

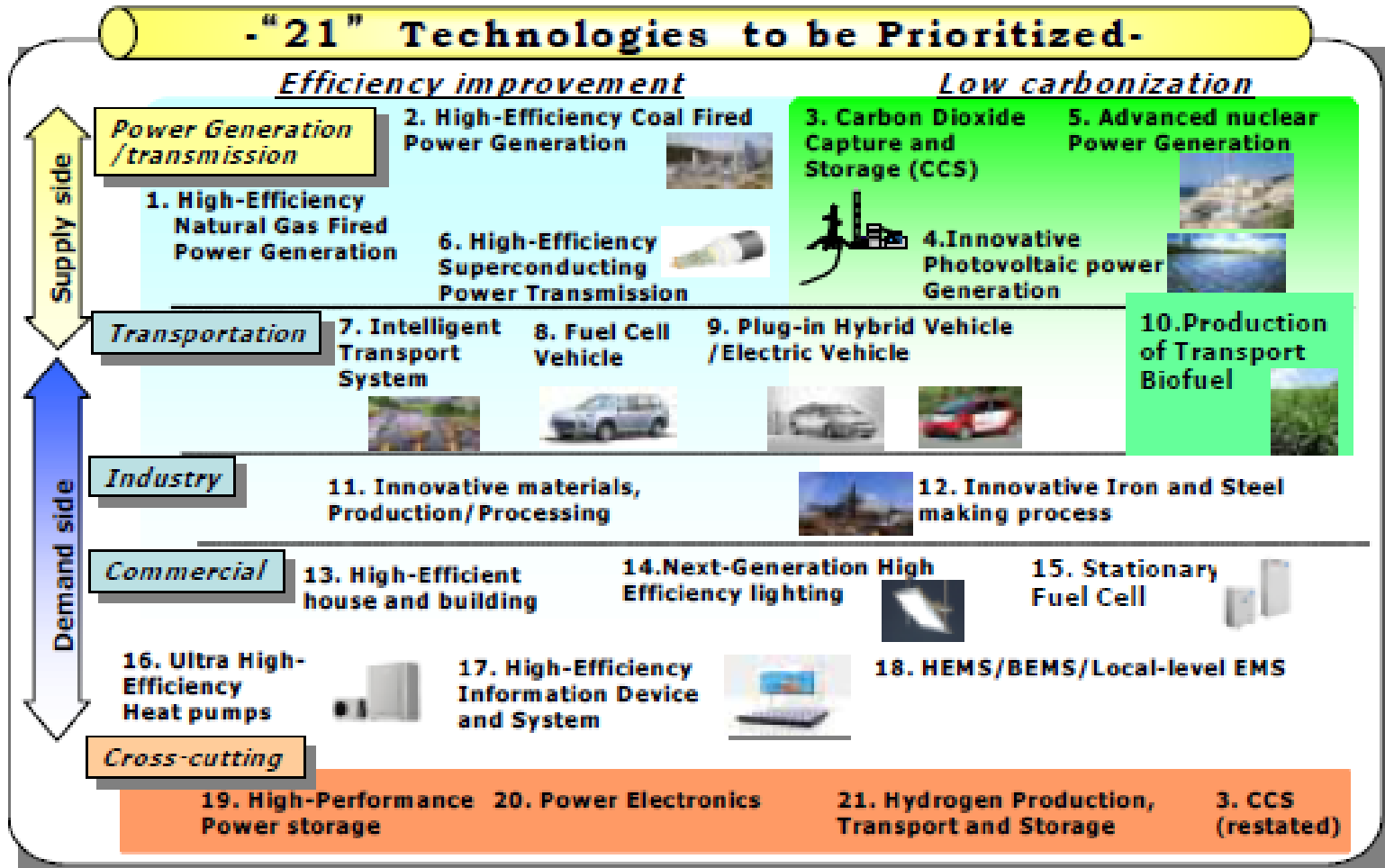
Japan's Energy Outlook for 2050 –

The Open Source Stochastic Sectoral Energy Modelling

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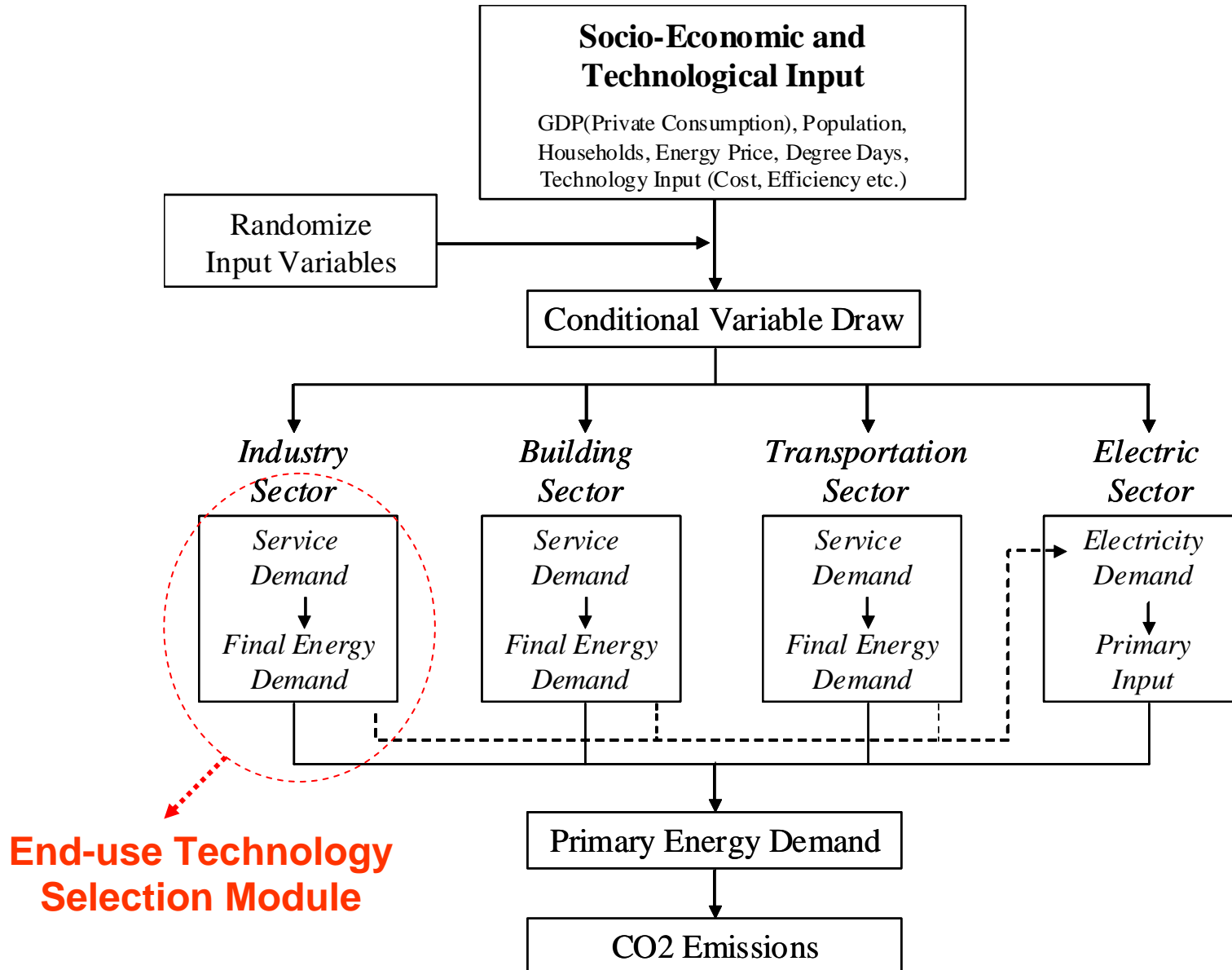
Background



