

#2 Renewable Energy Equipment

Subcommittee Meeting #2 Summary – Renewable Energy Equipment July 29, 2021 9AM-11AM

Subcommittee meeting #2 of the Renewable Energy Equipment Subcommittee (#2-REE) was convened virtually via Zoom on July 29, 2021 from 9AM-11 AM, CST. Attendance for #2-REE is provided in Table 1 below.

Table 1. #2-REE Subcommittee Membership and Attendance

Name	Company	Attended 7/29/21
Jeff Maxted	Alliant Energy	Present
Jenny Coughlin	MidAmerican Energy Company	Present
Chaz Allen	Iowa Utility Association	Present
Joshua Syhlman	TPI Composites	Absent
Rick Hurt	SCISWA	Present
Dan Nickey	Iowa Waste Reduction Center	Present
Shelene Codner	Region XII Council of Governments - Iowa Waste Exchange	Present
Shelly Peterson	IEDA	Present
Jerry Brown	Collins Aerospace	Absent
Sally Buck	Valmont Industries, Inc., Coatings Division	Absent
Steve Guyer	Iowa Environmental Council	Present
Kenneth Sulma	Iowa Utilities Board	Present
Dustin Miller	American Clean Power Association	Present
Mary Wittry	Carroll County Solid Waste Management	Present
Theresa Stiner	DNR Internal SMM Team	Present
Laurie Rasmus	DNR Internal SMM Team	Present
Jeff Fiagle	DNR Internal SMM Team	Present
Tom Anderson	DNR Internal SMM Team	Present
Jennifer Wright	DNR Internal SMM Team	Present
Amie Davidson	DNR Internal SMM Team	Present
Michelle Leonard	Consultant – SCS Engineers	Present
Christine Collier	Consultant – SCS Engineers	Present
Jeff Phillips	Consultant – SCS Engineers	Present
Karen Luken	Sub-Consultant – EESI*	Present
Adam Jablonski (Guest speaker)	MidAmerican Energy Company	Present

* Economic Environmental Solutions International

A. Subcommittee #2 - REE Summary

The meeting began with the project consulting team reviewing the agenda for this meeting (see Attachment A), the overall objectives of the Sustainable Materials Management (SMM) – Vision for Iowa project, the process and goals of this and the next Subcommittee Meeting, and the materials that were selected for further review during the Subcommittee #1 meeting held June 10, 2021. The identified materials are listed below:

- Wind Turbines
- Solar Panels
- Storage Batteries

The project consulting team presented a summary of wind energy production in the United States (US) and Iowa. Wind turbine installation has continued to increase across the US. In fact, the US installed more wind turbine capacity in 2020 than in any other year. Currently Iowa is the leader in wind energy generation in the US. Iowa has approximately 5,590 total turbines producing more than 10,951 megawatts (MW) of electricity. MidAmerican Energy Company and Alliant Energy own and/or operate the majority of windfarms in Iowa.

Wind turbines house three windmill blades which rotate to generate energy which is transmitted onto the electrical grid. These blades are primarily made of composite materials (i.e., glass and carbon composites) but also incorporate other metals, polymers, and electronic components. When these materials can be removed from the primary composite materials, they are generally easily recyclable. However, the composite material that the blades are made of has proven challenging to recycle.

It is estimated that there are currently more than 16,600 turbine blades operating in Iowa. As wind energy production continues to expand, it is assumed that additional turbines and blades will be manufactured and installed. MidAmerican currently has approximately 10,000 blades on their existing turbines in Iowa with plans to build 73 new turbines and repower 428 turbines through 2022. Alliant Energy has built 1,300 megawatts of additional wind generation in Iowa from 2018 through 2020, and operates 7 windfarms with 587 turbines.

Additionally, utilities are currently repowering the turbines with more efficient blades. This requires the end of life management of the removed blades occurring sooner than previously anticipated. It is estimated that 8,000 turbine blades will be decommissioned each year in the US by the year 2024.

The project consulting team presented strategies being implemented or evaluated for turbine blade recycling in the US. These include General Electric (GE) using the turbine blades as fuel in cement kilns, and a variety of other companies researching similar strategies.

The project consulting team then presented a summary of a life cycle analysis (LCA) report that was performed for turbine blades. The presented LCA evaluated the construction, on-site erection and assembly, transportation, operation, and dismantling of turbine blades.

The summary slides that were presented are located in Attachment B.

Adam Jablonski, Vice President, Resource Development with MidAmerican Energy Company (MidAmerican) presented information on their wind energy production in Iowa. Concerning the decommissioning of turbine blades, some Iowa counties require MidAmerican to enter into decommissioning agreements and others require financial assurance. The financial assurance requires that MidAmerican establish a fund that will be used to pay for the decommissioning of the blades when that occurs. Adam stated that MidAmerican would prefer not to have financial assurance requirements. However, perhaps this approach makes sense for smaller utilities that may not have the financial holdings of larger companies like MidAmerican or Alliant Energy.

Adam stated that future decommissioning contractors selected by MidAmerican will be required to repurpose or recycle the turbine blades. However, unfortunately there is not a proven “off-the shelf” technology for contractors to use as they decommission turbine blades. That said, he is hopeful that viable solutions will be developed prior to 2022.

Adam’s presentation slides are included in this summary report in Attachment B.

A question was asked if scheduled repowering projects currently had decommissioning contracts. Adam stated that they did and that these contracts required the contractor to reuse or recycle the turbine blades. These contractors are working to manage the turbine blades using cement kilns.

Dan Nickey, with the Iowa Waste Reduction Center (IWRC) indicated that the Iowa Energy Center has funded two research projects with Iowa State University (ISU). These projects are researching how to recycle turbine blades as well as how they could be manufactured so that they can be more easily recycled.

