ASSET2.0
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SOLAR PANEL RECYCLING & IR GET THE LATEST!

New IR Strategies Transform Solar Panel Lifecycle. With more and more solar panels at their end-of-life stage, investment recovery is faced with a reuse vs. recycle challenge for landfill diversion. But up until now, the options were too few and too costly. But thanks to an eye-opening presentation at the fall conference, new cost-effective processes and strategies are now available – tailored to IR! *Page 5* ►

Charge your EV Ride: The Future of Wireless Electrified Roads.

Electric vehicles. Despite the dreaded 'range anxiety,' consumer demand will be outpacing gas-guzzlers sooner than later. And the charging stations? Don't count on any infrastructure plans for these in the near future. But wait! There's a solution…electrified roads. Just imagine a long trip without stopping while the road sparks your ride. *Page 10* ►

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PRESIDENT'S MESSAGE

GREETINGS!

Greetings to all members and friends of the Investment Recovery Association! It is my honor to serve as the President of this incredible organization, and I am excited to connect with you through this edition of our trade journal. As we continue to grow and evolve as a community, it's important to celebrate the strides we are making in investment recovery, while also looking ahead to the challenges and opportunities that await us in the ever-changing landscape of environmental responsibility and sustainable practices.

One area that has seen rapid growth and transformation in recent years is the use of electric vehicles (EVs). As the world embraces the shift to cleaner transportation, investment recovery professionals face new opportunities for sourcing, recovering and recycling valuable materials from aging EV batteries and components. The increasing adoption of EVs brings an evolving demand for the responsible recovery of resources, such as lithium, cobalt, and nickel, which are critical to producing these vehicles. By staying ahead of industry trends and improving our recovery processes, we can ensure that these materials are efficiently reclaimed and reused, reducing the environmental impact while providing economic opportunities.

Another growing sector in our industry is solar panel recycling. With solar energy on the rise as a major source of clean power, the need for effective and sustainable solar panel recovery is more pressing than ever. As panels reach the end of their lifecycle, it is crucial that we develop and implement technologies and strategies to reclaim valuable materials such as silicon, silver, and aluminum. This not only helps reduce waste and environmental harm but also contributes to a circular economy where resources are reused to meet the increasing global demand for renewable energy. Investment recovery professionals play a key role in ensuring that these materials are safely processed and put back into the supply chain.

As we reflect on the significant progress we've made and the opportunities ahead, I would like to encourage all members to participate in our Annual Investment Recovery Association Conference this year in Colorado. This event will be an excellent opportunity to learn, network and share insights on the latest trends in investment recovery and emerging technologies. Let's continue to lead the charge in shaping the future of investment recovery, and I look forward to seeing many of you there!

—George Rheubottom
Investment Recovery Association President
and Manager of Investment Recovery Santee Cooper

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COVER STORY

Solar Panel Recycling & IR: Get the Latest!

It's been a few years since ASSET 2.0 reported on the state of solar panel recycling. But at the 2024 fall conference in Arizona, Garrett Powell, from *Solar Panel Recycling (SPR)*, and Darcy Otis, from *Energy Solutions and Supplies*, not only updated attendees on this fast-evolving topic but what it specifically meant to Investment Recovery.

- What are the current trends impacting solar equipment for both recovery and reuse?
- Going into 2025 and beyond, what's the outlook for the solar panel secondary market?
- Are there hidden costs that IR professionals need to take into account?
- What criteria should you use in selecting a solar panel recycler?

To gain a comprehensive perspective, SPR began their presentation with a background on what's driving these trends according to the National Renewable Energy Research Laboratory (NREL). The expansion of solar and other renewable energy over the past 20 years has been substantial with a significant increase in solar photovoltaic (PV) technology deployment. This trend was driven by falling costs and policy support, allowing solar to become a major contributor to the US electricity grid with projections showing continued rapid growth in the coming decades.

So, what we're seeing is that solar is growing at an absolutely crazy rate, and we don't see that trend slowing down. The demand for power is needed to generate data centers, charging EVs—you name it…everything is getting electrified. And so how are we going to support that generation and on the grid?

Breaking that growth down specifically into solar, where's the benchmark today? Where are we at? So today there's over 200GW of solar capacity that's installed nationwide.

