

Informational Meeting - Solar Panel Recycling and HB2197
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PA House of Representatives Environmental Resources and Energy Committee

Representative Daryl Metcalfe, *Chair*

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Pennsylvania
Recycling Markets Center
Keystone of Circular Economy

**Recycling markets development experts helping
industry decision makers throughout Pennsylvania.**

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1 Good morning, I am Robert Bylone, President and CEO of the Pennsylvania Recycling Markets
2 Center or RMC. In operation 15 years since 2005, the Pennsylvania Recycling Markets Center
3 (RMC) is a non-profit corporation that bridges synergies between economic development and
4 use of Pennsylvania's recycled materials supply, facilitating manufacturing use of recycled
5 materials across Pennsylvania.

6 **Introduction.**

7 Many believe that glass recycling can be troublesome, difficult, costly, and problematic.
8 Well as with the old adage, the glass may be half empty, but it may be half full. In Pennsylvania,
9 I offer that Pennsylvania end use of recycled glass is more than half full. Today I provide
10 information on how we can use solar panel recycling to bring and support jobs, manufacturing,
11 investment, and living wages to Pennsylvania.

12 It is important to first realize that most solar panels consist of soda-lime glass, amongst
13 other reclaimable materials such as valuable metals like gallium. Soda-lime glass which is made
14 of sand, limestone, and soda ash also forms the most predominant type of glass to be recycled,
15 as the overwhelming majority of glass in the world is soda-lime glass, including our beverage
16 and food bottles and jars. Thus, in many manufacturing applications and end uses, solar panel
17 glass can be used in the same recycled content product applications that container glass is
18 presently used.

19 With markets and economic development facilitated by the Pennsylvania Recycling
20 Markets Center (RMC), since 2007 Pennsylvania end market, manufacturing uses for recycled
21 glass have grown significantly. I will show and explain many of these Pennsylvania produced
22 products today. These markets and related recycled content products include:

- 23 1) Remelt cullet for manufacture of new glass bottles and containers;
- 24 2) Water distribution and filtration media in on lot septic systems;
- 25 3) Expendable blasting abrasives;
- 26 4) Certified community pool and spa filter media;
- 27 5) Wear fillers in carpet and flooring backing;
- 28 6) Engineered structural fill for pipe bedding in PennDOT, transportation, and utility
- 29 applications;
- 30 7) Manufactured ultra-lightweight foam glass aggregate;
- 31 8) New fiberglass;
- 32 9) Wastewater treatment reed bed anchor media.

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35 **Glass Cullet, Bottles & Containers.**

36 Glass is the only material that can be perpetually recycled with 100% recycled feedstock
37 in a new bottle or container and therefore it can be argued as the most sustainable packaging
38 material. During our current COVID-19 society, food and beverage manufacturing, glass
39 container manufacturing, and recycling were deemed essential by the Commonwealth and
40 federal government. Given the need for recycled glass within the manufacturing costing of a
41 new glass bottle or container, the availability of recycled glass has a direct impact on our ability
42 to survive as your recycled glass cullet is a primary manufacturing ingredient in manufacture of
43 new glass containers. With shifts in the economy inclusive of limited use of restaurants and
44 pubs, along with changes in consumer beverage spending during the pandemic, at one point,
45 glass recycling was down in Pennsylvania by as much as 35%. So, the question becomes, how
46 can we continue to get enough recycled glass to the glass bottle and container manufacturers
47 who critically need manufacturing feedstock? It is to supplement glass container recycling with
48 recycling of solar panel glass. Pennsylvania is home to 3 glass container manufacturing sites,
49 inclusive of the largest glass container manufacturer in the world, OI Glass. For instance,
50 Yuengling beers produced in Pennsylvania are packaged in OI Glass bottles produced in

51 Pennsylvania. Each bottle contains 7% recycled glass, and has been returned to the shelf in 30
52 days or less. Recycled Glass cullet produced in Pennsylvania travels as far south as Winston-
53 Salem North Carolina to be manufactured into new containers.

54 **On Lot Septic Systems.**

55 In Pennsylvania, the Pennsylvania Department of Environmental Protection (PA DEP) approves
56 the use of manufactured recycled glass sand as a substitute for quarried fine aggregate filter
57 media in onlot septic systems such as sandmounds. The recycled glass must be crushed to meet
58 PennDOT's grading and quality specification for Fine Aggregate - Bituminous Concrete Sand
59 #B3. Gradations for this material range from 3/8 to 0.0029 inches and must contain less than
60 15% weight of deleterious material. It is important to note that at this size, the glass is rendered
61 sharp-free, and is physically safe to use around heavy equipment and general labor. It is
62 equally important to note the manufactured glass sand in 1 onlot septic system ranges from 80
63 – 170 tons of material. Typically, a rural Pennsylvania county collects 150 – 300 tons of glass
64 annually. Therefore, a municipality can quickly use a significant amount of glass in on lot
65 applications and while selling the manufactured glass sand.