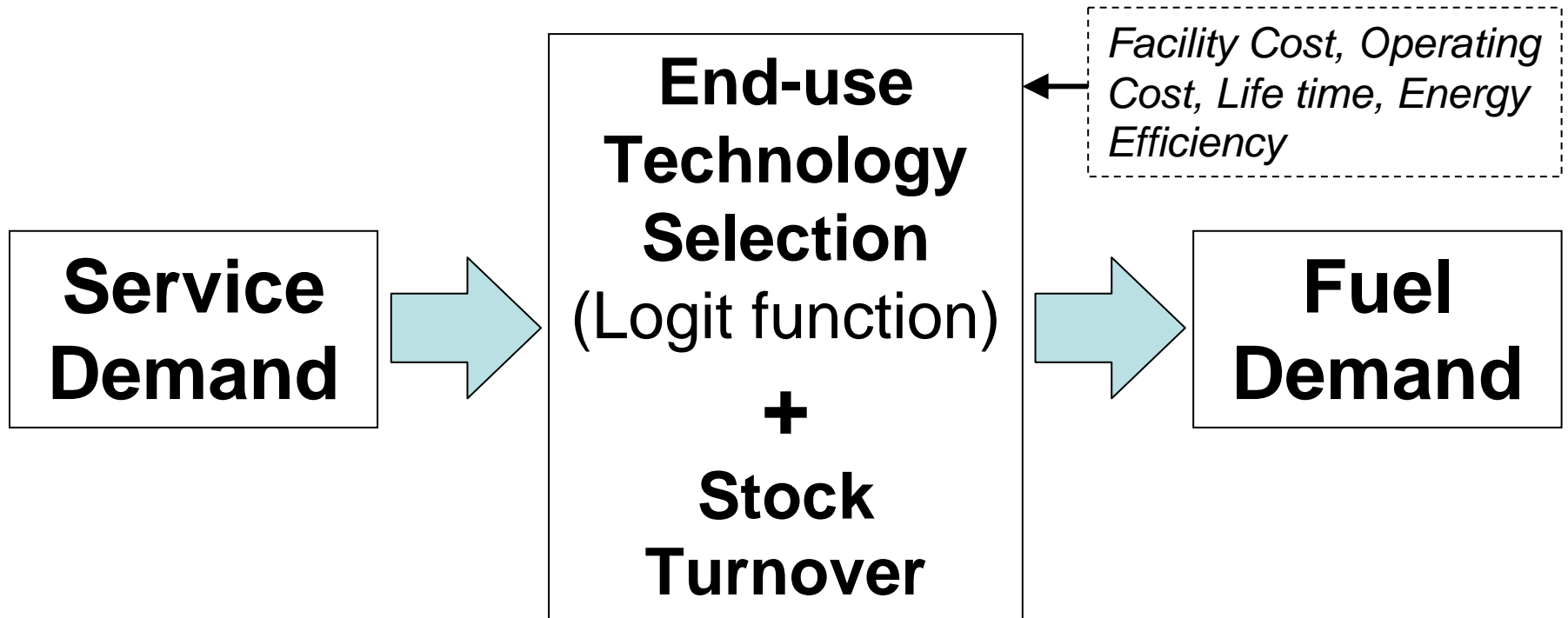
(Source) Ministry of Economy, Trade and Industry, "Cool Earth-Innovative Energy Technology Program & Technology Development Roadmap", March 2008

In order to evaluate the effectiveness of low carbon technologies, we develop Japan's energy supply and demand scenario for 2050

Model Structure



End-Use Technology Selection Module



Technology Selection is Considered in Following Parts

Industry: *Iron, Cement, Paper, Chemistry, Other Six Sectors*

Building (Residential & Commercial): *Heating Insulation, Space Heating, Space Cooling, Hot Water, Lighting, Refrigeration, Photovoltaic (PV)*

Transport (Passenger & Freight): *Automobile, Trains, Aircraft, Ships*

Power Generation: *Utility, Private CHP*

Scenario

■Reference Scenario

Most probable state of future energy supply and demand based on continuous economic trends, current technology developments and energy policies

■Technology Advancement Scenario

The market penetration of low carbon technology is assumed to be more extensive than in the reference scenario

e.g.

□ Building Sector □ Electric water heating, LED Lighting, PV, High Efficient Air Conditioner etc.

□ Transport Sector □ PHEV, EV, HEV etc.

