Natural Energy Resources for Human Kind

GIES March 13 2008

The Need for Clean Energy —The Photovoltaic Power Generation Era is Coming—

Photovoltaic Power Generation Technology Research Association

President

Dr.Yukinori Kuwano

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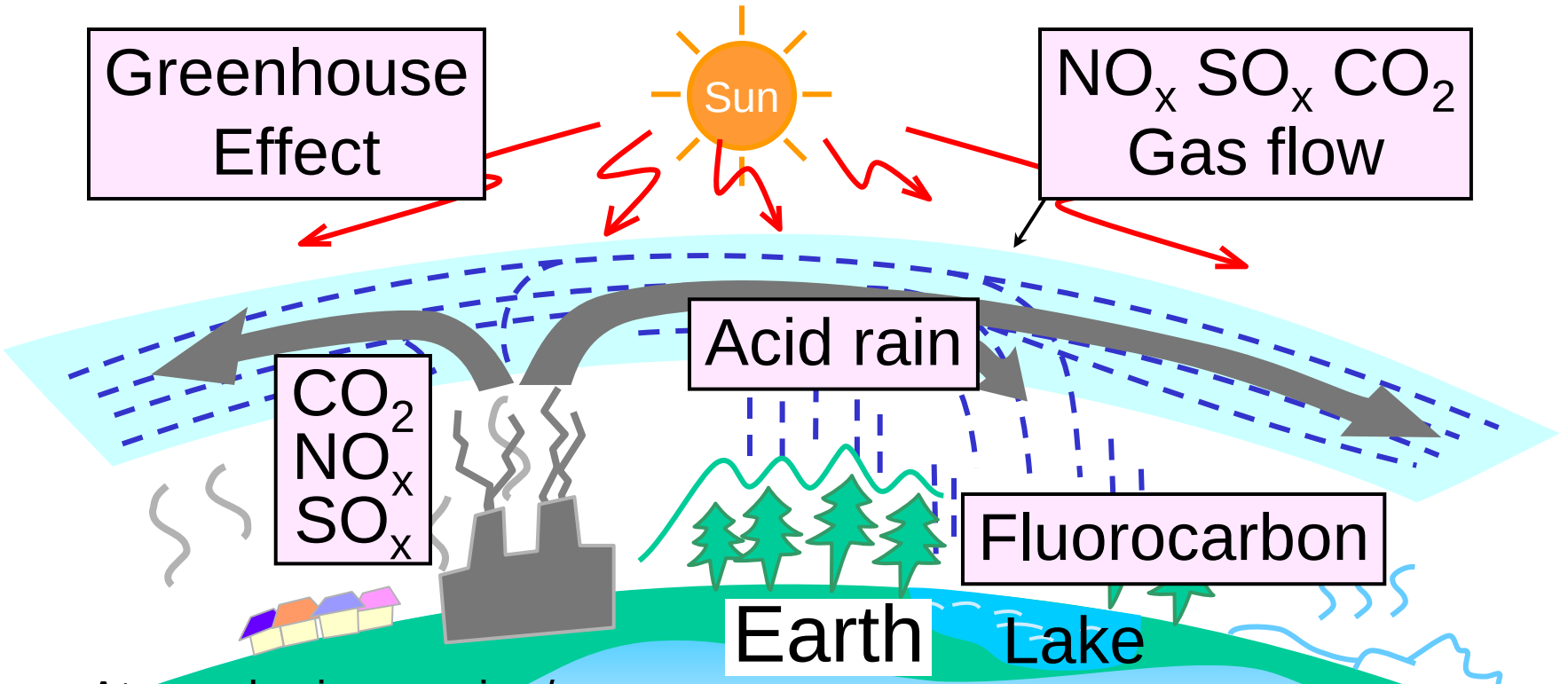
1. **Environmental issues and energy problems**
2. **Solar Energy**
3. **Progress of solar cells**
4. **PV has the possibility to save our future**

GENESIS project

– the possibility of a final energy solution-

Degradation of the Global Environment

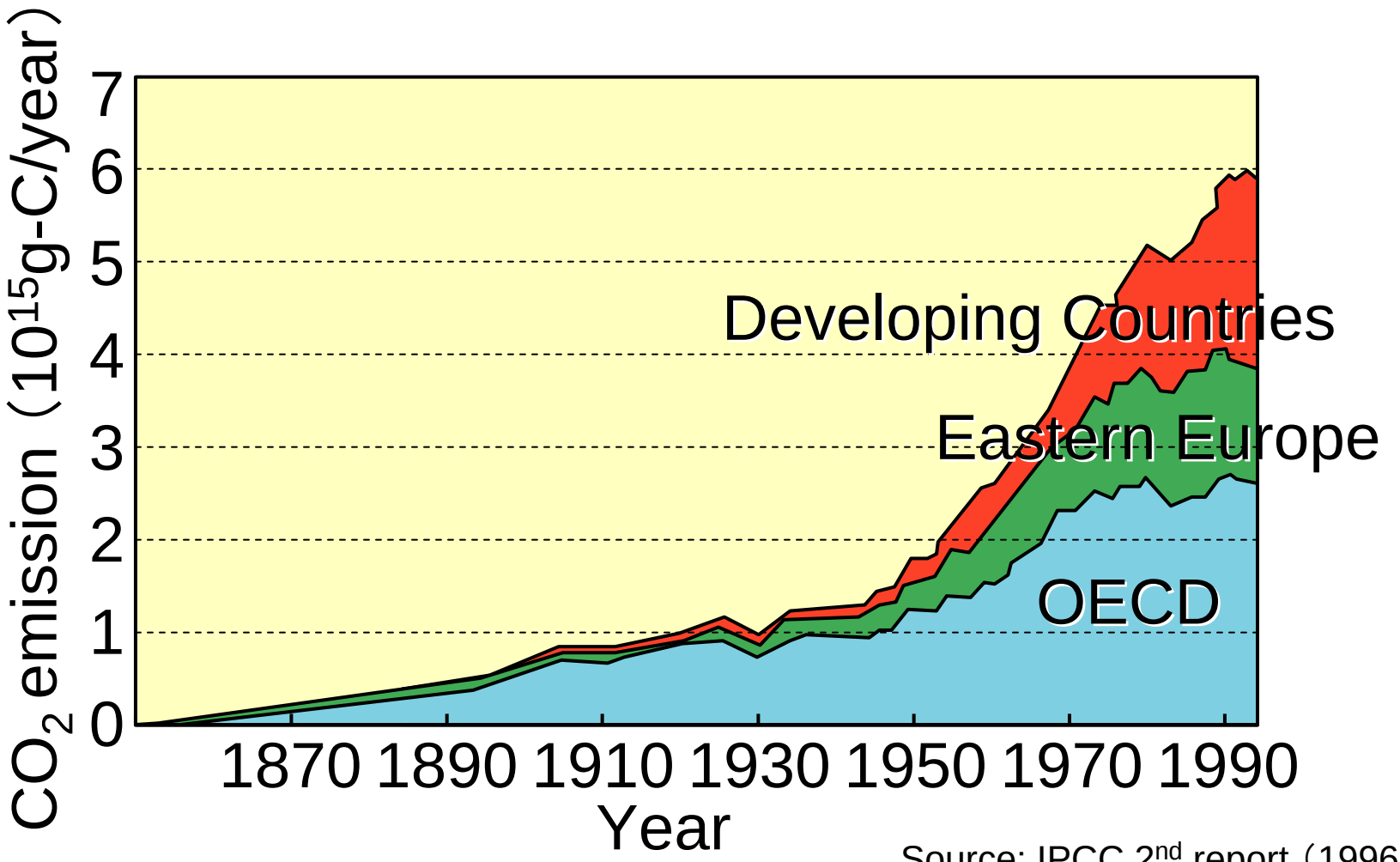


Atmospheric warming/
Pollution:
Unnatural ecosystems
Abnormal weather
Desertification

Acid rain:
Death of marine life forms
Destruction of plant life

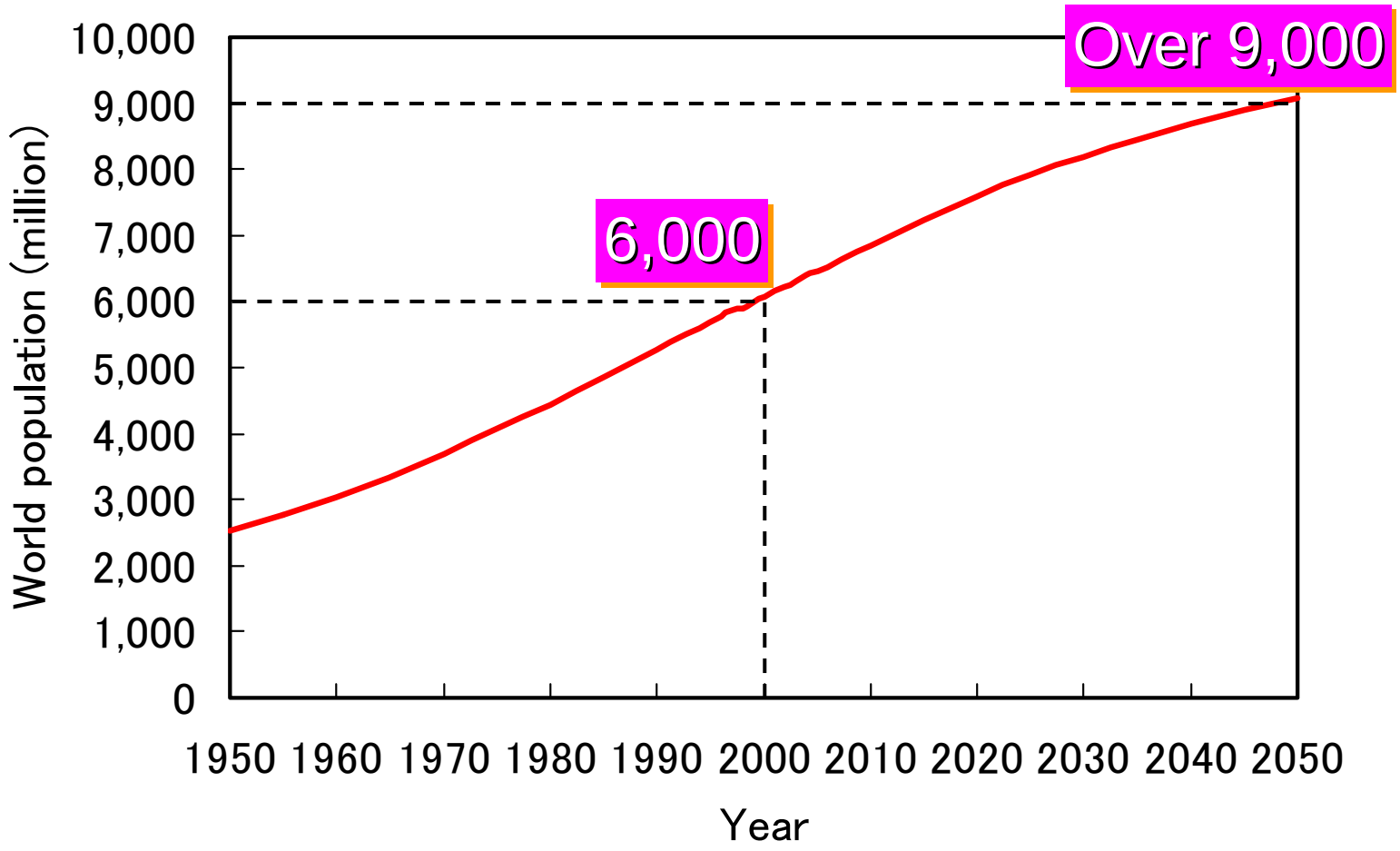
Melting of polar ice caps:
Average temperature Increases by 3℃

