

# Dismantling and Recycling of Wind Energy Plants

## Dismantling

Dismantling of wind energy plants is regulated by the German construction law (Baugesetzbuch), the law for the protection against emissions (Bundes-Immissionsschutzgesetz) and several laws on waste management.

- For demolition, the following requirements and recommendations have been developed.
- Notification of deinstallation at the plant register of the Federal Net Agency,
- Closed-down by a qualified person,
- Deconstruction by means of crane instead of using a wrecking ball or blasting,
- Shelled and protected sawing, in particular for fiber-reinforced plastics,
- Complete demolition of groundings, crane spaces and paths,
- Keeping the rules of environmental and occupational safety as well as protection against noise.

year	Glass fiber reinforced plastic	Glass / carbon fiber reinforced plastic	steel	copper	aluminium	concrete	Electronic waste
	t	t	t	t	t	t	t
2020	0	0	0	0	0	0	0
2021	50,868	9	847,700	12,458	2,083	3,213,839	25,580
2022	29,816	9	421,403	6,806	906	1,694,005	12,685
2023	36,800	9	522,440	9,117	1,072	2,137,698	15,543
2024	29,802	18	407,432	7,462	838	1,750,188	12,341
2025	22,355	416	319,353	6,269	662	1,551,112	9,454
2026	20,310	469	295,495	5,589	604	1,454,516	8,597
2027	23,812	1,454	352,332	6,323	694	1,652,742	10,241
2028	17,445	1,206	258,577	5,561	540	1,285,948	7,867
2029	15,040	1,192	225,907	4,810	470	1,078,614	6,777
2030	18,720	1,022	280,550	7,076	629	1,607,386	8,708
2031	14,888	867	226,452	5,494	533	1,385,931	6,874
2032	19,246	1,514	288,547	6,872	714	1,855,381	8,609
2033	25,360	2,292	359,174	7,958	1,069	2,420,860	10,258
2034	33,953	3,581	440,832	8,326	1,631	2,981,945	11,653
2035	59,018	6,815	691,289	13,112	2,837	4,496,682	18,741
2036	52,144	6,954	601,338	10,203	2,605	4,044,531	15,702
2037	63,128	8,669	726,088	12,477	3,319	4,984,553	18,624
2038	73,584	10,611	836,216	14,161	3,745	5,527,403	22,015
2039	51,766	6,533	539,361	10,279	3,091	3,650,641	14,229
2040	41,990	5,709	439,549	8,253	2,438	2,891,676	11,740

