ELECTRICITY INFRASTRUCTURE

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ENERGYSCAPE

When thinking about a landscape, it is common to recall features such as vegetation, bodies of water, weather, geographies, land, infrastructure, seasons, human settlements, industry, among others. A landscape can be tough about as a setting that assembles different features. Landscapes are not static, they vary across time and space. They rely on the perspective of the viewer. In other words, a landscape can be explored as a unifying idea within an environment. It is characterized by a changing representation that relies on perspective. Landscapes can also be navigated by agents who experience and constitute larger formations, driven by the sense of what these landscapes offer (During 1999:222).

Electricity is a feature that can be part of a landscape. It operates at a macro scale and takes part in different landscapes. Electricity is constituted by relations between utility companies, the state, society, and other infrastructures. Also, it is comprised of different technologies, materials, technical knowledge, natural laws, economic principles, political practices, and social needs. Elements that, together, portray electricity as a complex topic to address. Hughes (1993), when talking about electrical systems, recounts how they operate with a certain sense of variation of form and function that makes it possible to encompass this complexity. He states "[electricity] systems embody the physical, intellectual and symbolic resources of the society that construct them" (1993:3).

This piece deals with this complexity. In order to unravel it, I suggest engaging energy and its infrastructures as constitutive elements of what has been referred to as Energyscape (Strauss et al. 2013; Appadurai, 1990). The reason why Appadurai uses the suffix "scape" is that it "indicates first of all that these are not objective given relations which look the same from every angle of vision, but rather that they are deeply perspectival constructs, inflected very much by the historical, linguistic and political situatedness of different sorts of actors" (1990:296).

ELECTRICITY INFRASTRUCTURE

According to Larking (2013) infrastructures operate in a network fashion. They “facilitate the flow of goods, people, or ideas and allow for their exchange over space” (2013:328). This approach implies that infrastructures are relational. It opens the possibility to explore interactions between other infrastructures, agents, nature, and space. They can be advanced by their technical features since they represent a built system of materials, components, technology, and knowledge. They can also be approached by their position in space. Infrastructures of energy have been designed and located in places. Infrastructures can also be understood as mediators of objects, places, people, industry, institutions, and politics. They can advance disagreements, struggles, and enforcement of rules. The technology embedded in infrastructures can become a political terrain and enact what it is called techno-politics (Von Schnitzler,2013; Sadow[illegible] Levenda (2020). They are the material representation of an electrical project carried [illegible] the name of innovation but also embody a particular form of energy politics (Grandclément et al. 2015).