World CO_2 Emissions



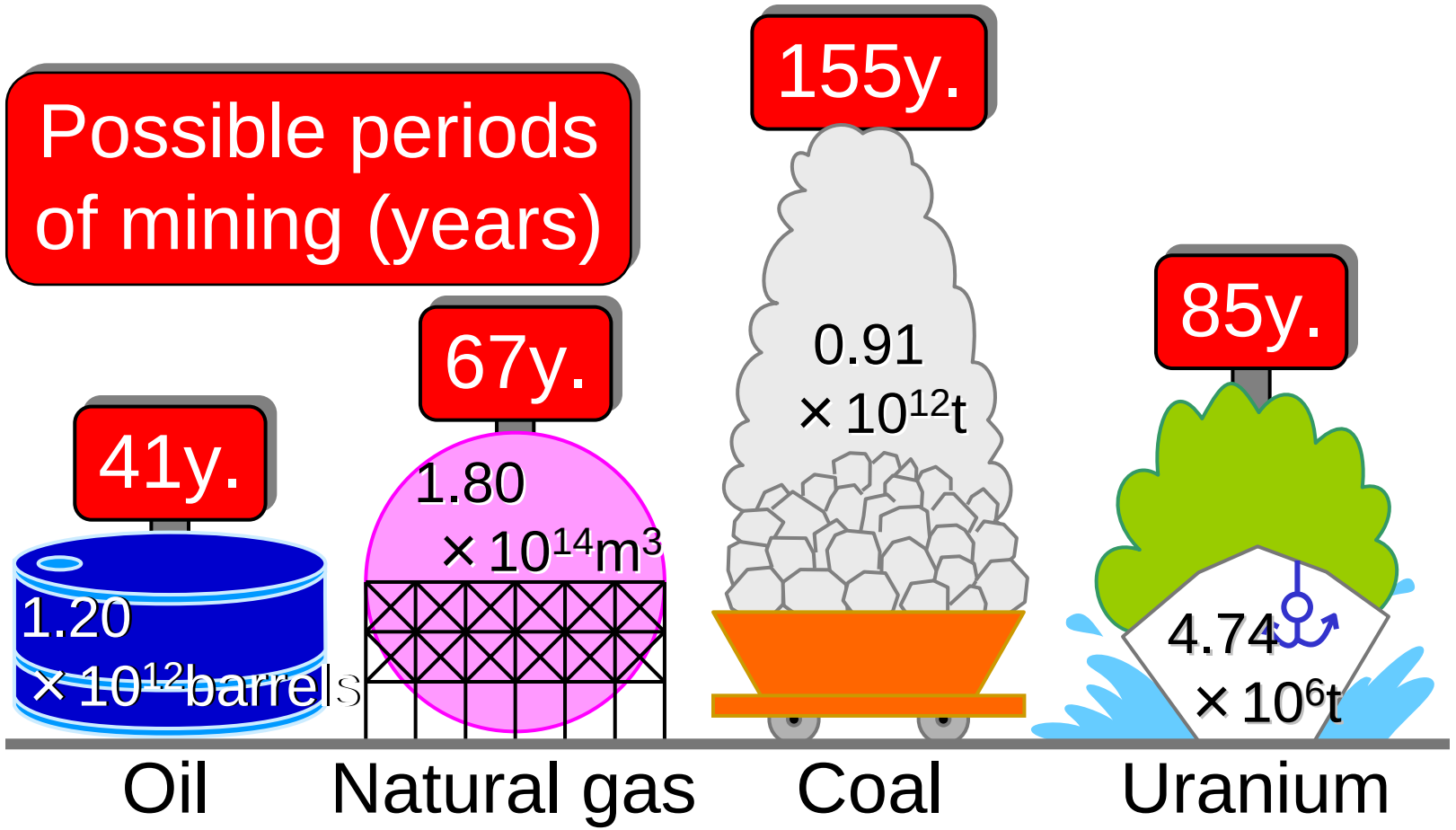
Source: IPCC 2nd report（1996）

World Population Growth Trend



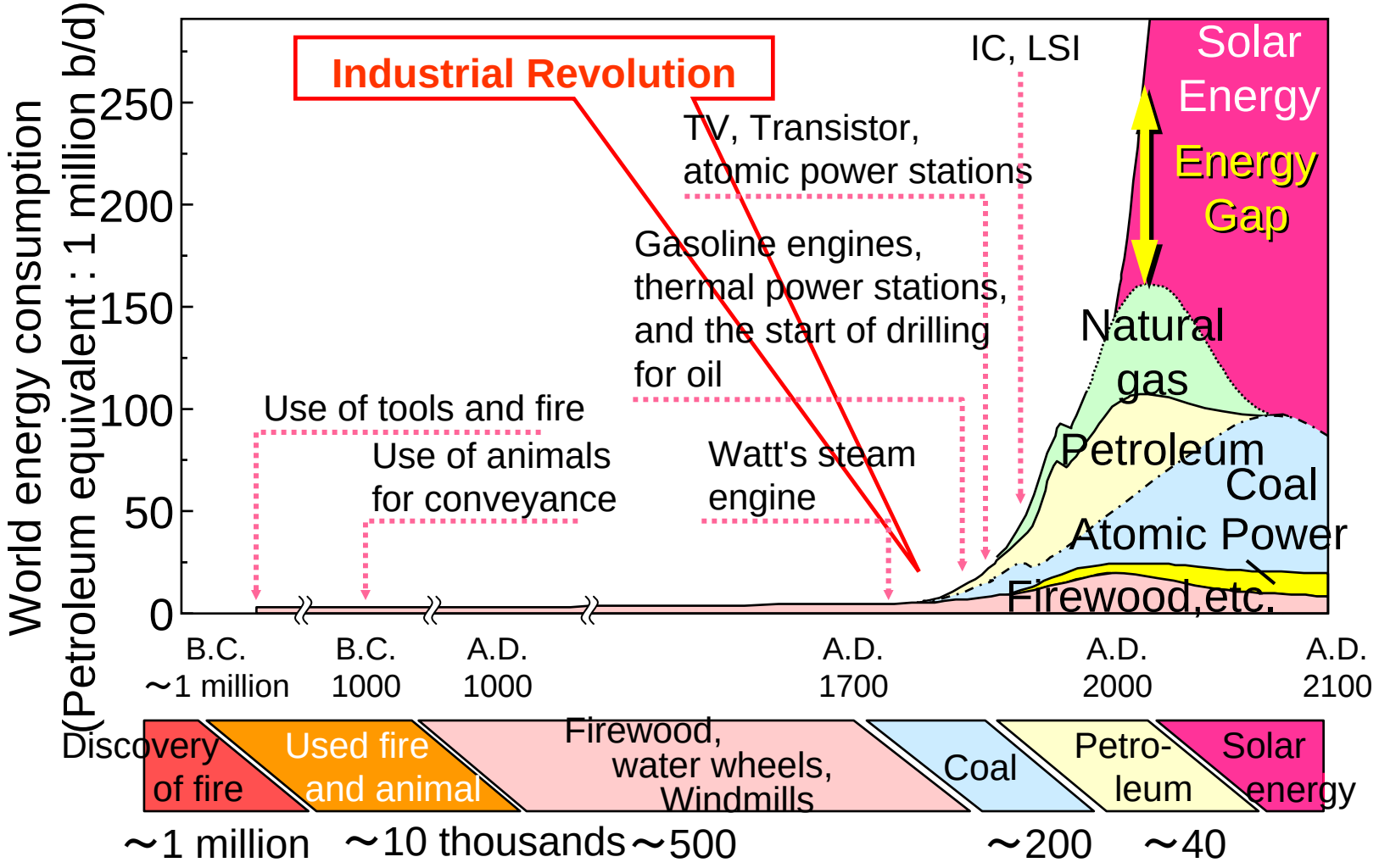
Source：Ministry of Internal Affairs and Communications, Statistics Bureau

