Climate Change and Nuclear

―Two Issues of Waste Management―

2014-10-9

Energy Think Tank Co.Ltd

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1. Modern Civilization in short

・Renaissance：

・Social contract

・The Second Industrial Revolution

・Great Improvement of Productivity

・Energy Revolution（Coal, Oil, Nuclear ・ ・ ・）

・Pollution problem（NOX,SOX、PM2.5 Waste of Fossil Fuel）

・1970 Limits to Growth

・ Oil Crisis

・1990～ International issues on Climate Change（ Waste of Fissile Fuel ）

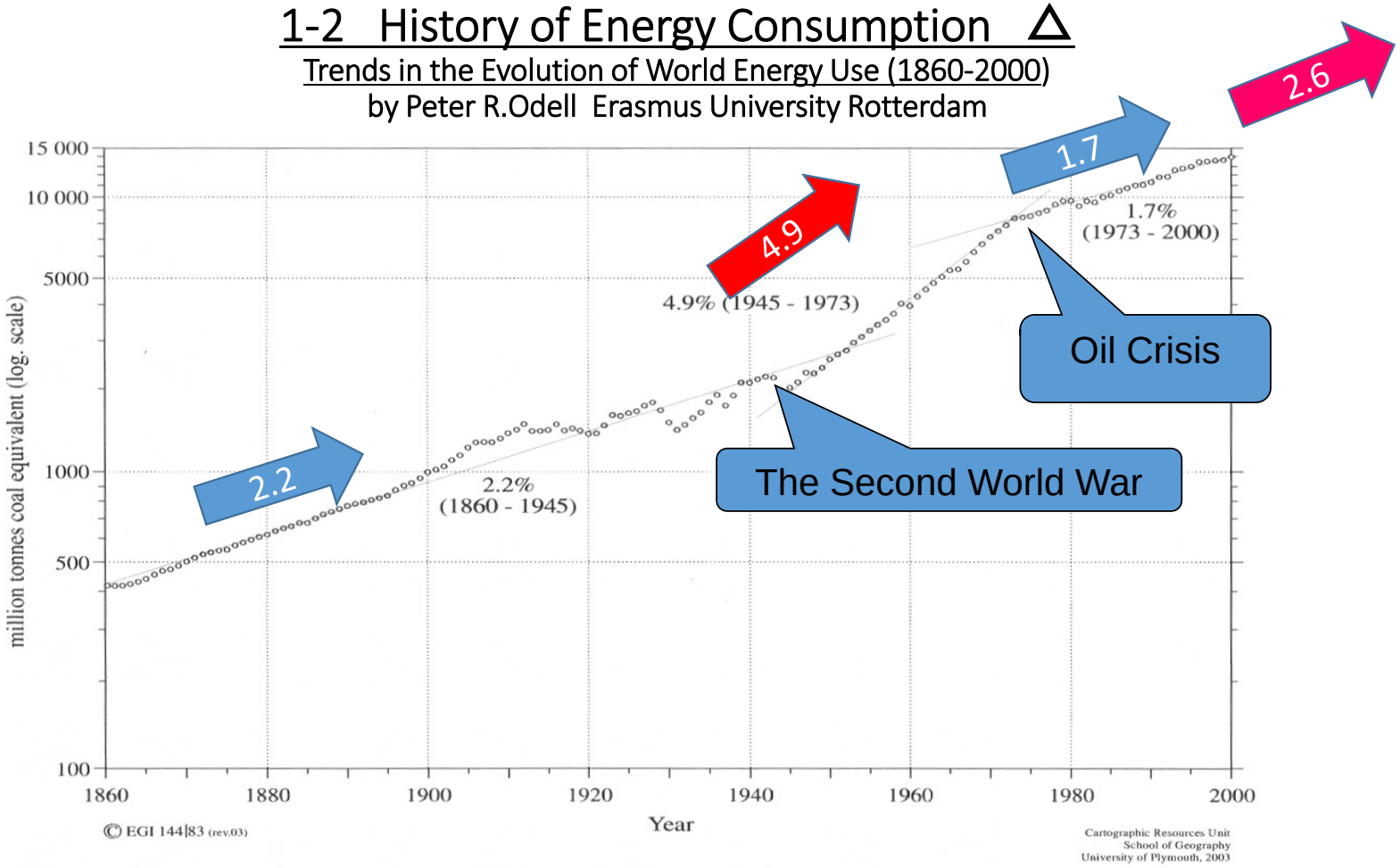
・2001～

・Economical Growth in Developing Countries

1-2 History of Energy Consumption △

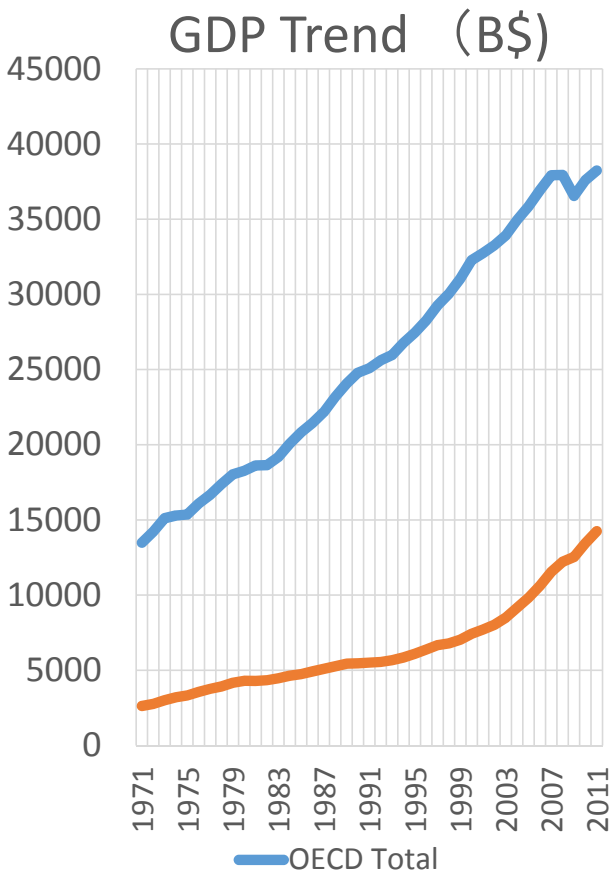
Trends in the Evolution of World Energy Use (1860-2000)

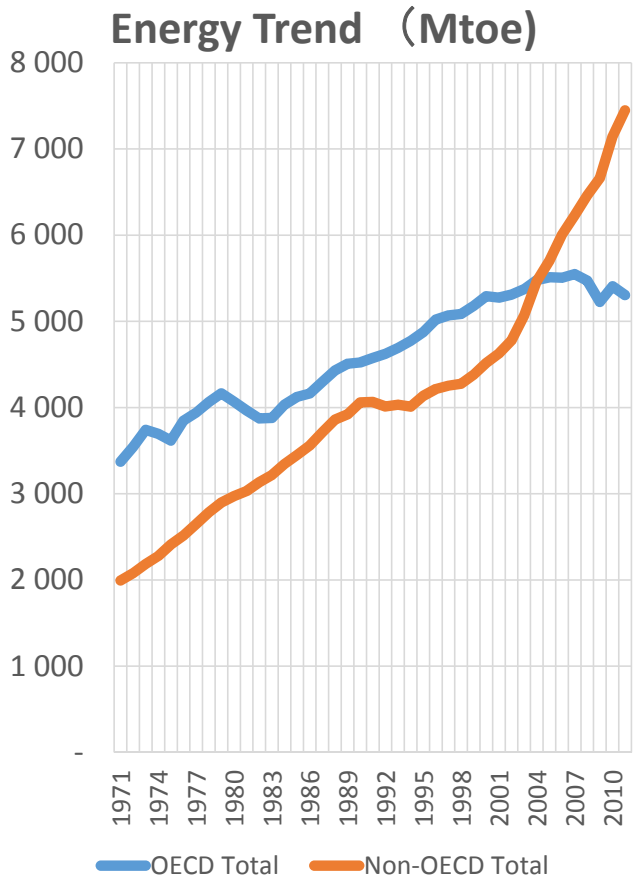
by Peter R.Odell Erasmus University Rotterdam

