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Research Summary: I work to develop new materials for organic photovoltaics. Unlike the heavy, rigid, dark-colored inorganic panels you probably think of when you hear "photovoltaics," organic photovoltaics are made from small, carbon-based molecules. Therefore, they are lightweight, flexible, and have tunable color and transparency. In other words, through organic photovoltaic technology, everything from fabric to windows can produce energy! In fact, solar windows and roll-up sheets of solar plastic are already commercially available. However, improved materials could catapult this technology from an emerging field to a staple of energy production, so I work to improve material lifetime and charge transport properties.

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Concentrating solar power (CSP) has long held promise as a renewable energy technology. CSP uses mirrors, or heliostats, to harness the power of the sun by heating and storing an inexpensive medium such as sand, rocks, or molten salt for on-demand energy dispatch.

To spur CSP industry advancement and achieve an energy cost goal of 5 cents per kWh, the U.S. Department of Energy"s (DOE"s) Gen3 CSP program funds research to explore the potential of several heat transfer mediums. National Renewable Energy Laboratory (NREL) researchers are contributing to this effort, tackling several challenges related to the use of one potential medium--liquid-hot molten salt--for energy transfer and storage.

Three years ago, the Gen3 program established three pathways to potentially reach the CSP energy cost goal: a liquid pathway (exploring use of molten salt as a heat transfer material, led by NREL), a particle pathway (using sand-like particles as a heat transfer material, led by Sandia National Laboratories), and a third pathway exploring the use of gas as heat transfer material (led by Brayton Energy).

In March of 2021, DOE down-selected among the three pathways to fund further research into particle-based storage, but also created an opportunity for NREL to further develop the liquid pathway over the next two years.

Craig Turchi leads thermal energy science and technologies research at NREL. He said that molten salts are a desirable option for a heat transfer and storage material--liquids are easy to work with as they can be pumped

through pipes and heat exchangers to move around a CSP system. Unfortunately, some practical challenges also remain, which are the focus of current NREL research.

While easy to move around, salts are also corrosive to the tanks and pipes that hold them. In fact, according to Turchi, "Everyone initially thought that salt corrosivity would torpedo this effort. We actually solved that problem by and large. NREL and partners did a lot of great science on the salt chemistry--how to purify it, how to make it relatively noncorrosive if you control the chemistry, and we demonstrated that in the lab."

So, corrosivity is not the biggest problem with using molten salts. Instead, the challenge lies in achieving very high temperatures needed for a high-efficiency power plant. The salt"s energy density requires relatively large--and therefore, expensive--storage tanks and one must keep the salts from freezing in the pipes (while thermally stable as a liquid to very high temperature, these salts freeze at a not-so-chilly 400?C).

Turchi said this is related to how you insulate the system. "We had performed testing to show which materials could work but hadn"t actually built a tank to demonstrate that it did work. Our design is a steel tank, but whereas the current tanks are insulated on the outside, our proposed tank was insulated on the inside to protect the steel."