by power generation (SO<sub>x</sub>):

flue-gas desulfurization equipment

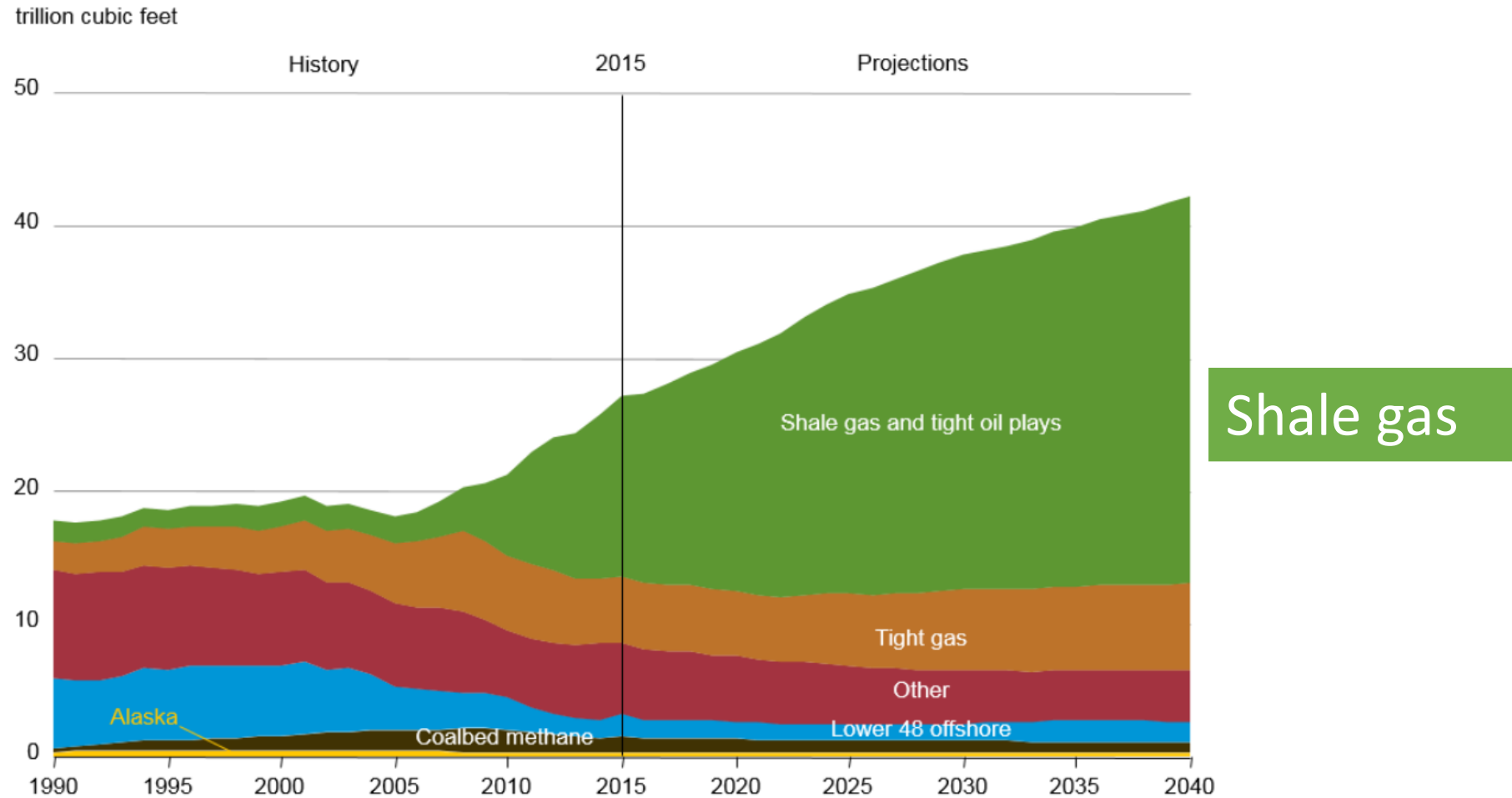
# Successful examples of CO<sub>2</sub> reductions

When there were **affordable technologies**, CO<sub>2</sub> were reduced.



# Shale gas

Figure MT-46. U.S. dry natural gas production by source in the Reference case, 1990–2040



# Other examples of affordable technology

- LED lamp
- Liquid-crystal display

\* Energy efficiency standard also accelerated diffusion of affordable equipment



# Future

Technological progress will continue in many aspects...

