Developing an understanding of electronic waste flow for the United States

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Introduction

- Quantity and variety of discarded electronic items in the US continue to increase due in part to the accelerated average life cycle for such materials.
- Combinations of hazardous materials, toxic materials, and valuable elements such as precious metals and rare earth elements can be found in electronic products.
- Disposal of used electronics has significant attendant human health risks. Presently, there is Incomplete information for electronics products across their lifecycle.
- Sustainable management of this highly waste/reuse stream material calls for a more comprehensive understanding of material flows

National Strategy for Electronics Stewardship

"Better management of electronics through the product lifecycle…to prevent environmental harm, conserve valuable resources, save money, create jobs, and invest in our economic development " 2011

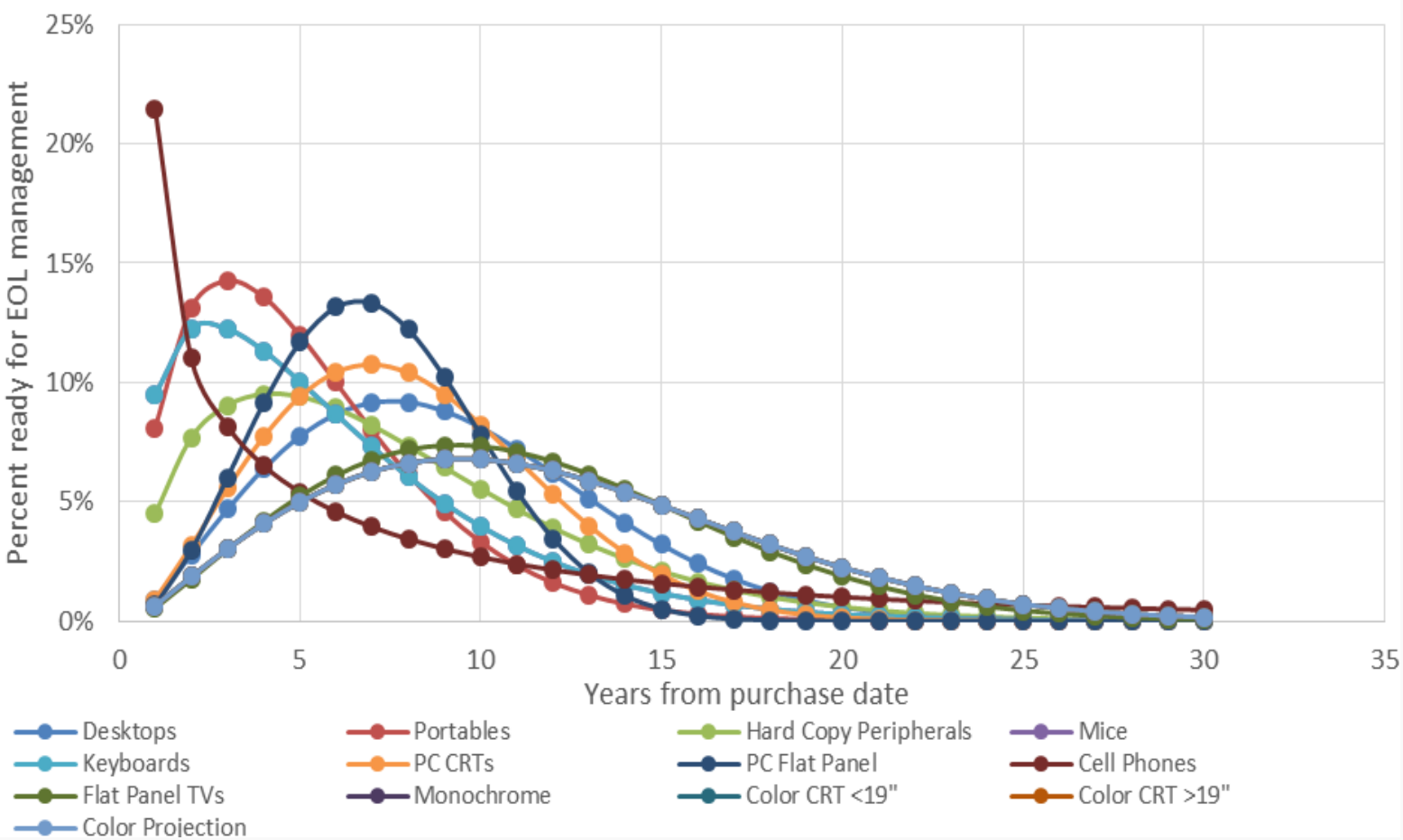
Action #3	**Increase Safe and Effective Management and Handling of Used Electronics in the U.S**

Impetus

- 400 iPhones' Worth of E-Waste a Year trashed by each U.S. family
- For 2016, the world e-waste average was 13.5 pounds (6.1 kilograms) per person, or for a family of four 54 pounds (24.5 kg) or the average American/Canadian family wasted 3.3 times .
- Some 30 % of the e-waste in the U.S. goes to landfill, incineration, informal recycling, exported or disposed indiscriminately. The fate of 80 % of the world's e-waste in 2016.
- The potential recovery of cell phone metals could yield an estimated 5.3 pounds (2.4 kilograms) of gold, more than 1,984 pounds (900 kilograms) of copper, 55 pounds (25 kilograms) of silver, and more. That's about $250,000 dollars' worth of metals, depending on current prices.

Global-E-waste Monitor 2017

Percentage of Products Ready for End-of-life Management after Each Year of Sale

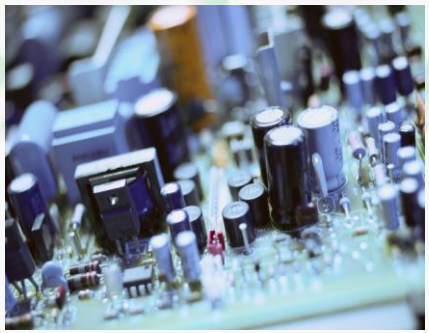


Objectives

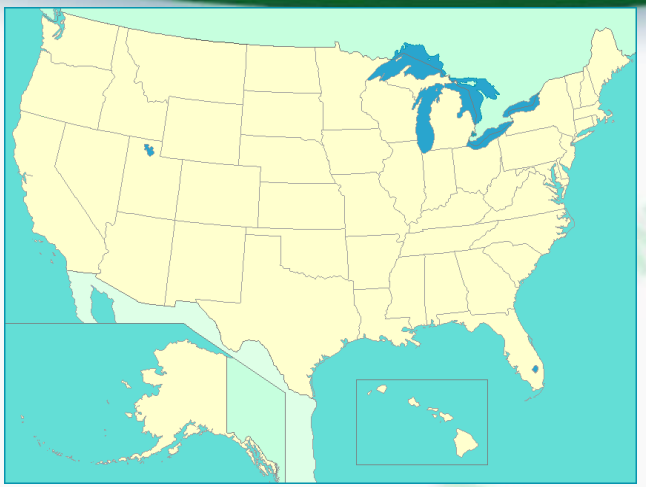
- Assess the flow of historic, current, and potential future quantities of used electronics and electronic waste
- Assess the potential effects of the state-level electronics recycling requirements (e.g., benefits and drawbacks)
- Evaluate the existing methods for quantifying and tracking used electronics
- Develop an information-based method for estimating the flow of used electronics and electronic waste within the U.S. using data generated at the state level
- Provide information and support for decision making