Reserves of Various Energy Sources



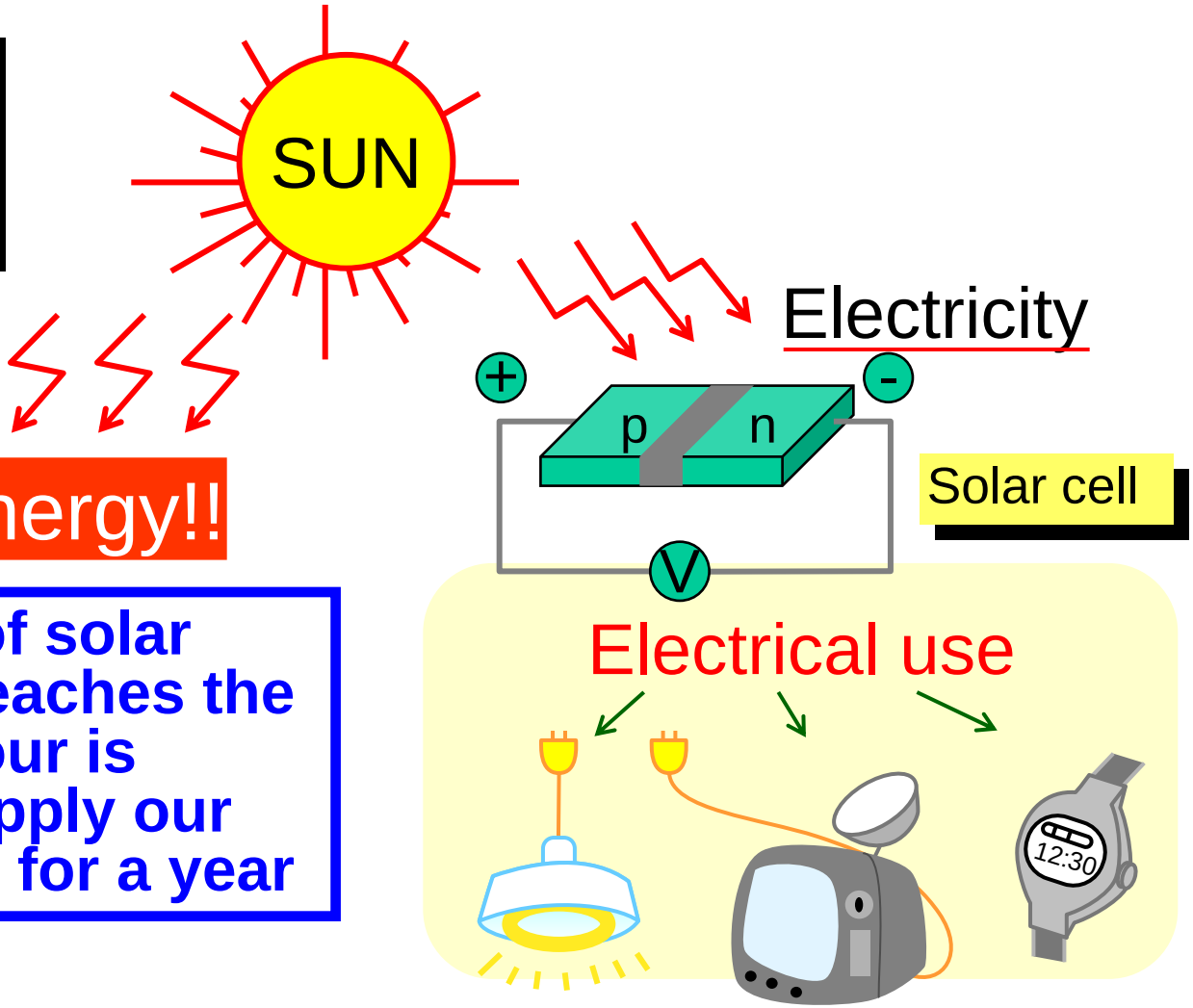
British Petroleum Statistical Review of World Energy 2006, URANIUM2005

History of Energy Consumption by Humankind



Uses of Solar Energy

- Limitless
- Clean
- Everywhere



Huge energy!!

The amount of solar energy that reaches the earth in an hour is enough to supply our energy needs for a year

History of Solar Cell

1954	Single crystalline silicon solar cell（Pearson）
1973	Oil crisis
1974	National project started in U.S., E.C and Japan etc (ex. Sunshine Project)
1975	*P/n* control of amorphous Si (Spear)
1976	*P-i-n* solar cell with initial efficiency of 2.4% (Carlson and Wronski)
1980	Consumer electronics powered by a-Si solar cell (calculator etc)
1988	Revelation of environmental degradation
1989	GENESIS project (PVSEC-4, Sydney)
1992	Practical reverse-flow solar power generation system (Kuwano's solar power station)
1994	Basic guideline for new energy introduction
1996	SILK ROAD GENESIS (SRG) Plan
2004	Roadmap Toward 2030 (PV2030)
2005	Annual solar cell production exceed 1GW (equal to a nuclear power plant)
2007	Present
2010	
2020	
2030	

