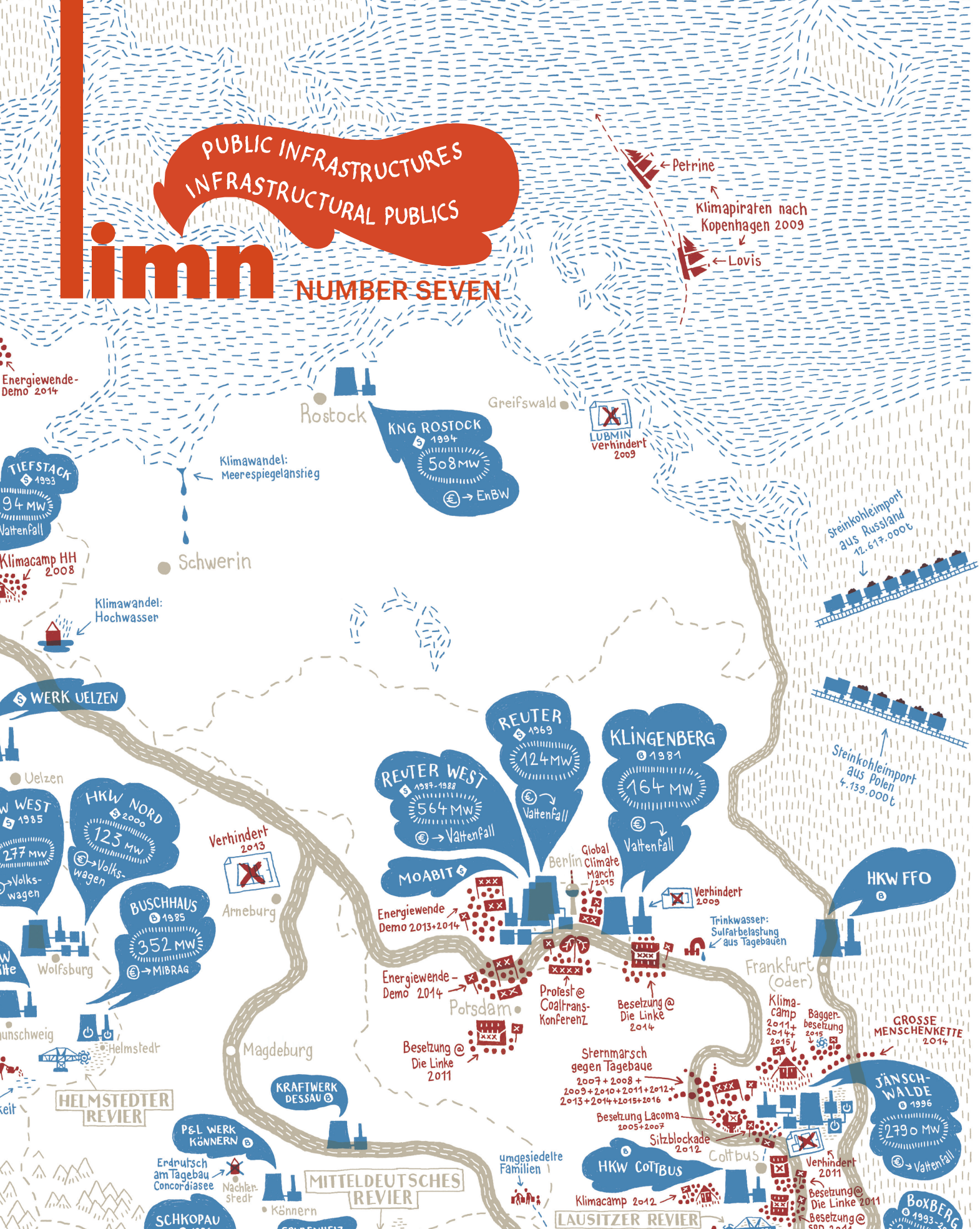
PUBLIC INFRASTRUCTURES
INFRASTRUCTURAL PUBLICS
imn
NUMBER SEVEN
Petrine
Klimapiraten nach Kopenhagen 2009
Lovis
Energiewende-Demo 2014
Rostock
Greifswald
KNG ROSTOCK
1994
508 MW
→ EnBW
LUBMIN
Verhindert
2009
TIEFSTACK
1993
94 MW
Vattenfall
Klimawandel: Meerespiegelanstieg
Schwerin
Klimacamp HH
2008
Klimawandel: Hochwasser
Steinkohleimport aus Russland
12.617.000t
WERK UELZEN
Uelzen
Steinkohleimport aus Polen
4.139.000t
REUTER
1969
124 MW
Vattenfall
REUTER WEST
1987-1988
564 MW
→ Vattenfall
KLINGENBERG
1981
164 MW
Vattenfall
MOABIT
Berlin
Global Climate March
2015
Energiewende Demo 2013+2014
Verhindert
2009
Trinkwasser: Sulfatbelastung aus Tagebauen
HKW FFO
HKW NORD
2000
123 MW
→ Volks-wagen
Verhindert
2013
Arneburg
BUSCHHAUS
1985
352 MW
→ MIBRAG
Wolfsburg
Energiewende-Demo 2014
Potsdam
Protest @ Coaltrans-Konferenz
Besetzung @ Die Linke 2014
Frankfurt (Oder)
Klima-camp 2011+2014+2015
Bagger-besetzung
2015
GROSSE MENSCHENKETTE
2014
Besetzung @ Die Linke 2011
Helmstedt
Magdeburg
Sternmarsch gegen Tagebaue
2007+2008+2009+2010+2011+2012+2013+2014+2015+2016
HELMSTEDTER REVIER
KRAFTWERK DESSAU
Besetzung Lacoma
2005+2007
Sitzblockade
2012
JÄNSCH-WALDE
1996
2790 MW
→ Vattenfall
P&L WERK KÖNNERN
Erdrutsch am Tagebau Concordiasee
Nachter-stedt
Könnern
MITTELDEUTSCHES REVIER
umgesiedelte Familien
HKW COTTBUS
Cottbus
Verhindert
2011
Klimacamp 2012
Besetzung @ Die Linke 2011
Besetzung @
LAUSITZER REVIER
SCHKOPAU
BOXBERG
1993


**LIMN** NUMBER SEVEN **PUBLIC INFRASTRUCTURES/INFRASTRUCTURAL PUBLICS**

Edited by Stephen J. Collier, Antina von Schnitzler, and James Christopher Mizes

# PUBLIC INFRASTRUCTURES

**PREFACE**
**Stephen J. Collier, Antina von Schnitzler, and James Christopher Mizes ask how infrastructures and their publics are taking shape today.**

**IN THE TWENTIETH CENTURY,** governments around the world assumed a central role in building, managing, and regulating infrastructures that produced public goods in the public interest. Today, however, the status of "public infrastructure" is being reconfigured and challenged in a striking range of circumstances. Technological developments, the renewed importance of private capital, and the spatial rescaling of infrastructures have raised questions about the connection between infrastructures and established forms of political collectivity. And the "publicness" of infrastructure is contested through claims and counter-claims about the values produced by infrastructure, about the publics those values serve, about the kinds of expert or nonexpert knowledge that are relevant for defining these values, and about the technical means required to realize them. The contributors to this issue of *Limn* survey this fraught political terrain, examining infrastructure and its publics at many scales—from the local to the supranational—and in a broad range of countries. In keeping with *Limn's* general orientations, the issue focuses in particular on technology and technical expertise, and its relationship to politics, publics, and other kinds of collectives.

## INFRASTRUCTURES, EXPERTS, PUBLICS

There is a stylized historical story one can tell about public infrastructure that provides a useful orientation to our infrastructural present. Since the nineteenth century, but particularly in the twentieth century, governmental reflection on infrastructures has been intimately related to a particular conception of collective life and to a particular role for technical experts. Government managed or regulated infrastructures such as highways, telecommunications systems, electricity generation and distribution, systems for water control, and sewage systems were planned for—and valued in relation to—a public understood to be homogenous and largely passive. Experts were assigned a privileged role in knowing the public interest, and in defining the needs that infrastructures were designed to meet and the values according to which infrastructural goods (and bads) might be assessed. This basic articulation of public infrastructure was not confined to Europe and the United States. Similar ensembles of experts, governmental mechanisms, and forms of collectivity took shape in socialist countries and in developmental states of the postcolonial world, with significant variations across sectors and countries relating to patterns of ownership, mechanisms of pricing, degrees of decommodification, and the inclusion or exclusion of different groups.

Beginning in the 1960s and 1970s, these formations of public infrastructure were challenged as longstanding critiques gained purchase in the context of acute fiscal shortfalls in many countries. Critics from many points on the political spectrum argued against expert definitions of public interest, and in support of alternate mechanisms for linking infrastructure to its publics, whether through participation, polycentric forms of governance, or markets. Critics also pointed to the unintended and previously neglected consequences of infrastructure development: the destruction of ecological systems, whether on a local or a global scale; the risk of catastrophic accidents or disruptions; and new patterns of exclusion produced by public infrastructures. More recently, technological developments—from distributed energy generation to wireless communications to social media—have raised questions about the status of infrastructure as a public good, about the kinds of collectivities that can be formed through infrastructure, and about the government role in building and regulating infrastructural systems. This is not to say that the old models of state-centered infrastructure governance in the public interest have vanished; indeed, their persistence and dynamic reformulation is a crucial feature of the contemporary scene. But these models are now supplemented and in some cases challenged by new arrangements.

## NEOLIBERALIZED INFRASTRUCTURES?

One significant recent development—which has received a great deal of scholarly attention—is the liberalization of infrastructure systems through outright privatization,

# INFRASTRUCTURAL PUBLICS

leasing deals to private companies, the commercialization of infrastructure services, or deregulation. Surveying these trends, Stephen Graham and Simon Marvin argue in their influential study *Splintering Urbanism* (2001) that an "infrastructural ideal" of reliable, low-cost, and universal government infrastructure provision in the *public* interest is being replaced by market infrastructure provision, with infrastructural goods allocated through the interplay of *private* interests. Their claim is suitably qualified, both in its account of the infrastructural ideal, which was never realized in many contexts, and in its account of the emerging "neoliberalization" of infrastructure, which has been resisted and blocked in a variety of ways. But they nonetheless point to a broad secular trend: the loss of a past paradigm of state-provided (or regulated) infrastructure and its replacement by market logics of allocation and distribution.

Examples of the dynamics that Graham and Marvin describe can, no doubt, be found around the world: in this issue, for example, see Nikhil Anand's description of a proposed water infrastructure reform in Mumbai and the mobilization that successfully blocked it. But it is not at all clear that they are the defining features of our infrastructural present. One contemporary tendency that diverges from this account is the remarkable dynamism of state-led infrastructure development, as is evident from the otherwise diverse cases described here by Jonathan Bach (on Chinese infrastructural development), Sven Opitz and Ute Tellmann (on infrastructural Europe), James Christopher Mizes (on infrastructural Africa), and G. Soe Lin Aung (on infrastructure construction in a special economic zone in Myanmar). Of course, these new projects of state-led infrastructure development have some distinctively contemporary features. For example, Andrew Barry shows that while the United Kingdom's "National Infrastructure Delivery Plan, 2016–2021" echoes Soviet planning, it hardly involves government seizure of the "commanding heights" of the economy. Rather, this contemporary variant of the five-year plan relies on private capital and promises "transparency" to private investors and, in an unspecified way, to citizens. The familiar idioms of government direction, centrally defined public purpose, and large-scale planning are combined—in still-emergent ways—with market mechanisms, private actors, and public input.

It is not only in rich, well-established democracies that privately funded projects of state-led development lay claim to longstanding idioms of public purpose or national interest. Mizes, for example, examines how Pan-Africanism is being revived in programs of infrastructure planning that rely on private investment, both from African publics and from non-African investors. Aung explores how infrastructure development for a special economic zone in Myanmar—also dependent on private funding—is justified as serving the national interest. Such claims certainly deserve critical scrutiny. What publics benefit from these projects? And which are excluded or displaced? But as Mizes and Aung both argue, they should also be taken seriously, particularly against the background of postcolonial histories in which the "infrastructural ideal" of universal state provisioning was always highly attenuated.

Stepping back, the cases presented in this issue point to various combinations of markets and states—and of public and private value—that run orthogonal to the axial distinction in discussions of "neoliberalization." In another significant contemporary arrangement, privately provided infrastructural goods are justified as serving a public interest. Consider, for example, the pervasive contemporary attempts to promote renewable energy through decentralized and market based mechanisms. As Andreas Folkers and Canay Özden-Schilling show in articles on renewable development in Germany and the United States, respectively, liberalization and market provision are purposively calibrated to the production of public goods in an attempt to address the negative externalities and democratic deficits of state provision. Or, in a totally different arrangement, consider Emma Park and Kevin Donovan's description of how a private telecommunication corporation, Safaricom, dons the

Mumbai's public water system, comprising more than 4,000 kilometers of pipe, has recently been the target of reform proposals that aim to improve supply. Nikhil Anand (p. 97) explores protest movements that advance a competing vision of the utility's "hydraulic public".
PHOTO BY NIKHIL ANAND


Jonathan Bach ('China's Infrastructural Fix') explores China's massive contemporary projects of state-led infrastructure development (p. 35). PHOTO: LAIN. HTTPS://WWW.FLICKR.COM/PHOTOS/LAIN32/8687588863

*accoutrements* of a developmental state in Kenya. Though not a public agency (indeed, this private company is now partly owned by foreign investors), Park and Donovan argue that Safaricom is held responsible for realizing public purposes, and is subject to some effective mechanisms of public accountability. The point is not that these are cases in which markets succeed where government fails, or that markets are managed exclusively in the public interest. Rather, it is that distinction between markets and private value on the one hand, and government and public values on the other, may be too limited. We need to wrap our minds around situations in which these elements are all mixed up.

## INFRASTRUCTURAL PUBLICS

As an alternative point of entry to this terrain, we might focus greater analytical attention on the *publics* in public infrastructure. In traditional thinking about public infrastructure, a government—or, more precisely, the officials and experts who are delegated the authority to make policy—builds, manages, or regulates infrastructures on behalf of a public, understood as a predefined collective. But there is another tradition of thinking about infrastructures' publics that is traced back to the American philosopher John Dewey. Observing the increasingly urban and industrial United States of the 1920s, Dewey argued that people are not joined together because they have "voluntarily chosen to be united" through some original act of will. Rather, they are linked by "vast currents" of circulation and complex interconnection. And it is not formal political organization but these "vast currents"—flowing along what would later be called infrastructures—that are the most important force shaping publics. "Green and red lines, marking out political boundaries, are on the maps and affect legislation and jurisdiction of courts," Dewey famously wrote, "but railways, mails and telegraph-wires disregard them." These systems "influence more profoundly those living within the legal local units than do boundary lines" and determine "the most significant constituents of the public and the residence of power" (Dewey 1927: 107).

As a number of recent commentators have pointed out, Dewey's observations suggest a provocative alternative to the conventional way of thinking about publics, and his approach might be extended to thinking about the publics of "public infrastructure." If, following Noortje Marres (2005), Dewey was interested in the way that publics were "called into being" by problems and events, he also suggested that that they might be "called into being" by infrastructures. Thus, rather than examining infrastructures as systems meant to serve a preconstituted public—as in the traditional formulation—we might ask: What collectives are gathered by the materiality of infrastructural connections, the spatiality of infrastructural flows, and the definition of technical standards? Of course the point cannot be simply that material, spatial, and technical elements shape publics in a deterministic way. We still have to consider how public infrastructures—and thus these material, spatial, and technical elements—result from collective decision-making arrangements. How is the power to plan, build, and value infrastructure delegated to community leaders, activist and advocacy groups, elected representatives, government officials, or technical experts, and how are the decisions or judgments they make contested? In other words, we have to explore the interplay between the planning and construction of infrastructures and the gathering of publics, with an accent on the mechanisms of collective choice, expert evaluation, and contestation that mediate among them.

One way to get at this interplay—and its contemporary mutations—is to study the sites of interconnection, boundary objects, and calculative devices through which infrastructures, publics, and experts are linked up. Take, for example, a ubiquitous calculative device in old and new infrastructure planning: the cost-benefit analysis. Cost-benefit analyses were a core element of the traditional paradigm of public infrastructure. Embedded in these analyses were both the values that were made to


An advertisement combines the colors of the Kenyan flag with 'Safaricom green'. Kevin Donovan and Emma Park ('Between the Nation and the State') examine how this private corporation is assuming some functions of the post-colonial developmental state (p. 72). PHOTO BY EMMA PARK

The lock system in the Panama Canal uses 2 billion gallons of fresh water a day—more than the daily water use of 18 million Panamanians. Ashley Carse examines the consequences of seeing drought as an 'infrastructural' event (p. 77). PHOTO BY ASHLEY CARSE

count in infrastructure planning and the kinds of experts (preeminently, but not only, economists) whose knowledge was considered authoritative in defining these values. Since their introduction (in the United States, for example, they were first required by law for government-funded flood control projects in the 1930s), cost-benefit analyses have been criticized on various fronts: for their insensitivity to distributional issues; for the status of the expert knowledge that goes into constituting them; for their failure to incorporate the values and preferences of those affected by infrastructures; and for their manipulation to serve narrow political interests. Despite this long-standing criticism, cost-benefit analyses remain ubiquitous in contemporary infrastructure planning, as the articles here suggest. But their role has changed, and in important respects they have been dislodged from a former position of authority. As such, both in their technical details and in the range of their application—including, importantly, the limits of their application—cost-benefit analyses can be read as hieroglyphs that allow us to decipher the current arrangements of publics, experts, and infrastructures.

Consider Andrew Lakoff's study of water management and the protection of an endangered species in California—a small fish called the delta smelt. At one level, this is a case in which cost-benefit analysis is expressly forbidden. The provisions of the U.S. Endangered Species Act (1973) exclude consideration of cost and benefit in designing management strategies for listed species; species survival cannot be assigned a price, and cannot be deemed too costly. This statutory prohibition does not mean that costs and benefits are not considered, or that expert evaluation is irrelevant. And debates continue to revolve around technical arcana such as the "entrainment risk" of smelt near turbines, the accuracy of fish surveys, and the relationship between turbidity and smelt reproduction. But consideration of these issues is displaced to public debates over the relative priority that should be afforded to protection of an endangered species versus other values, such as farming incomes or urban water use.

This case of water management in California points to a broader phenomenon: the technical procedures of expert judgment in infrastructure planning and management are increasingly opened to scrutiny and contestation of various sorts. Experts, or officials whose authority derives in part from expert judgments, must face publics (and their elected representatives). Another variant of such disputes involves what Annemarie Mol (1999) has called "ontological politics": contests over the very nature of the objects of expert knowledge. Consider another case of water management, Andrea Ballestero's analysis of disputes over the extension of an aqueduct in Guanacaste, Costa Rica, to provide water for a new private development. Once opponents of the extension realized that official claims about sustainable rates of extraction were not based on a model of the aquifer, debates shifted to "what kind of entity" the aquifer is. Is it a container with an impermeable wall and a fixed volume? Or is it a sponge with changing shape, leaky borders, and indeterminate absorptive capacity? Similar stories emerge from Ashley Carse's account of drought in Panama—is drought a natural phenomenon, or is it systematically produced by infrastructural modernization?—and Cymene Howe and Dominic Boyer's account of the wind in Mexico.

## THE PUBLIC MULTIPLE—AND CONTESTED

Our somewhat accidental survey of contemporary infrastructure suggests that it is not only the things extracted, transformed, and circulated through infrastructures that are today being reshaped, but the public—or publics—of infrastructure. If at one time the public was imagined as a homogenous and passive subject of need, today multiple publics are involved in contesting and making (differential) claims on the state. And in many cases, this diversity of public interest is being taken into account in infrastructure planning, which now often includes a mandate to actively solicit "community" input or even to summon relevant publics into being.

A montage produced by Rem Kohlhaas depicts Paris as adjacent to the African desert—linked by a common infrastructural network. Sven Opitz and Ute Tellmann ('Europe's Materialism') describe the disjunctures between the topology of infrastructural Europe and the shape of its political institutions (p. 89).
IMAGE COURTESY OF EUROPEAN CLIMATE FOUNDATION

Take Stephen J. Collier, Savannah Cox, and Kevin Grove's analysis of post-Sandy resiliency measures in New York, which examines planning for a berm to protect the city's Lower East Side from flooding. Following the protocols of the U.S. Department of Housing and Urban Development, the project was required to satisfy a test of cost and benefit. Notably, the benefits attributed to the project in expert analysis assumed a public that extends far beyond the local area slated for protection, since the berm is designed to prevent disruption of critical infrastructure and economic activity that is significant for a large region. But this initial analysis was only the criterion of admission to a planning process in which design thinking was employed to create a complex ecology of knowledge producers. This ecology includes an array of technical experts, planners, and designers, reflecting a more general trend to multidisciplinary and multifunctional infrastructure planning. It also includes producers of nonexpert (but still highly specialized) knowledge, most notably that of a second public, scaled to the local effects of the project as a feature of daily life. In this complex ecology of knowledge we see new arrangements of expert authority and public voice—akin to what Michel Callon (2009) has called a "hybrid forum"— as well as the "activation" of a local public, whose members are asked to speak for themselves about their values and interests.

In one sense, this case of flood protection in the Lower East Side is unusual. Even in New York, a city with well-developed institutions of community engagement, such robust participation is the exception rather than the rule. But this case points to broader dynamics that are at work across many sites: the scalar recalibration of infrastructures, experts, and publics; the "activation" of publics previously assumed to be the passive recipient of infrastructural goods and bads; and the multiplication of publics. Dewey's observations—nearly a century old—help us understand these dynamics. The public of infrastructure is not a fixed and prefigured mass (defined as citizens in general), but a collectivity of common interest shaped by the events and "vast currents" of contemporary life. Lest this sound like an overly-optimistic story, in which democratic publics become active around an ever-changing set of circumstances, we should bear in mind that Dewey's central question in his investigation of the public and its problems was the prospect for democracy in increasingly urban, industrial, technological, and infrastructural collectivities. He was particularly concerned about the difficulties of constituting publics around "conjoint actions which have indirect, serious and enduring consequences," each of which "crosses the others and generates its own group of persons" (Dewey 1927: 137). A number of articles here point to related questions. What kind of "public" might correspond to infrastructures that cross the boundaries that define citizenship, as in Opitz and Tellmann's account of infrastructural Europe, which exceeds the boundaries of political Europe? What happens when multiple infrastructural systems overlap, and groups or individuals are simultaneously pulled into multiple publics and counter-publics?

Penny Harvey and Hannah Knox pose these questions vividly in their article on infrastructure in the Cusco region of the Peruvian highlands. In 2009 construction was completed on the Interoceanic Highway, linking Cusco to the Brazilian border in the Amazon. The road provided "goods" for different publics at different scales. Locals living along the road benefited from better access to health care facilities, increased trading opportunities, and greater ease and safety of travel. A much larger collectivity

stood to benefit from the circulatory flows that linked the Pacific and Atlantic oceans. During their research Harvey and Knox heard rumors of another project, a $4 billion dam that would flood 120 kilometers of the recently completed highway. The dam project would, if built, wipe out much of the purported benefits identified in the original cost-benefit analysis for this project. But it threatened different goods, and different publics, in different ways. The rerouting of the road would simply be absorbed into the project's costs. Compensation would not be so readily available to residents of the road sections flooded by the new planned project. These tensions between "public" beneficiaries, Harvey and Knox point out, "make it abundantly clear that there never was a single or coherent public that stood to benefit from the road construction project, or who might in turn be served by the dam."

In Cusco, protests in the name of ecological protection and indigenous rights blocked the new project. But if this is a story about successful contestation, it also suggests the tenuous position of publics constituted in response to, or against, large-scale infrastructure projects. Indeed, if the articles collected here provide us with innumerable examples of the new activity and ferment of infrastructural publics, they also provide us with many examples of publics that have, in effect, gone missing.

This problem is strikingly laid out in Catherine Fennell's account of lead contamination in the United States. In contrast to the public uproar about water contamination in Flint, Michigan, there has been relatively little mobilization against lead contamination in housing. The problem, Fennell argues, is that the infrastructure of housing—comprising government financial arrangements, standards, and systems of provisioning—is largely invisible. Moreover, because housing is understood to be private and individual, it is not recognized as a public problem. We also find "missing publics" in cases in which the emergence of infrastructural publics is an explicit aim of planners. As Alan Wiig shows in his exploration of a smart city project by IBM in Philadelphia, designers did not take into account various structural issues that prevented an imagined digital public of job seekers from taking shape around new technology. Similarly, Gökçe Günel shows that a futuristic personal transport project in Masdar City, Abu Dhabi, ended up serving only as a quirky tourist attraction because an imagined eco-public that would use the system never emerged. These cases remind us that many new technologies are actually infrastructural platforms whose success depends on the emergence of new collectivities that act—to one degree or another—as publics. At times these collectivities take shape with astonishing speed; at times they never materialize.

Here, perhaps, we run up against the limits of a story that places too much emphasis on infrastructures themselves in shaping publics. As Opitz and Tellmann put it in their article on European Union infrastructuralism, infrastructures "do not necessarily produce political unity." Andreas Folkers makes a related point in his article on the legacy of protests against the "authoritarian" tendencies of nuclear power, and the dreams of decentralized democracy that have been attached to renewable energy in Germany since the 1970s. "[T]he reason why the promotion of alternative forms of energy generation…does not quite fulfill the hopes of decentralized forms of grassroots democracy is not because of smart technology," Folkers writes, "but because of a lack of ideas for smart and politically progressive uses of it." In recognizing the power of infrastructure to activate and produce publics we also have to keep in view the arduous and often unsuccessful labor—for legal subjects and not for objects—of working out a politics that corresponds to the new forms of infrastructure. ■

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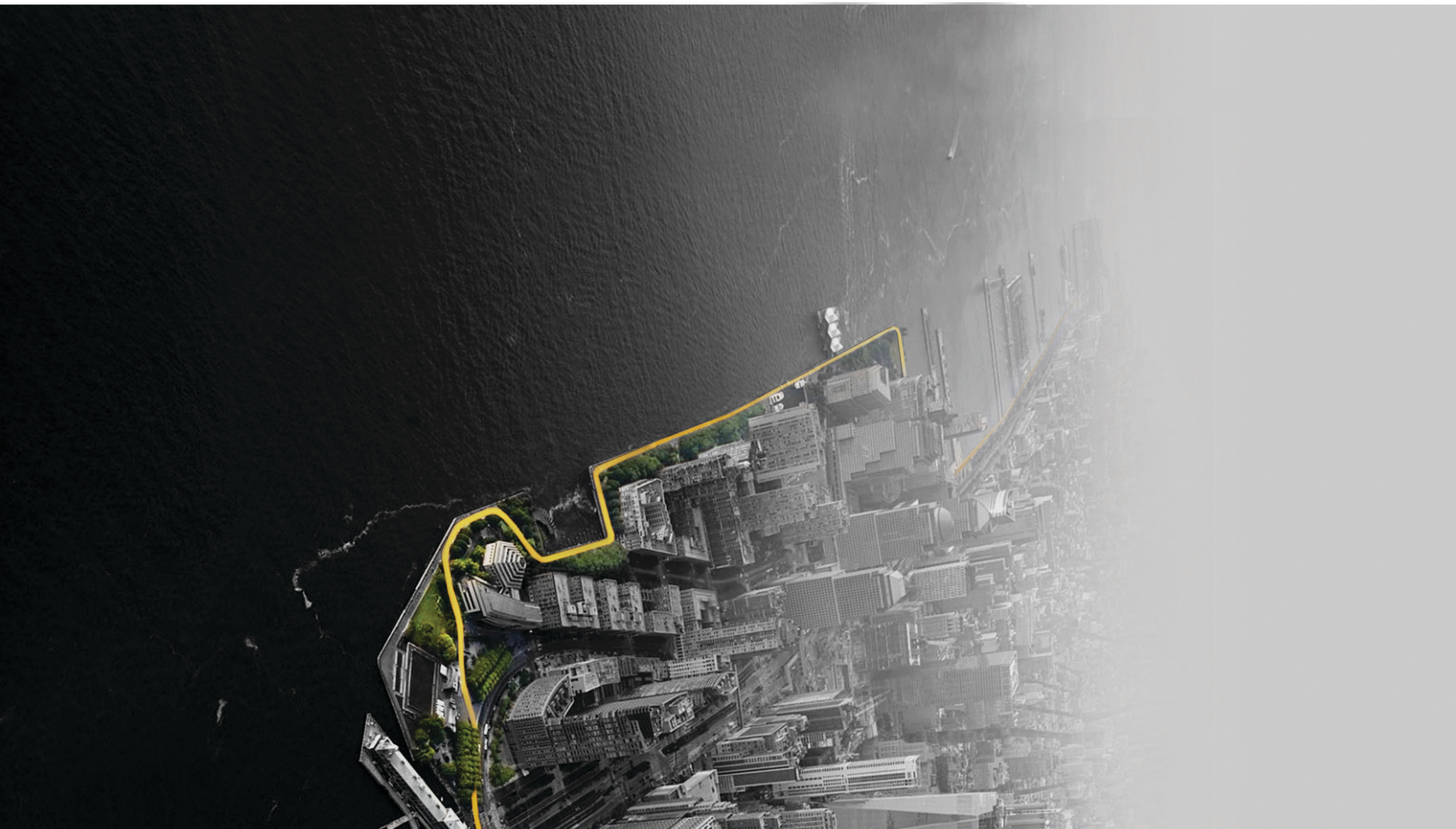
# REBUILDING·BY·DESIGN IN·POST-SANDY



**What is the scope for local planning in large-scale infrastructure projects today? Stephen J. Collier, Savannah Cox, and Kevin Grove explore the multiple publics of flood control in New York City**

**TWO PUBLICS:** In October 2012 Hurricane Sandy moved through the Caribbean and along the Atlantic coast of North America, causing extensive damage to coastal communities from Cuba to Canada. Economic losses in the United States—estimated at $71.4 billion—were most severe in the New York metropolitan area, with its high concentration of vulnerable residences, globally significant businesses, and critical infrastructure (U.S. Dept. of Commerce 2013:25).

**BATTERY PARK, MANHATTAN**
Flooded Tunnel after Hurricane Sandy (PHOTO: TIMOTHY KRAUSE)

One lesson experts and officials drew from Sandy was that it would not be enough to simply repair damage; it was imperative to rebuild with an eye to a climate-changed future. A little more than a month after Sandy's landfall, Michael Bloomberg, then mayor of New York City, proclaimed, "We can't just rebuild to what was there and hope for the best." The "biggest challenge the city faced" was adapting "to risks associated with climate change." Meeting that challenge would require "a leap into the future" (Bloomberg 2012). President Barack Obama's Executive Order of December 7, 2012, which established a Hurricane Sandy Rebuilding Task Force, framed the problem in similar terms. "The region's aged infrastructure"—including "its public housing, transportation systems, and utilities"—had to be upgraded to a "more resilient condition given both current and future risks" (*Federal Register* 74341).

Among the Task Force's major recommendations was to create a "multi-stage regional design competition to promote resilience for the Sandy-affected region" called Rebuild by Design (RBD) (Task Force 2013:1). The U.S. Department of Housing and Urban Development (HUD), which oversaw the competition, described two goals for RBD. First, it would solicit innovative proposals for "regionally scalable but locally contextual solutions that increase resilience in the region" (Task Force 2013:1). Second, it would implement winning projects using funds from HUD's Community Development Block Grant program.

What did the Task Force mean by framing post-Sandy reconstruction as a problem of design? Most obviously, it referred to the consensus among after-action and recovery reports that it was imperative not just to reconstruct what had been destroyed, but to rebuild with an eye toward a climate-changed future. But more than this, design referred to a particular approach to organizing experts and publics in planning for complex, large-scale infrastructural projects.

The contours of this design-based approach were laid out in HUD's competition brief, which outlined requirements for project teams (Task Force 2013:3–7). The brief

is notable both for what its instructions include and for what it omits. It provided no guidance on which parts of the New York metropolitan region or which specific vulnerabilities competition entries should address, noting only that projects should focus on dense urban areas with "highly complex built and human systems and significant economic value for the entire region," and should also "provide collateral benefits for communities" (Task Force 2013:11). Nor did the brief dictate the approach that competition entrants should take. Proposals were expected to range "from large-scale urban and multi-functional green infrastructure to small-scale distributed flood protection measures and resilient residential structures" (Task Force 2013:1–2).

The HUD brief did, however, provide elaborate detail about the process through which proposals should be formulated. Project teams were required to include experts from a wide range of areas, including infrastructure engineering, landscape design, urban design, architecture, industrial design, community engagement, and communications design, among many others. The brief also directed project teams to "set new standards" for participation through an iterative process of public engagement, underscoring that particular attention should be paid to the inclusion of "underserved populations" (Task Force 2013:3–9).

Both RBD organizers and design teams saw the introduction of design thinking to disaster recovery and infrastructure planning as an exciting departure from past practice. Henk Ovink, the Dutch water planner who conceived RBD, proclaimed that the competition set "a new standard of regional resilience in design and development, in building and rebuilding" and presented "a way to answer climate change, sea-level rise and future economic, ecological, and cultural demands" (Dutch Water Sector 2014). Matthijs Bouw, a lead designer on one project team, saw RBD as a "new type of project," given its emphasis on community engagement and the central role of designers in infrastructure planning, which had "historically been the domain of engineers." "Everyone feels that this is the way of working in the future," he enthused. "[W]e can bring a certain level of urbanism, excitement, aesthetics…community buy-in, [and] intelligence" (Lau 2015).

This insistence on RBD's novelty may seem puzzling given ubiquitous contemporary demands for participation and interdisciplinary collaboration. It is easier to understand when we consider how experts and publics have traditionally been organized in U.S. infrastructure projects in general and specifically in planning flood protections. Since the nineteenth century, U.S. government investment in flood control projects such as dams, levees, and flood walls has been justified by arguments about market failure and public goods: since private markets "underprovide" flood protection, public investment is justified as a means to maximize collective welfare. Technical experts calculated economic benefits and costs of these projects, and were authorized on this basis to act on behalf of a passive public. These figures of the all-powerful expert and the passive public are not absent in RBD. But there is a second public suggested in the RBD brief: an active public that participates in the design process through task force meetings, town halls, public comment periods, and workshops. We also find a different formation of expertise. Economists and engineers, who previously occupied a uniquely privileged position in infrastructure planning, no longer work in enclosures of administrative authority in which only facts, rather than struggles over values and interests, are considered.

Without taking the description of the RBD brief for granted—or being swept up in the enthusiasm of designers—it is worth probing further into this new ecology of experts and publics.

## THE BIG U

On June 2, 2014, the "BIG U" was announced as one of six RBD winners. BIG referred to the Bjarke Ingels Group, the architecture, urban planning, and design firm that led the project's development. The "U" referred to a 10-mile flood protection system that wraps around the lower part of Manhattan (Figure 1). BIG's final proposal addressed RBD's directive that projects should focus on high-density urban areas that are both vulnerable and vital for a broader region, noting that the project area is "at the core of an economy with a $500 billion annual GDP" (BIG Team 2014:8). The proposal also addressed the RBD directive to establish new standards of participatory design for infrastructure projects and "provide collateral benefits for communities" (Task Force 2013:11). The BIG U, designers argued, would "shield the city against floods and stormwater," provide "social and environmental benefits to the


**FIGURE 1:** The BIG U.
(SOURCE: BJARKE INGELS GROUP COURTESY OF REBUILD BY DESIGN)

community," and "inject new urban life forms into our cities" (BIG Team 2014:7–8).

In developing its final proposals, the BIG Team created separate but coordinated plans for three segments of the waterfront and adjacent communities, called "compartments." Each compartment comprised "a physically separate flood-protection zone" in which proposed interventions had a "benefit-cost ratio greater than one" (BIG Team 2014:8). This benefit-cost ratio was assessed using a standard methodology: flood models were used to predict each compartment's likelihood of flooding and the damage that flooding would cause; estimates of the damage that would be averted by proposed protective measures—the project's benefits—were then weighed against costs (BIG Team 2014:211).

Here we have a familiar story: engineers and economists make technical calculations about benefits and costs that a passive public will bear. But this was not the whole picture. Each compartment was also approached as "a field for integrated social and community planning." Compartment-level plans would be "designed in close consultation with the associated communities and the many local, municipal, state and federal stakeholders" (BIG Team 2014:8). In this sense, the compartment was also scaled to the second kind of public described in the RBD brief: a more local public actively engaged in and mobilized around matters of common concern.

The first compartment of the BIG U to be funded was a segment extending along the East River from East 23rd Street to Montgomery Street (Figure 2). Dubbed the "East Side Coastal Resiliency Project" (ESCR), the plans for this area included a complex of infrastructural works that simultaneously provided coastal protection and amenities to surrounding communities. A "Bridging Berm" (Figures 3 and 4) running along the East River Park would provide "robust vertical protection…from future storm surge and rising sea levels" while offering "pleasant, accessible routes into the park" and opportunities for "resting, socializing, and enjoying views of the park and river." Further south, deployable flood walls would be flipped up in good weather as "an inviting ceiling above the East River Esplanade" and flipped down during winter to create space for "a seasonal market" (BIG Team 2014:122, 144).

The selection of the ESCR as the first compartment to be built was interesting and in some ways surprising. The area protected by the ESCR is hardly an exclusive enclave of the rich. As the BIG Team noted, the neighborhood is economically (and otherwise) diverse, with a significant number of low-income households (median incomes are $41,640 versus $73,145 for Manhattan as a whole (The Furman Center 2014:109–112)). The area also has a long history of mobilization and resistance to development efforts. In the 1950s, local activists successfully opposed redevelopment plans in the Cooper Square area. One spinoff from this organized opposition evolved into Good Old Lower East Side (GOLES), a tenants' rights group that continued to resist what its members saw as a succession of city-imposed development plans (Angotti 2010). When the city unveiled a plan to "dramatically redevelop" the East River waterfront in 2005, GOLES and other

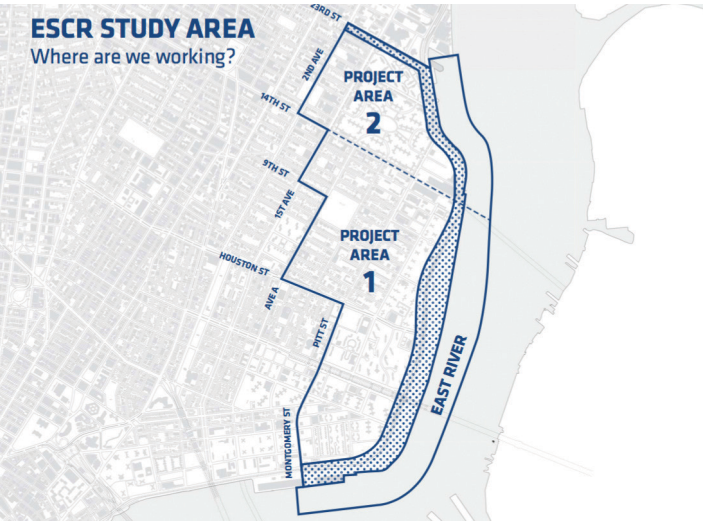



**FIGURE 2:** The ESCR area running along the East River in Manhattan, from Montgomery Street in the south to East 23rd Street in the north.
(SOURCE: EAST SIDE COASTAL RESILIENCY PROJECT / NEW YORK CITY DEPARTMENT OF DESIGN AND CONSTRUCTION)

neighborhood organizations charged that the project had "the potential to exacerbate gentrification" and was "not responsive to the needs of the surrounding community" (O.U.R. Coalition 2009:2). A coalition of local groups issued a counter-proposal, "A People's Plan for the East River Waterfront," that called for a "community-centered" development scheme, and ultimately forced the city to abandon its efforts (Rice 2009).

After Hurricane Sandy inundated many neighborhoods along the East River and knocked out essential services, GOLES and other local organizations mobilized around disaster preparedness. This mobilization was fueled by residents' new awareness of their vulnerability to flooding, as well as their sense of abandonment in the wake of the storm. On some accounts, critical city agencies were virtually absent after Hurricane Sandy, leaving residents with the impression that they were being "left for dead" (Buckley and Wilson 2012). As Michael Callaghan, executive director of Nazareth Housing, recalled, "We realized…that we didn't have strong community skills or capacity because we had no power, and needed to figure out how to do this stuff together" (personal interview, 1 March 2016). Callaghan and GOLES executive director Damaris Reyes created an umbrella emergency preparedness organization called LES Ready! that united more than 25 local groups, organized around ethnic identity (Hispanic, Chinese, and Ukrainian groups were included) and a range of specific issues (services for elderly, homeless, and disabled residents; legal and social services; public housing and rent control, etc.).

