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Development of the Backcasting model –Application to Japan LCS Study –

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Summary

What did we do?

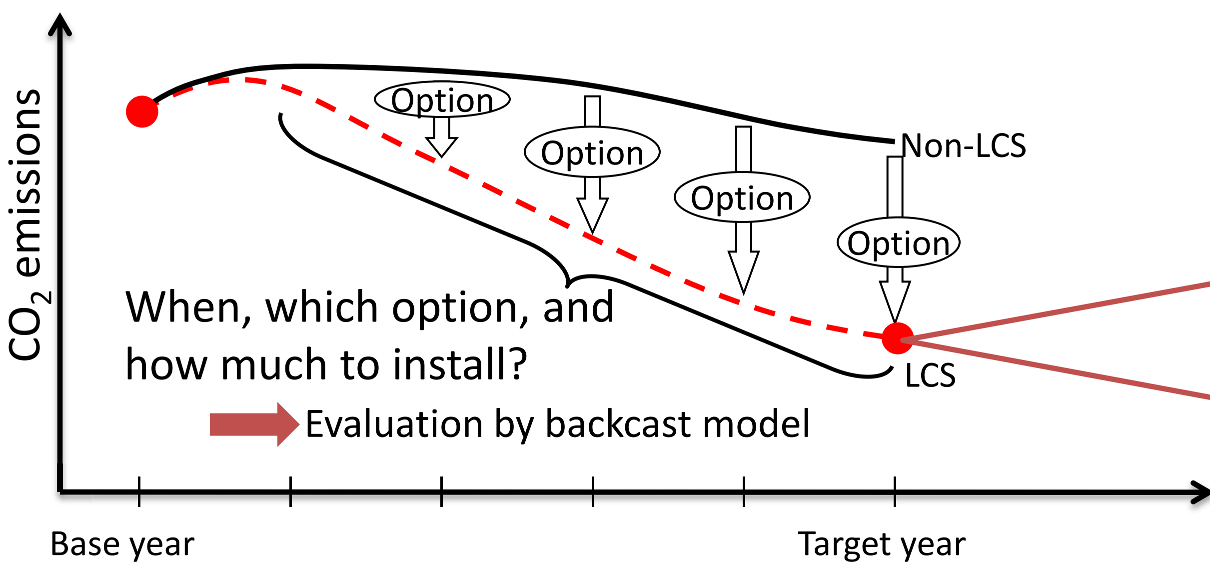
- We draw up future roadmaps for technologies, policies, and optimal investment timing toward the achievement of a low-carbon society in Japan by 2050 using an analytical model based on a backcasting methodology.

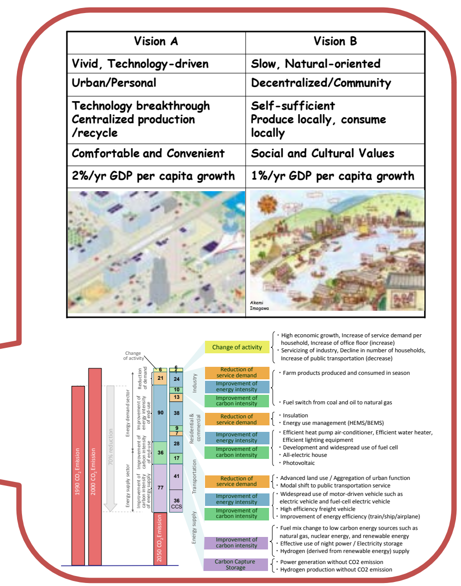
What did we find?

- Early actions can lead to pathways for minimizing the costs toward an LCS in Japan. However, to take early actions, large investments will be needed at the initial stages. Because:
  1. Technologies have learning-by-doing effects: the additional cost of reducing CO2 emissions will fall as the technologies spread.
  2. If actions are delayed, learning-by-doing effects may fail to work sufficiently, resulting in higher total investment requirements for achieving a LCS.
  3. No infrastructure can be built immediately; hence it would be difficult to switch suddenly to a LCS in the years just before 2050.
  4. Future technological development has several uncertainties. Early actions will open up new opportunities for the spread of alternative actions toward the LCS should a dominant technology fail in some way.

Current status of Japan LCS Study

- We have shown feasibilities of Low-carbonization in Japan by 2050.
  - Some journal articles and reports have been published.
  - Our outcomes (probably) affects national policy/strategy about climate change (esp. CO2 reduction).

