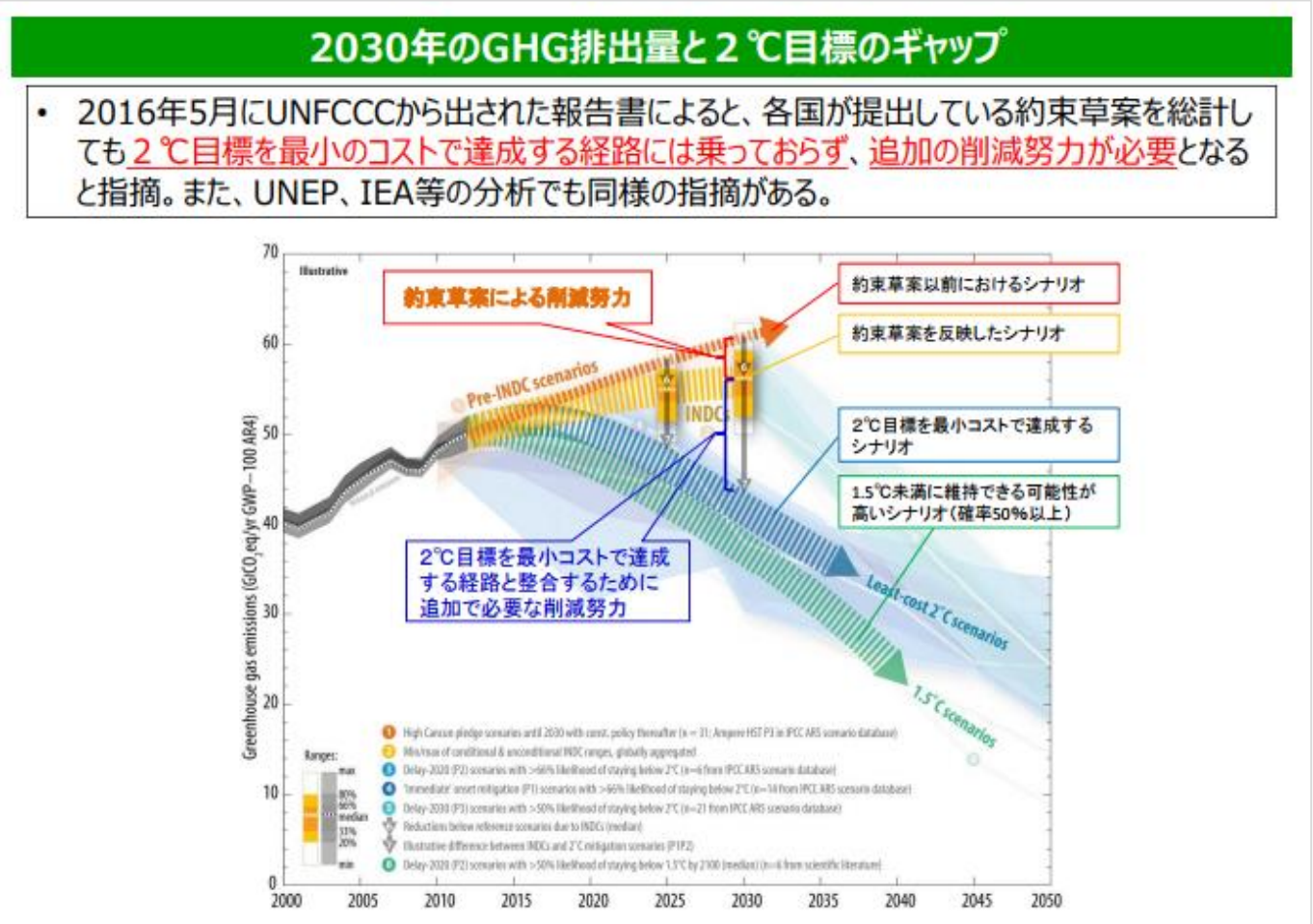
Promotion of Innovation to mitigate GHG emission

CIGS
25 October 2018

1. Role of innovation

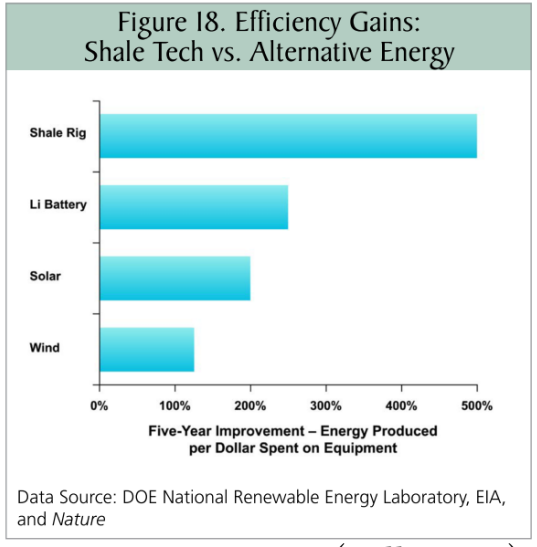
Reality：on the trajectory?



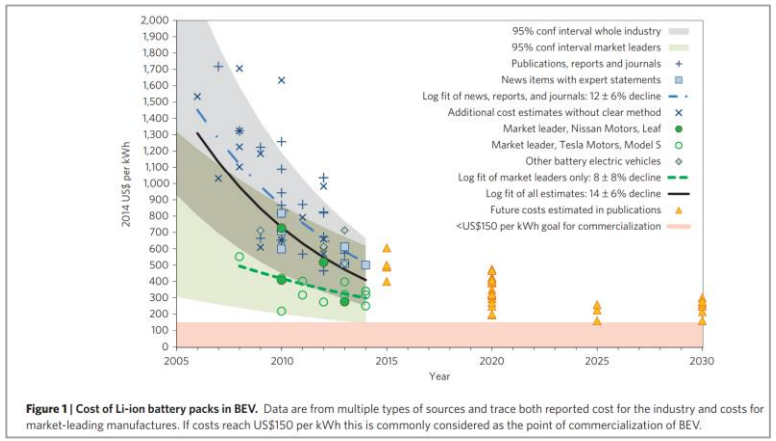
（出所）UNFCCC「Aggregate effect of the intended nationally determined contributions: an update(2016)

