8th June 2004

Toward a Sustainable Energy Society:

Alternative Scenarios for the Future of Our Energy, Environment, and Economy

Supplementary Materials

Citizen's Open Model Projects for Alternative and Sustainable Scenarios (COMPASS)

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*METI : Ministry of Economy, Trade and Industry

Project of COMPASS Participants-Collaborators

Participants:

ANDOU Taeko (People's Research Institute on Energy and Environment, PRIEE)
IIDA Tetsunari*, ISHIMORI Yumiko, OHBAYASHI Mika, HATA Naoyuki , FURIHATA Kei, YAMASHITA Noriaki (Institute for Sustainable Energy Policies, ISEP)
KAMIOKA Naomi (The Coalition of Local Government for Environmental Initiative)
KATSUTA Tadahiro, NISHIO Baku , FUJINO Satoshi (Citizens' Nuclear Information Center, CNIC)
SUZUKI Kazue, NAKAJIMA Masaaki (Greenpeace Japan)
TAKASE Kae (Shonan Environmental Research Forum, S.E.R.F. Inc.)
NAKAJIMA Masaru (ViaTech corp.)
HIRATA Kimiko (Kiko Network)
MUROTA Yasuhiro (Shonan Econometrics Inc.)
YANO Yuko (Yano & Associates)
YAMAGISHI Naoyuki (World Wide Fund for Nature Japan, WWF Japan)

Collaborators:

UEZONO Masatake , HAYAKAWA Mitsutoshi (Citizens' Alliance for the Atmosphere and the Earth, CASA)
TSUCHIYA Haruki (Research Institute for Systems Technology)
YOSHIOKA Hitoshi (Kyusyu University)

Secretariat:

Institute for Sustainable Energy Polices (ISEP)

Section 1
The economy will collapse under BAU!

The government forecast is not truthful about what will happen unless we change course.

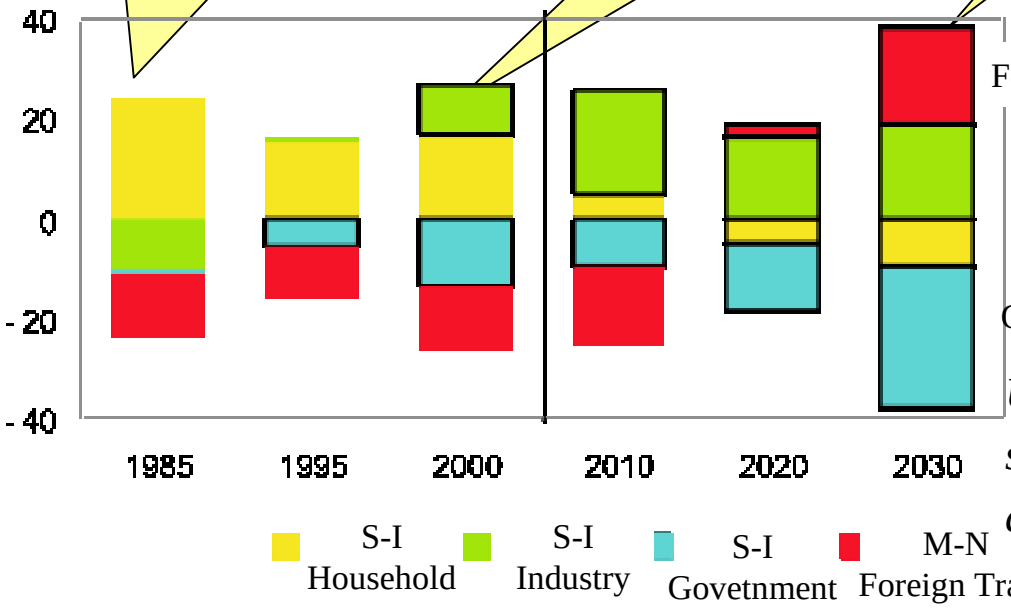
IS (Investment-Saving) balance

Japan in boom times

1980
Household budgets in the black.
Industry in the red (active investment).
Government finances balanced.
Foreign trade in the black (minus).

2000
Household budgets in the black.
Industry in the black (no investment).
Government in the red.
Foreign trade in the black (minus).

2030
Households in the black (hard to save money because of aging and falling incomes).
Industry in the black (no investment).
Government in the red.
Foreign trade in the red (plus).

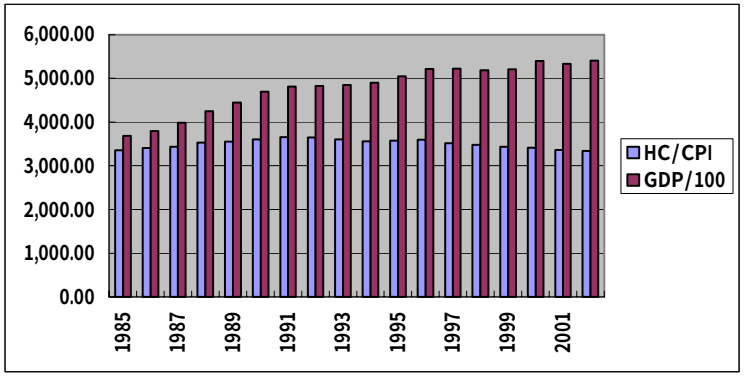


$$GDP=C+\underline{\mathbf{I+G+X-M}}$$
$$=YD+T$$
$$=C+\underline{\mathbf{S+T}}$$
$$I+G+X-M=S+T$$
$$(S-I)+(T-G)+(M-X)=0$$

Unbalanced budget or difference between savings and investment reflect trade deficit (*Dornbusch and Fisher*)

Implications of minus growth

- **GDP** has indeed grown.
- But real consumption per household has been shrinking since 1992.
- In consequence, the consumption level in 2002 was the same as that in 1985.