... Affordable technologies will enable CO<sub>2</sub> emissions.

By what strategies & policies ?

# Massive CO<sub>2</sub> cut of cars by three revolution

- Self driving, EV, and carsharing(=3R) lead to large economic benefits and CO<sub>2</sub> reductions.

## 3R Scenario Global Results

Compared to the BAU case in 2050, the 3R scenario produces impressive global results. It would:

- Cut global energy use from urban passenger transportation by over 70%
- Cut CO<sub>2</sub> emissions by over 80%
- Cut the measured costs of vehicles, infrastructure, and transportation system operation by over 40%
- Achieve savings approaching \$5 trillion per year

## Three Revolutions in Urban TRANSPORTATION

How to achieve the full potential of vehicle electrification, automation and shared mobility in urban transportation systems around the world by 2050

Lew Fulton, UC Davis  
Jacob Mason, ITDP  
Dominique Meroux, UC Davis

Research supported by:  
ClimateWorks Foundation, William and Flora Hewlett Foundation, Barr Foundation

**UC DAVIS**  
SUSTAINABLE TRANSPORTATION ENERGY PATHWAYS  
of the Institute of Transportation Studies

**ITDP** | Institute for Transportation & Development Policy



# Changes occur in the whole economy

- Transport sector: 3 Revolution

EV + self driving + sharing => Economic benefits & CO<sub>2</sub> reductions

-> More generally ->

- Whole economy:

The entire science and technology, in particular,

progress of General Purpose Technology

(GPT :=ICT, AI, IOT, Chemistry, Bio-tech, etc )

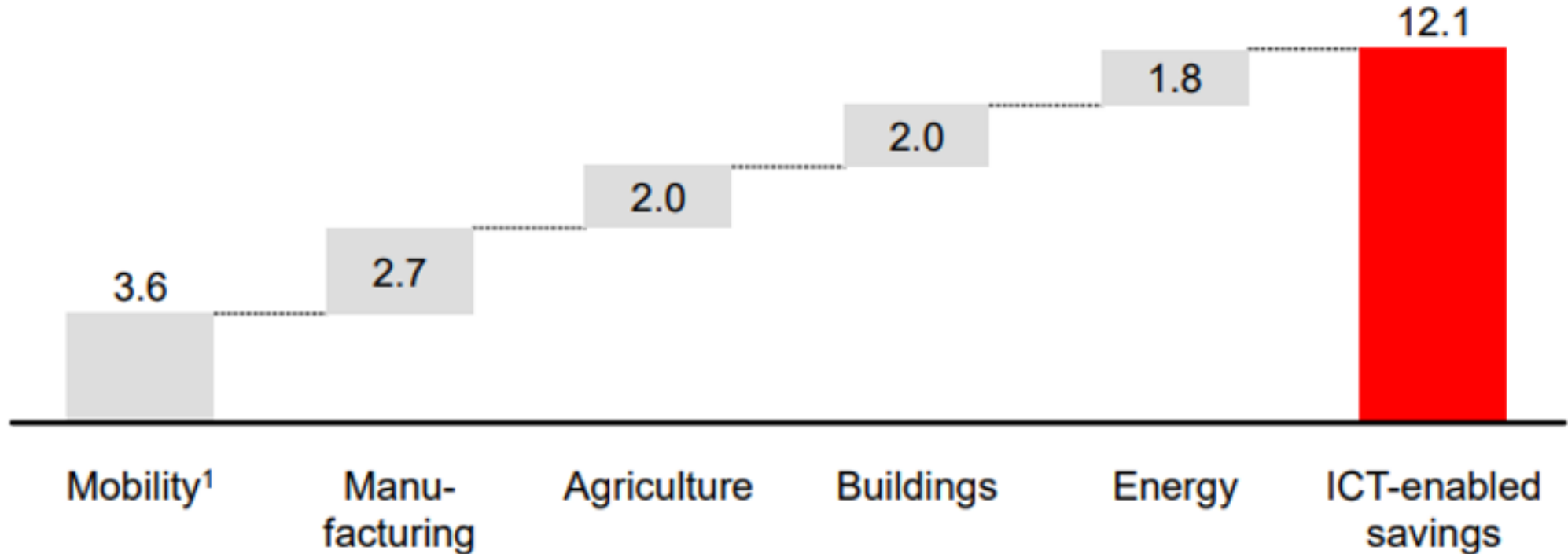
=> Economic benefits & CO<sub>2</sub> reductions

Time span of technological progress is much shorter than that of global warming (Chance!)