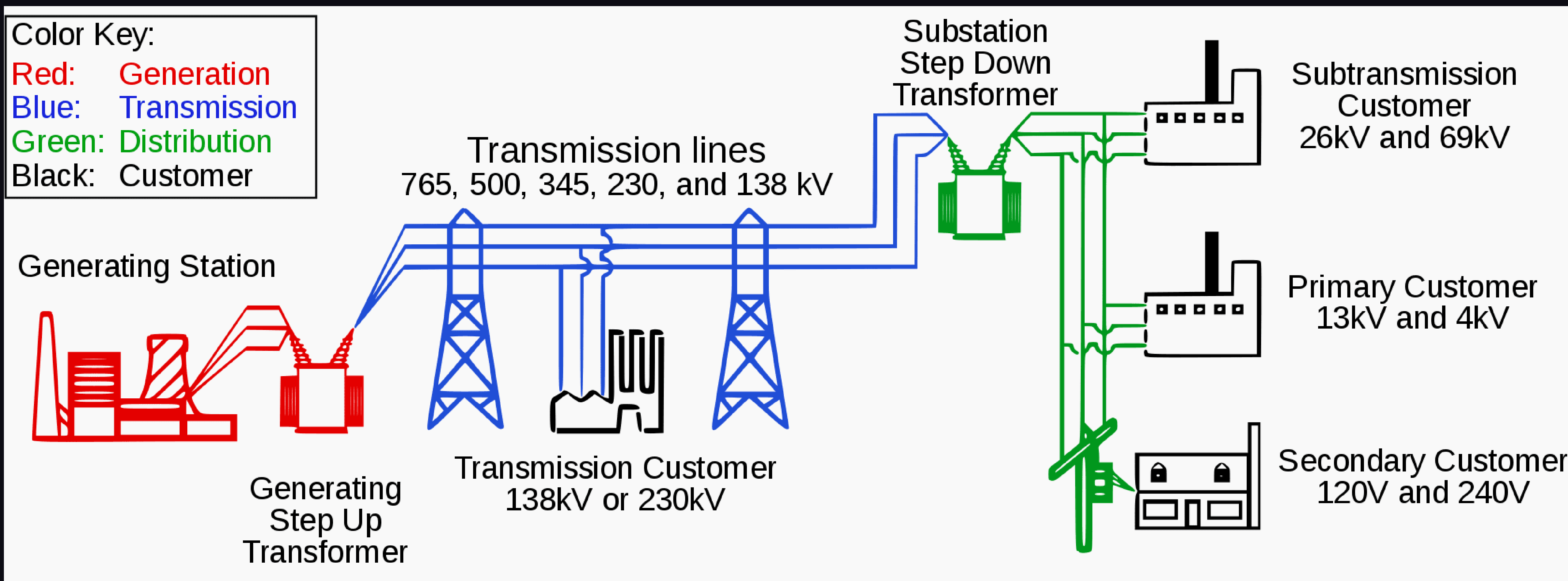
There is a debate regarding **invisibility** and **visibility** as an inherent condition of infrastructures (Strauss et Al. 2013; Star 1999; Larking 2013). Although invisibility of infrastructures is a feature that must not be disregarded, Larkin explains that the point is not to assert one over another, but “to examine how (in)visibility is mobilized and why” (2013:336). Both visibility, and invisibility, are situational. This means that they depend on a set of circumstances and affairs to be seen. It is paradoxical to conceive energy infrastructures as invisible since these are intertwined in daily activities and spaces. But nowadays, undergrounding is a widely extended practice. This refers to the practice of replacing overhead cables with underground ones. These new technologies are described as beneficial in terms of health and aesthetics. But, this practice has also been questioned, since it is considered to produce magnetic and electrical fields that can be detrimental to natural life (Lienert, Sütterlin, & Siegrist, 2018).