	HC/CPI		GDP	
1985	3,352.65	-0.20%	368.21	4.30%
1986	3,406.54	1.60%	379.85	3.20%
1987	3,433.33	0.80%	398.93	5.00%
1988	3,534.19	2.90%	424.29	6.40%
1989	3,556.78	0.60%	444.88	4.90%
1990	3,601.66	1.30%	469.57	5.60%
1991	3,655.94	1.50%	480.86	2.40%
1992	3,651.70	-0.10%	483.02	0.50%
1993	3,597.67	-1.50%	485.30	0.50%
1994	3,562.92	-1.00%	489.59	0.90%
1995	3,574.69	0.30%	504.83	3.10%
1996	3,595.13	0.60%	521.36	3.30%
1997	3,518.01	-2.10%	522.22	0.20%
1998	3,484.51	-1.00%	518.71	-0.70%
1999	3,434.04	-1.40%	520.77	0.40%
2000	3,416.77	-0.50%	539.16	3.50%
2001	3,362.86	-1.60%	532.44	-1.20%
2002	3,344.34	-0.60%	540.61	1.50%

Section 2
Two alternative scenarios for staving off economic collapse

Proposals for a sustainable energy society by

COMPASS

Goals under Scenarios B and C

Reduce Environmental Risk

□ Reduce Risk of Climate Change

- IPCC stresses that climatic changes that have occurred over the last 50 years are attributable to human activities, and that climate change and sea level rise will intensify in the 21st century (1).
- Inevitable surprises may occur in the next 10 to 30 years (2).
- Preventing dangerous climate change by achieving a significant reduction in greenhouse gases is an obligatory task for developed countries such as Japan.

□ Reduce Risk of Radioactive Materials

- Nuclear power is not an option as a sustainable energy source due to its environmental risks (present and future).
- Close down all nuclear plants by 2030.

(1) IPCC Third Assessment Report（2001)

(2) "Abrupt Climate Change: inevitable surprises," National Research Council（USA, 2002)

Goals for Scenarios B and C

Shift and Improvement of Economy

☐ Scenario B: Economic Revival

Promote "Strategic Environmental Industries"

Create Jobs (Economic Regeneration)

- Promote environmental industries that have competitive advantages on the world market (solar panels, hybrid cars), and create more jobs than BAU.

☐ Scenario C: Switchover Scenario

Value not measurable with GDP

- Energy- and resource-wasting
- economic structure that tries to
- increase material output

(Bell curve, Schmalensee "World Carbon Dioxide Emissions: 1952-2050, R. E. Stat., Vol. 80, No. 1 (1998)")

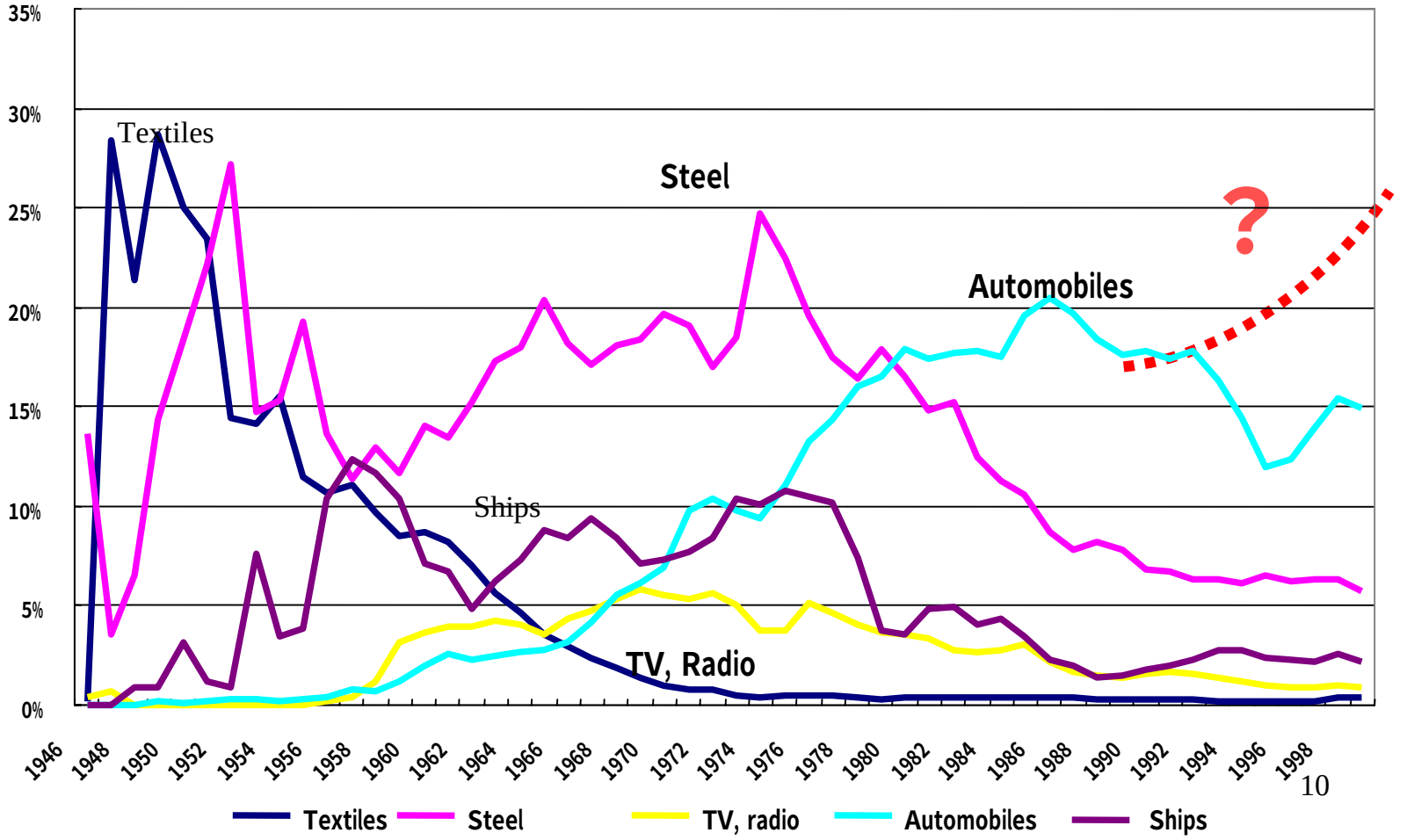
- Life with more leisure time

– requires going "beyond capitalism" and starting discussion.

