

Governance Design Laboratory

**“Spent Fuel and Reduction of Radiological Risk After Fukushima” Project  
The Japanese Energy Sector, Energy Policies, and the  
Japan LEAP Modeling Effort**

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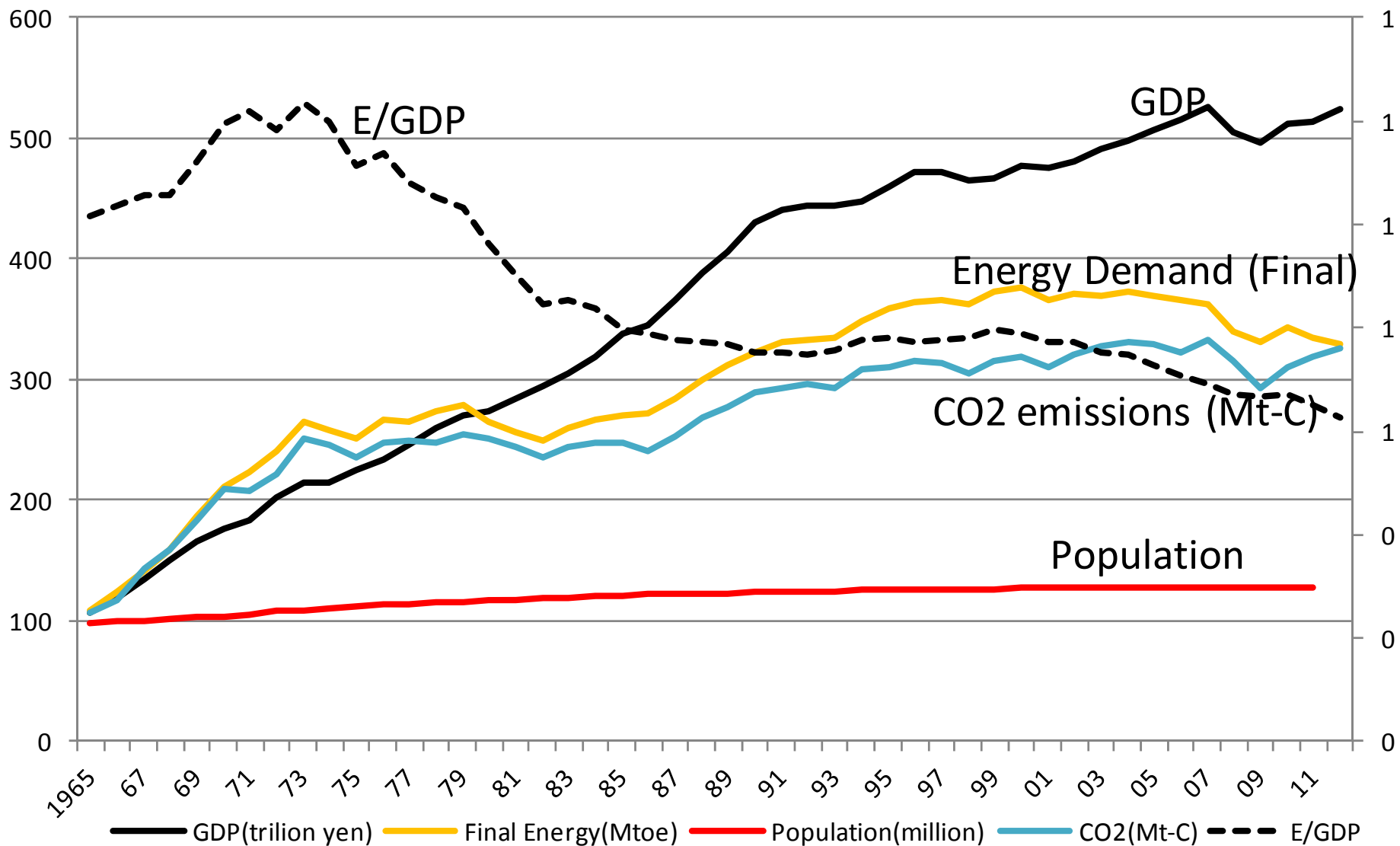


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# Overview of Japanese Energy Sector

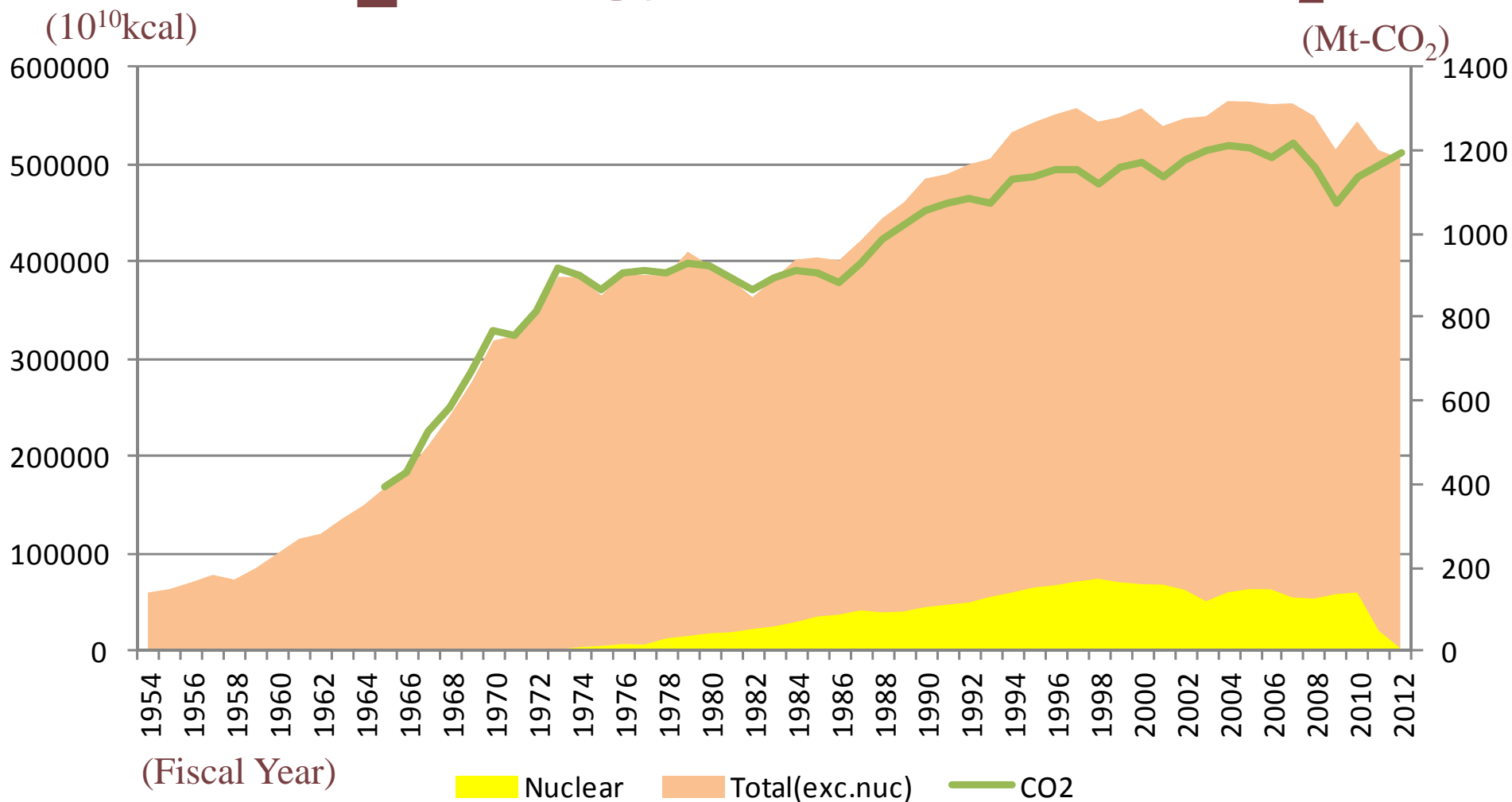
# GDP, Energy, CO2



Source: 1965-2011, EDMC/IEEJ, EDMC Handbook of Energy & Economic Statistics in Japan 2012

\*Data for 2012 is estimated by GDL with various sources.

# Energy Demand and CO<sub>2</sub>



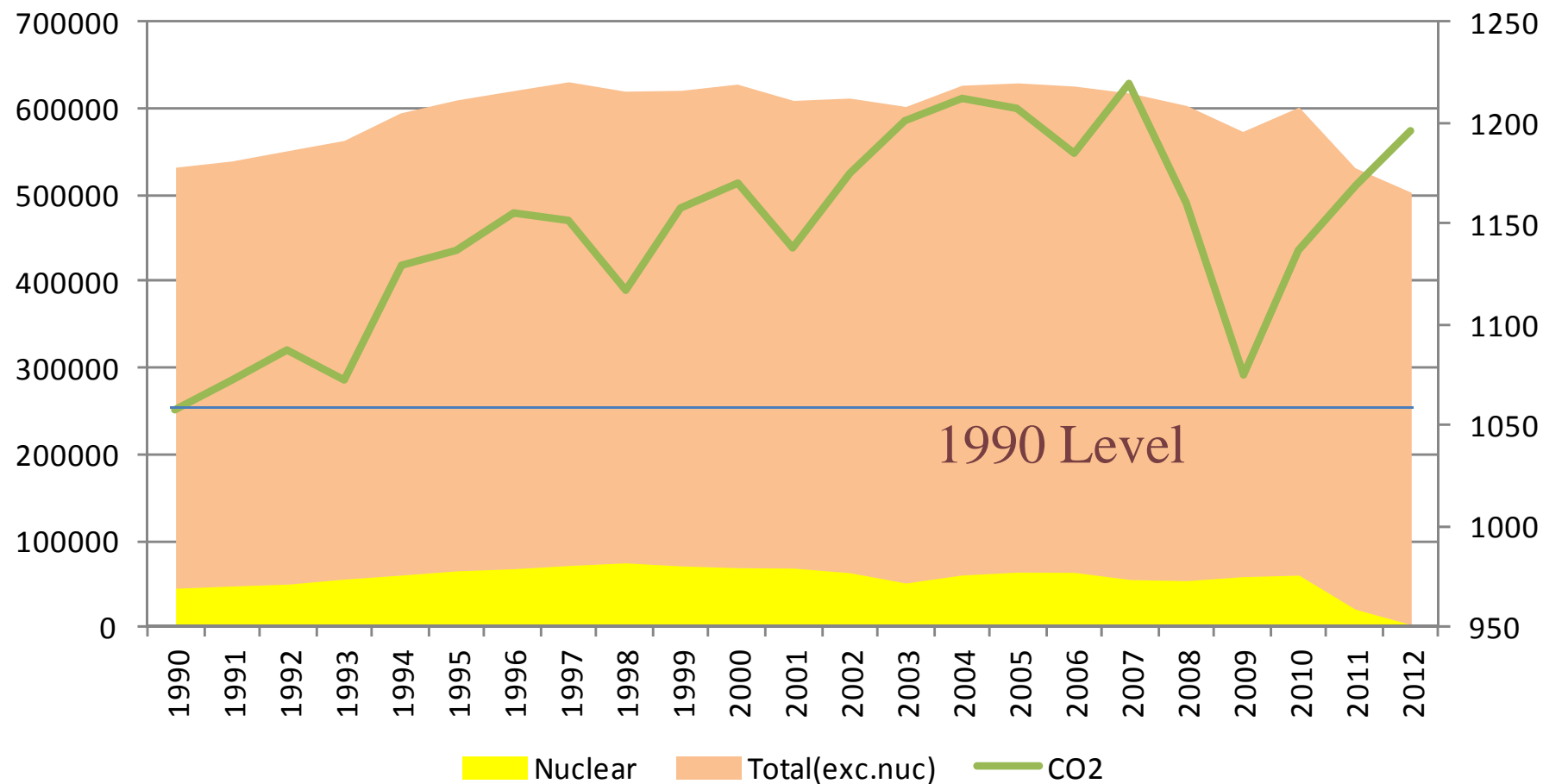
Source: 1965-2011, EDMC/IEEJ, EDMC Handbook of Energy & Economic Statistics in Japan 2012

\*Data for 2012 is estimated by GDL with various sources.