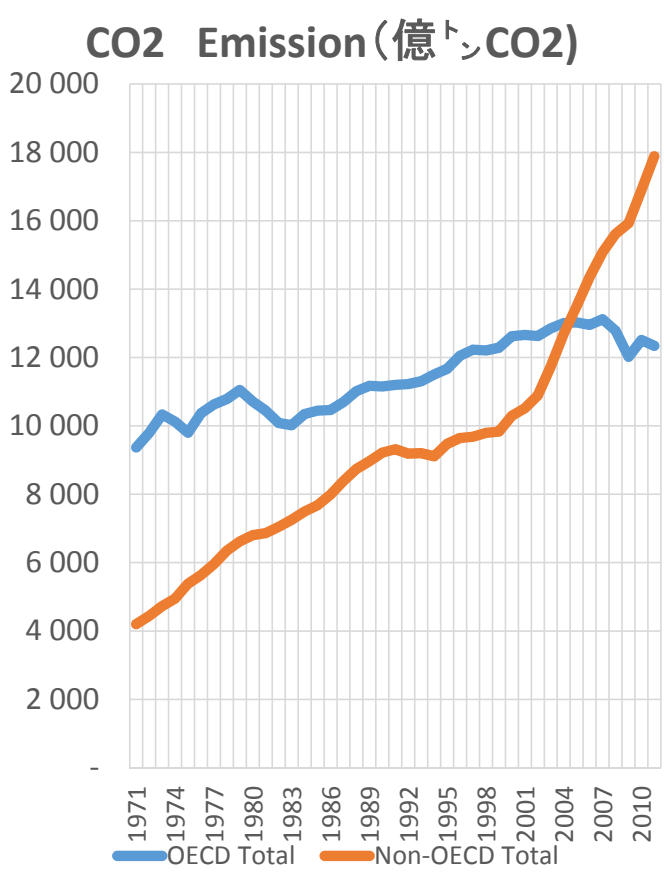


1860～1945年：2.2%　1945～1973年：4.9%　1973～2000年1.7%　2000～2010年2.6%

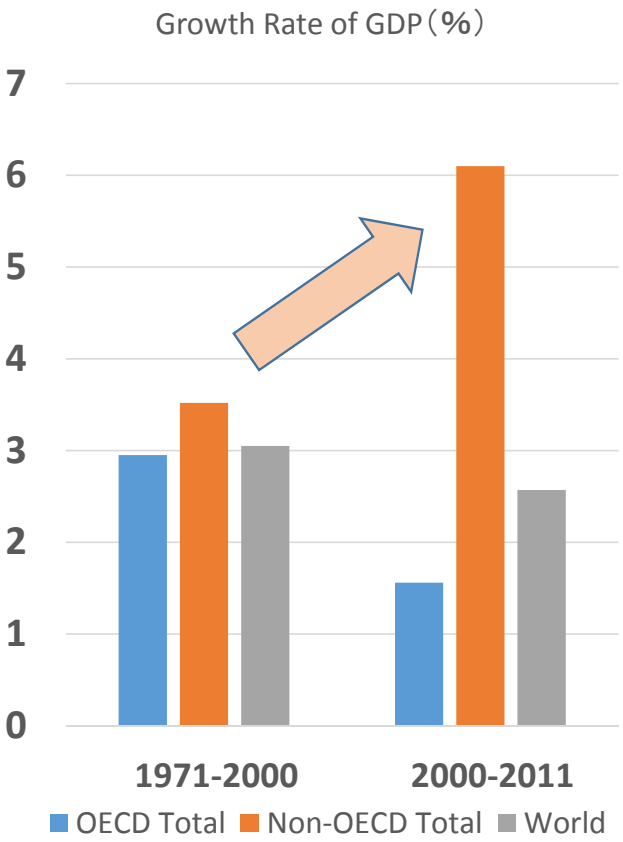
2-1　1971-2011▪Trend of GDP▪Energy and▪CO2Emission