Approach

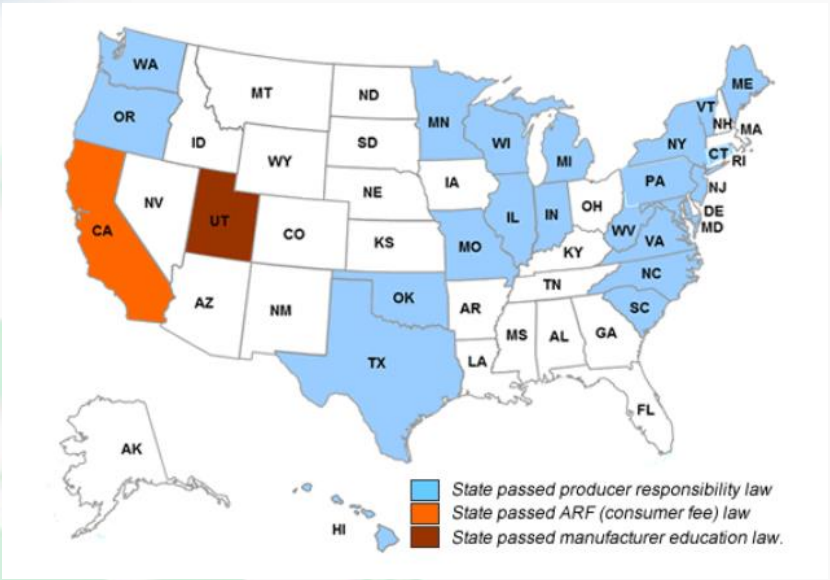
- Select a representative sampling of states that will serve as the proxy for assessing the practice of used electronics management across the U.S.
- Assemble available information about the generation, recycling, export, recovery, reuse, and downstream flow of used electronics
- Develop a flow model, identify data gaps, and devise methods to estimate, or ascertain, unavailable data
- Assess environmental and economic impacts of the e-stewardship programs for the selected states.



Selection of Research Focus



50 states



26 states with e-laws

5 selected for assessment study

Midwest Cluster Details

A range of regulatory approaches including the absence of state regulations.

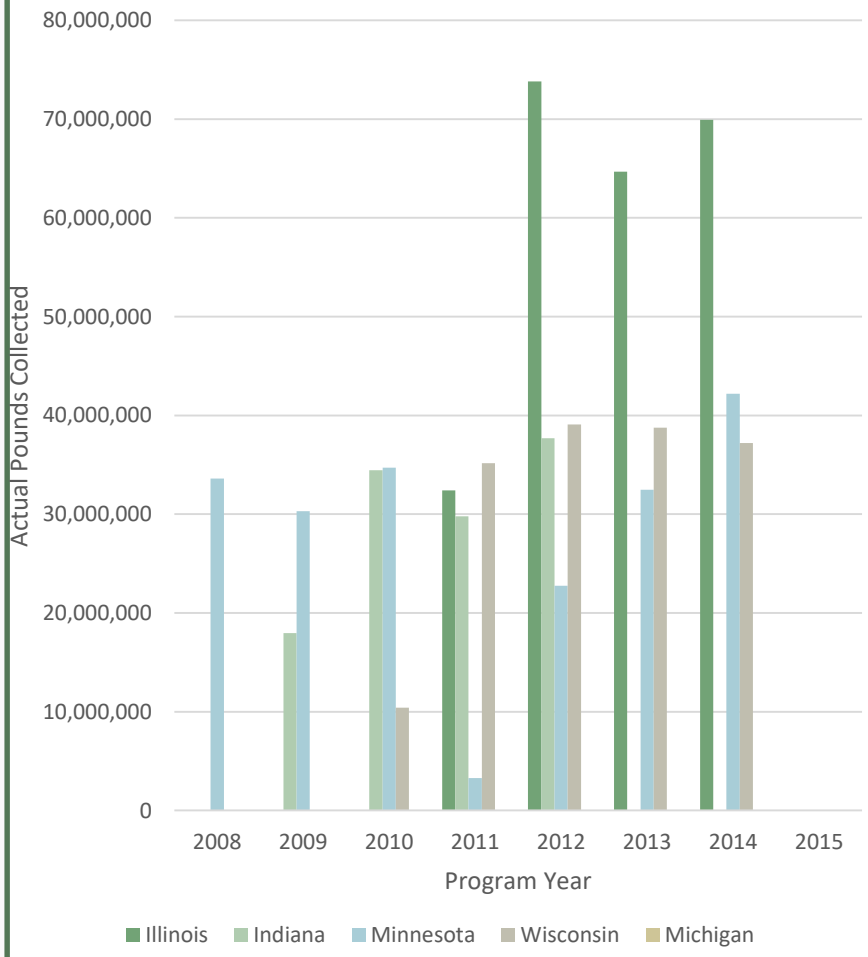
The selected Midwest states have similar e-waste legislation with the exception of Ohio which has no state regulations for e-waste.

Information for used electronic and e-waste flows found:

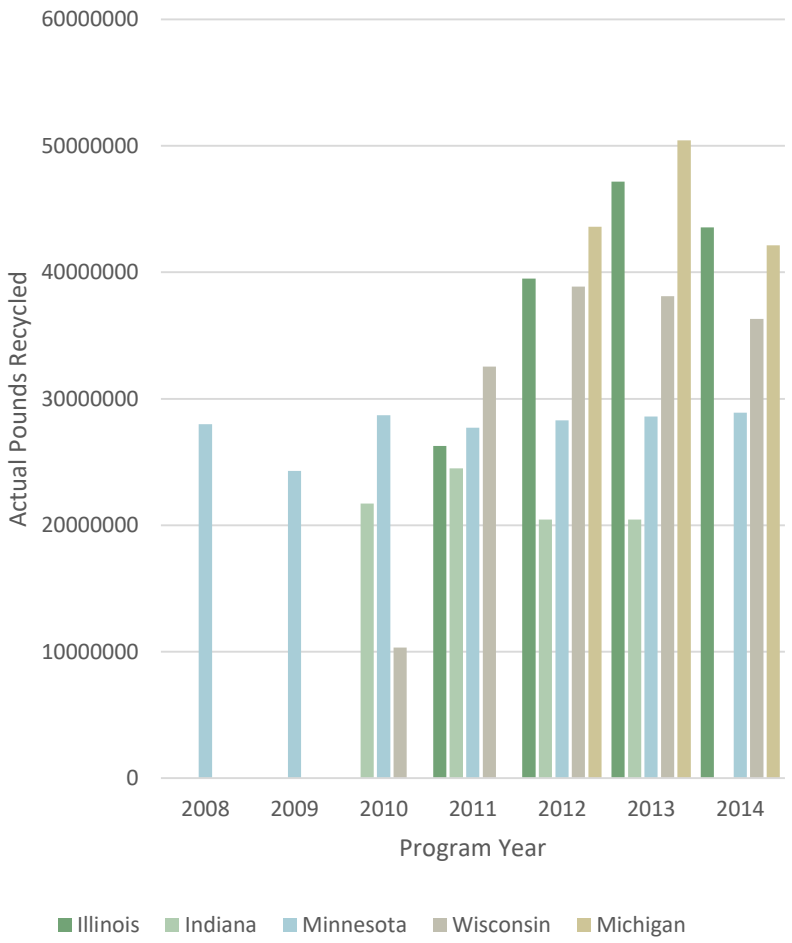
- Region-wide (MN, WI, IL, MI, IN, OH)
- Focus on select states (e.g. WI, MN)
- County focus (Hamilton County, OH)