# Energy Demand and CO<sub>2</sub>

(10<sup>10</sup>kcal)

(Mt-CO<sub>2</sub>)

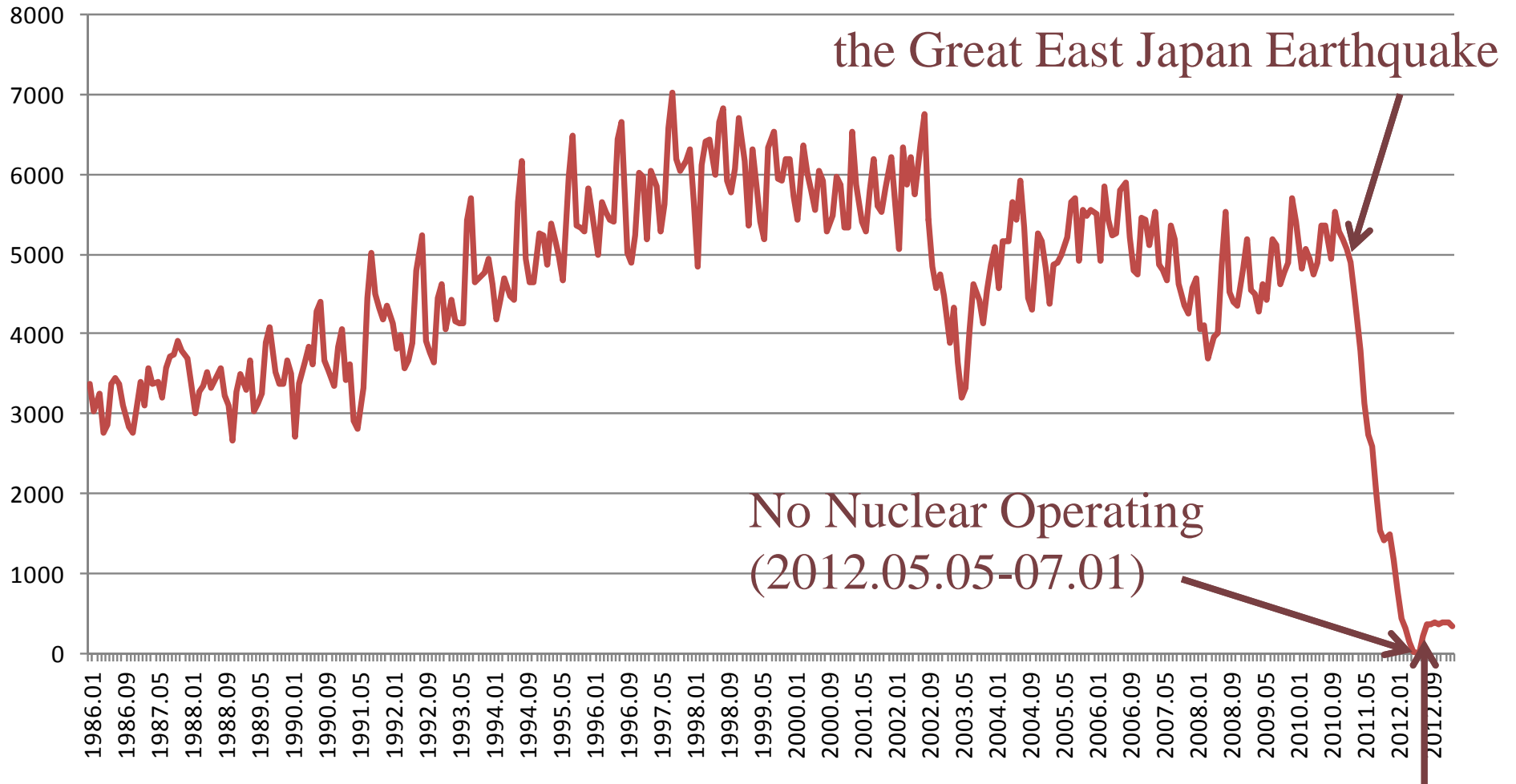


Source: 1965-2011, EDMC/IEEJ, EDMC Handbook of Energy & Economic Statistics in Japan 2012

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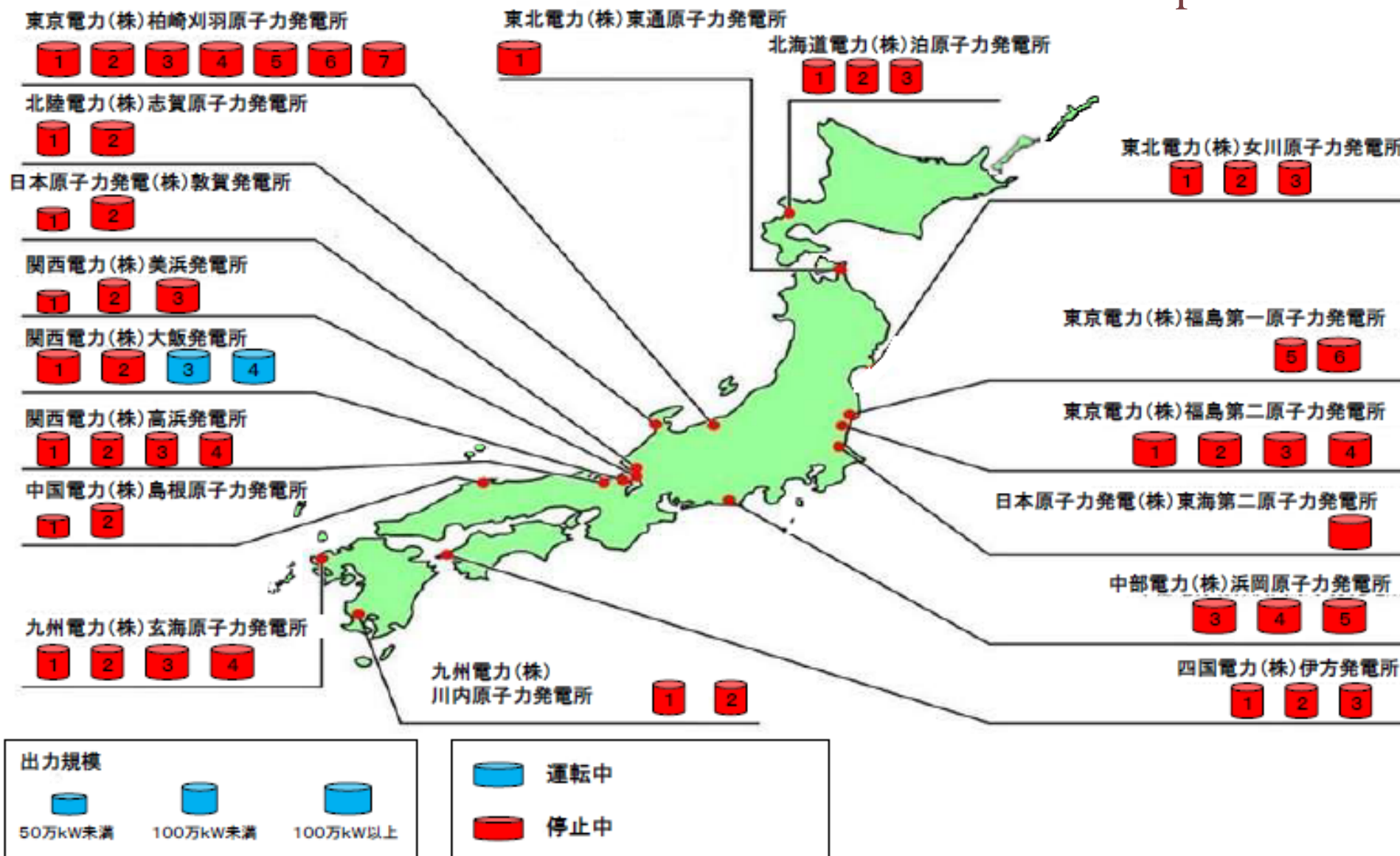