Electricity Grid

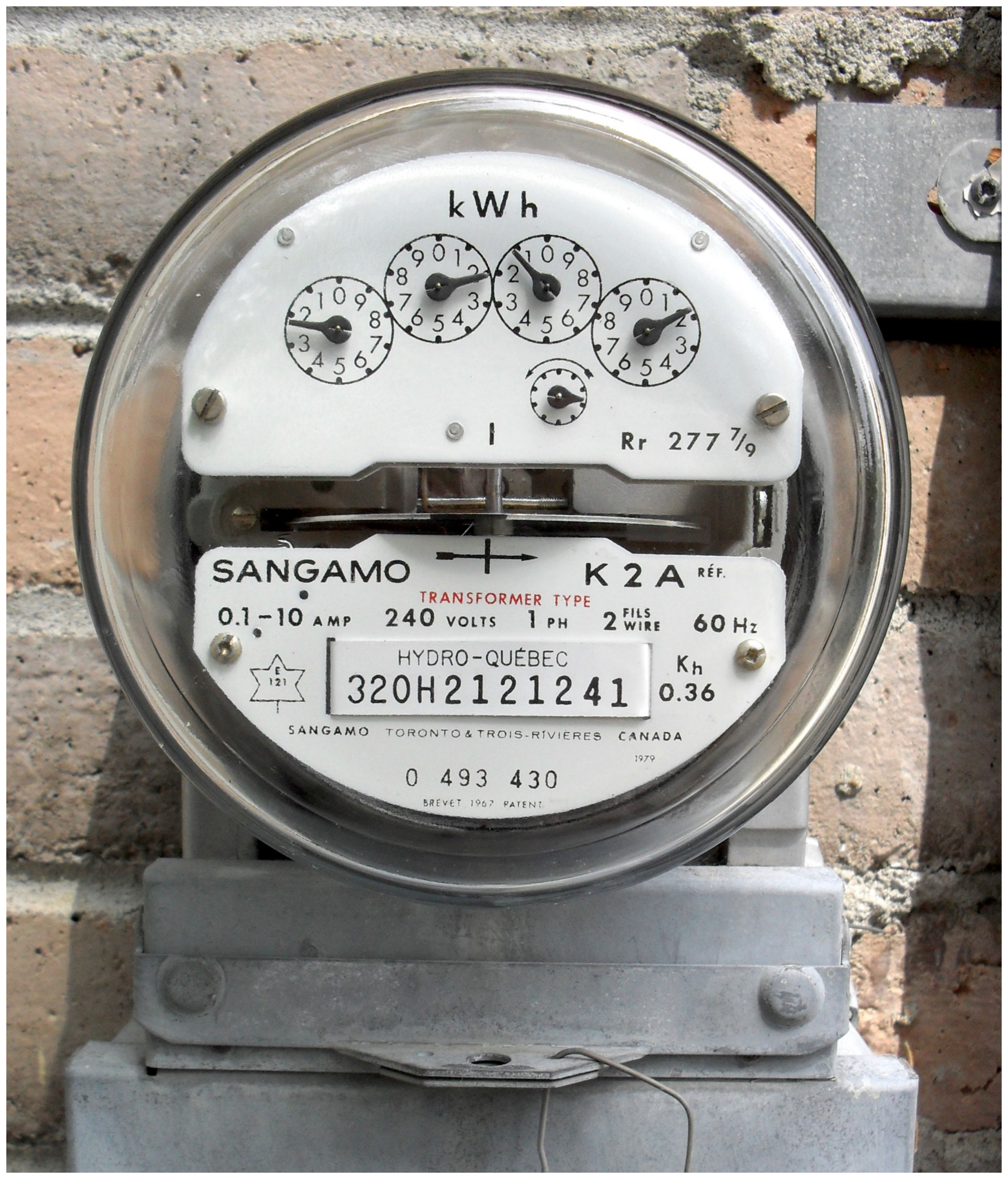
Electricity infrastructure can be approached by considering individual devices, switches, light bulbs, wires, power plants, fuse boxs, etc. But also, as part of a network. Grids are interconected systems that, synchronically, work together to guarantee the demand for electric power in a region or a country. Physical infrastructures and humans are constituent elements of what is known as electrical grids.

