Michigan's Scrap Tires

A Circular Economy approach

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CONTENTS

INTRODUCTION

The automobile industry has had a shift toward sustainability in recent years. “Electric Cars” are the new innovative idea of sustainable transport. [1]But even with the new electric design, the tires, as we know, are still a crucial part of the machine. Tires are made of a mix of rubber that is produced through the refining of petroleum. At the end of their life, a high quantity of raw material with high energy and mechanical value still remains.

Throughout the world, over one-billion tires complete their life cycle every year.[2] In Michigan, about 18 million tires were scrapped in 2019 creating a big source of pollution (EGLE).[3] This waste can contaminate groundwater and surface water and creates an ideal habitat for the mosquitoes that carry diseases like Eastern Equine Encephalitis[4].

The State of Michigan has designed a waste management system that regulates the final destination of scrap tires. This regulation is in Part 169 of the Natural Resources and Environmental Protection Law. The management system regulates transportation, storage, and disposal of the scrap tires. This law makes the user responsible for the final destination of the scrap tires and is focused on decreasing the environmental impact of the used tires.

This white paper will describe an economic, social, and environmental alternative for scrap tire disposal that extends the life of the product, allowing the value of the materials to spend more time in the economy. This paper will describe the current management of the waste scrap tire program by the Michigan Government from a Circular Economy perspective using the butterfly methodology introduced by the Ellen MacArthur Foundation in 2013. In addition, the white-paper will define how, by applying circular concepts, it is possible to create great value for society.

[1] Retrieved from https://www.nature.com/articles/456436a
[2] Retrieved from https://www.thebalancesmb.com/the-importance-of-tire-recycling-2878127
[3] Retrieved from https://www.michigan.gov/egle/0,9429,7-135-3312_4123_4122-122613--,00.html
[4] Retrieved from https://www.michigan.gov/egle/0,9429,7-135-3312_4123_4122-122613--,00.html

1. GOALS AND METHODOLOGY

The study has the goals of:

- Describing the legal environment of scrap tire management in Michigan
- Describing a Circular-Economy approach to scrap tires waste in Michigan using the Butterfly Method outlined in Figure 1 from the Ellen MacArthur Foundation (Ellen MacArthur Foundation, London (2013))
- Reviewing data from yearly reports of the Michigan Department of Environment, Great Lakes, and Energy Materials Management Division scrap tire program
- Conducting a Qualitative Analysis of the data

