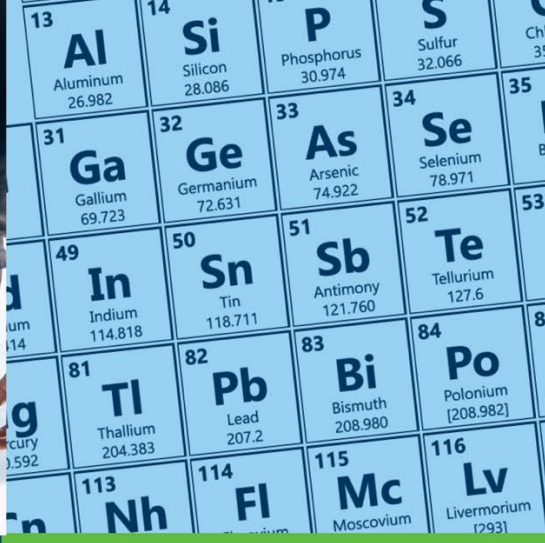
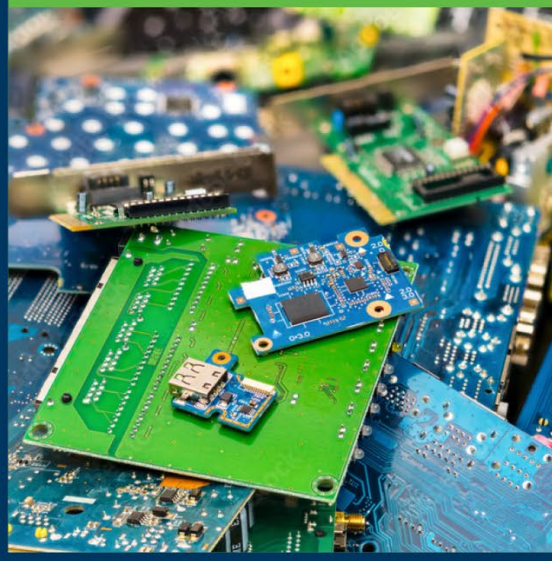


REPORT TO THE LEGISLATURE

DECEMBER 2025

Critical materials recycling and recovery task force

Critical materials and minerals are key to making new technology and have a supply chain that is largely controlled outside the United States. In 2024, the Minnesota Legislature tasked MPCA with exploring how Minnesota could recover and recycle more critical materials. This report captures the Task Force's findings and recommendations.



MINNESOTA POLLUTION CONTROL AGENCY

Critical materials recycling and recovery task force

Critical materials and minerals are key to making new technology and have a supply chain that is largely controlled outside the United States. In 2024, the Minnesota Legislature tasked MPCA with exploring how Minnesota could recover and recycle more critical materials. This report captures the Task Force's findings and recommendations. Report to the Legislature, December 2025.

Legislative charge

Subd. 3.**Duties.** (a) The Task Force must advise the commissioner of the Pollution Control Agency with respect to policy and program options designed to increase the recovery of critical materials from end-of-life products by:

(1) developing a strategic road map for achieving domestic recovery of critical materials;

(2) investigating emerging technologies employed to recover critical materials from electronic waste, components of renewable energy generating systems, and other end-of-life products;

(3) evaluating the economic, environmental, and social costs, benefits, and impacts associated with various methods of recovering critical materials from end-of-life products;

(4) identifying options to prevent products containing critical materials from being disposed of in a landfill or waste combustor;

(5) consulting with stakeholders regarding recycling and end-of-life management options for products containing critical materials that enhance the possibility of recovery; and

(6) identifying infrastructure needed to develop an integrated system to collect, transport, and recycle products for critical materials recovery.

(b) The Task Force must convene at least one public meeting to gather comments on issues regarding critical materials recovery.

Subd. 5.**Report.** No later than December 30, 2025, the Task Force must submit a written report containing its findings and recommendations for administrative and legislative action to the commissioner of the Pollution Control Agency and the chairs and ranking minority members of the senate and house of representatives committees with primary jurisdiction over solid waste. The recommendations in the report must be specific and actionable and may not include recommendations for further reports or studies. The Task Force expires December 30, 2025, or upon submission of the report required by this subdivision, whichever occurs first.

Task Force Leadership Team

Dave Benke, Minnesota Pollution Control Agency

Moaz Udin, Great Plains Institute (GPI)

Chris McConn, Ottertail County Solid Waste

Amanda Cotton, Minnesota Pollution Control Agency

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Document number: lrw-sw-1sy25

Leadership letter

On behalf of the leadership team, we are writing to express our sincere gratitude and appreciation for the commitment, knowledge, and diligent effort brought by the Critical Materials Recovery Advisory Task Force in completing this essential work to create a strategic roadmap for how Minnesota can strengthen the recovery and recycling of critical materials.

This collective work, carried out over five focused meetings in 2025, involved sharing expertise, reviewing research provided by SDK Strategic Services, and engaging in thoughtful discussions on potential approaches to critical materials recovery and recycling.

This collective participation, representing diverse perspectives across Minnesota's critical materials ecosystem, including recycling and waste management, Tribal nations, environmental organizations, labor, academia, manufacturing, and retail, was essential to the success of this mission.

The economic necessity and challenge of achieving circularity are central to this report. This connection between resource management and future generations was summarized by Kelly Applegate with the Mille Lacs Band of Ojibwe, who stated:

"We have to hand this world down to our future generations in a good way. That means reducing waste, making wiser decisions about how we view critical materials, and setting them on a path for recycling. Nothing we use is infinite; the Earth has already given a lot, and sometimes it feels like we are churning the Earth inside out with the carbon footprint we have created so far."

We are proud of the resulting report and the strength of the recommendations developed. This Task Force has successfully laid out a broad framework for Minnesota's approach to recovery and recycling of all critical materials. The recommendations are ambitious, yet they fulfill the legislative requirement that they be specific and actionable.

This report captures the public input, research, and expertise needed to guide Minnesota's future. It represents a unique opportunity to invest in a new economic sector that is projected to grow significantly in both demand and importance in the coming decades.

Thank you once again for this strategic commitment to advancing critical materials recovery and recycling. This report is being submitted to the Commissioner of the Minnesota Pollution Control Agency and the Chairs and Ranking Minority Members of the Senate and House of Representatives committees with primary jurisdiction over solid waste. These leaders now have the opportunity to utilize the detailed findings and go forward with specific and implementable steps for Minnesota, as defined by this Task Force's work.

Sincerely,

Dave Benke, MPCA	Chris McConn, Otter Tail County	Moaz Uddin Mian, Great Plains Institute	Amand Cotton, MPCA

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Executive summary

The Critical Materials Recycling and Recovery Task Force ("Task Force") was established by the Minnesota Legislature in 2024 to create a strategic roadmap for how Minnesota can strengthen the resource recovery and recycling of critical materials. The Task Force brought together appointees of the Commissioners of the Minnesota Pollution Control Agency (MPCA) and the Department of Employment and Economic Development (DEED), as well as representatives across Minnesota's critical materials ecosystem, including recycling and waste management, Tribal nations, environmental organizations, labor, academia, manufacturing, and retail. The Task Force met five times in 2025 to share expertise with others assembled, review data provided by the consultant team, and deliberate on potential approaches to critical materials recycling and resource recovery.

This work is timely. Demand for clean energy technologies, electric vehicles, and other advanced electronics continues to grow, increasing the need for a reliable supply of critical materials. For example, the lithium-ion battery market is projected to grow by 30 percent per year from 2022 to 2030, according to McKinsey & Company. At the same time, communities in Minnesota and globally are experiencing the environmental and social impacts of increasing demand for critical materials. The Task Force was convened to explore how improving resource recovery and recycling of critical materials already in circulation could help Minnesota reduce waste, support local/regional economic development, and contribute to more resilient supply chains.

"Critical minerals" is a broad term for any mineral, substance, or element designated as critical by the U.S. Secretary of the Interior. A "critical material" is any element, material, or substance that the U.S. Secretary of Energy determines is at high risk of supply chain disruption and serves an essential function in one or more energy technologies. The federal critical materials list is updated periodically. The Task Force was charged with developing recommendations based on the 2023 Critical Materials list.

Given the breadth of this list, the Task Force chose to focus on creating a broad framework for Minnesota's approach to resource recovery and recycling of all critical materials, rather than developing detailed recommendations for individual materials or products. The recommendations that follow capture the key ideas and approaches that emerged from this process, including the Task Force's vision for the work:

> ***"[To] Create conditions where Minnesota leads the nation in critical material recovery and recycling across minerals and materials."***

Principles in complexity

With support from SDK Strategic Services (SDK), the Critical Materials Recycling and Recovery Task Force identified four guiding principles to inform Minnesota's approach to critical materials recovery and recycling amid a complex and evolving landscape. Within a policy framework, principles articulate the core beliefs that shape expected attitudes and behaviors. In this context, they define the boundaries and anchor values within which all goals, strategies, and actions should align.

1. ***Environmental Protection***. Minnesota's approach to critical materials recycling must begin by continuing to protect the health of our people and the health of our natural resources – land, air, and water.
2. ***Economic Viability***. Minnesota should focus its critical material recycling and resource recovery efforts on the minerals with the greatest potential for sparking a circular economy in the state.

3. ***Circularity Leadership***. Minnesota should be at the forefront of developing a circular economy built around critical materials recycling.
4. ***Innovation***. Minnesota should build on its history of technology innovations (think 3M, medical devices) to create leading-edge approaches to critical materials recycling.

The Critical Materials Recycling and Recovery Task Force urges the Legislature and agencies to keep these principles in mind when considering policies that impact – or are impacted by – critical materials. Given the complexity of critical materials recovery and recycling, using these guiding principles as a touchstone will help Minnesota stay on the best management path.

Recommendations for action

Within these principles, the Task Force identified four key pillars that can anchor Minnesota's future leadership in critical materials recovery and recycling. They are:

- **Pillar 1: Reduce and Reuse.** Wherever possible, seek to decrease the demands on critical materials by reducing consumption and reusing products that contain them or incentivize replacing critical materials with non-critical materials in products.
- **Pillar 2: Consumer Recycling.** Improve capture of end-of-life products through clear guidance on where and how to recycle items containing critical materials. Critical materials appear in almost every technology-tied product, from stuffed animals that light up and greeting cards that sing, to cars, computers, and more. However, the public is often not aware of critical materials generally, let alone specific minerals that appear within a specific product.
- **Pillar 3: Business and Industry Recycling.** Building the capacity to collect, sort, and recycle products containing critical materials will require a variety of new skills, equipment, and resources for the private businesses that sort, disassemble, harvest, and deploy critical materials from products. This holds true whether the products recycled are large infrastructure, like scrap materials from semiconductor manufacturing, or grid infrastructure, or small consumer electronics.
- **Pillar 4: Encourage A Circular Approach to Minnesota's Critical Materials Recycling**. Critical materials are, by definition, a series of minerals and materials slated for explosive growth and economic opportunity in the years ahead. The lithium-ion battery market alone accounted for an estimated $54.4 billion (US) in 2023, and it's expected to grow almost fourfold to $182.5 billion (US) by 2030. Other critical materials like rare earths face a constricted supply chain and yet are an essential component to magnets in all sorts of products. The economic opportunity and challenge of circularity here require strategies and thinking on a scale far beyond the collection and sorting of consumer electronics and similar products.

Conclusion: A strategic investment opportunity

Minnesota has a unique opportunity to invest in a new economic sector that is projected to grow in both demand and importance within the next few decades – and already has major industrial supply sectors such as renewable energy, advanced technology, and medical devices – that are needed to create and sustain new economic sectors. This Task Force report and supporting appendices capture the public input, Task Force member and agency input, research by the consulting team at SDK Strategic Services and specific recommendations to guide Minnesota's future approach to critical materials recycling and recovery.

Introduction

The legislation establishing the Critical Materials Recycling and Recovery Task Force set clear expectations for its scope and lines of inquiry. The legislation also required that the Task Force include representatives from state agencies, solid waste administrators, organized labor, environmental justice organizations, energy advocacy organizations, electronic waste recyclers, Minnesota Tribal governments, manufacturers that use critical materials, and electric utilities, so that its work reflected perspectives from the diverse sectors and communities affected by critical materials recovery. This report provides key definitions, a summary of Task Force meetings, an overview of the policy framework that emerged, the resulting recommendations, and supporting materials.

Scope of the Task Force

The Critical Materials Recycling and Recovery Task Force was charged to:

- Develop a strategic roadmap for achieving domestic recovery of critical materials.
- Investigate emerging technologies related to recovering critical materials from electronic waste and other end-of-life products.
- Evaluate the economic, environmental, and social costs, benefits, and impacts associated with various methods of recovering critical materials.
- Identify options to prevent products containing critical materials from being disposed of in landfills.
- Consult with stakeholders regarding recycling and other end-of-life management options.
- Identify infrastructure needed to develop an integrated system to collect, transport, and recycle products for critical materials recovery.
- Convene at least one public meeting to gather comments on the issue of critical materials recycling.

Core questions of the Legislation

The legislation included six core questions about critical materials that the Critical Materials Recycling and Recovery Task Force worked to gain answers to:

1. How can Minnesota recover more critical materials from the domestic waste stream?
2. What kind of strategic roadmap is needed to advance domestic recovery of these materials?
3. Which emerging technologies show promise in recycling e-waste and other products containing critical materials?
4. What are the environmental, social, and economic costs and benefits of pursuing critical materials recycling and recovery through different approaches?
5. How do we prevent products containing critical materials from ending up in landfills?
6. What infrastructure is needed to consistently capture and recycle products containing critical material?

Definitions

Critical materials

"Critical minerals" is a broad term for any mineral, substance or element designated as critical by the U.S. Secretary of the Interior. A "critical material" is any element, mineral or substance that the U.S. Secretary of Energy determines (1) is at high risk for supply chain disruption and (2) serves an essential function in one or more energy technologies. These two definitions point to the important and fragile role that critical materials play in the economy of Minnesota, the nation and globally. The topic of critical materials has moved to the forefront of U.S. policy in 2025, in large part due to the heightened emphasis on bolstering domestic production and refinement of critical materials. Yet the topic of critical materials has been a source of growing U.S. policy attention since the Critical Materials Subcommittee of the National Science and Technology Council was created in 2010. The U.S. critical materials list varies slightly year-to-year, but Minnesota's Task Force was charged with developing recommendations based on the 2023 Critical Materials List.

HF 3911 passed in the 2024 legislative session, tasked the MPCA to create a Critical Materials Recovery Task Force to investigate increasing the recovery of critical materials from end-of-life products. The legislation defined "critical materials" as the materials listed on the final 2023 Critical Materials List published by the United States Department of Energy (DOE). The list includes the "Electric 18", or the 18 materials deemed critical for energy infrastructure:

- Aluminum
- Cobalt
- Copper
- Dysprosium
- Electrical Steel
- Fluorine
- Gallium
- Iridium
- Lithium
- Magnesium
- Natural Graphite
- Neodymium
- Nickel
- Platinum
- Praseodymium
- Silicon
- Silicon Carbide
- Terbium

As well as additional critical minerals deemed critical by the U.S. Department of the Interior:

- Antimony
- Arsenic
- Barite
- Beryllium
- Bismuth
- Cerium
- Cesium
- Chromium
- Erbium
- Europium
- Fluorspar
- Gadolinium
- Germanium
- Graphite
- Hafnium
- Holmium
- Indium
- Lanthanum
- Lutetium
- Manganese
- Niobium
- Palladium
- Rhodium
- Rubidium
- Ruthenium
- Samarium
- Scandium
- Tantalum
- Tellurium
- Thulium
- Tin
- Titanium
- Tungsten
- Vanadium
- Ytterbium
- Yttrium
- Zinc
- Zirconium

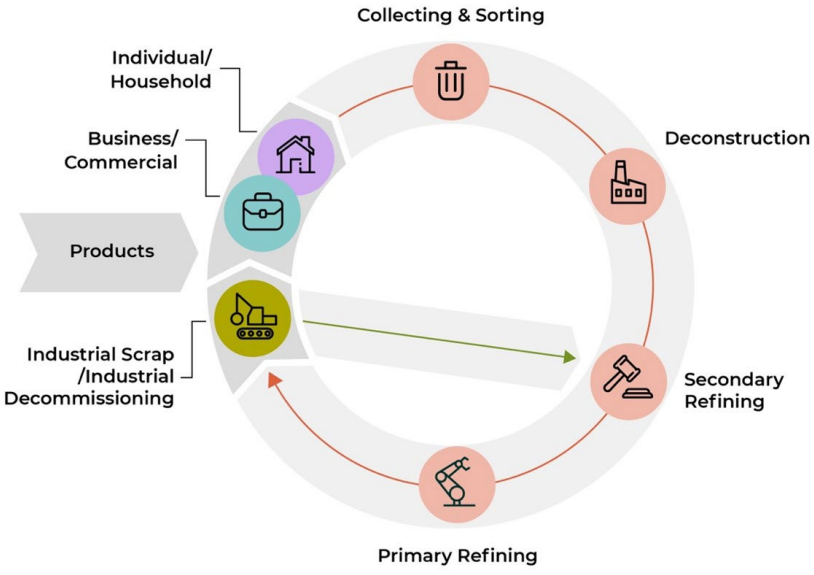
The United States Geological Survey (USGS) inventories the inflow and outflow of nearly all these materials in the U.S. market. The Legislature authorized the Critical Materials Recycling and Recovery Task Force to set Minnesota's approach to recovering these materials for current and emerging waste streams.

Circularity

Task Force members emphasized the value of circularity in setting Minnesota's path for critical materials recycling and recovery. Circularity, in the context of critical materials, refers to designing and managing products, supply chains, and recovery systems so that critical materials stay circulating in the economy at their highest useful value for as long as possible. Figure 1, below, was prepared by SDK Strategic Services to illustrate the various stages of circularity for Task Force discussions. Green and yellow circles illustrate the traditional product-to-recycling pathway, in which products such as refrigerators, cell phones, and other devices are collected, sorted and deconstructed to harvest critical materials. Batteries follow a similar pathway but are processed into a "black mass" before those materials are further refined into minerals that can be reused in new products. The purple circle illustrates the circular pathway for industrial-scale minerals. Here, "industrial-scale" references the higher volume and purer minerals available when recycling and recovery is fed by a steady industrial supply, such as discarded material from a manufacturing process.

Figure 1: Recycling lifecycle

The graphic lists the steps to the recycling process in a circle, starting with the products being separated into two categories: Consumer and industrial. The consumer products move from products to collection and sorting, deconstruction, then secondary refining, and finally primary refining before heading back into the products stage. Industrial products go straight to the secondary refining stage.



The steps to the recycling process that are encompassed in full circularity of critical minerals are:

1. **Collection and Sorting**: Involves collecting end-of-life products from individuals and businesses, akin to what mixed recycling currently does.
2. **Deconstruction**: Can be broken down into two separate parts – first stage deconstruction and second stage deconstruction. After moving through this process, large blocks of scrap metal and electronics move to step three.

3. **Secondary Refining**: Where sorted materials are processed and refined into more concentrated streams of recoverable minerals. For batteries, this includes producing "black mass," an intermediate mixture of metals that still requires further refinement to be reused in products.
4. **Primary Refining**: Where black mass is further refined into a quality equal to virgin material and ready for use in manufacturing. This most often occurs at manufacturing facilities that already have the equipment to refine the mineral.
5. **Products**: The commercial goods created with critical materials.

A circular approach to critical materials requires attention to the full life cycle of a mineral – from when it's separated from a consumer product all the way through to refining the mineral back into a level of purity that allows for new production. This full mineral life cycle lives in harmony with the solid waste hierarchy (Figure 2) that is recommended for all natural resources.

Reduce, reuse, recycle, recovery

Minnesota's overall recycling policy approach is anchored by the state's Solid Waste Management Hierarchy, which emphasizes reducing, reusing and recycling resources in lieu of waste-to-energy or disposal in landfills. The approach is visualized in Figure 2, below.

Figure 2: Solid Waste Management Hierarchy Graphic

The graphic lists seven different solid waste management practices on a continuum from left to right of most preferred to least preferred. Most preferred is waste reduction, then reuse, recycling, organics recycling, waste to energy, landfill with gas recovery, then landfill as least preferred.

Reduce

Reducing the overall demand can lower costs and limit supply chain disruptions. This is primarily accomplished by using fewer products and materials in the first place and by designing products that require fewer critical materials. Today, some critical materials are used in low-durability, difficult-to-recycle applications, such as certain electronic and novelty items, which limits opportunity for recovery.

Reuse

Reuse refers to using a product or its components again, either for its original purpose or a new one, without significant processing or deconstruction. Because reuse avoids the time and energy needed to deconstruct products and refine them into raw materials, it often provides greater environmental value

than recycling and keeps items out of the waste stream longer. Within the solid waste management hierarchy, reuse has the second-highest value, only behind general waste reduction. The Task Force discussed this topic in relation to items like electric car batteries being repurposed as backup batteries on an electric grid, as one example of emerging reuse methods for critical material-dense products.

Recycling

Recycling encompasses the collecting, sorting, and processing of products at the end of their life so their materials can be used to manufacture new products. Typical recycling includes deconstructing items into raw materials. Mixed recycling is a common practice in Minnesota households, while recycling electronics is a more complicated issue that generally is left to specialty recyclers to safely recover their components. Some manufacturers of consumer electronics, like Apple and Amazon, manage their own recycling programs with trade-in incentives for new devices. While company-specific programs can expand consumer options, Minnesota currently has a statewide electronics recycling law that requires manufacturers to register and meet annual recycling obligations by purchasing recycled pounds from certified recyclers. Public and privately owned facilities still perform most collection, sorting, and deconstruction, and manufacturer obligations help fund and support that work.