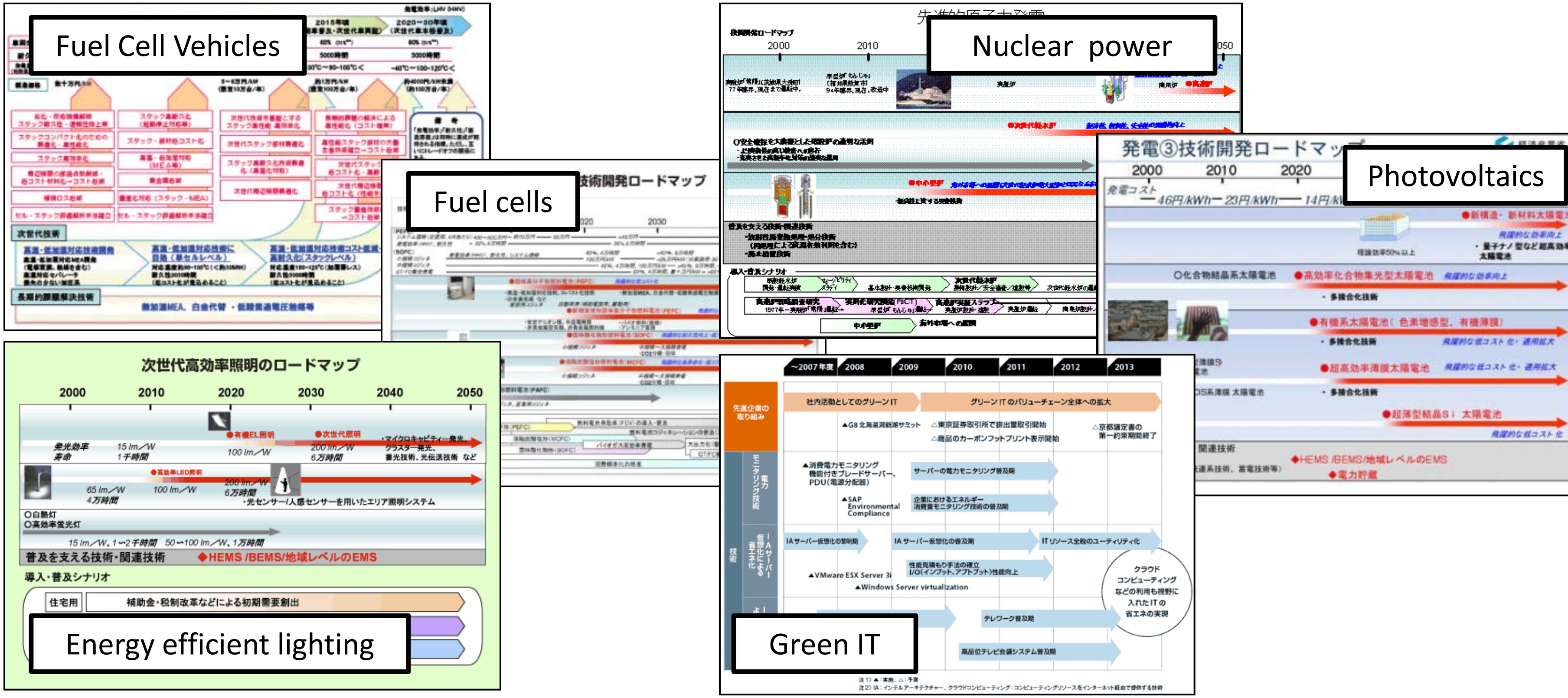




- Next question: “How to reach the future?”

How to make a roadmap to the LCS?:

- We already have several roadmaps by experts. But…

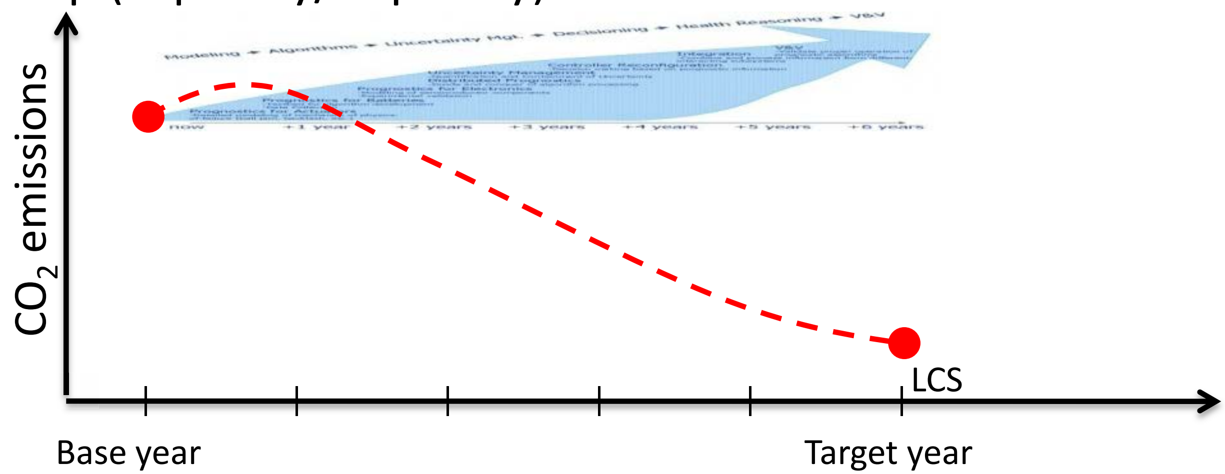


- These roadmaps (usually) focuses one technology/segment in a society.

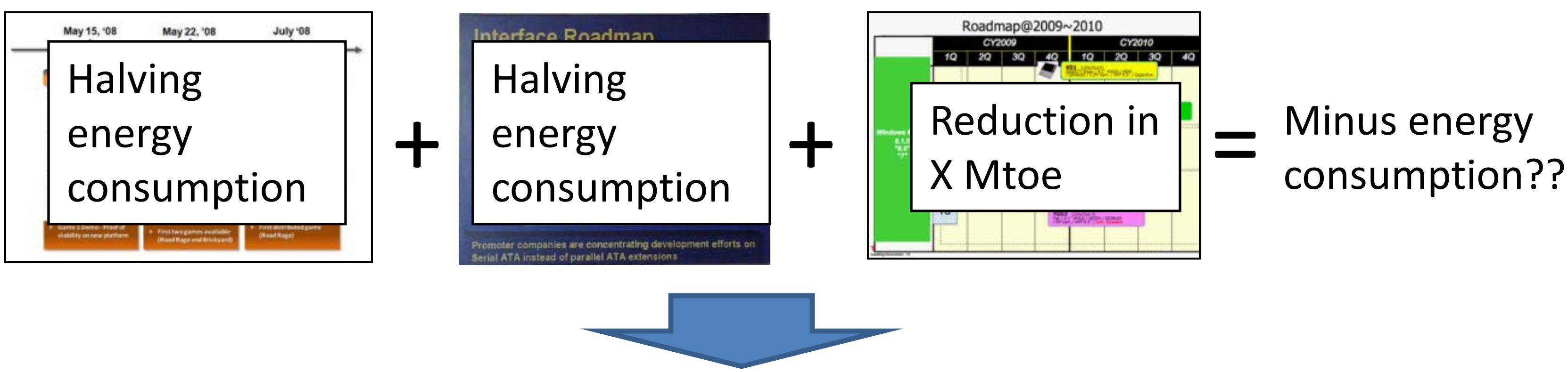
- In order to find “comprehensive” roadmaps towards LCS, we need to combine the information appropriately.

Issues to be considered in depicting comprehensive roadmaps

- Each roadmap (explicitly/implicitly) aims to the LCS?



