

# Quantitative Scenario toward Zero-Carbon Power Generation System

WEC 2019

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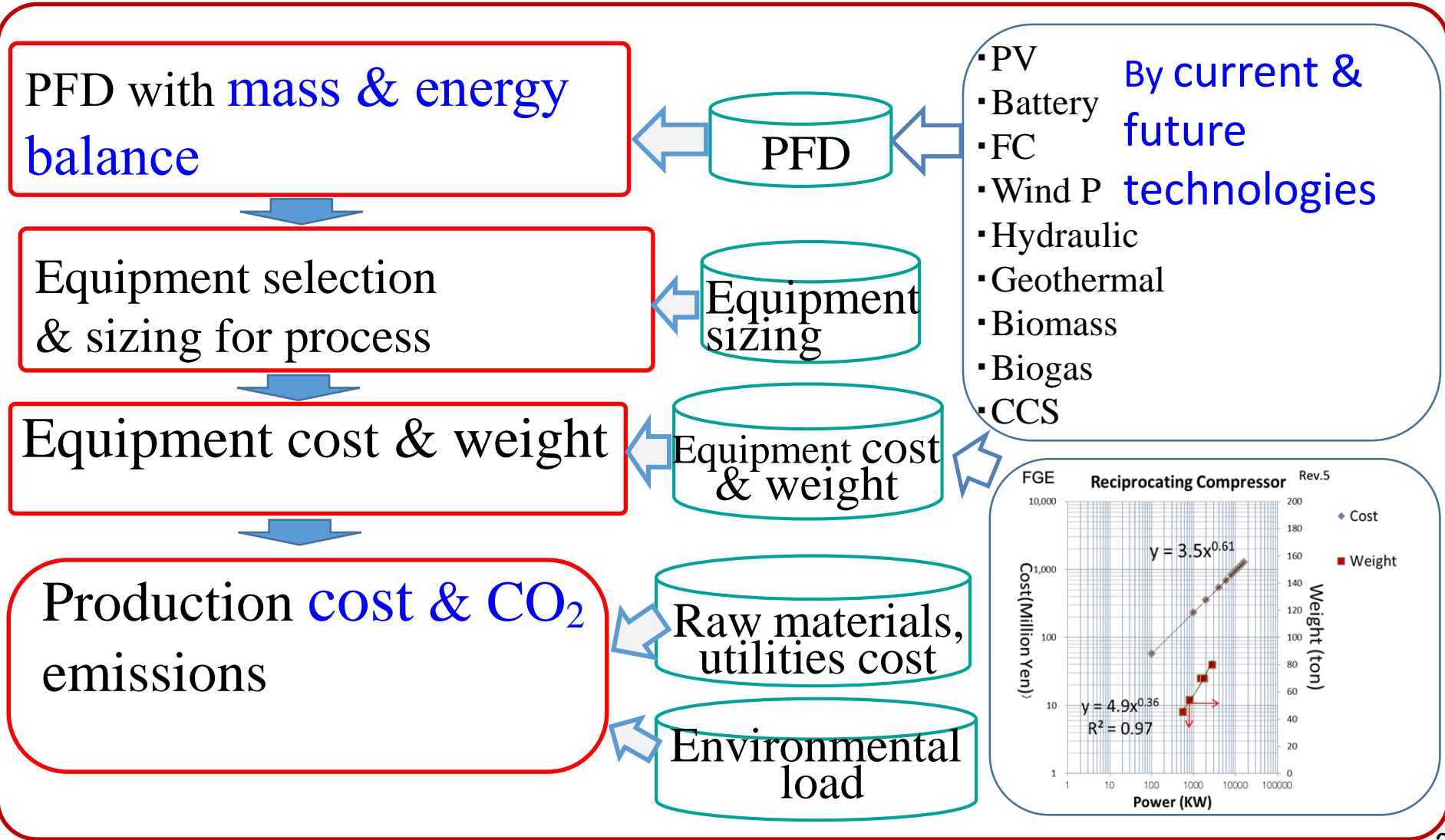
Japan Science and Technology Agency  
Center for Low Carbon Society Strategy