環境省資料　http://www.env.go.jp/press/103822/105478.pdf

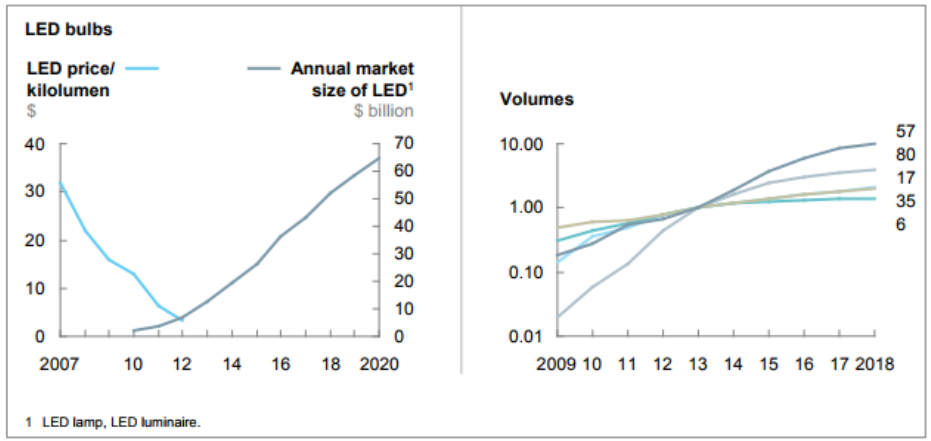
Role of innovation : Rapid cost reduction in many tech fields (PV, battery, shale rig, LED, MEMS, sensors, internet, …)



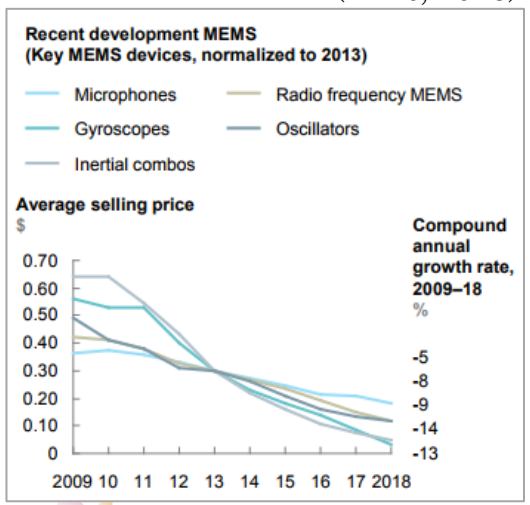
(Mills, 2015)

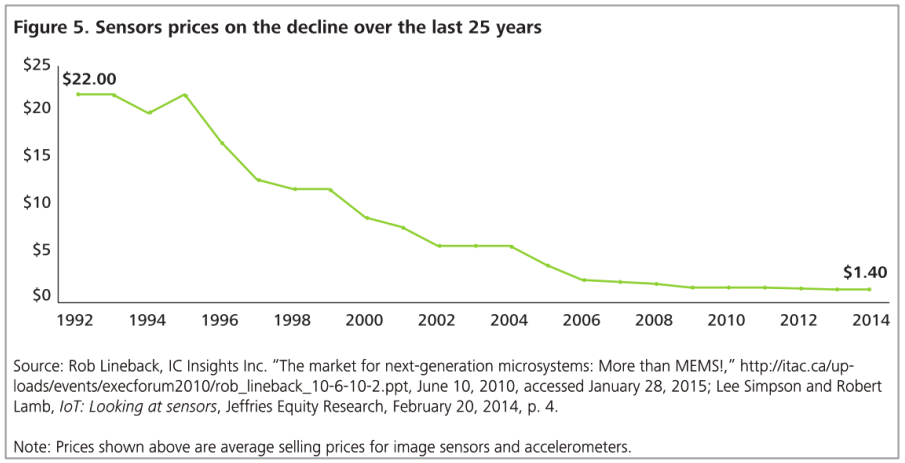


(Nykvist & Nilsson, 2015)

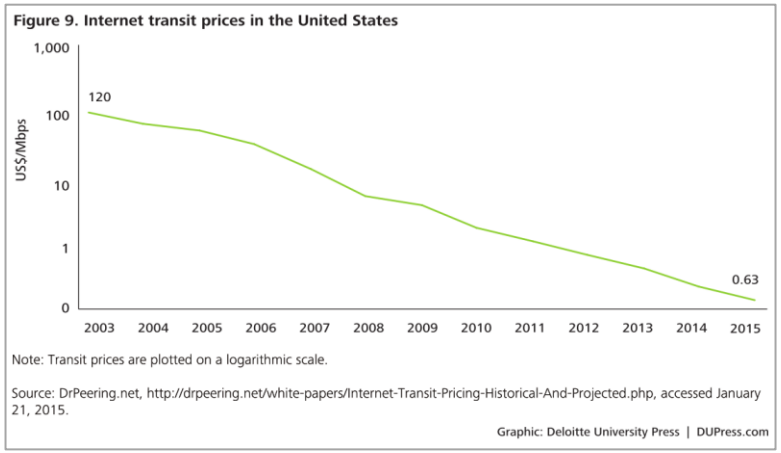


Manyika, J., Chui, M., Bisson, P., Woetzel, J., Dobbs, R., Bughin, J., & Aharon, D. (2015).





(Holdowsky, Mahto, Raynor, & Cotteleer, 2015)



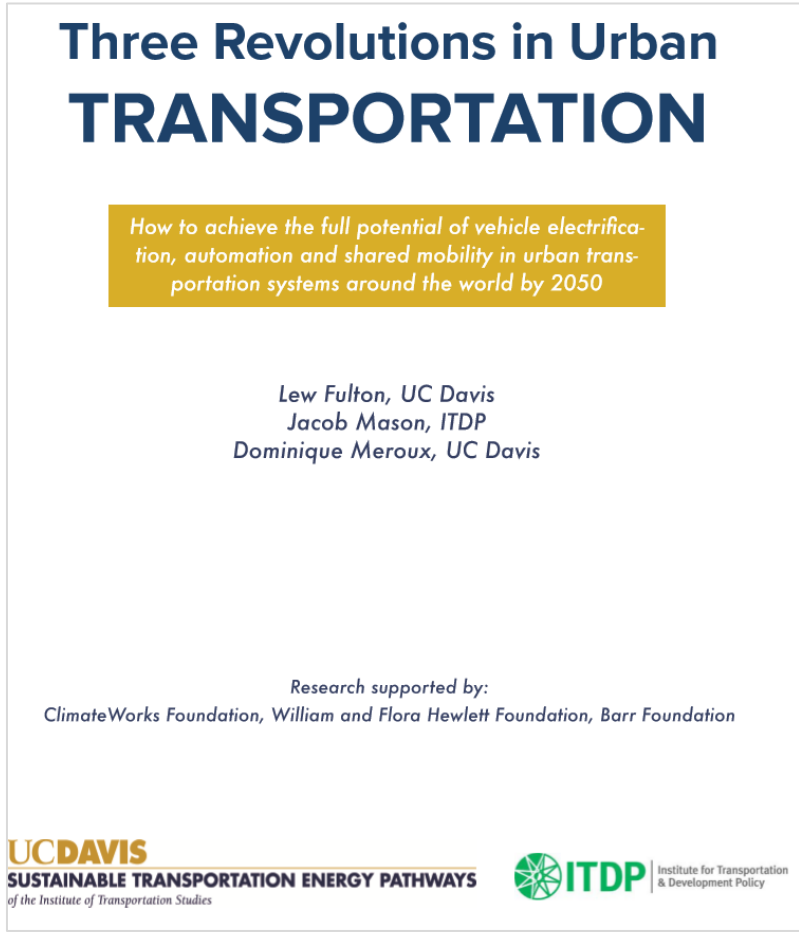
GHG emission mitigation through three revolutions

- 自動運転車、EV、カーシェアリングにより大幅な経済便益とCO2削減。

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_2 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



Benefits

- Transportation sector : 3 Revolutions

EV + automatic driving + sharing ⇒ Econ benefits + CO2 reduction

But more generally,

- All sectors :

Rapid development in all science and tech sectors, particularly in general purpose tech sectors (GPT :=ICT, AI, IOT, nano tech, etc.)