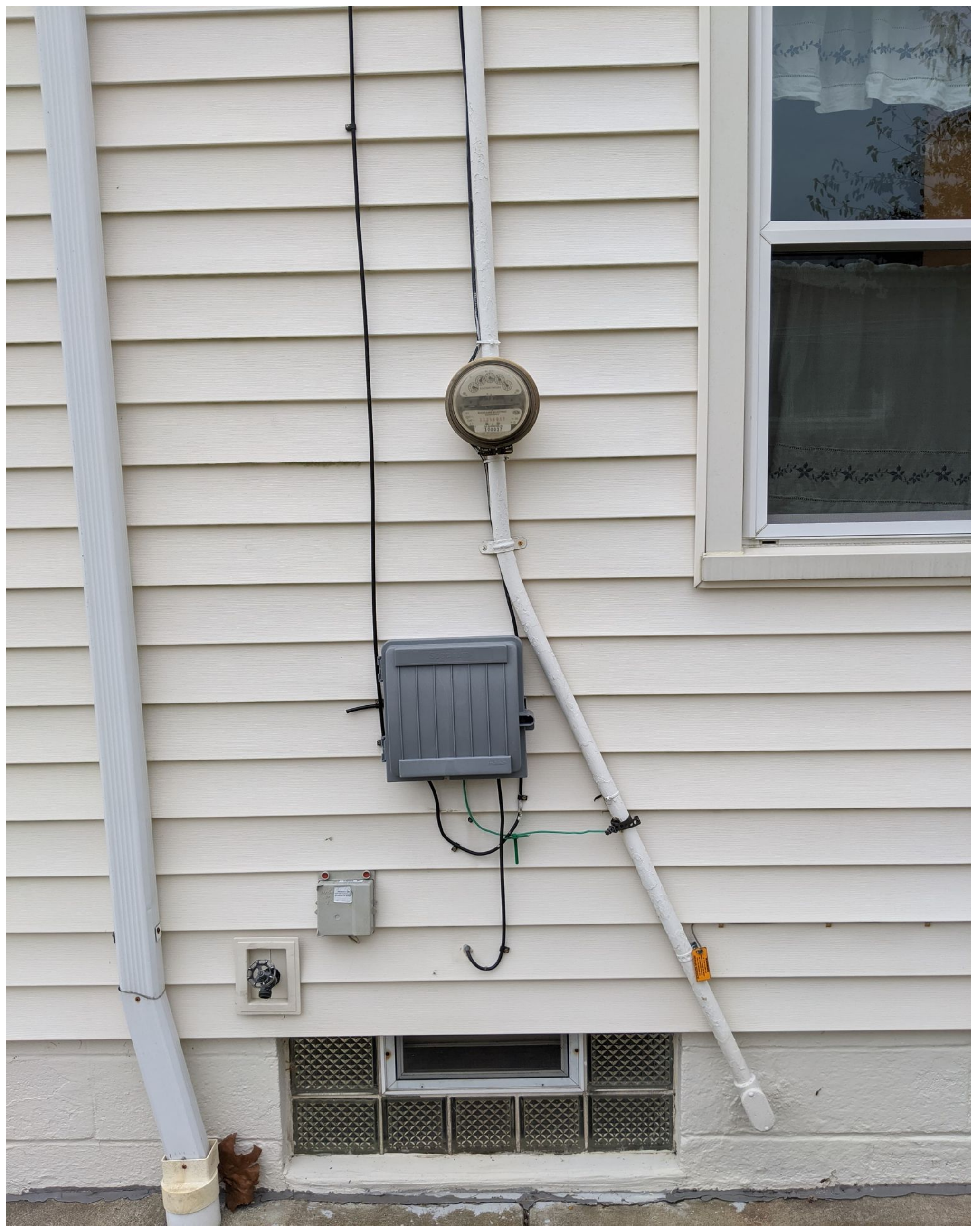
The current US national grid is the result of a project that began in 1880. Early electric energy was meant to function near devices or services requiring that energy. According to Hugues “power transmission increased in extent from a few city blocks to regions comprising tens of thousands of square miles. Power distribution networks carried the electric supply from the transmission network to the power utilization machinery and appliances. Control components regulated supply systems following established standards such as voltage, frequency, and directed the system for optimum performance as measured by goals, including efficiency and economy” (1993:7).

By 2016, according to the Energy Information Administration (EIA), the U.S. electricity grid was comprised of over 7,300 power plants, approximately 160,000 miles of high-voltage power lines, and millions of miles of low-voltage power lines and distribution transformers, connecting millions of customers throughout the country (EIA, 2016). In 2019 the EIA reported that the U.S. consumed 3.9 trillion kilowatt-hours. This consumption figure includes retail sales of electricity to consumers



Source: Federal Energy Regulator Commission. https://www.ferc.gov/sites/default/files/2020-04/reliability-primer_1.pdf





It is important to explore the different types of social-electricity infrastructures relations that can arise. Anthropology, alongside other disciples, has engaged in the understanding the social dynamics and challenges that can emerge (Strauss et Al. 2013; Von Schnitzler, 2013; Winther, 2008; Gupta,2015; White,1943) This scholarship argues that electrical infrastructures are capable of transforming lives but they can also be contested. It also highlights the elements that contribute to the creation and sustainment of these relations. People can engage by integrating culture, perceptions, effects, beliefs, and values.