# Nuclear Power (monthly)



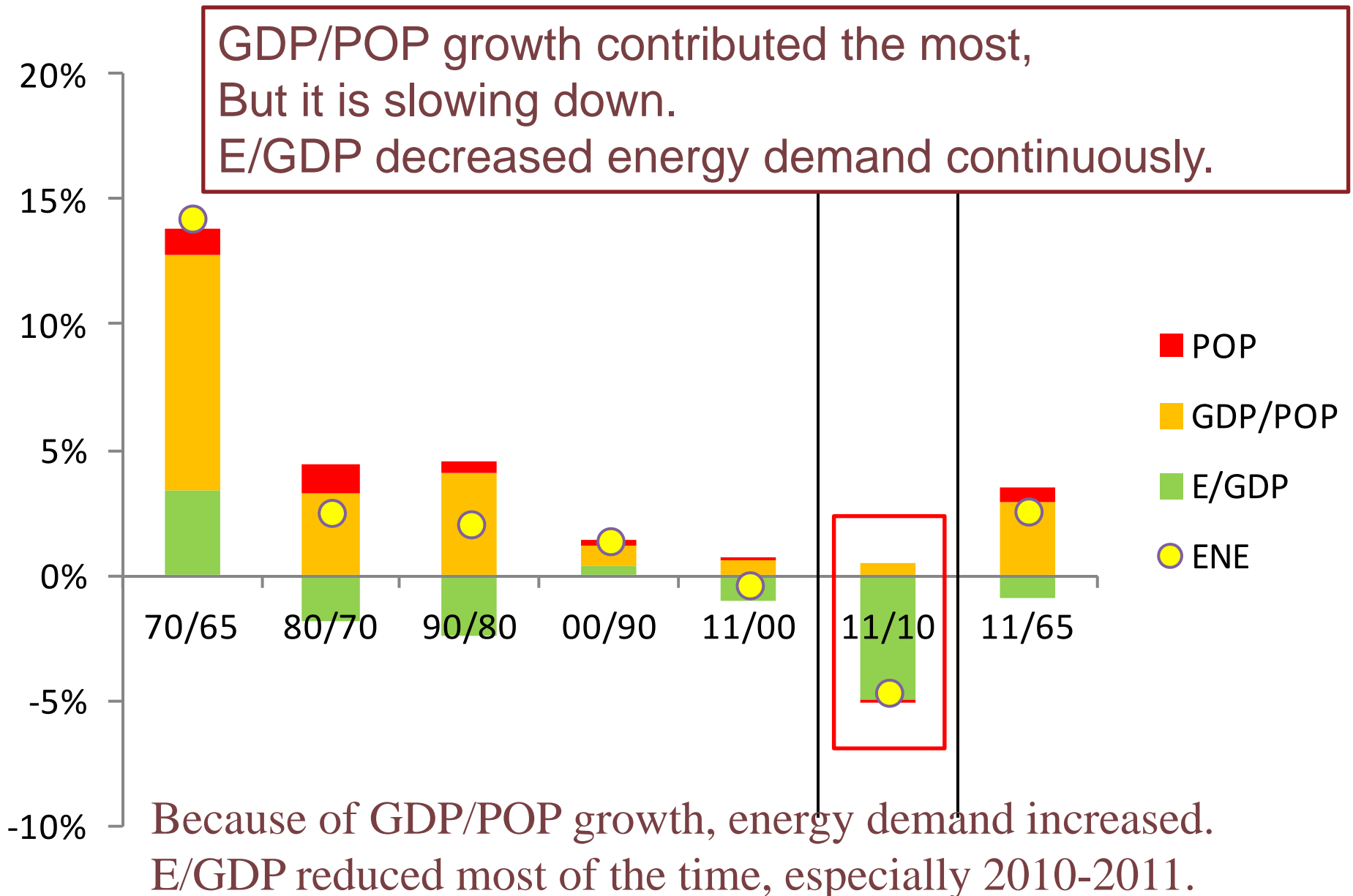
# 50 nuclear plants

54 - 4 Fukushima plants = 50





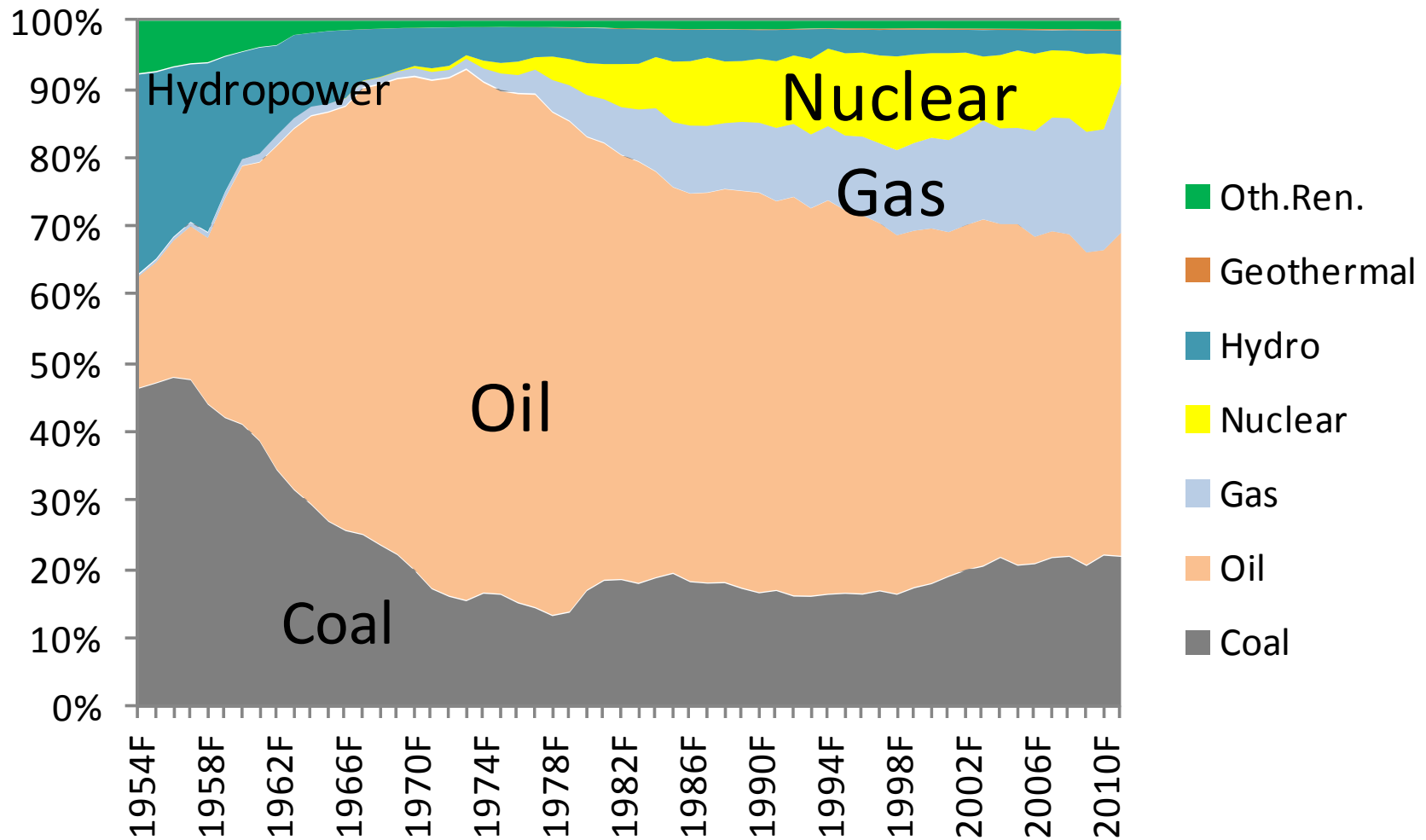
# Factor of Energy Demand

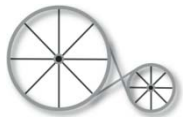




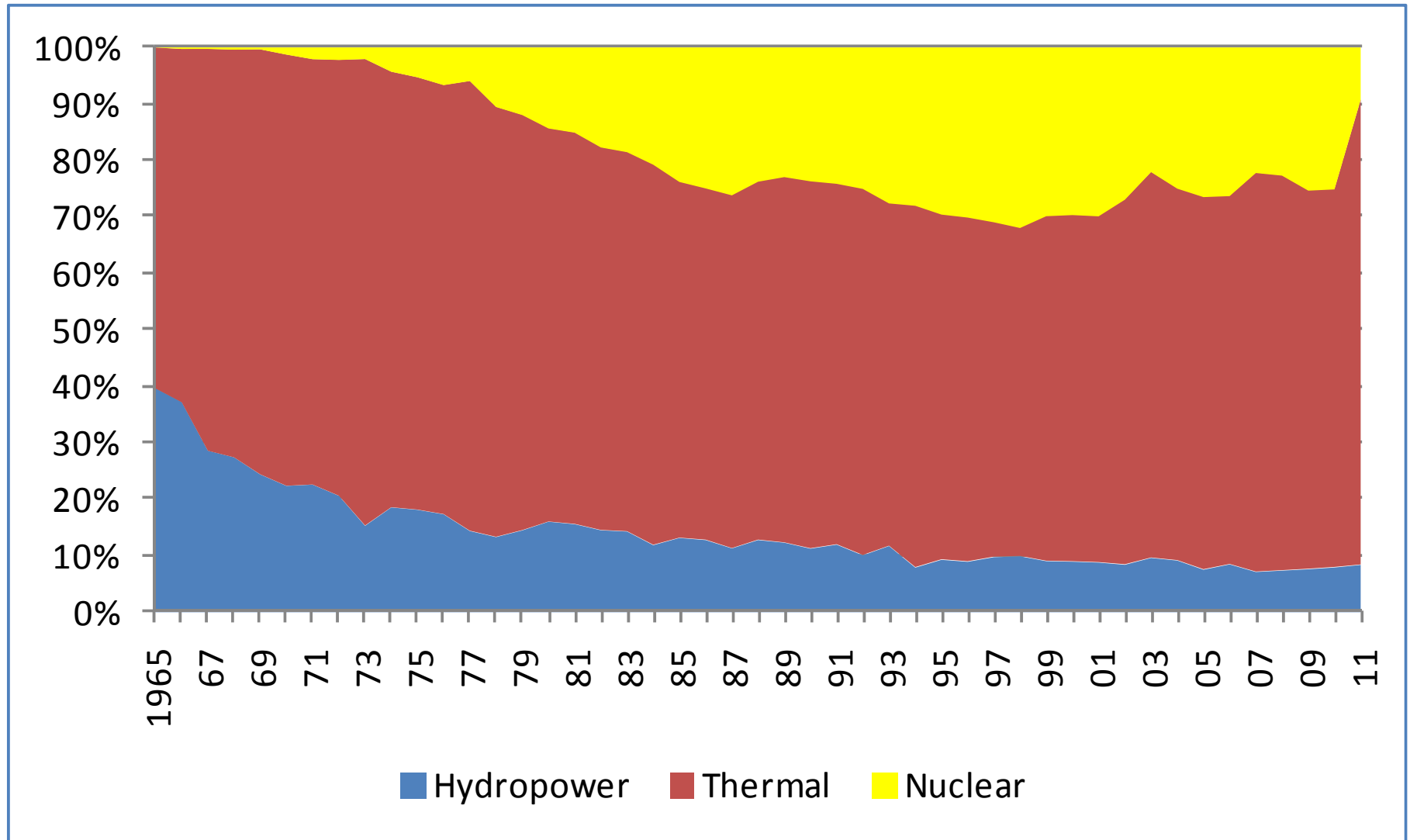


# Sources of energy supply



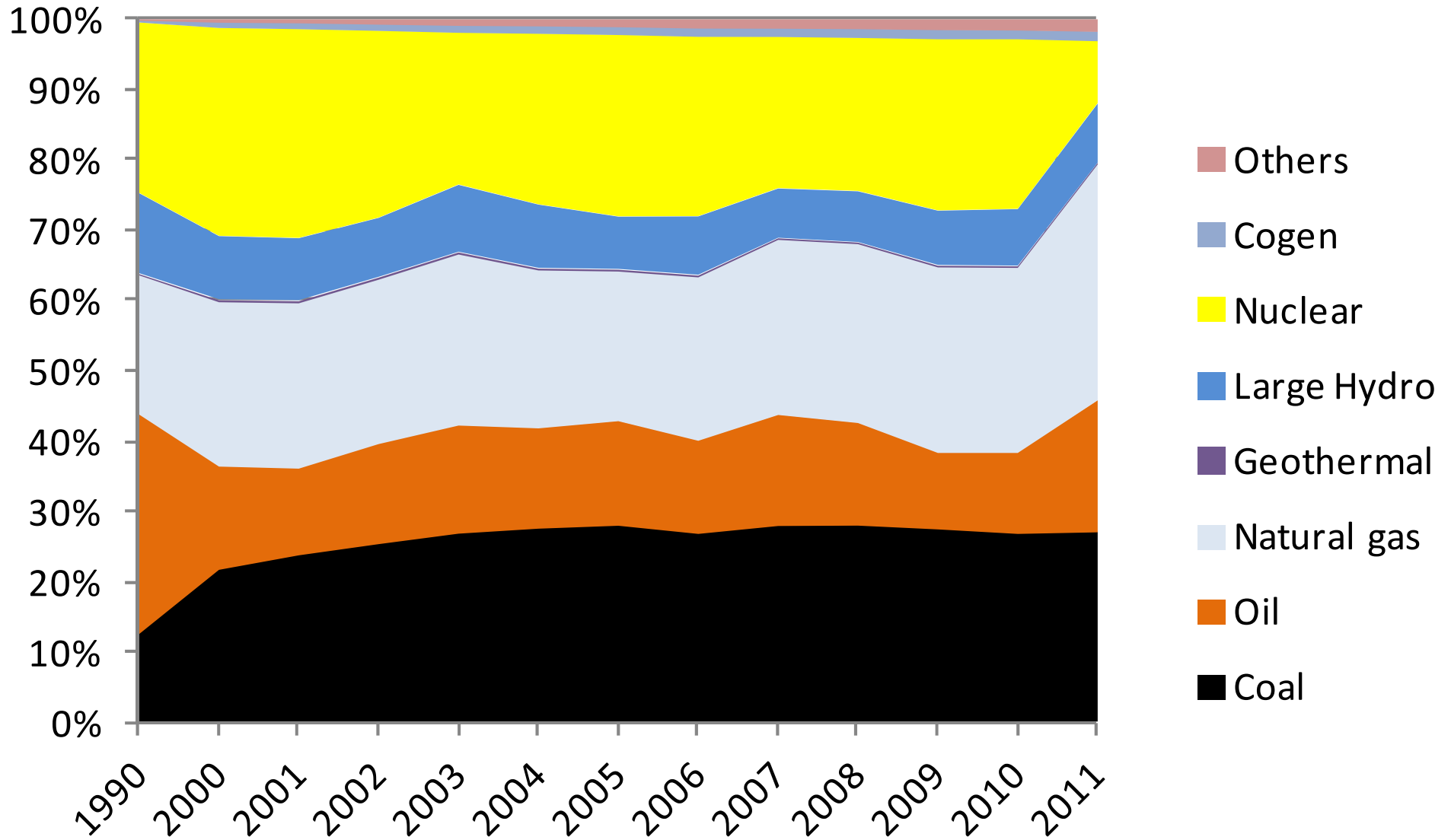


# Electricity generation by sources





# Electricity generation by sources





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# Topics of Japanese Energy Policies



# Topics

## ■ Nuclear power undecided

- ◆ Dominant political party has changed from DPJ to LDP.
- ◆ Strategy by DPJ was not approved by the Cabinet, and newly under discussion.