# CO<sub>2</sub> cut potential by ICT

CO<sub>2e</sub> abatement potential by sector (2030)

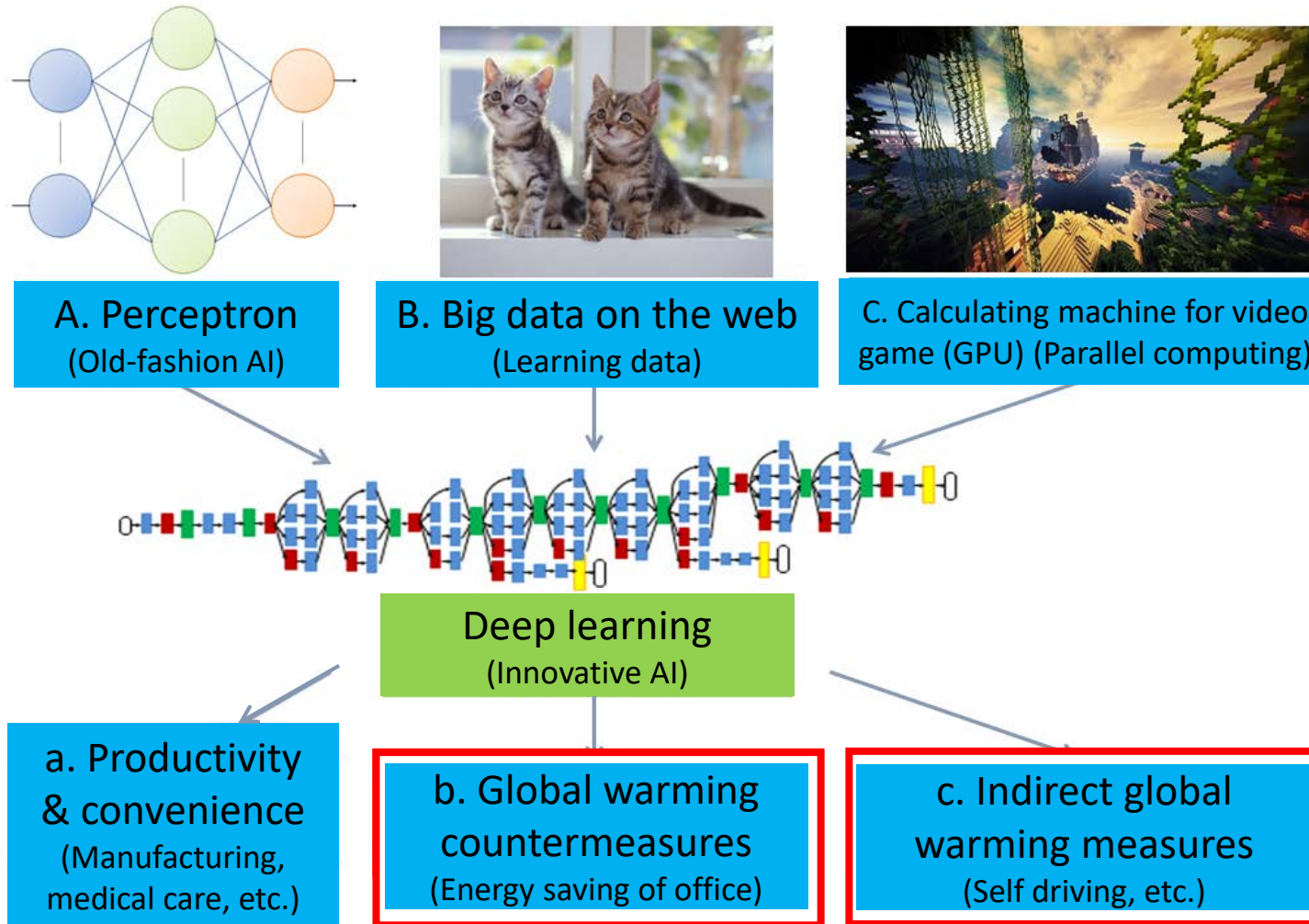


[http://smarter2030.gesi.org/downloads/Full\\_report.pdf](http://smarter2030.gesi.org/downloads/Full_report.pdf)

\* Reduction of Global CO<sub>2</sub> emissions in chemistry sector by 1/5 may be possible

