SPACESHIP IN THE DESERT

ENERGY, CLIMATE CHANGE, AND URBAN DESIGN IN ABU DHABI

GÖKÇE GÜNEL

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EXPERIMENTAL FUTURES

Technological Lives, Scientific Arts, Anthropological Voices

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ENERGY, CLIMATE CHANGE, *and* URBAN DESIGN *in* ABU DHABI

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Introduction: The Soul of Carbon Dioxide

In May 2011, shortly before I left the United Arab Emirates, I took a long cab ride with Marco from Masdar City to Dubai. Marco was an Ecuadorian man in his late thirties and had been working with Abu Dhabi's Masdar Carbon as an environmental consultant for about two years, focusing on climate change policy. I had been researching Abu Dhabi's emergent renewable energy and clean technology infrastructures, spending my days on the same floor as Marco for almost a year, but we had never exchanged words before taking this ride. My cubicle was a few feet away from his office, which, despite its glass partition wall, afforded him relative privacy. He also specialized in a project that I did not know much about and did not collaborate very often with my group. But on this afternoon, for reasons purely coincidental, we were headed to our apartments in Dubai, sharing the back seat of a heavily air-conditioned Toyota.

Masdar, where Marco worked and I conducted research, had officially been founded in May 2006 as a multifaceted renewable energy and clean technology company. Abu Dhabi–owned Mubadala, an investment company that seeks to facilitate economic diversification in the emirate, provided funding for the project. The word *masdar* means "source" in Arabic, an origin from which something comes or can be obtained. The company was widely known for Masdar City, the "futuristic" eco-city that had been

master-planned by the London-based architecture firm Foster + Partners to rely entirely on renewable energy. Prior to being selected as the planners for Masdar City, Foster + Partners had designed famous projects such as the Gherkin in London and the Reichstag in Berlin, and were also working on a building in Abu Dhabi called the Souk, Abu Dhabi Central Market.[1] Their Masdar City master plan would offer living and working space to fifty thousand residents and forty thousand commuters in a 640-hectare area neighboring the Abu Dhabi International Airport, the Yas Marina Formula 1 Circuit, and the Al Ghazal Golf Course.[2] Strategically located to facilitate transportation for the renewable energy and clean technology professionals who would live on site, Masdar would be linked to the airport by existing roads. A twenty-minute drive from Abu Dhabi proper and about an hour's drive from Dubai, the site was situated to serve as a hub for the UAE's renewable energy and clean technology sector.

While the eco-city and its multiple infrastructure facilities were central to Masdar's development, Masdar had also been investing in renewable energy via its other operations—Masdar Power, Masdar Carbon, and Masdar Capital—in an attempt to ensure that Abu Dhabi would remain a significant player in the energy industry well after its oil reserves run dry or become less valuable. Masdar Institute, the energy-focused research center that was set up and supervised by the Massachusetts Institute of Technology's Technology and Development Program, operated on a growing campus amid the fledgling eco-city.

During 2010 and 2011, the period of focus for my research into renewable energy and clean technology infrastructures in Abu Dhabi, the Foster-designed Masdar Institute campus was the only operational structure at the Masdar City site (though other buildings such as the Siemens headquarters were under construction). The campus had officially been inaugurated in November 2010 (see chapter 1). It provided classrooms, laboratories, office space, and dormitories for Masdar Institute students and faculty, and housed a cafeteria, a sushi restaurant, a coffee shop, a small gym, a library, and an organic grocery store. Yet most of the professionals working with Masdar, such as Marco, spent their days in a simple makeshift compound next to the Masdar City parking lot that was intended to be dismantled upon the construction of the Masdar headquarters building. The compound had a separate cafeteria, but occasionally Masdar employees walked, took a shuttle bus, or rode the personal rapid transit pods

FIGURE I.1 · Masdar City

to the Masdar Institute campus to have lunch at the sushi restaurant or take a coffee break at the Caribou Café branch. Some Masdar employees also frequented the Institute building to collaborate on research projects or supervise the construction process. Depending on my daily research schedule, I divided my time between the Masdar Institute campus and the compound and took rides back to Dubai in the evenings.

For about a thirty-mile stretch, the eighty-mile road from Abu Dhabi to Dubai was ornamented with date palms, green grass, and at times wildflowers. While there were no clear estimates of how much water was required for these landscaping practices, it was widely believed that the Abu Dhabi government expended an extraordinary amount of resources to keep these roads verdant, nearly as much as the military budget for the emirate. They used desalinated water to take care of the imported plants. When these plants died, they quickly replaced them with new ones, within a matter of hours. The vegetation was even more manicured around the Masdar City site due to the construction of a VIP airport for members of Abu Dhabi's ruling family.

Looking out the window, Marco began drawing on his knowledge of ethnobotany to suggest that the plants were actively rejecting their new location. They did not want to be here. He recounted to me that at the age

FIGURE 1.2 · Imported flowers on the road from Masdar City to Dubai, as seen from inside a car, 2014. Photo by the author.

FIGURE 1.3 · Date palms on the road from Masdar City to Dubai, as seen from inside a car, 2014. Photo by the author.

of ten, in the jungle together with his parents, he had tried *yage*, a hallucinogenic drug obtained from an Amazonian vine known as *ayahuasca* and used in ceremonies among the indigenous peoples of the Amazon basin. This experience had served as the beginning of his cosmological education. The jungle had become alive, demonstrating its interiority in a way that had astonished Marco. In further developing his ontological theories, Marco had been influenced by Carlos Castañeda, Richard Evan Schultes, Fritjof Capra, Albert Hoffman, and Ken Wilber—writers interested in hallucinogenic experiences and in seeking to combine spirituality with scientific findings. And now he was reading *Return of the Children of the Light: Incan and Mayan Prophecies for a New World* (2001), by Judith Bluestone Polich, which proposed that all matter was made of light: "The new worldview will make it evident that the world we live in is part of a larger whole. We will be able to perceive that all matter is energy, that we are wave-like, that we are in constant communication with the whole. Through this shift in consciousness, we will begin to function as multi-dimensional beings, and we will realize we have potentials beyond anything yet dreamed of, adding our heightened light vibration to the Earth's own."[3]

I had read Carlos Castañeda's *The Teachings of Don Juan: A Yaqui Way of Knowledge* (1968) some years before moving to the UAE, and knew a little about the other authors Marco mentioned.[4] In *The Teachings of Don Juan*, Castañeda experiments with peyote, jimson weed, and magic mushrooms on the path to becoming "a man of knowledge" (under the strict guidance of his mentor Don Juan). It was surprising to hear this writer's name in association with the plants on Abu Dhabi's medians. I analyzed my experiences there differently. Before I had arrived in Abu Dhabi in the summer of 2010, when I was still preparing for my time there, Jack, an American faculty member at Masdar Institute who held a PhD in engineering science, had asked me over the phone if my research would result in a book like Bruno Latour's *Aramis, or the Love of Technology* (1993). In that book, Latour embarks on a sociological investigation of the failure of Aramis, a high-tech automated personal rapid transit (PRT) system that was developed in France during the 1980s; he seeks to convince his readers "that the machines by which they are surrounded are cultural objects worthy of their attention and respect."[5] Given the presence of a similar PRT system in Masdar City, the association was perhaps understandable. Glad to share a common vocabulary, I conveyed to Jack that the reference to

Aramis accurately reflected some of the goals of my research. But Marco's allusions to writers like Castañeda were a bit difficult to fathom in this context of high-tech renewable energy projects.

Marco was quick to explain that his ontological theories fit the market-based technological projects of Masdar. He imagined humans would soon awaken to a new understanding of how animals and plants, but most importantly carbon dioxide, have souls. Over the past few years, Marco had been developing some practical tools to acknowledge the soul of carbon dioxide. He believed that a market-based system would be an effective mechanism for suspending the differences among humans, animals, plants, and carbon dioxide: all beings would be redeemable in cash, made equivalent under a common denominator. Before he was recruited by Masdar Carbon, Marco had worked with a number of climate change consultancies around the world. He explained that he had started out at a critical moment, just as the global governance of climate change was becoming more urgent. Unlike many of the consultants he worked with, he had faith that global governance could sort out the climate change problem, and he reminded me that we were still at the very beginning of the Kyoto Protocol—that the treaty had been adopted in 1997 but entered into force only in 2005. The Kyoto Protocol was an international agreement that bound its signatories to certain carbon dioxide emission reduction goals. It acknowledged that developed countries were responsible for the high levels of greenhouse gas emissions due to more than 150 years of industrial activity, and it placed a heavier burden on these nations in mitigating climate change. Marco perceived the Kyoto Protocol as a significant first step toward a global emission reduction regime that would eventually allow humans to control emission levels, providing the groundwork for future international collaboration on climate change. The climate change regime would improve, but it would take time. Carbon markets, created as part of the Kyoto Protocol, were small (roughly the size of the flat-screen TV market), but they helped everyone understand that the air was not free. Through carbon markets, we could recognize carbon dioxide as a spiritual being.

As we approached Dubai, the plants disappeared, the quality of the asphalt changed, and the road became bumpier. Abu Dhabi could invest in iconic projects like Masdar City, but Dubai had been shaken significantly by the economic crisis of late 2008, an event that made the differences

between the emirates more evident. Once a small fishing and pearling community, Dubai grew as a trading center in the early twentieth century. The oil revenues of the 1960s facilitated a frenzy of consumerism and helped accelerate the early development of the city in the 1970s and 1980s. The city invested in aviation, financial services, tourism, and real estate, managing to diversify away from fossil fuels and attract foreign white-collar and blue-collar labor. As of the mid-1990s, non-oil revenues constituted about 90 percent of Dubai's economy. Because Dubai was more susceptible to the booms and busts of the global financial markets than its oil-rich neighbor Abu Dhabi, it had felt the impact of the 2008 crisis more forcefully. Many argued that the real estate bubble that had propelled Dubai's expansion—enabling some of the city's more fantastical projects, such as the construction of an archipelago of small, artificial islands in the shape of the world map, situated 2.5 miles off Dubai's coast—had finally burst. In late 2008 and early 2009, the international media reported on white-collar workers abandoning their cars with the keys in the ignition at the airport parking lot, leaving the city for good.[6] Blue-collar workers were losing their jobs in the construction sector and looking for ways to return to their home countries. More than two years after the crash, the impact of the financial crisis still remained visible. We drove past billboards advertising recently shelved real estate development projects. One billboard promised that Dubai's coastline could be doubled, while others promoted theme parks. There had also been plans to import a blue whale, which would live inside an aquarium in the largest shopping mall in the world, but no one really talked about this prospect any more. Dubai had planned to re-create nature for itself through bold gestures; after the crisis, the city was transformed, marred by abandoned construction sites.

When I stepped out of the taxi outside my apartment building in Dubai, Marco pleaded, "Please don't think I've gone crazy."

Technical Adjustments

This book has three aims. First, it seeks to understand how cosmopolitan, innovative actors in Abu Dhabi, such as Marco or Jack, set about the task of building a renewable energy and clean technology sector. Second, it attempts to show that these actors shared the common yet heterogeneous

goal of constructing what I call "technical adjustments" as central components of the renewable energy and clean technology industry, aspiring to mitigate climate change and future energy scarcity through new business models, technological innovations, and design solutions. I see Marco's proposal of acknowledging the soul of carbon dioxide through carbon markets as one such technical adjustment. Third, it documents and analyzes the discursive and technical means by which these actors deferred the question of success or failure in reflecting on their work, thereby generating the material and conceptual indeterminacy described in the following chapters.

Articles on Masdar had been appearing in the international press since the official launch of the project in 2006. "Abu Dhabi, the capital of the United Arab Emirates, the fourth largest OPEC oil producer with about 10 percent of the known reserves, is seeking to become a center for the development and implementation of clean-energy technology," a *New York Times* article announced in 2007.[7] Masdar City, the proposed "zero-carbon" district, would cost $22 billion and eventually accommodate 1,500 businesses. The proposed automated personal rapid transport (PRT) network would allow the city to completely prohibit car entry. The effort to start a graduate research institution focused on renewable energy at the center of the city by bringing in MIT was also publicized by Masdar's marketing department, with the promise that it would transform Abu Dhabi in the same way that MIT had transformed the Boston area into a start-up haven (chapter 2). Together with other satellite campuses, including New York University in Abu Dhabi (NYU-AD) and the Sorbonne, Masdar Institute would play a significant role in instituting a knowledge-based economy in Abu Dhabi.

Some commentators appreciated the fact that an oil-rich emirate was investing in renewable energy resources and acknowledging that the energy portfolio of the future would not consist of fossil fuels only. Others mocked the Masdar City project for being located in a country where the carbon footprint per capita was the highest in the world. Many drew attention to the fact that the Abu Dhabi government was starting a massive renewable energy and clean technology project that would be funded by oil revenues. To these commentators, the project seemed rather paradoxical.

In response, the project's proponents argued that the oil-based infrastructure could be gutted because Masdar could provide a whole new

circulatory system for Abu Dhabi. In a 2013 documentary on the project, Sultan Al Jaber, then CEO of Masdar, extended his earlier arguments on the main goals of their initiative: "Masdar is a strategic, holistic, comprehensive approach to renewable energy, to seriously and in a meaningful way contribute to the advancement of clean technologies. We believe this is a logical step for a major oil-producing nation to venture into. Who knows energy better than us? We are trying to create the home for renewable energy, which is Masdar City. . . . There has never been a single attempt by anybody in the whole world as aggressive and as ambitious as Masdar City."[8]

This book is about the ways in which Abu Dhabi might prepare for a post-oil future. In exploring this imagined transition, it investigates the construction of a renewable energy and clean technology sector and pays specific attention to the Masdar project as it unfolded in the years 2010 and 2011. The book draws on ethnographic research at MIT in Cambridge, Massachusetts (between January 2010 and May 2010), in Abu Dhabi (between September 2010 and June 2011), and at the United Nations Framework Convention on Climate Change (UNFCCC) office in Bonn (in March and April 2012). After completing this fieldwork, I continued to follow the project's developments, met my interlocutors in various places around the world, attended conferences on energy and climate change where I had the opportunity to sharpen some of my questions, and took short trips back to the UAE. Yet given the high turnover of foreign workers in the region, many of the people whose perspectives I discuss here no longer work with Masdar; they have mostly left Abu Dhabi. In this book, I do not claim to provide a comprehensive overview of the project's present condition. Instead, this book describes and analyzes how cosmopolitan actors shaped the field of renewable energy and clean technology in Abu Dhabi in the years 2010 and 2011. This period is particularly important as it saw the opening of the eco-friendly Masdar Institute campus in November 2010, enabling Masdar Institute students, the first residents of Masdar City, to start living in student residences on campus. This period also set the stage for the cancellation of the Foster-designed Masdar City master plan and its associated transportation infrastructure in late 2010. Masdar City eventually transformed from what its developers had called "a zero-carbon eco-city" to what later marketing campaigns labeled "a city of possibilities," in other words, a special economic zone for renewable energy and clean

technology companies. This book studies the occasions when Masdar's renewable energy and clean technology projects failed, succeeded, or were reformulated in response to everyday hindrances.[9]

By providing an in-depth analysis of developments in Abu Dhabi's Masdar in 2010 and 2011, the book demonstrates that the Masdar project was capacious and heterogeneous enough to involve actors with various contradictory agendas. Thus, Masdar was not one thing but rather an amalgam of widely varying ambitions and demands for the future; the believers, the utopians, the cynics who contributed to this project all acted upon this future in unique ways. Interrogating how imaginaries of renewable energy and clean technology are articulated and experienced both at a personal level and at the level of project management, this book provides gateways to understanding the emergence of novel infrastructures of knowledge, technology, and governance in Abu Dhabi.