## ■ Growing renewables

## ■ Electricity market to be deregulated

# Topics (Overview)

## Nuclear Power

DPJ → LDP

Zero by 2030s → Restarting ones when safety is confirmed

## Renewables

FIT started 2012.4

7GW has certified by 2013.1

## Deregulation of Elec. Market

2016: Full retail deregulation is to complete

2018-2020 :Vertical separation is to complete

# Nuclear Power Undecided

- “Innovative Strategy for Energy and the Environment” was not approved by the cabinet. (No nuclear in 2030s, no new nuclear plants, 40 years operation, FBR research to be finished, research for direct disposal to start)
- Dominant political party changed from Democratic Party to the Liberal Democratic Party, and Advisory Committee for Energy started for the new strategy. (2012.3.15, 4.23)
- New Prime Minister Abe addressed in his administrative policy speech on Feb.,
  - ◆ Restarting nuclear power plants which safety is confirmed.
  - ◆ Maximum renewables and efficiency improvement to be deployed.
  - ◆ Deregulation of electricity system.

# Growing Renewables

- FIT (Feed-in Tariff) for rooftop PV started in November, 2009, and expanded to all renewables since April, 2012.
  - ◆ PV, Wind, Small Hydro, Biomass, Geothermal.
  - ◆ PV less than 10kW: surplus , 10 years, Others: all, 20 years.
  - ◆ PV price is decreasing (42 yen/kWh → 38 yen/kWh)
  - ◆ Wind: 23.1-57.75, Small Hydro: 25.2-35.7, Geothermal: 27.3-42, Biomass: 13.65 – 40.95.



# Growing Renewables

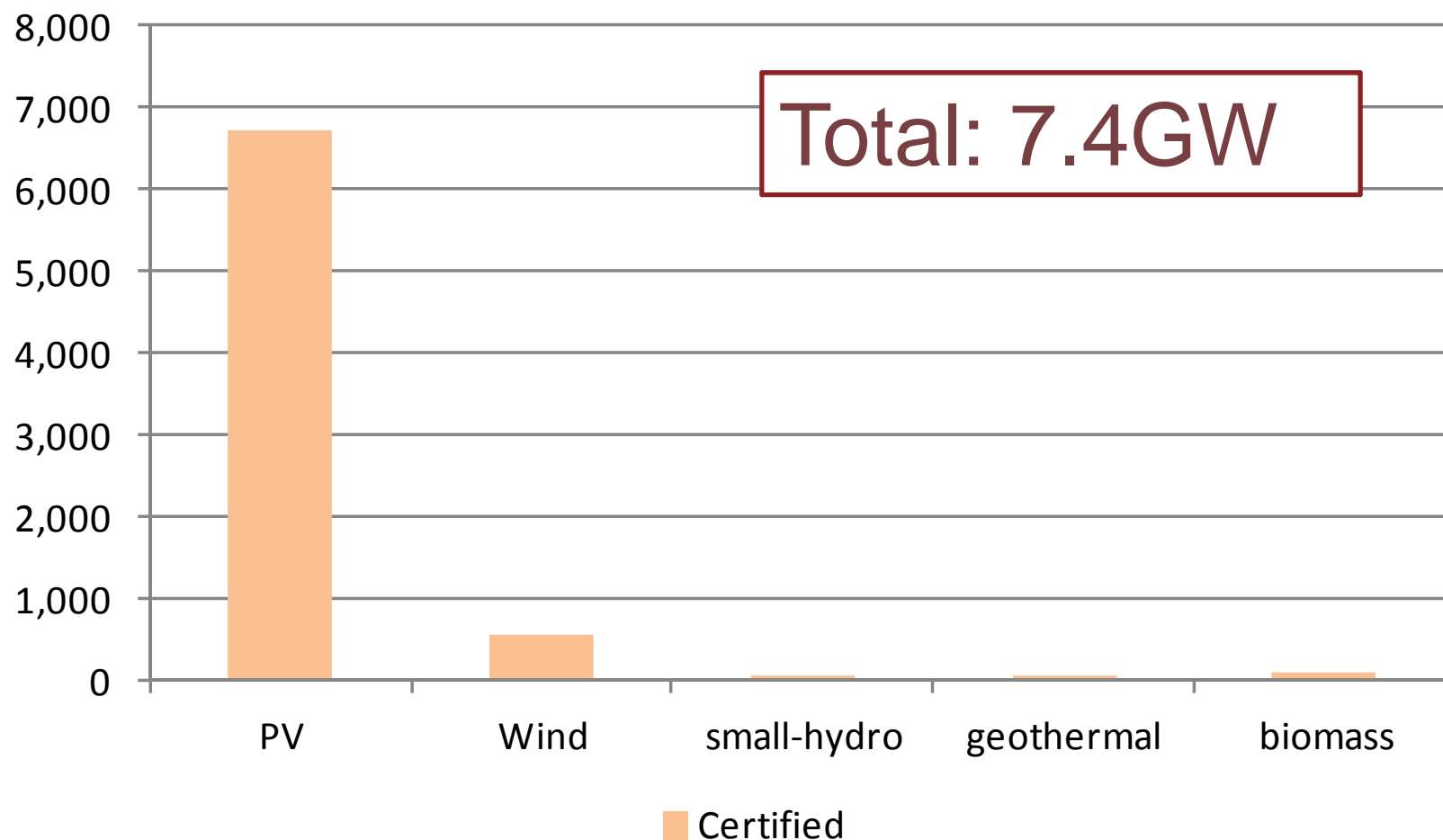
■ FIT (Feed-in Tariff) for rooftop PV started in November, 2009, and expanded to all renewables since April, 2012.

◆ PV, Wind, Small Hydro, Biomass, Geothermal.

			Price		
			2012FY	2013FY	
PV	- 10kW	surplu s	42 yen/kWh (34 w/ FC)	38 (31 w/ FC)	10 years
	10kW-	all	42	37.8	20
Wind	-20kW	all	57.75	57.75	20
	20kW-	All	23.1	23.1	20
Small Hydro	-200kW	all	35.7	35.7	20
	200-1000kW	all	30.45		20
	-100kW	all	25.2		20

# Renewables under FIT

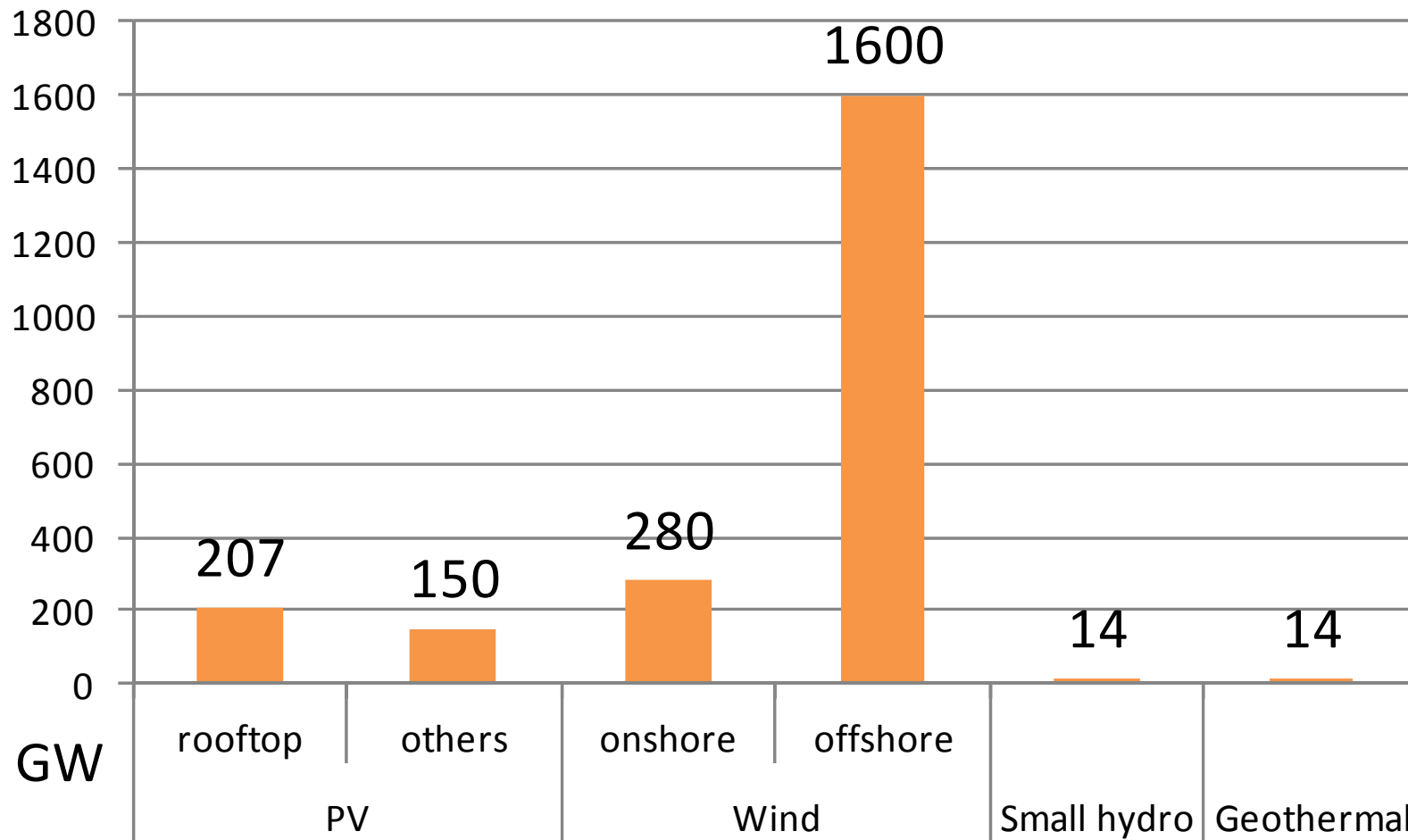
## ■ Certified renewable facility (MW) by 2013.1.31



Source: METI (<http://www.enecho.meti.go.jp/saiene/kaitori/index.html>)