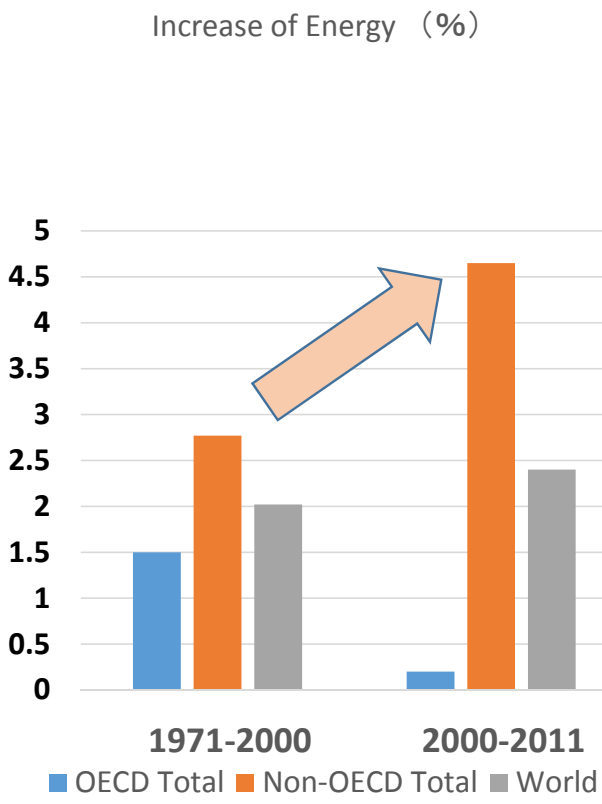


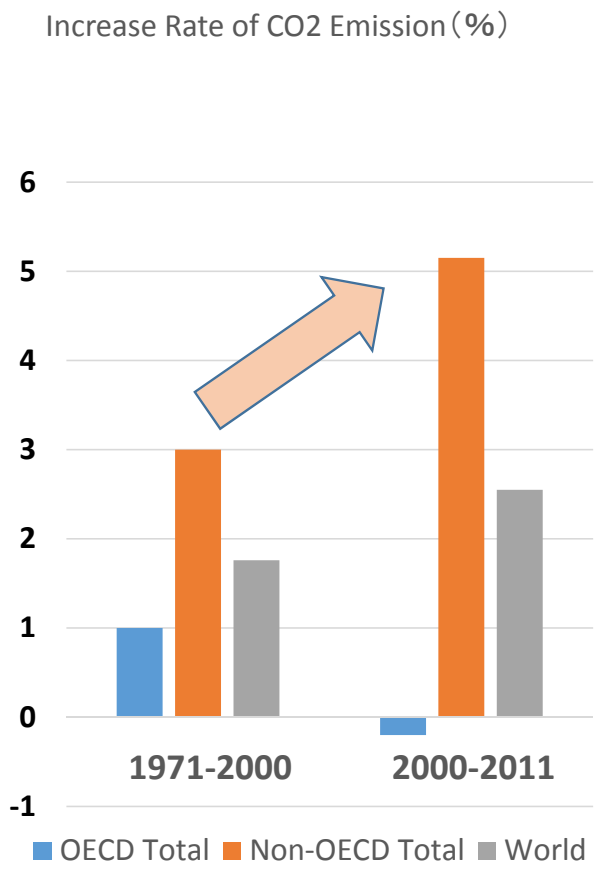




2-3 World GDP ,Energy and CO2 Emission

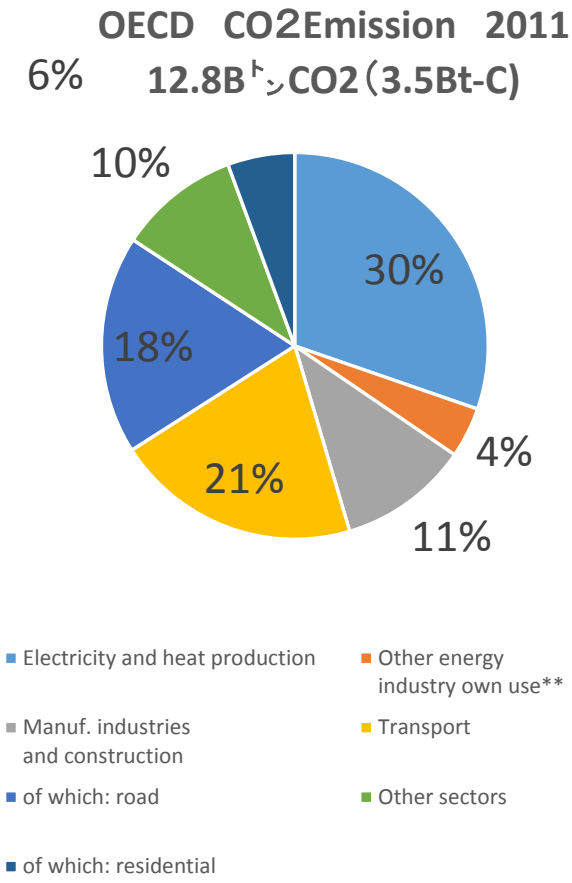






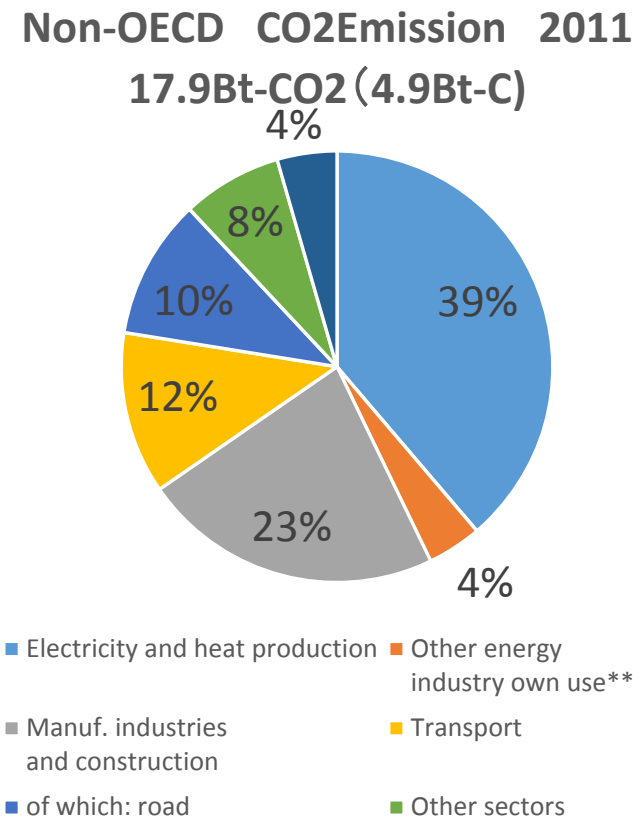
2-4 CO2Emission 2011（IEA Data） ◎

Waste of Fossil Fuel

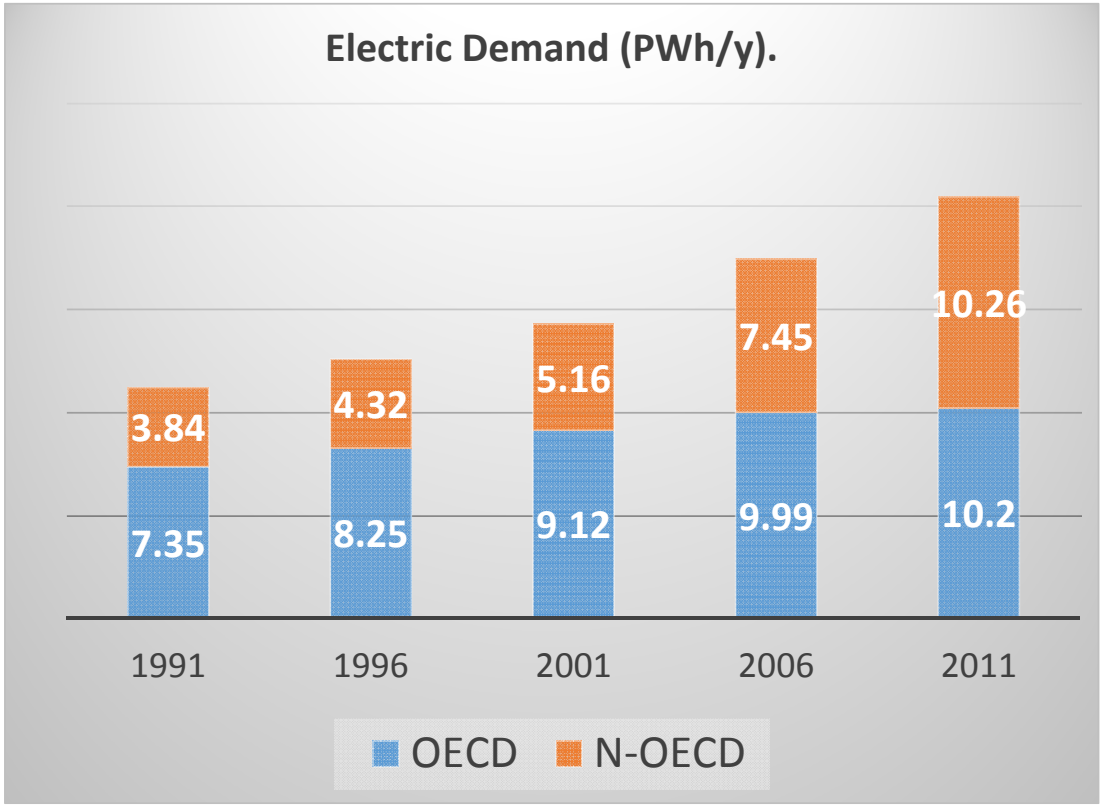


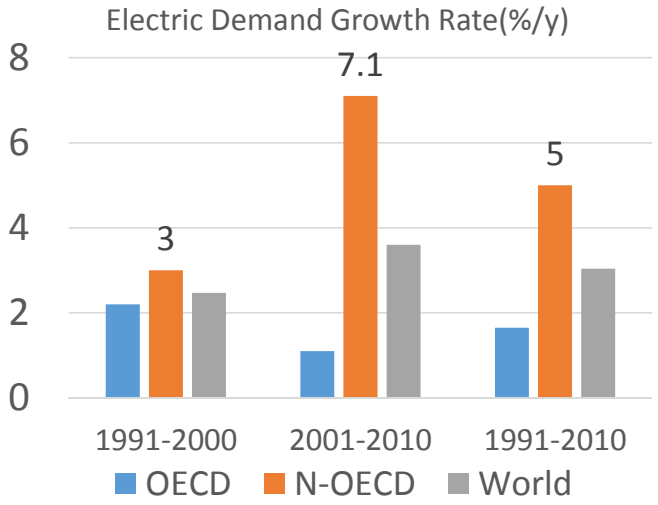
・**30～40%：Electricity**

・Transportation
40%：OECD 、
22%：Non OECD
➡Argent Grosse in Next 30years
➡HC（Hybrid Car）、**EV、FCV（Fuel Cell Vehicle)**

