



# Models applied to road map toward low carbon Japan

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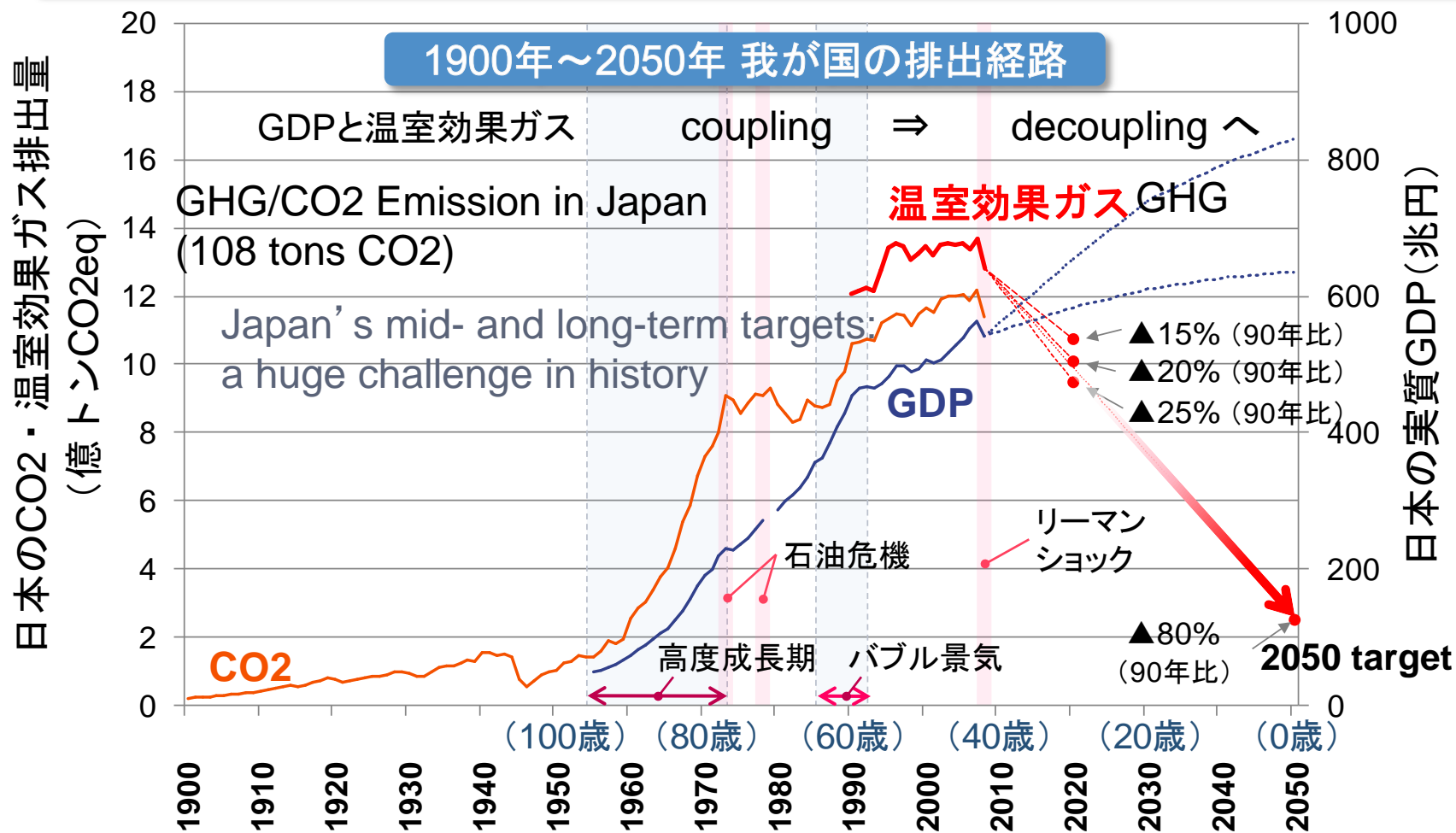
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# Global cooperation and Japan's policies in progress toward climate stabilization

- Science: the ultimate goal is to achieve near-zero emissions for climate stabilization. Back to pre-industrial era?
- International cooperation (Cancun Agreements in December 2010):
  - Recognized that deep cut of GHG are required so as to hold the increase in global average temperature below 2 degree Celsius above preindustrial level
  - A call for early peak out of GHG emissions, introduction of monitoring, reporting and verifying system, and the provision of financial aid to developing countries
- Japan's policies: the Basic Law on Global Warming Countermeasures to the Diet in 2010  
Showing first political commitment to mid- and long-term reduction
  - Clearly indicating numerical targets for mid- and long-term reduction (with conditions attached)
    - From 1990 levels: -25% by 2020, -80% by 2050
  - Presenting specific measures (Taxes, Emissions trading, Feed-in tariff)

# (1) 中長期目標～まだ誰も見たことがない社会への挑戦～

2050年80%削減はこれまでの延長線上にない社会。2020年・2030年の中期目標は80%削減を見据えた目標であることが必要で戦略的に進めるのが肝要。



1) ( )内の年齢は、各年に生まれた人が2050年を迎えたときの年齢

2) GDPの将来値は国立環境研究所 脱温暖化2050プロジェクト A・Bシナリオの想定値

## Mid- and Long-Term Roadmap to Low-carbon Japan

(an interim summary)

- Japan's GHG emissions reduction targets:  
**25% reduction** by 2020, and **80% reduction** by 2050, from 1990 levels
- **Building the world's pioneering model of a low-carbon society may serve as a basis for Japan's future growth.** It should be noted, however, that **an unprecedented, drastic innovation will be required to build such a society.**
- **The objective of building the mid- and long-term roadmap is to present a springboard for discussion** about possible paths toward achieving a low-carbon society. (e.g. the timing and details of measures/countermeasures to be implemented)
- The roadmap are expected to serve as a springboard for **public discussion in all sectors and levels**, to help build a low-carbon society in and outside Japan.