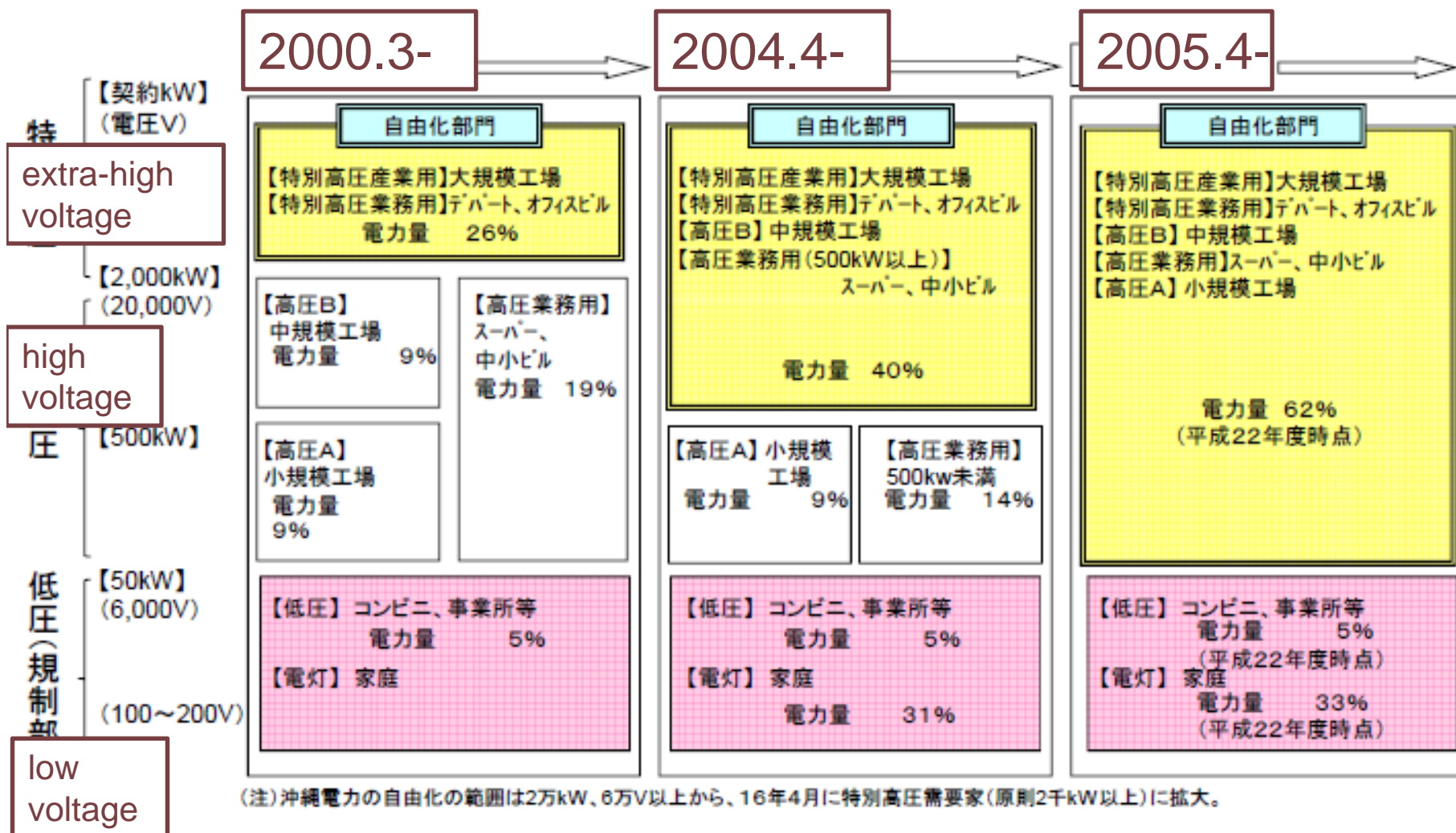
# Potential



Source: MOE, <http://www.env.go.jp/earth/report/h23-03/gaiyo.pdf>

\*For rooftop PV, data is for the maximum resource. Others are deployment potential.

# Current Electricity Retail Market

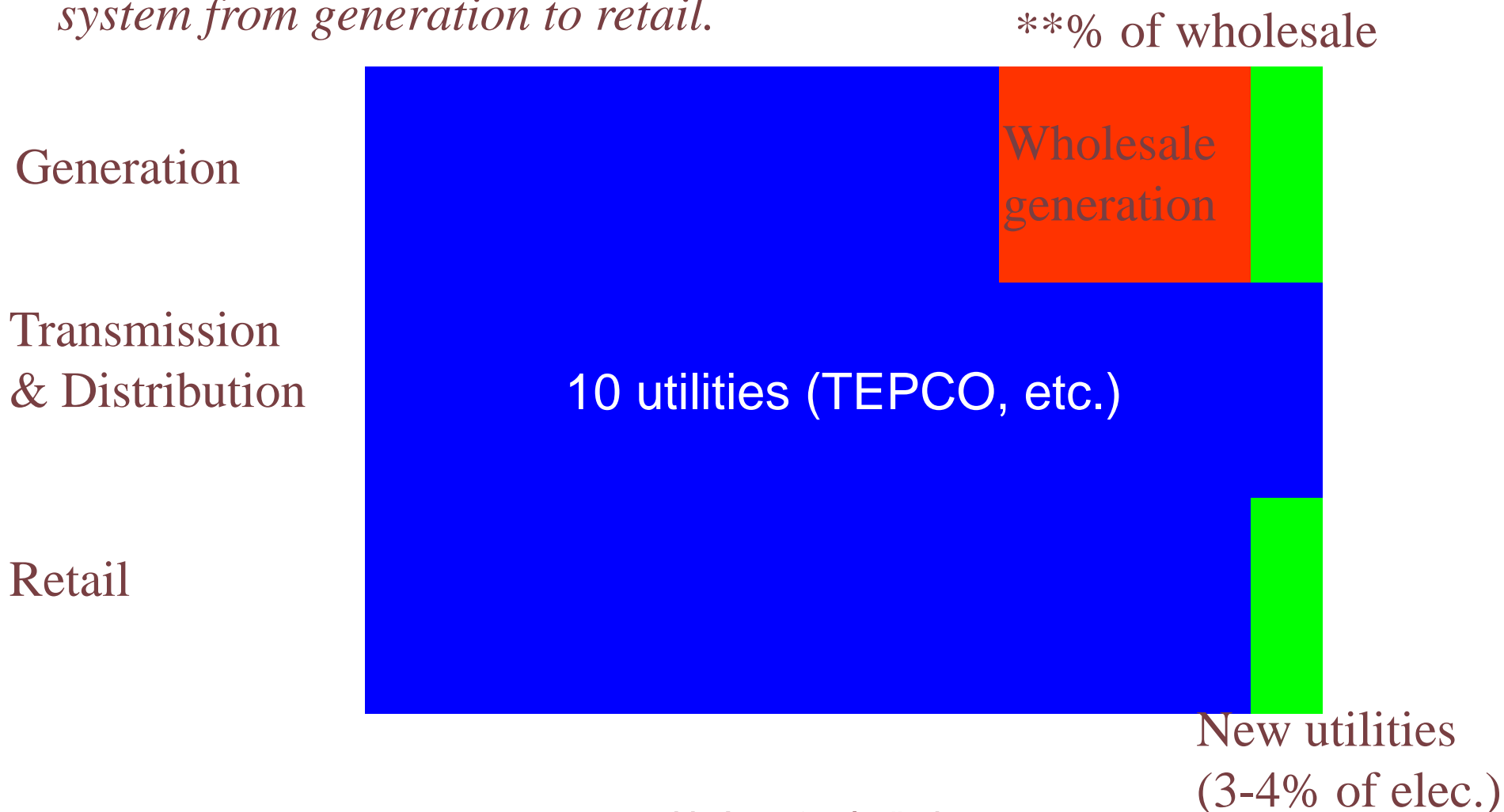


**Low voltage sector has not been liberated.**

Source: METI (<http://www.enecho.meti.go.jp/denkihp/genjo/seido.pdf>)

## Current electricity supply system


*Wholesale electricity market is open, but since T&D is dominated by 10 regionally \*\* dokusen utility, they are nearly dominating electricity system from generation to retail.*



\*autoproducing at the factory etc. and 特定電気事業者 is not included in this picture.

## Deregulation of Electricity Market

In April, 2013, **revision policy of Electricity Business Act** for deregulation of electricity market was approved by the Cabinet. (Diet deliberation will start today (28<sup>th</sup>)).

- 
- 2015 Establish “wide-area utility grid operating organization”
  - 2016 full liberalization of **retail** electricity market
  - 2018~2020 “Transmission&distribution” sector is to be legally separated from generation & retail sectors.  
Electricity retail price to be fully liberated.

vertical separation (2018-2020),  
full retail liberalization (2016)



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# LEAP Model Simulation

## *Current Status and Plan for this year*



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# Japan LEAP Model

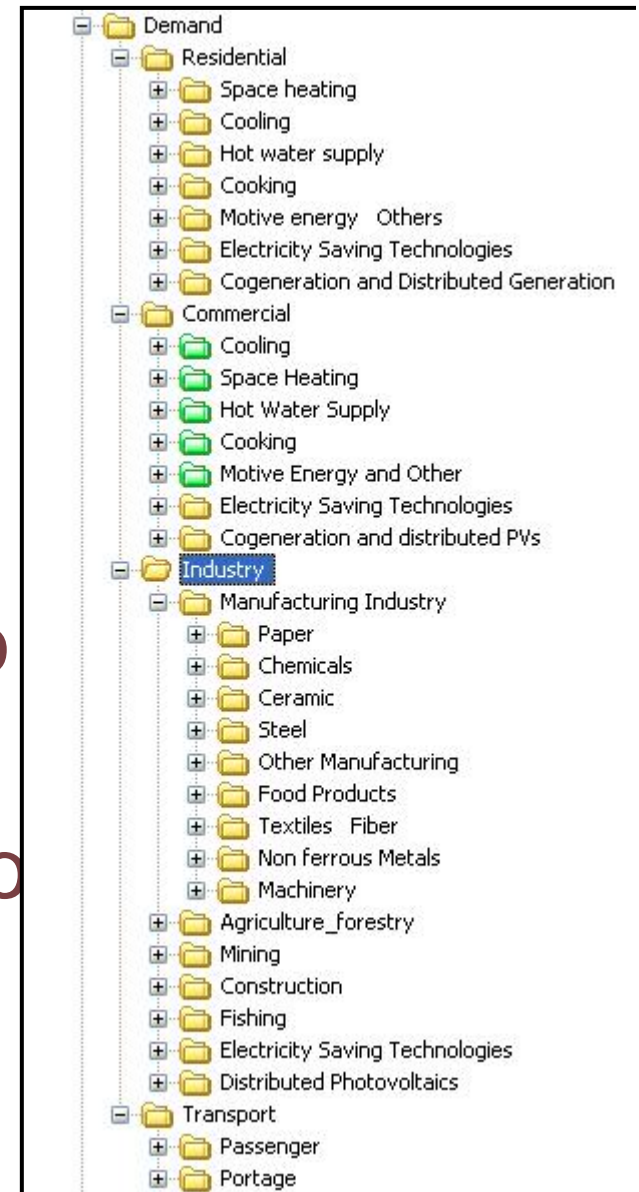


# Japan LEAP Model

- Software: LEAP (the Long range Energy Alternatives Planning System)
- Calculate bottom up energy demand, and energy supply to satisfy the needs under the condition described in the model. (no optimization, but there are “rules”.)
- Base data :2011 -->calculate to 2030

# Demand Structure

- Demand = unit energy use X activity level.
- Residential & commercial sectors are divided into 5 usages.
- Industrial sector is divided into 13 sectors.
- Transport sector is divided into passage & portage.