Yet, however varied the visions of the actors who built Masdar, there are certain fundamental inclinations and preferences that they held in common and reproduced. In order to explain how innovative actors shape energy and climate futures in Abu Dhabi, and to foreground these shared qualities, I have found it useful to focus on a central idea that I label "technical adjustments." Abu Dhabi's renewable energy and clean technology projects, such as Masdar City, have aimed to generate technical adjustments as a means for vaulting ahead to a future where humans will continue to enjoy technological complexity without interrogating existing social, political, and economic relations. In effect, I understand technical adjustments as imaginative and wide-ranging responses to global climate change and energy scarcity, which open up certain interventions (such as extending technological complexity) while foreclosing others (such as asking larger-scale moral, ethical, and political questions regarding how to live). Invested in an image of the future drawn from science fiction, the technical adjustments that the producers of Masdar implemented served as methods for concentrating on modifications that bring forth promissory capital, enabling a multiplicity of actions and nonactions to be taken in the face of global environmental collapse. While producing innovative (and at times fun) artifacts, technical adjustments eventually obfuscate and efface the simple realization that humans cannot continue to live and consume as they do.

The idea of "technical adjustments" offers a mode of response for dealing with climate change independent of ethical, moral, and political entailments.[10] According to this perspective, climate change is a management problem that experts may resolve, rather than an ethical and moral problem that humans around the world should recognize, discuss, and address as political agents. This approach indicates that solutions to climate change are not centrally about ethics, morality, or politics. Instead, they involve market-oriented technical fixes—such as green buildings (chapter 1), research into renewable energy and clean technology (chapter 2), novel ways of imagining exchange (chapter 3), innovative designs for vehicles (chapter 4), and new global governance mechanisms (chapter 5)—that promote a belief in the possibility of sustaining the status quo and even improving life for certain segments of society through technology. Technical adjustments, which are intended to maintain existing values while inventing new technology to address climate change and energy scarcity, operate in opposition to environmentalism. The hope is that technical adjustments will allow humans to extend their beliefs and perspectives into the future without requiring them to ask new moral and ethical questions and without developing new virtues.[11]

To illustrate this approach, let's turn to Sam, a Lebanese executive in his late forties who was critical in starting the Masdar project in 2006. Sam had been working in Dubai as a consultant for about a decade when he came up with the idea of founding an eco-city. He partnered with two other consultants and presented his idea to ruling elites in Qatar, but he was not given the green light. Eventually, he contacted the Abu Dhabi government, presented the same idea, and found more support from the ruling elites there. "Abu Dhabi has always been the most visionary of the Gulf states," he explained to me. "It's not unusual that they liked the idea and pursued it immediately." After the project took off, Sam was hired as an executive, managing Masdar Carbon, the climate change policy wing.

During one of our meetings in his office in the temporary buildings of Masdar Carbon, Sam explained to me that in the long run humanity needed something that altered capitalism by reformulating consumerism. "There are projections, like, in seventy years a bottle of water will cost $500," Sam said. "We shouldn't let that happen." He believed that humans needed to stop making insatiable demands on the planet for short-term

benefits. "But of course, these are only long-term goals," he continued, "and this is not how or why we started Masdar." Sam knew that Masdar did not have the capacity to overcome the workings of capitalism: it could only operate in conjunction with the status quo. While he was aware of the multiple challenges of the climate change problem, he could not attend to them. According to Sam, instead of seeking to challenge capitalism, the Masdar project attempted to rechannel consumerism through resource management—through the efficient and effective deployment of the earth's resources, not necessarily to be framed as environmentalism. That's why, Sam said, it was not extraordinary to see hundreds of SUVs in the eco-city's parking lots. The technical adjustments endorsed inside Masdar City through innovative vehicle designs such as automated pod cars also embraced the SUV.

In Abu Dhabi, climate change and future energy scarcity emerged as business opportunities. When defining their understandings of renewable energy and clean technology, many of my interlocutors, who came to Abu Dhabi from all over the world, explained that they did not advocate closing down businesses and stopping production. Just the opposite: they imagined Masdar as a test bed that would create more business potential for Abu Dhabi. They did not aspire to surrender or challenge capitalist consumerism, which is often seen as the reason for dwindling resources and climate vulnerability, but instead attempted to generate a strategic, holistic, comprehensive approach to renewable energy. In addition to admitting that not many of them would self-identify as "environmentalists,"[12] renewable energy and clean technology professionals in different sectors found it significant to highlight how "the environment was a sexy part of the economy," and therefore could be integrated into existing models of social and political life seamlessly. Like many businesses around the world, they could supply environmentally friendly products that would perhaps supplant the demand for nongreen products, such as fossil fuels.

Yet because the drive for technical adjustments was varied at Masdar, the professionals there not only advocated market-oriented technological solutions for climate change, but also consistently crafted justifications for their projects in light of various contradictions that they recognized as existing in such a perspective. For instance, Marco suggested that market-based solutions would in fact allow humans and nonhumans to be redeemable in cash over an egalitarian platform, producing a new world

order. Sam used market mechanisms, specifically price, as signifiers for future destitution, and expressed his worries about the planet by talking about his preoccupation with the cost of water. He knew that humans needed to rethink capitalism, but he didn't know exactly how. In engaging with planetary-scale conditions as well as everyday realities, the people at Masdar experienced dislocations, about which many of them spoke with passion, anxiety, and confusion. In thinking through their challenges, they went back and forth between abstract conceptions of the planet and the everyday realities of social and professional life, consistently inhabiting sets of unanswered (or perhaps unanswerable) questions and conflicts.

The tensions between domains that inevitably gave rise to inconsistencies was evident in the results of a survey conducted by Elif, a Turkish master's student in engineering systems design at Masdar Institute, for a term project on transportation and the environment. Almost all of her one hundred respondents (most of them students, postdocs, faculty members, and employees of Masdar) self-identified as caring about the environment.[13] However, in answering another critical question on the survey, they had expressed that they would "never" use public transportation, regardless of their dedication to the environment and their sensitivity toward planetary-scale problems. In Elif's analysis, while "caring about the environment" was embraced as an abstract value that demonstrated thoughtfulness regarding planetary-scale problems, the immediate practices associated with this sentiment were not socially desirable—in the emirates, public transportation was denigrated as a mode of travel for low-wage immigrant workers.

Rather than examining or resolving such tensions, the producers of Masdar responded by suggesting that their initiative was "not environmentalism," and that the project did not seek to be located outside the present social, political, and economic conditions. Instead, Masdar City would build and promote technical adjustments and thereby produce and offer a status quo utopia, creating technological innovations with the goal of preserving the present during a time of ecological destruction. Simply put, the future was a thinly disguised version of the present.

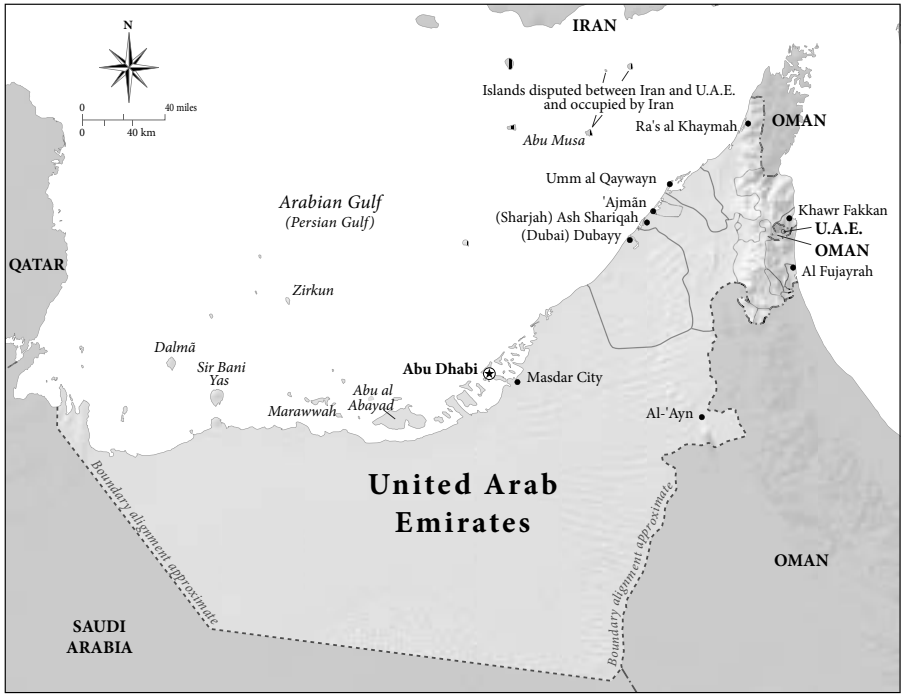
People at Masdar—for example, Elif, Sam, and Marco—interrogated the market-based and technologically complex aspirations of the project, and often called for reformulations based on the problems they perceived on site on an everyday basis. Articulating their understandings of the project

through the use of metaphor and metonymy, they referred to Masdar as "spaceship in the desert" (chapter 1), "a technocratic dictatorship" (chapter 3), or "an expensive toy" (chapter 4). In this way, they managed to keep the project not only materially but also conceptually incomplete. By creating new language to talk about the project, they demonstrated how—despite its willingness to remain within the confines of the status quo—Masdar was proposing rather strange new material conditions for them.

Oil Futures

This book is the first full-length ethnography of contemporary Abu Dhabi. The Arab Gulf has long been marginalized in the social sciences and humanities, and it received little attention in older ethnographies. At times, the Arab Gulf has been considered culture-less and history-less, a misconception that has slowly been corrected through important contemporary research projects on immigration patterns, legal structures of citizenship, transnational connections, and the built environments of the region.[14] Yet there remain major thematic lacunae in studies of the Gulf. Anthropologists working in the Middle East more broadly have not taken a deep interest in environmental issues, a situation that is now changing through emergent research.[15] At the same time, while some significant works have started looking into the ways in which global technologies transform social relations and become vernacularized,[16] science and technology studies do not inform studies of the region adequately.[17] By investigating the ways in which the Abu Dhabi government prepares for a future with less oil, this book demonstrates the increasing importance of environmental issues and technological projects in thinking about this part of the world.

Through projects like Masdar, a marketing department representative at the company explained to me, Abu Dhabi managed to preserve the legacy of Sheikh Zayed, the founding father of the United Arab Emirates, and to follow his perceived commitment to a green environment. Zayed was known for having a special interest in wildlife and hunting, which led him to build environmental organizations. For instance, he announced a public afforestation policy in 1969, and founded the emirate's first "artificial forest."[18] In the late 1970s, he established the National Avian Research Center to protect falcons and houbara bustards. A faculty member at Masdar



MAP I.1 · United Arab Emirates map.

Institute suggested that the Sheikh Zayed legacy, and any romanticized notion of being "at one with nature," were actually an impediment for the adoption of environmentally friendly practices in the UAE. "It's as if when you mention the Sheikh Zayed legacy, you automatically become green, so you don't really have to do anything about it, you don't have to change your behavior," she underlined. While for the marketing department "the Sheikh Zayed legacy" appeared to be an incentive to engage with environmental projects, for others at Masdar it was almost a setback, through which Abu Dhabi residents legitimized their often wasteful preferences. But perhaps at the representational scale the argument about Sheikh Zayed's legacy did work, for it framed Abu Dhabi's investments in initiatives like Masdar as having reverence for the founding father of the United Arab Emirates.

In the early 1960s, while still under British control, Abu Dhabi commanded around 10 percent of the world's proven hydrocarbon deposits. However, under the rule of Sheikh Shakhbut, often remembered for not

fully complying with British interests, Abu Dhabi refused development interventions.[19] From 1946 to 1966, Zayed, Sheikh Shakhbut's youngest brother, was the governor of Al-Ayn, Abu Dhabi's second-largest town, an oasis where many would spend the summer (before the arrival of air-conditioning); Zayed developed his power base there. Christopher Davidson, a political scientist who has written extensively about the UAE, suggests that "Zayed had no fear of the future and the changes it might bring," and explains that he demonstrated his entrepreneurial spirit by transforming Al-Ayn into the region's economic hub, surpassing the capital city Abu Dhabi.[20] For example, Zayed built a modern hospital in Al-Ayn six years before a hospital was built in Abu Dhabi. Such transformations were welcomed by the elites in the region. Sheikh Zayed replaced Sheikh Shakhbut in 1966, not only with British backing but also with his family's recognition and support. As promised, he drastically transformed policies during his rule, prioritizing oil concessions and contracts until his death in 2004.[21]

Sheik Zayed was a critical actor in founding, in late 1971, what is now known as the United Arab Emirates, bringing together the seven constituent emirates (which had previously been part of a British protectorate called the Trucial States): Abu Dhabi, Dubai, Sharjah, Ras al-Khaimah, Fujairah, Ajman, and Umm al-Qawain. Given its great oil wealth, and therefore its capacity to finance a federal state, Abu Dhabi was named the capital of the newly established union under President Zayed. The emirates transferred key issues, such as control of the military, foreign policy, and immigration, to the central federal government, but retained power over their natural resources and their economic development strategies. Since the founding of the UAE, Abu Dhabi and Dubai have dominated the central government, with their rulers taking the positions of president and prime minister, and have held veto power over the decisions of the Supreme Council, which is the highest authority in the federal state.

