Opportunities and Challenges of the Digital -Energy Nexus
Atlantic Convergence Digital-Energy Nexus Working Group

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1. Background

According to the ITU, in 2025, nearly three quarters of the world's population were internet users, nearly double the share from a decade earlier[1]. There are significant geographical differences, ranging from 95% or more in much of Europe, North America, and Asia, dropping to the mid 70% in Latin America and still below 40% in Africa. The urban / rural divide is also much more pronounced in areas with low penetration[2].

Over this same period, global internet traffic has increased 25 times[3], with further acceleration underway as AI capability is expanded. By early 2026, this has resulted over 11,000 data centres worldwide, the vast majority of which are in the USA, EU, China and SE Asia. The demand is expected to triple in the next 5 years. This growth using existing technology is accompanied by major localized increases in electricity and cooling water demands, frequently creating actual or perceived conflicts with local communities and businesses[4]. The growth is also pressuring the ability of communities, companies, and countries to meet their various greenhouse gas emissions targets to mitigate climate change.

Another key factor in the Digital Energy Nexus is access to reliable, affordable energy services including electricity. In most regions of the world, well over 90% have access to electricity, with sub-Saharan Africa being the outlier with many countries falling below 60%[5].

2. Challenge

Near universal access to reliable and modern energy and data services will be key to individual, community and national economic and social well-being. The scale and speed of adding new data centres in the developed and rapidly developing economies is already challenging the availability of power and water from the incumbent utilities. Additionally, new data centres are often seen as unwelcome additions to local communities for a variety of economic, social, and environmental reasons.

This paper is aimed at starting a discussion around the possibility that the disruption caused by data centre growth creates new positive opportunities. These include improving the availability and quality of community energy service and internet access, along with capturing the local investment and economic benefits from data centres and collateral businesses, whilst minimizing the impact on climate change.

3. Conventional Wisdom

A useful starting point for this discussion is to assess the current and emerging "conventional wisdom" as to how the Digital Energy Nexus is being addressed in the developed economies. From this assessment, the next step would be to explore possible different approaches that could be adopted by underserved areas to capture most benefits and avoid some of the difficulties.

An obvious caveat to this approach is to recognize that every individual data center discussion will have its local characteristics, so of necessity, some broad generalizations must be made. With that in mind, two typical approaches to adding significant data centre capacity will be explored.

Model 1 – Use Existing Siloed Regional Utilities

This is the most common approach in the USA and many other parts of the world. The target location is selected by the data centre operator for a variety of market reasons and is subject to zoning approval by local (municipal) authorities. The operator negotiates for sufficient power from a regionally (state) regulated utility. Cooling water is supplied by the local water utility, frequently subject to regulations from both local and regional authorities. Power demand increase will be met by the incumbent utility adding capacity as needed, maybe supplemented with onsite/near site natural gas generation owned by the data centre operator. On-site demand and emissions reduction measures through technical and operating efficiency choices will mostly be at the sole discretion of the data centre operator.

In effect, the data centre is added to the existing technical and regulatory status quo as would be any other new business; what makes it challenging is the sheer scale and speed of the demand addition relative to its surrounding neighbours.

This approach puts stress on the capacity of the existing energy and water services. Adding capacity quickly requires unplanned investments that are challenging to recover using existing regulations and often negatively affect rates for all consumers. The economic benefits for local communities tend to be limited to some local employment during the construction phase. Even this may be small due to the extensive use of "out of town" construction teams.

From a carbon footprint standpoint, scope 2 emissions will increase rapidly based on both the existing GHG index of the grid (US average is about 350kg CO2e/MWh) and any necessary added capacity that will mostly be natural gas fired with a comparable GHG index. Some of these emissions increases will be mitigated by added renewables and power storage, but rarely sufficiently quickly to offset the underlying increase.

This approach tends to create large amounts of direct and indirect unused thermal energy (aka "waste heat"). Thermal (fossil and nuclear) power plants serving the grid typically waste 60 to 70% of the primary fuel in conversion and distribution heat losses. Onsite/near site thermal power generation will have at least 35% conversion loss. The water-based cooling systems within the data centre have relatively high return temperatures. While there may be some local recovery for space heating, the majority of this heat is rejected through cooling towers.