Recovery

Recovery refers to processes that capture critical materials from secondary end-of-life products like equipment, electric vehicles, automotive vehicles, waste scrap or similar products. IDTechEx, an independent research firm focusing on emerging technologies, estimates that critical materials recovered from secondary products will constitute a $110 Billion (annual) industry by 2045.

Task Force meetings

In light of the directives from the legislation, a series of meetings was planned for both the Critical Materials Recycling and Recovery Task Force and for the public. All meetings were held between March and October 2025. All were held online and open to public comment.

- **Meeting 1 – Orientation.** Review enabling legislation. Agree to a consensus-based approach for finalizing recommendations.
- **Meeting 2 – Task Force Scope**. MPCA and DEED presented materials on Minnesota's assets in recycling, policy and areas of economic leadership. The Task Force chose to focus on creating a broad policy framework for all 56 critical materials, rather than create recommendations for building circularity around a few minerals, materials or products. Vision approved.
- **Meeting 3 – Evaluating Economic, Environmental and Social Costs.** SDK Strategic Services presented research and a framework for evaluating recycling approaches across critical materials. Task Force discussion focused on the experiences with recycling critical materials and products that contain critical materials.
- **Meeting 4 – Investigating Emerging Technologies for Reuse, Recovery and Recycling.** SDK presented research on emerging recycling technologies and their environmental impacts.
- **Meeting 5 – Principles and Priorities.** The Task Force discussed and evaluated core principles for Minnesota's approach to critical materials recycling and set priorities for report recommendations.
- **Meeting 6 – Report Recommendations.** The Task Force discussed priorities for report recommendations.

Public input: Key ideas

All Task Force meetings were open to the public for commentary. Additionally, two public meetings were held to gather input from the public on their priorities related to critical materials recycling. The main topics that were discussed from the public are as follows:

- Scaling up recycling to relieve mining pressure
- Access, equity, and costs
- Altering policies and regulations to incentivize recycling
- Consumer labelling
- Enabling reuse of products
- Civic responsibility, jobs, and environmental benefits

In addition to public meetings, the Task Force held webinar-type discussions with experts in a variety of aspects of critical materials recovering and recycling. SDK Strategic Services and MPCA conducted outreach to several local, state and national stakeholder groups, as well, to ensure diverse perspectives informed the discussion and recommendations.

Minnesota's critical materials assets

Task Force investigation of Minnesota's critical materials landscape began with an asset-based inventory of Minnesota's existing policies and economic sectors that could feed, and benefit from, a robust system for recycling and recovering critical materials. Staff from MPCA and DEED organized information about their agencies' respective policies and programs to inform the discussion.

Recycling and Economic Development Policy

Minnesota has a strong foundation of existing product stewardship laws. MPCA staff presented an overview of these existing programs – as well as new policy ideas – that aim to strengthen recycling and recovery for products that are rich in critical materials. Minnesota already has two key frameworks in place: 1) the Minnesota Recycling Act, which covers household video display devices (VDDs) and other covered electronic devices (CEDs), and 2) the Rechargeable Battery Law, which supports collection and management of rechargeable batteries at retail locations such as Lowe's and Home Depot, as well as at household hazardous waste sites.

Additional policies are under consideration to build on this foundation. There are potential proposals around electronics and batteries that would establish a Producer Responsibility Organization (PRO) to better coordinate statewide e-waste and battery management. Another proposal would require new standards to support responsible recycling of solar panels. These potential policies will help capture and recycle critical materials.

DEED has several programs that may support critical materials circularity. These programs include:

- Minnesota Forward Fund
- Minnesota Investment Fund
- Job Creation Program
- Launch Minnesota
- Energy Transition Office grant programs

Several of these programs provide packages of incentives for businesses focused on launching new technology start-ups, clean energy, or other industries that are building and growing. Others are specifically focused on supporting workforce development to ensure that Minnesotans are well-equipped to contribute to the new jobs these industries will yield.

Economic sectors of opportunity

Minnesota has business sectors that would both contribute to and benefit from a critical materials circular economy. These sectors of opportunity are discussed further below.

- **Clean Energy**: Minnesota's carbon-free by 2040 policy has accelerated investment in clean energy production, transmission, and storage. All require large amounts of critical materials and deemed critical infrastructure – meaning they would greatly benefit from the local production of critical materials mass to use in their production to maintain access for all in the state. Because clean energy technologies have a finite lifespan, decommissioning will create both a consistent demand stream for recycled critical materials and a predictable supply stream from decommissioned technology.
- **Advanced Technology**: A variety of technologies, from personal devices and computers to data centers and semiconductors, depend on critical materials. Minnesota is a national leader in semiconductor manufacturing, and the sector continues to grow. All these demands require a consistent supply of critical materials to maintain technological access and reliability.
- **Medical Devices**: The medical device industry is one of Minnesota's largest. In fact, the medical device sector makes up more than 10% of the state's gross domestic product, with more than 500 companies already present in Minnesota. Like advanced technology, today's medical devices require critical materials to manufacture. The high concentration of manufacturing in Minnesota could contribute to a high volume of scrap materials that could anchor recycling. That said, intellectual property is a recycling concern for the industry. That is, harvesting critical materials from scrap medical devices could require a higher level of disassembly to protect manufacturers' intellectual property. This level of effort could be costly in already small and fragile medical devices.

Each sector relies on a different mix of critical materials, and each plays an important role in Minnesota's economy that could offer a starting point for fostering a circular approach to critical materials recycling.

SDK Strategic Services Research

In addition to the information provided by MPCA and DEED, SDK Strategic Services supported the Task Force with detailed research and broader stakeholder engagement to capture the critical materials landscape. That work included:

- Policy scan of state and national policies and approaches on critical materials, broadly.
- Stakeholder outreach to understand the emerging technology, research and perspectives of business, environmental and other groups.
- Critical materials recycling cost and potential, capturing the current state of recycling technology and potential value of various critical materials within the full list of materials.
- Emerging recycling technology research, capturing the current state of recycling technology and the environmental considerations of various recycling methods.

A complete summary of this work is provided in Appendix B.

Recommendations

The Critical Materials Recycling and Recovery Task Force explored all aspects of critical materials recycling, with a focus on circularity as the anchoring ethos behind discussions. The recommendations that follow capture the key ideas and approach explored across five meetings.

Vision

The Critical Materials Recovery and Recycling Task Force is recommending the following vision guide Minnesota's approach to the topics:

> ***"Create conditions where Minnesota leads the nation in Critical Material recovery and recycling across minerals and materials."***

Principles

Within a policy framework, principles are the fundamental beliefs about the attitudes and behaviors that should guide all actions. Here, the principles serve as the broad boundaries and anchoring values that all goals and actions should fall within. The recommended principles for critical materials recycling and recovery are presented below:

1. ***Environmental Protection***. Minnesota's approach to critical materials recycling must begin by continuing to protect the health of our people and the health of our natural resources – land, air, and water.
2. ***Economic Viability***. Minnesota should focus its critical material recycling and recovery efforts on the minerals with the greatest potential for sparking a circular economy in the state[1].
3. ***Circularity Leadership***. Minnesota should be at the forefront of developing a circular economy built around critical materials recycling.
4. ***Innovation***. Minnesota should build on its history of technology innovations (think 3M, medical devices) to create leading-edge approaches to critical materials recycling.

Goals

The Task Force identified three broad goals to anchor Minnesota's future critical materials recycling and recovery work. These goals are also intended to serve as the concrete objectives of Minnesota's critical materials recycling and recovery "Strategic Roadmap."

1. **Goal 1: Reduce, Reuse, and Recycle First.** Create actionable targets that significantly increase the portion of critical materials that are reused or recycled in Minnesota, and a consistent system for updating targets as critical materials markets mature.
2. **Goal 2: Cultivate Implementation Readiness.** Review and set recycling project oversight processes that ensure Minnesota's commitment to the principle of environmental protection is

[1] Minnesota only captures 23.7 percent of e-waste for recycling. The projected job creation, if 100 percent of e-waste in Minnesota for recycling is 1,718 direct jobs, and a total of 3,345 new jobs, $3.2 billion annual revenue value, and 78 million pounds of value elements. Source: Jensen, Phadke, Steva, and Riffel, The Economic Potential of E-Waste Recycling in Minnesota: A Pilot Study, August 2023.

preserved, while fostering open communication with project leaders so that processes can get the attention needed to keep pace with innovation.

3. **Goal 3: Identify Criteria for Bet-Worthy Critical Materials**. Focus on building Minnesota's supply-chain partnerships around a small number of materials where the state has natural leadership opportunities because of its existing industries, natural resources and location. This approach is the most viable route to further Minnesota's circular economy ambitions around critical materials recycling.

Measurement + Governance

A circular economy approach to critical materials recycling will require new enabling conditions: measurement and governance. Here, measurement speaks to the new data and measures that will be required for Minnesota to track progress towards the goals of its critical materials recycling and recovery strategic roadmap. Governance speaks to the reality that the full value chain of circularity around any specific product or mineral touches the regulatory authority of several state agencies, and implementation of the strategic roadmap will require active engagement from several state agencies as a result.

Governance recommendation: Engage with Minnesota state agencies and the Environmental Quality Board (EQB) to evaluate existing laws and regulations related to critical materials circularity, from mineral mining and employer site selection to the full recycling process. Identify a pathway for Minnesota to lead on critical materials and coordinate across agencies, whether through an existing coordination body like the EQB or a topic-based governance approach, like Minnesota's Climate Action Framework. Policy examples to consider include product stewardship laws that support circularity beyond collection, updated materials classifications so recycling feedstock is not automatically treated as waste, procurement policies that prioritize recycled content, and criteria that incentivize mineral recovery and manufacturing from recycled feedstock.

Measurement recommendation: Equip Minnesota's state government to track measures of critical materials recycling and recovery. Leverage data to facilitate coordinated action by the MPCA and other state agencies engaged in critical materials circularity, recycling and recovery governance. Top priority measures of the Task Force are:

Critical material use and recovery:

1. Track the volume of products containing critical materials in the waste stream.
2. Track the amount of critical materials recovered from products.
3. Track the volume of products containing critical materials entering Minnesota's economy.

Why:
These measures show how important critical materials are to Minnesota's economy so policies governing these materials are more relevant, and to track how policies and market changes impact the flow of materials over time. These measures also help companies identify the number of resources in the state that are available for recovery and the potential demand for manufacturing.

Environmental and health impacts:

4. Track the environmental impact of recycling facilities through measures like air emissions, including viewing human health measures from an environmental justice perspective.
5. Track the net environmental impact of critical materials recycling and reuse and compare it to the environmental impact of mineral mining.

Why:
These measures will help decide where and how to support industries and specific processes that lower environmental and human health impacts while promoting commerce. They will also ground comparisons between recycling and mining in realistic expectations, recognizing that national assessments find end-of-life recycling can supply only a small fraction of projected critical mineral demand.

Energy and economics:

6. If possible, track the energy needed to disassemble and recycle products containing critical materials. Compare the recycling energy costs to the total market value of recovered materials.

Why:
This helps assess whether recovery pathways are both environmentally and economically viable, informing decisions about which technologies and facilities to prioritize for investment and support.

Recommendations Pillars for Recycling and Recovery

The Critical Materials Recycling and Recovery Task Force is recommending four pillars to anchor Minnesota's approach to critical materials recovery and recycling moving forward.

Pillar 1: Reduce and Reuse. Wherever possible, seek to decrease the demands on critical materials by reusing products that contain them or incentivize replacing critical materials with non-critical materials in products. Specific recommendations within this pillar are:

1. ***Equip the next generation of repair.*** Work with educational institutions, community colleges, training centers, and unions to create workforce training opportunities around the repair of products that contain critical materials. Equip technicians to repair machines (phones, refrigerators, cars, etc.) that include critical material components like screens, batteries, magnets, and more.

2. ***Create incentives for battery reuse.*** Support second-life opportunities for used electric vehicles and other large-scale batteries so they can be repurposed for other uses. For example, by treating reused batteries as distributed storage or microgrids rather than hazardous waste, streamlining permits for stationary and behind-the-scenes meter systems, and allowing second-life packs to count toward utility batter storage or grid resilience goals.

3. ***Create incentives for businesses whose products are built for easy repair and reuse, or who create product alternatives to critical materials***. Offer benefits such as product development funding, tax incentives, or grants for producers who create products that can be easily repaired. Consider similar incentives for companies that create product alternatives to critical materials. An example of alternatives is Niron Magnetics in St. Cloud, which has invented an iron ore magnet that does not rely on rare earth materials. The goal is not simply to replicate existing global supply chains in Minnesota, but to innovate new product designs that are not dependent on critical materials.

4. ***Evaluate the implementation of Minnesota's newly enacted Right-to-Repair law for opportunities to include additional products that contain critical materials.*** Policy expansion could include items with smaller amounts of critical materials but more abundant in consumer use, and may also include rules or fees for manufacturers that recycle their own products internally. Identifying additional product subject to the Right-to-Repair law would enable

consumers and the repair industry equitable access to tools, manuals, and diagnostics associated with those products.

Pillar 2: Consumer Recycling. Critical materials appear in almost every technology-tied product, from stuffed animals that light up and greeting cards that sing, to cars, computers, and more. However, the public is often not aware of critical materials generally, let alone specific minerals that appear within a specific product. The Critical Materials Recycling and Recovery Task Force recommends the following actions to encourage Minnesota consumers to recycle more of the products that contain critical materials:

1. ***Public education and awareness campaigns.*** Fund campaigns to build public awareness of what critical materials are, how they show up in products, and how to best reuse and/or recycle the products that contain them. The campaigns could include a separate but related awareness effort about how to safely recognize, store, and dispose of batteries.
2. ***Make drop-off easy***. Establish a network of convenient locations, both urban and rural, where consumers can drop off products that contain critical materials, such as e-waste.
3. ***Create a cost-sharing program that makes it cheap or free for consumers to recycle products containing critical materials***. The Task Force recommends reducing or removing recycling fees on products containing critical materials.
4. ***Consumer labeling***. Establish clear, standardized labels that indicate whether a product or its components are recyclable and provide basic guidance on safe recycling.
5. ***Extend Task Force principles to product stewardship policies.*** Minnesota is currently exploring a variety of policy updates aimed at increasing recycling of a variety of products that contain critical materials, such as e-waste products, solar panels, and rechargeable batteries. Minnesota is also exploring policy mechanisms that would make producers and manufacturers financially responsible for the cost of end-of-life product collection and recycling. The Task Force is recommending that MPCA and other stakeholder groups evaluate proposed policies through the lens of critical materials recycling and recovery principles.

Pillar 3: Business and Industry Recycling. Building the capacity to collect, sort, and recycle products containing critical materials will require a variety of new skills, equipment, and resources for the private businesses that sort, disassemble, harvest, and deploy critical materials from products. This holds true whether the products recycled are large infrastructure, like scrap materials from semiconductor manufacturing, or grid infrastructure, or small consumer electronics. That said, the volume, scale, and guaranteed consistency of critical materials recovered from products over time will have a direct impact on the potential profitability – and circularity – of critical materials recycling. The Task Force is offering the following recommendations to support building capacity for critical materials recycling in Minnesota:

1. ***Workforce Training***. Offer apprenticeship programs and new skills training to equip workers at recycling facilities to use the existing and new technologies required to recycle products that contain critical materials.
2. ***Worker Safety and Fair Wages***. All facilities that disassemble and sort products containing critical materials should be required to provide employees with safety training and information about preventing and managing fires, and disassembling and processing products containing critical and potentially toxic materials, broadly. All facilities recycling critical materials should offer prevailing wages to staff.

3. ***Grants and Loans for Recycling Equipment***. Minnesota's existing grant and loan programs, or any comparable funding mechanisms administered by the state or partner organizations, should prioritize projects that enhance the safe handling, disassembly, and recovery of critical materials from products.

4. ***Streamline Permitting***. The Minnesota Pollution Control Agency should undertake a permitting process review specifically aimed at ensuring that environmental protections stay at the forefront of critical materials recycling, while the permitting process itself is managed in a simple and efficient manner for businesses seeking permits.

5. ***Make Liability and Facility Insurance Costs Deductible.*** Recycling facilities are facing 20% or more annual rate increases, in large part due to the fire and safety challenges of products containing critical materials and the large equipment costs needed to make this recycling safer and easier. Minnesota should make these insurance costs fully deductible for private recycling facilities, and offer an elective pay incentive for city and county-owned facilities.

Pillar 4: Encourage A Circular Approach to Minnesota's Critical Materials Recycling. Critical materials are, by definition, a series of minerals and materials slated for explosive growth and economic opportunity in the years ahead. The lithium-ion battery market alone accounted for an estimated $54.4 billion (US) in 2023, and it's expected to grow almost fourfold to $182.5 billion (US) by 2030. Other critical materials like rare earth elements face a constricted supply chain and yet are essential components for advanced magnets and other products. The economic opportunities and challenges of circularity require strategies and thinking on a scale far beyond the collection and sorting of consumer electronics and similar products. The Task Force has aligned around four key recommendations to enable Minnesota's future leadership in a circular economy built around critical material recycling and recovery.

1. **Create a Minnesota tax credit package aimed at encouraging major critical materials recycling projects and related development**. Nevada, Kansas, and Oklahoma have each created unique tax credit packages to encourage critical materials recycling and circular development throughout the critical materials supply chain. Examples include:
    - **Recycling Facility Property Tax Abatement**. Nevada currently exempts eligible recycling facilities from property taxes for 10 years after construction.
    - **Mega Project Tax Credit Package.** Kansas currently provides projects of $1 billion or more with tax credits for the cost of capital, payroll, and staff training for new major projects, including critical materials manufacturing and recycling. Materials used to build the facilities of these mega projects are also exempt from sales tax.
    - **New Product Development Exemption.** Oklahoma encourages innovation in products, including those containing critical materials, by excluding new products invented in Oklahoma from counting toward taxable income, so long as the products are manufactured in Oklahoma.

2. **Create "Major Projects" Implementation Process and Tools.** The MPCA has had recent success shepherding an innovative, major solid waste project — DemCon — through the regulatory and permitting process in a way that preserved environmental protection standards and enabled the developers to keep pace with finance and other needs. The Task Force is recommending that MPCA identify thresholds and strategies to replicate this project-development process for other projects that rely on critical materials recovery and recycling.

3. **Support Investment in Emerging Environmentally Friendly Recycling Technology.** Researchers continue to explore new technologies that can recycle critical materials using methods that are less consequential to the environment. The Task Force recommends that Minnesota look for

opportunities to support and grow environmentally friendly recycling methods in the state and region to help ensure future critical materials recycling happens in ways that protect people and natural resources.

4. **Review permitting criteria in Minnesota and the surrounding region, and identify pathways to allow for primary and secondary refining of critical materials in the United States.** Critical materials recovered from manufacturers or consumer products are currently disassembled, and the recycling process is begun in the United States. However, materials are shipped overseas for final refining needed to turn critical materials into forms that can be used in new manufacturing. The Task Force is recommending that Minnesota clarify and modernize its permitting processes to allow for a complete supply chain of recycling. The modernization process should include criteria and monitoring to ensure that any potential impacts on people and natural resources are minimized and are not disproportionately borne by any one racial, cultural or economic group or community.
5. **Create incentives (tax credits, deductions or other financial tools) to encourage reuse of recovered and refined critical materials**. The Task Force is recommending that Minnesota consider creating new incentives for manufacturers to use critical materials derived from recycling. The goal of these incentives would be to further encourage circularity by incentivizing dedicated markets for the products that result from manufacturing.

