BADGER WIND, LLC

Decommissioning Costs Analysis Report

Badger Wind LLC

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Task and objective:

This report presents the results of wind power project decommissioning analysis completed by DNV.

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Abbreviation	Meaning
ADLS	Aircraft Detection Lighting System
BoP	Balance of Plant
COD	Commercial Operation Date
HV	High-voltage
MW	Megawatts
O&M	Operations and Maintenance
WTG	Wind Turbine Generator

EXECUTIVE SUMMARY

At the request of Badger Wind, LLC (“Badger Wind”), DNV Energy USA Inc. (“DNV”) performed a decommissioning analysis of the Badger Wind wind project (the “Project”). The study estimates the costs associated with the dismantling, transport, and disposal of the equipment; all costs in this study are given in 2025 U.S. dollars.

The Project is in Logan and McIntosh Counties, North Dakota approximately 2.5 miles west of Wishek. The Project consists of 92 GE 2.8-127-2.82 MW wind turbine generators (WTG) with an aggregate rated output of 259 MW, and associated infrastructure. Badger Wind has indicated that the Project includes one substation, one operations and maintenance (O&M) building, two meteorological (met) towers, and one Aircraft Detection Lighting System (ADLS) tower. The turbines are mounted on 89 m tubular steel towers. The Project is anticipated to commence commercial operations on 31 December 2025. Per Badger Wind’s request, it is assumed that decommissioning of the Project will take place 30 years after the start of commercial operations. Other Project assumptions are presented in Appendix A.

The Project’s decommissioning plan is subject to *North Dakota Administrative Code Chapter 69-09-09 – Wind Facility Decommissioning* and must also respect county level permitting conditions pertaining to decommissioning.

DNV assumes that there are strong parallels between wind power project construction and decommissioning programs and consequently, bases the estimates for decommissioning costs on its broad experience of wind power project construction programs and the associated costs of labor, plant, and materials. The complete decommissioning cost is calculated as the sum of the cost of disassembly, transport, and disposal of the turbines and balance of plant (BoP) infrastructure. For the purposes of this study, no resale or salvage of components have been accounted for in this cost study. It is noted that crane costs are the most dominant cost item in disassembly while transportation of the large turbine components dominates the costs of transport.

In most decommissioning studies, DNV typically includes revenue from the scrap value of metals; however, this study excludes such revenue at the Customer’s request. Costs provided are a high-level estimates, which have not been verified independently by contractors or suppliers and may not be fully representative of market conditions at the time of decommissioning of the Project. Many factors could vary this estimate in the future including but not limited to government requirements, transportation costs, labor rates and decommissioning market maturity. This report does not consider the time value of money; the results should therefore be adjusted to represent the inflated costs at the time of decommissioning. Although DNV assumes certain commodity prices and disposal service rates based on present day estimates, it does not forecast such future values.

The decommissioning estimate is the sum of the disassembly, transport, and disposal costs. The decommissioning costs of the Project are presented in Table ES-2.

Table ES-2 Project net decommissioning cost

Item	A	B	C	D=A+B+C
	Disassembly [$]	Transport [$]	Disposal [$]	Total Costs [$]
WTG	10,120,000	5,235,000	460,000	15,815,000
Collection system	34,000	5,000	1,000	40,000
HV substation	266,000	107,000	97,000	470,000
Access roads and crane pads	2,107,000	906,000	3,199,000	6,212,000
Met masts	49,000	8,000	3,000	60,000
Mobilization/soft costs	2,158,000	-	-	2,158,000
Project Totals	14,734,000	6,261,000	3,760,000	24,755,000
Total per WTG [$]				269,080
Total per MW [$]				95,580
Total for Project (92 WTGs) [$]				24,755,000
Note: negative values in parenthesis are positive returns to the Project.				

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1 \INTRODUCTION

Badger Wind, LLC (“Badger Wind”) retained DNV Energy USA Inc. (“DNV”) to perform a decommissioning analysis of the Badger Wind Project (the “Project”). The Project is in Logan and McIntosh Counties, North Dakota; and consists of 92 GE 2.8-127-2.82 MW wind turbine generators (WTG) with a total rated power of 259 MW, one substation, one operations and maintenance (O&M) building. two meteorological (met) towers, one Aircraft Detection Lighting System (ADLS) Tower, and associated infrastructure.