And in the last few months of 2024, there was a major announcement that there were over 5M solar systems deployed in the US. This is an aggregate number combining three major power users—residential, commercial and utility installations.

But the biggest and most rapid expansion has been on the utility side over the past decade driven by various factors such as infrastructure investments, technological advancements, increased energy demand and the shift toward renewable energy sources.

The operative word here is 'decade.' As solar panels reach the end of their life cycle (typically 25–30 years), the industry is focusing increasingly on reuse and recycling to manage the growing volume of solar waste.

However, we're seeing a lot of systems getting repowered much earlier than that—roughly in a 15-to-20-year cycle starting with the rapid expansion in 2010.

> Continued from previous page

Photo credit: Solar Panel Recycling

Factor in the hidden costs of logistics.

So, from a refresh perspective, we have to be able to develop both the reuse and recycling markets to make sure that we're prepared when obsolete or harvested materials hit the waste stream. And it has the potential to be exponentially growing.

But it's both fantastic and worrisome news. What are we going to do with these? Tens of millions of solar panels are going to come out of service. What can be reused, recycled? How can we mitigate the dreaded landfill option?

But first…reuseability

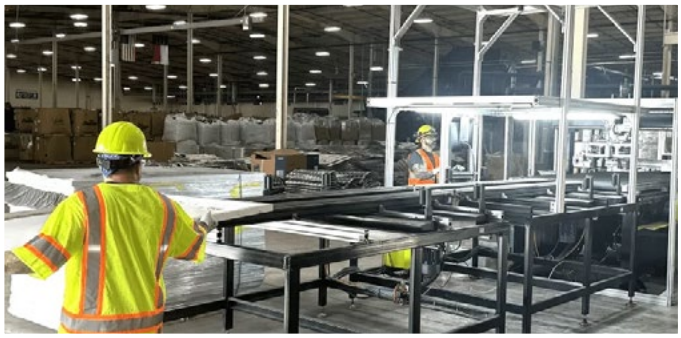
Before we get into recycling solar panels, let's focus on what should be a top priority for IR professionals – reuse or a better word…reuseability. There is a lot of reuseability specs that need to be in compliance – or what we refer to as 'what specs are still desirable?' Topping the list? Panels must be in good working condition along with a required level of associated wattage…and the bottom line is all about how many watts that panel produces.

And so, reuse marketability appeals to different markets. For example, better solar panel manufacturers with a reputable brand will have a higher value in some markets while others will find value in the number of panels and their wattage output. The bigger the number of panels, the more value from both a recovery and a reuse perspective.

Other reuseability markets include inverters, solar-related equipment, profits/non-profits and DIY. Markets overseas are expanding as well in Africa, South America and the Caribbean.

Another exponentially growing market is in existing implementations (20+ years) that's in need of a refresh or decommission. With solar panels coming at us at an accelerated rate, come new value opportunities—especially for utility companies. One case study exemplifies the value of a refresh or reuseability option. With an oversupply of new panels flooding the market, they could have had new replacements for a lower price. But that would have accrued hidden costs for packaging, shipping (and potential damage enroute) which are all major factors to keep in mind. The cost-effective solution? They had 60,000 panels in storage, so SPR worked with them to essentially reclaim 90% reusable and 10% recycled.

Also to watch? Broader industry trends are an increase in domestic and offshore manufacturing of new panels. This coupled with supply chain and potential tariffs can impact the resale market.

