# OFFICIAL NOTICE AND AGENDA

of a meeting of a City Board, Commission, Department Committee, Agency, Corporation, Quasi-Municipal Corporation, or Sub-unit thereof.

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|---|---|
| **Meeting:** | **SUSTAINABILITY, ENERGY AND ENVIRONMENT COMMITTEE** |
| **Members:** | John Kroll (C), Carol Lukens, Jay Coldwell, Mary Kluz, Jesse Kearns, Jean Abreu |
| **Location:** | Board Room of Wausau City Hall, 407 Grant Street. |
| **Date/Time:** | **Thursday, January 11, 2023 at 5:00 p.m.** |

1. Welcome and Introductions
2. Public Comment
3. Approve minutes of December 7, 2023 meeting
4. Updates: GHG Baseline, WLGCC, GTLC
5. Discussion and Possible Action: 'No Mow May' alternative program selection
6. Discussion: Draft website review
7. Discussion: Supporting Local Food Systems
8. Discussion: UniverCity Year Program ByBlock report
9. Next meeting date: February 8, 2024
10. Adjourn

It is likely that members of, and a quorum of the Council and/or members of other committees of the Common Council of the City of Wausau will be in attendance at the abovementioned meeting to gather information. **No action will be taken by any such groups.**

In accordance with the requirements of Title II of the Americans with Disabilities Act of 1990 (ADA), the City of Wausau will not discriminate against qualified individuals with disabilities on the basis of disability in its services, programs or activities. If you need assistance or reasonable accommodations in participating in this meeting or event due to a disability as defined under the ADA, please call the ADA Coordinator at (715) 261- 6622 or ADAServices@ci.wausau.wi.us to discuss your accessibility needs. We ask your request be provided a minimum of 72 hours before the scheduled event or meeting. If a request is made less than 72 hours before the event the City of Wausau will make a good faith effort to accommodate your request.

Questions regarding this agenda may be directed to the City Planning Office @ (715) 261-6760.

| **This Notice was posted at City Hall and emailed to the Media on 01/05/2023** |
|---|
| Any person wishing to offer public comment may email City Clerk Kaitlyn Bernarde at clerk@ci.wausau.wi.us with "SEEC comment" in the subject line prior to the meeting start. All public comment, either by email or in person, will be limited to items on the agenda at this time. The messages related to agenda items received prior to the start of the meeting will be provided to the Chair. |

Other Distribution: Media, Alderpersons, Mayor, City Departments

**City of Wausau** **Sustainability, Energy and Environment Committee**

# MINUTES

December 7, 2023

| | |
|---|---|
| Members Present: | John Kroll, Jesse Kearns, Jay Coldwell, Jean Abreu |
| Others Present: | Dan Barth, Cathy Barth, Christine Daniels, Andrew Lynch, John Kahon, Jackie Beran |

In compliance with Chapter 19, Wisconsin Statues, notice of this meeting was posted and transmitted to the Wausau Daily Herald in the proper manner.

**1. Welcome and Introductions**

Meeting started at 5:00pm

**2. Public Comment**

Dan Barth: Would like to partner with the Citizens Climate Lobby and Kathy Kunz of Dane County to get the word out on the IRA benefits for residents. Would like to have electric buses and recommended Trevor Young from Racine as a resource.
Cathy Barth: Noted Rewiring America as a good resource for IRA information. Also the Citizens Climate Lobby has a lot of webinars available for education.

**3. Approve minutes of November 9, 2023 meeting**

Motion/second by Abreu/Kearns to approve minutes. Passed unanimously.

**4. Discussion: City Forester John Kahon and Horticulturist Jackie Beran – plant selection and use of pesticides and herbicides**

Kahon discussed that the goal of urban forestry is to have diverse trees. The current City crop is about 34% maple. They have been planting more Lindenwood and basswood trees which are good for pollinators. The only tree related pesticides they use are injections of 6-10 trees a year to slow down the emerald ash borer. Trying to slowly and selectively remove ash trees but they are having a hard time getting back in time to plant new trees. They are working with DNR to apply for a grant from the IRA to help repair the urban canopy.
Beran noted she and her crews work to treat with fertilizers, do hand weeding, and mulch in order to limit use of herbicides/pesticides. This year she did experiment with some organic versions that seemed to work well and may be more fully adopted in the future.
Both suggested that residents focus on native plants that are good for pollinators and create bee gardens. Mulching leaves and grass. A good resource is a website called Bluethumb. Abreu asked how the city could encourage or fund bee gardens. The City currently does not have a resource to do this. Coldwell asked about reintroducing chestnut tree varieties and Kahon noted that they do have this in the mix as well as other food bearing trees.

**5. Updates: GHG Baseline, WLGCC, GTLC, website**

No updates.

**6. Discussion: Midwest Climate Resiliency Conference – Jay Coldwell**

Coldwell provided a handout that summarized the major presentations from the conference. He noted that the upper midwest will experience a minimal temperature shift however there will still be disruptions to the world as we know it. He suggested to model the Climate Action Plan from Stoughton, WI which has a range of options across many areas of ways to reduce carbon emissions and protect the environment. The big take aways from the conference are to protect what we have, and increase local food production.

**7. Discussion and Possible Action: Inflation Reduction Act resources for residents**

In the packet were provided two resources, Rewiring America and Dane County Sustainability. Both had good information for residents to take advantage of the tax incentives or rebates. These two resources will be included on the future website as well as any other that come to our attention.

**8. Next meeting date: January 4**

The committee has decided to tentatively next meet on January 11 and make it more of a work session to plan out the year ahead.

**9. Adjourn**

Motion/Second by Kluz/Abreu. Approved unanimously. Adjourned at 6:20 pm

# After No Mow May, Should You Do a Slow Mow Summer?

No Mow May is a start, but there's much more you can do to help pollinators.