Badger Wind has advised DNV that the required decommissioning includes the removal of all towers, WTGs, substation, ancillary equipment, and other physical material owned by and pertaining exclusively to the Project and restoration of the property, including the Project roads. Based on the required depth of underground collection system removal (down to 24 inches) stated in N.D. Admin Code 69-09-09, and the fact that the collection system is generally installed 48 inches below ground level, DNV has assumed that the collection system will be abandoned in place except for limited portions of the collection system connecting to above-ground components.

2 STUDY ASSUMPTIONS

DNV’s decommissioning study methodology assumes there are strong parallels between wind power project construction and decommissioning programs. DNV has used an internal bottom-up decommissioning model that it developed from its experience in the wind industry to formulate these study results.

All costs are quoted in 2025 dollars, and it should be noted that no specific quotes from third-party vendors were obtained in relation to this study, although the Project’s location has been included in the modeling. The study is broken down into three sections: disassembly, transport, and disposal. DNV has rounded costs to the nearest $1,000, unless otherwise noted.

2.1 Regulatory requirements

The decommissioning of the Project is subject to *North Dakota Administrative Code Chapter 69-09-09 - Wind Facility Decommissioning* [1].

NDAC Section 69-09-09-05 states that decommissioning activities must include

- Dismantling and removal of all towers, turbine generators, transformers, fencing, overhead cables, inverters, transformers, substations and other equipment.
- Removal of underground cables to a depth of twenty-four inches [60.96 centimeters];
- Removal of foundations, buildings, and ancillary equipment to a depth of:
    - Three feet [91.44 centimeters] for facilities constructed before July 1, 2017; and
    - Four feet [121.92 centimeters] for facilities constructed on or after July 1, 2017;
- Site restoration and reclamation to the approximate original topography that existed prior to construction of the facility with topsoil respread over the disturbed areas at a depth similar to that in existence prior to the disturbance; and
- Grading and restoring topsoil of areas disturbed by the facility, and reseeding according to natural resource conservation service recommendations, unless the commission approves an owner request signed by the

applicable landowner, identifying the surface features the landowner prefers to remain in place, and the reason the landowner prefers those features to remain.

Additionally, the regulation states, in section 69-09-09-08, that appropriate financial assurances will need to be made by the developer prior to construction of the facility and prior to commercial operation of the facility. Badger Wind advised DNV that it will commit to providing financial assurance "*in the form of a performance bond either as, or combination of, cash escrow held by a federal insured financial institution, a surety bond, irrevocable letter of credit, guarantee, parent guarantee, or another form of financial assurance that is acceptable to the commission to cover the anticipated costs of decommissioning.*"

2.2 General assumptions

Badger Wind has advised DNV that the required decommissioning activities will include the removal of all WTGs, substation, ancillary equipment, and other physical material owned by and pertaining exclusively to the Project and restoration of the property, including the Project roads [1]. For the purpose of this study and in line with industry standards, the following general assumptions have been applied:

- Decommissioning will start after the end of the Project operating life (assumed to be 30 years after commissioning), and all decommissioning work is performed in generally conducive weather conditions;
- Decommissioning includes removal of wind turbines, cabling, electrical components, roads, and any other associated facilities down to 4 feet below grade:
    - The wind turbine foundation pedestals and transformer pad foundations have only 4 feet of concrete removed and the remainder of the foundation is left in place.
    - The majority of the Project underground collection system cabling is installed more than 24 inches below ground level and, therefore, will be abandoned in place. 0.7 miles (1%) of the total collection system length is still considered to be removed to account for areas where the collection system goes above grade (Junction boxes, Turbine Foundations, etc.)
- The Project substation will be completely decommissioned.
- All Project roads (approximately 36 miles) will be decommissioned. DNV considers this a conservative assumption as many landowners may find such roads a benefit to their land and request to keep them.
- Demolition of the operations and maintenance (O&M) building has been estimated and is included in the substation costs.
- Drawing on experience with similar wind project decommissioning requirements, DNV anticipates that decommissioning this Project will not adversely affect current or future natural resource development in the area if all federal, state and local regulations, permits and approvals are complied with.