These kinds of interactions create spaces of communication where people exert agency. This exchange, also show how Electricity infrastructures are embedded in systems that become mediums to enact politics. Infrastructures become visible vehicles to advance ideas such as modernization and progress (Larkin, 2018). They are also historical since they have changed according to the needs of society, markets, and technological development (Hughes,1993; Nye, 2018; Hausman, Hertner & Wilkins, 2008). And they will keep changing.

EXPLORING ELECTRICITY INFRASTRUCTURE IN CUYAHOGA COUNTY

To explore and to bring forward our daily coexistence with electrical infrastructure, this piece will rely on Geographical Information Systems -GIS- and photography as mediums to visualize the designed energyscape in the U.S.

This project will use GIS as a tool that can be of assistance in exploring how electrical infrastructures intersect with and/or affect spaces, such as cities, railways, national reserves, highways, etc. It is a way to visualize large-scale spaces, allowing a thorough understanding of how infrastructures are present in our social world.

There a final reason why I decided to use this tool. In one of the government's design manuals for transmission lines, GIS was presented as a key tool to define the route where transmission lines are situated. This is interesting because this is possible thanks to the availability of data and information. Hence, I believe that GIS is a tool that can also be reshaped and handle by different users, not just government and utility companies. It can help in socialize knowledge; in creating awareness of where and how are we situated. GIS can help to "reclaim geospatial information produced by third-party sources, and “remixing” or representing it in ways that meet their needs" (McMahon,2017:444).

Data

I will work with shapefiles containing electricity transmission lines, power plants, and electric substations. Also, I will integrate photographs that I capture while I was living in this particular county. I did not include information regarding low voltage distribution lines, since I was not able to find this information for public use.

Scope

Due to COVID-19, I was not sure what was going to be my future. I decided to focus my attention on the place I was dwelling at that time and to centered around my immediate surroundings. That is why I decided to limit my project to Cuyahoga County in the state of Ohio.

This map represents the area of the **Industrial Valley** in Cleveland. It is known for harboring companies that work with steel, recycled materials, and construction materials. The Cuyahoga river can be observed. There is also a commercial area called **Steel Yard** (marked with a pink circle) this is a busy shopping area.