<https://www.nikkakyo.org/sites/default/files/ghghoukoushogaiyo.pdf>

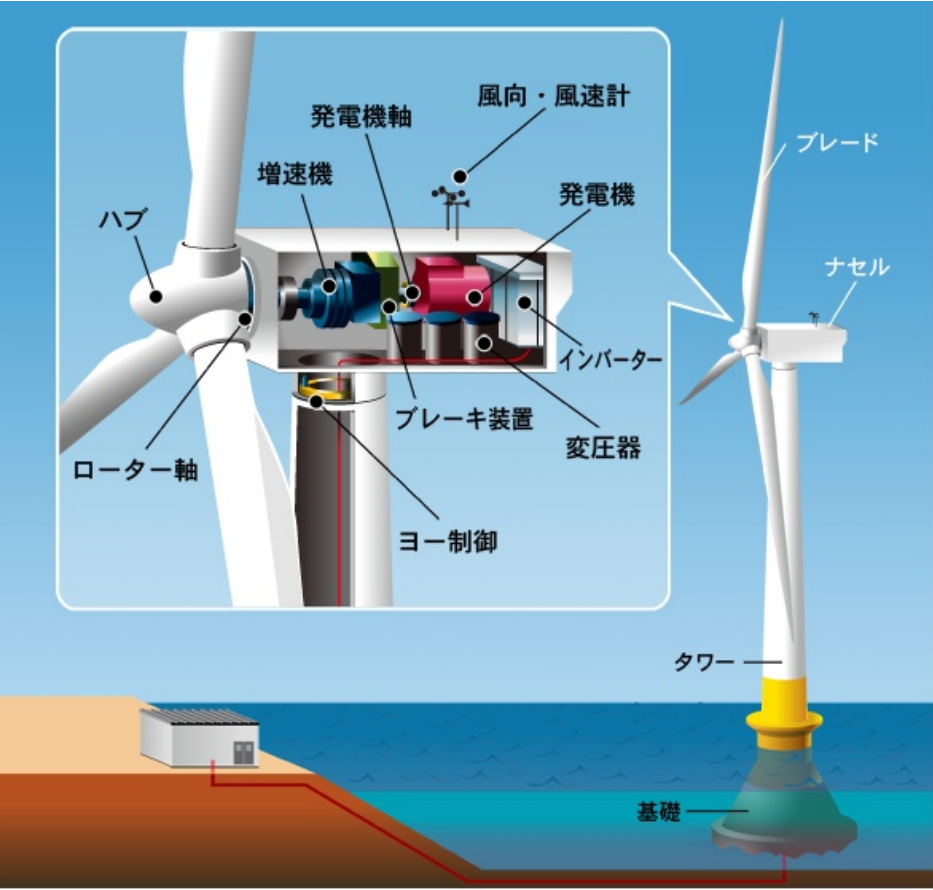
# Deep learning (Artificial Intelligence)