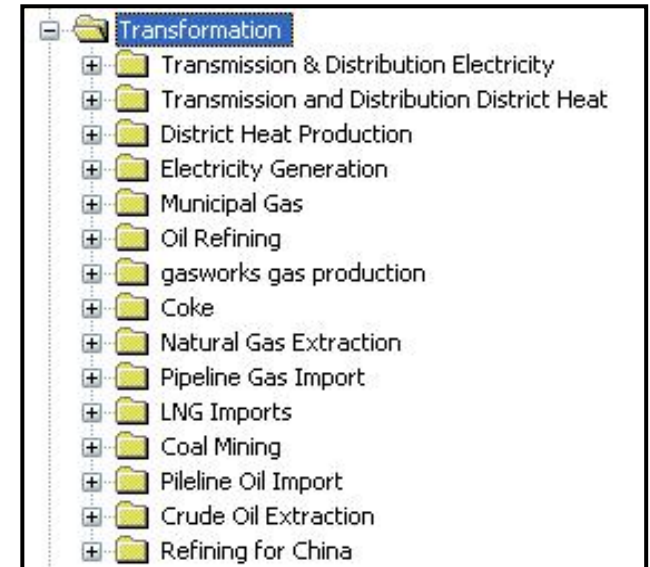
# Supply Structure

## ■ Transformation:

- ◆ Electricity generation, oil refinery, etc.

## ■ Resources:

- ◆ Underground fossil fuel resources.
- ◆ Renewable annual yields.



# Scenario Structure #1

## Common assumption

-Fukushima#1 1~4 decommissioned in 2011.

1.BAU	+2 plants. (Ohma(2015)& Higashidori(2017)). 40 years operation.
2.Maximum	+2 plants. 50 years operation.
3.Minimum	$\pm 0$ . 40 years operation.

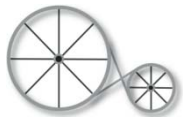


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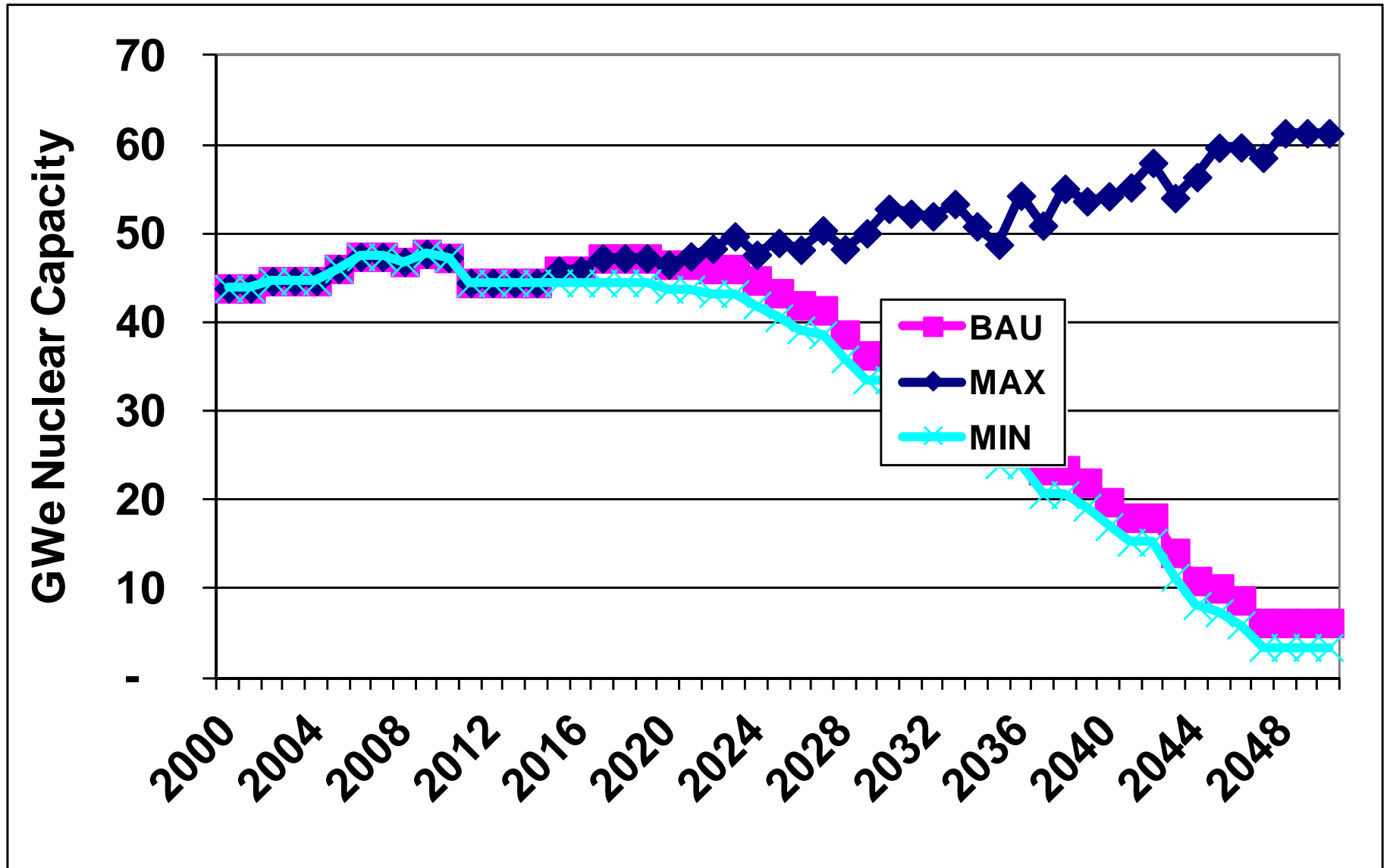


& METI energy balance

& EDMC databank,  
METI (renewables), etc.



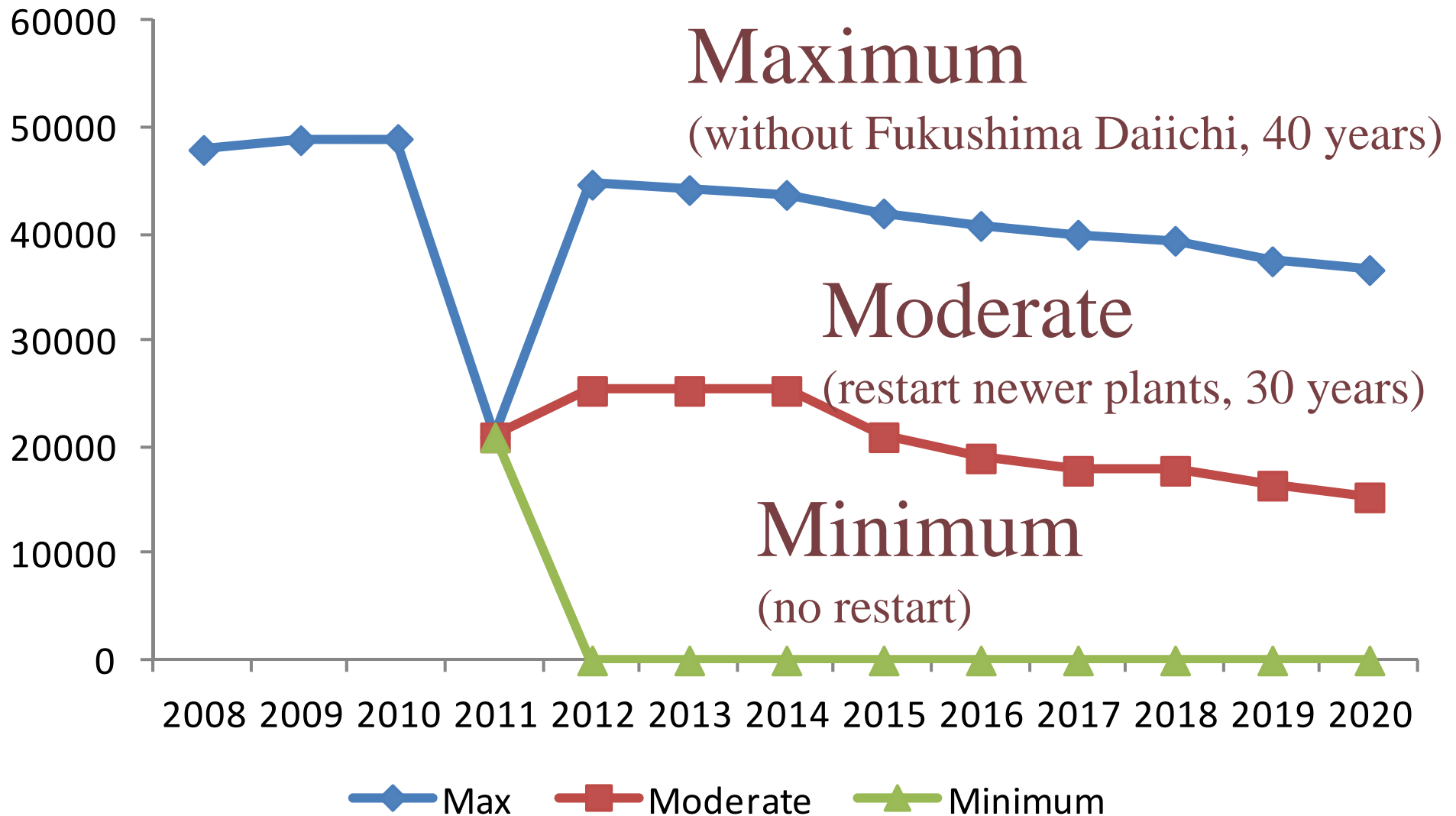
# Scenario Structure #1-2



Provided by David von Hippel in 2013. Need to be revised.