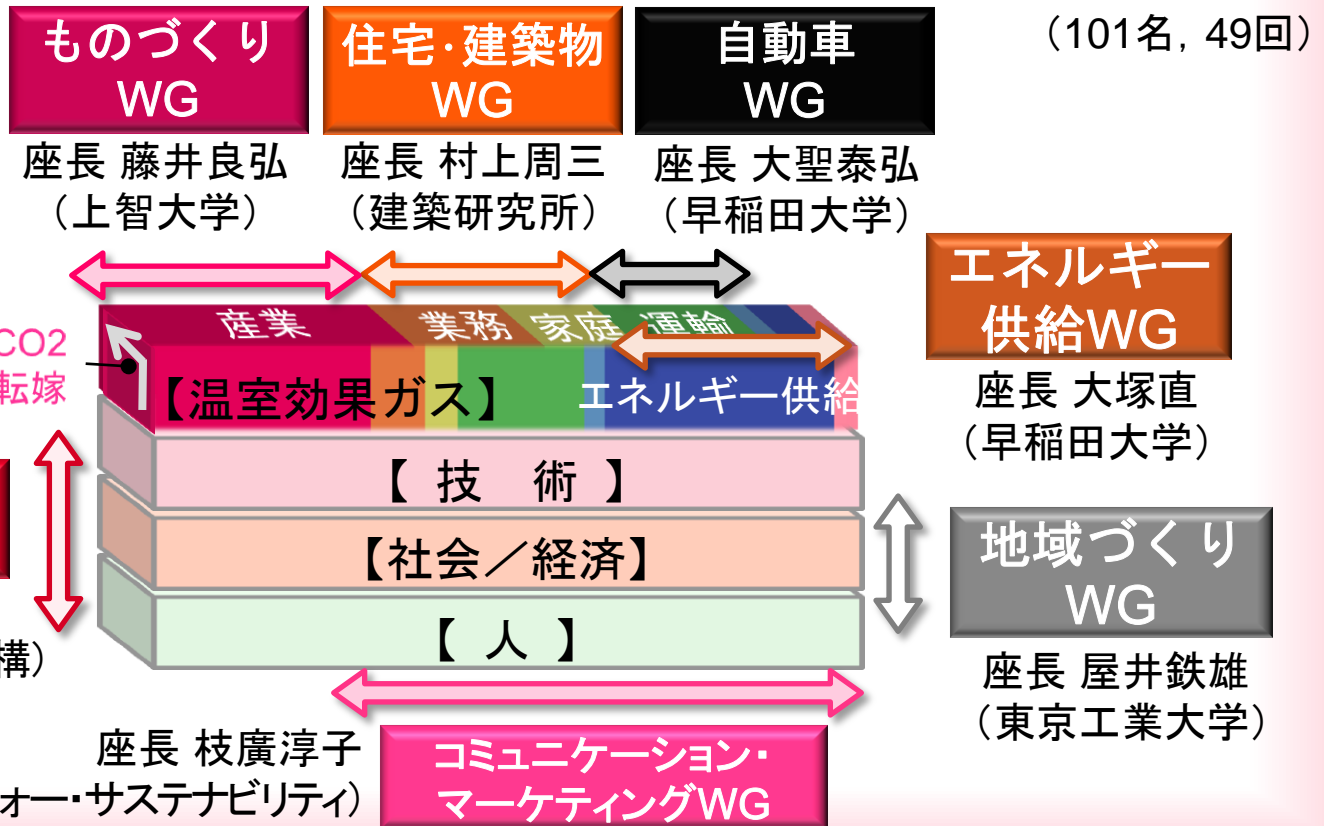
## (5) 多くの専門家によって検討

2010年度は4月～12月にかけて、各分野の100名を越える専門家によって検討。

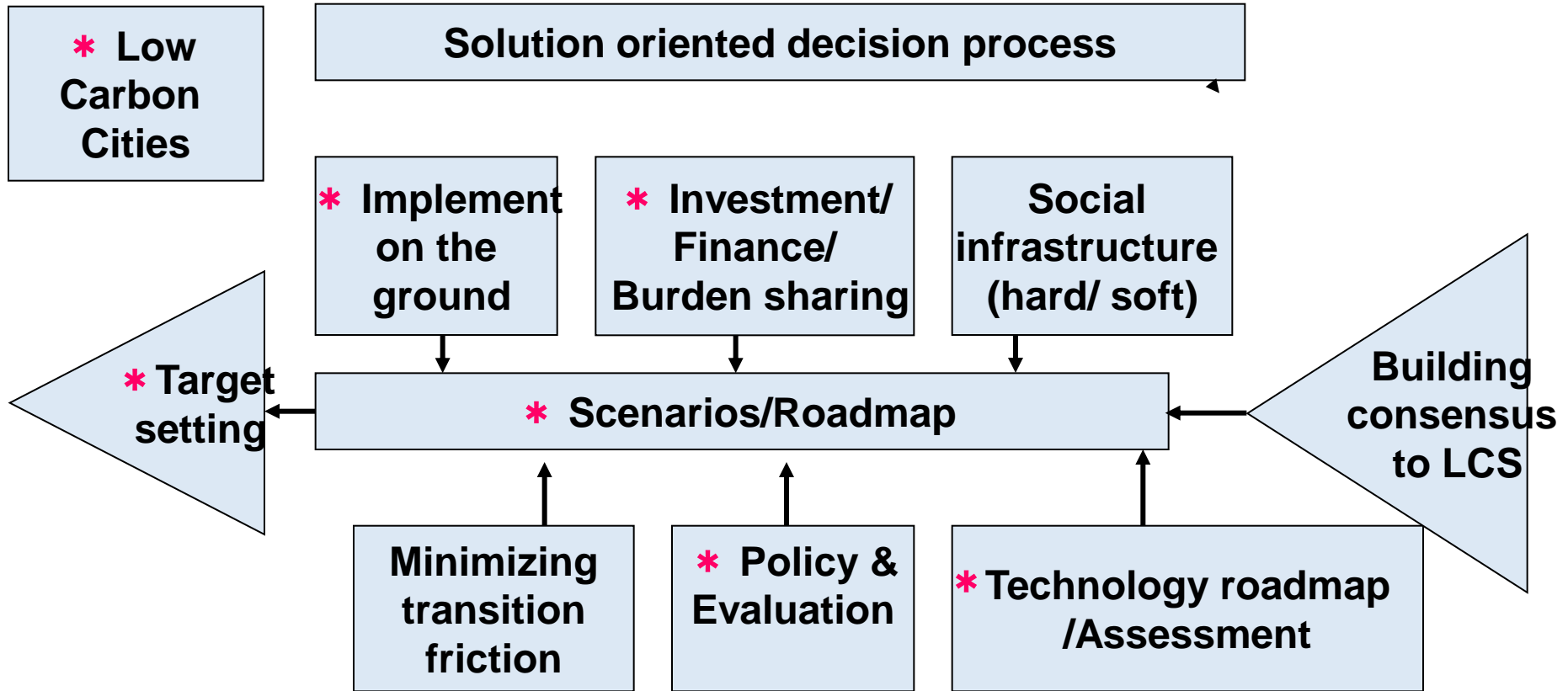
中央環境審議会 地球環境部会中長期ロードマップ小委員会

地球温暖化対策に係る中長期ロードマップに関するワーキンググループ

中朝目標達成のための対策・施策に関する専門的・技術的観点からの検討



# Formulation of Low Carbon Society



## Stepwise planning for realizing a Low Carbon Society

**\* Models applied**

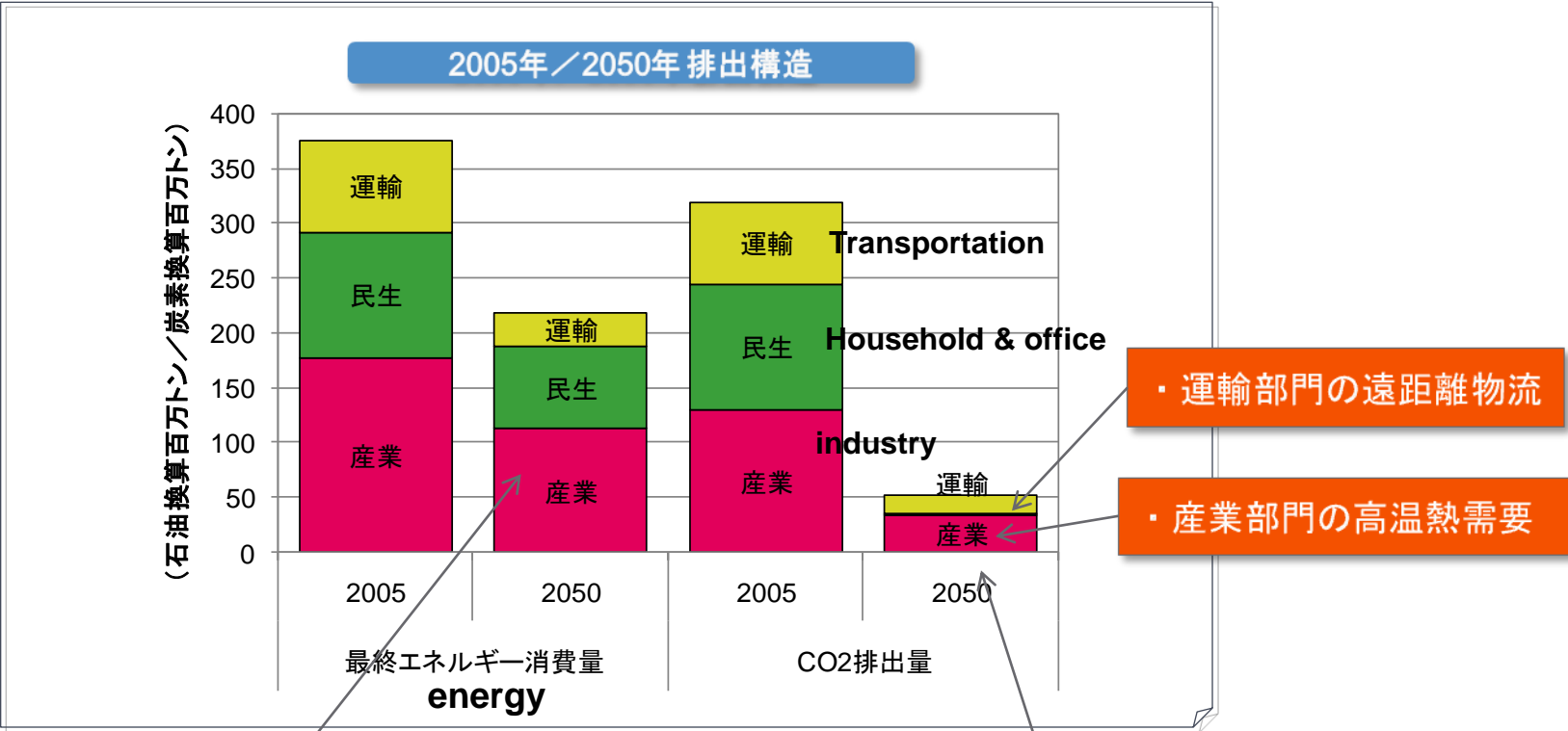
# 2050 vision for Japan

	Progress in global warming countermeasures by 2050	Multi-Benefits
Manufacturing industry	Japanese technologies helping the rest of the world to cut GHG emissions by half	Low-carbon manufacturing-oriented country
Houses and buildings	Achieving zero emissions of houses and buildings (stock average)	Healthy, comfortable living space
Vehicles	Next-generation vehicles accounting for nearly 100%	Reduced air pollution, traffic congestion, and heat island phenomena
Community	Achieving compact cities, Improvement of low-carbon districts	Pedestrian oriented safe town
Rural areas	Community planning toward zero-carbon emissions	Improved self-sufficiency rates of food and timber products
Energy supply	Zero-carbon power sources	Improved energy self-sufficiency