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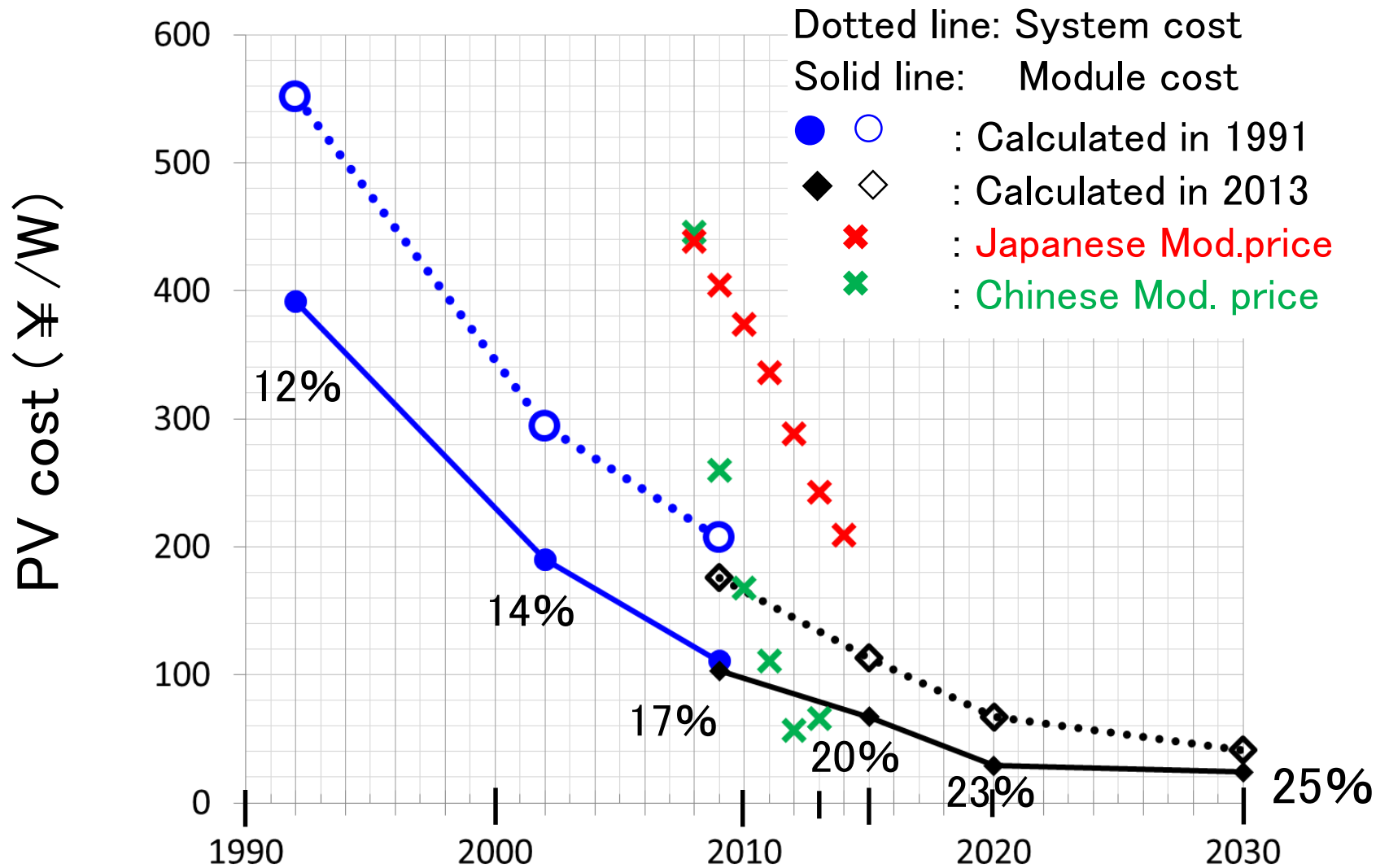
Cost and CO<sub>2</sub> emissions of energy technologies

- ① Platform for design & evaluation of products
- ② Prospects of PV, battery, hydrogen, pumped hydro storage power system
- ③ Zero-carbon power generation cost