B. Background of the Revival Scenario

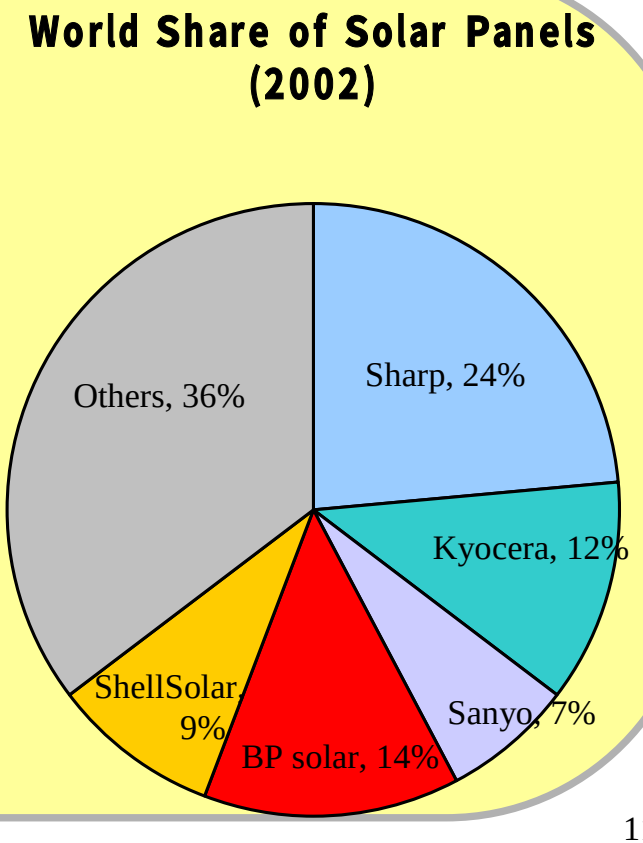
Expectations for the New Leading Force

Export Trends



B. Revival Scenario
Strategic Environmental Industries

- Japan's environmental industries and technologies lead the world
  - Solar panels, hybrid cars
  - Inverters, high-efficiency motors, heat pumps, insulation, fuel cells
- Strongly promote these as strategic industries

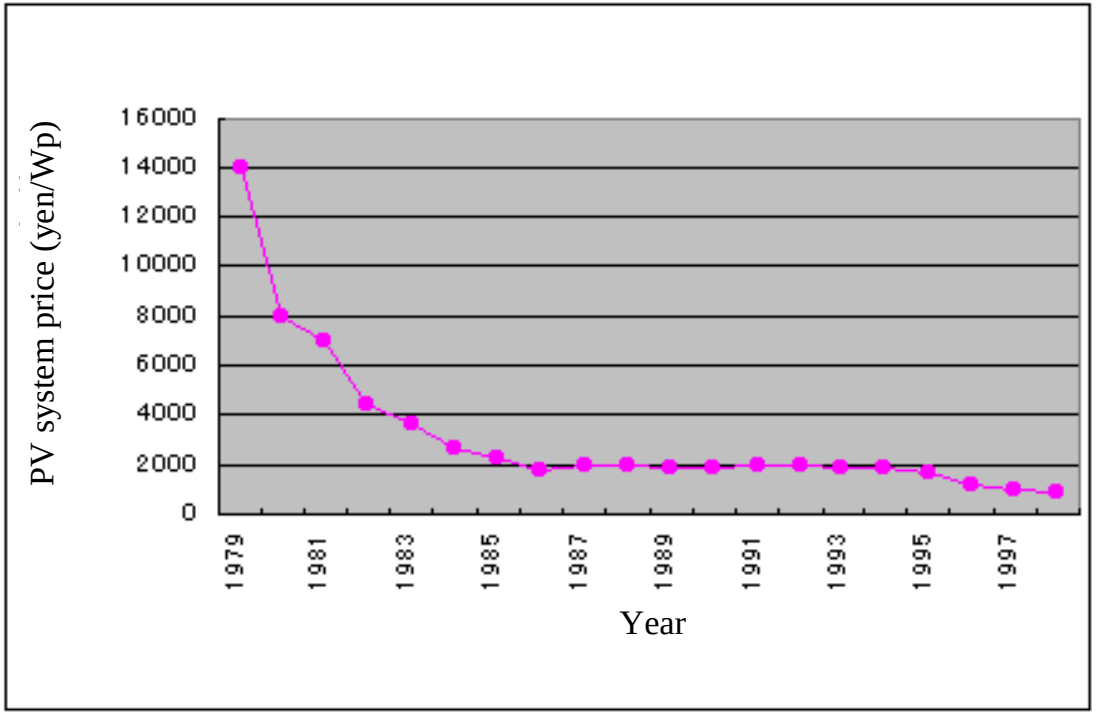


B. Theoretical Background

Revival Scenario (2)

②Learning Curve

When cumulative production doubles, required cost and time for production decrease at a certain rate.