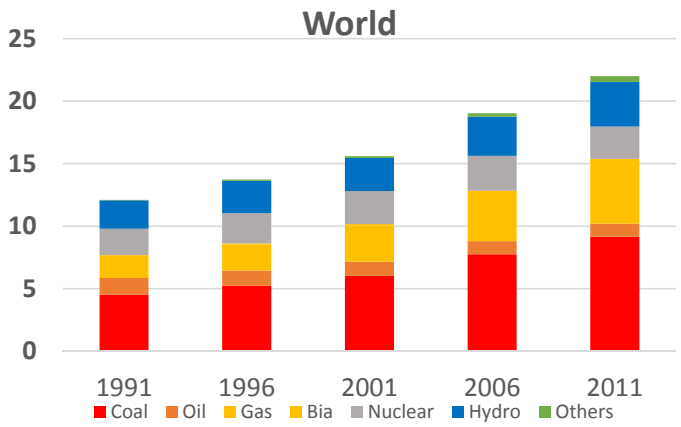


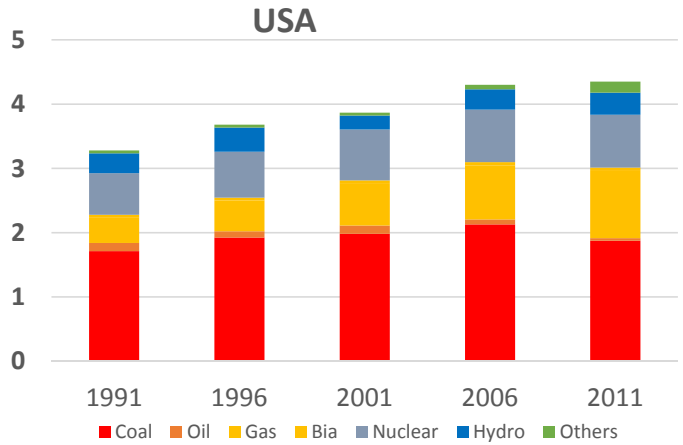
2-5 World Electricity

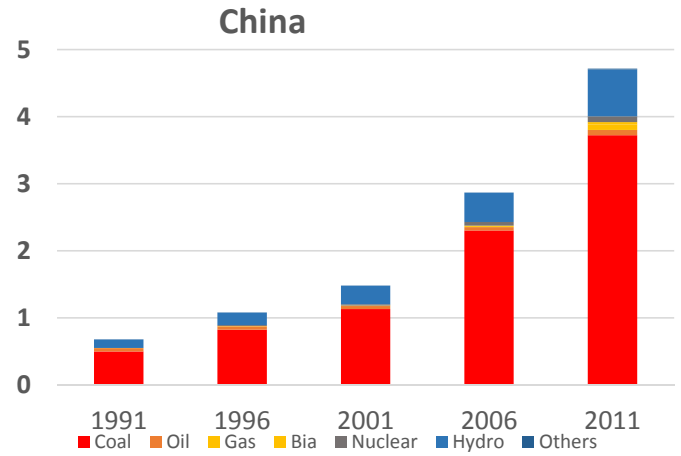


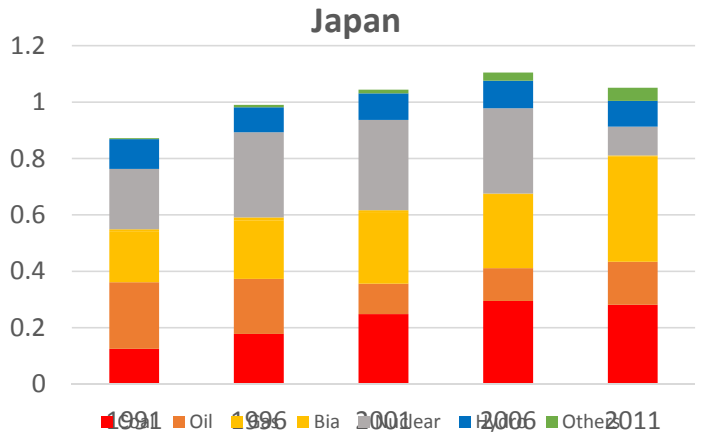


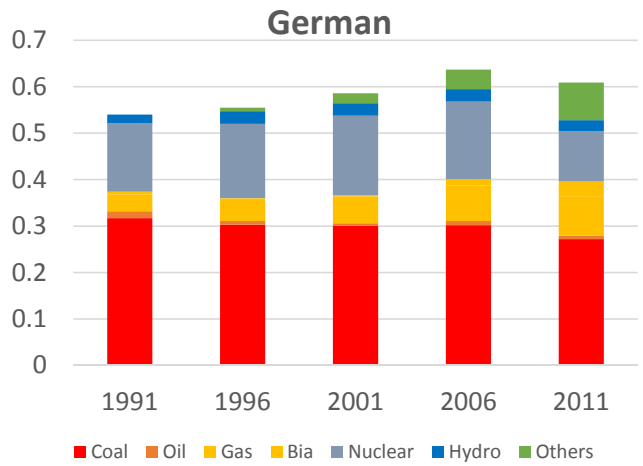
2-6 World Electricity Generation（PWh）◎

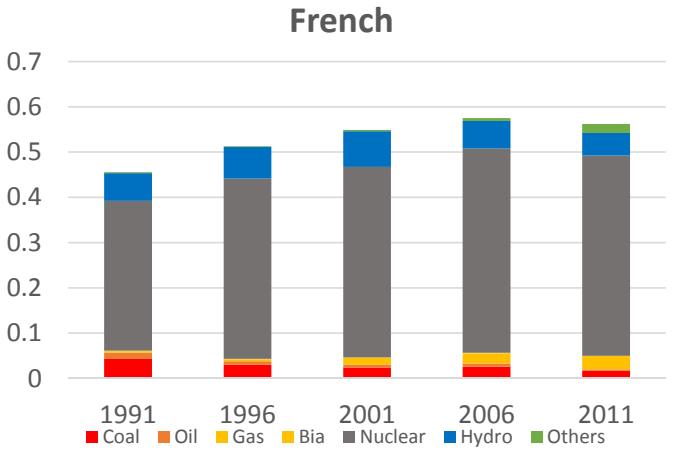






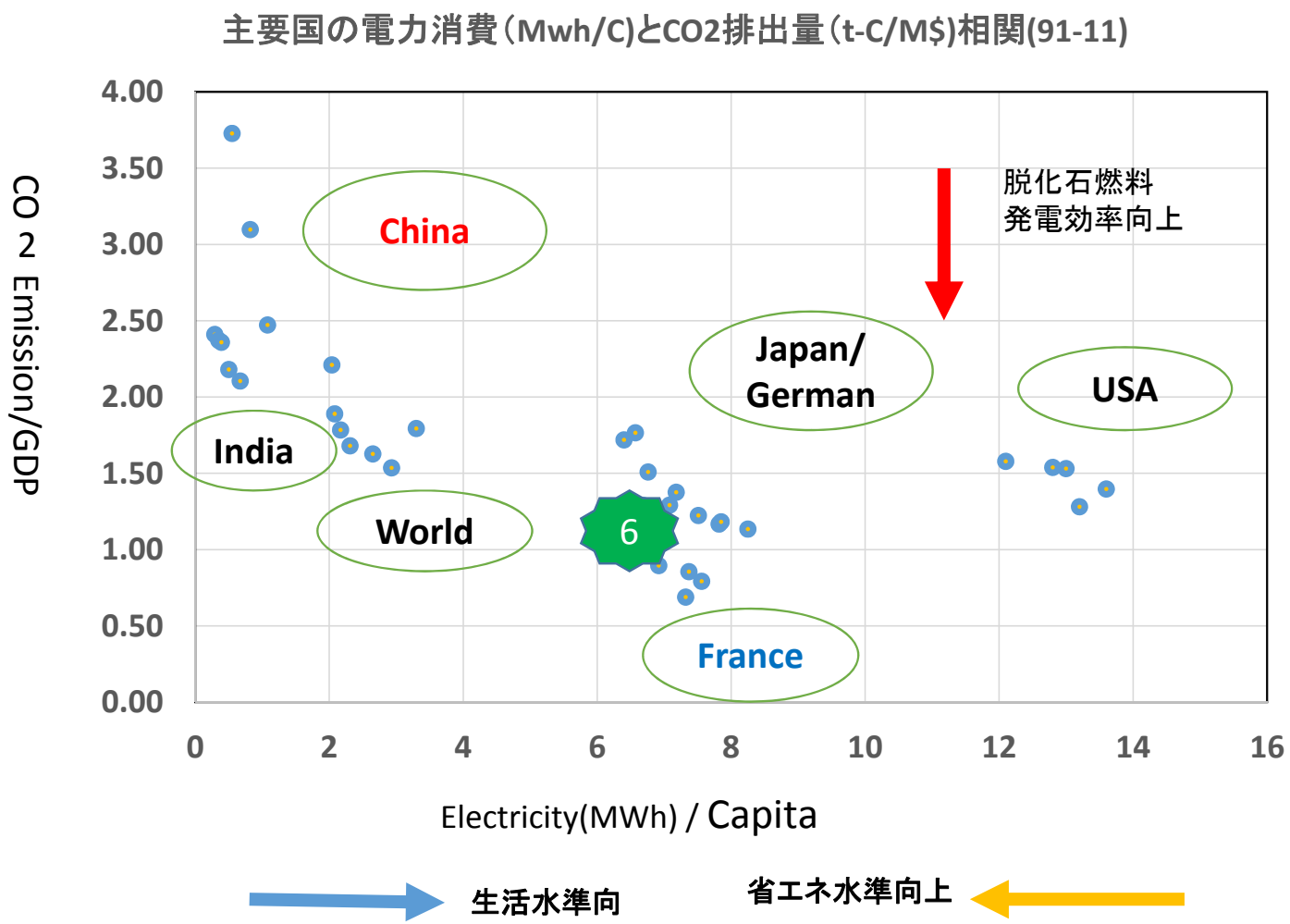






注：Efficiency of thermal Plant（ave 09-11）：China35%、USA41%、Japan45%、India30%、World37%

2-7　Electricity Consumption and CO2 Intensity

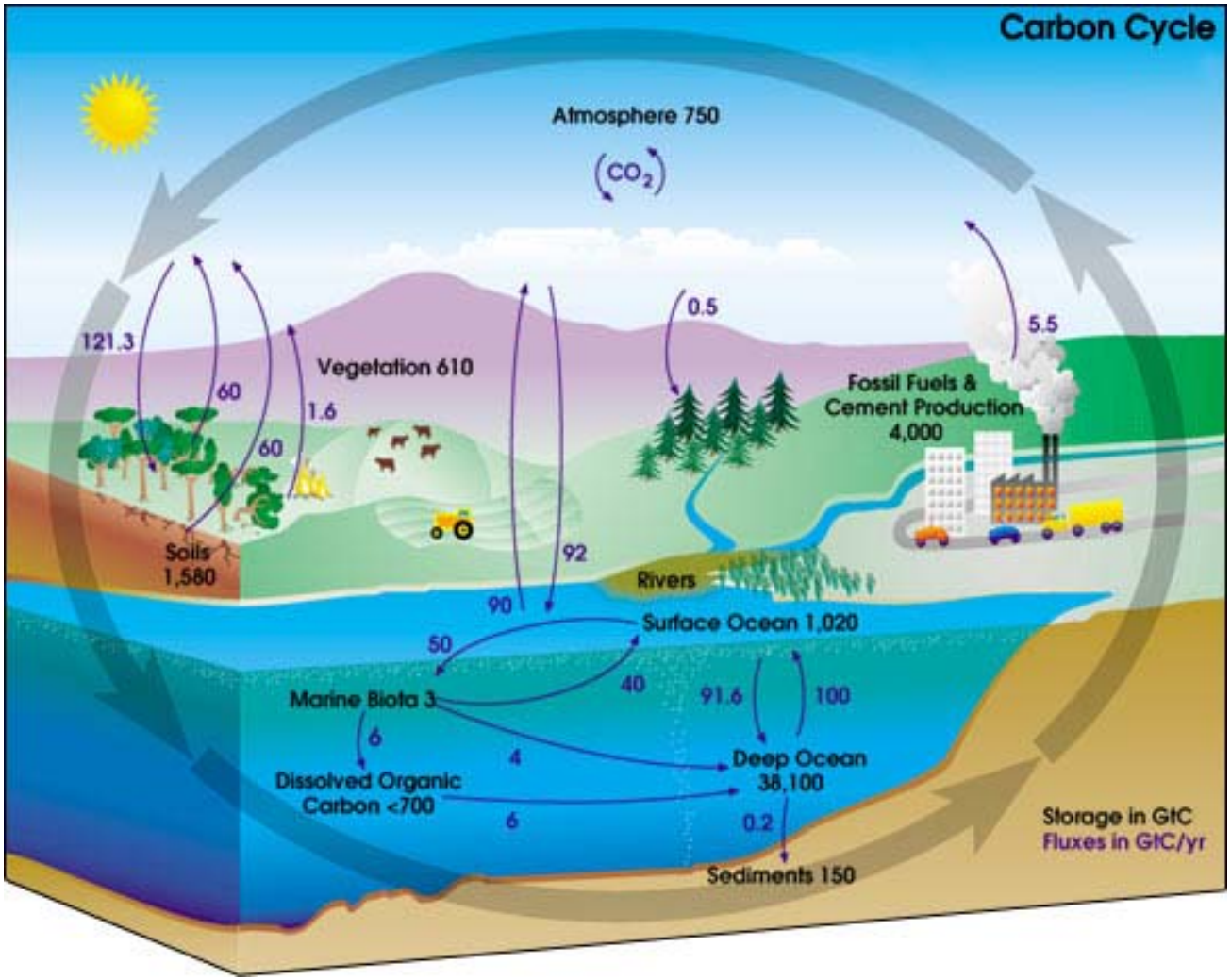


1．OECD countries
- ＊ Much consumption, Low CO2 Intensity by better thermal efficiency
- ＊Especially better CO2 intensity by Nuclear in France

2．Non-OECD countries
- ＊ Less consumption,　but High CO2 intensity by low thermal efficiency

3．Improvements
- ＊High thermal efficiency
- ＊Fuel conversion to natural Gas
- ＊Nuclear
- ＊Renewable　Energy