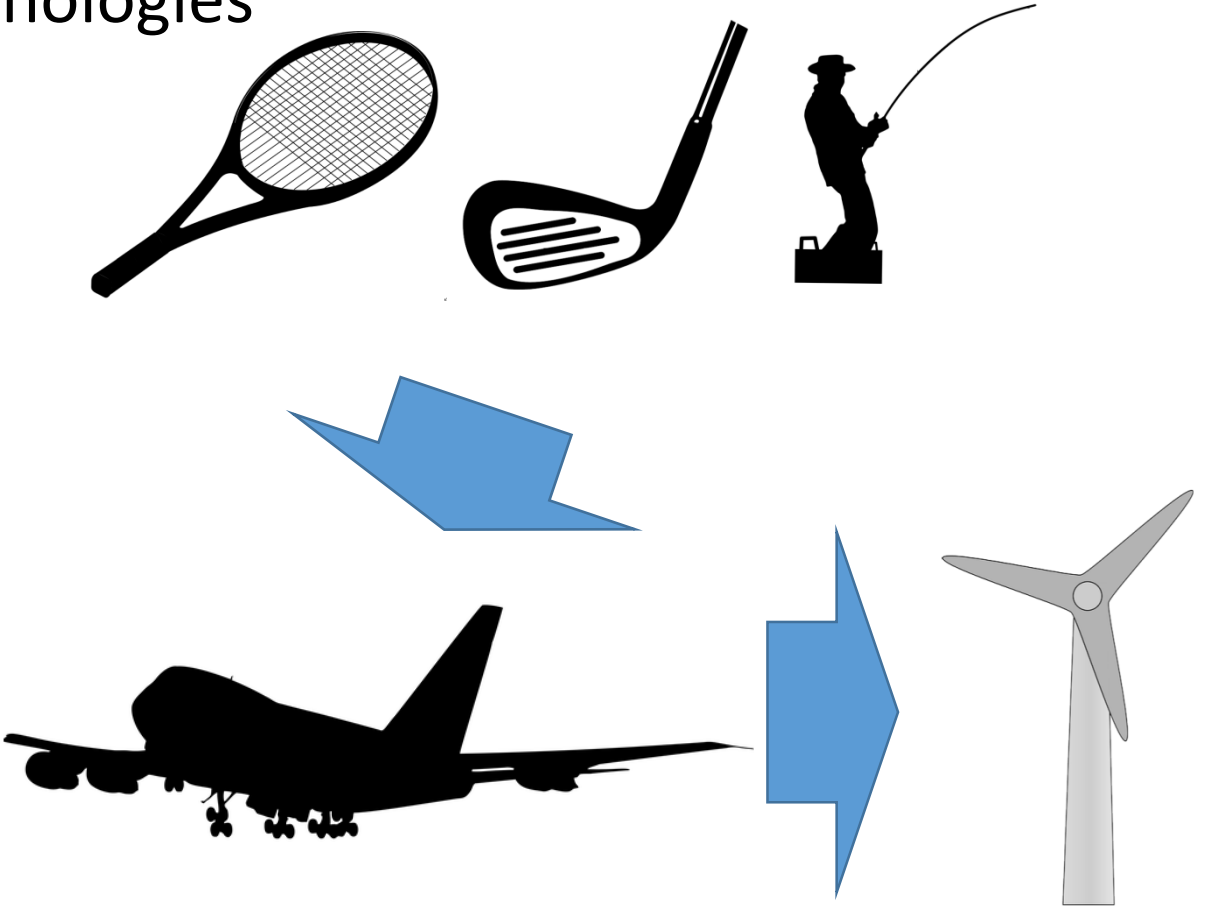
As part of general progress of science and technology, climate technologies emerge.

# Wind power generation is...

Combination of general purpose technologies



<http://www.nedo.go.jp/fuusha/kouzou.html>



Large blade with reinforced plastic (CFRP)

Thanks to the progress of GPT, wind power scaled up.

# How technological progress occurs?

- <Combination> New technology emerges by combination of existing technologies

Technology “evolves”

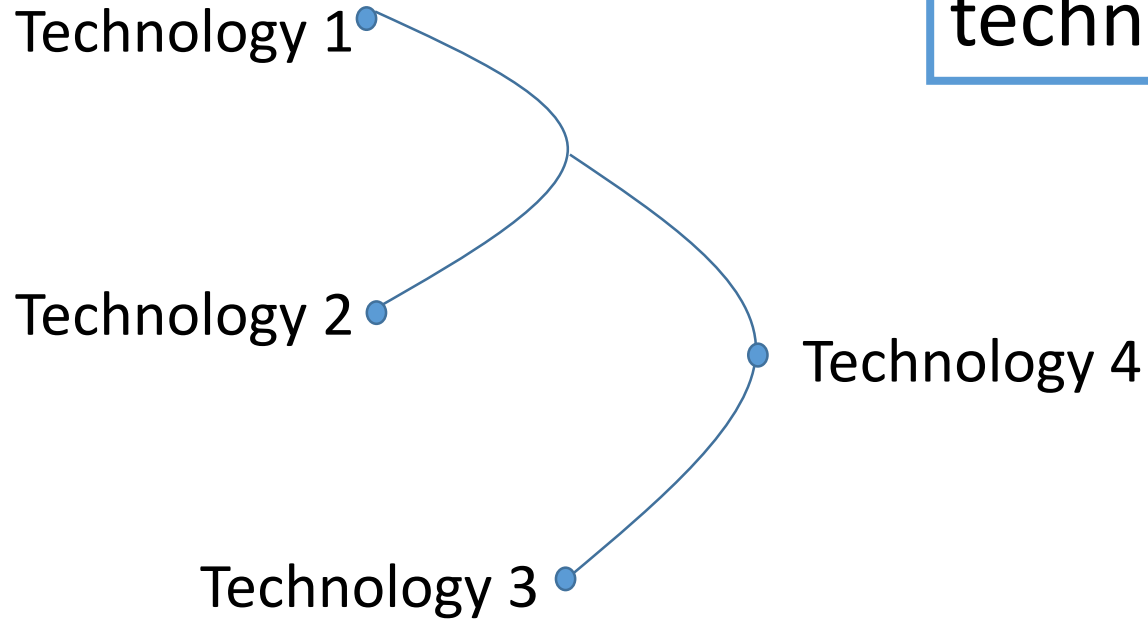
- <Accumulation> Once born, it never disappears

The source of long-term economic growth

- <Acceleration> The technological progress accelerates

The chance to solve global warming

New technology emerges  
by combination of existing  
technologies



Like parents and  
their offspring...