Jeff Maxted with Alliant Energy stated that their windfarms are newer than MidAmerican’s and they will not be decommissioning a significant number of turbine blades in the near future. Jeff reiterated that solutions for reusing or recycling turbine blades are closer than people may think. As solutions are proven across the globe, the utility industries learn from these examples and work to replicate these results in the US.

The project consulting team then presented a summary of solar energy in Iowa. Iowa currently hosts six solar facilities that each generate more than 1.5 MW. It is estimated that Iowa has somewhere between 1 million to 1.6 million solar panels currently installed. It is also estimated that an additional 3.7 million to 6 million solar panels may be installed in Iowa in the next 3-years.

Due to the low numbers of solar panels (compared to wind turbines), and the durability and long-term use of solar panels, there has not been a significant concern over the end of life management of these materials. However, with the continued increase in their use across Iowa, it is important to work on developing sound management solutions ahead of the end of life management needs for these materials.

The project consulting team then presented example strategies for the reduction of solar panel waste. These included a summary of reuse and recycling practices active in Europe and the US. The European Union requires solar panels to be recycled. Europe solar panel manufacturers participate in a network that helps craft legislation and engage in the management of their products throughout their lifespan. In the US, the state of Washington has passed legislation mandating the recycling of solar panels. The examples from Europe and the state of Washington may provide a model for the Iowa to follow.

The project consulting team presented the LCA performed solar panels and compared the costs of recycling against those of disposal. The summary slides that were presented are located in Attachment B.

The project consulting team then presented information pertaining to storage batteries. Batteries are generally used to store the energy produced by wind, solar, and hybrid power plants. These batteries are typically lithium-ion batteries. California is currently the global leader in an effort to use batteries on a utility scale to help balance the intermittency of renewable energy in electric grids. In Iowa, MidAmerican operates one battery plant and Alliant Energy operates three plants. As the installation of renewable energy production in Iowa continues, so too will the demand for batteries.

The project consulting team presented four models that are being considered by the state of Minnesota to encourage reduction of renewable energy equipment waste generation and to divert the material from being landfilled. Presented example models are summarized below.

Decommissioning Plan Model:

- In this model, the permittee is regulated and required to be responsible for decommissioning renewable energy equipment. This model also establishes financial assurance so that the decommissioning plan it is fully funded when the facility/material needs to be decommissioned.

Product Stewardship Model:

- Manufacturers or their stewardship organization will operate the end of life program.

Rate Payer Funded Program Model:

- Since all rate payers benefit for the solar/wind mix, these rate payers pay a fee for the end of life management of the products.

Permittee Funded Program Model:

- Permittees would fund all of the end of life costs management. They establish a fund and that fund is managed by a third party entity.

Subcommittee participants were then asked what barriers they see as needing to overcome in order to improve how the following materials identified during the Subcommittee Meeting #1 are managed in Iowa:

- Wind Turbines
- Solar Panels
- Storage Batteries

The following are summaries of discussions or statements that were made by Subcommittee members concerning the following main topics:

Reuse and Recycling of Renewable Energy Equipment:

- Models evaluated should also consider how they will also capture rural co-op and municipally owned utilities. Presented models may work well for large utilities but wouldn't capture smaller ones.
- While smaller utilities may not individually have the primary share of renewable energy equipment, when aggregated, they will have a lot of equipment that will need managed.

What ever models are being considered, it will be important to understand that the energy market is changing rapidly and may not look the same in 5-years as it does today. Established policies will need to be flexible to adjust to changes in the market.

- It isn't the governments responsibility to manage the material at the end of life. If you make a profit from the manufacturing or use – then you should be responsible for managing it at the end of life. But the solutions have to be cost effective for the market to be able to afford.

B. Research Request List

Through the discussions and in follow up discussions, various topics have been identified for further research. These are provided below.

- Identify Iowa co-op and municipally-owned utilities; obtain contact information
- Get a copy of a few decommissioning agreements and financial assurance agreements that MidAmerican has.
- Get a copy of a decommissioning contract that MidAmerican has with a contractor that requires the contractor to reuse or recycle with turbine blades.
- What has the IEDA done in the past to incentivize large scale infrastructure/technology to move into Iowa?
- Review State of Washington solar panel recycling legislation

C. Other Notes

Other items of note from the #2-REE meeting are as follows:

- Next Renewable Energy Equipment subcommittee meeting dates and times are:
 - September 2, 2021, 9AM – 11 AM CST
- Second Stakeholder Meeting will be held on September 30, 2021. Subcommittee members in addition to other interested parties are invited and encouraged to attend.

Attachments:

Attachment A: Agenda

Attachment B: PowerPoint Presentations

Attachment A
Agenda

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Subcommittee Meeting #2 – Renewable Energy Equipment

July 29, 2021

9:00AM – 11:00AM (CST)

Virtual Meeting

- 1. Subcommittee Meeting Purpose and Goals**
- 2. Material Types Discussion**
 - a. Wind Turbine Blades
 - b. Solar Panels
 - c. Inverters
 - d. Batteries
- 3. Existing Activities in Iowa**
- 4. LCAs, WARM Model, Other Research**
- 5. Strategies From Around the US and Elsewhere**
- 6. Next Steps**
 - a. Begin Strategy Prioritization
 - b. Future Meetings Dates and Logistics

Attachment B
PowerPoint Presentations

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Renewable Energy Subcommittee Meeting #2
July 29, 2021

The slide features a sunset over a field with a tree in the distance. The top has a dark blue header with logos for IOWA DNR, PHASE II SMM VISION FOR IOWA, and SCS ENGINEERS. The bottom has a dark blue footer with the meeting title and date.



