



## Lithium-based Battery Fire Threat to U.S. Single Stream Material Recovery Facilities

Materials Recover Facilities (MRFs) process single stream recycling across the country. Increasingly, these facilities are experiencing fires, some catastrophic. Lithium batteries are believed to be the main cause of increasing fire frequency at MRFs, based on available research and supported by recent interviews with a large percentage of MRF operators. Due to public misconceptions on how to manage lithium batteries at their end of life, an alarming amount arrive commingled with single-stream recyclables. According to operators who regularly count their presence in the recycling stream, single stream MRFs receive dozens of misplaced lithium batteries each day.

From collection to receipt and processing at the MRF, lithium batteries experience physical abuse; loading, compacting, unloading, sorting, baling, stacking, crushing, and densification. This abuse can damage the lithium battery, often leading to thermal runaway. Even “dead” batteries can experience thermal runaway. Thermal runaway is a chain reaction of the battery chemicals that produces more heat resulting in more reaction, creating even more heat. This can occur incredibly fast, within milliseconds. As a result, the batteries can explode and start fires, igniting both the battery and any flammable materials nearby. MRFs contain an abundance of flammable material, such as recyclable paper and plastic. Between the potential damage to lithium batteries and the presence of paper and plastic, lithium battery fires at MRFs can be severe and present long-lasting implications for essential public services.

While associated mainly with electronics, lithium battery use has dramatically increased over the past ten years, growing in the variety of products used. Additionally, the size of the batteries has shrunk as engineers pack more energy into smaller packages. Lithium battery use is expected to continue to increase, with a six-fold growth anticipated between 2022 and 2030. With increased growth in lithium battery usage and energy density, MRF fires will happen more often unless sweeping efforts are made to address the issue.

RRS evaluated the frequency and financial impacts caused by these fires. Based on available documentation, interviews with MRF operators, insurance providers, and other experts on the matter, RRS’ analysis found the following:

1. Fire frequency:
  - A. Currently, according to a broad sampling of MRF operators, on average, each MRF has more than 18 fires per year. This number is expected to increase in the future unless broad efforts are made to address the fires.
  - B. With just under 300 operating single stream facilities nationwide, it is estimated over 5,000 MRF fires occur annually.
  - C. Small MRF fires are handled by staff without calling the fire department and cost around \$2,600 for each fire.
  - D. Major MRF fires can destroy facilities completely and cause over \$50 million in damage.
  - E. More than 1% of MRFs experience a catastrophic loss every year! The damage from the average catastrophic fire averages \$22 million.
  - F. The rate of catastrophic losses has increased by 41% in the last five years. With lithium batteries increasing by six-fold, this number could increase significantly over the next decade.
2. Property insurance impacts:
  - A. Actual MRF property insurance rates do vary widely and are dependent on the size of the MRF company, loss rate, and how different types of insurance are bundled together. However, on the open market, stand-alone MRF property insurance has increased between 10-50 times due to fires, from a range of \$0.15 to \$0.18 dollars per hundred insured value to a range of \$1.80 to \$10 per hundred dollars; and costs between \$7.50-\$40 per ton of recyclables processed.
    - i. The numbers are increasing and are expected to grow if the problem continues. Consequences may likely include the inability of single stream MRFs obtaining property insurance.
    - ii. By comparison, a homeowner with a \$400,000 home would need to pay between \$7200-\$40,000 each year for their homeowner’s insurance.