Collection and Recycling of Electronic Devices

Collected



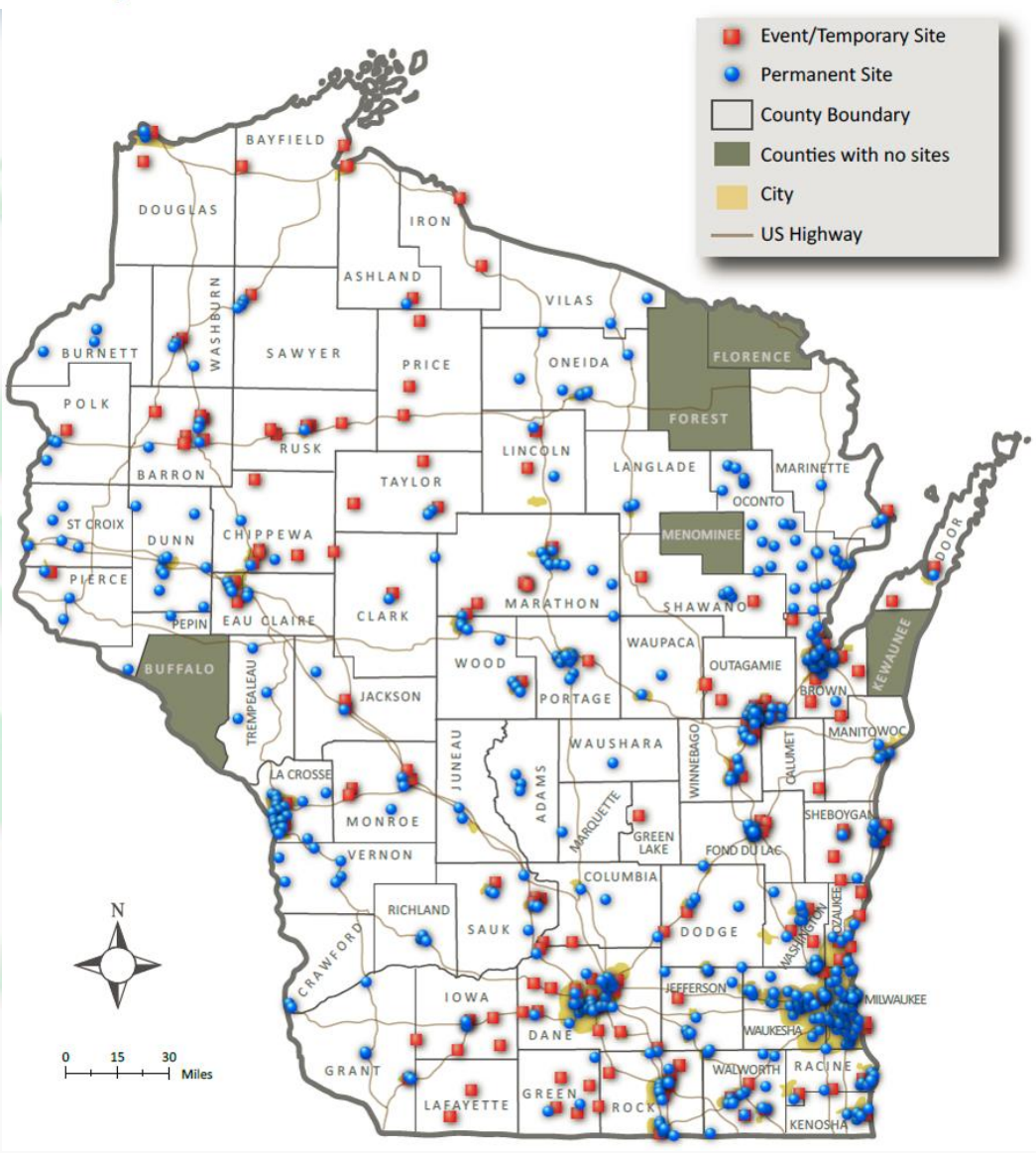
Recycled



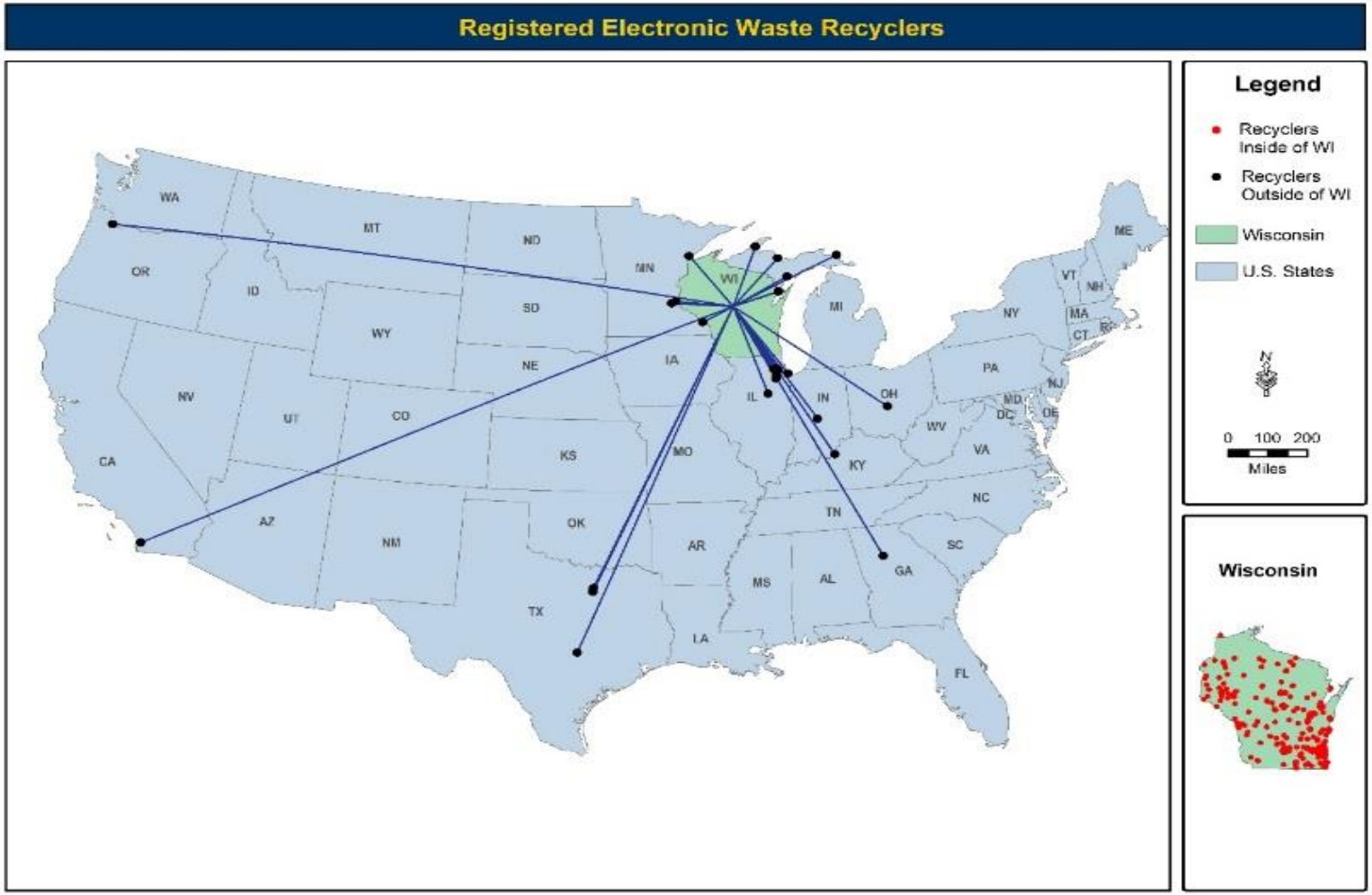
Data collection varies by state, Better data on recycled material, data incomplete

Wisconsin E-Cycle Program Collection Sites

- Landfill and incinerator bans
- 130+ registered collectors with about 400 collection sites
- 25 registered recyclers
- 115+ registered manufacturers with nearly 200 brands