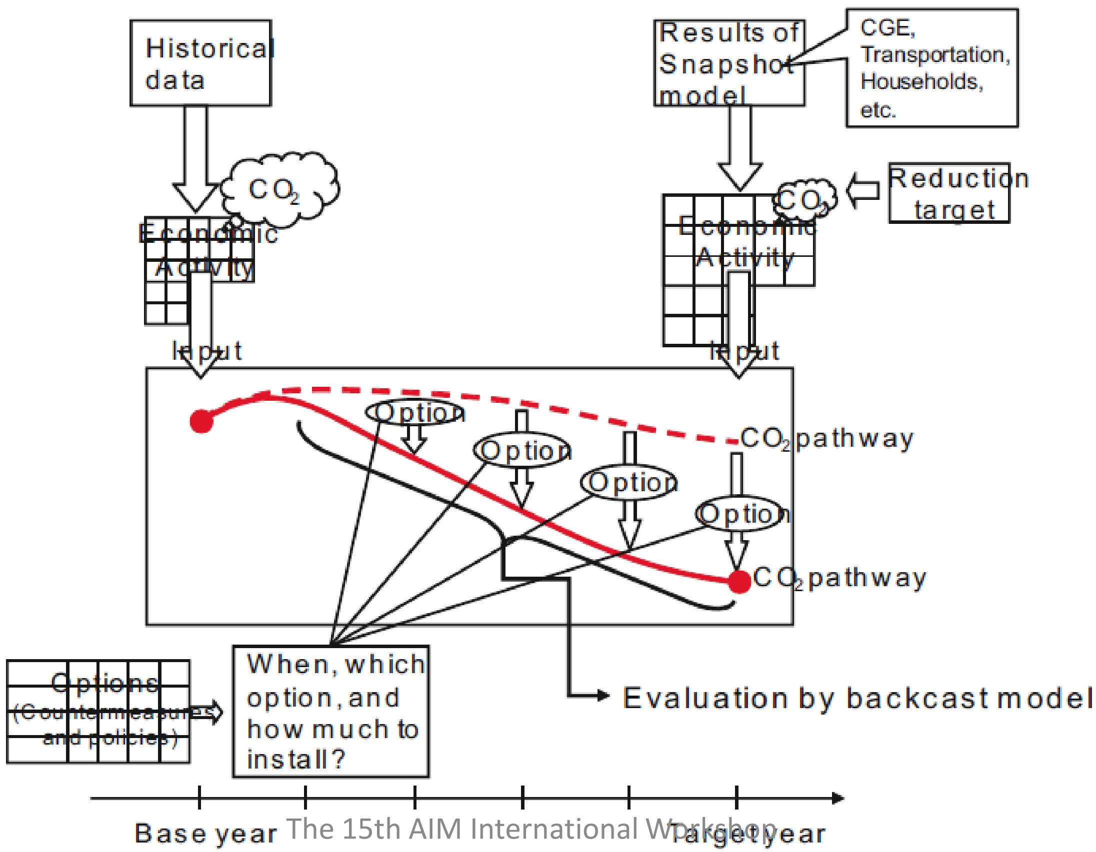
- Combination of roadmaps brings inconsistency in energy balance, economic structure etc ?



In order to find comprehensive roadmap with keeping consistency in energy balance and/or economic activity, an "AIM/Backcast" model has been developed.

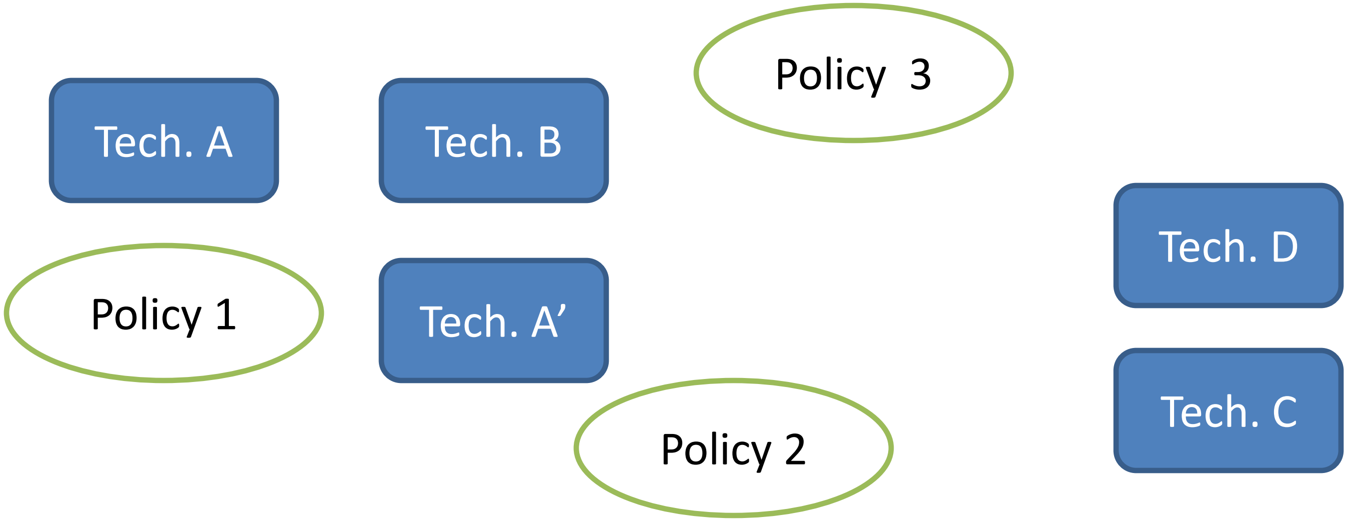
Overview of the AIM/Backcast model

- The model investigates and selects which options (countermeasures and policies) to introduce and when and at what intensity in order to best achieve the future social and economic activities portrayed in the scenarios while satisfying the service demand today and throughout the period up to the target year based on certain criteria.
- The model also presents a Gantt chart with pathways of CO_2 emission, investment



How to address existing roadmaps in the model?
(1) Decompose to individual technology and/or policy