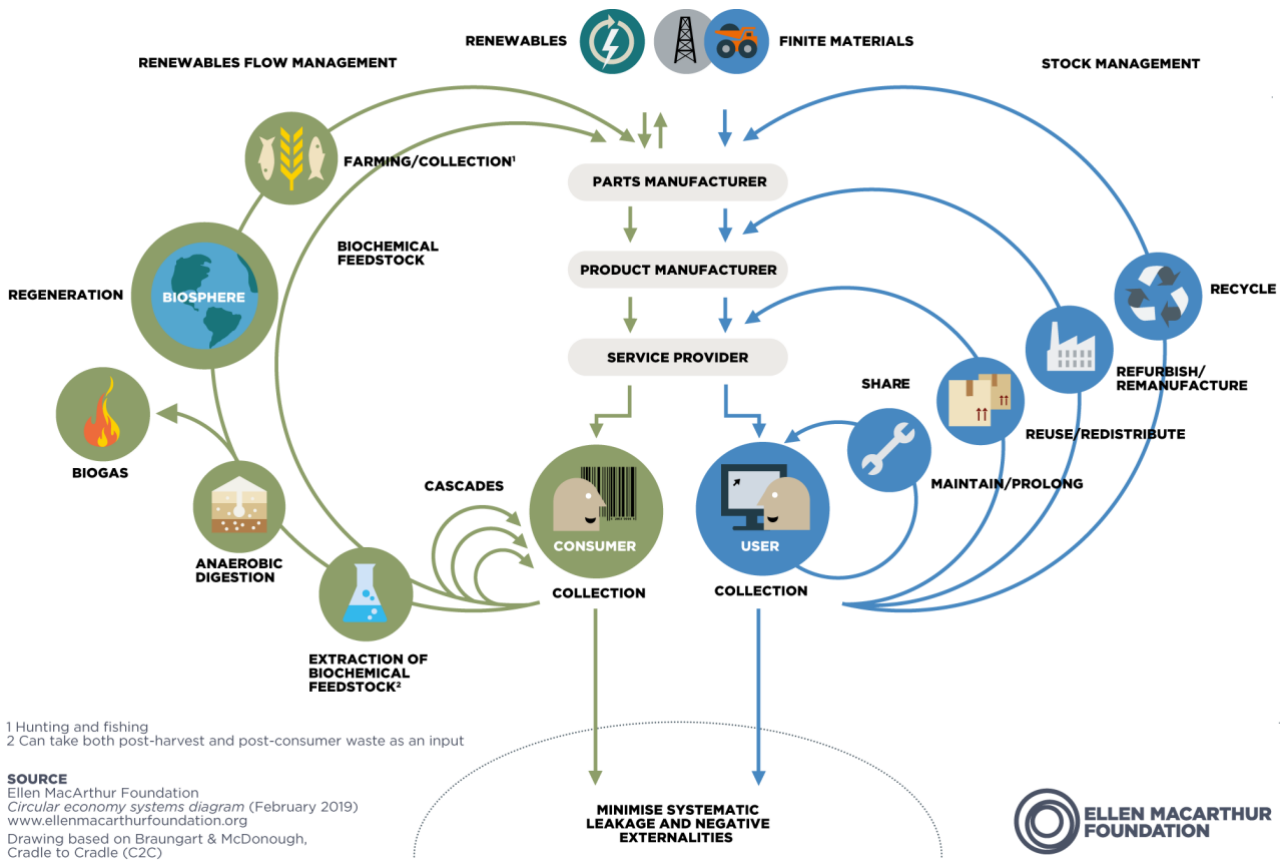

Fig 1. Circular Economy Butterfly Methodology (Ellen Macarthur Foundation,2019)

2. LEGAL ENVIRONMENT

In many countries throughout the world, solid waste management has become a major problem in society (Ferronato, 2016). Often the governmental regulations do not support the development of strong solutions. "Two innovative policy approaches designed to promote cost-effective diversion and recovery of post-consumer solid waste are increasing in popularity: Extended Producer Responsibility and Product Stewardship" (Wagner,2013).

Michigan has not implemented an Extended Product Responsibility Law for tires (Michigan Recycling Coalition, 2011). The department of Environment, Great Lakes, and Energy (EGLE) is the institution that is in charge of waste management. EGLE has a Scrap Tire Advisory Committee that was created by the Waste and Hazardous Material Division in 2005 with the purpose of providing discussion the current and future trends in the scrap tire industry (EGLE).

Since 2004, The Federal Law of Natural Resources and Environmental Protection, in Part 169, determines how scrap tires have to be transported, stored, disposed of, and kept out of landfills. This law does not discuss the importance of reuse of this material and doesn't have a circular vision. It also determines the needs for certification of the companies that store, transport, and dispose of scrap tires. Sections 16903(6) and 16903(1) determined that if a storage company wants to extend the certification, it needs to show that 75% of the tires are recycled.

3. COLLECTION

The collection of waste is part of the structure of the Circular Economy. A good collection, with good quality and a good price, is key to developing the Circular Economy. (Ellen MacArthur Foundation,2013).

In Michigan, the law does not permit tires to go to the landfill. These tires have to go to registered collection areas. As of 2019, these registered collection companies can charge 4 to 10 USD per tire. In most cases, the companies that sell new tires collect these used tires and make direct contact with the collection company.

Fig 2. Tires in Disposal Center Of Lansing (www.Granter.com,2016)

In Michigan, small-scale illegal dumping occurs in some areas. The cost to collect these tires is high and the Government of Michigan has a grant program with an annual budget 1 million USD in 2019 that would oversee the cleanup of the various sites (EGLE, 2019).

Fig 3. Dumping tires(WMEAC,2013)

In Michigan, municipalities do not have responsibility for the collection of scrap tires. The cost is supported in part by Federal Grants and by the consumer who has to pay tire collectors. This allows for a very good collection system in Michigan, but in this situation, the responsibility belongs to the consumer and not the producer.