3-1 Climate Change Carbon Cycle

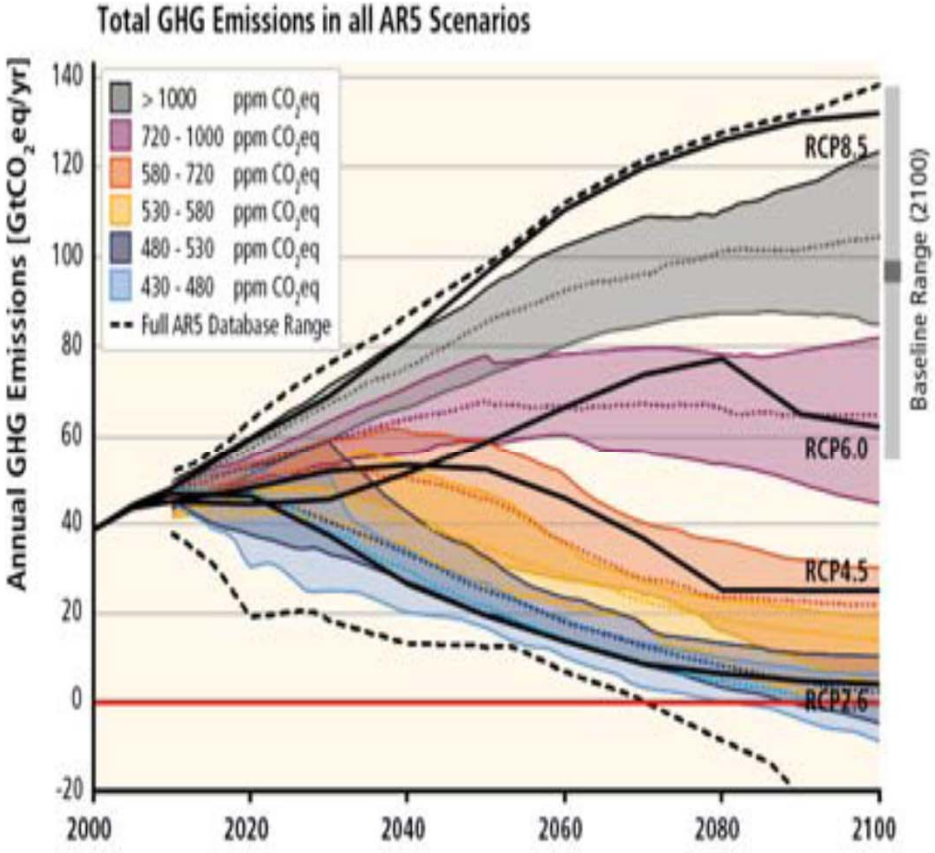


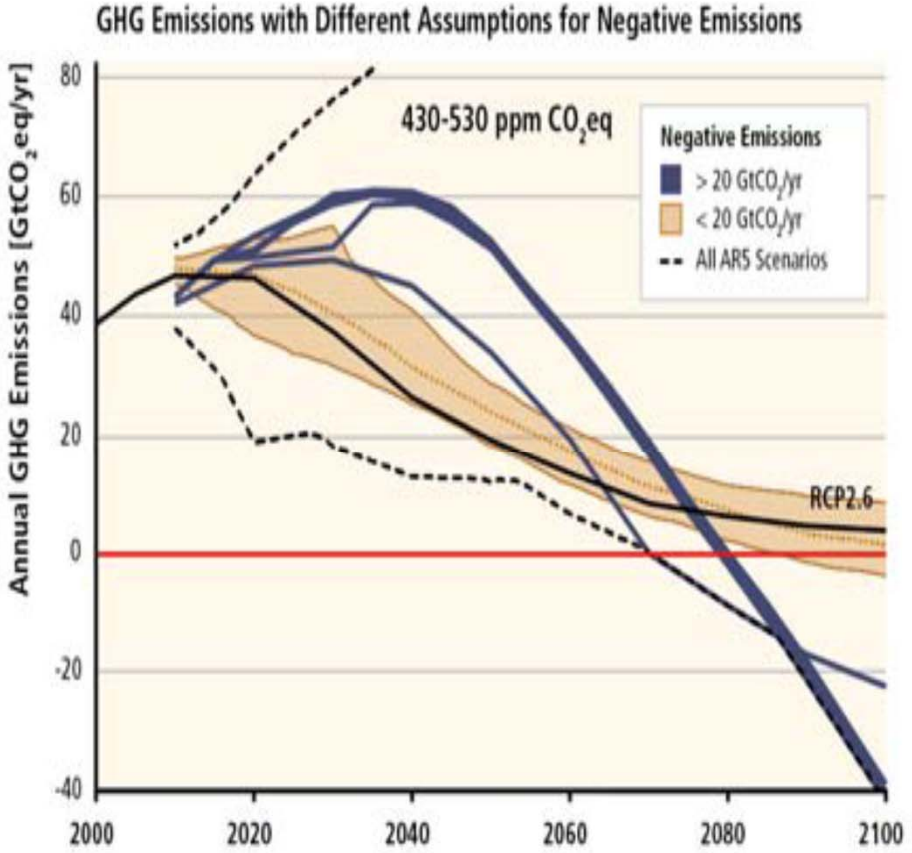
Increase CO2 in atmosphere is about 60% of artificial emission in 1980-1990.
About 40% CO2 absorbed in sea.

Sample
Material Balance Bt-C

- **Emission** **55**
- Natural
  - **Sea（排出900-吸収920）** **-20**
  - Forest -5
  - Land（排出1216-吸収1213） 3
  - Balance in nature -22
- Total Balance 55-22 ＝＋33

3-2 IPCC No.5 Report GHG Emission





IPCC Recommendation ：Target 40～70%Save of 2010 Emission.

注）GHG（CO2eq):Including CH4 etc. Artificial CO2 emission is about 65%。

3-3　No.5 IPCC Recommendation

2014・3　IPCC Recommendation

＊Target Co2 Emission at 2050（450ppm、<2℃）

2.7～5.3Gt-C　(CO2 8.86Gt)

←40-70% Saving at 2010 CO2 Emission(8.86Gt-C)

＊Allowable CumlativeCO2 Emission（2010-2050）　280Gt-C（-40%）

CumlativeCO2 Emission

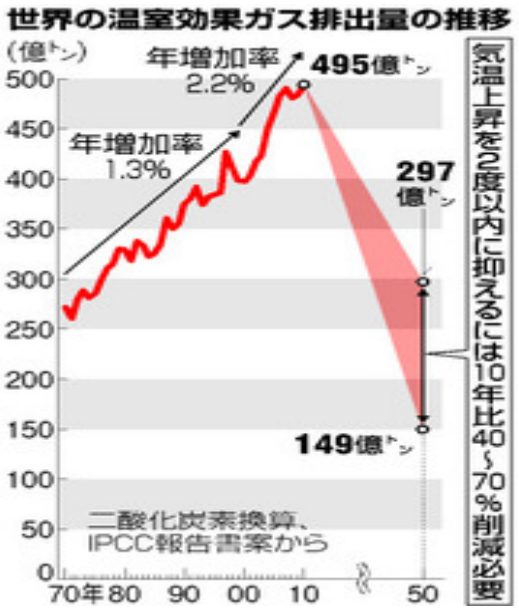
Predictive value CO2 Emission 2010～2050

500～600Gt-C

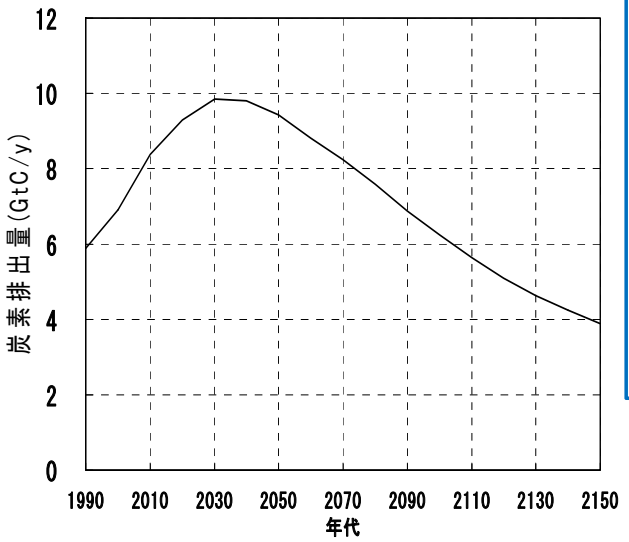
IPCC Recommendation　～280Gt-C

550ppm　Curb　～360Gt-C

We should save CO2 Emission 140～220Gt-C



WRE550(Typical 550ppm Curb)



Typical Saving CO2 Emission (Sample)

