Current entry title: "Recycling: the politics, the science, and the technology"

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Recycling of our waste arose in response to two separate but related issues: first, as a reaction to limitations of space or attempts to avoid waste incineration (Denison & Ruston, 1990); second, as a response to the increased need for virgin materials. There are, thus, both environmental and economic causes: traditional disposal of waste in landfills is not feasible for communities with limited space and/or growing populations, and virgin materials are on the whole more expensive that recycled materials. For example, the recycling of aluminum saves 96 percent of energy than producing aluminum from bauxite, while – and the lower end – the recycling of glass saves 21 percent of energy. The energy to haul these materials still puts it nowhere near the energy levels needed for harvesting of virgin materials (Hutchinson, 2008). In other words, not recycling or not using recycled materials is analogous to increases in costs.

Yet, until the Mobro 4000 barge was unable to find a location to dump its garbage in 1987, there was very little public discussion about recycling. All that mattered was finding a proximate landfill location for us to haul our waste. At that point, the related policies amounted to assessing a tax on residents for hauling away their waste to the landfill and settling pollution issues with the populations neighboring landfills. For some areas of the U.S., there has been significant and positive change, but the federal government offers no uniform strategy and, thus, there is great variance across the country.

Connecting recycling to the science and technology

Current methods of recycling rely heavily on generations-old technology. This leaves a lot of room for improvement for a country like the U.S., which has five percent of the world's population, consumes 25 percent of the world's energy, and produces around 250 million tons of garbage a year. Energy consumption and waste production must be considered together because scientific and technological advances in how we process our waste – i.e., how we recycle – have direct implications for our energy consumption patterns. These connections are largely not sufficiently institutionalized because elites are not focused on the issue and because the science and technology (S&T) targets the recycling sorting process as opposed to the point at which we could divert waste from the garbage bin to the recycling bin.

To elaborate, discussion of S&T is typically held among elites, whether they are elected officials, policy analysts, or members of the scientific or business communities. Because the generation of S&T-related innovations is inherently risky, often translating into inaction by the private sector and/or the government, the government employs a corps of savvy individuals to make well-informed, S&T-related decisions. For example, the National Science Foundation's (NSF) Division of Chemical, Bioengineering, Environmental, and Trans port Systems, the NSF's Directorate for Engineering Industrial Innovation and Partnerships' Small Business Technology Transfer Program, and the Small Business Innovation Research Program of the Department of

Energy have contributed to advances in recycling sorting technology such as IR spectroscopy for polymer identification, machine vision for color sorting, air jet selection of materials, and, with automobile shredding companies, optoelectronics for sorting metals at ultra-high speeds into pure metals and alloys (Wessner, 2008). Again, up to the sorting stage, recycling continues to be a relatively low-tech process with advancements only at the margins such as more fuel efficient hauling vehicles or improved recycling receptacle designs. In some cases, tracking chips are put on recycling bins to determine diversion rates, but these innovations are still relatively new (Heid, 2010).

Domination of economics

When the government is not promoting R&D directly through research grants, technological advancements occur indirectly through policies. These policies include taxation of waste and subsidization of recycled and post-consumer content use. For the most part, though, notable successes are a result of businesses closely monitoring the market value of recycled materials and implementing relatively low-tech features. The Brooklyn Brewery, for example, implemented a variety of recycling and waste reduction measures, including recycling its cardboard and plastic waste, and reduced annual waste generation by more than 50 percent, saving it more than $25,000 a year in hauling costs. Also, the San Diego Wild Animal Park generates more than 23,000 tons of waste annually but discards only four percent of this waste in landfills because of its comprehensive composting program and the careful distribution of recycling containers throughout its 1,800 acres, saving more than $1 million in hauling fees each year. The Environmental Protection Agency has also provided a couple of models for helping businesses calculating greenhouse gas emissions reductions through waste diversion methods (U.S. Environmental Protection Agency, 2007), most likely in anticipation of the advantage this would create in the presence of some sort of emissions trading program.

Local solutions are important

Solutions to the recycling-energy consumption disconnect have been best treated at the local level. This is consistent with research showing that collective actions problems are best treated locally (Ostrom, 1990), given that waste is easily recognized as a "local problem" – i.e., landfills are used for locally produced waste. As such, when plastic bags have significant negative effects on, for example, healthy oceans, the entire state of California begins to consider banning plastic bags. The same is true when there are concerns about the abundance of electronic waste (e.g., computers and cellular phones) around urban areas or the leaching of landfill toxins into the soil and groundwater in farming communities.

