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Evaluation of fusion during 21st century as primary energy

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Fusion Reactor Study at JAERI

Improvement for social reception

- Resource(Reuse)
- Waste

in collaboration
with RITE

- Life cycle analysis
- Co₂ exhaust

- DEMO & far future reactors(VECTOR)

- Energy use
(ex. Hydrogen production)
- Prediction of
demand & market

in collaboration
with IEEJ, RITE

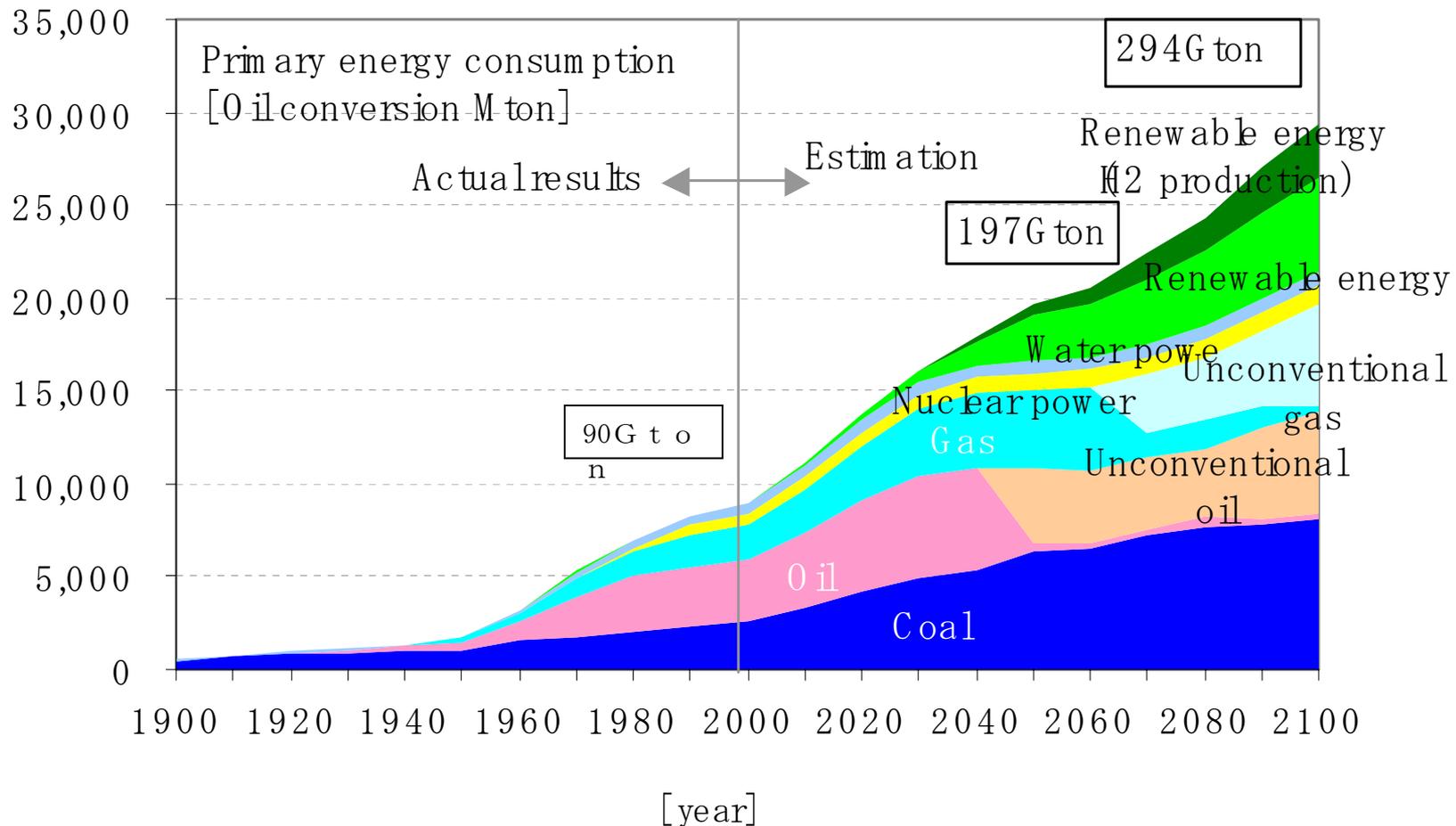
World Integrated Model for New Generation in the 21st Century (WING model)