⇒ Further econ benefits + CO2 reduction
Take place in shorter time period

3D printer

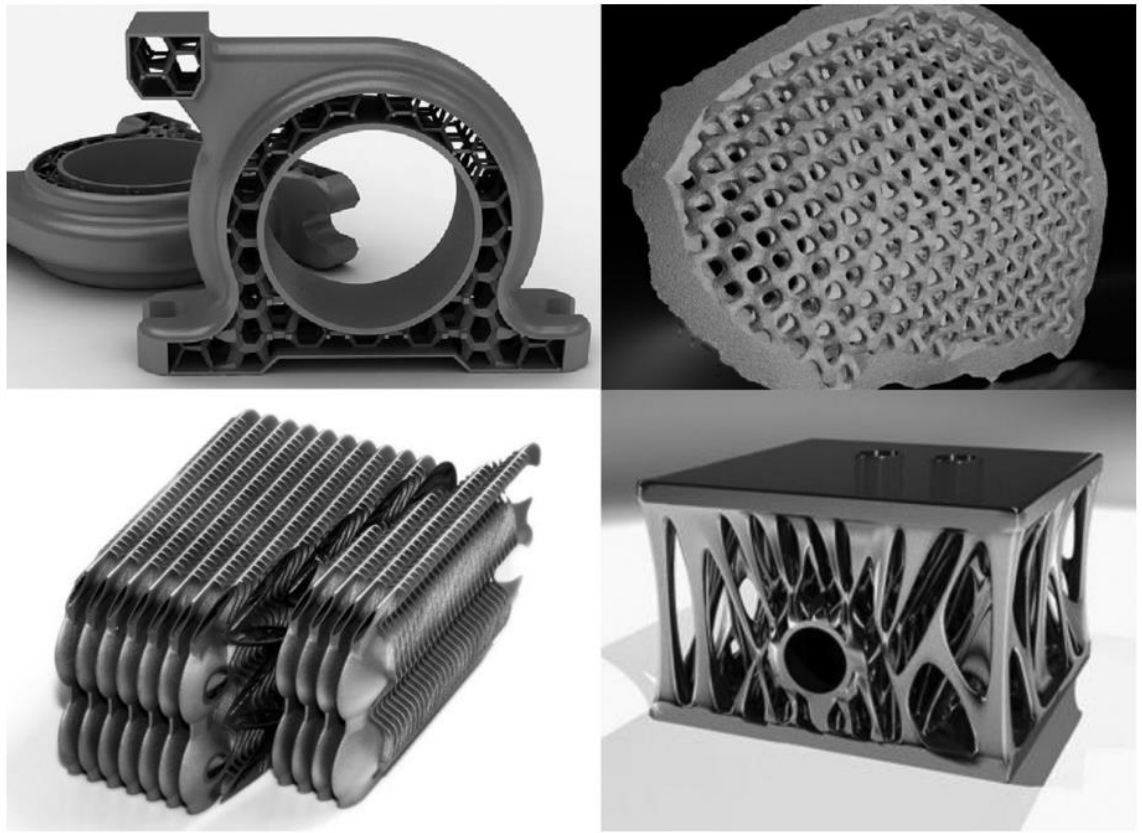


Fig. 7 Parts designed with Within software: optimized lightweight support part (top left); cranial flap implants (top right); radical heat exchanger (bottom left); pipe manifold (bottom right) [26]

・遺伝的アルゴリズム
・流体シミュレーション

More sophisticated design and lightweight parts
⇒More energy efficient

(Beyer, 2014)

Precision agriculture in the US

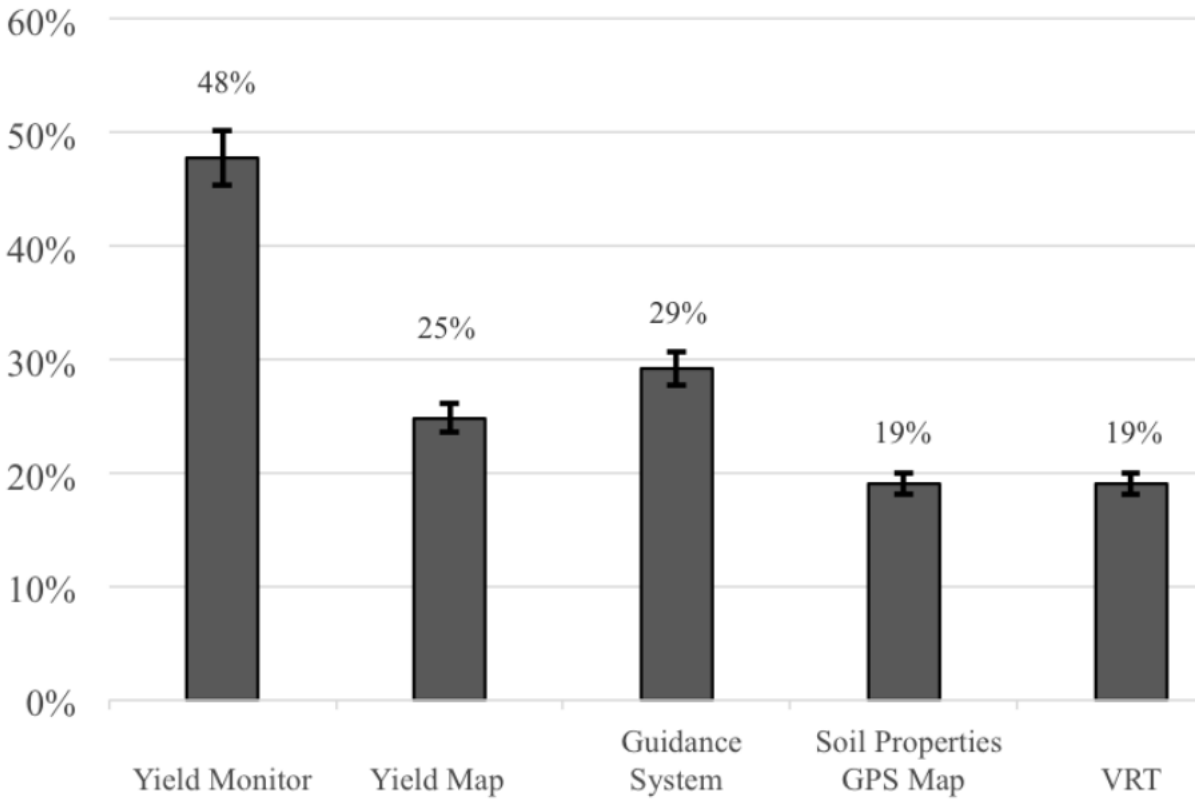


Figure 1. Adoption of PA Technologies among Corn Farms

Notes: Error bars represent positive and negative standard errors of the mean percent estimates.
Source: 2010 USDA Agricultural Resource Management Survey (ARMS).