(1) The dawn of solar power generation

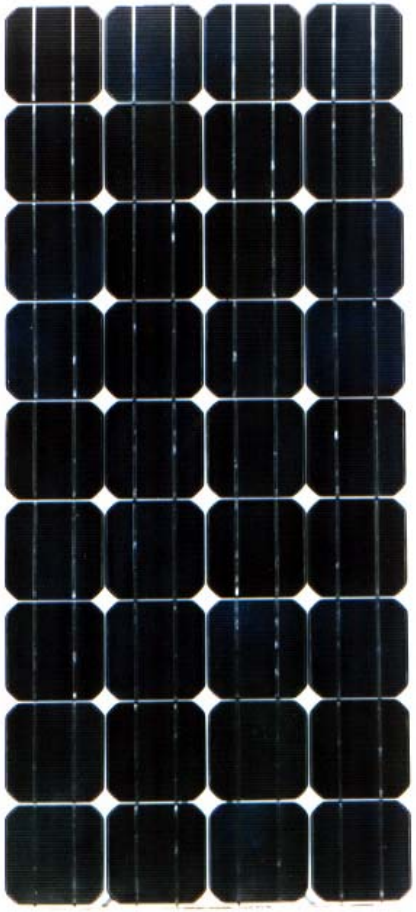
(2) Advance to supply electric power

-30 years of next stage-

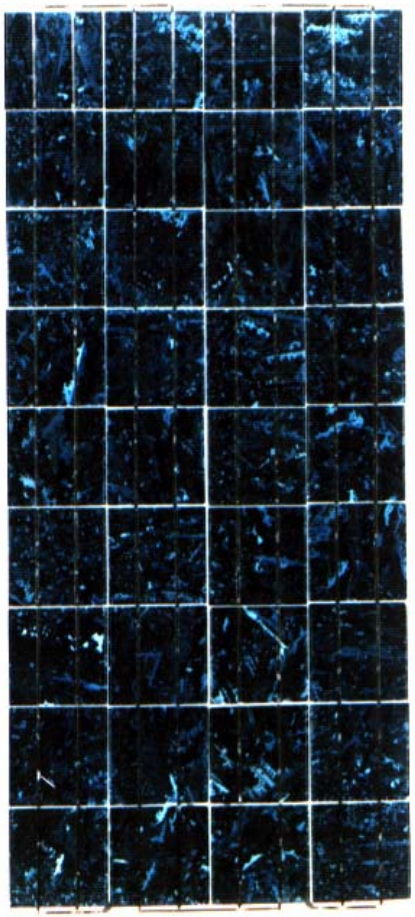
Future Prospect for Solar Cell

(3) Spread of solar power generation on a global scale

Various Types of Solar Cell Module



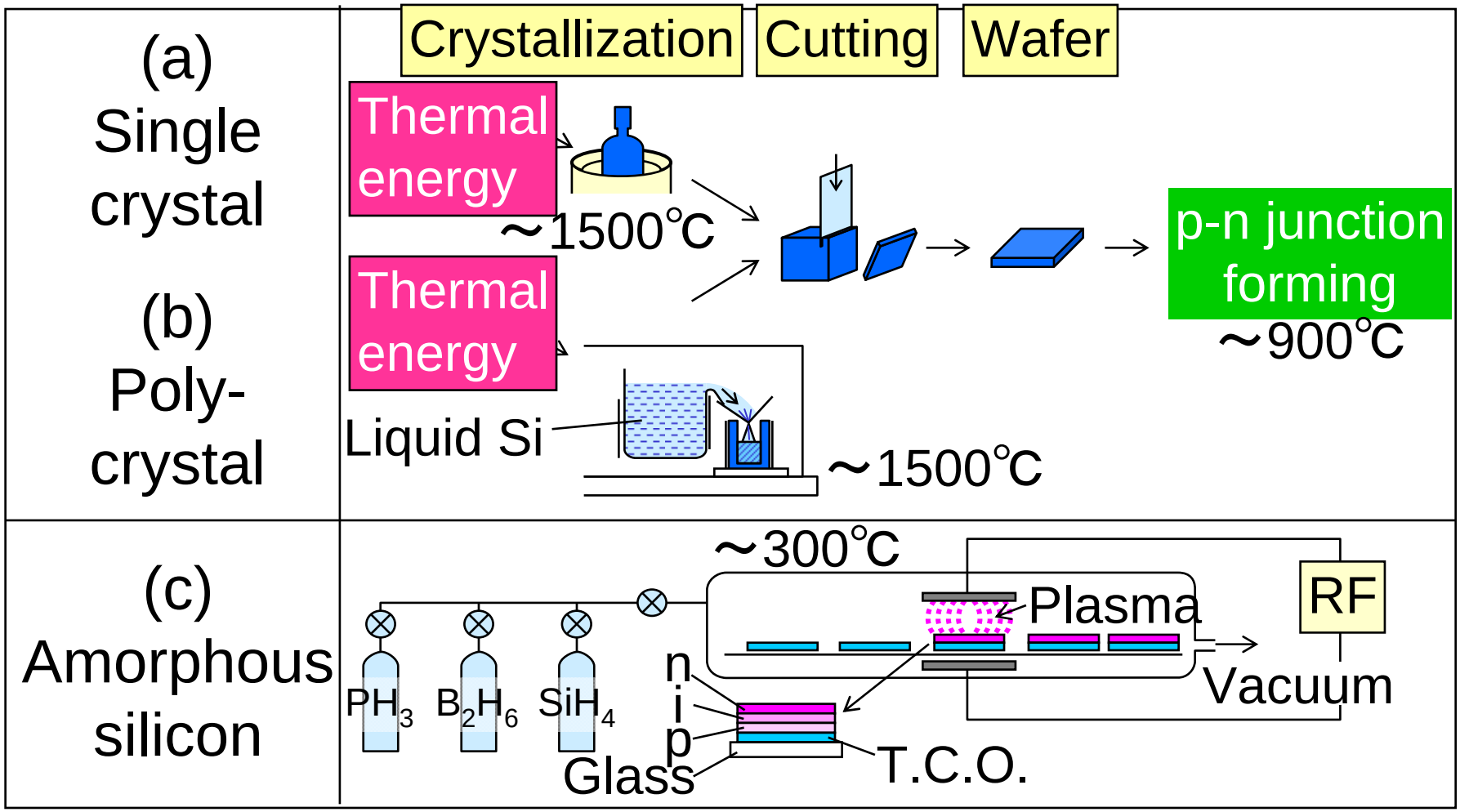
Single crystal Silicon



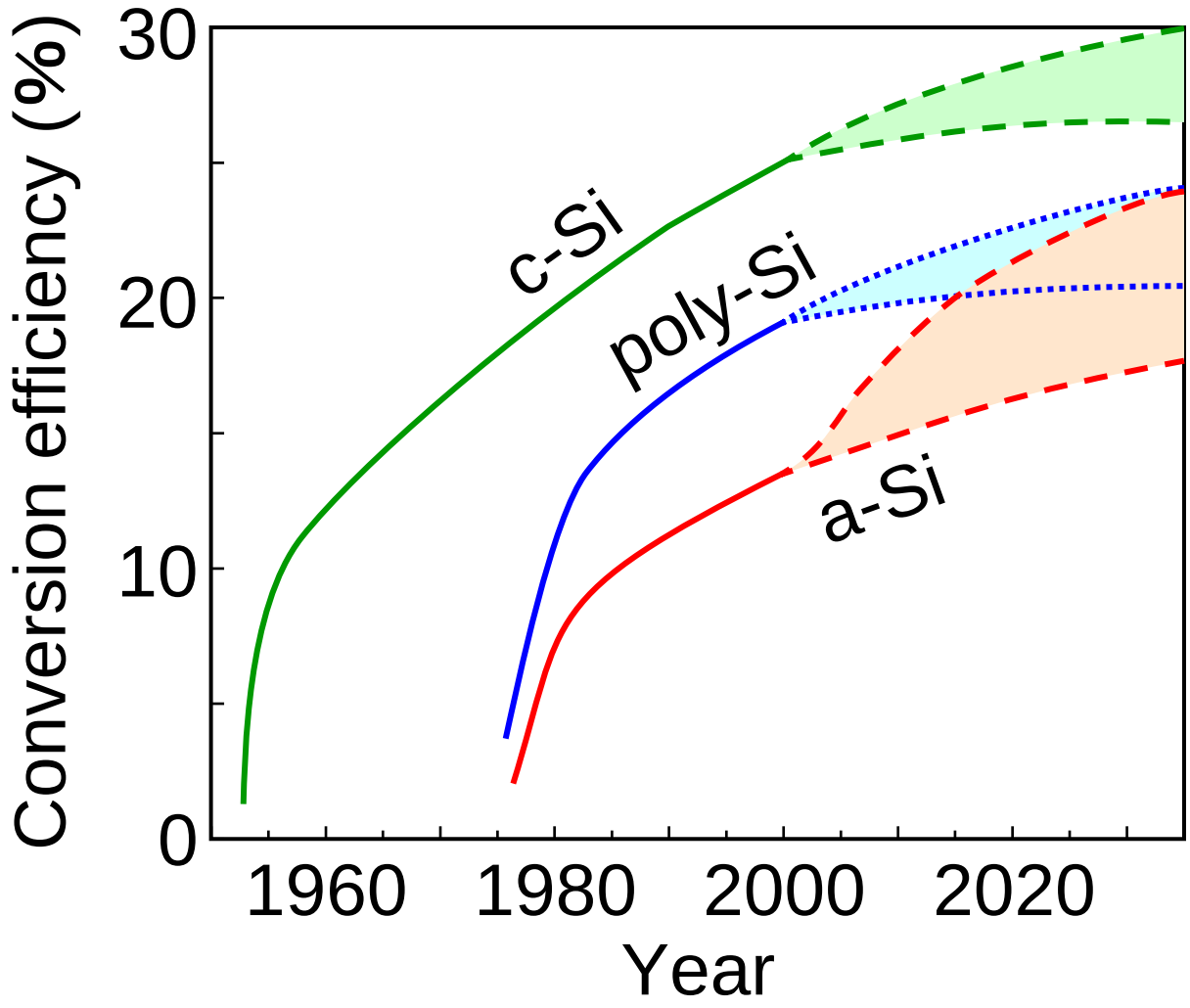
Poly-crystal silicon

Amorphous Silicon

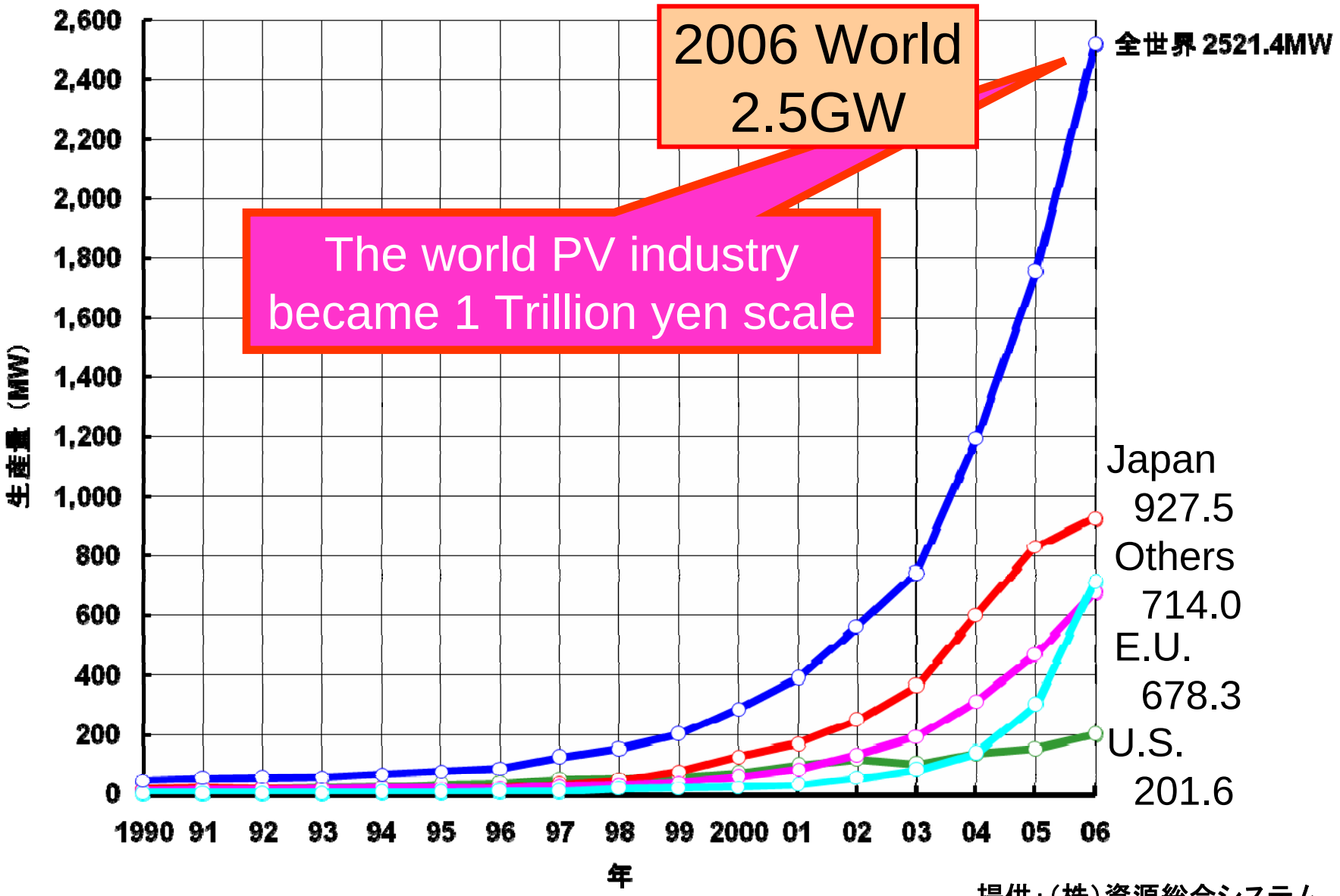
Comparison of fabrication methods of for Various solar cells