Of all the emirates, Dubai has been known globally as the Gulf's cosmopolitan center and business hub. Its large shopping malls, tall towers, and luxury hotels are often in the news. (So are the failures of these projects.) Given its physical proximity to Dubai, Sharjah has also become a recognized node (known for the American University of Sharjah and the Sharjah Biennial, an international art exhibit), and comes after Dubai in terms of wealth. Relatively inconspicuous, Abu Dhabi has, since the founding of the UAE, been what Davidson terms a "capstone" emirate: fundamental to

the union, critical for Europe's and Japan's oil supply, and much wealthier than the other six.[22]

By the 1990s, twenty years after the formation of the federation, Abu Dhabi accounted for over 90 percent of the UAE's oil exports, with the capacity to pump 2.5 million barrels per day. Sheikh Zayed's successor, Sheikh Khalifa, took charge in 2004, and began to mold a more globally competitive image for Abu Dhabi, specifically by investing in high-profile development projects in the fields of tourism, urban transformation, and technology transfer, importing new technology from other countries in an attempt to boost the emirate's economy.[23] UAE-based architect and writer Yasser Elsheshtawy explains that while Sheikh Zayed had transformed Abu Dhabi from "a provincial backwater to a modern city," he had been reluctant to make it readily available for international investments, thereby precluding it from becoming a crossroads comparable to Dubai. This was expected to change under Sheikh Khalifa, with the construction of globally significant cultural projects such as NYU-Abu Dhabi, the Guggenheim Abu Dhabi, and the Louvre Abu Dhabi.[24]

Strikingly, foreign labor has designed, built, and managed these projects. Of the 9 million people who live and work in the UAE, almost 8 million are not Emirati citizens. These immigrants come to the UAE on temporary renewable work contracts sponsored by their employers—a system known as *kafala*. Although the work contracts can be renewed indefinitely, the temporary nature of these contracts makes it difficult for immigrants to form communities, or to feel a sense of belonging in the UAE. The contracts ensure that they will remain perpetual outsiders, with no prospect of cultural assimilation or naturalization as Emirati citizens; indeed, they often expect they will be forced to leave.[25]

In the UAE, some of these immigrants hold white-collar jobs in sectors such as tourism, finance, and construction, while many of them are low-wage male workers from South and Southeast Asia. For white-collar workers, the UAE is an attractive location, especially because of its high salaries, low taxes, and convenient and cosmopolitan environment. Conditions are very different for blue-collar workers, who come to the UAE mostly from Pakistan, India, Bangladesh, Nepal, and the Philippines, and receive on average salaries between 500 and 750 dirhams (US$135–$190) per month. Many of these workers live in decrepit all-male labor camps far away from city centers, such as Dubai's infamous camp Sonapur, literally

meaning "land of gold" in Hindi and Urdu, and often travel to their work sites on non-air-conditioned Tata buses. The violation of workers' rights by the UAE, especially on construction sites of large projects such as the Guggenheim and NYU-Abu Dhabi, has been well documented by international institutions as well as the media.[26]

Meanwhile, in publicizing the aspiration to diversify the economy away from oil exports, the Abu Dhabi Economic Council published a key document in November 2008 titled "Abu Dhabi Economic Vision 2030." The document, a topic of conversation at Masdar during the time of my research, proposed: "Economic growth is currently coupled too closely with oil prices and the key to more sustainable development lies in stimulating non-oil sectors, diversifying the range and depth of economic activity taking place in the Emirate, and increasing productivity through a focused approach on Abu Dhabi's competitive advantages."[27] Practices of resource management were expected to protect Abu Dhabi from fluctuations in oil prices, to ensure consistent levels of welfare in an oil-less future.[28] In contextualizing these aspirations, Abu Dhabi officials made comparisons between the emirate and various oil-rich countries. For instance, Norway produced quantities of oil similar to Abu Dhabi, but its energy sector accounted for just 24 percent of its GDP, making it far less dominant.

In the literature on oil wealth and networks, it is often argued that conceptions of endless oil supplies enable progress to be conceived as infinitely expandable, without material constraints. In the mid-twentieth century, the cost of energy did not present a limit to economic growth, as oil prices continuously declined. Given how simple it was to ship oil across the world, this resource could easily be treated as inexhaustible. In his book *Carbon Democracy* (2012), Timothy Mitchell shows how this belief in the infinity of oil also played a key role in producing "the economy" as an object that could expand without limit.[29] We now know that the age of abundant fossil fuel supplies is ending, but we seem unable to abandon the ways of living and thinking that fossil fuels made possible. In preparing for a future without abundant oil, the Abu Dhabi government has attempted new strategies of resource management, hoping to generate a new type of infinity through technical adjustments.

In line with these developments, the UAE government announced a renewable energy policy in 2009 that set the goal that renewable energy sources would provide at least 7 percent of the emirate's power generation

capacity by 2020.[30] Some have estimated that Abu Dhabi could rely on oil exports for another 150 years.[31] For the 2013 edition of *Campbell's Atlas of Oil and Gas Depletion*, a guide to the future of fossil fuels, the seasoned geologist Colin Campbell argued: "For the moment, the Emirates are enjoying the benefits of the high price of oil, whose revenues have allowed them to develop major industries, a world airline and an important regional financial centre. . . . It is thought that they can maintain their current level of oil production for another 20 years or so, meaning that they will continue to enjoy ever larger revenues, albeit subject to volatility in the face of global economic recessions."[32] According to Campbell, the oil will be gone by the end of the century.

Yet, as geologists often note, the study of oil depletion is an inexact science, which allows for variations in imagining and planning the future of fossil fuel resources (see chapter 5). This lack of precision is coupled with a lack of clarity regarding the value and the future price of oil.[33] Predictions about global peak oil differ based on methodologies, which are in turn based on a number of contentious assumptions regarding coping with uncertainties of supply, demand, and technology.[34] Whether there has been or will be a peak, and if so when, are ongoing matters of debate.

I asked oil executives in Abu Dhabi and at energy and climate change meetings around the world how much oil they think is left. They mostly responded to me with a question: "How much are you willing to pay?" They were referring to recent investments in new techniques for the production of petroleum. Due to the possibility of future oil scarcity, oil industries and governments internationally have been investing in unconventional oil sources, such as shale oil and oil sands, which has sparked environmental concerns regarding the impact of these new sources. As with conventional oil exploration, the production of unconventional petroleum is a frontier that remains obscure, uncertain, and widely debated.

The Abu Dhabi government might find a way out of these ambiguities by diversifying its economy and becoming less dependent on oil exports. It could build museums, universities, and industrial facilities, generating new types of returns. The construction of a renewable energy and clean technology industry in the emirate, specifically at Masdar City, could be perceived as an admission that the oil will one day run out or become less valuable—that someday oil would cease to serve as the bedrock of Abu Dhabi's economy.

As Douglas Rogers, an anthropologist who studies oil in Russia, proposes, "Oil as an item of anthropological knowledge has . . . been closely tied to cyclical perceptions of oil's scarcity (and associated soaring prices) in high-consuming metropolitan centers."[35] One example of this type of work is Mandana Limbert's *In the Time of Oil* (2010), which offers an analysis of the possible depletion of oil in Oman and foregrounds a different, more cyclical understanding of the future. Limbert explains how, for some of her interlocutors, oil depletion marks a return to the pre-oil past—a time when Omanis lived in palm-frond *barasti* huts rather than air-conditioned villas. As she points out, "the *now* in this logic is the temporary and anomalous state of wealth between eras of poverty." When the oil runs out, "Oman's recent past, its 'renaissance,' [will] have indeed been just a dream."[36] This sense of a "dream" is useful in understanding other locales that are enlivened by oil wealth, then troubled by its disappearance. For instance, Todd Reisz, an architect and writer who specializes in Gulf urbanism, describes how "Dubai's optimism was at its peak in 1968, when oil seemed to be what would vouchsafe its permanence." Toward the end of the 1980s, however, "Dubai began to segue from the promise of oil wealth to the alarm of oil's impending depletion. The period in between—a fat time of oil money—seemed to have ended before it had begun." Oil depletion forced Dubai to diversify its sources of income. Yet, according to Reisz, "Dubai has grown rich, but it has never achieved what it wanted from that wealth—a place whose existence was unquestionable."[37] Instead, the city is always on the verge of disappearance, dismayed by the possibility of becoming irrelevant.

Unlike Oman and Dubai, where progress became tainted by the inevitable disappearance of resources, Abu Dhabi has physically and socially constructed knowledge of renewable energy and clean technology as an alternative resource, a safeguard for the future. The Abu Dhabi government has done so to refute and challenge the idea that its energy resources are finite. In my fieldwork during 2010 and 2011, I observed that the practices adopted in promoting renewable energy and clean technology infrastructure—such as setting up a research institute, entering joint ventures with environmentally conscious utility companies, and generally investing in an eco-city—were aimed at transforming Abu Dhabi's "brand image" from oil producer to technology developer, rendering the emirate "more elite." Through projects like Masdar, Abu Dhabi hoped to induce a "perception shift" that would attract foreign investment. "In 2005,

Abu Dhabi was perceived to be a high polluter, and was heavily associated with hydrocarbon consumption and exports," a marketing department employee told me. But in 2010 and 2011, through Masdar and other initiatives like the World Future Energy Summit, an annual trade show dedicated to renewable energy and clean technologies, Abu Dhabi seemed to be at the forefront of the emergent renewable energy and clean technology development. Masdar constituted a renewable "source" for the growth of a knowledge-based economy (chapter 2), and facilitated the transformation of oil-based relations into knowledge-based ones. In this framework, "resource management" implied another direction toward which Abu Dhabi's economy could be steered by building new sites of production to extend economic diversification efforts.

In Abu Dhabi, an environment afflicted with climate change and energy deficiency problems, the proposed renewable energy and clean technology infrastructures served as spaces of hope.[38] Conceptions of the approaching end of the world were complemented with imaginaries of a utopian future, driven by a coming together of vernacular architecture and experimental technology. The on-site Foster + Partners architects I spoke with regularly during my research suggested that they borrowed from old Arab cities in thinking about Masdar and pointed to Shibam of Yemen as an example (chapter 1). Moreover, the city would be "smart"; it would have "a hidden brain," which, in the words of one architecture critic, "knows when you enter your building, so that your flat can be cooled before you arrive, while in public places flat screens broadcast uplifting news on the environmental performance of the complex" (chapter 3).[39] Framed as a utopian (or science fiction) project that might be completed, the renewable energy and clean technology infrastructure of the UAE needed the backdrop of a world being struck by climate change and energy deficiency. The marketing and communications campaigns put together by Masdar aimed at proving that the opposite was also true—that the world needed Masdar City.

The Luster of Potential

Laura, an American student in her mid-twenties, had relocated to Abu Dhabi from the United States with an ambition to learn about renewable energy and clean technology at the new Masdar Institute, having received

her bachelor's degree from a private engineering college in Massachusetts. "The first night of living in a Masdar apartment was hilarious. I didn't understand how anything worked: the stove, the lights, the bathroom faucet, the cabinets, and I couldn't figure out how to turn off the AC," she wrote on her blog in September 2010, right after moving onto the campus of the Masdar Institute. Her studio apartment was situated at the center of the Masdar City site, inside a student dormitory. "The Masdar Institute is the first part of [Masdar City] to be completed, it includes the library, laboratory buildings, and the student residences," Laura continued. "And all these buildings fit together in a cube. And this cube is located in the middle of what is still a giant, flat, dusty, deserty construction site as progress on other phases of the city continues. It's quite a mind flip to be in such a strangely beautiful environment, then look [*sic*] a window and see flat dusty landscape stretching out to the horizon." She titled the blog post "I live in a spaceship in the middle of the desert."[40]

On her blog, Laura defined herself as an "engineer and eco-geek," and added that she "has fanatic obsession with social entrepreneurship as a tool for solving poverty."[41] She was planning on moving to Ghana after graduation to start an organization that would apply renewable energy technologies as a humanitarian tool. When she posted the entry "I live in a spaceship in the middle of the desert," she received unexpected attention from journalists and researchers around the world. Laura represented the hundred or so students who had moved onto the Masdar Institute campus: she was trying to make sense of her experience with Abu Dhabi's emergent renewable energy and clean technology infrastructures.

Laura's writings on her blog indicate that she struggled with the novel technical features of the Masdar City project. The stove, the lights, the bathroom faucet, the cabinets, and the AC became central to her understanding of her new apartment, and they gave her a hard time. These new materials, coupled with the unfamiliar dry land surrounding the campus, made her feel like she was in an exotic environment. It took Laura some time to get used to the occasionally uncontrollable trajectories of the materials she relied on. She felt like a test subject, and she also had a sense of the inherent potential of the half-working materials; the same could be said for many of her classmates at the Masdar Institute (chapter 1).

The fundamental difficulty of the materials Laura tinkered with wasn't that they were breaking down, but that they were never really coming

to life. For instance, while the building management system of Masdar Institute attempted to stay outside the conscious awareness of its residents through an intelligent air-conditioning system, constant dysfunction prohibited such invisibility (chapter 3). Masdar Institute students like Laura could not help but always sense the building management system. They did not know whether it would ever function as intended, but they continuously talked about it and tried to resolve its problems. While emergent infrastructure seemed to define the project of building a renewable energy and clean technology sector in Abu Dhabi, it remained consistently out of reach. As harbingers of future technical adjustments, Abu Dhabi's renewable energy and clean technology infrastructures increasingly became laden with lustrous potential.

People like Laura who produced and used this emergent renewable energy and clean technology infrastructure came to reject the ideas and labels of success and failure, and instead imagined and believed that the projects they were part of had potential. Scholars have often written about success and failure, trying to analyze the lives of technological or developmental projects. The example Jack used in relating to my research—*Aramis*, wherein Bruno Latour shows the multiple steps that led to the cancellation of a personal rapid transit project in Paris—is one of these studies. Another important work that addresses this quandary is James Scott's *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (1998), which demonstrates how high-modernist projects that attempted to design society in accord with what are believed to be scientific laws have resulted in failure.[42] In his book *Anti-Politics Machine: Development, Depoliticization, and Bureaucratic Power in Lesotho* (1994), James Ferguson underscores how such failure may be productive, and looks at what he calls its "instrument effects." The subjects of Ferguson's study, development workers seeking to implement projects in Lesotho, admit that their projects have failed, or have not worked in the ways they had imagined, but Ferguson's ethnography shows that their projects had overarching effects nonetheless.[43] In each of these studies, there is an agreement over failure that I did not find at Masdar City, and this led me to ask a different set of questions.

How exactly do people feel potential, and feel that they can rely and act upon technical adjustments to confront climate change and energy scarcity? How is potential negotiated, realized, limited, or changed? I propose

that potential becomes embedded and condensed around particular half-finished or half-working networks of things; I highlight the dynamic materiality of such imaginaries. It is not only words or images—in the form of unstructured everyday conversations on site, or of polished marketing and communications campaigns—that evoke a potential for technical adjustments, but also the inklings of the stove, the lights, the bathroom faucet, the cabinets, and the AC. Ingrained in these half-finished materials, the possibility of a technically adjusted future becomes a way of making the projects sensed, not only by the residents of Masdar but also by outsiders. Abu Dhabi's renewable energy and clean technology infrastructures become visible not because they break down, but because of the potential that they insistently radiate.[44]

Given that many of Masdar's projects, such as the Masdar City master plan or the full-scale implementation of automated personal rapid transit pods, were left permanently unfinished, in this study I consider the existence of such potential without any relationship to growth, expansion, or realization. In other words, by studying the potential in this permanently incomplete state, I wish to highlight the presences rather than the absences that Abu Dhabi's half-working projects carry. In turn, I seek to understand what this material and conceptual incompleteness generates through Masdar. I suggest that Masdar's technical adjustments, in their half-finished material state, were not going to change, as would a seed into a plant. On the contrary, they were going to remain permanently indeterminate, and therefore permanently incipient, indicating the possibility of technical adjustments in an unidentified space and time inside or outside Masdar City.

Critical theorist Giorgio Agamben's essay "On Potentiality" (2000) has been inspiring for me in this context, because Agamben argues against the idea that potential only exists in an act or through its realization.[45] In this Aristotelian description of potentiality, the poet keeps her ability to write or has the potential to compose poems even if she does not do so. Similarly, Italian philosopher Paolo Virno thinks of potential as an infinite incompleteness, and proposes that potential does not expire with the culmination of an act.[46] Karen Pinkus's work identifies this potentiality as a way to distinguish between fuel and energy.[47] But as anthropologist Gisa Weszkalnys notes, "To approach potentiality empirically and ethnographically differs quite markedly from contemplating it philosophically."[48] In the

context of Masdar, my interlocutors saw potential in renewable energy and clean technology projects that did not and would not take off. For them, Masdar City could offer a new form of eco-friendly urbanism to the world even though it would never be built in the way it was planned. My goal is to focus on the ways in which my interlocutors summoned this potential, engendering particular perspectives toward their work.