Model 2 – Become an Integrated Community Object

This approach is increasingly seen in Europe and parts of Asia. Before summarizing the data centre aspect, some background to community energy is important. For a variety of historical reasons, many European cities developed extensive district heating systems directly delivering heating and hot water services to homes and buildings. Many of these started by using waste heat from industry and power generation and evolved to be institutionally managed by municipal thermal utilities. Regulatory and market reforms in the EU starting in the late 1980s have also resulted in greater municipal participation and investment in the structure, management and provision of utility services including electricity, heating, cooling, natural gas, and water.

In parallel other regulation and market measures have focused on systematically increasing the end use efficiency and emissions impacts of existing and new buildings and industrial processes, again with somewhat greater municipal influence than seen elsewhere.

In many cities, this background has resulted in an energy use and supply structure that is more integrated at the community level. Statistically meaningful demand reduction is combined with horizontally integrated management of water, electricity, natural gas, and heating and cooling services that are somewhat tailored to the differing demand of neighbourhoods and even single large energy users. This horizontally integrated distribution facilitates the integration of multiple energy sources into a single flexible supply portfolio. This flexibility includes the systematic integration of waste energy, onsite and near site clean and renewable power and thermal generation, and energy storage as well as the more traditional regional utilities.

To a first approximation, the per capita primary energy use of a city with this integration is about half that of one following Model 1's more siloed regulatory and technical framework.

There are different dimensions to managing the Digital-Energy Nexus in a community that has this pre-existing framework. Most obviously, the municipality represents both the zoning partner and the energy services partner. The Data Centre can be viewed not only as a new energy and water source, but also as a potential source of unused energy that can be economically captured and resold elsewhere in the municipal system. On-site/near site energy supply and storage may be configured for dual service to serve the Data Centre needs and those of surrounding neighbourhoods.

This approach tends to reduce the overall increase in energy and water demand through some combination of negotiated end use efficiency, waste energy recovery, and collateral "over-the-fence" infrastructure investment. It also increases the potential for community benefits in terms of local employment, energy costs, energy service levels and environmental impact.

There are many examples of communities and data centre operators implementing some version of an integrated approach. Stockholm has an initiative to team with 20 data centres to heat 30,000 apartments. The Google Data Centre in Hamina, Finland heats 80% of the City's needs. A suburb of Dublin invested in infrastructure to distribute waste heat from an Amazon data center to a university, municipal buildings, and social housing. Rjukan in Norway heats a large trout farm from a nearby data centre[6].

One of the most systematic approaches to community integration of data centres can be found in the Frankfurt region, home to the largest concentration of data centres in Germany. For a number of years data centres have been viewed as valuable and significant heat sources to contribute to both the expansion and the decarbonisation of the region's extensive district heating and growing district cooling system.[7]

4. Discussion

Clearly, adding major facilities like data centres in any existing community will have significant impacts and raise potential controversy. Communities have faced similar disruptions in the past with the arrival of major new industries, usually accompanied by serious challenges to the energy systems, social fabric, and environment. Over time, these initial challenges were balanced by local economic development, and a wider range of lower cost goods and services.

Large parts of Latin America and Africa are underserved in terms of both energy and digital services. The service shortfalls are even greater between smaller, more rural communities and the larger cities. Proactively adopting and regulating the second approach of structured community integration of Data Centres could be the pathway to rapidly and cost-effectively improve energy services for the wider population, while also increasing internet access, with the least impact on the environment.

Pursuing this approach in underserved areas might even create successful new data centre/community examples that could become transferable to the developed parts of the world struggling with the energy and water capacity consequences of the more siloed approach.

A recent assessment by the World Economic Forum[8] essentially raises the same discussion of turning data centres into strategic climate assets, irrespective of location.

5. Questions to Consider

- To what extent could communities currently following Model 1 adjust to incorporate elements of Model 2?
- What adjustments would be needed for these communities to capture meaningful benefits in a realistic timeframe?
- What priority actions would underserved communities need to make for Model 2 to become the preferred approach?
- What roles could the transnational structure, corporate goals, resources and influence of data centre operators and users play?

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[1] Statistics
[2] Statistics
[3] Data centres & networks - IEA
[4] Measuring the Data Center Boom: Facts and Statistics (2026) - Programs.com
[5] Access to electricity (% of population) | Data
[6] Data Center Waste Heat Recovery (March 2026)
[7] PowerPoint-Präsentation
[8] Can we turn data centre demand into strategic climate infrastructure? | World Economic Forum