Carbon Neutrality in 2050 and the LTO of Nuclear Power Plants
- Status and Challenges in Japan -

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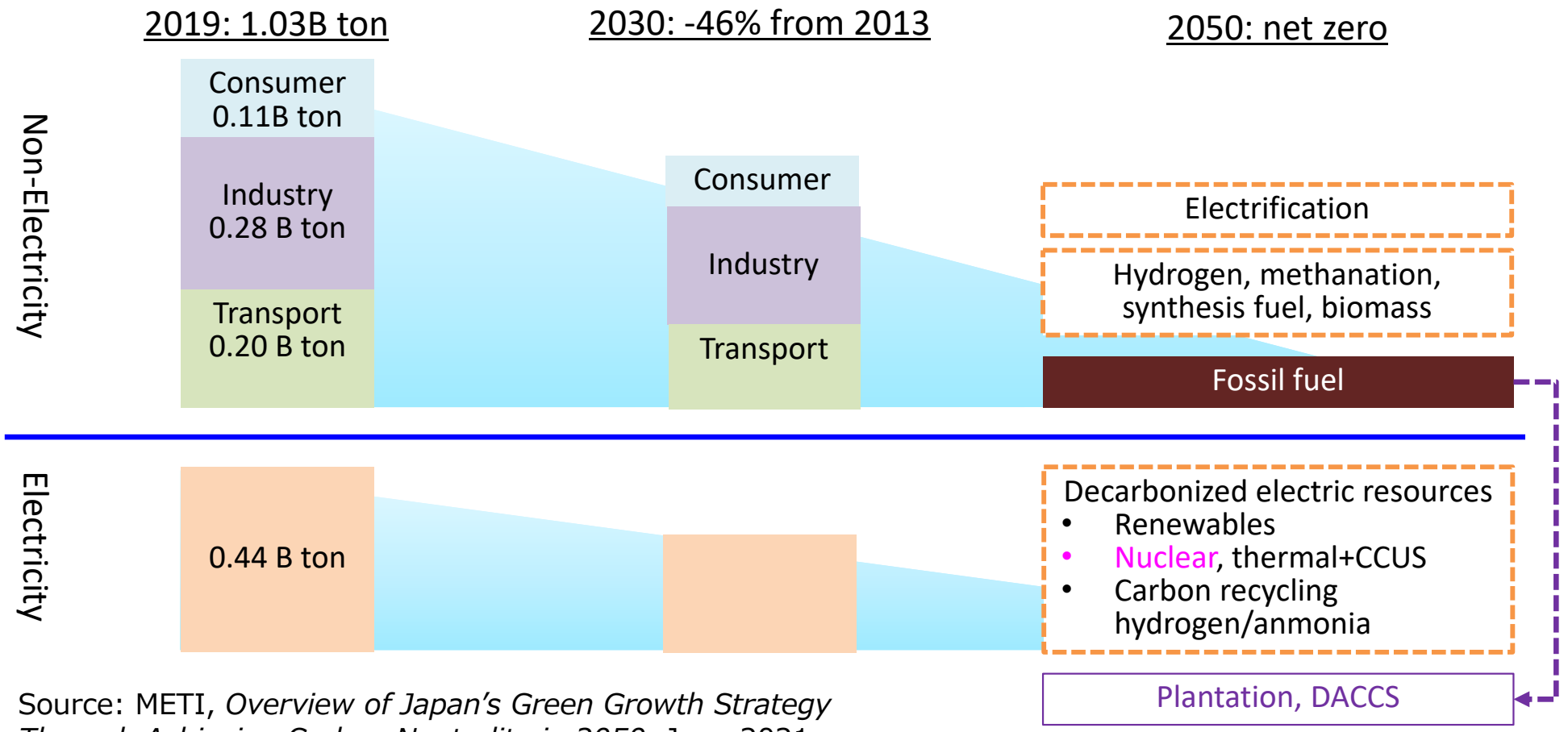
The Green Growth Strategy through achieving Carbon Neutrality in 2050

- In October 2020, Prime Minister Suga declared the goal of realizing a carbon-neutral, decarbonized society by 2050.
- METI released the "Green Growth Strategy Through Achieving Carbon Neutrality in 2050" in collaboration with related ministries and agencies on December 25th. (Latest revision was released on June 18th 2021)