- ✓ Simulation period : 2000year~2100year
- ✓ Simulation area : 12 area in the world
 - (China, ex-USSR&Eastern Europe, India etc, NIES/ASEAN, USA, OECD Europe, Japan, Middle East, Oceania, Latin America, Africa)
- ✓ Energy source species :
 - Final energy(4) : Solid, Liquid, Gas, Electric power
 - Primary energy(6) : Coal, Oil(conventional& unconventional), Natural gas(conventional&unconventional), Water, Nuclear power, Renewable energy
 - Conversion technology : Power generation, H2 production (by Large scale solar, Nuclear Fusion), Fuel cell, Fusion etc)
- ✓ Estimation method : Calculation of future energy market by market balance of energy price
 - <Characteristics of model> : Taking into account of the relation between evaluation of economics and population, energy consumption

Case study for introduction of nuclear fusion

Scenario element Case	Promotion for Energy saving Renewable energy (C · R)	Promotion for Nuclear fusion (No H2 production) (F (A))	Promotion for Nuclear fusion (H2 production) (F (B))	COE of nuclear fusion (2030→2100year)
B A U case				pessimistic : 30 →30cent/kWh
Energy saving, renewable nuclear fusion promotion (C · R · F (A))	◎	◎		Optimistic : 30 →3cent/kWh
Energy saving, renewable nuclear fusion promotion (H2 production) (C · R · F (B))	◎		◎	Optimistic : 30 →4cent/kWh