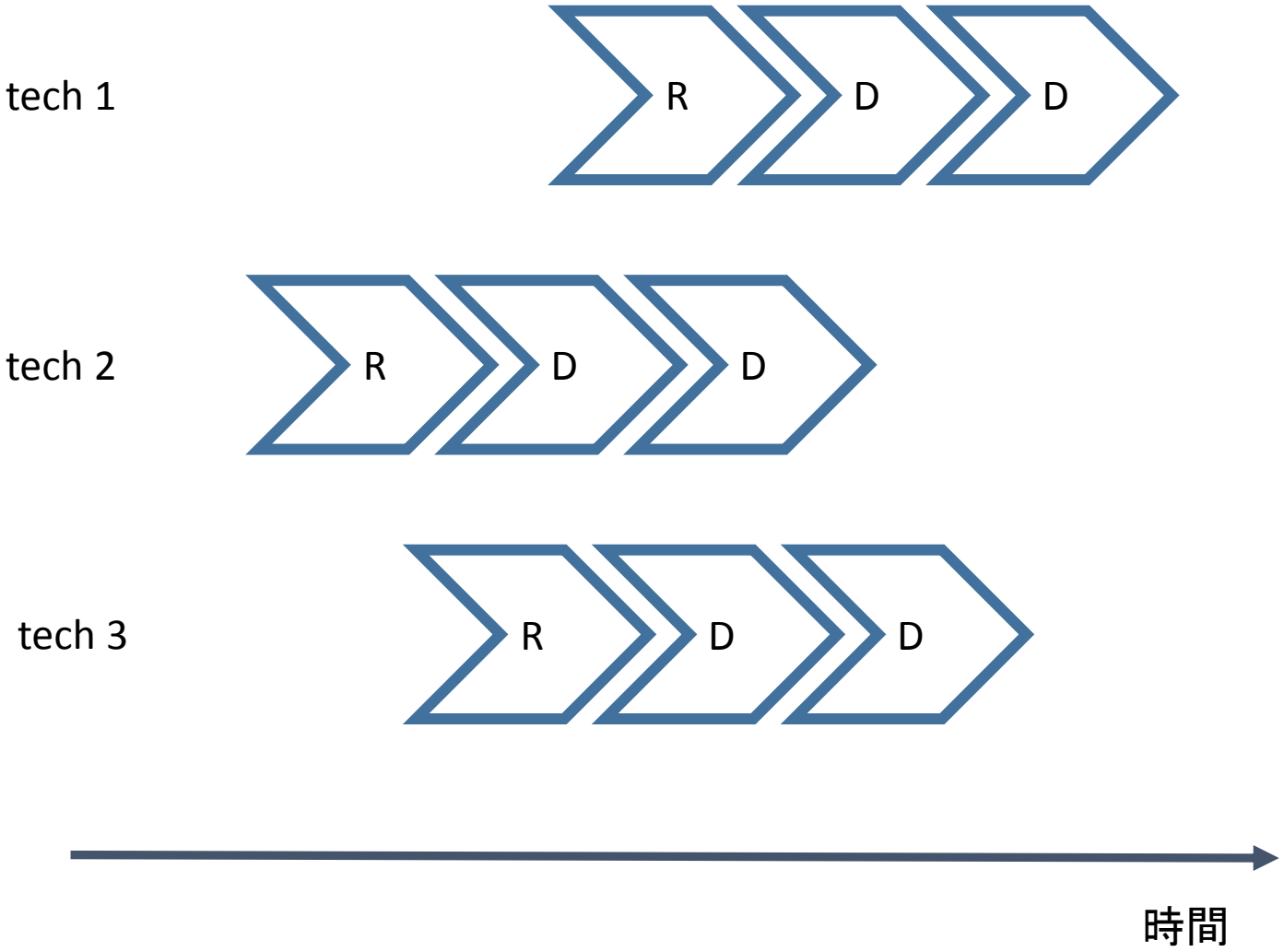
- Big data
- GPS

- Increased production with reduced fertilizer
- Energy efficient
- Reduced CO2

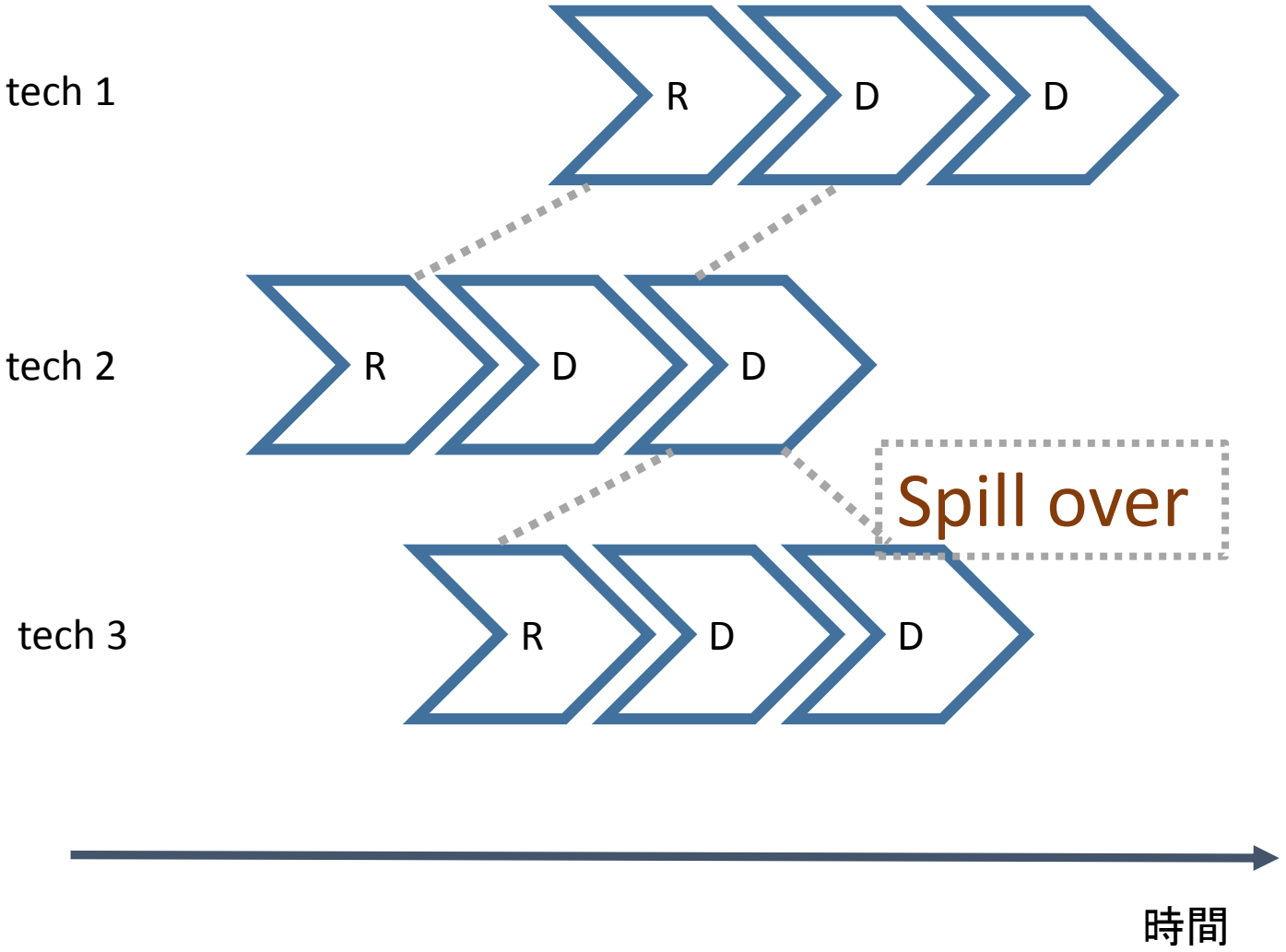
(Schimmelpfennig & Ebel, 2016)

