

PROPERTIES AND BENEFICIAL USAGE OF FLAT GLASS WASTE

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BACKGROUND

FLAT GLASS

- GLASS IS CLASSIFIED AS NON-BIODEGRADABLE WASTE BUT CAN BE RECYCLED, MAKES UP ~4% OF NYS WASTESTREAM
- LARGE PIECE OF GLASS THAT CAN BE USED FOR LARGE WINDOWS, DOORS, COUNTERTOPS, ETC.
- FRAGILE NATURE —> BROKEN PIECES OF GLASS IS SEEN AS UNUSABLE AND OFTEN DISPOSED OF.
- THESE SHATTERED PIECES CAN BE UNSAFE TO WORK WITH AND CONTAMINATION BY CONSTRUCTION DEBRIS CAN MAKE IT HARD TO REUSE.

ENERGY TO RECYCLED GLASS < ENERGY TO MAKE FROM RAW MATERIALS

CHEMICAL COMPOSITION:

- SILICA (SiO_2) AND OXIDES SUCH AS Na_2O , CaO , Al_2O_3
- ADDITIONAL ADDITIVES TO ENHANCE QUALITIES (SUCH AS LAMINATES) AND POTENTIAL CONTAMINANTS SHOULD BE CONSIDERED



BENEFICIAL USE OPTIONS

RECYCLING/ REUSE PATHWAYS

- **CONCRETE DESIGN - POZZOLANIC AGGREGATE**
 - LOWER SPECIFIC GRAVITY COMPARED TO NATURAL AGGREGATES, CAUSES LOWER SLUMP DENSITY
 - CAN ENHANCE COMPRESSIVE AND FLEXURAL STRENGTH WHILE REDUCING WATER ABSORPTION AND DRYING SHRINKAGE
 - INCREASES THE MODULUS OF ELASTICITY
 - CULLET AGGREGATES HAVE LOWER THERMAL CONDUCTIVITY THAN NATURAL AGGREGATES



- **PARTIAL CLINKER REPLACEMENT**
 - HIGH SILICA CONTENT PROMOTES POZZOLANIC ACTIVITY AND REDUCES REQUIRED CLINKER
 - GLASS OBSERVED TO PRODUCE A COMPOUND THAT WOULD INCREASE THE SETTING TIME OF CONCRETE AS WELL AS REDUCE THE STRENGTH
- **ADDITIVE TO BRICK MATERIAL PRODUCTION**
 - THE OPTIMAL MIX RATIO WAS FOUND TO BE 1:3:2 (CEMENT, COARSE SAND, AND GLASS)
 - PRODUCING BRICKS THAT MET THE REQUIRED STANDARDS FOR DIMENSIONS, WARPAGE, ABSORPTION, AND COMPRESSION.
- **CERAMICS**
 - CAN PRODUCE A PORCELAIN TILE OF ~80% WASTE CONTENT= REDUCED RELIANCE ON MINED MATERIALS BY 16%, WATER SAVING (50%) AND ENERGY CONSUMPTION (20%)
 - AGGREGATE NATURAL RESOURCE AND ENERGY REDUCTION OF 86%.
 - PROPERTIES COMPARABLE TO CONVENTIONAL PORCELAIN TILES: VITRIFICATION, LOW WATER ABSORPTION, MECHANICAL STRENGTH
- **SECONDARY FILTER TO FILTER WATER**
 - REPLACEMENT FOR SAND IN WATER FILTRATION SYSTEM, REMOVED 90% TO 95% OF SOLIDS AND CHEMICALS IN WASTEWATER
 - PERFORMED MUCH BETTER THAN THE SAND FILTER IN TERMS OF TOTAL NITROGEN REDUCTION, AT 1.5 TIMES
 - HOWEVER, LIKELY TO BE LESS EFFECTIVE DUE TO DEBRIS THAT MAY BE LEFT ON GLASS
- **PHOTOVOLTAIC GLASS SHEETS**
 - TRANSPARENT SOLAR PANELS THAT GENERATE ELECTRICITY BY CONVERTING SUNLIGHT INTO POWER WHILE FUNCTIONING AS A WINDOW OR BUILDING FACADE
 - RECYCLED GLASS CAN BE USED REUSED INTO PV GLASS