Appendix A: Task Force members

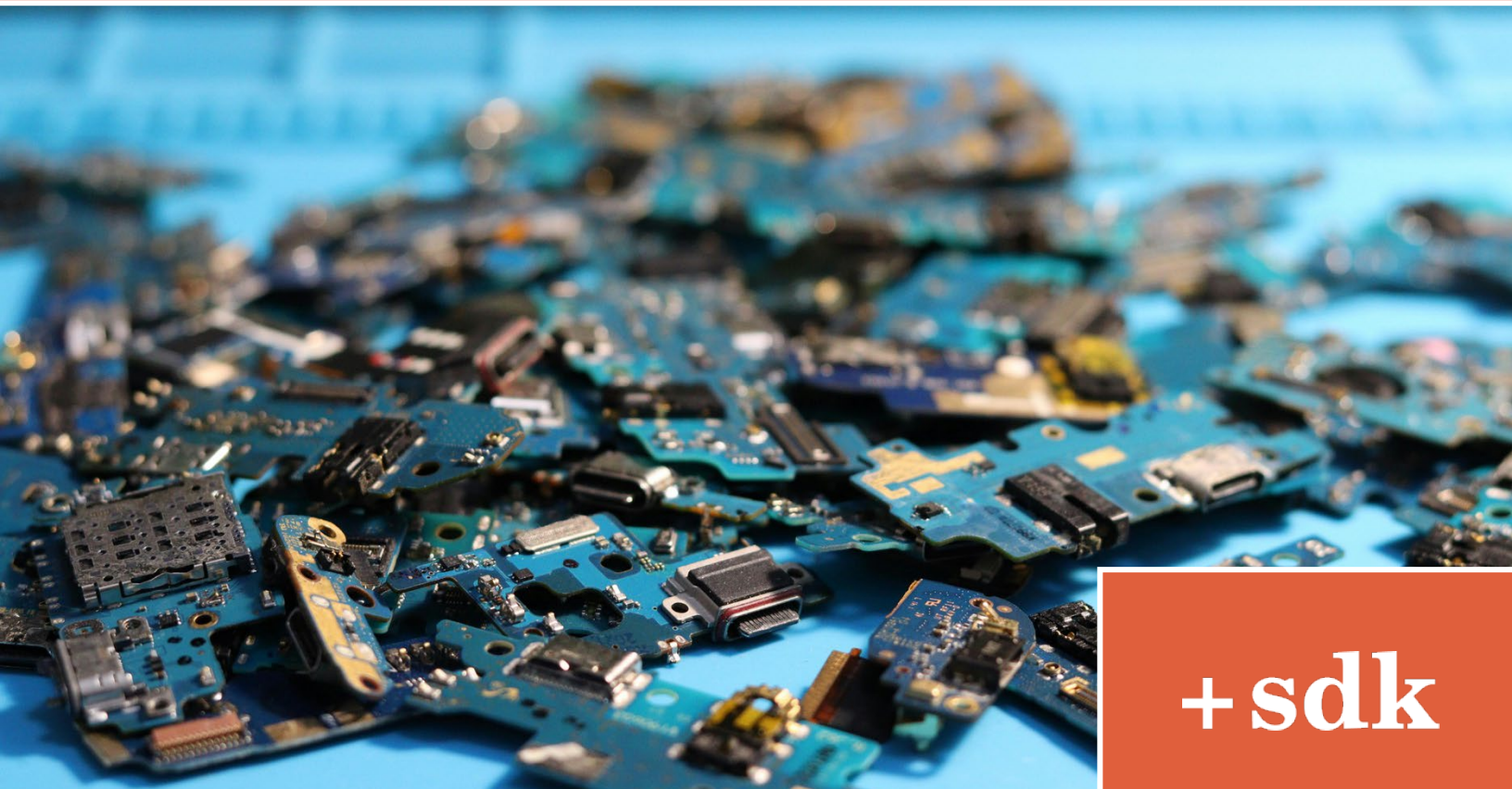
As specified in statute, the Critical Materials Recycling and Recovery Task Force was required to contain a representative from the following sectors: the trades; an expert in one of the subject areas; the Solid Waste Administrators Association; a company that disassembles electronic waste; an energy advocacy organization; an environmental justice organization; an industrial labor union; a manufacturer of products that use critical materials; the Minnesota Indian Affairs Council; an electronics manufacturer that is also a retailer with an e-waste program; a utility providing electronic services to customers in Minnesota; the Natural Resources Research Institute (NRRI); and a recovery infrastructure operator (serving as a nonvoting member). To that end, the Task Force included the following members:

Organization Name	Working Group Member	Organization Information
BENCO Electric	Jordan Nickels	BENCO Electric / About Us
Best Buy	Timothy Dunn	Best Buy Environmental Sustainability
BlueGreen Alliance	Michelle Manson	BlueGreen Alliance / About Us
DEED	Ed Hodder	DEED / About Us
Dynamic Lifecycle Innovations	Amanda Tischer Burris	Dynamic / Home
Great Plains Institute	Mian Moaz Uddin	Great Plains Institute / Who We Are
LiUNA	Patrick O'Connell	LiUNA / About
Mille Lacs Department of Natural Resources	Kelley Applegate	Mille Lacs DNR
Minnesota Pollution Control Agency	Dave Benke	MPCA / About Us
Ottertail-Todd-Wadena Solid Waste	Chris McConn - **Chair**	Ottertail County Solid Waste
NRRI	Patrick Schoff	NRRI / About Us
Panasonic	Josh Freeman	Panasonic / Our Business
Recycling Electronics for Climate Action	Roopali Phadke	RECA
Redwood Materials	Tricha Dutcher	Redwood Materials / About
United Steelworkers	John Arbogast	United Steelworkers / About

Appendix B: SDK Research Report

APPENDIX B:

Foundations for Minnesota's Critical Materials Policy Framework



+sdk

SDK Strategic Services Project Team

Stephanie Devitt – Project director & Principal investigator

Paul Shanafelt – Project manager

Amy Bendtsen – Junior Associate / Research Assistant

Contributors:

Alishia Wright
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Sources interviewed by SDK Strategic Services

U.S. Department of Energy, Ames Laboratory, Argonne National Laboratory, National Science Foundation – Transportation Research Board, S&P Global, Michigan Environment, Great Lakes and Energy (EGLE), as well as a variety of Minnesota associations, small businesses, and others.

Delivered to the Minnesota Pollution Control Agency

December 2025

Introduction

In the 2024 session, the Minnesota Legislature passed a bill creating the Critical Materials Recycling and Recovery Task Force (Task Force). The Task Force was charged with developing a strategic road map for the future recycling and recovery of critical materials in Minnesota. A cross-section of recycling stakeholders was identified to contribute to determining recommendations. The Task Force's final recommendations are due to the Commissioner of the Pollution Control Agency (MPCA) and the Environment Committees of the Legislature on Dec. 30, 2025.

MPCA contracted with SDK Strategic Services (SDK) to support the Task Force through process design and facilitation, stakeholder outreach, and research. This report summarizes the results of research, interviews and stakeholder outreach conducted by SDK from March to October 2025 and serves as a data underpinning to the Task Force report and recommendations.

Research Methods + Questions

SDK Strategic Services research encompasses both primary and secondary sources, including:

1. **Policy and literature research**. This work includes a review of federal, international, and state-level policies about Critical Materials as well as policy frameworks and goals. Literature research included a review of scientific articles about recycling technology, publications about supply chains and economic variables, and other related materials. SDK maintained a bi-weekly review of local and national articles about critical materials recycling from March to December 2025 in support of the project.
2. **Stakeholder interviews**. SDK conducted meetings and interviews with a variety of critical materials experts and stakeholders in Minnesota and nationally. Additional stakeholders provided input at Task Force meetings and public meetings. Interviews included consulting with academic and applied critical materials researchers, state agencies, solid waste providers, economic development, recycling facilities, mineral experts, environmental groups, and others.
3. **Primary research.** Finally, research included review and capture of primary sources such as U.S. Geological Survey (USGS) maps and indexes of critical materials deposits, and review of market prices for various materials.

The Task Force chose to focus on creating a framework for Minnesota's approach to all critical materials, rather than focusing on the recycling and recovery systems of a narrow set of minerals (like lithium or rare earth elements) or products (like batteries or magnets). The Task Force's enabling legislation specifically cites the 2023 U.S. Department of Energy (DOE) critical materials list, which encompasses 56 different

minerals. Additionally, the Task Force's enabling legislation identified specific directives that scoped the project:

1. Create a "strategic roadmap" for achieving domestic recovery of critical materials.
2. Investigate emerging technologies for recovering critical materials from electronic waste, components of renewable energy-generating systems, and other end-of-life products.
3. Evaluating environmental, social and economic costs, benefits and impacts of various methods of recovering critical materials from end-of-life products.
4. Identifying opportunities to prevent products with critical materials from entering the waste stream.

As such, all research was designed to support a policy framework and explore three core questions:

1. What is the current state of critical materials recycling, and what are the opportunities of the future?
2. What are the economic opportunities and limitations of critical materials recycling?
3. What are the environmental, economic and social considerations of different recycling technologies and systems?

The report below summarizes these findings. Key ideas were also presented to the Task Force to inform the discussion and final recommendations, which are captured in the Task Force report.

Policy Context and Definitions

Critical materials is an umbrella term that encompasses the minerals, elements, substances, and materials that are at high risk of supply chain disruption and serve an essential function in one or more energy technologies. The U.S. DOE maintains a list of the United States' *critical materials*, while the Department of Interior's USGS maintains the nation's *critical minerals* data about specific minerals and the location of mineral deposits. The Critical Minerals Subcommittee was created in 2010 to coordinate federal activities on these minerals, especially as it relates to mining. The Infrastructure Investment and Jobs Act (IIJA) codified the Critical Materials Subcommittee as a permanent body for coordinating activities across federal agencies.

Clean energy is one of the sectors most impacted by critical materials, and DOE identified a list of 56 minerals that fall within the "critical material" designation.

Within this broad list, in 2023 DOE named the "Electric 18" – that is, minerals most needed to produce green energy at scale – as:

- Aluminum
- Cobalt
- Copper
- Dysprosium
- Electric Steel
- Fluorine
- Gallium
- Iridium
- Lithium
- Magnesium
- Natural Graphite
- Neodymium
- Nickel
- Platinum
- Praseodymium
- Silicon
- Silicon Carbide
- Terbium

As well as additional materials deemed critical by the U.S. Department of the Interior:

- Antimony
- Arsenic
- Barite
- Beryllium
- Bismuth
- Cerium
- Cesium
- Chromium
- Erbium
- Europium
- Fluorspar
- Gadolinium
- Germanium
- Graphite
- Hafnium
- Holmium
- Indium
- Lanthanum
- Lutetium
- Manganese
- Niobium
- Palladium
- Rhodium
- Rubidium
- Ruthenium
- Samarium
- Scandium
- Tantalum
- Tellurium
- Thulium
- Tin
- Titanium
- Tungsten
- Vanadium
- Ytterbium
- Yttrium
- Zinc
- Zirconium

The IIJA committed nearly $8 billion to critical materials initiatives such as demonstration projects for processing battery materials, supporting advanced battery manufacturing, and demonstrating the feasibility of extracting rare earth elements from waste such as coal ash. The Inflation Reduction Act (IRA) made additional investments in critical materials such as a tax credit for 10 percent of the cost of producing and refining critical materials in the United States. The IRA also dedicated $500 million toward the Defense Production Act (DPA) to support creating Rare Earth Element (REE) separation and refinement facilities in Texas and California, among other investments.

Research Findings

The following findings capture key themes and supporting research developed to support the Critical Materials Task Force. Across primary research, interviews with

stakeholders and public input, all information explored aimed to inform key questions of the enabling legislation while holding true to the Task Force's decision to pursue a broad policy framework that could inform Minnesota's strategy across all critical materials.

Finding 1: Economics and product development trends are accelerating the demand for critical materials unevenly.

Modern technologies -- from personal devices like computers, car parts, and phones, to major infrastructure like data centers and electric grids – are designed to include a variety of critical materials. The demand for critical materials is projected to grow by more than 150% across all materials between 2024 and 2040, with some specific materials facing even steeper demand.

The economics of supply and demand have made some critical materials especially "critical." For example, lithium is an essential component of lithium-ion batteries that power electric vehicles and contribute to many other green energy technologies. The cost of lithium increased 10-fold from 2020 to 2022 alone, according to McKinsey & Company, while the cost of another critical material, aluminum, has held flat or declined in recent years. These different cost swings mirror the reality that products containing lithium, like electric vehicles and climate-friendly power sources, face a high demand that accelerated further with the passage of the Inflation Reduction Act. Price spikes also sparked a new wave of research into new product designs for the lithium battery to create a battery composition that stores more energy for less money, more safely.

As the lithium example illustrates, high-demand critical materials are subject to significant cost fluctuations – and these fluctuations make them a focal point for product design changes that could change future demand for a particular material. This volatile interplay between material cost and product design presents new challenges for mineral recycling and recovery, when compared with traditional products' end-of-life recycling.

Finding 2: Some of the products that most rely on critical materials are also sectors of strength for Minnesota.

The critical materials landscape is broad and fast evolving, but the sectors most impacted by this topic are advanced technology, healthcare and medical devices, and green energy. Uses of these materials include:

- **Clean Energy.** The clean energy sector includes a variety of green energy technologies at different scales. Large-scale examples include clean energy sources and electric grid infrastructure. For example, rare earths are a key material in magnets that are used in wind turbines, while other minerals are used in solar panels at solar farms or an individual's home. Alternative transportation, like lithium-ion batteries in cars, scooters and e-bikes, are another personal-scale example of critical materials powering new carbon-free energy technology.

Clean energy technology is also the fastest-growing segment within the technology sector. Jobs in clean energy jumped up to 48% between 2021 and 2023, according to McKinsey & Company's technology trend analysis. Job growth can be viewed as a leading indicator of future production, pointing to continued growth in clean energy use of critical materials. Prices of relevant critical materials have also spiked as demand increases. For example, Lithium carbonate prices grew from about $5 per kilogram in mid-2020 to just over $80 per kilogram at the start of 2023. Lithium prices have come down slightly, but this cost swing illustrates the fragile economics of critical materials. The price fluctuations vary from mineral to mineral across the full list of critical materials, but these minerals are among the most in-demand materials and have seen some of the steepest price increases.

- **Advanced Technology.** This term encompasses everything from personal devices like smartphones and tablets, to large equipment like data centers and military technology. The minerals that contribute to these products include gallium, silicon, graphite and magnesium. Some aspects of advanced technology, like personal smartphones and tablets have already grown to reach a critical mass of consumer technology adoption. However, these personal devices are small and dispersed, posing some collection and recovery challenges. Other technologies, like data centers, are larger products and are projected to see significant in growth in the years ahead. The U.S. Department of Defense (DOD) is actively researching many aspects of the critical material lifecycle for advanced technologies because so much defense equipment relies on these materials, as well.

- **Healthcare and Medical Devices.** Implanted medical devices, like pacemakers and the batteries that power them, are examples of devices that rely on critical materials to produce. Platinum metals, zinc, and titanium are among the most prominent critical materials used in this industry, and these materials are used in implanted devices and the batteries that power them, surgical tools, and more.

  Medical devices are a more developed industry than others in Minnesota that use critical materials, but the sheer volume of competition for these minerals stands to impact the medical device industry. This industry is of interest to Minnesota because the state is considered the world's largest health technology cluster,[1] with more than 7,400 medical device-related companies in the state.
  At the same time, features of the industry could make it a less-likely candidate to anchor supply for critical material recycling and circular economic growth. Relevant factors include the purity levels required of many materials, the

significant approval processes required for medical devices (which lowers the appetite for recycling among industry leaders, according to some consulted), steep intellectual property protections on most devices, and the small size of the devices (which leads to a lower return on investment for disassembling products, even at the factory waste stage).

The Minnesota Department of Employment and Economic Development (DEED) representative to the Task Force presented comprehensive data about how these critical material-rich sectors are represented in Minnesota.

Finding 3: Critical Materials have been a focus for innovation in new recycling technology and new, circular business models

Material recycling has played an essential role in solid waste management for decades. In fact, Minnesota's solid waste recycling laws date back to the 1960s, and the state has had laws regulating the recycling of some products, like rechargeable batteries, since the early 1990s. Critical materials recycling and recovery stand to build on the existing policy and infrastructure foundations set via past products. At the same time, our research found that the fast-evolving technologies at the heart of the spike in demand for critical materials recycling are driving the development of new recycling technologies.

Recycling Technology Research

The technology for recycling some critical materials, like aluminum, are well-established, but the recovery and recycling process is a significant area of opportunity for most of them. DOE and researchers across the nation and globe are making significant investments to develop the recovery and recycling processes across critical materials, especially among the "Electric 18." Key investments and pilot projects underway include:

- Battery material processing ($3 billion)
- Battery manufacturing projects ($3 billion)
- Battery recycling ($335 million)
- Critical material mapping ($320 million)
- Coal ash recovery pilot ($140 million)
- Advanced technologies for electric vehicle batteries and reuse ($70 million)

In addition, DOE has invested in Ames Laboratory, and a partnership of 10 universities exploring technology options for the extraction, recycling, and reuse of critical materials, exploring new frontiers of using Artificial Intelligence (AI) and more. Some existing methods of recycling, such as bioleaching and incineration, are also being revisited as the need for critical materials accelerates the need for metal and material recovery.

Emerging Business Models

New recycling technology is just one factor that products containing critical materials must contend with to create a circular economy. Other factors include:

- Whether and how personal electronics and other products are disposed of;
- Whether the solid waste system captures products containing critical materials (rather than shredding or bundling); and
- The work needed to harvest specific critical materials from their waste stream.

These variables can run counter to the business model of existing recycling facilities. For example, one traditional recycler interviewed commented that they could get more money for some materials present in the waste they process, but their equipment is best suited to shred and bundle end-of-life products. As a result, the recycler interviewed chooses not to capture critical materials at their facility.

- **Manufacturer-Led Recycling**: Manufacturer-led recycling Apple offers the most concrete example of this model in action, with cell phone and computer buy-back programs and incentives offered several times per year at a variety of retailers. Under this program, Apple captures past iPhones, iPads, computers, and other devices, and then deconstructs its products in-house. This approach allows the innovative manufacturer to reuse materials wherever possible while also protecting product design patents.

- **Business-Sponsored Recycling.** Researchers interviewed from Ames Laboratory emphasized the importance of business partnerships in even the earliest stages of recycling research. Ames Laboratory's research has discovered recycling technologies that can go as far as deconstructing platinum from other minerals at an almost atomic level, as one example. But the true value of this research will only be realized when a business can reuse the mineral efficiently.

These examples point to the significant role that manufacturers play in creating and generating value from critical materials recycling outside of the traditional end-of-life waste management and recycling ecosystem.

Manufacturer-led recycling will not replace the need for recycling critical materials from end-of-life products. However, this larger role of manufacturers and businesses in seeding critical materials recycling presents a significant paradigm shift from traditional recycling business models that build and focus solely on the point of end-of-product-life.

Finding 4: The circularity opportunity varies across the list of critical materials.

The Critical Materials Recycling and Recovery Task Force emphasized attention to all critical materials, rather than focusing on a select mineral, group, or product. The Task Force also emphasized the importance of encouraging circularity throughout the process and in its final recommendations. These two ideas are somewhat competing. That is, policy for all 50+ materials is wide by definition, while achieving circularity requires a focused approach to fully connect a specific material or product lifecycle. Nevada's Lithium Loop is an example of a focused strategy to drive circularity.

Recycling Feasibility Framework

Given this reality, SDK developed a Recycling Feasibility Framework to inform the state's policy framework and also help identify critical materials best poised to successfully anchor a circularity strategy. The framework relied on analysis of each mineral on the critical materials list against several key data points:

- Analysis of current if technology to recycle the material was scaled throughout the U.S.
- Approximate cost of recycling (where available).
- Location of mineral refining (inside vs. outside the United States).
- If the current mineral supply is projected to meet future demand.

The Recycling Feasibility Framework also incorporates data such as the price per ounce, availability of raw minerals in the United States, hazards related to transporting or breaking down the material, and whether the material can be recycled more than once. Analysis of these variables illuminated four distinct categories of critical mineral recycling within the framework:

1. **Scaled**. The infrastructure needed to recycle these materials is widely available across the United States. Expanding recycling of these critical materials is more likely to rely on new policies or awareness that could increase recycling of end-of-life products.
2. **Scaling**. The infrastructure needed to recycle these materials is expanding and gaining traction within the United States at a relatively rapid scale. The recycling technology for these minerals and the products that contain them is proven, and critical minerals are valuable enough to warrant investing in expanded recycling operations.
3. **Emerging**. The recycling technology has moved beyond research and development, but still relies heavily on venture capital, government grants and loans, or other alternative financing to establish the operations needed to transition out of research and development and into a viable recycling business.

4. **Research and Development**. Finally, technology needed to recycle some critical materials remains in the research and development phase.

Table 1 (below) offers more detail on how all 56 critical materials fared when evaluated against the four levels of the Recycling Feasibility Framework for Critical Materials. Only 7 of the 56 critical materials can be recycled with a recycling technology that is scaled and widely available. By comparison, 15 of the 56 critical materials evaluated can be recycled with technology that is rapidly scaling. However, the recycling technology for the remaining 36 of 56 critical materials remains as either an emerging technology or something still in research and development. A more detailed description of each of the four levels is provided below Table 1.

Table 1: Recycling Feasibility Framework For Critical Materials

	Scaled	Scaling	Emerging	Research & Development
Example materials	Aluminum Copper	Lithium Cobalt	Graphite Magnesium Silicon Carbide	Dysprosium Tellurium
Number (of 56)*	7	15	16	20
Number with projected supply/demand match	1	4	3	4
Median price per ounce**	$0.44/oz	$5.14/oz	$6.80/oz	$13.93/oz
Mean price per ounce**	$0.70/oz	$710/oz	$49.28/oz	$514/oz
Portion of Refining in the U.S.	3.23%	0.8%	0.34%	Thullium:11.5% All others: 0.15%

***Price per ounce based on daily market rates collected June 15 – 30, 2025.*

Scaled recycling technology is in place for more traditionally known materials, like aluminum and copper. However, these minerals are also among the cheapest (per ounce) of the 56 minerals evaluated. Scaled minerals had a median price of $0.44 per ounce, and a mean price of $0.70 per ounce.

Materials with **scaling recycling** capacity are moving past the technology development process to emphasize building adequate material supplies to reach economies of scale. These materials are more valuable than the scaled materials, and this grouping has the widest variance in the value of materials. Specifically, the median price per ounce of critical materials where recycling capacity is scaling is $5.14 per ounce, while the mean

price is $710 per ounce. This delta points to a few minerals within this grouping that are facing an especially high market demand for the material that recycling and other harvesting methods, like mining, aim to capitalize on. Lithium is the most prominent critical material in this grouping, and a mineral that has been a focus of recycling attention from producers of clean energy technology, electric vehicles, and other emerging technologies that rely on the mineral.

Emerging recycling describes the critical materials where recycling technology is developing, but it may be relying on research grants or venture capital to develop and refine the technology. The grouping includes many minerals that are key to advanced technology, like semiconductors, as well as many minerals that make up Rare Earth Elements that are critical to magnets. This grouping is more valuable as a group, with a median price of $6.80 per ounce and a mean price of $49.28 per ounce. These minerals are also among the most dependent on other nations for final refinement. Only 1/3rd of 1% of material refinement for critical materials with emerging recycling happens in the United States.