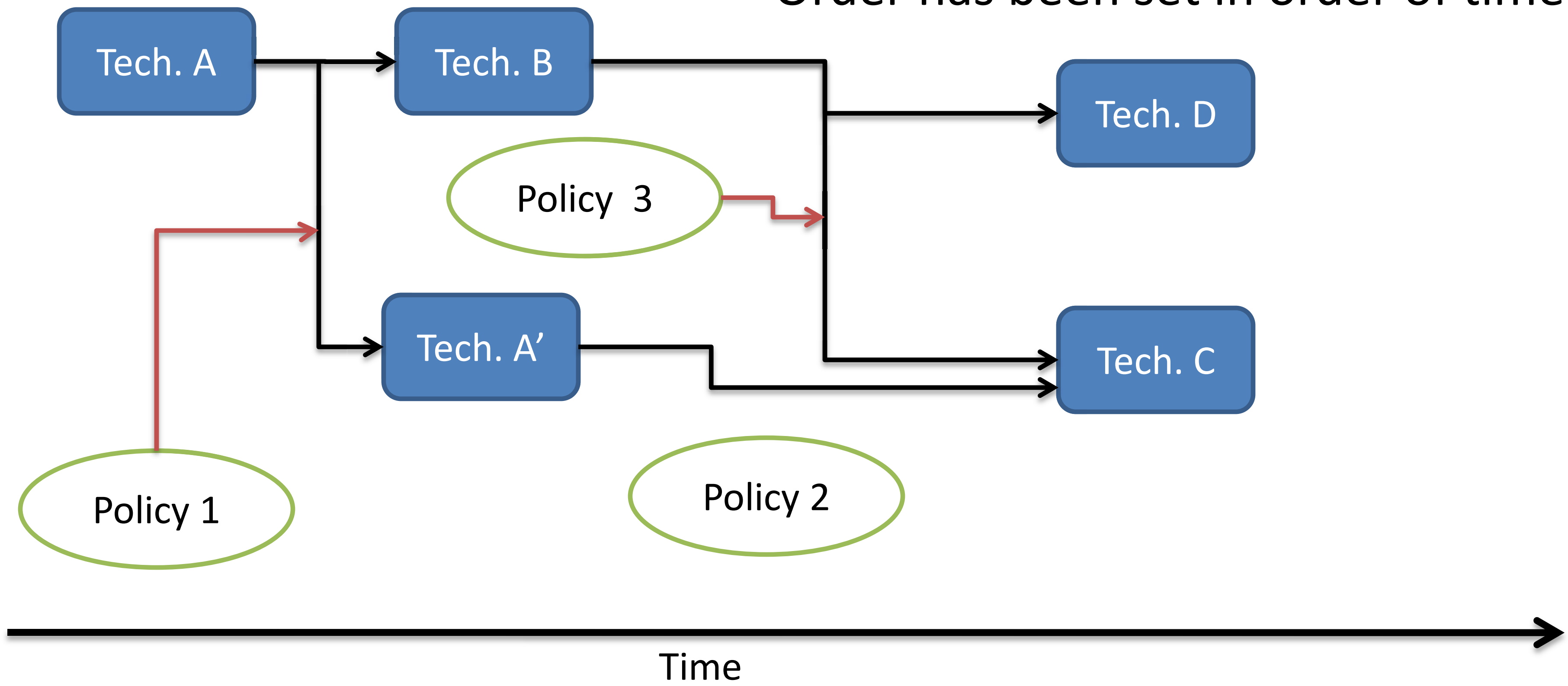
Ex. A roadmap contains five types of technologies and three policies:



How to address existing roadmaps in the model? (2) Set relationships/order between components

Ex. A roadmap contains five types of technologies and three policies:

Order has been set in order of time.



How to address existing roadmaps in the model?
(3) Set quantitative data for each technology/policy

Input

- Future target vision
- Social/Economical conditions
- Set of options

And, each options'

- Sequential order
- Elapsed time
- Kick-off period

→

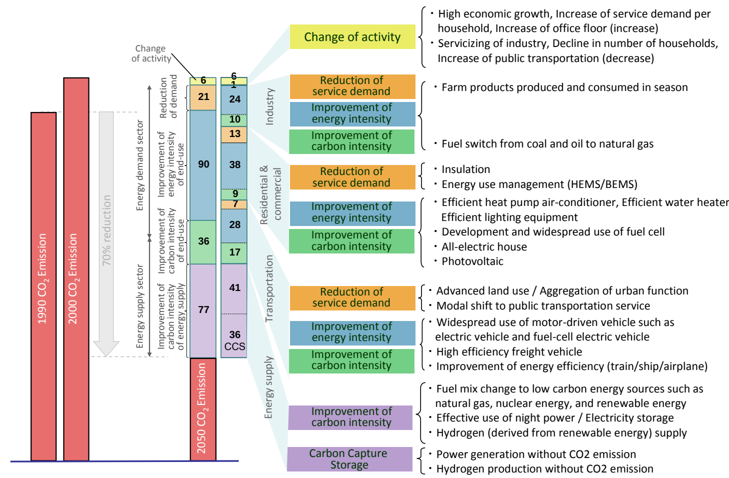
Output

- Feasibility of the target
- Roadmaps
- CO_2/Cost trajectories

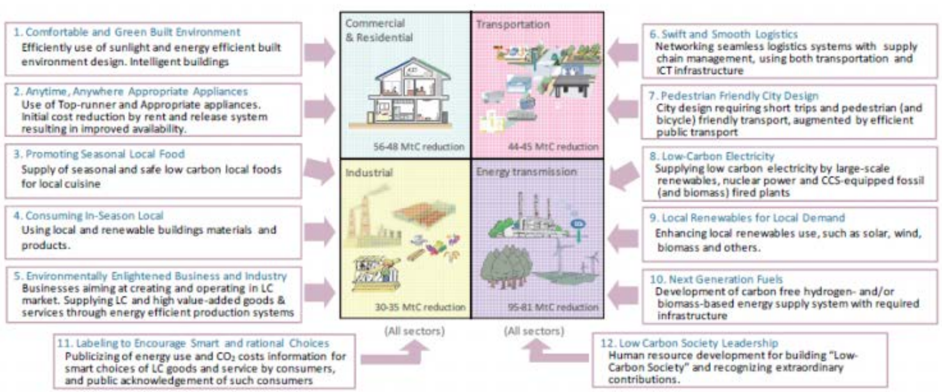
Application to Japan Low-Carbon Society Study
- How to reach the society with 70% reduction in CO2 emissions in 2050? -

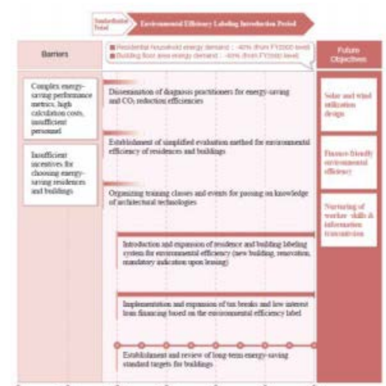
- Future society visions: Scenario A and Scenario B

Vision A	Vision B
Vivid, Technology-driven	Slow, Natural-oriented
Urban/Personal	Decentralized/Community
Technology breakthrough Centralized production /recycle	Self-sufficient Produce locally, consume locally
Comfortable and Convenient	Social and Cultural Values
2%/yr GDP per capita growth	1%/yr GDP per capita growth