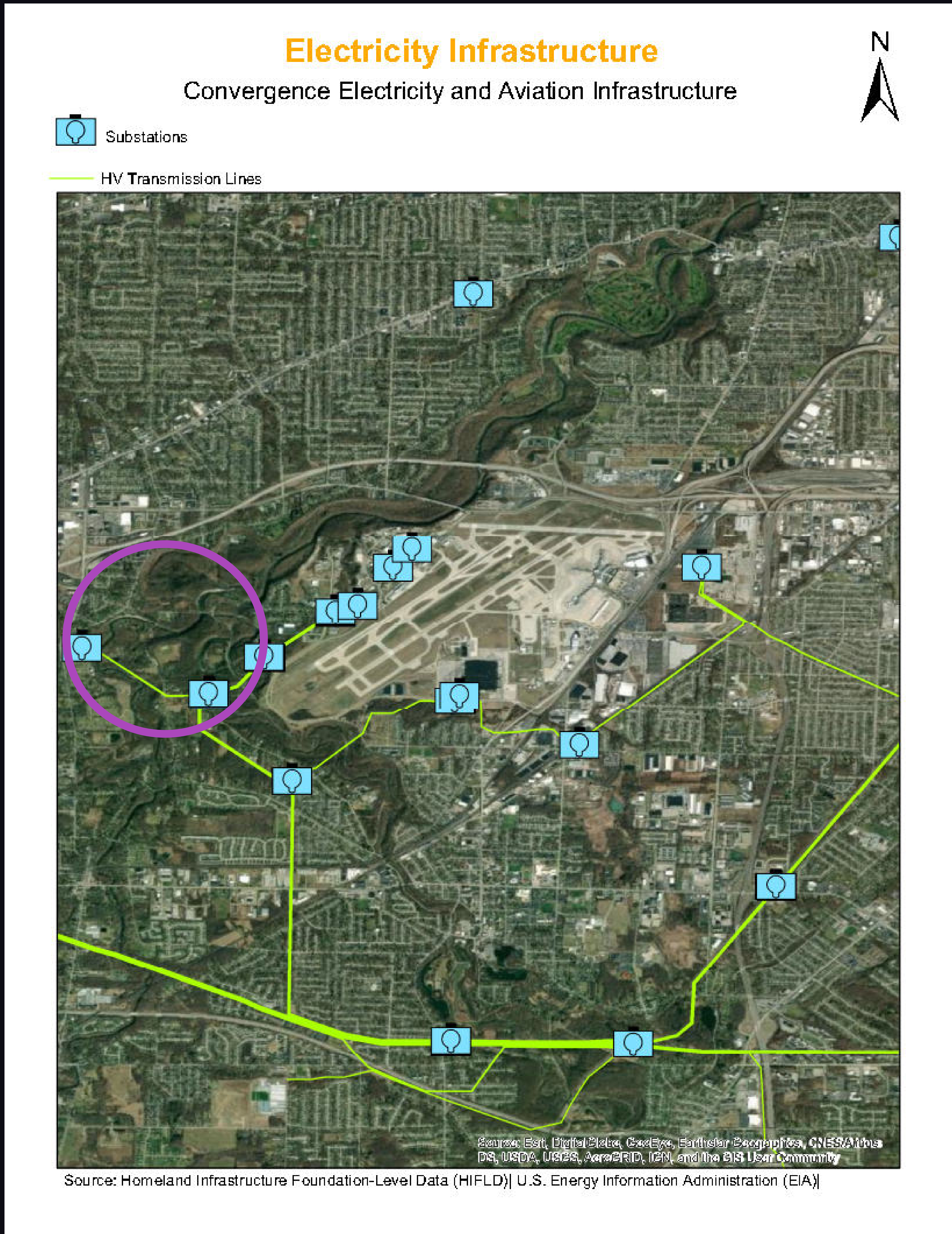
I decided to zoom-in this area of the city because there are different things going on in this particular location. First, there is a conglomerate of substations and High Voltage Transmission Lines. The reason behind this is that here, are located the **Norfolk Southern and CSX CORP:** two major railroad systems serving Cleveland. Electricity in this kind of transportation system is typically generated in stations, transmitted to the railway network, and distributed to the trains.

This map portrays a convergence of electricity infrastructure with industry, commercial, and transportation complexes. This scene reveals a dynamic relationship between the different infrastructures. Here, electrical infrastructure serves mainly the railroad system, but it is also intervening in commercial and industrial settings simultaneously.

Source: Homeland Infrastructure Foundation-Level Data (HIFLD)| U.S. Energy Information Administration (EIA)|

This map exemplifies the relevance of electrical infrastructure in allowing the functioning of larger infrastructures, such as **airports**. I was impressed by the number of substations that surrounds this infrastructure. When reflecting on it, this airport deals with multiple subsystems such as baggage handling, aircraft maintenance, security areas, concourses, runways, parking lots, cargo terminal operators, fuel depots, retail shops, restaurants, and cleaning services. In order for all of these to work properly, it is necessary a great amount of power. Next to the airport, is located the **NASA Glen Research Center and National Weather Service of Cleveland**. Here, the **Rocky River Reservation** is also situated (marked with the purple circle).

In this visualization, air transport infrastructure, electricity infrastructure, nature, and research centers take part in a dynamic articulation in space. Electricity infrastructure mediates a relation between multiple organizations and connects them. This interaction provides information about the ways airports have been designed and their patterns of energy consumption. But, what do these sociotechnical constructions tell us? Are they following a formula? All these infrastructures make certain things possible and other things impossible. As Easterling (2014) explains [infrastructures] is an updating platform unfolding in time to handle new circumstances, encoding the relationships between buildings, or dictating logistics.

