Energy Industry Notes
In New York, a study of what would happen if New York met it's electric vehicle goals with 3 different scenarios (normal electricity rates, off peak charging behavior modification, and DC fast chagrin equipment being widely available), in all three scenarios there was a net benefit of billions of dollars, with savings coming from tax credits, gasoline and operations and maintenance costs, and emission reductions.

Solar in Australia is booming in particular. So much so that regulators are putting in rules to prevent blackouts due to overloading the infrastructure. Some rules like the ability to turn off your solar panels/prohibiting the charging of utilities when prosumers push energy into the system/even export fees when you push energy into the system if it's congested. SA Power Networks (Southern Australia Power Networks) is planning on doubling solar capacity within 5 years. ~20% of Australians partly meet their energy needs via solar on rooftops. SA Power projects hitting a minimum demand of 0% by 2023, which would be dangerous for grid.

Common theme among renewable energy is changing consumer behavior to do things during the day (when solar and renewable energy is plenty) and less at night. Also batteries and energy storage is continually key.

Spending areas:
- Upgrading outdated infrastructure (wires, inverters, transformers, circuit breakers) and adding smart devices/sensors/smart meters are a big point of spend
- Customer services and information systems (notifying customers of outages and providing better customer service)
- Addition of electric distribution systems
- Operations and maintenance costs due to DRMs, variability of weather, wear and tear on transformers due to reverse power flow heating transformers, etc

https://www.iea.org/programmes/digital-demand-driven-electricity-networks-initiative

Solar.com is making a marketplace that allows customers to shop around for solar contractors for the best price and installation/setup that works for them.

Electrum (subsidiary of solar.com) does the same, but also partners with various utilities to allow the utilities to offer the marketplace in partnership with them. Pretty smart because then the utilities get insight into consumer patterns. This also gives the utilities an easy launch point to integrate with these DERs as they're helping the consumer buy the solar products. Both of these companies thus far seem to be fairly successful/profitable.

Interoperability, aka "glue work" that combines all of the various data streams and systems to control (ie utilities, DERs, EVs, battery storage) are integral to getting everything to work seamlessly, but right now there's no good solution because everything is proprietary.

“...DERMS can address a wide variety of issues, solution providers have shifted away from all-encompassing proposals. Instead, over the last few years, partnerships within a broad community of DERMS providers have emerged.

We expect to see continued consolidation of this space, as more solution providers collaborate to capture the full value chain between customers and the grid.”

Maybe a key idea is to create software that services the DERMs. We can do the “harder” tech ie AI/ML and DERMs can use our MLAAS to improve their offerings to utilities.

Also presents the idea that utilities aren’t solely using one DERM for everything, chances are they’re using a variety of offerings for various different situations.

Strong and clear regulatory definitions and rules are necessary to facilitate the DERs ecosystem. There are clear rules that energy generators have to follow as well as loads have to follow, but it gets messy when energy storage comes into the system, as it can serve as both. Ambiguity about what side it falls into, or if it has to fall into both sides, stalls progress and adds friction. As of 2018, states are *still* actively working to clarify this.

Non wire alternatives (NWAS), which emcompasses DERs, can also be advantageous to utilities. Instead of being forced to invest in the traditional means of meeting increasing demand (which is finding pole and wire bottlenecks and replacing that with new infrastructure which is expensive), utilities can create DERs closer to the source of the energy demand growth and delay/not do expensive hardware infrastructure upgrades. Additional means exist, such as providing rebates for end users to upgrade existing poor efficiency appliances to high efficiency appliances, significantly reducing energy demand.
“Con Edison has implemented the largest NWA to date; the Brooklyn-Queens Demand Management program, a $200 million investment to defer a $1 billion substation upgrade.

The program relies largely on energy efficiency measures, from traditional incentives for replacing inefficient appliances and air conditioning units to new building management systems. However, the program also calls for other DER such as fuel cells, demand response, and energy storage, and it employed a novel descending clock auction process to procure the resources for this program, as opposed to simply issuing an RFP.”

FERC (Federal Energy Regulatory Commission) in Sept 2020 issued Order 2222 that gives *regional grid operators* a year (but has already been extended for various regional grid operators) to reorganize their market structure such that DERs have the same fair rules and opportunities that traditional energy providers (gas and coal and oil) have in the *wholesale energy market*.

Note that the *wholesale energy market (MISO, RJM, SPP, ISO-NE, etc)* is different from the *retail power market*. *Wholesale energy market* is between generators and resellers, and *retail power market* is when the end user actually buys and uses electricity. What exactly this means

is hard to nail down, because there are 6 deregulated energy markets in the US that all have different rules for participation, so what it means is different per market.

Note, DERs also includes energy curtailment, so demand response programs like paying customers money to back off their energy consumption to reduce grid congestion.