・Coal Fire 1GWe　CO2 Emission1.6Mt-C/y

40years　64Mt-C

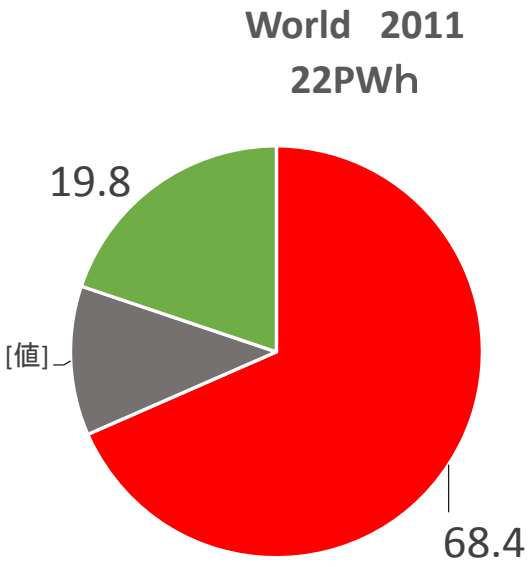
1000Units/40years　64Gt-C➡NG 32Gt-C

Save CO2 Emission 32Gt-C

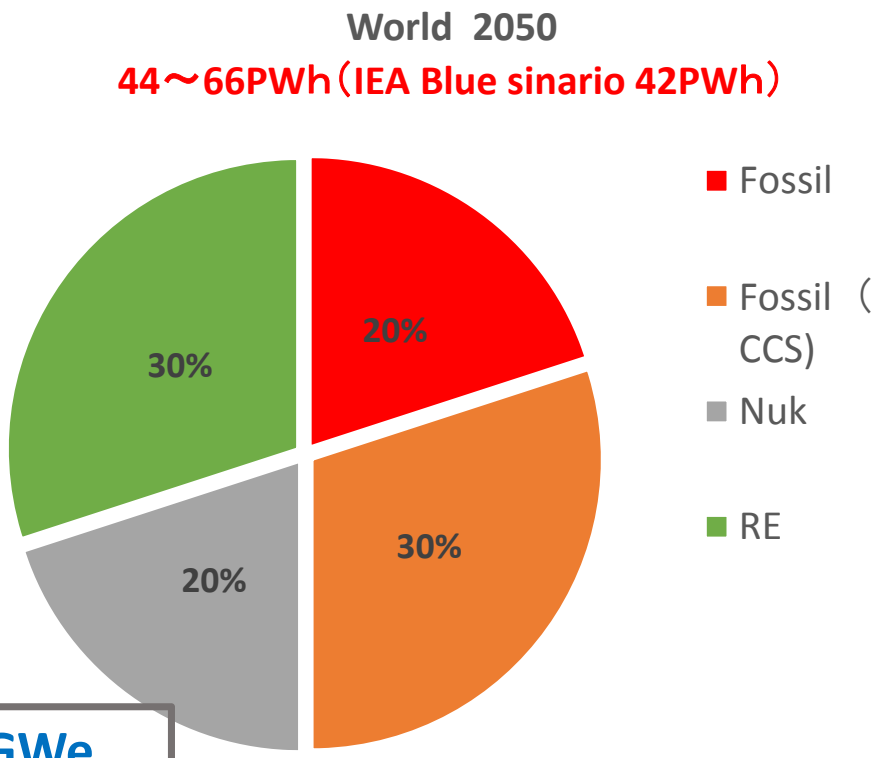
・Nuclear 400 Units to 1000Units 2050

Save CO2 Emission 42Gt-C

4-1 Electricity Present and 2050 Request for Nuclear（Demand)



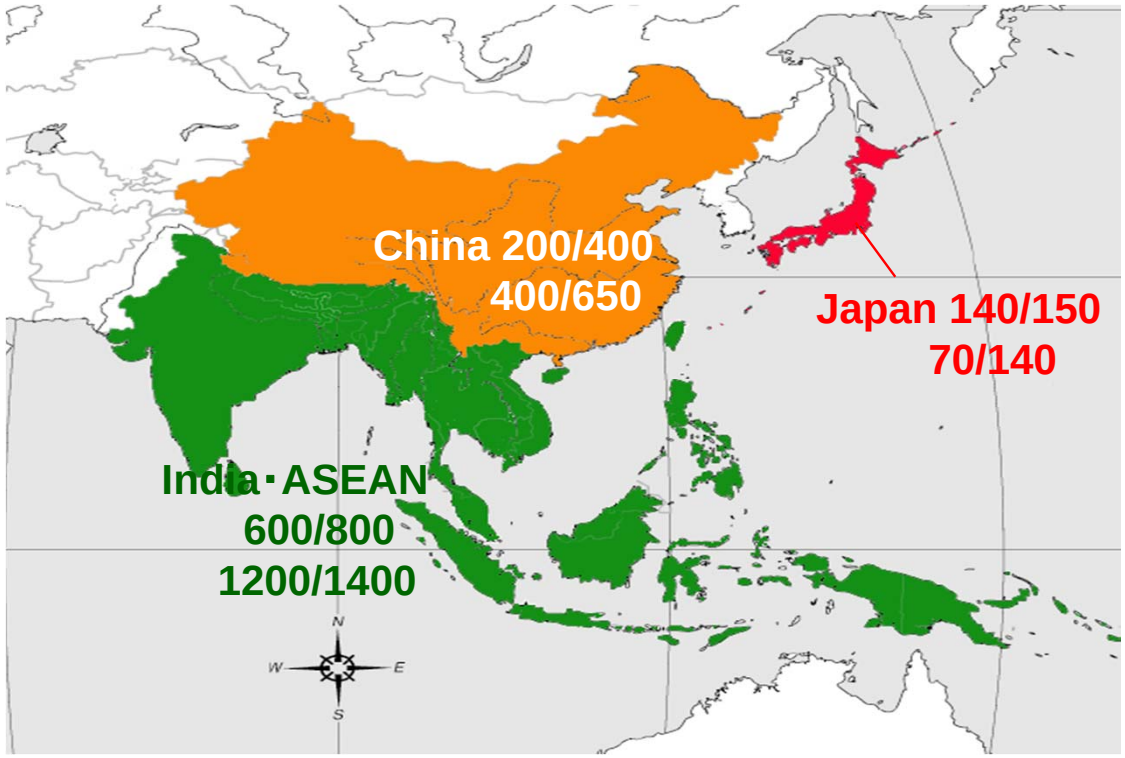
1. IPCC suggest max.80%
   Electricity supply by Low Carbon System
2. Fuel Conversion From Coal to Natural Gas.
3. CCS
4. Nuclear
5. Renewable Energy



Nuclear 2000GWe
Expect ～1000GWe?

4-2 Nuclear Perspective in Asia ◎

（Typical Simulation Result 550ppm by GRAPE）



※2050年/2100年
上段：現実ケース
下段：アジアエネルギー拡大ケース

＊Simulation Result meanses
"**World Government and Planning Economic Policy for 100years "**
The Result shows the optimum solution of cost under the constrains.

450ppm 2050年
＊RITE* 2050 15～17PWh(～2000GWe)
＊IPCC Ave.1400GWe,Max 2200GWe (21Cases)
＊EU WETO－2：約2000~2500GWe

IAEA Perspective（2050年）
World 440～1113GWe
Asia 240～ 574GWe

Garment Plane（2050）
China 300～400
India ～300

4-3 Natural Resource and Plant Supply

（1）Natural Resource

a. Confirmed	～7.5Mt
b. a+ speculative	～18Mt
Non Covetional	～ 3Mt
U in Sea	～4Bt

Past Record in 1950~2007	
Reactor Operation	10000GWy
Total Electricity	70PWh
Used U	~1.6Mt
Producted Puf	～1600t

Pu Fuel Resource

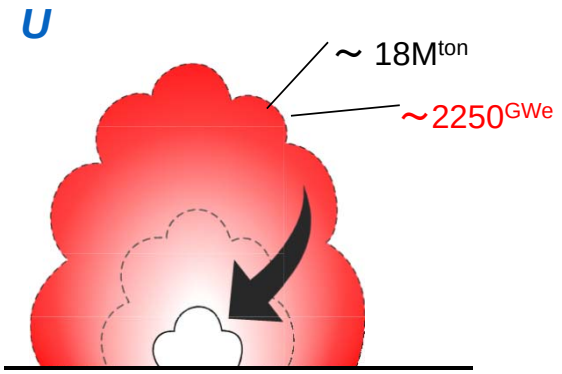
Originated in LWR

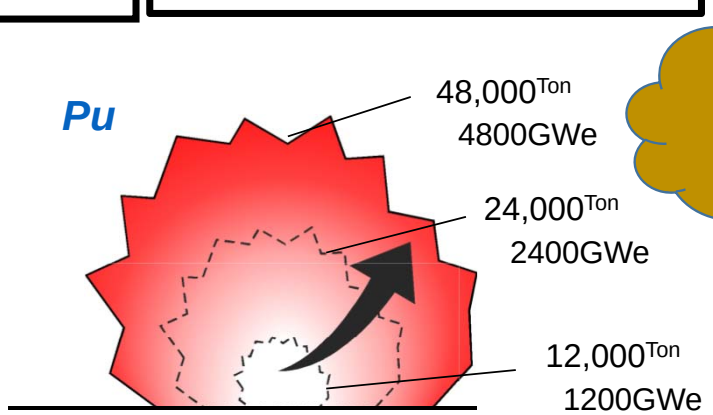
2010 **Confirmed Resource**

Puf 1600t＋MA 160t

Specific Character

Breeding characteristic by FR





（2）Plant Construction etc.

＊Plant construction（Heavy Component、Engineer、・・・）

＊Plant Operation ,Maintenance, Repair Staff etc.