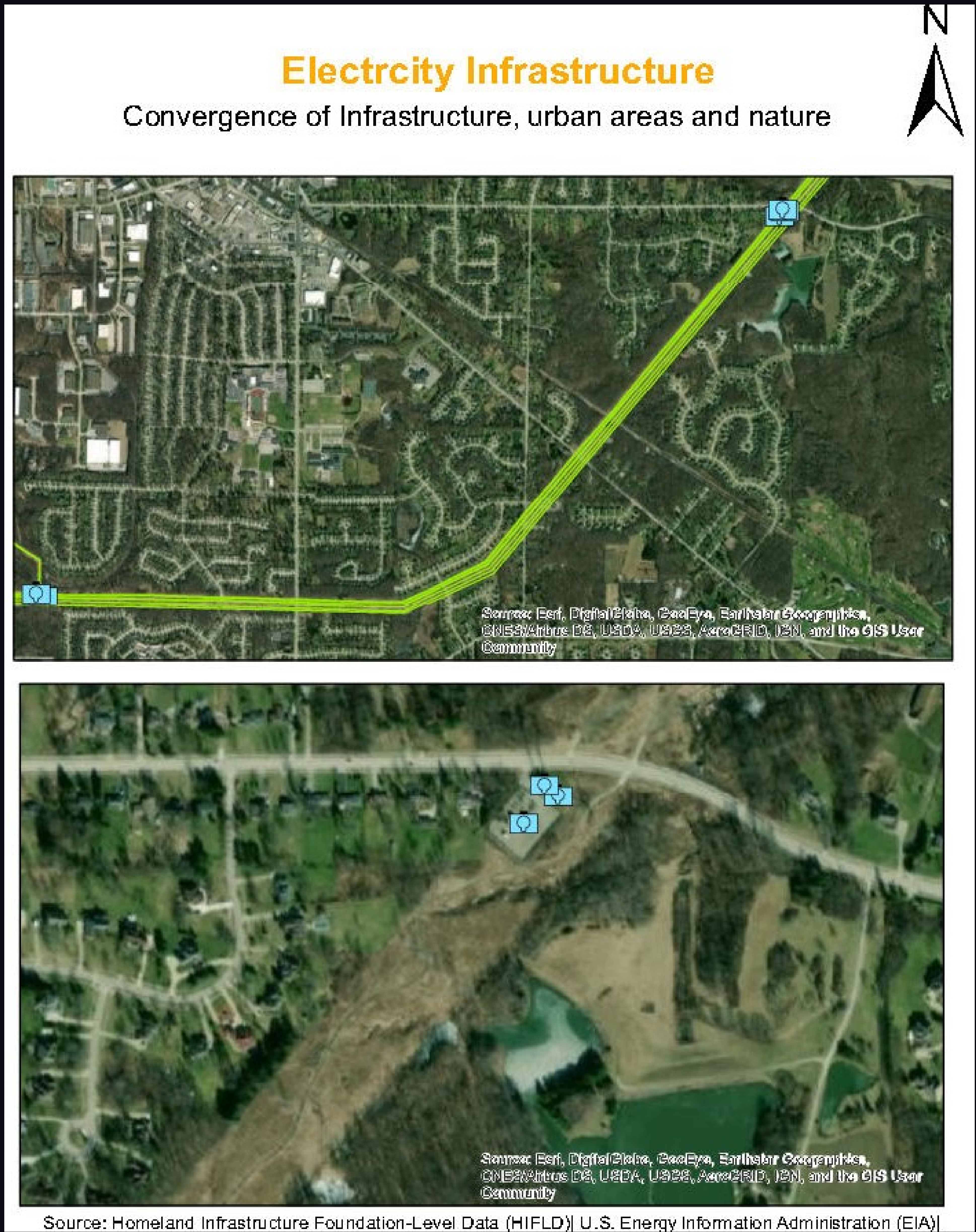


On this map, I explored data related to power plants. Ohio power plants have been through a transformation, influenced mostly by the introduction of alternative sources of energy generators. This scene portrays a downtown Cleveland area. **Hamilton Avenue** is a commercial and residential area. I was surprised to find a gas-powered plant. It is possible to observe the structure of the power plant itself, with its two chimneys and a substation right next to it. **Gas power plants** have been under scrutiny due to the high amount of greenhouse gas emissions. According to the website of Corix Cleveland Thermal, this plant provides heating and cooling for the downtown service areas.