**The prospect of economic growth, population, energy price and nuclear power plant are identical in both scenario.*

Socio-Economic Assumption

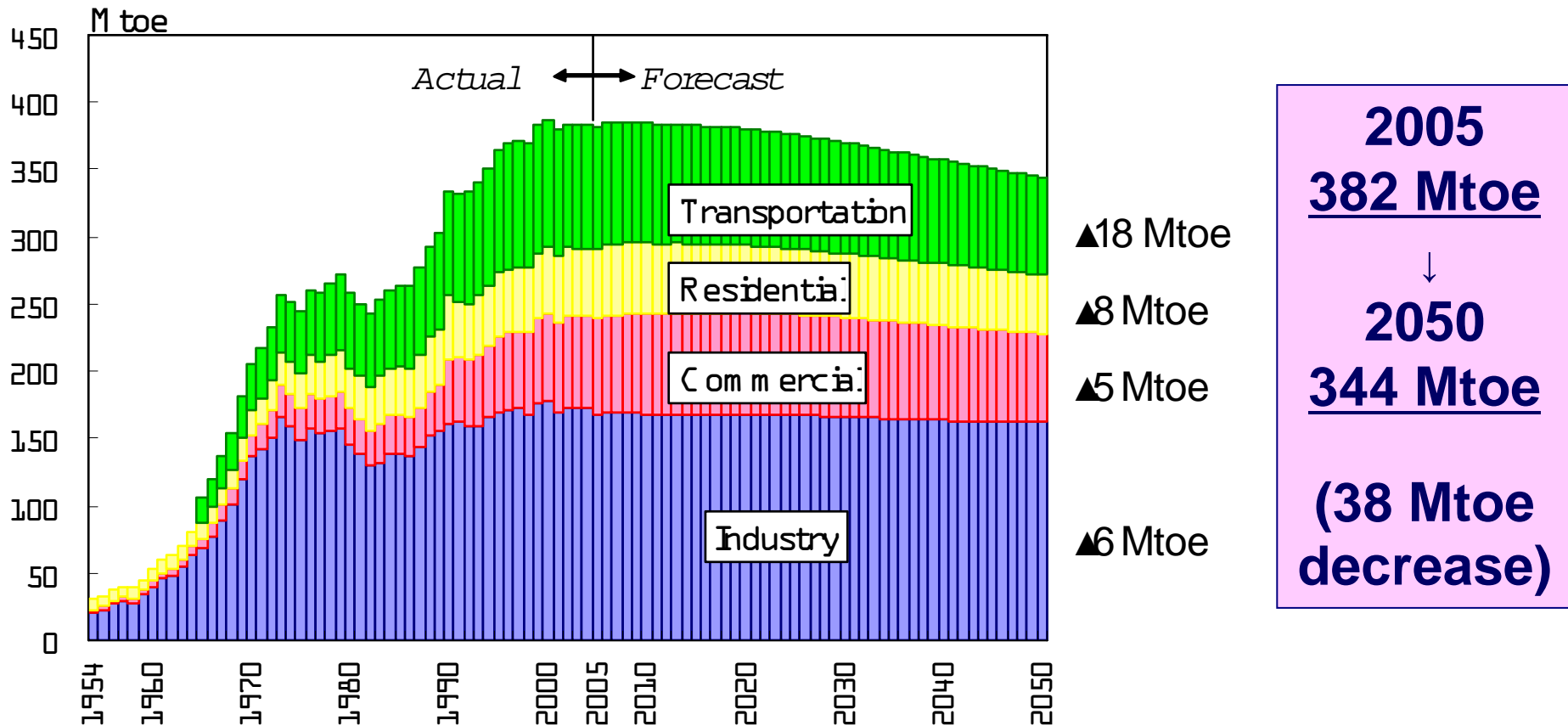
	Actual				Forecast			Average annual growth rate (%)			
	1980	1990	2000	2005	2010	2030	2050	1990/ 1980	2005/ 1990	2030/ 2005	2050/ 2005
Real GDP (Unit: trillion yen, value as in 2000)	303.8	448.7	504.3	547.0	606.6	825.0	986.9	4.0	1.3	1.7	1.3
GDP per capita (Unit: million yen)	2.60	3.63	3.97	4.28	4.77	7.16	10.37	3.4	1.1	2.1	2.0
Total population (Unit: million)	117.06	123.61	126.93	127.77	127.18	115.22	95.15	0.5	0.2	-0.4	-0.7
Crude steel production (Unit: million tons)	107.39	111.71	106.90	112.72	113.70	115.80	118.43	0.4	0.1	0.1	0.1
Ethylene production (Unit: million tons)	3.87	5.97	7.57	7.55	7.14	6.90	6.74	4.4	1.6	-0.4	-0.3
Cement production (Unit: million tons)	85.88	86.85	82.37	73.93	68.66	65.80	64.63	0.1	-1.1	-0.5	-0.3
Paper/paperboard production (Unit: million tons)	17.53	28.54	31.74	31.05	32.61	36.39	36.92	5.0	0.6	0.6	0.4
Commercial floor space (Unit: million m2)	936	1,285	1,656	1,758	1,904	2,173	2,003	3.2	2.1	0.9	0.3
Passenger vehicle (Unit: million)	23.65	35.15	1,419.7	57.05	60.29	63.48	61.67	4.0	3.3	0.4	0.2
Freight vehicle (Unit: million)	14.0	22.3	578.0	17.8	16.5	14.4	12.5	4.7	-1.5	-0.8	-0.8

- *Population decreasing due to low birth rate*
- *Saturation of economic growth*
- *Sluggish growth of energy-intensive raw material production*
- *Leveling off of automobile ownership etc.*