Progress in Conversion Efficiency of Solar Cells

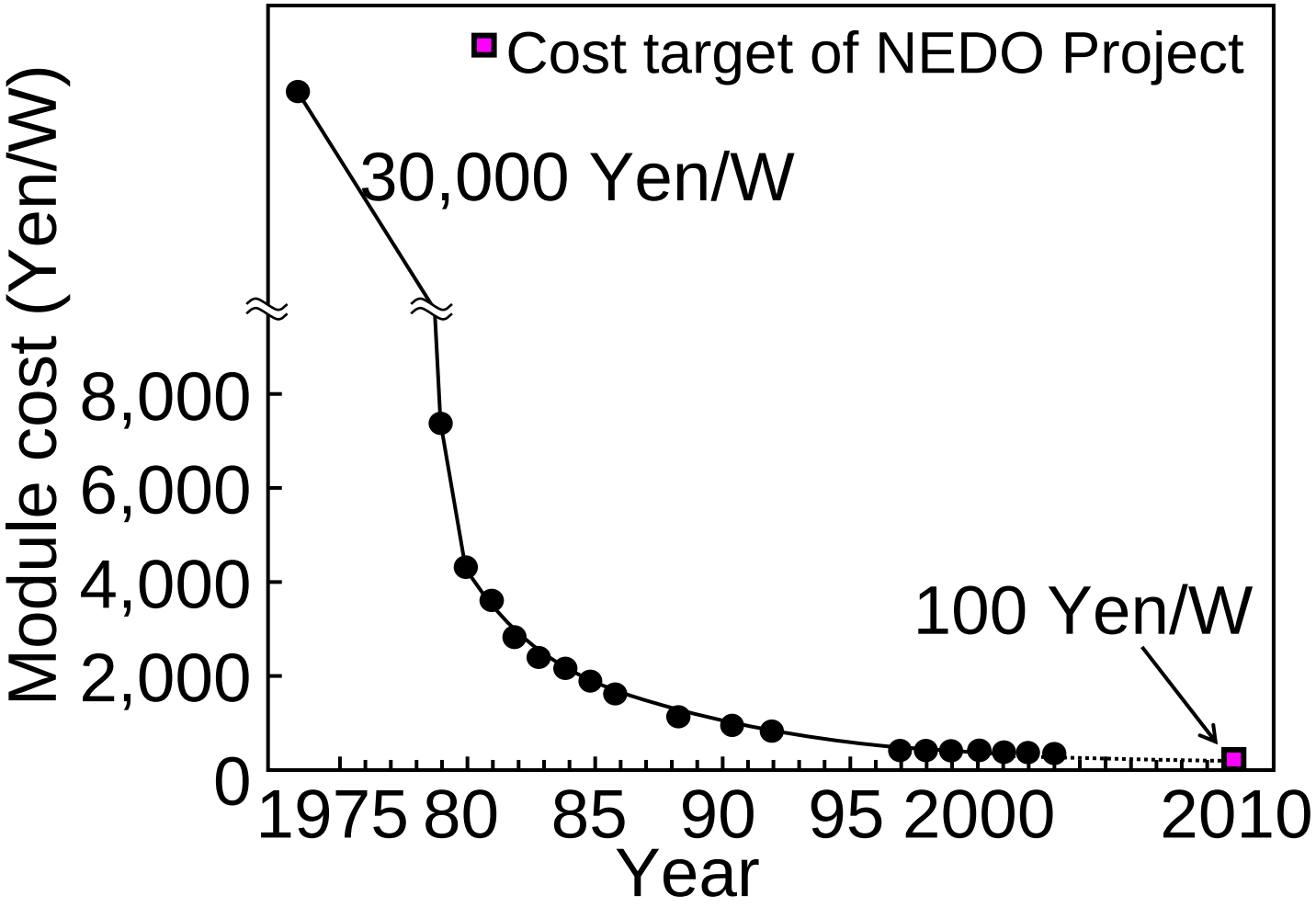


Progress in Global Production Volume



提供：(株)資源総合システム

Actual and Target Cost of Solar Cells



Electric Calculator and Wristwatch (the First Products)

The First Practical Use of Reverse-flow PV System in a Japanese House

Total 2,130kW of the PV in the House Group, 553 houses

Worldwide Large Scale PV Plants

Geiseltalsee Solar Park (4MW) Braunsbedra,Germany

Serre (3.3MW) Serre,Italy

Floriade Haarlemmermeer (2.3MW)
Haarlemmermeer,Netherlands

Rancho Seco (3.9MW) California,US

From : PHOTON International

EPT（Energy Payback Time）

$EPT = E_0 / E_g$

E_0: Energy to need to produce PV

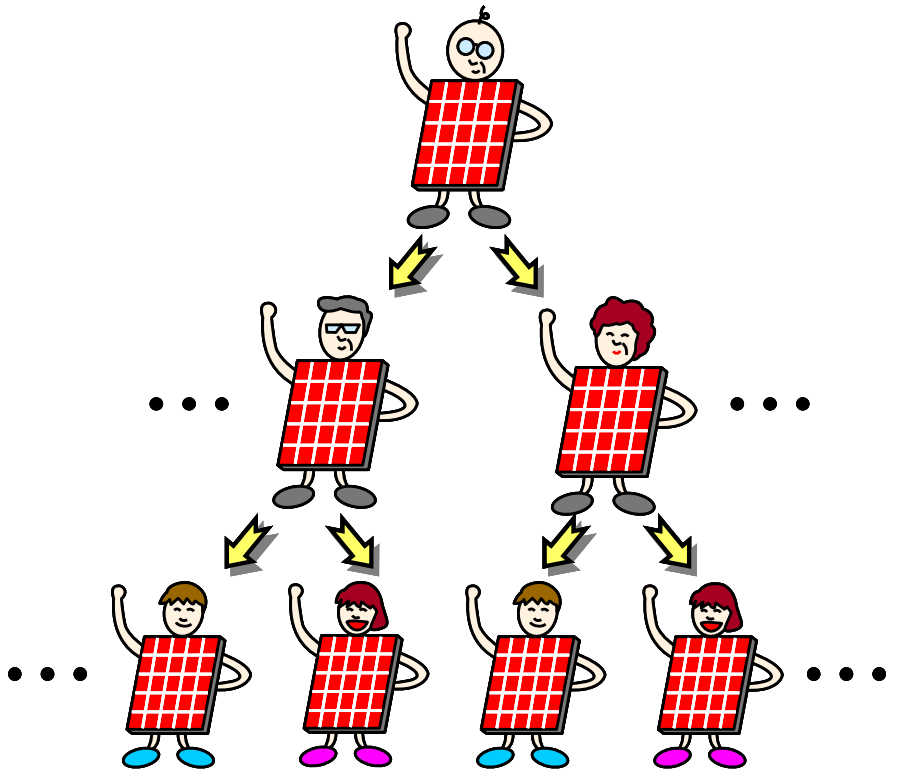
E_g: Energy that PV generates electricity for one year

1) a-Si solar cells

≒1 year

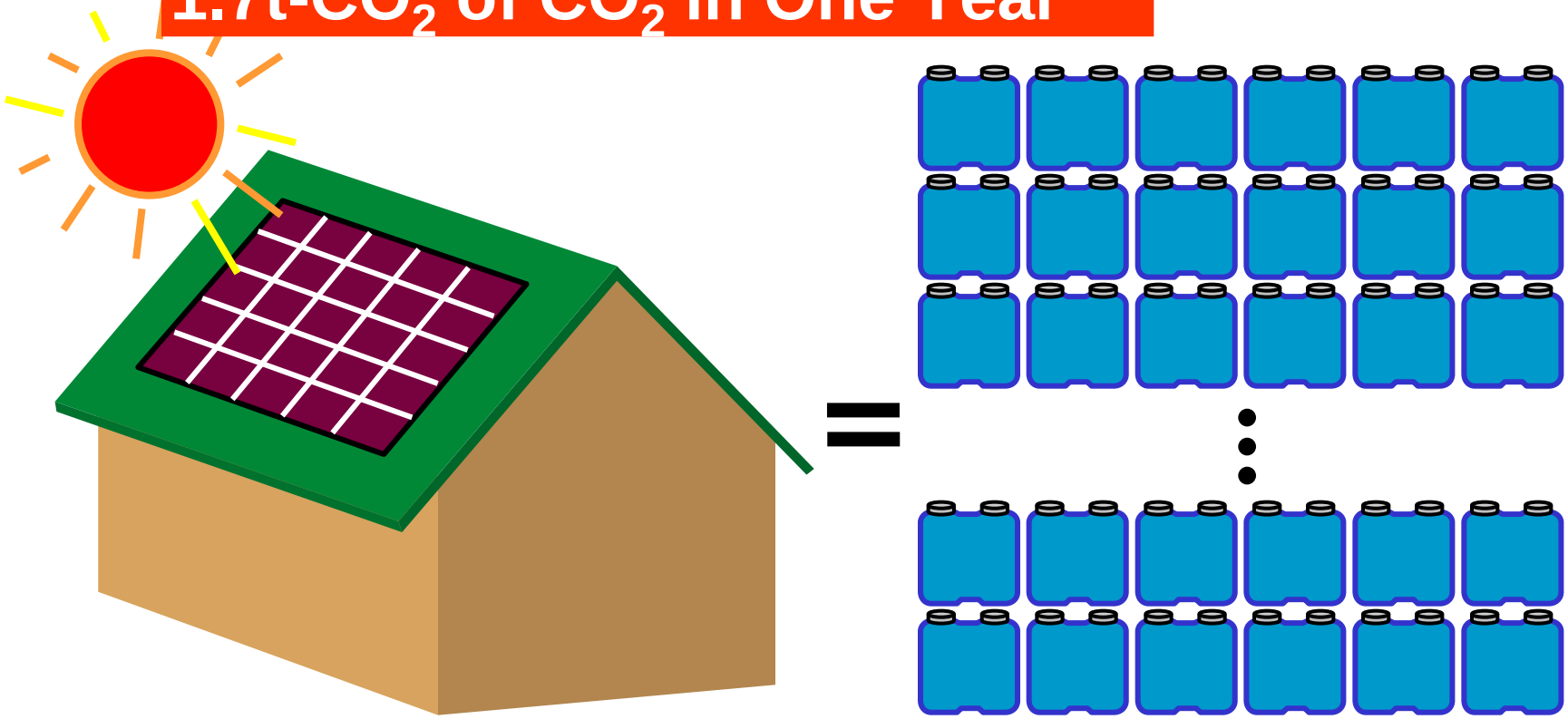
2) Crystalline Si solar cells

≒1.5-2 years



3kW PV System Saves About 630 l/year of Oil

3kW PV System Can Reduce 1.7t-CO_2 of CO_2 in One Year



Annual electrical power generated from 3kW PV system

35cans of oil (18l/can)