It could be argued that the placement of a power plant, in the middle of the city, goes against a cohesive idea of what an integrated and orderly urban city is. What these infrastructures mediate are “premium networked spaces”. According to Graham (2000), this term refers to new or retrofitted infrastructures that are customized to comply with the needs of users taking into consideration space. This also takes into consideration the physical and socioeconomic segmentation of many contemporary cities.

This map shows an urban area, high voltage transmission lines, substations, vegetation, and bodies of water. This area is called **Windy Hill Lane** in Solon, Ohio. This was an interesting space to explore since different things are happening here. First, the electricity infrastructure has a **priority in space**. According to the design manual for high voltage transmission lines, the first task to be finished on a transmission line is, usually, clearing the right-of-way. When clearing, they state, the environment is taken into consideration. Nevertheless, it seems like electrical infrastructures convey the politics on how nature ought to be managed and contained to avoid damaged infrastructures. There is a security issue at stake here, since these are lines conducting high voltage electricity. But, the government seeks to apply a pattern of design, in order to align infrastructures and to comply with the norms in place.

Here nature is disrupted in order to advance an energy policy. Also, here urban planning adapts and takes into consideration the placement and hazardous characteristics of high voltage electricity lines.



Smart Grid

In 2007, the Energy Independence and Security Act established the development of the smart grid as a national policy. It is focused primarily on the modernization of the electricity grid. Grandclément et al. define smart energy as "the integration of "smart" technologies that are data-driven, network-connected, and (semi-)automated into nearly every level of the energy system—from extraction to generation to transmission, distribution, and end-uses" (2015:2).

Arguments have arisen regarding the design and transition towards this new system. The most relevant one is the advancement of renewable energy. These renewable technologies pose problems for the current electrical grid. For instance, the output of wind and solar generators varies considerably over time and it is unpredictable. Hence, the system and its operation must be modified to handle this variability. Another issue at stake is that both solar and wind farms are located in places that are far from major load centers. This means that more transmission lines are needed to connect these centers. Advanced devices such as smart meters have already been introduced as part of this transition. The smart meter will allow utility customers to access pricing information and avoid periods of peak electricity use when electrical power is the most expensive. Also, the consumer will have more control of their energy consumption and this will help by lower their respective electricity bills. In 2019, U.S. electric utilities had installed 94.8 million smart meter infrastructure(EIA, 2020). It is expected that other "smart" technology will follow such as in-home energy displays, smart thermostats, and other control devices that will enable consumers to reduce their energy consumption.

It seems that the idea of smartness has become mandatory. It is a way of organizing life following automated control and data-driven decisions. The kind of technological modernization that this idea of smartness, embedded in electricity systems, is advancing; Makes relevant to question the new ways of governance and interaction that will arise within society. Although the discourse assures that this change will be beneficial for society, it will also bring new ways of control, since these technologies are constantly monitored and controlled by computing and communication technologies (Gouglidis et al. 2018).

Towards a new energyscape...

An energy scale approach can provide a framework for the understanding of a new ongoing dynamic in a disjunctive order. Different discourses and forces are shaping our social world. When thinking about the energyscape, it is important to bring to the discussion the climate change phenomenon, as well as the diversification of sources for renewable energy, policies to regulate carbon footprint, environmental technology, and other efforts to reduce consumption of energy. There is another element to take into consideration, which is the increasing dependence on digital technologies. A development that predicts a future where individuals will become more dependent on electricity than ever.

Although this work focused just on one part of a vast territory. It is an invitation to further exploration of other spaces and data, to understand the dynamics from a large scale perspective. This requires that we pay attention to electricity's infrastructure intersection with domains such as other infrastructures, territory, culture, economics, politics, technology, and society. It invites us to think of infrastructures beyond their materiality, technology, and technical design. But as networks of infrastructures that fulfill a project, as the role, they exert while inhabiting spaces, as mediators of ideals and enactors of power relations.

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