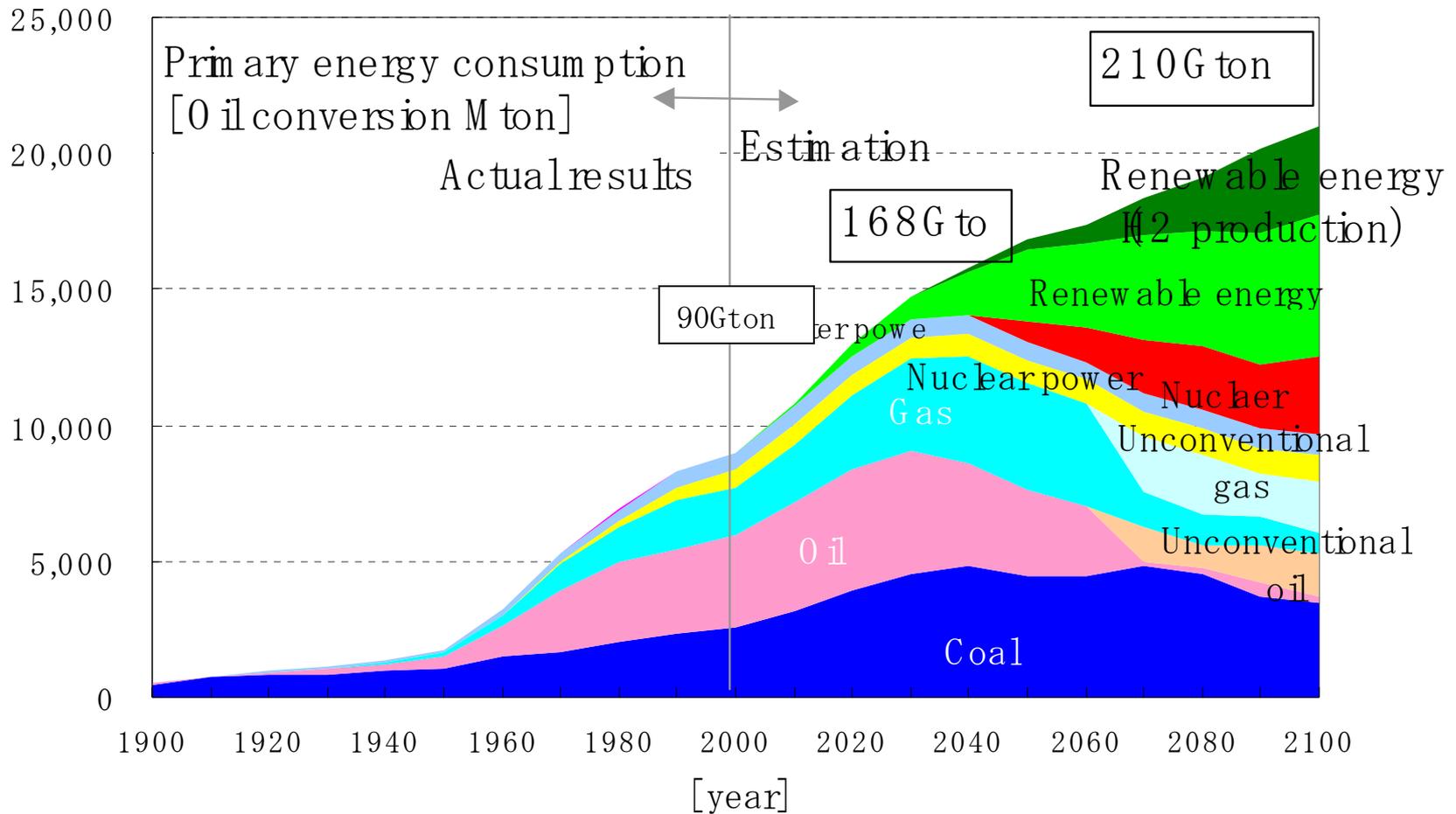
Time evolution of primary energy consumption (BAU case)



- ✓ Coal consumption increases smoothly (Increment of consumption in China & India) Consumption of conventional oil is maximum at 2040. Production of unconventional oil is started.
- ✓ Consumption of natural gas is maximum at 2060. Production of unconventional natural gas is started. (Tight Sand Gas etc.)
- ✓ Nuclear fusion is entered the energy market at 2100.