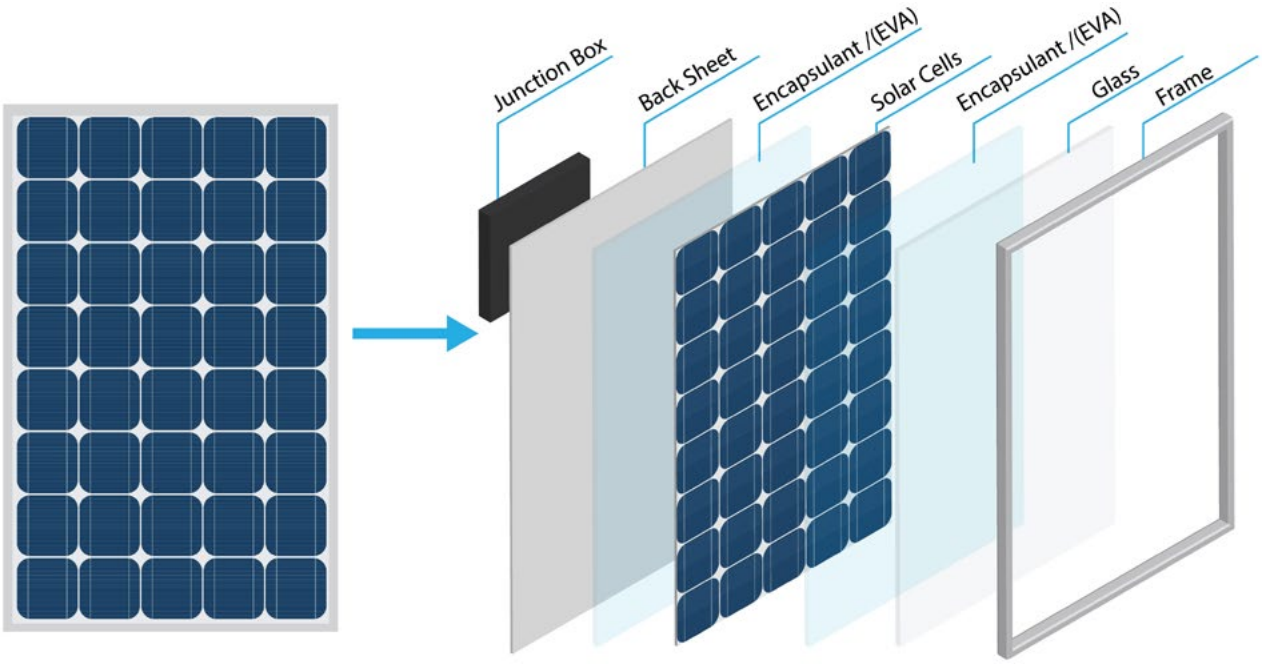


The big question

So the big question is—do we recycle or reuse certain panels? Obviously, a panel that is beyond economical repair is going to be recycled, but what about the 'maybes'? Let's look at how to make those determinations.

- Junction box repair: Not worth it—cheaper to replace
- Fast-evolving desirable specs: Avoid obsolescence in the secondary market. Monitor the latest 'must-haves' on a quarterly basis.
- Wattage output: Minimum of 300W—anything below won't be worth logistics costs.

Of course, the overarching goal is to keep as much of the solar panel waste out of landfills—and much of that waste can be recovered and put back into new production of renewable energy. And that starts with understanding the materials that comprise a panel. There are different types of panels but let's look at the most common composition that includes an aluminum frame, lit solar



cells, single-sided glass caps, backsheet, junction box and an encapsulant film (material placed between the solar cells and the glass cover, providing protection and adhesion.) For starters, batteries are universal waste, and the inverters are recycled through your e-waste partners.

What other parts of a solar panel are recyclable and their inherent value?

- Glass: 76%—is easily recyclable but has low value.
- Aluminum frame: Biggest recovery material that's 100% recyclable and has the highest value.
- Copper wire: Can be recycled and reused.
- Plastic junction box: Recyclable.
- Silicon: 5%—but can be recovered using chemical processes.
- Silver and internal copper: Valuable components, but in small amounts.

And the recycling market?

Considering that panels are mostly comprised of low value glass, the big question for IR should be, "Is this a no-cost scenario or even a negative one?" And when you factor in the logistics and clean separation costs, solar panel recycling from a commodity standpoint, at the present doesn't look very promising. But on the horizon?

Research and development

In 2018, SPR was working with a forward-thinking utility company that didn't like the available recycling options. Faced with an accumulation of solar panel waste, SPR jumped into action with R&D, spending the next three years developing new efficient and cost-effective processes (both chemical and mechanical). The result was a successful method for the clean separation of materials on a large scale. At the present, clean separation is a primary initiative by the recycling industry followed by handling the volume. And today, only a few recyclers in the US are actually getting a clean separation!

New processes for the clean separation of materials.