By Benjamin Vogt | Published on June 14, 2023

In This Article




The last few years have seen the spread of No Mow May, a campaign that encourages folks to mow their lawns and meadows less in order to reduce fossil fuel emissions and water use as well as help wildlife. On the face of it, it seems almost too good to be true–you could do a lot of good things for the environment by doing literally nothing. So perhaps it's not surprising that letting your lawn grow for a month has fallen short of its promises.

However, No Mow May has provided an important stepping stone for rethinking what pretty means in urban and suburban landscapes, and how these spaces can provide valuable habitat and other environmental benefits. Our yards have the potential to support butterflies, bees, and birds while also cleaning and cooling the air, rebuilding compacted soils, and reducing urban flooding through landscapes that absorb more storm water. To take the next step into creating healthier landscapes for our families and neighbors, we have to understand the flaws of No Mow May and look at these goals with more nuance.

**RELATED:** Are Robotic Mowers the Future of Lawn Care?



PHOTO: HELIN LOIK-TOMSON / GETTY IMAGES

## Why No Mow May Isn't Such a Great Idea

No Mow May has a few issues that may actually do the opposite of its intended goals. For example, according to Sheila Colla, associate professor at York University and a conservation scientist, the initiative to mow less each May began in the UK, where not mowing "doesn't

One challenge is that most of us live on highly altered urban and suburban lots where there is no native plant seed bank. Native plants are critical to feeding butterfly and bee larvae because they co-evolved with many native insect species. What is likely present in the soil are invasive weed seeds–think Canada and musk thistle, as well as aggressive annual weeds like crabgrass–that will provide few resources for wildlife.

### Only Temporary Support for Native Bees

In addition, Colla points out that some bee species nest above ground, such as the once-common but now-threatened American bumblebee (*Bombus pensylvanicus*). Their homes will be destroyed when the mowers come back in June.

One primary study often cited as showing the benefit to bees in the United States was conducted on unmown lawns in Appleton, Wisconsin. It argued that there was a significant diversity of bees present on a diversity of native flowers. The paper has actually been retracted due to errors in plant and bee identification, yet the piece is still often cited.

**RELATED:** 5 Easy Ways to Create Gardens for Bees That You'll Enjoy Too



### Promotes Less Valuable Flowers

Heather Holm, author and pollinator conservationist, notes that one of the predominant flowering species we'll see in our lawns are non-native dandelions. While these plants make tasty additions to our salads, and their taproots help amend soil, their pollen is "nutritionally inadequate to support bee larvae on its own, primarily due to the low protein count."

So even if there are lots of dandelions around, bees still have to expend more energy gathering resources from a greater diversity of flowers, which may or may not be present in an unmowed urban lawn. Bees often exhibit floral fidelity when foraging, which means they tend to stick to one species in bloom to make things easier on themselves and use less energy. But when the primary resource lacks the nutrition to support bee larvae growth and development, a lawn full of dandelions may end up in giving us fewer pollinators.



## Focus on Plant Diversity

Scientists at the University of Minnesota Bee Lab suggest an alternative: "Slow Mow Summer." This concept advocates for mowing infrequently all summer long while reducing lawn spaces in general. This is where you can take the next, exciting step in your landscape to help wildlife. Consider diversifying your space with an increased number of plant species and plant types (herbaceous perennials, grasses, sedges, shrubs, trees), and not just replacing one monoculture with another.

For example, many folks are broadcasting dutch white clover into their lawns as a lawn alternative in the hopes it also provides floral rewards for insects. However, it's still a near monoculture that also doesn't serve as a host plant for caterpillars (and caterpillars are important baby bird food in nesting season, not to mention those caterpillars turn into butterflies if they survive the birds).

Holm also points out that exotic clover, which honey bees evolved with and thus commonly use, may act as a "pathogen spillover between honey bees and native bees." Due to their large numbers and range, honey bees harbor a variety of diseases that they lay on flowers as they pollinate; when a native bee, such as a bumblebee, comes to forage it picks up those pathogens[1], which can lead to illness, deformity, or death for the bee and its young.

Taken collectively, our native bees provide superior pollination compared to honey bees, while some 25% of them are specialists with specific groups of native plants (meaning the plant and bee rely upon one another as they co-evolved to use each other either for pollen or pollination). One of the best things you can do after being inspired by No Mow May is to garden with plants native to your zip code, and to include a diversity of species that provide floral resources from spring through fall.

**RELATED:** 10 Native Prairie Plants That Attract Birds and Butterflies



## Avoiding Bad Bugs

wooded ones. A 2-year study by the US Forest Service in Massachusetts showed that even lawn/meadow spaces at 10 inches high did not harbor tick populations. [2]

Best practices will always include spraying yourself with a repellent and doing a body check after being outdoors, but there are a few design strategies that also can help:

1. **Create wider paths through the landscape.** Paths help show intention and provide access points, but making them wider helps you avoid brushing up against vegetation where ticks "quest" on leaf edges, reaching out to hitch a ride.
2. **Increase plant diversity and habitat cover.** Encourage predators of species that serve as disease vectors by including habitat for them. Think owls, foxes, and coyotes, who prey on white-footed mice, a vector for lyme disease that ticks catch when feeding on the mice.
3. **Choose shorter plants.** Keep your plants under 2–3 feet tall. Pollinators still will have plenty to forage, but it will reduce the attractiveness to ticks.

TIP

When creating a diverse landscape in place of lawn, a sign explaining what's going on and why helps a lot when it comes to staying on good terms with your neighbors and your local weed ordinance enforcers. A few habitat certification programs offer sturdy ones.

## Taking the Next Step

What No Mow May began in other parts of the world we can take to the next level wherever our home landscapes may be. By reducing lawn and using a diverse mix of native plants matched to the site (soil, light, moisture), you'll use less water and fertilizer while supporting bees and caterpillars. You'll also increase ecosystem services through that plant diversity such as mitigating storm water runoff via dense, layered landscapes that also help clean and cool our urban air.