2.3 Crane assumptions

DNV has assumed that, on average, one main tracked crane will dismantle one turbine every day (including time for crane movements from turbine to turbine, crane teardowns where necessary, and some minor weather delays). The number of cranes used determines the approximate time to complete the job. The Project layout was also analyzed for crane walking impediments to estimate crane teardown requirements. While a detailed analysis in this regard was not performed, the Project was assumed to require the number of main and base cranes and teardowns presented in Table 2-1.

2.4 Initiation and mobilization

Before executing any decommissioning work, it is necessary to plan the work carefully, secure the appropriate permits and insurance, and manage the program of work and associated health and safety risks to ensure successful completion of the work. It is assumed that mobilization and soft costs are overhead. Soft costs, for the purposes of this study, include costs not specifically accounted for in the derivations presented later in this Report, including environmental studies, obtaining permits, environmental protection plans, hazardous material disposal, on-site administrative infrastructure and staff, utilities, off-site project management, and insurance/legal services. DNV assumed 5% of the total disassembly and transport costs will be required for soft costs coverage.

In addition to soft costs, DNV also assumed that an additional 1% of the total disassembly and transport costs will be needed for contractor mobilization. DNV separately accounted for a lay-down yard of 15 acres to house the office trailers and staff parking, and facilities for mobilizations and demobilizations. Table 2-1 summarizes the crane, mobilization, and soft cost assumptions used in this report, as well as the total cost estimate for such activities.

Table 2-1 Mobilization and soft costs assumptions

Item	Quantity
Number of main cranes needed	3
Number of main crane tear-downs needed (1)	14
Number of base cranes needed	6
Number of base crane tear-downs needed (1)	28
Decommissioning contractor's lay-down yard size [acres]	15
Additional mobilization as percent of total hard costs (2)	1%
Decommissioning soft costs as percent of total hard costs (3)	5%
Total Mobilization	**$2,158,000**

(1) Between turbines
(2) Represents the costs of contractor's mobilization/demobilization
(3) For soft costs, it is assumed that the decommissioning would be done for the entire project at once.

2.5 Schedule

Section 69-09-09-04 - Decommissioning period of the regulation defines the responsibilities of the owner regarding the time of decommissioning as follows:

"The owner shall begin decommissioning within twelve months after abandonment or the end of its useful life. Decommissioning must be completed within twenty-four months after abandonment or the end of its useful life unless the commission approves a plan specifying the steps and schedules to return the facility to operation."

It is assumed that the decommissioning program would be 13 to 15 weeks. This timeline assumes that the dismantling rate of the wind turbines is approximately one turbine per workday per crane pair and that 7 to 10 workdays of mobilization and demobilization are allowed before and after turbine dismantling. During the construction of wind power projects, it is typical that the time for erection across the entire project schedule averages about one turbine per day per main crane on a simple site. While disassembly could in theory be done with slightly less care than during assembly (damage to turbines not as much of a concern), safety considerations will likely dictate that disassembly be accomplished in much the same fashion as erection, although in reverse order.

It is also assumed that other works across the site, such as foundation removal, substation disassembly, and reclaiming of roads, crane pads, and other excavations will be done simultaneously and/or in concert with the turbine dismantling and crane progress.

3 DISASSEMBLY

The disassembly of the Project pertains to all work just prior to the physical transportation of the infrastructure from the site. In the case of the wind turbines, it includes the dismantling and loading of the tower sections, nacelles, and blade scraps onto trucks for transport. In the case of concrete foundations, roads, and crane pads, it pertains to the tear down, aggregate stripping, excavation, backfilling, and all reclaiming as necessary. Reseeding of removed roads and turbine areas, including crane pads, is included in these costs.

Although certain activities must be sequenced appropriately, based on DNV's knowledge of wind project construction considerations, it is assumed that many activities (e.g., turbine and substation disassembly) may be undertaken in parallel, facilitating an efficient decommissioning process.