(The table above was prepared based on reviews at working groups.)

# Scenario: Breakdown of energy consumption and CO<sub>2</sub> emissions in 2050

- In Low Carbon Japan ( 80% reduction in GHG emissions from 1990), high-temperature heat demands in the industrial sector and long-distance logistics in the transportation sector will account for most of the direct combustion of fossil fuels.
- Zero emissions need to be achieved in the commercial/residential sector, electric power generation sector, passenger vehicles, and short-distance logistics.



\* The graph above was prepared based on the estimations of the Low-Carbon Society Scenarios towards 2050 snapshot model.

• Reducing final energy consumption by 40%

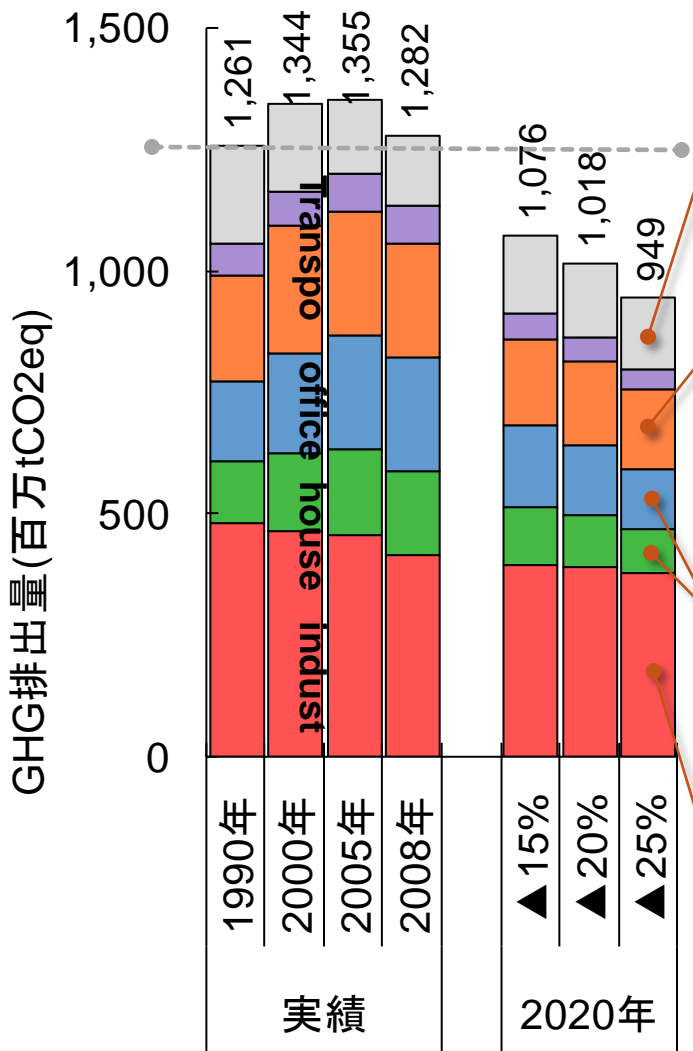
• 民生部門、電力部門、乗用車や近距離物流 →ゼロエミッション化。



## (2) 削減目標の達成のために導入される対策は？①

関係者ヒアリング結果を十分にとりいれた専門家WGの検討で、既存の導入が見込まれる対策技術の積み上げにより削減目標達成は可能であると結論。

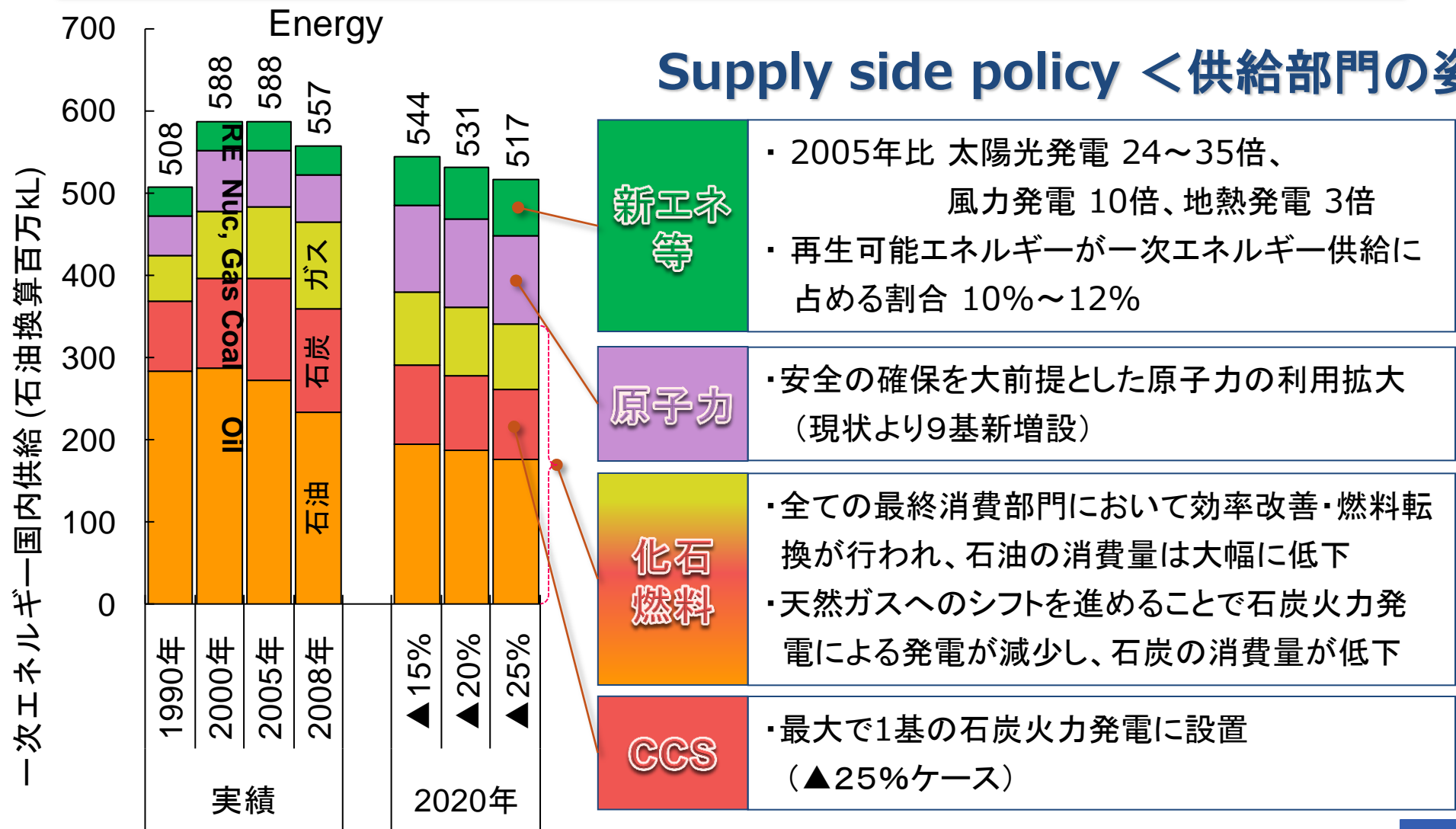
### Demand side policy < 需要部門の姿 >



<b>非エネ</b>	<ul style="list-style-type: none"> <li>・ 自然冷媒を利用した冷凍機の普及など</li> </ul>
<b>運輸</b>	<ul style="list-style-type: none"> <li>・ 乗用車燃費4~5割改善 (保有ベース、次世代自動車含む)</li> <li>・ 次世代自動車 新車販売のうち最大で2台に1台</li> <li>・ カーシェアリング利用率 都市部人口の0.3~1%</li> <li>・ エコドライブ実践率 2~3割</li> </ul>
<b>業務</b>	<ul style="list-style-type: none"> <li>・ 新築住宅・新築建築物の全てが高断熱・省エネ化</li> <li>・ 高効率給湯器 世帯普及率 5~7割</li> <li>・ ビルエネルギー計測制御システム 普及率 3~4割</li> <li>・ 太陽光発電の世帯普及率 1~2割</li> </ul>
<b>家庭</b>	
<b>産業</b>	<ul style="list-style-type: none"> <li>・ 世界最先端の技術 (BAT) の着実な普及</li> <li>・ 燃料の天然ガスへの転換</li> </ul>