E-Waste Shipments from Wisconsin



Summary of the Midwest E-cycling Programs

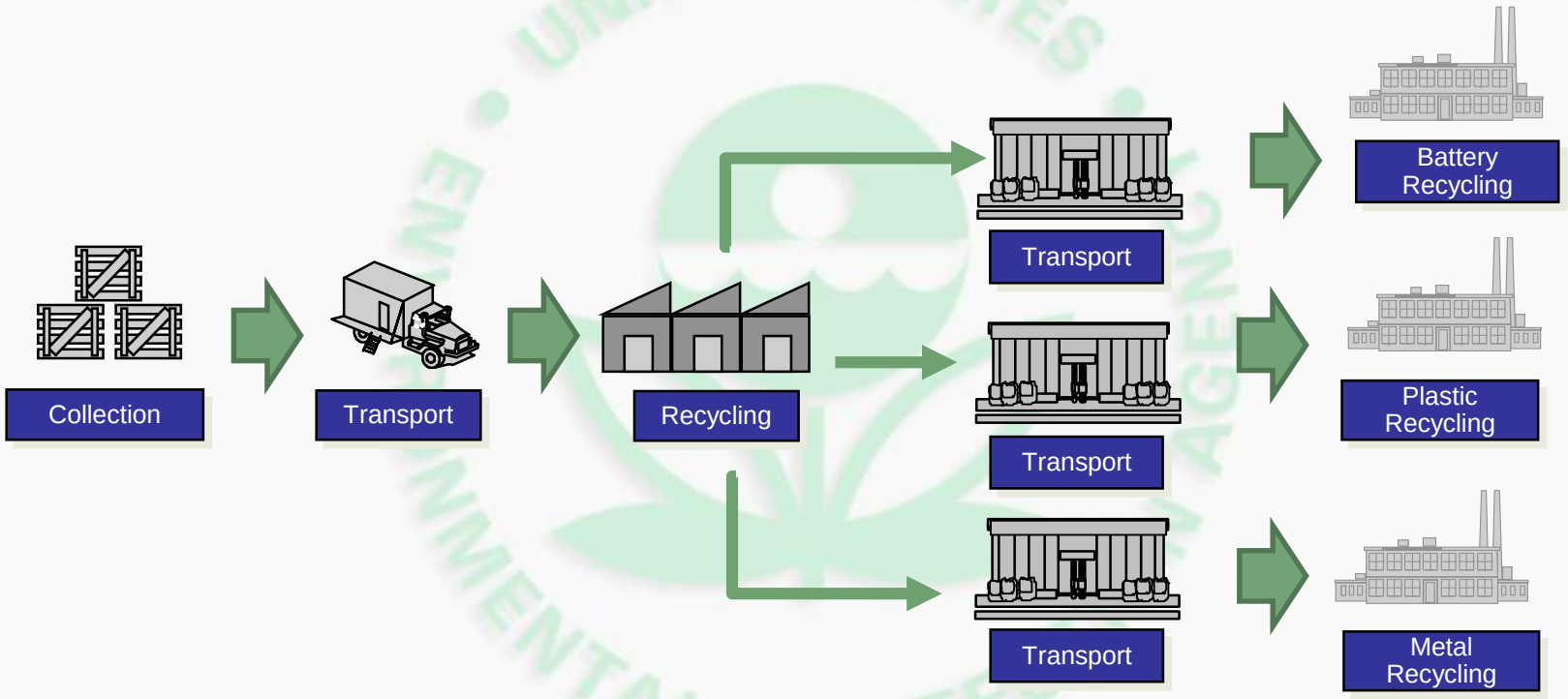
- High collection volumes for states with convenient collection and established goals
- Encourage and support a variety of collectors, [government, NGO, school, universities and businesses]
- Many new hand held devices are not in the program
- Little incentives for product reuse and rural collection
- Low performance measures limit recycle (e.g. Illinois)
- Increased public awareness and disposal ban to increase recycling
- Expand certification and standards to ensure best practices

Manufacturer Registration Requirements for the Midwestern Programs

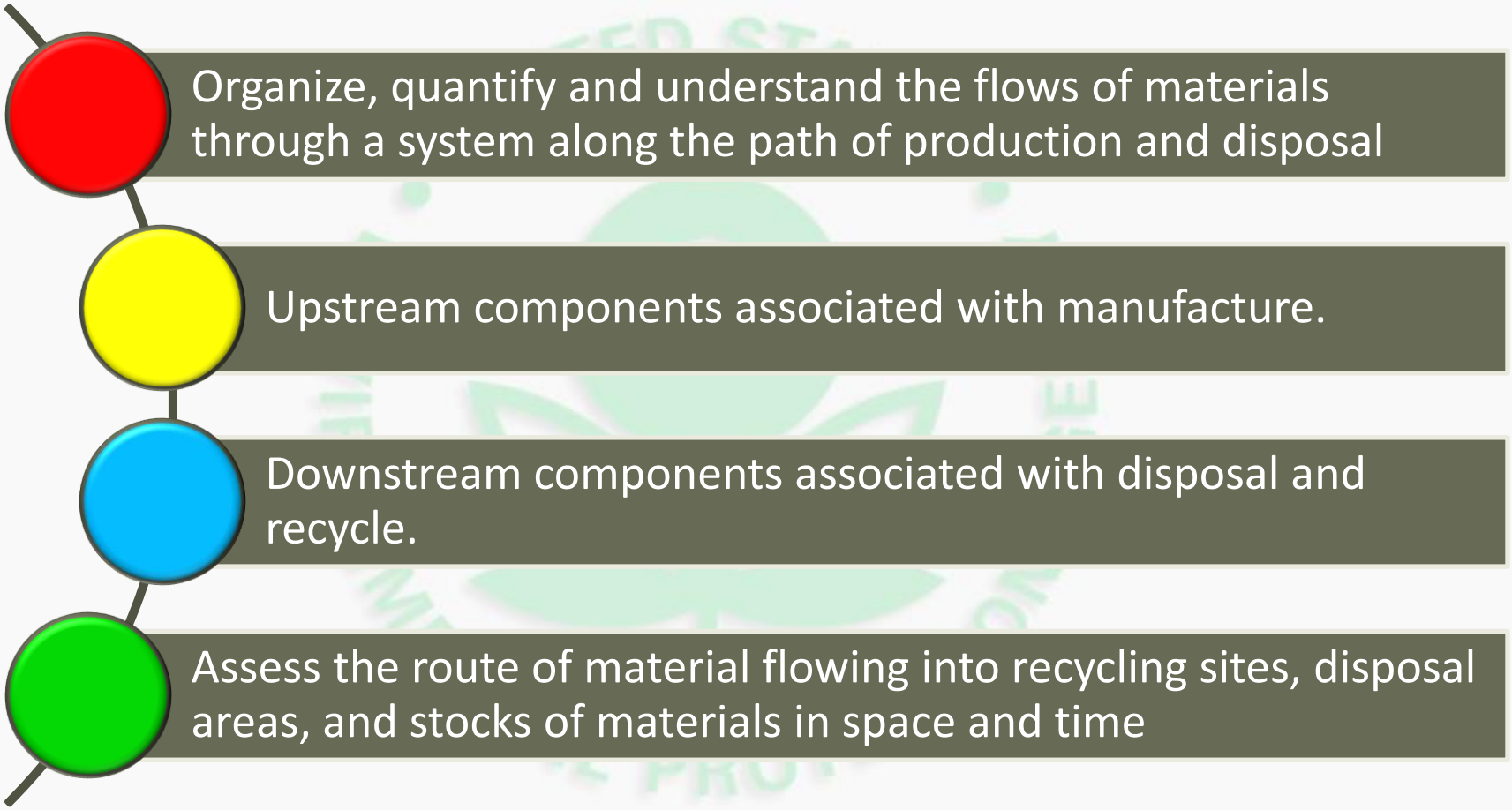
State	Requires list of brands?	Requires data on weight of CEDs?	Requires certification of compliance with state and federal laws?	Additional Requirements
IL	Yes	No, OM annual report only, based on sales records or national sales data	**Yes**	Disclosure if video display devices sold to households exceed maximum concentration values established for substances under the RoHS Directive
IN	Yes	Yes, Sale based estimated of the total wt. OEM's video display devices sold annually	**Yes**	Demonstration as to how the manufacturer plans to meet their recycling goal for the upcoming program year
MI	Yes	Yes, The total weight of CEDs received by the manufacturer's take-back program in the previous year	**No**	OEM is to educate consumers about how and where to return CEDs with the manufacturer's label Must detail the processes and methods used to recycle or reuse CEDs received from consumers Identification of the collector(s) and/or recycler(s)
MN	Yes	No, OEM annual report only, based on sales records	**No**	Disclosure as to whether any video display devices sold to households exceed maximum concentration values established for substances under the RoHS Directive
WI	Yes	No, OEM annual report only,	**Yes**	include a description wt. calculation Manufacturers are not required to report these numbers until its CEDs have been sold or offered for sale to households or schools in the state for one full program year. Disclosure as to whether any video display devices sold to households exceed maximum concentration values established for substances under the RoHS Directive