PV System as Basic Energy Supplier

【Conditions】		Electric energy	PV
4/5 of houses (21 million) with PV of 4kWp	・・・	67billion kWh	67GW
4/5 of apartment (0.44 million) with PV of 20kWp	・・・	7 billion kWh	7GW
4/5 of factory (420 thousand) with PV of 200kWp	・・・	67 billion kWh	67GW
Other public building	・・・	45 billion kWh	45GW
Very large PV	・・・	50 billion kWh	50GW

240GW in total

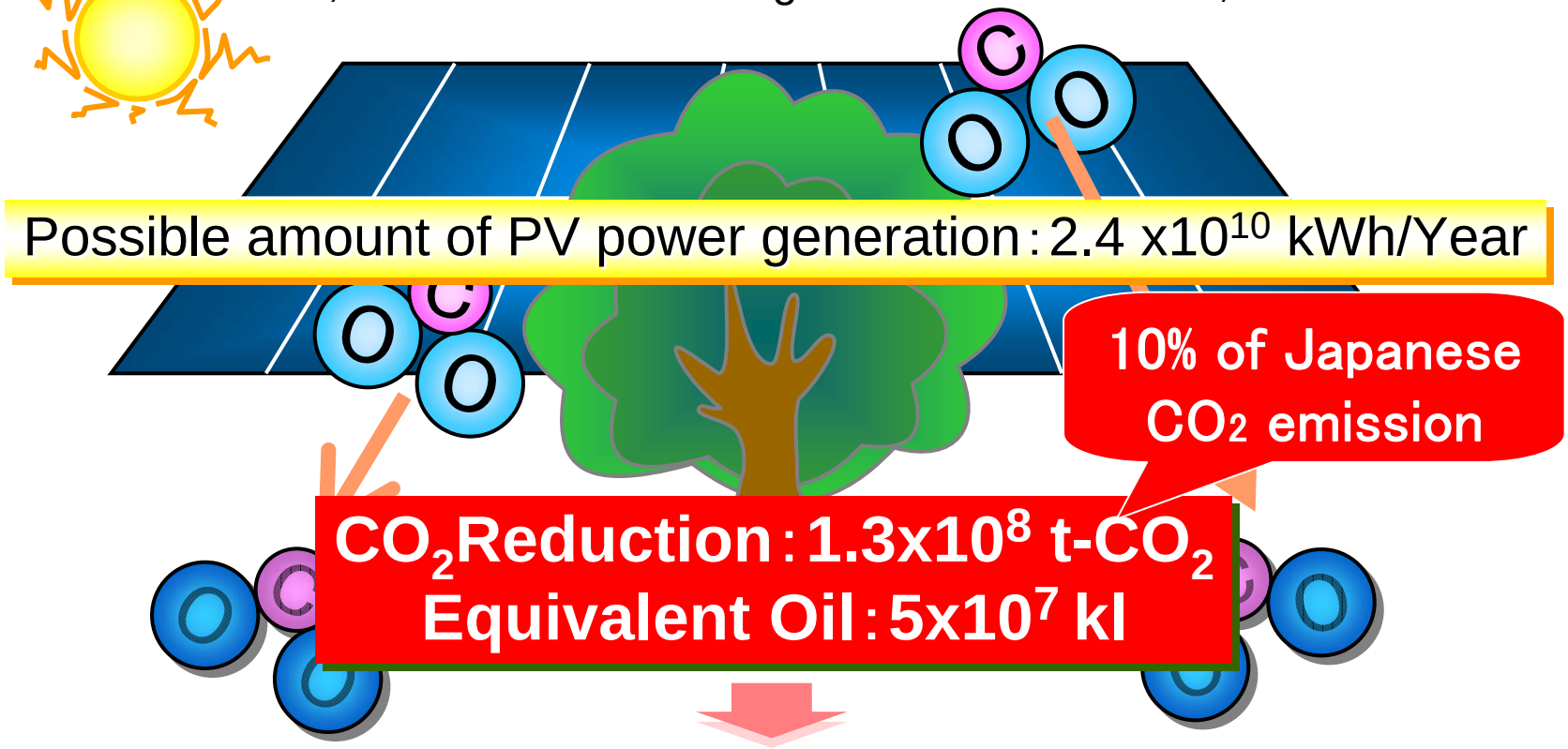
Capabiliy：240 billion kWh

Total demand（2006）:890 billon kWh

30% of electricity in Japan could be supplied by PV

Reduction of CO_2 by Photovoltaic Power Generation

if PV systems were installed in the roof of the Japanese private house, the roof of the building and the unused land,



Could reduce 20% of the current crude oil use

Dependence of the CO_2 Reduction by the Scale of the PV

（in one year）

Scale of the PV System	Quantity of Reduction of CO_2 (Unit ton)
1KW	**0.56**
1MW	**560**
1GW	**560,000**

‘What are the Challenges’ for PV

1. Results of 50 years of PV development

a. Efficiency increases: 4 to10 times（Silicon）

b. Cost reduction : 1/100

c. Practicability of reverse-flow PV system was confirmed

d. Module has more than 20 years of reliability

e. PV is effective for CO_2 reduction

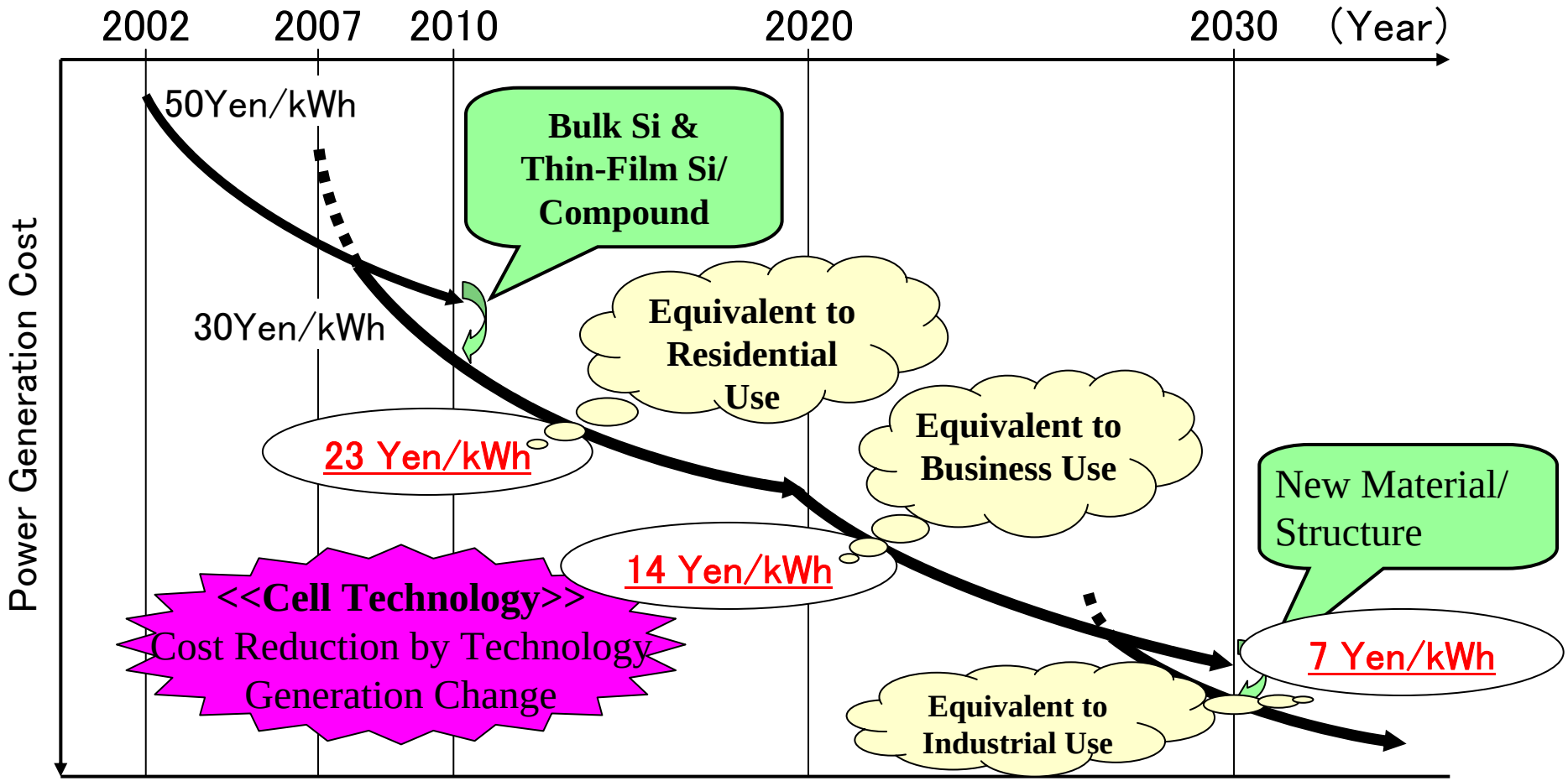
2. Future Challenge

a. Additional cost reduction needed: 1/2 to1/4

b. Reliability : from 20 Years to 50 - 100 Years

c. New Deal for the spread of PV

PV Roadmap Toward 2030 (PV2030)