WELCOME

IOWA **DNR** | PHASE II SMM VISION FOR IOWA | **SCS ENGINEERS**

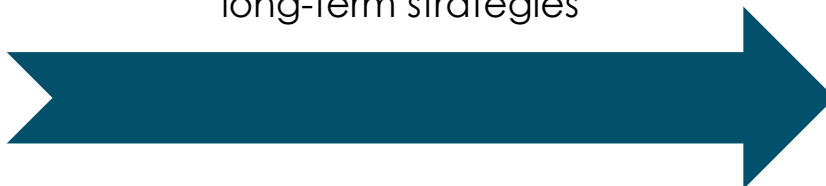
The slide features the word 'WELCOME' in large white letters centered on a background of various sized, semi-transparent orange and brown squares. A dark blue vertical bar is on the left side. The bottom has a dark blue footer with logos for IOWA DNR, PHASE II SMM VISION FOR IOWA, and SCS ENGINEERS.

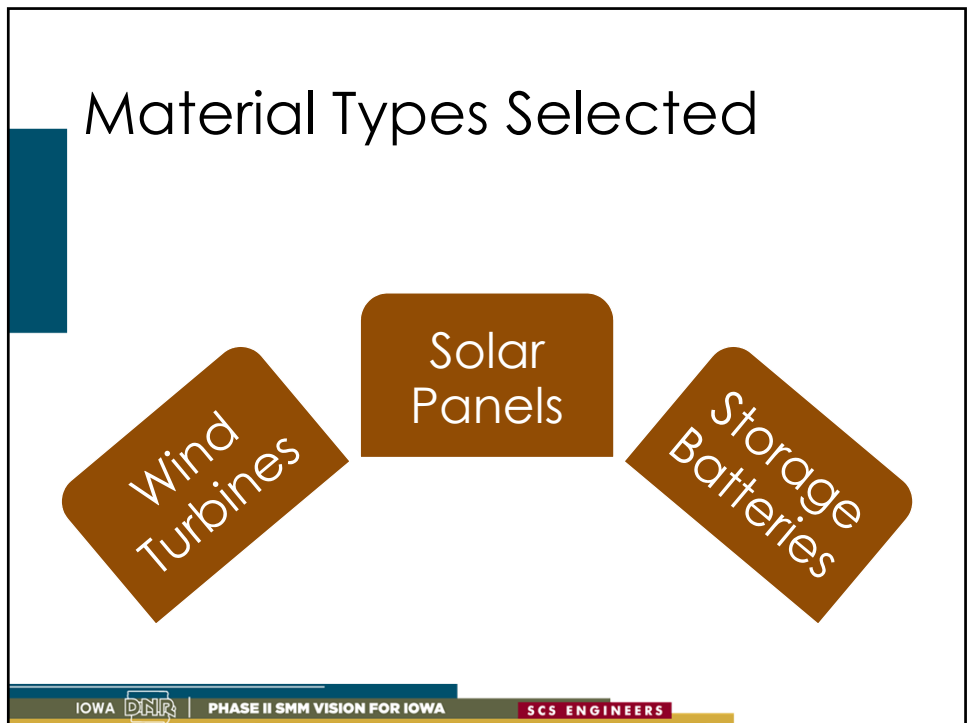
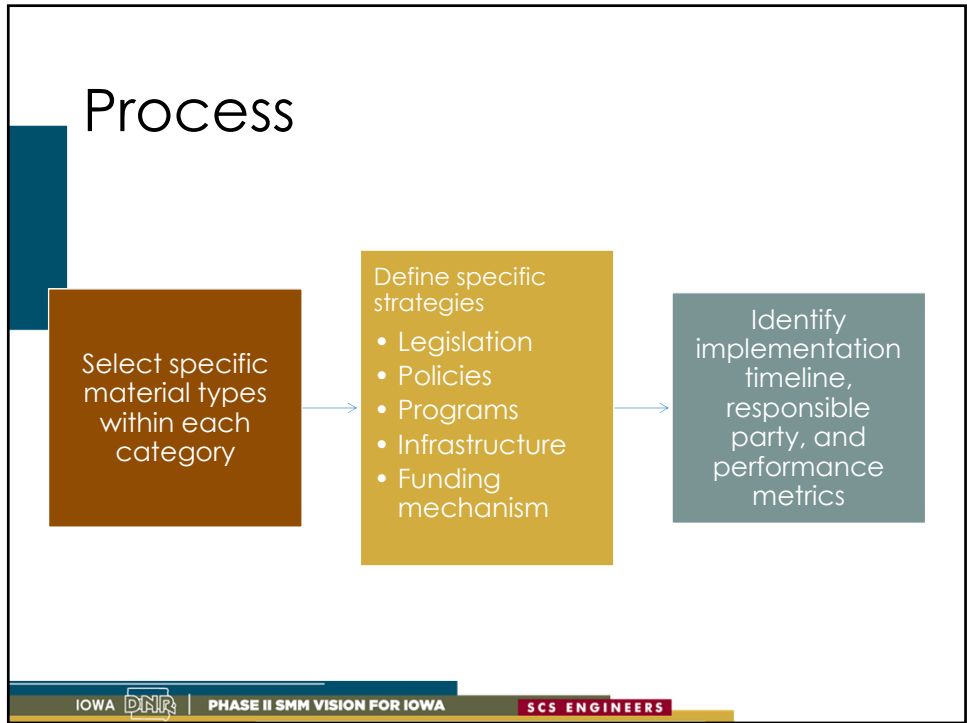
Agenda