Note: The RoHS Directive, adopted by the European Union, restricts the use of lead, mercury, cadmium, hexavalent chromium

Conceptual depiction of recycle flows



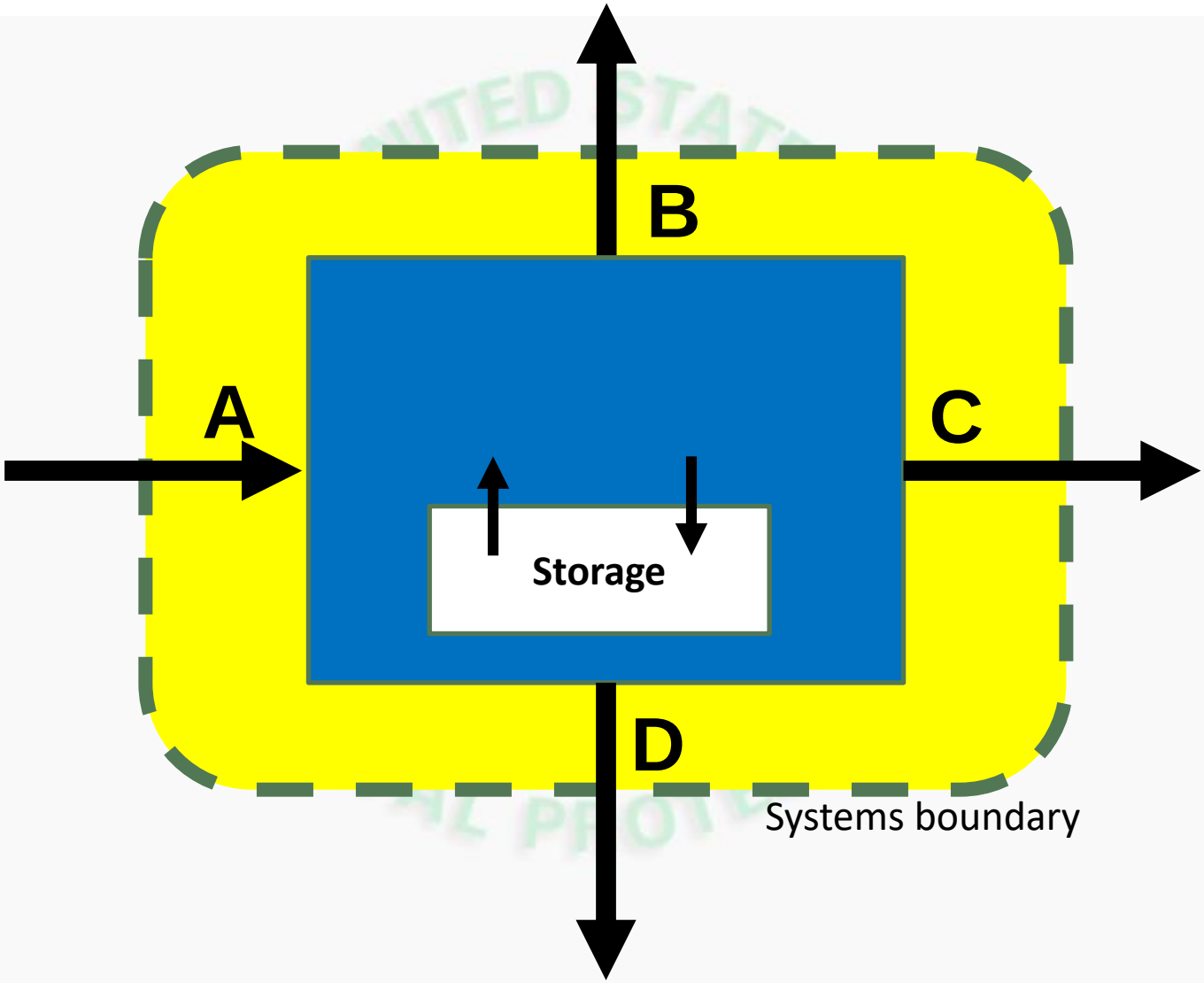
Material Flow Analysis



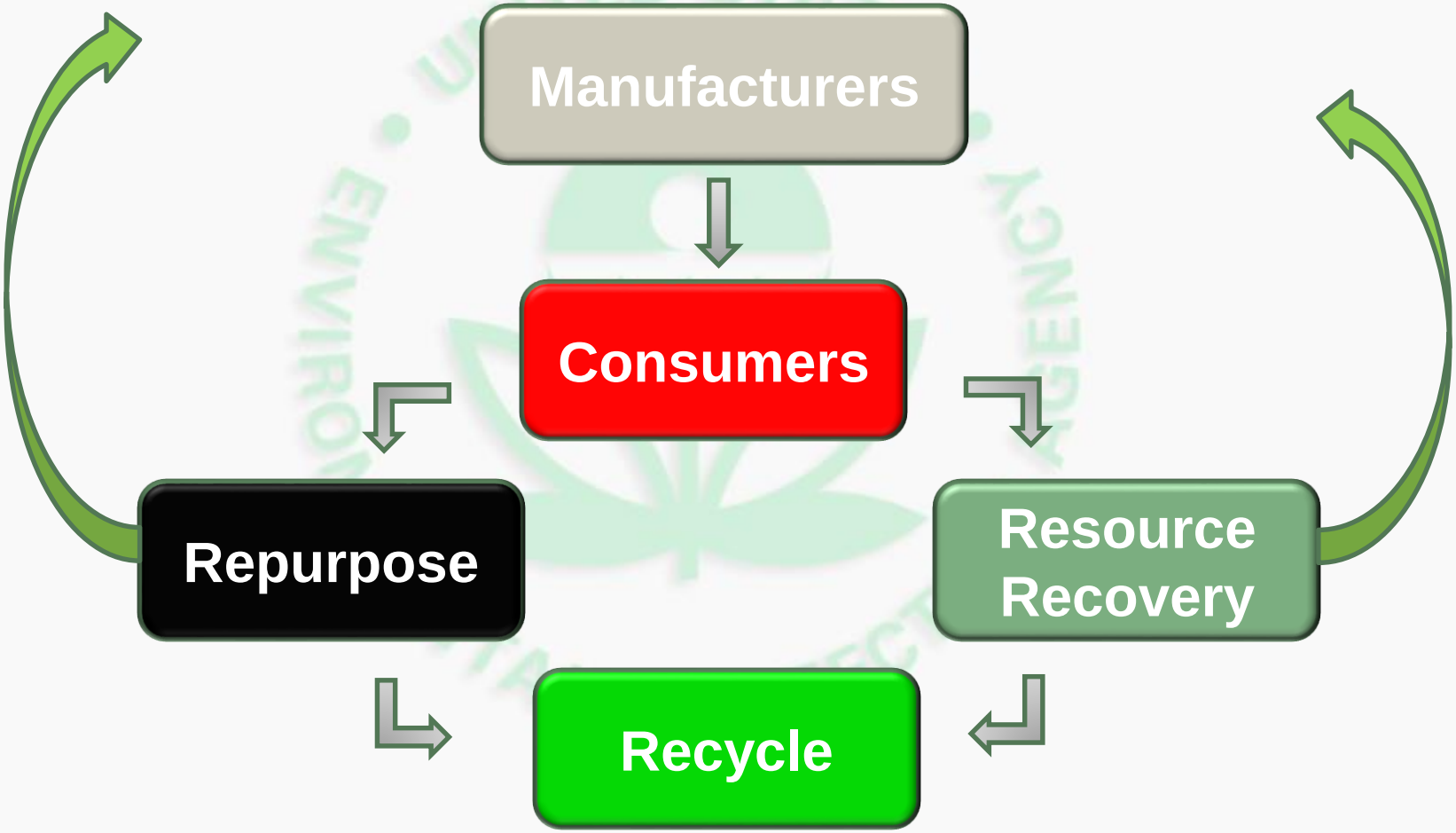
Objectives of a Material Flow Analysis

- MFA is an accounting and analysis tool that is based on a systems approach and mass balance. The system consists of a system boundary (e.g. – state or region, processes, stocks, and flows
- Track the flow of electronic materials through to end use or disposal
- Implement a guidance tool which serves as a proxy for a regional environmental management and audit platform
- Identify data gaps
- Define the basis for evaluation
- Assess data requirements in a decision-oriented manner in concert with other complementary tools.
- Examine short- and long-term flows and volumes as well as potential accumulated stockpiles

Material Flow Analysis



Flow Nodes for Electronic Materials



Material Flow Analysis - Assumptions

Product Sales

- EPA *2008 Waste Management Approach* model (also used in EPA 2011) Projected sales from 2008 to 2014 using historical seven year growth trend (2000-2007). exception: using 3 yr. growth for flat panel TVs, State % of National GDP obtained from BEA used to distribute national product sales.

Market Share

- Market shares for product purchases based on real data on market share (consider BEA's Total Requirement Tables)

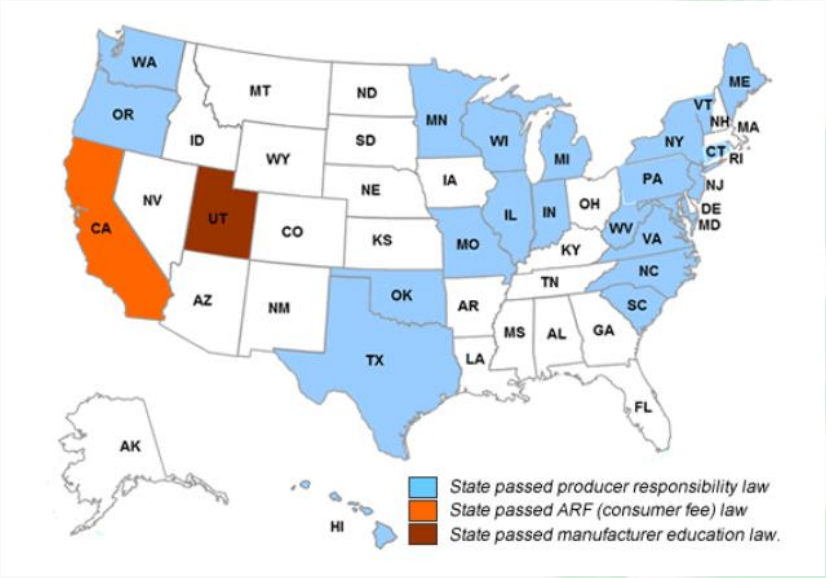
Lifetimes

- Limited historical data available on the life span of electronic Device, Product lifetimes developed from U. N. data using Weibull distribution curves.

Weights

- Product weights assumed to be constant since 2007 EPA model estimates.