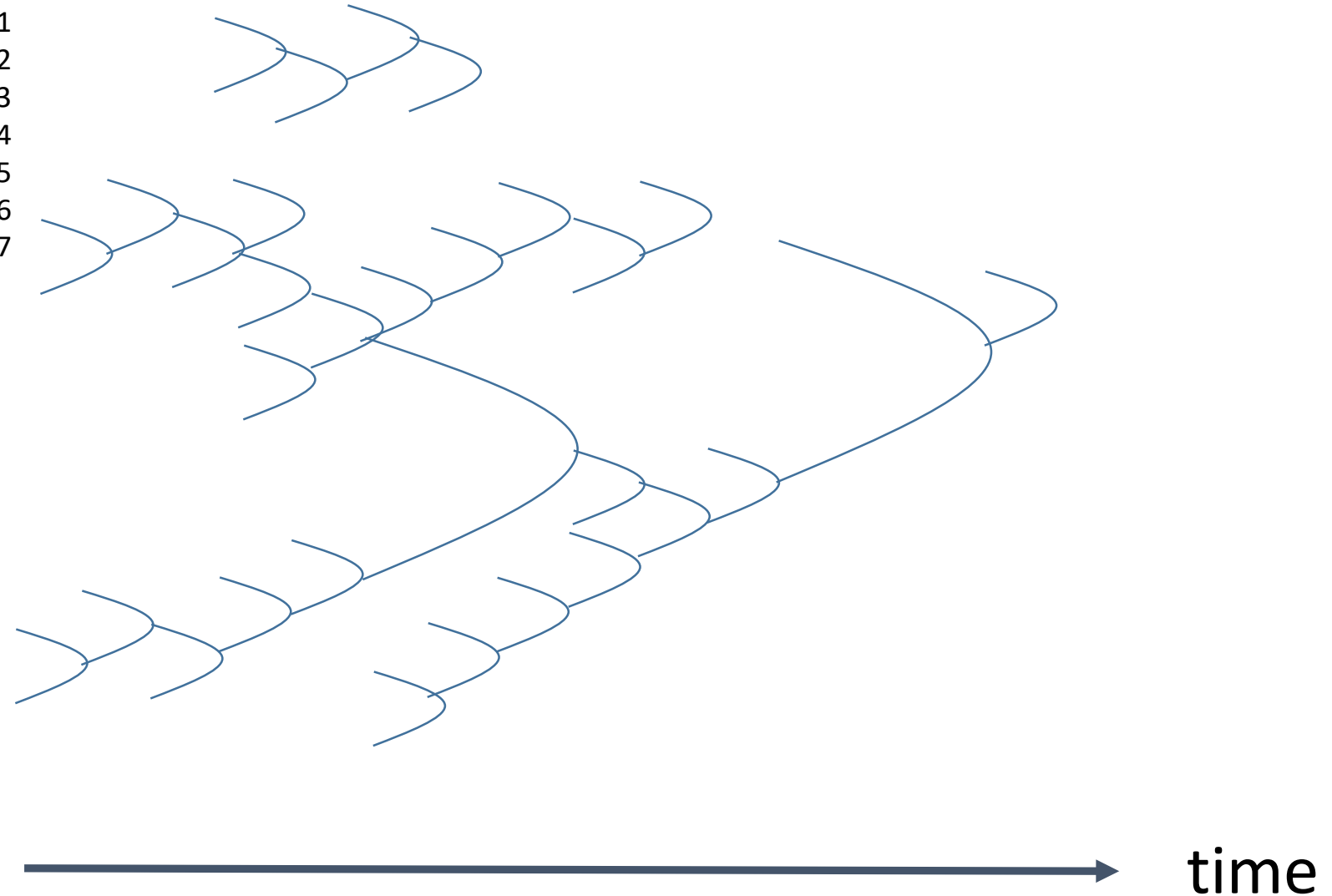


# “Evolution” of technology (complex systems)

Technology 1  
Technology 2  
Technology 3  
Technology 4  
Technology 5  
Technology 6  
Technology 7

...  
...  
...  
...  
...  
...  
...  
...  
...  
...  
...  
...  
...  
...  
...  
...  
...  
...  
...  
...