# Scenario 2012

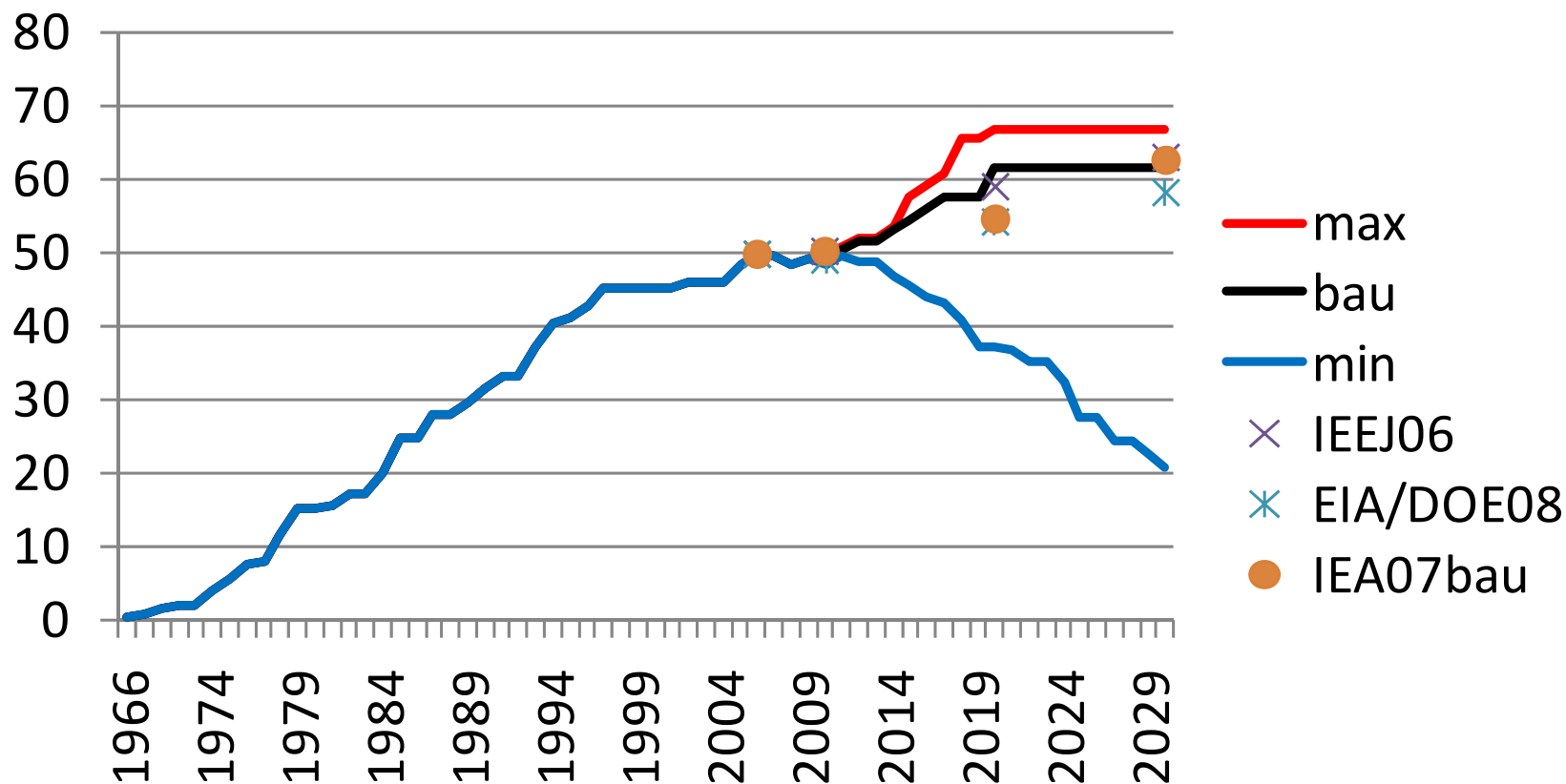


\*2011 data: average capacity of plants under operation.

\*\* Actual scenarios are to be fixed after the discussion within Japan team.

## Scenario, 2010

- Minimum: **+3** by 2020, 40 years operation.
- BAU: **+10** by 2020, 60 years operation.
- Maximum: **+14** by 2020, 60 years operation.
- **Maximum** is close to “Energy Basic Plan”.

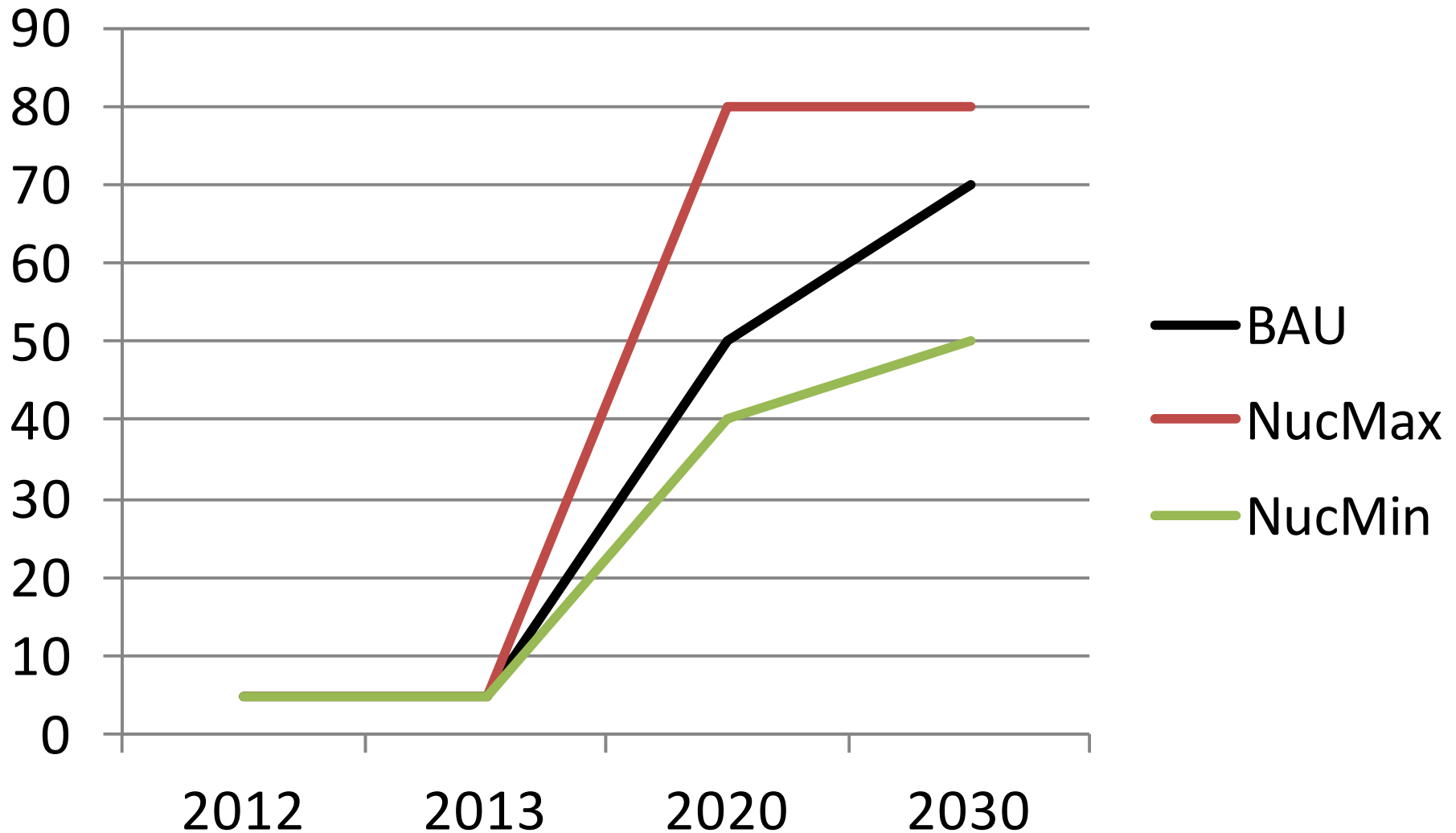






# Scenario Structure #2

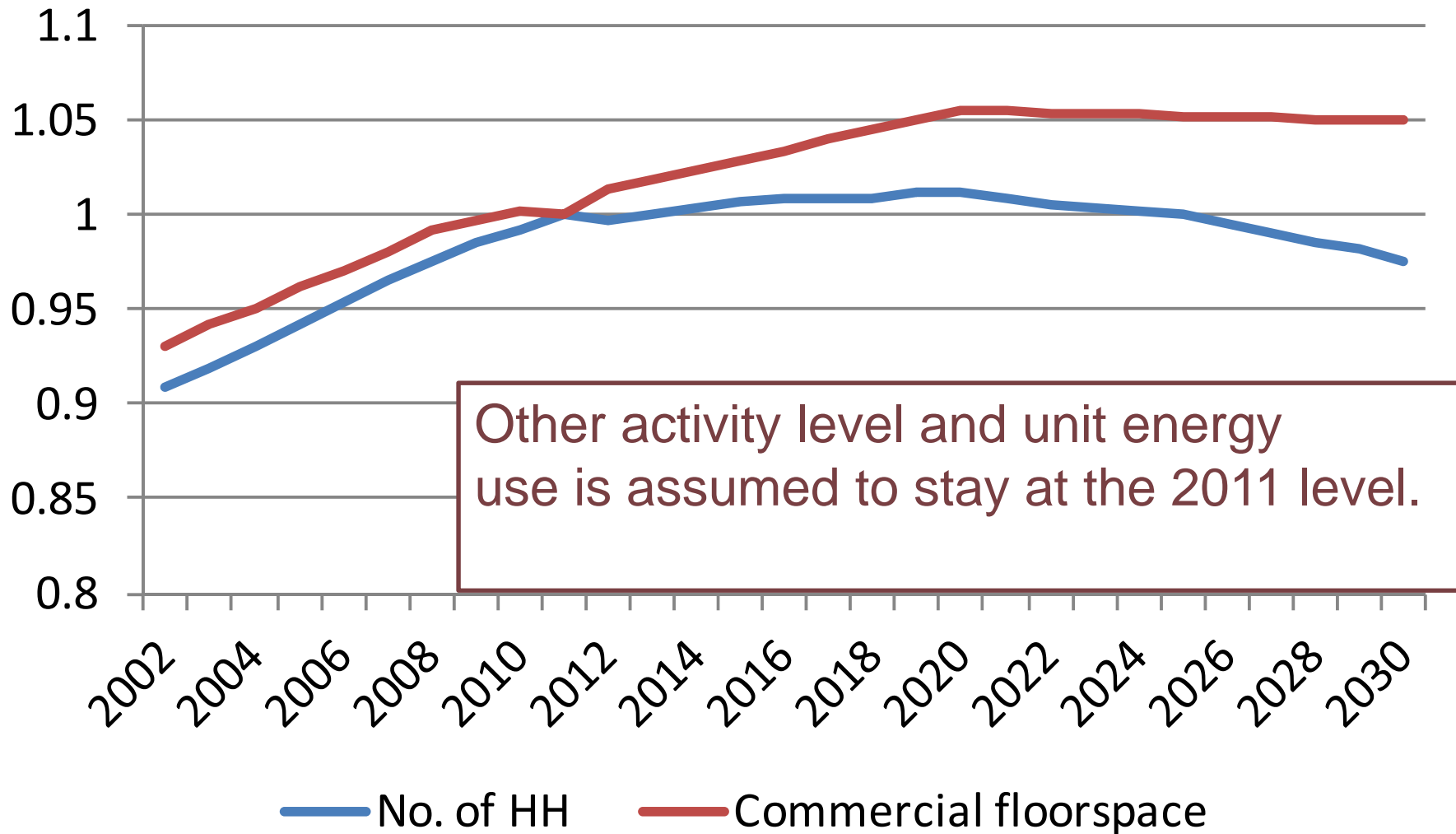
## Capacity Factor (Maximum Availability)

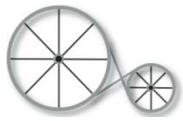




# Other Assumptions

- Number of households start decreasing 2020, commercial floorspace also start decreasing around 2020, but not much.