Finally, recycling technology for about 20 critical materials remains in the "**Research and Development**" phase. The "about" is an acknowledgement that recycling technology for 2 minerals is already "Scaling" or "Emerging," but research into other recycling methods for those same minerals is in the Research & Development phase. Minerals in this grouping are among the most valuable, with a median price of $13.93 per ounce and a mean price of $514 per ounce. These minerals are also the most dependent on other nations for final refinement. Aside from Thallium, only 1/10th of 1% of refinement happens in the United States for these critical materials, where recycling is still in the research and development stage.

Critical materials research experts at the Ames National Laboratory, which houses the DOE's Critical Materials Innovation Hub, noted that often the most successful recycling research pairs scientific investigation into the recycling technology with a business positioned to use the technology.

Finding 5: Critical material recycling is gaining the most traction where recyclers can rely on an industrial-scale supply.

While critical materials recycling is taking many forms across the 50+ minerals encompassed in the list, one variable consistently emerged in SDK research as anchoring successful circularity strategies: access to industrial-scale supply. Here, we use the term "Industrial-scale supply" to capture the volume of a specific critical material or set of critical materials' scrap that can be generated by the waste, mistakes or other remains from a manufacturing plant.

The large volume of recycling-ready material generated from waste at a manufacturing facility is fundamentally different from consumer and business end-of-life products. The large volume of recycling-ready material generated from industrial waste, like at a manufacturing facility, represents a large, more pure, easier to disassemble and

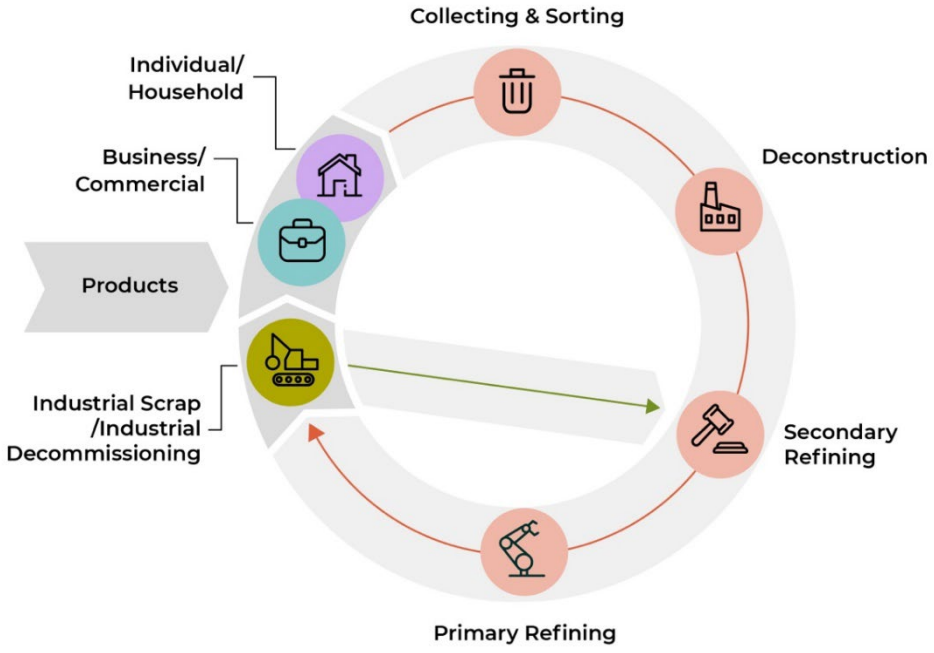
guaranteed supply of recovered critical materials to feed recycling. This is a sharp contrast to the time and effort needed to recover critical materials from a variety of products across consumer, retail and business avenues, and presents a fundamentally different business model from traditional end-of-life recycling of consumer products.

Figure 1 (below) illustrates this idea. The diagram shows where consumer and business end-of-life products enter the waste stream and may require collection and sorting, followed by deconstructing and separating the components of various technology products to be shipped for refining. Consumer and business end-of-life products may still feed critical materials recycling, but successful cases consistently show the importance of industrial-scale supply to anchoring a recycling process that will instigate a circular economy.

It's also worth noting that full circularity of critical materials would require processing and refining recycled materials back into usable minerals. That refinement process – depicted as "primary refining" below – is often the same process used in mined minerals into manufacturing-ready materials. Primary refining is largely unavailable in the United States at this time. Instead, most materials are sent to other countries for refining. The analysis of current recycling methods (see Finding 6 below) focuses on the environmental impact of collecting and sorting, deconstructing, and secondary refining of critical materials.

Figure 1: Recycling life cycle graphic

The graphic lists the steps to the recycling process in a circle, starting with the products being separated into two categories: Consumer and industrial. The consumer products move from products to collection and sorting, deconstruction, then secondary refining, and finally primary refining before heading back into the products stage. Industrial products go straight to the secondary refining stage.



Examples of this idea in practice include:

1. **Redwood Materials + Panasonic Battery Manufacturing**. Redwood Materials was represented on the Task Force. The company was founded by the co-founder of Tesla, JB Straubel, and the company's first facility is strategically located near Panasonic's Nevada factory, where Tesla batteries are manufactured. Access to the manufacturing waste and scrap of that lithium battery facility provided the guaranteed supply needed to anchor Redwood's early work and allow them to expand further. A full company history is available here.
2. **Cyclic Materials + Vacuumshmelze Manufacturing (Vac)**. Cyclic Materials describes itself as an "advanced metals recycling company building a circular supply chain." In 2024, the company initiated its first partnership with Vac to receive rare earth materials from the Vac magnet manufacturing facility. This partnership was expanded in 2025, when Cyclic and Vac expanded their partnership to guarantee Cyclic access to all Vac magnet byproducts for rare earths recycling.
3. **DemCon + Ramsey / Washington Recycling & Energy Center**. In Minnesota, the DemCon anaerobic digester project is another illustration of this principle in action. Conversations with project developers found that contracts with a guaranteed supply of food waste from a 20-year agreement with Ramsey / Washington County Recycling & Energy Center was the cornerstone needed to secure financing and other agreements that made the project possible.

These examples of guaranteed supply contracts and partnerships between manufacturers and recyclers illustrate the essential role of manufacturers in critical materials recycling and circularity – a connection to producers that is not present in traditional recycling policies.

Finding 6: Emerging Recycling Methods Are More Delicate, But More Environmentally Friendly

SDK conducted an assessment of established and emerging technologies for recycling critical materials to inform Task Force discussions. The information SDK gathered indicated that long-standing forms of recycling were not equipped to handle retrieving critical materials from most devices due to their small quantities and the intricate details of the items they are used in. Therefore, new ways of recycling critical materials containing items must be developed to accurately and efficiently retrieve this critical supply.

Three long-standing recycling methods were included in the assessment, each described below:

1. **Shredding and grinding** (linked) - physically separating recyclable materials into similar types and breaking them down into smaller, more usable pieces.
2. **Pyrometallurgical** (linked) - using fire or heat to separate out different types of metals for reuse.
3. **Hydrometallurgical** (linked) - using water-based processes to separate out the different substances for reuse.

In addition, three broad types of new recycling methods emerged through interviews and literature review. These methods, overall, are also described below:

1. **Liquid-Liquid recycling** (linked) - using chemical-based processes that more efficiently pull out specific metallic elements and/or small, rare earth elements.
2. **Direct recycling** (linked)- taking the items and directly using them for some other type of process, such as using old car batteries for energy storage.
3. **Battery Recycling and Water Splitting (BRAWS)** (linked) - this kind of recycling is specialized to rare earth minerals and other elements that are in batteries such as Lithium and is a two-stage process involving direct deconstruction of the product before going through a hydrometallurgical process.

Emerging recycling methods offer a variety of benefits and limitations when compared with traditional recycling methods. Namely:

1. **New recycling methods evaluated are often less harmful for the environment**. Recycling methods under development or newly developed, such as Liquid-Liquid and Battery Recycling and Water Splitting (BRAWS), rely on water or other liquids to deconstruct products. This is a departure from traditional methods like shredding end-of-life products or using heat or chemicals to separate components of a product.
2. **Traditional recycling methods are better equipped to handle a high volume of products and materials**. Traditional recycling methods like shredding and heat can be applied *en masse* to a number of or a variety of products at once, rather than requiring careful deconstruction of a single product. This large-scale process often produces a high volume of its own environmental contaminants, such as dust, air pollution, or requires a lot of energy to complete the process. These

traditional recycling methods also often rely on large equipment or facilities to complete the recycling process.

3. **New recycling methods require a much more detailed understanding of the product being recycled than traditional recycling methods**. The emerging recycling methods designed to capture critical materials use more delicate practices that require at least some knowledge of the product or material being deconstructed to retrieve minerals. These methods require a more technical approach for each product, and the exact application of new recycling methods could change over time as the composition of different technology products themselves changes at an unprecedented speed.

Table 2: Recycling Types Comparison Chart:
Pros and cons of different recycling processes

		Traditional Recycling Methods			Emerging Recycling Methods		
		Shredding & Grinding	Pyro-Metallurgical	Hydro-Metallurgical	Liquid-Liquid	Direct Recycling	"BRAWS" Battery Recycling and Water Splitting
Environmental Considerations	*Dust Free*	x	x	x	x	✓	x
	Does not use additional hazardous Materials	✓	x	x	x	✓	✓
Economic Considerations	*Not energy intensive*	x	x	✓	✓	✓	✓
	Produces high quality alloys	✓	x	✓	✓	✓	✓
Scalability	*Does not require intimate knowledge of product*	✓	✓	✓	x	x	x
	Can handle large volume of e-waste	✓	✓	✓	✓	x	x
	Applicable to a wide range of technology	✓	✓	✓	✓	x	x

Figure 2 (above) illustrates these comparisons. Traditional recycling methods are captured in the left three columns, and emerging recycling methods are captured in the right three columns. As the figure illustrates, new recycling technologies are not as energy-intensive and can produce high-quality alloys without dust or additional hazardous materials. However, these new recycling technologies also require more intimate knowledge of the product being recycled and must be recycled in smaller batches. These limitations make new recycling technologies that capture critical materials more labor-intensive and potentially require a higher level of skill to execute.

Finding 7: Some states are showing early leadership in cultivating critical materials circularity.

Minnesota is the first state to explore critical materials policy across the full list of minerals and materials. However, other states have made significant strides in economic development policies around specific products or critical materials to seed a circular economy. Their progress offers worthwhile lessons. Some states reviewed include Nevada ("Lithium Loop"), Oklahoma, Kansas, and Michigan.

- **Focus on where an industrial-scale supply of a specific mineral or material exists**. States that are making the greatest traction in building a circular economy from critical materials recycling first have a large manufacturing presence that relies on a specific type of critical materials, such as Rare Earth Elements (REEs) or lithium-ion batteries.
- **Lead from economic development.** The states making headway are investing in critical materials recycling and cultivating new recycling with economic development incentives and tools that build on and complement the federal "Qualifying Advanced Energy Credit Program" (48c). States like Nevada are offering incentives like 50% tax abatement for investments in new recycling equipment. Facilities are also eligible for up to 50% property tax abatement. Oklahoma has created incentives like tax rebates for research and development, income tax exemptions for new inventions manufactured in Oklahoma, and streamlined permitting processes. These incentives are aimed at making Oklahoma a leader in new energy manufacturing and technology innovation, including critical materials recycling.
- **Cultivate a circular ecosystem.** Nevada's "Lithium Loop" is the most well-defined, comprehensive circular economy strategy, but many states making headway are cultivating cross-sector collaborations that support critical materials recycling. This circular ecosystem often includes university partnerships or state-led efforts to encourage private-sector innovation, catalytic investments in new projects or technology, and committed partnerships between government, manufacturers, and critical materials recycling facilities to enable regulatory approvals and related public sector actions.

These variables point to policy drivers that start from an economic development and manufacturing-first lens to ensure the supply necessary to anchor critical materials recycling.

Discussion: Strengths and limitations

SDK Strategic Services' research efforts were specifically scoped to the direction and priorities identified by the Critical Materials Recycling and Recovery Task Force. From this lens, we identified several strengths and limitations of the research that can inform future work and properly contextualize conclusions.

1. **"Critical" Is a supply chain issue first**. The "critical" in critical materials refers first and foremost to supply chain and economic risk. This research focused on current critical materials recycling infrastructure, transportation, and related systems issues. However, research did not model future demand projections for minerals or industries, an acknowledged limitation of the study.
2. **Governance.** The topic of circularity around critical materials presents a new paradigm for recycling and recovery policy. Agencies regulating mineral mining (Department of Natural Resources), green energy and grid infrastructure (Commerce and Public Utilities Commission), and economic development incentives (Department of Employment and Economic Development) have a significant influence on the topic beyond their representation in the Task Force. Federally, critical materials issues are governed by a multi-agency coordinating body, the Critical Materials Subcommittee, to allow for coordinated approaches across multiple agencies impacted by the topic. Engaging broader agency perspectives on an ongoing basis would ensure strong governance of Minnesota's circular approach to critical materials recycling and recovery and enable Minnesota's future leadership on the topic.
3. **Changing Federal context.** Critical materials policy has increased in importance over the course of Task Force work due, in large part, to the fast-changing federal landscape. New tariffs, changes to federal clean energy tax credits, and other federal actions have increased awareness of critical materials among policymakers and the public. At the same time, these changes have increased volatility around critical materials.

Underneath these topics is a recognition that critical materials have largely been a niche policy issue for experts in energy, defense, auto manufacturing, and a few other industries – but will be central to the economy of the future. The Task Force has helped raise awareness of the issue among Minnesota leaders across sectors, but building greater awareness will be important to facilitating future implementation of the Task Force's recommendations.

Conclusion and recommendations

Based on research conducted in support of the Critical Materials Recycling and Recovery Task Force's charge, SDK reached three core conclusions:

1. **Minnesota has unique assets that could anchor a circular economy and critical materials recycling**. Those assets include our nation-leading green energy law and the large-scale green infrastructure serving Minnesota today; Minnesota's industrial leadership in critical material-rich industries like manufacturing semiconductors and medical devices; and state political and agency leadership with a demonstrated interest in cultivating new economies and a clean environment.
2. **The Task Force's all-materials approach to critical material recycling is positioning Minnesota for a successful long-term strategy.** The broad policy framework can provide consistent guardrails to Minnesota's approach across critical materials and the products that contain them. It provides a stable floor to build from as the products that rely on critical materials continue to evolve.
3. **Achieving circularity will require Minnesota to build on the Task Force's work with a focused strategy and sustainable governance.** While the framework provides a stable floor, additional strategic direction and coordination will be needed to make Minnesota a leader in this fast-evolving field.

As a result, we are recommending the following milestones for consideration by the Task Force and the Minnesota Pollution Control Agency (MPCA).

- **Establish sustainable governance**. Whether through an existing coordinating body, like the Environmental Quality Board (EQB), or as a separate initiative, Minnesota will be well-served by bringing together all state agencies that touch critical materials in a circular economy to develop a consistent process for critical materials management and a coordinated strategy for advancing a circular economy.
- **Investigate the economic opportunity of high-potential industries**. Minnesota is a recognized leader in some industries and natural resources that have the potential to anchor a circular economy and critical materials recycling. However, each industry has detailed specifications of what could be needed for circularity, such as purity specifications, and current and future costs of a specific mineral or material. Specific areas of the greatest potential include Minnesota's significant green energy and grid infrastructure, the potential development of significant data center campuses across Minnesota, and the state's growing semiconductor manufacturing industry. Each shows potential, but would need more focused research to create a complete critical material value chain in Minnesota and/or the surrounding region.

Minnesota would benefit from conducting an economic analysis of the potential market opportunity of critical materials recycling across industries present in the state. A market analysis of this nature should serve as the starting point for a circular economy strategy that integrates the full value chain, from production to recycling, in Minnesota or the Midwest.

- **Develop a menu of incentives**. Once Minnesota's markets of opportunity for a circular economy are more clearly defined, the state would benefit from a deeper review of potential incentives to offer and assets to cultivate for a complete circular economy strategy. Examples that could serve as a jumping-off point include:
    - ***Kansas' "Attracting Powerful Economic Expansion (APEX)",*** which attracts mega-projects ($1b +) with tax credits on qualifying capital, payroll, training reimbursement and sales tax exemption for materials used to build facilities.
    - ***Nevada "Real property tax abatement,"*** which provides an up to 50% abatement of tax due on property over 10 years for recycling facilities.
    - ***Nevada "New Markets Jobs Act (NMJA)"*** provides investments to major economic development projects in targeted areas. A total of $200 million was authorized in 2019 and another $170 million in 2023.
    - ***Oklahoma "New Product Development Exemption"*** encourages invention and manufacturing by exempting inventors of new products exclusion from taxable income for 7 years, so long as the product invented is produced/manufactured in Oklahoma.

- **Create a dedicated Circularity Development Team or Project Office**. Projects like DemCon show that MPCA and Minnesota can lead innovative, circular waste management projects. The DemCon project also highlights the importance of focused project management collaborations with state agencies that move at the speed of capital. These lessons are transferable, and even more urgent, in the fast-evolving field of critical materials recycling.

- **Review Minnesota's existing recycling regulations against the Recycling Feasibility Framework and emerging critical materials recycling technology.** Critical materials recycling is impacting the field of recycling in unique ways. New technologies that end up in traditional trash, like small lithium-ion batteries, are creating safety challenges for traditional recyclers. At the same time, private manufacturers and developers are becoming involved in recycling earlier in the supply chain or they are transporting materials across states to feed critical material-specific recycling facilities. One example of this is the transport of electric vehicle batteries. MPCA could benefit from reviewing its end-of-life regulations through the lens of emerging critical materials recycling trends such as smaller products, more manufacturer-led recycling, and emerging harvesting and safety

concerns that will accompany new materials and fast-evolving technology trends uncovered in this report.

Taken in total, these recommendations are intended to support the Critical Materials Recycling and Recovery Task Force's aim of creating a circular economy rooted in critical materials recycling and provide MPCA, DEED, and stakeholders with data and considerations to support further Minnesota's critical materials policy.

Appendix C: Public meeting summary

Critical Materials Task Force

Public Meeting 1 Notes

Date: 7/23/2025 2:30p.m. – 4:00 p.m.

Attendance

- Stephanie Devitt (SDK Strategic Services, Task Force Management/Facilitator)
- Amanda Cotton (MPCA, Task Force Management/Support)
- Angela (Dynamic)
- Roopali Phadke (Recycling Electronics for Climate Action)
- Paul Shanafelt (Senior Consultant, SDK, Task Force Management/Facilitator)
- Mercedes Hamilton (Associate, SDK, Task Force Support)

Welcome

- Stephanie Devitt started the meeting with a quick agenda on what the task is and who is involved.
- Amanda gave an overview of the recommendations that are needed out of the task force.
- Stephanie Devitt provided an overview of what Critical Materials are and where the task force is in its work.
- Stephanie Devitt then facilitated public comments.

Public Comment

- **What do you want the task force to consider as they think through Minnesota's approach to critical materials?**
    - Local supply chains
    - Can we safely and efficiently recover what is already in landfills
    - Building a system where collection and recycling is incentivized
        - Not have the cost be a burden on the taxpayers
    - Keep energy use for recycling in mind
    - No more unfunded mandates on counties/cities
    - Meeting people where they are at
    - Keeping junk collectors honest and properly recycling
    - Ensuring the items collected are recycled domestically
    - Manufacturer requirements
- **What are the values of critical materials recycling?**
    - Circularity
    - Stewardship
    - Responsibility

    - Creativity
    - Reuse
    - Future success
    - Problem solving
- **What does success look like for Minnesota?**
    - Not increasing costs on people
    - “Evidence ecosystem”
    - Beneficial to everyone along the value chain
    - Becoming a blueprint for others to follow
    - Education of citizens
    - High but achievable bar
    - Sustainable practices
    - Increasing e-waste recycling from 20%
    - Social responsibility
    - Accessible and inclusive
    - Jobs that are created are high quality, safe, and accessible
    - Mitigating landfill contamination

Critical Materials Task Force

Public Meeting 2 Notes

Date: 7/30/2025 7:00 p.m. – 8:00 p.m.

Attendance

- Stephanie Devitt (SDK Strategic Services, Task Force Management/Facilitator)
- Amanda Cotton (MPCA, Task Force Management/Support)
- Angela Remus (Dynamic)
- Roopali Phadke (Recycling Electronics for Climate Action)
- Paul Shanafelt (Senior Consultant, SDK, Task Force Management/Facilitator)
- Mercedes Hamilton (Associate, SDK, Task Force Support)
- Members of the public: Crystal Palmer (CW Companies), Neil Byce (CW Companies, Beth Croteau-Kallestad (MnDOT), Ean Kuhlmey (CW Companies), Emily Burlinghaus, Mitch

Welcome and Recap of Meeting 1

- Stephanie Devitt started the meeting with a quick agenda on what the task is and who is involved.
- Amanda gave an overview of the recommendations that are needed out of the task force.
- Stephanie Devitt provided an overview of what Critical Materials are and where the task force is in its work.
- Stephanie Devitt then facilitated public comments.

Public Comment

- **What do you want the task force to consider as they think through Minnesota's approach to critical materials?**
    - DOE is very specific between critical minerals vs. Critical metals – so it's very important to understand these delineations in the legislation.
    - Focus on small to mid-sized batteries as they are the most problematic in the waste stream.
    - Getting the word out to people that there is alternatives to the landfill
    - We need good data
        - Where are we missing data and how we can address that
    - Small battery changes in composition makes recycling difficult
    - Use the structures we already have but making them more efficient
- **What are the values of critical materials recycling?**
    - Education
    - Make recycling easy
    - Mandatory labeling of embedded batteries
    - Use current recycling structure
- **What does success look like for Minnesota?**
    - Increase the percentages of recycling in the existing mechanism we have
    - Recording the materials as much as possible
        - Not publicly available so as not to disturb private companies
    - Current legislation unfairly excludes lower economic persons from recycling economy (copper license)
    - People supplement their income by recycling products to provide for their families more often than recycle because they should

Appendix D: Meeting minutes and slides

Critical Materials Task Force

Meeting 1 Notes

Date: 3/21/2025 2:00 p.m. – 4:00 p.m.