- Subcommittee Meeting Purpose and Goals
- Guest Speakers
- Material Types Discussion
 - Wind Turbines
 - Solar Panels
 - Storage Batteries
- Existing Activities in Iowa
- Reuse and Recycling
- LCAs
- End-Of-Life Management Models
- Next Steps
 - Begin to prioritize strategies
 - Future meetings dates and logistics

Goal

Establish a clear direction for implementing an SMM system with immediate, medium and long-term strategies





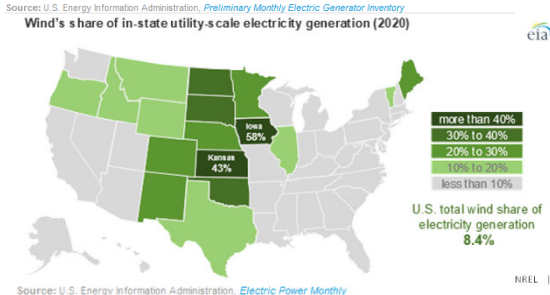
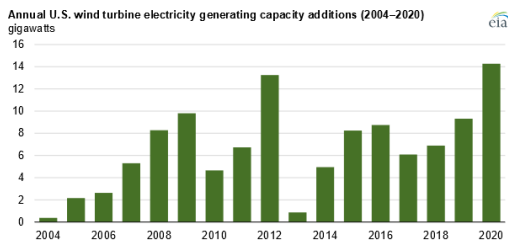


Wind Energy



Growing U.S. wind energy generating capacity

The U.S. installed more wind turbine capacity in 2020 than in any other year



Wind Turbines Are Getting Larger

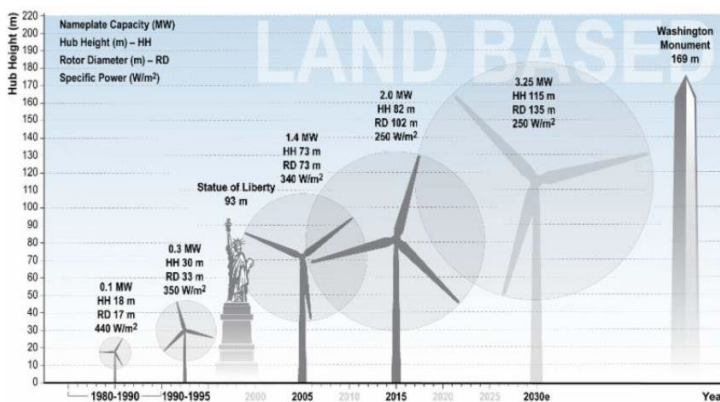
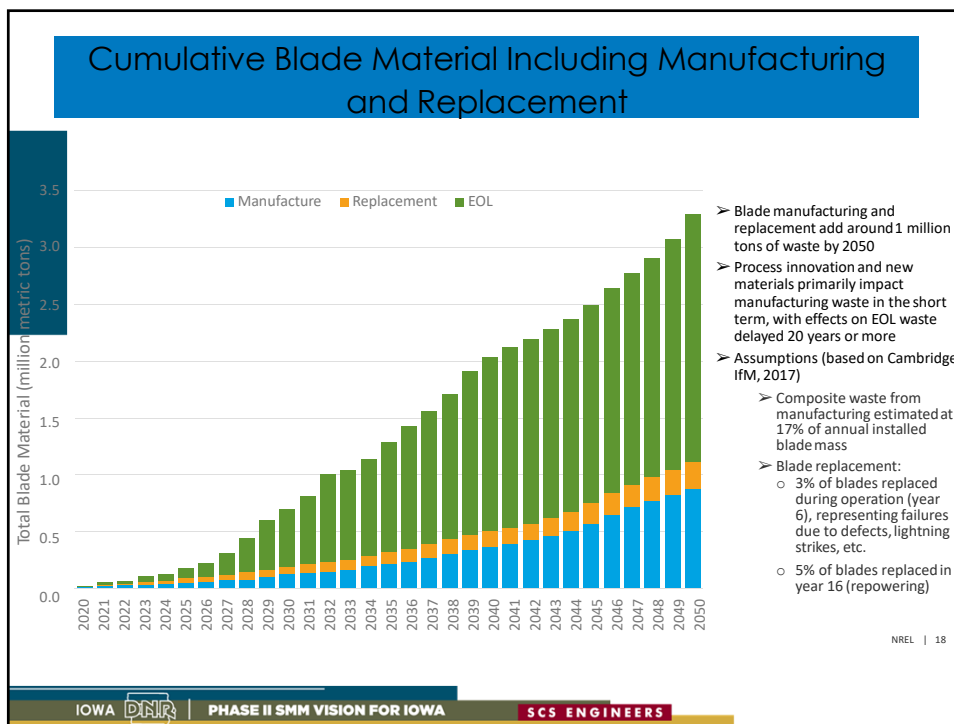


Figure 1. Expected Growth in Land-Based Turbine Size in North America
Source: Lawrence Berkeley National Laboratory, *The Future of Wind Energy, Part 3*, November 2016



Wind Energy in Iowa

- 5,590 total wind turbines that are producing over 10,951 megawatts (MW) of electricity.
 - 16,670 individual wind turbine blades

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Wind Energy in Iowa

MidAmerican has built 7,129 megawatts of wind generation in Iowa from 2004 through 2020.

MidAmerican operates 36 windfarms with 3,341 turbines.

MidAmerican completed the largest Iowa economic project of all time by creating 7 new wind farms from 2017-2019, with a total of 970 new wind turbines added



Wind Energy in Iowa

Alliant Energy has built 1,300 megawatts of additional wind generation in Iowa from 2018 through 2020.