The Technium



(Kevin Kelly 2014; Brian Arthur 2011; Stuart Kauffman 2002)

# How to accelerate the “evolution” of technology?



# How to accelerate the “evolution” of technology?

Ecosystem evolves:

- in a hot and humid climate

=> Evolution accelerates, diversity increases

(J. H. Brown, 2014)



Ecosystem of technology evolves:

- in a good economy

=> Business activity are active, innovation occur.

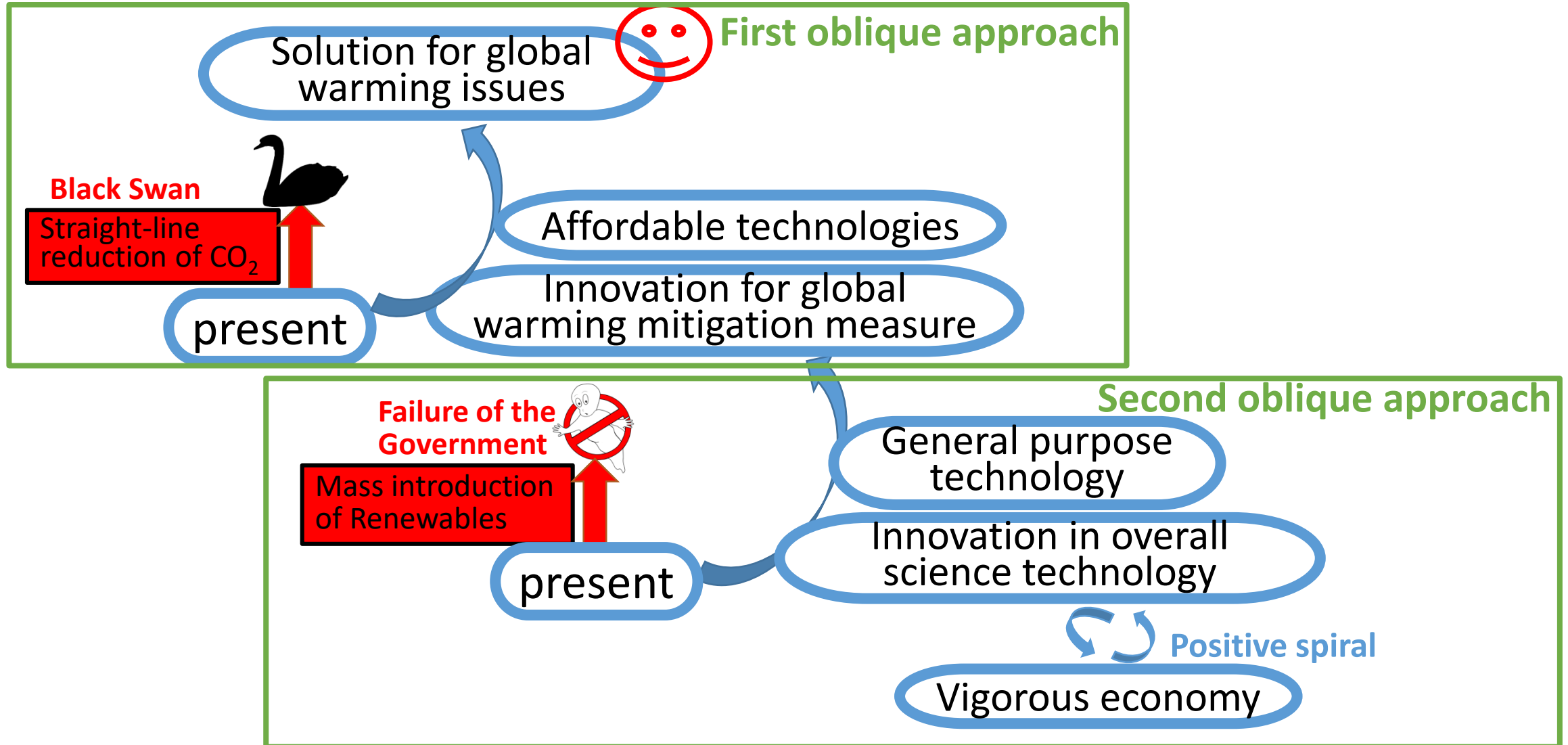


# Lessons from past measures for global warming mitigation

- Energy Efficiency Standard: Promoted affordable energy saving
- National R&D project(Sunshine, Moonlight): accelerated progress of thermal power generation or heat-pump technology (Kimura, 2015)
- FIT: Massive introduction of PV. Resulting in additional cost of \$690 billion (Asano, 2017). PV cost remains high(Nomura and Amano, 2014). Unsolved Issue of grid integration. Japanese manufacturers lost the market(Nakata, 2016). Failure of the Government