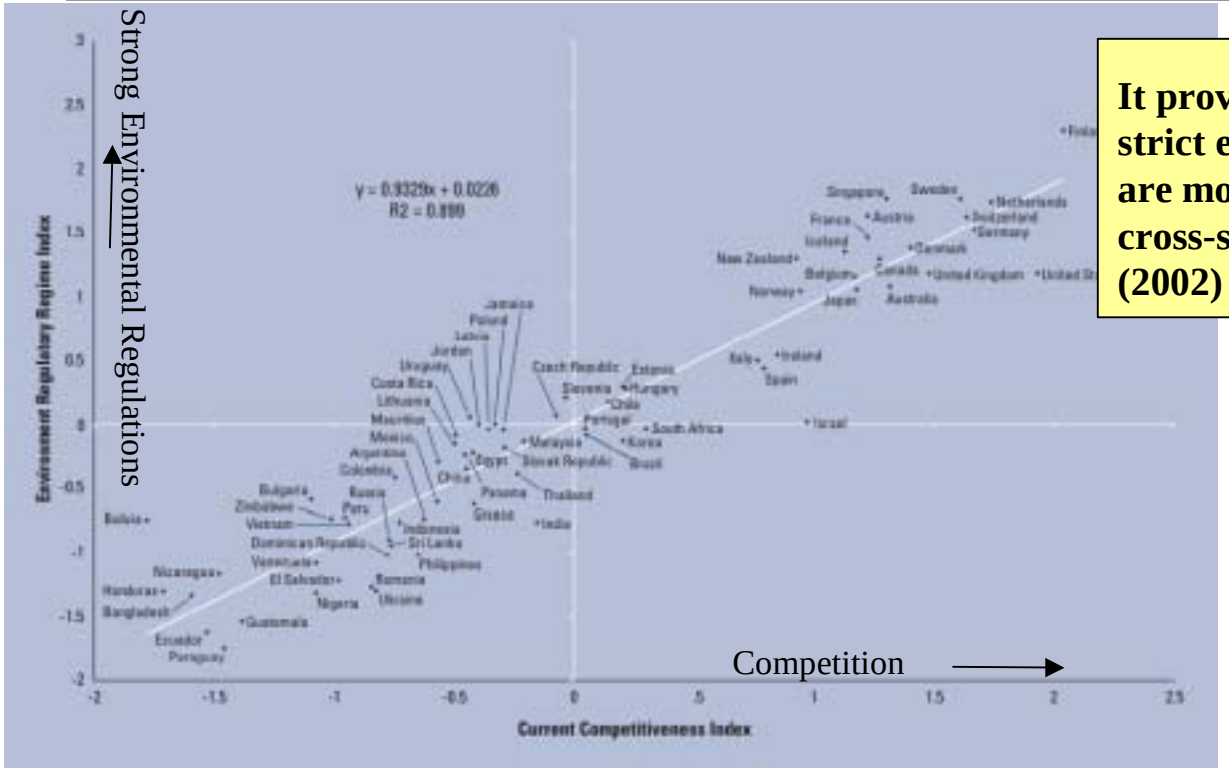
Source: Web Site (www.systemken.com)

B. Theoretical Background

Revival Scenario (1)

①Porter Hypothesis

Environmental Protection and Economic Competition do not conflict→ Stricter environmental regulations mean better competitiveness **(1)**



It proved that countries with strict environmental regulations are more competitive, based on cross-section data of 75 countries (2002)

(1)Esty and Porter, ”Ranking National Environmental Regulation and Performance: A Leading Indicator of Future Competitiveness?” in World Economic Forum, The Global Competitiveness Report 2001-2002, Oxford Univ. Press, 2002

B. Measures for the Revival Scenario

- Energy Conversion
  - Wind: 10,000 MW by 2010; solar: 5000 MW, large increase in renewable energy
  - Natural gas replaces coal fired plants (phaseout of nuclear plants in the long term)

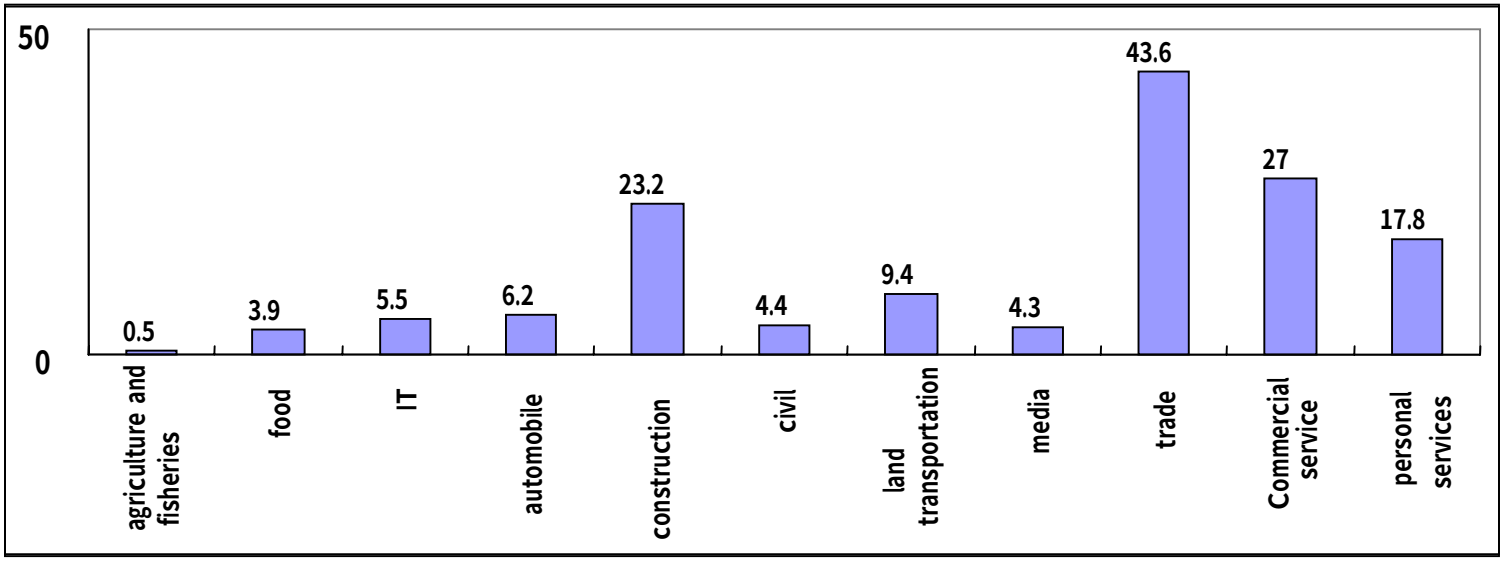
(Coal generation in 2010 will be about 30% of that in scenario A in 2000 and 2010. Natural gas generation will increase by 40-50% of Scenario A in 2000 and 2010.)