DNV has assumed that the scope of the disassembly work includes the cost of labor, machinery, and tools required to perform the tasks described in each of subsections 3.1 to 3.7, as well as the loading of the dismantled material onto vehicles for transport from the Project site.

3.1 Turbines

Once the site contractor has completed mobilization activities at the Project site, it is assumed that the decommissioning of turbines would start immediately and sequentially. This typically entails the individual removal of the rotor assembly, followed by the nacelle enclosure. The tower internals are stripped of lifts, cables, cabinets, lighting, and other miscellanea and are then dismantled, section by section, down to the foundation surface.

For the Project, 92 turbines are to be removed, consisting of 2.82 MW nacelles, with three-section, 89-m steel towers as well as 62-m blades. It is assumed that the scope of the disassembly work includes the cost of labor, machinery, and tools required to perform the tasks and the loading of the dismantled material onto vehicles for transport from the site. The main crane(s) would be required on site for approximately 8-10 weeks during the turbine dismantlement activities. The base crane(s) may be required for a slightly longer period to assist with the transport loading activities and substation dismantling.

It is also assumed that aside from the possible removal of the drive train to aid lifting, the nacelle and its contents will remain fully intact for purposes of transport. All cooling, heating, and lubrication fluids will be drained, stored, and appropriately disposed of before the nacelle is removed from site. Blades, however, will be cut into sections for easier transport to a disposal facility.

The costs presented in Table 3-1 include the cost of the main crane(s) to handle the hub/rotor, nacelle, and top tower section (or top sections, depending on base crane(s) hired). They also include the cost of a base crane for lower tower sections as well as to aid in loading the components onto transport trucks. The costs take into consideration the rental of special tools needed from the manufacturer as well as the fact that the GE Vernova turbines have an external pad mounted transformer.

To comply with the regulatory requirement that the site be remediated to 4 ft below grade, it is assumed that the concrete structures are to be cut and crushed down to 4 ft below grade. It is assumed that about 38 yd^3 of crushed concrete will result from removing each turbine's foundation pedestal and pad-mount transformer foundation essentially in their entirety, thus achieving these criteria. Table 3-1 summarizes the turbine disassembly costs for the Project.

Table 3-1 Turbine disassembly costs

Cost item	Costs per WTG [$]
Dismantle hub and blades (3 blades per turbine)	
Dismantle nacelle (drive train and generator included)	
Dismantle tower sections, internals included	
Dismantle pad-mounted transformer	
Remove turbine foundation	
Total per WTG	**110,000**
Total Project (92 WTGs)	**10,120,000**

DNV notes that the disassembly costs of WTGs are highly dependent on crane costs (which include crane, crane crew, tools, and equipment). DNV estimated this cost based on experience from various projects in North America. It is noted that crane availability may greatly influence crane costs, and that it is not possible to accurately predict crane costs given the long study horizon.

3.2 Collection system

DNV notes that on many decommissioning study requests, the underground portion of the collection system does not need to be removed because it is often below the required grade clearance. Badger Wind has informed DNV that the portions of the collector system installed below the required removal depth for this Project will be abandoned in place. Therefore, it was assumed that most of the underground cabling will not be removed.

The Project collection system will be composed of 72.8 miles of three-phase buried lines along with bare copper grounding cable. For the purposes of this study, only 0.73 miles (1%) of the total length of the collection system will be considered to be removed. The portion to be removed accounts for sections of the collection system that transition from the minimum burial depth (24 inches) to above- grade equipment.

It is assumed that the scope of the disassembly includes the cost of labor and the loading of the dismantled material onto vehicles for transport from site. It is assumed that the disconnection work at the terminals would be performed as part of turbine disassembly or substation disassembly. The results are reported in Table 3-3.

3.3 High-voltage substation

Badger Wind has advised that the Project will be equipped with one high-voltage (HV) collector substation, inclusive of two 34.5/230 kV, 167 MVA transformers. The remaining portion of the HV substation is assumed to include typical equipment seen in North American wind power project substations for projects of this size, including grounding transformers, bus bars, relay switches, circuit breakers, air disconnect switches, capacitor banks, reactor banks and a control building. It is assumed that a dead-end structure will also be present. Demolition of the O&M building is also included in this section.