LES Ready! was well established by the time BIG began its work. For BIG's designers, according to project leader Jeremy Siegel, the group was a "pre-packaged community" that could be enlisted in participation (personal interview, 19 March 2015). Meanwhile, the highly

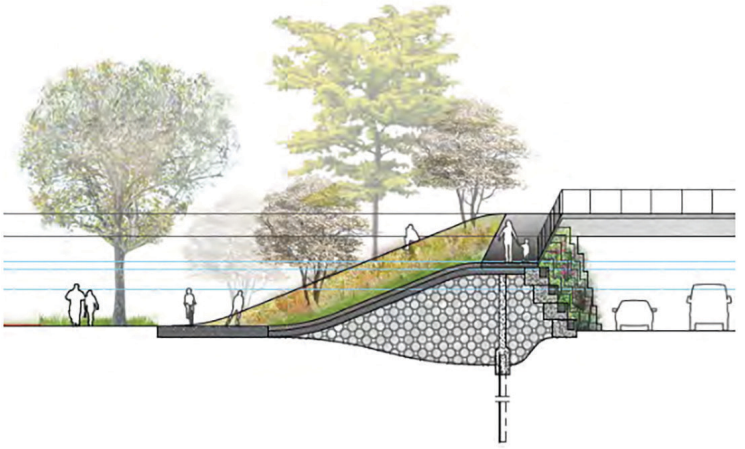


**FIGURE 3: THE BRIDGING BERM.** The diagram shows the flood level of Hurricane Sandy (bottom blue line) and the FEMA 100 year flood plain projection for 2050 (middle blue line). (SOURCE: BJARKE INGELS GROUP COURTESY OF REBUILD BY DESIGN)

mobilized members of this "pre-packaged community" were initially skeptical about working with RBD's designers. Callaghan recalled concerns "that people were going to come in and do this project and there wasn't going to be any community input" (personal interview, 1 March 2016). Lilah Mejia, disaster preparedness coordinator for LES Ready!, recounted that "when they approached us on the idea, we were all taken aback. We were like, 'Is this a good idea, a bad idea' just for the simple fact that…we have all these developers coming in, taking over, changing the landscape, and we weren't sure if they were one of them as well" (personal interview, 7 November 2015). At one community meeting, a local resident worried that RBD's proposals were "just another way for the city to increase rent and kick out the poor" (Office of Recovery and Resiliency 2015).

**On some accounts, critical city agencies were virtually absent after Hurricane Sandy, leaving residents with the impression that they were being "left for dead"**

## PUBLICS BY DESIGN?

So how did the design process actually play out? And how was it viewed by activists and organizers who had long been mobilizing against development plans in the area?

First, though local activists remained vigilant about gentrification, they came to believe that RBD was not simply a front for luxury development. "Even though we fight developers," said LES Ready! co-chair Damaris Reyes, "[Rebuild by Design] wasn't necessarily about housing. It wasn't so direct in terms of, 'We're building luxury apartments,'…. [W]e felt that at the very least…the intentions were not to get rid of us" (personal interview, 27 March 2016). Indeed, private development was never one of ESCR's significant goals. Rather, it was social exclusion and the *unlikelihood* of private investment that created a case for prioritizing government intervention in the Lower East Side. According to BIG designer Jeremy Siegel, public officials felt that the LES was "sort of a population and a building stock which…was particularly appropriate for public funding given that there aren't a lot of development opportunities" (personal interview, 7 January 2016).

Local activists also reported that they were closely involved with—and satisfied by—the process of "community engagement." The organizations in the LES Ready! coalition were intimately involved in planning "community workshops"—both during the competition and following BIG's selection as a competition winner—successfully pushing for changes in location and format that would make them more accessible to a wide range of residents. GOLES staff member James Rodriguez also reported to us that LES Ready! had "control of outreach," a fact that may be attributable both to RBD's mandates for participation and to local groups' mobilization and close relationships with local residents (personal interview, 24 March 2016).

The public meetings themselves used familiar design strategies to elicit feedback and interaction. The design team used "interactive models to demonstrate potential flood protection options and generate discussion" (BIG Team 2014:75). Attendees completed surveys about the proposal and placed colorful stickers on maps of the neighborhood where they wanted increased park access, safety measures, and green space. Local organizers reported that this input was taken seriously into account. Lilah Mejia of LES Ready! told us that "once [BIG] had these meetings, they kind of came back and showed the final idea. And they also had these miniatures to help explain the idea of the design…. It kind of gave ownership to the people who were there" (personal interview, 7 November 2015). LES Ready! co-chair Damaris Reyes—who had recently spearheaded resistance to city development plans—painted a similar picture. "The only reason that our support has remained," she insisted, was "because I have felt that I've seen the input of my community reflected in these designs. If I hadn't seen that, I promise you we would have fought tooth and nail to keep this project from becoming a reality" (personal interview, 27 March 2016).

Still, suspicions lingered, and some participants left

meetings unsatisfied. After a town hall forum in which city officials spoke for nearly an hour and left little time for public comment, one man charged that the city was paying "lip service" to participation. Others found that questions beyond amenities and local quality of life were pushed to the side (Office of Recovery and Resiliency 2015). At one public meeting, an attendee who raised broader issues about the overall scope of the project was instructed to relay them on a comment card rather than engaged in public discussion (Office of Recovery and Resiliency 2015). Indeed, we might ask whether "design" in this case was simply a way to secure community acquiescence while officials and experts retained their old control of the important aspects of the project, which concerned not local amenities but large-scale questions of structural protection and the allocation of hundreds of millions of government dollars.

But it is worth at least pausing before jumping to such conclusions. This is, after all, a "community" that has been continuously mobilized to address urban development issues for half a century. It is certainly noteworthy that the leaders of local organizations—who are hardly political naifs—see RBD as a significant break from a long history of top-down development projects in which they never had a meaningful voice. At the same time, we should not be too quick to assume that the truly important aspects of the project were only those issues about structural protection and economic benefits that were not part of the participatory process. It is notable that in public comment periods, residents' highest priorities were local amenities and the integrity of the participatory process itself. Indeed, design-based interventions like RBD challenge us to think about participation not merely as a means to an end—a way for particular interests to lay claim on particular resources—but as a highly meaningful *outcome* of planning. This sentiment was echoed in many of our interviews, even with local leaders who remain skeptical about the prospects of the BIG U. LES Ready! co-chair Michael Callaghan, who continues to harbor doubts that the project will be implemented as currently envisioned, observed that "RBD helped give us a focus, not just in responding to disaster and getting over that, but thinking critically together" (personal interview, 1 March 2016). The value of infrastructure here is realized not just in the protections it affords, or the amenities it supports, but in the very organization of a collective process: the (self-) constitution of an (active) public to address the planning and construction of common things. ■

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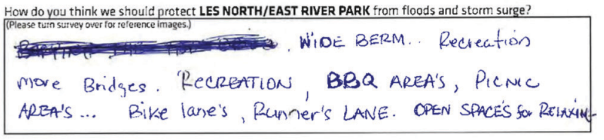


**FIGURE 4 (PREVIOUS PAGE):** A rendering of unprogrammed public space on the Bridging Berm.
**FIGURE 5 (THIS PAGE TOP):** Composite of a community workshop meeting, as well as workshop survey responses.
**FIGURE 6 (THIS PAGE BOTTOM):** Lower East Side resident leads discussion on resilience planning in an ESCR project area. (ALL IMAGES: BJARKE INGELS GROUP COURTESY OF REBUILD BY DESIGN)

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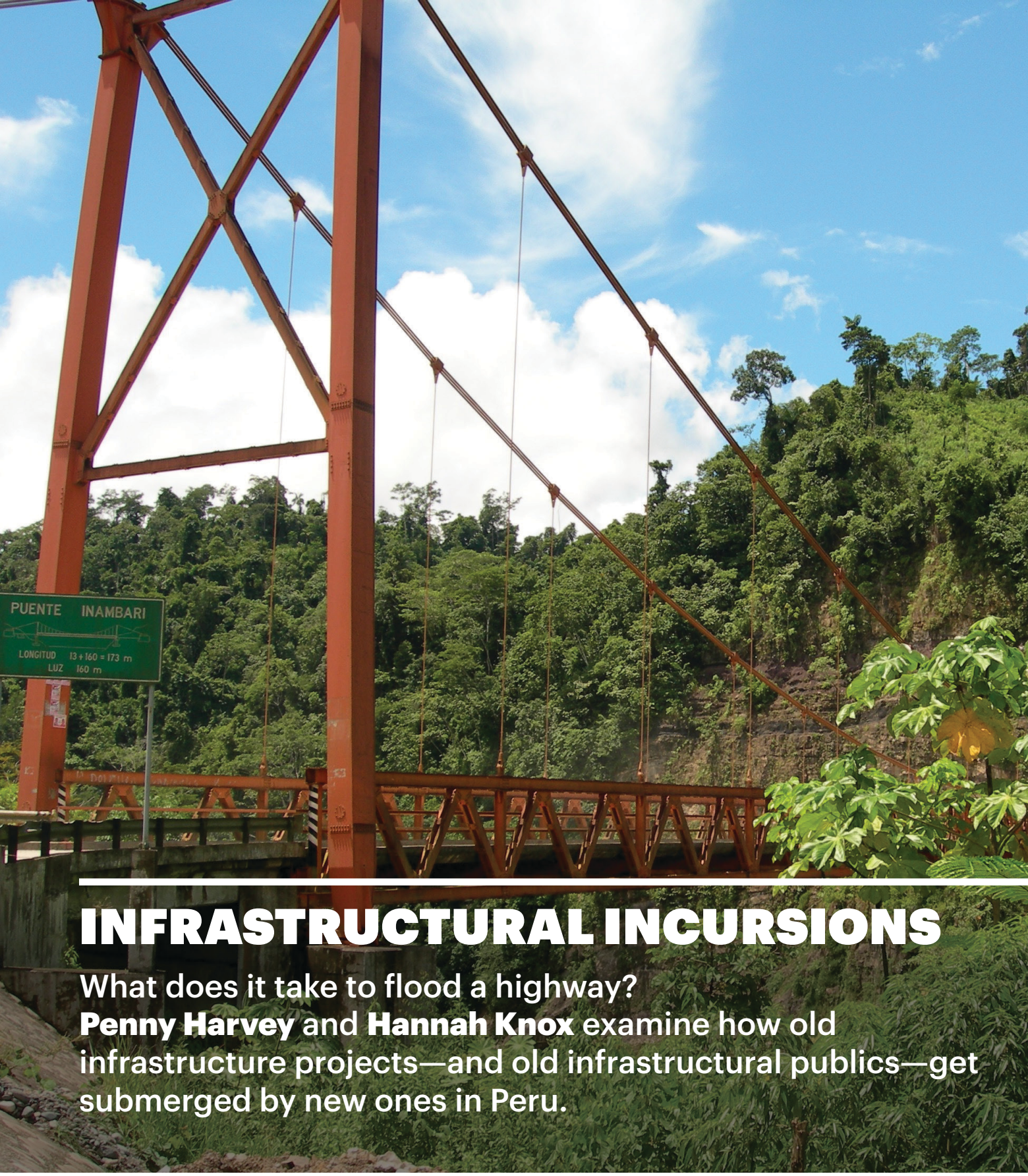



# INFRASTRUCTURAL INCURSIONS

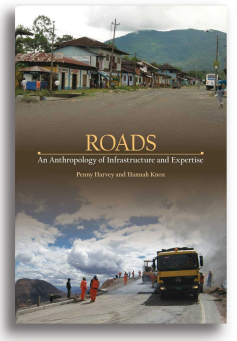
What does it take to flood a highway? **Penny Harvey** and **Hannah Knox** examine how old infrastructure projects—and old infrastructural publics—get submerged by new ones in Peru.

**FIGURE 1.** The Inambari Bridge, where the Interoceanic Highway crosses the River Inambari. SOURCE: AUTHORS.

**IN 2009 A US$2 BILLION PROJECT TO PAVE A HIGHWAY** through the southern Peruvian Andes was nearing completion. For the preceding four years, heavy machinery had trundled its way up precipitous mountainsides, carving out and building up a roadway through rocky crevasses and waterlogged jungle terrain. Engineers had surveyed and measured, churned and dug, mixed and spread, excavated and eventually laid an asphalt strip that was now wending its way from the highlands of the Cusco region of Peru to the border with Brazil in the Peruvian Amazon. This 700-km (435-mile) route was known as the Interoceanic Highway.

At that time, we were engaged in an ethnographic study of this space (Harvey and Knox 2015), and traveled this road often. Somewhat to our surprise, we found that many people shared our fascination with roads.

Regardless of whether we were talking with residents, academics or taxi drivers, engineers or manual workers, shopkeepers or frontier extractivists, everybody had an opinion. Roads mattered to people and seemed to hold a particular fascination as indices of state care: a testimony to considered investment, reckless expenditure, and/or thoughtless abandonment. In the course of these casual conversations rumors emerged suggesting there were new plans to undo the road before it was even finished. Online and in roadside cafes, people began to talk about an even bigger, US$4 billion project to dam and flood the river valley at Inambari to create a huge hydroelectric power plant. The planned hydroelectric project was expected to flood 46,000 hectares (nearly 114,000 acres) of forest and would notably also flood some 120 km (nearly 75 miles) of the newly built highway. It would literally wash away millions of dollars of investment, not to mention years of struggle by local populations living along the route of the road to open up the highway from the jungle to the highlands.




Infrastructures usually do not appear de novo, but rather build on the legacy of previous infrastructural forms. The Interoceanic Highway, for example, was built in the footprint of a previous road: construction on Route 26 (as it was called) had begun in the 1930s. Gradually, the state took on the mule paths and river fords long used by explorers and traders in the region as a public works project. State investment was sporadic, however, and by the time the road reached Puerto Maldonado, the surface in other sections was in an appalling state of disrepair. Travel was slow and dangerous. The Interoceanic Highway project brought a new injection of capital, this time through the collaboration of the Peruvian state, international lenders, and a construction consortium led by the Brazilian transnational company Odebrecht. No longer a project of national territorial integration, the new highway promised international connectivity not just for terrestrial movements, but via all the other infrastructures that the new road brought with it, most notably mobile phone towers, internet cables, and electricity.

However, the plan to build the dam suggested innovation of a different order. How could something as huge and solid as a 700-km road be simply swept away in the imagination of another, bigger, better infrastructure project? The suggested decimation of the new road ran counter to our understanding of the palimpsest of infrastructural formations, the material accretions that leave visible traces of earlier forms. If floodwaters submerged the road, what traces would remain once the dams were built? And what might these traces tell us about the contemporary politics of infrastructure?

First, let us consider why flooding a road with a dam would be a problem. What would be undone, curtailed, or denied by the proposal to flood the road? Infrastructure projects like the Interoceanic Highway occur in part because the investment is legitimated in the name of the public good. Historically, road construction projects in Peru came under the remit of the Ministry of Public Works (Ministerio de Fomento). The concept of *fomento* (encouragement or impulse) was a precursor of the now more pervasive "development" terminology. State investment in road construction was uneven and discontinuous, but in periods of major construction investment (in the 1920s and 1930s and again in the 1980s) roads were explicitly connected to the formation of "national space," "public good," and "economic progress."

In the 1920s and 1930s manual labor was conscripted, and although the historical records show disquiet over how powerful landowners abused the law, the public generally welcomed the building of the roads themselves, not least for the ways in which both the labor and the physical structures created an otherwise fragile sense of citizenship. Even now, the public benefit of road construction is written into law: the Interoceanic Highway project was legally constituted as a public good in Ley 28214. Other legal statutes outlined the right of the state to purchase land alongside the highway for its widening or extension and access to the subsoil for purposes of excavation in road construction, all with the expressed aim of ensuring cohesion through terrestrial connection.

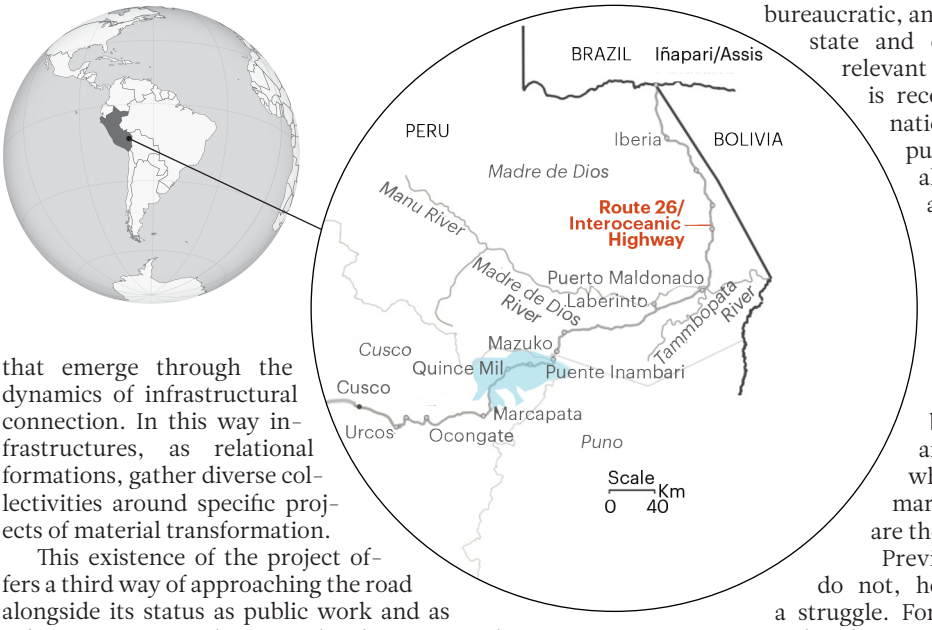
So, roads in Peru continue to have an almost undisputed status as a public good. However, neither the "public" nor the "good" are stable states, and the dam project brings some of these instabilities into view. Local communities living alongside Route 26 often had a clear idea of the good that the Interoceanic Highway could bring them. They talked about a new proximity to health care, about new trading opportunities, and about the increasing ease and safety of travel. But the local desire for improved connectivity, though important to some, was far from sufficient to make a case for the US$800 million investment, let alone the US$2 billion actually spent on a road construction project. In retrospect, perhaps there was something else at play that enabled a project of this size to purport to be a "public good."

That something, in this case, was a much broader sense of what the road would enable. Conceived not just as a public work but as an infrastructure, the road in this case was not only supposed to benefit Peruvian populations, but was also expected to generate all kinds of other circulatory flows. The very name *interoceánica* points to the relative unimportance of the 700-km stretch of road in its own right. The project was not just a project to build a bit of road between the highlands of Peru and the border with Brazil, but also an attempt to place the last piece of a jigsaw creating a terrestrial connection between the oceans on either side of South America (an interoceanic connection) *and*, perhaps even more important, to foster a trade connection between Brazil and China through the ports of Peru. The Interoceanic Highway as infrastructure would thus enable the simultaneous flows of goods, capital, and people at multiple scales.

But this shift from public work to infrastructure does not explain why a new dam could plausibly wash away a road project of this scale. The dam might retain some of the benefits of the road as a public work, though not perhaps for those who needed to move between towns on either


**FIGURE 3:** Public Appeals.

side of the flooded section of the highway, but surely it would undermine the flow of goods and people from Brazil upon which the whole cost-benefit analysis of the project had originally hinged. The contradictions in turn make it abundantly clear that there never was a single or coherent public that stood to benefit from the road construction project, or who might in turn be served by the dam. In the planning stages of infrastructural projects, beneficiaries are identified and enumerated as justification for investment. The projected benefit to each and any social group is calculated and offset against the projected costs. Multiple publics can be specified in such enumerations. An additive logic is deployed whereby residents, haulers, entrepreneurs, town councils, voters, farmers, students, ill people, tourists, and others become commensurable, and thereby also abstracted from the particularities of their interests and sensibilities. However, in practice, interested publics arise through specific relational possibilities




that emerge through the dynamics of infrastructural connection. In this way infrastructures, as relational formations, gather diverse collectivities around specific projects of material transformation.

This existence of the project offers a third way of approaching the road alongside its status as public work and as infrastructure. By the time the dam proposals appeared in the media, the road was well established as a "project." Funded by IIRSA (Initiative for the Integration of Regional Infrastructure of South America), and brought together through a collaboration between Peruvian and Brazilian engineering companies under the umbrella of the Conrisa consortium, the Interoceanic Highway was a project oriented—as the language of "project" implies—toward an as-yet unrealized future. Creating the Interoceanic Highway project had involved much more than building a road. The Interoceanic Highway as "project" was a temporary coming together of people, institutions, money, and materials held together in an alliance that would by definition dissolve upon completion. It was not the public work, nor the infrastructure, but the project that had gained funding from the CAF (Central Andean Fund). Odebrecht ran the *project*, which was backed by the Peruvian government, structured around feasibility plans, argued for in Parliament, and supported by environmental agencies that mitigated the risks of international investors.

The dam, likewise, was a similarly created project. Like the Interoceanic Highway, it too was a consortium involving a Brazilian construction company, this time OAS. Like the Interoceanic Highway project, it gained backing and investment from the Brazilian state and was the outcome of negotiations between the Peruvian and Brazilian governments. Understanding the dam as a project does not undermine the achievements of the Interoceanic "project." For within the logic of the "project," or now in this case the "megaproject," the cost and logistics of rerouting the 120 km of road was simply something to reabsorb into the new plans. The focus on the project makes visible the traces of the road in the emerging contours of the dam. The project as palimpsest makes visible the continuities in what otherwise appeared as a radical change. And although not immediately visible, the traces of the Interoceanic Highway would remain in the financial, bureaucratic, and political relations between state and engineering company. The relevant public, on the other hand, is reconfigured as overtly transnational. The relevant public of public works is at some level always a citizen. Public works are conceived and managed through state agencies. Infrastructures break this mold and blur the boundaries between public and private institutions and interests. The project can move between these possibilities and can also become an entirely private affair in which the consumer and the market rather than the citizen are the primary beneficiaries.

Previously configured publics do not, however, disappear without a struggle. For two years various parties protested and opposed the dam. In the end, just before the Peruvian elections in June 2011, then-President Alan García announced that the project had been abandoned, citing protests by indigenous groups who argued that their land would be flooded. Ecological protection and indigenous rights cohered momentarily as a new conjoined space of public interest in need of protection. However, it is significant that the dam project was never definitively cancelled and remains "viable" as an object of public investment. Meanwhile, Odebrecht, OAS, and the Brazilian and Peruvian states face ever-deepening charges of corruption. The political agreements that allowed the imagination of a seamless move from road to dam are, for the moment, destabilized in the face of global uncertainties concerning how exactly "public" benefit accrues from private investment. ■

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# ARE WE ALL FLINT?

Why is lead-contaminated water a matter of public concern but contaminated housing is not? **Catherine Fennell** explores infrastructure and the politics of solidarity.

PHOTO: STEVEN DEPOLO

**FOR THE PAST SEVERAL DECADES,** Flint, Michigan, has staggered under waves of deindustrialization, disinvestment, and abandonment that have left the city depopulated, its built environment in shambles, and its remaining residents reeling from high unemployment and crime rates, a decimated tax base, and dwindling municipal services. While grim, Flint's decline is by no means unique in a region whose cities have become synonymous with the booms and busts of twentieth century American manufacturing. Nor is the degree of its decay unusual. Aficionados of ruin will find crumbling infrastructures arresting and aplenty in most any "Rust Belt" city. What is singular, however, is the attention that Flint's contaminated water has received in recent months, an attention that is now amplifying ongoing debates concerning America's ailing and aging infrastructures. That amplification is especially apparent in variations of a phrase that has recently echoed through local, regional, and national media and activist circles: "We are all Flint."

With every disclosed email, alleged wrongdoing, and denial of responsibility, the course of Flint's contamination grows as murky and foul as the water that began flowing from its taps in 2014. In April of that year, the city switched its water source from Lake Huron to the Flint River. The switch unfolded amid a climate of intense fiscal austerity in which state-appointed emergency managers pushed Michigan's most financially beleaguered cities to cut costs. In Flint, part of this push included a proposal to bypass Detroit's Water and Sewerage Department as the city's water supplier, and to instead source cheaper water through a newly constructed pipeline into Lake Huron. Yet until that pipeline came on line in 2016, the city would draw directly from its river. Decades of heavy industry, pollution, and salted roads meant that more than water rolled through that river. Bacteria, chloride, and chlorine-based disinfectants transformed Flint's treated river water into a highly corrosive soup that ate into aging copper, iron, and lead pipes. Heavy metals then leached from the service lines that connected individual homes, schools, businesses, and factories to Flint's broader water infrastructure.

Flint's residents complained almost immediately about the rank, rust-colored water that tasted strange and sickened them. Local water workers and state environmental monitors, however, repeatedly brushed off these complaints, even as they failed to combat pipe corrosion. According to recent criminal charges, some even went so far as to tamper with tests and readings that would have confirmed the heavy amounts of lead in Flint's water system (State of Michigan Attorney General 2016). Pressure mounted throughout 2015 as residents clamored for action, and as researchers and medical professionals documented high lead levels in Flint's water alongside a spike in cases of children with elevated levels of this potent neurotoxin in their blood.

"Flint's Katrina," as some activists and politicians have taken to calling the contamination, might seem an isolated event born of the catastrophic convergence of emergency management, shifting water chemistry, aging pipes, and failed governmental oversight. After all, what makes an event a disaster is its ability to rupture everyday life, expectations, and routines. Yet "We are all Flint's" traction in local, regional, and national media suggests something else. Doctors, journalists, and activists have all invoked the phrase when pointing to the ongoing presence of lead in Americans' everyday lives, especially within the water systems of older cities. If "We are all Flint" is a rallying cry, exactly who and for what does it rally?

In the face such a question, it's tempting to argue that there is something universalizing about water because it is a substance that *all* humans depend on. Consider comments made by Erin Brockovich, an environmental activist known for her legal advocacy. In Brockovich's recent article "We Are All Flint" (2016), the city emerges as just one entry in a list of municipalities afflicted by a common denominator: tainted water. Water is "the one thing that sustains us all," Brockovich writes, and for that reason, contaminated water doesn't "see any boundaries of rich or poor, black or white, Republican or Democrat" (Brockovich 2016). Flint is unusual only because it is "the perfect storm" of pollution and government inaction that might just cause "everybody else to wake up" to the presence of toxins in all our lives and bodies (Brockovich 2016). Here, our biological dependence upon water collapses social boundaries, drawing us into a universal political body with a shared stake in clean water.

In the face of such universalisms, it's also tempting to underscore that not every American navigates tainted water in the same way. After all, it is not just any city being poisoned through its degraded and neglected infrastructures, but an impoverished Black city. Take a recent column by *New York Times* journalist Nick Kristoff titled "America Is Flint." "Today the continuing poisoning of half a million American children is tolerated," Kristoff writes, "partly because the victims often are low-income children of color" (Kristoff 2016). Kristoff's column does not back away from the sentiments undergirding "We are all Flint." It merely qualifies them by pointing out the ubiquity of lead in Americans' lives alongside the uneven distribution of its risks. A more pointed critique might suggest that were "we" to foreground that that unevenness, we might be forced to recognize that if "America is Flint," it is not because of the ubiquity of lead in our water infrastructures. It is because like Flint, America is a place built on profound, longstanding, and enduring racial and

**Like Flint, America is a place built on profound, longstanding, and enduring racial and economic inequalities that continue to waste some but not all of its citizens' bodies and communities.**

economic inequalities that continue to waste some but not all of its citizens' bodies and communities. From this perspective, the sentiments that undergird "We are all Flint" bear more than a passing resemblance to those associated with "All Lives Matter." They gesture to enduring inequalities at the same time they blunt any serious criticism of those inequalities by diluting them in a wash of misdirected solidarity. Here, "We are all Flint" isn't just hogwash: it's whitewash.

While American society's enduring inequalities are troubling, they are not exactly news. News commentary surrounding Flint in fact dwells on how racial animus directed against residents of this "majority minority" city might have driven the neglect and disregard that ushered in its contamination. "We are all Flint's" power then rests not on the phrase's affirmation or denial of social inequalities, but on its capacity to summon a "we," an expansive group comprising countless Americans concerned with "our" aging municipal water infrastructures. In the process, a down-at-the-heels, Black city in a down-at-the-heels state has become emblematic of the dangers that infrastructural degradation poses to *all* Americans. The question that "We are all Flint's" traction raises then is not whether this "we" actually includes those Americans most at risk from lead poisoning. It is rather about the kinds of risks that a far-flung group of citizens can recognize as shared, and thus worthy of collective concern and action, and those that will, despite their ubiquity, seem isolated events that will never break the surface of widespread attention. Scholars of mass media in liberal democratic societies have a term for such groups: *publics*.

Publics form when strangers consume media forms, like newspapers, newscasts, and novels. As they respond to these forms, and imagine countless others throughout their cities, states, or nations doing the same, they constitute themselves as a political whole (Calhoun 1998; Habermas 1991; Warner 2002). Members of publics come to imagine themselves as part of much larger wholes capable of voicing collective interests and making collective demands upon entities tasked with protecting those interests. Publics emerge through speaking, listening, and reading. As such, they are discursive formations. Yet those formations are never divorced from a material world. Brockovich's readers have no trouble imagining a "we" indignant at tainted water precisely because they have spent lifetimes opening and closing their own taps, lifetimes filling glasses, tubs, and pots with the water that comes gushing out, and lifetimes expecting that water to be clean. And they have spent lifetimes expecting that their taxes supported the care that fellow citizens took with protecting important collective goods such as water. Yet it's not every infrastructure that raises a public able to make demands about the soundness of the collective goods it delivers. Consider, for instance, the relative silence that surrounds lead's presence within another major infrastructure: housing.

Housing does not often show up in conversations about infrastructure, but it should. When understood as a thing that draws other entities into relation, an infrastructure need not be limited to the pipes, wires, or roads that so often come to mind whenever we utter the term (Larkin 2013). We can also understand it as a thing that facilitates flows, standardizes distributions, and extends political projects (Anand 2017 Chu 2014; Collier 2011; Joyce 2003; von Schnitzler 2016). Beginning in the 1930s, subsidized housing in both its public and private guises became a premier infrastructure of the American welfare state. On the one hand, public housing, at least in its earliest years, delivered sound shelter to working- and middle-class Americans shut out of housing markets on account of their limited means or the color of their skin. On the other hand, federally guaranteed mortgages allowed many Americans in the middle class—and those who aspired to join its ranks—to stabilize their housing costs by spreading them over several decades. They obtained, on extremely favorable terms, a major asset that they could then leverage to finance things a household's members might need, or just want: educations, retirements, second homes, business ventures, enough accrued wealth to pass onto children. The trappings of middle-class security became bound up in the mortgaged home and the orientations to time, place, saving, and spending that it disciplined among mortgage holders. But as much as this welfare infrastructure facilitated the expansion and distribution of financial and economic wellbeing, it was also a thing in its own right. And in the course of older American cities, that thing became thoroughly leaded.

By the early twentieth century, lead was common in the pipes that snaked through growing industrial cities and in the soils of areas that surrounded smelters and foundries. When lead became a common additive in gasoline in the 1920s, lead particles in the air and soil became even denser (Shea 2007). Yet it was lead's presence in house paint that threw—and continues to throw—American children most directly into its

path. Consumer tastes for colorful domestic interiors grew in the 1920s. The electrification of cities meant that consumers no longer needed their house paint to cover soot from coal- and gas-burning lamps, and thus dark, oil-based paints fell out of fashion. Lead paint made the surfaces it covered bright, durable, and easy to clean, adding to consumers' conceptions that it was the most hygienic way to treat surfaces (Markowitz and Rosner 2002; Warren 2000). As lead paint was more expensive than other paints, consumers tended to save it for surfaces that would see more wear and tear, such as baseboards, windowsills, doors, and stairs. And so the very surfaces small children gravitate toward for ballast as they learn to stand up and walk around became covered in a thin, metallic layer. Without regular maintenance, those surfaces could break down and release leaded dusts. Small children easily ingested these dusts because they explore their worlds as much with their mouths as they do with their hands. During the middle decades of the twentieth century, doctors and researchers gradually tied such ingestion to a host of ailments, including lifelong cognitive impairments, behavioral problems, stunted growth, and in severe cases, death (Markowitz and Rosner 2013). More recently, researchers have suggested that lead-poisoned children afflicted with behavioral problems can age into erratic, aggressive, even criminal behavior (Nevin 2007).

By the 1950s, physicians understood that deteriorating paint had ushered in a lead poisoning epidemic among children, especially among impoverished children living in the dilapidated housing stocks of aging industrial cities. They clamored for regulations, and two strategies emerged. The first called for eliminating lead from American life, and a total ban on its circulation. The second, considered far more cost effective, focused on limiting individual instances of exposure (Markowitz and Rosner 2013). Federal regulations finally emerged in the late 1970s that prohibited the use of lead in paint destined for residential uses. Even so, many leaded homes would remain leaded: to this day, health professionals advise homeowners and landlords that aging lead paint poses little risk when neatly sealed with a layer of clean paint, tile, drywall, or wallpaper, and when dust is contained during renovation. The main public health intervention is to direct those who own homes built before 1980 to make sure that lead paint is properly contained, that renovations are properly conducted, and that children avoid suspect surfaces. In short, lead paint still lingers in all manner of homes financed and delivered through governmental subsidies and programs. Yet in a society that takes homeownership aspirations for granted, and treats the responsible mortgage holder as an exemplar of citizenly virtue, it is difficult to parse the lead layered in one's walls and windowsills as a collective matter that warrants widespread attention and concern. There is no "we" here; there are only individual homeowners and landlords who act more and less responsibly when grappling with the residues of bygone building practices, homeowners and landlords who are more or less able to safeguard the health of both their investments and the people who live within them. This ethos of individual responsibility is in fact so strong that it has come to govern even obsolete housing infrastructures and their disposal.

Consider here the serious effort that another financially beleaguered Michigan city has recently undertaken to mitigate the hazards posed by the vacant houses that litter its landscape. In 2014, Detroit embarked on an ambitious, federally funded plan to take down 40,000 derelict structures. Those coordinating the demolitions put in place measures to suppress the spread of demolition dust, which typically comprises a range of heavy metals, including copper, manganese, iron, and lead. Coordinators have concerned themselves especially with lead. Like many cities in the region, Detroit has struggled with high childhood lead poisoning rates: although rates have fallen in the past decade, they are still nearly twice the national average (Bienkowski 2013). Adopted measures included requiring contractors to forgo the wrecking ball in favor of equipment and procedures that release less dust, to wet down houses and the resulting debris piles as they demolish houses and cart them off to the dump, and to distribute materials to neighbors that offer tips for avoiding dust. While federal regulators have lauded these steps as a "best practice," they have not required Detroit to undertake any of them. Were this "best practice" to fall by the wayside under mounting criticisms about rising demolition costs and dwindling federal funds to cover them, nothing apart from personal vigilance would stand between a resident and her exposure to potentially hazardous dusts.

Now compare this situation with that of Flint. Federal regulations phased out lead pipes, paint, and gasoline around roughly the same time. And like leaded housing, many leaded water infrastructures have remained leaded because remediation strategies have likewise centered on containment instead of removal. This is where the similarity ends. Federal regulations in place since the early 1990s require water utilities to take standard corrosion control measures (U.S. Environmental Protection Agency [EPA] 1991). Adding phosphates to water during the treatment process coats pipes in ways that inhibit lead and copper from leaching into water from a utilities' own aging and outmoded piping, but also from consumers' aging and outmoded piping. This second point is crucial: regulations exist governing the disposal of leaded paint in occupied buildings, but they target the actions and inactions of *individual* property owners. The responsibility for lead mitigation within water infrastructures is neither localized nor localizable.

**Lead paint made the surfaces it covered bright, durable, and easy to clean, adding to consumers' conceptions that it was the most hygienic way to treat surfaces**

Instead, the service provider must assume responsibility for the health of water distributed throughout the entire network. As such, it must mitigate leaching risks in the houses of private homeowners by making sure that the water it sends into those houses will not cause aging pipes and fixtures to leach lead. This is the step that water workers failed to take in Flint, and the step that state and federal regulators failed to enforce. In the process, they set off a public health emergency that has captured national attention. Federal and state governments are heavily involved in providing and regulating the goods of shelter and water. Yet in contrast to water, Americans do not generally consider shelter to be a collective good, as evinced by that fact that its provision, maintenance, and regulation is in most instances not centrally administered. Publics raised through water infrastructures can make demands of public entities that publics raised through housing infrastructures generally cannot. This means that heads can and will roll for toxic water in a way that they have not and cannot roll for physically and financially toxic housing.

Once airborne, demolition dusts can circulate beyond the point of their origin. In this respect, they resemble the expansive reach of flowing water. Yet even though dust generated by the demolition of homes poses public health hazards in cities across the United States, we are not all Detroit. Just as we are not all Baltimore, Chicago, or Milwaukee, all cities that have, courtesy of leaded house paint, struggled with epidemic lead poisoning rates. Flint is an entirely different matter because Americans have come to conceive of water and its delivery in an entirely different fashion. Water infrastructures may send water flowing through an individual home, but they are not ultimately of that home. They tap deep into investments in a good whose care seems utterly beyond the reach of any single individual. And these investments float the stuff not just of collective imagination and identification, but also of collective administration and related demands for collective protection. So while "we" might all be at risk for ingesting toxins, some of us can spit back the lead soup that leaches from "our" pipes, even as others must swallow the lead dust that flakes off "our" walls. ■

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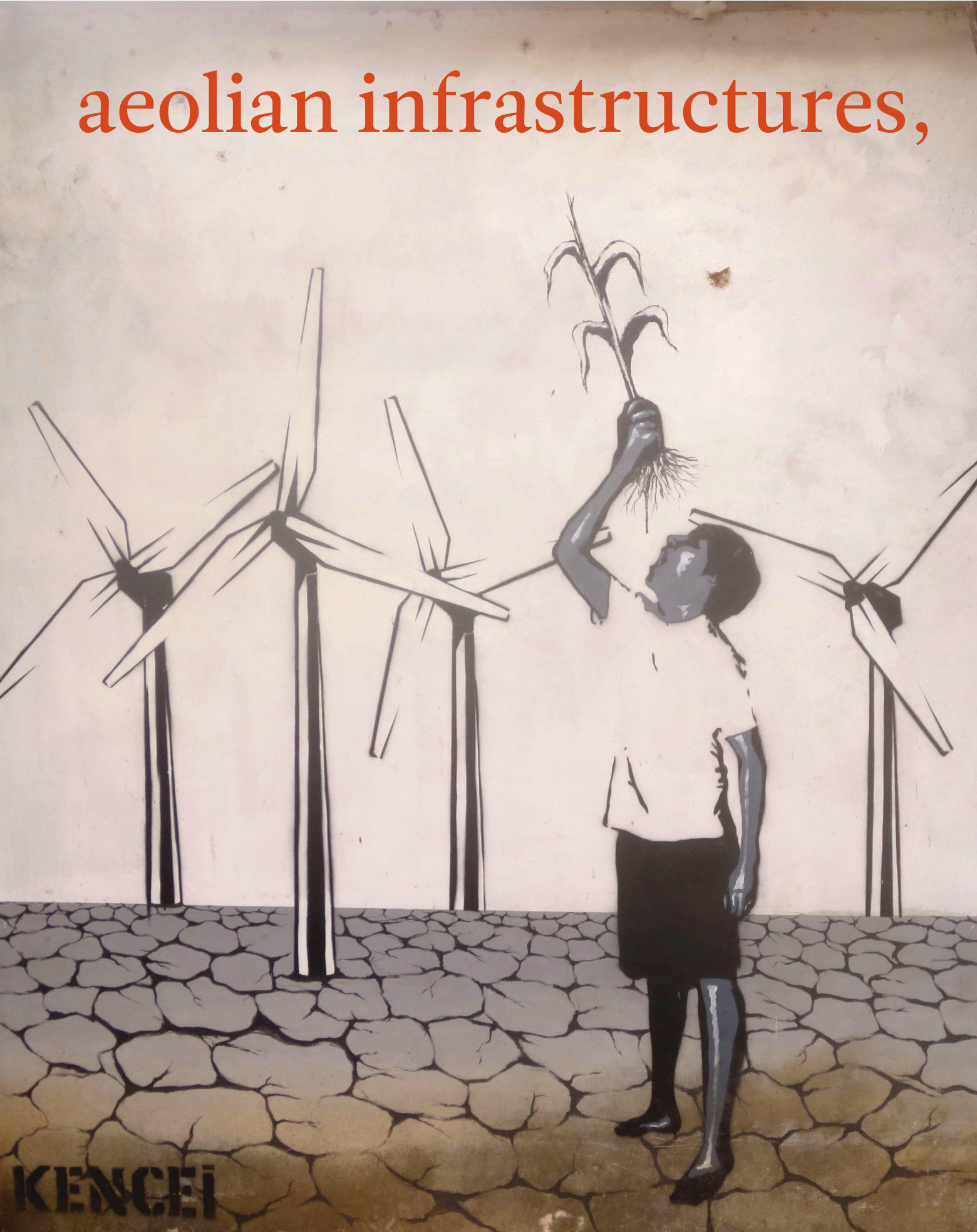
# aeolian infrastructures,



# aeolian publics

## Cymene Howe and Dominic Boyer examine the politics of wind and power – in all their turbulence – in Oaxaca, Mexico.

**WHAT KIND OF INFRASTRUCTURE IS THE WIND?** And what kind of public might it produce? If the main purpose of an infrastructure (Larkin 2013) is to set other things in motion, then wind turns out to be quite amply infrastructural. It fills sails, cools skins, helps lift anything with wings into the sky. In a way, the wind is purely infrastructural; one sees what it *does* much more than what it *is*. And yet, wind also feels very much unstructured. It is elementally loose, a force that may be captured, but never contained. Wind is motion: without movement, it becomes merely air. Wind is nothing if it is not animated. It is an unmooring that acts upon bodies, often best known through our touching (in) it (Ingold 2007). After having been pelted and blown for many months, our skin made arid by the winds of southern Mexico, we came to recognize that wind can only operate as an infrastructure by composing many publics, by pulling persons into its spheres of politics and potential (Sloterdijk 2014). The raw form of *aeolis* may be a resource, a cosmological force, or quotidian oscillating pressures, but in the quest for renewable forms of power, wind's infrastructural capacities are made more tempestuous through the manifold human attempts to capture it (Howe and Boyer 2016). Multiple forms of aeolian publicity operate contemporaneously, competing for prominence and authority in channeling the force of the wind and its infrastructural capacities.