Nuclear Power Plant Prospect

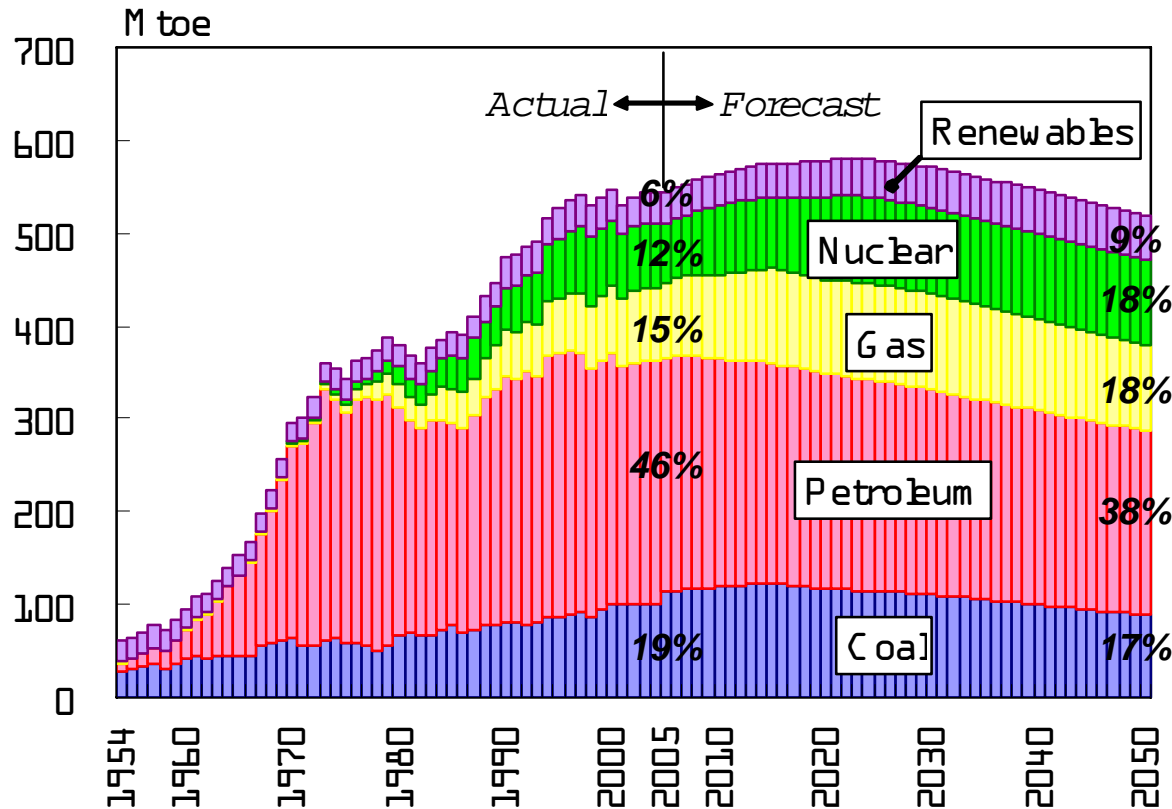
GW	1990	2005	2010	2020	2030	2040	2050
Nuclear	31.48	49.58	50.14	61.50	61.50	61.50	61.50

Final Energy Demand by Sector (Reference Scenario)



Final energy demand will continue to decline due to population decreasing, saturation of economic growth, and promotion of energy conservation. 7

Primary Energy Supply (Reference Scenario)

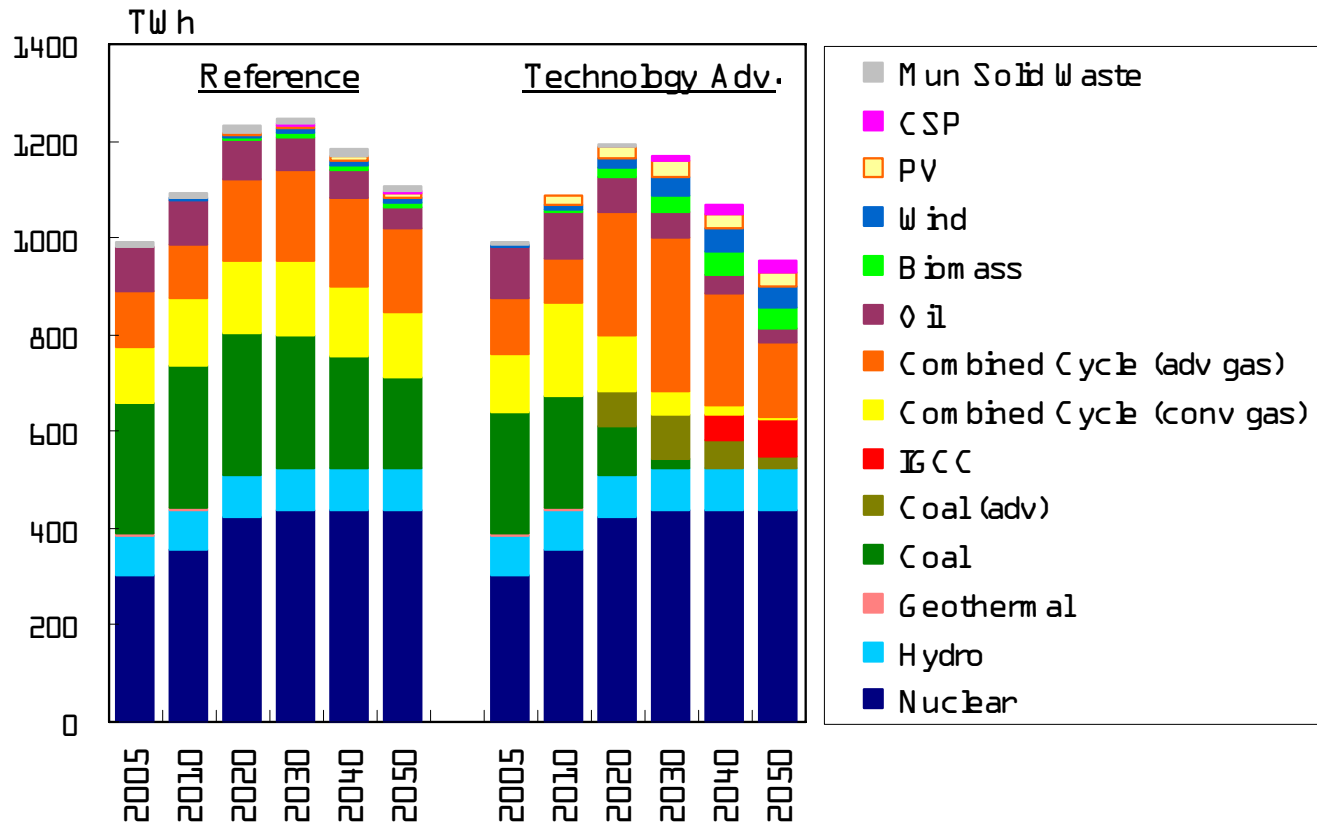


2005
543 Mtoe
 ↓
2050
515 Mtoe

(28 Mtoe decrease)

- Primary energy supply will level out until around 2020, and thereafter represent a moderate decreasing trend.
- Petroleum will decline by fuel switching, improved efficiency of appliances and fuel efficient vehicle. Oil dependence will be below 40% after 2020.