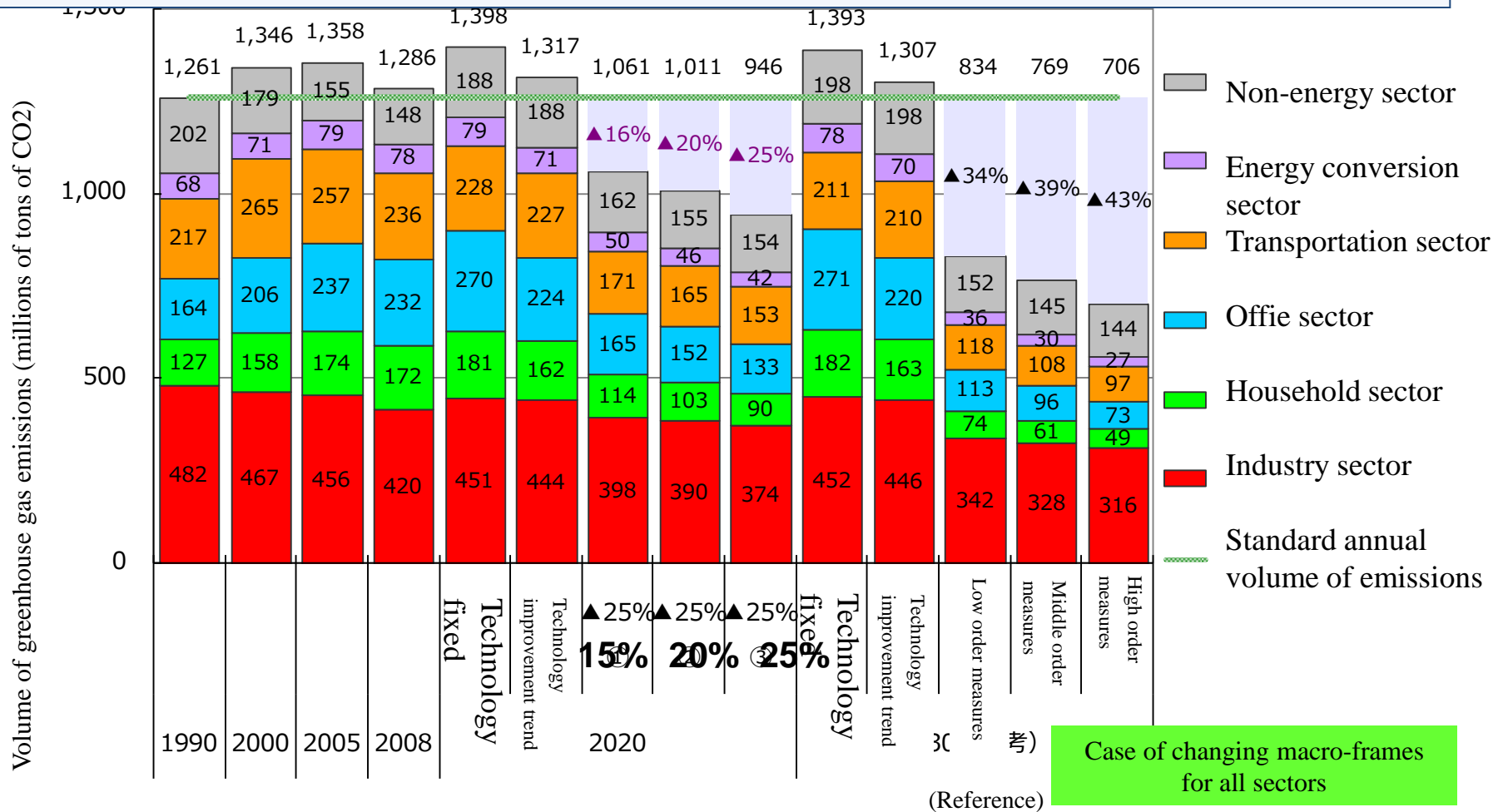
## (2) 削減目標の達成のために導入される対策は？②

施策の効果の定量的な検証、低炭素技術の供給体制、施策の実施に伴う追加的な負担発生の有無などについては、更に検討を深めていく予定。



# Scenario: Projected greenhouse gas emissions [2020/2030]

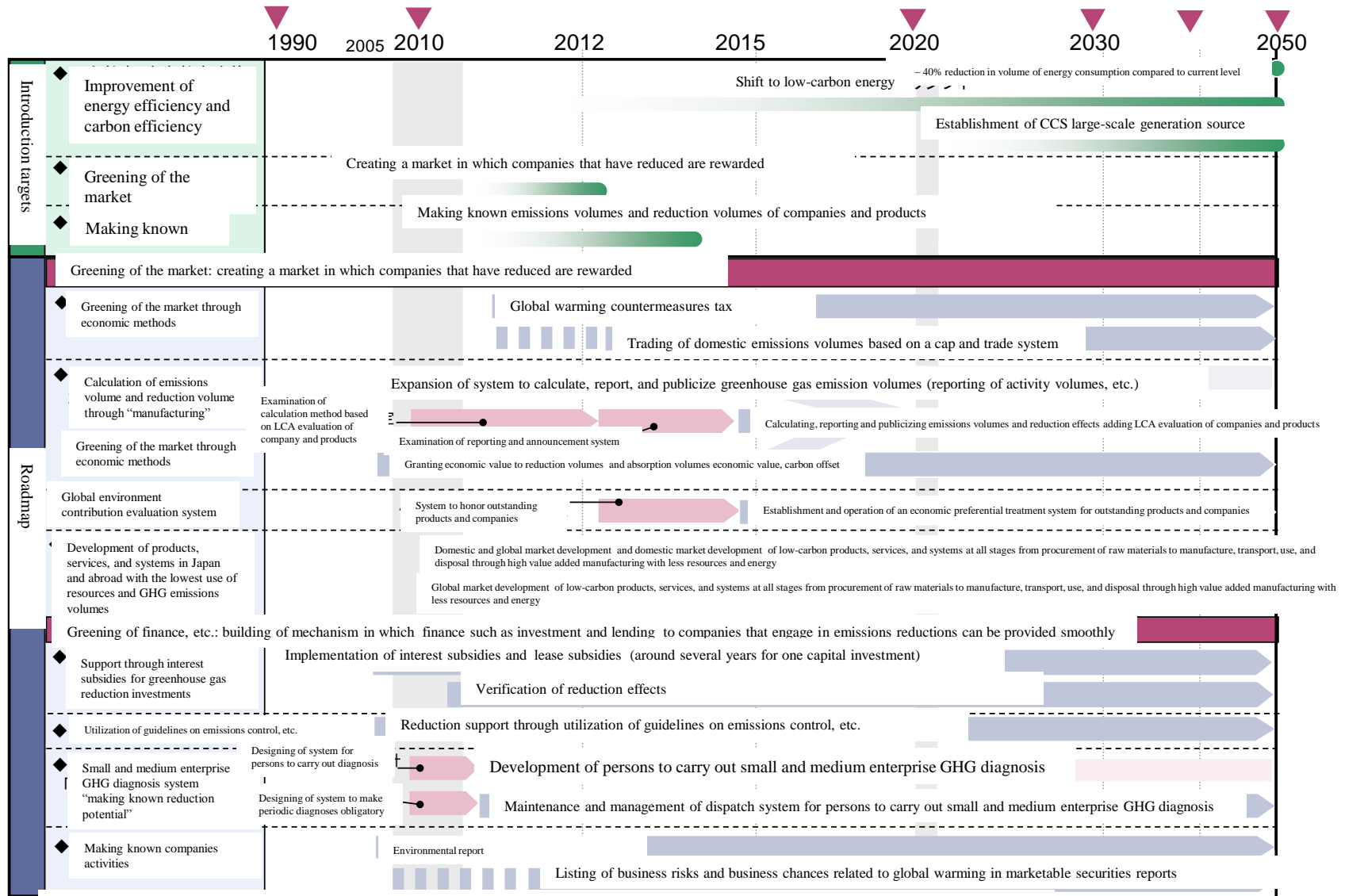
- 25% reduction of GHG in 2050 is technically possible
- Demand side (household, office, transportation) reduction is the key