The Isthmus of Tehuantepec, which tapers across the state of Oaxaca in southern Mexico, has among the best terrestrial wind resources anywhere in the world. Anyone who has been through the isthmus knows this is no normal wind. The barometric pressure differential between the Gulf of Mexico and the Pacific Ocean urges air through a narrow gap in the Sierra Madres, creating routine conditions of near tropical storm force in the winter months. Blowing at speeds of up to 30 meters per second, *el norte*, the northern wind, is known to strip the paint off boats, raise the roofs from houses, and mangle 18-wheelers. As one might imagine, for centuries (or longer) the *Istmeño* wind has been a powerful presence and medium for cultural and moral reflection. According to the *binnizá* (Zapotec) and *ikojts* (Huave) populations of the isthmus, the wind has breathed the world into being. It has likewise made "strong backs" and tenacious wills; anyone who has been pummeled by the dust and stones the wind carries within it will also readily recognize why Istmeños sometimes call this "the devil's wind." Nothing controls or thwarts *el norte*; one simply shelters from it as best as possible.

Beginning in 2008, the Mexican government undertook a rigorous plan to harness the wind of the isthmus for the purpose of renewable energy development. Mexico remains a petrostate, but oil is faltering: Mexican heavy crude extraction dropped by nearly 50% from 2004 to 2012, and the supergiant oil field in the Gulf of Mexico is running dry. The nationalized oil company Petróleos Mexicanos (PEMEX) will no longer be able to contribute the immense revenue stream it has provided to the Mexican nation state. In his interview with us, former President Felipe Calderón admitted that in some years as much as 43% of the government's operating budget comes from oil sale revenues. In light of recent production declines, and in an attempt to partially staunch greenhouse gas emissions and slow the growth of global warming, Mexico instituted some of the most aggressive climate change policies in the world. During his tenure, Calderón created legislation that made Mexico one of only two developing countries in the world to enshrine long-term climate targets into federal law. The 2008 Renewable Energy and Energetic Transition law, for one, requires that 35% of Mexican electricity come from non-fossil fuel sources by 2024.

The advent of renewables and carbon mitigation targets, however, have also raised questions about how renewable energy development may disenfranchise local populations and limit local autonomy. To meet the ambitious goals set in place, wind parks have rapidly been erected across the isthmus, now a dense crop of white towers blooming across the skyline. And as wind parks have proliferated in number, so too have the towers themselves grown in size, with 3-megawatt turbines topping 105 meters (32 stories) and weighing 285 tons. Thus it is not surprising that many Istmeños have come to refer to them as "the white giants." Where the giants have found footing, responses to them have become polemical. From the vantage point of some residents and many government officials, wind parks will bring riches and development to

**LEFT:** Mural in La Ventosa

the region. But for others, the turbines raise the specter of neoimperialism, simply another instance of resource extraction in a place sensitive to these kinds of exploits. In the region, the expansion of wind parks has been troubled by two essential worries: one, that land is being expropriated by foreign capitalists aided by government agencies; and two, that local ecosytemic conditions are being forever altered, disrupted, and perhaps destroyed by the installation of industrial-scale wind parks. Though the turbines may themselves be trained to "eat the air"—as one local headline put it—the preoccupations cycling through the isthmus have largely pivoted upon questions of land and water. Whether in critique or in support of wind power expansion, local populations, state agents, and corporate representatives have found themselves caught up in what we have come to think of as an aeolian public (Howe and Boyer 2015).

In their efforts to enroll political support for wind development, the Mexican and Oaxacan governments, together with international energy companies and financiers, have engaged in processes to create a supportive public for the region's terralogical and energetic transformation. How does one go about making an aeolian public? In southern Mexico it is, at minimum, a four-step process consecrated by government functionaries and renewable energy developers. Through public meetings, advertising campaigns, and, on occasion, door-to-door solicitation, residents occupying the perimeters of the wind parks, or landholders who might lease parcels for development, have been encouraged to become a public by: 1) embracing the broad economic developmental potential of wind power for the region (rather than viewing it as a force that beats down crops, antagonizing everything in its path); 2) monetizing the kinetic energy of wind as a quantifiable, calculable, and remunerative good (rather than a cosmological force that has breathed the world into being); 3) joining with national policy regimes to increase cleaner forms of energy production and to take part in a new kind of Mexican exceptionalism generated by wind, sun, water, and biofuels (rather than continuing to rely on the petrologics of nationalized oil); and, finally, 4) imagining one's self as enmeshed in a larger climatological public, a global anthropos of energy makers and users that actively seek remediation to the harms of atmospheric contamination, severe weather, and threatened crops, which are also well-known phenomena in the isthmus.

As in other fragile neoliberal political situations, the infrastructural powers of the "wind rush" are expected to close the gap between the promises of liberal citizenship and governments' failures to fulfill core responsibilities worthy of civic fidelity (such as providing clean water, energy, security, shelter, and a vigorous economy; see, for example, Anand 2011; von Schnitzler 2013). Istmeño wind has taken on a salvational form; it is expected to blow jobs and prosperity into one of the poorest areas of one of the poorest states in Mexico while at the same prototyping a new energy future for the Mexican petrostate. For one former director of sustainable energy for the State of Oaxaca, the wind is the "diamond" in the resource crown of the region. Without this wind, he stated, "there would be no development in the isthmus." He likewise had great aspirations to construct a "City of Knowledge" that would train young Istmeños for future engineering careers in Mexico and abroad. "Today," said the director, "our people migrate to the United States to pick strawberries, but with the wealth and training the wind boon will bring, soon they will be running your wind parks!" The technoprofessional ambitions of such officials were not lost on deaf ears; Istmeños hoped for more employment and educational opportunities that would spare them having to migrate like so many in the region. While the City of Knowledge has yet to appear, by the end of 2015, 80% of Mexico's installed wind power capacity, 2,300 megawatts, was located in the isthmus.

Isthmus wind parks have had some true believers to be sure. Don Porfirio Montero, a large landowner and evangelical Christian leader in the isthmus, built a considerable empire for himself on land rented to wind companies. He and his allies see a blessed partnership with wind energy companies that are transforming an agricultural region into an epicenter of white-collar industry, opportunity, and prosperity. Yet, even within Montero's hometown of La Ventosa, one of two towns almost entirely encircled by wind parks, we sensed great ambivalence to the proliferation of wind turbines. Many residents complained that only a small group of wealthy landowners (like Montero) had amassed the promised benefits, with new revenues ploughed into fancy trucks and new homes rather than into projects like enhancing schools, refurbishing health clinics, or improving roads that would benefit the community more widely. Within the contract system established in the isthmus, renewable energy companies share a percentage of the profits generated by the wind parks once they are in operation. Communities can expect some small portion of company profits to be put toward human infrastructural projects like schools and health initiatives. But speculation about graft and a lack of information about how, and to whom, revenues are distributed has caused enduring suspicions. Some local residents have found work during the construction phase; far fewer have acquired more permanent jobs (repairing specialized turbines, for instance). Most management positions are still held by Spanish and American professionals whose companies build and run the parks. Streets have been paved, lowering the dust and grit profile in places like La Ventosa, but residents are often unclear who has carried out these good works and whether in fact they *are* good. Many of those living in La Ventosa appreciated the modern glimmer of newly paved streets, for example, but they scorned the fact that their new streets were without drainage, meaning that in the rainy season the roads ran wild with flooding and their toilets sometimes belched murky waters of origins unknown.

For those who have been especially vocal in challenging the wind parks, it is not a matter of opposing renewable energy per se, but instead of critcizing the way that Mexico's turn to renewable energy has proceeded. Dominated primarily by Spanish energy corporations, the wind sector seems to reiterate a politics of colonial exploitation through the means of transnational capital. As many in opposition to wind park development have voiced, the turbines are a sign of a *nueva conquista* (new

conquest). The regulatory environment that the Mexican government created for renewables is highly advantageous to foreign direct investment. Initial contracting for wind parks also took place under somewhat suspicious conditions, with select corporate sponsors given exclusive negotiation rights over prime land that, in turn, prohibited landowners from seeking competitive bids on contracts. Land that is privately owned has generally been less contested; owners receive a direct rental payment from renewable energy companies and thus directly benefit from wind park development. However, wind parks have also been planned for communally held land, designated by the federal government due to historic farming rights (*ejidos*) or historical indigenous stewardship (*bienes comunales*). Here, the relationship between land and the people attempting to manage its future is more complicated. Circulating throughout the isthmus are stories of collective authorities being manipulated and "bought" at the expense of the communities to which they are supposed to be accountable. Critics of wind development readily claim that exploration and usufruct rights were ill gotten, often through bribes paid to *presidentes municipales* (mayors) or *comisariados* (collective land commissioners). With contracts lasting 30 years, and "evergreen" unless nullified by the landowner, accusations of corruption are invariably paired with charges of land expropriation or the "*despojo*" (sacking and looting) of indigenous and *campesino* lands.

Wind park development in the isthmus, like many infrastructural initiatives in Mexico, has followed a neoliberal and individualized economic logic. The industrial model instituted in the isthmus is predicated on a corporate self-supply model called *autoabastecimiento*. Autoabastecimiento forges partnerships between private wind developers and large industrial clients—such as Walmart and Coca-Cola—over a period of many years. Corporate consumers are able to secure below-market prices for their electricity and benefit from *bonos de carbono* (emission reduction credits); companies are also able to "green" their corporate profiles. Meanwhile, the Mexican state receives infrastructural assistance—in the form of substation construction, for instance—at no, or low, cost. In the discourses of clean energy development, local communities are often portrayed as profiting from the autoabastecimiento model because landowners receive rents. However, many Istmeños have begun to wonder about the true benefits of wind development. Following a longer political tradition in the isthmus, residents have voiced concerns about megaprojects in general, even those that are supposed to be clean and green.

The office of the Assembly of Indigenous Peoples of the Isthmus of Tehuantepec in Defense of Land and Territory is easily seen on the streets of Juchitán; it is the edifice with the anti-turbine art on its facade. Our meeting with two of the founders of the "*anti-eólico*" (anti-wind) resistance took place inside a tiny room decorated with images of past victories and heroes from Che to Zapatista Subcomandante Marcos. Rodrigo, one of the movement's founders, emphasized that he and his compañeros are not opposed to renewable energy; they are opposed to the way its institutionalization has taken place. To illustrate this point, Rodrigo narrated a political genealogy linking wind parks, foreign domination, and resource extraction in an account of economic imperialism that needed to be thwarted. For this, he said, we need to turn to history: the student movement in Mexico City in 1968 and a guerrilla *foco* in Chihuahua before that; the Zapatista rebellion, the beginning of the North American Free Trade Agreement (NAFTA), and a battle over an airport outside of Mexico City in the early 2000s; the teacher's strike and state reactions in Oaxaca City in 2006; and finally Maoism itself with its agrarian peasant insurgencies and challenges to first-world imperialism. Rodrigo's political lineage drew from multiple sources of inspiration, weaving a timeline through resistances near and far, both temporally proximate and distant. His cartography of responses to foreign domination, urban hegemony, and rebellions against neoliberal development brought us to the origins of the isthmus anti-eólico resistance in 2005. Rodrigo explained that the resistance could claim several significant victories, including nullifying contracts across the region and "rescuing" 1,200 hectares of land from being contracted and thus turned into wind parks. For Rodrigo and the several hundred protestors who have come to identify with the resistance, wind parks are less a proposition regarding wind or electricity than they are a means to extract land from local hands.

In other communities, like the binnizá hamlet of Álvaro Obregón and the ikojts village of San Dionisio del Mar, planned wind park projects have catalyzed powerful political polarization and violence. Roads have been blockaded, town halls occupied, community radio stations attacked, trucks kidnapped, stones thrown, and limbs broken. Although land expropriation is an enduring concern in the shadow of the turbines, in maritime places such as Álvaro and San Dionisio, it is fish, shrimp, and lagoonal waters that seem most imperiled. The sandbar of Santa Teresa is home to mangrove stands, and its surrounding waters provide a reservoir of subsistence for many local fishing families. The *barra* is also where local residents have blockaded a road and prevented the installation of what would have been Latin America's largest single-phase wind park to be constructed on the barra by Mareña Renovables. Fisherfolk were concerned about the park's impact on their fishing grounds. Would the barra shake with every lop and turn of a turbine blade? Would the lights and sounds of the machines terrorize and disperse the aquatic creatures upon which many local people survive? Luis Gutierrez-Doblado, a teacher from the region and an opponent of the wind parks, put it this way:

> I understand this is supposed to be a form of clean energy. [But] if they gave us all the money in the world, we'd still say "no." Our children and our grandchildren will depend on the fish, the shrimp, the love of the land, respect for nature, and all of our cosmology that we have as an indigenous community.

Forging a rhetorical link between indigenous peoples, love of land, and respect for nature may not be a novel statement, but it does index the troubled paradox be-

tween forms of energy that are environmentally beneficial writ large, but that may nonetheless negatively affect ecosystems and people living in places where new models of industrial power are being generated. The giant wind park never did come to fruition. Resistance against the "white giants" had become increasingly fierce and investors' patience increasingly overtaxed.

In the isthmus, the hopeful promises of "wind power" have been constantly drawn back down to earth through decades-old battles over land tenure, local ecosystemic possibilities, and centuries-old conflicts over the expropriation of Istmeño resources by faraway powers. While government and corporate functionaries have attempted to create a singular aeolian public, we argue that aeolis compels, by necessity, multiple publics, surfacing manifold routes to authority, management, and cosmologies. Many models of publicity suggest that publics are constituted by circulating messages (e.g., Anderson 1998; Warner 2002). Other accounts of public formation show how infrastructures themselves mobilize publics around their capacities, flows, and durability (Anand 2011; von Schnitzler 2013). Aeolian publics are something different altogether. Wind does not operate in the systemic fashion that electric grids, transportation networks, or pipelines do. It is a more expansive and open infrastructural entity, one that is constantly in motion, refusing closure. Aeolian publics are thus constantly undone and remade through the ontological status of wind itself as a fleeting, gusting, and turbulent force facilitating wealth and energy but also cosmological worlds and powers of resistance. ■

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# CRAFTING A DIGITAL PUBLIC

**WHAT MAKES A CITY SMART? ALAN WIIG EXAMINES A PROJECT TO PROMOTE URBAN DEVELOPMENT THROUGH INFORMATION INFRASTRUCTURE IN PHILADELPHIA.**

**PHILADELPHIA, LIKE MANY CITIES IN THE GLOBAL NORTH,** has augmented traditional, established, face-to-face workforce education services in public schools, community centers, and library programs with a constellation of digital services accessible through computers and, increasingly, internet-enabled smartphones. Such efforts underpinned conceptualizations of the smart city that IBM fostered and Philadelphia adopted beginning around 2010. These digital services format into a platform with the potential to increase civic engagement and job opportunities in novel ways by breaking down geographic barriers between inner-city residents of postindustrial neighborhoods and the locations of jobs in the new economy, which are typically either downtown or on the city's suburban fringe. While this digitally driven project was rhetorically focused on a public good—jobs for marginalized residents—it is crucial to also examine how Philadelphia's mayor enrolled this project into an economic development agenda that focused more on promoting innovative economic policy than actively achieving the job-creation goals of the project itself.

Smart city projects integrate information and communication technology (ICT) infrastructures into the provision of civic services. Their core implication is that mobile, digital technologies hold the potential to provide novel solutions to longstanding social and economic issues. Such an approach assumes that new technologies can effect change quickly, more efficiently, and for a lower price than a low-tech, "dumb" policy strategy. These efforts harness the ubiquitous connectivity and data-gathering potential of digital infrastructures: the internet and wireless mobile communication, smartphones and other computing gadgets, and also software, algorithms, and machine-sorted data in widespread use today. These networks and devices are built and maintained by massive, trans-national ICT corporations, not least Apple, Alphabet (Google's parent company), AT&T, Cisco, Microsoft, and Oracle (Dullforce 2015). The complexity of digital systems—hardware, software, and data—leads to a unique set of experts and private institutions attached to the provision and maintenance of the infrastructure underpinning smart city policies and projects. This is a markedly different situation from other, more state-centric forms of public services such as the provision of water or transportation.

The logic of smart city policies builds off of the easy utility of personal connectivity to the mobile internet. This infrastructural connection acts as a platform to provide digital facsimiles of services previously offered through brick and mortar locations for civic interaction: replacing an office with an app. To this end, implementing "smart" solutions to urban issues adapts the ongoing, neoliberal cost-cutting in city governments into new digital systems like smartphones that earlier were used for social exchange but not to engage with public services (Hackworth 2007; Hollands 2008).

At issue is the expectation of smart city experts both that the digital solution is best, and that users will adopt said solution in the fashion the experts planned for. Here I present Philadelphia's experience partnering with IBM to harness digital infrastructure and residents' smartphones to provide a workforce education app that would both train residents with skills relevant for jobs in emerging industries and also connect residents to potential employers. With this case study, I focus on the inability of experts to foresee the sort of pitfalls that emerge when new technologies are deployed into the public sphere too quickly and without the knowledge resources on hand to adapt a prototype into a more complex "real-world" situation.

IBM emerged as a main actor providing smart city consulting starting around 2010 with their Smarter Cities Challenge (IBM 2013); they maintain the focus to the present day (Wiig 2015a). Worldwide, IBM's Smarter Cities Challenge initiatives took the potential of ICT infrastructure to connect city to citizen in original, often untested ways. These initiatives proposed harnessing ICT's potential to address a "matter of concern" (Latour 2004) decided by a city's mayor and IBM. The topics IBM addressed were civic engagement, economic development, education, environmental health, public safety, transportation, and urban planning. IBM wrote plans and left implementation to civic intermediaries: city officials, nongovernmental organizations, and the private sector (Wiig 2015b:263). IBM provided the consultation for free; the city was responsible for funding, staffing, and deploying the effort on their own, even though finding staff trained to build civic technologies could be difficult (Interview, Director of Civic Technology, 2012).

**Philadelphia's mayor noted that, by his office's calculus, 600,000 city residents were unqualified for jobs in the twenty-first century information and innovation-focused economy**

Philadelphia requested IBM design an online and mobile app to implement digital literacy–focused workforce education training (Rowinski 2010). In addition, the app would contain a social media–styled component to connect trainees to potential employers. Philadelphia's mayor noted that, by his office's calculus, 600,000 city residents were unqualified for jobs in the twenty-first century information and innovation-focused economy (Nutter 2012a, 2012b). As a result, residents first needed workforce training for positions relevant to this emerging economy to secure jobs.

The program was called Digital On-Ramps, a reference to providing an on-ramp to the information superhighway (Interview, Director of school initiatives, 2013). In this conceptualization, for Philadelphia to become a smart city, it needed to improve on education and job attainment among marginalized, inner-city residents. Investing directly in public schools was fraught with local, state, and national politics: the city's public schools have been failing for decades (Jack and Sludden 2013; Leblanc 2013; Maranto 2005). In addition, improving public schools wholesale would not provide a stage for deploying a technological solution to an audience of tech-savvy, "innovative" businesses that might have been identified to hire participants.

In deploying an app-based solution, the city and IBM

sought to sidestep the contentious politics surrounding the underfunded public education system and bring workforce training straight into the hands of local youth via the smartphone many—if not most—likely carried with them everywhere. In this conceptualization of a smart city, smartphones and their connective digital infrastructure are deployed to solve the problem of underfunded public schools unable to provide relevant educational opportunities and linkages to jobs in the new economy.

In the fall of 2011, IBM's team spent about two weeks in Philadelphia, interviewing 66 people from "city government, private sector employers, universities and colleges, schools and community-based organizations" (IBM 2011:21). From these interviews, the consultants chose "to view the Digital On-Ramps stakeholders in three groupings: citizens, providers, and employers" (IBM 2011:21). Absent from the interviewed stakeholders, however, were members of the public: citizens who might need workforce education. Their view was represented by the civic, nongovernmental, and private sector organizations working with the public. The planning document was presented to the city in late 2011 (IBM 2011). Development of the app began immediately.

Digital On-Ramps' workforce education app, conceptualized by a steering committee and implemented by midlevel staff, would be accessed through a personal computer or smartphone. It would provide short lessons in a variety of digital skills that could be completed, for instance, during a participant's commute to school via public transportation. An app platform for workforce education offered multiple sorts of flexibility. New lessons could be added and old removed remotely, an individualized learning plan for each participant could be created, and the app could grow users without necessarily requiring more teachers or support staff, or finding additional classroom space. The app could, in design, fulfill the learning needs of as many Philadelphians as were interested. Conceptualizing the lessons and crafting the achievable skillsets would happen through a badge-based system introduced by the Mozilla Foundation (Surman 2011) in which completing a suite of lessons would produce a badge, and a collection of badges could qualify a participant for a certain sort of job. This badge-based digital learning through a smartphone represented a path-breaking step forward for Digital On-Ramps and public education in Philadelphia more generally, but by the time of the pilot, the lessons and the badge system were not yet fully conceptualized, nor were the sort of jobs for which the training would qualify participants.

**Investing directly in public schools was fraught with local, state, and national politics: the city's public schools have been failing for decades**

A pilot took place in the spring of 2013 involving more than 500 local youth at four public high schools. Garnering the interest of this many youth was seen as a prominent success for the pilot (Interview, Director of School Initiatives, 2013), which targeted the advanced manufacturing industry. This was part of the push to bring precision, flexible manufacturing back to the United States, one of the Obama administration's economic goals in 2010 (Science and Technology Policy Institute 2010). When asked to identify the specific sort of jobs for which Digital On-Ramps participants received training, staff was reluctant to provide an answer. The only concrete example given was a photocopier technician, responsible for printing and maintaining the paper output of an office (Interview, Development Manager, 2013).

The pilot quickly ran into multiple problems: miscommunication between Digital On-Ramps' staff and teachers at the involved high schools meant no one assisted the youth as they navigated through the lessons. The app's programming, done by a third party not located in Philadelphia, had technical problems such as no way for a participant to automatically generate a new login password if they forgot their existing one. The piloted lessons were not even available as an app: they only worked through the web browser on a desktop, so the youth could not continue the lessons on their smartphone later in the day (Wiig 2015b:6–13). Digital On-Ramps' staff was pushed to implement the app without adequate resources, most importantly a software provider up to the task of coding the app they needed, on a too-short timeline. While this was not inherently the fault of any one expert, it speaks to the complications in relying on, in this case, computer and app programmers working at a distance to provide a core element of the digital education system.

Digital On-Ramps emerged at the intersection of multiple public and nongovernmental education organizations in Philadelphia, groups that historically had worked without effective coordination of services and resources. One important success of this smart city effort, mentioned by multiple interviewees across all the involved organizations, was that partnering with IBM finally made them communicate with each other. However, the mayor's and the steering committee's demand for brand new, innovative programming meant that the proposed app did not sync with existing vocational programs in the city. An assumption underlying the effort was that to be "smart" necessitated creating something path breaking. This was also illustrated by the focus on advanced manufacturing, an industry cluster that, while represented in the city, was small and likely unable to provide jobs in the way an established, but perceived as less innovative, field could, such as health care.

The planning challenges Digital On-Ramps faced did not stop the mayor from proclaiming the program a success even before the pilot ran (Wiig 2015b). The potential for widespread public benefit was operationalized to promote Philadelphia and IBM's innovative, entrepreneurial capacity, without taking into account how to actively achieve the goals of the plan. The parameters of success as planned by IBM and promoted by Digital On-Ramps' steering committee and the mayor were not met: the bombastic hype of app-based workforce education as a vehicle for economic promotion was the most prominent outcome of the project. Today, Digital On-Ramps has scaled back their vision to focus on more attainable workforce education and job creation outcomes: connecting

residents to jobs, providing career advice, and hosting an online e-portfolio site where participants can upload resumes, certifications, and recommendations (Digital On-Ramps 2014).

Digital On-Ramps targeted a particular population; the process of targeting, in turn, produced particular "problems" for which an app could then provide the solution. Enabled through digital infrastructure's constant, mobile connectivity, Digital On-Ramps crafted a public in need of skills for a new industry that did not yet exist in the city, but through the process of gaining workforce education, the new industry would see that Philadelphia was a "smart" city in which to locate. This digital solution to a lack of job skills, general unemployment, and the need for economic growth was originally framed in terms of 1) convenient attainment of targeted, almost vocational training for jobs in a new economy, and 2) social media-style knowledge coordination providing employers with better access to potential employees. With Digital On-Ramps, private, non-state actors like IBM defined new understandings of the public for the state, a public that was conversant in and comfortable with digital technologies, perhaps lacking more specific, job-relevant, and professional digital skills, but amenable to learning said skills as well as seeking jobs in this new economy. While IBM's planning did not (or could not) foresee the social and technological problems participants ran into, Digital On-Ramps' steering committee, with their focus on advanced manufacturing seeking to align the city's economy into new, relevant industries, was unable to adequately provide the connections to employers promised to participants. The advanced manufacturing industry likely did not need many photocopier technicians. In a fashion, Digital On-Ramps ran into a chicken-or-egg, which-comes-first conundrum: they needed participants interested in jobs, but they also needed potential employers willing to hire participants through new means. Digital On-Ramps' shift since the pilot into a more realistic and less ambitious plan to align education with job opportunities, without the online, mobile education component, will hopefully realize some success, even if it does not attain the smart city ambitions originally proclaimed. As future smart city projects of this sort are planned, it is important to consider, in a smart city, who is the public and how will they benefit from the project. ■

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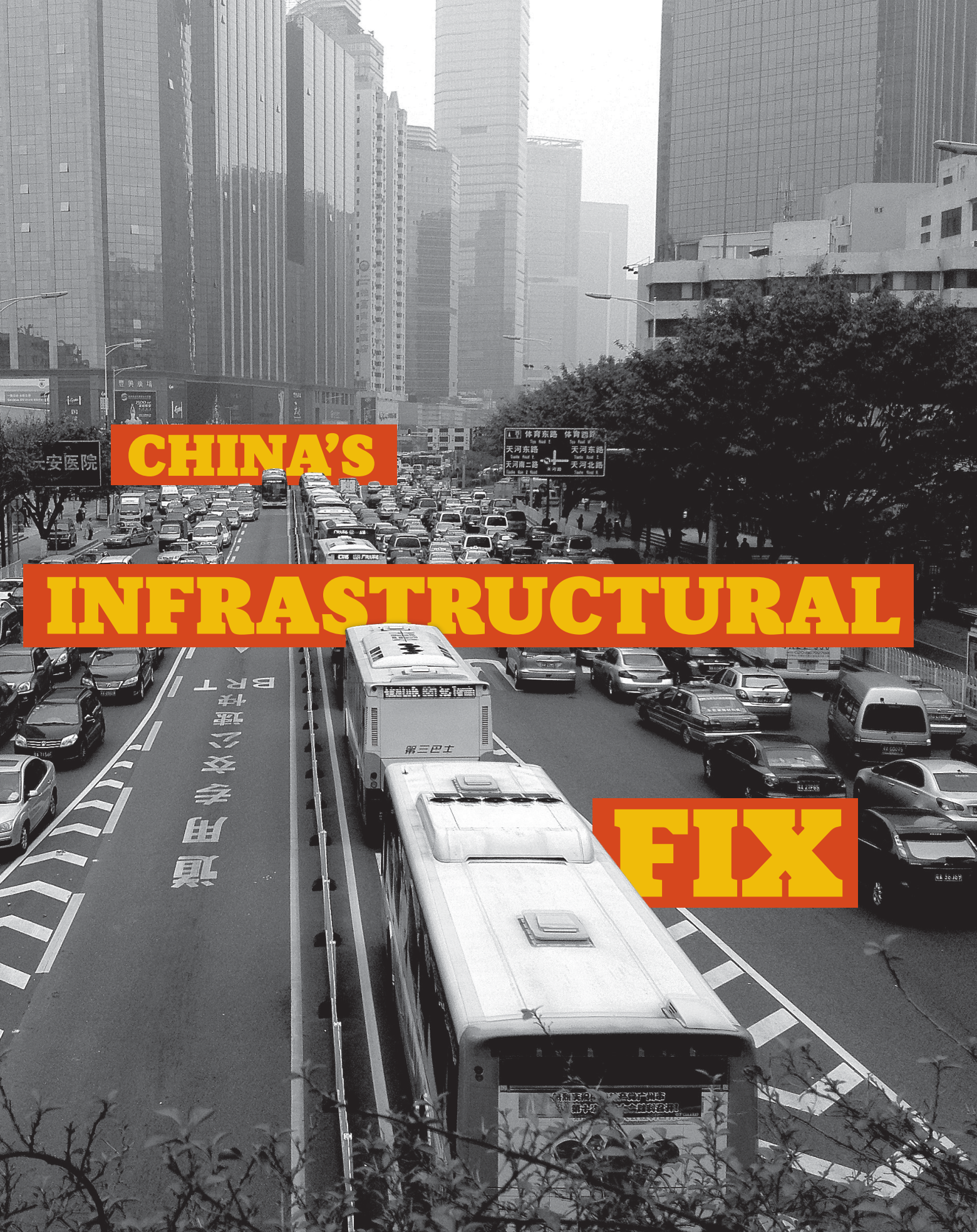
CHINA'S
INFRASTRUCTURAL
FIX
体育东路
体育西路
天河东路
天河东路
天河南二路
天河北路
BRT
通用专交公建快

# How is modernity being reclaimed as a Chinese project? Jonathan Bach investigates the politics of infrastructure in today's most ambitious developmental state.

*"To be rich, first build a road."*
– Chinese proverb

**IN OUR PRESENT ERA,** China stands out as the paradigmatic infrastructural state: a state produced by and through infrastructure as a modern project. About 43% of China's total investment goes towards infrastructure, or roughly $2.3 trillion. This amounts to 14% of gross domestic product (GDP), in comparison with about 2% spent by the United States (Zhang and Barnett 2014). This investment is reflected in the massive and seemingly endless major infrastructural projects that embody Chinese state power: the Three Gorges Dam, the world's most extensive high-speed rail network, longest cross-sea bridge, Asia's largest train station, biggest hydroelectric project, etc. In less spectacular ways, it is reflected in the role that infrastructure plays at the heart of fiscal, legal, and public transformations at all levels in the seemingly permanent reforming of Chinese economy and society. In this article I explore some of the sites where infrastructure oscillates between the spectacular and the mundane, creating new forms of publics and counterpublics that symbiotically shape a new national culture premised on infrastructural prowess.

The Chinese state's long list of flamboyant infrastructure projects makes visible the rise of China and the distance it has covered since the beginning of the post-Mao era. This classic deployment of state power uses both awe and jobs to create a multiplier effect at the symbolic and economic levels. It also serves to make visible both China's financial might and vulnerabilities. Infrastructure projects are spurred to ever-greater heights to keep the economy growing. The Chinese state used infrastructure investment to successfully stimulate the economy during the 1997 and 2008 financial crises, but at the unavoidable cost of pouring money into unneeded projects, making infrastructure also the visible excess of an overheated economy. As outlined in a report by economists from the Chinese National Development and Reform Commission, up to 40% of projects once begun remain unfinished; many are widely considered economically inefficient (Pei 2014).

Showcase projects, though, are not the meat and potatoes of infrastructure. Most infrastructure projects concern transportation, water, electricity, gas, and information at municipal levels in a rapidly urbanizing country. While the spectacular infrastructure projects make headlines, 75% of infrastructure investment in China is local.[1] Such projects are predominantly financed through local governments, part of the less visible background of fiscal policy, which is essential to understanding China's infrastructural phenomenon. Fiscal reform in 1994 redirected tax revenue that once

**1** This figure comes from a study by the Shanghai Institute for Finance and Law, cited in Barreda and Wertime (2013). See the discussion of local government financing in Zhang and Barnett (2014), and also the argument about how local governments are part of the state building process in Wong (2015).

**OPENING PAGE:** Tianhe Road, Guangzhou. (PHOTO: DAVID290)
**ABOVE:** Qianzang Railway, the highest. (PHOTO: BY JAN REURINK, WIKIMEDIA.)

stayed with local governments to the central government, without a commensurate change in how the central government redistributed this money. The result was that local governments became increasingly squeezed because the central government effectively shifted the burden of paying for infrastructure, social services, and education (including school construction) onto local governments. Chinese banking law severely constrains bank loans to local governments, municipal bonds are not an option, and there are no local property taxes per se (W. Wu 2010; X. Wu 2016).

The source of revenue for cash-starved and increasingly desperate local governments lies primarily in land transfers from public to private ownership. Revenue is generated in various ways, commonly through the money a local government can generate from the difference between the compensation paid to former residents and the price charged to developers for the land, as well as increased revenue from business taxes, which is one of the few taxes that remains local rather than being paid directly to the central government. But because the central government sets limits on the amount of land available for conversion from rural to urban use, there is a limited supply of land available to convert.

Recently, local governments have found a way to commodify the allocation of rural and urban land within their jurisdiction. They issue land quota certificates to developers who "create" rural land by, for example, knocking down existing structures in an officially urban area to "empty" it; they then reclassify the land as rural, and transfer the "quota" to an urban area. They can then spatially manipulate rural and urban designations for development. These certificates function as a market solution to a command economy legacy, as they themselves can be traded on an exchange in the manner of pollution credits (Cui 2011). As Yuan Xiao (2015:2) writes, "such a transfer does not trade actual land parcels, but rather virtually transfers development permission from the countryside to cities" and effectively increases both local government control over land while redirecting resources to urban areas (see also Xiao and Zhao 2015).

The search for revenue has become the motor driving China's urban form by inexorably turning formerly rural land on the outskirts of cities into factories, eco-cities, high-rise suburbs, shopping malls, golf courses, theme parks, and business districts, all needing to be connected to electrical grids, water and sewage, transportation, and telecommunications. This too requires raising money. To finance infrastructure, local governments developed a Chinese variation on the public-private partnership model. In the absence of municipal bond markets, many local governments create and operate so-called Local Government Finance Vehicles (LGFVs) that borrow from banks to support infrastructure projects. The politics of financing infrastructure—including the role of former state-owned enterprises, the use of shadow banking, relations between companies and politicians, the awarding of contracts, and the creation and enforcement of regulations—become a focal point for the politics of urban life.

To acquire more land to transfer, and therefore raise more revenue, cities expand their borders to encompass ever more rural areas such as Chongqing, the largest single municipality that now encompasses 31,816 square miles. In the center of the city, old residential neighborhoods become prime targets for redevelopment for skyscrapers and shopping malls, while villages are swallowed by expanding city borders and become new ring roads and conurbations. The single most controversial part of these processes is the displacement of residents, who are offered compensation according to formulas that most always seem to undervalue their property. If residents do not accept the compensation, varying forms of pressure can


**ABOVE:** New China. (PHOTO: LAIN)

be applied to convince them to leave their homes, from effectively de-infrastructuralizing their neighborhoods through the cutting of utilities, to tricking them into briefly stepping away from their homes, which are then quickly demolished before residents return (Shao 2013).[2] In such villages and quarters condemned to demolition, infrastructure literally becomes weapons of both the strong and the weak. Those with power can disable or deny basic infrastructure to force out residents without power. In response, and to continue to live, those without power then "steal back" and jerry-rig basic infrastructure.

Infrastructure thus both sunders and sutures residents in peri-urban villages and poorer inner-city residential neighborhoods into infrastructural publics and counterpublics. Infrastructure mediates their experiences with the state through their encounter with the withdrawal, denial, and demolition of infrastructure as a tactic of displacement, which often results in heightened consciousness of property rights and compensation rules and can take the form of protest and collective action.

When residents are resettled, often in new high-rise enclaves, the same residents find themselves effectively forced into a new type of "legitimate" home ownership. This makes them a lower socioeconomic mirror of the new "homeowner" publics of the growing middle classes that Li Zhang (2010) has explored in her work on Kunming. As Zhang shows, the new middle and upper classes are also turned into infrastructural publics, albeit demanding services they feel are due them by dint of their status. Their anger with property management companies takes form over leaking water pipes and exorbitant fees for utility hook-ups, and turns into conflicts over contractual obligations and new forms of activism and interest articulation.[3] Both those facing displacement and those buying into new housing estates are learning new forms of contestation and protest, and both require fluency with contracts, courts, and regulations.

**2** See also my discussion of how the Shenzhen government sought to take control of its urban villages (Bach 2010).

**3** On the rise of rights discourse regarding property, see Cheuk-Yet (2015).

As Julie Chu (2014) shows, the increasing role of infrastructure as a political space thus also has the effect of absorbing and diffusing politics into legal structures that deflect accountability: on the one hand, under rapid urbanization infrastructure becomes increasingly visible through its anticipation, lack, refusal, or appropriation. On the other, the agents that produce infrastructure become increasingly invisible, dispersed within a shadow infrastructure of "public notices and formal hearings, city plans, and housing documents…that routinize, if not dispel, ongoing conflicts over redevelopment by simultaneously narrowing and proliferating the sites of accountability…" (Chu 2014:355).The more bureaucratized infrastructural politics becomes, Chu argues, the more it shifts the terrain of encounter between state practices and people's experiences to the legal sphere, where the state holds a distinct, if not ironclad, advantage in both obfuscation and interpretation. The "simultaneous narrowing and proliferating sites of accountability" introduced by bureaucratization causes the agents of infrastructure to disappear into a world of regulation and adjudication.

In the more extreme cases, however, people literally become invisible. The same bureaucratic systems that draw people into the legal sphere to adjudicate their claims also provide the backdrop for regulatory failure and concomitant disasters where people die, bodies are often unrecovered, and unnamed migrant workers go missing. In 2015 there were two spectacular disasters among many smaller ones: the colossal explosions of improperly stored chemicals in Tianjin that damaged buildings more than a mile away and killed up to 181 people, and the gigantic landslide of construction debris in Shenzhen that smothered 25 acres, destroyed 33 buildings, and left at least 77 people killed or missing. Infrastructure catastrophes like these are not primarily the result of neglected and crumbling infrastructure, as in the United States. When

**ABOVE:** Kangbashi district, Ordos City, Inner Mongolia. (PHOTO: WIKIMEDIA)

a bridge collapsed in Harbin in 2012, it was only a year old and had cost $300 million, as widely reported in the media at the time. These disasters conjure the infrapolitics behind the infrastructure: the politics below the structures below. These kinds of disasters demonstrate how politics and infrastructure function together topologically, including the often fine line between corruption and encouraging rapid infrastructural expansion in the name of revenue, economic growth, and perceived real need. Spectacular infrastructure breakdowns sometimes show how the system works, not how it fails.

A corollary case of invisibility concerns the infamous "ghost cities" of China where new buildings are effectively abandoned before anyone ever lives in them. These are the result of urban expansion outstripping demand, resulting in empty streets, libraries without books, museums without art, theaters without audiences, buildings without tenants. Ghost cities arise at the intersection where the need for local government revenue through urban expansion, discussed above, meets two additional factors. First is competition among municipalities for politically important national designations such as "National Central City" or "National Regional City" (F. Wu 2015:123–127). Second is the rise of the housing market as a vehicle for investment, which rests in turn on the high cultural status of apartment ownership. At the root of the ghost city phenomenon, Christian Sorace and William Hurst (2016) explain, is an urgent social need for money and prestige both for cities seeking national-level recognition and individuals seeking to buy apartments as investments, even if they are never lived in but simply resold to other investors. Sorace and Hurst argue that ghost cities are, at their core, an illusion of money and prestige not unlike a classic bubble or pyramid scheme: the distinction between "real" value and the appearance of value must be blurred both to make its accumulation easier and to forestall its collapse. The result is the illusion of infrastructure, from numerous disconnected satellite cities near major metropolises to Kangbashi, a 137-square-mile modern city built for a million yet with fewer than 20,000 inhabitants (see Shepard 2015).

**What is made visible through infrastructure both at home and abroad is thus also a redemptive narrative of the nation.**

These cases show how infrastructure in China shapes the praxis of urban formation and citizenship in addition to boosting GDP. The converse of this is the role of infrastructure as a major export product. The visibility of Chinese infrastructure financing is central to its global image: China building railroads, pipelines, stadiums, cities, and ports across Asia, Latin America, and Africa as part of direct investment and deals for access to resources; China showing international leadership through the creation of the Asian Infrastructure Investment Bank (AIIB) as an alternative means of infrastructure financing to the World Bank, the Asian Development Bank and others with their roots in the Cold War–era financial architecture; China leading the "One Belt, One Road" project that seeks to connect 60 countries containing most of the world's population through the financing of new ports, highways, and railroads. This infrastructural foreign policy echoes, on the one hand, historical colonial projects such as massive railroad and port building in China by imperial powers. On the other, it echoes the hegemony-seeking dominance of the United States in the Bretton Woods institutions, while purporting to invert the imperialist legacy by having a former victim of imperialism lead global development.