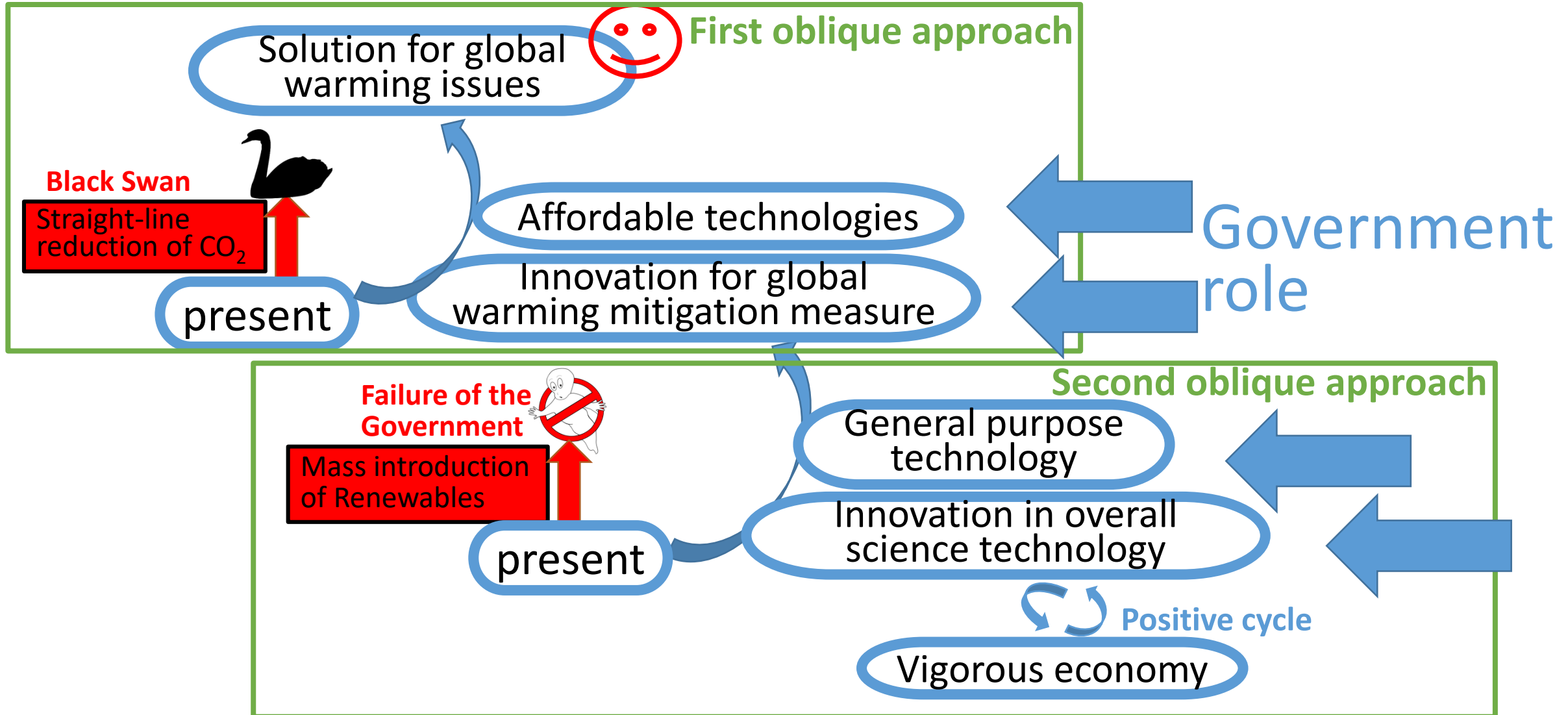


# Doubly oblique approach





# Doubly oblique approach



# Governmental role in the approach

1. Establish virtuous cycle of economic growth and innovation. Do not undermine the cycle by misplaced mitigation measures.
2. Invest in basic research & technology development
3. Reform regulatory systems timely to benefit from and accelerate rapid progress of technology
4. Implement CO<sub>2</sub> reduction measures as they become affordable by the technological progress