Source: METI, *Overview of Japan's Green Growth Strategy Through Achieving Carbon Neutrality in 2050,* June 2021
https://www.meti.go.jp/english/policy/energy_environment/global_warming/ggs2050/pdf/ggs_overview_all.pdf

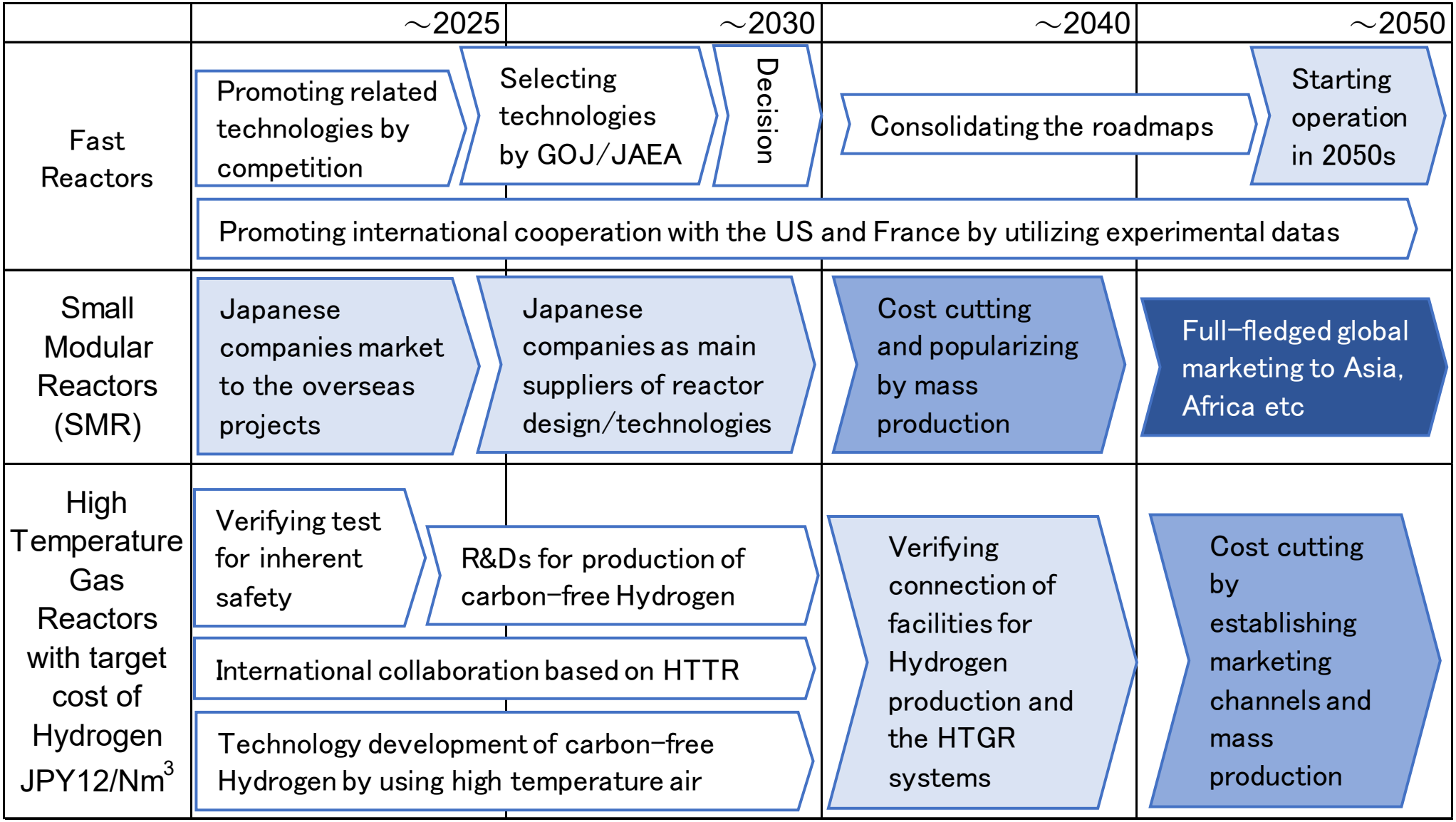
14 growth sectors listed in the Green Growth Strategy