Welcome and Agenda Overview

Task Force members in attendance	Task Force members not in attendance
• Moaz Uddin (Great Plains Institute [GPI], Subject Matter Expert) • Dave Benke (MPCA, Co-facilitator) • Amanda Tischer Burris(Dynamic Lifecycle Innovations) • Ed Hodder (DEED) • Chris McConn (Otter Tail County) • Tim Dunn (BestBuy) • Jordan Nichols (BENCO Electric Cooperative) • Pat Schoff (UMN) • Roopali Phadke (Macalester College) • Patrick O'Connell (LiUNA) • Tricia Dutcher (Redwood Materials)	• John Arbogast (United Steelworkers) • Kelly Applegate (Minnesota Indian Affairs Council)
• Stephanie Devitt, SDK Strategic Services – Task Force Management / Facilitator • Alishia Wright, SDK Strategic Services – Task Force Project Management / Support • Amanda Cotton, MPCA – Task Force Management / PCA	

Chair Election (Facilitated by Dave Benke)

- Chris McConn expressed his willingness to serve as chair and work towards bringing people together for the task force's goals.
- Chris McConn was elected as chair by a show of hands.

Presentation of Charge, Context, and Mindset (MPCA, SDK Strategic Services, GPI)

- Amanda Cotton (MPCA) discussed the charge of the task force as outlined in legislation as well as MPCA's approach to sustainability.

- Stephanie Devitt (SDK Strategic Services) discussed the context the task force is working within, covering critical materials as a whole, policy implications, and the nuance within the topic.
- Moaz Uddin (GPI) discussed what a circular economy would look like, defining circularity for the group.

Discussion: Critical Materials and Potential Scopes

- Tricia commented on the difference between industrial waste and end-of-life waste, noting that industrial waste could be easier to access than others.
- Tim concurred, adding that knowing what Minnesota's current infrastructure looks like would help in knowing what can be expanded on, increasing speed of development and implementation.
- Pat S. commented that data he saw noted it was 5x more expensive to recover critical metals from products than it was to mine for more and that an opportunity could be finding technologies that recover these materials more efficiently.
    - Roopali noted that data she saw contradicted this finding.
- Discussion centered on the question, "What is in Minnesota's space to impact?"
    - Patrick O. noted that Minnesota has significant nickel deposits, as well as others, and the mining responsibly and safely would be important.
- Pat S. commented that part of determining impact could include looking at the quantities of materials used in various products as well as the quality of materials needed for them to be used in production again.
- The need to define "critical materials" for the group was noted, specifically noting how quantities may impact where the group focuses.
- Members noted part of the plan could include promotional materials educating the public on the toxins contained in products to encourage recycling.
- Members also commented on the need to develop measures of success as part of the roadmap.
- Ideas for potential scoping identified through discussion included:
    - Industrial / Production waste
    - Recycling + Recovery
    - Advanced technology
    - Clean energy
    - Sustainable mining
    - Focusing on specific material(s)
    - Need measurements of success

Discussion: Future Data Needs

- Amanda commented Dynamic could provide data on electronics recycling and material breakouts, such as what materials are coming through their facilities.

- Roopali mentioned she had survey data from a study administered at the Minnesota State Fair regarding barriers to recycling.
- Potential data complications identified included:
    - Batteries exceeding initial projected lifespans with many finding second, third, or fourth life.
    - Products getting "lost" in the process of recovery due to being kept by consumers after they cease working or they are taken overseas and tracking is lost

Discussion: Principles of Working Together

- Mentimeter was utilized by SDK to poll task force members regarding decision-making models and values to be reflected in the conversations.
- Regarding decision-making, group members noted they wanted:
    - Moderate approach of advancing recommendations that have general consensus among the group but allow for discussion of alternative viewpoints or emerging data.
        - This is rather than the two other options: Taking an up-or-down vote on each recommendation or decision; or only moving forward with ideas that have 100% consensus among the group
- Dave noted that consensus-based decision-making can vary in function and that it can be revisited later in the process.
- Stephanie emphasized SDK's role in working with the Task Force members to get agreement on recommendations, and the importance of early decisions – like how the topic of critical materials recycling is scoped – in setting up the Task Force for manageable discussion.

- Members also highlighted values they want to see grounding all Task Force work moving forward:
    - Transparency
    - An open-minded approach
    - Grace
    - Less foreign dependence
    - Modesty

Public Comment

- No public comment was received.

CRITICAL MATERIALS TASK FORCE

MEETING 1

MINNESOTA POLLUTION CONTROL AGENCY

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March 21, 2025

OUR AGENDA

01 Introductions

02 Chair Election

03 Our Charge: Legislation Overview

04 Our Context: Critical Materials Overivew

05 Our Mindset: Circular Economy

06 Our Collaboration: Principles

07 Public Comment

08 Next Steps

ABOUT US

GREAT PLAINS INSTITUTE

Moaz Uddin
Senior Electric Vehicle Policy Specialist
Subject Matter Expert / Co-Facilitator

MINNESOTA POLLUTION CONTROL AGENCY

+sdk STRATEGIC SERVICES

GREAT PLAINS INSTITUTE

ABOUT US

MINNESOTA POLLUTION CONTROL AGENCY

Dave Benke
Division Director
Task Force Co-Facilitator

Amanda Cotton
E-Waste Coordinator
MPCA Staff for Task Force

MINNESOTA POLLUTION CONTROL AGENCY

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ABOUT US

SDK STRATEGIC SERVICES

Stephanie Devitt, M.P.P.
Founder + Principal consultant
Task Force Facilitator

Alishia Wright, M.P.P.
Consultant
SDK Facilitation Staff

MINNESOTA POLLUTION CONTROL AGENCY

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INTRODUCTIONS

01 Why are you interested in Critical Materials?

02 What do you hope to see the Task Force achieve?

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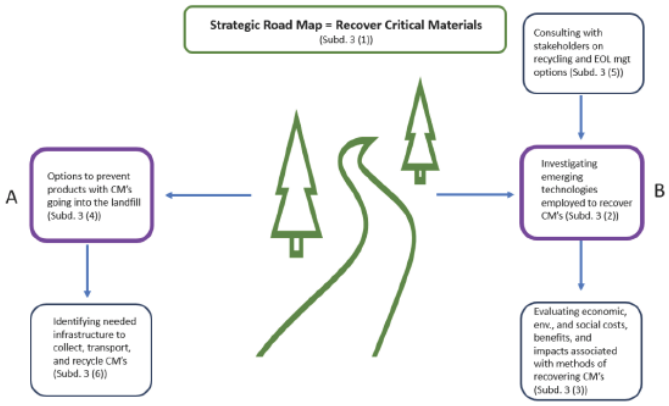
CHAIR

Chris McConn
Director of Solid Waste
Otter Tail, Todd and Wadena Counties

OUR LEGISLATIVE CHARGE



MINNESOTA POLLUTION CONTROL AGENCY

OUR CONTEXT

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> *Any non-fuel mineral, element, substance or mineral that the U. S. Secretary of Energy determines is:*
>
> 1. *At a high risk of supply chain disruption; and*
> 2. *Serves an essential function in one or more energy technologies, including technologies that transmit, store, produce and/or conserve energy*

United States Department of Energy

"CRITICAL" SPEAKS TO SUPPLY RISK + ECONOMIC IMPORTANCE

Source: What Are Critical Materials and Critical Minerals?
https://www.energy.gov/cmm/what-are-critical-materials-and-critical-minerals

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MINNESOTA'S HIGH-IMPACT INDUSTRIES DEPEND ON CRITICAL MATERIALS

Clean Energy

- Electric vehicles
- Wind turbines
- Solar panels
- Scooters + e-bikes

Advanced Technology

- Cell phones
- Tablets
- Any other technology with batteries

Medical Devices

- Pacemakers
- Implantable devices
- Other medical technology

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IMPACT INDUSTRIES RELY ON A MIX OF CRITICAL MATERIALS

Clean Energy

- Copper
- Lithium
- Cobalt
- Nickel
- Graphite

Advanced Technology

- Rare Earth Metals
- Silicon
- Gallium
- Palladium

Medical Devices

- Platinum Metals
- Zinc
- Titanium

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CLEAN ENERGY SOURCES ARE ESPECIALLY VULNERABLE

"ELECTRIC 18"

In 2023, the US Department of Energy named the "Electric 18" - minerals most needed to produce green energy at scale - as:

- Aluminum
- Copper
- Dysprosium
- Electric steel
- Fluorine
- Gallium
- Lithium
- Magnesium
- Natural graphite
- Neodymium
- Nickel
- Iridium
- Platinum
- Praseodymium
- Silicon
- Silicon carbide
- Terbium
- Cobalt

CRITICAL MATERIALS:

EMERGING POLICY TRENDS

International

- EU: Goal of 25% of critical materials from reuse
- Focus: Material independence

National

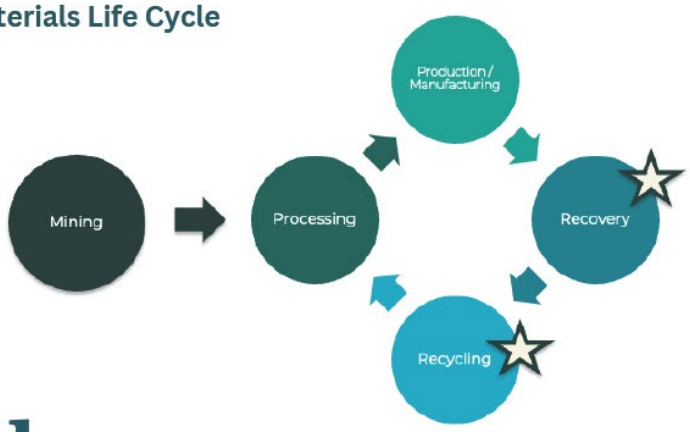
- Critical Materials Collaborative
- Increase recovery, recycling, processing

State

- Illinois: Renewable Energy Recycling
- California: Critical Materials

OUR FOCUS: RECOVERY + RECYCLING

Critical Materials Life Cycle



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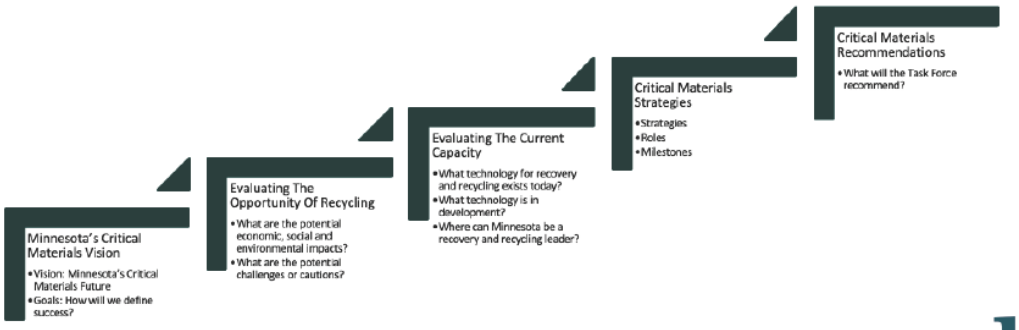
OUR WORK AHEAD:



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OUR MINDSET:

CIRCULAR ECONOMY

What is the Circular Economy?

A model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and proucts as long as possible.

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WHY ADOPT CIRCULARITY?

Moving towards circularity could deliver opportunities like:

- Reducing pressures on the environment
- Enhancing security in supply of raw materials
- Increasing competitiveness
- Innovation
- Economic growth and jobs

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DISCUSSION

MINNESOTA POLLUTION CONTROL AGENCY

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PRINCIPLES

HOW WILL WE WORK TOGETHER?

01 Decision making

What do we want to expect from each other as we make decisions as a Task Force?

Examples could include choosing between consensus and majority decision making, consulting with stakeholders, or others.

02 Values

Are there shared values that we want to anchor our work together as a Task Force?

Examples could include integrity, transparency, equity, economic innovation, "Fourth Generation" decision making, or something else.

03 Representation

Do we have any expectations of each other for how we talk about our work on the Task Force outside of meetings?

For example, can we expect that no one will represent themselves as speaking for the Task Force to media or Legislature?

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PUBLIC COMMENT

The Critical Materials Task Force will reserve 10 minutes at the conclusion of each meeting for any comments that observers would like to share with the Task Force members.

Use the "Raise Hand" feature if you would like to share a comment.

Please keep comments to 1 minute per person so that we can accomodate all who wish to speak.

Thank you

NEXT STEPS

MINNESOTA POLLUTION CONTROL AGENCY

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March 21, 2025

Critical Materials Task Force

Meeting 2 Notes

Date: 5/12/2025 1:00 p.m. – 3:00 p.m.

Welcome and Agenda Overview

Task Force members in attendance	Task Force members not in attendance
• John Arbogast (United Steelworkers) • Kelly Applegate (Minnesota Indian Affairs Council) • Moaz Uddin (Great Plains Institute [GPI], Subject Matter Expert) • Amanda Tischer Burris (Dynamic Lifecycle Innovations) • Ed Hodder (DEED) • Chris McConn (Otter Tail County) • Tim Dunn (BestBuy) • Jordan Nichols (BENCO Electric Cooperative) • Pat Schoff (UMN) • Roopali Phadke (Macalester College) • Tricia Dutcher (Redwood Materials) • Michelle Manson (BlueGreen Alliance)	• Dave Benke (MPCA, Co-facilitator) • Patrick O'Connell (LiUNA)
• Stephanie Devitt, SDK Strategic Services – Task Force Management / Facilitator • Alishia Wright, SDK Strategic Services – Task Force Project Management / Support • Amanda Cotton, MPCA – Task Force Management / PCA	

Welcome and Recap of Meeting 1

- Chris McConn (Otter Tail County) opened the meeting, discussing highlights from the first Task Force meeting as well as laying out the agenda for today's meeting.
- Stephanie Devitt (SDK Strategic Services) reviewed what is legislatively required of the group, what a strategic roadmap is, and set up the idea of looking at Critical Materials through an asset-based approach.

Minnesota's Foundations

- Amanda Cotton (MPCA) presented on the MPCA's policies, programs and initiatives related to e-waste, batteries, solar, and wind power disposal.
- Ed Hodder (DEED) presented on DEED data related to industries most impacted by critical materials: clean energy, advanced technology, and medical

devices. He also discussed DEED programs that promote economic development in Minnesota.

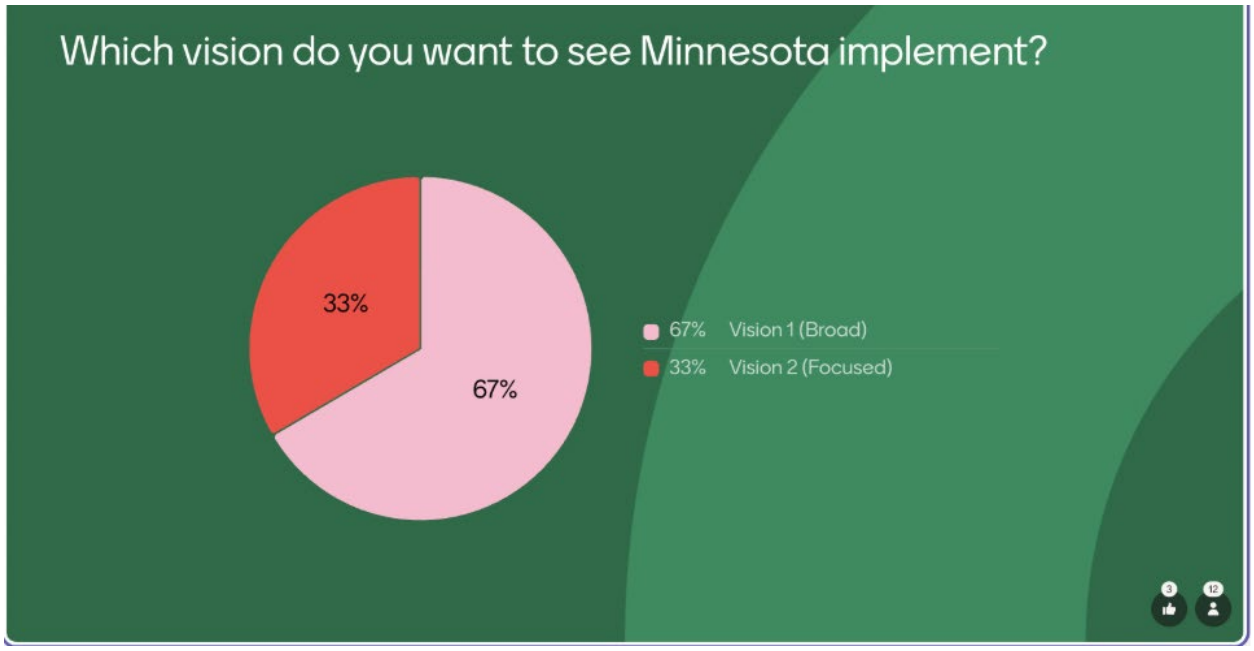
Case Study: Redwood Materials

- Tricia Dutcher (Redwood Materials) presented on Redwood Materials' approach to developing a business around recycling electric vehicle batteries and closing the circle regarding critical materials lifecycle.

Discussion: Minnesota's Critical Materials Recycling Vision

- Stephanie Devitt presented the two visions SDK Strategic Services developed to move the Task Force towards meeting it's legislative mandate. The presentation included the future discussions and roadmap components for each option. The two options were:
    - Vision #1: Create conditions where Minnesota leads the nation in Critical Material recovery and recycling across all minerals and materials.
    - Vision #2: Minnesota develops a strong Critical Materials recycling sector, capitalizing on Minnesota's existing assets and emerging industries.
- Task Force members began the conversation by voting via Menti on which vision they most wanted to adopt. After voting, each member shared their vote. They also shared what they were considering when making their decision. The breakdown of the vote is as follows:

Vision #1 – Broader Approach	Vision #2 – Focused Approach
• Amanda Tischer-Buros • Kelly Applegate • Michelle Manson • Jordan Nichols • Roopali Phadke • Patrick Schoff • John Arbogast • Ed Hodder	• Tricia Dutcher • Chris McConn • Moaz Uddin • Tim Dunn



- While the group selected Vision #1, there was extensive interest in looking at case studies to be able to learn more from both success stories and past challenges.
- Near the end of the discussion, comments focused on policies, programs, and market emphasis to address batteries. Task Force members in the recycling field pointed out that federal policy is being developed on batteries; they believe that additional review of batteries would be duplicative, and more opportunity is likely outside of batteries.

Public Comment

- No public comment was received.

CRITICAL MATERIALS TASK FORCE

MEETING 2

MINNESOTA POLLUTION CONTROL AGENCY | +sdk STRATEGIC SERVICES | GREAT PLAINS INSTITUTE

May 12, 2025

WELCOME + RECAP

CHAIR

Last meeting focused on...

- Task Force member introductions
- Elected Chris McConn as Chair
- Discussed fundamentals on critical materials and circular economy
- Discussed operating principles and norms

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OUR AGENDA

01 Welcome + Meeting 1 Recap

02 Our Charge:

03 MN's Assets: Recycling Policy Foundation

04 MN's Assets: Industries That Rely on Critical Materials

05 A Circular Approach to Recycling: Redwood

06 Our Vision: Framing + Discussion

07 Public Comment

08 Next Steps

OUR CHARGE

"The task force must advise the commissioner of the Pollution Control Agency with respect to policy and program options designed to increase the recovery of critical materials from end-of-life products..."

STRATEGIC ROAD MAP

A Critical Materials Strategic Road Map will identify....

- **Vision:** What is our vision for how Minnesota's place in the Critical Materials ecosystem?
- **Role:** What is the state's role in achieving that vision?
- **Goals:** What activities and milestones can the state take to get there?

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AN ASSET BASED APPROACH

WHAT STRENGTHS DOES MINNESOTA BRING TO CRITICAL MATERIALS RECYCLING?

Recycling Leadership

The MPCA is a leader in recycling policy, programs and practices on products such as:

- E-waste + batteries
- Solar Panels
- Wind Turbines

Economic Leadership

Major economic sectors rely on critical materials, including:

- Clean energy
- Medical devices
- Advanced manufacturing

Policy Leadership

Minnesota's policy leadership creates unique opportunities:

- Next Generation Energy Act (2007)
- Critical Materials Task Force

OUR FOUNDATION

MINNESOTA POLLUTION CONTROL AGENCY

MINNESOTA

DATA + TOOLS AVAILABLE TODAY

Sector-Specific Data

DEED captures data on existing sectors in the economy. Tools are strong at looking backward, and can inform a look forward

New Industry Incentives

DEED provides investment incentives for promising industries and projects. Different programs offer different opportunities.

EMPLOYMENT AND ECONOMIC DEVELOPMENT

WHO USES CRITICAL MATERIALS?

CLEAN ENERGY

- Wind
- Solar
- Transmission
- Electric Vehicles
- Micro-mobility

ADVANCED TECHNOLOGY

- Computers
- Cell phones + tablets
- Data Centers
- Defense technology

MEDICAL DEVICES

- Implanted devices
- Surgical equipment
- Prosthetics
- Monitoring equipment

EMPLOYMENT AND ECONOMIC DEVELOPMENT

CLEAN ENERGY ASSETS

SOLAR POWER

4 manufacturers; 4,795 jobs

2,867 megawatts installed

4.70% of Minnesota electricity

0.02% of Minnesota's land area

WIND POWER

2,703 turbines

4,928 megawats of installed utility-scale capacity

25% of Minnesota's electricity generation

Minnesota clean energy employment is more than 62,000 jobs!