Note: 2020 25% (1): case including around 10% of international contribution and sinks; 25% (2): case including around 5% of international contribution and sinks; 25% (3): case including no international contribution and sinks. 2030 lower order to high order measures: the emissions volume for 2030 is done assuming that the measures that have been carried out in order to reduce emissions toward the 25% reduction in 2020 will continue to be carried out in 2012 through 2030.



# Roadmap (ex) : Sector-wise Roadmap



\* Strengthening of the above policies and measures utilizing tax revenues from a global warming countermeasures tax to be implemented starting in FY2011.

Policy to promote measures      Measure that must be carried out as preparation

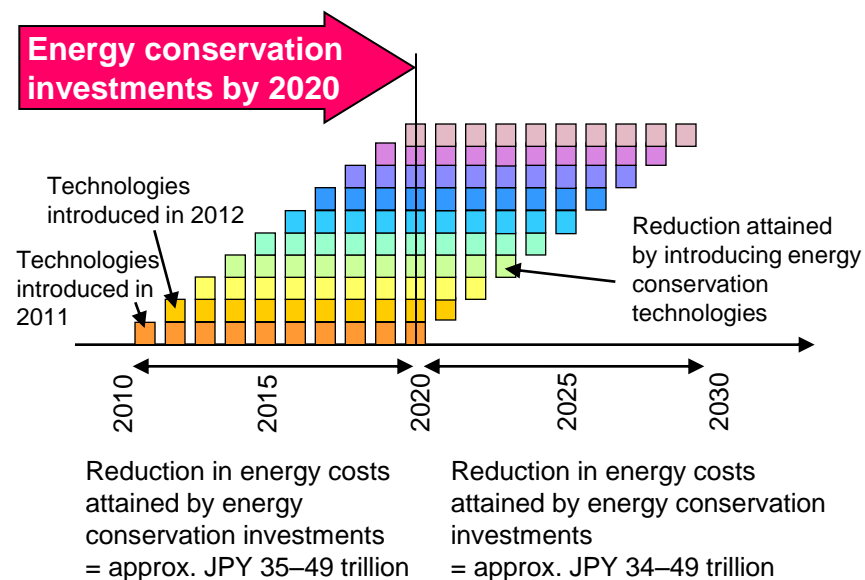
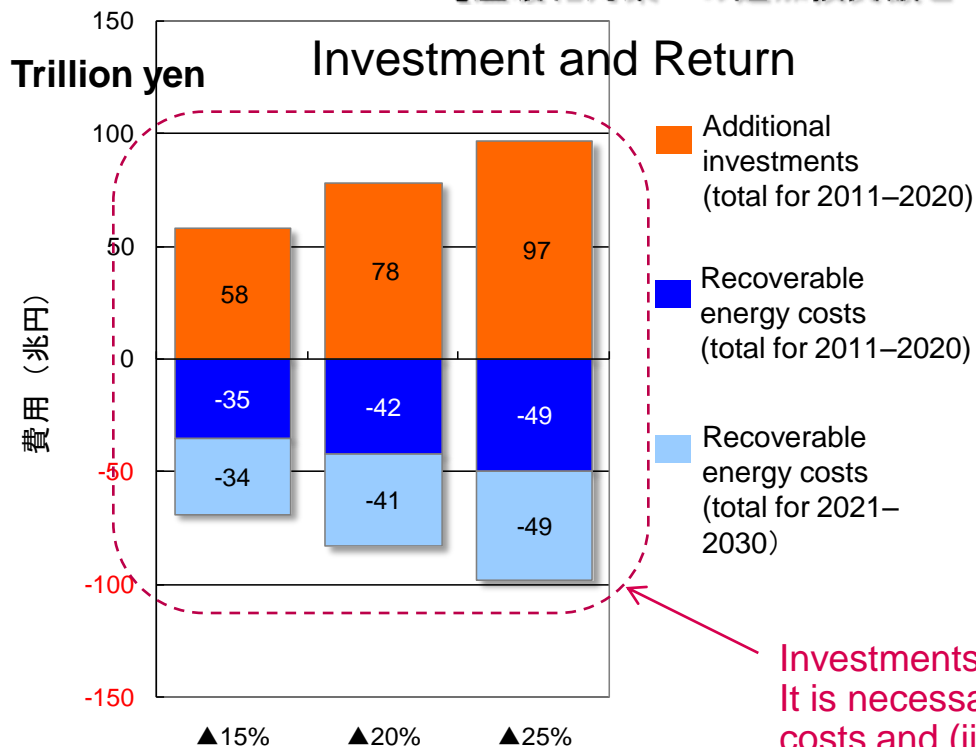
# Economic evaluation : 1-2% of GDP/y

## Expected return on low-carbon investments in terms of energy conservation

Additional investments for global warming countermeasures will be recovered in the form of reductions in energy costs attained by introducing new technologies. Overall, in Japan, half of additional investments will be recovered by 2020, and the other half by 2030.

Further review will be required to determine (i) the arrangements for sharing the initial costs and (ii) the framework for ensuring quick cost recovery.

【温暖化対策への追加投資額とエネルギー削減費用の関係】



Investments can be recovered over the long term. It is necessary to review (i) the arrangements for sharing costs and (ii) the framework for recovering costs.

○Comments expressed at Roadmap Sub-committee

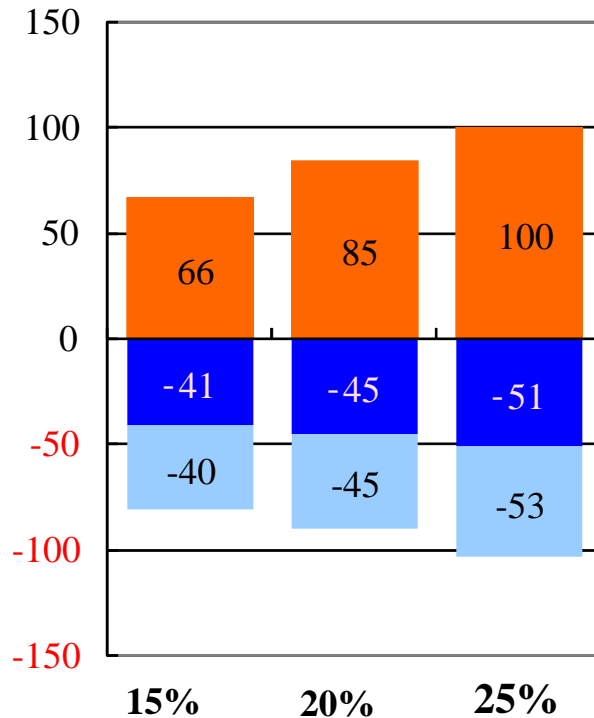
- It is necessary to take into consideration co-benefit of energy conservation in evaluating these numbers.
- It is not realistic for companies to develop investment plans while taking into account the advantages of energy conservation 10 years or 20 years ahead.
- The impact of climate change is accompanied by a time lag; the generation making investments does not necessarily benefit from such investments.