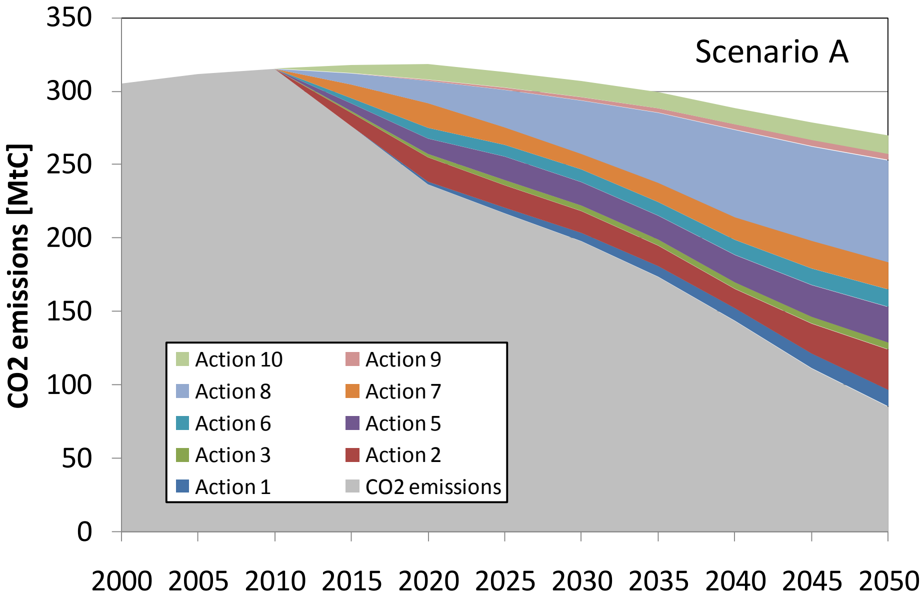
- Individual roadmaps and technology/policy are set based on “Dozen Actions” which is one of comprehensive and qualitative study about roadmaps towards LCS.