Michigan has 21 collection areas licensed throughout the state where 24 million tires are collected every year. Figure 4 shows that the number of tires in landfills decreased significantly in 2019 in comparison with other years in accordance with the Federal Law of Natural Resources and Environmental Protection

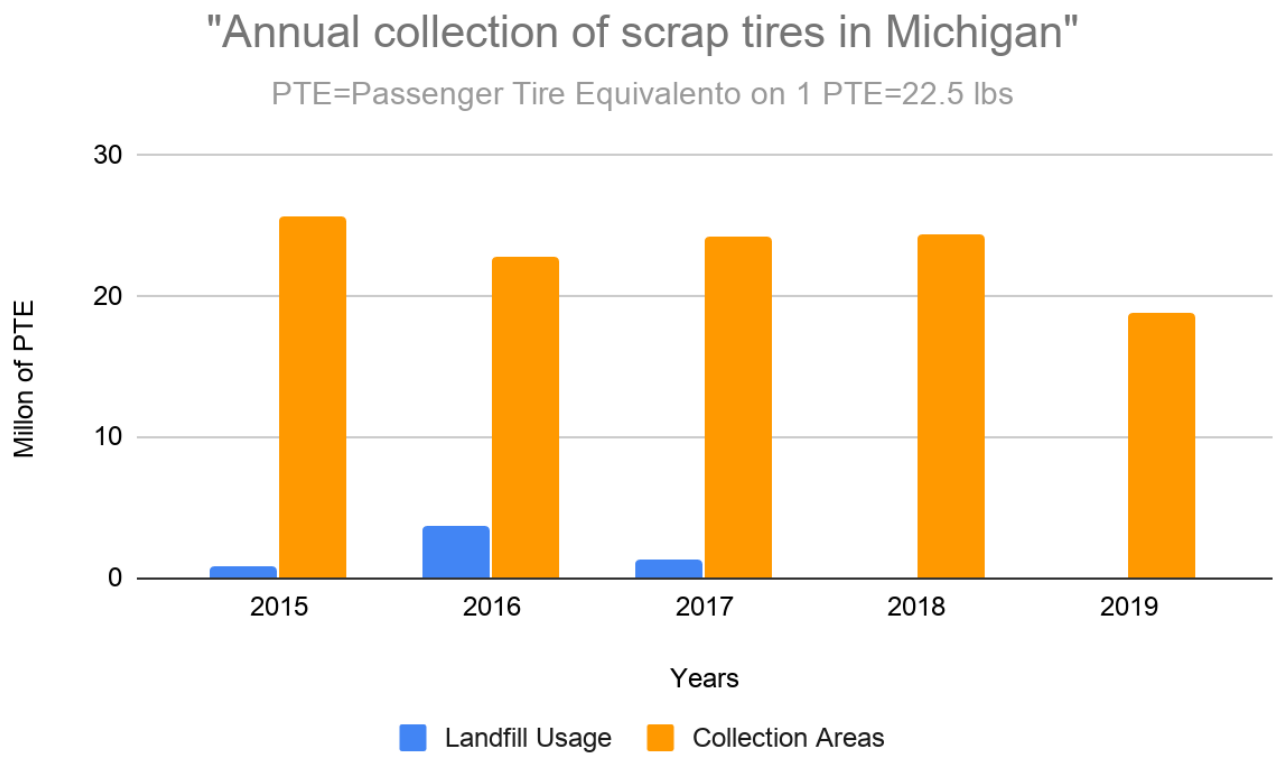

Fig 4.“Annual Collection For Scrap Tires in Michigan”

Data source: Scrap tire report. (2019, March 10). Retrieved from https://www.michigan.gov/egle/0,9429,7-135-3312_4123_4122_4346-235849--,00.html

4. MAINTENANCE

Maintenance is an aspect of Circular Economy that attempts to increase the "time of life of the product" and keep this product in the economy as long as possible (Ellen MacArthur Foundation, 2014). Tires are a product that can be affected by the state of the roads, excessive use, and tire wear norms.

In Michigan, the state of the roads is not very good, and this affects the life span of the tires. Also, the sodium chloride, used on roads during the winter, reduces the lifespan of the tires. (Anne Leppänen, 1996). In spite of this, the law is very strict about the acceptable condition of tires on vehicles and Michigan Vehicle Code doesn't permit a block, stud, flange, cleat, spike, or other protuberance on the periphery of the tires. The maintenance of tires in Michigan is not common but if it is necessary, it happens in the tire store or in the brake shops. Therefore, used tires have a good quality in Michigan and they can retain about 80% of the original material.