ENVIRONMENTAL IMPACTS

NYCEDC CIRCULAR CONSTRUCTION GUIDELINES

- GOAL TO ACHIEVE REDUCED EMBODIED CARBON BY A 50% CUT
- CLIMATE MOBILIZATION ACT IN 2019 AND LOCAL LAW 97
 - FOCUS ON BUILDING EMISSIONS TO REDUCE GREENHOUSE GAS EMISSIONS
 - **GOAL TO BE CARBON NEUTRAL BY 2050**
- ~13% CO2 EMISSIONS FROM CONSTRUCTION AND DEMOLITION
- IN NYC, CONSTRUCTION AND DEMOLITION WASTE MAKE UP ~60% OF LOCAL WASTE STREAM
- CLEAN CONSTRUCTION EXECUTIVE ORDER 23 OF 2022 55 COMMITTING ALL CITY CAPITAL PROJECT AGENCIES TO DEVELOP ACTION PLANS TO INCORPORATE LOW-CARBON CONCRETE SPECIFICATIONS

NEW YORK STATE SOLID WASTE MANAGEMENT PLAN

- PROPOSAL FOR CIRCULAR ECONOMY, INCORPORATING RECYCLED MATERIAL INTO CONSTRUCTION DESIGN.
- PREVENT ENVIRONMENTAL DEGRADATION AND ECONOMIC LOSS BY KEEPING VALUABLE MATERIALS CIRCULATING WITHIN THE ECONOMY