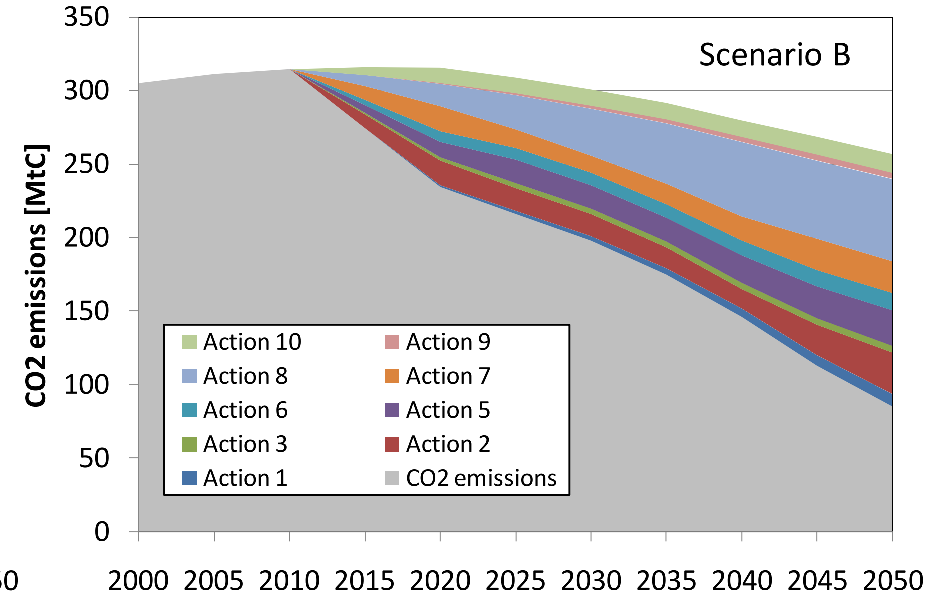




- Criteria : Cost minimization

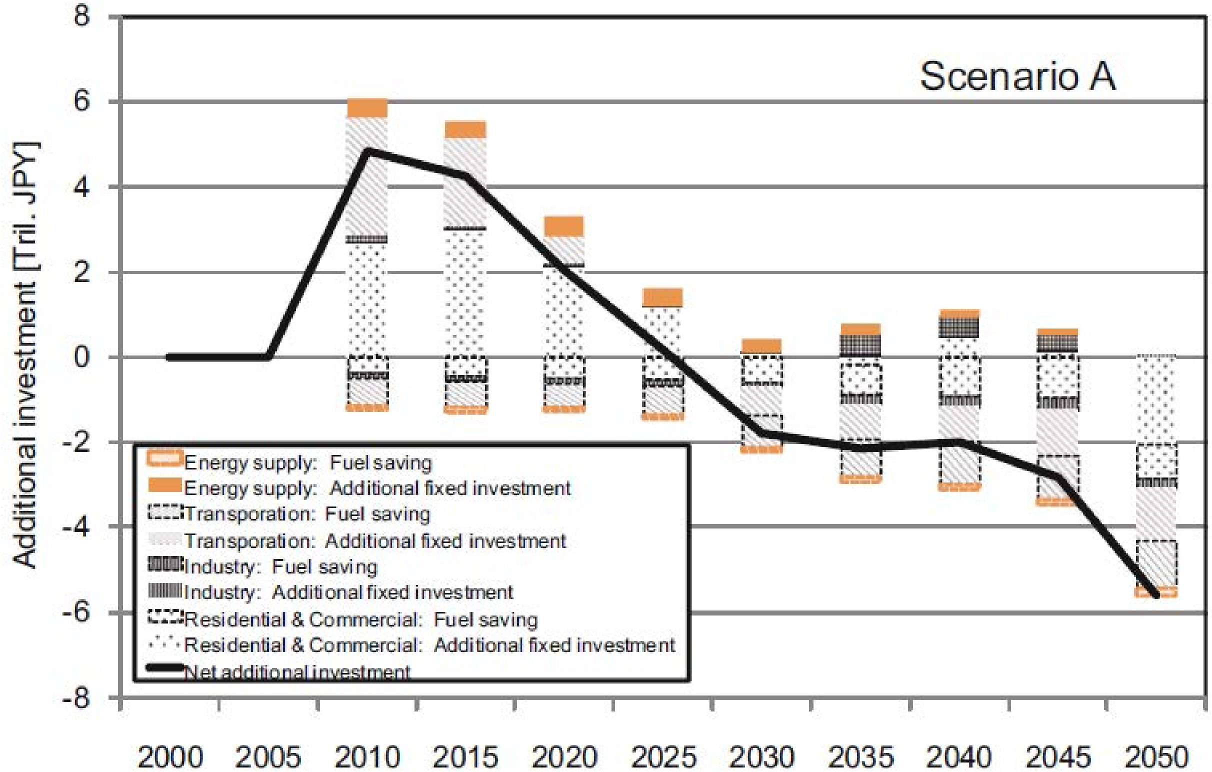
Results: CO2 pathways towards LCS





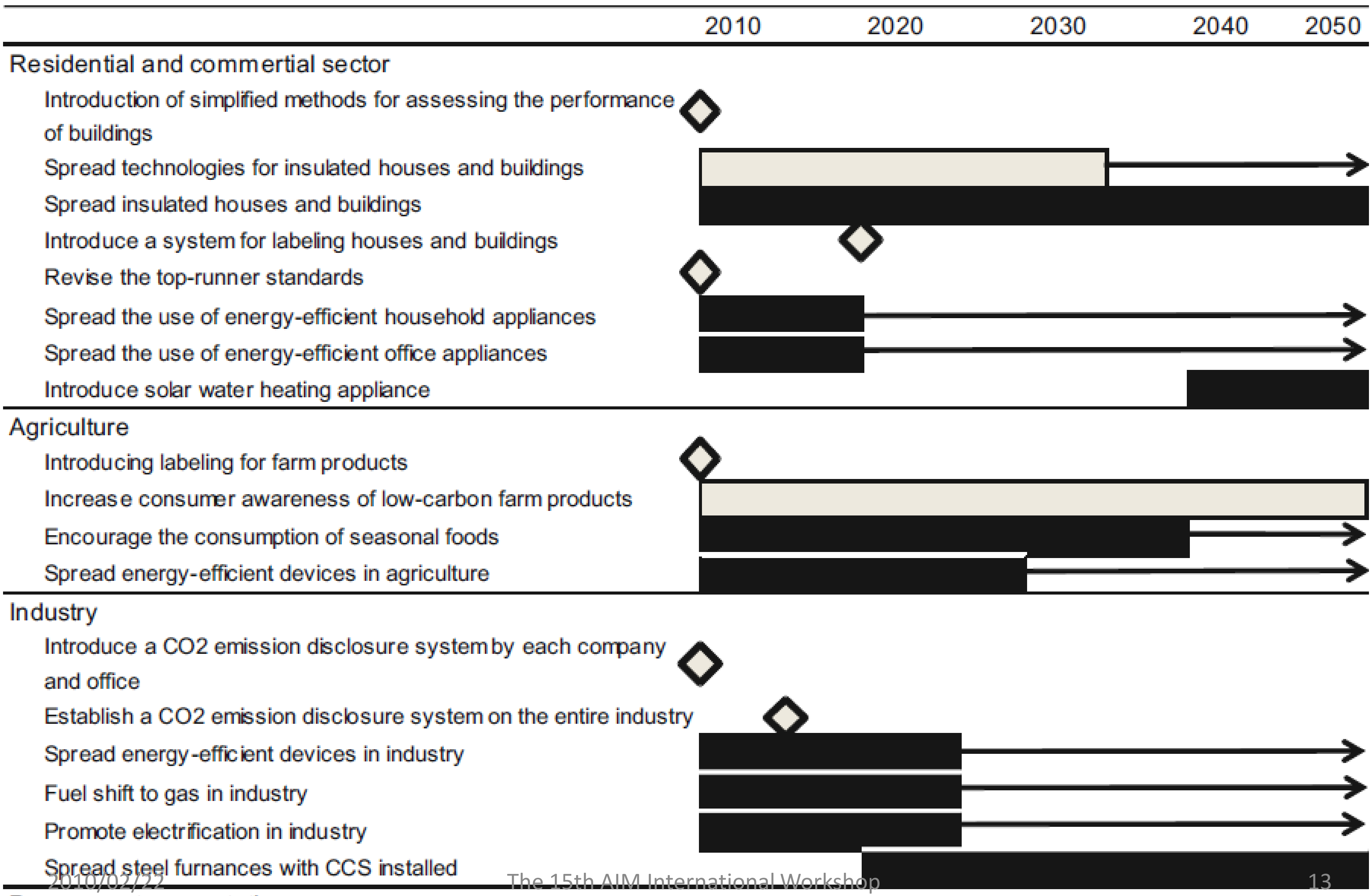
- When the CO2 target for 2050 is set 70% lower than the 1990 level, the pathways to reach the target in scenarios A and B are quite similar.
- The optimum course in terms of total cost is to start introducing measures by as early as 2010 and reduce emissions by 17% compared to the 1990 level by 2020 and by 30% by 2030.

Investment pathways for achieving LCS under the total cost minimization



- The investigation has also revealed a key piece of information to be determined for prompt action, namely, the necessary initial investment.
- In both scenarios sharply as a consequence of learning-by-doing effects and reductions in the demand for transportation services due to changes in the structure of cities. By 2020, the costs reach close to zero.
- Meanwhile, however, the additional fixed costs in the residential and commercial sectors stay at around 2 trillion JPY per year until 2030.