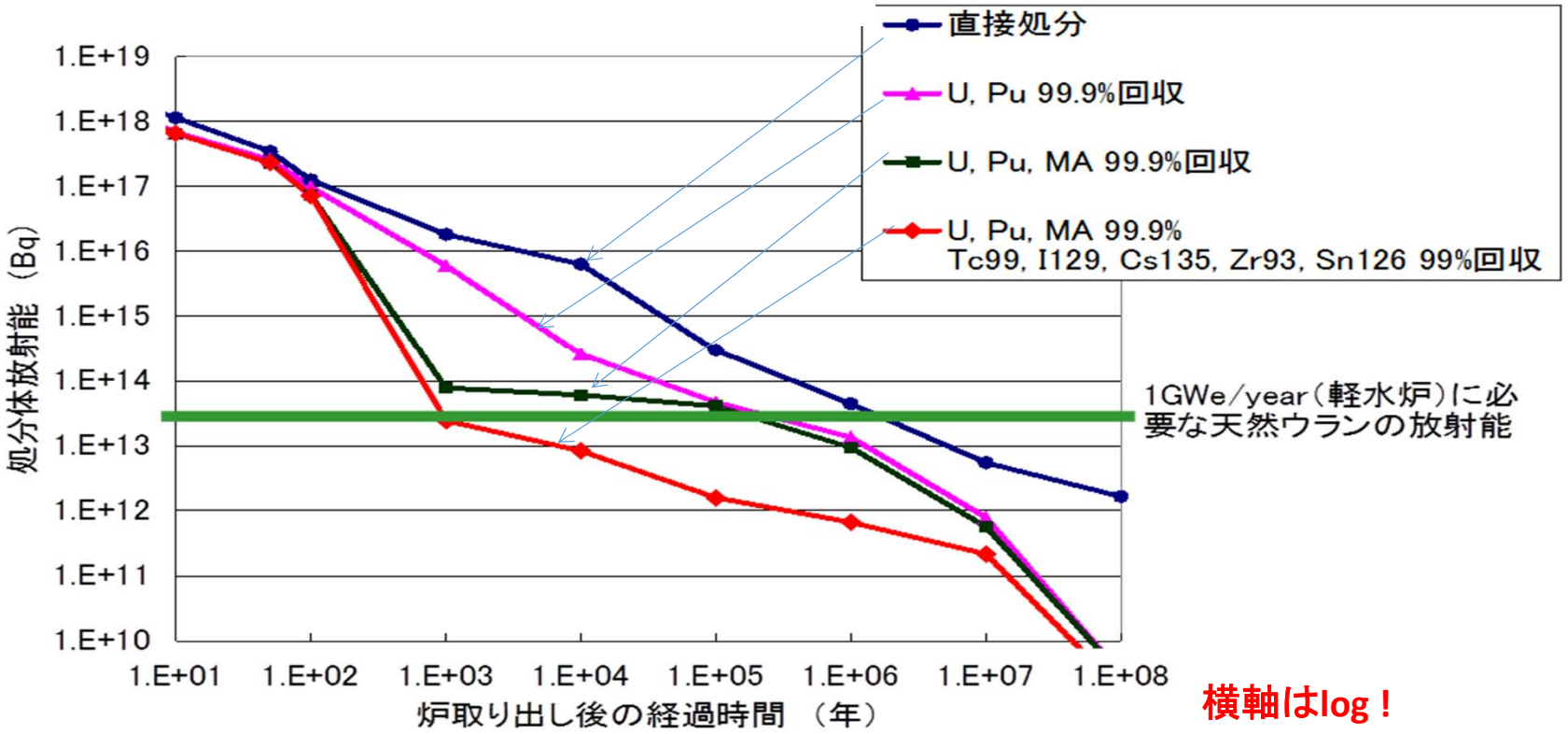
New Plants are expected 30～40 Unit(Gwe)/year

➡Total New Plants ：1000 Units till 2050

5-1 Human perception of time: How long is “long”?

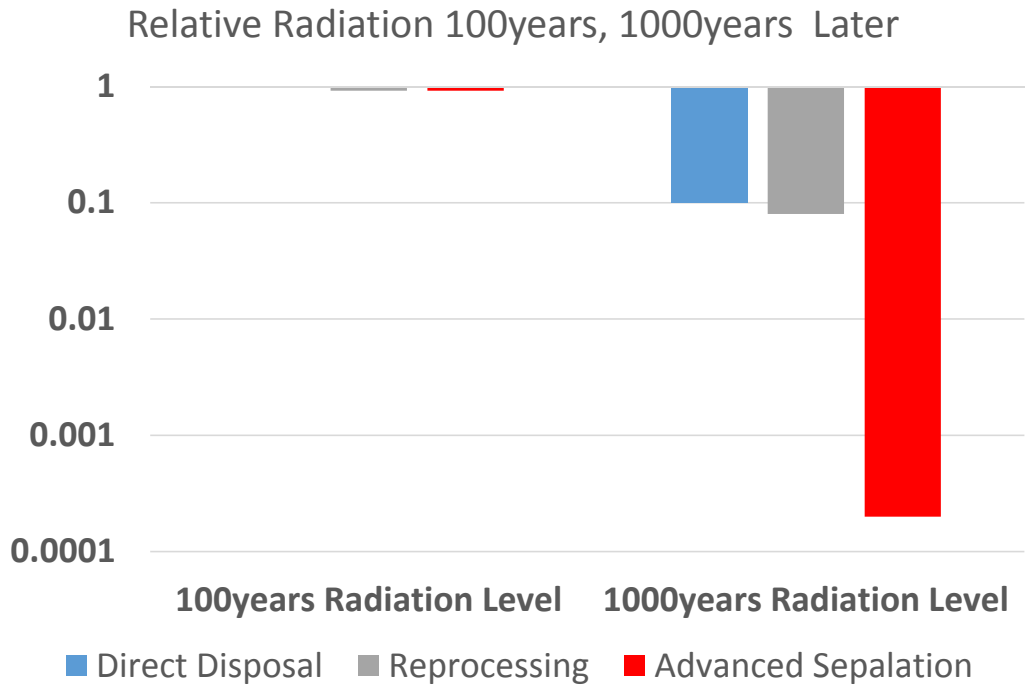
- c 2,000,000 – c 10,000 BC: Old Stone Age （Cro-Magnon, Neanderthal man）
- 2700 BC to 2200 BC：Old Kingdom of Egypt, Pyramids
- 80 :Roma Antiqua(Roman Irrigation System, The Roman Colosseum and other antiquities using Roman concrete）
- 710–794：Nara Period, Todaiji-Temple(wooden architecture), Old Tomb of Emperor(miniture hill) build in 725
- 1336–1573 ：Muromachi period(Ashikaga Shogonate) Katsura Imperial Villa（straight grain）
- 1603-1868: **Edo period** (～300yrs of Tokugawa Shogunate feudal rule)
- 1800-2000：Modern Nation States

5-2 **Reduction of radioactivity**



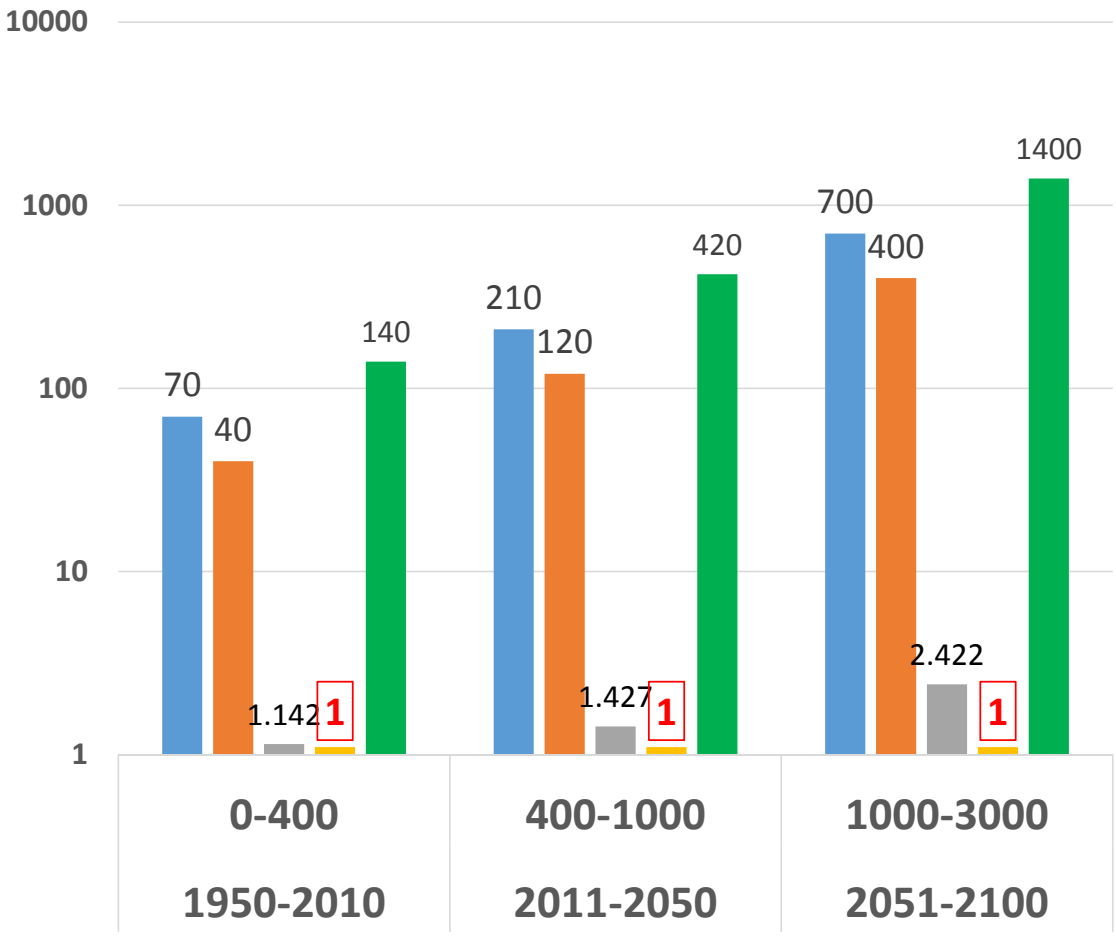
横軸はlog！

5-3 Difference between Three Management



1. No difference 100year later
2. 1000years later
   Decay 1/10 Level by DP and RP
   Decay 1/4000 Level by Advanced Separation Process
   ➡Radiation Level decay to same as Natural U.