2. Structure of innovation

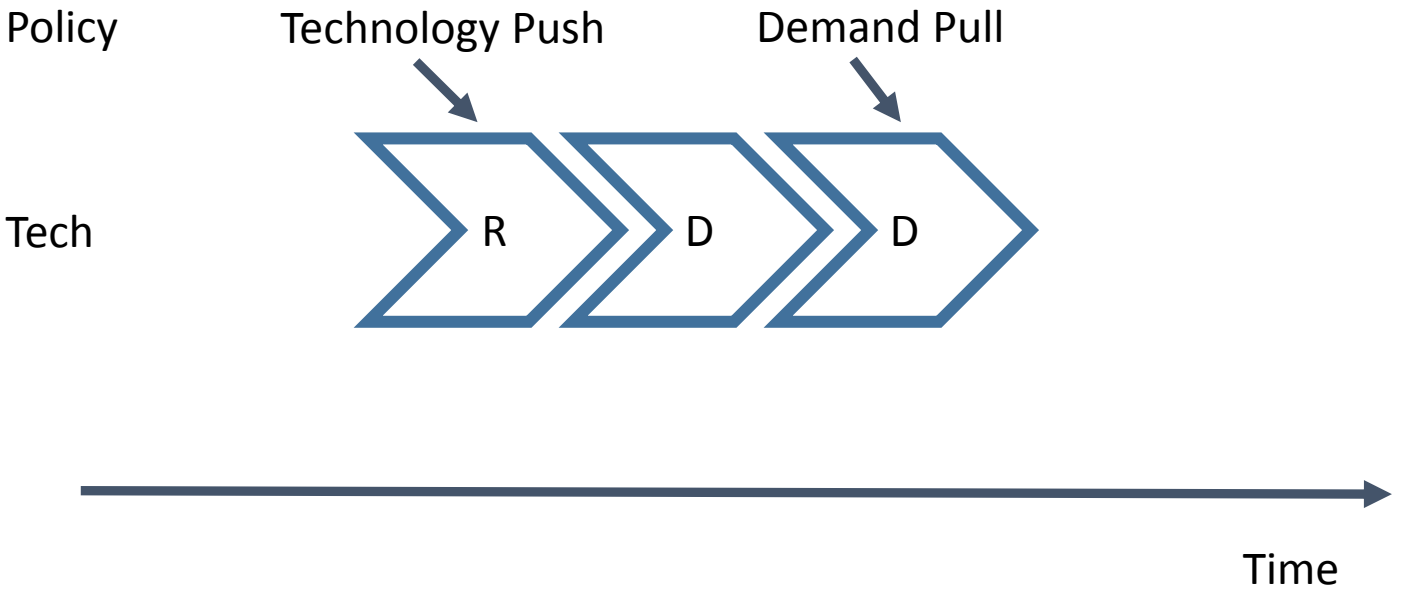
Linear model



Linear model ＋ Spill over

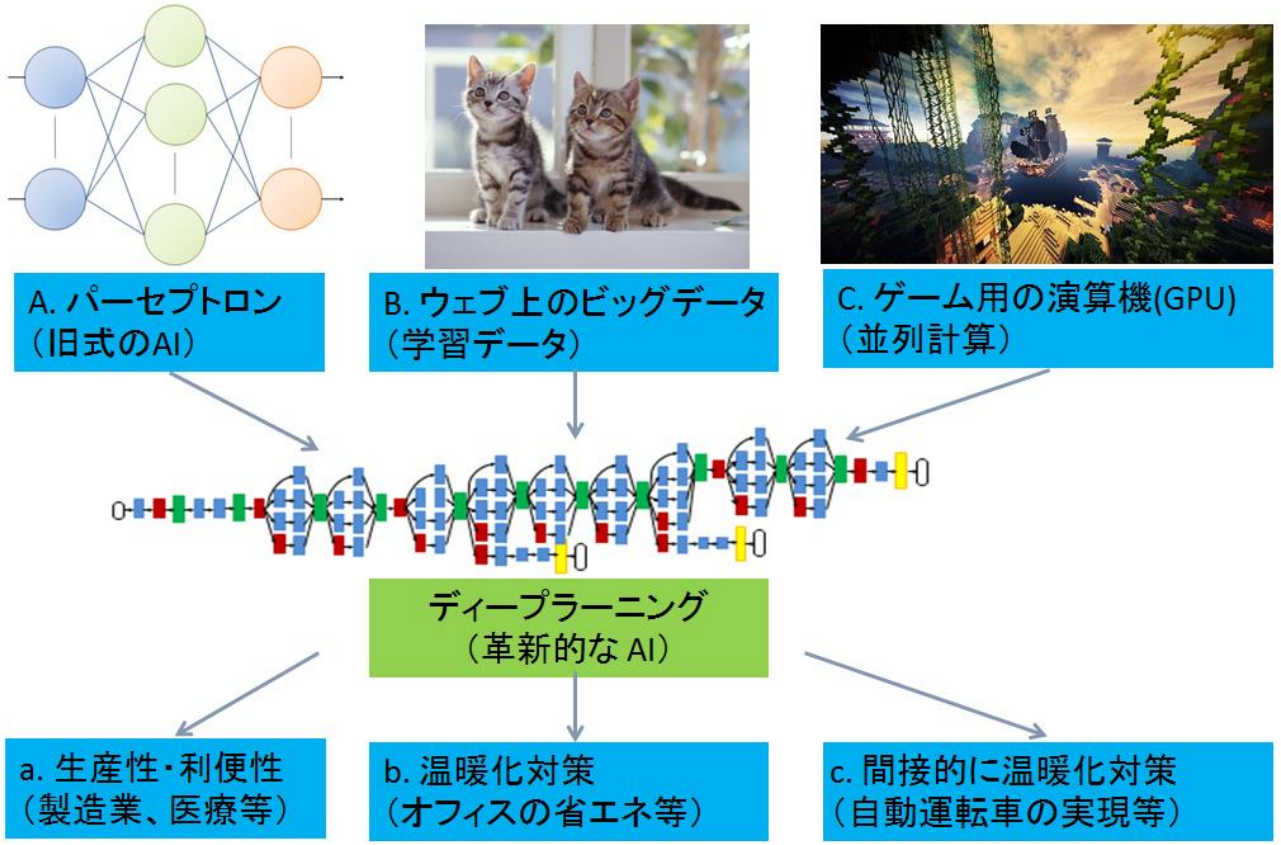


Government intervention : Linear model



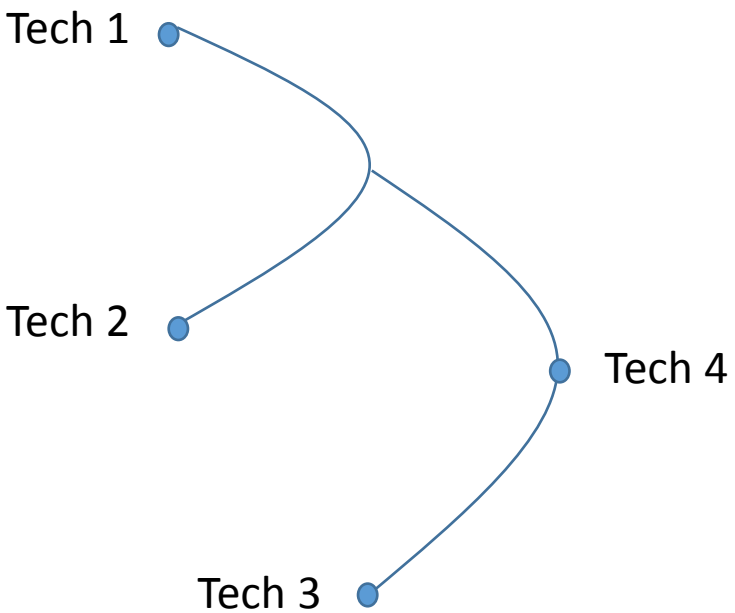
