Pictured from left to right, Stewart Leeth, Smithfield Foods; Marco Castaldi, City College of New York; and Craig Cookson, American Chemistry Council.

2016 REW Conference: Circular circumstances

Waste-to-energy processes can be part of the product life cycle while also adding value.

Extracting as much value as possible from products is an idea that is gaining traction. Beyond use as a material, waste has tremendous energy value. Speakers during a session titled Waste-to-Energy in the Circular Economy, during the 2016 Renewable Energy from Waste Conference in Long Beach, California, in mid-November, shared several examples of waste's value.

Craig Cookson, director of sustainability and recycling for the Plastics Division of the American Chemistry Council, Washington, discussed how plastics of all the energy resources, 97 percent goes into fuel, power and other chemicals. Only 3 percent ends up in plastics production. Of that plastics production, over 70 percent of that comes from the ethane in natural gas.

"Natural gas in North America really is the feedstock for plastics," said Cookson.
He said a critical step in sustainable materials management of plastics is post-use collection and recycling everything that can be recycled, or break it back down to a monomer, or if that can't be done, then getting the energy back out of it.

Cookson pointed out the many environmental benefits of plastics, including:

- reduce material use, weight;
- maintain freshness;
- reduce breakage;
- reduce transportation costs through lightweighting;
- economical; and
- reduce waste

A recent study, he said, showed if you took plastics away, through a variety of applications, energy use would increase and greenhouse gas emissions would also increase. Another study showed costs of materials and transportation would increase if plastics went away.
He showed the evolution from coffee packaging from a steel coffee can, which was very recyclable, to a plastic canister, to a vacuum-packed plastic brick.

"Even though the plastic packaging does not get recycled, it still reduces life cycle greenhouse gas emissions by about 75 percent compared to that steel coffee can," Cookson noted.

Cookson referenced the U.S. Environmental Protection Agency's (EPA's) recently released Advancing Sustainable Materials Management 2014 Report.

He explained that the question the EPA asks is do recycling rates tell the whole story? For example, the report notes, the U.S. recycled 22,378,489 more containers in 2012 than 2005, an increase of 30.5 percent, but measured by weight, it is only an increase of 18.6 percent. So the increase in the number of containers does not tell the whole story because it leaves out the story of lightweighting and all the benefits that come from it.

He shared a graphic which showed how the provision of materials creates about 42 percent of total greenhouse gas emissions with about a 32 percent recovery rate. He said even if the recovery rate was 95 percent, it would only cause a 6 percent decrease in GHG emissions.

While that is important, Cookson said, "We still have to remember it is really what happens upstream that has the biggest benefits." That is why he said we are seeing more and more plastics in the waste stream.

The ACC worked several years ago with Columbia University and its Waste-to-Energy Research and Technology Council (WTERT). Researchers found that plastics in the waste stream have about 15,000 British thermal units (BTU) per pound. The only two energy sources higher than that are natural gas and crude oil, said Cookson.

A report being release early in 2017 is a collaboration with the Earth Engineering Center (EEC) at City College of New York and the city of Edmonton. Researches have been doing pilot tests at Edmonton's pilot gasifier modeled after the Enerkem's gasification plant there.

They took a baseline biomass feedstock and tried to show that increasing plastics in the feedstocks would:

- make it more efficient;
- produce more useful fuel and chemical to sell; and
- produce less ash or byproduct needing landfilled.

He also shared an infograph showing that if you took all the waste landfilled in the U.S. each year and converted it into energy, you could power 14 million homes, or about 12 percent of the homes in the U.S. It would also save 6,000 acres of space. And if just the plastics portion were converted to gasoline, we could power 9 million cars per year.

A company that is doing much within its operation to take waste and put it toward energy use is Smithfield Foods, Smithfield, Virginia. Smithfield is the largest pork processor in the world with 490 hog farms in the U.S.

The company's vice president of regulatory affairs and chief sustainability officer, Stewart Leeth, explained, "We look at the circular economy in a basic way that is to try to bring more value out of existing products and waste materials in a way that creates value for the company."

"The renewable energy issue for us is squarely within our sustainability program," said Leeth. The program focuses on environment, animal care, food safety and quality, helping communities, people and value creation.

Leeth explained that the value creation part of the program was added to capture the idea of a shared value approach where the company is "not just creating a monetary value, but value for its customers." Those customers include grocery chains, restaurants and food distributors.

He said renewable energy is a challenge "because sometimes our return on investment is not good."

The company's largest processing plant in the world in North Carolina has a covered anaerobic digester. It processes 3 million gallons of wastewater per day to create steam and power for the plant. At the an anaerobic digester in Souix Falls, Iowa, gas is either flared or goes to the plant. Smithfield operates four or five of these types of digesters around the country.

"The issue for us is power generation is not as expensive as it once was," said Leeth.
He spoke about the energy value contained in manure, mentioning that as feed efficiency becomes better, the energy value of the manure declines. Today the feed is 75 percent more efficient than it was 50 years ago.

He described the different ways Smithfield manages manure at its farms. A typical systems in the Midwest includes barns hooked up to anaerobic digesters. The manure is digested and applied to fields. In cooler temperatures, barns are hooked up to a slurry tank and tractors apply it to crops. In the desert, the company uses evaporation ponds, evaporates the manure and it is then applied as fertilizer or landfilled.

Leeth said Smithfield has digesters in Utah and North Carolina with power purchase agreements, where the energy is sold to the grid. In Mexico, where energy prices are double what they are in the U.S., the return on investment for digesters are less than 24 months, he added. Leeth said Smithfield has a number of joint ventures in place there.
Another major project underway for Smithfield is the Roeslein Alternative Energy project in Missouri, consisting of covering existing anaerobic lagoons. The gas will be cleaned and compressed and will go direct into the natural gas pipeline. It will consist of 88 lagoon covers and is designed for 2 billion cubic feet of renewable natural gas per year. At the time of the presentation, the project was about halfway complete.

Finally, Marco Castaldi, associate professor, The City College of New York, provided a bigger picture of some of the research the EEC and WTERT has been working on. He emphasized the importance of conversion technologies being affordable, distributed and versatile.

He pointed out that 0 percent of the world is without waste, but that does not get the visibility and attention from global entities. In terms of recycling, he said metals have a high rate of recycling and can be recycled infinitely. Glass is also infinitely recyclable, but has economic barriers, he added.

With paper and plastic recycling, he said even in areas with the highest recovery, they are only achieving recovery rates of 85 percent.

"Prior to shale gas, there was a big impetus to look at waste as an energy resource," noted Castaldi. He also shared that the hydrocarbon coming online today far outstrips our energy needs.

"What can we do with it? Can we make more product?" he asked.
According to Energy Information Administration (EIA) the U.S. had the same carbon dioxide output in 2013 as it did in 1995.

"The U.S. met its obligation," Castaldi said. "What to me this means is that waste recovery is a resource issue, not so much an environmental issue."

He added that is it not so much "how can we get more energy?" It is, "What kind of materials are in the waste stream?"

He described pyrolysis, gas and combustion processes stating the difference is the amount of air each technology requires. Each technology also lends itself to different scales.

Incineration creates ash, and there has been some research into using ash to produce cement. Preliminary tests show a reduction in carbon dioxide, nitrous oxide and Sulphur oxide.

In conclusion, Castaldi said, "The low price of energy means waste is a source of materials."

The session was moderated by Ted Michaels, Energy Recovery Council. The Renewable Energy from Waste Conference was Nov. 14-16 at the Westin Long Beach in Long Beach, California.