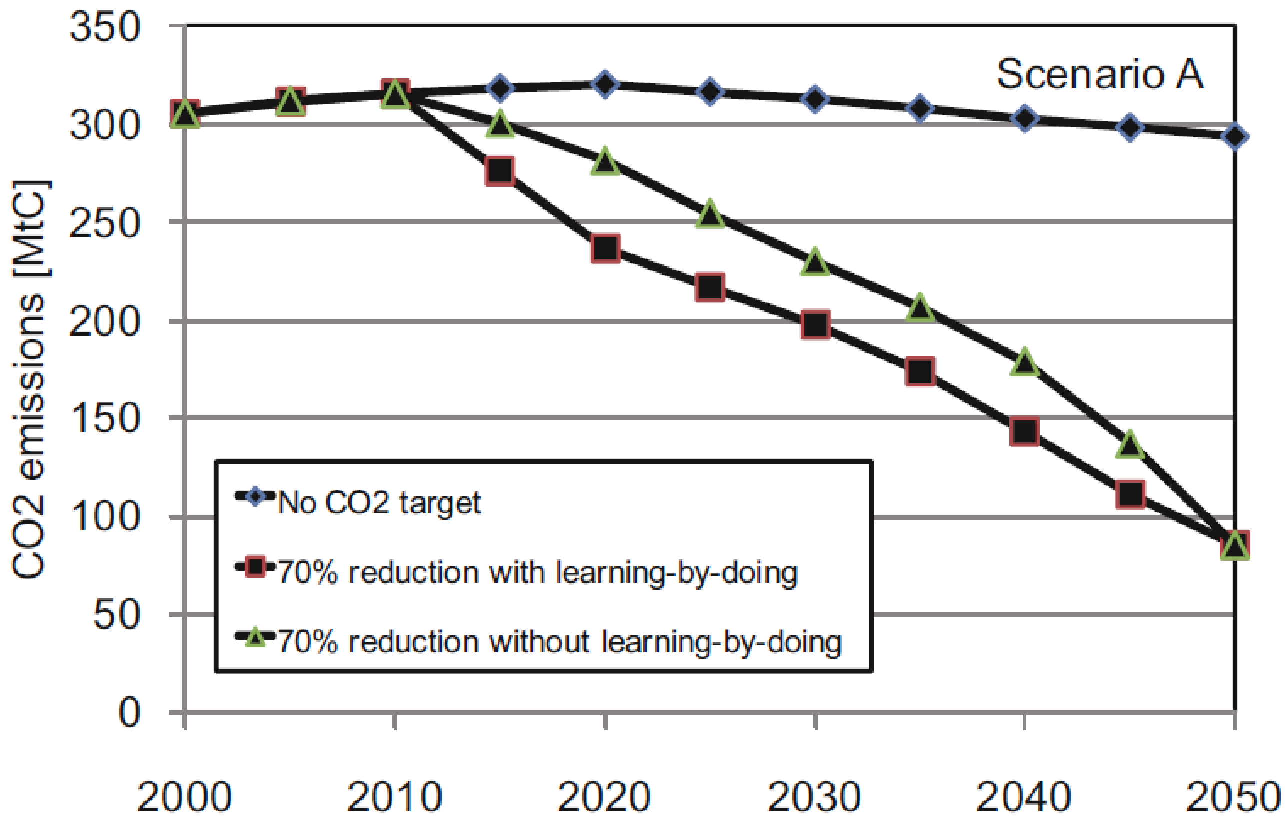
Gantt Chart towards LCS (a part)



Viewpoints of future pathways: Four reasons for taking early actions

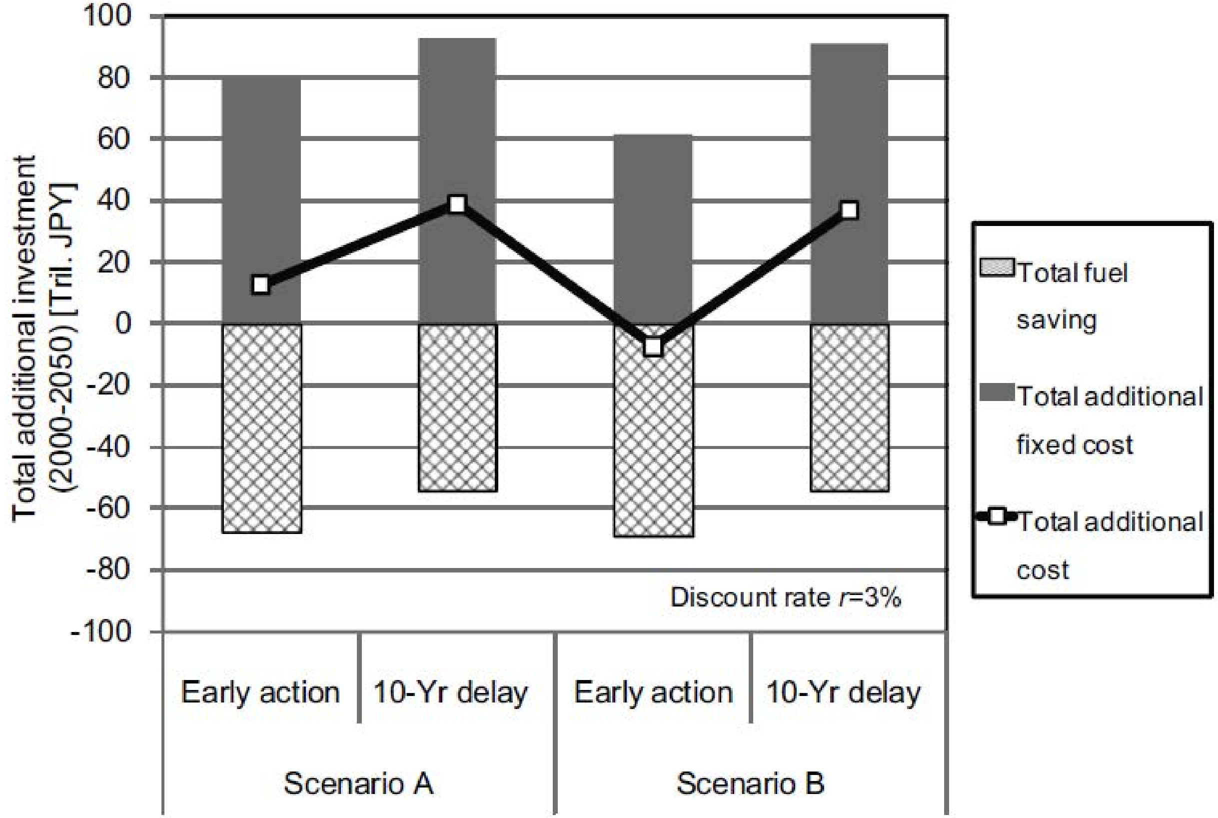
1. Technologies have learning-by-doing effects: the additional cost of low-carbon technologies will fall as the technologies spread.
2. If actions are delayed, learning-by-doing effects may fail to work sufficiently, resulting in higher total investment requirements to achieve a LCS.
3. No infrastructure can be built immediately; hence it would be difficult to switch suddenly to a LCS in the years just before 2050.
4. Future technological development has several uncertainties. If one of the currently dominant technologies falls behind schedule, it will fail to spread as expected and CO_2 emission targets will not be met. Early actions will open up new opportunities for the spread of alternative actions toward the LCS should a dominant technology fail in some way.

