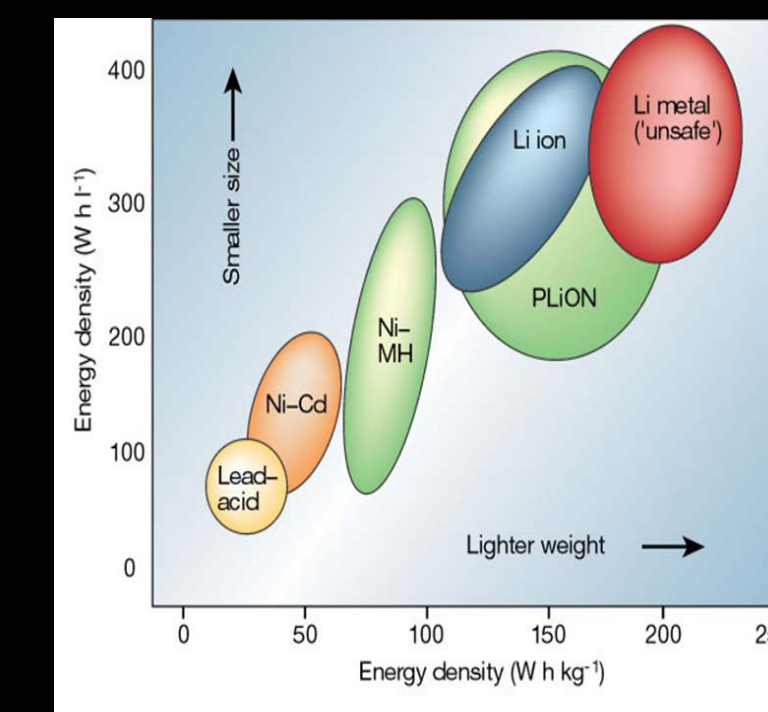
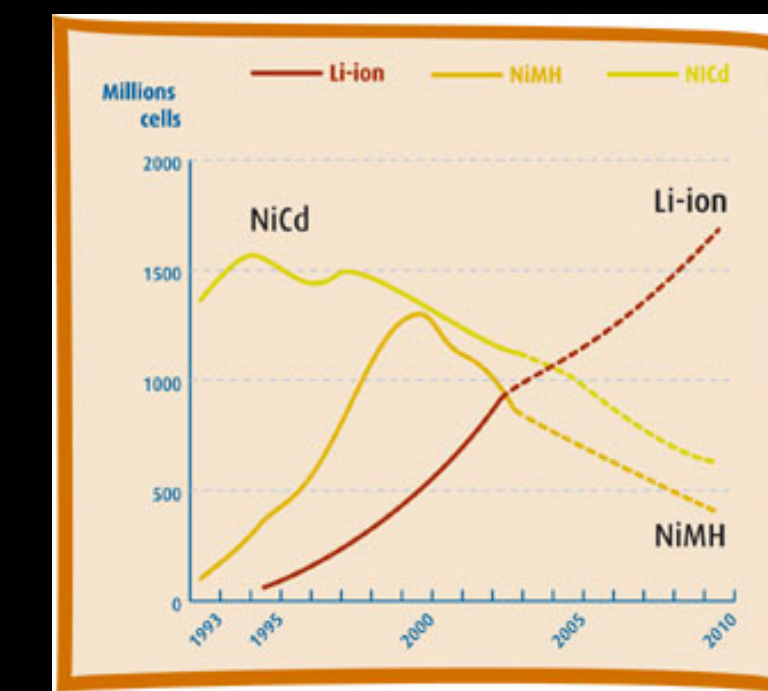