Photo credit: Solar Panel Recycling

Get up close and personal

Choosing a solar panel recycler requires careful consideration to ensure environmental responsibility, regulatory compliance, and cost-effectiveness. Here are the key criteria:

- Ensure the recycler complies with EPA regulations or equivalent national standards.
- Look for certifications such as R2 (Responsible Recycling), e-Stewards and ISO 14001.
- Verify compliance with state and local e-waste laws—they are evolving…so close monitoring is needed.
- Make a thorough onsite inspection and analysis of how they process panels – especially separation and what happens to the materials once separated.
- Look for a high material recovery rate (e.g., silicon, glass, aluminum).
- Ask about methods for handling hazardous materials.
- Ensure they minimize landfill waste by maximizing reuse and repurposing.
- Choose a recycler with experience handling solar panels specifically.
- Look for customer reviews and case studies to gauge reliability.
- Verify if they work with utility companies or large-scale solar firms.
- Ensure they provide documentation and tracking for proper disposal.
- Check if they offer reports on recovered materials and environmental impact.
- Factor in hidden costs of packaging, transportation and processing.
- Consider recyclers offering pickup services or drop-off locations.
- Look for volume-based pricing for disposing of large quantities.
- Choose recyclers with low-carbon processing methods.
- Check if they use renewable energy or eco-friendly recycling practices.

And finally

The future of solar panel recycling is evolving rapidly as the demand for renewable energy grows and the first generation of solar panels reaches the end of its lifespan. Investment Recovery will be faced with both reuse and recycling challenges dealing with compliance, environmental issues and market trends that all impact the bottom line.

So, vet your vendors and collaborate with them on current and future plans for overall scope on how to identify salvage value early on. This will cut costs and minimize environmental impact and non-compliance in both the short and long term. ■

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FEATURE STORY

CHARGE YOUR EV RIDE: THE FUTURE OF WIRELESS ELECTRIFIED ROADS

When asked if folks are considering switching to an electric vehicle people fall into two categories. There's the gung-ho group or "I'm amped up about buying a new electric car," and the not so gung-ho group, "Electric cars (EVs) are cool and responsible except for the price tag." So, there are pros and cons on both sides of the EV buying issue. But here is a simple truth: The electric vehicle future is already here. And here is another simple truth: Some of those cons are in the rearview mirror thanks to new technological innovations and consumer demand.

But recently…

Politics and the economy could play a big role in EV adoption over the next few years. The eco-friendly, EV acceleration policies put in place by the past administration may be modified by the new administration. In the months and years ahead, they are recommending major changes to roll back support for electric vehicles and charging stations – including blocking cars, components and battery materials from China.

In spite of this, here in the US, EVs are rapidly gaining traction as consumer attitudes drive market demand. In VinFast and The Harris Poll's 2023 survey of 1,800 US drivers, 54% of gas vehicle drivers reported considering an EV for their next purchase or lease. And to no one's surprise, EV demand was more prevalent with younger drivers aged 18–44. However, against a backdrop of growing demand, the future of electric vehicles requires significant investment, innovation, collaboration and government initiatives.

Are you 'amped'…or not so much?

When it comes to the benefits and headaches of EV ownership, many folks who have already made the switch will have their own opinions.

In general, EV ownership provides drivers with lower carbon emissions, zero gas fees and cost-effective maintenance. That being said, electric cars require different driving and purchasing behaviors, which make up the EV 'naughty' list such as a higher upfront and battery replacement costs, longer charging times, limited range and low resilience to extreme weather conditions.

More recently, EV auto companies are advancing battery manufacturing, updating and recycling techniques to improve battery performance while driving down costs. As EV technology advances, we can expect decreased initial purchase and replacement battery costs as well as increased lifespans and weather resilience. Overwhelmingly though, the lack of a charging infrastructure seems to top the list of consumers' reluctance for not switching from gas to electric vehicles. And a solution is now appearing on the horizon where the rubber meets the electrified road.

Spark your ride

In the not-so-distant future, you could be driving cross-country in your EV…without wasting time to stop and recharge. That's right.

Electric road projects are appearing across the world as a potential solution to supplement stationary charging. And what does this mean? EV drivers can wirelessly charge their cars while they drive without having to make frequent stops.

How does that work?

Electrified roads are nothing new. There are actually three technologies to spark your ride. They include:

- **Conductive Charging:** Overhead lines or in-road rails deliver electricity to the vehicle, mostly utilized for large trucks and buses. Although efficient, they pose a hazard due to exposed conductive surfaces.