Data from SEIA March 2025 and Green and Clean Employment in Minnesota: The Energy Sector Trends December 2024

EMPLOYMENT AND ECONOMIC DEVELOPMENT

ADVANCED TECHNOLOGY ASSETS

8,625 advanced manufacturing companies

$26.8 billion Minnesota industry (Advanced Technology specifically)

127,287 jobs (Advanced Technology specifically)

EMPLOYMENT AND ECONOMIC DEVELOPMENT

MEDICAL DEVICE ASSETS

7,407 life sciences companies

$48.5 billion or 10.3% of MN's GDP

530 medical device companies

34,520 jobs

1,145 pharmaceutical + biotech R&D companies

14,265 jobs

EMPLOYMENT AND ECONOMIC DEVELOPMENT

DEED PROGRAM ASSETS

- Minnesota Forward Fund
- Minnesota Investment Fund
- Job Creation Program
- Launch Minnesota
- Energy Transition Office grant programs

EMPLOYMENT AND ECONOMIC DEVELOPMENT

REDWOOD MATERIALS

A CIRCULAR APPROACH TO CRITICAL MATERIALS RECYCLING

MINNESOTA'S CRITICAL MATERIALS RECYCLING VISION

HOW CAN WE BUILD FROM THESE ASSETS AND LESSONS TO SCOPE OUR WORK?

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VISION #1

Create conditions where Minnesota leads the nation in Critical Material recovery and recycling across all minerals and materials

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VISION #1

Components might include:

- Values + Principles
- Data Needs
- Governance Needs
- Technology + innovation incentives
- Regulations or prevention to consider

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VISION #1

Questions to explore would include:

- What values + principles should anchor how Minnesota makes decisions about critical materials recycling?
- What information + reporting will Minnesota need to monitor and grow critical materials recycling?
- If, when or how should Minnesota incentivize Critical Materials recycling?
- What education and collaboration - and with whom (actors or sectors) – is needed to foster Critical Materials recycling leadership?

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VISION #2

Minnesota develops a strong Critical Materials recycling sector, capitalizing on Minnesota's existing assets and emerging industries.

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VISION #2

Compontents would include:

- A strategy for achieving and growing recycling of a specific critical material or product-specific set of critical materials.
- Clear roles for the state and others in advancing Critical Material recycling.
- Recommended "Moonshot" targets for growing Critical Material recycling and circularity.

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VISION #2

Questions to explore would include:

- What industries + existing assets (e.g. clean energy batteries; research capacity) does Minnesota have that could anchor Critical Materials recycling and seed circular economic growth / leadership?
- How can Minnesota best leverage these assets to foster Critical Materials recycling?

Vision	Document Type	Strengths	Weaknesses	Opportunities	Threats
Minnesota is a leader in critical material recycling. (Across all 53 materials)	Policy Framework	• Comprehensive - covers all 53 minerals • Sets direction + vision to build from • Creates greater flexibility in structure • Potential for greater resiliency to changing ecosystems	• Sector-wide vision makes detail at scale difficult • Does not set concrete steps for moving forward	• Minnesota will be first state-level policy, role, + framework • Important topic impacted by clean energy, trade, and more • Could address more than recycling	• Broad scope makes focused strategies harder for investment and traction • Current recycling ecosystem still encourages exporting (from Minnesota) materials
Minnesota has a strong industry recycling sector, capitalizing on existing and emerging industries in the state.	Strategic Roadmap	• Strategic focus makes achieving a roadmap with momentum easier • Specificity creates clarity on how to move forward	• Only impacts one slide of critical materials • Could be difficult to adapt to another industry later • Changing industries and technologies may make roadmap obsolete quickly	• Minnesota's policy leadership puts MN at forefront of clean energy + EV adoption • Builds on MN's strong energy + recycling laws • Builds on MN's Climate Action Framework	• Narrowing focus too much could close MN off to other opportunities, including emerging technologies • Recycling is just one aspect of critical materials policy

DISCUSSION

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PUBLIC COMMENT

The Critical Materials Task Force will reserve 10 minutes at the conclusion of each meeting for any comments that observers would like to share with the Task Force members.

Use the "Raise Hand" feature if you would like to share a comment.

Please keep comments to 1 minute per person so that we can accomodate all who wish to speak.

Thank you

NEXT STEPS

MINNESOTA POLLUTION CONTROL AGENCY

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May 12, 2025

Critical Materials Task Force

Meeting 3 Notes

Date: 6/23/2025 1:00 p.m. – 3:00 p.m.

Attendance

Task Force Members in Attendance	Task Force Members Not in Attendance
• Dave Benke (MPCA, Co-facilitator) • John Arbogast (United Steelworkers) • Moaz Uddin (Great Plains Institute [GPI], Subject Matter Expert) • Amanda Tischer Burris (Dynamic Lifecycle Innovations) • Ed Hodder (DEED) • Chris McConn (Otter Tail County, Chair) • Tim Dunn (BestBuy) • Pat Schoff (UMN) • Roopali Phadke (Macalester College) • Tricia Dutcher (Redwood Materials) • Patrick O'Connell (LiUNA) • Michelle Manson (BlueGreen Alliance) • Josh Freeman (Panasonic)	• Kelly Applegate (Minnesota Indian Affairs Council) • Jordan Nichols (BENCO Electric Cooperative)
• Stephanie Devitt (SDK Strategic Services, Task Force Management/Facilitator) • Alishia Wright (SDK Strategic Services, Task Force Project Management/Support) • Amanda Cotton (MPCA, Task Force Management/Support) • Amy Bendtsen (SDK Strategic Services, Task Force Project Support)	

Welcome and Recap of Meeting 2

- Chris McConn (Otter Tail County) opened the meeting, discussing highlights from the second Task Force meeting as well as laying out the agenda for today's meeting.
- Chris introduced the newest member of the Task Force, Josh Freeman from Panasonic representing a manufacturer.
- Chris mentioned the two upcoming public meetings in July, encouraging Task Force members to attend.

Current State of Critical Materials Recycling Technology

- Stephanie Devitt (SDK Strategic Services) reviewed the decisions made in the previous meeting and the work the SDK team has done since then. The

information centered on research into the state of recycling for each critical material. This culminated in four categories of recycling technology: scaled, scaling, emerging, and research and development. This portion ended with policy considerations moving forward as the group explored other facets of recycling.

The Economics and Infrastructure Considerations of Electronics Recycling

- Dave Benke (MPCA) spoke with Amanda Tischer-Burros (Dynamic) regarding the economics and infrastructure needs and realities of the electronics recycling industry overall. Special highlights of the discussion include:
    - The need for targeted collection and material identification
    - Potential for expansion of refining capabilities in the U.S.
    - The impact of changing product compositions

Consumer Recycling vs. Industrial Recycling

- Moaz Uddin (Great Plains Institute) spoke with Tim Dunn (Best Buy) regarding what consumer recycling programs look like and the challenges associated with them. Tim noted that key barriers are concerns about data security and nostalgia for consumers. He also emphasized the importance of maintaining safe and efficient operations that protect employees and ensure the quality of recycled materials.
- Moaz then spoke with Josh Freeman (Panasonic) to discuss manufacturing's role in the supply chain, particularly regarding recycling. Josh highlighted the challenges of industrial recycling and the importance of collaboration and partnerships to address these challenges.

Discussion: Supply Chain, Consumer Involvement, Mid-Size Consumer Devices, and Policy Considerations

- Discussion with the Task Force was robust. The following are highlights from the discussion:
    - EV battery recycling tends to be on dealerships, dismantlers, and original equipment manufacturers due to the size and weight of the batteries
    - Mid-size batteries, such as lawn mowers and scooters, pose a challenge because they are not easily recycled through traditional channels, however brand loyalty can help facilitate this
    - The need for education and policy changes to address this recycling

Public Comment

- No public comment was received

CRITICAL MATERIALS TASK FORCE

TASK FORCE MEETING 3
JUNE 23, 2025

OUR AGENDA

01 Refresh: May Mtg.

02 Recycling Landscape: Critical Material Analysis

03 Discussion: Recycling Considerations

04 Discussion: Product Scales and Recycling

05 Looking Ahead: July Meeting; Public Meeting Dates

OUR WORK

TASK FORCE FOCUS: BROAD FRAMEWORK

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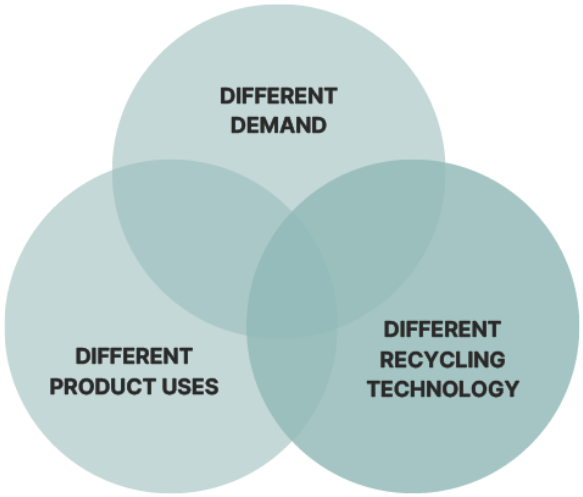
YET ACROSS 56 MATERIALS...



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OUR APPROACH

1 SCALED

- Materials with long history of recycling
- Well established recycling infrastructure

2 SCALING

- Materials with established recycling technology
- Fast-growing infrastructure

3 EMERGING

- Materials with newly established recycling technology
- Fast-growing infrastructure

4 RESEARCH + DEVELOPMENT

- Materials where recycling technology is under research + development or in pilot stage
- No infrastructure
- Government or private research funding

ADDED CONSIDERATIONS

NO TECHNOLOGY

- Two materials have no known recycling technology

CHANGING TECHNOLOGY

- Recycling technology for some materials is both scaled and in R+D
- Other materials are part of new product research aimed at making recycling easier

COMBINED + COMPLEX MATERIALS

- Rare Earth Elements (REEs) are often mined, priced, and sold together
- Recycling technology varies among those combined in uses or used in fine amounts

CRITICAL MATERIALS RECYCLING & MARKET DEMAND

	Scaled	Scaling	Emerging	Research & Development
Example Materials	Aluminum Copper	Lithium Cobalt	Graphite Magnesium Silicon Carbide	Dysprosium/ Rare Earths Tellurium
Number (of 56)	7	15	16	20
Number with projected supply/demand match	1	4	3	4

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CRITICAL MATERIALS RECYCLING & MARKET DEMAND (CONT.)

	Scaled	Scaling	Emerging	Research + Development
Median Price	$0.44/oz	$5.14/oz	$6.80/oz	$13.93/oz
Mean Price	$0.70/oz	$710/oz	$49.28/oz	$514/oz
Portion of Refinement in U.S.	3.23%	0.8%	0.34%	Thullium: 11.5% all others: 0.15%

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QUICK FACTS: SUPPLY + REFINING

Number of minerals projected to **NOT** meet supply:
32

Percent of global mineral refining in U.S. currently:
6.1%

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REFINING IN THE U.S. IS LIMITED ACROSS CATEGORIES

Materials with at least 1% of global refining in the U.S.

Scaled	Scaling	Emerging	R+D, Pilot
Antimony - 4.8%	Tin - 5.8%	Beryllium - 58%	Fluorine - 2%
Copper - 3.4%	Zinc - 6.25%	Magnesium - 1.9%	Thillium - 11.5%
Electrical Steel - 7.9%		Silicon Carbide - 3.5%	
Palladium - 4.8%			

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CONSIDERATIONS

FOR POLICY + RECOMMENDATIONS

Minnesota's Approach

How can Minnesota increase critical materials recycling at each level of recycling technology - from scaled to research & development?

Circularity

What [types of] incentives are needed to create circular economy opportunities from critical materials recycling?

Incentives + Limitations

What types of incentives - and limitations - should Minnesota consider for the future of critical materials recycling, generally?

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Critical Materials Task Force

Meeting 4 Notes

Date: 7/28/2025 1:00 p.m. – 3:00 p.m.

Attendance

Task Force Members in Attendance	Task Force Members Not in Attendance
• Dave Benke (MPCA, Co-facilitator) • John Arbogast (United Steelworkers) • Moaz Uddin (Great Plains Institute [GPI]) • Amanda Tischer Burris (Dynamic Lifecycle Innovations) • Ed Hodder (DEED) • Chris McConn (Otter Tail County, Chair) • Tim Dunn (BestBuy) • Pat Schoff (UMN) • Patrick O'Connell (LiUNA) • Josh Freeman (Panasonic) • Jordan Nichols (BENCO Electric Cooperative) • Kelly Applegate (Minnesota Indian Affairs Council)	• Roopali Phadke (Macalester College) • Michelle Manson (BlueGreen Alliance) • Tricia Dutcher (Redwood Materials)
• Stephanie Devitt (SDK Strategic Services, Task Force Management/Facilitator) • Amanda Cotton (MPCA, Task Force Management/Support) • Amy Bendtsen (SDK Strategic Services, Task Force Project Support)	

Welcome and Recap of Meeting 3

- Chris McConn (Review of Public meeting last week & Mining Minnesota presentation)

Minnesota's Existing Waste Laws

- Amanda Cotton (MPCA) spoke on the current e-waste laws and regulations in place in MN which include:
    - E-waste law (electronics recycling act)
    - Landfill bans
    - Rechargeable batteries & products laws (partially manufacturer funded)
    - Laws in progress:
        - Electronics and Battery bill
        - Solar policy working group

- Product Stewardship = partial manufacturer fee payment
  - Extended Producer Responsibility = full manufacturer fee coverage

Review of Previous Meetings & Where We Are Now

- Stephanie Devitt (SDK Strategic Services) reviewed the work SDK has done with the Task Force in previous meetings to regroup everyone to the primary focus of this meeting on Environmental, Social, and Economic impacts and concerns. Key ideas:
  - Task Force vision: Focus on a policy framework to support recovery and recycling of all critical materials (rather than a select few minerals or products).
  - Minnesota sectors: Top economic sectors that rely on (and may have significant recycling needs from) critical materials include the state's nation-leading green energy infrastructure, Minnesota's global leadership in medical device manufacturing, and the state's leading advanced technology industries. Green energy infrastructure is about the work of decommissioning and replacing Minnesota's existing and growing green energy that will meet the 100% green by 2040 goals. Minnesota leads the other sectors (medical device, advanced technology) in Manufacturing, design and production.
  - Critical materials recycling: Not all critical materials can be recycled today – the technology for recycling varies across the list of 56. SDK analyzed the critical materials by both current recycling technology capacity and the potential profitability of recycling. This analysis found that there is a scaling segment of the recycling, with lithium and lithium-ion battery components at the core of this segment, where recycling is currently nearing profitability. There are other segments of critical materials where recycling is poised for future growth and profitability.

The Economic, Environmental, and Social Impacts of Recycling Critical Materials

- Dave Benke (MPCA) spoke with Kelley Applegate (MN Indian Affairs Council, Mille Lacs Band of Ojibwe) and John Arbogast (United Steelworkers) & Patrick O'Connell (LiUNA) regarding the impacts of recycling critical materials through economic, environmental, and social lenses. Highlights of the discussion include:
  - Indigenous lessons teach us that the earth should be treated with respect and dignity – that extends to items removed from the earth – so we need to be thoughtful on how we move forward.
  - Tribes should be proactively involved - but involvement should not be financially burdensome on the tribes themselves.

- Mining companies “recycle” their own high CM items in salvage yards, after which the actual recycling is questionable.
- Registered apprenticeships help provide routes into local employment, as well as prevailing wage rates.
- Recycling would be a great economic investment for the Northern Minnesota economy.
- Permitting reform is an issue.
- Capturing waste from businesses more consistently.

Scales of Recovery for CM

- Moaz Uddin (Great Plains Institute) spoke with Chris McConn (Ottertail County) regarding what recycling collection looks like and how integrating CM recycling into that process would work.

- Highlights include:
  - Landfilling is the most cost-efficient way to deal with waste, even though it is the least preferred method
  - Reducing the consumption of materials should be included in the recommendations
  - Should be conscious of how long it took just the regular recycling program to get going at the rate we have now
  - Cost is a big issue for taxpayers
- Moaz then spoke with Pat Schoff (UMN) to discuss circular economy research. Key highlights include:
  - Value Proposition: What is the value? And at that value, what scale do you have to operate at to make it work?
  - The actual value of the materials is a challenge as they can fluctuate due to supply and demand & changing manufacturing practices
  - Actual value of CM in a cell phone less than $1 (according to AI)
  - Best Buy’s program is not even profitable, their goal is to break even
  - Having a dedicated supply chain is an essential prerequisite for it to be successful

Public Comment

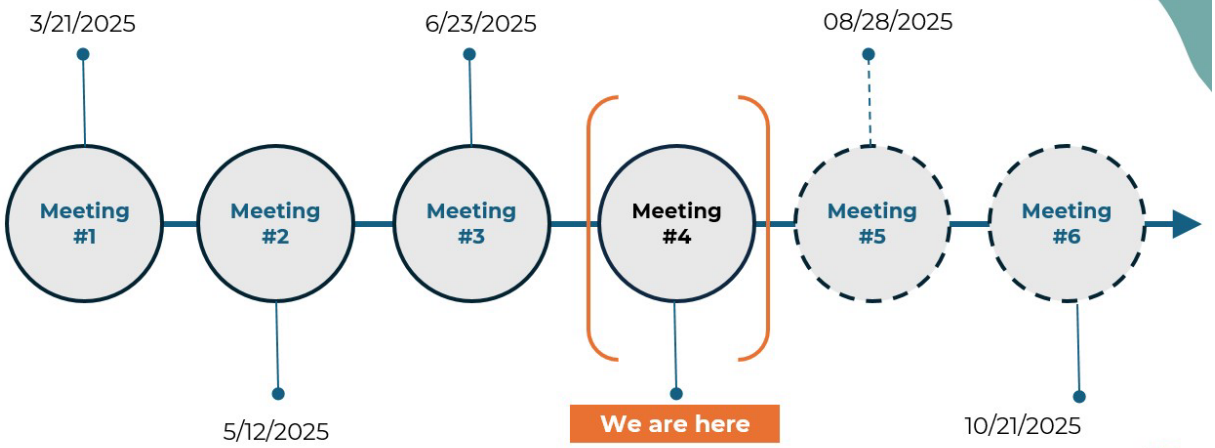
- No public comment was received

Wrap Up

Stephanie Devitt (SDK) closed out the meeting by going over some of the upcoming landmarks, including:

- Public meeting scheduled virtually for Wednesday 7/30
- Survey coming up for task force members
- AMES lab webinar

Task Force Timeline



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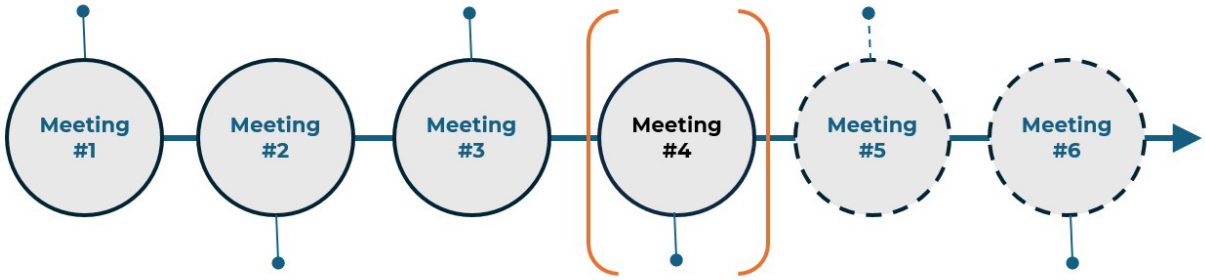
Project Timeline

- Introduction
- Chair election
- CM issue background
- Task force operating principles

- Current CM Recycling Tech
- Economy and Infrastructure
- Consumer vs industrial
- Discussion: Supply chain, consumer devices & policy

Recommendations, p. 1



- Existing laws and top sectors
- Minnesota's Critical Materials Recycling Vision

- Social, Environmental and economic evaluations of CM

Recommendations, p. 2

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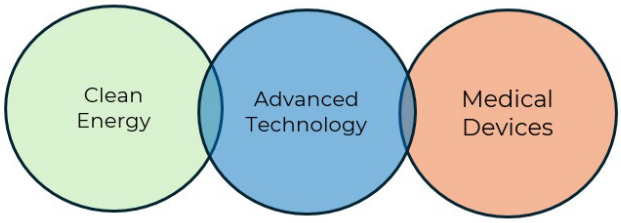
Minnesota's Approach, Vision + Assets

Approach:
Policy Framework to Encourage Recovery + Recycling of All (56) Critical Materials

Vision:
Minnesota leads the nation in critical material recovery and recycling for a circular economy

Minnesota Is A Leader In Several CM-Rich Sectors



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Recycling Critical Materials Differs From Traditional In Key Ways

Challenges: CM recycling presents unique challenges	**Opportunity:** MN's policy foundation for CM recycling
Private research & Emerging recycling tech	Sustainable Materials Management
IP law, privacy considerations	Solar Panel Recycling
Fast-changing products and mineral demand	E-Waste + Rechargeable Battery Laws