So go ahead and take a Slow Mow Summer if you want to as you think about how you can really move the needle in your yard. I suggest visiting a meadow example nearby wherever you live to get inspiration from the plant species that thrive there. Watch as native bees forage on blooms and birds nab caterpillars and beetles to feed their young. Then, through organizations such as Pollinator Partnership, the Xerces Society, Wild Ones, Audubon, and the National Wildlife Federation, learn more about those plant species and the wildlife they support so you can recreate the ecosystem in your yard.

Why? Because your landscape matters and can help turn the tide for a healthier, more resilient future that a monoculture of lawn (mowed or unmowed) will never provide.



## Related Articles

CARING FOR YOUR YARD

### 5 Ways to Participate in "No Mow May" and Help Bees This Spring

By Anne Readel

POLLINATORS

### Native Plants Help Pollinators, But Experts Say Be Wary of "Nativars"

By Lynn Coulter

NATURE LOVERS' GARDENING

### Create a Backyard Wildlife Habitat

By Viveka Neveln

PLANT ENCYCLOPEDIA

### How to Plant and Grow Sideoats Grama Grass

By Judy Nauseef

# Cost Benefit Analysis Report of Wausau ByBlock Project

Yinong Ding

December 2023

## Project Proposal

Plastic, an epochal human invention, is now emerging as an environmental challenge. According to the data provided by the UN Environment Program, an annual discharge of 19 to 23 million tons of plastic waste clogs ecosystems, and equivalent to a volume commensurate with 2000 fully loaded garbage trucks. The indiscriminate disposal of plastic poses a threat to global water bodies, such as oceans, rivers, and lakes at risk of congestion.

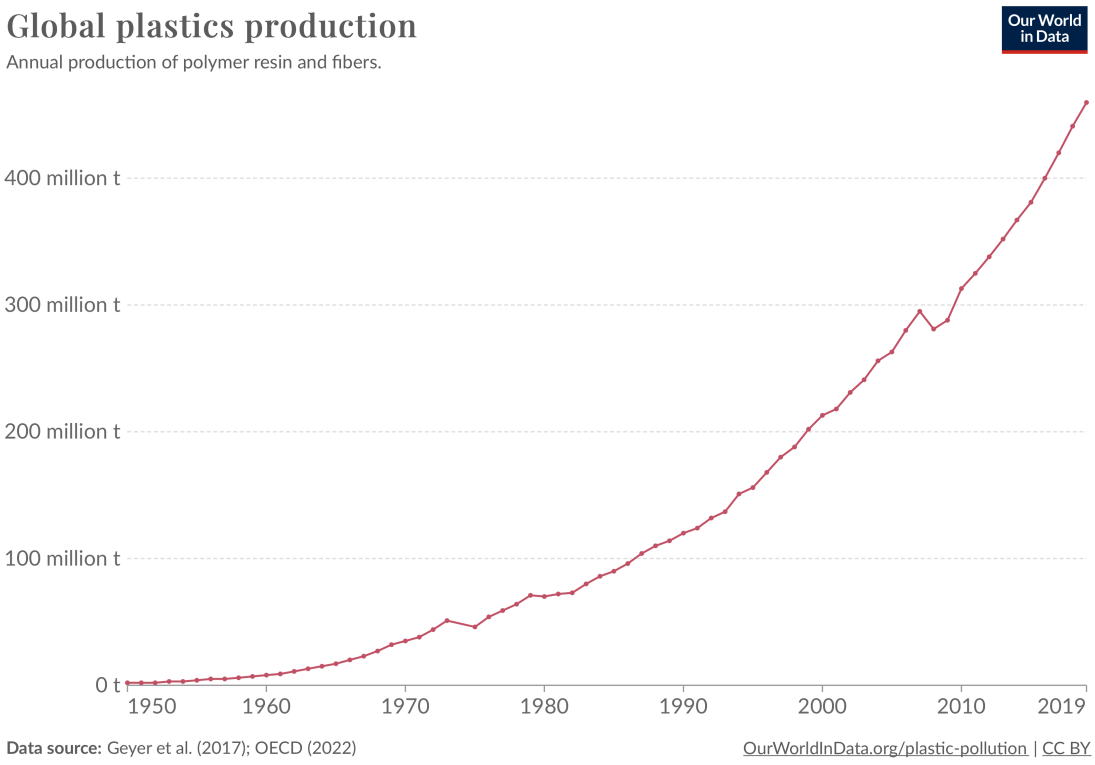


Figure 1: global-plastics-production,Data Source: Geyer et al. (2017); OECD (2022)

Figure 1 is the line chart shows global plastic production. From the source of Our World in Data, during past 70 years, the annual production of plastics has increased nearly 230 times, and global plastic production reaches 459 million tons. If the current waste deposal ratio persists, predictions suggest that by the year 2040, the Earth could accumulate a staggering 710 million tons of solid plastic waste.

Plastic pollution not only have damages upon animal habitats and natural processes, but also directly impacts the livelihoods of millions of human beings. It is noteworthy that among the seven types of plastic, only two are recyclable. Certain plastics, such as polyvinyl chloride (PVC), can pose hazards and generate toxic masses under high temperatures, even at very low concentrations (Groh et al., 2019).