# LCS Platform for Design & Evaluation of Current & Future Product

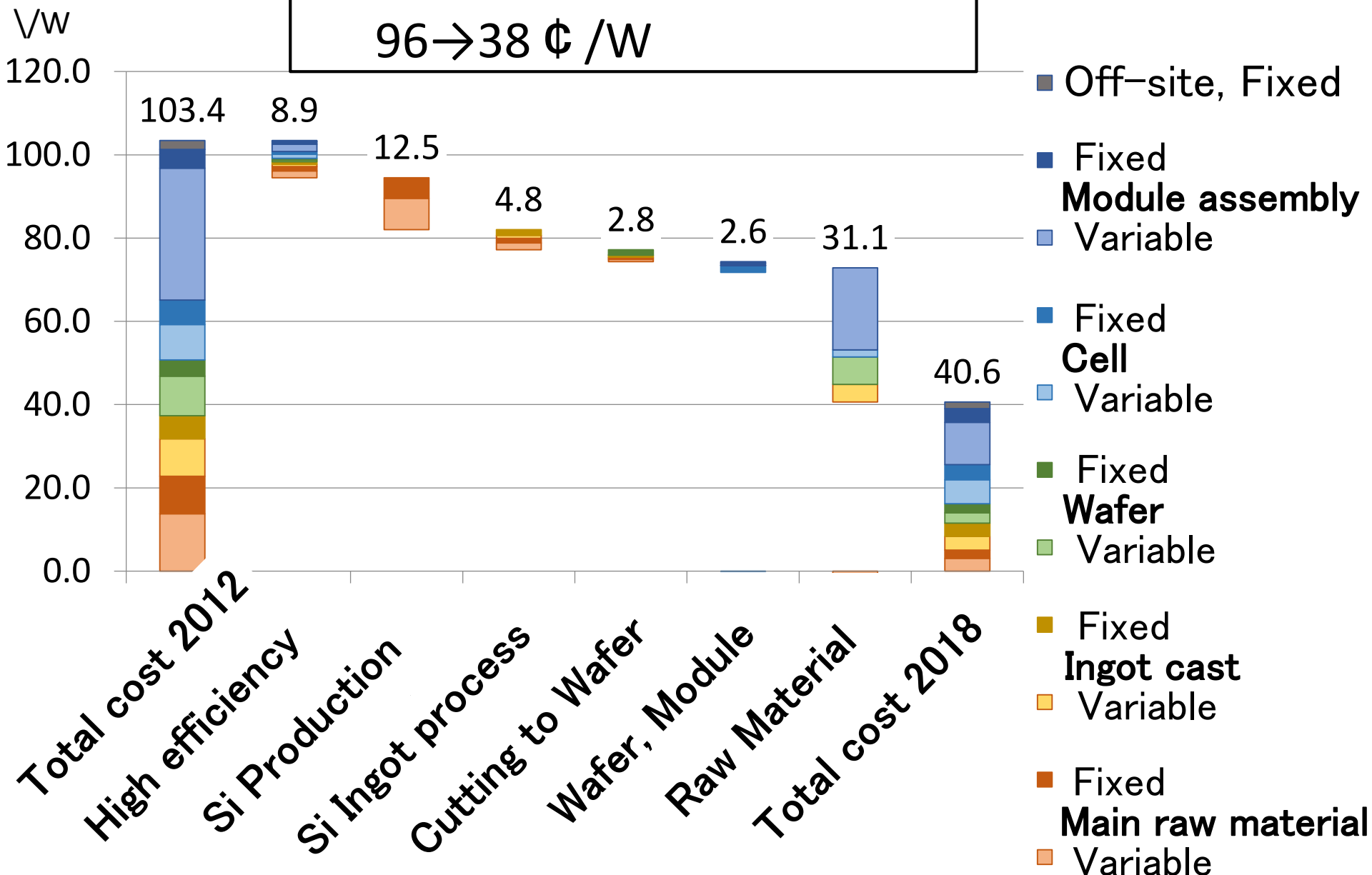


# Calculated cost and actual price of PV module and system



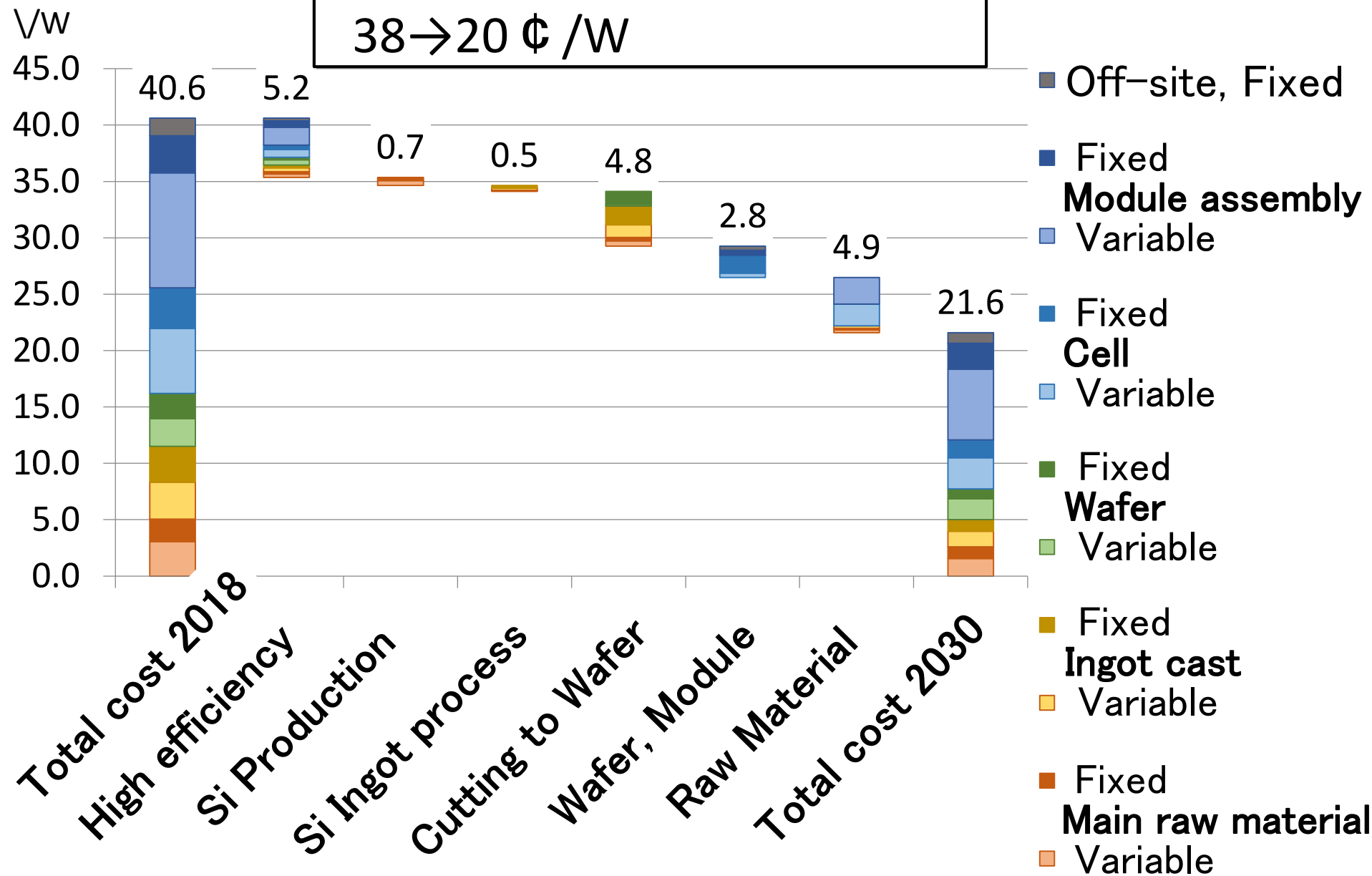
# Change of PV module cost from 2012 to 2018

Total cost down= ¥63/W, 61%  
96→38 ¢ /W



# Change of PV module cost from 2018 to 2030

Total cost down=¥19/W, 47%  
38→20 ¢ /W



# PV system costs (Yen/W)



		2018	2030						
		Simono	Si mono	Si mono	CIGS	CIGS Tandem	Perovskite		Si+Pe
Module eff.		20%	22%	25%	22%	30%	15%	20%	30%
Wafer thickness (μm)		150	150	100	-	-	-	-	100
Kerf loss (μm)		120	100	100	-	-	-	-	100
Module (Yen/W)	Material	23	16	14	18	14	23	14	12
	Utility	4	3	1.6	1.2	1.3	2	1	2
	Equipment	12	10	6	7	6	12	7	8
	Labor	2	1	0.6	0.2	0.2	2	0.4	0.6
	ModuleTotal	<b>41</b>	<b>30</b>	<b>22</b>	<b>26</b>	<b>21</b>	<b>39</b>	<b>22</b>	<b>21</b>
BOS	Mounting str.	29	9	8	9	6	12	9	6
	Electric sys.	20	9	9	9	9	9	9	9
Total system (Yen/W)		<b>95</b>	<b>48</b>	<b>39</b>	<b>44</b>	<b>36</b>	<b>60</b>	<b>40</b>	<b>36</b>