66 **Expendable Blasting Abrasives.**

67 When finishing or cleaning is needed of almost any outdoor surface, especially concrete
68 and metal surfaces, to prepare the surface for a new coating, pneumatic (pressurized air) blast
69 with an abrasive is needed. Over the last several decades, common blasting abrasives have
70 included sand and coal slags. Sand carries with it the hazard of free crystalline silica which is
71 considered carcinogenic and if inhaled with continuous exposure will cause silicosis of the
72 lungs. Silicosis is the scarring of the lung tissue rendering it impossible to breathe. Coal and

73 mineral slags contain heavy metals which can cause disease similar to silicosis, along with nerve
74 damage that can result from heavy metal exposure.

75 However, milled and size graded recycled glass can be used as an expendable blasting
76 abrasive. Recycled glass abrasive has many advantages, including that it does not have free
77 crystalline silica such as sand, as glass is an amorphous silica and therefore does not cause
78 silicosis. Recycled glass is sharp free, and does not contain heavy metals as does coal and
79 mineral slags. Additionally, since recycled glass is inert and does not have metals content as do
80 sand and slags, the cleaned surface is not prone to the phenomena of “blooming” which is
81 when a blasted metal surface instantaneously begins to oxidize and rust. Further, since
82 individual particles of recycled glass abrasive are more geometrically uniform piece to piece
83 than sand or slag particles, the resulting blasted surface is more even in microscopic peaks and
84 valleys caused by the physical act of the recycled glass abrasive striking it – thus, the surface will
85 use less coating material when refinished as the surface profile is more even. The recycled glass
86 abrasive must be manufactured to a known standard, Society of Surface Preparation and
87 Coatings Standard SP6, and the companion International Standards Organization standard ISO
88 8501-1 Sa2. With decline in coal derived power generation, and also with increased need of
89 sand as fracking agents, recycled glass is a strong abrasive substitute and is upward in
90 manufacturing growth. Additionally, the Pennsylvania Recycling Markets Center completed the
91 process for certifying Pennsylvania produced expendable blasting abrasives resulting in these
92 products being added to the federal Qualified Procurement List. Since Pennsylvania recycled
93 glass abrasives are on the federal QPL, our nation’s military equipment arriving back to the

94 United States from conflicts abroad in Afghanistan and Iraq are being refurbished as a result of
95 Pennsylvanians recycling glass.

96 **Public Non-Potable Water Filtration, Pools & Spas.**

97 Milled, recycled glass that has been sized graded and is screened free of other materials
98 so that it simply contains sharp-free glass particles can be substituted for sand and used in the
99 filtration of non-potable, community-based pool and spa water. Again, there is a performance
100 standard of which the recycled glass filter media must meet, in order to assure public safety
101 and health. This standard is the National Sanitation Foundation (NSF) Standard 50, which is co-
102 approved by the American National Standards Institute (ANSI). Once certified, the graded and
103 milled recycled glass filter media can be directly substituted for filter sand in both community
104 pool and spa filter systems. At present, Pennsylvania recycled glass is being manufactured into
105 this type of filter material and in use for the same.

106 **Wear Fillers.**

107 Since soda-lime glass is one of the hardest, most abrasive, cost-effective abrasive
108 materials, the physical property of this hardness can be leveraged as a filler. Grinding the glass
109 downward typically to a physical size of individual particles less than or equal to 325 mesh size
110 produces a sharp free material similar, but not exactly the size of talcum or chalk powder. As
111 this powder can be blended with the plastics that compose the backing of carpeting, the wear
112 of the carpet in use can be extended given the backing is made harder and therefore more
113 resistant to wear at contact to the floor/surface. This product has been made of Pennsylvania
114 recycled glass.

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116 **Engineered Structural Fill for Pipe Bedding in PennDOT Applications.**

117 Through previous investment from the Commonwealth's Recycling Fund and as is
118 required under Act 101, the Pennsylvania Department of Transportation operates their
119 Strategic Recycling Program or SRP. About 10 years ago, PennDOT issued a provisionally
120 approved specification for use of PennDOT Standard 601.2 Pipe Trench Bedding and Backfill
121 using Crushed Glass for stabilization of pipes (bedding), which makes use of the manufactured
122 glass structural fill eligible for use on liquid fuels projects. Pipe bedding of recycled glass or
123 another material like stone is necessary to prevent the piping from moving as a result of forces
124 created by the material carried in the pipe or the forces acting external to the pipe, such as the
125 weight of passing vehicle traffic above grade. This is an example of a locally allowed use,
126 especially in the rural areas of Pennsylvania.