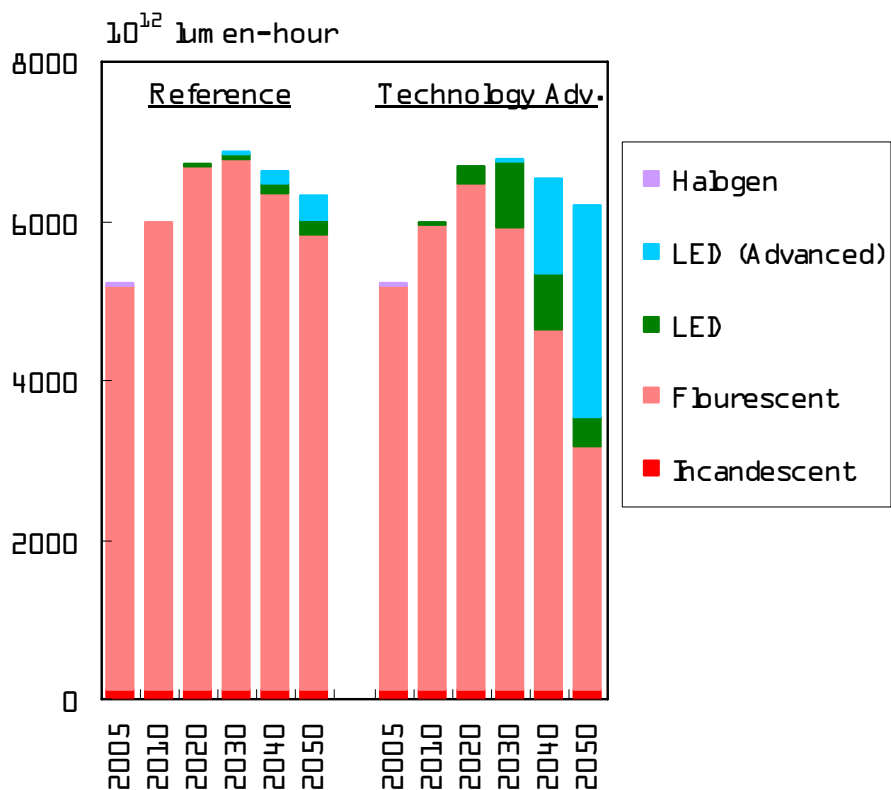
Power Generation Mix



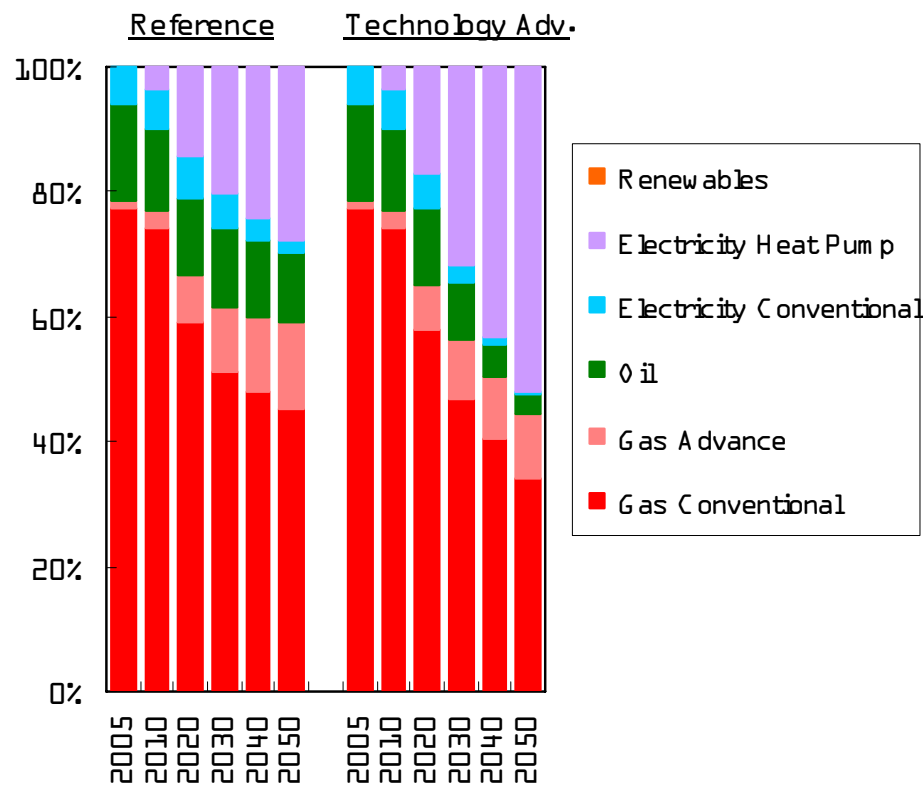
- The construction of 9 new nuclear plant is assumed by 2050
- The share of power generation mix

Nuclear: 2005: 31% -> 2050 39%(Ref.), 46%(Technology Adv.)
Fossil Fuel: 2005: 60% -> 2050 49%(Ref.), 30%(Technology Adv.)
Renewables 2005: 9% -> 2050 12%(Ref.), 24%(Technology Adv.)

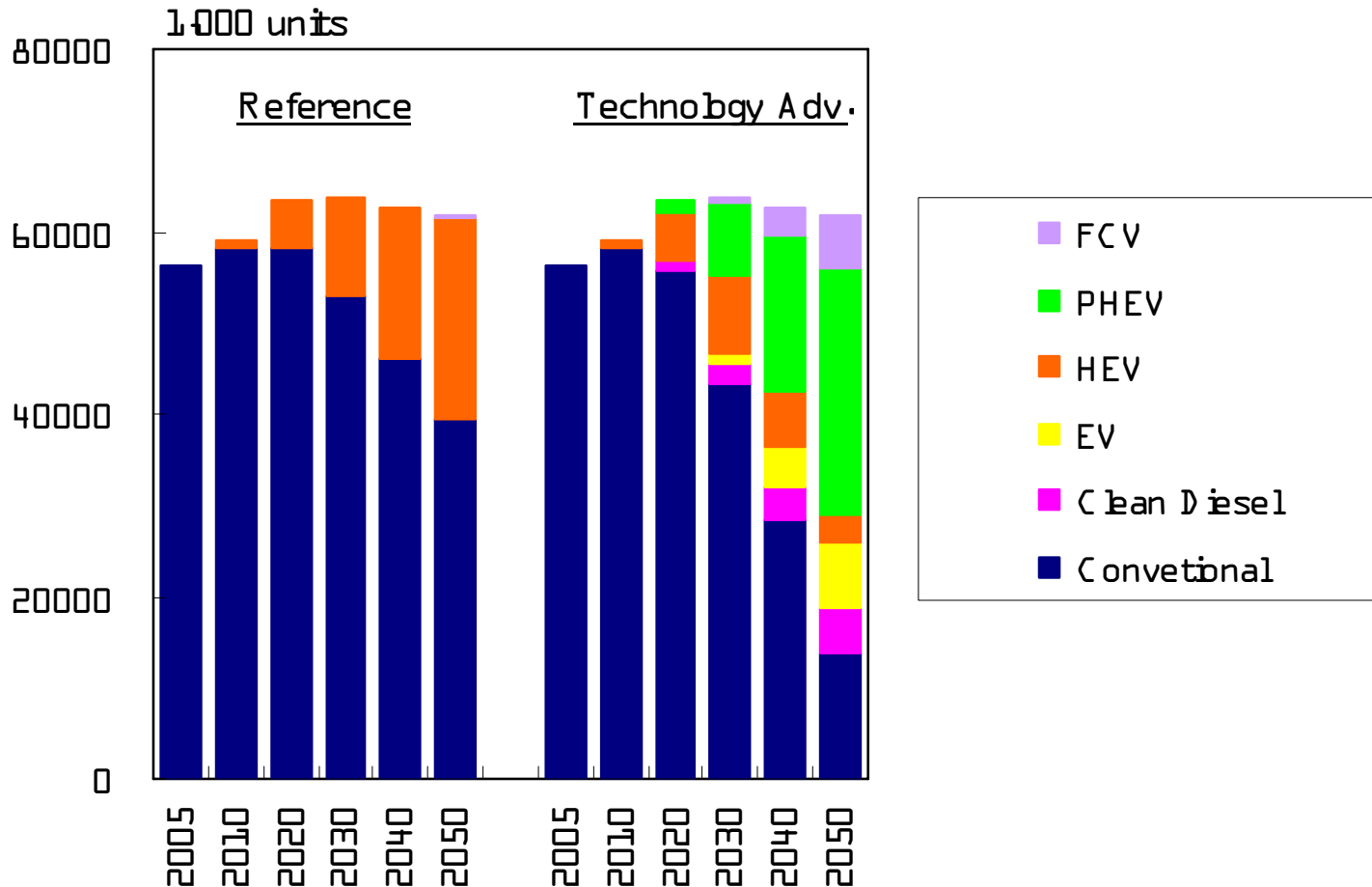
Lighting (Building Sector)