- Industry
  - Co-generation by industry: 9800 MW by 2010
- Commercial
  - Co-generation by business: 1700 MW by 2010
  - Enhanced insulation
- Residential
  - Replacement of old refrigerators: 20 million energy efficient refrigerators by 2010 (4.1 million sold)
- 5.23 million sold in 2001
  - Improved residential insulation
  - Energy-efficient air conditioners
  - Introduction of residential co-generation: 3900 MW by 2010
- Transport
  - Widespread use of hybrid vehicles: 12.75 million cars by 2010 (21% of fleet)

B. Effects on Employment in the Revival Scenario

- 1.95 million more jobs in 2030 than in Scenario A.

  -Increased investment results in creating jobs in building industry, then in commercial (service) sectors through economic interlinkage.



B. Other Policies and Measures in the Revival Scenario

－Imposing a Carbon Tax－

- Sensitivity analysis

  Calculation of the CO2 emission reduction when carbon tax is introduced in Scenario B, the Revival Scenario.

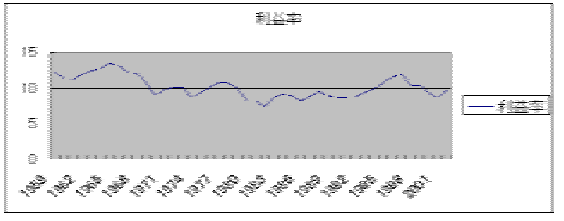
  - Result: About 40 million tons (slightly under 4%) emissions reduction for Scenario B, when 6000 yen/ton carbon tax is imposed in 2005.

*The reduction is induced only by the rise in oil prices due to the tax. Other parameters are identical with those in the Revival Scenario.

C. Background of the Switchover Scenario **(1)**

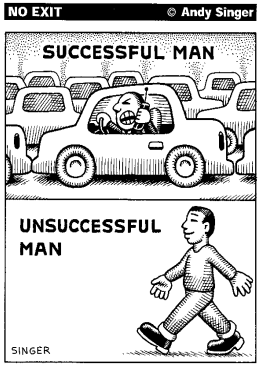
End of the line for the current GDP-based economy

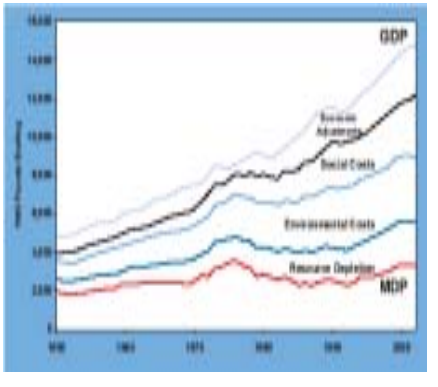
Law of diminishing profit rate - slowing of economic growth *" This may be happening in the IT world"*— HSBC economist S. King (2002)



"GDP is not an appropriate index to describe Social Happiness" Nordhaus and Tobin

(Alternative indexes such as GPI, MDB, GNH, and ISEW have been studied.)





* GPI: Genuine Progress Index, MDP: Measure of Domestic Progress, GNH: Gross National Hapiness, ISEW: Index of Social Economic Welfare

Japan is losing its presence in global society.

Political and economic stagnation, economic rise of China, democratization in Korea and Taiwan

C. Background of the Switchover Scenario (2)

Rise of the New Social and Economic Paradigm

Crumbling of the current economic structure and dematerialization (IT revolution, enhanced flexibility, and the soft-based economy)

- Success of Linux (peer-production with digital commons (Benktler))
- Shift from "having" to "being"
- Decline of the welfare state and rise of the "Third Realm" such as community, local society.
- Free-agent society, various styles of working

Inevitable crisis of climate change in the short-term

IPCC reports the risk of climate change (severe temperature and sea-level rises will be inevitable in the 21st century) and even the possibility of a drastic change in 10 to 30 years (1) →time to face reality and prepare for the negative effects.

(1): e.g. "Abrupt Climate Change: inevitable surprises," National Research Council (USA, 2002)

We must shift to a new social and economic paradigm.

C. The Socioeconomic Structure of the Switchover Scenario

An open society that focuses on individuals and local communities

The subsidiary principle, breakdown of bureaucratism, open and widely debated decision-making process, development of individual potentials

Flexible life and work styles with diverse values

Shift from controlled and uniform work style to diverse styles that accommodate pride, self-fulfillment, and willingness to contribute to society (a free-agent society)

Economic system that fully internalizes environmental and social costs

Appropriately evaluate external costs (polluter pays principle, extended producer responsibility principle)

A society reliant on energy efficiency and renewable energy

Making energy and resources renewable, shifting from “energy supply” to “energy service supply”

Shift in values from “material possessions” to “time”

More services and less ownership. Shorter working hours, more time with family and friends. Higher quality life and surrounding landscape.

