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Conduit Urbanism

Regional Ecologies of Energy and Mobility
It is frequently predicted that the depletion of carbon-based fuels will precipitate a decline in automobility, a collapse of global trade networks, and even a return to small-scale city patterns. Other than a tacit belief that the near future might look something like the near past, there is little evidence to support this vision. Current patterns indicate, however, that across North America an entirely different urban order is emerging, driven by a complex of forces whose spatial and operative logistics anticipate a peri-urban condition unlike the structures witnessed to date. Parallel to the current crisis of carbon-based fuel supply, planners, politicians, engineers, and industrial leaders foresee a future of increasing demands for mobility combined with an unprecedented intensity of urbanization and a decaying transport infrastructure. Interconnected large-scale regional urbanities as well as contemporary energy concerns present thus an organizational infrastructural challenge. In this context, existing infrastructures constitute a spatial matrix that, when combined with intensified systems of mobility and the strategic harnessing of energy potentials, serves to anticipate the emergence of a synthetically networked hybrid infrastructure to support and propagate emerging urbanisms.

Network

The highway was arguably the single most instrumental factor in structuring settlement patterns and economic development in North America during the second half of the twentieth century. An astonishingly efficient and strategically engineered system comprised simply of permutations of near horizontal asphalt surfaces, it is configured to optimize the logics and logistics of transit and transport throughout the continent. Although separate interstate highways had been constructed as early as the Lincoln Highway in 1913, it was Eisenhower’s Federal Aid Highway Act of 1956 that promoted the interstate highways as an integrated and complete network. The Act not only provided funding for highway construction but also gave each state twenty years to build out the network, so that mobility could operate continuously throughout the nation. More than fifty years later, rapidly evolving urbanization and energy needs demand a similarly totalized approach that prioritizes a synthetic networking of mobility, energy, and economy. Where the latter half of the twentieth century witnessed the establishment of a fine-grained mobility network and the production of low-density urbanism, the twenty-first century will be defined by the consolidation of supersized, multicentered, networked urbanities, as the interconnection and densification of proximate urban centers create the emerging megaregions of North America. This urban formation, first identified by French geographer Jean Gottman’s 1961 Megalopolis, has become the focus of several prominent land use and planning agencies. Megaregions can be defined as agglomerated networks of metropolitan areas with integrated labor markets, infrastructure, and land-use systems that share and organize complex and interdependent transportation networks, economies, ecologies, and cultures.

The geography of megaregions inevitably coincides with areas of maximal stress and congestion, due to population concentration and increased mobility and freight movement, within current infrastructures, threatening imminent systemic failure. This geographic situation coincides with the demise of cheap and plentiful carbon-based fuels and a projected energy transformation from single-sourced fuel to a variety of sources, including solar, wind, nuclear, carbon, geothermal, hydrological, and biomass. An ambitious and robust regional vision that reconceives an entire network is necessary. Such a vision would opportunistically combine the agendas of regional mobility and renewable energies with potential new urbanities centered around the highway infrastructure, and connect existing urban centers and other modes of transport such as air, water, and rail with critical resource supply and strategically differentiated economic clusters, reinforcing and supporting the diverse spatial logics of megaregional agglomeration economies, as identified by Saskia Sassen. Through such a lens, the megaregion becomes a primary sociopolitical unit, overshadowing the agency of individual state, provincial, and even national boundaries and structures, and its polycentric form becomes a powerful enabler for diverse populations and economies.

Fields

The largest and most populous of the emerging North American megaregions is the Great Lakes Megaregion (GLM), including Chicago, Detroit, Toledo, Toronto, Buffalo, Pittsburgh, and Cincinnati and in some cases extending to the Atlantic port of Montreal and the Midwestern cities of Milwaukee, Columbus, Indianapolis, and St. Louis. However, its geographic, ecological, and resource-related territory should tactically expand this boundary to include the watershed of the five Great Lakes. As a regional territory, it controls one-fifth of the world’s supply of fresh water and 10,900 miles of shoreline, constitutes the world’s largest concentration of research universities, and is home to percent of North America’s and 11 percent of the world’s Forbes’ 2000 international company headquarters. Daily, more than $900 million worth of goods, or 25 percent
of bilateral trade, crosses the Ontario-U.S. border via the highway system within the GLM. Southern Ontario’s Highway 401 holds the dubious honor of being North America’s busiest highway. The section of 401 that cuts through Toronto has been expanded to eighteen lanes and typically carries 420,000 commuter and commercial vehicles a day.\(^5\) Traffic congestion on Highway 401, already severe, will be aggravated by projected population growth in Canada and the U.S. being planned adjacent to existing major highway arteries within the GLM.\(^6\)