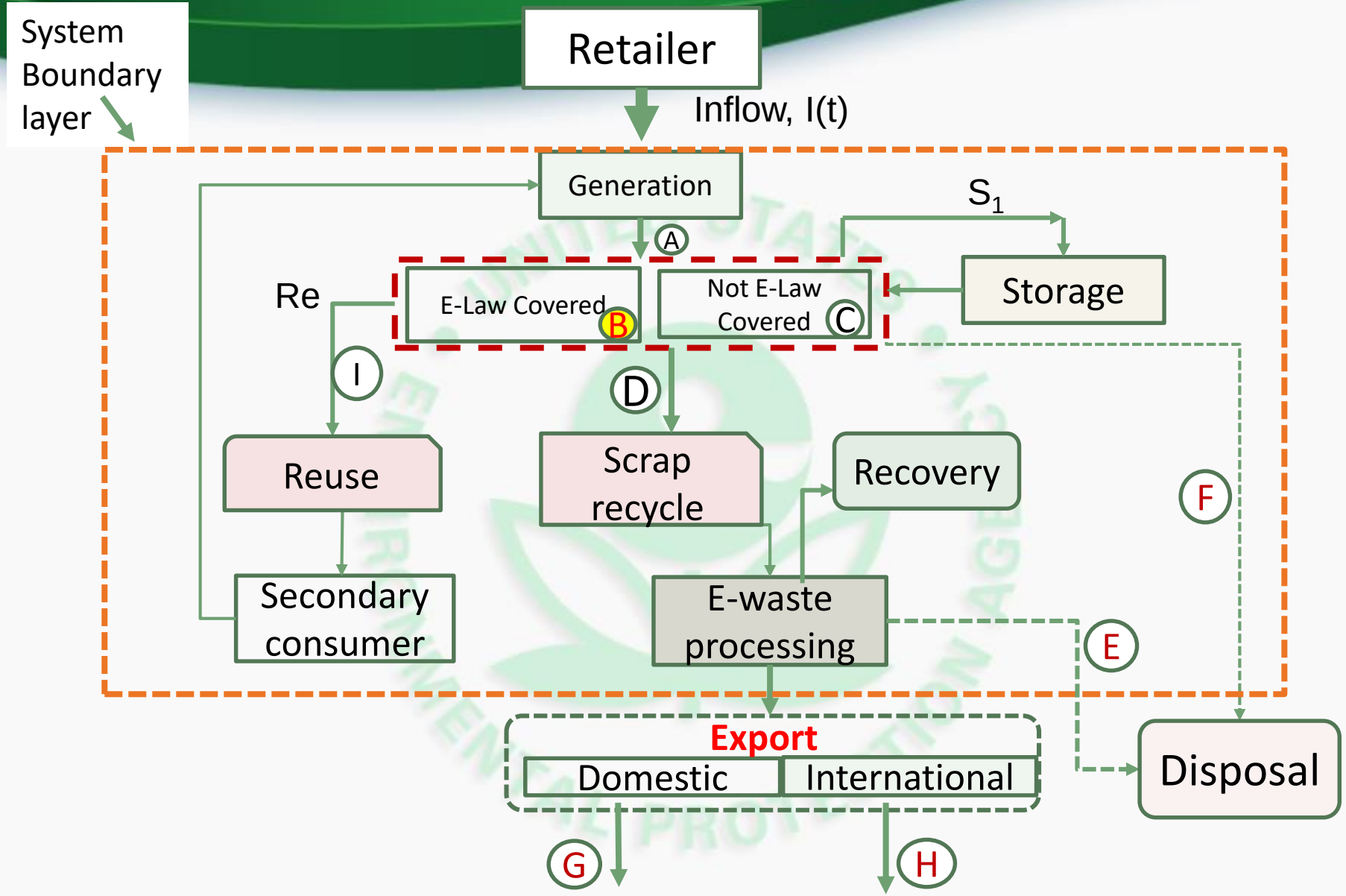
E-Waste Legislative Action by State



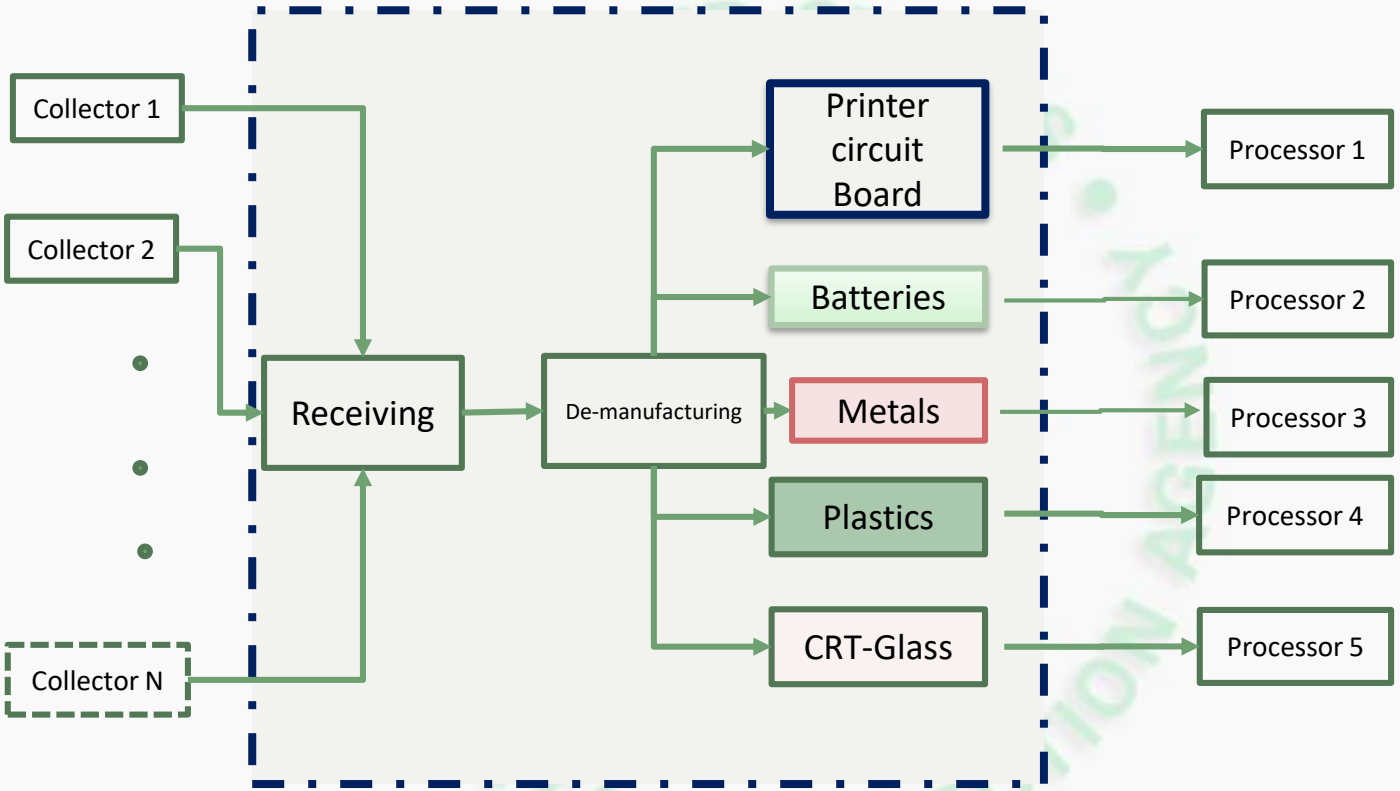
- 26 states have passed laws requiring statewide e-waste recycling and data collection for the volume of electronic material that is recycled.
- Additional states are working to pass new laws or improving existing laws.