### Abstract

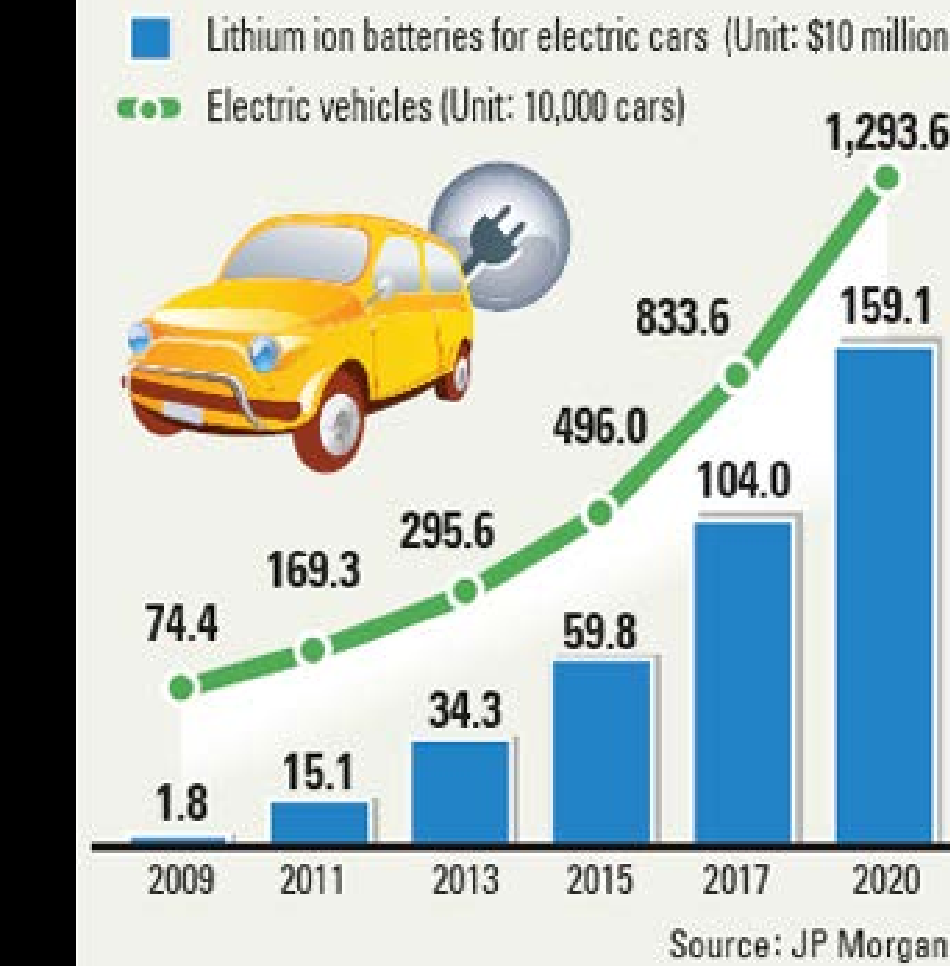
Lithium-ion batteries are quickly becoming the dominant product in the rechargeable battery industry. As global production of these batteries increases, so does the rate at which the materials used to make them is depleted. Upon reaching end-of-life, most lithium-ion batteries make their way into the municipal waste stream, their components wasted. Others saw this problem and have developed exceptional processes by which lithium-ion batteries can be recycled. Despite these processes being available, the incentive to recycle is not, and the lack of supply to recycling companies renders the processes unprofitable. This project endeavors to provide the framework by which incentives to increase the recycling of lithium-ion batteries can be implemented.



### Questions Asked

- ❖ How are lithium-ion batteries being recycled today?
- ❖ What is the main problem faced with recycling lithium-ion batteries?
- ❖ What kind of recycling infrastructures are already in place?
- ❖ How is the market for lithium-ion batteries changing?
- ❖ Are there any environmental hazards involved with the recycling of lithium-ion batteries?
- ❖ Why is there a lack in the recycling of lithium-ion batteries?

### Future of the electric car and lithium ion battery markets



### Information Gained

- ❖ Umicore and Kinsbursky Brothers currently have the technology for effectively recycling lithium-ion batteries.
- ❖ Environmental effects depend on method of disposal of recycling byproducts
- ❖ **Major issue:** Lack of supply of end-of-life batteries.
  - Lithium-ion batteries being disposed of in landfills rather than being recycled.

### Background

**NOT** classified as "hazardous waste" products by the US Environmental Protection Agency (EPA)

Over **2 billion** landfilled in US each year

Market rapidly growing due to the increasing demand for electronic and portable devices.

**Issue:** Lack of supply of end-of-life batteries.

Why use lithium-ion batteries?

- ❖ High energy density – ability to store more charge in a smaller space
- ❖ Available in a variety of shapes and sizes
- ❖ Extremely light in weight
- ❖ Lower self-discharge rate

### Recommendation

*Create infrastructure to incentivise the recycling of lithium-ion batteries.*

*Increase public awareness of recycling programs, benefits, necessity for recycling, and environmental sustainability.*

#### What Others Have Done

Government mandated recycling of lithium-ion batteries



#### Our Approach

Tax incentivized recycling of lithium-ion batteries from state governments

The risks involved with not recycling batteries are uncontrolled (for example, batteries combusting in a landfill while no one is watching), while the downsides of recycling are known and planned against.

Our solution to the problem works through the idea of providing rewards for recycling rather than a requirement that reprimands people if they don't recycle.

### Conclusion

People are much more likely to respond to incentives rather than imposed requirements. This is the overarching basis of the solution proposed in this project. The idea of recycling is usually associated with the extra work needed to reclaim the materials of the recycled product. The proposed solution of a minimal tax to be refunded on return of the battery breaks this mindset in a fashion similar to the bottle collection system, with perceived rewards for doing the right thing. Studies of the methods by companies, such as Kinsbursky Brothers and Umicore, have revealed that the downsides to these recycling processes are minimal, and increasing the supply of end-of-life material to these companies would be beneficial for both the supply stream of materials and the environment.

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### Methodology

**Research:** Summon, Google Scholar

**Determine focus:** Policies of battery recycling

**Interviews:** Dr. Novis Smith, Mark Caffery, Prof. Yan Wang

**Develop recommendation:** Tax incentives

### Acknowledgements

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