Alliant Energy operates 7 windfarms with 587 turbines.



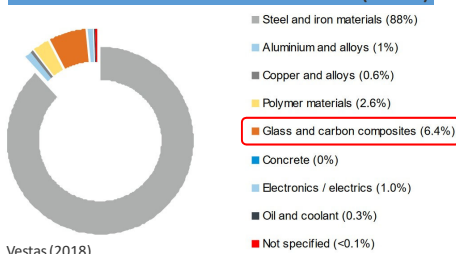
Wind Energy in Iowa

- Scout Clean Energy is developing a wind farm in Crawford County.
- Woodbury County just approved an ordinance to construct the county's first wind farms.
- 200 MW wind farm being built by Chicago-based wind energy developer Invenergy LLC in Plymouth County.
- Washington County is awaiting a hearing on a wind energy ordinance.
- Winnebago County is studying wind power after permit approvals.
- Delaware County has approved permit for CED Manchester Wind, LLC to construct a new windfarm.

According to the Iowa Office of Energy Independence, lack of transmission line capacity is beginning to restrict further growth of wind farms in the state.

Wind Turbine Recycling Potential

Material breakdown of V120-2.0 MW turbine (% mass)



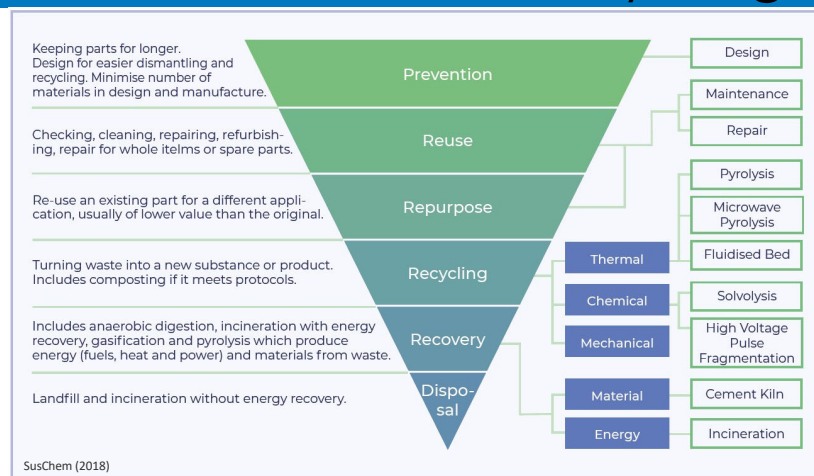
Vestas (2018)

Composite blade materials make up largest fraction of turbine materials that are not recycled

End-of-life treatment of V120-2.0 MW turbine components

Material	Treatment		
	Recycling	Incineration	Landfill
Large metal components (tower, nacelle frame)	98%	0%	2%
Other major components (generator, gearbox, cables)	95%	0%	5%
Steel	92%	0%	8%
Aluminum	92%	0%	8%
Copper	92%	0%	8%
Polymers	0%	50%	50%
Fluids	0%	0%	100%
All other materials	0%	0%	100%

Wind Reuse and Recycling



L | 22

Wind Reuse and Recycling

- Bloomberg Green estimates that 8,000 blades will be decommissioned each year until 2024
- 85% of turbine component materials — including steel, copper wire, electronics and gearing — can be recycled or reused
- Separating the plastic and glass fibers for recycling is difficult

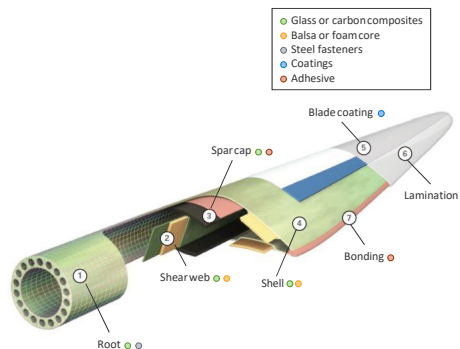
Wind Reuse and Recycling

- G.E. announced a wind turbine blade recycling program
 - Fuel source for cement kilns (Similar to Vestas)
- Two cement kilns in Iowa - Buffalo and Mason City
- One cement kiln in Omaha, 3 near Chicago, 1 in Kansas City, and 2 near St. Louis

According to Utility Dive "The process should make wind turbines fully recyclable while also reducing carbon dioxide emissions from cement production by a net 27%."

Wind Reuse and Recycling

- Scientific American reported on the new turbine blades, which use a thermoplastic resin instead of epoxy thermoset resin to set the fiberglass into shape.
- The new material can be reclaimed at the end of a blade's life by melting and reusing it in new blades



