The Vision

Cleaner waterways and healthier communities by 2040 through

– a 50% or greater reduction in U.S. waterborne plastic emissions into the ocean (relative to 2016), and
– the reintroduction of a cumulative 10 million metric tons of plastics into the circular economy.

Sensing  Collection  Conversion  Redesign
Sources of Plastic Debris

Waterborne Plastic Assessment & Collection Technologies

Renewable power
Measurement
Collection
Conversion
Redesign

VALUATION OUTPUTS
- Economic
- Carbon
- Energy
- Environmental
- Social
- Health

Circular Economy
Timeline

**FY21**
- Partner Outreach and Engagement
- Sites, Methods, Equipment, & Data Workshop

**FY22**
- Fieldwork begins
- Laboratory Analysis begins

**FY23**
- First data posted online
- U.S. ocean emissions estimates
- Circular Economy and Avoided Costs Valuation Estimates

**FY24**
- Field Campaign
- Field Campaign
- Field Campaign
- Modeling
- Valuation
- Dissemination
- RD&D
## Assessing U.S. Rivers

<table>
<thead>
<tr>
<th>River</th>
<th>Mississippi</th>
<th>Delaware</th>
<th>Sacramento</th>
<th>Los Angeles</th>
<th>Columbia</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>764 GWhr/yr</td>
<td>7 GWhr/yr</td>
<td>31 GWhr/yr</td>
<td>&lt;1 GWhr/yr</td>
<td>2.7 GWhr/yr</td>
<td>805 GWhr/yr</td>
</tr>
<tr>
<td>Outflow</td>
<td>13,300 m³/s</td>
<td>340 m³/s</td>
<td>797 m³/s</td>
<td>6 m³/s</td>
<td>3,592 m³/s</td>
<td>18,035 m³/s</td>
</tr>
<tr>
<td>Plastics</td>
<td>699 tons/yr</td>
<td>15 tons/yr</td>
<td>10 tons/yr</td>
<td>8 tons/yr</td>
<td>26 tons/yr</td>
<td>745 tons/yr</td>
</tr>
<tr>
<td>% of Total</td>
<td>58 – 65%</td>
<td>2%</td>
<td>1%</td>
<td>0 – 1%</td>
<td>1-2%</td>
<td>51 – 71%</td>
</tr>
<tr>
<td>Population</td>
<td>76.7 M</td>
<td>7.5 M</td>
<td>6.0 M</td>
<td>5.0 M</td>
<td>7.3 M</td>
<td>102.5 M</td>
</tr>
<tr>
<td>Terminus</td>
<td>Gulf of Mexico</td>
<td>Atlantic</td>
<td>San Fran. Bay</td>
<td>Pacific</td>
<td>Pacific</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rationale</th>
<th>Magnitude</th>
<th>Watershed data</th>
<th>Planned Project</th>
<th>Periodicity</th>
<th>Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Partner</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HBCU/HSI/AIANSI</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Estimations of riverine plastic from Schmidt et al. 2017. Estimations of the hydrokinetic resource are from the MHK Atlas.
Field Campaign & Laboratory Analysis

Repeated sampling of a river over the course of a year

- Capture seasonal highs and lows as well as flooding events at sites using accepted monitoring and assessment guidelines
- Work executed by local universities or nonprofits

Comparable high-quality, cross-watershed, full-spectrum data

**River**
- Condition (e.g. flooding)
- Flow rate (avg., max., min.)
- Current profiles
- Turbulent kinetic energy
- Turbidity
- Depth and water level (stage)
- Substrate
- Seasonality (drought & flooding)
- Presence of large debris
- Precipitation
- pH
- Solar irradiance

**Plastics**
- Total mass
- Water column position
- Resin type
- Additives and elemental analysis
- Resin form (e.g. film)
- Particle size and shape
- Surface topology
- Molecular weight distribution
- Crystallinity and thermal properties
- Mechanical properties
- State of degradation
- Source