It is important to note, however, that half-finished infrastructures do not always carry or convey the same effects. They oriented the producers of Masdar toward a future through practices of speculative forecasting, and they have given rise to different and at times contradictory versions of that future. For some, the future of Masdar is a ruin that operates as an amusement park. For others, the future is a special economic zone, perhaps devoid of the various half-finished technological artifacts, but still invested in a business plan around renewable energy and clean technology. In effect, potential does not necessarily induce a linear temporal movement toward the completion of projects in the way that was intended, but rather an assemblage of varying, overlapping, and contradictory trajectories.

As such, these trajectories allow people to change scales and mobilize various orders and dimensions in speaking about their actions and nonactions. They have warranted the producers of Masdar to think simultaneously about, say, carbon markets and the soul of carbon dioxide. As half-finished infrastructures, Masdar's technical adjustments have the potential to propose incentives toward one trajectory over another, enabling planetary-scale transformation. The people I spoke with at Masdar negotiated this potential through varying imaginaries, pushing them to their limits.

The infrastructures of technology, knowledge, and governance that make up the future renewable energy and clean technology sector in Abu Dhabi are still in the making. Bettina, a German environmental consultant who had been working with Masdar since 2007, concentrating most specifically on the making of carbon capture and storage policy, explained to me in December 2012 at the Climate Summit (COP 18) in Doha that despite the construction of some new buildings within Masdar City, Abu Dhabi authorities were frequently discussing the possibility of abandoning the project, because it did not generate satisfying economic returns. "We always criticized Masdar for investing so much into marketing and promotions," she noted, "but in 2012, when the company was almost closing due

to a shortage of profits, we saw that marketing also works as a promise." Through widely circulating imaginaries of its future presence, Masdar had promised its audience that it would deliver, and the Abu Dhabi leadership could not break its promise so easily, Bettina clarified. Promissory words and images operated together with the physically and conceptually incomplete infrastructure in fueling novel imaginaries of the future.

Rather than taking failure versus success as a given, this book explores what each comes to mean in the context of various renewable energy and clean technology projects. In the following chapters, I try to answer this question by studying five different artifacts. The Masdar City project may be shelved, it may transform into a regular real estate development project, or it may eventually be completed as planned (chapter 1). Keep in mind that cities are by definition incomplete aggregates, which will never be "finished." In discussing the "completion" of Masdar, I refer to the realization of the master plan as originally designed by Foster + Partners. In thinking about half-finished artifacts, I refer to the completion of the projects in the ways they were planned by particular Masdar executives. Attempts at producing carbon capture and storage policy may add to Abu Dhabi's international prestige, regardless of the fact that they do not instigate the removal of excess carbon dioxide from the atmosphere (chapter 5); the personal rapid transit units may be considered to "work" depending on whom you ask, or how you conceptualize the project (chapter 4). In examining the different artifacts, I stay away from classifying the projects as successes or failures, and instead focus on their physical and conceptual indeterminacy, foregrounding the debates around their implementation.

Research Methods

"Masdar is about a commitment to trial and error," Anna, a former faculty member at Masdar Institute who grew up in Bulgaria, lived in the United States and the UAE, and finally moved to Germany, explained to me during a meeting in Bonn. After finishing her PhD at an American university, Anna had been hired as a full-time faculty member at Masdar Institute. She was among the first group of full-time faculty who came to Abu Dhabi to, in practical terms, set up the Institute. She had an intimate understanding of the project—she professed that during the three years

she worked at the Institute she was more involved in its founding than in her research into the role of women in science and technology in Abu Dhabi. When her contract expired in 2011, she left the UAE for a position at a development agency in Bonn. We had initially met in 2008, during my preliminary research on Masdar, saw each other often in 2010 and 2011, and kept in touch after she left. We agreed to catch up in March 2012, when I was conducting research at the United Nations Framework Convention on Climate Change in Bonn.

For Anna, the potential of Masdar lay in its capacities as a test bed, where everything was in beta mode. The technical adjustments Masdar proposed could malfunction, but this would constitute only a temporary problem, and would encourage the next version of these adjustments. The everyday disruptions people faced at Masdar, Anna theorized, would help build a better smart city in Rio or New York or Shenzhen. Through trial and error, developers would prepare a next version, and engineers and planners would unearth a code for eco-friendly modes of living, facilitating the rapid construction of new test beds globally. As historian of science Orit Halpern (2015) shows in her work on the construction of South Korea's smart city Songdo, this trial and error would never end, especially because every limit would become a new engineering challenge, a new frontier to develop toward an ever-extendable horizon.[49] This mode of thinking allowed Anna and her colleagues to render questions regarding success or failure irrelevant.

"And a project that is about trial and error needs documentation. That's the most important way in which we can contribute to discussions on sustainability," Anna emphasized. "We need to know exactly why the concept of sustainability could not be implemented at Masdar in the way it was planned, or why it was such a great challenge." She told me how she had been part of an initiative some years before to document the everyday workings of Masdar in order to learn more about practices of trial and error, specifically by collaborating with ethnographers. Anna's proposed project had demanded the close cooperation of anthropologists and sociologists from universities in the UAE in producing a database regarding the seemingly mundane daily dynamics of the initiative. She imagined that having such a database at their disposal would elicit and encourage self-reflection, enabling the producers of Masdar to look back and understand what had gone wrong at what stage of the project, possibly to help

them correct their mistakes in the future. Since someone who had direct stakes in the development of the project could not do this, they needed to bring in independent ethnographers. In this way, the project would also have global impact, Anna imagined, providing others with a thorough knowledge base that would clearly illustrate the potential tribulations of implementing such a large and complicated technological project.

But Anna's plan would be shelved, like so many other plans conceived for Masdar. She had been able to recruit two anthropologists interested in working at Masdar full-time, but she had not located sources for funding. She had contacted the company's sustainability department, explaining her need for funding. But the executives did not fully agree with her understanding of such knowledge-making practices. "Unfortunately," she explained, "this [anthropological] type of knowledge was argued to be too esoteric for a project like Masdar." After listening to her concerns and claiming to understand her rationale, the sustainability department had decided to hire a global management consulting company to conduct research within the organization for three months. This research culminated in a comprehensive report titled "The Masdar Experience," which concentrated on raising questions such as who should be residing at Masdar City upon its completion, rather than interrogating the on-site debates and queries in the way Anna had proposed.

Anna's attempt at bringing anthropological tools into the project had somehow been sidelined, demonstrating the tensions between two types of knowledge inside the institution. While anthropological knowledge was perceived to be marginal and commercially ineffective, the consultants' knowledge would be readily digestible and transferrable to capital. The consulting company promised to deliver a report in just three months, while Anna had hoped that the anthropologists would conduct fieldwork in the company for one or two years and be compensated accordingly. In the executives' analysis, the longer ethnographic study was somewhat impractical and unnecessary. When the consultants from the multinational company did complete their work, however, they had managed to produce new imaginaries for Masdar to implement, but had overlooked decision-making processes and potential conflicts within the organization while neglecting to document in detail the project's different stages.

While my ethnographic study did not benefit from the financial or organizational means that Anna had planned for, it started out with similar

prospects, aspiring to investigate and examine the various trajectories of the renewable energy and clean technology projects at Masdar. After conversations with administrators at Masdar, I had come to believe that I would be able to live on the Masdar Institute campus. Accordingly, during the first two weeks of my stay in the UAE, I was hosted at a hotel together with the Masdar Institute students, and I expected to move into the dormitories with them. However, at the end of those two weeks, two administrators pulled me aside and explained that I needed a security clearance to be able to reside in the Masdar dorms. They estimated that the security clearance would materialize roughly two weeks after I submitted an application. That evening, I talked to a close college friend who lived in Dubai and asked if I could stay with her during those two weeks while I waited for the security clearance to be processed. Despite repeated efforts on my part, my application never received a response and I did not move out of my friend's apartment until the end of my fieldwork.

As a result, I lived in Dubai's Dubai Marina neighborhood from September 2010 to June 2011, carpooling to the Masdar City site every day along with a number of people who worked at Masdar's various departments. The trip back and forth was approximately 125 miles and took about two hours a day. Given the conversations that the enclosed space of the car and the relatively long trip facilitated, the people who gave me rides from Dubai to Masdar became my closest friends and research collaborators in the UAE. During our car rides, Eda, Michael, Anna, and Alexander, among others whose pseudonyms appear in this book, offered me feedback on my interviews, pointed to other potential sources of information, and introduced me to fellow employees; overall, these interlocutors had a drastic impact on the ways in which my fieldwork was formulated. It is fair to say that much of my ethnographic research on the production of renewable energy and clean technology infrastructures took place inside SUVs, driving on the Dubai–Abu Dhabi highway.

During the workday, which typically lasted from 9 AM to 5 PM, I collaborated with Masdar Institute faculty on an energy currency experiment; I worked with Masdar Carbon, assisting them with a policy proposal on carbon capture and storage; and I was asked to help present Masdar Institute's master's programs at Turkish universities in Ankara and Istanbul. Even though I had no formal attachment to Masdar, I had two cubicles in different parts of the company (one at the Masdar Carbon building and

the other within Masdar Institute), which rooted me inside the organization and allowed for routine conversations and everyday engagements with neighboring students, faculty, and professionals. I shared my writing with some of my research collaborators at different stages of the project and received feedback from them, but I did not officially contribute to decision-making protocols on site.

Many of my interlocutors had come to the UAE with the belief that they would leave in two or three years. Some of them had contracts with limited durations. Others imagined that their work experience at Masdar would be beneficial for them elsewhere, and indeed, they were able to take up new positions in multinational corporations, nongovernmental organizations, and academic institutions in other countries. My acquaintances at Masdar held citizenship in countries including Algeria, Colombia, Egypt, Germany, Greece, Iceland, India, Iran, Lebanon, the Sudan, Romania, the United Kingdom, the United States, and Turkey.[50] While most of these professionals were men, there was also a constituency of Emirati and non-Emirati women in the organization, who were well trained and received relatively high salaries. They were all fluent in English, the language of conduct at Masdar (and many institutions in the UAE). I kept in touch with a number of these engineers, architects, researchers, and students after they left the region; through these longer-term relationships, I learned of my interlocutors' reflections on Masdar beyond their employment there.

At the end of my research, I agreed with Anna that this project required an ethnographer to track the multiple trajectories of Masdar's technical adjustments; this book presents the multiple challenges inherent in five Masdar projects. By following projects with different goals, I not only analyze the ways in which business models, economic returns, and technological complexity were celebrated at Masdar; I also foreground the social relations that have produced and sustained Masdar's aspirations.

Perhaps we can understand the Masdar project as an indicator of a general trend in climate change management. This book is grounded in the technical adjustments in Abu Dhabi's Masdar; however, it is easy to observe such adjustments in other parts of the world. Electric cars, biodegradable plastic bags, and energy-efficient light bulbs exemplify contemporary methodologies of engaging with energy scarcity and climate change, and they provide the piecemeal means through which humans seek to extend their lifestyles into the future while tackling climate change. Here

"technical adjustment" emerges as an ethnographic category that finds various expressions in different contexts, and that guides living arrangements and shapes social possibilities in technocratic, typically anthropocentric, ways, along lines drawn by affluent nations. To see these innovations as mere continuations of an existing apparatus, however, is to underspecify the novel infrastructures of technology, knowledge, and governance, which elicit new tensions in the contexts in which they manifest themselves.

Our current era is marked by contingencies that force us to question dominant modes of thinking about the world, and to seek novel ways of attending to climate change and impending energy issues. In this book, I show how the production of technical adjustments—only one among many ways of responding to global environmental collapse—evoked potential in the UAE, where this potential was instrumental for economic diversification and generating a new brand image. The clean technology infrastructure of Masdar City fueled an aspiration for the manageability of ecological problems, where business models were thought to contain and resolve climate change and energy scarcity without surrendering hope for increasing productivity and technological complexity. But in fact, climate change and energy scarcity should propel humans to challenge such ideals of technological development and economic growth, to pay attention to the alternative futures rendered invisible by the drive for infinity, and to cultivate new modes of inhabiting the planet.

Outline of Chapters

This book tells the story of Masdar, at once a "utopia" sponsored by the emirate's government and a company involving different sorts of actors who participated in the project, each with their own agendas and desires. In this telling, as people with varying visions act upon the project, it emerges as not just one spectacle but many, all serving different ends. For those involved, the goal has not necessarily been to produce one totalizing object, but rather a whole host of things, some of which may be mutually incompatible. In reflecting this diversity of viewpoints, I follow a Rashomon-like structure, where each chapter focuses on a different artifact (such as personal rapid transit pods or policy documents) to present what Masdar is as well as different imaginings of what it can and should

become.[51] This multifaceted perspective demonstrates the contradictory ways of thinking, knowing, and interpreting Masdar City, and is useful for understanding the complexities and the ambiguities of the project. Each chapter represents distinct visions of Masdar, foregrounding contested interpretations of developments in the company. While the chapters are peopled by multiple actors who had diverse responsibilities, each features central characters—among them Laura, Fred, Alexander, Elif, Salim, and Anand—whose perspectives are essential to the descriptions and analyses that follow. This book starts by asking what Masdar means and goes on to show that a univocal statement would miss the richness of the project.

I start by focusing on the construction of Masdar City, specifically concentrating on the imagery that was deployed in speaking about the eco-city in the years that followed the project's launch. One of the central characters in this chapter is Laura, the American student at Masdar Institute who coined the term *spaceship in the desert* to describe the project. This chapter explores the intellectual origins of Masdar City as an urban-scale test bed whose design and construction were widely discussed by its producers as well as the international media. Why and how did Masdar become conceptualized as a "spaceship," and what did it mean for the project to be located in an "other" time, in addition to being located within a bounded area in the desert, often conceptualized as an "other" space? What, or perhaps when, was the future imagined through Masdar City? While showing how, at Masdar City, the present was teeming with activity, I point to the ways in which the imagery used in framing Masdar City consistently formulated the present as a vacated category and located the city in a perpetual future. In addition to thinking through the imaginaries of the city, the chapter addresses the material reality of Masdar, and investigates the exclusions it enacts in its current state, keeping laborers, such as the "man with a brush," outside its confines. In this way, this chapter seeks to generate a sensibility of how technical adjustments produce space and time.

The second chapter tells us the story of Masdar from the perspective of Fred, an MIT faculty member in his early seventies, who was critical in building Masdar Institute as a renewable energy and clean technology research center. In June 2011, about eighty students from around the world completed MSc degrees at Masdar, which were aiming to replicate degree programs at MIT.[52] These first alumni often remarked that they had been test subjects in the experiment of building an eco-city.[53] On the

other hand, the UAE government, which offered full scholarships to all enrolled students, expected they would stay in the country, contributing to a knowledge-based economy based on clean technology and renewable energy. In this chapter, I study Masdar Institute as a node that may transform the UAE by producing knowledge on renewable energy and clean technology. In doing so, I concentrate on "beautiful buildings" and "research contracts" as networking devices through which relationships might be established and preserved, facilitating—as technical adjustments for an oil-less future—the emergence of an economy of innovation.