Source: https://cpowerenergymanagement.com/a-primer-for-understanding-ferc-order-2222/

Tesla in collaboration with the Australian government is piloting a VPP (virtual power plant) where in a certain area they are installing over 3000 solar panels and storage batteries in customer houses. This network of energy producers and storage solutions will work in unison and be centrally managed by Tesla software to trade energy on the Australian Energy Markets. Multiple side benefits such as lower energy bill for consumers and greater grid reliability. (Started August 2020) https://arena.gov.au/projects/tesla-virtual-power-plant/

“Buildings consume approximately 75% of U.S. electricity and drive as much as 80% of peak power demand in some regions”

Smart buildings seem like a pretty good place to start. Large company office buildings are large users of electricity, and on that scale money saved would be decently significant that they’re interested. They also seem like a pretty large piece of the pie, so would be large impact. Other ideas could also be integrated and connected neighborhoods.

Advanced Microgrid Solutions develops AI-enabled optimized bidding software for utility-scale storage and generation assets. Combination of “advanced price forecasting, portfolio optimization and market bidding to ensure energy storage and flexible generation assets are responding optimally to price signals sent by the market”
“The market bidding software is currently available in the U.S. in the California ISO (CAISO) and in Australia’s National Electricity Market (NEM), where it optimizes over 15 percent of Australia’s wind and solar resources, with plans to expand to additional markets in the near future.”

So an opportunity to strike is to target one of the 6 marketplaces that AMS isn’t targeting and absolutely kill it in that market and then expand.

Bill Nussey is an entrepeneur that pivoted from 30 years in software to clean energy. Extremely bullish on the ramifications of *local energy* and how that will revolutionize the energy world, because it:

- Circumvents old engrained dirty generators who have no incentives to pivot away from producing electricity due to sunk cost into the factories and the need to pay off the hefty investment into the generators
- Distributed, so a lot more resilient to targeted outages and disaster scenarios
- Are *technologies* so overtime the price will go down, where as oil, natural gas, and coal are *resources*, so they’re finite and the price won’t drop as adoption increases

Interoperability is going to be a big problem moving forward with so many various different DERs that need to be connected together in order for everything to work intelligently and in sync. One possibility is having a central node that all data from all DERs flows to. Heila Technology is betting that that kind of central node system is *exponentially* more complex (not incrementally) as more DERs and constraints get added in. Heila Technologies solution is to instead go to each individual DER and adding controllers to each individual DER and locally optimize. Exact technical details I don't understand, but the premise seems sound.

David Energy is attempting to be a new type of energy provider. In New York City, the energy markets work by:

- Having wholesale markets between wholesale suppliers of energy (big power plants that provide energy) and retail energy providers, utilities that agree to buy the energy in bulk from the suppliers of energy
- Having retail markets between retail energy providers and customers (normal people, buildings, etc) where customers buy energy from retail energy providers (REP) at a large mark up, typical 2x to 3x.
- The reason for the retail markets is because of risk - there's inherent risk because the the supply of energy can suddenly skyrocket based on hard to predict events.

However, with the recent advent of DERs, things get complicated for REPs, as customers now have the ability to sell back into the market/have much more variable energy usage.

- David Energy attempts to be the "Energy Operating System" (ESO) of major buildings in NYC. David Energy claims to manage and optimize all DER usage in the buildings, all the while using machine learning to intelligently manage traditional energy contracts with *wholesale suppliers skipping the retail energy providers*. In addition, they charge a SAAS fee to the buildings/customers to align incentives (they're incentivized in keeping energy bill as low as possible for the customers).
- It seems the company still does non-scaled targeted jobs for specific building needs, so not an easy agnostic system that anyone can integrate with

David Energy could potentially be a customer of Heila Technologies, as David Energy would purchase Heila Edge to help manage the DERs inside of various buildings.

In depth research on how fine tune control of water heaters can help balance electricity demand:
https://www.raponline.org/wp-content/uploads/2019/01/rap-farnsworth-lazar-shipley-beneficial-electrification-water-heating-2019-january-final.pdf

Thorough investigation of the incident that destabilized the European electrical grid and why it happened:
https://eepublicdownloads.entsoe.eu/clean-documents/pre2015/publications/ce/otherreports/Final-Report-20070130.pdf

On distributed energy resources:
https://eta-publications.lbl.gov/sites/default/files/lbnl_locational_value_der_2021_02_08.pdf

Open report that interviewed utility operators to understand their most pressing needs: https://h7g7q8k5.stackpathcdn.com/cdn/ff/BZS4ZVDaugogJMwNlDBe-oOXuK4_fUjBwjWcY79ESgA/1601912159/public/2020-10/20%20SDR%20Electric%20PDF%20FINAL.pdf