This results in a variance of recycling infrastructures across municipalities and geographic areas. Portland, OR, for example, is extremely effective in terms of its waste diversion rates, although it still pales in comparison to other municipalities which are forced to recycle because of limited land space (see Sidebar: The Korean Case). The city has an extensive curbside recycling and composting program in which inorganic and organic materials are picked up on a weekly basis (City of Portland, 2012). So much of the city's waste is recycled that its non-recyclable waste is picked-up only once every two weeks. Portland's system is tailored, though, to an urban setting in which there are only 600,000 people and two-thirds of the population live in single-family homes (www.census.gov). Portlanders also seem to have been exposed to a much different recycling culture as they follow instructions to place "food scraps in a container in the freezer and add them to the green roll cart the night before pickup" (City of Portland, 2012). The majority of Americans have yet to be acculturated to composting at home much less putting a container of fish bones and banana peels in the freezer next to their frozen pizza and ice cream. How can the Portland case – an ideal to a certain degree – be replicated elsewhere when the recycling culture of other locales is much different?

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Sidebar: The Korean Case

Nearly everything is recycled in Seoul, the capital city of South Korea. Seoulites do not pay a regular tax for their municipal trash pick-up services. Rather, citizens must throw away their garbage in specially designated bags, costing approximately 75 cents to one dollar apiece and available for purchase at any corner store or supermarket. This pay-as-you-go system is complemented by hand-sorted recycling bins outside of each apartment building and in the alley of each business. There are bins for all of the different types of plastic, the different colored glass, plastic wrappers, metal bottle tops, plastic bottle tops, newspaper, cardboard, etc. Koreans also do not use garbage disposals, so there is a container for food waste. Each household and business owner, thus, scrupulously participates in recycling.

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Integrating the public

The politics of the S&T of recycling is affected by how salient the issue is to the general public. We know that there are forces which facilitate recycling, such as environmental groups and geographic characteristics, but we have not yet determined how recycling can be increased en masse. Recycling is safe and easy for use at home, office, schools, or really anywhere that organic and inorganic waste is thrown away, but there remain gross information asymmetries. These are exacerbated by limited focus on innovations which could increase waste diversion at the household level (see Sidebar: Composting and the Ewww Factor).

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Sidebar: Composting and the Ewww Factor

Across the U.S., 34 million tons of organic waste is discarded of which only three percent is recovered for reuse and recycling as compost (Mooney, 2012). Meanwhile, it costs the U.S. around $1 billion every year just to dispose of all its food waste (U.S. Environmental Protection Agency, 2011). Institutions have been set up to address this problem such as the U.S. Environmental Protection Agency's "Food Recovery Challenge", targeting groceries, universities, and sports and entertainment venues. Yet, these efforts are in their infancy and omit the residential sector. There are clear benefits from implementing a widespread composting program, including lower emissions of methane, decreased costs for fertilizer, and cost-savings for the taxpayer (Sterner & Solla-Yates, 2010). This is particularly important, as methane, the gas which is produced by food, traps 23 times as much heat in the atmosphere as the same amount of CO_2, and landfills account for 34 percent of all methane emissions in the U.S. (U.S. Environmental Protection Agency, 2011). R&D can target the generation of in-house, odor-free, and aerobic methods of composting which can be regularly picked up by a municipality or used in household gardens and planters. For the U.S. diet, this means that there must be a focus on food waste which is high in protein and low in fiber such as meat, cheese, oil, and fish. This should be done in the context of aerobic composting, but individuals will have to occasionally smell their garbage as it rots.

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Conclusion

Increases in recycling and waste diversion rates are a function of two principal factors. First and most importantly, the problem must be acknowledged openly by the general public and our policy makers. Second, the recycling process itself must not impose significant costs – financial, physical, temporal – upon those who are being asked to recycle. In addition, it has been shown here that the current S&T is relatively simple and uncontroversial – at least with regard to recycling of conventional waste (as opposed to sewage, radioactive waste, etc.). The politics filters in as we witness relative apathy on the part of our elected officials to convey a sense of urgency around the issue of recycling and, thus, increase information asymmetries. There are relative success stories, such as Portland, OR, but these are still largely the exception. Only with the active conveyance of information to all levels of society can the recycling issue increase in saliency.

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