What is made visible through infrastructure both at home and abroad is thus also a redemptive narrative of the nation. One can see a certain continuity with local patriotic movements of the early twentieth century to buy out railways from foreigners who had wrung the right to build them from the weak Qing government. The first railroad in China was built by the British in 1876; by the turn of the twentieth century, 80% of railroads in China were under foreign control, either directly or through loans (Yin-Nor 2016:44–45).

The subsequent dependence of China's infrastructural development on Western technology, often in the form of colonial or, later, Soviet origins, constitutes an important historical context for contemporary infrastructural politics. In this sense, infrastructure is about reclaiming modernity as a Chinese project.

In all these cases, infrastructure appears as an ultimate fix in its multiple senses: as a form of repair for the humiliations of the past, as a solution for the economic problems of the present, as an addictive form of power and revenue generation, as a remedy to overaccumulation especially in foreign reserves, and, in the colloquial sense, as a difficult or awkward situation. It is through infrastructural fixes that the relationship between the Chinese state, its people qua publics, and the role and function of law is being formed and reformed in the context of new narratives of the nation.

China is the paradigmatic infrastructure state, yet it is also paradigmatic of the state of infrastructure today: a complex juxtaposition of sites that generate publics and counterpublics and which, taken together, confound straightforward ideological instrumentalization.

In this juxtaposition of sites, we see how the intertwining of different infrastructural inheritances produces the modern Chinese state. Like the infrastructure it promotes, the state strives to be both visible and invisible at the same time. It is by looking at the junctures of visibility that we can see the genealogies, trajectories, and possibilities of the structures below. ■

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**SOE LIN AUNG** examines the Thilawa special economic zone to shed light on infrastructure's changing publics in contemporary Myanmar.

# THE THICK AND THIN OF THE ZONE

**SEVERAL YEARS** into a major political transition in Myanmar, the Thilawa special economic zone (SEZ) officially opened for business in September 2015. Located on a riverbank 14 miles southeast of Yangon, Myanmar's largest city and former capital, the Thilawa zone is a joint venture between Myanmar and Japan. In an opening ceremony short on neither pomp nor pageantry, hundreds of business executives and politicians clustered beneath a tent, looking on as a marching band and cheerleaders streamed forth. Japanese and Myanmar flags danced in the breeze atop the flag poles, while an array of shiny new cars—Toyota SUVs, a white Rolls Royce—adorned the freshly sealed roads (Mahtani 2015).

In many ways, the Thilawa SEZ confirms a familiar narrative about economic zones. Behind barbed-wire walls and a grand gated entranceway, the Thilawa SEZ offers manufacturers substantial investment incentives and high-grade hard infrastructures, sharply differentiating it from its surroundings in a country recently ranked 134 out of 140 in quality of infrastructure (Schwab 2015). It creates a space apart from the messiness of national politics and degraded public infrastructures: the electricity that always seems to cut out, the water that sometimes runs once a day, the roads that wash out in the rainy season. By carving out an exceptional, enclaved space that stands alone, the zone solves a problem: how to attract investment in a country of exceedingly poor infrastructure. The answer the zone provides is not, of course, broad economic stimulus through state investment in infrastructure: infrastructure for all, in a sense, as in the story of the Keynesian public provisioning of erstwhile developmental states. The answer is infrastructure for some, namely elite workers and foreign corporations. This thinned-out, more differential politics of infrastructure supposedly emerges in sharp contrast to an earlier, thicker, more inclusive politics of state-led, nationally articulated projects under developmental states (Bach 2011; Ferguson 1999, 2006; Ong 2000, 2006).

I want to suggest the story is more complicated than this. Not long after independence, the government of Myanmar, then known as Burma, convened a group of planners, policymakers, and economists—led by the American engineering firm Knappen Tippets Abbett (KTA)—to produce the country's first major development plan, released in 1954. The plan was known as the Pyidawtha Plan, its name connoting happiness, prosperity, and material well-being in a national frame. In the wake of World War II, the plan focused heavily on the reconstruction of roads, railways, waterways, and communication systems that had been decimated in the war. Like midcentury approaches to infrastructure elsewhere under Keynesian liberalism or developmental states, the plan ties infrastructure development to a broadly egalitarian state welfarism: mixed, in this case, with overtures to Buddhist principles. "But do not forget," the report's closing section reads, "that the objective of all these steps—separately and together—is a Burma in which our people are better clothed, better housed, in better health, with greater security and more leisure—and thus better able to enjoy and pursue the spiritual values that are and will remain our dearest possession" (ESB Rangoon nd:10–11).

**FIGURE 1** The opening ceremony for the Thilawa special economic zone. FROM IEMS (2015)

**OPENING PAGE** Burma Railways. FROM KNAPPEN TIPPETTS ABBETT (1953:258–259).

The Pyidawtha Plan resonated widely in the 1950s, even if the plan itself—a sprawling and highly technical document exceeding 800 pages, written in English and printed in London—had limited circulation in Burma. U Nu, Burma's prime minister and leading political figure in the 1950s, hosted a Pyidawtha conference at which he gave a series of speeches introducing the plan in vernacular terms. Collected in a book edited by the poet and writer Zaw Gyi, the speeches were printed in Burmese in Rangoon. Part of U Nu's broader attempt to forge a socialist politics consistent with Burmese cultural and religious values, the speeches aimed at cultivating support for the plan not just among technocratic elites, but also among ordinary people across the country (Than 2013). Maung Maung (1953), a public intellectual who later led, briefly, the military government, wrote that "without question, pyidawtha has caught on in Rangoon." He described city buses carrying signs proclaiming "Pyidawtha" as their destination; children singing Pyidawtha songs in the street; and Pyidawtha coffee bars where one could buy a cup of "Pyidawtha coffee" or cold glass of "Pyidawtha milk." Marveling at the building and rebuilding of reservoirs, roads, bridges, and schools, Maung Maung claimed that "Pyidawtha aspires not merely to develop Burma in material ways, but also to create the 'new man,' that is, a responsible citizen who will participate actively and constructively in government, an intelligent, public-spirited individual possessing a reasonable share of modern education."

Such is the universalized citizen-subject of Pyidawtha developmentalism, a "new man" for a new era. Yet beyond the public rhetoric of figures

**FIGURE 2** FROM *PYIDAWTHA: THE NEW BURMA* (1954)

like U Nu and Maung Maung, it is hardly clear that Pyidawtha-era infrastructure development effectively cultivated this kind of inclusive national subject. One recalls, in this context, that U Nu indeed oversaw claims to an egalitarian developmental paradigm linked to a Buddhist-inflected state welfarism. But he also presided over crippling counterinsurgency campaigns in largely Christian highland areas, where his decision to make Buddhism the state religion still rankles today amid persistent civil conflict (*The Irrawaddy* 2014; Saw Yan Naing 2013). Chinese and Indian communities, once dominant in trade and colonial administration, also suffered acute persecution and economic discrimination, the echoes of which some see in more recent anti-Muslim violence (Brown 2013; Crouch 2014). In the Pyidawtha Plan itself, plans for infrastructure development rarely extend past the Burman Buddhist lowlands. Map after map of plans for power grids, road and rail projects, and telecommunications networks trace and retrace a skein of connections across—but not often beyond—the Irrawaddy River valley. In other words, nostalgia for the lost solidarities of developmental socialism would be misplaced. Appeals to the plenitude of "our people" invoked in the Pyidawtha vision would have to reckon with who those people are, and who they are not.

In the decades that followed the military coup in 1962, the ideal of a collective subject that may have inhered at least in the public discourse, if not the actual functioning, of Pyidawtha-era infrastructure politics disappeared altogether. The political scientist David Steinberg (2005:110) argues that by the 1990s and early 2000s, the military "used the construction of infrastructure of all varieties as demonstrations of their economic and political efficacy," including the new capital in Naypyidaw, built ex nihilo in the plains of central Myanmar. Ian Brown (2013:184), an economic historian, writes: "(N)ew highways, bridges, dams and reservoirs, indeed a new capital city for Myanmar, rising in Burma's historic heartland, were to be seen as impressive physical evidence of (the military's) command of economic progress." By the late decades of military rule, infrastructure projects had come to address a subject who would be not so much served by, provided for, or made civic-minded by such projects—better clothed and better housed, and more responsible and active as a national citizen—but rather made to be overawed, obeisant, and—not least—neither active nor agentive as a danger to military rule. Well after the rhetorics of the Pyidawtha era, infrastructure under the military symbolizes the generals' power and prestige, a far cry from egalitarian welfarism or the making of a new postcolonial subject.

The Thilawa economic zone could be read as accentuating this shift away from Myanmar's mid-century Pyidawtha developmentalism. However, the distinction between two politics of infrastructure—the one public and egalitarian, the other private and exclusionary, as in the conventional account of economic zones—rests upon a particular reading of developmental states. In Myanmar, it is not obvious that the developmental state can provide that point of contrast, that universalizing politics of infrastructure against which a more differential set of arrangements would draw its specificity and particularity. Without taking for granted the publics that infrastructures do or do not draw together, then and now, one might follow, instead, whom and what infrastructures actually connect or bring into relation, and how new technologies may redistribute the main actors and agencies of infrastructure differently than in the past. Three aspects of the Thilawa zone—its financing mechanisms, the users of its hard infrastructures, and the schemes used to relocate former residents of the area—help make clear what this alternative approach might look like.

First, the finances. Two features stand out: the public shareholding model used by the majority Myanmar shareholder, and the emphasis on a public-private partnership (PPP) approach by the Japanese government stakeholder. Both

mechanisms incorporate actors well beyond the state and its bureaucracies, expanding and diversifying who is involved in infrastructure provisioning in Myanmar. Myanmar Thilawa SEZ Holdings Co. Ltd. (MTSH) is the majority Myanmar stakeholder, a group of nine companies that accounts for 41% of Myanmar's 51% stake in the zone. MTSH first sold public shares in the company in March 2014, seeking to generate funds needed for the first phase of the Thilawa project (San Yamin Aung 2014). Shares sold quickly, and after an additional round of offerings and eventually listing on the Yangon Stock Exchange (YSX)—the bourse, Myanmar's first, opened in May 2016—MTSH would sell a total of more than 3 million shares to some 17,000 shareholders (Aung San Oo 2014; MTSH 2016). After decades of government-backed infrastructure projects reliant on state funding, MTSH and its formation of a public company mark the integration of novel actors in infrastructure provisioning, from a 17,000-strong group of private shareholders to a series of companies making use of an emerging financial sector.

The PPP approach driven by Japan's main government stakeholder, the Japan International Cooperation Agency (JICA), also reflects an enlarged role for private actors in infrastructure provision. Although itself formally of the public sector, JICA has joined many other major international development agencies in using PPPs to explicitly promote and cultivate private sector contributions to development finance, including infrastructure development. JICA's 2014 annual report, for example, argues that government financing and development aid are insufficient to address the funding needs for infrastructure development in low-income countries, such that JICA now includes funds from partners in the private sector in the loans it makes for projects like Thilawa (JICA 2014:104). In fact, the report highlights Thilawa as a case study in JICA's embrace of PPPs, emphasizing that JICA's loan-making for construction activities substantially incorporates private-sector investment finance. Helping to rearticulate public and private in the context of Thilawa, JICA's pursuit of PPPs has earned plaudits from the Myanmar government, with two key government officials recently praising JICA's PPPs (JICA and DICA 2016; Oxford Business Group 2015). Both state they will encourage the use of PPPs to fund infrastructure elsewhere in Myanmar.

The public shareholding model and PPPs indicate the convergence of a different kind of collective, more tilted towards private finance and expertise, than that of Pyidawtha-era planning and provisioning. Those who use the hard infrastructures these financing mechanisms have helped bring into being—the pipes and wires of the zone, its roads and buildings, the adjacent port being redeveloped and integrated into the zone—account for another part of this collective. A range of companies, and indeed the workers they employ, feature prominently here, brought to the zone, as the *Financial Times* puts it, by "the kind of reliable electricity, water, and logistics they lack elsewhere in the country" (Peel 2013). Workers are housed in purpose-built dormitories in and around the zone; garment, electronics, and auto parts manufacturers are moving into factory spaces and installing machinery; and logistics companies are handling, *inter alia*, road transport, shipping, and various goods processing services. Unsurprisingly, given Japan's leading role in financing the Thilawa zone, the manufacturers now operating there are mainly Japanese firms, as are the logistics companies (Myat Nyein Aye 2015; TMC 2016a).

JICA, for its part, specifically frames the Thilawa zone as part of the Japanese government's "Infrastructure Systems Export Strategy." According to this strategy, Japan supports the development of the policy frameworks and physical infrastructure needed to "promote the creation of Japanese business bases" overseas, particularly through "regional development projects beginning in the initial stages" (JICA 2014:105). In Thilawa, Myanmar's adoption of the "Japanese model," as JICA refers to it—part of Myanmar's turn away from Chinese investment in large-scale infrastructure projects—allows Japan to expand its role as a driver of foreign investment and infrastructure development in Southeast Asia (ADB 2016a; Peel 2013).[1] With JICA and the Asian Development Bank (ADB), a strongly Japanese-led institution, now implementing several road construction projects linking Myanmar to Thailand and beyond, Thilawa emerges as a node in a wider spatial and material realignment, tending towards regional integration along Japanese lines.[2] This process is grounded in roads, pipes, ports, and wires that are bringing together some actors and not others—Japanese manufacturers more than Chinese heavy industrial enterprises, for example—as Myanmar rebuilds connections to key trading partners and regional production networks.

Indeed, in Thilawa as in other economic zones, the work of drawing together certain actors and agencies in the zone has also meant excluding others, a reminder that the making of enclaved spaces often involves attempted forms of disentanglement and disconnection from surrounding areas (Appel 2012). Among those excluded from the collective assembled by the Thilawa zone are former residents of the project area. In late 2013, the Yangon Regional Government evicted several hundred

1 For one account of Myanmar's shift away from China, see Jaishankar (2015).

2 See JICA (2016) and ADB (2016b) for overviews of each organization's activities in Myanmar.

families from the Class A project area, after which some of those displaced grouped together and built relations with national and international civil society organizations. The resulting Thilawa Social Development Group (TSDG) issued a formal complaint to JICA claiming, among other things, that no consultations preceded evictions; that compensation has been insufficient and the relocation site unsanitary; that the government used threats and lies to make farmers sign eviction agreements; and that having proceeded as such, the resettlement process has violated Myanmar law and international guidelines, including those of JICA and the World Bank that the government insisted they would uphold (ERI 2015). The complaint triggered a JICA investigation, which TSDG criticized as "inadequate" and "overly optimistic," that found no wrongdoing on the part of the government (Yen Snaing 2014).

In contrast to TSDG, officials and advocates of the zone have hailed the resettlement process as setting a new precedent in Myanmar, even while acknowledging some of its shortcomings. The Thilawa SEZ Management Committee (TMC), a governmental oversight and coordination body, described the resettlement process as follows:

"It is the first time in the entire history of Myanmar in conducting the relocation and resettlement of the Project Affected Persons (PAPs) according to the international standard. Since it is the first experience, it is not a perfect process; however, it is considered a success and a good learning process as the relocation was complete peacefully in accordance with the Resettlement Work Plan, which was drafted in accordance with the guidelines of JICA and the World Bank's environment and social safeguard policies" (TMC 2016b).

In an interview soon after the evictions in 2013, Set Aung, the TMC chairman, offered a more succinct account: "This is the first experience. We can't claim we are perfect in every step." An analyst close to the project, meanwhile, said, "The Thilawa project is landmark, in terms of doing a proper population resettlement plan. But the problem is the government hasn't really done things in the right order – so there is a lot of rumor and misunderstanding" (Peel 2013).

The resettlement scheme and TSDG represent a final series of collective arrangements brought into being by the zone. While the Yangon Regional Government coordinated with the TMC to implement a relocation plan reaching international standards, the evictions that resulted spurred former residents to build connections, create alliances, and form an organization, TSDG, that links them to larger and better established organizations (such as Earthrights International and Physicians for Human Rights). These two formations—one tasked with the work of exclusion and disentanglement, the other raising concerns over the terms of their displacement—underline how zones remain sites for the making of political projects, from governmental techniques for managing resettlement to strategic coalitions that may challenge how such processes unfold. A challenge of this kind, moreover, would have been all but impossible under military rule. The novelty of this politics notwithstanding, for one farmer, the removal of people from the project area is still a reminder of times past. Describing the evictions in a news report at the time, he said, "We have been under military dictatorship for such a long time—we are still in the old habits" (Peel 2013).

The old habits have a history: a history one could tell through thick and thin. After the national solidarities of Pyidawtha-era developmentalism, the military used infrastructure to project its exclusive power and prestige. Similarly, the Thilawa zone does not provide for a generalized, collective subject, but rather convenes a range of differential, sectional interests: some 17,000 private investors; state bodies now linked to private financing; and largely Japanese firms engaged in manufacturing and logistics operations. This narrative charts the progressive dissolution of the socially "thick" world of the developmental state. But what is it that dissolves? What subject—stable, firm, solid in some way—is assumed to be lost or disintegrated along the way? The boundaries of the Pyidawtha public, evident in destructive counterinsurgencies and overt Burman chauvinism, suggest that in Myanmar, at least, the mythic solidarities of the developmental state provide at best a limited counterpoint for conceptualizing a thinner, narrower politics of infrastructure today. In turn, the lack of such a counterpoint reopens the story of economic zones and the problem of their critique.

It is worth noting as well that some idea of a general good, conceived inclusively and with reference to a "people," is not the sole province of Myanmar's earlier developmental politics. Such concepts remain embedded in contemporary public discourse about infrastructure and SEZs. In an address to a conference of academics and policymakers, TMC Chairman Set Aung explained that SEZs can further the government's pursuit of "equitable development in economic, social, and environmental spheres"; that SEZs' potential to offer "top-notch hard infrastructure" must be linked "to a situation where a level playing-field can be created"; and that the goal is "people-centered, equitable, inclusive, and sustainable development" (Set Aung 2014). For Set Aung, there is no necessary contradiction between concentrating high-grade infrastructure in the zone and pursuing broad-based, inclusive developmental objectives. Serge Pun, head of the FMI Group, a leading Myanmar firm and one of the main companies that formed MTSH, has spoken of Thilawa as "the only industrial park which is planned and intended for the development of Myanmar itself" (Matsui 2013). Investing in Thilawa "in hope of contributing to

job creation and Myanmar's economic growth," Pun differentiates Thilawa from the Dawei and Kyaukphyu SEZs in Myanmar, both heavy industrial projects tied closely to Thai and Chinese support, respectively. Thilawa, for Pun, is more consistent with a nationally framed developmental vision, an SEZ for "Myanmar itself." Set Aung and Pun remind us that while the actors and agencies of infrastructure can change, the purposes they are said to serve—material well-being, economic growth, shared national prosperity—prove durable.

Is it thus possible to see, in Thilawa's financing mechanisms and the zone's hard infrastructures, an appeal or address to something equitable, shared, people-centered: a concept, that is, of a public or public interest? What might it mean for these ideas to resonate in this time of market reforms, when new connections between public and private are also premised upon eviction, resettlement, and the changing management thereof? At stake, perhaps, is less the decline or persistence of a politics of publicity, but rather the redistribution of such a politics through new technologies and different agencies: a public shareholding model, a JICA-led turn to PPPs, a shifting approach to resettlement, and a collective of investors and manufacturers who are resituating Myanmar in regional production networks. Put differently, this rearticulation of power and publics might not displace an earlier politics of infrastructure so much as represent an evolving set of arrangements. As the occasion for these arrangements to emerge, the zone itself operates as a kind of technology of liberalization, generating political and economic realignments that are changing the who and how of infrastructure in Myanmar. ■

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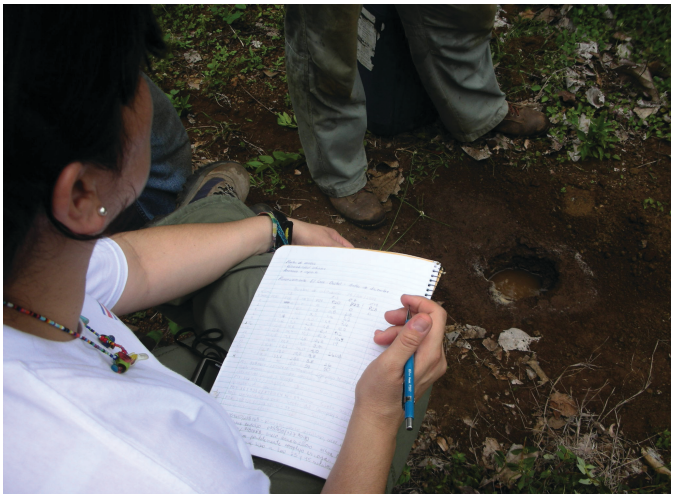
# SPONGY AQUIFERS, MESSY PUBLICS

**IS AN *AQUIFER* A TANK OR A SPONGE? ANDREA BALLESTERO INVESTIGATES HOW PUBLICS NAVIGATE THE SCIENTIFIC INDETERMINACY OF THE UNDERGROUND IN COSTA RICA**

Pipes waiting to be installed near Sardinal. PHOTO: ARCHIVES KIOSKOS SOCIO-AMBIENTALES, UCR COSTA RICA.



Infiltration test results being recorded. PHOTO: AUTHOR.

**I CONDUCTED** my first hydrogeological infiltration tests in 2008. At the time, the task seemed daunting. Hydrogeology as a discipline challenges our familiar temporal and spatial parameters. This first became evident when I leaned over a hole watching water slowly dissolve while discussing with scientists from the Underground Water Research Agency in Costa Rica how texture, granularity, and seepage affected water flow. What came next posed the real challenge. Wrapping my head around the peculiar space-time of an aquifer required a four-dimensional imaginary that simultaneously considered multidirectional pressures and converging and diverging movements, all in flux due to the passage of time.

The infiltration speed that we recorded that day would undergo many transformations until, combined with other data points, it gave some clues about what the aquifer we were studying could do for the town of Sardinal and for the new tourism developments investors were building in the touristy province of Guanacaste. In previous years, developers had raised $8 million to connect their new construction to the Sardinal aqueduct, a system built more than four decades earlier that extracted the liquid from the Sardinal aquifer to supply local populations. Taking advantage of the access they had to central governmental authorities, investors agreed with the country's largest utility, an entity owned by the state, to fund the expansion of the aqueduct in exchange for guaranteed access to the water the new infrastructure would make available.

Despite the public relations efforts of both the investors and the utility, activists and Sardinal residents unearthed a series of inconsistencies and illegalities in the project. Most crucially, they found no appropriate hydrogeological study to support the water extraction rate that the utility had guaranteed investors. There was no acceptable basic model rendering the qualities of the aquifer and the quantity of water it could provide. That quantity is calculated through an extraction rate, a number that defines the volume of water that can be extracted from an aquifer per unit of time, such as liters or cubic meters per second. An extraction rate can have a broad significance; for instance, in the case of Sardinal it came to reflect the historical struggles and environmental worries behind the decision to use underground water for commercial enterprises, especially under conditions of scarcity.

A collective comprising residents, students from an environmental extension program from the University of Costa Rica, and environmental activists challenged the supposed environmental viability of the water extraction rate endorsed by the utility, municipal council, and investors. They opposed the project by arguing that the extraction rate guaranteed to the developers would sooner or later deplete the aquifer and, most crucially, that such a rate was another instance of authorities making decisions to benefit investors and not local residents. But once the news that there was no solid hydrogeological model backing up the project circulated, the conflict changed in nature, moving from a dispute over an extraction rate that could potentially be resolved by changing it, to a dispute over the very conceptualization of the aquifer, a struggle over what kind of entity it was. In the process, an old, latent conflict between investors and residents turned into a confrontation that resulted in protests, arrests, and a legal order to suspend work. That year, the Sardinal conflict became an icon of water struggles in Costa Rica.

## LAW, BUREAUCRACY, SCIENCE

In several legal actions from all parties, courts sided with those opposing the project. In their decisions, different judges noted how scandalous it was that despite completing most of the construction work (about 75% of the project) and launching international marketing campaigns promoting luxury accommodations to American and Canadian expats and tourists, those responsible for the construction of the new infrastructure still "ignored" what the aquifer really was; the details of its material constitution remained opaque. As a result, the courts mandated public institutions with jurisdiction over water to produce the missing model. The infiltration tests that introduced me to hydrogeological thinking were performed in response to the court's ruling and were directly supervised by an inter-institutional committee of state entities established to study the situation. Once the missing model was developed, that committee would determine the viability of any plan to tap water from the Sardinal aquifer. Thus, technoscience was commissioned to resolve the Sardinal dispute.

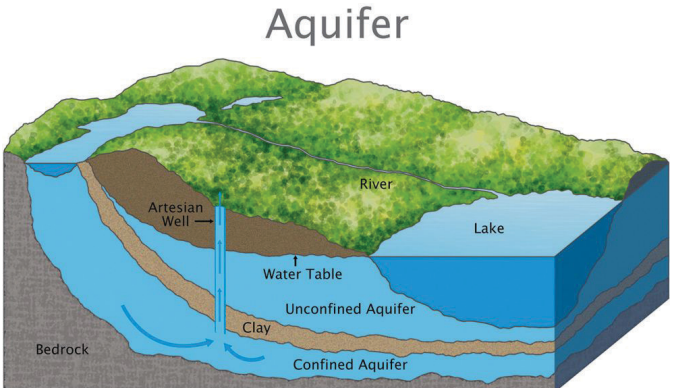



Figure 1: Aquifer rendered as a clear-cut container of water. FROM NATIONAL GEOGRAPHIC ENCYCLOPEDIA, ILLUSTRATION BY TIM GUNTHER.

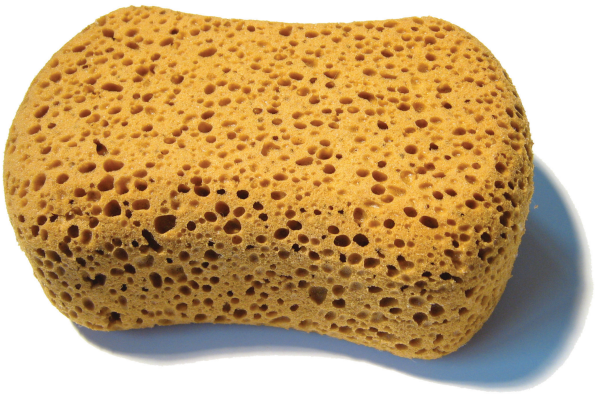


Figure 2: A sponge. FROM WIKIMEDIA COMMONS CC-BY-SA 3.0..

Once the conflict turned into a struggle over the very nature of the aquifer and its legitimate use, local residents expressed on many occasions that they would not let the developers take water from Sardinal "with or without a permit." The utility, on the other hand, spun the project as a necessary investment to create new jobs in tourism, an activity that employs most residents in the area. And, along with the investors, they often repeated the argument that water is a public good and nobody—not even a local community—can claim its ownership and bar others from accessing it. These conflicting perspectives highlighted the long-standing and tense coexistence of different senses of community, solidarity, and ultimately notions of legitimacy to control a public good, such as water, that Costa Rican law establishes cannot be privately owned. Yet at the vortex of these spiraling forces of capital, communal values, nation-building projects, and transnational flows of people (whom we call tourists and expats, not migrants) we find a series of unanswered questions about the aquifer's material qualities and temporal behavior: its hydrogeological conceptualization. The interrogation of the material qualities of the aquifer, and whether or not they can be known, was densely infused with broader concerns about history, the future, and the limits of knowledge in the face of environmental unknowns such as climate change and extraordinary droughts.

From one perspective, the Sardinal case seems familiar. In many ways it is a conflict in which the environmental and economic costs of capitalist accumulation result in local dispossession. Local residents were tired of the cyclical rationing and water service interruptions they had endured for years, and that anger resulted in a more intimate engagement with any infrastructural "improvement" in the area to monitor its impact on their everyday lives. Yet amid that heightened awareness, opponents of the project repeatedly came back to what they saw as the kernel of the conflict: a lack of awareness and an unwillingness to accept the fundamental indeterminacies intrinsic to the Sardinal aquifer and to the technoscience by which it was known. In other words, they believed an aquifer is much more than a water extraction rate, and those other qualities cannot simply be ignored. Those indeterminacies take material form in the very underground structure of the aquifer and should also be part of the technoscientific tools used to define it. On one level their insistence on the indeterminacies of the aquifer crystallized the sense of risk local residents experienced when imagining their precarious infrastructure supporting massive new developments. On another level, however, the activists and local residents demanded hydrogeological knowledge that was "more" appropriate to the historically specific conditions of Sardinal's aquifer. But the meaning of "appropriateness" in this case was unusual: in Sardinal, people demanded knowledge that appropriately reflected the material indeterminacy of the aquifer as made evident by the lack of a conclusive model of its properties, by the possibility of using different types of assumptions to build that model, and by the types of data and information available for their aquifer. Their demands challenged any conclusions based on the assumption that appropriate and accurate knowledge is intrinsically, and necessarily, more precise. In an unusual turn, more appropriate knowledge in this case was actually more indeterminate knowledge incorporating the unknown and changing conditions of social and hydrogeological life in Guanacaste. This was not a gap to be filled; it was a different type of knowledge altogether, one that reckoned with the ontological indeterminacy of the Sardinal aquifer in all its historical specificities.

## ATTEMPTING DIFFERENT IMAGINARIES

But how can this indeterminacy be imagined materially? How does historical struggle find a place in hydrogeological models? The answer lies in the type of imaginaries that can orient hydrogeological work. Hydreogeologists rely upon at least two images to depict underground water. The most familiar depicts aquifers as infrastructural formations whose social life is determined by a single function: supplying water for human use. This function is efficiently summarized by the water extraction rate, a figure that reinforces the image of the aquifer as a well-demarcated container (Figure 1). Taking an aquifer as an entity with clear borders surrounded by impermeable layers of rock resembles the image of a tank with a single opening into the surface of the earth and from which humans collect water to finally give it a variety of uses. These tank-like aquifers are passive receptacles waiting for humans to activate them by extracting water. Considering the

morphological stability of the image of a tank, it is easy to see how aquifers can be reduced to an extraction rate without losing much meaning or liveliness in the process. People in Costa Rican schools, water activist circles, water policy circles, and elsewhere have been taught historically to imagine aquifers in this way, as clear formations with stark boundaries and a primordial function as reservoirs for human use.

But aquifers can be more than containers holding water for humans to quench their bodily and economic thirsts. Technically, aquifers can consist of layers of rock that hold water in their pores and cracks and are rarely surrounded by impermeable borders. More often than not, aquifers are formations with blurred borders between rock, water, and air. Their hydrolithic architecture challenges the easy separation between content and container intrinsic to our tank-like imagination.

Furthermore, when located in volcanic formations, such as in Costa Rica's territory, as one of my collaborators in the research project I am working on explained, aquifers look a lot like kitchen sponges (Figure 2). This is the second image hydrogeologists use to conceptualize an aquifer. Sponges are dense and open formations occupied by water and air and characterized by constant movement. In a spongy aquifer, water migrates by flowing through variegated openings and saturating its substrate. It seeps in where space becomes available, colonizing possible nooks, flowing into more open locations, pushing against impermeable walls and being pushed away by new molecules. Directed by gravity, water seeps in capricious ways into adjacent formations. We know these types of aquifers by tracing their constant movement, their "internal" and external flows of water (e.g., toward surface rivers, oceans, and lakes, or deeper into the underground toward other aquifers). Sponges help hydrogeologists imagine this slow and constant movement, directing their, and our, attention to structural dynamics, to leakage when substrates are saturated, and to contraction when dry. Like kitchen sponges, spongy aquifers are lively and in "communication" with neighboring aquifers to which they contribute or from which they take water. They are constantly changing their four-dimensional form, and thus require ways of knowing that can handle the indeterminacies of constant change.

This kind of subtle and sometimes dramatic spongy movement makes hydrogeologists' efforts to determine an aquifer's precise boundaries incomplete. If an aquifer is essentially movement, how can you establish its borders to pinpoint its function? Can you trace its edges as if it were a container? While theoretically possible, actually tracing those borders in detail is implausible, partly because you would have to drill an incredible number of wells to verify underground geologic structures and precisely locate the movement of water through them. The financial costs of doing so in a place like Costa Rica, and elsewhere, are so high that only oil exploration enterprises can afford it. Due to these practical limitations, when hydrogeologists calculate a water extraction rate, they often need to set those indeterminacies aside, a move that poses questions about the extraction rates by which we manage aquifers, about how one aquifer bleeds into another, and about the legal instruments (e.g., water use permits) that we use to try to distribute water more democratically. People in Sardinal were aware of these difficulties and wanted the technical depiction of their aquifer to squarely reflect them. They were convinced that if any extraction rate was produced, it needed to incorporate what they saw as radical material indeterminacies.

The utility's inability to grasp and work from those

"...the developers came and built tourism projects without a single technical study about whether there was enough water. They now pulled studies from nowhere and want to take our water and jeopardize the future of our community."

indeterminacies galvanized the organization and emergence of a contradictory public around Sardinal's aquifer. The issue was not whether the aquifer could, theoretically, be precisely known. Project opponents knew the aquifer was not actually known with the certainty developers pretended. This proved that their decisions were undergirded by a fundamental indeterminacy that the developers and the utility did not embrace. The tension between those different ways of knowing, one that embraced indeterminacy and another that ignored it, each with their logical and practical twists, created a peculiar kind of interdependence between all the parties involved. This was a public whose members remained tied to each other in a constant push and pull without settling on any form of closure. In the years that followed a succession of meetings, studies, resolutions, mobilizations, new local organizations, and institutions became part of the conflict, entwining even more entities into the process. Experienced as confrontations (sometimes violent ones), their interdependencies kept the parties connected. All of them had different legal and material avenues to break their connection to each other—police intervention, final permitting, or infrastructural disruption. And yet, that did not happen. All the parties exerted pressure without crossing a line that would implode the contradictory public they had become and break apart any need for confrontation. The conflict itself kept the parties connected, having to acknowledge each other as part of the aquifer's existence. This also kept the aqueduct expansion project halted, practically defying, if only temporarily, the agile and strong grip that global investment usually has on places like Sardinal.

## MESSY INDETERMINACY

I think of the residents, activists, nongovernmental organizations (NGOs), investors, utilities, and water managers in Sardinal as a contradictory public kept alive by the politics of messy indeterminacy. They came together to elucidate traditional politics and challenge unequal forms of distribution of wealth, costs, and risks across different groups of people. At the same time, they remained in contradictory articulation around two types of scientific knowledge and expertise: one that embraced indeterminacy seriously enough to remain open to the messy materiality of the aquifer and another that erased such indeterminacy to yield a predictable investment and flow of tourists to the area. Opponents of the project wanted to act from a space of "not knowing" aquifers in the usual precise and function-oriented ways. They refused to accept studies that pushed indeterminacies to the margins or quickly settled on the calculation of an "extraction rate." Supporters were satisfied with a science that brushed indeterminacy to the side to provide enough financial and legal predictability to their investments. They saw a knowledge gap that could be easily filled.

These different expectations were reflected in the uses of available scientific data about the aquifer. Take, as an example, one of the studies produced to placate the conflicting parties and resume construction near Sardinal. Based on data gathered in the 1980s and 1990s, the study concluded that there was enough water for Sardinal and for the more than 2,000 future connections to the water line. On that basis, it proposed a slightly amended extraction rate. Community members, activists, and NGOs challenged the certainty of that figure as an exercise in what I would call "minimalist science," a habit of considering the smallest possible number of issues when investigating a question and ignoring fundamental gaps in available knowledge. This was technoscience oriented to the idea of an aquifer as a tank-like container and thus amicable to precise, manageable, and quickly produced water extraction rates. Pedro, one of the Sardinal residents, referred to the political context of this type of science by saying:

> *...the developers came and built tourism projects without a single technical study about whether there was enough water. They now pulled studies from nowhere and want to take our water and jeopardize the future of our community. We are not going to let them do that. We are rebelling to prevent their tentacles from reaching our community. The people are united, because you know, the people united cannot be defeated.*

Pedro's rebellion was based on the claim that the conflict could not be resolved by replacing one weak certainty with another: they were not merely demanding the replacement of the extraction rate this study defined with a smaller one. No extraction rate could encompass the density of historical struggles and material complexities of the aquifer. Residents did not ask science for more precision; instead, they demanded a science capable of embracing the indeterminacy of not settling on a single figure, the indeterminacy of a historical struggle that could not be condensed into a rate. They wanted to stay attuned to an aquifer's peculiar four-dimensional space-time, its watery liquidity, with its obsession with gravity and its tendency to flow anywhere it can. Opponents to the project hoped for imaginaries that resembled the sponges hydrogeologists often think with, rather than settling on familiar tank-like images that they use to explain to the public how underground water works. They hoped to move from a science of tanks to a science of sponges that emphasized shifting forms, undetermined borders, and historical change.

The Sardinal experience directs our attention to a particular type of public conversation and process of adjudication that considers what an infrastructure such as the aquifer could be if science did not privilege the reduction of its significance into an extraction rate. The emerging contradictory public in Sardinal kept exploring the limits of the political space-time of the aquifer and the potential future history of its use through tactical, focused, and open-ended interventions. Those voicing their concerns wanted science, law, and bureaucracy to consider how spongy thinking could refashion technical expertise and yield an expansive science of the indeterminate.

Postscript: The financial crisis of 2009 halted any development efforts in Sardinal. All construction activity stopped, leaving half-finished structures waiting to be completed. Then a major multiyear drought began to affect Guanacaste in 2013, revealing the actual limits of available water and making dramatically apparent the consequences of living without enough of it. The utility and investors identified an alternative source to supply water for part of the finished developments near the coastal area and did not push to re-start construction of the aqueduct expansion for developments near town. While there are rumors of reactivation, the construction of the original aqueduct expansion near Sardinal is still stalled. ■

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# WHO OWNS AFRICA'S INFRASTRUCTURE?

**James Christopher Mizes** examines how an emerging style of African infrastructure planning and finance is inflecting an old political collectivity with "new" values.


**FIGURE 1** Images of public works used in the Gabonese state's online advertising for the initial public offering of its sovereign bonds. Translations: Road Network Development; Watershed Construction; Fiber Optic Construction, Connection to the Electrical Network. FROM HTTP://WWW.EMPRUNTOBLIGATAIREGABON2016.COM/

**PUBLIC INFRASTRUCTURE IS BACK ON THE AFRICAN** development agenda. So, it seems, is public debt. In 2010, a team of researchers at the World Bank completed "Africa's Infrastructure," a widely influential report that estimated the continent would require an additional $31 billion per year in the next decade to close Africa's growing "infrastructure financing gap." The report, and many that have followed it, frame today's infrastructural problem in terms of finance: How are African governments going to access enough capital to meet large-scale infrastructural needs? In response, 14 African governments have issued their first sovereign bonds on European and American securities markets totaling around $25.8 billion in new debt, most of which is intended to fund infrastructural investments (Adams 2015). And subnational governments, such as municipalities, are quickly following suit. Today, there are more African governmental bond issuances than ever before, and a flurry of policy reports, conferences, and visioning documents that herald bonds as an "innovative financing solution" to the continent's perennial infrastructural ills (see Guttman et al. 2015).

But who will own Africa's infrastructure? This question of ownership is at the heart of debates about how public services are provided today. Many scholarly and popular critiques of public infrastructure focus on how ownership has changed hands from a public entity (like a state) and shifted to a private entity (like a firm). This is commonly referred to as *privatization*. In Africa, such critiques dominated public debate in response to the debt crisis of the 1980s. As governments defaulted on existing development loans, scholars and activists alike criticized development banks for imposing fiscal austerity through new, conditional loans that required the sell-off (i.e., privatization) of state assets such as infrastructure. But issuing African governmental bonds does not result in the privatization of public infrastructure; in fact, African infrastructure is still overwhelmingly public. Most expenditures on energy, water, sewage, and roads on the continent are funded with or subsidized by tax dollars, and are subsequently owned by African governments (Foster & Brinceño-Garmendia 2010). But private investors *can* increasingly own state debt as a financial asset, and this debt is linked to a new way of understanding—and providing for—the African public.