It is assumed that the scope of the disassembly work includes the cost of labor and machinery required to perform the disassembly tasks, including disconnection work at the terminals, and the loading of the dismantled material onto vehicles for transport from site. The following table summarizes the costs to disassemble the Project's HV substation.

Table 3-2 Substation disassembly costs

Item	Cost [$]
Preparation	9,000
Dismantle HV equipment	28,000
Dismantle and prep. main transformer for shipment (each)	37,000
Remove control and O&M building	84,000
Remove foundations	44,000
Large machinery hire	25,000
Small machinery hire	21,000
Reclaim and reseed	18,000
Total	**266,000**

3.4 Site access roads and crane pads

In practice, it is probable that most of the roads will be kept after the completion of the Project, except for the dead-end access roads that lead to the turbines. However, for purposes of the study, DNV has assumed that the entirety of the approximately 36 miles of roads will be remediated. Based on Badger Wind's information, DNV has additionally assumed that 92 crane pads will be remediated during decommissioning. The lay-down yard reclamation is accounted for in the mobilization/demobilization costs. Decommissioning of the site access roads will typically include stripping back the surfaces of project roads connecting the turbines and the crane pads and replacing them with topsoil in keeping with the surrounding environment. In the case of the Project, this phase also includes stripping and piling geotextile material used for the access road section. The costs additionally include reseeding in accordance with ND Natural Resources Conservation Service recommendations, unless otherwise requested by the landowner and approved by the PSC.

The results are reported in Table 3-3. Note the cost of aggregate base transport off site is captured in transport costs.

3.5 Meteorological masts and ADLS towers

Two permanent 89 m met masts and one permanent ADLS tower are to be installed at the Project site. It is assumed that these met masts will be disassembled at an appropriate time during the decommissioning activities so as not to interfere with other ongoing work. This typically involves the use of a base crane to dismantle the masts, section by section, down to the foundation surface. The instrumentation and booms would be either removed before the sections are laid down, or removed from the sections once on the ground.

It is assumed that the scope of the disassembly work includes the cost of labor, machinery, and tools to perform the dismantling tasks, including foundation removal to appropriate below grade level, and the loading of the dismantled material onto transport vehicles for transport from site. It is also assumed that only one crane is needed for transport. Based on experience installing and removing met towers in the United States (U.S.), DNV has included an allowance for disassembly of the two met masts and one ADLS tower. The results are reported in Table 3-3.

3.6 Disassembly conclusions

The estimated cost of the disassembly of the Project is summarized in Table 3-3.

Table 3-3 Summary of disassembly costs

Item	Cost [$]
WTG	10,120,000
Collection system	34,000
HV substation	266,000
Access roads and crane pads	2,107,000
Met masts	49,000
Mobilization and soft costs	2,158,000
Total	**14,734,000**

4 TRANSPORT

This section refers strictly to transporting the equipment from the site to the appropriate landfill, aggregate rework facility, or scrap yard. Various distances and truck sizes are applied in the DNV decommissioning model, depending on which Project component is being calculated. Transport costs also include the costs of unloading the material once it reaches its destination. DNV notes that appropriate landfills and scrap yards appear to be in the general region of the Project. Dump trucks are assumed to have 10 yd^3 in capacity.

For all subsections below, it is assumed that the scope of transportation includes the cost of labor and vehicles required to transport the dismantled material to an appropriate final destination.

4.1 Turbines

The dismantled materials shall be transported to an appropriate disposal facility. It is assumed that the transport distances for general waste would be within a radius of 60 miles whereas the more complex and valuable material is assumed to be transported within a radius of 310 to 470 miles — 310 miles for the tower internals, and 470 miles for the main turbine and substation components. These assumptions may be somewhat conservative considering there are several disposal facilities near the Project site (e.g., in Bismark, North Dakota). DNV additionally notes the presence of rail transport in the vicinity could decrease costs for transport of turbine components. While most of the main turbine components are modeled to be removed much as they were initially transported to the site during construction, the turbine blades, nacelle, and tower sections will be sectioned to limit oversize transport.