Time evolution of primary energy consumption

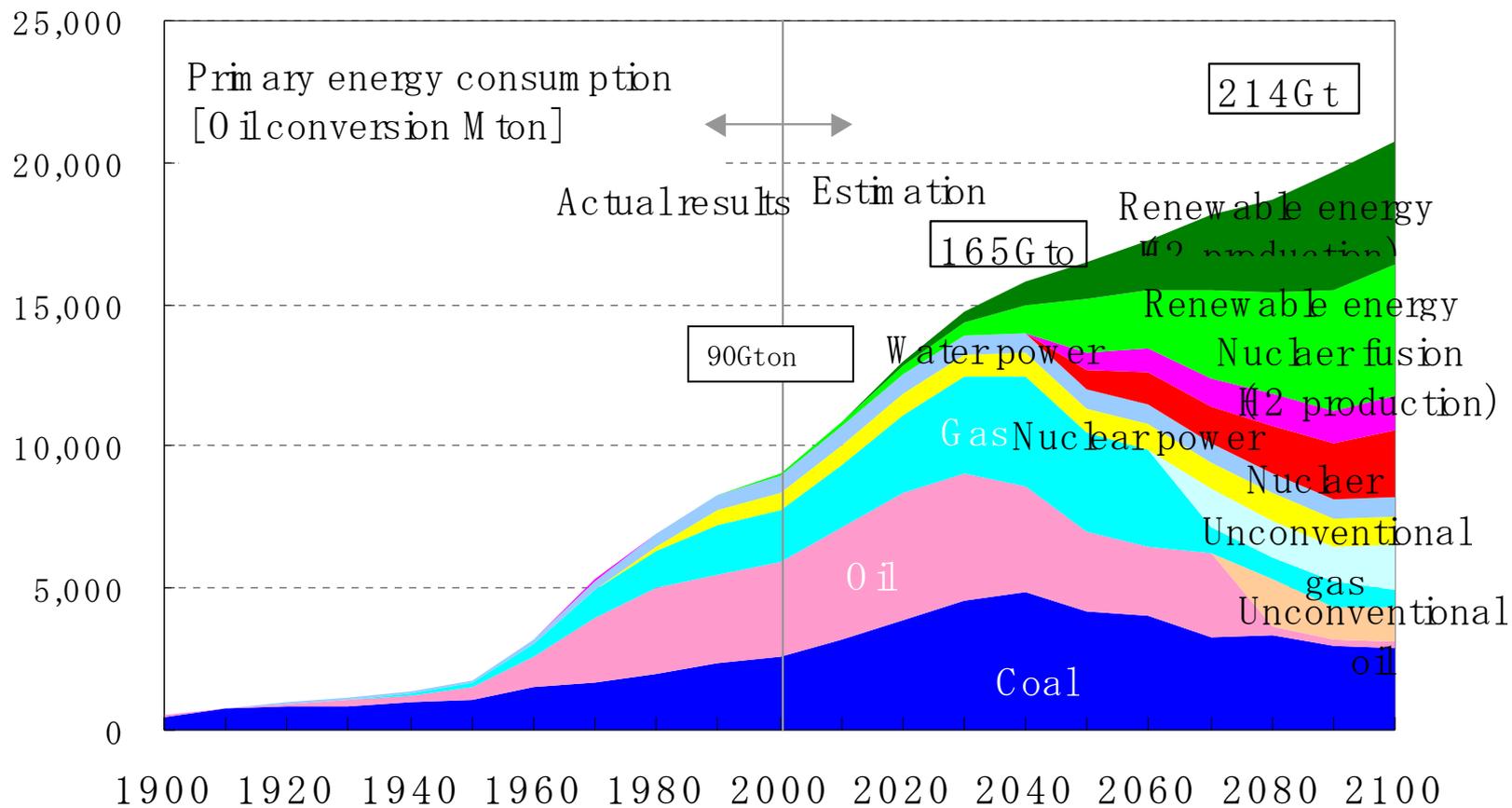
(Promotion for Energy saving • renewable energy • nuclear fusion)



- ✓ Nuclear fusion (the case of optimistic COE) is entered the energy market at 2040.
- ✓ Share of nuclear fusion in the primary energy is 13.7% at 2100.

Time evolution of primary energy consumption

(Promotion for Energy saving • renewable energy • nuclear fusion(Including H2 production))



- ✓ Nuclear fusion(the case of optimistic power cost & including H2 production) is entered the energy market at 2040 decade.
- ✓ Share of nuclear fusion in the primary energy is 17.3% at 2100 decade.
- ✓ Production of H2 by nuclear fusion results in increment of market share and contribution the hydrogen society.

Results of technological evaluation in the super long term energy model

① Contribution to the energy supply

The nuclear fusion can be one of the primary energy resources if succeeded in cost down is done. If hydrogen is produced by the fusion, the fusion will take a large share.

- ✓ The nuclear fusion appears in the energy market from 2040.
- ✓ If hydrogen is produced by nuclear fusion, switching from the hydrogen society originated from the fossil fuel is accelerated. (Timing of the switching is changed from 2080's to 2060's decade.) The share of the nuclear fusion in primary energy sources is about 17% in 2100.

② Contribution to measure against the global warming

Nuclear fusion is a candidate of clean energy which is contributed to measure against the global warming.

However, there is no ace of the measures, it is important to a systematic deal which is integrated into a compound measure including saving energy and development of new energy etc.