2018 Waste Generated by Waste Type

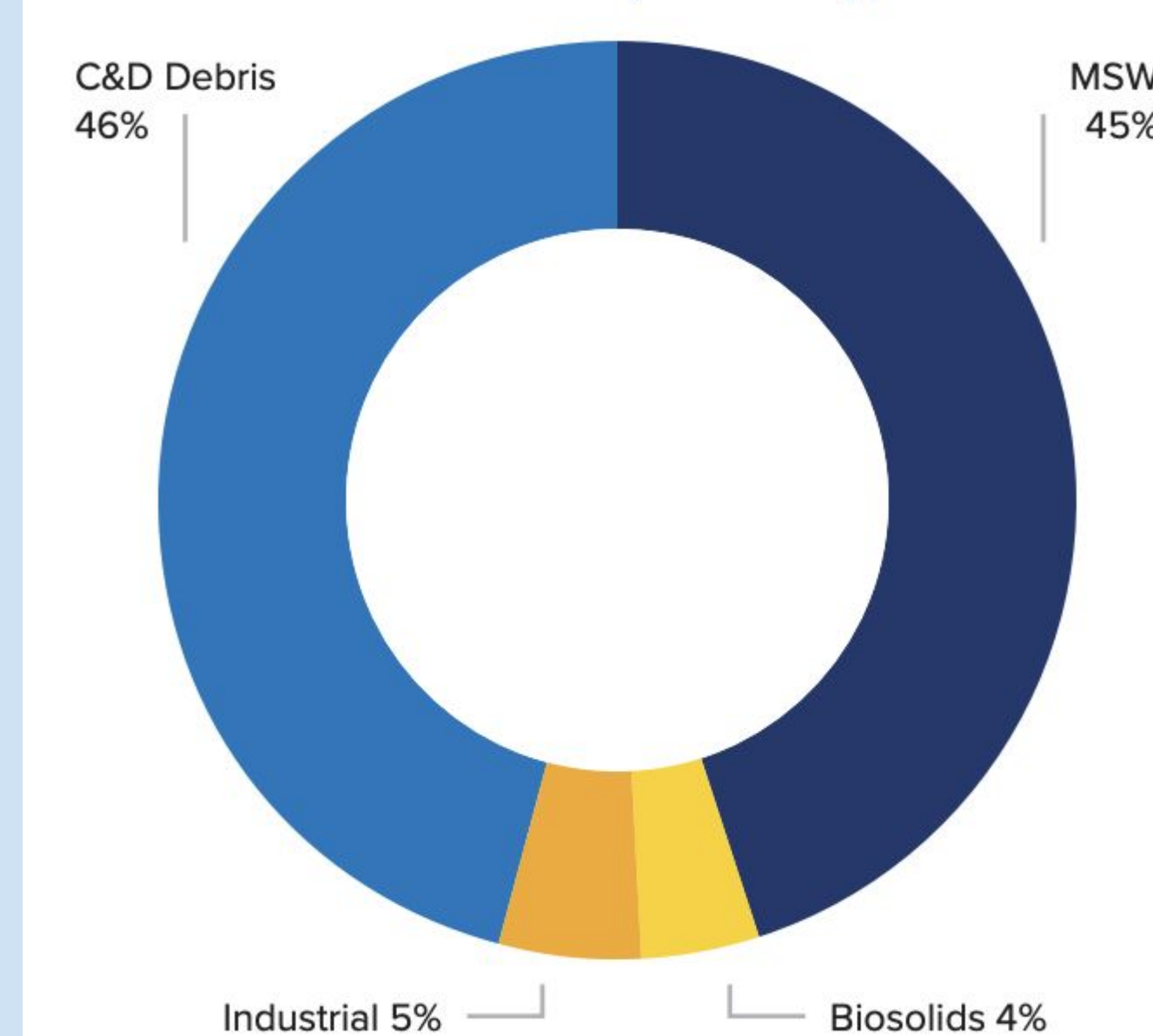


Figure 3.2. 2018 Waste generated by waste type in New York State

Recycling Rate for Total Waste Stream Generated in New York State