**Locality**
- Piers and ramps
- Dams or weirs
- Wastewater resource recovery facilities
- Combined sewage overflows
- Material Recovery Facilities
- Endangered or sensitive species
- Recreational activity
- Commercial activity
- Industrial activity
WaterPACT + EPA Region 3

• Methods/Equipment/Planning Workshop
• Collaboration in on-river field sampling
  o Multi-day transects, 3x per year
  o Leveraging equipment, experience, expertise
  o Ship Ops, Collection, Netting, Bottling, Blanks, (Shipping)
• Leveraging existing river networks, data, analysis, and ongoing work
Sample Workflow

For more information on EMSL Large Scale Awards, see: https://www.emsl.pnnl.gov/projects
Modeling

Energy, fate & transport modeling of a river and estuary

• Watershed and hydrodynamic modeling of:
  o Riverine hydrokinetic resource
  o Fate and transport of measured particles
• Leverages existing 3-D particulate, hydrodynamic, and watershed models
• Calibrated against field measurements
• Leverages BER-funded Integrated Coastal Modeling (ICoM) project

Along-river model of sources, sinks, transports, and transformations of plastics

For more information on ICoM project, see: https://icom.pnl.gov
Valuation

- Valuating reclaimed plastics feedstocks relative to existing, emerging, and prophetic supply chains
- Leveraging the modeling tools of the BOTTLE initiative, and partnering with global leader and HBCUs, HSIs, and AINASIs

Economic, carbon, energy, social, health and environmental valuation of measured plastics

For more information on Bottle, see: https://www.bottle.org
Data Dissemination

Data Portal and Visualization Atlas

- Key stakeholder-facing website to directly share TBs of field measurement, laboratory analysis, modeling, and valuation findings
- Leverages riverine hydrokinetic MHK Atlas work and informs improvements

Accessible, actionable data

Anticipated to be available in FY22: www.waterpact.org
WaterPACT - waterborneplastics@nrel.gov
Ben Maurer - ben.maurer@nrel.gov

www.waterpact.org coming soon
### Links

<table>
<thead>
<tr>
<th>Link Description</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Power Technologies Office</td>
<td><a href="https://www.energy.gov/eere/water/water-power-technologies-office">https://www.energy.gov/eere/water/water-power-technologies-office</a></td>
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<tr>
<td>Advanced Manufacturing Office</td>
<td><a href="https://www.energy.gov/eere/amo/advanced-manufacturing-office">https://www.energy.gov/eere/amo/advanced-manufacturing-office</a></td>
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<tr>
<td>Bioenergy Technologies Office</td>
<td><a href="https://www.energy.gov/eere/bioenergy/bioenergy-technologies-office">https://www.energy.gov/eere/bioenergy/bioenergy-technologies-office</a></td>
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<tr>
<td>Office of Science Biological and Environmental Research</td>
<td><a href="https://www.energy.gov/science/ber/biological-and-environmental-research">https://www.energy.gov/science/ber/biological-and-environmental-research</a></td>
</tr>
<tr>
<td>Environmental Molecular Sciences Laboratory Projects</td>
<td><a href="https://www.emsl.pnnl.gov/projects">https://www.emsl.pnnl.gov/projects</a></td>
</tr>
<tr>
<td>BioOptimized Technologies to keep Thermoplastics out of Landfills and the Environment (BOTTLE)</td>
<td><a href="https://www.bottle.org/">https://www.bottle.org/</a></td>
</tr>
<tr>
<td>Integrated Coastal Modeling</td>
<td><a href="https://icom.pnnl.gov/">https://icom.pnnl.gov/</a></td>
</tr>
<tr>
<td>Waterborne Plastics Assessment &amp; Collection Technologies</td>
<td><a href="https://www.waterpact.org/">https://www.waterpact.org/</a> (not up yet)</td>
</tr>
</tbody>
</table>