Bonds suggest a potentially new role for private ownership in African public infrastructure and public finance. Yet this is not the only or even the most important story about ownership in African infrastructure today: governments and development institutions are also articulating new notions of and techniques for the *African* ownership of infrastructures and debts. This vision of African ownership is reflective of the broader reorientation of development values in Africa toward development "Beyond Aid." In a 2010 keynote address of the same title, Dr. Ibrahim Mayaki, CEO of the New Partnership for African Development (NEPAD), outlined a vision in which development is "the result of African efforts that aim at utilizing innovative financing mechanisms…particularly domestic resources" (Mayaki 2010). Speaking to "Africa" in general, Mayaki's address calls for a style of development in which "*aid is no longer the primary determinant of policy design*" and instead, "the private sector, civil society, and the regional economic communities are…taking firm ownership" (2010). Spanning both the public and private, Mayaki's broad vision implores Africans to take ownership of planning Africa's infrastructural development. In common usage, the word "ownership" denotes the legal possession of property. But it can also be used, as Mayaki does, to imply a more general sense of belonging: in this case, belonging to—and by—the more general "we" of Africa.

## PARTICIPATION AS OWNERSHIP

Although Mayaki's vision for African infrastructure development self-identifies as "new," it is part of a

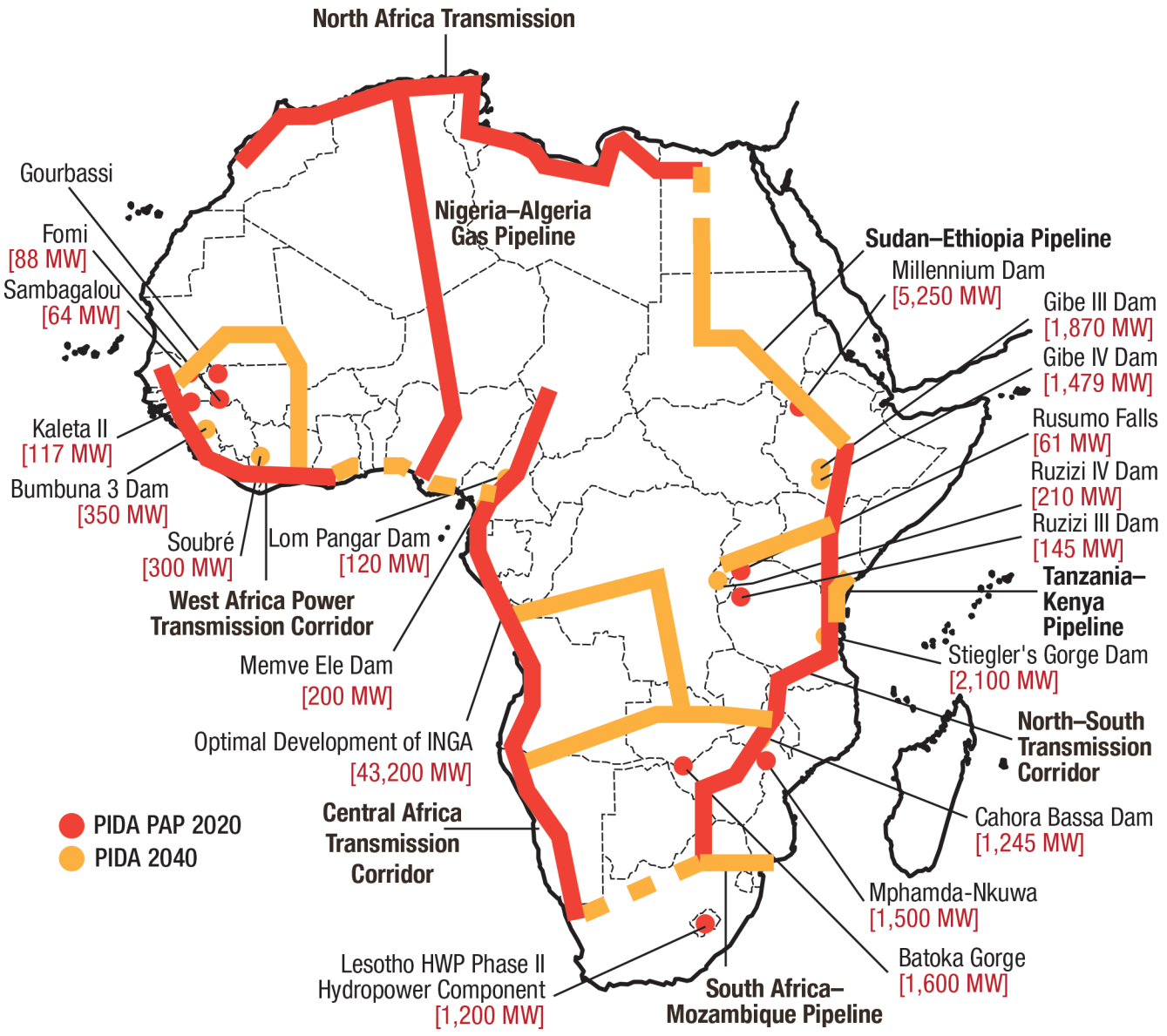


**FIGURE 2** "PIDA's Energy Impact" FROM THE AFRICAN UNION'S VISION STATEMENT, "PROGRAMME FOR INFRASTRUCTURE DEVELOPMENT IN AFRICA: INTERCONNECTING, INTEGRATING, AND TRANSFORMING A CONTINENT," P. 12.

Pan-African ideology that is not. Pan-Africanism is a long and diverse intellectual and political movement that, in the mid-twentieth century, played a key role in anticolonial resistance and national independence in Africa. Member-states subsequently institutionalized Pan-Africanism into the Organization of African Unity (OAU), which in its political platform prioritized the sovereignty of nation-states. But critics of the OAU note that the defense of national sovereignty often entailed the de facto defense of national dictators who, by the 1990s, were responsible for the deaths of millions of their own African nationals (Murithi 2007). Although Pan-African in name, critics argued that the OAU was not so much a shared vision for African unity, but instead, as one scholar calls it, a "toothless watchdog" that was "perceived as a club of African heads of states, many of whom were not democratically elected representatives of their own citizens, but self-appointed dictators and oligarchs" (Murithi 2007:3).

Such critiques of the OAU, of course, are themselves invested in a different vision of African unity, a vision that, in 2002, member-states intended to realize by forming the African Union as a new, more democratic successor to the OAU. The Constitutive Act of the African Union outlines

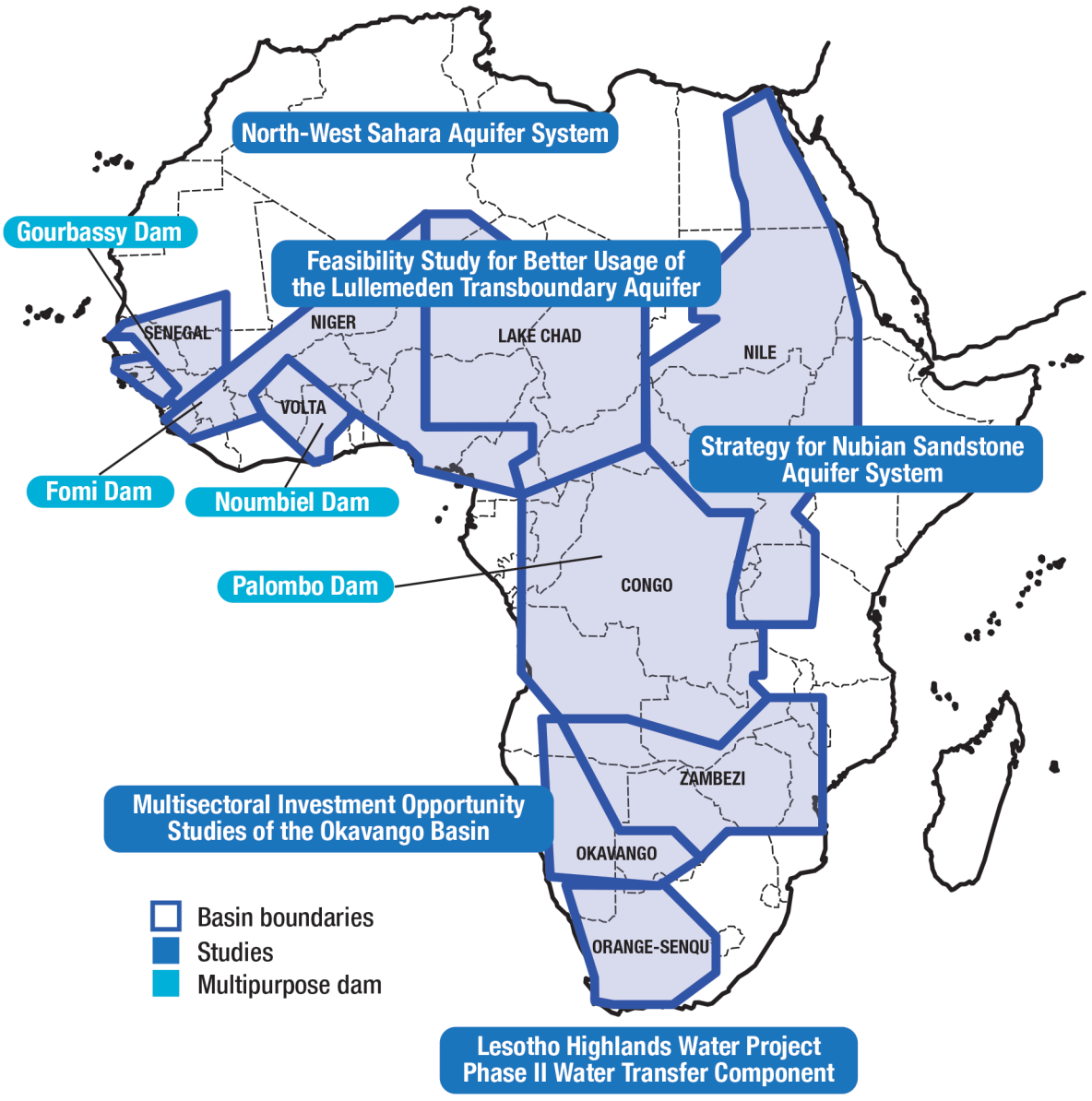


**FIGURE 3** "PIDA's transboundary water Impact" FROM THE AFRICAN UNION'S VISION STATEMENT, "PROGRAMME FOR INFRASTRUCTURE DEVELOPMENT IN AFRICA: INTERCONNECTING, INTEGRATING, AND TRANSFORMING A CONTINENT," P. 14.

not only the familiar objective to "defend the sovereignty, territorial integrity, and independence of its member states," but also to "promote democratic principles and institutions, popular participation, and good governance" (African Union 2002). Today, the African Union is extending this new vision of democratic participation and political unity into "technical" development planning via NEPAD, the self-described "technical body of the African Union." NEPAD officials quite explicitly "believe that infrastructure development is the key to all aspects of social and economic transformation" (Mayaki 2014). And the Programme for Infrastructure Development in Africa (PIDA) is NEPAD's central, collective effort for planning the continent's physical infrastructure. PIDA prioritizes infrastructure as part of "a common vision of regional integration" (African Union 2010:3) with an overall aim to "finally build [the African] common market" (African Union 2010:2).

Although this belief in physical infrastructure development is at the core of PIDA, infrastructure is not a particularly new addition to economic development practice in Africa. Instead, the novelty of the "new partnership" is in how the program goes about setting priorities and whom it includes in the process. Here, it is the

participatory nature of PIDA's planning process that officials anticipate will provide a sense of "ownership" among its regional stakeholders. In one sense, the program is simply a list of 51 projects. But in another sense, it represents "what makes PIDA unique and what will help ensure its continuing relevance and support: African ownership" (African Union 2010:4). NEPAD officials claim that the participatory nature of PIDA's planning process gives African institutions "ownership" over the plan itself. From this perspective, ownership is a sense of propriety and belonging that derives from the collective act of participation. And the resulting African "ownership" of infrastructure planning is a cornerstone of the program's efforts to realize the African Union's broad political mission of continental integration.

PIDA's planning process culminated in the Priority Action Plan (PAP), a continually updated list of priority projects. Ninety-five percent of these infrastructures are in the energy and transport sectors, including projects like the Great Millennium Renaissance Dam in the Nile River Basin, a plethora of transregional highway corridors, a 15-country port upgrading program across all of West Africa, and even the Single African Sky program, which would create a "high-level" satellite-based air navigation system for the entire continent (African Union 2010:18). Despite having finalized this expansive and ambitious list, the program emphasizes that the PAP is a dynamic document that "should be viewed not as a single list cast in stone," but as a first step in delivering the PIDA program (African Union 2010:5). And PIDA's vision statement argues that it is precisely this dynamism that undergirds the program with a "sense of well-studied pragmatism and African ownership" (African Union 2010:10).

PIDA argues that its infrastructure priorities are based on a "detailed empirical foundation," developed from an 18-month research and diagnostic review (African Union 2010:4). But program officials also claim to have combined this analytical effort with an extensive and painstaking participatory process. In July 2011, PIDA brought stakeholders together in Tunis for a high-level technical meeting to agree on the strategic framework and project selection criteria. The project report claims that participants came to a consensus on three central project criteria: eligibility and regional integration; feasibility and readiness; and development impacts. Although it is not clear from PIDA's reports exactly which stakeholders were present at the high-level technical meeting or how they came to such a consensus, PIDA officials still argue these criteria came from a "bottom-up" process that, later in 2011, also included two-day consultations with a further set of stakeholders in Nairobi (Kenya), Libreville (Gabon), Abuja (Nigeria), Yamoussoukro (Côte d'Ivoire), and Rabat (Morocco). It is this consultative process that PIDA claims, "...led to a continent-wide consensus" and "...laid the foundation for continuing ownership through all phases of implementation" (African Union 2010:4).


**FIGURE 4** A full-page advertisement for Gabon's initial public offering of sovereign bonds published in the late-May 2016 issue of *Jeune Afrique*.

But who, exactly, are the stakeholders that "own" PIDA's planning? In contrast to the African Union itself, PIDA is not a federation of nation-states. Instead, its stakeholders are "the Regional Economic Communities (RECs), the power pools, the lake and river basin organizations, specialized agencies, sector ministers and other relevant development stakeholders" (African Union 2010:4). A report on PIDA's consultative process states that its meetings "assembled more than 300 representatives of

the RECs and their agencies, along with representatives of 36 governments" (SOFRECO 2011:44). PIDA explicitly organizes a greater role in the planning process for regions and regional institutions. To PIDA, closing the infrastructure deficit is "a regional and continental problem that requires a regional and continental solution" (African Union 2010:2). Yet some critics argue that PIDA's set of regional stakeholders is not extensive enough.

In two open letters addressed to NEPAD's Head of Infrastructure and the United Nations Economic Commission for Africa, a group of self-identified "civil society actors," implored officials to evolve PIDA "in a more transparent and participatory way," saying that an "open and transparent engagement between civil society and PIDA decision-makers will be important to demonstrate respect for democratic decision making" (Alexander et al. 2014). Led by the South African office of the Heinrich Böll Foundation, this group of civil society actors also critiqued the content of PIDAs action plan as "infrastructure mega-projects" that may "exacerbate the colonial patterns of extraction" with a limited focus on natural resources and export-based growth (Alexander et al. 2014). And a further report by the foundation argues there is a disconnect between continental decision-making and the "domestic level" where negative impacts like displacement and environmental damage are "felt the most" (Qobo 2014:2). Such critiques focus attention on a different scale of ownership—"citizen ownership"—that, they argue, is excluded from PIDA's limited set of regional stakeholders. At the same time, it is precisely PIDA's stated value of democratic participation that opens up "ownership" to these kinds of public debates.

## OWNERSHIP AS PARTICIPATION

Despite PIDA's emphasis on "ownership" of this planning process, its stakeholders envision African national governments as the legal owners of infrastructure projects as property. The RECs, in addition to a novel panoply of civil society and private sector organizations, are the core stakeholders involved in the planning, monitoring, and debating of Africa's infrastructure. But PIDA's vision statement outlines that, in fact, it is "countries that will drive and own projects," and that "funding will rely on strong and committed national leadership" (African Union 2010:6). Thus, African governments will be owners too, but will be additionally responsible for the debt needed to close the "infrastructure funding gap." In response, governments are also linking the language of "participation" to this more legal sense of "ownership" in the continent's growing securities markets; in this case, the ownership of sovereign bonds. In this emerging vision of "domestic finance," the African public itself will be able to purchase—and subsequently own—the state debt required for infrastructural investments. And African governments are framing the ownership of this debt as a way for the public to participate in African development itself.

Gabon's marketing campaign for its 2016 issuance of sovereign bonds is exemplary in this respect. Unlike most sovereign bonds in Africa, this bond was not issued on European and American markets, nor was it issued in a foreign currency. Instead, this bond—the Gabonese government's third in as many years—was issued on the Securities Exchange of Central Africa (BVMAC) and is denominated in the Central African franc. Although the government's issuance was a call for private investment, the call itself was made to the African public more generally. A full-page advertisement for Gabon's bond appeared in the late-May 2016 issue of *Jeune Afrique*, a widely read African business and politics periodical. Although it is not the first advertisement for such bonds to appear in the magazine, it is exemplary in its imagery and language (Figure 4). Scrawled across the ad are two large, blue texts that read "*Participons au développement*" ("Let's participate in development") and "*Valorisons notre épargne*" ("Let's promote our savings"). The government also maintains an astonishingly well designed and accessible website (www.empruntobligatairegabon2016.com/) dedicated to the bond issuance. Like its print version, the bond's online marketing uses the colors of the Gabonese flag and adds a constant rotation of images of infrastructure projects in which the funds from the issuance will ostensibly be invested (Figure 1).

Similar to PIDA's planning process, Gabon's marketing program addressed potential investors by using the language of participation. This seems to have garnered widespread interest, considering the bond was 138% oversubscribed, allowing Gabon to take out significantly more debt than was originally on offer. Ironically, Gabon's marketing campaign was quickly followed by a contested and violent presidential election, itself framed in the press as a crisis of democratic participation (see Bavcon 2016). Nevertheless, the campaign implored investors to participate in development by owning bonds. Moreover, this marketing addressed multiple scales of ownership: whereas "development" calls up the national infrastructure projects proposed in the bond details, "our savings" is referencing not a national, but the regional currency and regional securities market. And the third-person imperative (*participons/valorisons*) suggests that these collectivities are doing the participation and promotion together. Further, its publication in *Jeune Afrique* also suggests a continental elite audience to which the marketing campaign was also addressed. Although other governments have hinted at this kind of participation by ownership, Gabon used this language and imagery as a cornerstone of this marketing campaign for its sovereign bonds.

Gabon is a positive example of an emerging model of development finance focused on "domestic finance." But it is not yet exemplary of how most African sovereign bonds are issued today. Many development experts applaud the expansion of bond issuances as a useful and innovative private sector solution to today's lack of infrastructure finance. And more than an injection of private wealth, bonds are also an injection of private sector principles in which governments and their projects are evaluated in terms of profit, productivity, and financial risk. Many others, of course, critique bond financing for these very same reasons. In fact, a host of prominent critics argue that the recent rise in sovereign debt today portends a second round of African debt crisis reminiscent of—if not worse than—the crisis of the 1980s (Stiglitz

& Rashid 2013; Walker 2013). But in contrast to the more familiar development bank loans of the 1980s, today's loans are increasingly derived from private investors buying up debt as a risky, high-yield asset on European and American securities markets. From one perspective, the rise of state debt in Africa is part of a broader story of global economic imperialism in which Euro-American finance capital responds to crisis at home by seeking higher returns on investments in far-flung, frontier markets abroad (see Harvey 2003).

But African governments—such as Gabon, Ghana, and Senegal—and development experts are creating a kind of African infrastructure finance that is very different from the existing practice of Western investors and vulture funds buying up risky public debt. There is nothing short of an avalanche of policy reports, workshops, and media coverage across a variety of developmental domains that take "domestic capital markets" and "domestic finance" as the innovative development solution of the future. And European, American, and African institutions together have converged on this growing consensus. Although African governments like that of Gabon are infusing capital markets with a kind of collective vision, economists also suggest that domestic bonds make rational, economic sense (Tyson 2015). When African governments issue bonds in foreign currencies such as U.S. dollars, there is a risk that the exchange rate will change by time the bond matures. And paying back international debt with a devalued currency can significantly increase the costs of borrowing and can decrease the value of the bond itself. Issuing in a domestic or regional currency, of course, eliminates this risk. Despite the European and American provenance of the virtues of domestic finance, African governments and Pan-African institutions are taking up this transatlantic convergence of development expertise and enrolling it in broader values of African unity, collective development, and ownership.

## TAKING OWNERSHIP

More than a story of contemporary Africa, today's infrastructure planning and finance are also part of a more general history of democracy and markets, core values of modern liberalism. Instead of understanding such global encounters as a straightforward expansion of liberalism, scholars have encouraged us to explore how these movements might reconfigure liberal values themselves (Appel & Kumar 2015; Collier 2011). And scholars of Western modernity argue that civil society, markets, and the publics that constitute them are at the heart of the modern liberal imaginary (Taylor 2003). Yet African institutions are taking up these forms and providing a contrasting vision and ownership of modernity, inflected with long-held, anticolonial, and Pan-African political values. However, the reverse is also evident: the belief in democracy and markets is infusing African infrastructure planning and African unity with a hefty dose of liberal values. This explains some of the purchase these programs have among a familiar cast of decidedly liberal "development partners" like the International Monetary Fund, the World Bank, and even private foundations like the Bill & Melinda Gates Foundation. And institutions like NEPAD envision re-configuring this mix of values through the technical provision and planning of physical infrastructures, which have long been understood as key symbols of modernity and modernization on the continent (Larkin 2008).

Africa is not a country. But Africa *is* and *has been* imagined as a political collectivity, once as a federation of nations and perhaps today as a continental network of financial markets, "new" partnerships, and the physical infrastructures to match. African officials like Mayaki view this new configuration of African ownership as an intentional departure from the previous era of structural adjustment programs imposed by the World Bank. Mayaki himself sees structural adjustment as an "erasure" of Africa's capacity to "prioritize and think strategically," and argues that institutions like NEPAD are here to "fill the vacuum" (Mayaki and Abdelaziz 2013). African ownership of infrastructure-led development is one such attempt to fill this void that has only begun to emerge since the turn of the new millennium. But this new vision of African-owned development also opens up a different set of possibilities and pitfalls: How far will the language of participation be extended to broaden—or curtail—public input in technical development plans? And how and to whom might these publics make claims? How will African regulators keep up with a rapidly changing terrain of interconnected and cross-border financial markets? And what kinds of continental systemic risks and intra-Africa debt crises might this entail (Enoch et al. 2015)? And how might all of this create new fissures in what is today a rather clean vision of African ownership, partnership, and unity? ■

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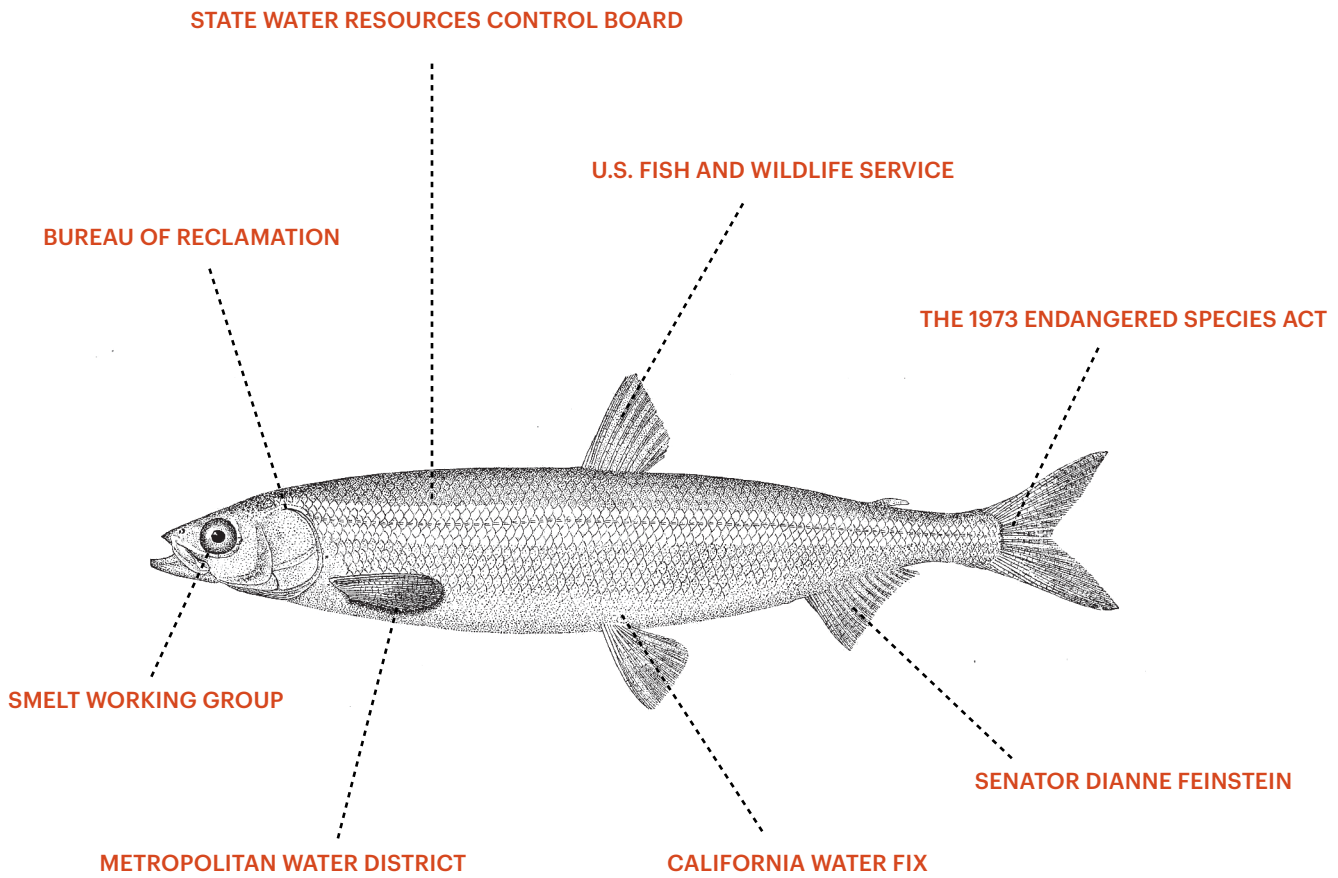
# the zone of entrainment



# We know that environmental concerns have been used to block infrastructure projects. But can infrastructure be used to side-step environmental concerns? Andrew Lakoff on water provision and species protection in California.

**IN MARCH 2016, FEDERAL WILDLIFE OFFICIALS** faced a barrage of criticism from California politicians concerning the regulation of the state's water system. Senator Dianne Feinstein and a group of Republican congressmen from the Central Valley each sent public letters to President Obama demanding that he order the U.S. Fish and Wildlife Service to relax its restrictions on water system operators in the San Francisco Bay-Delta.

The letters noted that recent storms in Northern California had markedly increased the flow of water from the Sacramento River into the delta, but that endangered species regulations sharply limited the amount of this water that could be shipped south. After four years of severe drought, Central and Southern California water contractors were livid that they would not be able to use this winter's relative bounty of water to replenish their drained aquifers and reservoirs. Even though river flows had more than doubled during the late winter storms, Feinstein argued, less water was being pumped to the south than during the same period of the prior year. The waste was "inexcusable," she continued, citing data on the amount of water that should have been diverted south by water operators: "180,000 to 200,000 acre-feet of water was allowed to flow out to the sea instead of being captured and stored—enough water to supply 360,000 homes for a year" (Feinstein 2016b). She urged regulators to let state and federal water projects pump at the maximum allowable levels during times of high storm water flow: "If we can't increase pumping during an El Niño year, then when else can we?" Similarly, the Central Valley legislators demanded that pumping rates from the delta be increased "over and above" the maximum amount allowed by the regulations: "The fate of California and the lives and livelihoods of our constituents are at risk" (McCarthy et al. 2016).

The specific focus of the lawmakers' criticism was the use of federal endangered species regulations to protect the delta smelt, a once abundant fish whose population has fallen in recent years to alarmingly low levels. The Fish and Wildlife Service is required, under these regulations,

to limit the rate of pumping by the water projects' facilities at the southern end of the delta when there is a danger that the endangered fish might be sucked in, or "entrained," by the pumps. Over the last decade, smelt protections have been a target of ongoing criticism for those—especially in the agricultural Central Valley—who argue that environmental regulation is strangling the state's economic productivity. But beyond the issue of how to weigh the protection of the delta's fish against the demands of farms and cities to the south, the debate points to a more general question about the operation of vital infrastructures such as California's public water circulation system: How, in an age of concern about the environmental consequences of modernization processes, do ecological needs recast infrastructural norms?

## THE VALUE OF ENVIRONMENTAL THINGS

California's water circulation system comprises a vast network of dams, reservoirs, and canals that deliver water from the wetter northern and eastern parts of the state to its drier southern and western regions. The system's main components were built between the 1930s and the 1960s, following the mid-twentieth century model of government-built public works projects (Reisner 1986). According to this model, technocratic planning was oriented to the instrumental use of "natural resources" for social and economic purposes such as increased energy generation and agricultural productivity. In the cost-benefit calculations made by government agencies such as the Bureau of Reclamation to justify its dam and reservoir projects, potential ecological harms were not taken into account. Indeed, sophisticated intellectual tools were not yet available for measuring the condition of the environment and for projecting the damage to this condition that might be inflicted by such projects.

As early as the 1930s, but with increasing clamor by the 1960s, critics began to point to the unintended consequences of public infrastructure projects (Collier 2014), arguing that engineered systems for generating electricity, increasing agricultural productivity, and expanding habitable terrain were having disastrous effects on wildlife and on ecosystems. New publics emerged to speak for


**FIGURE 1 (PREVIOUS PAGE LEFT):** The California Aqueduct and the Delta-Mendota Canal.
PHOTO BY DOC SEARLS

**FIGURE 2 (PREVIOUS PAGE RIGHT):** The delta smelt.
PHOTO BY U.S. FISH AND WILDLIFE SERVICE/PETER JOHNSEN

**FIGURE 3 (THIS PAGE):** California Department of Fish and Wildlife found one lone smelt when they sampled 40 locations throughout the delta in April 2016.

those beings under threat from human-built systems, new fields of expertise were invented to monitor the well-being of native flora and fauna, and regulations were put in place to protect this environment from the side effects of human-built systems.

The 1973 Endangered Species Act was a major outcome of this newly articulated government responsibility to mitigate the ecological damage caused by public infrastructure development. The Act requires any federal agency whose planned action may "jeopardize the continued existence" of a threatened species to consult in advance with wildlife officials, who then identify a set of "reasonable and prudent alternatives" that can mitigate the threat to the species while enabling the agency to go ahead with its planned action in modified fashion (Lakoff 2016).

Over the last four decades, the Endangered Species Act has proven to be an especially powerful regulatory tool because it does not allow government agencies to engage in a cost-benefit analysis in determining how or whether it is to be enforced. According to the Act and subsequent court rulings, the value of the continued existence of a species is "incalculable." The Supreme Court upheld this principle in the case of *Tennessee Valley Authority v. Hill* (1977), ruling that the preservation of an obscure fish—the snail darter—had priority over any benefits that might accrue from the construction of a costly dam project. As the majority opinion put it, the duty of federal wildlife officials is to "halt and reverse the trend toward species extinction, *whatever the cost*" (italics added). In other words, the benefits of the resources to be extracted by an infrastructure project could not be weighed against the cost of the loss of a species whose existence was threatened by the project. According to the Court, these two forms of value were incommensurable.

For this reason, the US Fish and Wildlife Service's 1993 decision to list the delta smelt as threatened has had a profound effect on water politics in California (Alagona 2013). The effect has become more pronounced in the wake of an important 2007 federal district court ruling that the operations of the state and federal water projects imperiled the survival of the smelt. The ruling required the Fish and Wildlife Service to closely monitor the wellbeing of the smelt population, and to calibrate the pumping operations of the state and federal water projects in relation to the results of such monitoring (San Luis & Delta-Mendota Water Authority v. Jewell [9th Cir. 2014]). The resulting restrictions, argue Central and Southern California water managers, have markedly reduced the amount of water available in storage. According to the Metropolitan Water District, which provides water to 17 million people in Southern California, 1.43 million acre-feet of water has been lost since 2008 due to endangered species-related restrictions placed on pumping (Maven 2016).

From the perspective of those who advocate for the protection of the delta's native fish species—an alliance of environmental advocacy organizations, delta farmers, and sport-fishing lobbyists—the delta smelt is not the object of value per se. Rather, the smelt is an "indicator species," a sentinel for the declining health of the delta ecosystem more generally. But since endangered species regulations must focus on a single threatened species, efforts to protect the smelt have come to stand in for the more abstract—and difficult to measure—effort to improve the wellbeing of the ecosystem. However, the use of the smelt as a proxy for the ecosystem has the complicated effect that regulatory measures end up focusing as much or more on preserving smelt existence as on broader ecological aims such as limiting the salinity levels of the delta or minimizing the incursion of invasive species.

Let us now return to the 2016 debate over regulations designed to protect the smelt from the water projects' pumping operations, with particular attention to the techniques used by wildlife officials to gauge and manage the wellbeing of the smelt population. In their practices of risk assessment, we can see the attempt to integrate ecological knowledge into the everyday operations of vital infrastructures.

## THE ASSESSMENT OF ENTRAINMENT RISK

Wildlife biologists monitor the smelt population in relation to its historical prevalence through regularly conducted fish surveys. In these "trawls," a boat trails a net for a set amount of time through specific sites in the delta, and the number of each species caught is registered. Since these surveys were first conducted in the 1960s, the number of native fish caught in the nets has declined markedly, not only for delta smelt, but also for other species such as steelhead trout and the winter-run Chinook salmon. By the end of 2015, specialists on native fish in the delta agreed that the smelt were close to extinction. Only seven had been found in the year's Fall Midwater Trawl, by far the lowest number ever recorded. For this reason, Fish and Wildlife Service officials were highly attuned to the needs of the smelt as they entered their most sensitive period of the year, the months from January to March when they migrate upriver and spawn.

The specific task of wildlife officials was to protect the weak-swimming smelt—especially gravid females, juveniles and larvae—from the massive pumping facilities at southern end of the delta that transfer water into the state and federal water projects. These pumps reverse the course of the delta's rivers, diverting water south at a maximum rate of 10,000 cubic feet per second. The key question regulators had to ask was whether, in this delicate late winter period, vulnerable smelt were present in the "zone of entrainment": the section of the delta in which reverse currents are strong enough to pull fish into the pumps to their death. And if so, what was the optimal rate of pumping to limit the risk of entraining the vulnerable fish while at the same time enabling the water projects to capture runoff from the long-awaited winter storms?

On roughly a weekly basis during this period, a group of fish biologists from several state and federal agencies, known as the Smelt Working Group, met to assess the risk posed to the smelt by water project operations and to make recommendations to the Bureau of Reclamation and the State Water Project on maximum pumping rates. The stakes of its risk assessment were high: the difference between allowing a pumping rate of -5,000 cubic feet per second (the maximum allowable under the regulations)

and -1,250 cubic feet per second (the minimum) would quickly add up to tens of thousands of acre-feet either in reservoir storage to the south or in freshwater flowing "out to the sea," as Feinstein put it. To make a recommendation, the working group analyzed data on such factors as the temperature and turbidity of the delta's water, the flow rates of its tributaries, and the abundance and location of smelt as measured by "early warning" surveys.

In its January meetings, the working group focused on how to protect adult female smelt during their period of migration just before spawning. One problem in making recommendations was that there were so few smelt remaining in the delta that it was hard to know where they were. Overall, the group admitted, "current distribution is unclear." But it argued that given the "depressed level of abundance" of the smelt, the Fish and Wildlife Service "must take a precautionary approach to protect this portion of the population during the critical migration and spawning period" (US Fish and Wildlife Service 2016a). Based on the working group's recommendation, the Fish and Wildlife Service reduced the maximum pumping rate to -2,500 CFS over a 14-day period beginning in late January.

In the following weeks, water agencies to the south expressed increasing agitation about the regulatory decisions that were limiting their expected deliveries from Northern California storms. Feinstein articulated their concerns in a March 11 statement: "Days of high flows were squandered," she complained. "Rather than pumping as much water as possible" during post-storm periods, "pumping levels were ratcheted down for an entire month between mid-January and mid-February" (Feinstein 2016a). She questioned the rationale for the Fish and Wildlife Service's interventions: "In some instances these decisions were made even though available data suggested no smelt or salmon were anywhere near the pumps." And she called for a new regime of "daily monitoring of fish near the pumps during times of high turbidity" so that "real-time data can be used to inform decisions rather than relying on intuition" (ibid.).

At around this time, however, a new regulatory criterion came into play for the Smelt Working Group. The temperature of the delta reached 12 degrees Celsius, the threshold at which experts think that smelt spawning activity begins. For this reason, there was a "probable presence of larval delta smelt in the south and central delta," according to the working group. Given its understanding that "eggs and juvenile smelt emulate free floating particles in the water column," the working group argued, it was necessary to again reduce the speed of reverse flows to avoid entraining the young fish (US Fish and Wildlife Service 2016b). Using a flow modeling technique, the working group calculated the entrainment risk to the larvae at a flow rate of -5,000 CFS to be between 50% and 60%. Based on these findings, Fish and Wildlife Service regulators released their determination to the Bureau of Reclamation on March 24: given indications of the "potentially persistent presence of the early life-history stages of Delta Smelt in a region vulnerable to entrainment at more negative OMR [old and middle river] flows," reverse flows should be no higher than -2,500 CFS over a two-week period (US Fish and Wildlife Service 2016c).

This decision further inflamed defenders of regular water deliveries to the south. In her March 24 letter to President Obama, Feinstein attacked the regulators' precautionary approach: not only do the agencies restrict pumping when smelt are found far away from the pumps, she wrote, "they will also reduce pumping due to the absence of smelt, based on the idea that historically low smelt populations make detection difficult" (Feinstein 2016b). She pointed to "a fundamental problem with our water system: a dogmatic adherence to a rigid set of operating criteria that continues to handcuff our ability to rebuild our reserves" (Feinstein 2016b). More accurate knowledge about the actual presence of smelt near the pumps, she argued, would lead to "a more nimble system": in other words, to higher pumping rates during winter storms. A Northern California congressman, Rep. Jared Huffman of Marin County, countered that in fact the regulatory science was sound: "The U.S. Fish and Wildlife Service is using the real-time monitoring protocols that everyone has been asking for" (Lochhead 2016).

**One problem in making recommendations was that there were so few smelt remaining in the delta that it was hard to know where they were.**

Over the following months, the debate remained unresolved, as House and Senate "drought relief" legislation seeking to modify the application of endangered species regulations foundered in a more general legislative standstill. But it was worth noting the terrain on which the political debate over water distribution was being conducted: over the methods and findings of a relatively novel type of science that sought to care, in great detail, for the living and reproductive conditions of an obscure, but increasingly endangered, population of fish.

## INFRASTRUCTURAL BYPASS

If the short-term fight was over issues such as maximum pumping rates and methods of tracking fish, a longer-term struggle over the future relation of vital infrastructure to ecosystem health was unfolding at the same time.

The State Water Resources Control Board was preparing to hold what promised to be contentious hearings over the proposed $15 billion California Water Fix, which, if built, would be one of the largest public infrastructure projects in the state's history. The Water Fix, supported by Governor Brown as well as Central Valley and Southern California water suppliers, sought to stabilize and secure deliveries of fresh water from the delta to the south through the construction of two 30-mile-long and 40-foot-wide tunnels that would take water directly from the Sacramento River directly north of the delta to the pumps at the south end. The water could then be pumped at high rates without concern about directly disturbing the smelt or other endangered fish in the delta.

In late March, the Bay-Delta Imported Water Supply Program Manager for the Metropolitan Water District reported to members of Metropolitan's Bay-Delta Committee that if the Water Fix project had already been in place, "with the new modern system with more fish friendly intakes," from January 1 through March 3 "we could have put about another 486,000 acre-feet in storage—enough for 3.6 million people" (Maven's Notebook 2016). Notably, the proposed tunnels were not projected to increase the total amount of water going to the south; rather, the goal was to ensure a steady future rate of pumping so that suppliers would not find themselves beholden to the unpredictable meanderings of endangered fish. This new moment of massive infrastructure construction was an attempt not to resolve, but to bypass, the long-running tension between the human demand for resources and the requisites of ecosystem health. ■

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What does Abu Dhabi's green future look like? **Gökçe Günel** explores Masdar City in a once-promising Personal Rapid Transit Pod.

# AN "EXPENSIVE TOY"

## INTRODUCING THE PRT

The Personal Rapid Transit (PRT) pods of Masdar City were first exhibited at the World Future Energy Summit in Abu Dhabi in January 2009, giving the visitors a sense of the eco-city's ambitions. Masdar City is a "futuristic" eco-city designed by the London-based architecture office Foster + Partners to rely entirely on renewable energies. It was launched in 2006 by the Abu Dhabi government and attracted media attention between 2007 and 2011. The zero-carbon district would cost $22 billion, and house 50,000 people and 1,500 renewable energy and clean technology businesses.[1] The PRT pods, considered the most innovative element of Masdar City (see, for instance, Mostafavi and Doherty 2010) were designed by Zagato, an Italian engineering company famous for racing cars, and manufactured in the Netherlands by 2getthere.