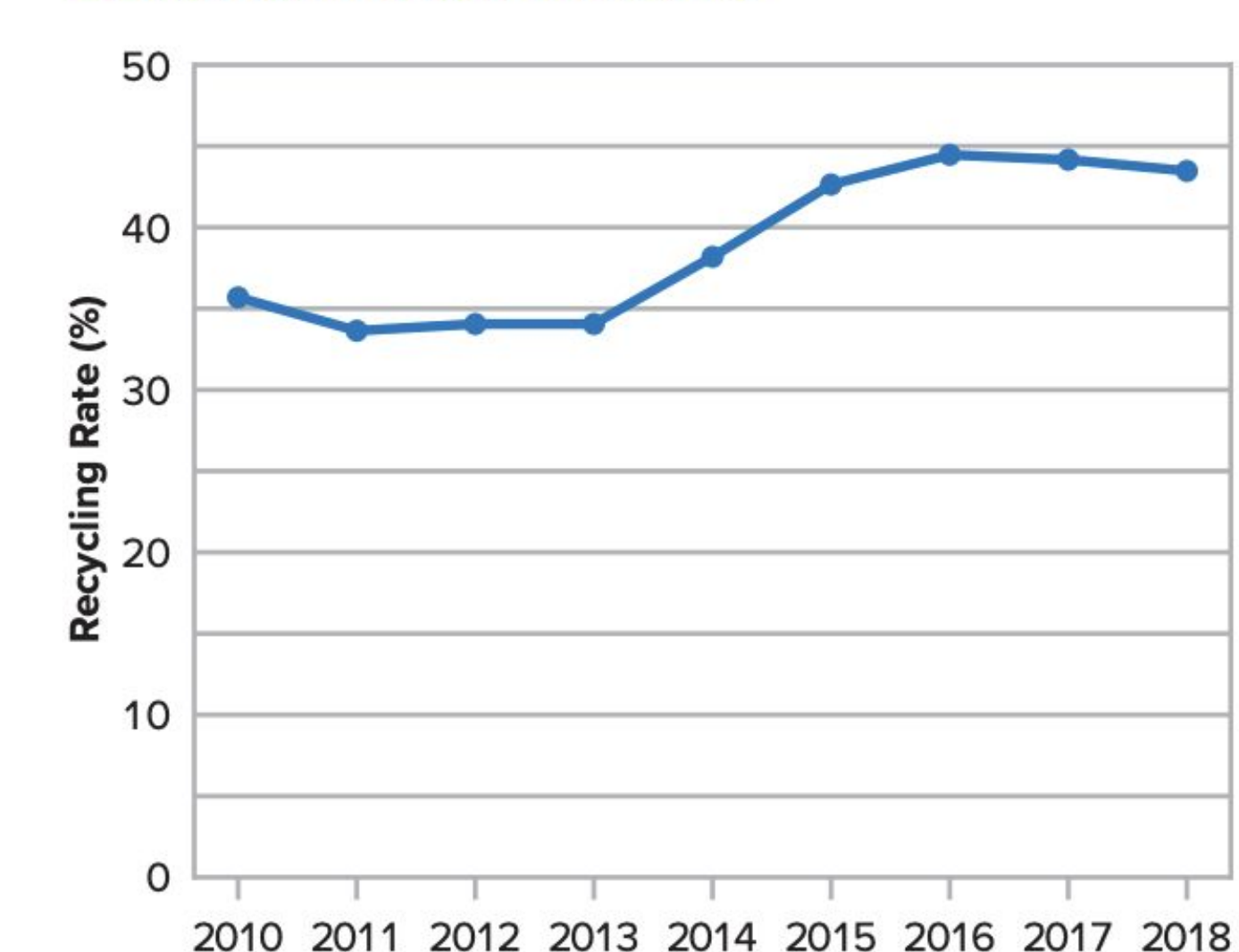
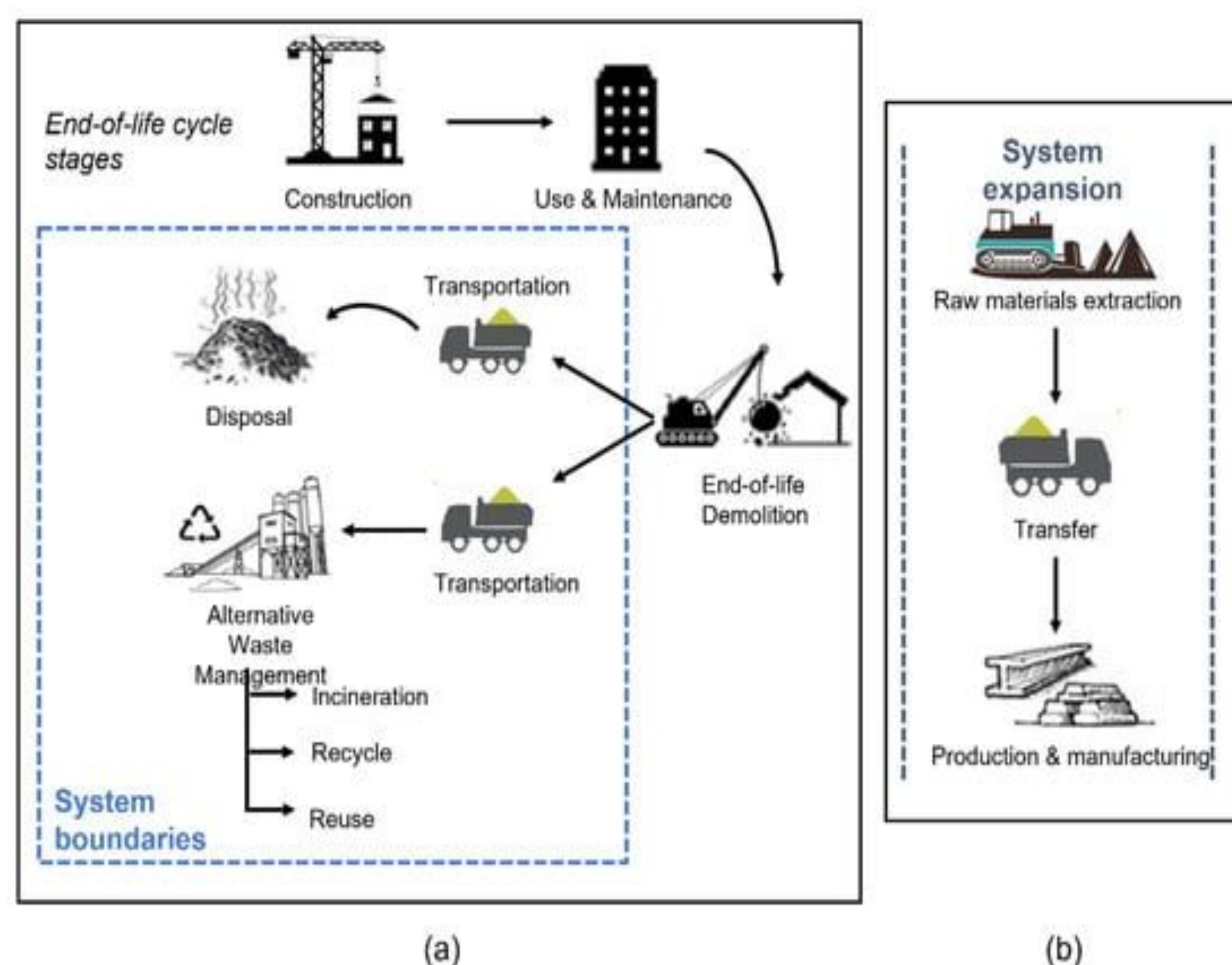


Figure 3.3. Recycling rates for the total waste stream in New York State 2010–2018