127 **Ultra-Lightweight Foam Glass Aggregate.**

128 Ultra-lightweight foam glass aggregate is aggregate or manufactured rock which is
129 extremely lightweight, approximately 90% lighter than quarried aggregates, and is made from
130 color mixed recycled soda lime glass. AeroAggregates near Philadelphia is known to be the first
131 location of ultra-lightweight foam glass production in the United States. The aggregate is
132 approximately the physical texture and appearance of outdoor grill lava rock, and can be made
133 to various sizes by heating and aerating the near-molten glass. At present, the facility is bringing
134 their third kiln online, which will allow manufacture of 48,000 tons per year of the ultra-
135 lightweight foam glass aggregate – equivalent to the weight of 192 Statues of Liberty or 220
136 million beer bottles per year. So what is its use? Uses abound; as a much needed lightweight,
137 load bearing fill. As an example, a building in Harrisburg is demolished and a new structure,

138 larger and heavier is to be built in the same location. However, utility pipes underground, but
139 close to the surface will be crushed if the vacant lot is filled with traditional soil, and with also
140 the weight of the larger building on the site. This is an application to fill the building site with
141 ultra-lightweight aggregate. The ultra-lightweight aggregate is capable of filling the void space
142 in a lightweight manner while taking advantage of the aggregate property of being
143 compressively strong, able to distribute and carry the heavy load to be placed on it from the
144 new building. In the last year alone, AeroAggregates has made over 140 million beer bottles
145 (weight equivalent) into Ultra-lightweight foam glass aggregate. The aggregate is now being put
146 into use across the United States, in places such as the Philadelphia Airport; the Philadelphia
147 Naval Yard; underneath I-95N/S; and the Subaru Technical Center. With start-up about 3 ½
148 years ago, AeroAggregates is approved in about half of US States Department of Transportation
149 projects and growing. Using Pennsylvania as a model facility, AeroAggregates is beginning to
150 build their second manufacturing site in Florida.

151 **Fiberglass.**

152 Pennsylvania milled, sized, and graded sharp-free glass has also been used as a primary
153 feedstock in the manufacture of fiberglass insulation. Not unlike the aforementioned
154 Pennsylvania products, the glass cullet used for fiberglass manufacturing must conform to the
155 Association for Testing and Materials (ASTM) Standard D5359-98(2015), "Standard Specification
156 for Glass Cullet Recovered from Waste for Use in Manufacture of Glass Fiber." A relatively high
157 purity of glass cullet is required for manufacture of fiberglass, and must be devoid of pieces of
158 broken ceramic. Ceramics do not melt at the same temperature of the recycled soda-lime glass
159 and will block the small openings by which the molten glass is introduced to the spinner which

160 makes and layers the glass fiber – very similar to layering sugar fiber to manufacture cotton
161 candy.

162 **Wastewater Treatment Solids Handling Reed Bed Anchor Media.**

163 With the first known site in the United States, the Pennsylvania Recycling Markets
164 Center working in conjunction with the Northern Lebanon County Authority and Cogle’s
165 Recycling, Inc. facilitated installation of the first location of recycled glass used as Reed Bed
166 anchor media. Reed Beds, essentially a constructed wetland of reeds in an open top,
167 rectangular concrete tank, and supported and planted in a bed of recycled glass, manufactured
168 roughly to the PennDOT 703.1, Fine Aggregate Grading Requirements. The new reeds were
169 then planted in the recycled glass media, grow throughout the growing season while uptaking
170 the various organic contaminants in the sludge/biosolids, and then the reeds are harvested in
171 the fall each year. Using the solids as nutrient, the reed bed is effective for an estimated period
172 of 10 – 15 years. The Northern Lancaster County Authority used about 1,400 tons of glass in the
173 process of renovating existing reed beds and in construction of new treatment beds as well. For
174 visualization, this is approximately equal to the weight of 5 Statues of Liberty or 6 million beer
175 bottles, at a cost savings to the Authority as the manufactured glass anchor media cost less
176 than the comparative stone needed for the same application.