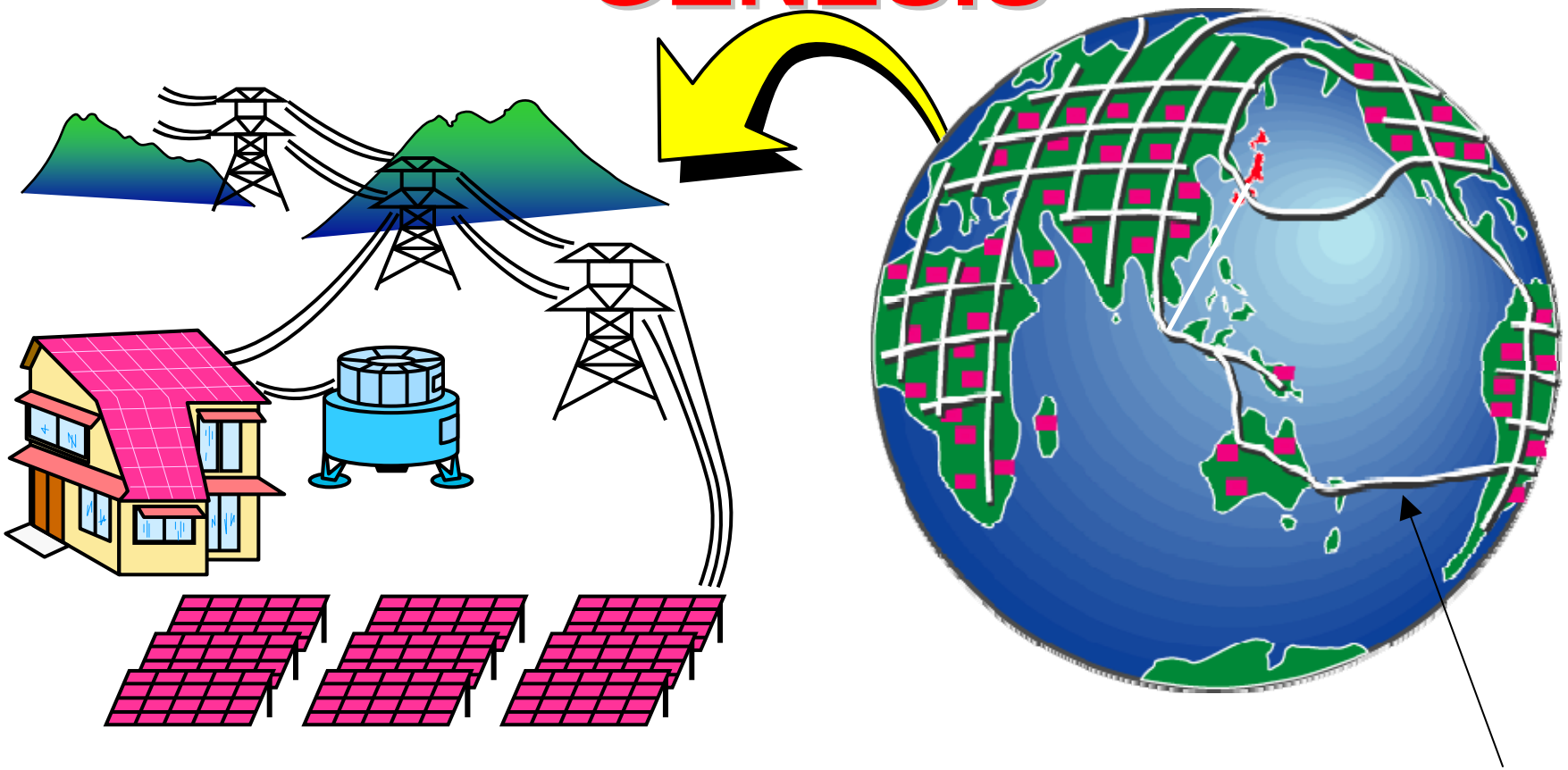


Source：NEDO"PV Roadmap Toward 2030"（PV2030）」

Global Energy Network Equipped with Solar Cells and International Superconductor Grids

GENESIS

Proposed in 1989



Solar Cells

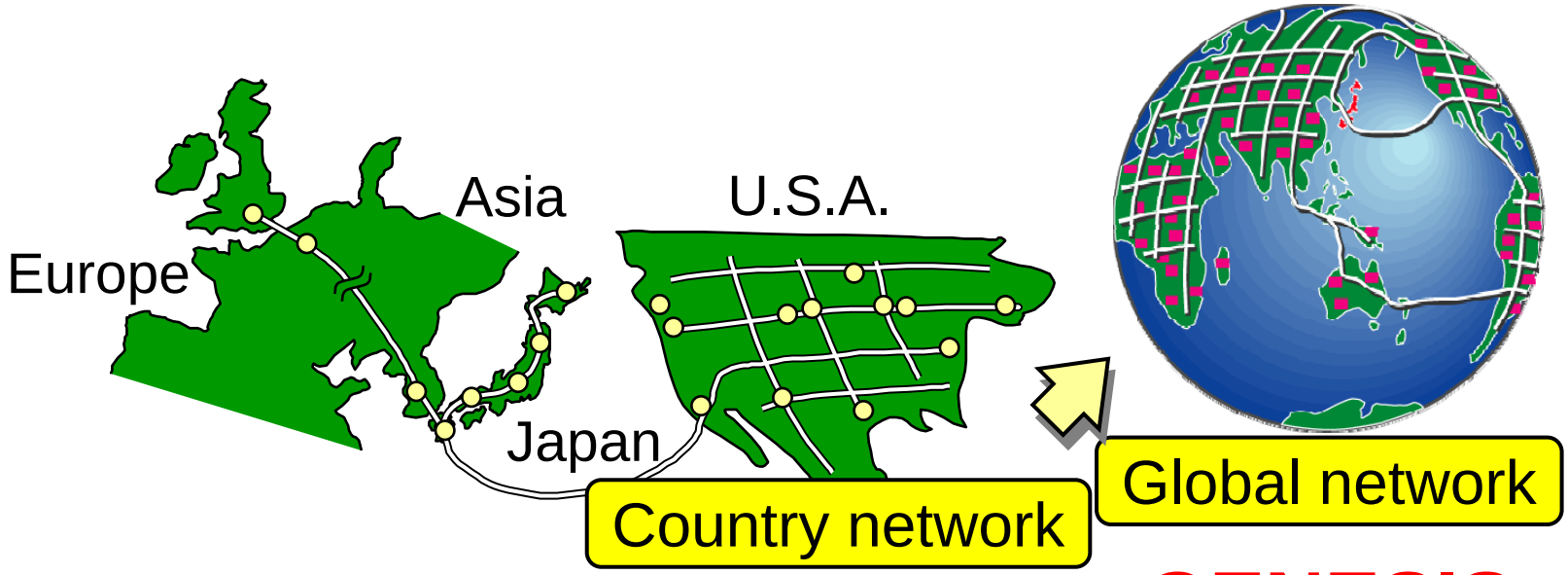
International Superconductor Grids

World's Energy Consumption and Required Solar Cell System Area

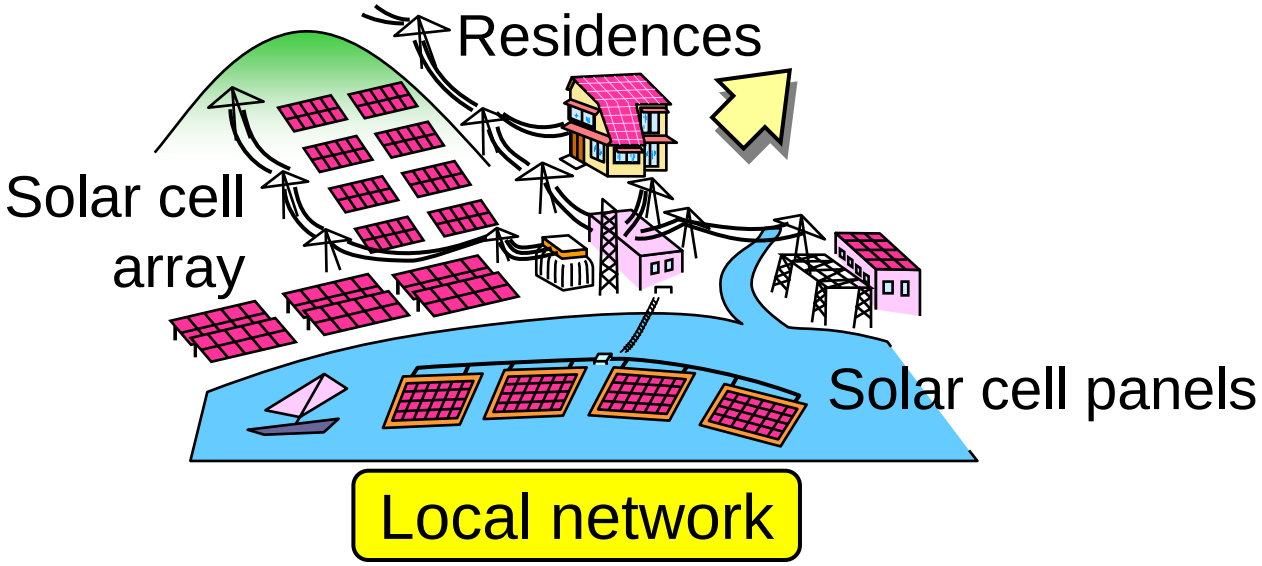
Year	Energy consumption (billion kl/y.)	System efficiency (%)	System area (km square)
2000	11	10	729
2010	14	10	802
2050	35	15	1,030
2100	111	15	1,850