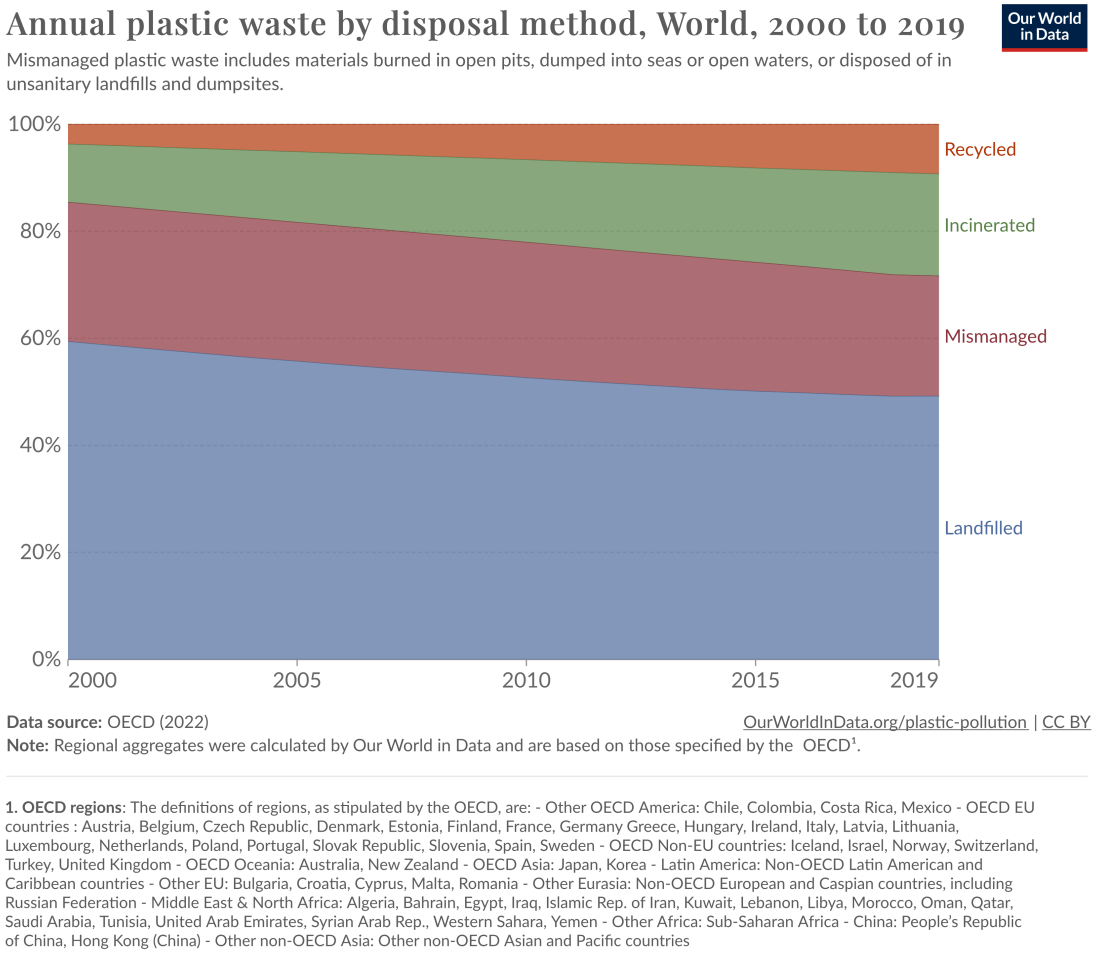


Figure 2: Waste Management Methodd, Data Source: OECD (2022)

From the figure above, it is clear that despite these safety concerns, the prevailing methods for plastic management continue to be land-filling. Up to 40 percent of plastic waste is mismanaged or using combusting methods, potentially giving rise to issues related to food safety and social well-being.

This urgency makes it significant of developing recycling methods to address the challenges posed by

plastic pollution. A noteworthy initiative in this regard is a startup company located in Los Angeles, known as ByFusion. Established in 2017, the company has devised a strategy to address the recycling of non-recyclable plastic types. Leveraging the Blocker System machine, virtually all categories of non-recyclable plastics, with the exception of dense foam, can be transformed into 22-pound blocks, referred to as "ByBlock" by ByFusion (ByBlock Product Data Sheet,2022).

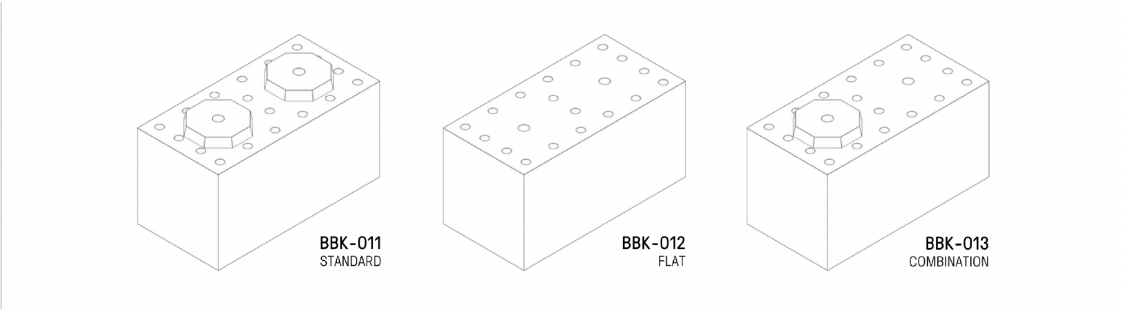


Figure 3: ByBlock Schematic diagram, Source: ByFusion Global Inc (2022)

Theoretically, ByBlocks are structurally equivalence to a hollow-core concrete cinder block, possessing comparable strength. As illustrated in Figure 3, these blocks, fabricated from non-recyclable plastics, can be connected using inner rods to construct various structures such as retaining walls, sound walls, sheds, privacy fencing, terracing and landscaping features, accent walls, and furniture. Notably, ByBlocks offer a solution to the challenges posed by conventional recycling methods, specifically the pre-sorting and pre-washing requirements. The Blocker System machine employed by ByFusion circumvents these processes by steaming and compressing the raw plastic material, enabling the rapid shredding and fusion of plastic into solid blocks within few minutes. This innovative approach obviates the need for specialized labor, and post-production contaminant levels are maintained at a very low level.

ByFusion is actively seeking collaboration with the government of Wausau to establish a new facility in this region. The purpose of this report is to assist the Wausau government analyzing the costs and benefits associated with partnering with ByFusion. The aim is to determine the financial feasibility of initiating the ByBlock project in the area.