One blogger positively reviewed the exhibit at the World Future Energy Summit in Abu Dhabi, writing, "The comfort and safety of the pods shows us a rather favorable vision of the future. Ride on cushioned seats, holding hands or facing each other. Have a conversation, catch up on the morning news. The car will stop to let you off at your chosen destination. Chauffeurs for everyone, and Green at that? That's our future? Not bad. Not bad at all!" (Alternate Energy 2009). The PRT pods confirmed that the future would be one of technological complexity, just as many people imagined when they watched science fiction movies. The logics of autonomy and individualization, long associated with cars, would characterize the future of transport technologies. All in all, the exhibit showed that the imaginaries of the future would remain untouched by problems of energy scarcity, and enabled a comforting and enjoyable narrative in the face of environmental conditions that are deeply unsettling.

According to the initial plans, the PRT pods would offer personal, on-demand, nonstop transportation between any two points on a network inside Abu Dhabi's Masdar City, arguably combining the advantages of cars (private travel at any time) and public transport (no congestion and parking issues). Connecting the entire eco-city through a 23-mile network, the PRT would accommodate 1,800 vehicles at 87 stations while also allowing for the widespread distribution of goods. As the Foster + Partners renderings indicated, this transportation network would be located at the basement level of the eco-city, commonly referred to as the "undercroft," preventing the pod cars from disrupting the everyday life of the Masdar City streets. This meant the whole city would have to be raised one level, about 20 feet above the ground. Although initially a plausible scenario, the project soon proved financially demanding, leading Masdar executives to drop the plans for the PRT completely and search for alternative emission-free means of transport, such as electric buses or cars. And yet there remained one destination to which passengers at Masdar Institute could travel: the parking lot outside the building.

The Personal Rapid Transit pods were first exhibited at the Word Future Energy Summit. 2009. PHOTO BY ALI HAIDER.

## ENJOYING THE PRT

In April 2011, Elif and Salim, both graduate students at Masdar Institute—a research institute that the Massachusetts Institute of Technology established inside Masdar City—gave me a guided tour of the PRT pod cars, joining me in the short trip between Masdar Institute and the parking lot outside. Elif and Salim were part of the first cohort of students to tackle the strange material conditions of Masdar City. They lived in the Masdar Institute building, together with another 100 students, and spent most of their time on campus.

In attending to the functions and problems of the PRT pod car, Salim and Elif found it necessary to break it into parts, while also underlining the interactions between these multiple elements. For instance, they explained that the uneven concrete surface of the road increased friction, triggering problems for the suspension system. According to Salim and Elif, these parts ensured that the pod cars moved, and therefore facilitated a future of technological complexity. At the same time, the pod cars were confined between the two stops, and thus could never reach their intended speed of 25 miles per hour because of the short distance they ultimately covered. The PRT pods also experienced unexpected frictions due to the material condition of the road. If in their movement they allowed the emergence of a future where humans managed to mitigate climate change and energy scarcity through technological means, in their restrictedness they demonstrated the impossibility of this imaginary.

Salim and Elif sometimes called the PRT an "expensive toy," rendering its functionality secondary. This seemed especially apt when the pod cars malfunctioned, trapping passengers in the vehicles for up to 20 minutes. Masdar Institute students would begin to complain, promising they would take the shuttle bus next time. Yet the students confirmed the pod cars were "fun." The innovative mode of transport gave the city a futuristic feel, even though it did not have the capacity to transport crowds. In other words, Salim and Elif were at times quick to laud the PRT, but they also harbored doubts. They suggested the pod cars served as an appropriate metonym of Masdar City, and that the whole idea of the eco-city was lavish.

1 For this article I draw on ethnographic research that I conducted in 2010 and 2011. The prospects of Masdar City have changed since then, and major news outlets that were once enthused about the project have started calling it a ghost town. See, for instance, Goldenberg (2016). For a more extensive analysis of renewable energy and clean technology in Abu Dhabi, please see Günel (In press).

Computer renderings of the Masdar City undercroft were circulated in the media between 2007 and 2010. IMAGE BY FOSTER + PARTNERS.

Visitors to Market @ Masdar waited to ride the pod cars. 2011. PHOTO BY THE AUTHOR.

They stressed that such increasing obsession with technological innovation was not unique to Masdar, but rather defined the eco-city concept around the world.

In these discussions, the notion of an "expensive toy" appeared to be a dismissive way of describing the pod cars, as well as the future that they characterized. Yet this depiction also permitted the students to frame the project as an exciting opportunity, and revealed an impulse to experience the world in ways that were not yet fully realized. While such emergent infrastructures seemed to define the project of building a renewable energy and clean technology sector in Abu Dhabi, they remained consistently ambivalent and out of reach.

In addition to calling for ways of experiencing the world that were not yet feasible, the proposed infrastructures seemed to dismiss or exacerbate the race and class divides that characterize the United Arab Emirates. In the imagined future of high technology, Abu Dhabi remained a liberal space for Western white businessmen, and a space of invasiveness for South Asian workers. During an interview, the PRT consultants for Masdar City explained to me that the Abu Dhabi authorities enjoyed the pod cars specifically because they took the driver out of the picture. In some ways, they celebrated the PRT because it would exclude low-wage immigrants from access to the city even as workers. Criticism regarding the segregated nature of the Masdar project became public when the architecture critic of the *New York Times* called the imagined city "a self-sufficient society, lifted on a pedestal and outside the reach of most of the world's citizens" (Ouroussoff 2010).

In response to such comments, Masdar City executives planned the Market @ Masdar, an open house where the residents of Abu Dhabi were invited to experience the eco-city. Though this group did not include workers, thousands of people paid a visit. After leaving their cars at the parking lot, visitors refused to take the readily available shuttle buses, instead insisting on riding the pod cars. They lined up for 20 to 30 minutes, as if waiting for a roller coaster ride in an amusement park.

Sylvia, who was the operations manager for the PRT subcontractor 2getthere, perceived these long lines as a clear victory. Her previous work experience with the London Underground and Dubai World was critical for this position: she seemed to understand large transport infrastructures, and knew about professional life in the United Arab Emirates. Also, in a way, she "loved" the pod cars, and advocated their uses for Masdar City. "About 4,000 people took the PRT that day," she reported when we chatted about the open house. "There were huge lines, and I was telling people standing in line that there is a bus they can take, but they refused to take the bus; they'd rather stand here and wait, they said they came here to take the PRT." According to her team, the crowds did not indicate a flaw, but rather demonstrated how much everyone appreciated the pod cars, and proved how valuable they were for the eco-city. "Some people understand

The Personal Rapid Transit pods were charged in their docks. 2011.
PHOTO BY THE AUTHOR.

that as a failure because there were long lines. The system is not designed for such heavy demand, you must understand; our target is the residents at the Institute, which is very small.... But others may have misunderstood," she clarified.

Sylvia was right: for others like Brad, who knew the eco-city, the long lines proved the PRT was not an appropriate way of organizing a city's transport system. Brad was an Irish man in his early forties, and had been trained as an architect in the United Kingdom. Since 2009, he had been working for Masdar City, mostly managing the relations between Masdar and Foster + Partners. Like Sylvia, he had experience of working in the Arab world: his previous employer was the Energy City of Qatar, and he had also managed a campus development project in Libya. After the open house, Brad remarked, "On Market @ Masdar City, we witnessed the failure of the PRT. It is just not very practical. It does not work for a city. We saw that you cannot just pay, and buy efficiency like that." Regardless of how much the crowds enjoyed taking the PRT, the system had been incapable of transporting these crowds from one point to another. It had been unable to perform the most essential function of a transport system: to transport people.

In this context, the idea of "enjoying the PRT" (perhaps as opposed to "using the PRT") was significant to understanding the way that both Sylvia and Brad narrated the PRT project. The observation that the visitors to the Market @ Masdar refused any other means of transport, and preferred to line up for the pod cars, implied that they did not understand the PRT as a means of transport per se, but rather as an expensive toy. It was accurate that the system could not cope with such unprecedented demand, but still Sylvia considered the PRT a successful experiment because newcomers to the site enjoyed it as a spectacular experience.

Like Elif and Salim, Sylvia also emphasized the multiple material fragments that made up the PRT infrastructure of Masdar City. First, the PRT's magnetic track needed to be smoother. 2getthere representatives had requested asphalt flooring to ensure this condition, but authorities at Masdar wished to use concrete from the recycled concrete plants on site. Second, the supervisory system was very sensitive. "If a bird enters this space," Sylvia explained, "then the PRT stops because it thinks that it's going to hit the bird." For the PRT to function properly, there had to be no birds inside. 2getthere had preempted this issue and asked for high walls to surround the tracks, containing the vehicle inside a sealed tunnel, but this request was not granted. Third, Sylvia walked me to the PRT doors to show

> “…a past where the option of a renewable energy and clean technology future was still available.

that the runners below were full of sand, and argued that the spaces where two systems contacted with each other were the most difficult to manage. Despite the friction, the pod cars were on track: with the goal of transporting or entertaining passengers. The experimental infrastructure produced a sense of flaw as well as a sense of awe at every step.

## IMAGINING TRANSPORT FUTURES

“Anyhow, when they stop building it, and finally give up on the clean technology cluster, Masdar City will probably transform into an amusement park, don’t you think?” Salim said. He was referring to spaces like the EPCOT Theme Park that were originally conceived as futuristic communities, but later abandoned to become objects of amusement. According to him, in a few decades people would come to visit the ruins of an eco-city—or what was meant to be an eco-city—that would signify not only decay but also traces of an idea, once pursued ambitiously. In this imagined future, Masdar would become more of a spectacle, and its ruin would once again offer entertainment to its spectators in addition to nostalgia for a past where the option of a renewable energy and clean technology future was still available. Yet the entertainment provided in this case would be slightly different from a ride on the pod cars: the automated transit infrastructure promotes innovations for a renewable energy economy, whereas the ruins would denote a possible surrendering of that ideal in a future where this perception was a mere relic.

All in all, the half-finished PRT infrastructure effectively situated automated transit in the interstices between hopefulness and anxiety. On the one hand, the pod cars helped their users escape to a science fiction future; on the other hand, they kept the fantasy impossible and inaccessible. As they moved back and forth on magnetic tracks, stopped to charge in their docks, and were photographed by the visitors to the site, the PRT pods took on various meanings. In the years following its launch, students, researchers, and professionals at Masdar City tried to determine whether the PRT would remain relevant, especially in the face of other emergent mobility projects such as electric or driverless cars, and asked why innovation in mobility did not focus on more collective solutions.

“It’s difficult to foresee what will happen next with Masdar,” Sylvia told me as we chatted inside the PRT station by the parking lot in April 2011, months after the cancellation of the project had been announced. She pointed to the large model, provided by Foster + Partners to represent the first phase of Masdar City. “As you can see in this model, the PRT moves throughout the buildings, but those plans have been discontinued, though here it is still being advertised as if the city included the PRT.” According to Sylvia, this partially proved how the PRT attracted more people to the city, making it a more desirable destination than it actually was. It also showed how the imaginaries of a future Masdar still had some footing in the city. The canceled plans for PRT still retained significance in Masdar City’s image as a “futuristic sci-fi eco-city.” ■

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# BETWEEN THE NATION AND THE STATE

**Is your mobile phone company seeing like a state? Emma Park and Kevin P. Donovan explore telecommunications and contemporary nationalism in Kenya.**


PHOTO: WIKIMEDIA COMMONS/NAIROBI123

**IN SEPTEMBER 2014** streams of people flowed into Kenya's largest stadium, located a few miles from downtown Nairobi on the much-celebrated Thika Superhighway. This arena is typically host to major sporting events and political speeches; Barack Obama recently addressed "the Kenyan people" there (White House 2015). But on this day, it was the site of a more unorthodox event. The crowds, dressed in their Sunday best, disembarked from their buses and walked toward the grounds, now peppered with new signage. The first of these gave a hint of what was to come: a large billboard identifying the destination as Safaricom Stadium Kasarani (Figure 1).

The occasion was the 2014 annual shareholder meeting for Safaricom, a mobile network provider that is the country's largest and most profitable company. Like other publicly traded corporations around the world, Safaricom stages this yearly event as an occasion to distribute information and receive feedback. It invited shareholders to celebrate *their* company's successes, critique its perceived failures, and weigh in on the policies that will drive the corporation's strategies in the year to come.

But if annual shareholder meetings are a global form, Safaricom's meeting was particularly Kenyan. On that September day, the signs of the corporate body and the signs of the body politic were brought together in a way that distilled a doubling of meaning increasingly common in Kenya, where Safaricom holds considerable cultural cachet, political import, and economic significance. Every few feet, as the national anthem played, one was confronted by Safaricom's telltale green logo. Although this marketing blankets the country—across billboards, shops, and news media—within the stadium it existed in telling cohabitation with a highly charged symbolic palette: the forest green, blood red, and dark black of the Kenyan flag. Most strikingly, the "Kenyan green" of the flag—which symbolizes the land lost to white settlers, gained through decolonization, and subsequently the source of (sometimes violent) ethnic politics—was juxtaposed against a green of a lighter hue. This shade, Kenyans will tell you, is "Safaricom green" (Figure 2).

If the iconography of the stadium sought an uneasy conviviality between Kenyan nationalism and commercial branding, there were also indications of a more thorough entanglement. The stadium itself, a historically important sign of independent Kenya, had only recently received its corporate name, which came on the heels of Safaricom's large injection of capital to revive the site. In a few discreet places, however, the old name remains in a smaller, red font: Moi International Sports Centre. It is the name of Daniel Arap Moi—the strongman who ruled Kenya for nearly a quarter of a century—that previously greeted citizens' arrival at this venue of national and sporting


**FIGURE 1.** "The Home of Heroes": Safaricom Stadium Kasarani in Nairobi, Kenya. (SOURCE: HAPAKENYA.COM)

spectacle. Today both he and a state that once seemed omnipresent are sidelined, their importance mediated by a company that, as one informant told us while patting his pocketed phone, "has an intimate relationship with millions of Kenyans."

In his influential account of the aesthetics of postcolonial power, Achille Mbembe (2001) emphasizes its banality: it is through the everyday proliferation of an autocrat's presence—through required portraiture, inscriptions on currency, and ubiquitous media coverage—that political hierarchies are reproduced. Through the mobilization of national symbols and corporate iconography, Safaricom today is replicating such patterns of statecraft. Although the resulting formation differs in important ways from the dictatorial regimes studied by Mbembe, a close examination of Safaricom's operations in Kenya reveals how new configurations of capital and politics shape life in Kenya today. It is not only through advertisements that Safaricom impresses its symbolic order upon Kenya—though it does so considerably—it is also through the pomp and circumstance of new store openings, the sponsorship of cultural events and philanthropic initiatives, and the routine use of text messages to remind, nudge, and discipline users. Tracing the stylistics of Safaricom's power reveals more than the aesthetic registers at play in Kenya. It demonstrates how corporations—often in close relationship with states—are able to shape the intimacies and banalities of everyday life in Kenya and elsewhere.

**SAFARICOM IS NOT JUST ANOTHER** mobile phone company. Both in Kenya and abroad, Safaricom has carved out a conceptual and material presence that far outweighs such a generic description. Across the world, it is widely lauded for its innovations, most notably the mobile money transfer service M-Pesa, which today is used by 20 million Kenyans. Within the country, it is the most profitable company and largest taxpayer. By most accounts, Safaricom was established in 1997 as a subsidiary of the parastatal Telkom; in 2000, the United Kingdom–based Vodafone acquired 40% of the shares and the authorization to autonomously manage the firm. Today, the government maintains a 35% share, while the rest is traded publicly on the Nairobi Securities Exchange (NSE). In addition to providing mobile infrastructure to nearly 70% of Kenyans and many government offices, Safaricom was tasked with building a multimillion-dollar surveillance system for Kenya's national security apparatus in 2014. But one regulator gave perhaps the best summary of its importance: if Safaricom's network goes down, he told us, "everything else stops."

The unwieldy entangling of this multinational corporation and the postcolonial state are refiguring notions of citizenship and bringing Safaricom into a direct, even intimate, relationship with Kenyans. Many Kenyans will tell you, with a hint of pride, that their countrymen are "peculiar," and Safaricom invests considerably in the cultural work of fitting this distinctiveness. In doing so, Safaricom has established itself as a corporation deeply attuned to a national milieu, in large part through the calling forth of Kenyan publics *as* new markets. Put another way, as it extends its infrastructures to a growing body of paying customers, Safaricom invokes a seemingly noncommodified public: the nation.

Consider an example. In dialogue with a wider network of development aid organizations and researchers, Safaricom invests considerably in multiple forms of market research, much of which resembles the fine-grained knowledge work associated with ethnography (see Holmes and Marcus 2006). Indeed, the company routinely attributes its success to its capacity to map vernacular practices and preferences in a bid to simultaneously create new markets and secure the "public good." Many of its commercial innovations rely upon this acuity. For example, an oft-cited early success was Safaricom's proactive cultivation of cash-strapped users through the introduction of per-second billing. More famously, the employees credited with designing M-Pesa initially imagined it as a microcredit repayment scheme; it was only by monitoring the unexpected behavior of the pilot populations that M-Pesa became what it is today: a person-to-person money transfer service, mimicking in digital form the already existing networks of domestic remittance (Morawcyznski 2009). Cultural expertise is thus generative of new forms of commercial infrastructure that many see as crucial to Kenya's vibrant future as the continent's "Silicon Savannah" (Bright and Hruby 2015).

In other cases, Safaricom engages in practices and invokes idioms with long genealogies in Kenya's patrimonial politics. For example, if the 2014 shareholder meeting was a performance evocative of Kenyan politicking, this was a staging borne of criticism. In preparation for the first shareholder meeting in 2009, Safaricom announced that the cost of providing lunch, printed documents, and branded gifts for the thousands of expected attendees was prohibitively high. Shareholders reacted vocally. As one wrote to the *Daily Nation*, not providing free lunch was a sign of "disrespect":

> I have an issue with the contention that [these shareholder meetings] "are not social events." This view is snobbish; what's wrong with mixing business with interaction? Don't managers routinely


**FIGURE 2.** The Merger of Corporate and National Colors (SOURCE: EMMA PARK).


**FIGURE 3.** Safaricom Symbolism Seeks to Unite Kenya (SOURCE: SAFARICOM ANNUAL REPORT 2015).

> meet at leisure spots to do business while partaking of fun and food? Are ordinary shareholders lesser investors? (Ombega Mageto 2009).

Here, the author was drawing on an enduring expectation in Kenya (as elsewhere) that solidarities in business or politics be marked through gift exchange. If this has been most evident historically in political rallies and electioneering, it is an idiom that readily incorporates Safaricom. These, in other words, were critiques emanating from a public conceiving itself in the registers of both shareholders and citizens.

Safaricom has learned in the years since how their shareholders expect to be treated. When they entered the stadium in 2014, attendees were provided a boxed lunch and a Safaricom T-shirt. Investors expressed approval. One gentleman rose to ask about financial accounting but received applause for beginning his question by congratulating the company for becoming attuned to shareholders' expectations: "Mr. Chairman, we have been entertained today. We have had transport, we have had some lunch, we have had some giveaways. This meeting is a big improvement in the history of Safaricom. Thank you very much. *Asante sana. Asante sana.*"

It is a common—and justifiable—fear that the privatization of infrastructure removes the capacity of citizens to make demands upon providers; the case in Kenya, however, suggests more subtle processes are at play. While Kenyans are first and foremost customers of Safaricom, more than half a million of them are also shareholders. Moreover, and because Safaricom's corporate strategy includes national branding, sometimes these publics make their critiques not as shareholders or customers: they make their claims as Kenyan nationals, demanding the company acknowledge theirs as a relationship of reciprocal obligation and respect.

**WHILE SAFARICOM RELIES** on foreign capital, expertise, and infrastructure, our emphasis on the *peculiarity* of Safaricom belies any straightforward notion that the liberalization of markets and the privatization of infrastructure engender a deterritorialized, homogenous space of flows. Instead, the formation of capitalism visible in Kenya relies on nuanced translations and heterogenous forms of capture (Bear et al. 2015; Collier 2011). This puts the historical and cultural specificity of place at the center of Safaricom's ability to generate profits.

It also means that Safaricom reflects and responds to ideas about the social good and public interest that are both firmly embedded in Kenya and circulating globally in development thinking and corporate strategizing. One of the crucial ways this plays out is through Safaricom's extensive investment in corporate social responsibility (CSR) initiatives. Like many companies, Safaricom has a philanthropic foundation that provides goods traditionally considered the responsibility of modern states: education, health services, clean water. And it is important to note many Kenyans *expect* Safaricom to step in to provide services that the Kenyan state is either unwilling or unable to provide. As one Safaricom employee told us, when something terrible happens, people ask, "What is Safaricom doing" to help? Through CSR, in other words, Safaricom engages in state-like actions.

Globally, CSR is now big business, but it is not always good business (Rajak 2011). Instead, it is often seen as a necessary expense stemming from relatively selfless commitments to philanthropy or an interest in managing public image. In Safaricom's case, however, CSR and core commercial services often exist in a zone of indistinction: what qualifies as philanthropy and what qualifies as business is not always obvious. For example, their enormously successful and profitable mobile money transfer service, M-Pesa, was originally promulgated as a CSR initiative. For a contemporary development industry that sees connectivity as a human right, simply selling airtime bundles is framed as a means of securing the public good (Figure 3). For Safaricom, however, while this indistinction requires vigilant management, it is not a problem to be solved, but rather a strategic stance. It is through the work of "building communities" and "transforming lives" that new markets and new profits result (Safaricom Foundation 2014).

CSR is concurrently a global corporate strategy and a means of more firmly embedding Safaricom within a particularly Kenyan milieu. However, proximity to Kenyan particularity can be a liability for the company. Although Safaricom can parlay its state-like actions into profits, it cannot predict how Kenya's multiple publics will register their claims and critiques. In a country where the reach of infrastructures often maps onto ethnoregional patterns of stratification, Safaricom's role as provider of infrastructures and services—its state-like actions—are always open to accusations of engaging in ethnic politics. This happens in ways significant and mundane: the public even scrutinizes promotional giveaways for signs of ethnic favoritism, requiring Safaricom's CEO to publicly insist on the company's objectivity. It is Safaricom's efforts to manage these contradictions to which we now turn.

**IF SAFARICOM'S IMPORTANCE** in Kenya suggests the emergence of something like a *corporate state*, it is a stature dependent on the savvy enactment of *corporate*

*nationhood.* Understood as a unifying, emotional bond, nationalism has a precarious status in Kenya. Often loyalties are more circumscribed, leading to moments of intense fragmentation along the lines of ethnicity, or what John Lonsdale (1992) calls "political tribalism." As Safaricom seeks to don the mantle of the nation, its position is similarly fraught, but the company does much to address this. For example, other large corporations in Kenya are considered biased due to their management's ethnic affiliation. Safaricom, in contrast, employs foreign management to avoid accusations of favoritism. In its public performances, too, it does its best to present itself as an undifferentiating national force, such as in its advertisements, which soar through landscapes of natural vitality and human productivity (Safaricom 2010, 2013).

In both cases, it is through a strategy of *distance* from certain aspects of Kenyan business and politics that Safaricom seeks to achieve a national identity unencumbered by the ethnic politics that have characterized postcolonial Kenya. Thus, although we argue here that Safaricom relies on an intimate relationship with Kenya's distinctiveness, that relationship is calibrated to maintain a distance from some of Kenya's more divisive aspects. Indeed, maintaining this distance is critical to its profit-making capacities.

**SAFARICOM'S SUCCESS I**n Kenya is widely celebrated as an emblem of "Africa rising," an aphorism that signals an end to "the hopeless continent" (*The Economist* 2000), its patronage politics, and the uneven service delivery that are said to beleaguer the continent's progress. Less noted, however, is how Safaricom's success has been dependent on the uneasy management of the dialectics of intimacy and estrangement, of proximity and distance. It is by working these unwieldy middle grounds that new relations of power among "the public," "the private," and "the philanthropic" become visible. It is here that the lines between market making and the public good, enacted through infrastructure, come to the fore and change the terrain on which Kenyans can make claims for services, redistribution, and recognition. ■

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# DROUGHT AS INFRASTRUCTURAL EVENT

ASHLEY CARSE

**explores water distribution and its publics on the Isthmus of Panama**

**IT WAS BACK IN 1968, ENEIDA TOLD ME**—the same year that she and her husband Juan settled along the Boquerón River—when she learned that the gringos controlled the water.[1] She recounted the story like this: one day they were clearing the plot they had begun to farm along the riverbank when she came across a metal rod driven into the soil. "What is this doing here?" she asked. Juan explained that the rod was a boundary marker and that the U.S. government—not Panama—controlled the river, the land along its banks, and the reservoirs downstream created to collect river water for moving ships through the Panama Canal. "It is here because the gringos control the lakes," he explained. "There will come a day when they will flood all of this and we'll have to move up higher."

The Panama Canal moves an estimated 5% of global seaborne trade (Rodrigue et al. 2013:33). Unbeknownst to many, canal operations depend on a continuous supply of fresh water. The canal uses river water stored in two large artificial reservoirs to move oceangoing ships up and over the spine of Panama via a series of six locks. Unlike the sea-level, saltwater Suez Canal, each Panama Canal ship transit releases 52 million gallons of fresh water out to sea. The canal has averaged around 37 transits daily in recent years. Thus, canal lockages use nearly 2 billion gallons of fresh water on an average day, which is more than the individual water use of 18 million Panamanians (at 106 gallons per person per day). To put this comparison in perspective, consider that the entire country of Panama has a population of less than 4 million people.[2]

Eneida described her discovery of the metal rod as a moment of recognition. Juan's narrative linked the uneven geopolitical relationship between the U.S. and Panamanian governments to the historical experiences of rural displacement associated with supplying water for the canal (Carse 2014). The rod revealed a regional hydropolitics. Since 1906, when the U.S. government decided to build a freshwater lock canal instead of a sea-level design, regional water supply has been a recurring concern for both infrastructural and environmental reasons. First, the canal system is interconnected with national water and power networks. The major reservoirs that provide water for shipping, Gatun Lake and Alajuela Lake, also supply most of the potable water for the nearly 2 million people that live in the urban sprawl that stretches from Panama City (the nation's booming capital and canal's Pacific terminus) to Colón (a neglected city by the Caribbean terminus). Second, regional precipitation is typically characterized by a rainy season from May to December and a dry season from January to April. Water is plentiful, even excessive, in the rainy season. But the dry season can push the stored water supply to its limit, particularly during drought years when the beginning of the rainy season arrives later than expected.

For Eneida, the metal rod illuminated infrastructural relationships linking her body, farm plot, and community to the canal and its dispersed publics, including the state institution that manages the waterway (once American, now Panamanian), the shipping firms that make up its clientele, and the transnational networks of transportation, logistics, and business actors that are indirectly dependent on the waterway. Given the networked character of shipping and municipal water infrastructures, droughts can bring these uses—and, by extension, their publics—into tension.

Nearly 50 years after Juan predicted that the canal administration would extend the water storage system further into rural Panama, his words may come true. In August 2015, the Panamanian government declared a state of emergency due to an El Niño–related drought and proposed increasing water supply by creating another large reservoir. But if the drought was an emergency, what kind of emergency was it? Media and political narratives often present droughts as meteorological events: abnormal precipitation deficits that reflect disruptions in atmospheric circulation like El Niño. This framing implies that droughts arrive suddenly and come from the outside, eliding the historical construction and spatial interconnection of thirsty infrastructural networks that create conditions of possibility for shortage. Droughts are, by definition, temporary and caused by abnormal climatic conditions (Kallis 2008:86). This distinguishes them from normal dry conditions like aridity. In practice, however, the droughts that people define as emergencies are not meteorological events, but socioeconomic problems: instances in which water demand approaches or exceeds a climate-related deficit in supply (Garza 2003:343).

I propose that we conceptualize Panama's drought and others like it as *infrastructural events*. This framing highlights two key points. First, droughts, like other natural disasters, are not temporally or spatially discrete phenomena. They are environmental manifestations of how infrastructures become intertwined with the more-than-human world through the accretion of sociotechnical decisions and, crucially, of how water shortage in a given region can be influenced by the built national and transnational networks that circulate liquid from one place to another. Second, infrastructures can naturalize some water uses in ways that shape the emphases of drought response and the capacities of various publics to make claims. Sometimes this infrastructural invisibility is an outcome of a given community's distance in time or space from the mundane organizational work that allows large, complex systems to operate. Sometimes it is an outcome of concerted efforts to manage environmental and political variability, dependency, and vulnerability (Benson 2015; Starosielski 2015).

## SOVEREIGN TERRITORY, IMPERIAL WATER

Eneida and Juan were among a handful of families who, beginning in the 1950s, settled the steep, forested lands along the Boquerón River. Word had spread through *campesino* networks that this region was *tierra libre*

**FIG. 1 (PREVIOUS PAGE):** Boundary marker near Gatun Lake in 2008. In the early twentieth century, U.S. canal administrators placed metal rods along the boundary between the U.S. Canal Zone and the Republic of Panama, as well as around canal-administered water sources. Today, the monuments identify the administrative space of the Panama Canal Authority, a domestic state institution. (PHOTO BY THE AUTHOR)

1 Eneida and Juan's names have been changed.

2 Estimate is based on 2010 figures provided to the news agency EFE by Panama's national authority of public services that place per capita consumption of potable water in Panama at 106 gallons per day, the highest in Latin America. Meanwhile, as the article notes, 16% of the population has no access to potable water. See Agencia EFE (2010).

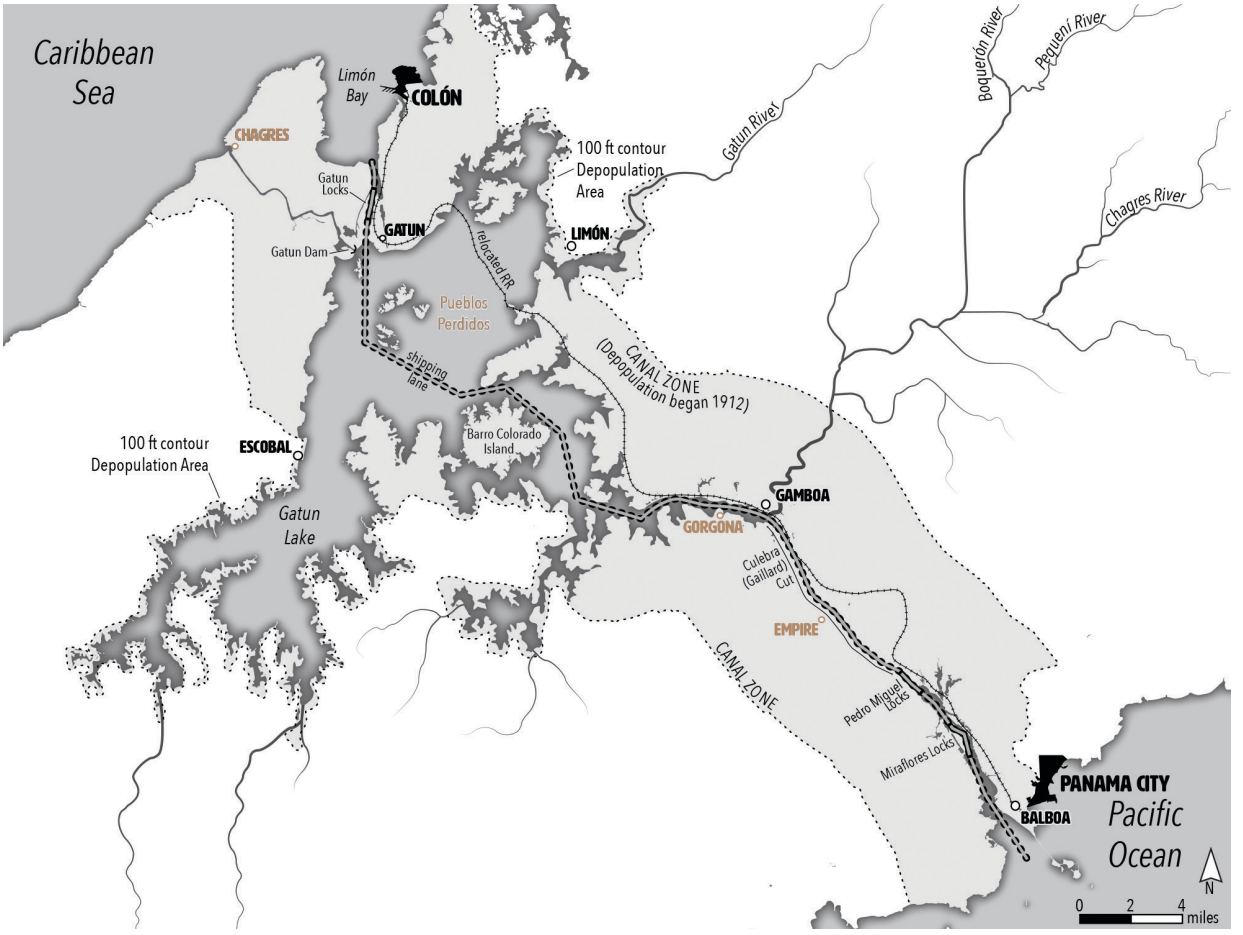


**FIG 2:** For most of the twentieth century, the U.S. government controlled the Canal Zone (shaded), a quasi-colonial enclave that split Panama in two. It also managed water across the entire Chagres River basin for shipping and other purposes. (BY TIM STALLMANN, USED WITH PERMISSION).

(free land), where a hardworking family could make a living by farming. But, even then, as the metal rod revealed, the water flowing across that land was not free.

From 1903 to 1979, the U.S. government exercised quasi-sovereign power within the Canal Zone (more than 500 square miles) and managed water across an even larger swath of Panama. According to the terms of the 1903 canal treaty, the United States had authority over the water drained by the 1,300-square-mile Chagres River basin, which extended deep into Panamanian territory (see Figure 2).[3] Thus, the U.S. government managed the Boquerón River as part of an extensive system of rivers and lakes. Metal boundary markers were placed along the rural sections of the Canal Zone–Panama boundary and around the canal's water sources, where Eneida found one.

The United States exercised its imperial power in Panama through conventional geopolitical means such as exploitative treaties, but also through the material politics of the engineering projects that we now call infrastructures (Carse 2016). In the first two decades of the twentieth century, the U.S. government enacted a sprawling sanitation campaign to control malaria and yellow fever around the canal. Yellow fever was primarily an urban problem due to the feeding and breeding preferences of the mosquito *Aedes aegypti*, its vector; the virus thrived in tropical port cities without modern water and sewer infrastructures like Panama City and Colón (Sutter 2016:253). Thus, yellow fever control entailed managing disease ecologies emerging at the intersection of demographic conditions, local water use practices, and built environments. *A. aegypti* did not respect the political boundary between Panama and the U.S. Canal Zone, so American sanitarians worked with their Panamanian counterparts to reengineer Panama City and Colón. They built paved roads, sewers, and piped water systems to eradicate the open-water sources such as cisterns, rain barrels, latrines, and muddy streets where the mosquitoes bred.

The U.S. government built urban infrastructure in

3 The United States–Panama Treaty of 1903 gave the United States extensive territorial power and environmental control within the Canal Zone. According to the treaty, the United States controlled the water that drained into the canal and could appropriate more territory for water or other uses deemed necessary for the "use, sanitation, and maintenance" of the waterway.

Panama not to promote modernization, per se, but to protect the health of white U.S. citizens in adjacent Canal Zone communities. The sanitary engineering projects established a public defined by the material and symbolic power of imperial pipes, cables, and roads rather than political representation. Water and sewer systems linked bodies and households to the body politic (Anand 2011; Bakker 2012), forging an infrastructural public that did not map onto the geography of the nation-state. The Panamanian government got modern infrastructures and the United States established a sanitary buffer around the Zone.

Eneida's discovery on the riverbank took place about a decade before U.S. President Jimmy Carter and Panamanian leader Omar Torrijos signed a treaty in 1977 that would gradually transfer both the canal and the Canal Zone from the United States to Panama by the year 2000. The treaty also initiated the transfer of administrative authority over regional water sources to Panama. In 1997, the Panamanian government created the Panama Canal Authority (ACP) and gave it the mandate of managing the canal for profit and "the human and socioeconomic development of the country" (Government of Panama, 1997). The quasi-autonomous state institution has operated the canal since 2000. Since then, the ACP, like its U.S. predecessor, has been responsible for the administration, maintenance, and use of regional water resources.

Today, the gringo engineers are gone, but the metal rods endure (see Figure 1), a reminder that canal administrators still manage the region's lakes, even though the waterway is now under sovereign control. Not only does the ACP manage reservoirs for ship transits, it also sells lake water to the national water utility for municipal use and hydropower to the national electrical utility (Panama Canal Authority 2014). It is not rainfall alone, but this historical assemblage of transportation, water, and power infrastructures that shapes how drought unfolds on the isthmus.

## THE DROUGHT

In 2014, Panama was the fifth rainiest country in the world (World Bank 2015). By August 2015, with the annual rainy season months overdue, the Panamanian government declared a state of emergency because an El Niño–related drought had affected more than two-thirds of the country. Concern was most acute in the metropolitan region around the canal. The government responded by suspending new water concessions for landscaping and agriculture, creating a water security commission to coordinate institutional efforts, and initiating a media campaign called "*Gota a gota, el agua se agota*" ("drop by drop, the water runs out"). The campaign asked residents to take individual responsibility for the drought response by reducing everyday consumption. The Panama Canal Authority announced plans to reduce the maximum ship draft—or depth below the water line—by 6 inches due to low water levels (which would force some ships to reduce cargo). After some rainfall, however, the restrictions planned for September were suspended.


**FIG. 3:** During a drought in 2015, Panamanian President Juan Carlos Varela proposed the creation of a new reservoir on the Indio River to increase regional water supply (PHOTO BY THE AUTHOR).

By the time I arrived in Panama in September 2015, the conversation was shifting from an emphasis on reducing demand to increasing supply. I attended a speech by President Juan Carlos Varela in Panama City about water problems. Speaking to a well-dressed crowd who had each paid 35 dollars to attend the event in a posh hotel, Varela attributed the national emergency to El Niño, deforestation, climate change, and individual consumption. He began by citing Pope Francis's encyclical—water is a human right—and concluded with a proposal to flood a new lake linked to the canal, which would displace an estimated 2,000 people in the process.[4]

Sitting in the audience as Varela discussed the project, I recalled what Juan had told Eneida decades before: "There will come a day when they will flood all of this and we'll have to move up higher." The drought was framed as a national emergency: an abnormal meteorological event that might portend a dryer future or a "new normal." But many rural people in the region would have recognized it as an "old normal" that fit a clear historical pattern of enclosure and displacement. Given the expansionist hydropolitics of the U.S. era and its relationship to issues of Panamanian sovereignty, I was surprised that nobody asked the president about the proposed lake or projected human displacement that was glossed as a "social consideration" (see Figure 3) during the hour-long question and answer period that followed. I should emphasize that the audience that night was a specific public, representative of the economic and political elite, not the rural and urban poor. I have no doubt that the reservoir proposal would have provoked questions elsewhere in the country.

4 The proposed site was the same location where, a decade before, the canal authority had attempted to create a reservoir to provide more water for an expanded canal before campesino social movements, the Catholic Church, and environmental groups succeeded in halting the project. The canal expansion proceeded and is slated for completion in June 2016, but the reservoir plan was shelved for nearly a decade until the 2015 drought response.

## AN INFRASTRUCTURAL EVENT

Political ecologists (Bakker 2000; Kaika 2006; Swyngedouw 2015) characterize droughts as socionatural phenomena that emerge at the intersection of meteorological variability, socioeconomic water demand and collective behavior, and broader discursive fields. But when do they begin? And where do they come from? Building upon the political ecology literature, I argue that some droughts can be seen as infrastructural events: slow disasters that are decades—even centuries—in the making and bound up with global circulatory systems built by humans.

Historian Scott Knowles (2014) observes that disasters unfold slowly, but we only tend to pay attention to their end points. It is no surprise, then, that politicians and pundits on the isthmus looked forward, not back. They predicted that drought might become normal—a permanent feature of modern life (Taylor et al. 2009)—due to climate change. While low rainfall is undeniably a manifestation of atmospheric patterns, drought also underlines how systemic risk (Collier and Lakoff 2011) can be built into the environment through infrastructure and made invisible through practices of insulation (Benson 2015; Starosielski 2015). At 52 million gallons per transit and 2 billion gallons per day, the Panama Canal uses an enormous volume of water, but political discourse and policy responses to drought did not emphasize reducing its use.

Conceptualized as an infrastructural event, the drought draws our attention to how Panamanian rainfall, rivers, institutions, and cities are linked to the metabolism of global transportation and trade. Panama is far from the only illustration of how planetary connection can format situated experiences of and responses to droughts. The emerging global virtual water trade network (Dalin et al. 2012) promises to shape the geography of drought occurrence and response in the future. In California, for example, the export of water-intensive crops such as almonds, pistachios, cotton, and rice siphons billions of gallons from the state's water supply. Almond and pistachio farmers used 1.245 trillion gallons of water in 2010—second only to alfalfa—and exported two-thirds of the nut crop (Philpott and Lurie 2015). There is an interesting, if imprecise, parallel to the Panama drought here. In both cases, the drought response discussion placed relatively little emphasis on the sectors using the most water. However, the canal does not produce commodities: it moves them. Its water problems are shaped by the infrastructural logic through which global transportation systems transform and make environmental demands on the places they cross. In the absence of the demands of these infrastructures and their far-flung publics, there would arguably have been no drought in the socioeconomic sense described above.