Water Heating: Share (Residential Sector)

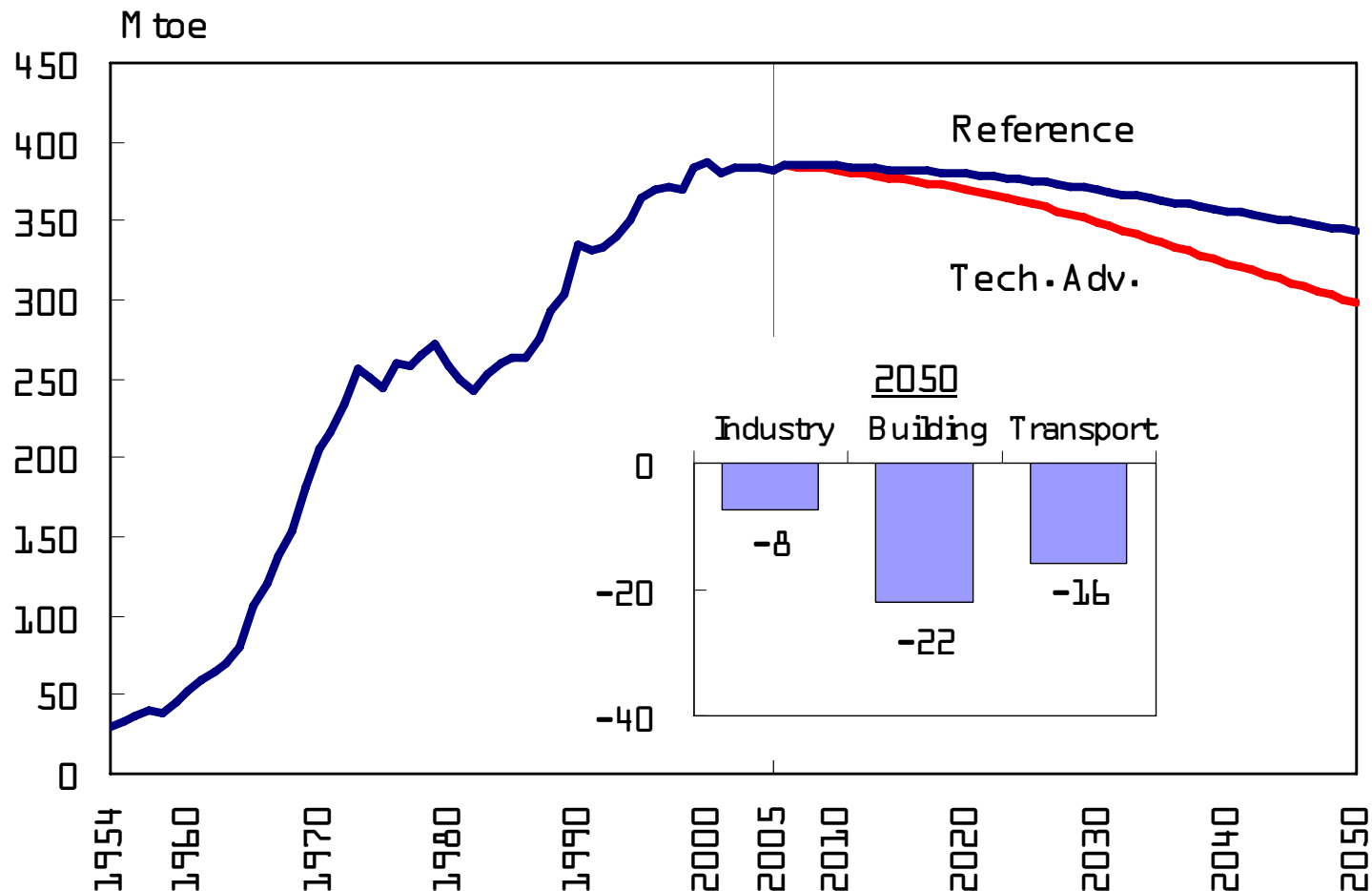


Passenger Vehicle



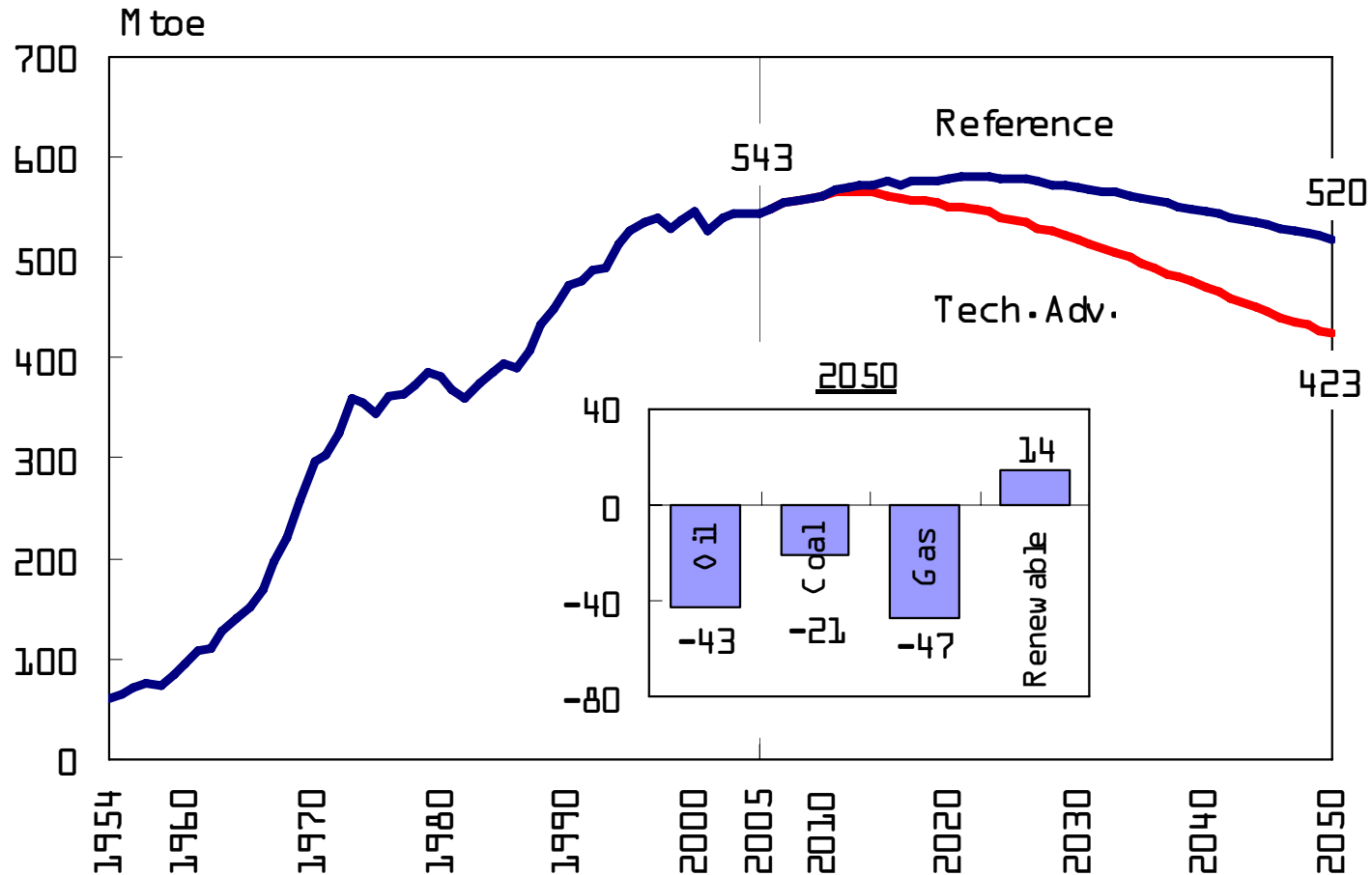
- Hybrid vehicles penetrate with more than 20 million by 2050 in reference.
- In technology adv. scenario, Clean Energy Vehicle (PHEV, EV and FCV etc.) will hold 80% of total passenger vehicle ownership by 2050.