- Aggregate data collected by the states are available from different sources; however the data are incomplete
- Data collection from states without a codified e-waste program is still a challenge

Source: Electronics TakeBack Coalition

Electronics Material Flow Analysis



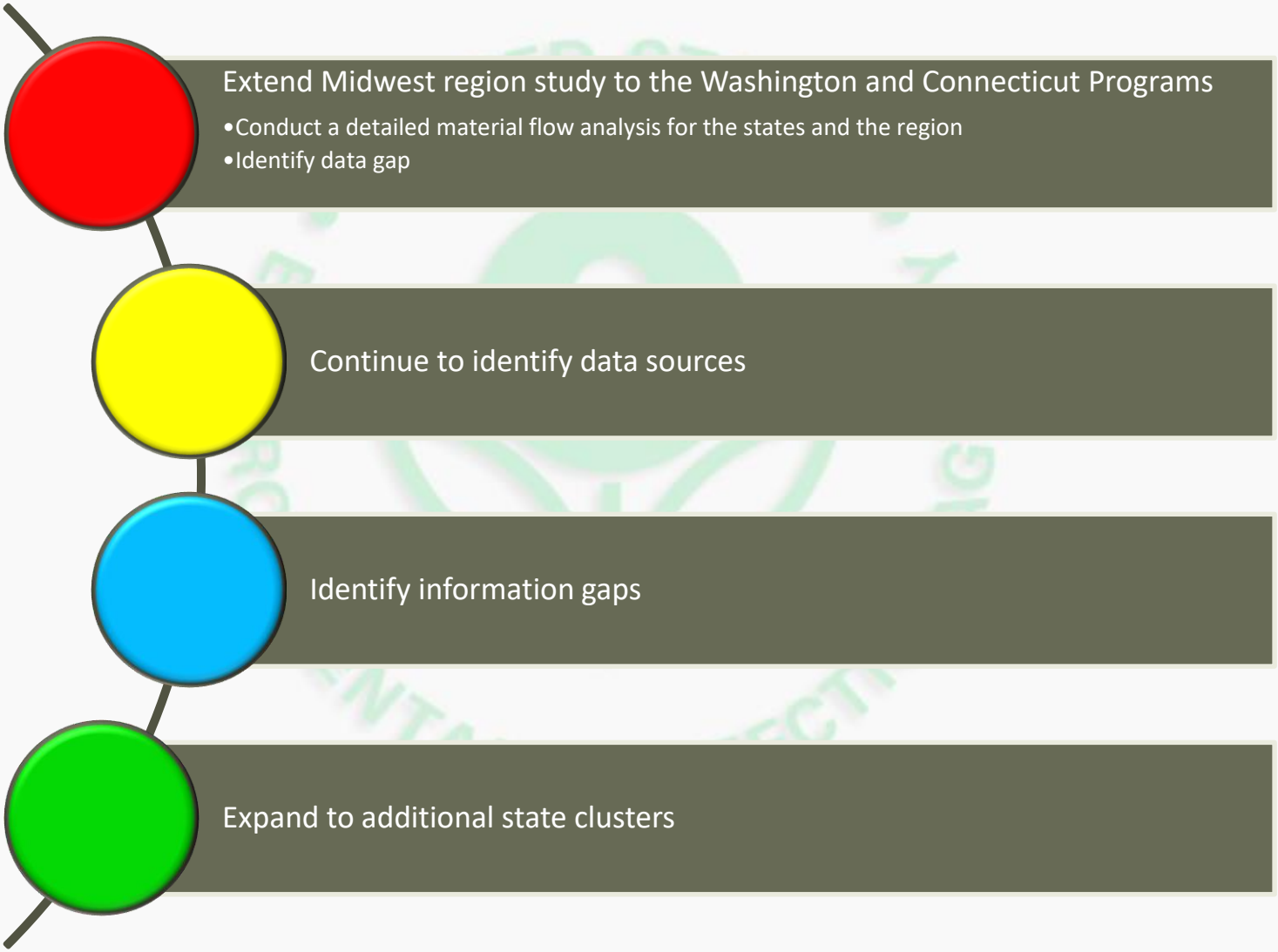
Material Flow Tracking Points for e-Waste Movement