Energy	Transport/Manufacturing	Home/ Office
Offshore wind power	Mobility and battery	Housing and building, Next generation PV
Fuel ammonia	Semiconductor and ICT	
	Maritime	Resource circulation
Hydrogen Turbines for power generation, hydrogen reduction steelmaking, carrier ships, water electrolyzers	Logistics, people flow and infrastructure	
Nuclear power SMR (Small Modular Reactor), nuclear power for hydrogen production	Foods, agriculture, forestry and fisheries	Lifestyle-related industry
	Aviation	
	Carbon Recycling	

Source: METI, *Overview of Japan's Green Growth Strategy Through Achieving Carbon Neutrality in 2050*, January 2021
https://www.meti.go.jp/english/press/2020/pdf/1225_001a.pdf

How can we achieve commercialization of these technologies?

Road map to 2050 for the nuclear power sector

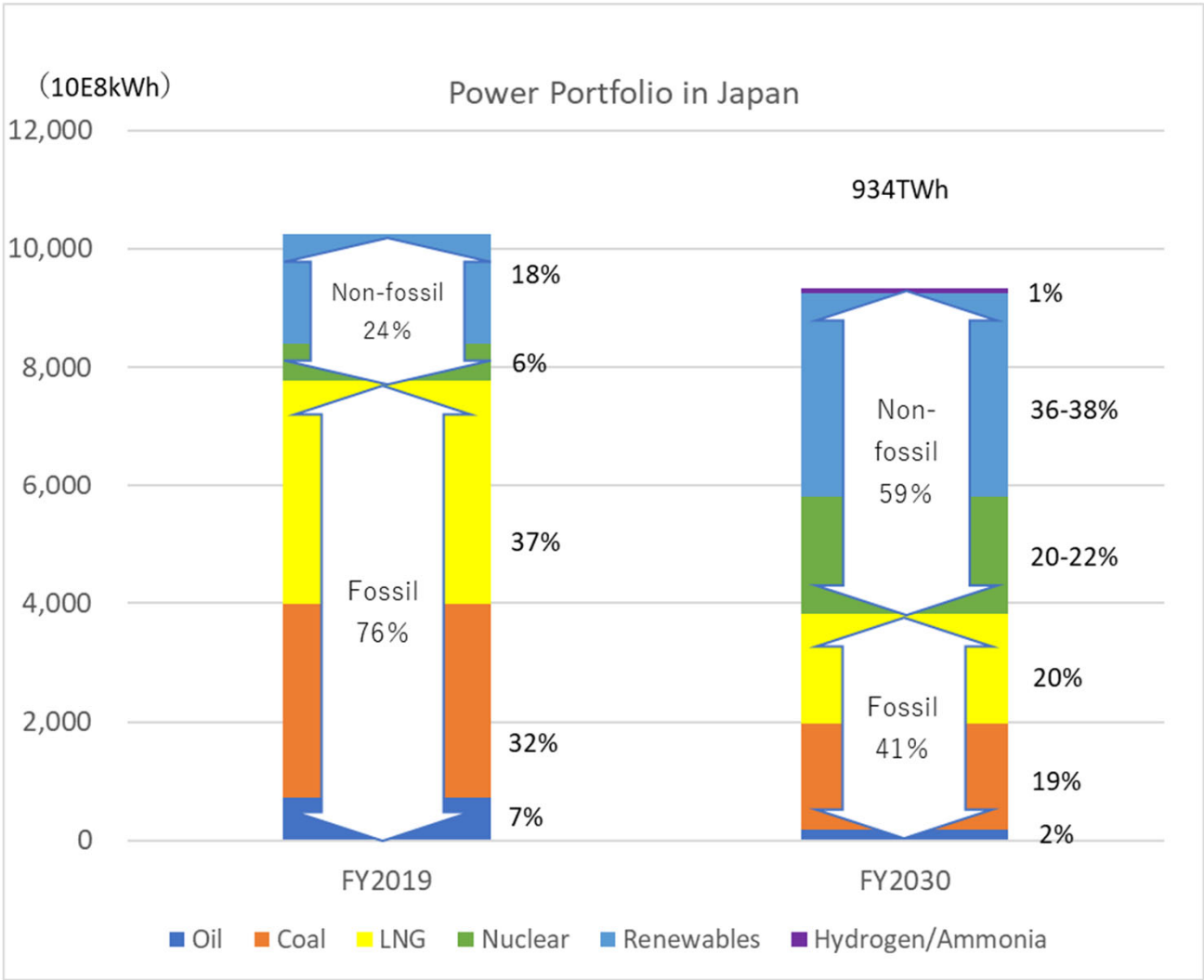


Source） https://www.meti.go.jp/press/2021/06/20210618005/20210618005-4.pdf P46

No Generation-III+ light water reactors !!!

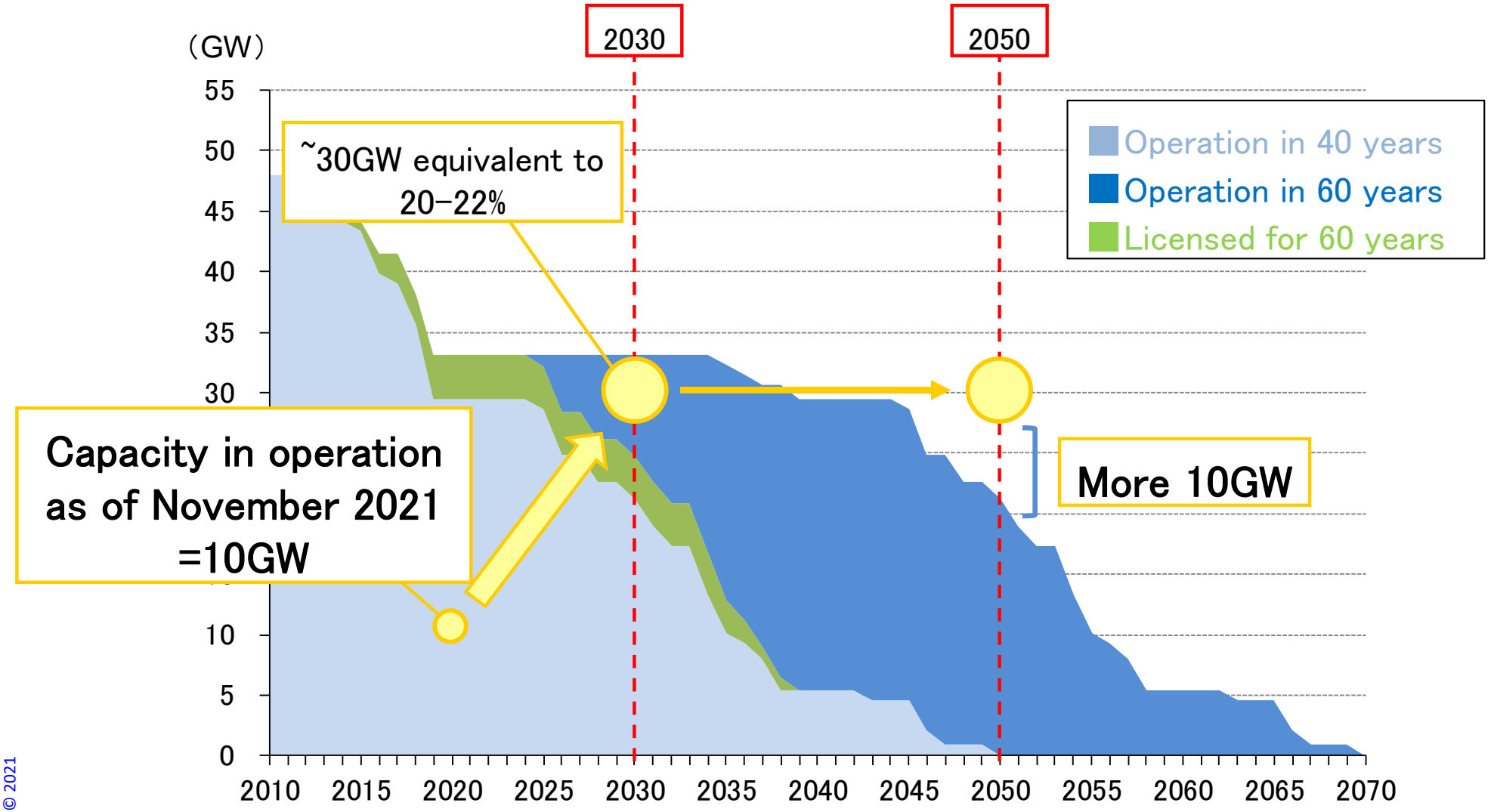
Capacity of existing nuclear reactors necessary in 2030