# Data Description

## 0.1 Wausau Demography

As Wausau contemplates a potential collaboration with ByFusion, understanding the city's demographic and economic landscape becomes crucial in evaluating the feasibility and impact of the potential partnership.

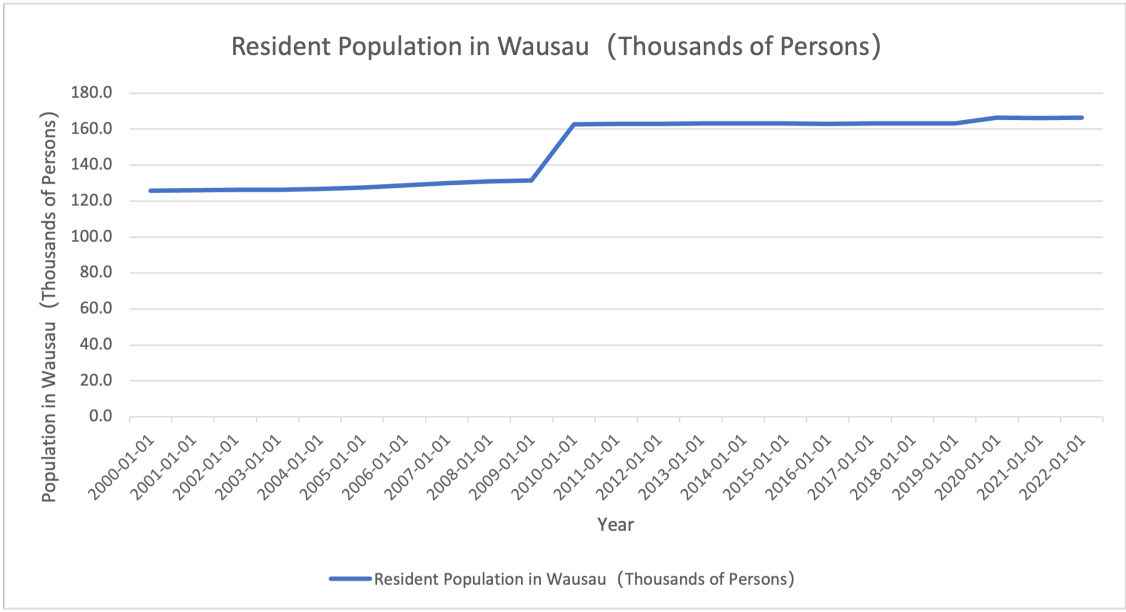


Figure 4: Resident Population in Wausau, Data Source: FRED

Setting along the Wisconsin River, the city of Wausau locates at central Wisconsin, with the rich resources from the Rib Mountain. The city size is relatively small but owns a vibrant community with a diverse economic landscape. Its resident population keeps a stable trend. The city reaches a maximum of 166,476 residents in 2020, averaging around 148,000 individuals.

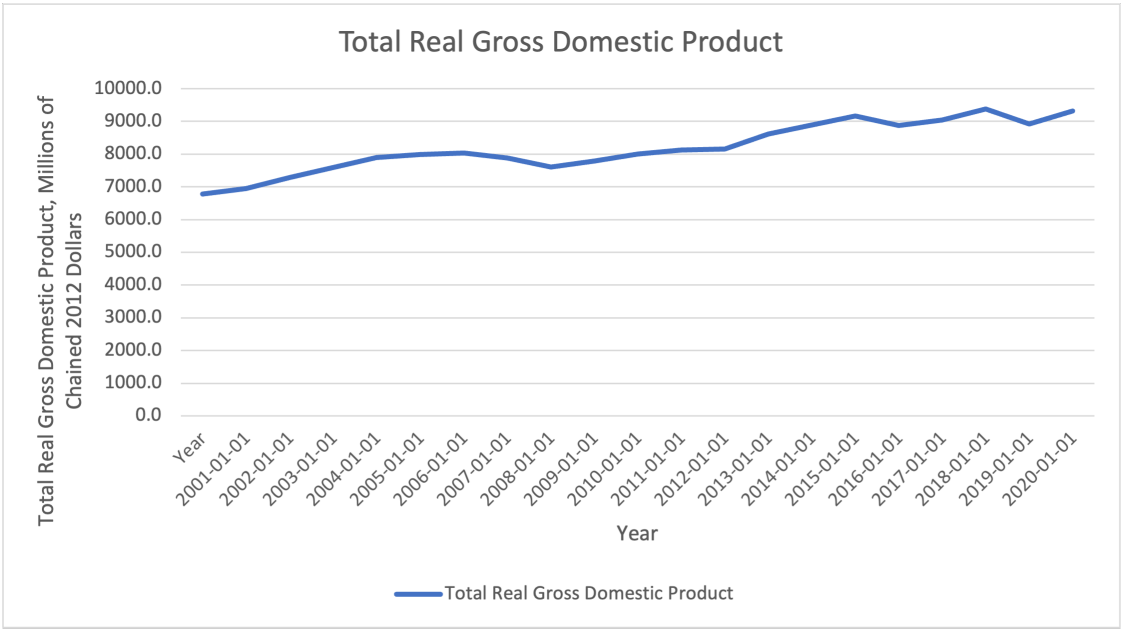


Figure 5: Total Real GDP in Wausau, Data Source: FRED

Figure 5 reflects Wausau's economic vitality. Generally, Total Real Gross Domestic Product (GDP) keeps

increasing steadily, the maximum of 9,386 million dollars was reached in 2019, and maintaining an average of 8,205.63 million dollars.