# Power generation cost & potential of renewable energy (Japan)

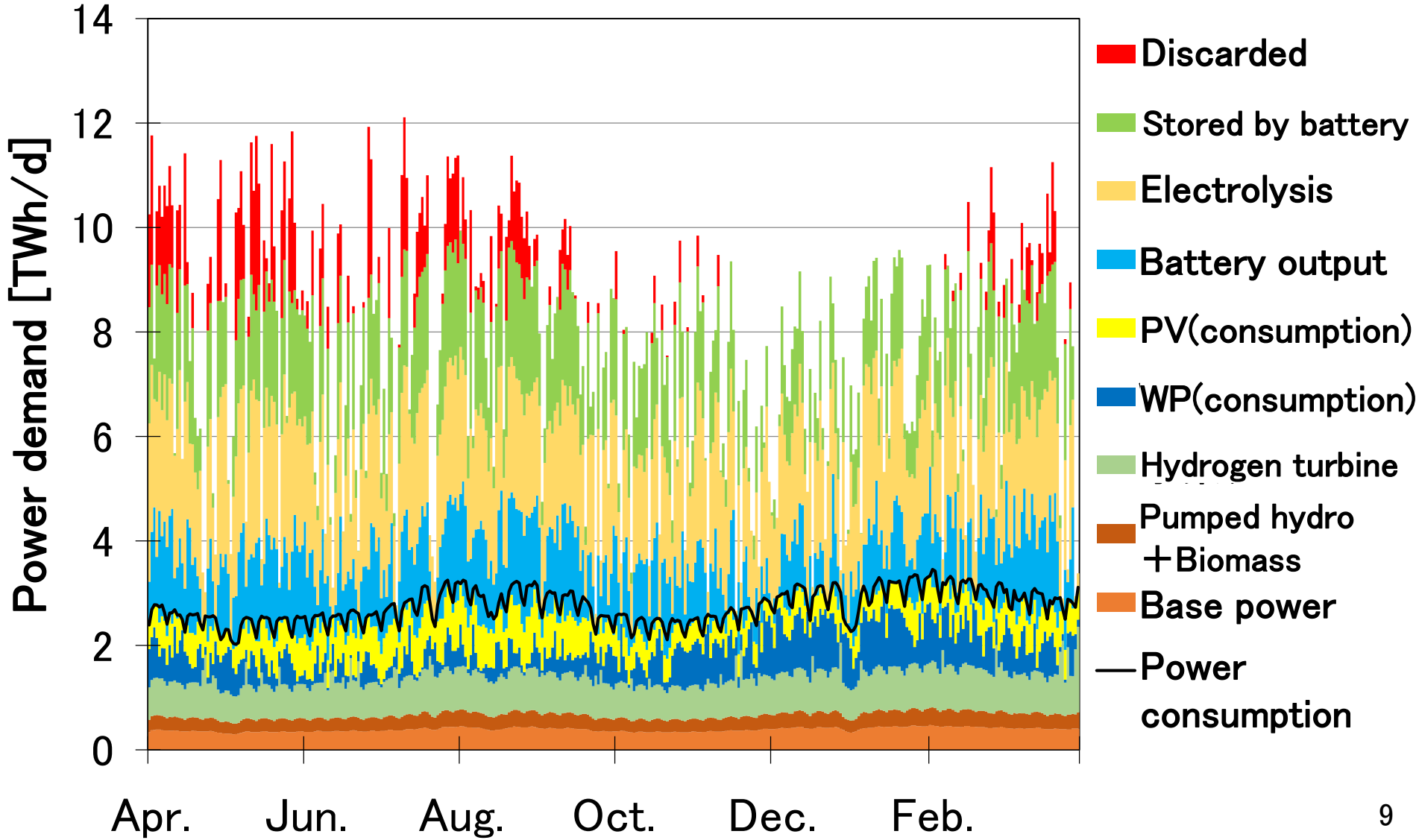
	Cost ( ¥ /kWh)		Potential (TWh/y)
	Current	2030	
Photo voltaic	10	4	800 ~ 2200
WP (land)	16	8	>500
Geothermal	25	8	500
Hydro (small/medium)	30	15	70
Biogas	25	13	15
Biomass	25	12	40
Battery ( ¥ /Wh)	19	6	