Rationale : Appropriability and Env. Externality

Structure of innovation：Deep learning



「温暖化対策イノベーション」は真空から生まれるものではない。
科学技術全般のイノベーションから生まれる

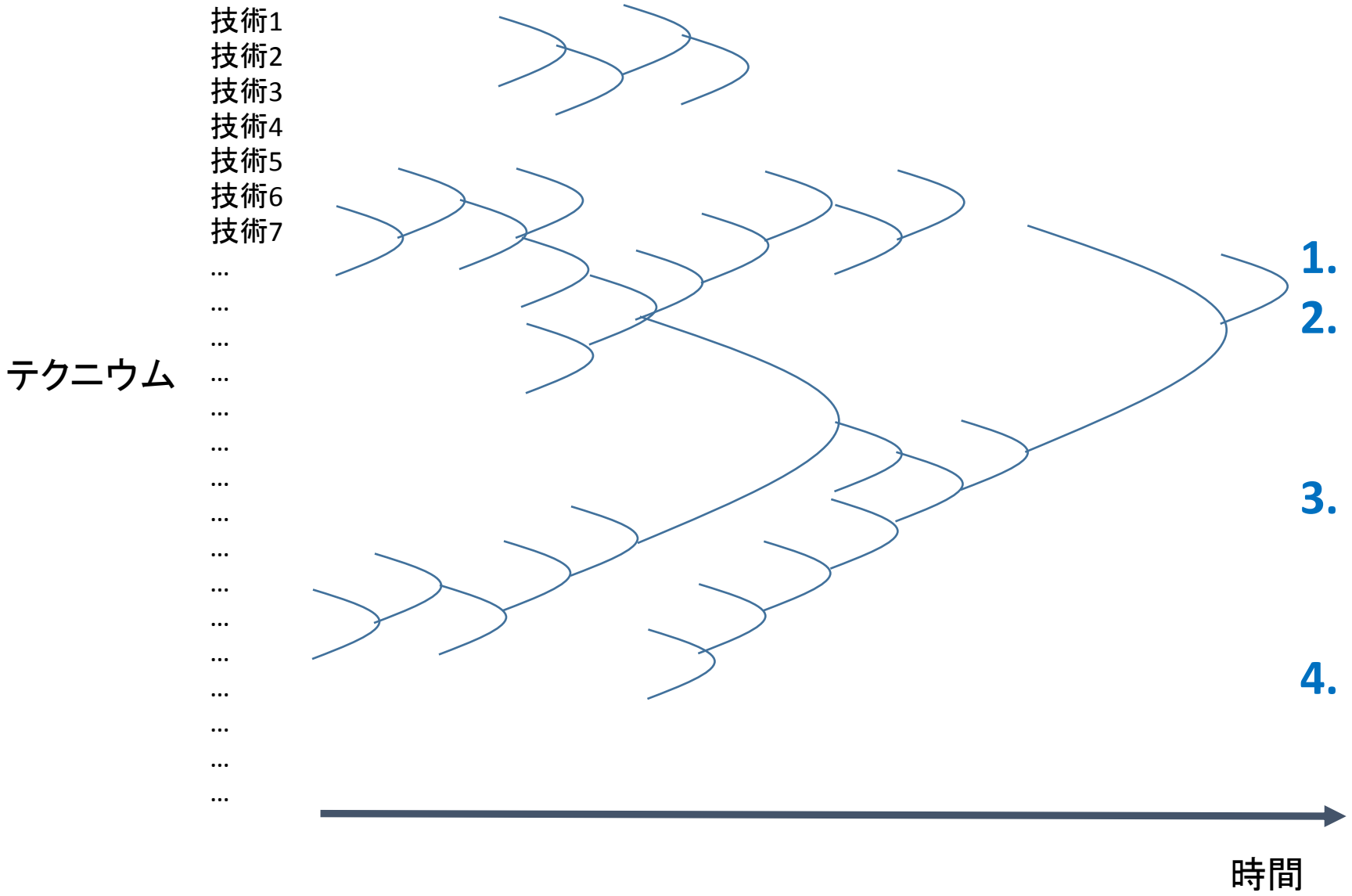
Spill over



"New combination" promotes innovation

B)

