

Wind Power Generation Systems (Vol. 2):

Economic Evaluation for Future Wind Power Generation Systems Which Are Adapted to Japan Considering Large Scale Installation and Related Technological Development Issues

After summarizing technological issues relating to Japan's unique topography and meteorological conditions, offshore wind turbines with high capacity factor suitable for Japan were evaluated. Using these results, economics of several types of large-scale installed wind power systems in Japan were analyzed.

- To expand the introduction of wind power generation in Japan, wind power generation systems with high capacity factors - even in regions with low wind speed - must be developed. Reducing the cost of power generation also requires the large-scale installation of offshore wind power.
- The economics of wind power system were evaluated, considering a large-scale installation, including offshore wind turbines with a high facility utilization rate of 50% (Table 1), with lower specific power and large rotor diameter.
- For the standard case, the construction cost of a high capacity factor offshore wind turbine is double, but the power generation cost is 12 JPY/kWh (bottom-fixed) or 13.6 JPY/kWh (floating) (Figure 1). Lower transmission costs due to improved capacity factors lead to overall reductions in grid costs. Therefore, it would be worthwhile to adopt this model when constructing a zero-carbon power system.

Proposals for Policy Development

The following considerations are required for Japan-specific technological development and industrial strategies related to the large-scale domestic introduction of wind power.

- 1) Development of materials / structure / device design technologies needed for high capacity factor wind turbines suitable for Japanese weather conditions.
- 2) Development of wind turbine / operation technologies suitable for Japan's complex terrain, typhoons, and winter lightning, and consideration of strategies for launching to the global market.
- 3) Overall system designs and economic assessments for offshore wind power, including cost reductions and connections to the grid.

Table 1: Wind power system specifications in each case

Wind turbine type		(1) Onshore	(2) Offshore bottom-fixed	(3) Offshore bottom-fixed with high capacity factor	(4) Offshore floating	(5) Offshore floating with high capacity factor
Rated power	MW	3	5	2.5	10	7
Rotor diameter	m	82	126	126	150	150
Capacity factor	%	25%	30%	50%	35%	50%
Assumed average wind speed	m/s	6.4	7	7	7.6	7.6
Estimated number of WTs in a WF	WT	20	100	100	200	200
Estimated WF scale	MW	60	500	500	2,000	1,400
Water depth	m	-	30	30	120	120

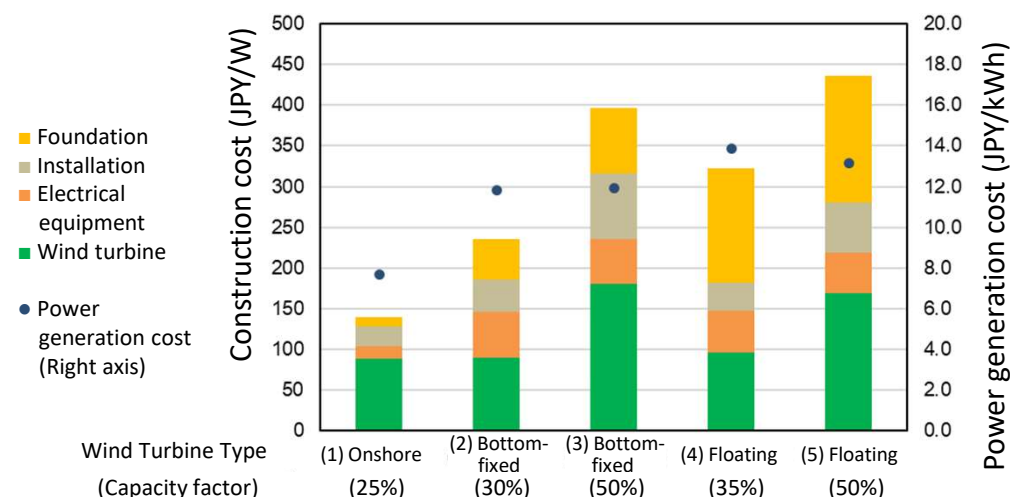


Figure 1: Generation costs for a future wind power system, assuming a large-scale installation