- **Solar Panel Charging:** Road surfaces are integrated with solar panels that collect and store energy, which can then be used to charge vehicles dynamically. The key advantage is using renewable energy while challenges include solar panel durability and high cost.

- **Wireless Inductive Charging:** Coils are embedded in the road surface to generate a magnetic field. This field transfers energy wirelessly to a receiver coil in the vehicle, charging its battery. With wireless efficiency and high resiliency, this option provides continuous charging while driving or idle. Despite its high installation costs and precise coil alignment disadvantages, inductive charging is already getting a trial run in Europe, Israel and the US. In partnership with Electreon, the leading provider of wireless charging solutions for electric vehicles, EVs are getting sparked up being driven or sitting still.

Europe takes the first trial run

France first demonstrated an electrified road ahead of the Formula E World Championship in Paris - charging speeds of 62 mph and 20 kilowatts. Installation is being implemented to electrify more of France's roadway network through 2027 to achieve their decarbonization goals.

In June 2021, the Smartroad Gotland project became the world's first public wireless inductive electric road for heavy-duty vehicles in Sweden. One mile in length, this represents a groundbreaking technological development in the field of sparking your ride.

Currently underway in Norway, is a 100-meter coil being embedded in a heavily traveled roadway. The pilot program is set to last for one year, during which the system's performance and efficiency will be analyzed under extreme weather conditions.

US joins the wireless journey

At the present, there are three electrified road pilot programs in process across the US.

Our first stop is the Motor City—the first successful deployment of US 'smart road' technology. Measuring just a quarter-mile in the heart of Detroit's Innovation District, Dr. Stefan Tongur, Electreon stated, "We're excited to spearhead the development and deployment of America's first wireless charging road," he said. "Alongside Michigan's automotive expertise…This project paves the way for a zero-emission mobility future, where EVs are the norm, not the exception."

At the "Crossroads of America," Purdue University engineers and the Indiana Department of Transportation (INDOT) are hard at work road testing their own wireless charging technology.

Construction is in progress on a quarter-mile stretch in West Lafayette, Indiana. Here, the team of Purdue engineers are

testing their own patent-pending system for powering heavy-duty electric trucks traveling at highway speeds. The pilot program begins in May 2025 and runs through the summer.

UCLA is expected to have the first wireless charging roadway in California following a $19.85 million dollar state grant for charging public buses. Starting with a half-mile road in Westwood, it will allow for longer run times without stops for static charging—thus improving service to riders. Construction is due to be completed ahead of the 2028 Olympics in Los Angeles, where the university will be hosting the Olympic Village.

Will 'smart roads' gain traction?

Yes…when you consider that they eliminate a main barrier to EV adoption—range anxiety. Presently, the charging infrastructure has not increased enough and the charging downtime has not decreased enough while the demand for EVs keeps growing. That makes electrified highways all the more viable in the near future with extended range capacity and no downtime with stationary charging. Smaller batteries could then be used requiring fewer raw materials in the EV production process to benefit the environment. And of course, fewer gas-guzzling vehicles means cleaner air for us all.

Behind-the-scenes technological developments are also paving the way for sparking your ride with:

- Improving efficiency with innovative coil design and energy transfer methods.
- Shifting towards charging vehicles at highway speeds rather than while stationary.
- Integrating AI and IoT to better manage energy distribution based on traffic patterns and vehicle energy needs.

However, there are challenges that need to be overcome such as:

- Retrofitting or building roads with embedded coils that would incur a high initial cost.
- Standardizing technology across different vehicle manufacturers and countries.
- Designing an embedded infrastructure to withstand heavy traffic and weather conditions.

And the future?

Owning an EV isn't about being trendy. Electric cars have clear benefits, and many drivers are making a conscious decision to go fossil-fuel free.

Despite the obstacles, new technology and growing consumer interest could prioritize wireless charging for advancing sustainable transportation. And the future is definitely moving towards EVs. By 2030, 40% of new sales will be EVS…and by 2040? 100%. By amping up roadways, cities could maximize utilization of their buses and delivery vehicles. Long-distance highways could support freight and passenger EVs. Collaboration between governments and companies is likely to fund pilot projects into large-scale implementations. New sustainability incentives could be a major factor in the transportation infrastructure and new energy initiatives.