## Recycling

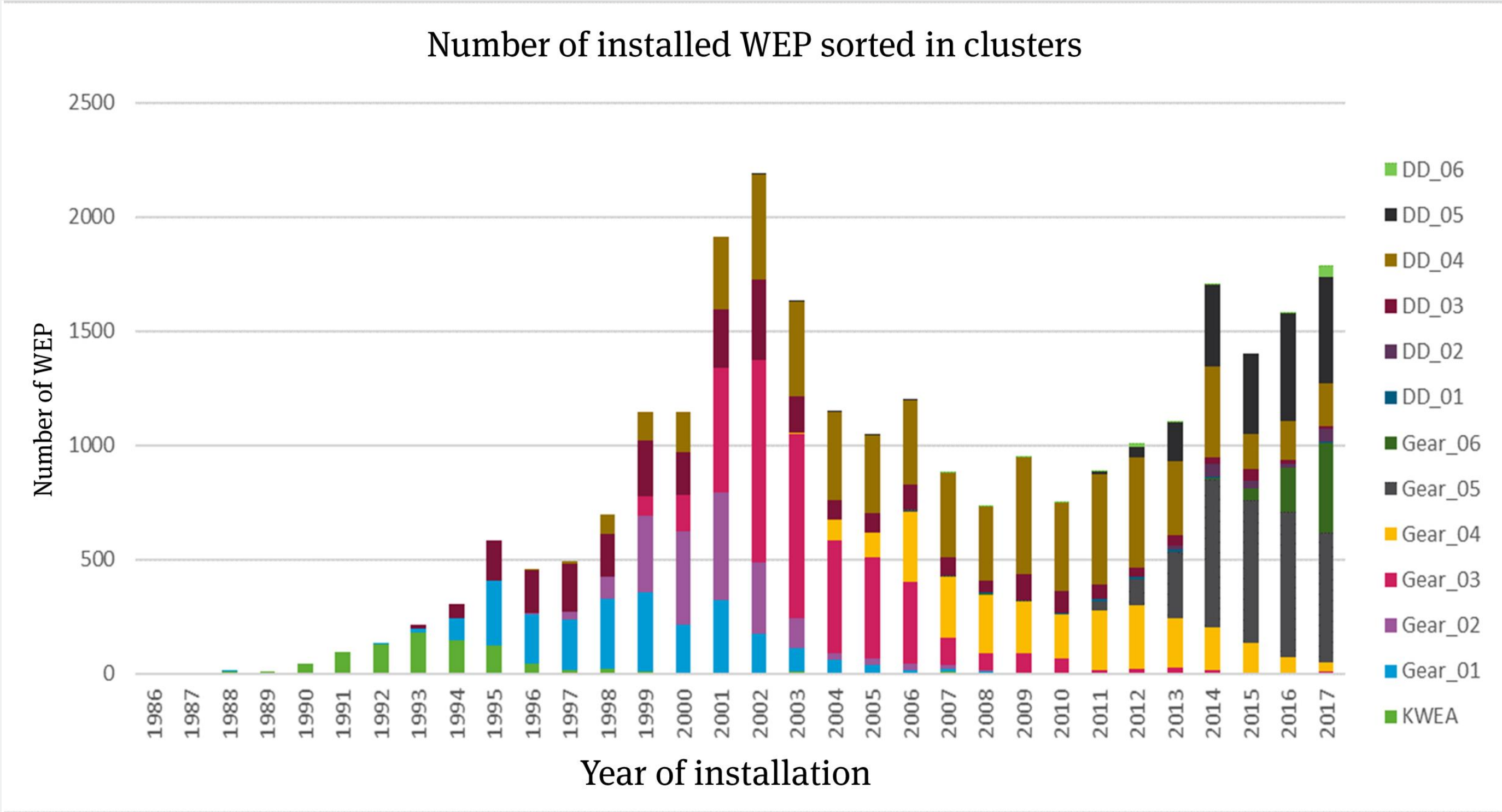
Already during dismantling recycling has to be considered, because the clear separation of materials is a prerequisite for a high valued use of secondary raw materials.

The previous table shows, which materials can be expected. They are recyclable concrete, valuable steal, copper, electronic waste and pure aluminum.

Wind turbine blades contain glass fiber reinforced plastics and sometimes also glass and carbon fiber reinforced plastics. Due to the huge size and rigidity of rotor blades a specialized processing cascade is necessary. It starts with a breaking at the demolition site, during which the environment has to be protected against dust. Afterwards a waste treatment in only one available recycling facility in Germany follows. It is run by neowa GmbH and realizes a separation of metals and carbon fiber reinforced plastics for further recycling. Glass fiber reinforced plastics are prepared for the use as surrogate fuels in a cement kiln.

## Wind energy plant inventory

The following figure is the result of an inventory of the wind energy plants in Germany. Similar types of plants are clustered and the colors highlight the technological progress. Furthermore, the figure give evidence on the year of installation. Considering an operation time of 20 years, the data are the basis for forecast of wind energy plant dismantling and recycling.



## Further recommendations

Firstly, the study recommends the development of guidelines which are accepted by the federal and local authorities.

Secondly, it reveals a lack of research and development regarding the recycling of turbine blades. Further capacities are needed and the responsibility for a high valued recycling has to be determined.

Thirdly, the study recommends the standardization of dismantling, breaking-up and processing. The aim is the high valued recycling and the sustainable repowering.

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