Nuclear power cost : ¥15/kWh



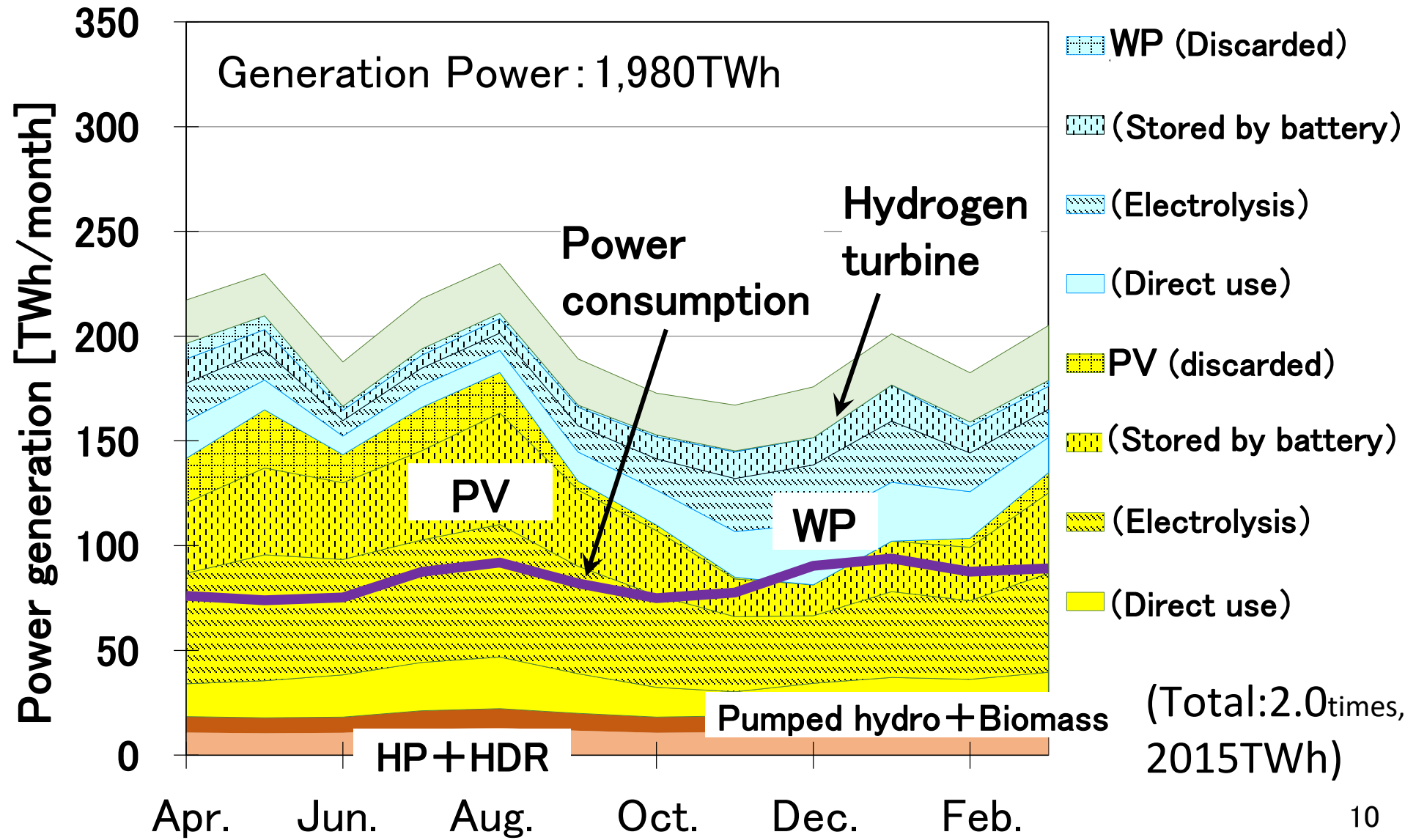
# Daily demand & supply of ZC power system