Theory of complex systems (Arthur, Kaufmann)



1. Tech advances
2. “New combination” promotes new technology/innovation
3. Performance increases and cost decreases (“Accumulation”)
4. Detailed forecast is not possible

Development in ecosystem

Policy to promote innovation

To develop ecosystem:

- High-temperature and humidity

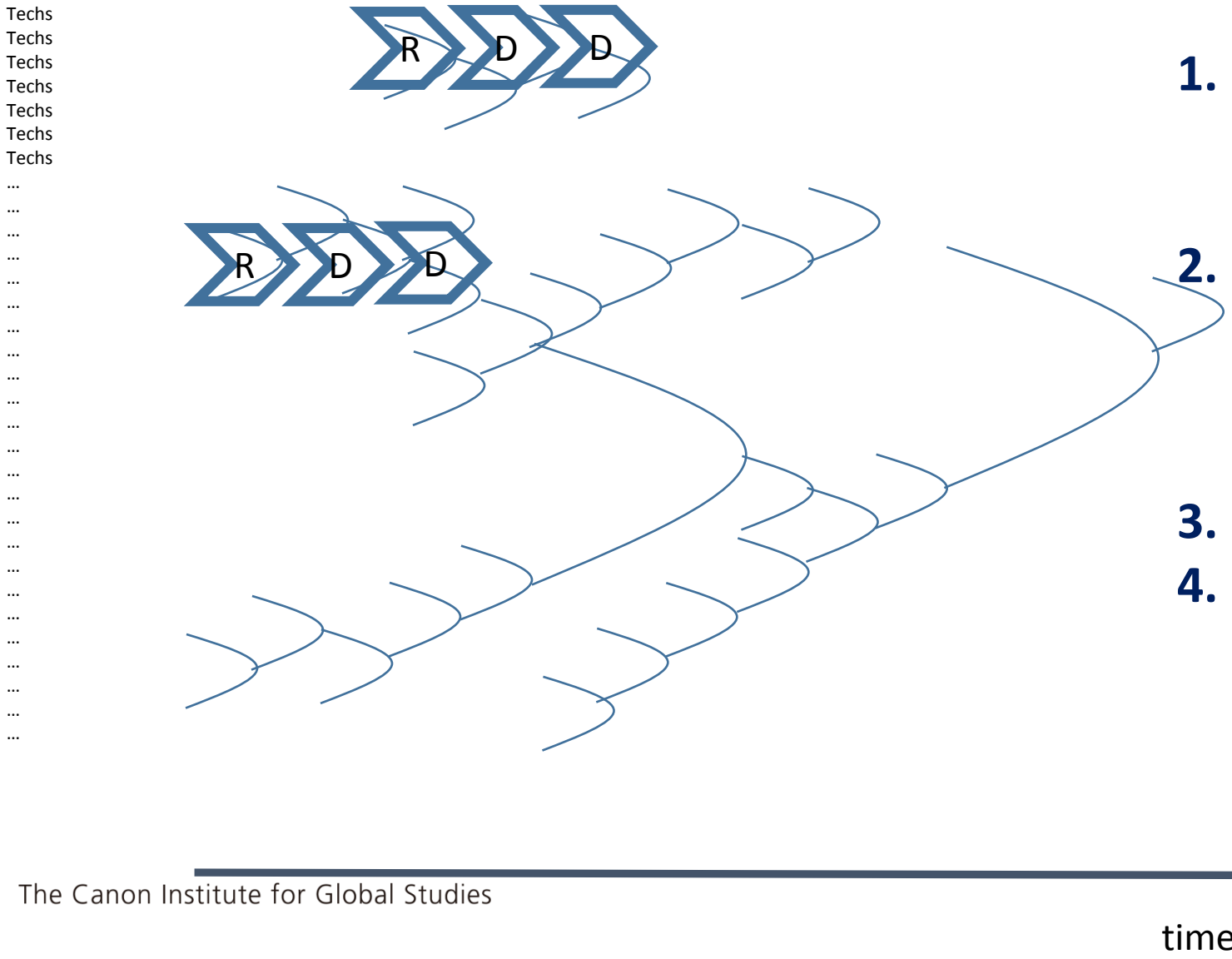
  ⇒ Biodiversity increases

To promote tech-ecosystem :

- Good economic environment

  ⇒ Business gets vitalized and innovation increases

Public intervention : Linear model



1. **Public intervention in the process of “new combination”**
2. **Possibility of opportunities for the specific tech to be combined**
3. **Timing is crucial**
4. **Therefore, this public intervention is NOT necessary to promote innovation**

Analysis of cases： several types and patterns

1. **Energy efficiency increase by AI**

   一般的なAIからのスピルオーバー (+ 政府によるR&D支援)

2. **Cost reduction of EV battery**

   ノートパソコン用バッテリー等からのスピルオーバー

   (+政府R&D: アルゴンヌ研究所等）

3. **CG animation** ムーアの法則の「スピルオーバー」を利用

4. **Space solar power system (SSPS)**

   ピクサー方式： 要素技術開発を重視しない

5. **Cost reduction of PV**

   A. 政府介入のお陰（米国、日本、ドイツ、中国）(Nemet 2018) VS

   B. スピルオーバーが本質（半導体産業、フラットパネル産業、中国製造業）(私見)

3. Strategy

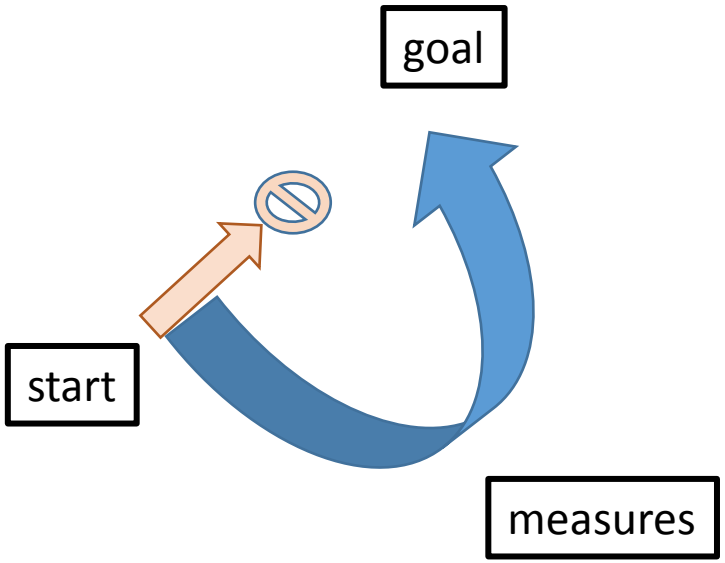
Lessons learned from the experiences

- PV : Large scaled installation amounting to 6.9 trillion yen of additional expenses under FIT scheme. However, the PV cost remains high.