Energy distribution networks in the GLM are inextricably linked and limited by the footprint and logics of existing highway infrastructures. Fuel pipelines, refineries, and service depots combine optimized transmission vectors with the cumbersome constraint of road-based distribution. Power corridors follow lines of expedience from resource origin to the highway’s population centers. Though robust, this matrix of energy delivery is inadequate to service the megaregion’s projected growth, as witnessed by “out of fuel” signage and system-wide grid shutdowns. Within this context of terminal congestion, an astonishing web of regional interdependence exists. Visualization of the resulting CommuterShed, CommodityShed, and PowerShed ecologies further reinforces the necessity of conceiving of a synthetic, regionally scaled interdependent infrastructure of resource development, distribution, and projection.

The Great Lakes Megaregion has significant amounts of renewable energy resources, with approximately 7.2 gigawatts (GW) of hydroelectric energy, a vast potential for biomass energy production, and 1.5 to 2 kW/hrs/m\(^2\) of solar energy potential daily.\(^7\) However, the region’s greatest potential PowerShed contribution lies in 320 GW of power that could be generated annually from Great Lakes offshore wind farms. If fully exploited, these sources could provide 25 percent of the power needs of the United States\(^8\) and constitute a significant interregional export base. This increased capacity demands a new network of high-voltage transmission lines. To realize the potential strategic advantage of this suite of opportunities, a retooling of infrastructure, an adaptation of new technologies, and the development of overarching political visions and cooperation are required. Geographically and logistically, the highway system network, replete with strategic conduit channels, might hold the key to the next generation of regional infrastructures.

**Conduits**

Transport experts argue that the most efficient technology for a mobility revolution resides in electrified high-speed rail tied to renewable energies. Maximum speed is coupled with minimal electrical conversion and distribution losses, as vehicles receive a steady supply of electricity from the grid.\(^9\) Electrified high-speed rail necessitates the construction of new elevated rail lines to achieve as horizontal a surface as possible for travel speeds of more than 300 kilometers per hour. This type of system has the capacity to link the GLM’s urban centers from Chicago to Toronto in less than three hours, radically altering effective intraregional time and space. High-speed passenger rail could also help alleviate congested highway surfaces and rail for freight (projected to double in the next twenty-five years) and could significantly decrease the use of short-haul flights, which encumber airports and consume disproportionate amounts of fuel.

At the confluence of the networks of people, goods, and energy, a significant opportunity emerges to consider the rapid urbanization occurring proximate to existing highways, the need for increased capacity along existing highways, the efficiency of electrified high-speed rail, and the need for new high-capacity energy transmission lines to distribute the electricity produced by renewable energy resources. The highway cross-section becomes a conduit of a bundle of networks of infrastructure, including high-speed rail and Mag-Lev electrified rail, dedicated vehicle lanes, high-voltage power transmission, and freshwater supply. These vectors are layered to maximize speed, safety, and accessibility thus increasing conduit bandwidth, in addition to forming a resource umbilicus that can service increasing densification and demand along the line. Dimensioned to operate within the existing right-of-way of major highways, this system facilitates ease of implementation by eliminating land acquisition and expropriation, and recognizes the geography of the highway as the driver for urban growth.

The introduction of these conduit structures has broader implications for the lands proximate to the line. At a macro level, lands located along existing corridors, and those bounded between the corridor and adjacent infrastructural systems (such as rail), enjoy a strategic advantage. Points of systemic crossing and crossover, understood through the ubiquitous landscape of the highway interchange, become charged with potential by virtue of their inherent availability for development and through the value they possess as points of transfer. As a network, the system privileges the node.

Nodes

As the system intensifies, the new typology of the multimodal transfer interchange will become the key nodal type and a dominant megaregional construct. These interchanges will be places where the system, its travelers, and resource flows will meet. The sites and footprints for such developments are already determined by the system. At the moment, each of the over 400 off-ramp interchanges along the I80-175-401 conduit simply serves for changes in speed and direction. However, the architecture of each interchange renders an average of 44.3 acres (18 hectares) of orphaned adjacent surface lands. These provide an ideal location for modal switch sites and terminal and interchange structures, as well as the potential to house new typologies that will benefit from the proximity to the mobility and renewable energy conduit. The traditional highway service center with its minimal amenities—fuel station, fast-food joint, strip motel—is no longer sufficient. In the post-carbon era of new fuels, a variety of refueling systems will be needed at every service point, each fully integrated with the differentiated modes of travel.