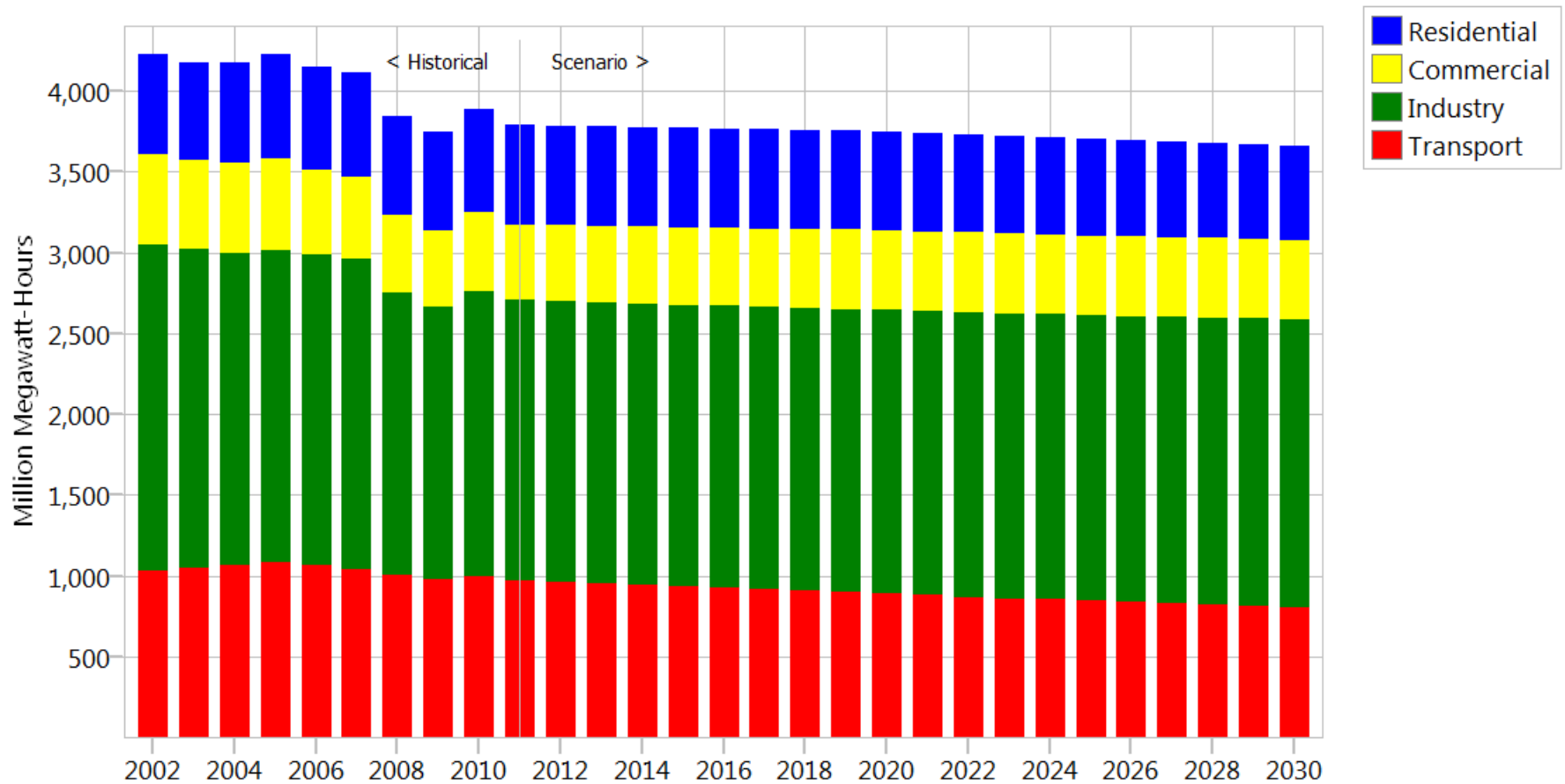




# Final Energy Demand

Demand: Energy Demand Final Units

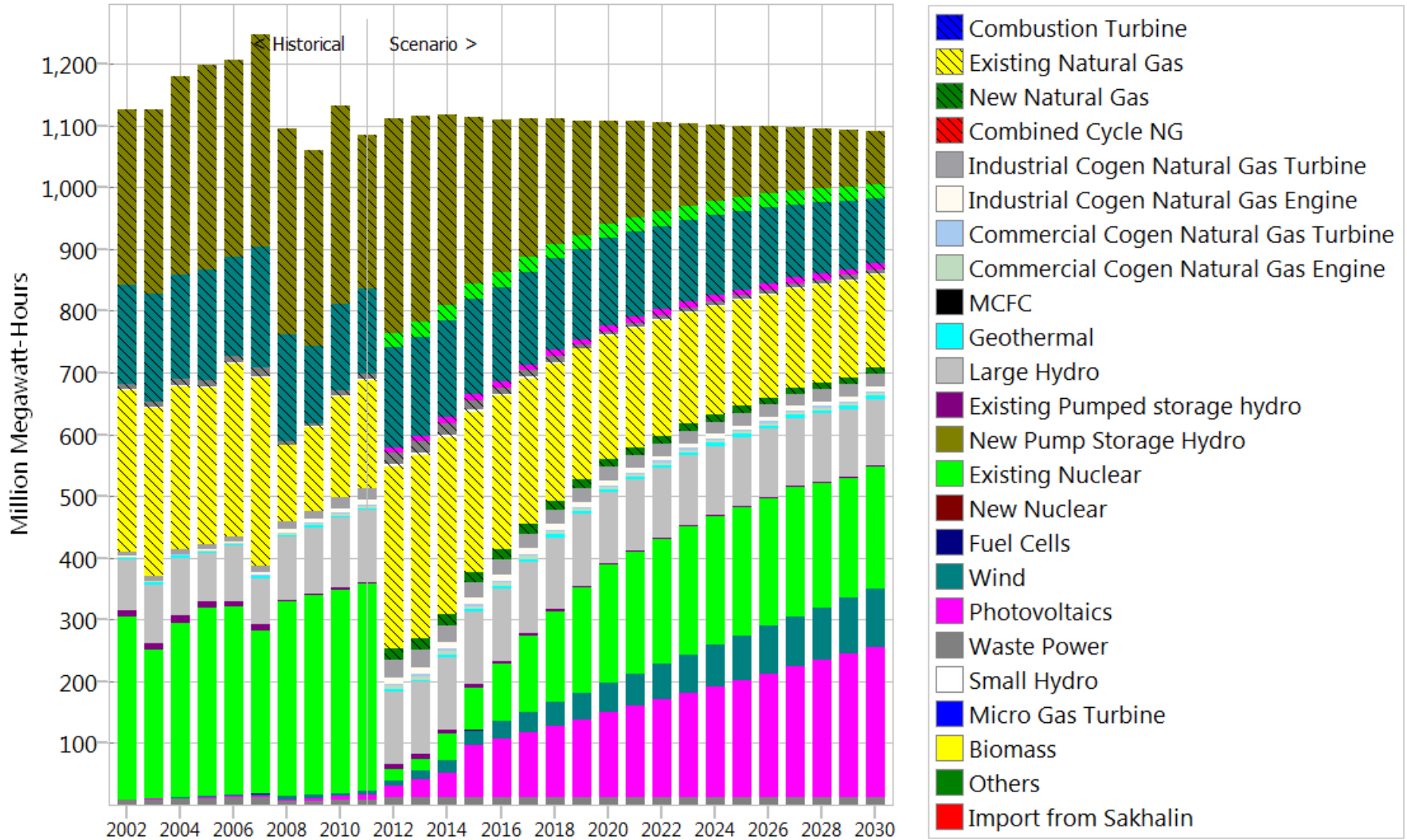
Scenario: NucMin, Fuel: All Fuels





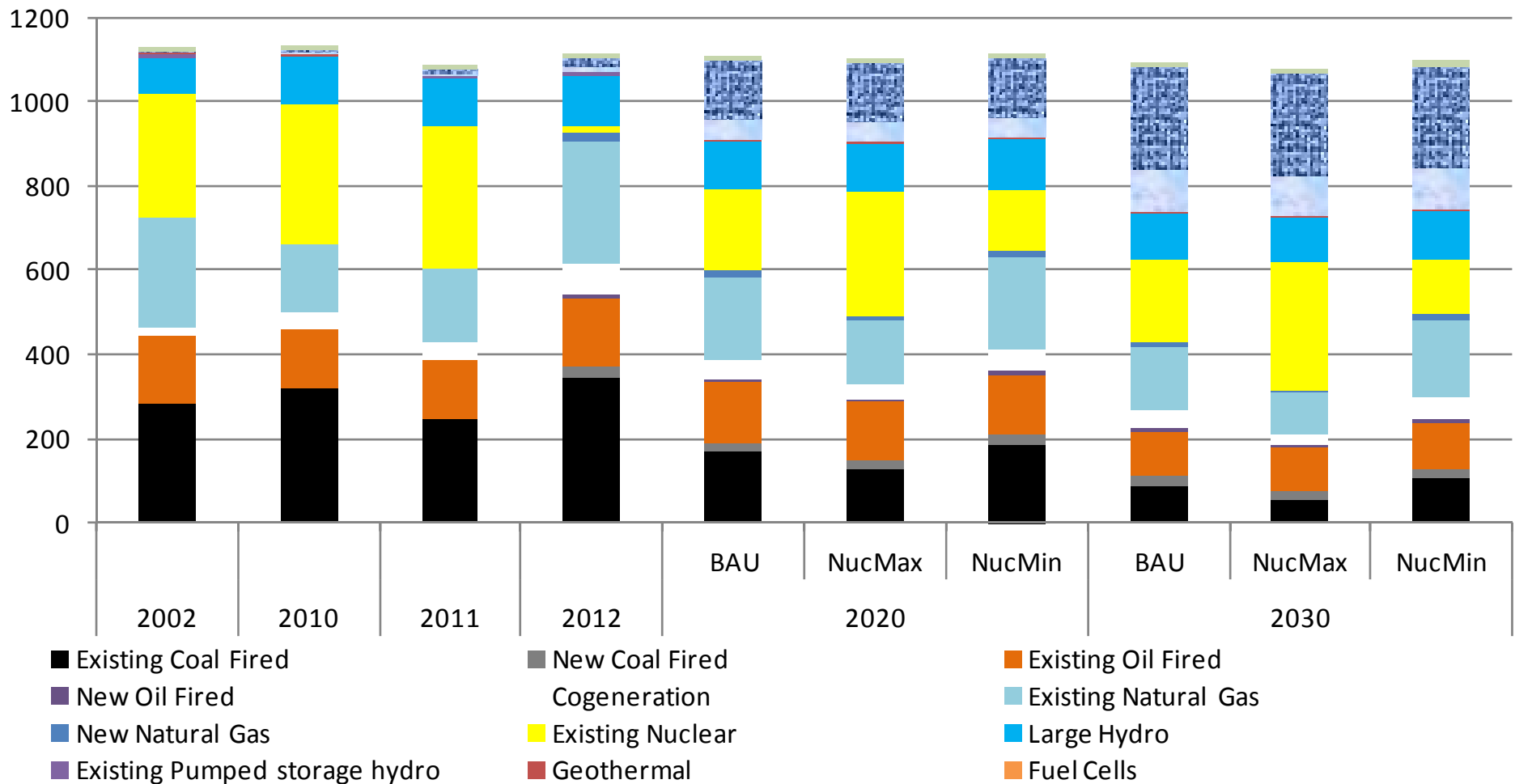
# LEAP Output (BAU), Electricity

## Electricity Generation by Sources Scenario: BAU2013, Fuel: All Fuels



# LEAP Output

## Electricity generation by sources, 3 scenarios (TWh)



## Work to be done

- Revise nuclear scenario with Japan team.
- Revise renewable scenario.
- Revise efficiency improvement scenario.
- Put branch(?) to calculate spent fuel accumulation in the model.
- Put reprocessing and final disposal branch (if possible) inside the model.
- Scenario could be separated by  
1) reprocessing, 2) final disposal.



## ■ Nuclear Path

◆ BAU

◆ Max

◆ Min

## ■ Reprocessing

◆ All

◆ Partially

◆ None

## ■ Final Disposal



# Overview