Final Energy Demand



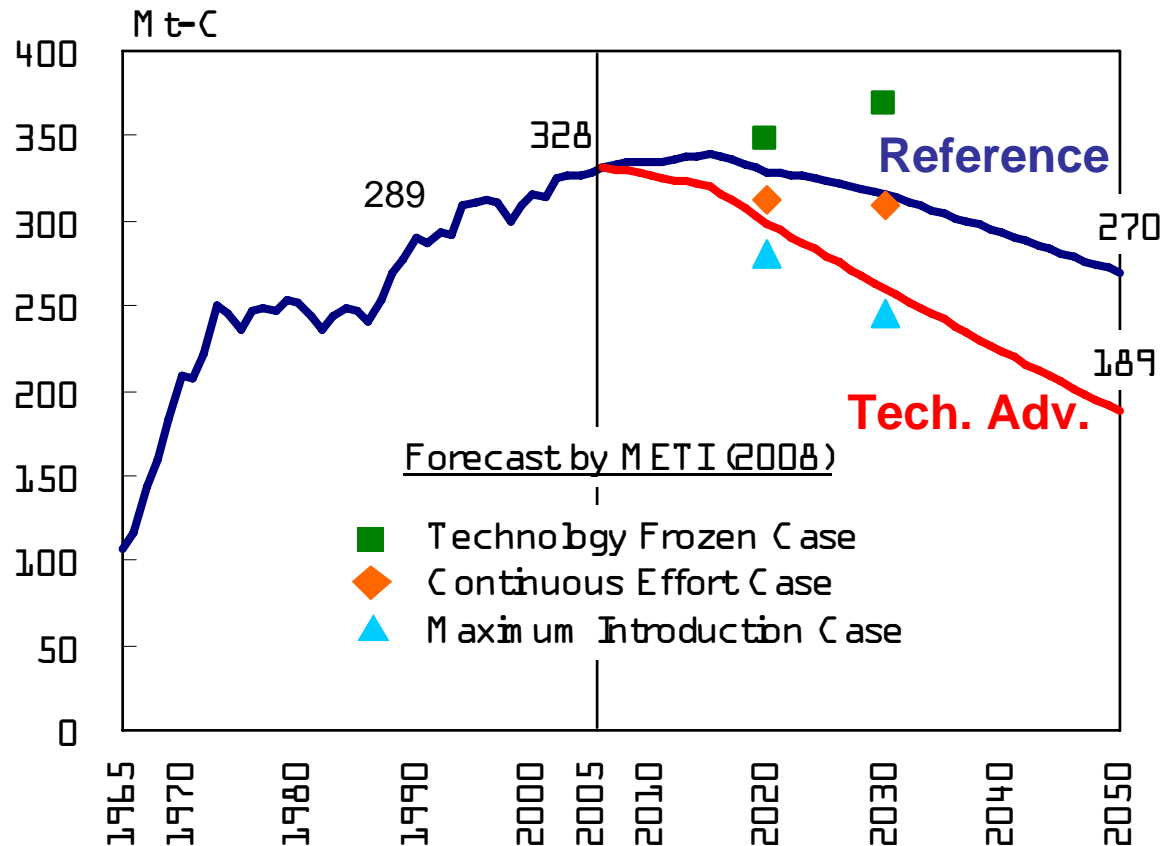
- The building sector will achieve the largest amount of energy-saving (22 Mtoe) accomplished by the spread-out of highly energy efficient appliances.
- Transport sector will show the second largest amount of energy conservation (16 Mtoe) due to high penetration of clean energy vehicles.