At the intersection of current urban centers, where the high-speed can intersect with local arterials and LRT loops, transport terminals will house parking facilities for commuters and provide secondary transit connections. Rail passes will be integrated with electric mini-car rental facilities for last-mile travel between the terminal and final destination. Gateway sites such as those proximate to regional and international airports will be integrated with access to urban transit networks, while specialized nodes will manage the logistics of border-crossing. Sorting and redistribution sites will include classification yards and consolidation terminals for freight flows, as well as sites for intermodal interface with rail networks. Considering the surficial requirements for warehousing and intermodal redistribution, horizontal fields of logistics zones could develop alongside the interchanges and may span spaces between the new highway and high-speed rail system and existing rail lines. Strategic institutional sites along the conduit can be created to capitalize on the research and development base of the Great Lakes Megaregion. This conduit urbanism will catalyze intensification and new infrastructural architecture typologies through the upgrade of highway corridors combined with emerging systems of renewable energy distribution, mass transit, and freight intelligence. Mobility and power will activate dormant peri-urban landscapes. These territories, ranging from vast field conditions to precisely defined nodal points, will emerge as key points of friction and opportunity that will condition and define both the Great Lakes and redistribution sites will include classification yards and consolidation terminals for freight flows, as well as sites for intermodal interface with rail networks. Considering the surficial requirements for warehousing and intermodal redistribution, horizontal fields of logistics zones could develop alongside the interchanges and may span spaces between the new highway and high-speed rail system and existing rail lines. Strategic institutional sites along the conduit can be created to capitalize on the research and development base of the Great Lakes Megaregion. This conduit urbanism will catalyze intensification and new infrastructural architecture typologies through the upgrade of highway corridors combined with emerging systems of renewable energy distribution, mass transit, and freight intelligence. Mobility and power will activate dormant peri-urban landscapes. These territories, ranging from vast field conditions to precisely defined nodal points, will emerge as key points of friction and opportunity that will condition and define both the Great Lakes and redistribution sites will include classification yards and consolidation terminals for freight flows, as well as sites for intermodal interface with rail networks. Considering the surficial requirements for warehousing and intermodal redistribution, horizontal fields of logistics zones could develop alongside the interchanges and may span spaces between the new highway and high-speed rail system and existing rail lines. Strategic institutional sites along the conduit can be created to capitalize on the research and development base of the Great Lakes Megaregion. This conduit urbanism will catalyze intensification and new infrastructural architecture typologies through the upgrade of highway corridors combined with emerging systems of renewable energy distribution, mass transit, and freight intelligence. Mobility and power will activate dormant peri-urban landscapes. These territories, ranging from vast field conditions to precisely defined nodal points, will emerge as key points of friction and opportunity that will condition and define both the Great Lakes and redistribution sites will include classification yards and consolidation terminals for freight flows, as well as sites for intermodal interface with rail networks. Considering the surficial requirements for warehousing and intermodal redistribution, horizontal fields of logistics zones could develop alongside the interchanges and may span spaces between the new highway and high-speed rail system and existing rail lines. Strategic institutional sites along the conduit can be created to capitalize on the research and development base of the Great Lakes Megaregion. This conduit urbanism will catalyze intensification and new infrastructural architecture typologies through the upgrade of highway corridors combined with emerging systems of renewable energy distribution, mass transit, and freight intelligence. Mobility and power will activate dormant peri-urban landscapes. These territories, ranging from vast field conditions to precisely defined nodal points, will emerge as key points of friction and opportunity that will condition and define both the Great Lakes Megaregion and the spaces of the Post-Carbon Highway.

Megaregion and the spaces of the Post-Carbon Highway.

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3 There is no consensus as to the definition of the boundary of the GLM, as identification parameters and methods vary, and economic data is inconsistent between Canada and the United States. See, for example, Epstein Delgado et al. “Methods for Planning the Great Lakes Megaregion” (2006).


8 For offshore wind potential of the Great Lakes, see the following studies: Land Policy Institute, Michigan’s Offshore Wind Potential (September 2008); Helimax Energy Inc., Analysis of Future Offshore Wind Farm Development in Ontario (April 2008), and U.S. Department of Energy, 20% Wind Energy by 2030 (July 2008).


GLM CommodityShed: Chicago-Columbus-Detroit Economic Interdependencies.
GLM Commuter Shed: Freight Based Volumes and Trans-border Flows.

Time-Space Compression. Toronto-Detroit-Chicago at 300km/hr.
Conduit Urbanism. Integrated Energy and Mobility Ecologies.
Conduit Urbanism. Strategic Sectional Differentiation.
Conduit Urbanism. Nodal Differentiation.
Conduit Urbanism. Possible urban worlds along the Multimodal Exchange.
Conduit Urbanism. Multimodal Transfer Exchange.