Table 4-1 summarizes the costs for the transport of each of the turbine components from the site.

Table 4-1 Turbine transport costs

Turbine component	Cost [$]
Blades (cut up prior to loading)	5,500
Hub (one on one truck)	5,500
Nacelle	11,000
Tower sections (cut up prior to loading)	33,000
Internals	700
Transformer	700
Crushed foundation	500
Total per WTG	**56,900**
Total for Project (92 WTGs)	**5,235,000**

4.2 Collection system

4.2.1 Underground collection system

For the purposes of this study, only 0.73 miles (1%) of the total length of the collection system will be removed. This is to account for portions of the collection system that transition from the minimum burial depth to above-grade equipment, which will require removal. The material will mainly include the wound reels and/or cut cables transported by trucks to an appropriate disposal facility. The results are reported in Table 4-3.

4.3 High-voltage substation

This study assumes that foundation rubble and general waste would be transported within a radius of 80 miles, whereas the more complex and valuable material is assumed to be transported within a radius of 310 to 470 miles.

The following table summarizes transport costs for the Project substation.

Table 4-2 Substation transport costs

Substation component	Cost [$]
HV equipment	11,000
Main transformers	22,000
O&M and Control building	12,000
Dead-end structures	11,000
Crushed foundations (local transport)	34,000
Yard gravel (local transport)	17,000
Total	**107,000**

4.4 Site access roads and crane pads

For the purpose of transport calculations per Badger Wind's request, the Project's 36 miles of roads to be removed were assumed to be 17 ft wide. This width is conservative, attempts to capture any shoulder material as well, and is expected to therefore cover the cost of decompaction and reclamation of any additional width required due to crane walking. All dump truck load trips are assumed to be local. The results are reported in Table 4-3.

4.5 Meteorological masts and ADLS towers

The dismantled material shall be transported to an appropriate disposal, salvage, or rework facility. The results are reported in Table 4-3.

4.6 Transport conclusions

Table 4-3 summarizes the total anticipated costs for removing the turbines, collection system, substations, roadways, and met mast from the Project.

Table 4-3 Summary of transport conclusions

Item	Cost [$]
WTG	5,235,000
Collection system	5,000
HV substation	107,000
Access roads and crane pads	906,000
Met masts	8,000
Total	**6,261,000**

5 DISPOSAL

While it is impossible to predict the exact evolution of an industry 30 years into the future, it is not unreasonable to assume that there may exist by that time consolidated centers that will fully recycle a WTG. Today 85% to 90% of an entire WTG mass can be recycled [2]. In addition, DNV notes that significant attention is being placed by industry into possible uses or methods for making WTGs more eco-friendly, for example:

- In February 2023 Vestas announced that together with some partners, it has developed a solution that can chemically break down epoxy resin from turbine blades into virgin-grade materials. The solution can be applied to blades currently in operation [3].
- A group of Danish wind industry players, through the DecomBlades project, have created the so-called Blade Material Passport (formerly known as Product Disposal Specifications) for recycling companies to recycle blade materials. The passport makes it easier to dismantle and recycle the blades. This will help industrializing the blade recycling industry and further reduce the footprint from the wind industry. [4]
- In September 2021 Siemens Gamesa launched the world's first recyclable wind turbine blade for commercial use offshore [5].
- In early 2020 Vestas announced a commitment to producing zero-waste wind turbines by 2040 [6].
- IEA Wind task 45 aims to identify and mitigate the barriers to the recycling of wind turbine blades in the near future [8].

DNV believes that at the time of decommissioning, the Project will be able to take advantage of evolutions in WTG recycling technologies.

While it may become easier to recycle WTGs in the future, DNV performed this study assuming that following the disassembly and transport of all materials from the Project site, all materials will be delivered to landfills or similar waste management centers. DNV considers this a conservative approach, as many high-grade metals—such as those found in towers, nacelle bedplates, gearboxes, steel cables, copper wiring, aluminum flooring, and transformers—retain significant scrap value and can be sold to help offset decommissioning costs. These materials are assumed to be delivered at no cost to the Project.