Engineered infrastructures provide an experience of


**FIG. 4:** The Panama Canal's locks require an enormous volume of fresh water to operate. Canal reservoirs also provide municipal water and hydropower for nearby cities (PHOTO BY THE AUTHOR).

environmental control, particularly over the short term and at smaller spatial scales. They provide warmth in winter, light at nighttime, fresh fruit out of season, and water in the dry season (Edwards 2003:188–189). But analyzed over longer periods and at larger spatial scales, our infrastructures—precisely because they buffer some of us, much of the time, from environmental processes—create the conditions for what Mike Davis calls "ordinary disaster" (1999). Through engineering hubris, false environmental assumptions, and shortsighted development policies, infrastructures facilitate and direct growth that they can ultimately no longer sustain. And yet, because economic development and cultural expectations are attached to the built environment thus produced—because systemic relations have momentum—it becomes difficult to change, to talk about reduction or redistribution rather than addition. ■

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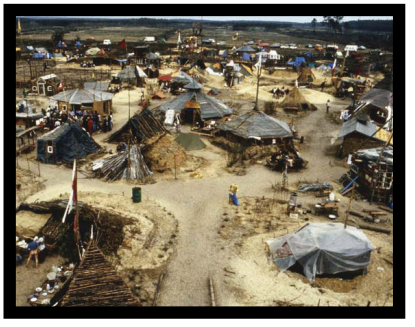
# NUCLEAR STATES, RENEWABLE DEMOCRACIES?

**Andreas Folkers** recalls how nuclear energy created a powerful counter-public in Germany beginning in the 1970s, and assesses the contemporary politics of energy alternatives.



**WHEN THE GERMAN FEDERAL PARLIAMENT** voted virtually unanimously in favor of an accelerated nuclear phase-out in June 2011, the country had finally reached its nuclear consensus. In the 1990s the then-reigning coalition between Social Democrats and the anti-nuclear Green Party had taken the first steps to ending the nuclear age in German energy policy. But now, only three months after the accidents in Fukushima, even the center-right government of Chancellor Angela Merkel, previously in favor of nuclear energy, could no longer resist the broad anti-nuclear sentiments in Germany. The decision to shut down all nuclear power plants before 2022 and to replace them with renewable sources of energy was widely seen as a precautionary measure to protect the population from a dangerous and utterly uncontrollable technology as well as an ecologically prudent step toward a (re)new(able) energy future. The broad consensus obliterated the conflicts once generated by atomic power in the (West) German public from the 1970s to the 1990s. Back then, the radical anti-nuclear movement did not regard their government as a precautionary state that protects them from catastrophic risks, but instead criticized it as a nuclear state and thus as an enabler of dangerous technologies and a genuine risk in itself.

The anti-nuclear movement and the recent history of German energy policy provide a particularly revealing lens on the dynamics of public infrastructures and infrastructure publics. Anti-nuclear activists in the 1970s and 1980s devised an effective political critique of technology that is paradigmatic for alternative and environmentalist movements of the late twentieth century. Members of the anti-nuclear movement and a number of associated critical intellectuals explicitly drew connections between atomic energy generation and the power of technocratic expertise, and between centralized energy infrastructures and the concentration of capital and political power. They pointed out both the health and political risks of nuclear energy and thereby turned energy infrastructures into a contested public problem. They also found ways to turn infrastructure into a terrain for political struggles in a very literal and material sense by

occupying construction sites for nuclear power plants and attempting to block the supply chain for nuclear energy. As an alternative to the nuclear state—which, they posited, required an anti-democratic energy infrastructure—they lobbied for an alternative form of energy generation and distribution that they hoped would have liberating effects: renewable energies generated locally by small business or individuals and distributed in decentralized grids. These dreams for an alternative energy future and a renewable democracy influenced the politics of the German energy transition often regarded as a globally significant attempt to make a rapid shift to renewables. Yet it did so under transformed conditions and in ways that the radical anti-nuclear activists could not have anticipated and likely would not have wanted.

**PREVIOUS PAGE AND ABOVE** Republik Freies Wendland. PHOTOS BY GÜNTHER ZINT.

Germany's first nuclear reactor was connected to the grid in 1961. But it was only after the oil crisis in the early 1970s that Germany's four vertically integrated energy companies promoted a massive roll-out of nuclear energies as a way to reduce Germany's dependence on foreign oil and to ensure the security of supply. Here the government did not act according to the precautionary principle (*Vorsorgeprinzip*) introduced into German environmental law around that time (Boehmer-Christiansen 1994) to protect the population against catastrophic environmental and technological risks. Rather, it acted according to the principle of *Daseinsvorsorge*, literally "taking care of existence," that guided the politics of infrastructure in the Federal Republic. Ernst Forsthoff, a legal scholar and disciple of Carl Schmitt, introduced the concept of *Daseinsvorsorge* in 1938. Forsthoff argued that the state had to ensure the provision of infrastructural services to a population increasingly dependent on centrally provided water, electricity, and transportation (Forsthoff 1938). He noted that the Nazi energy laws from 1935 were a crucial step toward the state of *Daseinsvorsorge*. The law guaranteed regional monopolies to the public utility companies, which were in turn obliged to deliver electricity at affordable prices to the population. These regional monopolies lasted until the unbundling of the electricity sector in the 1990s.

In the 1970s, government plans to build hundreds of nuclear power plants in a densely populated country caused growing unease among the West German public, which began to scrutinize the pretentions of the securing and caring state. With the successful protests against a planned reactor in Whyl in 1974, the anti-nuclear protest movement became a crucial factor in German politics. Local farmers, residents, religious groups, and peace activists protested together with members of the radical post-1968 student movement. The latter initially saw the anti-nuclear protests as an opportunity to spread their radical, anarchist, and communist beliefs to a broader public, but eventually adapted to the dynamics of the emerging ecological politics (Radkau 2011:226–229). The conflict was not between labor and capital or between capitalism and socialism: the problem shifted to technology itself, to the intrinsic political capacities and implications of sources of energies and their infrastructures.

The most prominent framework for understanding these problems was the concept of the nuclear state developed by dissident intellectuals and disseminated in pamphlets by the anti-nuclear movement. The notion of the "nuclear state" entered the scene with the publication of a book by the same title in 1977 by scientific journalist and political activist Robert Jungk. Jungk believed states that promote nuclear energy and/or weapons necessarily create a dangerous convergence of big science, big technology, big capital, and big government. He emphasized the various risks of nuclear energy and nuclear arms proliferation, but he was especially eager to point out the dangers of the nuclear security apparatus, from the planning for a nuclear war to emergency protocols specifying how to cope with an accident in a nuclear power plant. Jungk maintained that the dangers of nuclear technology could only be controlled (though never, of course, completely controlled) by an authoritarian political regime: "Atomic industries imply a permanent state of emergency under reference to permanent threat" (Jungk 1977:196; my own translation).

Jungk's argumentation resonates with concerns voiced by a number of other critical intellectuals at that time, such as Lewis Mumford's (1964) critique of "authoritarian technics" or the Frankfurt School's criticism of technocracy. In addition to these more general critiques of technology, authors such as Denis Hayes (1977) and Amory Lovins (1977) (whose works were immediately translated into German) and studies like the important "Energiewende" (Krause et al. 1980) by the Freiburg-Öko-Institut that emerged from the protests in Whyl focused critical attention on the problems of energy systems. In their own ways they all argued that the sheer size of nuclear infrastructures necessitates enormous concentrations of capital and a gigantic


**"Atomic industries imply a permanent state of emergency under reference to permanent threat."**

administrative apparatus. This in turn caters to the development of monopolies in the economy and hierarchical, authoritarian modes of state governance. Eventually the two spheres of state and economy, they argued, will fuse into a single technocratic machine ruled by experts.

Amory Lovins, whose work was a prominent, though at times controversial, point of reference in the German anti-nuclear movement (Radkau 2011:458), summarized the long list of concerns with what he called the "hard energy path," which "demands strongly interventionist central control, bypasses traditional market mechanisms, concentrates political and economic power, encourages urbanization, ...increases bureaucratization and alienation, ...inequitably divorces costs from benefits, enhances vulnerability and the paramilitarization of civilian life, ...reinforces current trends toward centrifugal politics and the decline of federalism, and nurtures—even requires—elitist technocracy whose exercise erodes the legitimacy of democratic government" (Lovins 1977:148). The common theme animating these diverse concerns and critiques was centralization: the centralization of energy production leads to a centralization of political power exercised by distant and detached technocrats over the dispersed and disempowered public.

In opposition to this technopolitical regime, the anti-nuclear activists placed high hopes in alternative forms of energy supply like solar and wind power. A soft energy path (Lovins 1977) or an *Energiewende*—the German name for energy transition popularized by the publication of the book by the same title in 1980 (Krause et al. 1980)—should not only entail new sources of energy but also a different distribution of political power. In his 1977 book *Rays of Hope*, which was translated into German just one year after its publication in English, Denis Hayes argued that "dispersed solar sources are more compatible than centralized technologies with social equity, freedom and cultural pluralism" (1977:121). If citizens were able to generate their own electricity through the use of windmills and solar panels, they would also be able to emancipate themselves from the remote control of technocracy: power to the people!

In the late 1970s and 1980s, experiments with alternative energy and alternative ways of life went hand in hand with militant protests against the construction of atomic power plants. Apart from a series of massive demonstrations in cities, the key strategy of the anti-nuclear movement was to occupy sites where the government and energy companies planned to build new reactors. After massive police force and brutality was deployed against these occupations, many activists felt their fears about a totalitarian nuclear state had been confirmed. The sites of occupation were not only battlefields with tear gas clouds, police helicopters, demonstrators with helmets, and German police with gas masks; they also served as a breeding ground for alternative ways of life. The most pertinent examples are the anti-nuclear village of Grohnde in 1977 and the *Republik Freies Wendland* ("Free Republic of Wendland") in 1980. The latter was formed in response to plans to establish a disposal site for nuclear waste in Gorleben, close to the border of the former GDR. With the help of concerned farmers from the potentially affected region, 5,000 activists from all over the country built an entire village of more than a hundred wood huts. This "free republic" had its own


**... VALID AS LONG AS HIS BEARER STILL CAN LAUGH** Passport for the Freie Republik Wendland. (BASED ON PHOTO BY HOLGER10/WIKIMEDIA COMMONS)

currency and issued passports for its "citizens."

It also established basic, primitive infrastructures by digging wells and constructing water pumps powered by windmills from recycled materials. Some of the water could even be heated with solar power. In contrast to the terrorist Red Army Fraction (RAF), which haunted German politics around the same time with its strategy of urban guerilla warfare, the anti-nuclear activists were much less violent, yet equally militant. They not only confronted the state directly in its capitals and metropolises, but imagined and constructed ways to escape the nuclear state's infrastructural networks of power by reclaiming the countryside and constructing alternative ways of life "off the grid."

In the 1990s, with no further plans for nuclear power stations on the horizon, the movement focused on the problem of nuclear waste. When the first waste transports were sent on their way from the nuclear reprocessing plant in La Hague, France, to storage sites in northern Germany, activists mobilized in protest. They organized sit-ins on the tracks as well as more-or-less elaborate schemes to sabotage the railways on which the transports had to pass. Though these protests never actually prevented the transports from reaching their destination, they generated public attention to the problem of nuclear waste and further raised the costs of nuclear power. Nearly 30,000 policemen were mobilized to secure waste transports against as many as 10,000 anti-nuclear activists positioned along their path.

Theories of the public sphere often emphasize the role of infrastructures in assembling and connecting political collectives. As early as 1927 John Dewey pointed to the ways traffic and communication made possible nationwide publics in his famous *The Public and Its Problems*: "Railway, travel and transportation, commerce, the mails, telegraph and telephone, newspapers, create enough similarity of ideas and sentiments to keep the thing going as a whole, for they create interaction and interdependence" (Dewey 1927:114). However, during the Castor waste transport protests, infrastructure did not just function as a means for the public to "keep the thing going." Rather, by rendering the infrastructure inoperable, the anti-nuclear activists enabled the constitution of a counter-public. The suspension

Anti-Castor protestors occupy railway tracks near Gorleben, 2010.
PHOTO BY GUENTERHH

of the functionality of the railway infrastructure turned the infrastructures of nuclear power into a matter of public concern. Like the workers who disrupted the flow of coal at the turn of the century (Mitchell 2011:21–27), the anti-nuclear activists formed a movement of disruptive democracy that exploited the vulnerabilities of centralized energy systems. Because of its very centralization, these systems depend on expansive infrastructure networks to distribute their power locally. The anti-nuclear activists explored the inherent dialectics of "infrastructural power" (Mann 1984) that can only operate globally and govern at a distance through local networks vulnerable to disruption.

By the 1990s, few members of the anti-nuclear movement occupied construction sites or railway tracks, but instead held powerful positions in the state they once fought. In 1998 the first federal government comprising a coalition between the Social Democrats and the Green Party (which emerged in part from the anti-nuclear and ecological movements of the 1980s) took office. One of their essential political projects was the nuclear phase-out and the promotion of renewable energies. The *Energiewende*—a concept with a utopian ring in the 1980s—became a state project. Government officials were eager to point out that the energy transition was not just another large-scale infrastructure project driven by a technocratic state. Subsidies for renewables should not benefit just huge energy companies, but also small businesses and private persons. They argued that the subsidies would level the field for renewables since they are only more expensive compared with fossil and nuclear energies when the negative externalities of the latter are not taken into account.

Among the key architects of the German energy transition during the Social Democratic and Green government coalition was Hermann Scheer, the member of Parliament chiefly responsible for devising new legislation promoting renewable energy. Scheer believed that beyond benefits for the economy and the environment, the promotion of renewables might also "renew" democracy. In numerous books Scheer laid out his vision for such a renewable democracy. Echoing the arguments of anti-nuclear movement, he believed that solar energy in particular could power democracy and local "energy autonomy" (Scheer 2007) because it does not rely on centralized energy infrastructures and huge, integrated energy supply chains. "The dense interconnections between individual energy companies…and other industries that result from fossil fuel supply chains will no longer be necessary. Shorter renewable energy supply chains also make it impossible to dominate entire economies. Renewable energy will liberate society from fossil fuel dependency and from the webs spun by the spiders of the fossil economy" (Scheer 2013b:89). It is not only the sources of energy per se that make renewables more democratic, but the infrastructures that might be assembled

Off Shore Windpark. North Sea, Germany. PHOTO BY LUTZ KOCH

around them: infrastructures that are smaller, more dispersed, and local, and that do not require huge concentrations of capital and political power.

In recent years the prospect of combining electricity and digital infrastructures has fired the imagination of renewable enthusiasts. Renewable energy infrastructures should not only be more decentralized, but also smarter than the old grids for fossil and nuclear energy. Smart grids and smart electricity meters promise to reduce the need for central steering. Instead, each individual should be able to monitor and control his or her energy consumption in economically and ecologically prudent ways while distributed signals, market mechanisms, and the inherent properties of electric current do the rest spontaneously. According to bestselling author and political advisor Jeremy Rifkin, the combination of internet technology and renewable energies will pave the way for a third industrial revolution that will leave the paradigm of centralized power behind and bring on an age of "lateral power.": "In the coming era, hundreds of millions of people will produce their own green energy in their homes, offices, and factories and share it with each other in an 'energy Internet.' The democratization of energy will bring with it a fundamental reordering of human relationships, impacting the very way we conduct business [and] govern society" (Rifkin 2011:2). The democratization of energy will also transform the economy and establish a new kind of "distributed capitalism" (Rifkin 2011:107–138) with smart energy networks that "function more like ecosystems than markets" (Rifkin 2011:104).

Rifikin prides himself on his impact on European politicians such as Angela Merkel. While Rifkin might tend to overstate his influence, it is plausible to argue that even the Merkel administration took on—though in distorted ways—some of the ideas and motives of the anti-nuclear movement. In the wake of the nuclear phase-out plans in 2011, the German government was eager to emphasize that the enforced energy transition will leave the old patterns of the nuclear age in which the state ensured the provision of services to a passive public. Rather, the energy transition should be a participatory project from the start. Shortly after the Fukushima accidents, Merkel appointed an ethics commission to develop political guidelines for Germany's energy future. One of its members was the sociologist Ulrich Beck, who has, since the publication of his groundbreaking book on the risk society (Beck 1986), continued to argue that a more prudent government of risks would have to go along with new and reflexive styles of politics in which critical publics engage in technopolitical debates with experts. Accordingly, the commission's report, issued in May 2011, which acted as the blueprint for the phase-out decision in June, emphasized the potentials for the "decentralized participation" of citizens during and after the energy transition.

"Users have multiple roles: they are market participants, 'consumer-citizens' and 'coproducers' in the energy system.... As political citizens they can take part in participatory processes of network expansion" (EKSE 2011:18; my own translation). Here the energy transition simultaneously figures as a project for an increased democratization and as a step towards a "distributed capitalism." As in the nuclear age, the intricate infrastructural entanglements blur the clear divisions between the political, the technical, and the economic, this time not in the state-capitalist megamachine, but on the side of the dispersed individuals enlisted to act as energy *prosumers*.

The reality is of course more complex. The higher volatility and geographical distribution of renewable energies currently requires more central steering efforts by four big network operators that are still natural monopolies, tightly monitored by state agencies. To enable the transmission of electricity from offshore wind parks in the North Sea to southern Germany, the country is currently establishing even larger electricity grids than those in the nuclear age. Advocates of decentralized renewable energies such as Hermann Scheer (2013a) criticize this recentralization of energy generation and the development of "supergrids." The energy transition is thus not a clear-cut regime change, but currently more of an interregnum in which new technologies and political agendas face path dependencies of persistent material infrastructures, political traditions, and personal dispositions. There is no simple passage in German energy policy from a nuclear state with a passive public receiving infrastructural services from a monopolistic utility companies to a renewable democracy in which citizens equipped with smart meters, rooftop solar panels, and a sense of civil and ecological duty act as active participants in the energy infrastructure. Rather, the history of the anti-nuclear movement shows that the degree of public interaction with the infrastructure does not solely hinge on this or that technology, this or that design of infrastructure networks. The anti-nuclear activists made an impact on the nuclear infrastructure with their occupations and blockades precisely because of the centralizations they criticized and deemed anti-democratic. And, in turn, the reason why the promotion of alternative forms of energy generation and the possibilities for a "material participation" (Marres 2012) in them today does not quite fulfill the hopes for decentralized forms of grassroots democracy is not because of smart technology, but because of a lack of ideas for smart and politically progressive uses of it. Not only material technologies but also political technologies—the arts and crafts of political action—make a difference here. Infrastructure and politics, energy grids and economic structures, expertise and hi-tech are intertwined in dense webs. But these webs are in no way "seamless" (Hughes 1986). Rather, they are full of gaps, unpredictable currents, and channels that allow for all kinds of electric and political forms of resistance. ■

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# Europe's materialism: Infrastructures and political space

Sven Opitz and Ute Tellmann explore energy infrastructure and the construction of a European commons.

**ON FEBRUARY 25, 2015, THE EU ACQUIRED** a new meaning: Since then this acronym not only stands for the *European Union*, but also for the *Energy Union*. Jean-Claude Juncker, who became president of the European Commission in 2014, launched a novel strategic policy focus that bears this weighty title. Energy is presented as the true force of European unification: "Energy is what binds us beyond borders" (Šefčovič and Cañete 2015). The Energy Union is expected to engender "true solidarity and trust" among the member states (European Commission 2015a:1). The Commission—the main executive body of the EU—hopes that "freely flowing" energy will create a unified Europe that acquires the strength and ability to "speak with one voice in global affairs" (European Commission 2015a:1).

On first sight, the name Energy Union might appear as just a rhetorical play on words intending to promote the energy policy of the Juncker Commission. But it is much more than that: The Energy Union is the latest incarnation of a long history of imagining Europe's political unification through infrastructural policies. "Infrastructural Europeanism" (Schipper and Schot 2011:246) began in the years after the First World War. After the Second World War, the Coal and Steel Union was the first building block for a political unification of Europe. While hopes of infrastructural unification ebbed and flowed since then, the Treaty of Lisbon in 2009 gave a new boost to the construction of Europe by infrastructural means. For the first time, trans-European networks of energy, transport, and communication became part of the "shared competence" between the EU and its member states.

In all these different incarnations and phases, infrastructures appear to harbor a political promise. In the long history of "infrastructural Europeanism," plans for infrastructural connectivity assume that roads, pipes, and cables help create a unity otherwise difficult to achieve given that multiple traditions, languages, and a political history of war divide the nations of Europe. Most recently, the debt crisis and the refugee crisis have provided prominent examples of the ongoing strife and division that reigns between the nation-states of Europe. In spite of these experiences or because of them, the current initiatives for trans-European networks intend to build a supranational unity through the material connectivity of infrastructures. Infrastructures promise to "make solidarity…operational" (European Union 2013:39).

But infrastructures themselves do not necessarily produce political unity. As the history of imperial rule, colonization, and globalization tells us, infrastructures may serve purposes of extraction or geopolitical control without being tied to a project of unification. For example, military bases, logistical cities, or offshore banking all rely on infrastructural connectivity, but these linkages are neither regarded nor operated as vital chains that bind a community. Infrastructures have to be built, maintained, governed, and used in a specific way to become a vehicle for creating a collective.

Europe is a rather interesting case for studying the fabrication of collectivity out of infrastructural connectivity. Different from the nation-state, Europe is lacking clearly defined territorial boundaries and a contiguous state space. Its political unity is always newly at stake, subject to experimentation and new forms of governing. Against this background, it is intriguing to look at the current infrastructure policy of Europe in terms of a collectivity in the making.

Unsurprisingly, it is impossible to understand the infrastructural collectivity of Europe apart from the language of the market. The idiom of a shared and single market functions as a key political term for negotiating and instantiating the political infrastructuralism of Europe. But the market is not a concrete term: its meaning and its material incarnations change. In the case of European infrastructuralism, the market appears in a twofold sense: it is end and means at the same time. On the one hand, the market is the means to create the common infrastructures of Europe. On the other hand, infrastructures are the means for producing the common European market. The European Commission takes the market and its infrastructural set-up to generate solidarity across a predefined political space. Yet, this solidarity is not understood to be co-extensive with the infrastructural network as a whole, which expands to other countries and regions outside of Europe. One has to look at the definitions of space and the definition of the market at the same time to understand the making of a European infrastructural collectivity.

**As the history of imperial rule, colonization, and globalization tells us, infrastructures may serve purposes of extraction or geopolitical control without being tied to a project of unification.**

At first sight, the link between infrastructure, the market, and Europe's spatial-political unity appears straightforward. Infrastructures are presented as the material backbones of a market-space, which is predefined in political and geographical terms. The regulations and communications of the EU envision a "Union-wide" and "pan-European" physical grid that ends the "isolation" of member states and leaves no "energy islands." Such a grid should make it possible to sell and to buy energy "from any source…anywhere in the EU, regardless of national boundaries" (European Commission 2011:13). We are confronted with a form of

PHOTO: LOCO STEVE

infrastructural unity that looks, to some extent, like a state writ large: The "pan-European" grid is thought of as a "connective tissue" (Edwards 2003) permeating the territories of its member states. The European Commission hopes to bring about internal cohesion through a contiguous and continuous connectivity of freely flowing energy.

To achieve such a physically defined geo-economy, certain market actors have a specific political role in the process of unification. In the most recent past, EU regulations put a strong emphasis on the transmission system operators (TSOs) that build and manage infrastructures for commercial gain. These enterprising entities recover their incurred costs through tariffs from network users (European Commission 2013:54). EU regulations delegate the public planning of the "pan-European" physical grid to the TSOs. Many have criticized this intermingling of commercial interest with the political role of devising the Ten-Year-Network Development Plan (TYNDP). Even subdivisions of the European governing bodies, such as the Committee on Industry, Research and Energy, which reports to the European Parliament, points at the predominant role of TSOs and project promoters and asks the Commission to ensure that assessments of economic, social, and environmental impacts are not influenced by commercial interests (European Parliament 2015:6).

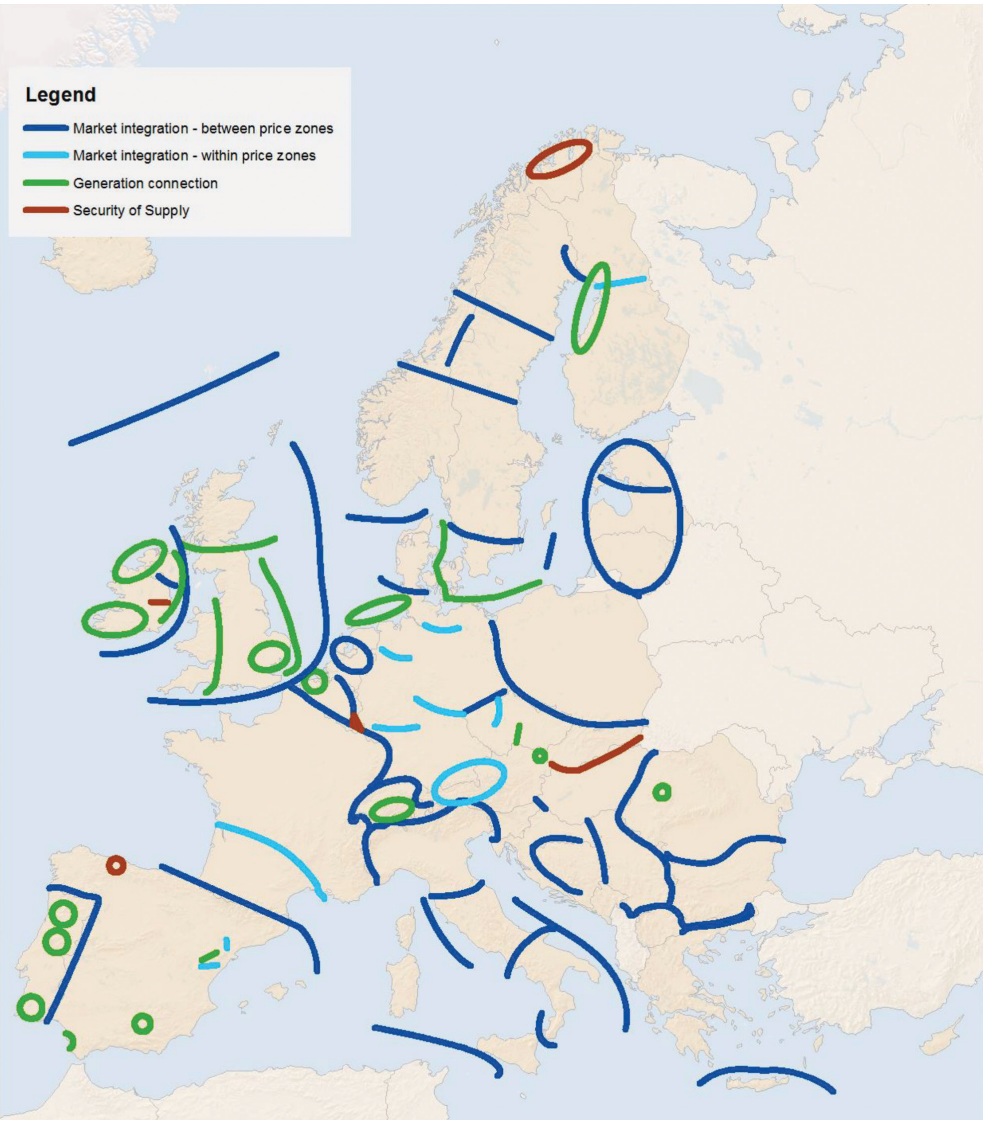


**FIGURE 1:** Map of main bottlenecks in the ENTSO-E perimeter (ENTSO-E 2014, P. 59).

The task of the European consortium of national TSOs is to conduct integrated market and network modeling to designate the "bottlenecks" of European integration. As a corollary report to the European planning process by the consultants of PricewaterhouseCoopers acknowledges, the notion of the "bottleneck" is a hybrid and normative term: "[B]ottleneck is not usually a blockage…it is a degradation in quality of service relative to some norm. What the norm is can often be a matter of judgment" (PricewaterhouseCoopers 2011:79). The norms that guide the definitions of "bottlenecks" amalgamate different concerns: unification of price zones and competition, increase of cross-border flows, integration of renewable energy, and the security of supply. They signal the need to improve connectivity across a geographical space. More than half (60%) of the 100 bottlenecks that the TYNDP (European Network of Transmission System Operators for Electricity (ENTSO-E) 2014:62) defines are associated with market integration, 30% with the integration of renewables. Interestingly, the integrated network and market modeling maps the space of the common market onto a contiguous geography that ignores not only the boundaries between European states, but at certain points also the boundaries between European members and non-members. As Figure 1 indicates, viewed through the lens of the Energy Union, Switzerland is as much a part of pan-Europe as is Tunisia, and bottlenecks between these borders need to be removed.

Yet the spatiality of infrastructural Europeanism is not fully captured by such a vision of a geographical market space. It conjoins a presumed geographical unity of Europe with an unbound topology of a highly fragmented


**RIGHT FIGURE 2:** Topological Europe. COURTESY OF THE EUROPEAN CLIMATE FOUNDATION

**FAR RIGHT FIGURE 3:** Project for a new interconnection between Italy and North Africa (ENTSOE-E 2014, P. 270)

common. We use the notion of topology to draw attention to the fact that infrastructural spaces are network spaces: they result from the particular relations forged by the pipelines, grids, and storage facilities. Whereas a geographical image of the common market presents us with a continuous and contiguous space, a topological understanding of space requires us to look specifically at how the grid is designed. Several factors are important in planning the grid. First of all, fundamental decisions about energy production shape the grid. For example, planning the infrastructural grid involves assumptions about desirable degrees of centralization or decentralization in energy generation. Infrastructures determine how sites of energy extraction are linked to sites of energy use. In addition, infrastructural connections entail definitions of borders and integration. They modulate the very contours of Europe's infrastructural space.

With regard to the topological dimension of Europe's infrastructural space, two aspects are particularly noteworthy: the first concerns the prioritization of physical connections that befit large and highly specialized sites of energy production; the second pertains to the status of borders within such an infrastructural vision of collectivity. Both taken together introduce a significant degree of unevenness into Europe's spatial constitution.

Highly indicative of the tension at the core of Europe's spatial order forged by infrastructural projects are so-called Projects of Common Interest (PCI). This category was introduced in the EU Regulation on Trans-European Energy Infrastructures (European Union 2013). Projects of common interest serve the implementation of "strategic trans-European energy infrastructure priorities" (European Union 2013:41). Although the PCIs are subjected to cost-benefit analysis and have to pass the test of market modeling, energy infrastructure projects become PCIs if they also serve a "wider European benefit," such as "market integration," "sustainability," or the "security of supply" in the case of electricity networks, or if they have "positive externalities" such as "security of supply, solidarity or innovation" (European Union 2013:47, 57). Selected on the basis of such criteria, PCIs benefit from simplified permitting procedures and could have access to public funding under the Connecting Europe Facility (CEF) or the European Fund for Strategic Investment (EFSI).

Interestingly, to become part of the Union-wide list of "common interest," projects do not necessarily have to traverse political borders. Technological connectivity can also possess a genuinely European quality if it is located in the territory of one member state only. One pertinent criterion for determining such PCIs within a country is the amount of voltage that a transmission line can bear. Only "high-voltage overhead transmissions lines" that change the "grid transfer capacity by at least 500 Megawatt" or projects that provides annual storage of 250 gigawatt-hours per year can belong to the "Union-wide list" of PCIs (European Union 2013:68).

The European importance of "high-capacity electricity highways" (European Commission 2013:6) results from the definition of so-called "priority thematic areas." The Energy Union requires a "high voltage grid" that can deal with "larger, more volatile power flows over larger distances across Europe" (ENTSO-E 2014:10). This is due to the assumption that "a significant share of generation capacities will be concentrated in locations further away from the major centers of consumption or storage", such as "offshore installations, ...ground-mounted solar and wind farms in Southern Europe or biomass installations in Central and Eastern Europe" (European Commission 2011:9). The "electricity highways" should accommodate wind and solar surplus generation in the North and Baltic seas as well as in southern Europe and northern Africa. Furthermore, "new generation hubs" and new major storage capacities in the Nordic countries and the Alps need to be linked with major consumption centers (European Union 2013:63).

The visual presentation of the Roadmap 2050, a project commissioned by the European Climate Foundation, pushes this topological coding of space a step further. It entails a montage produced by Rem Kohlhaas that depicts Paris as adjacent to the African desert (Figure 2). The image shows solar panels that capture the abundant energy in the Sahara to satisfy the demand in cities with iconic buildings and cloudy skies. This is not just the fantasy of an architectural firm; the EU itself has persistently aimed at linking large centers of energy generation "outside its territory" to the European networks, among them "northern African renewable energy sources" (European Commission 2011:13). Desertec, a large-scale project supported by a consortium of investors and planners, has probably been the most prominent initiative in this respect. Despite the fact that by the end of 2014 the vast majority of shareholders has withdrawn from the consortium and even though the most recent European

documents are more hesitant in depicting northern African countries as energy sources, the latest TYNDP still lists a "new interconnection between Italy and North Africa to be realized through an HVDC submarine cable" (ENTSO-E: 2014:272). In terms of infrastructure, Europe displaces its boundaries between inside and outside by forging differing degrees of connectedness (Figure 3).

Other attempts to further European connectivity beyond its political orders point to the southeast. In April 2015, Europe's continental synchronous grid was extended to Turkey. Reiterating the agenda of infrastructural Europeanism, Konstantin Staschus, secretary of the European consortium of TSOs, considered this not merely a technological achievement: "If there is no interconnection nothing can be done on integration from the political side of things or the markets. Electricity interconnection is the foundation for integration" (ENTSO-E 2015). The fact that network topologies are per se expandable thus seems to keep Europe from being spatially self-contained. While the latest infrastructure policy of the Juncker Commission clearly seeks to advance Europe's territorial cohesion by setting new "interconnection targets" between member states, by designing a new European Fund for Strategic Investments, and by defragmenting internal energy markets, the EU self-consciously declares at the same time that "the Energy Union is not an inward looking project" (European Commission 2015a:6). Instead, it "extends...beyond EU borders" (European Commission 2015b:12).

Europe is a moving target, not only because it has moving borders. The European common is an object of constant recalibration through commentary, proposals, regulations, and planning. The analysis we provide here should be understood as a snapshot of the European attempt to turn infrastructural connectivity into a new form of collectivity. European infrastructures are key sites where diverse political issues intermingle: the ecological with the geopolitical, the fabrication of a common with economic concerns. The analytical challenge, however, lies in recovering the political choices from the stubborn materiality of infrastructure and the dusty archive of regulatory literature connected to it. We have demonstrated that Europe has committed itself in a peculiar way to the idea of rendering a pan-European solidarity operational through trans-European networks. It envisions itself as what might be termed an "operative community," a form of political collectivity whose infrastructural connectivity furthers the common market and constitutes a space which combines both topographical and topological features. ■

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PHOTO: INFRASTRUCTURE AND PORTS AUTHORITY

# infrastructure made public

**Five year planning is dead. Long live the five year plan!** ANDREW BARRY **explores infrastructure's transparencies and opacities in the UK.**

**A FIVE-YEAR PLAN FOR DEVELOPING PUBLIC INFRASTRUCTURE OF A** nation-state sounds like an anachronism of state socialism. Yet in 2016, the UK government, led by Conservative Prime Minister David Cameron, published a five-year National Infrastructure Delivery Plan, covering all aspects of the nation's infrastructure such as transport, energy, housing, schools, and scientific research. In a striking echo of Lenin's famous analysis of the vital role of electrification for a socialist economy (Lenin 1920), the UK government pronounced that "infrastructure is the foundation on which our economy is built" (IPA 2016a).

If there are apparent continuities in the way the importance of public infrastructure to the economy has been conceived over the last hundred years, there are also significant differences. After all, there is no sense today that the UK's public infrastructure should necessarily be publicly owned or directly controlled by the state. On the contrary, the National Infrastructure Delivery Plan imagines a world organized through myriad regulators, nonprofit companies, and private corporations. The plan lays out the basis for a predictable future on which business can both capitalize and generate capital (Mitchell 2016).

Although, according to the UK government, the nation's infrastructure need not necessarily be owned by the nation-state, it is nonetheless public in a different sense. Indeed, one of the reasons for publishing a five-year plan is precisely to make the state of the nation's infrastructure public, fostering "transparency for the wider business community and general public about how the infrastructure they rely on is being maintained and improved" (IPA 2016a:24). This principle applies to a vast range of projects, including the high-speed rail line from London to Birmingham and Crossrail (an underground line connecting Heathrow airport to the City financial district and the East End) (fig. 1); super-fast broadband to 95% of all UK premises; new hospitals in Brighton, Birmingham, and Cambridgeshire; a Thames Tideway tunnel; 160,000 houses built on public land; five new prisons; a "world-class" public health laboratory; a nuclear reactor on the west coast of England (Hinkley C); and numerous flood protection schemes as well as major pieces of scientific infrastructure such as the Francis Crick institute ("a world leading" center for biomedical research) and even a Royal Research Ship.[1]

In emphasizing the importance of transparency, the British government is saying nothing unusual. In the past 20 years transparency has become a core principle of good governance. Indeed, there are a plethora of international agreements that include clauses promising transparency or public access to information, and international financial institutions such as the World Bank have been zealous in their promotion of the virtues of transparency. Even multinational companies seek to demonstrate their transparency, although arguably less now than they did previously. And lest anyone might think transparency is merely another manifestation of a wider neoliberal ideology, the idea is central to the program of the radical democratic organization DiEM25 (Democracy in Europe Movement 2025) recently founded by Yannis Varoufakis, the former finance minister of the Syriza government in Greece and one of the most prominent and vocal opponents of austerity in the European Union.

Yet if transparency has become a key term across the political spectrum, it has particular relevance to an understanding of


**FIG. 1:** One of the first of six Crossrail boring machines; each one has it's own name: Ada, Phyllis, Mary, Victoria, Elizabeth and Sophia. PHOTO: CROSSRAIL.

infrastructure, as the publication of the UK government's plan suggests. One reason for this should be clear: if the general public depends on the existence of infrastructures, then there is a public interest in infrastructure. But there is a second justification for transparency apparent in the UK government's plan: information about infrastructures needs to be made public because the state of a nation's infrastructure is an object of investment. The nation's infrastructure is constantly in the process of development; its component parts therefore need to be projected or planned and financed. Investors need to be aware of the attractive investment opportunities that infrastructural developments might bring. Naturally pipelines form a critical part of the nation's infrastructure. But, taken as a whole, the national infrastructure plan envisages a continuous "pipeline" of projects and investment opportunities.

There is sometimes the suggestion that infrastructure is best understood as something invisible or buried. It is the taken-for-granted base on which social and economic life rests, and only becomes visible when it breaks down (Star 1999). In practice, this is often not the case; urban residents, for example, need to be alert to the fluctuating state of the city's infrastructure, which is marked by frequent leaks, interruptions, and variations in speed, pressure of supply, or quality of service (Björkman 2015). Storms and hurricanes damage the nation's infrastructure, dramatically forcing the need for public investment (IPA 2016a:12). Businesses and the general public need up-to-date information about the state of a nation's infrastructure because this infrastructure is not a stable foundation, but a foundation that moves. After all, the physical state of infrastructures such as power stations, roads, and rail tracks never stay the same, and sooner or later they require repair; indeed, they undergo constant processes of deterioration.

The idea of transparency makes clear that the ongoing existence of infrastructures, whether they are pipes, roads, or cables, depends on their coexistence with a parallel infrastructure of knowledge production and information dissemination. If the future is to be predictable, it must be made knowable. Whereas

1 The research ship is intended for exploration of the Polar Regions. It was infamously named Boaty McBoatface following an online poll by the Natural Environment Research Council, and subsequently renamed Sir David Attenborough.

Lenin had once considered drawing on the experience of workers and peasants to counteract the dangers posed by the bureaucratization of the state, the contemporary developers of infrastructure contend that the ongoing and future existence of infrastructure depends on an army of financial analysts, developers, surveyors, environmental assessors, engineers, security advisors, and experts in risk management. Making infrastructure transparent is not a matter of making pipes and cables visible to the naked eye; it is instead a matter of making public a fraction of the knowledge continuously generated about infrastructure, thereby establishing a second-order infrastructure of information production. The UK government's infrastructure delivery plan itself is primarily concerned with the transparency of financial and investment information: its "sources and method provide a consistent, transparent and reliable estimate of infrastructure investment across periods, using publicly-available data" (IPA 2016b:3). Its authors cite the financial reports of public bodies and major energy, transport, and telecommunication corporations. However, as elements of the infrastructure plan—roads, broadband networks, flood protection schemes, research facilities—are progressively realized, other forms of information, such as assessments of infrastructure's environmental and economic impact, will also be made public (compare with Barry 2013). Multiple publics are thereby called into being and defined by the expectation that they should be progressively informed about an infrastructure's projected future, current state, and potential impact.