So where does this leave us today? Faced with the dynamic global, economic and political forces at this stage of our journey, consider this:

Why did the mechanic quit his job at the electric car shop? He couldn't handle all the current events. ■

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News of the Investment Recovery Association

CONTINUE THE CONVERSATIONS AT OUR OUR NEXT CONFERENCE & TRADE SHOW!

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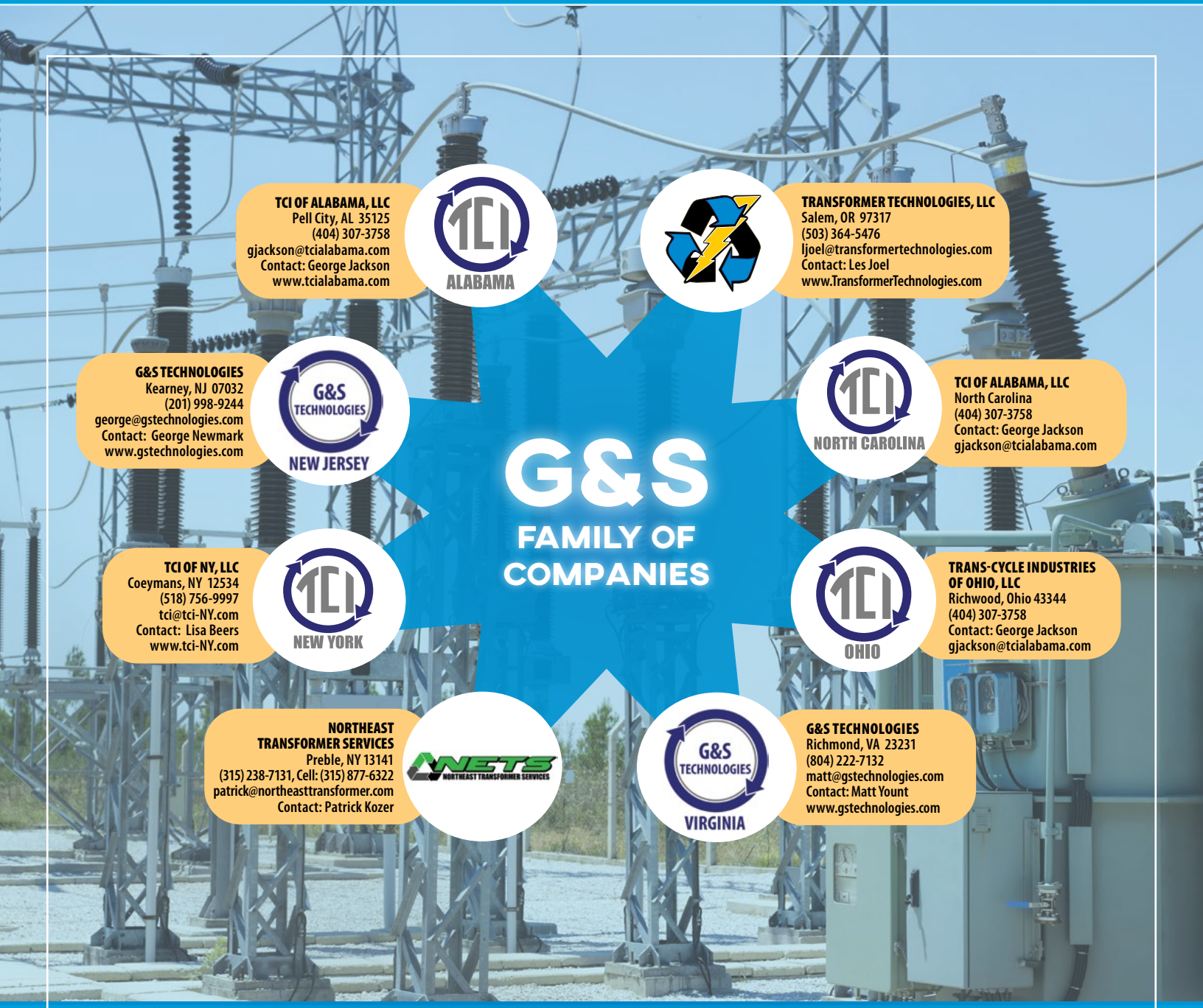

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