Besides helping implement the UAE's economic vision, Masdar Institute attempted to engineer an economic vision of its own, specifically by planning a new energy currency. As a faculty member at Masdar Institute, Alexander worked with a research team on the "ergos" project, which imagined that future inhabitants of Masdar City could be issued a balance of energy credits as a means of defining and regulating an allocated energy budget. Through individual monitoring and regulation, ergos aimed at decreasing the energy consumption of Masdar City's residents. And yet Alexander, like many of his colleagues, occasionally mentioned that the ergos project had a "Big Brother side" to it, and that it could lead to a "technocratic dictatorship." In this chapter, I explore the paradoxes that emerged during the project and map out the stakes of this currency proposal for the actors involved.

Another artifact that attracted much attention to the construction site of Masdar City was the driverless electric personal rapid transit (PRT) pods, offering automated transportation for groups of up to six people between two points on a network. While the PRT was envisioned to connect the entire eco-city, such plans were dropped in late 2010 due to financial challenges. Still, there was one destination that the PRT pods stationed at Masdar Institute could travel to: the parking lot outside the building. The ten pilot PRT vehicles completed around 250 trips per day, and their futuristic design drew many visitors to the site. The PRT was the subject of a central debate on the Masdar City site, leading some to designate it a victory, while others were more skeptical regarding its capacities. Many who experienced the PRT wondered why one wouldn't bicycle or simply walk the short distance, and some called the experimental transportation device "an expensive toy." Recurrent breakdowns resulted in complaints, facilitating discussions on technoscientific experimentation. Masdar Institute

students Elif (whose survey results I referred to above) and Salim gave me guided tours of the pod cars and helped me interrogate what failure or success meant for the PRT project. This chapter argues that the affective modalities of infrastructure may at times overcome expectations of functionality, demonstrating how, in the case of Masdar City, the experience of "fun" could override the debatable operational capacity of the pod cars.

In the fifth chapter, my ethnography descends underground, as I follow policy making on carbon capture and storage (CCS), a controversial climate change mitigation technology that operates by obtaining carbon dioxide from industrial compounds, carrying it to storage sites, and injecting it into the ground. By injecting carbon dioxide into fields and forcing oil out, oil producers could potentially extend the lifespan of the oilfields. Some policy makers and scientists have argued that CCS could cause the leakage of concentrated amounts of carbon dioxide, and that liability protocols related to such incidents remain lacking. By drawing on my experiences working with environmental consultant Anand and others at Masdar Carbon, I study the preparation of a CCS policy proposal for the United Nations Framework Convention on Climate Change (UNFCCC), and I focus primarily on how uncertainty and risk are defined by different groups of experts in realizing this technical adjustment. Providing insight into the backstage discussions of climate change governance, I lay out how participants translate across their zones of professional comfort, how business plans and government policy work at odds, and how national policies are crafted through negotiations with multinational oil companies.

In an epilogue, I look to the global horizons of Abu Dhabi's renewable energy and clean technology projects, which have moved forward and, indeed, have been disseminated globally regardless of their inherent problems and contradictions. This closing analysis of Masdar's attempts to produce an international carbon capture and storage policy, a new currency based on energy expenditure, a renewable energy and clean technology research institute, and, finally, an eco-city, provides an overview of how the actors producing Masdar participated in the constitution of constructive ambiguities for the contemporary renewable energy and clean technology sector.

Notes

Introduction: The Soul of Carbon Dioxide

1 Foster + Partners was founded in 1967 by Norman Foster. Currently they operate offices in London, New York, Madrid, Hong Kong, Beijing, Shanghai, Abu Dhabi, Buenos Aires, São Paulo, Silicon Valley, Singapore, and Dubai.

2 The Formula 1 tracks had been hosting the Grand Prix since 2009 on Yas Island. The Al Ghazal Golf Course is older, serving golfers since 1997. All of these zones assisted the drive for economic diversification in Abu Dhabi, while at the same time putting the emirate's name on the map, fostering its brand image for diverse target markets. In their segregation from Masdar City, these carbon-intensive sites staged different pathways toward which Abu Dhabi's economy could be steered. They demonstrated that Masdar City was not necessarily symptomatic of a greening effort across the emirate—it was only one of the experiments toward the production of a future that depended less on oil revenues. They could easily be perceived as unrelated spaces with no common social basis, but the Formula 1 track, the golf course, and the eco-city all attempted to address the challenge of generating non-oil-based revenues for the emirate, which united them under the drive for possible future profit. Despite seemingly contradictory agendas (and drastically different relationships to climate change and

energy scarcity), they collectively served the future economic vision of Abu Dhabi.

3 Polich, *Return of the Children of the Light: Incan and Mayan Prophecies for a New World* (Minneapolis: University of Minnesota Press, 2001), 121–22.

4 Castañeda, *The Teachings of Don Juan: A Yaqui Way of Knowledge* (Berkeley: University of California Press, 1968), 61.

5 Latour, *Aramis, or the Love of Technology* (Cambridge, MA: Harvard University Press, 1996), viii.

6 See, for instance, "Dubai's Six-Year Building Boom Grinds to Halt as Financial Crisis Takes Hold," *The Guardian*, February 13, 2009, https://www.theguardian.com/world/2009/feb/13/dubai-boom-halt, accessed April 21, 2017.

7 See "Abu Dhabi Explores Energy Alternatives," *New York Times*, March 18, 2007, http://www.nytimes.com/2007/03/18/world/middleeast/18abudhabi.html?pagewanted=all, accessed March 15, 2016.

8 *Brink Masdar*, Bloomberg documentary, May 2013, http://www.bloomberg.com/video/masdar-a-green-city-bloomberg-brink-05-13-azsX~xTlSsOJ03BGwXoufg.html, accessed February 7, 2017.

9 Many important books study energy infrastructures (particularly oil) from a systemic, macro perspective, an analysis that I will not provide in this book. For some examples, see Timothy Mitchell, *Carbon Democracy* (New York: Verso, 2012); Robert Vitalis, *America's Kingdom: Mythmaking on the Saudi Oil Frontier* (Stanford, CA: Stanford University Press, 2006); and Daniel Yergin, *The Prize: The Epic Quest for Oil, Money, and Power* (New York: Free Press, 1990).

10 The conversation on climate change is at times couched in an ethical, moral, and political language most often associated with environmentalism. For instance, in his book *A Perfect Moral Storm*, philosopher Stephen Gardiner explains how "the global environmental tragedy is most centrally an ethical failure, and one that implicates our institutions, our moral and political theories, and ultimately ourselves, considered as moral agents." He continues by suggesting that "ethical questions are fundamental to the main policy decisions that must be made, such as where to set a global ceiling for greenhouse gas emissions, and how to distribute the emissions permitted by such a ceiling." Similarly, Dale Jamieson claims that humans must move away from perspectives that focus on "calculating probable outcomes" and instead "nurture and give new content to some old virtues such as humility, courage, and moderation and perhaps develop such new virtues as those of simplicity and conservatism." In *This Changes Everything: Capitalism vs. The Climate*, Naomi Klein proposes: "Fundamentally, the task is to articulate not just an alternative set of policy proposals but an alternative

worldview to rival the one at the heart of the ecological crisis—embedded in interdependence rather than hyper-individualism, reciprocity rather than dominance, and cooperation rather than hierarchy," and explains that social transformation takes place through movements that are "unafraid of the language of morality—to give the pragmatic, cost-benefit arguments a rest and speak of right and wrong, of love and indignation." Stephen Gardiner, *A Perfect Moral Storm: The Ethical Tragedy of Climate Change* (Oxford: Oxford University Press, 2011); Dale Jamieson, "Ethics, Public Policy, and Global Warming," *Science, Technology, and Human Values* 17, no. 2 (1992): 139–53; Naomi Klein, *This Changes Everything: Capitalism vs. The Climate* (New York: Verso, 2014).

11 Anthropologists who study environmental issues and institutions explore how such global problems are vernacularized by actors in specific locales according to the exigencies of their worlds and unpack the ways in which climate change and energy problems are understood, articulated, and confronted. Ethical, moral, and political entailments are described as pertinent for some of these actors. For instance, drawing on an ethnography of matsutake mushrooms, Anna Tsing calls for a reevaluation of principles of progress, and an acknowledgment of indeterminacy and instability in the world. "We can't rely on the status quo; everything is in flux, including our ability to survive," she writes. "Thinking through precarity changes social analysis. A precarious world is a world without teleology. Indeterminacy, the unplanned nature of time, is frightening, but thinking through precarity makes it evident that indeterminacy also makes life possible." Similarly, Elizabeth Povinelli invites her readers to think about the "multitude of geological and meteorological modes of existence," which "have prompted people to demand an ethical and political reconsideration of who and what should have a voice in local, national, and planetary governance." Drawing on a variety of contexts across the globe, these ethnographies forge perspectives that foreground the environmental, economic, and political insecurities of the present, and accordingly call for challenging the status quo. Elizabeth Povinelli, *Geontologies: A Requiem to Late Liberalism* (Durham, NC: Duke University Press, 2016); Anna Tsing, *The Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins* (Princeton, NJ: Princeton University Press, 2015).

12 Marco, whose story I shared in the beginning of this introduction, is perhaps as an exception to this dominant perspective.

13 Elif informed me that one hundred people responded to the survey. Thirty of these people were Emiratis, whereas the others were expatriates. Of the one hundred people, sixty-two were male and thirty-eight were female. The age distribution was as follows: nineteen people aged between eighteen and

twenty-three, thirty-six people between twenty-four and thirty, twenty-one people between thirty-one and forty, eleven people between forty-one and fifty, eight people between fifty-one and sixty, and four people over sixty. One person did not enter their age.

14 For some examples of this scholarship, please see Ahmad (2017); Al-Nakib (2016); Chatty (1996, 2009); Gardner (2010); Hanieh (2011); Inhorn (2015); Kanna (2011); Limbert (2010); Longva (1997); Menoret (2014); Nagy (2000); Ramos (2010); Stanek (2015); and Vora (2013).

15 Timothy Mitchell's *Rule of Experts* (2002) is an exceptional account of environmental expertise in the Middle East. For other examples of work on the environment in the Middle East, please see Jessica Barnes, *Cultivating the Nile* (Durham, NC: Duke University Press, 2014); Laurie Brand, "Development in Wadi Rum? State Bureaucracy, External Funders, and Civil Society," *International Journal of Middle East Studies* 33, no. 4 (2001): 571–90; Gareth Doherty, *Paradoxes of Green: Landscapes of a City-State* (Berkeley: University of California Press, 2017); Gary Fields, "Landscaping Palestine: Reflections of Enclosure in a Historical Mirror," *International Journal of Middle East Studies* 42, no. 1 (2010): 63–82; Bridget Guarasci, "The National Park: Reviving Eden in Iraq's Marshes," *Arab Studies Journal* 23, no. 1 (fall 2015); Gökçe Günel, "The Infinity of Water: Climate Change Adaptation in the Arabian Peninsula," *Public Culture* 28, no. 2 (2016a): 291–315; Toby Craig Jones, *Desert Kingdom: How Oil and Water Forged Modern Saudi Arabia* (Cambridge, MA: Harvard University Press, 2010); Karim Makdisi, "The Rise and Decline of Environmentalism in Lebanon," in *Water on Sand: Environmental Histories of the Middle East and North Africa*, edited by Alan Mikhail (Oxford: Oxford University Press, 2013), 207–29; Alan Mikhail, *The Animal in Ottoman Egypt* (Oxford: Oxford University Press, 2014); Sophia Stamatopoulou-Robbins, "Occupational Hazards," *Comparative Studies of South Asia, Africa and the Middle East* 34, no. 3 (2014): 476–96; Rebecca Stein, "Traveling Zion: Hiking and Settler Nationalism in Pre-1948 Palestine," *Interventions: International Journal of Postcolonial Studies* 11, no. 3 (2009): 334–51.

16 For some examples of this scholarship, please see Hamdy (2012) and Sanal (2011).

17 Lara Deeb and Jessica Winegar, "Anthropologies of Arab-Majority Societies," *Annual Review of Anthropology* 41, no. 41 (2012): 537–58.

18 For some examples of Zayed's environmental projects, please see http://gulfnews.com/news/uae/environment/zayed-vision-transforming-desert-into-green-haven-1.132209 and http://www.thenational.ae/news/uae-news/environment/sheikh-zayed-laid-groundwork-for-environmental-protection, accessed May 30, 2017.

19 Rosemarie Said Zahlan, *The Origins of the United Arab Emirates: A Political and Social History of the Trucial States* (New York: St. Martin's Press, 1978).

20 Christopher M. Davidson, "After Shaikh Zayed: The Politics of Succession in Abu Dhabi and the UAE," *Middle East Policy* 13, no. 1 (2006c): 42–59.

21 Christopher M. Davidson, "Abu Dhabi's New Economy: Oil, Investment and Domestic Development," *Middle East Policy* 16, no. 2) (2009b): 59–79.

22 Davidson, "After Shaikh Zayed," 44.

23 Yasser Elsheshtawy's work provides a historical framework for Abu Dhabi's urban development and understands the death of Sheikh Zayed as a turning point leading to a globalized city. In describing the projects that characterize Abu Dhabi in the period after 2004, he uses the *souq* by Foster + Partners as an example. While the souq is marketed as "an attempt at reinventing the old market place, giving the city a new civic heart," Elsheshtawy shows that it "excludes these elements which were in some way 'spoiling' the modern metropolitan image that officials are trying to portray. There simply is no room for loitering Pakistani shoppers looking for a cheap bargain, or a gathering of Sri Lankan housemaids exchanging news." The patterns of exclusion that he finds are prevalent across new projects, such as Masdar City. Please see Yasser Elsheshtawy, *The Evolving Arab City: Tradition, Modernity and Urban Development* (London: Routledge, 2008).

24 These cultural projects are under construction on Saadiyat Island (meaning "island of happiness" in Arabic), located 0.3 miles off the coast of Abu Dhabi. NYU-Abu Dhabi opened in 2008 at a temporary site in downtown Abu Dhabi before moving to its permanent campus on the island. Guggenheim Abu Dhabi, designed by American architect Frank Gehry, will show contemporary art and will be the largest of the several Guggenheim Foundation museums internationally. Designed by French architect Jean Nouvel, Louvre Abu Dhabi will exhibit loaned works from the Paris-based collection and will be the French institution's first international branch. Construction of Guggenheim Abu Dhabi has been delayed several times—its opening date is unclear. But Jean Nouvel's Louvre Abu Dhabi was opened in November 2017.

25 For an analysis of how these policies impact migrant communities in the UAE, please see Vora, *Impossible Citizens*. For a comparable reflection on temporariness in Kuwait, please see Ahmad, *Everyday Conversions*. For an exposé of the types of exploitation that the kafala system facilitates, please see the Human Rights Watch 2014 report "'I Already Bought You': Abuse and Exploitation of Female Migrant Domestic Workers in the United Arab Emirates," https://www.hrw.org/report/2014/10/22/i-already-bought-you/abuse-and-exploitation-female-migrant-domestic-workers-united, accessed July 21, 2015.

26 This abuse has been the topic of a story in the *New Yorker*, among other general readership publications. Please see Negar Azimi, "The Gulf Art War: New Museums in the Emirates Raise the Issue of Workers' Rights," *New Yorker*, December 19, 2016, http://www.newyorker.com/magazine/2016/12/19/the-gulf-art-war, accessed February 17, 2017. Also see the Human Rights Watch 2015 report entitled "Migrant Workers' Rights on Saadiyat Island in the United Arab Emirates," https://www.hrw.org/report/2015/02/10/migrant-workers-rights-saadiyat-island-united-arab-emirates/2015-progress-report, accessed July 21, 2015. For a work of fiction that describes these conditions well, see Deepak Unnikrishnan, *Temporary People* (New York: Restless Books, 2017).