The UK government's five-year plan may be partly a way of stealing the language of the left. The wider ambition of the five-year British plan is not only to be a national economic project, but to affect a geographical shift: to transform the deindustrialized north of England, the political base of the opposition Labour party, into a "powerhouse." Conversely, the current leadership of the opposition Labour party has equally emphasized the strategic need for government funding for infrastructure, contradicting the government's fierce commitment to the virtues of austerity.[2] But by including private investment in the National Infrastructure Delivery Plan, the government has dramatically expanded the scale of investment in public infrastructure without the need for additional public borrowing. By making publicly owned land close to public infrastructure projects available to private developers, support is given to the UK government's prevailing policy that "affordable" housing is best provided by the market. The five-year plan also tells us something else about infrastructure today. Infrastructures are not, if they ever were, merely reducible to clearly delineated objects such as pipes, wires, tunnels, and bridges. The ongoing existence of infrastructure depends on the cultivation of consumers and businesses that have an interest, and generate interest through its future existence; transparency appears to offer governments and corporations a way of managing the relation between infrastructures and their publics, which needs to be sustained over time. But there is always a danger for multinationals as well as governments that transparency will lead to the demand for more transparency—indeed to publicity—about private deals and financial and legal arrangements, which is inevitably resisted. Infrastructure turns out to be much more than either Lenin or the current British government imagined: the "foundation" on which a damaged and unbalanced national economy can be reconstructed. In parallel, it has become a focus for debates both about what contemporary publics are and should be today, and what such publics need to know. ■

IN A STRIKING ECHO OF LENIN'S FAMOUS ANALYSIS OF THE VITAL ROLE OF ELECTRIFICATION FOR A SOCIALIST ECONOMY, THE UK GOVERNMENT PRONOUNCED THAT "INFRASTRUCTURE IS THE FOUNDATION ON WHICH OUR ECONOMY IS BUILT"

2 Speech by John McDowell to the Labour Party annual conference, September 2015.

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# HYDRAULIC PUBLICS

**Nikhil Anand explores why reforms to the Mumbai water system failed.**

Mumbai's public water network has long distributed water, difference, and inequality in the city. The city's hydraulic infrastructure, incrementally extended in the last 150 years, is today the sixth largest in the world. More than 7,000 city employees distribute nearly 3.5 billion liters of water daily by managing more than 4,000 kilometers of pipe. Their work makes possible the lives of more than 12 million of the city's residents, and generates handsome revenue surpluses for the city. Yet if the ledgers of the city's water department are overflowing with funds, maintenance works contracts, and, indeed, water, the city's hydraulic network does not distribute water continuously to individual households for 24 hours a day. Instead, water is distributed only for a few hours a day, and only to "co-operative housing societies"—in slums and high-rises alike— that then deploy various technologies to gather and distribute this water among their members every day.

Between 2003 and 2009 the Municipal Corporation of Greater Mumbai (MCGM) delegated a team of World Bank–appointed management consultants, Castalia Advisors, to reform and "improve" the distribution regime in one ward of the city. During this time, the consultants attempted to control leakages in the ward, audit water flows, and sought ultimately to transform the network from an intermittent system of scheduled supply to one in which water would be available to residents and commercial users 24/7. They attempted to convert the existing system from one in which the quantities of water distribution were rationed by the water schedule to one in which consumption would be regulated by price (see also Collier 2011; von Schnitzler 2013). In so doing, they proposed to shift the locus of regulation from state engineers to water meters charging 'rationalized' prices. The consultants at Castalia insisted that with this change, water would be more efficiently and equitably distributed.

This effort failed spectacularly in 2008 for a variety of reasons, not least because the consultants were unable to stabilize their measures of water during the water audit (Anand 2015). The reform effort also ran into trouble when slum dwellers opposed the pilot project, both through their daily practices, and by insisting that water was a public good. Here, I draw attention the ways in which residents regularly demand water, as a public matter, in the offices of city councilors and public hydraulic engineers. Their demands describe the quotidian ways in which hydraulic publics are made and managed in the city.

As a fecund and generative term, "public" has a variety of meanings. In his careful classification of its various uses, Jeff Weintraub (1997) draws attention to four different ways to understand the term: (1) as public *goods* (as opposed to those distributed by the market); (2) as political *communities* distinct from markets and the state (as the Habermasian public sphere, or Warner's (2002) counterpublics); (3) as a mode and space of stranger sociability that mediates between the bureaucratic realm and the space of the home (like Jane Jacobs's (1961) "eyes on the street"); and finally (4) as a category that demarcates a split between the family/household/*oikos* (as private) and a larger political masculine order that is public (Arendt 2013). Adjacent to, but drawing on elements of these definitions of the public, I demonstrate how publics are brought into being though efforts to care for and maintain water, and the enduring effects of water distribution infrastructures in the city (Marres 2012).

**HYDRAULIC CITY.** Water mains bring water from distant dams to the City. (PHOTO: NIKHIL ANAND)

## MATERIAL PUBLICS

Historians describe infrastructures as historical forms that emerged in the mid-nineteenth century to produce liberal forms of rule over citizen-subjects freed of the entailments of fragmentary political communities (Joyce 2003). As they proliferated both in the colony and the metropole, public infrastructures such as roads, water lines, and trains rearranged social collectives both in the country and the city. For example, the installation of public hydraulic infrastructure in Mumbai by the colonial government shifted publics from those congealing around the tanks, wells, and springs managed by wealthy native philanthropists to the taps, pipes, and political regimes of the colonial state (Dossal 1991). These colonial histories of public infrastructure continue to matter in postcolonial cities like Mumbai, and trouble the expectations of universal, undifferentiated service that frequently accompany accounts of public systems. The shifting history of the water infrastructure in the postcolonial city reveals how it has never produced a universal, homogenous public. Instead, the hydraulic public has long been plural—*publics*—and differentiated by different regimes, politics, and practices of infrastructure management in the city.

Mumbai's water network is structured to distribute water from large dams via trunk mains through secondary transmission lines to service lines. The reticulate form of the network distributes and gathers hydraulic publics in the city. On one hand, the nested scales of water distribution infrastructure allow the city water department to distribute different quantities of water to different regions of the city. On the other hand, to the extent that very wealthy and poorer residents often live alongside each other in the city, the city's hydraulic zones cannot easily discriminate between different classes of residents living in the same neighborhood and serviced by the same pipe (Björkman 2015). If publics are formed and distributed by the material entailments of the water network, these publics are often surprisingly heterogeneous and difficult to distinguish along class or religious lines.

**PIPE PUBLICS.** A gathering of water service lines in Mumbai. (PHOTO: JESSE SHIPLEY)

## PUBLIC PERFORMANCES

Publics are regularly reproduced through the quotidian maintenance and repair of water infrastructures in Mumbai. When water connections go dry, hydraulic publics today gather in the offices of city councilors (and not those of hydraulic engineers) to demand their share of water. Because city councilors in Mumbai owe their office primarily to the votes of those who live in the city's settlements, they are extensively focused on redressing the discrete grievances of their constituents. Many of them keep their offices open to the public in the evening, when residents of the many settlements they govern can come to have their problems redressed, or at least heard. Residents visit councilor offices with different kinds of problems, including domestic disputes, school admissions, or health matters. Yet, as councilors would often point out, most of their constituents' problems have to do with restoring water supply to their homes.

In the course of conducting fieldwork in 2007 and 2008, I documented several instances of such complaints in councilor's offices. When water pressure dropped in their service lines, women first approached social workers to arrange a meeting with the city councilor (see Anand 2011). Because water connections were shared, and because the councilors often responded to their claims more expeditiously, women ensured they went to the councilor's office as a "domestic public." This gendered gathering alternately entreated, demanded, and shouted at councilors to make the water reappear, as it should, for the "public" [using the English word]. They made claims to water

based on their kinship and/or friendship with those favored by the councilor. Councilors frequently noted their complaints and relayed them to the hydraulic engineer in charge of their ward, often at their next visit. Hydraulic engineers, recognizing that the approval of their works contracts was contingent on the good graces of city councilors, frequently found ways to solve these problems. Like councilors, engineers too recognized that their failure to resolve the problem would only make the complaints more vociferous. The city's publics, after all, needed water not just to live and to vote, but also to allow engineers to do their work without disruption.

Yet the engineers' ability to fix problems was contingent on the "political situation" of the city's water infrastructure (Barry 2013). The pipes, valves, and pumps that city engineers sought to fix to resolve one neighborhood's water difficulty were enmeshed in social/material relations with several others in other neighborhoods. Thus, even when councilors and engineers agreed to fix, repair, or install new water pipes for disconnected residents, they needed to negotiate how (and from whom) they could redirect water to remedy the situation. As they moved water to quell the demands of a protesting public in one neighborhood, they would invariably generate new protests, new petitions, and new publics in another. These publics (like the ones that preceded them) would demand that it is the duty of the government to "at least" provide water to its citizens. Because it is vital to survival, water was thus often and easily made a public matter (Fennell 2016).

## CONCLUSION

Publics are brought into being by the material and intimate political commitments to care about the enduring consequences of water distribution in Mumbai. Publics are situated and plural. They are formed around and by the materiality of the water network and its situated, regular, partial breakdowns in everyday life. Water infrastructures form and are formed by publics for whom water is a matter of life, and a matter *for* life. These publics emerge not only through associational relations between humans, but also through the various material infrastructures that are claimed, extended, and withdrawn through projects to govern the city. Public-ness therefore is not just an effect of human sociality, a political form that associates in already formed material worlds: publics are constituted through the distributed materialities that structure the city's water infrastructure. As publics emerge through the situated materialities and designs of the hydraulic network, these more-than-human arrangements of the hydraulic network create enduring if unstable forms whose politics continue to matter after they have been constituted.

Thus, having learned how to approach the city's authorities with their water problems—through collective, gendered petitions in the offices of councilors—residents of Mumbai's settlements were understandably anxious about water reform projects in the city. City publics, particularly those living in the settlements, have established a predictable and knowable (if also discretionary) practice of claiming and demanding water in the city through discrete claims in the offices of councilors and engineers. Throughout the pilot project, consultants saw these quiet claims and discrete flows as leakage, a pathology to eradicate through liberal reforms that would "free" the system from interference by councilors and engineers (and their politics). Yet, in contrast, residents wondered aloud about how and to whom they might register complaints in the future if the city's diverse water authorities were made redundant. In part, the pilot project failed to gather the support of the very residents for whom they claimed to be working because the proponents of privatization failed to recognize the vitality of water's public forms in a differentiated city. Challenged by both the subjects and the experts of the city's water system, the consultants' pilot project was effectively deferred to an as-yet-unknown future. As a result, Mumbai's water network today continues to generate known publics—differentiated communities of care—that demand the return of water amid (and from) mundane, ordinary disruptions in everyday life. ■

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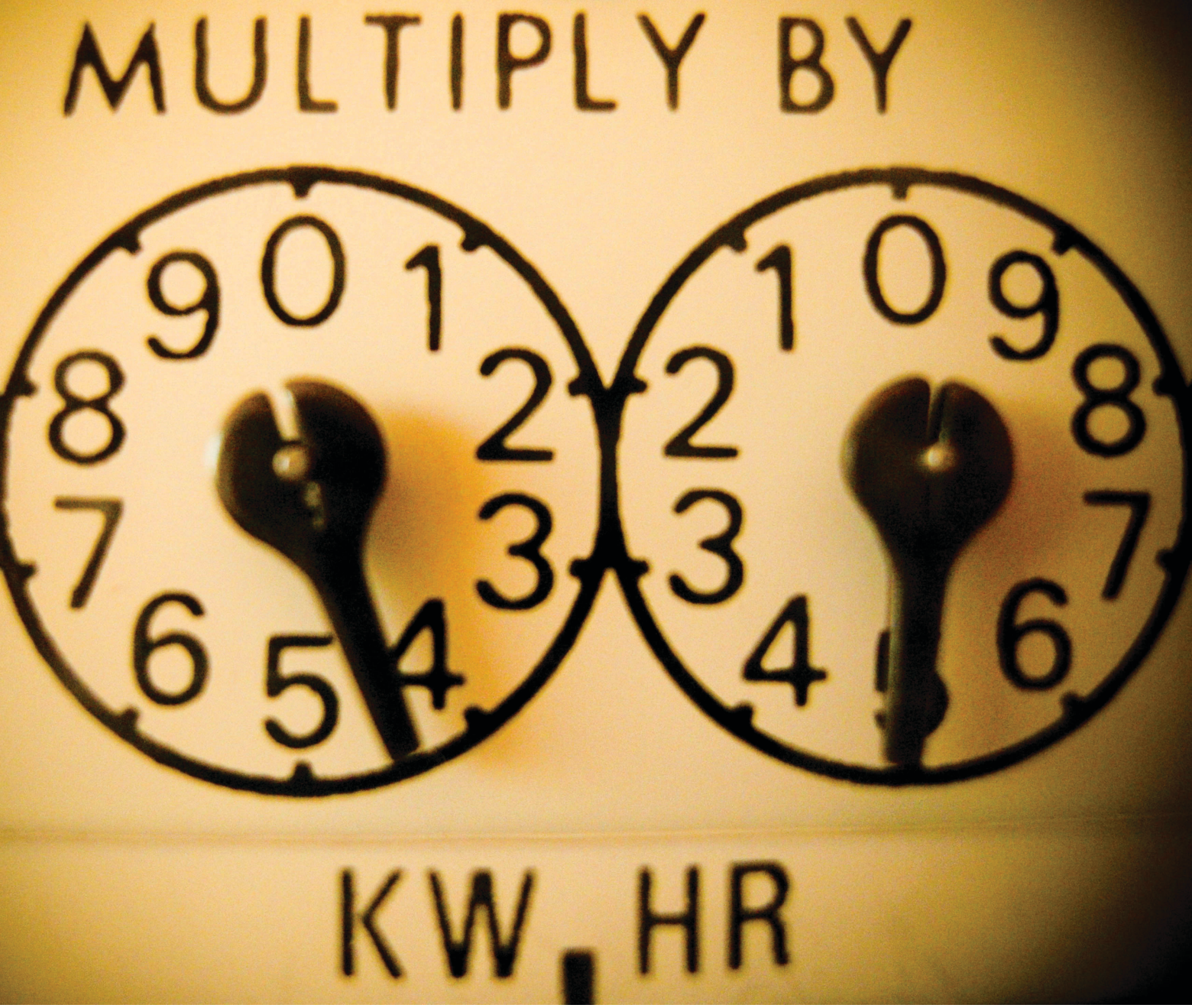


# Expertise in the grid

Do you know how to read your electricity bill? **Canay Özden-Schilling** examines how new electricity experts—and new publics—are creating and contesting the price of U.S. household energy today.

**AS FAR AS CONSUMPTION CHOICES GO,** electricity usage might seem uncomplicated. We don't shop for electricity: we receive it at home or at work, we get the monthly bill in the mail, and we pay it. What the bill doesn't reflect is the tremendous change in electricity infrastructure in the twenty-first century. Today, more and more electricity in the United States is bought and sold in seven competitive electricity exchanges before being delivered to consumers. Once widely believed by economists to be a *natural monopoly* good, electricity is now groomed as a market commodity par excellence. The burden and risk of creating organizing frameworks for buying and selling electricity now falls on a new, dispersed set of experts: electrical engineers who design markets (engineer-economists, if you will), traders employed by the buyers and sellers (i.e., generators and utilities), and computing experts who assist both market designers and traders. Even as electricity expertise splinters, these experts work together to create an infrastructure to transform both electricity producers and the electricity-consuming public into calculating economic actors. Whereas competition was once precisely the peril against which regulation was meant to protect producers and consumers, it is now seen as the safeguard of public good: the guarantee of efficiency and affordability for both producers and consumers. I find in my ethnographic research that the landscape of electricity is populated by new kinds of experts who promulgate this particular vision of competition and, importantly, discontented citizens.

For most of the twentieth century, economists and regulators considered electricity unsuited for competition (see Özden-Schilling [2015] for the origins of electricity's "natural monopoly" status). Large, vertically integrated companies produced, transmitted, and distributed electricity free of competition in delimited territories prescribed by state regulators. The transformation that recently occurred in the American electric infrastructure has a familiar alias: deregulation. Its origin story also fits the bill: the 1992 Energy Policy Act repealed restrictions on electric utilities to trade with each other—restrictions introduced under the New Deal—and allowed states to break up their monopolist utilities. The Federal Energy Regulatory Commission (FERC) followed suit in 1996 by announcing that it would allow nonprofit private companies to operate the electric grid as independent system operators (ISOs) and run markets simultaneously. Separate producers and distributors of electricity could now enter the industry as buyers and sellers of wholesale electricity. With prior regulations removed from the picture, markets could reign free. At least, that's what it looked like to critics who described deregulation (and its patron ideology, neoliberalism) as merely a negative, destructive process and as the "withdrawal of the state from many areas of social provision" (Harvey 2005:3; for a critique of this view, see Collier [2011]).

On a second look, deregulation is, in fact, *regulation reshuffled*, or regulation reassigned and redistributed to new actors. In the earlier regulatory environment, established during the New Deal, state regulation commissions functioned on the premise that utility companies had to be kept in check to secure public interest, which was reliable and affordable service. More often than not, they advanced the interests of the companies that welcomed the lack of competition and enjoyed close relationships with long-sitting regulators (Rudolph and Ridley 1986). Regulation now functions on the premise that competition enables both producers and consumers to perform at their best while also securing public interest in the form of reliability and affordability. Accordingly, the expertise required to circulate electricity freely and competitively itself should emerge competitively, and as such, cannot be contained in predetermined, centralized venues such as state regulation commissions.[1]

Today, there are seven ISOs across the country, each of which runs an electricity market and operates the grid based on market results. ISOs are responsible for the grid's long-term reliability, maintaining transmission lines and adding new ones as necessary. Although only 16 states so far have forced their monopolist utilities to unbundle,[2] electricity markets run by ISOs have grown to swallow those states that have not; they now cover all or parts of nearly 40 states. (There is no requirement for companies to unbundle to join ISOs. Therefore, for instance, a vertically integrated utility in New Hampshire, where deregulation has not occurred, still has to compete with other sellers and buyers across the six states that fall under ISO-New England's territory.) Across the ISOs' collective 2 million square miles of territory, state regulators now fulfill tasks that are derivatives of ISOs' functions: ensuring that utilities' retail prices do not diverge significantly from wholesale prices emerging in ISO-run markets, or approving—usually without a fight—ISOs' plans to expand the grid by adding new transmission lines.

Figure 2. Snapshot of the thermal map of real-time LMPs taken on 21 April 2014 at 07:35 PM. Source: https://edata.pjm.com/eContour/#

Regulators and the lawmakers who passed the Energy Policy Act of 1992, while familiar with electricity's quirks such as its land-boundedness and inability to travel more than a few hundred miles, were not fluent in the physics of electricity's exchangeability. At neither the state nor federal level did lawmakers propose the physical specifics of how a new regime of electricity with a multiplicity of buyers and sellers could be governed. What if, for instance, the intersection of electricity's supply and demand, where theoretically the competitive price must emerge, yielded a supply that transmission lines simply could not carry? New experts have emerged as the regulators of neoliberal electricity to answer such questions.

1 It is important to keep in mind that similar reforms were under way in Western Europe at the turn of the twenty-first century. Reformers in the United States observed and communicated closely with reformers elsewhere, especially those in the United Kingdom, where the start date of electricity deregulation predated that of the United States by a few years.

2 In seven additional states, the process is pending. See U.S. Energy Information Administration (2010).

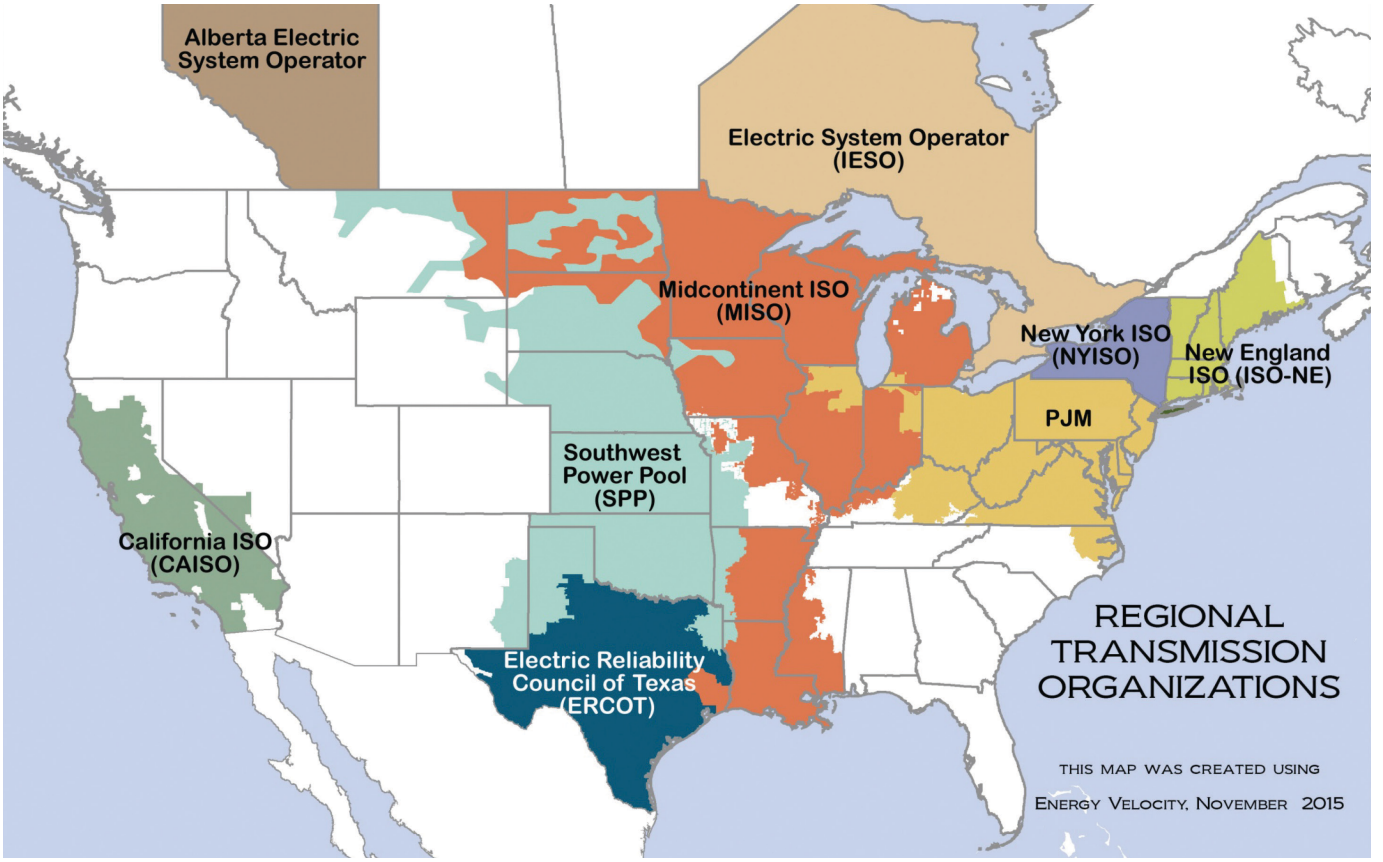


**FIGURE 1.** There are seven transmission operators in the United States, each of which operates an electricity market. SOURCE: WWW.FERC.GOV.

Some even explored a competitive avenue for electricity exchange and helped shape lawmakers' opinion in favor of deregulation well before deregulation became a legal possibility. In the early 1980s, a group of four academics based at the Massachusetts Institute of Technology and headed by Fred Schweppe, a professor of electrical engineering, sketched a spot-pricing mechanism to honor the physics of electricity as well as the textbook purpose of prices according to microeconomics: to reflect the varying costs of injecting and withdrawing electricity at different locations. A member of the group described the process to me as the "gluing of engineering and economics." A new kind of economics, one informed by the basics of microeconomics yet mindful of the physics of electricity, was in the making.

Today, all seven electricity markets in the United States use a mechanism called locational marginal prices (LMPs) that draws heavily on Schweppe's team's projections. LMPs are prices assigned to every designated "node" in the system (the substations where electricity is injected and withdrawn, and voltage is readjusted). Because LMPs are location specific, they are meant to reflect the varying costs of withdrawing and injecting electricity at different nodes of the grid that differ due to transmission line congestion in high-demand areas. With LMPs, Schweppe's team aimed to honor the economic view that prices are vehicles of information about the changing conditions of supply and demand on the ground. In the process leading up to April 1998, when the first American electricity market came online in California, electrical engineers like Schweppe accomplished the critical task of supplying ISOs with the mathematics of potential market arrangements. These engineers adopted the tools of economics—albeit in simplified, stripped-down articulations—and drew on economics as a discursive resource in their rhetorical advocacy for the introduction of competition. When one follows this kind of expertise, the history of deregulation only begins where critics like Harvey (2005) claim that it ends.

The influx of information workers into the electricity industry is the first tangible change that occurred in the twenty-first century in the United States. To be exchangeable, electricity must be standardized not only in terms of its physical properties (e.g., voltage and frequency, the standardization of which was already accomplished by the end of the nineteenth century when electricity industrialists built and connected large grids), but also in its computational representations. The buyers and sellers of electricity employ traders, who code electric flows into digital databases to forecast LMPs and make buying and selling decisions. Their models incorporate mountains of carefully organized data about electricity suppliers' and

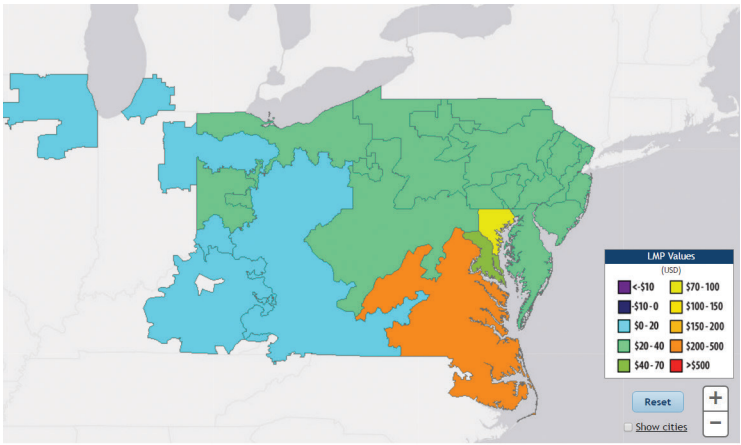


**FIGURE 2.** Locational Marginal Pricing Map from November 11, 2016 at 6:15 pm. This map shows the locational marginal price or LMP for each transmission zone in the region PJM serves.

buyers' properties and patterns of behavior. The neoliberal market appears as an "information infrastructure" (Bowker et al. 2010:98), which keeps the various actors that exchange electricity in computational tandem. The traders and market analysts often refer to the "granularity of data," the endless process of refining models, adding in relevant data, and weeding out the irrelevant, all with the goal of producing a more accurate forecast of LMPs. They feed their computerized LMP prediction models with data that go into market participants' bids and offers, such as generator fuel types, utility locations, and weather forecasts (since demand correlates strongly with weather). This work requires constant database building and maintenance. In contemporary electricity markets, the burden of organizing information is transferred from a central authority onto market actors, who, as data processors, turn commodities like electricity into computationally standard representations.

While traders primarily navigate these computing infrastructures, engineers work to enhance the physical infrastructure of the market: the electric grid. A "smart grid" is often defined as a grid upgraded with communication and information technologies. The smart grid, as imagined by engineers, also corresponds to an enhanced marketplace where communication and information technologies serve to better balance supply and demand. Smart grid engineers technologically intervene to decentralize the grid for better information circulation and better balance of supply and demand. Their project amounts to fashioning the grid in the image of a market as imagined by the economist Friedrich Hayek. In praising decentralized networks of information circulation, Hayek conceptualized the market as an information infrastructure reflecting the ever-changing supply and demand conditions on the ground that would be otherwise unknown to a central planner (1945). Similarly, smart grid engineers let various actors across the grid constantly exchange information (automatically, not personally) through technological devices, bypassing the ISOs' computers. In a more ambitious move, by designing new structures for monitoring consumer demand, smart grid engineers work to interpolate electricity users—all of us—into the domain of this enhanced marketplace. With the use of household devices, they hope, consumer-citizens who were relegated long ago to a passive relationship with the grid (i.e., receiving and paying a monthly bill) will soon be able to respond to real-time prices. Designs for household applications, like refrigerators and electric vehicles that solve optimization problems in constant communication with each other, are at a conceptual stage, yet they herald a new era that expands the domain of economic calculation and communication.

The new vision for electricity is scarcely challenged in the expert circles I outline here. But this vision does not address many political questions that saturate consumers' relationships with the grid. Consumers, cooperatives, and other public forces protested the previous regulatory regime because it was dominated by corporate interests (Rudolph and Ridley 1986); today, consumers might still find decision-making mechanisms located in ISOs and regulatory bodies out of reach. If we live in the countryside or the suburbs, we might find our landscape shot through with the metal bulk of the electric grid—transmission lines, towers, and substations—and our local energy sources depleted to produce electricity that bypasses us to go straight to centers of demand. The experts of the new regulatory environment, like the smart grid engineers focusing on household technologies, want us, the electricity consumers, to start reacting properly to prices, yet their models do not include new processes for us to learn how the prices are set or to protest when the prices pass utilities' costs onto us, or a mechanism with which to negotiate which costs they (and hence we) assume. While the experts are hoping to expand the domain of the economic to include our households, an emerging counter-public asks if the domain of public contestation and negotiation could be expanded instead.

A growing community is now after an alternative "economic imagination" (Appel 2014) for electricity, creating niches of possibility for alternative electric futures. These citizen activists were jolted into electricity politics in recent years when massive new transmission lines were proposed to cut through their neighborhoods. In 2007, the citizens of West Virginia's Jefferson County learned of the Potomac-Appalachian Transmission Highline (PATH), a proposed 765-kV line to deliver the cheap coal power of West Virginia 275 miles east to demand centers on the Atlantic coast.[3] Once the ISO approved the line as a requirement for the grid's future reliability, they were told, it would acquire the privilege of eminent domain. Wary of accusations of self-interested "NIMBYism," the organizers—mostly women—questioned whether the line was necessary at all. The difficulty of countering engineering arguments, of course, is part of how nonspecialist citizens often find themselves outside decision-making

3 PATH was the joint project of two major utilities, AEP and FirstEnergy.

mechanisms.

While dedicating themselves to online, self-directed research into the obscure regulations governing ISOs during the five-year battle that followed, the StopPATH movement has managed to reveal the line's role in the ISOs' economic functions and democratic dysfunctions. ISOs were promoting the delivery of electricity over long distances to enable long-distance trade: by bringing prices closer across large territories, long-distance lines would give producers far from demand centers a chance at increased profit and further the ISOs' goal to boost competition. On the other hand, when electricity travels over a long distance, the decision-making mechanisms also move farther and farther away from affected communities, to places where citizens do not hold voting privileges or access to representation. Carrying "coal by wire," as they put it, the line would both use up local resources in West Virginia and, in the long term, raise electricity prices for West Virginians by bringing them closer to those in demand centers, all without citizens' meaningful participation. Couldn't electricity flows *and* decision making take place, StopPATH asked, in shorter and more accessible circuits?

In 2012, the ISO (PJM-Interconnect) cancelled PATH, although without acknowledging StopPATH's savvy, engaged activism at the county, state, and federal levels. The movement remains active; its members have since refocused their efforts onto other electricity-related matters[4] and allied themselves with similar movements across the United States, including an Illinois-based group currently fighting against the construction of the Rock Island Clean Line (RICL). In questioning the need for a new transmission line to bring electricity from proposed wind power plants in Iowa to already wind-rich regions of Illinois,

4 Former StopPATH leader Keryn Newman has recently won a fight she has been pursuing at FERC to gain a refund of the cost of the cancelled line's public relations advocacy activities that were collected from all PJM consumers. More can be found on her blog (http://stoppathwv.com/stoppath-wv-blog.html).

**FIGURE 3.** Citizens and transmission lines, coexisting uneasily in West Virginia. PHOTO BY AUTHOR.

Block RICL[5] asks if the only way to introduce more renewable energy into the grid necessarily involves reinforcing a politically failing system and destroying, in RICL's case, thousands of acres of what they say will become a "nonrenewable" source of life upon the construction of the line: farmland.[6] Both groups are adept at locating electricity in the larger world of energy flows, though the ISOs continue to ignore their proficiency. While their proposed solutions often include a distributed vision for electricity production in a way that might echo the experts' vision for electricity, their approach to distributive justice is different in scope: it demands a distributed vision for political representation and an interrogation of the vestiges of the old electricity regime still upheld in expert designs such as strict divisions between producers and consumers, and electricity's status as an object of profit before a good for collective life.

To understand the new infrastructural landscape of electricity, I suggest following both experts as they tweak electricity to enable neoliberal relationships and citizen groups as they pose democratic challenges to that project. Such a task is critical to understanding how electricity flows are organized to generate new understandings of expertise and publics. It may help us not only to attend to the making of neoliberalism on the ground, but may also help us understand its limits. A new, more critical look at your electricity bill is in order. ■

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5 More on Block RICL can be found at http://www.blockricl.com/.

6 The farmers I met in Illinois explained that the damage to farmland from the introduction of transmission lines and towers goes beyond the announced square footage that the equipment is supposed to occupy. The concrete structures compress the soil and the circling around the towers to work the land (at times simply impossible given the size of the farm equipment) introduces the overspraying of crops and further soil and crop damage.

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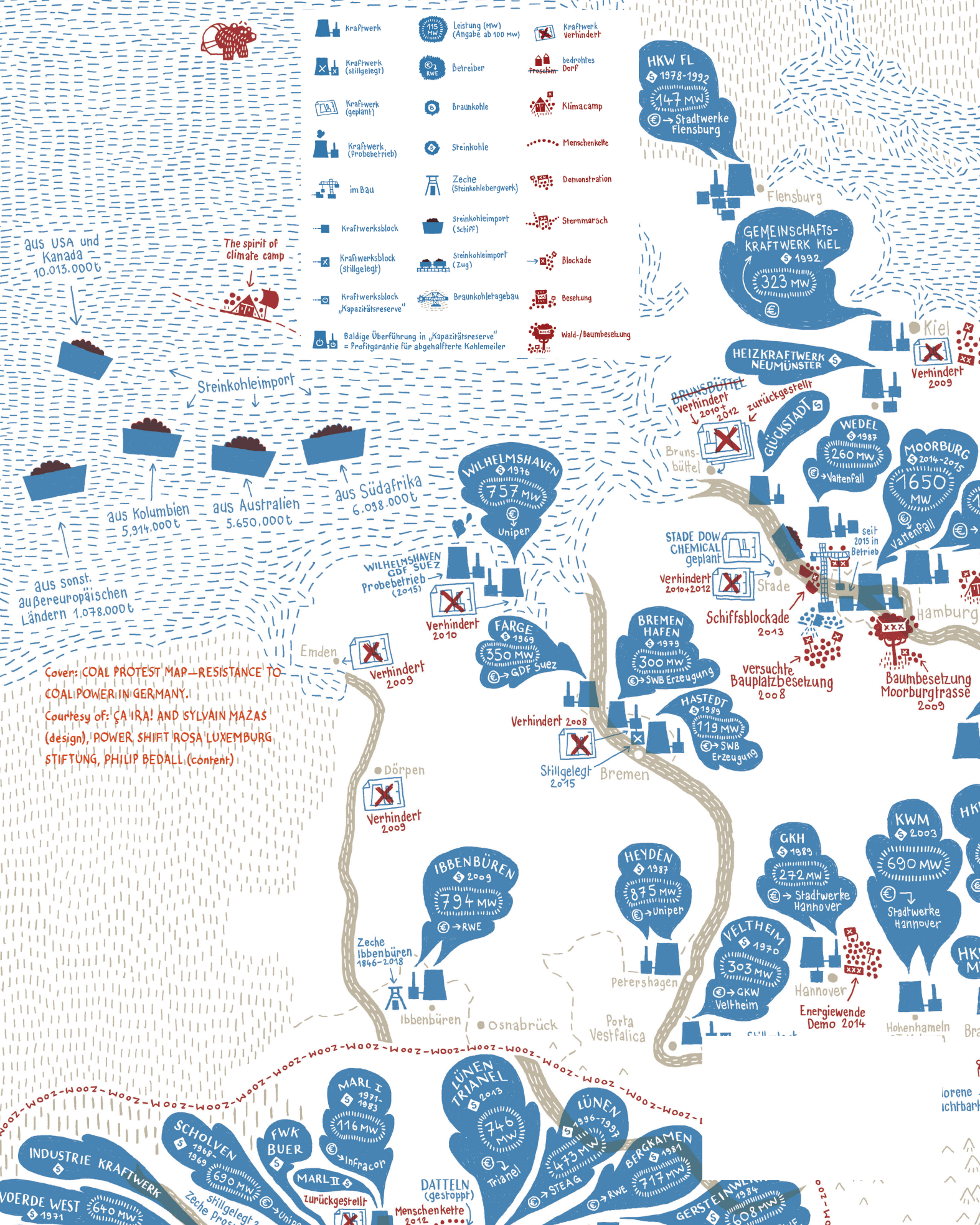
Kraftwerk
Kraftwerk (stillgelegt)
Kraftwerk (geplant)
Kraftwerk (Probebetrieb)
im Bau
Kraftwerksblock
Kraftwerksblock (stillgelegt)
Kraftwerksblock „Kapazitätsreserve"
Baldige Überführung in „Kapazitätsreserve" = Profitgarantie für abgehaltferte Kohlemeiler
Leistung (MW) (Angabe ab 100 MW)
Betreiber
Braunkohle
Steinkohle
Zeche (Steinkohlebergwerk)
Steinkohleimport (Schiff)
Steinkohleimport (Zug)
Braunkohletagebau
Kraftwerk verhindert
bedrohtes Dorf
Klimacamp
Menschenkette
Demonstration
Sternmarsch
Blockade
Besetzung
Wald-/Baumbesetzung
aus USA und Kanada 10.013.000t
The spirit of climate camp
Steinkohleimport
aus Kolumbien 5.914.000t
aus Australien 5.650.000t
aus Südafrika 6.098.000t
aus sonst. außereuropäischen Ländern 1.078.000t
HKW FL
1978-1992
147 MW
→ Stadtwerke Flensburg
Flensburg
GEMEINSCHAFTS-KRAFTWERK KIEL
1992
323 MW
Kiel
Verhindert 2009
HEIZKRAFTWERK NEUMÜNSTER
BRUNSBÜTTEL
Verhindert 2010+2012
zurückgestellt
Brunsbüttel
GLÜCKSTADT
WEDEL
1987
260 MW
→ Vattenfall
MOORBURG
2014-2015
1650 MW
Vattenfall
seit 2015 in Betrieb
WILHELMSHAVEN
1976
757 MW
Uniper
WILHELMSHAVEN GDF SUEZ
Probebetrieb (2015)
Verhindert 2010
STADE DOW CHEMICAL geplant
Verhindert 2010+2012
Stade
Schiffsblockade 2013
versuchte Bauplatzbesetzung 2008
Baumbesetzung Moorburgtrasse 2009
Hamburg
Emden
Verhindert 2009
FARGE
1969
350 MW
→ GDF Suez
BREMEN HAFEN
1979
300 MW
→ SWB Erzeugung
HASTEDT
1989
119 MW
SWB Erzeugung
Verhindert 2008
Stillgelegt 2015
Bremen
Dörpen
Verhindert 2009
IBBENBÜREN
2009
794 MW
→ RWE
Zeche Ibbenbüren 1846-2018
Ibbenbüren
Osnabrück
HEYDEN
1987
875 MW
→ Uniper
Petershagen
Porta Westfalica
VELTHEIM
1970
303 MW
→ GKW Veltheim
GKH
1989
272 MW
→ Stadtwerke Hannover
Hannover
Energiewende Demo 2014
KWM
2003
690 MW
→ Stadtwerke Hannover
Hohenhameln
Cover: COAL PROTEST MAP—RESISTANCE TO COAL POWER IN GERMANY.
Courtesy of: ÇA IRA! AND SYLVAIN MAZAS (design), POWER SHIFT ROSA LUXEMBURG STIFTUNG, PHILIP BEDALL (content)
MARL I
1971-1983
116 MW
→ Infracor
MARL II
zurückgestellt
SCHOLVEN
1968-1969
690 MW
Stillgelegt
FWK BUER
INDUSTRIE KRAFTWERK
LÜNEN TRIANEL
2013
746 MW
→ Trianel
LÜNEN
1996-1997
473 MW
→ STEAG
DATTELN (gestoppt)
Menschenkette 2012
BERGKAMEN
1981
717 MW
→ RWE
GERSTEINWERK
1984
608 MW
VOERDE WEST
1971
640 MW