Fig. 5. Maintenance in Michigan (https://witl.com/,2019)

5. RE-USE

Re-use provides the opportunity to prevent polymers from going into the landfill and extends the life of the product. It is also a good opportunity for Business (Ellen MacArthur, 2019).

In Michigan, scrap tires are commonly re-used to produce playground equipment. Also, people try to repurpose those tires by turning them into objects such as planters or tire swings.

Fig.6. Re-Use of tire in Lansing (www.grangernet.com,2016)

One of the most common solutions for scrap tires in developed countries is to export them to other places. In 2018, Michigan exported about 25% of its scrap tires to other countries and states. These tires were processed and after this and were sent back to Michigan with an aggregated value.

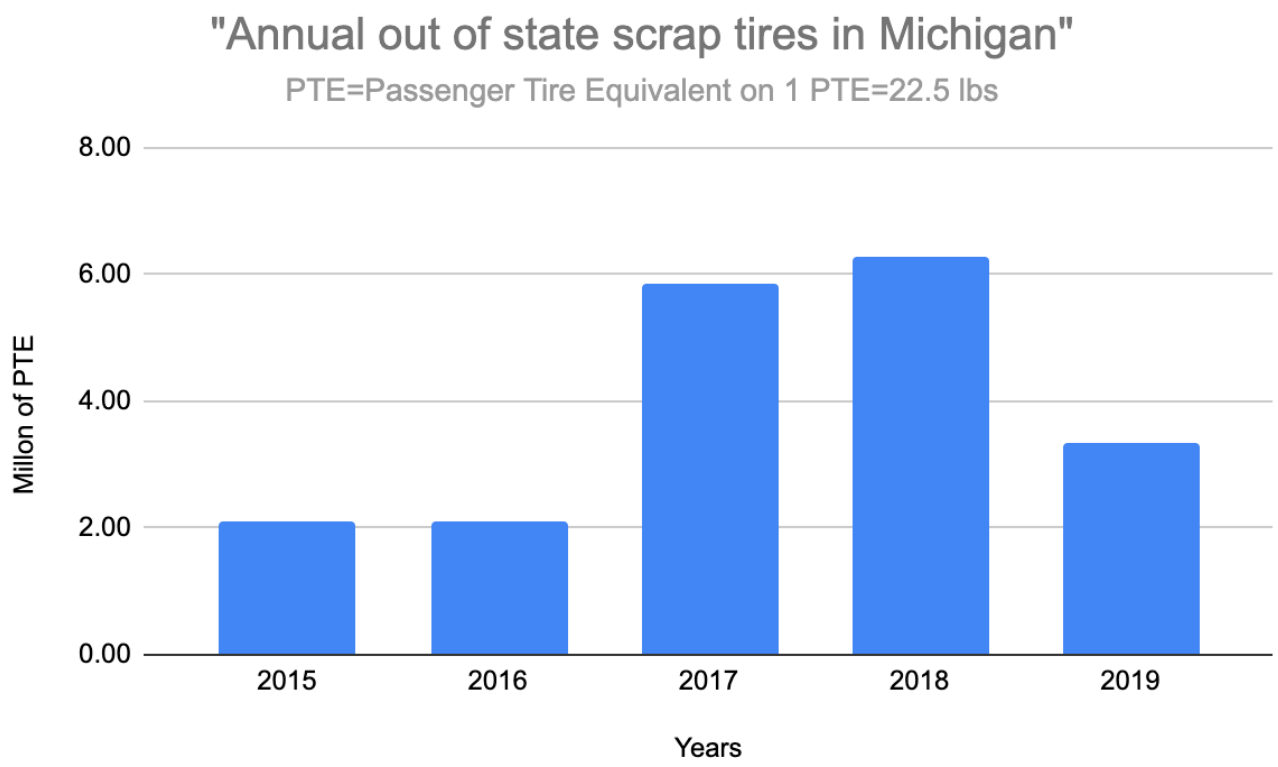

Fig. 7 . "Annual out of state scrap Tires in Michigan"

Data source:Scrap tire report. (2019, March 10). Retrieved from https://www.michigan.gov/egle/0,9429,7-135-3312_4123_4122_4346-235849--,00.html

6. RE-MANUFACTURING

The circular economy defines re-manufacturing as an important step to increasing the life of the product (Ellen MacArthur, 2013). Re-manufacturing takes the components of the used products and creates a new product that can be used like new at a lower cost. (Laurens,2005)

In the case of tires, this process is called "retread" and it is a technology that is commonly used throughout the world. This retread tire optimizes the energy and the material used and makes this a very ecological product. (Geraldo Ferrer,1997)

In the past years, due to low-cost tires being made in China the retread industry has declined. The belief by consumers that these retreaded tires are illegal and unsafe affects the market of this re-manufactured product. However, these products can have a very high quality, especially if they use the standardized manufacturing process (Ferrer,1997).