27 Please see Abu Dhabi Economic Vision 2030, https://www.ecouncil.ae/PublicationsEn/economic-vision-2030-full-versionEn.pdf, 24, accessed April 14, 2017.

28 Jane Guyer's work is illustrative in showing how the price of oil is constituted. For some examples of this discussion, please see Jane Guyer, *Marginal Gains: Monetary Transactions in Atlantic Africa* (Chicago: University of Chicago Press, 2004), 107 et seq.; Jane Guyer, "Composites, Fictions, and Risks: Toward an Ethnography of Price," in *Market and Society: The Great Transformation Today*, edited by C. Hann and K. Hart, 203–20 (Cambridge: Cambridge University Press, 2009); Jane Guyer, "Blueprints, Judgment, and Perseverance in a Corporate Context," *Current Anthropology* 52, no. 3 (2011): S17–S27; Jane Guyer, "Oil Assemblages and the Production of Confusion: Price Fluctuations in Two West African Oil-Producing Economies," in *Subterranean Estates: Life Worlds of Oil and* Gas, edited by Hannah Appel, Arthur Mason, and Michael Watts (Ithaca, NY: Cornell University Press, 2015), 237–52. For the making of oil price in the United States, listen to five *Planet Money* podcast episodes, http://www.npr.org/sections/money/2016/08/26/491342091/planet-money-buys-oil, accessed January 17, 2017.

29 Mitchell, *Carbon Democracy*.

30 N. Choucri, D. Goldsmith, T. Mezher, "Renewable Energy Policy in an Oil-Exporting Country: The Case of the United Arab Emirates," *Renewable Energy Law and Policy Review* 1, no. 1 (2010): 77–86. Please note that this research paper is a product of the MIT-Masdar Institute collaboration, coauthored by researchers from MIT and Masdar Institute.

31 "Abu Dhabi's oil reserves to last another 150 years," http://www.emirates247.com/eb247/economy/uae-economy/abu-dhabi-s-oil-reserves-to-last-another-150-years-2010–03–31–1.100837, accessed July 10, 2015.

32 Colin J. Campbell, *Campbell's Atlas of Oil and Gas Depletion* (New York: Springer, 2013), 322.

33 As Gary Bowden and Michael Aaron Dennis demonstrate, calculations regarding oil reserves are also linked to the corporate strategies and changing interests of the oil industry. For an overview, see Gary Bowden, "The Social Construction of Validity Estimates of US Crude Oil Reserves," *Social Studies of Science* 15, no. 2 (1985): 207–40; and Michael Aaron Dennis, "Drilling for Dollars: The Making of US Petroleum Reserve Estimates, 1921–25," *Social Studies of Science* 15, no. 2 (1985): 241–65.

34 For a more extensive discussion, see Gavin Bridge, "Geographies of Peak Oil: The Other Carbon Problem," *Geoforum* 41, no. 4 (2010): 523–30.

35 Rogers, "Oil and Anthropology."

36 Limbert, *In the Time of Oil*, 170–76. Also see Mandana Limbert, "Reserves, Secrecy and the Science of Oil Prognostication in Southern Arabia," in *Subterranean Estates: Life Worlds of Oil and Gas*, edited by Arthur Mason, Hannah Appel, and Michael Watts (Ithaca, NY: Cornell University Press, 2015).

37 Todd Reisz, "As a Matter of Fact: The Legend of Dubai," *Log* 13–14 (2008): 127–39.

38 For other examples of contexts where renewable energy and clean technology serve as solutions to present problems, see Dominic Boyer and Cymene Howe, "Aeolian Infrastructures, Aeolian Publics," *Limn* 7 (2016), http://limn.it/aeolian-infrastructures-aeolian-publics/, accessed May 31, 2017; Jamie Cross, "The 100th Object: Solar Lighting Technology and Humanitarian Goods," *Journal of Material Culture* 18, no. 4 (2013): 367–87; Rebecca Slayton, "Efficient, Secure Green: Digital Utopianism and the Challenge of a 'Smart' Grid," *Information and Culture* 48, no. 4 (2013): 448–78.

39 Rowan Moore, "Masdar City, Abu Dhabi: The Gulf between Wisdom and Folly," *The Observer*, December 18, 2010, https://www.theguardian.com/artanddesign/2010/dec/19/norman-foster-masdar-city-review, accessed April 23, 2017.

40 Laura Stupin, "I Live in a Spaceship in the Middle of the Desert," 2010, http://squidskin.blogspot.com/2010/09/i-live-in-spaceship-in-middle-of-desert.html, accessed April 7, 2017.

41 Laura Stupin, blogger profile, https://www.blogger.com/profile/05771450900786731642, accessed April 7, 2017.

42 Scott, *Seeing Like a State*.

43 Ferguson, *Anti-Politics Machine*.

44 Scholarship on infrastructure underlines how systems tend to disappear into the background when they function well. When they break down, however, they are easy to notice. At times, the dysfunctionality of infrastructure, particularly energy infrastructure, represents how people's expectations of

modernity dissipate. In studying the emergence of Abu Dhabi's renewable energy and clean technology infrastructure, I illustrate how these projects' potential to mitigate energy and climate change problems globally made the projects visible. Also see Brian Larkin, "The Politics and Poetics of Infrastructure," *Annual Review of Anthropology* 42 (2013): 327–43.

45 Giorgio Agamben, *Potentialities: Collected Essays in Philosophy* (Palo Alto, CA: Stanford University Press, 2000).

46 Paolo Virno, *Déjà Vu and the End of History* (New York: Verso, 2015).

47 Karen Pinkus, *Fuel: A Speculative Dictionary* (Minneapolis: University of Minnesota, 2016).

48 Gisa Weszkalnys, "Geology, Potentiality, Speculation: On the Indeterminacy of First Oil," *Cultural Anthropology* 30, no. 4 (2015): 611–39, 617. Also see Mette N. Svendsen, "Articulating Potentiality: Notes on the Delineation of the Blank Figure in Human Embryonic Stem Cell Research," *Cultural Anthropology* 26, no. 3 (2011): 414–37; and William Mazzarella, "Beautiful Balloon: The Digital Divide and the Charisma of New Media in India," *American Ethnologist* 37, no. 4 (2010): 783–804.

49 Halpern, *Beautiful Data*. For the logic of the test-bed, see Orit Halpern, J. LeCavalier, N. Calvillo, and W. Pietsch, "Test-Bed Urbanism," *Public Culture* 25, no. 2 (2013): 273–305.

50 In an article on offshore oil production, Hannah Appel studies the ways in which such highly mobile experts attempt to make oil production the same across different geographies despite local entanglements and shows how their paths and their work are hardly seamless. The context of Masdar is rather different from these offshore plants or from the oil industry that Appel describes, mainly because Masdar is located in a country that is almost entirely made up of such modular experts. The modularity and high turnover of the professionals in Abu Dhabi in particular and the UAE in general is at times perceived as a problem that should be mitigated through reformed citizenship protocols that encourage permanent residency in the country. The Emiratization movement, which calls for increased participation of UAE citizens in the economy and seeks to train them for positions of expertise, is another dominant reaction that emerges in other parts of the Arab Gulf as well (see chapter 2). Therefore, the modularity of the workforce is not necessarily a condition that the Abu Dhabi government always celebrates. At the same time, this modularity allows white-collar workers to mistakenly imagine Abu Dhabi as a noncontextual space where local politics can be shut out whenever necessary. Unexpected occurrences such as geopolitical tensions between Iran and the UAE, however, have shown these workers that social and political frictions are not always so easy to shut out (see chapter 2). Hannah Appel, "Offshore Work: Oil, Modularity,

and the How of Capitalism in Equatorial Guinea," *American Ethnologist* 39, no. 4 (2012): 692–709.

51 *Rashomon* is a 1950 Japanese film by Akira Kurosawa, based on two short stories by Ryunosuke Akutagawa in which a murder involving four individuals (suspects, witnesses, and surviving victims) is described in four mutually contradictory ways. Each account of the event, delivered by four different characters, is self-serving, intended to legitimize the narrator. As each of the four narrators testifies, the viewer sees that particular version of the events on film, so the visual image supports each testimony in turn. In this way, *Rashomon* seeks to convince the viewers of the truth of each perspective. Unlike detective stories, where viewers may reach a solid truth at the end, the film refuses to clarify the contradictions it creates. To further explore how this structure may color our understanding of anthropology as a discipline, please see Nur Yalman, "The Rashomon Effect: Considerations for Existential Anthropology," in *Rashomon Effects: Kurosawa,* Rashomon *and Their Legacies*, edited by Blair Davis, Robert Anderson, and Jan Walls (New York: Routledge, 2016).

52 Masdar Institute currently offers the following programs: MSc in Chemical Engineering, MSc in Computing and Information Science, MSc in Electrical Power Engineering, MSc in Engineering Systems and Management, MSc in Materials Science and Engineering, MSc in Mechanical Engineering, MSc in Microsystems Engineering, and MSc in Water and Environmental Engineering.

53 See Gökçe Günel, "Masdar City's Hidden Brain," *The arpa Journal*, 2014, http://arpajournal.gsapp.org/masdar-citys-hidden-brain/, accessed September 25, 2014.

Chapter 1: Inhabiting the Spaceship

1 See video, http://www.masdarcity.ae/en/49/resource-centre/video-gallery/?vid=1, accessed December 22, 2011.

2 The literature on the building of cities from scratch has at times touched upon this futurity. "Ciudad Guayana as an entity exists only in the publicity flyers of the development agency," Lisa Peattie writes, in reviewing the emergence of Ciudad Guayana, a new city that was started in the 1960s when the Venezuelan government invited planners from MIT and Harvard to create an emergent area of growth in the south of the country. "The design focus," Peattie continues, "served to convert the city into a kind of monument to the idea of progress, an ideological construction within which private gain could be thought of as social progress and the general good." This emphasis, according to Peattie, was thought to possibly facilitate the emergence of

an undivided community, while at the same time attracting investment and technically capable individuals to the city. In the case of Masdar, the eco-city would bring together a community of researchers, investors, and professionals working on clean technology and renewable energy infrastructures, thereby functioning as a magnet for investments and technically capable individuals. Through this emphasis on innovation, the eco-city set a stark contrast to the resource-led economy of Abu Dhabi. In discussing the construction of Brasília, James Holston also suggests, "This utopian difference between capital [Brasília] and nation meant that the planning of Brasília had to negate Brazil as it existed. Thus the Master Plan presents the founding of the city as if it had no history. . . . On inauguration day, [the government] planned to reveal a miracle: a gleaming city, empty and ready to receive its intended occupants." This strategy worked for the construction phase of Brasília. And yet, despite the attempts of the Abu Dhabi government, the plans for building a new city could not be put to use. The economic downturn of 2008 prohibited Abu Dhabi from completing the construction of the city fully, demanding that Masdar City be built step by step, together with the investors that it sought to attract. Masdar executives put together a sustainability code, expecting the incoming investors to abide by the city's guidelines. Companies such as Siemens, BASF, General Electric, and Bayer at once agreed to build research centers and office spaces within the clean technology cluster. The Siemens office was opened in 2014, while the others remain in planning stage. See Lisa Redfield Peattie, *Planning, Rethinking Ciudad Guayana* (Ann Arbor: University of Michigan Press, 1987); James Holston, *The Modernist City: An Anthropological Critique of Brasília* (Chicago: University of Chicago Press, 1989); and James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven, CT: Yale University Press, 1998).

3 See "Abu Dhabi's Masdar Initiative Breaks Ground on Carbon-Neutral City of the Future," http://www.prnewswire.com/news-releases/abu-dhabis-masdar-initiative-breaks-ground-on-carbon-neutral-city-of-the-future-56875567.html, accessed March 14, 2016.

4 "Masdar City—Zero Carbon," http://www.asylum.com/2010/04/22/UAE-Dubai-sustainable-carbon-neutral-masdar-city-abu-dhabi/, accessed July 15, 2014.

5 "Past Sci-Fi Flicks Are the Future of Masdar," http://www.gearfuse.com/past-sci-fi-flicks-are-the-future-of-masdar/, accessed March 15, 2016.

6 Scholars of urban planning, literature, and the history of science have reviewed some of these emergent city projects. On Chinese eco-cities, see Shannon May, "Ecological Citizenship and a Plan for Sustainable Development," *City* 12, no. 2 (2008): 237–44, and Julie Sze, *Fantasy Islands: Chinese*

Dreams and Ecological Fears in an Age of Climate Crisis (Palo Alto, CA: University of California Press, 2014). On the Songdo project in South Korea, see Orit Halpern, *Beautiful Data: A History of Vision and Reason since 1945* (Durham, NC: Duke University Press, 2014). For an analysis of eco-friendly architecture, please see Anne Rademacher, *Building Green: Environmental Architects and the Struggle for Sustainability in Mumbai* (Berkeley: University of California Press, 2017).

7 "Masdar City—A Glimpse of the Future in the Desert," http://www.guardian.co.uk/environment/2011/apr/26/masdar-city-desert-future, accessed March 14, 2016.

8 "American 'Eco-Geek's' First Week at the Masdar Institute," http://www.greenprophet.com/2010/10/american-first-week-masdar/, accessed March 14, 2016.

9 Peder Anker, *From Bauhaus to Ecohouse: A History of Ecological Design* (Baton Rouge: Louisiana State University Press, 2010). Also see Sabine Höhler, *Spaceship Earth in the Environmental Age, 1960–1990* (London: Pickering and Chatto, 2015).

10 For more on the Biosphere 2 project, see Sabine Höhler, "The Environment as a Life Support System: The Case of Biosphere 2," *History and Technology* 26, no. 1 (2010): 39–58.

11 Hans Blumenberg, *Shipwreck with Spectator: Paradigm of a Metaphor for Existence* (Cambridge, MA: MIT Press, 1996), 8.

12 Peter Sloterdijk, *Globes: Spheres 2* (South Pasadena, CA: Semiotext(e), 2014).

13 David Valentine, "Atmosphere: Context, Detachment, and the View from above Earth," *American Ethnologist* 43, no. 3 (2016): 511–24, 513.

14 For a biography of Fuller, please see Steven Sieden, *Buckminster Fuller's Universe: His Life and Work* (New York: Basic Books, 2000).

15 Buckminster Fuller, *Operating Manual for Spaceship Earth* (Rotterdam: Lars Müller, [1969] 2008); also see Anker, *From Bauhaus to Eco-House*.

16 Fuller, *Operating Manual for Spaceship Earth*, 52–54.

17 Ernst von Meijenfeldt and Marit Geluk, *Below Ground Level: Creating New Spaces for Contemporary Architecture* (Basel: Birkhäuser, 2003), 130.

18 "The Pritzker Architecture Prize: Norman Foster, 1999 Laureate," https://www.pritzkerprize.com/sites/default/files/file_fields/field_files_inline/1999_bio.pdf.