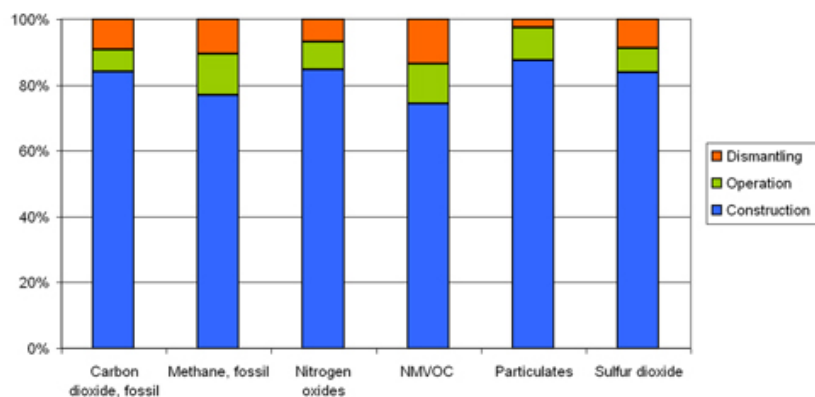
Adapted from www.gurif.com

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Wind LCA

- **Construction** comprises the raw material production (concrete, aluminum, steel, glass fiber and so on) needed to manufacture the tower, nacelle, hub, blades, foundations and grid connection cables.
- **On-site erection and assembling** includes the work of erecting the wind turbine.
- **Transport** takes into account the transportation systems needed to provide the raw materials to produce the different components of the wind turbine, the transport of turbine components to the wind farm site and transport during operation.
- **Operation** is related to the maintenance of the turbines, including oil changes, lubrication and transport for maintenance.
- **Dismantling**: Once the wind turbine is out of service, the works of dismantling the turbines and the transportation (by truck) from the erection area to the final disposal site.

Wind LCA



Presentation

Adam Jablonski, VP
Resource Development

Jenny Coughlin
Sr. Environmental Analyst



Jeff Maxted
Manager – Environmental
Services, Generation Operations
Support

Solar Energy



Solar Energy in Iowa

- Large scale solar investment in Iowa has been limited due to the states emphasis on wind power
 - 167 MW in 2020
 - Iowa hosts six solar facilities that are each generating larger than 1.5 MW
- Iowa has somewhere between 1,059,250 and 1,694,800 solar panels currently installed
- Total number of solar panels with approved projects: 2,372,500
 - ≈ 47,450 tons
- An additional 3,750,000 to 6,000,000 solar panels are expected to be installed within the next 3 years

Solar Energy in Iowa

Invenergy's Worthwhile Solar Farm East (149 MW)

- Estimated 372,500 solar panels.

Invenergy's Worthwhile Solar Farm West (300 MW)

- Estimated 750,000 solar panels.

Big Dave Solar Farm (300 MW),

- Estimated 750,000 solar panels.

CISCO's Wapello Solar (100 MW)

- Estimated 250,000 solar panels.

Holliday Creek (100 MW)

- Estimated 250,000 solar panels

Solar Reuse and Recycling

In Iowa, solar panel waste has not been a significant issue yet, as the state is relatively new to solar power and most panels are original and have yet to expire.

Most PV panels fall into two basic types and require two distinct recycling life cycles: silicon-based PV and thin film-based PV panels.

- Silicon-based PV panels are generally 76% glass, 10% plastic, 8% aluminum, 5% silicon, and 1% metals
- Thin film-based PV panels consist of 89% glass, 6% aluminum, 4% plastic, and 1% metals

Solar Reuse and Recycling

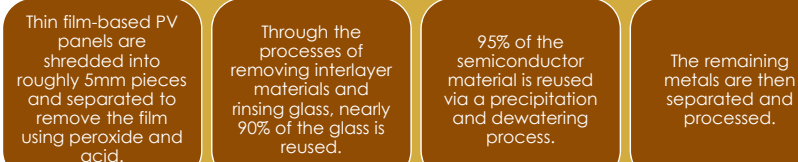
The silicon-based PV panels (the most common of the two panels) are first disassembled, and the glass and aluminum are separated

95% of the glass and 100% of the metal are reused

The remaining materials are heated to 930 degrees which causes the plastic to evaporate

The remaining silicon is recycled

Solar Reuse and Recycling



Solar Reuse and Recycling

- In Europe, solar panel recycling has reached a far more developed state than in North America.
- Over 70% of PV manufacturers take part in a global PV CYCLE Network that helps producers meet the legal obligations of the Waste Electrical and Electronic Equipment (WEEE) Directive legislation.
- As members of this initiative, producers are actively engaged in the sustainability of their product during manufacturing and throughout its lifespan.

Solar Reuse and Recycling

- While the European Union requires recycling of solar panels, only Washington state in the United States has a similar mandate.
- If North America followed the EU model, the promise of 96% material recyclability would be fulfilled, which would cover almost two billion new panels by 2050.
- Creating new recycling plants also increases employment opportunities for local communities.
- Recycling panels means we can manufacture new panels and contribute to the clean energy transition without filling up landfills.

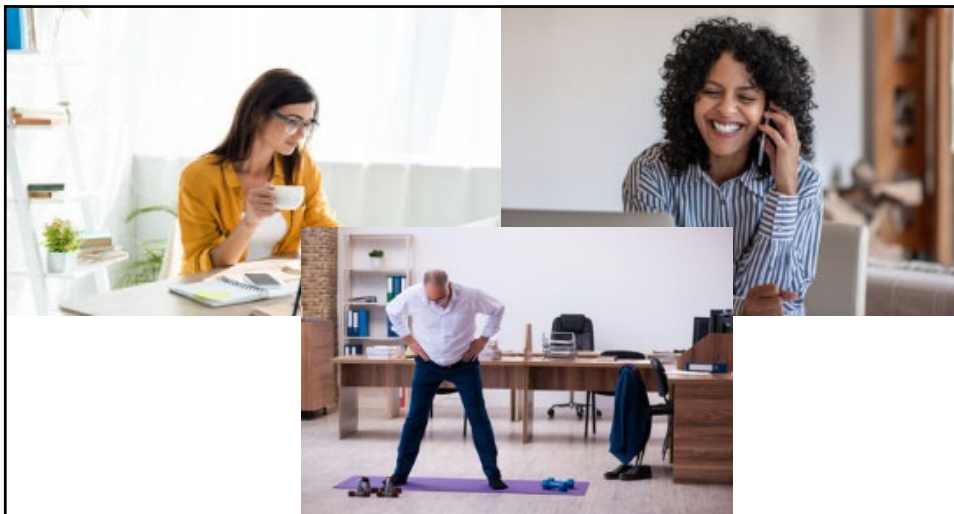
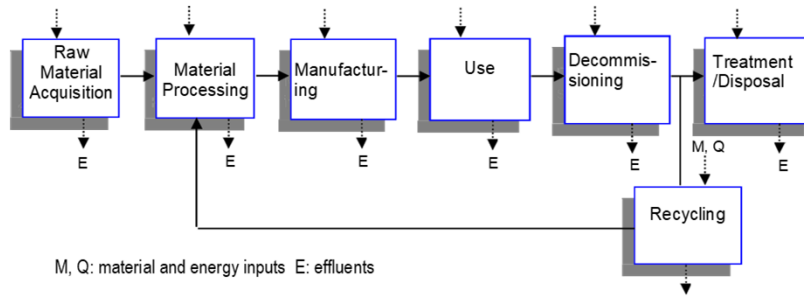
Solar Reuse and Recycling