4% of desert area

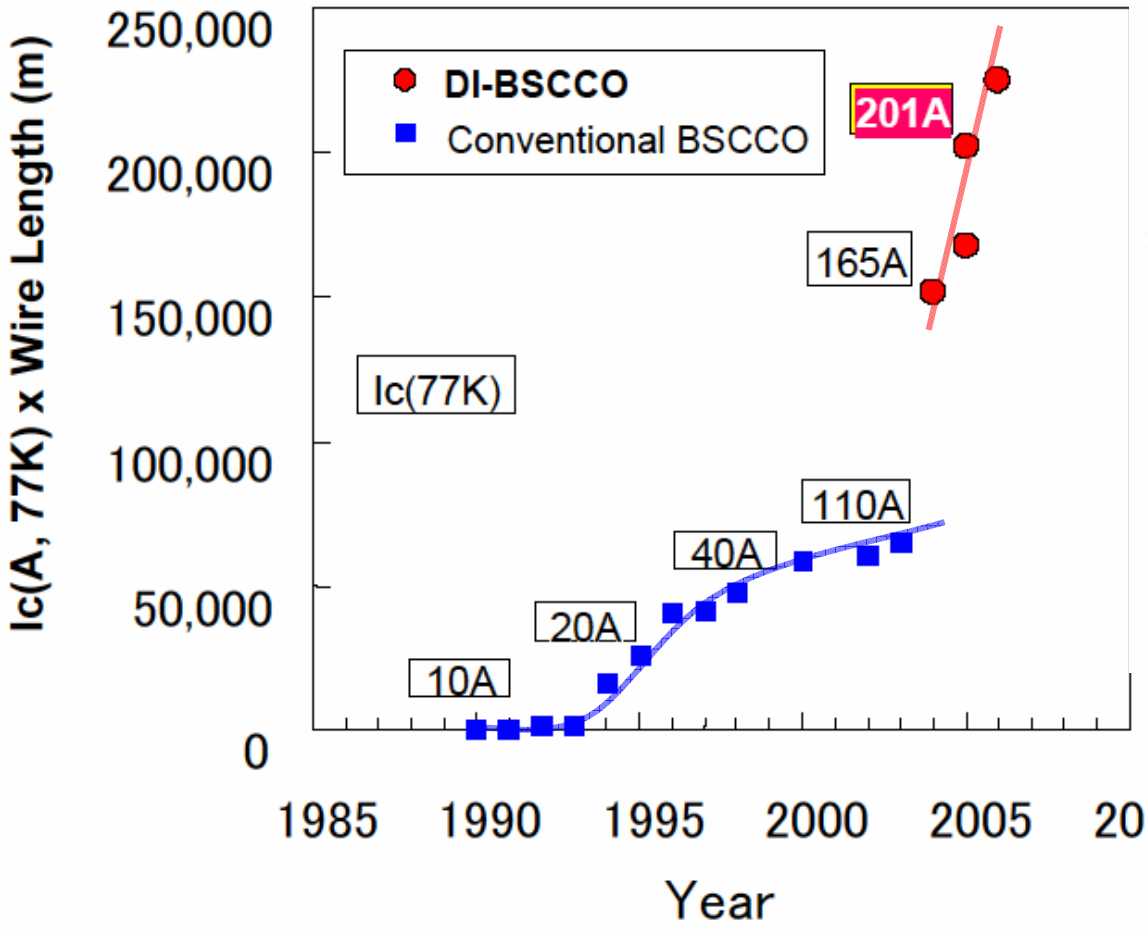
Step in the GENESIS Project

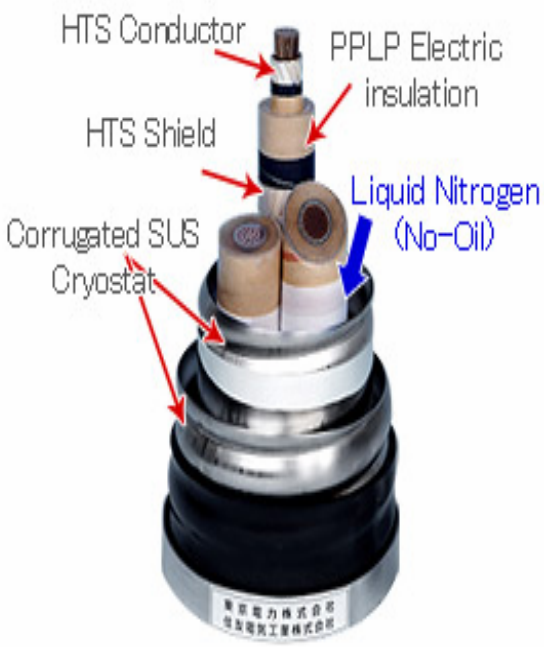


GENESIS



High-temperature superconducting Wire





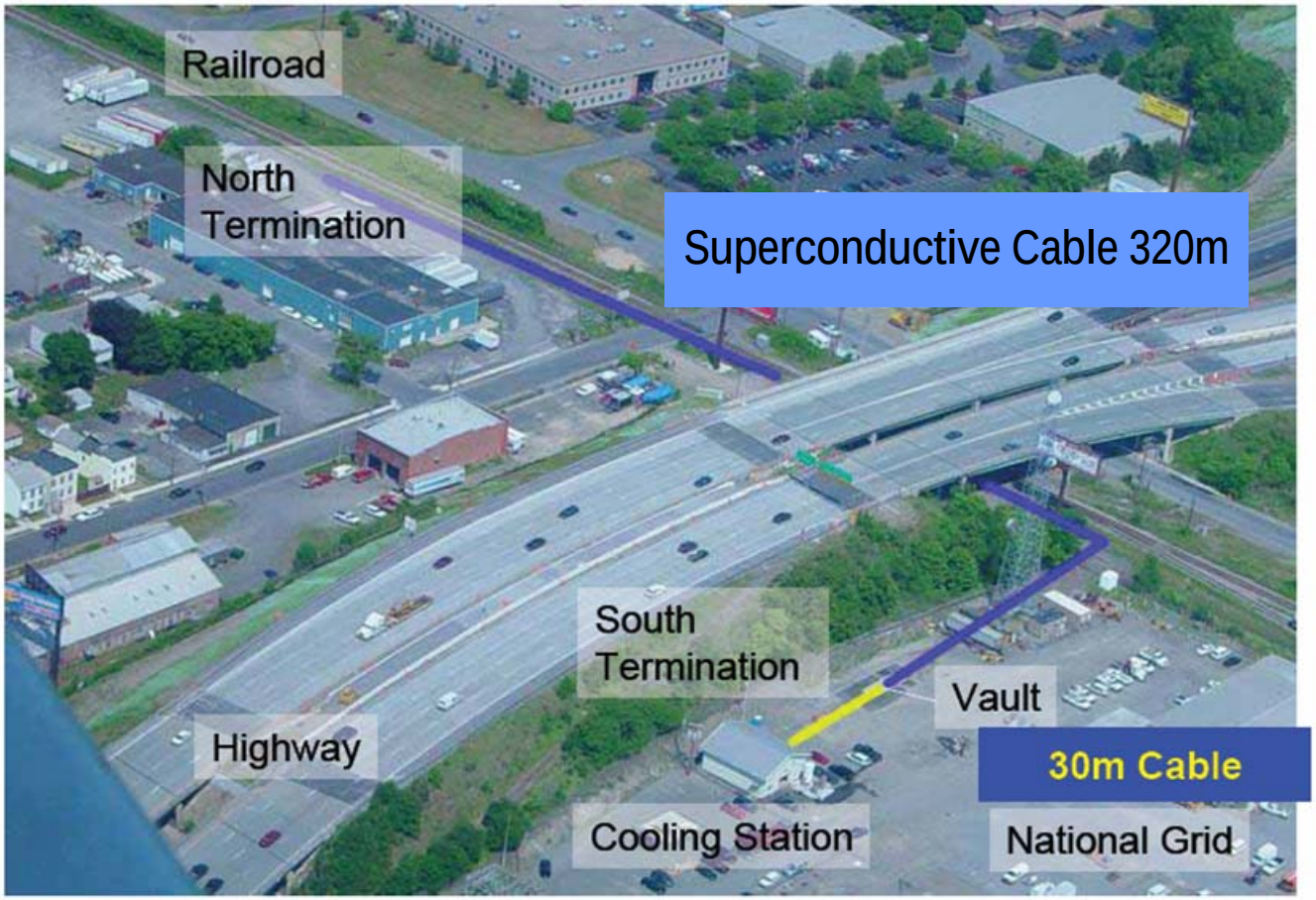
without Loss

Ingenious Dynamics

Source : Sumitomo Electric

In July of 2006

Albaney Cable (350m) site



SUMITOMO ELECTRIC INDUSTRIES, LTD.

Ingenious Dynamics

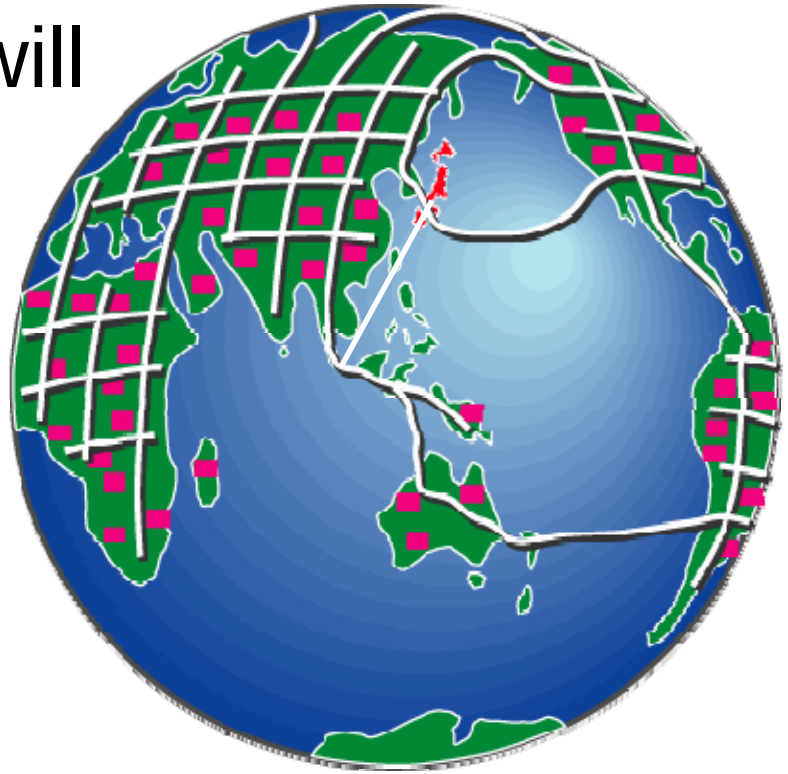
VIDEO


GENESIS

SILK ROAD GENESIS（SRG） Plan

Making Photovoltaic Power Generation on a Global Scale a Reality

If we mobilize all of our resources, we will resolve the global environmental and energy problems.



Thank you for your attention