- Consumer electronics: 100 billion yen subsidy for liquid crystal display equippments under Eco-point system for consumer electronics, however, little CO2 emission reduction was observed.

- Public R&D Projects such as Sunshine Project and Moonlight Project has measurable benefits.

Detour strategy for wicked problem



× Little benefit

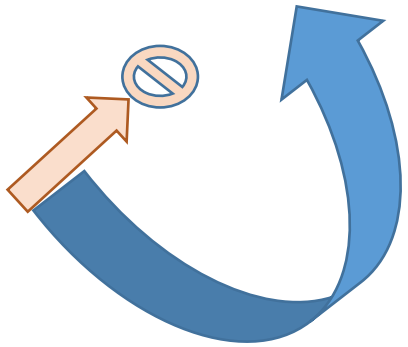
× Increased bad effect

Detour Strategy

: Prepare for the measures that ensure the goal

- ○ A range of options
- ○ Coordination with other policy issues

Detour strategy for global warming : Case 1



Directly aim to reach the large scaled mitigation of GHG emission :

- × Increased economic and security risk
- × Unstable policy

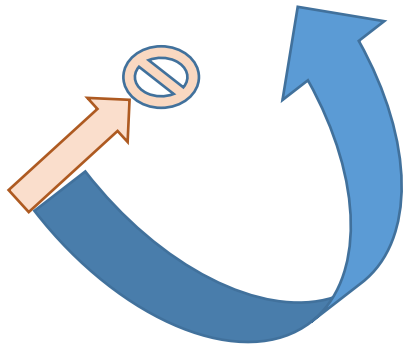
Detour strategy

Promote innovation in the measures to tackle global warming which enable mitigation of large scaled reduction of GHG emission

- ○ Harmonization with economy and security
- ○ Stable policy

Detour strategy for global warming : Case 2

-Promotion of innovation not only to tackle global warming instead of to mitigate GHG emission but in science and technology as a whole-



Directly aim to reach innovation in the tech of mitigation of GHG emission

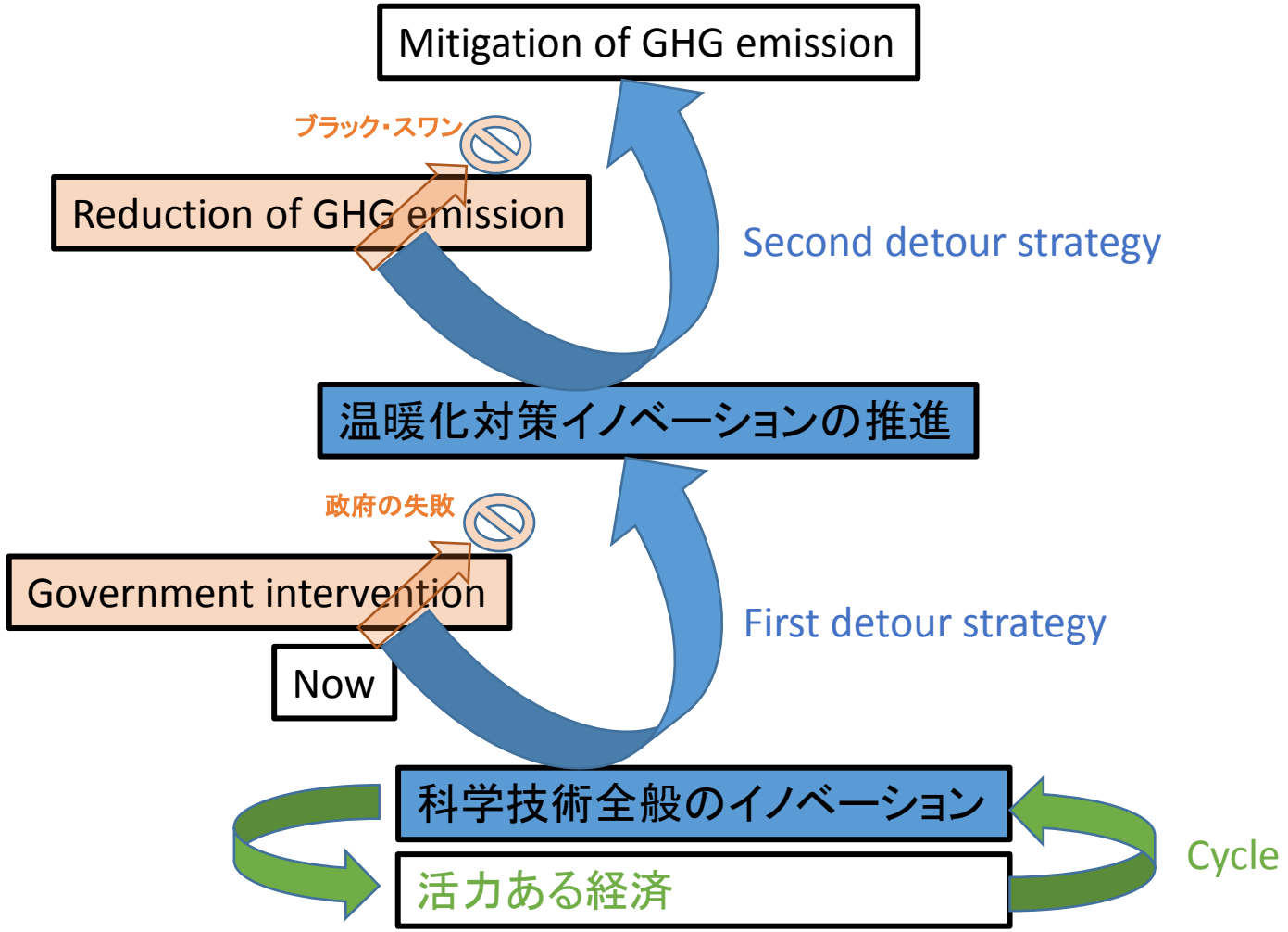
- × Concern of government failure
- × Limited options of available tech

Detour strategy

Promotion of innovation not only to tackle global warming instead of to mitigate GHG emission but in science and technology as a whole

- ○ Harmonization with economy and security
- ○ Increased opportunity for “New combination”

Dual detour strategy



Role of government
-Establishment of virtuous cycle between economy and innovation is crucial-

1. Climate change policy must not interrupt virtuous cycle between economy and innovation.
2. Investment should go to basic R&D.
3. The policy and related system should be reviewed from time to time according to the development of innovation.
4. Concrete measures that have become cost effective should be implemented.