A recycler taking apart a standard, 60-cell silicon panel can get about \$3 for the recovered aluminum, copper, and glass

The cost of recycling that panel in the U.S. is anywhere between \$12 and \$25 — after transportation costs

It typically costs less than a dollar to dispose a solar panel in a solid waste landfill

Solar Panel Life Cycle



BREAK (10 Minutes)

Storage Batteries



Storage Batteries Overview

- Batteries – generally lithium-ion batteries – used to store energy have become a key partner of photovoltaic solar, wind, and hybrid power plants, especially in areas that are not connected to a strong grid.
- Battery costs that have come down sufficiently to make industrial rollout possible.
- California is currently the global leader in the effort to balance the intermittency of renewable energy in electric grids with utility-scale batteries.
 - Florida, London, Chile and Lithuania are also installing large facilities

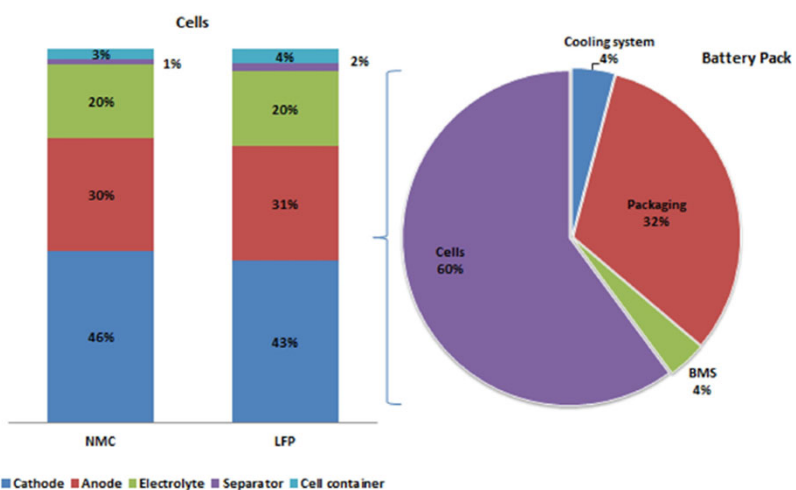
Storage Batteries In Iowa

Currently, MidAmerican operates one battery plant outside of Des Moines and Alliant Energy operates three.

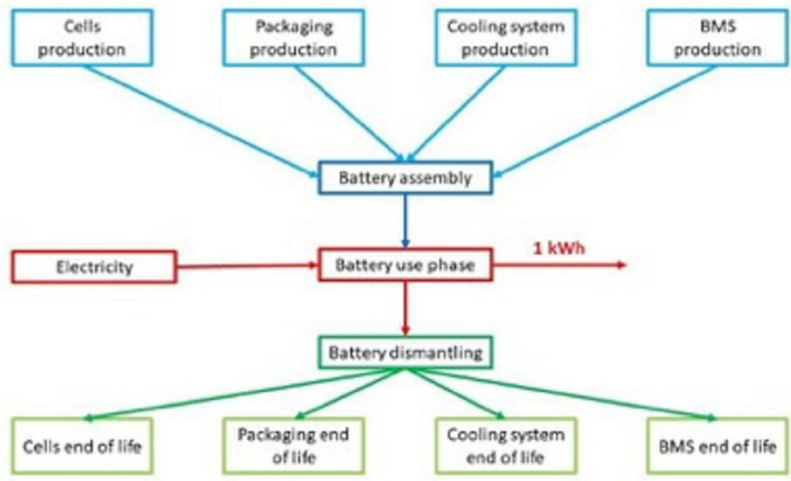
Over the long term, growth in Iowa's renewable energy industries will require more transmission lines to move power to a market and more storage to hold it until demand exceeds supply.

Battery demand in Iowa will soon reach all time highs.

Battery Reuse and Recycling



Battery Lifecycle



End-of-Life Management Models

Decommissioning Plan

Product Stewardship

Rate-Payer Funded

Permittee Funded

Decommissioning Plan Model

- Permittees for wind and solar facilities regulated by IUB would be responsible for decommissioning.
- Could be limited to wind facilities over 5 MW and solar facilities over 50 MW.
- Decommissioning plan included in initial permit application, update it every five years, start setting aside funds partway into the project life (no later than year 10), and be fully funded by the time of decommissioning.
- Decommissioning would prioritize reuse and recycling

Product Stewardship Model

- Manufacturers or their stewardship organization will operate the end of life program.
- Typically a program would be established on a specific date, would be financed through the panels/blades sold after that date, and would collect and recycle (properly manage) all panels/blades removed from service after that date, regardless of installation date, size of installation, or category of owner/permittee.
- The program fee assessed on panels/blades may be fully or partly internalized by the manufacturer or paid by the purchaser. No end of life fees.
- A stewardship program inherently provides manufacturers with incentives to improve a product's environmental attributes and recyclability, but manufacturer decisions may not change.