Power demand	Inertia rate	HDR	New pumped hydro	PV
1,000TWh	50%	0	0	1,400TWh



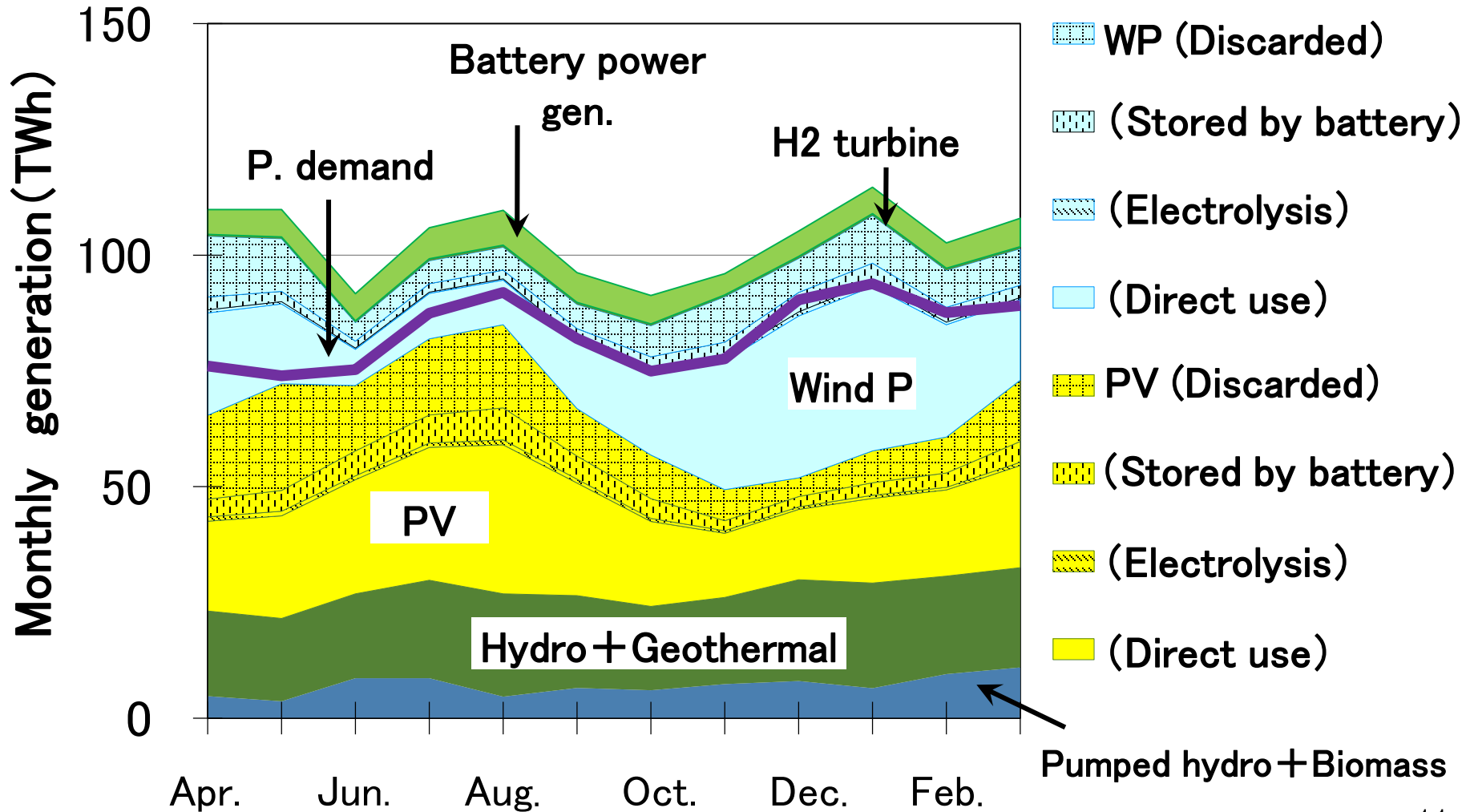
# Monthly demand & supply of ZC power system

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# Monthly demand & supply of ZC power system