# Investment for transition: 1-2% of GDP

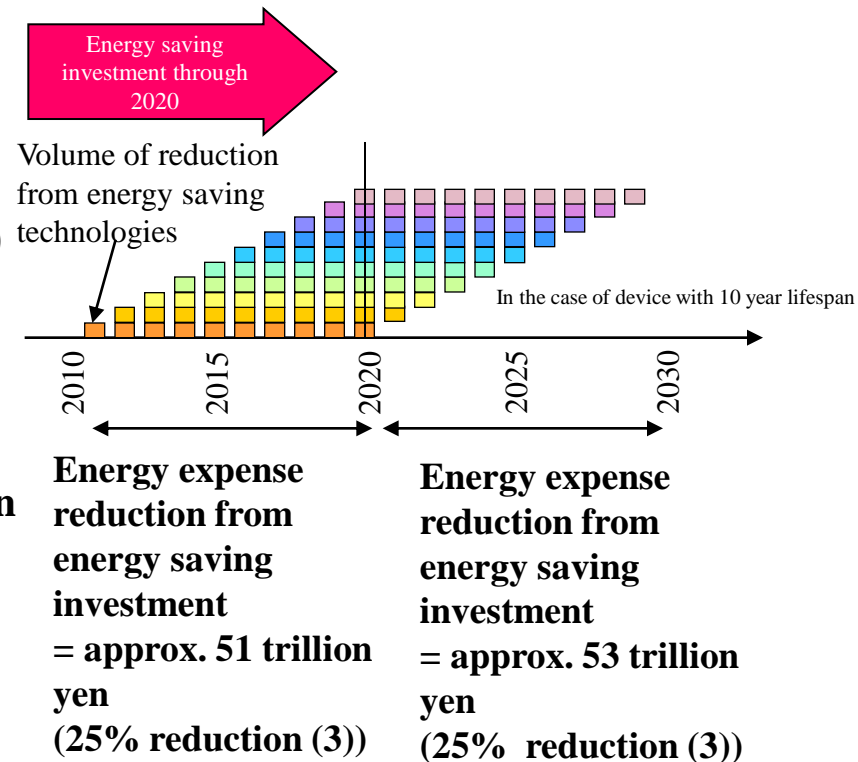
## Fully collected by energy expense reduction

- Half of the overall investment is recouped by 2020 and an amount equal to the investment will be collected by 2030 based on energy expenses that can be saved through technologies introduced.

<Low-carbon investment amount and energy reduction expense>



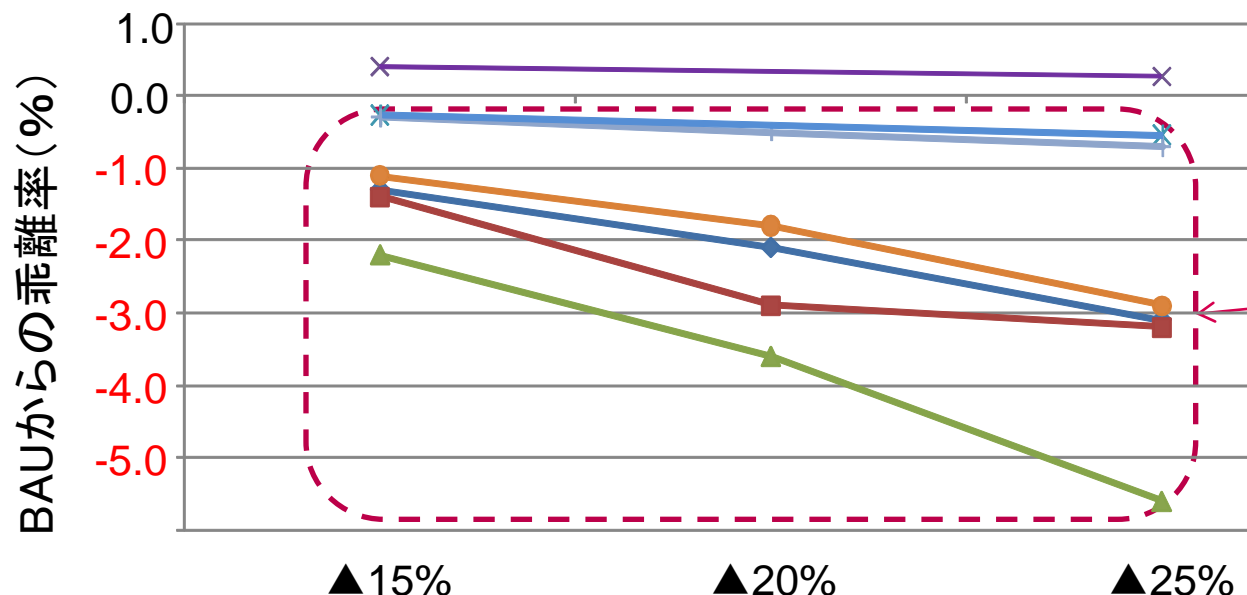
- Additional investment ('11 - '20 total)
- Energy expense reduction ('11 - '20 total)
- Energy reduction expense ('21 - '30 total)



## (7) 低炭素投資は経済成長や所得に影響？①

- ・ 計算の前提：2020年のGDPは2005年から約21%の伸び想定。
- ・ 気候安定化対策投資は、短期には回収できず、今の経済に若干の影響を与える可能性。しかし、長期には被害回避利益と国内投資効果について考慮が必要。（短期影響の程度：15～25%削減の場合、2020年までのGDP成長率が0.1%未満（伴モデル：政府・家計に還流）0.1～0.2%（AIM 経済モデル：家計一括還流）程度鈍化。）
- ・ 企業・家計が先を見た投資をしたり、技術を強化すれば短期の影響も解消の可能性【次頁】。

【経済モデルによる分析結果（GDPへの影響）】



将来の技術水準を現状の延長程度とした場合、温暖化対策はBaUと比較してGDP成長を鈍化させる可能性がある。

BaUの2020年GDPは2005年と比べて約21%増加するとの見通しのため、GDP成長の伸びが鈍化したとしても、2020年のGDPは2005年より約16～21%増加すると推計されている。

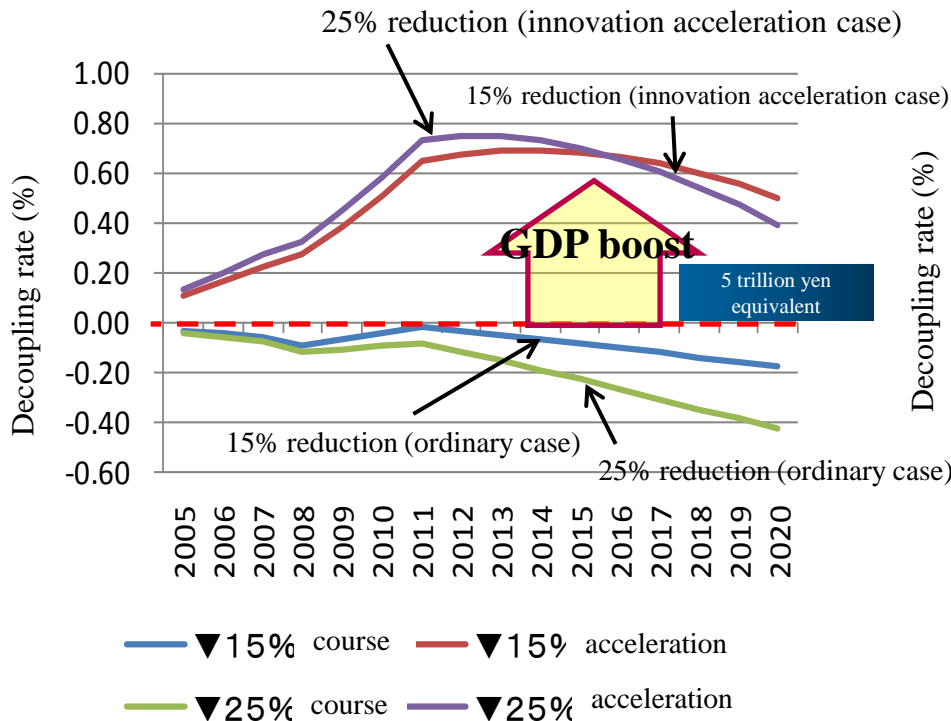
(※ BAU：2020年まで現行の地球温暖化対策を継続し何ら追加的な対策をとらない場合)

- ◆ (TF)日経センター
- ▲ (TF)KEOモデル
- ✱ (大臣試案)伴モデル(将来予測投資)
- ⊕ (RM小委)伴モデル(将来予測投資)
- (TF)AIM経済モデル
- ✕ (大臣試案)伴モデル(将来予測投資、技術革新投資)
- (RM小委)AIM経済モデル