Co-existence of diverse communities

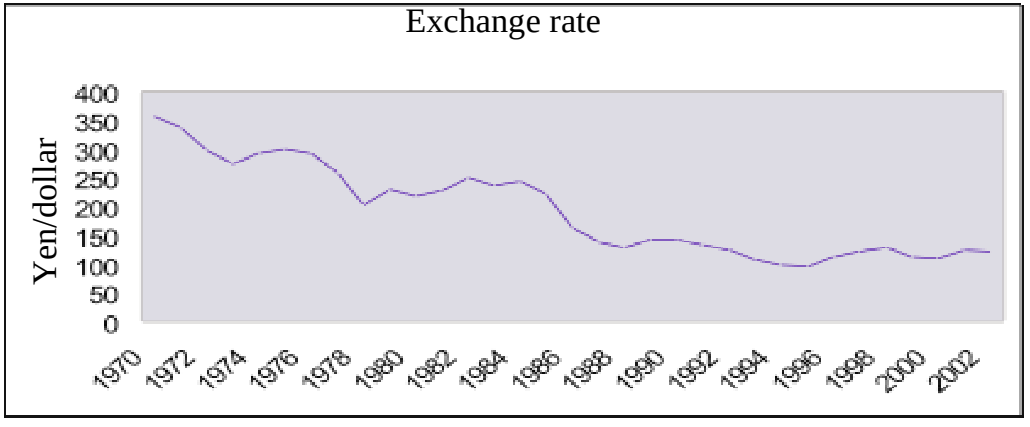
Renaissance of agriculture-based rural areas and provincial cities with local character. Capital cities that take influential environmental initiatives.

（*Though globalization is not to be denied, orderly and reciprocal economic and cultural relations should be preferred. Citizen science and intermediate technology will have priority, and technological progress should adopt the precautionary principle.）

C. Socioeconomic Structure of the Switchover Scenario

－Exchange rates, agriculture, etc.－

- The exchange rate will be about 200-300 yen/dollar
- Therefore, the economics of agriculture should be considered under the assumption that the price of imported food products will double.
  – The use of local currency



Section 3
Assumptions and Results
COMPASS Scenario Calculations

Assumption 1: International Factors

- Exchange Rate (weak yen)

	2010	2030
A. Collapse	130 yen/dollar	167 yen/dollar
B. Revival	130 yen/dollar	167 yen/dollar
C. Switchover		247 yen/dollar

- Oil Price (nominal price)

	2010	2030
A. Collapse	29 dollars/barrel	35 dollars/barrel
B. Revival	29 dollars/barrel	35 dollars/barrel
C. Switchover		36 dollars/barrel

Assumption 2: Socioeconomic Structure

☐Population & Households (Population decreases after the peaking in 2006)

	2010	2030
Population (thousands)	**127,532**	**117,635**
Households (thousands)	**50,139**	**49,024**

*Medium estimates, National Institute of Population and Social Security Research
*These parameters are common to all scenarios.

☐ GDP Growth Rate (The value cannot be expressed by GDP in scenario C)

	2000/2010 (2010 GDP)	**2010/2020 (2020 GDP)**	**2020/2030 (2030 GDP)**
A. Collapse	1.4% (618 trillion yen)	1.0% (685 trillion yen)	0.6% (725 trillion yen)
B. Revival	1.4% (622 trillion yen)	1.3% (706 trillion yen)	0.9% (770 trillion yen)
C. Switchover			-2.6% (354 trillion yen)

Main Assumption 3: Energy

☐Renewable Energy

	2010	2030
A. Collapse	**478 PJ**	**591 PJ**
B. Revival	**768 PJ**	**2475 PJ**
C. Switchover		**2424 PJ**

☐Nuclear Plants

A. Collapse: Four new plants currently under construction will be added, then the number will stay constant after 2010.

B. Revival: One new plant currently in trial operation will be added. Start to close down plants gradually from 2010, and complete by 2030.

C. Switchover: Same assumptions as Scenario B. However it is possible that all nuclear plants will be closed before 2030.

Capacity Factors

Set to 80% of full generating capacity for all scenarios.

Macroeconomic Outlook 1

	A. Collapse		B. Revival		C. Switchover
	2010	2030	2010	2030	2030
Real GDP (trillion yen)	618	725	622	770	354
Consumer price index (2000=100)	99	103	99	105	124
Inflation (%)	-0.1 2000/2010	0.4 2020/2030	-0.1 2000/2010	0.6 2020/2030	2.0 2020/2030
Industrial production index (2000=100)	116	138	118	149	—
Steel production (ten thousand tons)	9,200	6,400	9,300	6,900	4,800
Ethylene production (ten thousand tons)	660	540	670	570	300
Cement production (ten thousand tons)	7,100	5,500	7,100	5,900	2,600
Paper and pulp (ten thousand tons)	1,200	1,100	1,200	1160	740

Macroeconomic Outlook 2

Index \ Scenario	A. Collapse	B. Revival	C. Switchover
Characteristics	Environmental industries not promoted, business stagnates.	Environmental industries grow gradually, and economy improves more than in Scenario A.	Emerging new paradigm after capitalism of 20th century. Slow life, IT technology.
Unemployment rate	12.3% in 2030 (7,400,000 people)	8.4% in 2030 (5,040,000 people)	Community, society, personal services will generate jobs. Unemployment is a problem unique to industrial societies.
Current balance	Deficit after 2020	Deficit after 2030, but much smaller than in Scenario A.	Almost balanced. But the concept of international trade will loose its meaning.
Fiscal income	Deficit continues (4.5 times GDP in 2030)	Deficit continues, but smaller than A. (3.4 times GDP ratio in 2030)	Balanced. Economy is less dependent on fiscal expenditure.
Overall evaluation	High possibility of economic collapse before 2030.	Not a perfectly sustainable path, but far better than Scenario A.	Most promising path for a sustainable future.

Industrial Outlook

☐ A. Breakdown Scenario

- Changes in total production closely parallel those in GDP.
- Growth industries: IT, communications, media, office and service equipment
- Sunset industries: Fertilizers, forestry and agriculture, textiles, coal products
- Automobile industry will not grow due to saturated domestic demand and on-site production for overseas markets.