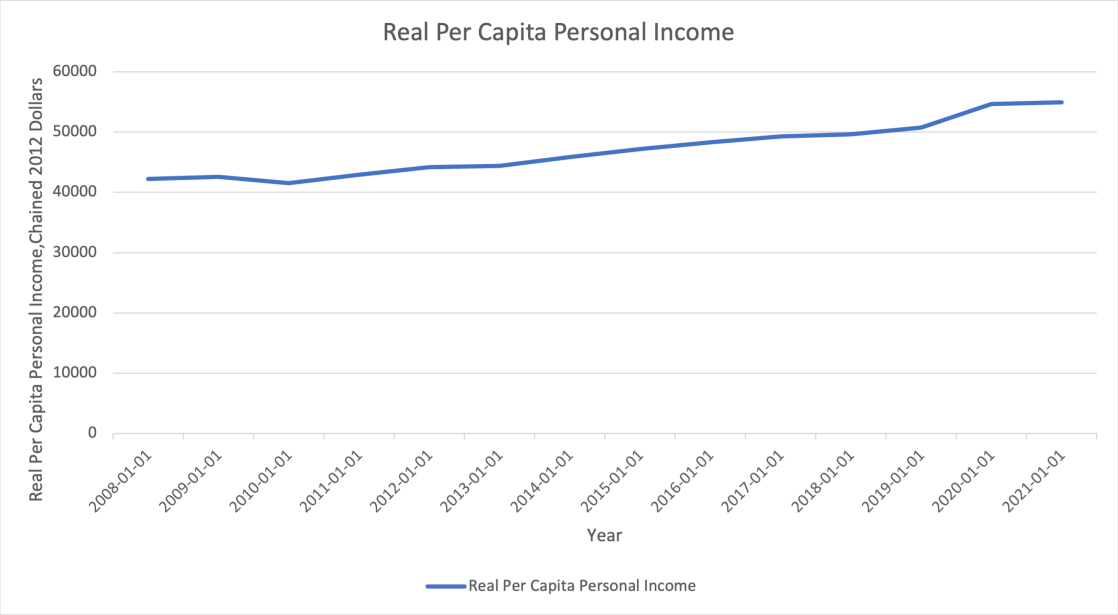


Figure 6: Real Per Capita Personal Income in Wausau, Data Source: FRED

lumber industry is historically rooted in Wausau, the city has a complete industrial park and is seeking to foster industries such as insurance, manufacturing, and healthcare. What's noteworthy is the city's commitment to individual prosperity. in Figure 6, exemplified by an Annual Real Per Capita Personal Income ranging from a maximum of $54,955 to a minimum of $46,530, with an average of $47,028.

## 0.2 Cost and Benefit

An in-depth analysis of costs and benefits was emerges to evaluate the potential collaboration between the city of Wausau and ByFusion. The costs associated with this venture include several facets. Firstly, buying the ownership of the Blocker System machine could be seen as a financial investment borne by the government. Additionally, the installation and construction of the facility should be a joint responsibility. In this case, the construction fee is shared by both the government and ByFusion, both facility fee and construction fee entail substantial initial investment. The after-production treatment, which might be a part of the construction, is also a shared cost between the government and the company. Furthermore, to avoid the possibility of decoloring, the ByBlocks cannot be exposed to sunlight directly (ByBlock Product Data Sheet,2022). Considering the special characteristics of ByBlock, there will be a need for a storage facility for the ByBlocks, if they were to be sold by the government.

Another nuanced concern involves the potential long-term effects on human health arising from microplastic chemicals runoff (Karbalaei, S et al., 2018). The microplastic runoff, however, is a rather new study so it's hard to say for sure how important the long-term would be. Thus, in this report, ByBlocks will be considered as regular plastic and the microplastic runoff effect will not be further discussed but this effect may require meticulous attention and deeper exploration.

Conversely, benefits from this cooperation is anticipated. What's most stand out is the introduction of new job positions Jobs within both ByBlock production facilities and through ByFusion's theoretical plastic waste pick-up service not only addresses unemployment concerns, but also contributes to the overall economic vitality. If inviting this new facility manages unemployment rate, the community will earn benefits and corresponds to the Wausau government's expectation of industry transformation. With new job positions, there will create new tax revenues. The outcome of the collaboration is anticipated as the improvement of city's financial standing. Via the contract from the pilot cooperation program with Tucson, the company agreed that the government owns part of the blocks created locally (N. Ludden, 2023). Assuming Wuasau will have a similar contract, owning those blocks establishes a revenue stream for Wausau. Additionally, the utilization of government-owned industrial parks or transportation infrastructure by ByFusion, entailing rent payments, represents a mutually beneficial arrangement.In terms of ongoing financial dynamics, the company should cover the utilities fees, which further boosts the economic partnership.

In addition, spurred by the creation of new job positions, the collaboration is expected to enhance local purchasing and encourage recycling-related businesses.Moreover, the venture aligns with environmental stewardship goals, with the potential to reduce greenhouse gas emissions, an outcome that may yield economic benefits not only for the local government, but also for the entire state in the long run.

However, it is crucial to acknowledge the opportunity costs associated with diverting resources from existing recycling partnerships. This entails a careful consideration of the collaboration on current waste management ecosystem in Wausau. The comprehensive assessment of these costs and benefits is pivotal for the Wausau government to make informed decisions about the feasibility and desirability of partnering with ByFusion.

Wausau's collaboration with ByFusion holds direct impacts through the creation of job positions, tax revenue generation, and the establishment of a new revenue stream through the sale of ByBlocks. Indirectly, the cooperation may stimulate economic growth in related industries, enhance local purchasing for the reduced unemployment rate (Al-Maaded,. et al, 2012). Foster recycling-related businesses and contributing to social and economic development are also expedcted. The induced impacts include potential changes in community behavior and values, fostering a more environmentally conscious and sustainable ethos. Pointing out the comprehensive effects of the collaboration, aligning with both economic prosperity and environmental

improvement will help the future decision making in Wausau.