In Michigan, this industry of retreading is totally legal but in the past years it has decreased as Figure 8 shows. In spite of this, maintaining the residual value of the used tires remains a good opportunity to develop the local economy in the state.

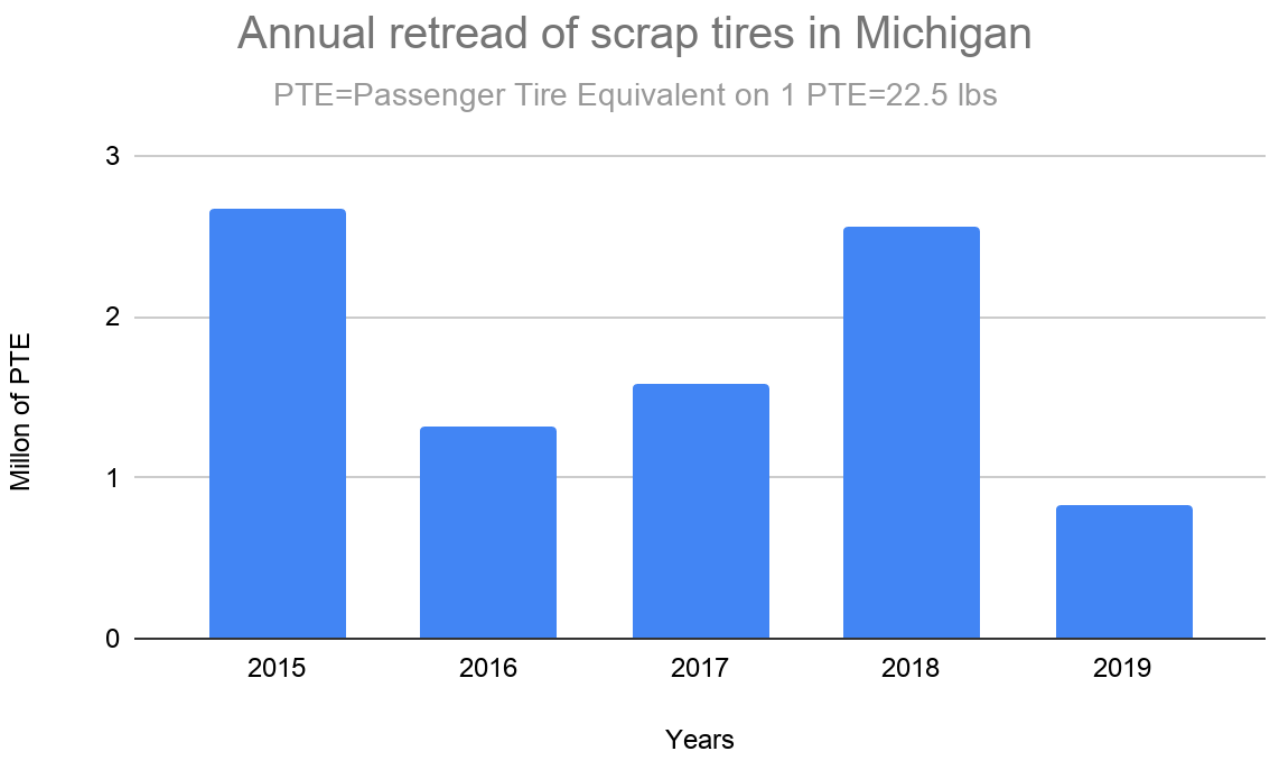

Fig 8. "Annual retread of scrap tires in Michigan"

Data source:Scrap tire report. (2019, March 10). Retrieved from https://www.michigan.gov/egle/0,9429,7-135-3312_4123_4122_4346-235849--,00.html

7. RECYCLING

Recycling used polymers into raw material for the production of new virgin materials with the same properties is one of the most important goals in plastics and rubbers (Haritz, 2018). Also, the framework expressed by the Butterfly methodology defines recycling as one important step to increasing the life of the materials and converting the waste into a new resource to produce a value-added product.