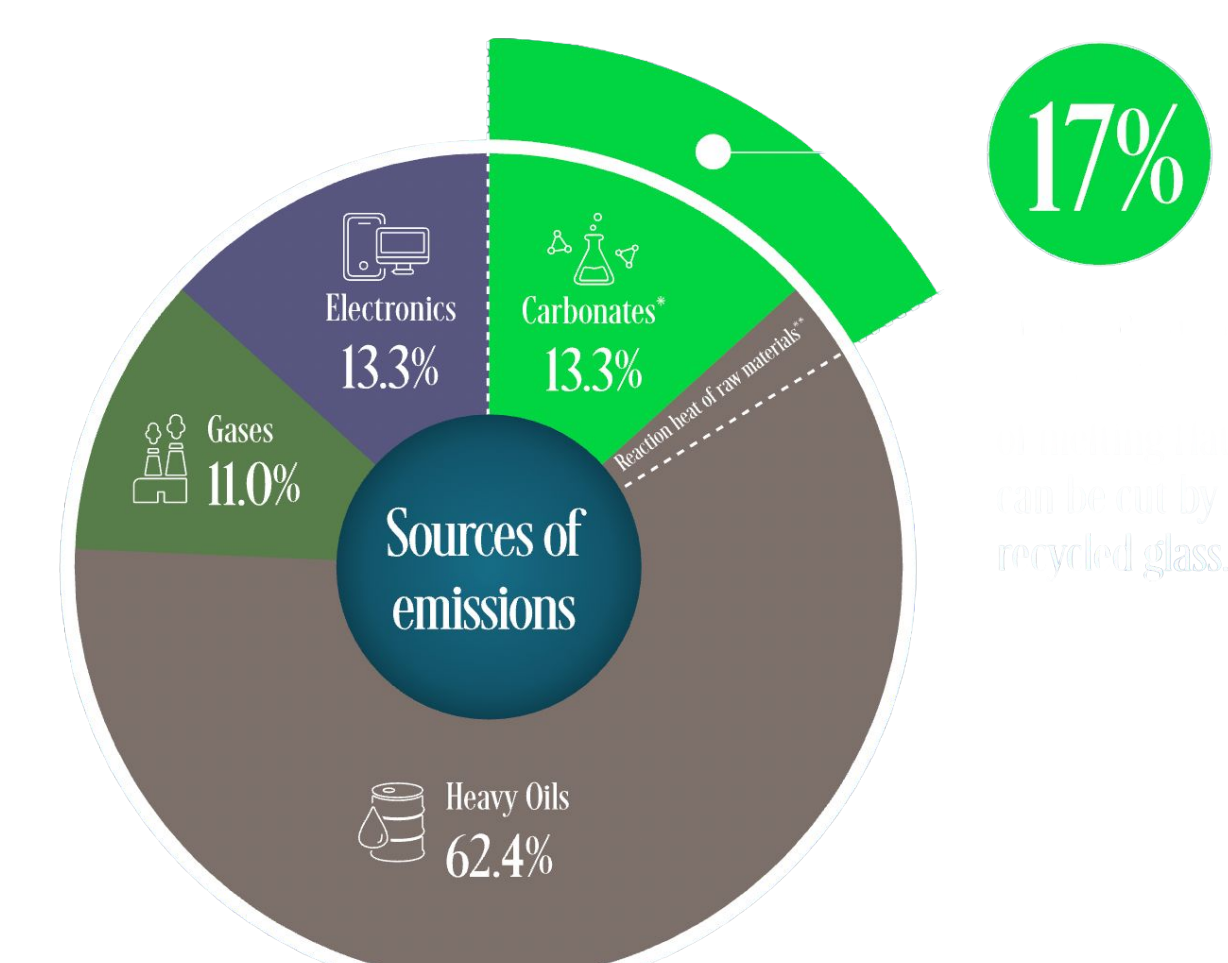
DISPOSABLE PATHWAYS

AFTER CONSTRUCTION AND DEMOLITION PROCESSES, IF GLASS IS NEEDED TO BE DISPOSED OF, IT WILL LIKELY GO TO LANDFILL OR RECYCLING FACILITY.



PROPOSED METHODS WOULD:

- REDUCE LANDFILL WASTE BY
- DIRECTING GLASS BACK INTO
- CONSTRUCTION DESIGN
 - CONCRETE, ASPHALT, BRICK,
 - CERAMICS
- CONSERVES NATURAL RESOURCES
 - SILICA, SODA ASH, LIMESTONE
- LOWERS GREENHOUSE GAS EMISSIONS
 - VIRGIN GLASS MANUFACTURING IS
 - HIGHLY ENERGY-INTENSIVE
 - (HIGH MELTING POINT)



17% OF SCOPE 1 AND 2 CO2 EMITTED IN THE PROCESS OF MELTING FLAT GLASS CAN BE CUT BY USING RECYCLED GLASS