- "Necessity of new construction of nuclear power plants" was not mentioned in the 6th Strategic Energy Plan of Japan released in October 2021.
- So we need to afford carbon-free electricity from renewables and EXISTING nuclear power plants only to increase the share of non-fossil power to 59% in 2030.



How much capacity will remain in 2030 and in 2050?

- 30 GW would be necessary to achieve 20-22% in 2030, and in 2050 as well.
- Lifetime extension to 60 years should be crucial, and more 10GW is necessary.



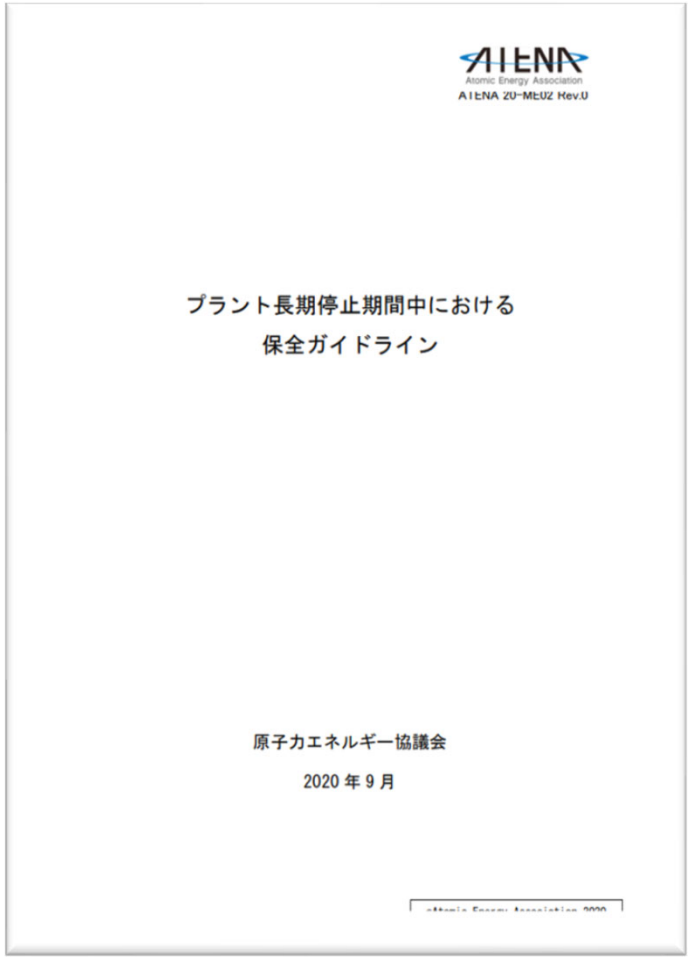
Challenges and activities in the nuclear industry

- Atomic Energy Association of Japan, ATENA, issued a technical guideline for maintaining integrity of the nuclear power plants in the long term shutdown (ATENA 20-ME02) in September 2020. (Japanese only, sorry!)
- Operators must set the Special Maintenance Program for the SSCs (structure, systems and components) to be used in case of a restart from the long term shutdown.

What is different from the normal maintenance?

- Sticking by rust (motors, pumps, valves…)
- Oxide film
- Corrosion extension under the different air condition
- …

… Based on the same regulation such as;
- PLM guideline by NRA, AESJ etc



Existing reactors remaining in 2021; up to 60 years!

The shutdown period in average (years)	
Reactors under safety review or yet to be reviewed (23 Units)	11.0
Reactors in operation (10 Units)	6.2

The reactors which are already in operation might be operated to 60 years old or more.

However, it is not the same as the reactors which have not yet been restarted.

-> Issues and challenges might be different between these two groups.