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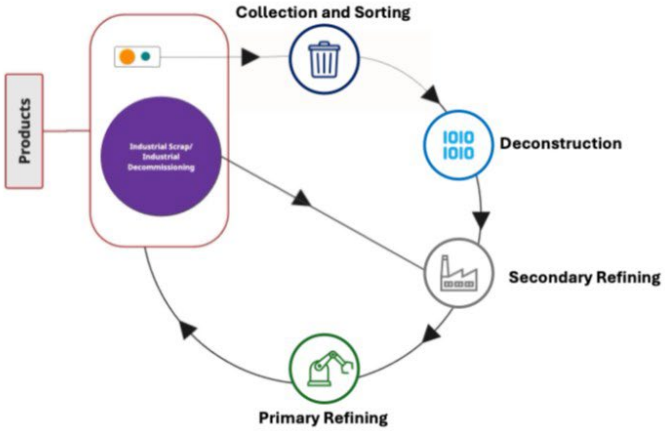
TF Membership Captures Critical Materials Recycling Ecosystem



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But Recyclability of CM Varies Across 56 Minerals

Scaled	Scaling	Emerging	Research & Development
Materials with long history of recycling	Established recycling process, growing business model	Materials transitioning from R & D to viable business	Materials where recycling technology is under research or early pilot
Well-established recycling infrastructure	Fast-growing infrastructure	Establishing consistent infrastructure	No infrastructure. Gov. or private research funding

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Today: Evaluating Recycling

- Recycling Methods:
  - Shredding, pyro, hydro
  - Harder on environment
- Business Models:
  - Scaled
  - Large-scale recycling established

Traditional Recycling

Critical Materials Recycling

- Recycling Methods:
  - Chemicals
  - Better for environment
- Business Models:
  - Niche
  - Targeted, more product-specific

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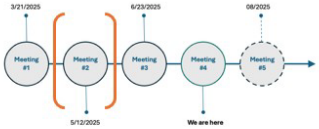
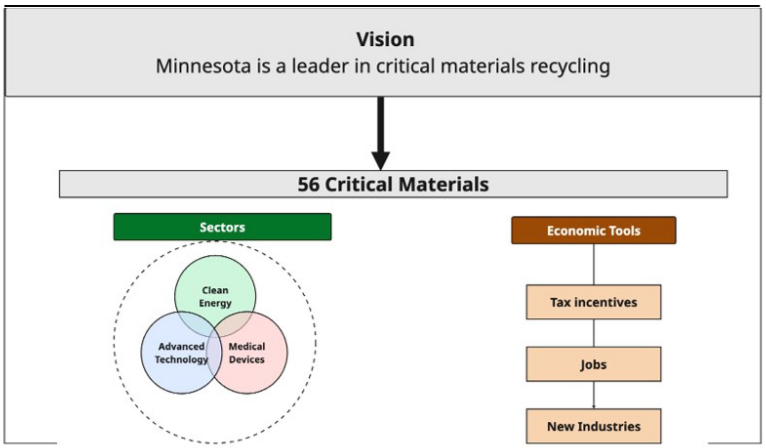
#2 : Vision, laws and top sectors





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#4 : Recycling Types Comparison

	Shredding & Grinding	PyroMetallurgical	HydraMetallurgical	Liquid-Liquid	Direct Recycling	BRAWS-Battery recycling & water splitting
Dust Free	🔴	🔴	🔴	🔴	🟢	🔴
Does not use additional hazardous materials	🟢	🔴	🔴	🔴	🟢	🟢
Not energy intensive	🔴	🔴	🟢	🟢	🟢	🟢
Produces high quality alloy	🟢	🔴	🟢	🟢	🟢	🟢
Does not require intimate knowledge of products	🟢	🟢	🟢	🔴	🔴	🔴
Can handle large volumes of e-waste	🟢	🟢	🟢	🟢	🔴	🔴
Applicable to a wide range of technology	🟢	🟢	🟢	🟢	🔴	🔴

Traditional recycling
not good for environment but easy to scale

CM Recycling
less damaging for environment, but requires low volume, detailed understanding of technology

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Next Steps: Meeting #5

Scaled	Scaling	Emerging	Research and Development
Questions	Questions	Questions	Questions

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Critical Materials Task Force

Meeting 5 Notes

Date: 8/28/2025 12:00 p.m. – 2:00 p.m.

Attendance

Task Force Members in Attendance	Task Force Members Not in Attendance
• Dave Benke (MPCA, Co-facilitator) • John Arbogast (United Steelworkers) • Moaz Uddin (Great Plains Institute [GPI]) • Amanda Tischer Burris (Dynamic Lifecycle Innovations) • Ed Hodder (DEED) • Chris McConn (Otter Tail County, Chair) • Tim Dunn (BestBuy) • Pat Schoff (UMN) • Patrick O'Connell (LiUNA) • Josh Freeman (Panasonic) • Roopali Phadke (Macalester College) • Kelly Applegate (Minnesota Indian Affairs Council) • Tricia Dutcher (Redwood Materials) • Michelle Manson (BlueGreen Alliance)	• Jordan Nichols (BENCO Electric Cooperative)
• Stephanie Devitt (SDK Strategic Services, Task Force Management/Facilitator) • Amanda Cotton (MPCA, Task Force Management/Support) • Amy Bendtsen (SDK Strategic Services, Task Force Project Support) • Paul Shanafelt (SDK Strategic Services, Task Force Project Management) • Pratibha Chauhan (SDK Strategic Services, Task Force Project Support)	

Welcome and Recap of Meeting 4

- Chris McConn (Introduce the topic of moving towards legislative recommendations)

Legislative Recommendation Scaffolding

- Stephanie Devitt (SDK Strategic Services) introduced the agenda for the day on discussion for the direction of the legislative recommendations. She reviewed the themes and ideas that were pulled from the individual interviews that were conducted the previous two weeks as well as what was heard at public meetings.
    - Key ideas were:
        - Encouraging recycling and reuse
        - Build on MNs green energy leadership
        - Balance sustainability & economy + environment
        - Ensure data and transparency
        - More public awareness
    - Stakeholders talked about:
        - National policies emerging on batteries
        - Size of mineral in products (small vs. large) under different policies at this time
        - Safe disposal of lithium batteries
        - Worker safety, insurance at recycling facilities
        - Focus on MNs leading sectors: semiconductors, green energy, medical devices
    - Task force 1-on-1 interview Emerging Themes:
        - Build a circular economy
        - Equity, safety, good jobs
        - Set clear goals and targets

Discussion: Principles

- Stephanie Devitt (SDK Strategic Services) asked the task force to fill out a Menti survey to rank emerging principles SDK was able to pull from interviews and public meetings. The results were displayed on screen to facilitate discussion on guiding principles for the legislative recommendations. The results were as follows:
-
    - Discussion that followed surrounded these topics:
        - Making the collection process easier and accessible to start off the rest of the process.
        - Some of the topics seem like precursors to the goals of the task force such as easer of collection & accessibility
        - Holistic approach is important
        - Innovation should be higher
        - Tough to narrow it down as they are all important
        - Keeping it simple will be important
        - All these topics are important – instead of getting narrower maybe pick 4 and then see how the other 8 support those or put them into categories

- Wondering if there is anywhere that Minnesota can take charge and become a leader
- Participants highlighted the importance of ease of implementation, with Patrick Schoff emphasizing that fewer barriers would enable broader adoption of recycling practices.
- Roopali suggested categorizing principles into process-oriented and outcome-oriented goals, such as accessibility and circularity, to better align with the task force's mission.
- Chris and others stressed the need for clear goals, measurable targets, and a focus on equity, safety, and workforce development to ensure a sustainable and inclusive approach.
- Moaz and Tim emphasized the importance of innovation and circularity as overarching principles, with Moaz advocating for fostering innovation to solve systemic challenges.
- Participants agreed that principles like environmental protection, economic viability, and leadership should guide Minnesota's efforts, ensuring alignment with long-term sustainability objectives.

Discussion: Incentives

- Stephanie Devitt (SDK Strategic Services) reviewed the incentives that have been heard and were grouped into different categories for conversation around the use of incentives to kick-start a circular economy. Discussion that followed centered on these topics:
    - The more that recyclers take in recyclables such as batteries, the less insurance companies are interested in insuring facilities, which translates to higher insurance costs, increasing the cost of recycling items containing CMs.
    - Extended Producer Responsibility (EPR) is a good way to encourage more people and businesses to recycle to an economic scale and reduce barriers to recycling
    - Identifying areas within the state that are well positioned to become leaders in new facilities for recycling and creating public acceptance to new infrastructure
    - We have to “truth” the incentives first to make sure that they will work the way we want them to
    - Allow for already existing companies to move into the sector instead of trying to just bring in new companies
    - Have and highlight areas that are attractive to industry such as good infrastructure & industrial locations where wetland issues have already been dealt with
    - Supporting innovation in manufacturing – to encourage ease of recycling for all sorts of materials
    - Convening exercises might be a good way to address issues that exist for multiple stakeholders

- Data on where recycling materials are, and where they go after being given to a recycler will increase recycling rates
- Accountability and transparency are important
- Amanda Tischer Buros highlighted the need for incentives targeting recyclers, such as tax credits, grants for R&D, and support for infrastructure to handle variable product streams.
- Roopali proposed state-led mapping to identify regions best suited for new industry development and consent-based processes for facility siting to ensure community acceptance.
- Dave suggested tailoring incentives to match stakeholder needs, citing the GreenStep Cities Program as an example of aligning incentives with long-term goals.
- Moaz and Chris advocated for extended producer responsibility (EPR) to motivate producers to design recyclable products and invest in recycling infrastructure.
- Tricia emphasized the importance of addressing logistical challenges, such as transportation and storage, and suggested focusing on solving hard problems to attract businesses.
- Josh stressed the need for "sticky" incentives that remain stable over time, ensuring businesses can rely on them despite political changes.

Discussion: How Will We Recommend Minnesota Balance Environmental Protection with Incentivizing Circularity?

- Stephanie Devitt (SDK Strategic Services) reiterated that there have been many comments on issues related to encouraging circularity
while maintaining environmental protections and prompted conversation on this topic. The topics discussed in this section were:
    - If the incentives need to be there, make sure the incentives can be there for a long time
    - Make sure that there is a labor force there for the support of the industry and that the jobs are good paying jobs
    - Having data around critical materials will be really important not only for incentivizing circularity but also for environmental protection
    - “Think global, act local”
    - Honest evaluations of the products do not currently exist(externalities) – but if it did then a circular economy would actually result in cheaper products
    - Permitting issues mostly come from the time it takes to get permitted rather than the content
    - Responsible mining in Minnesota starts with recycling and secondary market items

- Community benefits agreements can be used as a tool to balance economic development with environmental and social considerations, ensuring local communities' benefit from new facilities.
- Tricia questioned whether additional protections are needed for circularity-focused industries, emphasizing that current regulations may already suffice and that transparency and incentives could address gaps.

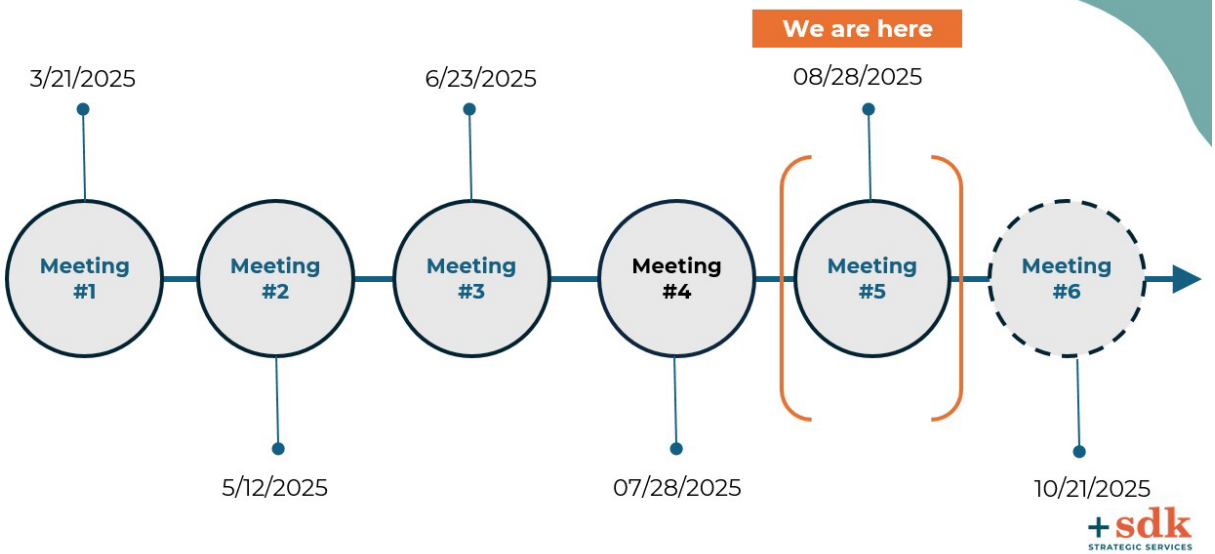
Public Comment

- No public comment was received

Wrap Up

Stephanie Devitt (SDK) closed out the meeting by thanking the group for their contributions and to remind the task force that there will be more conversations on these topics in the future as SDK works through writing the recommendations.

Task Force Timeline



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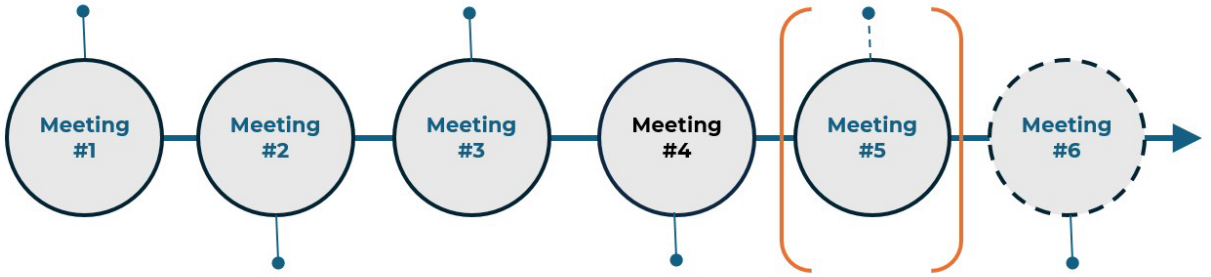
Task Force Timeline

- Introduction
- Chair election
- CM issue background
- Task force operating principles

- Current CM Recycling Tech
- Economy and Infrastructure
- Consumer vs industrial
- Discussion: Supply chain, consumer devices & policy

Recommendations, p. 1



- Existing laws and top sectors
- Minnesota's Critical Materials Recycling Vision

- Social, Environmental and economic evaluations of CM

Recommendations, p. 2

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Our Focus Today

- Early Themes: Public + Stakeholder Input
- Recommendations Framework
  - *Principles:* What principles should guide Minnesota's critical materials recycling policy moving forward?
  - *Incentives:* How will we incentivize reuse, recovery and recycling of Critical Materials?
  - *Balance:* How will we recommend Minnesota balance environmental protection with incentivizing circularity?

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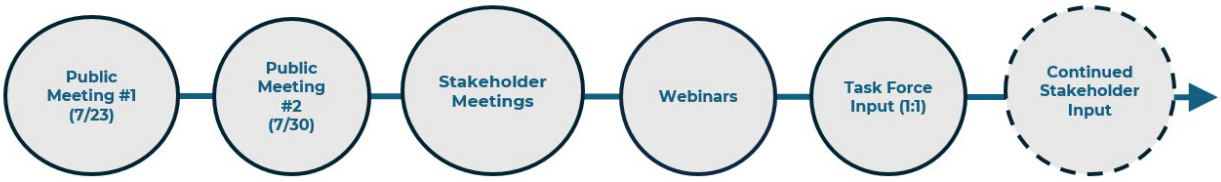
Stakeholder Perspectives on Critical Materials Recycling



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What We Heard: Public Meetings

- Encourage recycling + Reuse
- Build on MN's green energy leadership
- Balance sustainability, economy + environment
- Ensure data and transparency *(what products have CM's?)*
- More public awareness *(labels, campaigns)*

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What We Heard: Stakeholders

Policy	Safety	Economy
• National policies emerging on batteries • Size of mineral in products (small vs. large) fall under different policies at this time	• Safe disposal of lithium batteries • Worker safety, insurance at recycling facilities	• Focus on MN's leading sectors: semiconductors, green energy. • Medical device may have size, purity challenges.

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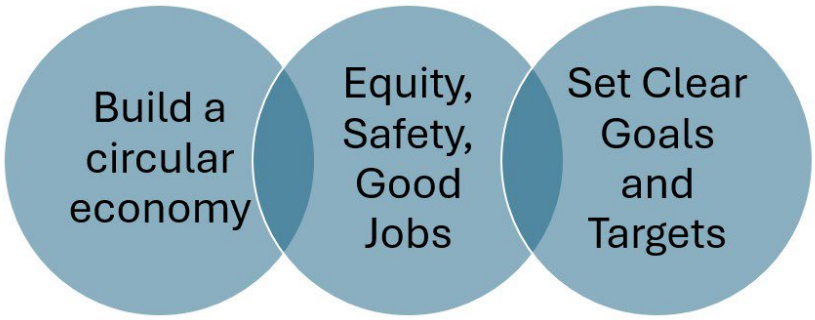
What We Heard: Task Force 1:1s



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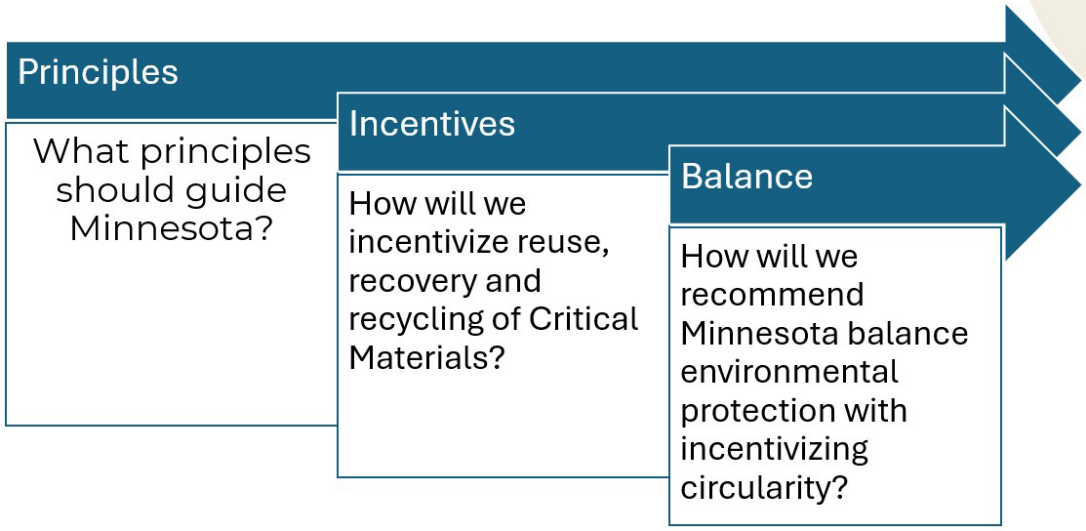
Discussion + Decisions



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Prioritization Exercise

The following is a list of principles that were discussed during interviews these past few weeks. Please select the four that you believe are most important to guiding Minnesota's Critical Materials approach for years to come.

Use this Code 7197 9794 in Menti
https://www.mentimeter.com or
scan the QR code below

Link: https://www.menti.com/alm74yr2urhb

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Potential Principles

- **Circularity** – Minnesota should encourage a circular economy built on critical materials recycling
- **Product Stewardship** – Producers should design products with end-of-life in mind
- **Innovation** – Minnesota should continue its history of innovation in Critical Materials recycling
- **Environmental Justice** – No community should bear disproportionate burdens from recycling
- **Leadership** – Minnesota should lead the nation in primary refinement of at least one recovered critical material
- **Environmental protection** – Minnesota policies should continue to protect our natural resources – land, air and water.
- **Future Workforce** – Minnesota should be at the forefront of training workers to collect, transport and recycle critical materials
- **Economic viability** – Minnesota should focus its critical materials efforts on select minerals with the greatest chance of sparking a circular economy
- **Reuse** – Minnesota policies should encourage reuse or repair existing technology containing critical materials
- **Accessibility** – Recycling should be close and affordable for everyone
- **Ease** – Products, businesses and communities should make recycling products with critical materials easy for every Minnesotan
- **Safety** – No one should be or feel unsafe using, moving, disassembling or disposing of products containing critical materials
- Other – What would you add? Please add in comment option after submitting.

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Incentives: How will we incentivize reuse, recovery and recycling of Critical Materials?

Reuse	Encourage Recycling for Consumers	Encourage Recycling for Business/ Industry	Incentivizing ?? Recycling
· Right to repair · Incentives for battery reuse	· Education awareness campaigns · Accessibility – make drop off easy · Cost-sharing – make it cheap or free to recycle · Consumer labeling	· Grants or loans for new recycling equipment · Incentives / tax breaks for insurance · Safety · Extended producer Responsibility · Producer responsibility organizations · Expand MN e-waste law on rechargeable batteries · Make solar / wind recycling easier · Streamline facility permitting	• Tax credits for new businesses • Permitting to allow for secondary recycling • Encourage end-markets / Economic development incentives

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Balanced Approach: Achieving Circularity

How will we recommend Minnesota balance environmental protection with incentivizing circularity?