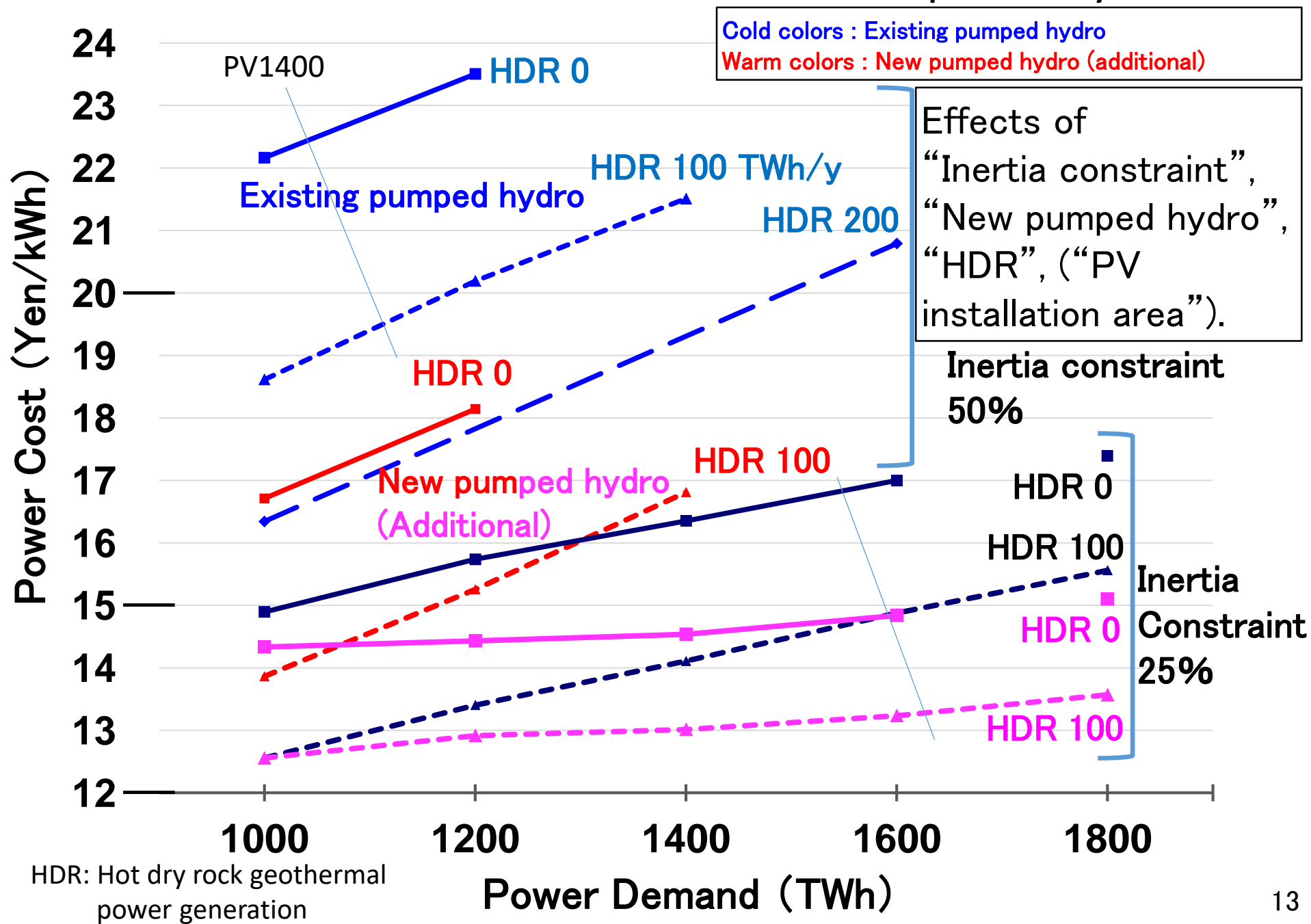
Power demand	Inertia rate	HDR	Pumped hydro	Generated power 1,120TWh
1,000TWh	25%	100	with	



# Zero-carbon power generation cost

Case	1	2	3
Inertia rate	25%	25%	25%
New pumped hydro	Without	With	With
Power demand (TWh/y)	1,000	1,000	1,000
HP	130	130	130
PV	726	629	499
WP	496	559	346
Geothermal	12	12	112
Biomass	31	14	27
Total	1,394	1,349	1,118
Battery	331	125	86
H <sub>2</sub> generation	64	14	5
Pumped hydro	72	224	190
Battery capacity (GWh-ST)	1,023	362	262
Generation cost (¥/kWh)	14.9	15.0	13.2

# Power cost and demand of Zero-carbon power systems



# Conclusion

To design a zero-carbon power source, it is important to evaluate systems using renewable energy under future technology clarification and calculate the cost and CO<sub>2</sub> emissions for each technology and the entire system.

This is an area that requires engineering thinking way.