The recycling of tires can be mechanical, chemical, or energy-recovering (Fukumori, 2002). In the US, 43% of the scrap tire recycling involves energy recovery. As is shown in Figure 9, Michigan burned more that 60% of its scrap tires in 2019, and this number has been increasing every year. This method produces more contaminants in some environmental indicators than what would result from collecting them in a landfill. (Feraldi, 2013)

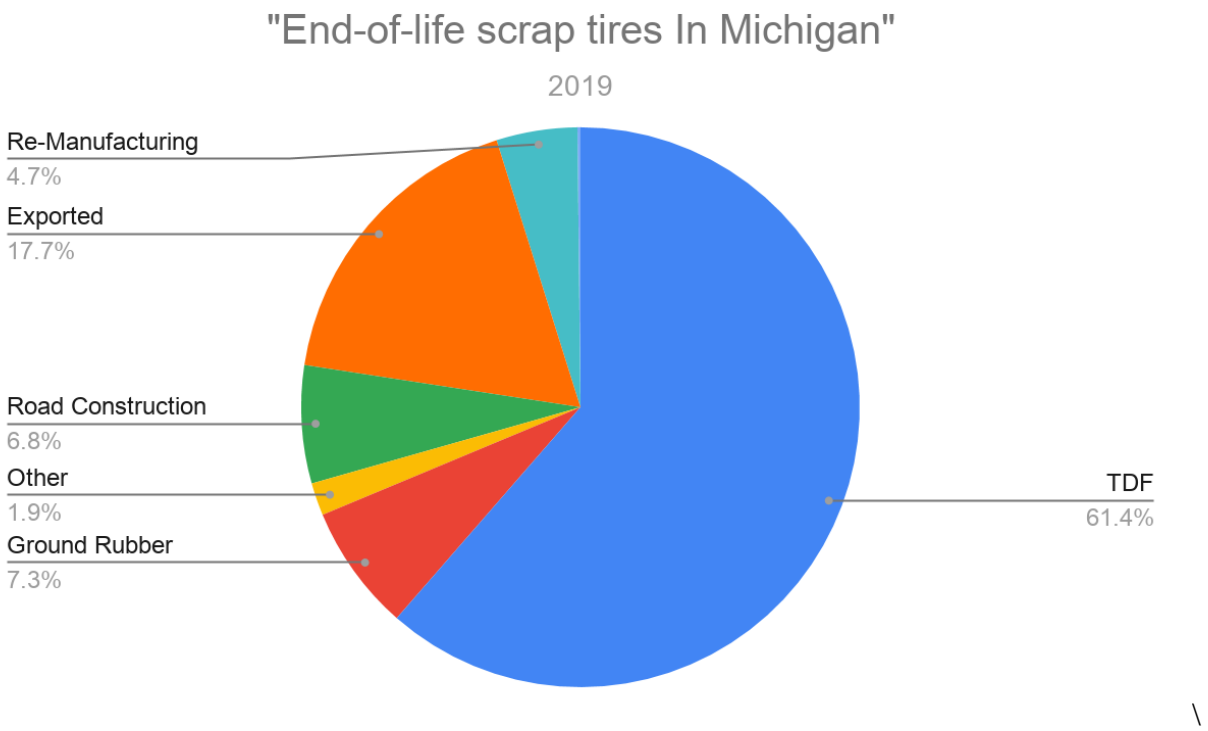

Fig 9. “End-of-life scrap tires in Michigan” 2019

Data source: Scrap tire report. (2019, March 10). Retrieved from https://www.michigan.gov/egle/0,9429,7-135-3312_4123_4122_4346-235849--,00.html

The second largest market for scrap tires, is ground rubber. This mechanical recycling process consists of breaking the rubber and then taking off the nylon and the steel. In 2017, 16% of the scrap tires in the US were converted into ground rubber. By comparison, in 2019 Michigan only converted 7.3% of its scrap tires into ground rubber, none of which was converted into granulated rubber to produce sports and playground flooring.