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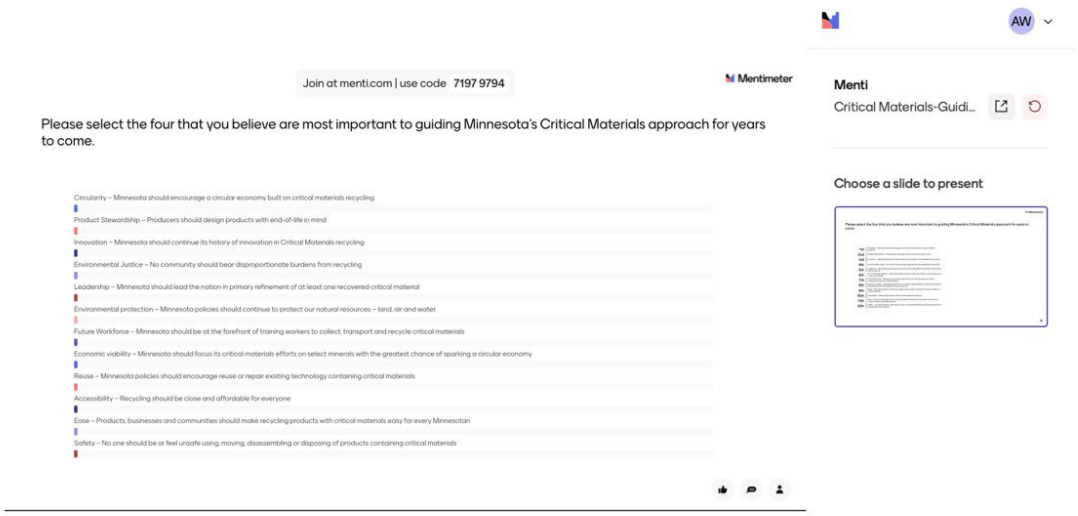
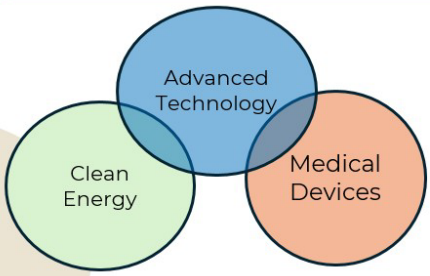


Minnesota's Approach, Vision + Assets

Approach:
Policy Framework to Encourage Recovery + Recycling of All (56) Critical Materials

Vision:
Minnesota leads the nation in critical material recovery and recycling for a circular economy

Context:
MN is a leader in CM-rich economic sectors



Context:
MN's policy foundation for CM recycling

- Sustainable Materials Management
- Solar Panel Recycling
- E-Waste + Rechargeable Battery Laws

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Introduction

Task force operating Principles

Moderate approach- Acknowledge differing viewpoints

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Evaluating Recycling

- Recycling Methods:
  - Shredding, pyro, hydro
  - Harder on environment
- Business Models:
  - Scaled
  - Large-scale recycling established

Traditional Recycling

Critical Materials Recycling

- Recycling Methods:
  - Chemicals
  - Better for environment
- Business Models:
  - Niche
  - Targeted, more product-specific

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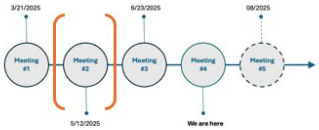
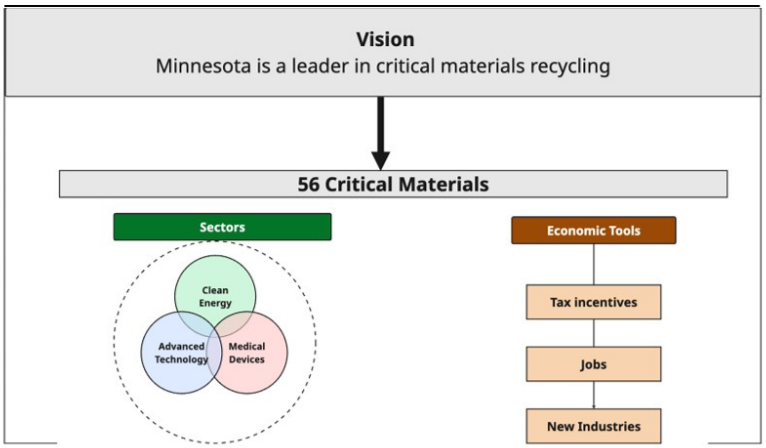
#2 : Vision, laws and top sectors





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#4 : Recycling Types Comparison

	Shredding & Grinding	PyroMetallurgical	HydraMetallurgical	Liquid-Liquid	Direct Recycling	BRAWS-Battery recycling & water splitting
Dust Free	🔴	🔴	🔴	🔴	🟢	🔴
Does not use additional hazardous materials	🟢	🔴	🔴	🔴	🟢	🟢
Not energy intensive	🔴	🔴	🟢	🟢	🟢	🟢
Produces high quality alloy	🟢	🔴	🟢	🟢	🟢	🟢
Does not require intimate knowledge of products	🟢	🟢	🟢	🔴	🔴	🔴
Can handle large volumes of e-waste	🟢	🟢	🟢	🟢	🔴	🔴
Applicable to a wide range of technology	🟢	🟢	🟢	🟢	🔴	🔴

Traditional recycling
not good for environment but easy to scale

CM Recycling
less damaging for environment, but requires low volume, detailed understanding of technology

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Next Steps: Meeting #5

Scaled	Scaling	Emerging	Research and Development
Questions	Questions	Questions	Questions

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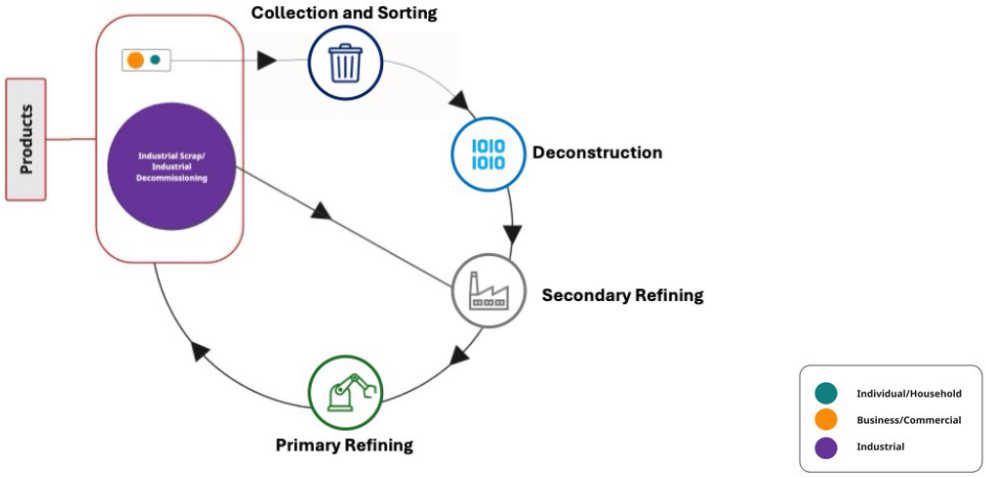
TF Membership Captures Critical Materials Recycling Ecosystem



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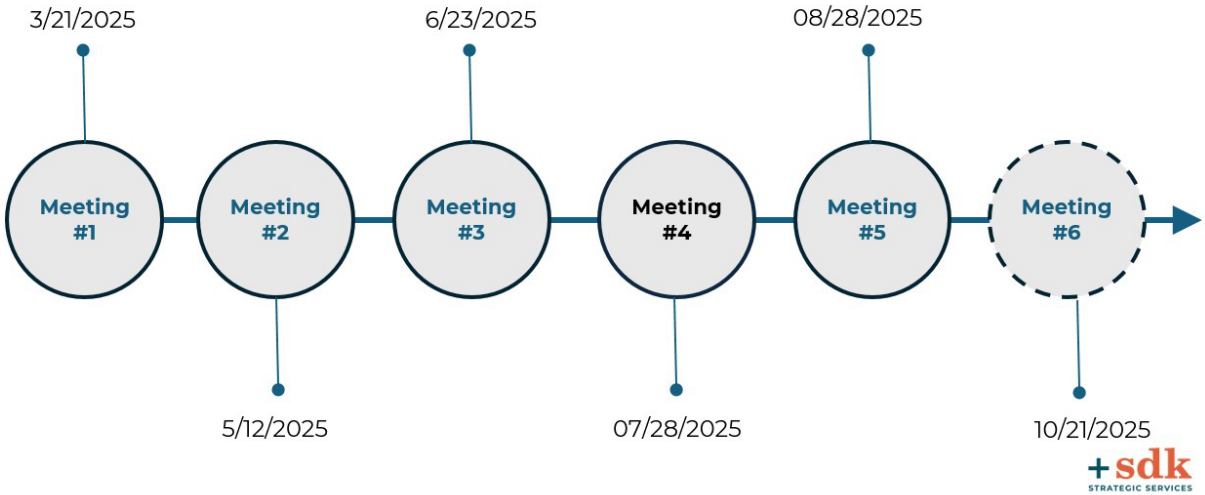
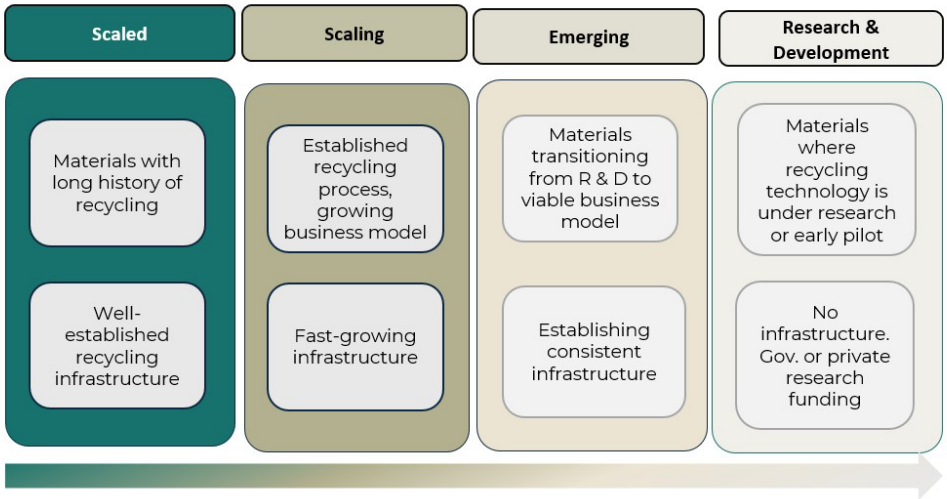
Task Force Timeline



But Recyclability of CM Varies Across 56 Minerals



Critical Materials Task Force

Meeting 6 Notes

Date: 10/21/2025 2:00 p.m. – 4:00 p.m.

Attendance

Task Force Members in Attendance	Task Force Members Not in Attendance
• Dave Benke (MPCA, Co-facilitator) • John Arbogast (United Steelworkers) • Moaz Uddin (Great Plains Institute [GPI]) • Ed Hodder (DEED) • Chris McConn (Otter Tail County, Chair) • Pat Schoff (UMN) • Patrick O'Connell (LiUNA) • Josh Freeman (Panasonic) • Roopali Phadke (Macalester College) • Kelly Applegate (Minnesota Indian Affairs Council) • Tricia Dutcher (Redwood Materials) • Michelle Manson (BlueGreen Alliance) • Jordan Nichols (BENCO Electric Cooperative) • Tim Dunn (BestBuy)	• Amanda Tischer Burris (Dynamic Lifecycle Innovations)
• Stephanie Devitt (SDK Strategic Services, Task Force Management/Facilitator) • Amanda Cotton (MPCA, Task Force Management/Support) • Paul Shanafelt (SDK Strategic Services, Task Force Project Management)	

Welcome and Recap of Meeting 5

- Chris McConn (Review of what happened in Meeting 5 and since – introduce draft recommendations)

Legislative Recommendations Draft

- Dave Benke (MPCA) talked about how they will be going about the review process and working on the final product to be finished by the end of December, then turned over to Stephanie for starting the conversation around the draft recommendations.
- Stephanie Devitt (SDK Strategic Services) talked about putting together the recommendations based on the previous survey and looking for input from the Task Force based on three questions:
    - What in this proposal do you most support?

- Are there any elements or details that you have concerns about?
- Is there anything that should be added to strengthen the framework?
    - Why you're seeing this framework like this:
        - This group decided early on that taking the moderate approach was the best – so general consensus not all consensus but also including some of the other opinions
        - Legislation said we needed to set a strategic roadmap for Minnesota to follow
        - We talked in May about the vision of the Task Force and how we wanted to scope the project – and we decided on a broad vision

Discussion: Recommendations

- Stephanie Devitt (SDK Strategic Services) gave the Task Force a few minutes to re-review the recommendations draft then gave each Task Force member time to bring up any topics of concern. The following are a summary of the comments made during this time:
    - Should bring reduction in critical material use more to the forefront
    - Applying the 3 R's (reduce, reuse, recycle) as much as we do with anything else
    - Prioritizing both environmental protections and economic viability is well done
    - Language about focusing on one or two materials could pose a risk moving forward into the future
    - Having some language on equity and a just transition would be nice
    - Want to make sure that we are staying in the lane of recovery since that is what we are here for
    - Just be careful about pushing all the costs to the producer since they will then have to recover those costs through consumers
    - Would like some more language about environmental protections for workers and communities around industry
    - Making drop off for these things was really nice to see as it is very important
    - The idea of being innovative and innovation – what does that actually mean? It would be nice to have that fleshed out a little bit more.
    - There seems to be a lot of inherent assumptions in the report which I think we should clarify – to get full circularity we will need to reduce the focus down to 5 or less materials
    - EPR isn't really a cost share – it is putting all the onus on the producer
    - Different waste streams are going to be targeting different materials
    - Having that protected environment is economic value, hope it is not viewed as one or the other
    - Wondering if Minnesota can handle this on its own – a regional approach might be more viable
    - Recycling is great but likely won't get us to where we need to be
    - It is within Minnesota's ethos to say environment first

- Don’t think we are ready for state-wide targets
- Could probably remove the things that are wading into muddy waters (pillar 2.2) since we have four good ones we do agree on

General comments on the recommendations were positive. Stephanie gave the floor to Moaz for public comment.

Public Comment

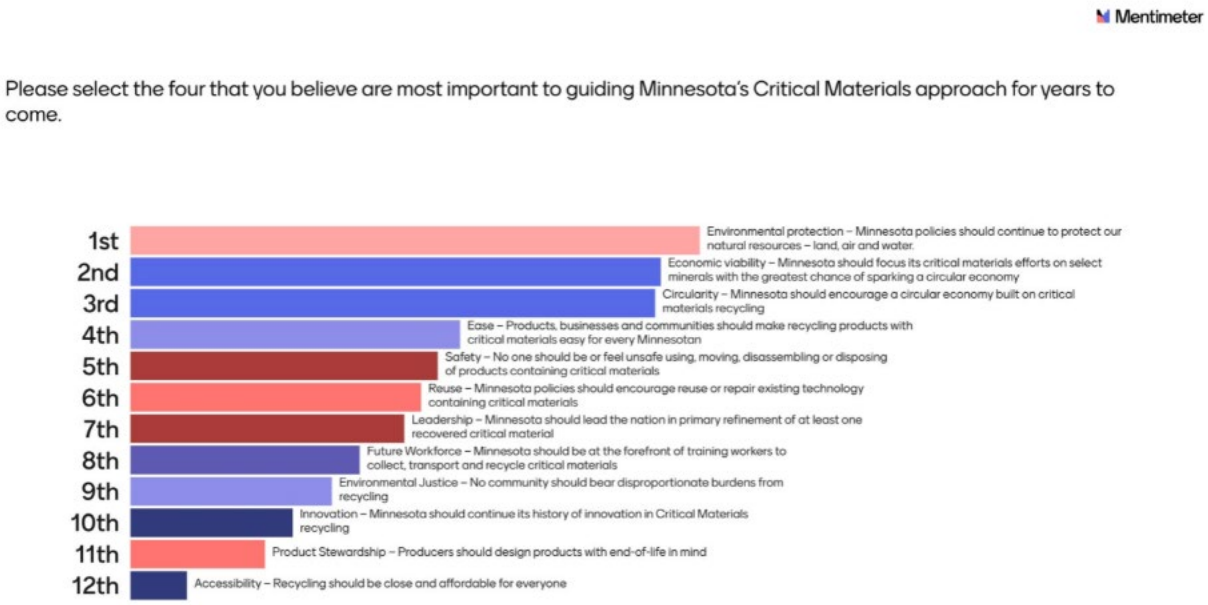
- Moaz Uddin (GPI) led the gathering of public comment for the final 10 minutes.

Comments generally concerned:

- You have to tell the legislature very clearly what needs to be done
- Would also like to do a study on the fluxes in demand on materials
- There is a high possibility that companies could make more in “urban mining” of materials to be recycled than mining raw materials, and that could be incentive enough for them
- There was a legislative task group that went abroad to look at solar production – which all of a sudden made that idea more popular now that legislators had actually seen it working to do it
- We should understand the potential before worrying about the other stuff
-

Voting on Recommendations

Paul Shanafelt (SDK) introduced a vote on the recommendation draft for priorities ranking and broader feedback on the recommendations. SDK gave time for the team to vote on these to get more feedback on the final construction on the recommendations. The results were as follows:



Wrap Up

Moaz Uddin (GPI) closed out the meeting by thanking the group for their contributions and SDK for the facilitation of the project. He also reiterated that there will be another meeting in January but it will not be a part of formulating the report, just a wrap up meeting, but that more opportunity to review the recommendations and other parts of the report will be coming in a couple of weeks.

Critical Material Task Force

Meeting #6
Date: 10/21/2025

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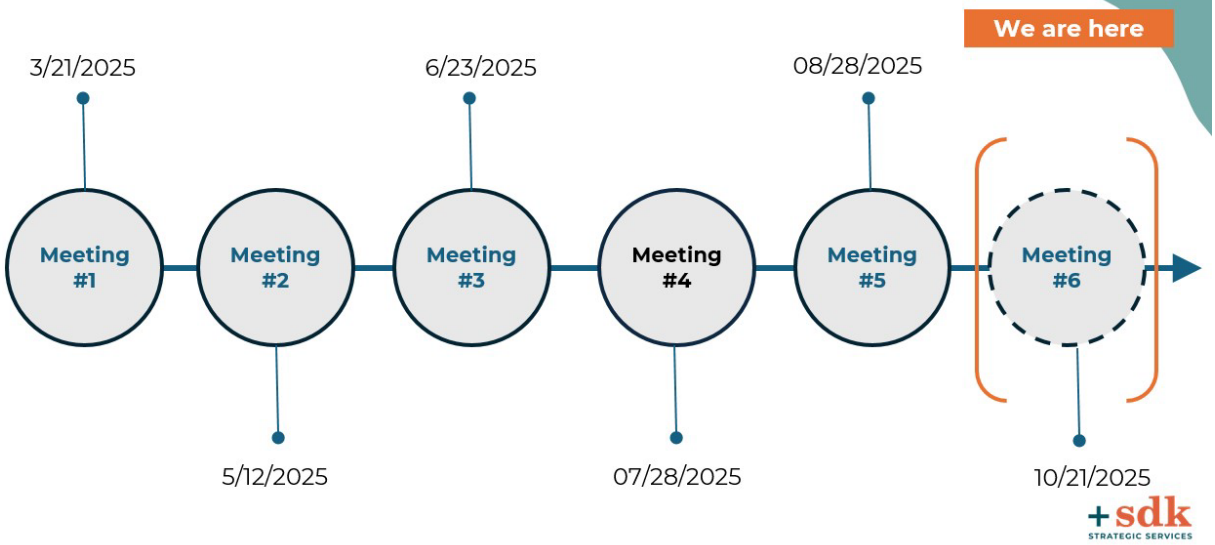
Task Force Timeline



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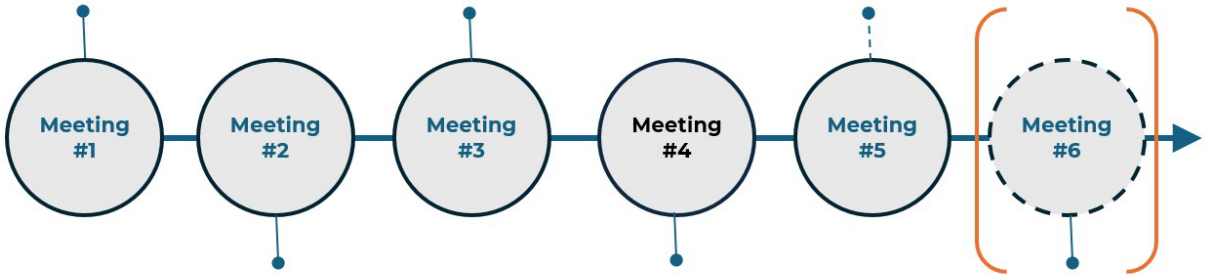
Task Force Timeline

- Introduction
- Chair election
- CM issue background
- Task force operating principles

- Current CM Recycling Tech
- Economy and Infrastructure
- Consumer vs industrial
- Discussion: Supply chain, consumer devices & policy

Recommendations, p. 1



- Existing laws and top sectors
- Minnesota's Critical Materials Recycling Vision

- Social, Environmental and economic evaluations of CM

Recommendations, p. 2

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Our Time Today

- Review draft recommendations framework
  - Principles
  - Goals
  - Data + Governance
  - Pillars

- Identify any refinement needed

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Decision Making Considerations

Agreement Approach	Recommendations Approach: "Strategic Roadmap"	Scoping Approach: Broad Vision
• "Moderate Approach" (mtg. 1) • Advance recommendations with general consensus • Acknowledge different viewpoints	• *High-level plan connecting long-term vision to actionable steps to achieving it.*	• Policy Framework: *What should be Minnesota's approach across the full DOE mineral list?*

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Discussion

- What aspects of the proposed framework to you support the most?
- Are there any elements or details you have concerns about seeing in the final report?
- Are there any ideas you think should be added to strengthen the framework?

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Discussion

Principles	Goals
Data + Governance	Pillars

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