177 **Connecting CDRA.**

178 At present, according to the unaudited 2019 recycling report(s) of the Pennsylvania
179 Department of Environmental Protection, Pennsylvania recycled approximately 327,415 tons of
180 post-consumer glass state-wide. Although there remains glass in the Pennsylvania disposal

181 stream, soda-lime glass properly extracted from solar panels can be used for the various
182 applications outlined in this testimony.

183 However, I encourage the committee to consider an independent bill for potential
184 enactment of solar panel glass recycling in Pennsylvania. Although in the Asia-Pacific and
185 throughout Europe electronics waste and solar panel glass recycling are often combined,
186 Pennsylvania's Covered Device Recycling Act is wrought with challenges and difficulties for both
187 equipment manufacturers and stakeholders, already unintentionally creating unfunded
188 mandates. Through various discussions of new or amended electronics legislation over the last
189 three legislative sessions, one point of agreement between electronics manufacturers and
190 recyclers is that the Covered Device Recycling Act should be repealed or amended greatly. Too,
191 if an independent solar panel recycling bill was passed, it may be possible to consider the new
192 solar panel recycling act as the vehicle to amend for new electronics recycling legislation to be
193 incorporated into it.

194 In examples of these challenges, the Covered Device Recycling Act is a weight based
195 producer responsibility model, whereby the amount by weight an equipment manufacturer
196 sold 2 years prior is the amount of covered device electronics waste by weight the
197 manufacturer is required to recycle in a given year. Yet, multi-year dated electronics devices
198 that are extremely heavy, such as floor model console televisions, make up the current 2-year
199 sales weight for goods like a present-day electronic watch. Consequently, in previous years, it
200 has not been challenging to meet weight based goals and solar panels as a covered device will
201 only continue to skew this model. Additionally, CDRA includes a disposal ban on all electronic
202 devices statewide, yet only mandates that 80% of the population be reached by electronics

203 manufacturer sponsored recycling programs to recycle electronics. At best, addition of solar
204 panel recycling makes this dichotomy worse.

205 Positively, one parallel of the Covered Device Recycling Act and solar panel recycling is
206 that both reclaim potentially hazardous and non-hazardous materials through the recycling
207 process. In many cases and on a daily basis, permitted electronics recyclers are already properly
208 managing hazardous components of electronics devices for recovery. For instance, those
209 electronics recyclers who are dismantling generation I LED flat televisions likely encounter 2 to
210 22 mercury containing bulbs in each television that require a person to dismantle and remove
211 prior to the unit being shredded. Prior to seeing these units in the waste stream, and even at
212 present, electronics recyclers also have to properly manage components with both leaded glass
213 and leaded solders, especially on console televisions and CRT monitors. Quite commonly, in
214 other types of industry, hazardous wastes often contain non-hazardous constituents that are
215 removed for recycling. For instance, organic, liquid solvents that are used to clean metals often
216 result in containing the residues of the same type of metal that was cleaned with the solvent.
217 These solvents can be screened, distilled, or refined with other processes to recover the
218 valuable, recyclable metals. In closing, solar panel dismantling for recycling will likely require
219 proper management of both hazardous and non-hazardous materials, which in both electronics
220 recycling and other forms of hazardous materials management is very common across the
221 United States and around the world.

222 I would also be certain to allow for a phased in approach so that mandatory recycling of
223 solar panels is planned into existence in the marketplace. Although we have the potential of
224 many end uses, the logistics of the same are not presently determined in comparison to the

225 relative value of the feedstock(s), most notably soda-lime glass. We do have eager,
226 entrepreneurial spirit and knowledge alive and well in the Commonwealth for use of recycled
227 soda-lime glass, but cautious approach is needed in order to build a successful economy of solar
228 panel glass recycling.

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232 The Pennsylvania Recycling Markets Center (RMC) is a non-profit corporation with mission to
233 reduce or eliminate barriers that lead to expanded use of Pennsylvania's recycled materials. The
234 RMC team brings markets development assistance to stakeholders that include entrepreneurs,
235 manufacturers, recycled material processors, collection programs, haulers, and governmental
236 agencies. Operating since 2005 and with funding from the Pennsylvania Department of
237 Environmental Protection, the RMC has an affiliation with Penn State and is headquartered at
238 Penn State Harrisburg with an office in Pittsburgh. Pillars of RMC outreach include
239 manufacturing feedstock connectivity, applied research and commercialization assistance;
240 technology acceleration; and concierge service to technical and business growth information.
241 Building and supporting Pennsylvania's \$22.6B recycling marketplace, the RMC bridges
242 economic development and use of Pennsylvania's recycled materials supply.
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