Rate Payer Funded/Statewide Program Model

- All ratepayers benefit from solar/wind energy in the state generation mix.
- Ratepayers fund an end of life management program for all products being removed from service in the state.
 - Surcharge on the electric bill, likely based on consumption, for the sake of equity. Flat fee, unit of consumption, percent of bill options
 - No end of life fees for owner/permittee.
- Utilities would collect and transmit the funds to an entity operating a statewide collection and management program for all products being removed from service.
- Fees may change over time depending on the needs of the program.

Permittee Funded/Statewide Program Model

- The owners/permittees would fund an end of life management program for all products being removed from service in the state; not paid at end of life.
- Permittees would pay into a fund that would be used by an entity operating a statewide collection and management program for all products being removed from service.
- The payment schedule could be tied to annual generation and/or number of panels and/or rated capacity of the installation. [option: reinstate sales tax]
- Fees may change over time depending on the needs of the program.





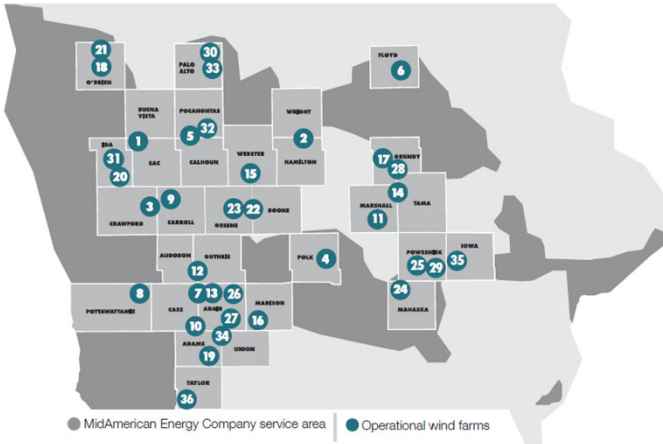
Sustainable Materials Management Wind Turbine Blades

Adam Jablonski
Vice President, Resource Development



MidAmerican Overview

- MidAmerican installed its first wind project in 2004
- MidAmerican's wind fleet is made up of 36 projects containing 3,341 turbines with a nameplate capacity of 7,129 MW; this equates to 10,023 blades
- MidAmerican is currently installing an additional 73 wind turbines with a nameplate capacity of 202.7 MW in 2021
- MidAmerican has plans to repower an additional 428 wind turbines (1,284 blades) through 2022
- An estimated 100-300 blades are estimated to be replaced over the next 20 years due to maintenance
- MidAmerican is evaluating options to repurpose or recycle blades for future repowering projects and blade replacements completed as part of maintenance



● MidAmerican Energy Company service area ● Operational wind farms

Decommissioning Considerations and Planning




- Certain Iowa counties require MidAmerican to enter into a decommissioning agreement, some requiring financial security, to ensure MidAmerican or others are responsible for the decommissioning and disposal or recycling of equipment
- Every easement agreement MidAmerican enters into with landowners contains decommissioning requirements for MidAmerican
- For previous repowering projects, MidAmerican's contracts put the disposal obligation on the OEM contractors to dispose of the blades, and most of those blades were disposed of in landfills as there is no viable option at the time to reuse or recycle
- MidAmerican's contracts for future repowering projects require the contractors to repurpose or recycle the blades
- MidAmerican has taken the blade repurposing or recycling scope for certain projects to ensure that scope is completed as planned
- MidAmerican is evaluating potential blade repurposing or recycling contractors to handle some of the 2022 repowering project blades
- MidAmerican's contractors are typically responsible for the blade disposal that occurs as a result of maintenance activities

Blade Repurposing or Recycling Evaluation



- Recycling or repurposing options are in their infancy with no well-established contractors
- MidAmerican is evaluating blade recycling and repurposing options to find a capable contractor to recycle or repurpose blades from certain past projects and future repowering projects
- MidAmerican is aware of three potential contractors that could provide repurposing or recycling services and is currently vetting those options which include visits to their processing plants
 - Renewablade, LLC with J. Pettiecord
 - Veolia ES Technical Solutions
 - Carbon Rivers with Logisticus Group
- MidAmerican expects to identify a viable solution by year-end 2021 for the repurposing or recycling for a vast majority of the blade material
- MidAmerican will provide updates to stakeholders as viable options are identified


Potential Blade Recycling Options




Recycling of blades into recovered fiberglass material

- Intake
 - Blade removal and field cutting
 - Transport to processing facility
- Preparation
 - Remove and salvage metal components
 - Cut blades into strips for grinding equipment
- Processing
 - Grind up blades with a series of shredders
- Recover fiberglass
 - Technology separates polymers and other organics from fiberglass reinforcement allowing the fibers to be reused for manufacturing 2nd generation composites


Intake




Cutting




Recovered Fiberglass



Processing



Potential Blade Repurposing or Recycling Options



- Unprocessed Blades
 - Approximately 35% of the blade volume is the highly reinforced spar that can be used for ground stabilization applications such as crane mats
- Processed material with no fiberglass recovery
 - Fuel for cement kilns instead of coal
 - Fiberglass utility pole internal core
 - Additive for concrete or other plastic products
- Recovered Fiberglass
 - The recovered fiberglass can be combined with fillers, binders, and reinforcements to produce new composite products
 - The products may be used for vehicles, wind and solar energy products, agricultural products, and performance sports equipment