Primary Energy Supply



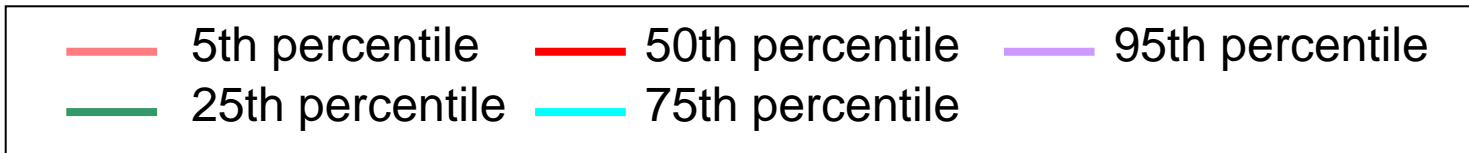
- Oil demand will decrease by 43 Mtoe reflecting on higher fuel efficiency vehicle.
- Gas and coal demand mitigation are derived mainly from the deployment of power generation with high conversion efficiency.

CO₂ Emissions

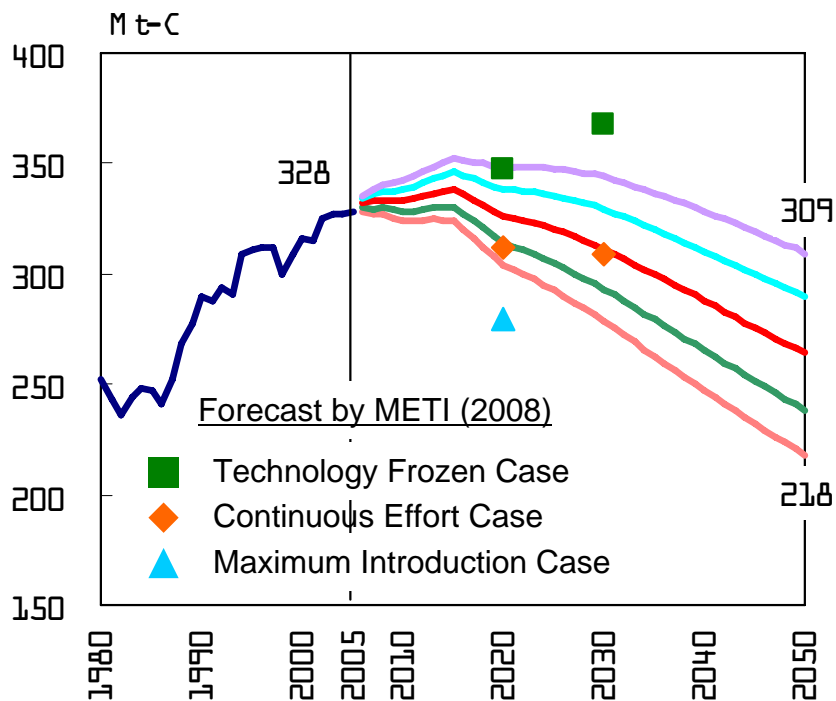


- By decreasing fuel combustion and increasing renewable energy, CO₂ emissions in technology adv. scenario will decrease by 81 Mt-C by 2050.
- CO₂ will potentially decline 40% from the current level of CO₂ emissions up to 2050.

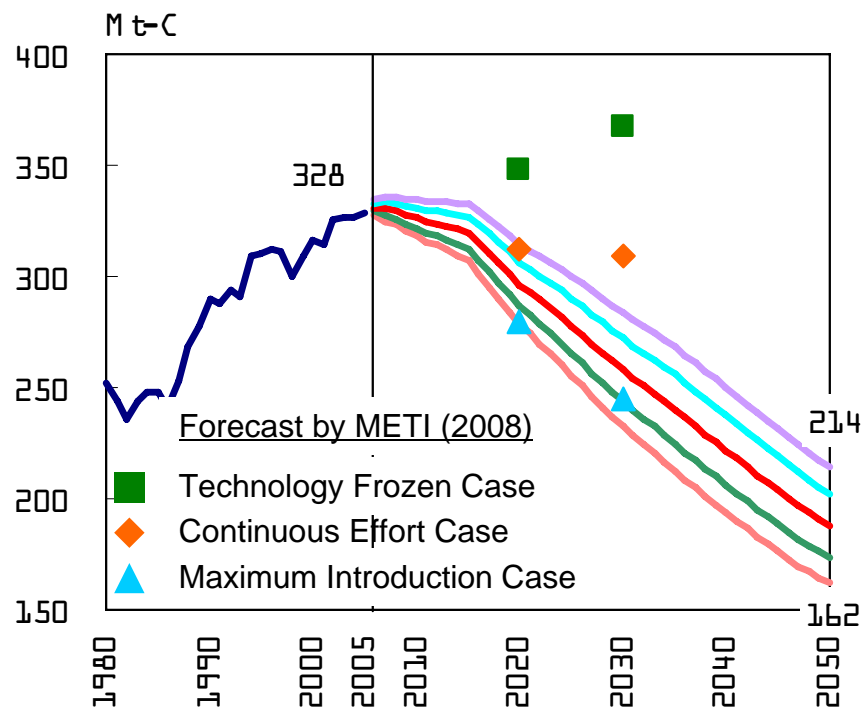
Uncertainty Analysis: CO₂ emissions



Reference



Tech. Adv.



Assuming uniform probability distributions in GDP growth, energy price and population. Maximum and minimum achievable value in 2050 is 15% larger and smaller respectively than the reference value.

Conclusions

- **Developing Japan's energy demand and supply outlook to 2050 with stochastic end-use modelling**
- **It is potentially possible to reduce CO₂ by more than 40% from the current level of CO₂ emissions up to 2050.**
- **Considering the future socio-economic uncertainty, careful energy policy analysis is required**