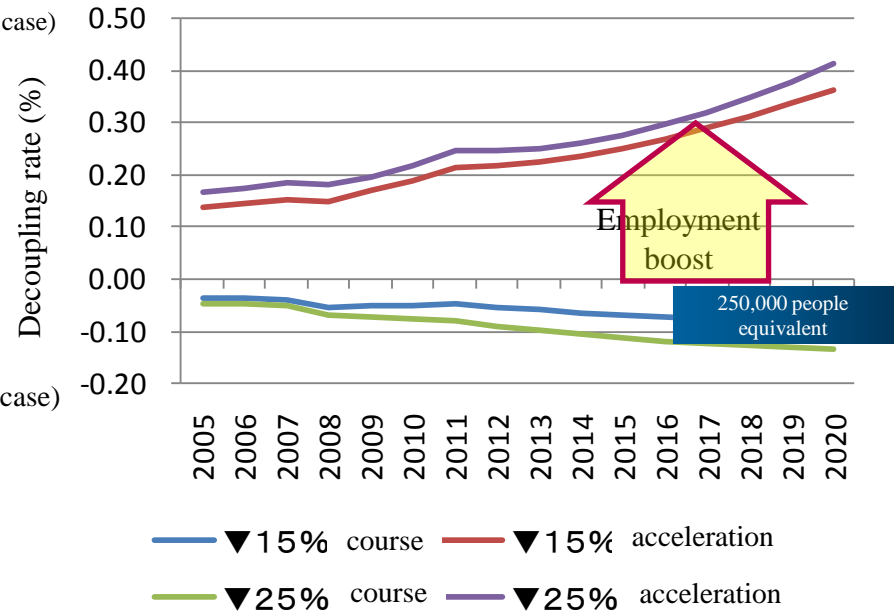
# Policy Evaluation: Early signal makes industry active

Suggestion from applied general equilibrium model

In a optimization model incorporating **forward-looking investment behavior**, there is a 5 trillion yen increase in GDP as of 2020 (consumption is replaced with assets) and a net increase in employment of 250,000 people when the direction of policy is clarified compared to when it is not clarified, and an early signal has an effect on the low-carbon society direction.



<Movement of GDP (comparison with course case)>



<Movement of employment (comparison with course case)>



## (4) 現行想定されている三施策の効果はどの程度？

三施策＝地球温暖化対策のための税、再生可能エネルギーの全量固定価格買取制度、国内排出量取引制度

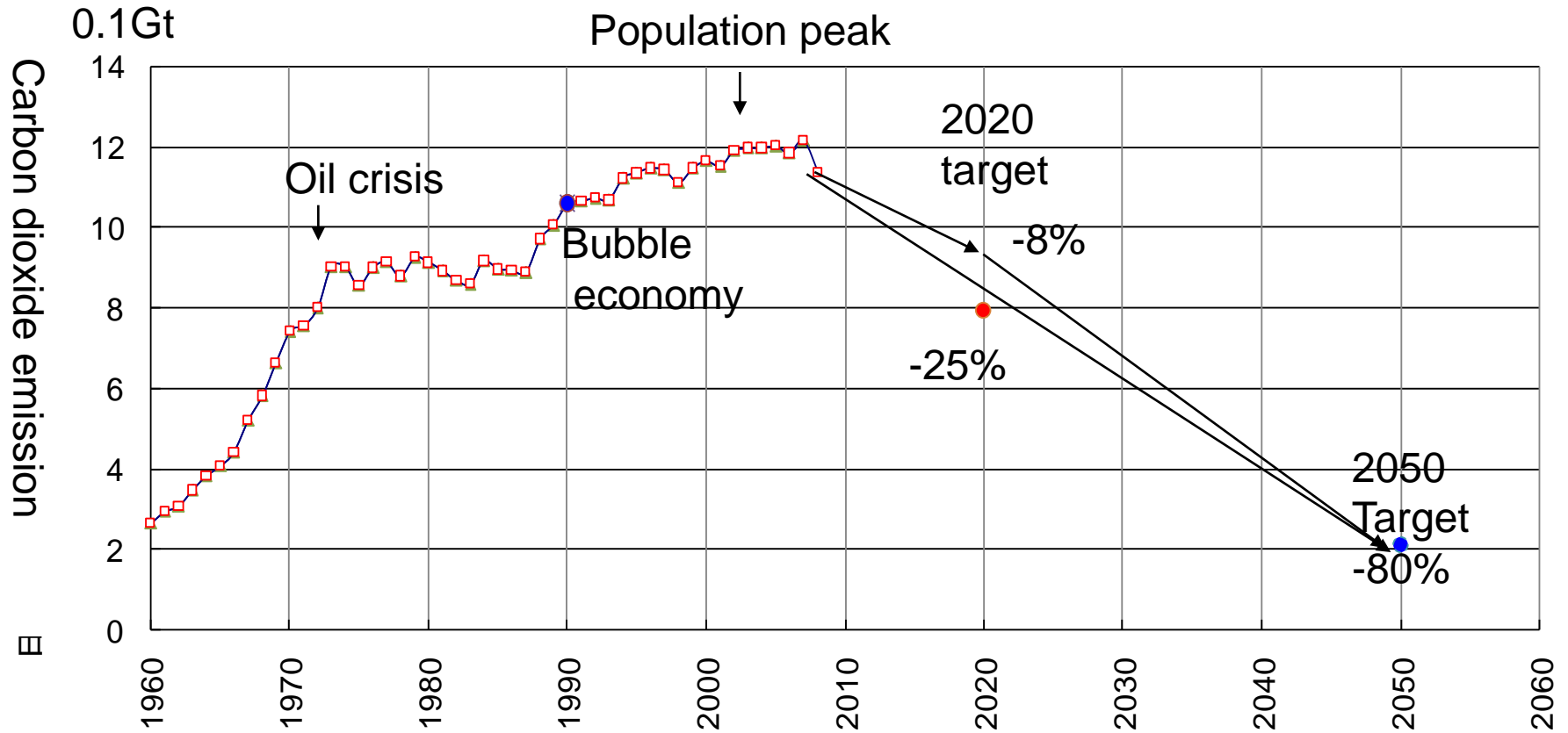
- ・ 三施策による効果は、2020年のエネルギー起源CO<sub>2</sub>をBAU比で7%から9%程度削減、経済影響はBAUケースと比較して、2020年時点で-0.1%から+0.1%程度。
- ・ 削減目標は、ここで設定された前提条件での三施策のみによって達成が可能となるものではなく、各ワーキンググループで検討されたような個別の対策技術の導入促進を目的とする施策などを総動員して目指していく必要。

	税率	2020年参照ケースにおけるエネルギー起源CO <sub>2</sub> 排出量	三施策を講じた場合のエネルギー起源CO <sub>2</sub> 排出量	三施策を講じた場合のGDPの乖離率(2005年から2020年までの15年間の累積の値)(2020年参照ケースからの乖離)
国立環境研究所AIM経済モデル(増井委員)による分析	1,000円/t-C	90年比±0%	90年比-7%~-8% (90年比-9%~-14%)	-0.02%~-0.04% (-0.1%~-0.3%)
	2,000円/t-C	90年比±0%	90年比-9%~-9%	-0.03%~-0.06%
大阪大学大学院伴委員による分析	1,000円/t-C	90年比+4%	90年比-3%~-4%	+0.1%
	2,000円/t-C	90年比+4%	90年比-4%~-5%	+0.1%