The principal uses of scrap tires in Michigan are divided into two categories, ground tires and road construction application. In the table 1 we can see the principal uses for mechanical scrap tires presented in the Annual Report of scrap tire management of EGLE, are:

Table 1. EGLE final disposal product of scrap tires in Michigan

Data source: Scrap tire report. (2019, March 10). Retrieved from https://www.michigan.gov/egle/0,9429,7-135-3312_4123_4122_4346-235849--,00.html

Group	Areas
Tire-derived fuel (TDF)	TDF
Ground Rubber	Feed Stock
Ground Rubber	Granules
Ground Rubber	Mulch/Ground Cover
Ground Rubber	Shreds
Other	Used/Grade Tires
Other	Others
Road Construction	Aggregate
Road Construction	Buffings
Road Construction	Crumb
Road Construction	Drain Field
Road Construction	Silage/Sidewall
RE-Manufacturing	Re-Use/Retread
RE-Manufacturing	Stell/Tire Wire

The price of one ton of scrap tires to be burned for energy recovery is 30 USD. If this material was converted into ground rubber this product could be sold for 400-500 USD per ton. The price of value - added rubber products, such as playground flooring or automobile parts increases to more than 1.000 USD per ton in 2019.

8. CONCLUSION

Using a butterfly methodology to describe the circular economy of tires in Michigan we can see that the collection, re-use, re-manufacturing, and remarketing process are working but not as efficiently as it could.

Michigan has a law that defines the waste system management of scrap tires. Even though the system is working, it doesn't have a circular vision and needs a lot of grants and payments for the user to accomplish the goal of keeping scrap tires out of landfills. Also, Michigan has not implemented a policy of Extended Producer Responsibility (EPR) and the responsibility for the disposal of the waste still falls upon consumers.

The Circular Economy approach in Michigan that has taken the responsibility to collect, re-remanufacture, and re-market the used tires has been developed by the private sector. It is supervised and funded by the government of Michigan. It is a system that was born out of regulation and is not supported by the market. It is for this reason that the system needs the support of the government for economic survival.

In Michigan, the majority of used tires are burned for energy recovery (61.4%) which is above the US average (43%) with a high environmental impact. The valorization of ground rubber is low (7.3%) and is below the US Average (16 %). Also, a large percentage of scrap tires are exported, creating value in other countries or states.

This is a good opportunity to implement a value-added project to convert the local waste into local products increasing the circular vision of the economy. A circular vision approach to the actual waste system management could have dramatic financial implications. For example, the value of one ton of products made from scrap tires is worth 30 times the value of a one ton of burned scrap tires.

This study shows how this Circular Economy is an opportunity to create a sustainable world by accomplishing a variety of the UN Sustainable Development Goals. At the same time, this new vision would help create Sustainable Cities (SDG 11) that generate Good Jobs and Economic Growth (SDG 8) through the encouragement of Industry, Innovation, and Infrastructure (SDG 9) that supports a market that is Consumption Responsible (SDG 12). All of this can be accomplished while generating substantial revenue for the state of Michigan.

9. REFERENCES

Arthur H.Purcell.1978.Tire recycling: Research trends and needs.

Navarro Ferronato.2019.Introduction of the circular economy within developing regions: A comparative analysis of advantages and opportunities for waste valorization

Navarro Ferronato.2016. Interdisciplinary approach for introducing sustainable integrated solid waste management system in developing countries: The case of La Paz (Bolivia)

Travis P. Wagner.2013 Examining the concept of convenient collection: An application to extend producer responsibility and product stewardship frameworks.

Liliana Guerrero .2013.Solid waste management challenges for cities in developing countries.

Anne Leppänen.1996.Final Results of Road Traffic in Winter Project: Socioeconomic Effects of Winter Maintenance and Studded Tires

Ellen MacArthur Foundation, 2013 Towards the Circular Economy Vol. 1:The Economic and business rationale for an accelerated transition

Ellen MacArthur Foundation, 2013. Towards the Circular Economy Vol. 2: Opportunities for the Consumer Goods Sector.

Ellen MacArthur Foundation, 2014. Toward the Circular Economy Vol. 3: Accelerating the Scale-up across Global Supply Chains.

Ellen MacArthur Foundation, 2015. Circularity Indicators: an Approach to Measuring Circularity

The Michigan Department of Environment, Great Lakes, and Energy (EGLE),2019.Scrap tire report. (EGLE 2019, March 10).

Retrieved from https://www.michigan.gov/egle/0,9429,7-135-3312_4123_4122_4346-235849--,00.html