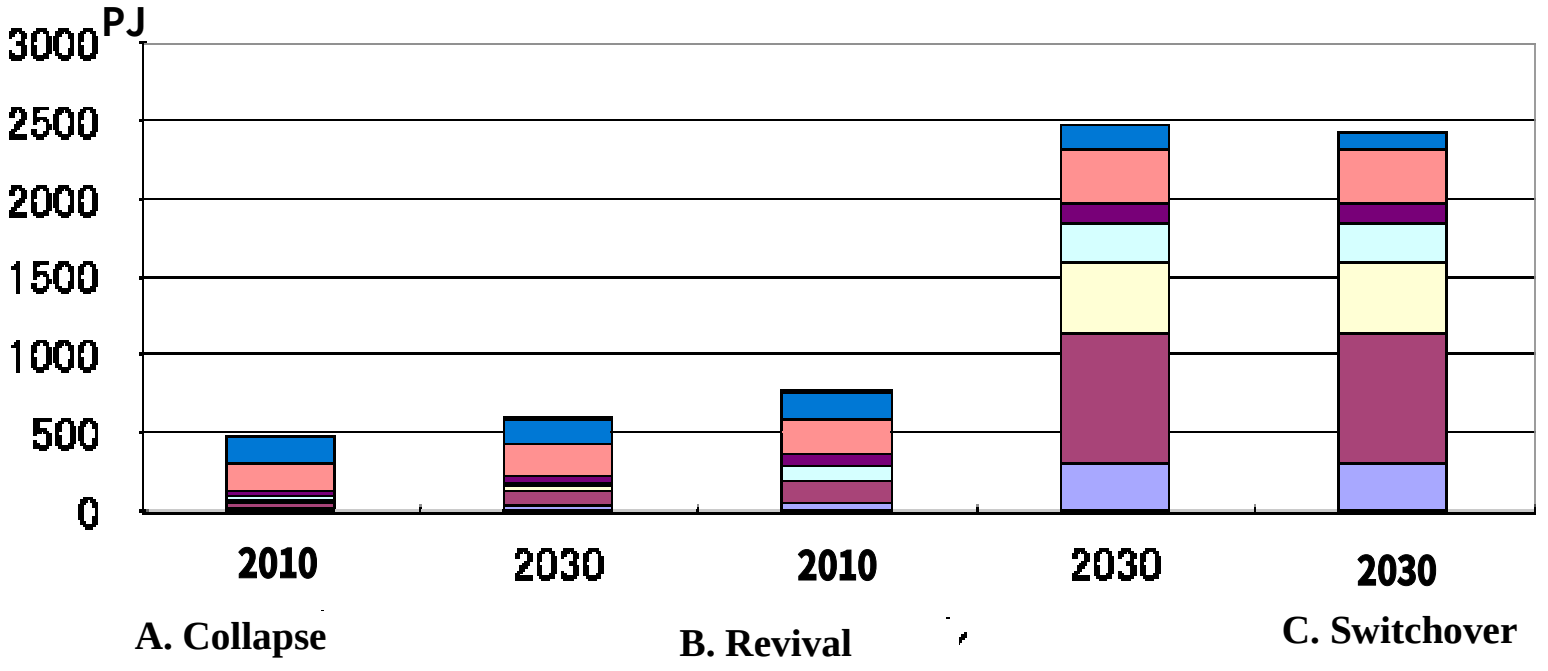
☐ B. Revival Scenario

- Changes in total production closely parallel those in GDP.
- Growth industries: IT, communications, media, office and service equipment
- Sunset industries: Fertilizers, forestry and agriculture, textiles, coal products
- Automobile industry will grow slightly through increased exports of highly efficient vehicles