DNV's decommissioning model is based on bills of quantities, typical material weights, masses, and volumes of modern WTG as the ones used in the Project. These values were derived from the manufacturer's technical specifications [7] or from DNV experience and WTG aggregated data when such is not available. The model uses commodity prices and disposal service rates as inputs.

DNV has assembled values for the disposal cost of various types of waste. These figures come from DNV's previous experience with similar decommissioning activities through planning of various wind projects. The following waste costs are used in this study:

- Blade disposal: $146/ m^3$
- Class 2 landfill, Industrial waste: $110/ m^3$
- Class 3 landfill, General waste: $55/ m^3$

6 TOTAL DECOMMISSIONING COST

The total decommissioning cost for the Project is calculated by subtracting the salvage value from the total of the disassembly, transport, and disposal costs. Table 6-1 summarizes the Project's net decommissioning costs.

Table 6-1 Project Net decommissioning cost

Item	A	B	C	D=A+B+C
	Disassembly [$]	Transport [$]	Disposal [$]	Total Costs [$]
WTG	10,120,000	5,235,000	460,000	15,815,000
Collection system	34,000	5,000	1,000	40,000
HV substation	266,000	107,000	97,000	470,000
Access roads and crane pads	2,107,000	906,000	3,199,000	6,212,000
Met masts	49,000	8,000	3,000	60,000
Mobilization/soft costs	2,158,000	-	-	2,158,000
Project Totals	14,734,000	6,261,000	3,760,000	24,755,000
Total per WTG [$]				269,080
Total per MW [$]				95,580
Total for Project (92 WTGs) [$]				24,755,000
Note: negative values in parenthesis are positive returns to the Project.				

6.1 Recommendations

It is stressed that this report is based on broad assumptions regarding the approach to decommissioning, the market conditions for contracting costs and disposal considerations/costs. DNV recommends that the total costs of decommissioning be reviewed toward the end of the operating period (e.g., 2 to 5 years prior to the end of operations) when better visibility on these factors would be possible. The value of decommissioning after 30 years of operation could be reviewed at this time as well as the value of decommissioning at another point in the future, taking into consideration potential extended operational revenue as well as Project operations beyond the originally planned operational life. The scenario would be easier to evaluate then and, if design and safety conditions warrant, it would be a viable alternative as long as future revenues outpace future expenditures.

7 REFERENCES

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[2] Accelerating wind turbine blade circularity, May 2020, WindEurope.

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[5] https://www.siemensgamesa.com/en-int/newsroom/2021/09/launch-world-first-recyclable-wind-turbine-blade

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[7] GE 2.8-127 documentation: 1.2 - Weights & Dimensions_2.0-2.5-107_116_127-60Hz_1-2MW_EN_r01.pdf

[8] https://iea-wind.org/task45/

[9] USGS web site: http://minerals.usgs.gov/minerals/pubs/commodity/

APPENDIX A – MAIN ASSUMPTIONS

1100	**Project Basics**	
1101	Wind power plant name	Badger Wind
1102	Construction status	Under Construction
1103	General location	46.25 Lat, -99,62 Long
1104	No. wind turbines	92
1105	Make and model of wind turbine	GE2.8-127
1106	Hub height [m]	89
1107	Project capacity [MW]	259
1108	Decommissioning to occur after which project year	30
1109	No. of main project transformers	2
1110	Length of underground collection system to remove [mi]	0.73
1111	Length of access roads to reclaim [mi]	36
1112	No. of meteorological towers to remove	2
1113	Average height of met towers [m]	89
1114	Met tower type	Self-Supported
1115	Depth of removal [ft]	4
1200	**Additional Information**	
1201	Commercial Operation Date	2025
1202	Estimated annual P50 production capacity factor [%]	Confidential
1203	Main step-up transformer voltage [kV/kV]	34.5/230
1204	Main step-up transformer rating [MVA]	167
1205	No. of transmission line steel poles	8
1206	Number of tower sections per wind turbine	3

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