Point 1: Learning-by-doing effects



- In the absence of learning-by-doing effects, the CO2 reduction pathway will be delayed.
- The introduction of major CO2 reduction options through the early-stage investment of large sums will not only gradually reduce the cost via learning-by-doing effects but also reduce the total investment required for achieving a LCS.

Point 2: Delays in initiating action will push up costs



- If actions are taken quickly, the total additional investment will be 12.7 trillion JPY in scenario A and 7 trillion JPY in scenario B.
- If action is delayed by 10 years, the total additional fixed costs will increase to 93 trillion JPY in scenario A and 91 trillion JPY in scenario B. The fuel cost savings, meanwhile, will come to only 54 trillion JPY in both scenarios, as these options will spread late. Thus, the resultant additional investment from 2010 to 2050 will be 39 trillion and 37 trillion JPY in scenarios A and B, respectively.

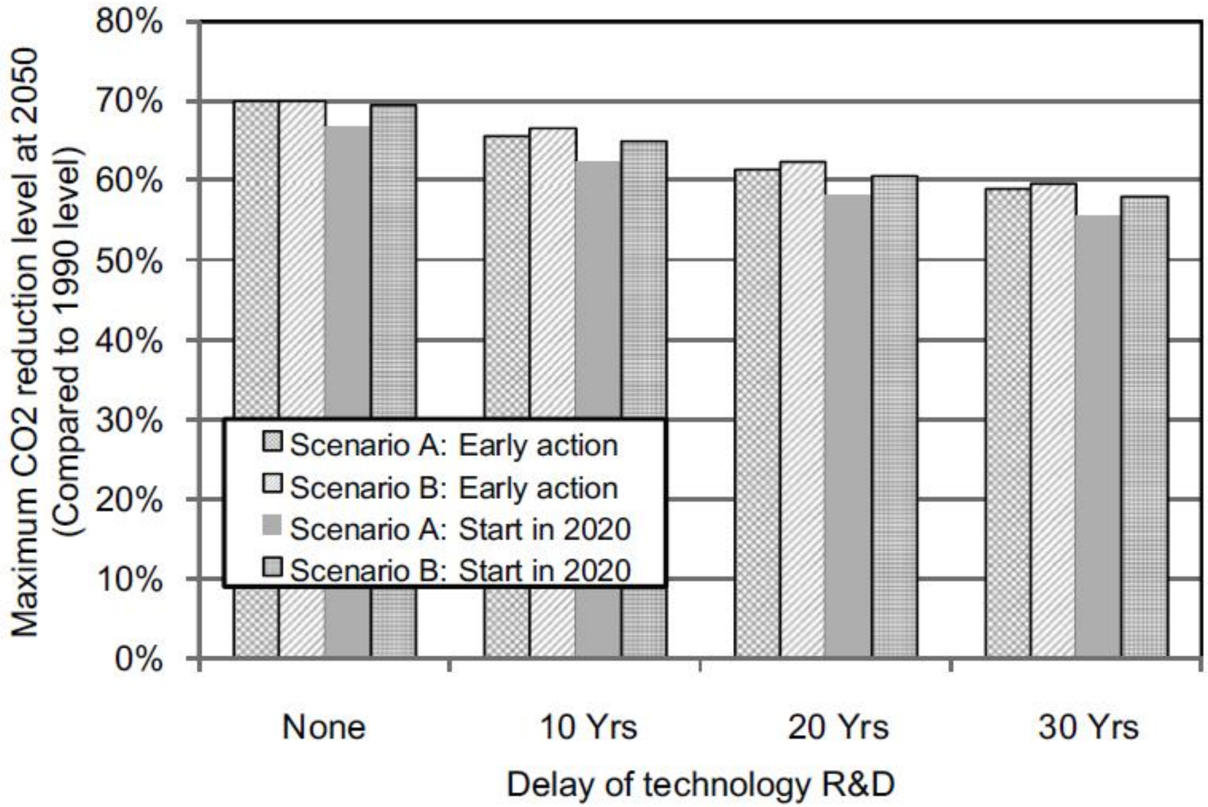
Point 3: It takes time to construct infrastructure

- Infrastructure (city infrastructure, transportation systems, energy infrastructure, buildings, etc.) generally has a long service life and cannot easily be modified once constructed.
- The infrastructure built today is likely to be in use in 2050. Thus, the framework of a LCS is already being established.

Sector/Assets	Average service life (Yr.)
Road	51
Harbor	49
Airport	16
Former Japan National Railways	22
Japan Railway Construction Public Corporation, etc.	26
Subways, etc.	34
Former Nippon Telegraph and Telephone Public Corporation	18
Sewerage	57
Waste disposal	40
Water works	39
City park	43
Education (Schools and academic facilities)	39
Education (social education, physical education and cultural facilities)	41
Flood control	85
Forestry conservation	50
Coastal protection	30
Agriculture	44
Forestry	49
Fishery	50
Postal service	18
National forest	47
Water works for industrial use	38

	Delays in infrastructure				
	Early actions	Start in 2020	Start in 2030	Start in 2040	Start in 2050
Scenario A (compared to the 1990 level)	85.2(−70%)	86.7(−69.5%)	109.5(−61.4%)	134.6(−52.6%)	161.3(−43.2%)
Scenario B (compared to the 1990 level)	85.2(−70%)	85.2 (−70%)	106.2(−62.6%)	131.7(−53.6%)	158.3(−44.3%)

Point 4: There are uncertainties in technological research, development, and deployment



- Taking action now to achieve a LCS will encourage active technology development, improve efficiency, reduce costs by learning-by-doing effects, spread the portfolio of alternative actions, prepare us for future uncertainties, and thus raise the possibility of achieving a costefficient LCS.

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Further information

- [Journal] Journal of Renewable and Sustainable Energy, in printing.
- [Journal] Climate Policy - modeling long-term scenarios for low-carbon societies - Vol.8 Supplement 2008
- [Report] Japan Scenarios and Actions towards Low-Carbon Societies (LCSs)
- [Report] Aligning Climate Change and Sustainability - Scenarios, modeling and policy analysis - (AIM, 2007), CGER-Report, CGER-I072-2007

ALL INFORMATION CAN BE ACCESSED THROUGH

http://2050.nies.go.jp

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Thank you for your attention!