5-4 Nuclear Energy Impact（Cumulative)



＊Artificial radioactivity Level by Direct Disposals expect to be 40～400 times more than natural radioactivity of U

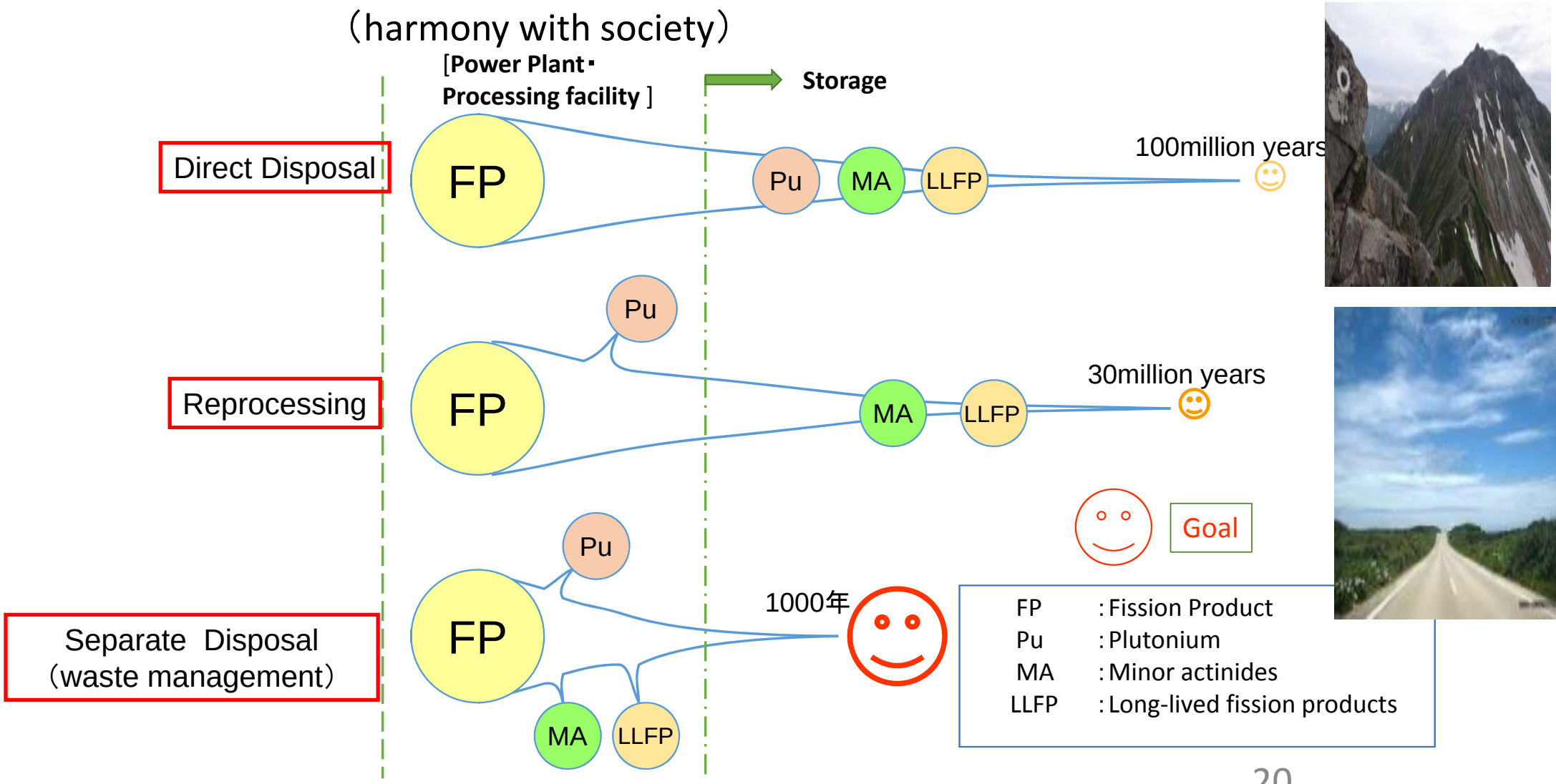
＊ Artificial radioactivity Level by Advanced Separation Process is same as Natural radioactivity of U

(**1**)

＊Saving CO2 Emission is expected to be about 2Bt-C in this Century.

5-5 How We Feel about Nuclear Waste Management

（harmony with society）



Conclusion

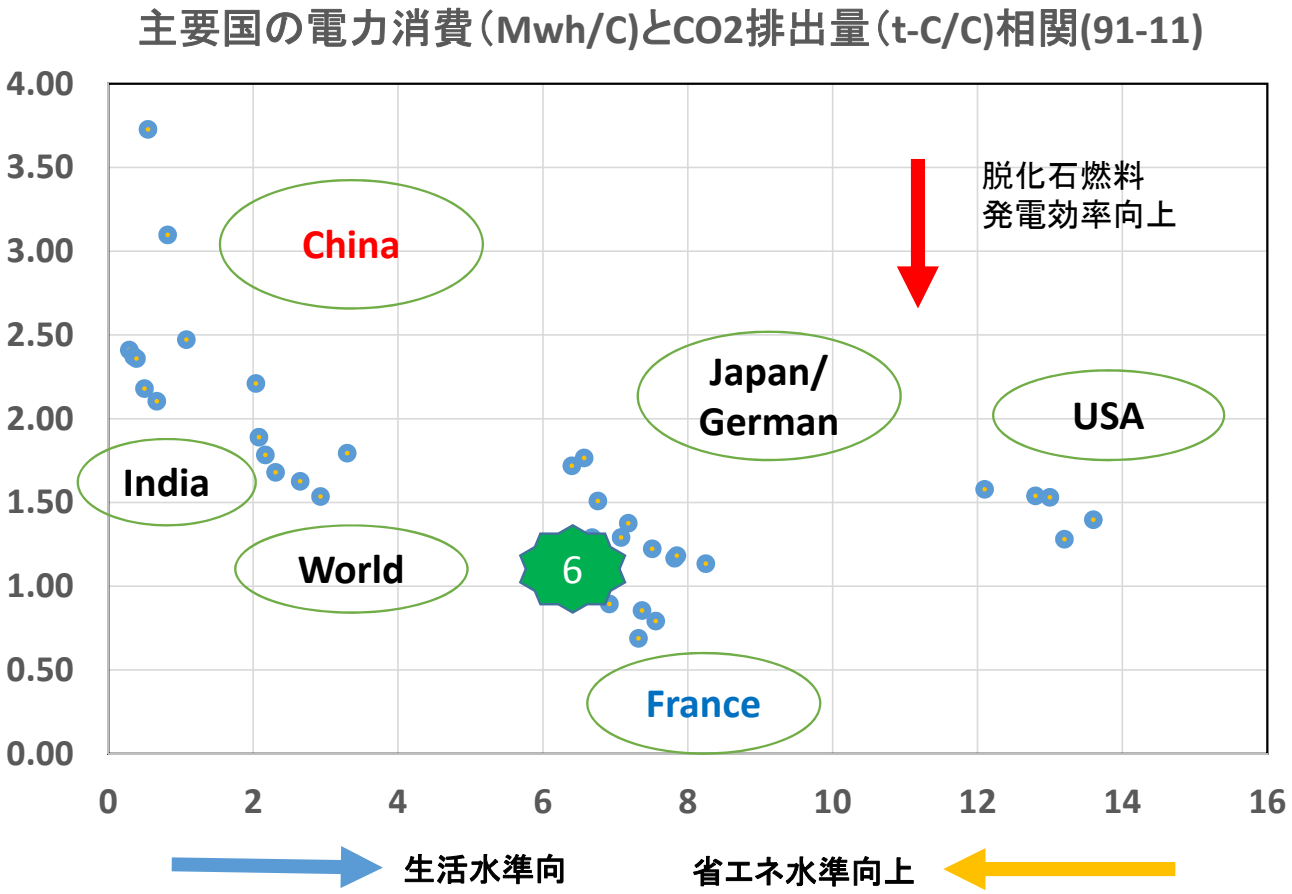
1. Two Issues of Waste
   - These are debt of modern civilization
   - Social Response：Quite Mild to Climate Change ,Hard to Nuclear
   - Issues of Climate Change should be Hard in This Late Century
2. Nuclear Energy is only one resource without CO2 except Renewable resource
3. We should work hard on following matters.
   - Improve Safety Features（Hard Wear、Operation、Institutional System）
   - Harmony with society
4. The debt of Nuclear should be reduce by R&D, and
   it should be demonstrated as **established business** .
   This is the Best Way to establish **the harmony with society** .
5. Establish nuclear Fuel cycle　Business in Japan and Asia
   (Climate Change and Energy Security)
6. International Collaboration in technology ,management ,institution.

Thank You !!

We should be Prudent,

but should not be Pessimistic !

2-7　電力消費とCO2排出量の傾向　〇



1．先進国は電力消費量は多いが発電効率が高く、相対的排出CO2排出量は低い。
殊にフランスは原発シェア高いで先進国でも際立って低い。

2．途上国は電力消費量は先進国の半分以下であるが、発電効率が低く、CO2排出量が大きい。
　特に**中国**は90年代は酷かったが2000年代からかなり改善された。しかし発電量の大幅に増加によりCO2排出量は大幅に増加。

3．今後途上国の発電量の増加が見込まれ、発電効率の向上と天然ガスへの燃料転換、原発利用拡大が望まれる。

5-1 人間の時間概念は　〇

・10～20万年前：旧石器時代（クロマニオン人、ネアンデルタール人）

・4500年前：エジプト古王朝時代、ギザの大ピラミッド

・2000年前：ローマの水道、コロッセオ等遺跡（セメント利用構造物）

・1200年前：奈良時代、東大寺(木造建築)AD725年、天皇陵（築山）

・500年前　：足利時代、桂離宮（柾目建築）

・300年間　：徳川幕府の統治期間(政府責任)

・200年間　：近代国民国家

5-5　人々の核廃棄物処理の理解