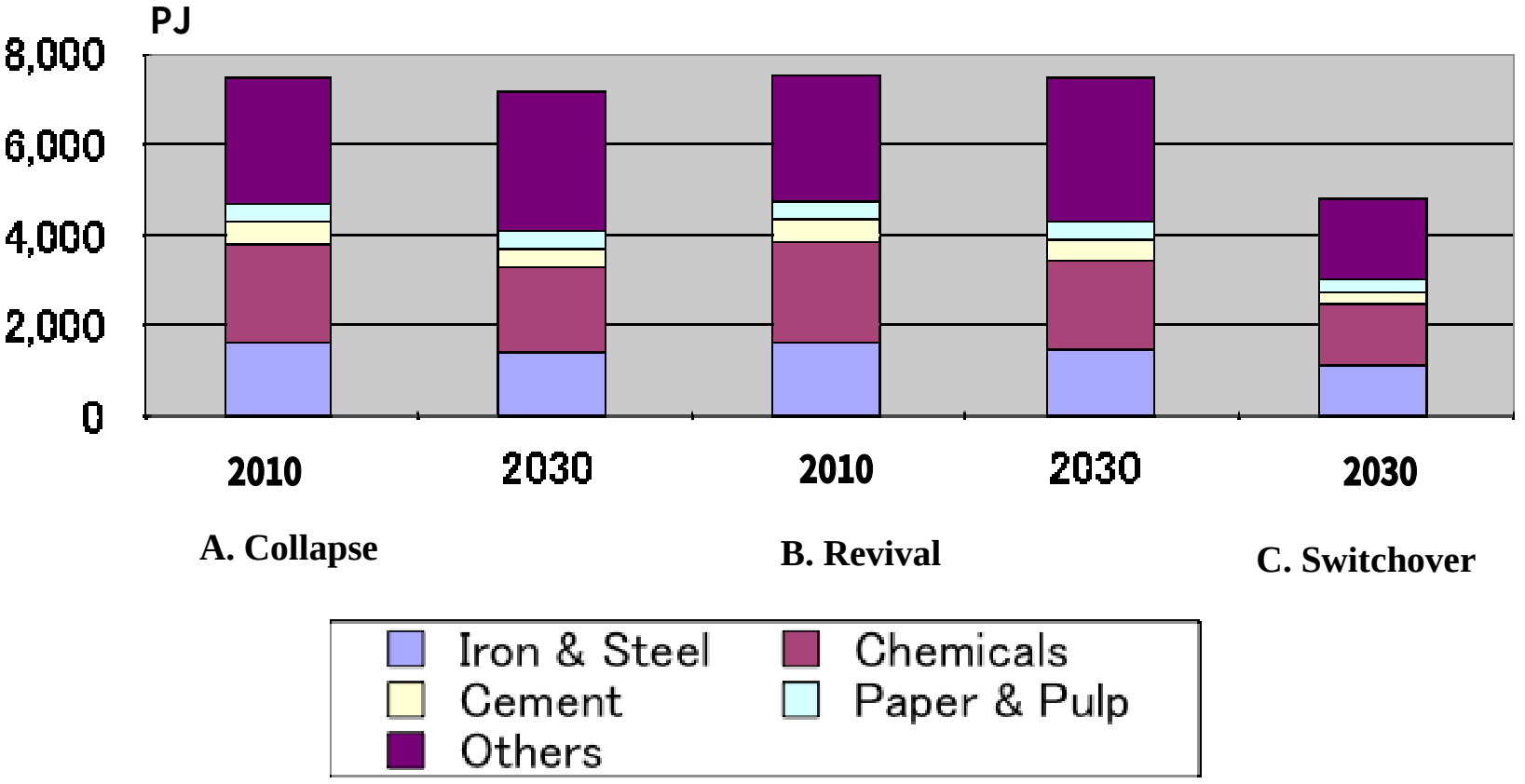
☐ C. Switchover Scenario

- Borderless business, new industries; i.e., nonprofit agriculture, peer-to-peer, open source software.
- These industries are not limited by national borders, or confined within existing industrial structures (since the Industrial Revolution).

Renewable Energy Grows Rapidly



Industrial Sector
Final Demand by Types of Manufacturing



Residential and Commercial Sector

	A. Collapse		B. Revival		C. Switchover
	2010	2030	2010	2030	2030
Energy consumption (PJ)	4,489	4,628	4,266	4,328	3,039
Residential	2,380	2,399	2,169	2,093	1570
Commercial	2,109	2,230	2,096	2,235	1042
Population (10,000)	12,753	11,764	12,753	11,764	11,764
Households (1,000)	50,139	49,024	50,139	49,024	49,024
Commercial floor space (100 million ㎡)	18.4	19.9	18.4	20.3	12.3
【Reference】 Total final demand (PJ)	16,425	16,509	16,074	15,658	10,146

Transport Sector

	A. Collapse		B. Revival		C. Switchover
	2010	2030	2010	2030	2030
Energy consumption (PJ)	4,146	4,341	3,948	3,395	2,437
Passengers	2,767	2,947	2,547	1,997	1,510
Freight	1,379	1,394	1,401	1,398	927
Passenger Transportation (Billion people km)	1,577	1,781	1,584	1,836	1,039
Freight Transportation (Billion t km)	618	648	634	646	389
【Reference】GDP (trillion yen)	618	725	622	770	354

Comparison with ACNRE (METI)

COMPASS B. Revival Scenario

v.s.

ACNRE Energy Conservation & BAU Case

∗Energy saving case in 2030, BAU case in 2010

- Similar approaches to promoting energy saving
- Huge differences in:
  (1) Reduction of CO2 emissions to 1990 levels by 2010
  (2) Phaseout of nuclear plans
- In COMPASS, strategic environmental industries are photovoltaic systems, hybrid cars, etc.
- ACNRE has no continuity between the cases

Comparison with ACNRE (1)

【In 2030】

Index	Advisory Committee for Energy		COMPASS		
【Section】	Reference Case	Exogenous Macro Factor Case	Scenario A Collapse	Scenario B Revival	Scenario C Switchover
【Main Premise】					
Exchange rate	120 (Yen/US$)	120 (Yen/US$) (?)	167 (Yen/US$)	167 (Yen/US$)	247 (Yen/US$)
Crude oil price	29 (US$/Barrel)	15 to 35 (US$/Barrel)	35 (US$/Barrel)	35 (US$/Barrel)	36 (US$/Barrel)
Population	117,580 thousand		117,635 thousand		
Households	About 49,670 thousand		49,024 thousand		
【Economy】					
GDP (2020/30 percent)	833 trillion yen (1.2%)	673 - 927 trillion yen (0.4 - 1.6%)	725 trillion yen (0.6%)	770 trillion yen (0.9%)	354 trillion yen (−2.6%)
Inflation rate	Not Released	Not Released	0.4% (2020/2030)	0.6% (2020/2030)	2.0% (2020/2030)
Unemployment	Not Released	Not Released	12.3%	8.4%	—
Current balance	Not Released	Not Released	−198 trillion yen	−16 trillion yen	—

(Note: Advisory Committee for Energy data come from the meeting held on June 16th (partly February 25th).

Comparison with ACNRE (2)

【In 2030】

Index	Advisory Committee for Energy		COMPASS		
【Section】	Reference Case	Energy Saving Case	Scenario A Collapse	Scenario B Revival	Scenario C Switchover
【Index】					
Industrial production index	136	136 (?)	138	149	—
Passenger transportation (billion people km)	approximately 1,840	approximately 1,840 (？)	1,781	1,836	1,039
Freight transportation (billion t km)	approximately 550	approximately 550 (？)	648	646	389
Total floor space (100 million ㎡)	approximately 21	approximately 21 (？)	19.96	20.3	12.3
【Energy】					
Primary energy supply (PJ)	approximately 23,390	approximately 20,290	22,747	20,183	13,765
Final energy consumption (PJ)	approximately 16,420	approximately 14,480	16,509	15,658	10,146
CO2 emission (compared with1990)	＋8%	－14%	＋7%	－9%	－42%

(Note: Advisory Committee for Energy data come from the meeting held on June 16th.

Comparison with China

China:

Neighboring country that contrasts with Japan because of its large size

- Calculations cover up to 2030.
- Macro economic model, energy model, and I-O table model are used.
- Computation performed for one case.
- Final energy demand of China in 2030 will be as five times that of Japan.
- In some areas, China already exceeds Japan (population, cement, CO2 emissions).
- In the future, China will exceed Japan in other areas (such as GDP, ethylene, and motor vehicle fleet size).