# Model and Methodology

## 0.3 WARM

To better anticipate the potential economic impact of ByFusion to Wausau, the Waste Reduction Model (WARM) was utilized. WARM is a tool developed by the U.S. Environmental Protection Agency (EPA), it provides estimates of greenhouse gas (GHG) emissions reductions, energy savings, labor hours, wages, and taxes associated with alternative end-of-life waste management decisions (U.S. EPA Office of Resource Conservation and Recovery, 2020). The model employs a life-cycle approach, comparing traditional methods such as landfilling and combustion to recycling practices, including source reduction, anaerobic digestion, and composting. It has built-in, embedded multipliers, facilitate a thorough evaluation of the impacts across diverse waste management scenarios. WARM's versatility extends to mixed material categories, allowing users to individually assess and implement source reduction strategies for specific components, and guide decision-makers to understanding the environmental benefits of adopting alternative waste management strategies.

## 0.4 Net Present Value

Due to the natural limitations of the WARM model, to better predict the viability and profitability of ByBlock project, Net Present Value (NPV) serves a significant role. NPV is employed to evaluate the present value of anticipated cash inflows and outflows within the a certain period of time. (Sudong Ye et al., 2000).

$$NPV = \sum_{t=0}^{T} \frac{CF_t}{(1+r)^t} - C_0 \tag{1}$$

(1) shows the basic form of NPV, where $CF_t$ is the net cash inflow during the period $t$, $r$ is the discount rate, $T$ is the total number of periods, and $C_0$ is the initial investment cost. For the ByBlock project, the cash inflows could be generated by revenues of industrial park lending, selling ByBlocks, potential tax revenues, and other financial benefits resulting from the collaboration. On the other hand, cash outflows comes from initial investments in machinery, construction, storage, and after production treatment. The discount rate applied to these cash flows reflects the opportunity cost of capital and the required rate of return. A

positive NPV would signify that the ByBlock project is expected to generate value and is financially worthy investment for the Wausau government. Conversely, a negative NPV would signal potential financial risks or inadequate returns.

NPV, by accounting for the time value of money and providing a more comprehensive outlook on the project's financial implications than WARM model alone.

# Results

## 0.5 WARM

By contacting the Wisconsin area recycling company, an average of 260 short tons of total plastic waste was give. WARM model provided comparative analysis of the baseline and recycling results for most common plastic materials, that are, HDPE, PET, PP and mixed plastics. The result reveals substantial reductions in annual greenhouse gas (GHG) emissions after employing recycling practices.

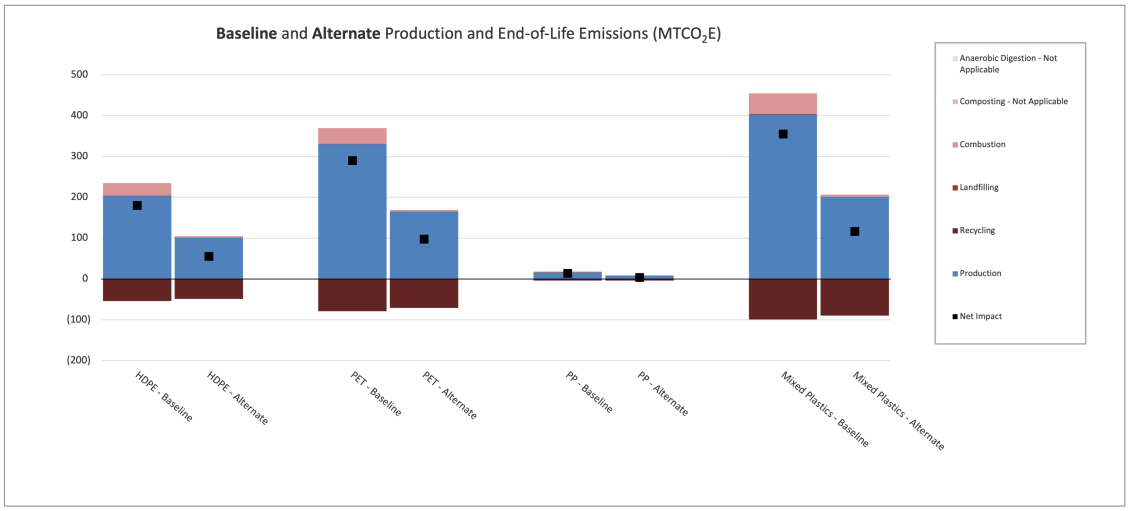


Figure 7: Annual GHG emission analysis

Plastic management significantly reduces GHG, the result is clearly shown in the graph above. The High-Density Polyethylene (HDPE), the baseline GHG emissions from production and end-of-life impacts total 180.19 MTCO2E, while recycling slashes this figure to 55.82 MTCO2E, marking a notable reduction of 124.37 MTCO2E. Similarly, Polyethylene Terephthalate (PET) drops from 290.63 MTCO2E to 98.13 MTCO2E through recycling, reflecting a substantial reduction of 192.50 MTCO2E. Polypropylene (PP) and Mixed Plastics follow suit, with recycling yielding reductions of 10.59 MTCO2E and 238.29 MTCO2E, respectively. Overall, the reduction in carbon dioxide across these plastic types aggregate to 564.74 short

tons, underscoring the effectiveness of recycling effect on environmental footprint associated with plastic waste management.

Comparing between baseline plastic management and recycling-specific waste management, WARM gives a notable reduction in labor hours per year as well. Using HDPE, PET, PP, and Mixed Plastics as standard measurement, traditional waste management methods involve substantial labor efforts for tasks such as landfilling and combustion. However, when adopting the recycling methods, WARM demonstrate a shift towards greater efficiency.

Table 1: Comparison of Baseline and Recycling Labor Hours

| **Material** | **Tons Recycled (Baseline)** | **Tons Recycled (Recycling)** | **Total Labor Hours (Baseline)** | **Total Labor Hours (Recycling)** |
|---|---|---|---|---|
| HDPE | 71.50 | 64.35 | 4,484 | 3,957 |
| PET | 75.92 | 68.33 | 4,761 | 4,202 |
| PP | 5.20 | 4.68 | 326 | 288 |
| Mixed Plastics | 107.38 | 96.64 | 6,606 | 5,827 |

As the table 1 present, in HDPE, labor hours decrease from 4,484 hours to 3,957 hours, and for PET, the labor hour decrease from 4,761 to 4,202. The trend is consistent across Polypropylene (PP) and Mixed Plastics, in total for all types of plastics recycled, labor hours decreased 778 hours.