三施策の効果は▲7%~▲9%削減(BAU比)  
削減目標の達成には三施策以外の施策の動員が必要

# Evaluation: backcasting from 2050

## Mid-term Target on the right track to 2050 target?

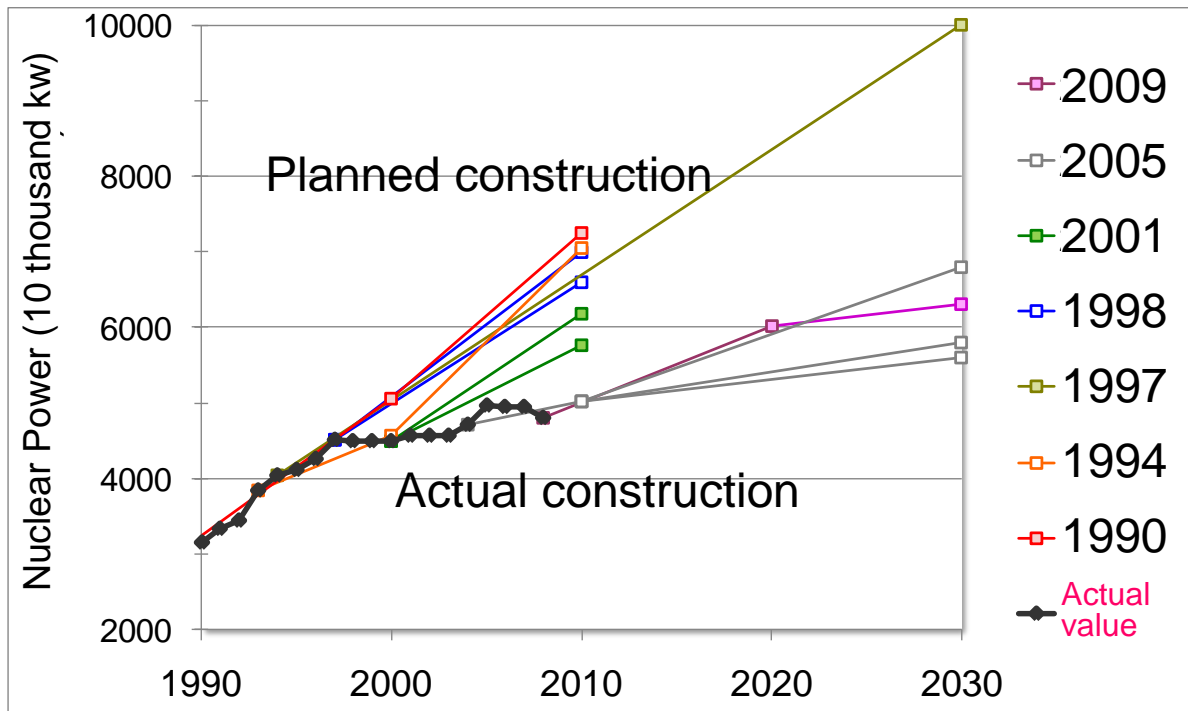


出典: IEA CO2 Emissions(-1989), 環境省 温室効果ガス排出量 (1990~2008)

# Risk management: Sensitivity analysis of nuclear Plant

Taking into consideration the forecast of the Advisory Committee on Energy and Natural Resources for this estimate, it is supposed that an additional eight atomic power plants will be constructed between now and 2020 (with a power generation volume of 60.15 million kW, equal to all the atomic power plants in Japan), but the plan for atomic power plants has been moving forward at a lower order than required, so the examination of a risk management proposal is needed.

<Forecast for atomic power at the Advisory Committee on Energy and Natural Resources>



One Nuclear  
=0.5% reduction

1% load factor  
=0.3% reduction

The years on the graph are the years in which long-term energy demand and supply forecasts were designed.

# (4) 計画自体のリスクヘッジの必要性 (例：原子力発電)

- 原子力発電は、設備利用率85% (1990年以降の平均75%)、2020年までに9基の新增設 (現在建設中の2基を含む) 案をとりいれている。
- 新增設1基増が約500万t-CO<sub>2</sub>削減、設備利用率1%増は約300万t-CO<sub>2</sub>削減に相当。

## ●原子力発電の新增設計画とCO2排出量の関係

設備利用率75%、新增設2基にとどまると、排出量は6,600万トン増加

=1990年排出量の5.2%相当

▲9,800万t-CO<sub>2</sub>  
(90年比 ▲7.8%相当)

2020年  
 ・設備利用率 **85%**  
 ・新增設 **9基**  
 ・総量 6,143万kW

・設備利用率 **75%**  
 ・新增設 **9基**  
 ・総量 6,143万kW  
 +3,000万t-CO<sub>2</sub>

・設備利用率 **85%**  
 ・新增設 **2基**  
 ・総量 5,160万kW  
 +4,000万t-CO<sub>2</sub>

(90年比 **2.4%**相当)

(90年比 **3.2%**相当)

・設備利用率 **75%**  
 ・新增設 **2基**  
 ・総量 5,160万kW  
 +6,600万t-CO<sub>2</sub>

(90年比 **5.2%**相当)

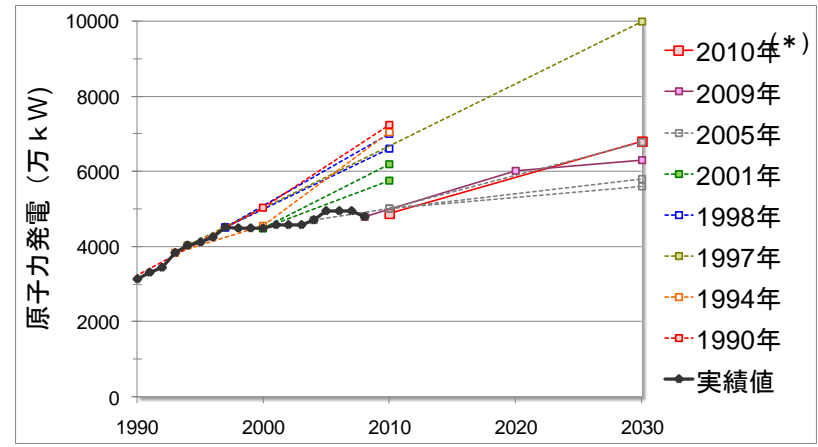
【▲25%ケースの場合】

2009年

・設備利用率 **66%**  
 ・4,885万kW

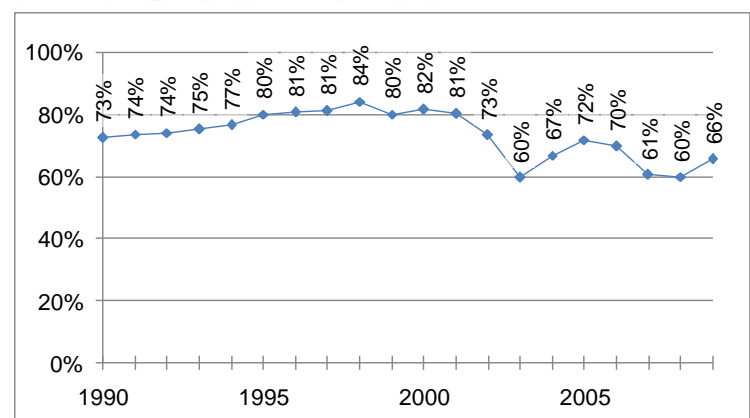
原子力発電所の新增設計画や設備利用率変動の影響は大。

## ●長期エネルギー需給見通し等における原子力発電見通し



(\*) 凡例の年号は総合資源エネルギー調査会における長期のエネルギー需給見通しの策定した年を示す。

## ●原子力発電の設備利用率の推移



## **Transition program: Drawing Roadmap toward 2020**

- **To show business and citizen a clear political signal and pathway to reach reduction target**
- **The underlying strategy is restructuring Japan to be a world-leading low-carbon society and make low carbon know-how as a core of economic growth.**
- **A set of technical and economic models (AIM : Asia-Pacific Integrated Model) was applied to confirm technical feasibility and to evaluate economic impacts of transition to low carbon society.**
- **A group of experts of more than 100, in housing, transportation, urban planning and industry sectors engaged in drawing concrete procedures to reach sector-wise reduction target by removing existing technological and institutional barriers.**
- **The study concludes that 25% reduction is technically feasible, with cost of less than 2% of GDP, but strong policy guidance is indispensable for realizing this low carbon transformation.**

# Implication of low carbon society

- Demand side energy reduction is essential and the key, which requires demand side technological development and, more importantly, deployment into society.
- Not only technology, but social-infrastructure change should be followed
- Achieving low carbon society requires acceleration of improvement in carbon and energy intensity into double than the past trend.
- One common barrier throughout sectors is the lack of human resources to apply new technologies in operation.
- Severe international technological competition for decoupling GHG emission and GDP has started already. Japan delayed in participating this transition race and is not easy to maintain its leading position in low energy technologies after 20 years' stagnation in improving energy intensity.
- In addition, a very rapid catching-up of Asian emerging countries, with technological leapfrogging possibilities as shown in the cases of PV and EV technologies, is another factor threatening Japanese industry.