19 Thomas Tse Kwai Zung, *Buckminster Fuller: Anthology for a New Millennium* (New York: St. Martin's Press, 2002), 2.

20 "Man on the Moon: Norman Foster Prepares for Architecture's Lift-Off," *The Guardian*, September 22, 2009, http://www.guardian.co.uk/artanddesign/2009/sep/22/moon-norman-foster-architecture, accessed January 24, 2014.

21 "Norman Foster Takes on Mars: Architect's Firm Reveals Their Award-Winning Vision for an Astronaut's Life on the Red Planet," *Daily Mail*, http://www.dailymail.co.uk/sciencetech/article-3253478/Norman-Foster-takes-Mars-Architect-s-firm-reveals-award-winning-vision-astronaut-s-life-red-planet.html, accessed September 30, 2015. Also see "Foster + Partners Reveals Concept for 3D-Printed Mars Habitat Built by Robots," http://www.dezeen.com/2015/09/25/foster-partners-concept-3d-printed-mars-habitat-robots-regolith/, accessed September 30, 2015.

22 "Norman Foster: Building an Oasis," http://www.thenational.ae/arts-culture/norman-foster-building-an-oasis, accessed January 24, 2014.

23 "Masdar: Abu Dhabi's Carbon Neutral City," BBC News, http://news.bbc.co.uk/2/hi/middle_east/8586046.stm, accessed January 24, 2014.

24 Easa Saleh Al-Gurg, *The Wells of Memory: An Autobiography* (London: J. Murray, 1998). Easa Al-Gurg started one of the UAE's most prominent family businesses in 1960 after gaining considerable experience in the fields of banking and finance. He was an adviser to Sheikh Rashid, the late ruler of Dubai, and was also one of the people who attended the meetings in which the UAE was formed on December 2, 1971. Easa Al-Gurg also served as UAE ambassador to the United Kingdom and the Republic of Ireland for almost two decades, starting in 1991.

25 Nicolai Ouroussoff, "In Arabian Desert, a Sustainable City Rises," *New York Times*, September 26, 2010, http://www.nytimes.com/2010/09/26/arts/design/26masdar.html?pagewanted=1&_r=1, accessed January 21, 2014.

26 Norman Foster, "Masdar City, Abu Dhabi: The Gulf between Wisdom and Folly," *The Guardian*, December 19, 2010, http://www.guardian.co.uk/artanddesign/2010/dec/19/norman-foster-masdar-city-review, accessed March 28, 2017.

27 David A. Mindell, *Digital Apollo: Human and Machine in Spaceflight* (Cambridge, MA: MIT Press, 2008), 12.

28 Environmental imaginaries of the desert have long been a point of contestation. While colonizers of the desert, say the French in Algeria, perceived the desert as an arid environment from which only death could emerge, their Algerian counterparts explained to them that they are unable to perceive the riches of this landscape. At times the desert suffered from what Diana Davis calls environmental orientalism, and was conceived as a homogeneous geography. In the case of Abu Dhabi, the desert had the double function of both being a place of wealth—as the source of oil—and a place that was a home for previous generations who knew the specific characteristics of their local environment, but for the contemporary generation could only be navigated by relying on a spaceship. See Diana K. Davis, "Imperialism,

Orientalism, and the Environment in the Middle East: History, Policy, Power, and Practice," in *Environmental Imaginaries of the Middle East and North Africa*, edited by Diana K. Davis and Edmund Burke III (Athens: Ohio University Press, 2011), 1–22. Also see George Trumbull's chapter "Body of Work" in the same edited volume, 87–113.

29 For a longer exploration of this theme, see Rosalind Williams, *Notes on the Underground: An Essay on Technology, Society, and the Imagination* (Cambridge, MA: MIT Press, [1990] 2008), 7.

30 As Sabine Höhler reminds her readers, "Appropriating space by compiling, registering, and neatly arranging the elements within it is a strategy not limited to the modern era of scientific collecting, archiving, and interpreting of the world. The procedure recalls the primal ship representing the inventory of the world, the biblical ark." Höhler, "The Environment as a Life Support System." Also see Höhler, *Spaceship Earth in the Environmental Age*.

31 Presentation at World Future Energy Summit, Abu Dhabi, UAE, January 18, 2011.

32 For a review of these figures, please see "Work Starts on Gulf 'Green City,'" BBC News, http://news.bbc.co.uk/2/hi/science/nature/7237672.stm, accessed March 28, 2017.

33 In recent years, scholars in the social sciences and humanities have become interested in the promissory nature of capitalism, wherein forward-looking statements give life to commercial futures without necessitating material counterparts. For instance, Stefan Helmreich, researching how the ocean becomes marketable, suggests, "In promissory capitalism, after all, money need not be made off marine microbes but can sometimes just as well or better be made off promises about the sunken treasure that will be extracted from them in a possible, artificially selected, blue-ocean future." Likewise, in *Promising Genomics*, Michael Fortun outlines "sequences of speculative activity as they operated across a range of global genomic territories," and studies the "forward-looking statements" that are abundant within his field site. Investigating speculations and promises that are associated with genomic research within Indian techno-science, Sunder Rajan states, "to generate value in the present to make a certain kind of future possible, a vision of that future has to be sold, even if it is a vision that will never be realized. The temporal order of production is inverted away from the present building toward the future instead towards the future always being called into account for the present." In this way, the imaginaries of a future potential constitute the reasons why and how any enterprise may be reliable or successful. Accordingly, he adds, "hype constitutes the grounds on which reality unfolds." All in all, Rajan concludes, for the "biotechnology corporation to exist and

survive it is credibility, rather than truth, with which it is essential to start." But how exactly does a techno-scientific venture produce this credibility? Stefan Helmreich, *Alien Ocean: Anthropological Voyages in Microbial Seas* (Berkeley: University of California Press, 2009); Michael Fortun, *Promising Genomics: Iceland and deCODE Genetics in a World of Speculation* (Berkeley: University of California Press, 2008); and Kaushik Sunder Rajan, "Subjects of Speculation: Emergent Life Sciences and Market Logics in the United States and India," *American Anthropologist* 107, no. 1 (2005): 19–30.

34 See Ahmed Kanna, *Dubai, the City as Corporation* (Minneapolis: University of Minnesota Press, 2011), 93–104. In her seminal article on the Islamic city, Janet Abu-Lughod also notes that "in many parts of the Arab world, and especially in Saudi Arabia and the Gulf, urban planners with a newfound respect for the great achievements of the past are searching for ways to reproduce in today's cities some of the patterns of city building that have been identified as Islamic." She reasons that these decision makers "have been influenced, whether wittingly or not, by a body of literature produced by western Orientalists purporting to describe the essence of the Islamic city." See Janet Abu-Lughod, "The Islamic City—Historical Myth, Islamic Essence, and Contemporary Relevance," *International Journal of Middle Eastern Studies* 19 (1987): 155–76, 155.

35 See one example here: http://masdarcity.ae/digitalbrochure/en/TheGlobalCentreofFutureEnergy/, accessed January 9, 2012.

36 Similar types of performances take place in other new research institutions around the world. For instance, one colleague who worked with a comparable institution in Singapore suggested that he had been "instructed on several occasions to come to work at a specific time, and to sit in front of his computer in formal business attire." After a while an ambassador/minister/CEO walked around the office for about 30 seconds. Upon his departure, everyone was allowed to go back home.

37 In his novel *Remainder*, Tom McCarthy portrays a man who loses his grasp on the world after a traumatizing accident. With the funds he receives from his insurance company, the character in the novel generates looping installations peopled by hired actors, hoping to realize a version of what he perceived as lived experience. In some ways, the Potemkin villages of the Masdar library and the wind tower were like these installations, seeking to generate and perform a particular version of reality for a particular audience. In both of these cases, the idealized repetitions were reminiscent of George Bataille's understanding of exuberance, where the value generated through these performances allows for a possible sovereignty for the characters involved. Tom McCarthy, *Remainder* (New York: Vintage, 2007).

38 "Masdar Looks Like a City from the Future: Owen," http://www.khaleejtimes.com/DisplayArticle.asp?xfile=data/theuae/2010/October/theuae_October373.xml&section=theuae&col=, accessed April 11, 2012.

39 "Der geplatzte Traum der Wüstenstadt Masdar," http://www.wiwo.de/technologie/modellmetropole-der-geplatzte-traum-der-wuestenstadt-masdar/5258478.html (my translation), accessed January 22, 2012.

40 Increasingly, "the mirage" has become a significant discursive tool in thinking about Masdar City. For instance, this news piece describes Masdar City as a disappointing mirage that did not live up to its promises: http://www.worldcrunch.com/smarter-cities/masdar-city-green-desert-paradise-or-disappointing-mirage-/masdar-city-abu-dhabi-smart-future-city/c15s18332/#.Va17jhNViko, accessed July 20, 2015.

41 See, for instance, this proposal for self-cleaning solar panels: "Self-Cleaning Solar Panels," http://www.technologyreview.com/news/420524/self-cleaning-solar-panels/, accessed July 2, 2014.

42 On labor conditions in the UAE, see David Keane and Nicholas McGeehan, "Enforcing Migrant Workers' Rights in the United Arab Emirates," *International Journal on Minority and Group Rights* 15, no. 1 (2008): 81–115, and Sulayman Khalaf and Saad Alkobaisi, "Migrants' Strategies of Coping and Patterns of Accommodation in the Oil-Rich Gulf Societies: Evidence from the UAE," *British Journal of Middle Eastern Studies* 26, no. 2 (1999): 271–98. For a recent account of struggles to protect immigrant rights in the Arab Gulf, especially in Abu Dhabi, see gulflabor.org, accessed July 15, 2014.

43 "Abu Dhabi: Oil Today, Green Tomorrow?" http://www.marcgunther.com/2011/01/17/abu-dhabi-oil-today-green-tomorrow/, accessed January 21, 2012.

Chapter 2: Beautiful Buildings and Research Contracts

1 Robert College, the oldest American school outside the United States, was established in 1863. Its founders were Christopher Rhinelander Robert (1802–78), a wealthy American philanthropist whose father had made a fortune in the West Indies and who himself built on that fortune by multiple ventures in shipping and mining inside and outside the United States, and Cyrus Hamlin, a missionary with a special interest in education. For more information on the biographies of these founders, please see Özlem Altan-Olcay, "Defining 'America' from a Distance: Local Strategies of the Global in the Middle East," *Middle Eastern Studies* 44, no. 1 (2008): 29–52. Also see Ali Erken, "The Making of Politics and Trained Intelligence in the Near East: Robert College of Istanbul," *European Review of History: Revue européenne d'histoire* 23, no. 3 (2016): 554–71.

2 This was not an entirely new strategy: by exploring TDP's history, this chapter shows that such beautiful buildings and research contracts had been relatively significant to the production of research institutions in countries such as Egypt, Lebanon, and Kuwait as well.

3 In his *Cultural Anthropology* article, Tom Looser asks why students would travel to branch campuses for their education. Although Masdar Institute is not a branch campus, some of his suggestions may apply: "Given these conditions, from a student's perspective, why fly off to one of these campuses? Why fly off to Songdo, or Pudong, or Abu Dhabi, if that is not already home . . . why would a student go? For the moment, the answer generally seems to be money (either scholarship inducements as at Abu Dhabi or cheaper tuition relative to the costs of private universities in the United States as at a place like Yonsei's UIC), and the promise of real, if nonetheless generic, excellence. And perhaps still some interest in a local area." While the generous stipends and excellence in education were influential in making students select Masdar Institute, none of the students I spoke with mentioned an interest in Abu Dhabi's local context, other than the fact that it was close to home for many of them. They compared Masdar with KAUST in Saudi Arabia, and said they preferred Abu Dhabi because it was socially more liberal than Saudi Arabia. Tom Looser, "The Global University, Area Studies, and the World Citizen: Neoliberal Geography's Redistribution of the 'World,'" *Cultural Anthropology* 27, no. 1 (2012): 97–117.

4 "Masdar Institute in US Student Recruitment Drive," http://www.thenational.ae/news/uae-news/environment/masdar-institute-in-us-student-recruitment-drive, accessed March 14, 2016.

5 Discussing the inauguration of KAUST, Toby Craig Jones writes: "[King Abdullah's] focus on science and technology, and his use of oil wealth to build up local expertise, which the king hopes will ultimately help the kingdom diversify its economy, establish a foundation for a future after oil, and make Saudi Arabia internationally competitive in science, are signals that these areas should figure prominently in how both Saudis and outsiders think about the kingdom." Toby Craig Jones, *Desert Kingdom: How Oil and Water Forged Modern Saudi Arabia* (Cambridge, MA: Harvard University Press, 2010).

6 In his overview of educational institutions in the Gulf, architect Kevin Mitchell, a faculty member at the American University of Sharjah, reports on Masdar Institute and KAUST, understanding them as part and parcel of a shared development strategy. Kevin Mitchell, "Design for the Future: Educational Institutions in the Gulf," *Architectural Design* 85, no. 1 (2015): 38–45.

7 Please see James Collins Jr., "The Design Process for the Human Workplace," in *Architecture of Science*, edited by Peter Galison and Emily Ann Thompson (Cambridge, MA: MIT Press, 1999), 410.

8 Nigel Thrift, "Re-Inventing Invention: New Tendencies in Capitalist Commodification," *Economy and Society* 35, no. 2 (2006): 279–306; also see Nigel Thrift, *Knowing Capitalism* (London: SAGE, 2005).

9 The Foster + Partners design suggested that the laboratories would have a "plug-and-play" function, where desks and office spaces would be modular, allowing for interdisciplinary work. However, this feature of the building was much less significant and much less visible than the ways in which it affected relationships with the outside world.

10 Ritchie Lorin and Kathlin Ray, "Incorporating Information Literacy into the Building Plan: The American University of Sharjah Experience," *Reference Services Review* 36, no. 2 (2008), 167–79, 168.

11 D. Kirk and D. Napier, "The Transformation of Higher Education in the United Arab Emirates: Issues, Implications, and Intercultural Dimensions," in *Nation-Building, Identity and Citizenship Education: Cross Cultural Perspectives*, edited by J. Zajda, H. Daun, and L. J. Saha (Dordrecht, Netherlands: Springer Science + Business Media B.V., 2009), 131–42.

12 Stephen Wilkins, "Higher Education in the United Arab Emirates: An Analysis of the Outcomes of Significant Increases in Supply and Competition," *Journal of Higher Education Policy and Management* 32, no. 4 (2010): 389–400.

13 In 1977, 502 students were enrolled at the United Arab Emirates University, of whom 313 were male and 187 were female. By 1990, enrollment had grown to 2,464 males and 5,483 females, or a total of 7,947 students; and in 1992 there were 2,525 males and 6,739 females, or a total of 9,264 students at the university. Please see Khalifa A. Alsuwaidi, "The Future of Higher Education in the United Arab Emirates," PhD diss., University of Southern California, http://ezproxy.library.arizona.edu/login?url=http://search.proquest.com.ezproxy4.1ibrary.arizona.edu/docview/1627800065?accountid=8360.

14 Kirk and Napier, "The Transformation of Higher Education in the United Arab Emirates," 137.

15 For a ranking of the universities, see "Top 10 Universities in the UAE: The United Arab Emirates Offers a Range of Educational Opportunities for Both International and Local Students," *Gulf Business*, http://gulfbusiness.com/top-10-universities-uae/, accessed May 8, 2017.