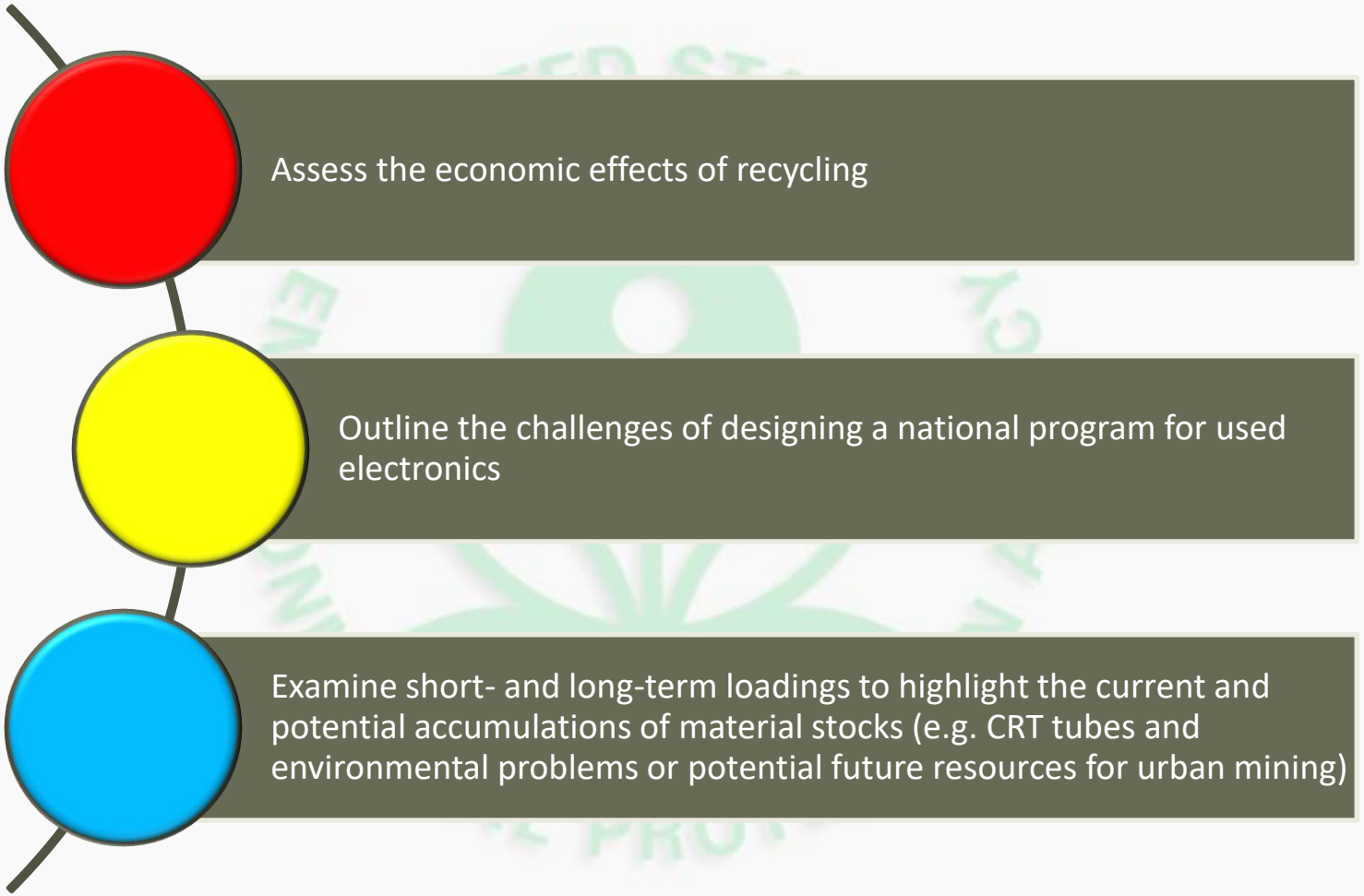
Goals of Material Flow Analysis – Model Development

- Provide to state policy makers a decision making tool with which to conduct scenario assessments
- Estimate the future quantities of used electronics for which appropriate infrastructure is needed
- Estimate the flow of specific quantities of e-waste materials – CRT glass in storage – recycler or exported
- Identify data gaps for trade flows of used and scrap electronics, flows invisible to trade statistics
- Compare the practices of different states

Current Directions

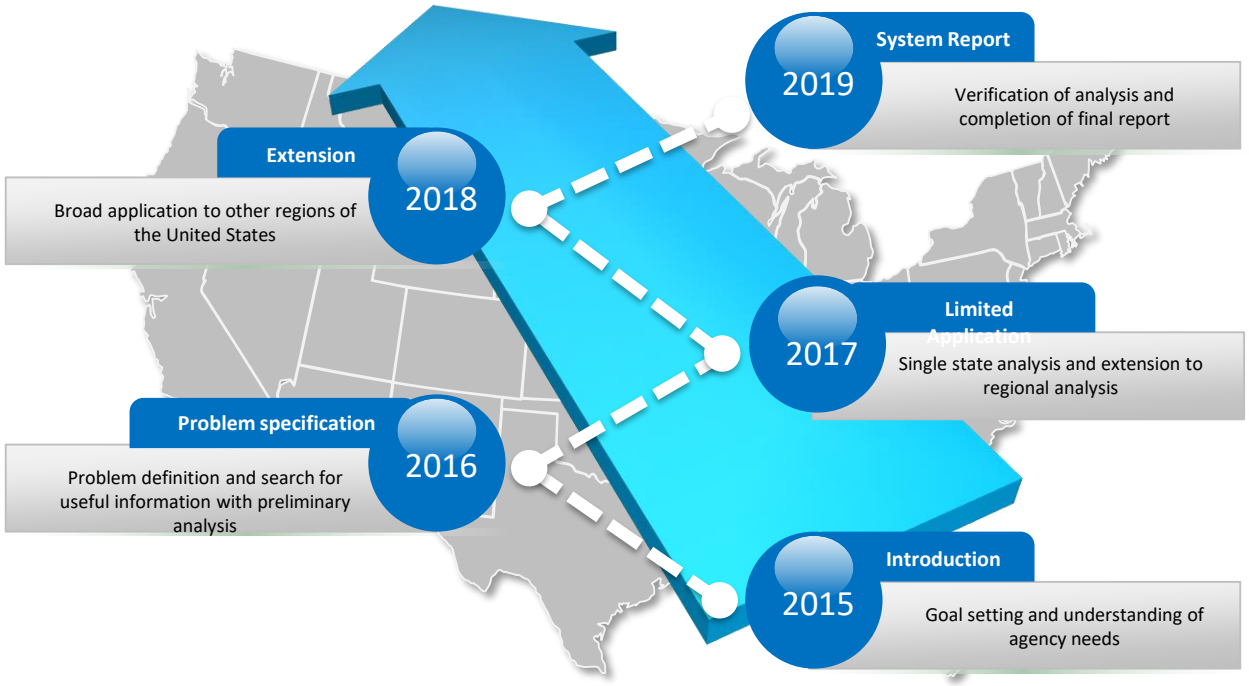


Future Research



USED AND RECYCLED ELECTRONICS FLOW DEVELOPMENT ROADMAP

2015-2019




Questions?