## 0.6 NPV

To utilize the result from WARM model and calculate Net Present Value (NPV), the discount rate is required. As a start-up, ByFusion don't have data related to the company's specific discount rate, so an average recycling industry discount rate provided by Alphaspread is adopted. Generally, the recycling industry have a discount rate of 7.12%Ȧnd according to the contract from Tucson, the government provided in total of $3,400,000 to build the facility (C. Migoya,2023) which will be considered as the project initial investment. By comparing the general industry construction duration, we assume that building the Blocker System takes three contract years. In this way, although from WARM model there are significant reduction of greenhouse gas emission, but the revenue brought by building the new facility will not start till the third year. Data from Ministry for the Environment stated that 1 short ton of greenhouse gas reduction brings $12to25$ economic benefit (Ministry for the Environment, 2007). So, start from the 3rd year of the project, in the NPV, the maximum of $25 is used to calculate the environment benefit.

Tax and wages are predicted based on labor hours calculated by WARM. According to website ZipRecruiter, the beginning three years of constructing period, average construction worker hourly salaries in Wausau are currently range $25.4, and the average hourly wage for recycling industry in Wausau is $17. Based on the

national policy encouraging recycling industry and carbon neutral act, there is a different tax rate correspond to traditional industry and recycling industry. In Wisconsin, tax rate of normal industry is 17.53%, while recycling industry has a tax rate of 16.9% (J. CARON et al., 2018).

Table 2: First NPV Scenario

| **Year** | **Cash Flows** |
|---|---|
| year0 | $(2,975,986.55)$ |
| year1 | $424,013.45$ |
| year2 | $424,013.45$ |
| year3 | $297,907.28$ |
| year4 | $297,907.28$ |
| year5 | $297,907.28$ |
| year6 | $297,907.28$ |
| year7 | $297,907.28$ |
| year8 | $297,907.28$ |
| year9 | $297,907.28$ |
| year10 | $297,907.28$ |

In the initial scenario, with only the construction investment is $3,400,000, the NPV for a 10 year period is calculated as -$612,717.96, a negative value. Indicating that at a 7.00% discount rate, the project may not meet the required rate of return and could potentially result in a financial loss. And the project's present value of cash inflows is less than the initial investment. It is noteworthy that to if the government decided to take the risk and invest this project, the rent and utilities fees covered by ByFusion must cover the $612,717.96 financial loss.

From a report in pilot program in Tucson, the government chose to relocate the ByFusion facility address, and saved more than $1,000,000 initial investment (N Ludden, 2023). If the government of Wausau takes the experience by building the new facility next to existing landfill and utilize current gauge, it is reasonable to assume there will be a second scenario with less initial investment.

Table 3: Second NPV Scenario

| Year | Cash Flows |
|---|---|
| year0 | $(1,575,986.55)$ |
| year1 | $424,013.45$ |
| year2 | $424,013.45$ |
| year3 | $297,907.28$ |
| year4 | $297,907.28$ |
| year5 | $297,907.28$ |
| year6 | $297,907.28$ |
| year7 | $297,907.28$ |
| year8 | $297,907.28$ |
| year9 | $297,907.28$ |
| year10 | $297,907.28$ |

In the revised scenario, with a reduced initial construction investment of $2,000,000, presents a more favorable NPV trajectory. Starting at -$118,229.56 at starting point, the NPV steadily climbs. Although the NPV of beginning five years keeps being negative, but it reaches $695,693.25 in 10th year, implying that the project has the ability to reach the break-even point.

The contrast in NPV outcomes between the two scenarios underscores the pivotal impact of location selection on the financial viability of the project. The initial construction investment, driven by the chosen facility location, substantially influences the project's upfront costs and, consequently, the overall financial performance.

## Conclusion and Limitation

While the Waste Reduction Model (WARM) and Net Present Value (NPV) analysis have provided valuable insights into the environmental and economic aspects of plastic waste management, it is crucial to be aware of their inherent limitations. WARM is a model relies on generalizations and assumptions. The smallest scale multiplier in the model is the state-level multiplier, the city of Wausau, however, is a small city comparing to Wisconsin State. Potentially WARM may overlook site-specific factors and variations in recycling practices. Moreover, the model's estimates are based on average values, limiting its precision. Based on WARM used manual, the model frame only include part of the indirect economic impacts (US EPA, 2022), impact such as local purchasing power relies on more accurate data and the access to detailed ByFusion multipliers.

On the other hand, the limitation to NPV that it is sensitive to factors such as discount rates and uncertainties in long-term projections. The use of average discount rates and existing prices from a different city affecting the accuracy of investment prediction. Since size of Wausau is smaller to the size of Tucson,

and the fact that facility size in Wausau is not settled. The initial investment and discount rate may not be as large as in Tucson. Recognizing these limitations is essential for informed decision-making, prompting the need for complementary approaches and continued refinement of tools to address the complex challenges posed by plastic recycling.

To enhance estimation accuracy, first of all, more in-depth investigation to ByFusion data, and negotiation with the company about contract details (such as whether the block ownership) is essential. Machine learning algorithms with WARM could enable the model to adapt more specific regional characteristics and dynamic waste management practices. Additionally, incorporating real-time data collection methods, such as IoT devices, would provide more precise information for input parameters. For NPV, a sensitivity analysis considering various discount rates would mitigate uncertainties. So far, the nationwide recycling industry is still at initial stage, thus the accessible data and information is limited. The combining with not only economic impact, but also with wisdom from environmental science, and insights of industry future development could better support the investment decision making of the government.

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