Data – reactors not yet restarted; 23 units

Copmany	Unit	Type	Outpout (MW)	Birthday	Age	Shutdown	Cause	Years of SD
JAPC	Tokai Daini	BWR	1100	1978/11/28	43	2011/3/11	East Japan Earthquake	10.7
	Tsuruga 2	PWR	1160	1987/2/17	35	2011/5/7	Unexpected event	10.6
Hokkaido	Tomari 1	PWR	579	1989/6/22	32	2011/4/22	Regular Inspection	10.6
	Tomari 2	PWR	579	1991/4/12	31	2011/8/26	Regular Inspection	10.3
	Tomari 3	PWR	912	2009/12/22	12	2012/5/5	Regular Inspection	9.6
Tohoku	Onagawa 2	BWR	825	1995/7/28	26	2010/11/6	Regular Inspection	11.1
	Onagawa3	BWR	825	2002/1/30	20	2011/3/11	East Japan Earthquake	10.7
	Higashidori 1	BWR	1100	2005/12/8	16	2011/2/6	Regular Inspection	10.8
Tokyo	KK1	BWR	1100	1985/9/18	36	2011/8/6	Regular Inspection	10.3
	KK2	BWR	1100	1990/9/28	31	2007/7/5	Unexpected event	14.4
	KK3	BWR	1100	1993/8/11	28	2007/7/16	Chuetsu-Oki Earthquake	14.4
	KK4	BWR	1100	1994/8/11	27	2007/7/16	Chuetsu-Oki Earthquake	14.4
	KK5	BWR	1100	1990/4/10	32	2012/1/25	Regular Inspection	9.8
	KK6	ABWR	1356	1996/11/7	25	2012/3/26	Regular Inspection	9.7
	KK7	ABWR	1356	1997/7/2	24	2011/8/23	Regular Inspection	10.3
Chubu	Hamaoka 3	BWR	1100	1987/8/28	34	2010/11/29	Regular Inspection	11.0
	Hamaoka 4	BWR	1137	1993/9/3	28	2011/5/13	Minister's request	10.6
	Hamaoka 5	ABWR	1380	2005/1/18	17	2011/5/14	Minister's request	10.5
Hokuriku	Shika 1	BWR	540	1993/7/30	28	2011/3/1	Maintenance works	10.8
	Shika 2	ABWR	1206	2006/3/15	16	2011/3/11	Regular Inspection	10.7
Chugoku	Shimane 2	BWR	820	1989/2/10	33	2012/1/27	Regular Inspection	9.8
Kansai	Takahama 1	PWR	826	1974/11/14	47	2011/1/10	Regular Inspection	10.9
	Takahama 2	PWR	826	1975/11/14	46	2011/11/25	Regular Inspection	10.0

Data – reactors restarted; 10 units

Copmany	Unit	炉型	Output (MW)	Birthday	Age	Shutdown	Cause	Restarted on	Years of SD
Kansai	Miahama 3	PWR	826	1976/12/1	45.0	2011/5/14	Regular Inspection	2021/7/27	10.2
	Takahama 3	PWR	870	1985/1/17	36.9	2012/2/20	Regular Inspection	2016/2/26	4.0
	Takahama 4	PWR	870	1985/6/5	36.5	2011/7/21	Regular Inspection	2017/6/16	5.9
	Ohi 3	PWR	1180	1991/12/18	30.0	2011/3/18	Regular Inspection	2018/4/10	7.1
	Ohi 4	PWR	1180	1993/2/2	28.8	2011/7/22	Regular Inspection	2018/6/5	6.9
Shikoku	Ikata 3	PWR	890	1994/12/15	27.0	2011/4/29	Regular Inspection	2016/9/7	5.4
Kyushu	Sendai 1	PWR	890	1984/7/4	37.4	2011/5/10	Regular Inspection	2015/9/10	4.3
	Sendai 2	PWR	890	1985/11/28	36.0	2011/9/1	Regular Inspection	2015/11/17	4.2
	Genkai 3	PWR	1180	1994/3/18	27.7	2010/12/11	Regular Inspection	2018/5/16	7.4
	Genkai 4	PWR	1180	1997/7/25	24.4	2011/12/25	Regular Inspection	2018/7/19	6.6

If we live without LTO, we must live without nuclear in 2050.

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