16 Kirk and Napier, "The Transformation of Higher Education in the United Arab Emirates," 136.

17 Christopher M. Davidson, *Abu Dhabi: Oil and Beyond* (New York: Columbia University Press, 2009), 149–52.

18 "Masdar Institute's Founding President Reflects on Career as Class of 2014 Graduates," http://www.thenational.ae/uae/technology/masdar-institutes-founding-president-reflects-on-career-as-class-of-2014-graduates, accessed May 16, 2017. For figures from 2015–16, please see "Masdar Institute Facts 2015–2016," https://www.masdar.ac.ae/images/pdf/LR-2016-March-MI-Facts-AA.pdf, accessed May 18, 2017.

19 The art market in the UAE started booming in 2006, serving as a space where Middle Eastern artists could auction their work and demonstrating how "for the first time, Middle Eastern art appears definitively to be part of a global scene." "Gold Rush: The Emerging Art Market in the UAE," http://bidoun.org/articles/gold-rush, accessed May 19, 2017. Also see two recent theses on the topic: Taymour Grahne, "The Rise of the Middle Eastern Art Market since 2006," master's thesis, Sotheby's Institute of Art, New York, 2013; and Mert Kaymakçı, "Art and Patronage in the Middle East: The United Arab Emirates," master's thesis, Sotheby's Institute of Art, New York, 2016.

20 http://www.forbescustom.com/abudhabi/index.html, accessed April 10, 2012.

21 For a discussion of the "idea capital" concept, please see Looser, "The Global University."

22 Please note that the organization changed its name from Technology Adaptation Program to Technology and Development Program in 1985.

23 The agreement between Masdar Institute and TDP was renewed in December 2011 and lasted until December 2016. At the time of writing, it is unclear whether the agreement will be renewed again.

24 "MIT Reports to the President 2007–2008," http://web.mit.edu/annualreports/pres08/2008.08.20.pdf, accessed April 6, 2012.

25 See "Abu Dhabi Economic Vision 2030," https://www.ecouncil.ae/PublicationsEn/economic-vision-2030-full-versionEn.pdf, 5, accessed July 20, 2015.

26 Similar types of transformation are taking place in other oil- and gas-rich Gulf countries, where governments increasingly grow concerned about their dependence on finite resources. Like the Abu Dhabi government, the Qatari government invests in arts and education with the expectation of establishing a knowledge-based economy that will safeguard the country's future. One of the major investments in Qatar is Education City, which houses the branch campuses of several U.S.-based institutions of higher education, such as Cornell, Texas A&M, and Georgetown. For an analysis of Education City, please see Neha Vora, "Between Global Citizenship and Qatarization: Negotiating Qatar's New Knowledge Economy within American Branch Campuses," *Ethnic and Racial Studies* 37, no. 12 (2014): 2243–60.

Also see Neha Vora, *Teach for Arabia: American Universities, Liberalism, and Transnational Qatar* (Stanford, CA: Stanford University Press, 2018).

27 As Nigel Thrift argues, this move may be perceived as an attempt "to engineer new kinds of . . . subject positions that can cope with the disciplines of permanent emergency." Nigel Thrift, "Performing Cultures in the New Economy," *Annals of the Association of American Geographers* 90, no. 4 (2000): 674–92.

28 Michel Callon, "An Essay on the Growing Contribution of Economic Markets to the Proliferation of the Social," *Theory, Culture and Society* 24, nos. 7–8 (2007): 139–63.

29 During a conversation in November 2016, a Masdar Institute faculty member suggested that the MIT partnership would soon be phased out, mainly because it was too expensive to keep the U.S. institution as a partner. At the same time, rumors in 2016 indicated that Masdar Institute could be merging with one of the undergraduate universities in Abu Dhabi, another reason the MIT partnership was no longer considered feasible.

30 Fred announced his retirement at the 2014 Masdar Institute commencement ceremony, yet remained an important figure in the institute after his retirement. See http://www.thenational.ae/uae/technology/masdar-institutes-founding-president-reflects-on-career-as-class-of-2014-graduates, accessed July 11 2014.

31 http://web.mit.edu/mit-tdp/about/, accessed February 27, 2012.

32 During my fieldwork at MIT in Cambridge between January and June 2010, I observed that the TDP received criticism for being too insular, and for working with the same faculty members on different projects, rather than involving new people.

33 After Steve moved to Abu Dhabi in August 2010 to work at Masdar Institute, MIT Professor Duane Boning took over Steve's role in Cambridge, and was appointed executive director.

34 An institutional review board (IRB) is a type of committee used in research in the United States that has been formally designated to approve, monitor, and review biomedical and behavioral research involving humans. For an analysis of IRB practices in the United States, please see Laura Stark, *Behind Closed Doors: IRBs and the Making of Ethical Research* (Chicago: University of Chicago Press, 2012).

35 While there were no IRB protocols at Masdar Institute during the years I conducted research there, by 2016 these protocols had been established in the UAE.

36 However, not everyone agreed with this argument about reciprocity. One faculty member at Masdar Institute insisted, for instance, that their faculty

partners at MIT were, most of the time, not invested in these collaborative projects. Referring to the sums of money that the MIT faculty received for providing syllabi and other basic forms of guidance, she emphasized how they enjoyed extensive financial privileges through these contracts.

37 In the past decade, scholars in social sciences and humanities have examined the so-called global university, focusing on the emergence of satellite campuses in Asia and the Middle East. These critics underline how the branch campuses are a reflection of the transforming nature of the North American university system, which relatedly propels changes outside the North American setting. By investigating the types of subjects that branch campuses produce, some scholars emphasize the neocolonial nature of such university functions, while others point to the new types of thinking that are born in these venues. For an article that summarizes these discussions, please see Neha Vora, "Is the University Universal? Mobile (Re)Constitutions of American Academia in the Gulf Arab States," *Anthropology and Education Quarterly* 46, no. 1 (2015): 19–36.

38 For instance, one model proposes that there are seven different ways in which such campuses work and categorizes them as replica campuses (NYU-Abu Dhabi), branch campuses (Cornell Medical), old turnkey campuses (AUB and AUC), new turnkey campuses (AUS), transnational programs (DePaul Business School), foreign campuses (American University in Dubai), and virtual branch campuses (University of Phoenix). According to this model, Masdar Institute would perhaps be categorized as a new turnkey campus, based on the foreign model of higher education, affiliated with or founded in collaboration or consultation with foreign institutions, accredited (or in the process) in the foreign affiliate country and granting degrees recognized in that country, though Fred would resist this category. For more information on these categories, please see Cynthia Miller-Idriss and Elizabeth Hanauer, "Transnational Higher Education: Offshore Campuses in the Middle East," *Comparative Education* 47, no. 2 (2011): 181–207.

39 For a thorough analysis of the production of American higher education institutions in the Middle East, especially Robert College, American University of Beirut, and American University of Cairo, please see Altan-Olcay, "Defining 'America' from a Distance." Also see Erken, "The Making of Politics and Trained Intelligence in the Near East."

40 For more details on the nature of the collaboration between the Petroleum Institute and the University of Maryland, please see http://www.eerc.umd.edu/. For a review of the program from 2008, please see http://www.civil.umd.edu/news/news_story.php?id=2909, accessed May 16, 2017.

41 "Global University Branch Campuses in the UAE Need More Regulation," http://www.thenational.ae/uae/global-university-branch-campuses-in-the-uae-need-more-regulation, accessed May 16, 2017.

42 In an article published in 2014, Neha Vora examines branch campuses in Qatar including Cornell, and analyzes how noncitizen students (many of whom were born and raised in Qatar) respond to the production of a knowledge-based economy in the country. The article investigates the seemingly contradictory categories of "global citizenship" and "Qatarization," which are jointly mobilized in constructing knowledge infrastructure, but does not touch upon the imagined longevity of the branch campus as an institutional model. Please see Vora, "Between Global Citizenship and Qatarization."

43 This independence would also leave wiggle room to both mother and branch institutions, allowing each to assert its own understanding of the politics and ethics of pedagogical practice. In the case of NYU-Abu Dhabi, for instance, issues such as the admission of Israeli students or faculty members had become problematic, requiring the two sides to negotiate on whose principles would be enacted within NYU-Abu Dhabi—NYU's or Abu Dhabi's? The Abu Dhabi government had also impeded scholarly research on the emirate's abuse of workers' rights, basically by preventing certain NYU faculty from entering the country. In this latter case, NYU refused to intervene, suggesting that they could not challenge the country's sovereignty. For an informative news piece on this controversy, please see "N.Y.U. Professor Is Barred by United Arab Emirates," *New York Times*, March 17, 2015, http://www.nytimes.com/2015/03/17/nyregion/nyu-professor-is-barred-from-the-united-arab-emirates.html?_r=0, accessed July 21, 2015.

44 Interview with Steve, February 16, 2010.

45 For in-depth studies of development in Egypt, see Julia Elyachar, *Markets of Dispossession: NGOs, Economic Development, and the State in Cairo* (Durham, NC: Duke University Press, 2005), and Timothy Mitchell, *Rule of Experts: Egypt, Techno-Politics, Modernity* (Berkeley: University of California Press, 2002).

46 E. F. Schumacher, *Small Is Beautiful: A Study of Economics as if People Mattered* (New York: Blond and Briggs, 1973), 21.

47 Schumacher, *Small Is Beautiful*, 21.

48 Schumacher, *Small Is Beautiful*, 29–30.

49 See "Evaluation of the Technological Planning Program Cairo University/Massachusetts Institute of Technology Aid Contract NE-C-1291," http://pdf.usaid.gov/pdf_docs/PDAAM411.pdf, accessed May 16, 2017.

50 "Lebanon: American University of Beirut," http://web.mit.edu/mit-tdp/projects/lebanon.html, accessed May 16, 2017.

51 In early 2014, Siemens moved into a Sheppard Robson–designed building in Masdar City. The city plans to host BASF, Bayer, and Schneider Electric, as well as GE. For a review of the Siemens building, please see "Siemens HQ in Masdar City/Sheppard Robson," http://www.archdaily.com/539213/siemens-hq-in-masdar-city-sheppard-robson, accessed July 24, 2015.

52 I asked Fred how the humanities and social sciences would fare under this model. Given his faith in contract research, he suggested that media organizations such as History Channel could support the humanities and social sciences in their academic inquiries. While this approach would transform the workings of social sciences and humanities, he argued that it would integrate them within the corporate funding model.

53 "GE Moves Smart Appliance Testing to Masdar City: Kitchen of the Future Takes a Trip to Abu Dhabi," http://www.greenchipstocks.com/articles/ge-moves-smart-appliance-testing-to-masdar-city/851, accessed July 22, 2015.

54 "Sovereign Wealth: Abu Dhabi Fund Gains General Electric Stake in $40bn Partnership," *The Guardian*, July 23, 2008, http://www.guardian.co.uk/business/2008/jul/23/generalelectric.sovereignwealthfunds, accessed February 22, 2012. Also see "General Electric Opens 'Ecomagination Centre' in Masdar City," http://www.thenational.ae/business/industry-insights/energy/general-electric-opens-ecomagination-centre-in-masdar-city, accessed May 8, 2017.

55 Please see Daniel Haberly, "Strategic Sovereign Wealth Fund Investment and the New Alliance Capitalism: A Network Mapping Investigation," *Environment and Planning A* 43, no. 8 (2011): 1833–52, and Daniel Haberly, "White Knights from the Gulf: Sovereign Wealth Fund Investment and the Evolution of German Industrial Finance," *Economic Geography* 90, no. 3 (2014): 293–320. Also see Rawi Abdelal, "Sovereign Wealth in Abu Dhabi" *Geopolitics* 14, no. 2 (2009): 317–27.

56 "GE and Mubadala to Launch Multi-Billion Dollar Global Business Partnership," http://www.mubadala.com/en/news/ge-and-mubadala-launch-multi-billion-dollar-global-business-partnership, accessed March 14, 2016.

57 Marilyn Strathern proposes a political and methodological corrective to the study of networks, arguing that scholars should pay attention to the moments of blockage rather than seeing relations as limitless extensions. Paying attention to these moments of exclusion is not only politically significant, providing an opportunity to examine where and how these blockages are built, but also methodologically important in showing limits. Marilyn Strathern, "Cutting the Network," *Journal of the Royal Anthropological Institute* 2, no. 3 (1996): 517–35.

58 In the UAE, it is common for immigrants to state their religions both on employment application forms and on visa application forms. Such declarations are not specific to Masdar Institute.

59 For a geopolitical review of Iran's relations with its Arab neighbors, please see: Anoushiravan Ehteshami, Neil Quilliam, and Gawdat Bahgat, *Security and Bilateral Issues between Iran and Its Arab Neighbors* (London: Springer, 2017).

60 "Linking Capital's Knowledge Hubs Can Fulfill Its Vision, *Huffington Post*, http://www.huffingtonpost.com/sultan-sooud-alqassemi/linking-capitals-knowledg_b_757376.html, accessed March 14, 2016.

61 For an exploration of Abu Dhabi's collaborators at Kizad, please see "Big Names Flood into Abu Dhabi's Kizad," http://www.thenational.ae/business/economy/big-names-flood-into-abu-dhabis-kizad, accessed March 14, 2016.

Chapter 3: Ergos: A New Energy Currency

1 See, for instance, Nawal Al-Hosany and Hisham Elkadi, "Sustainability Approaches for Incarceration Architecture," *Renewable and Sustainable Energy Reviews* 6, no. 5 (2002): 457–70.

2 For more information on the START campaign, please see http://www.masdar.ae/en/MediaArticle/NewsDescription.aspx?News_ID=155&News_Type=PR&MenuID=0&CatID=64, accessed December 22, 2011.

3 For more information, please see "Masdar Trains Staff in Sustainable Practices," http://www.tradearabia.com/news/env_191145.html, accessed December 22, 2011.

4 George Orwell, *Nineteen Eighty-Four* (New York: Signet Classic, 1950), 220.

5 Philip Mirowski, *More Heat Than Light: Economics as Social Physics, Physics as Nature's Economics* (Cambridge: Cambridge University Press, 1989).

6 Thorstein Veblen, "Why Is Economics Not an Evolutionary Science?" *Quarterly Journal of Economics* 12, no. 4 (1898): 373–97, 389.

7 One article about DESERTEC summarizes the aspirations of this now-cancelled initiative: "The Desertec concept is relatively simple; generate renewable energy in sparsely populated deserts and export that energy to population centers. Within six hours deserts around the world receive more energy from sunlight than the humans consume in a year, and 90% of the world's population lives within roughly 1,850 miles of a desert. The Maghreb contains some of the best solar and wind resources in the world. Therefore, clean, renewable electricity can be generated by large scale wind and solar plants in EUMENA and either consumed locally or exported to neighboring countries (primarily from North Africa to Europe). The proponents of the Desertec vision even go on to say that meeting 90% of EUMENA's electricity needs with renewables by 2050 is both economically and technically viable with an interconnected EUMENA grid." For more information on the project,

please see Scott Burger, "Desertec: A Fata Morgana?" *Africa Policy Journal* 8 (2012): 52–53. Also see the project's official website, http://www.desertec.org/, accessed May 7, 2017.

8 See Gustav Peebles, "Inverting the Panopticon: Money and the Nationalization of the Future," *Public Culture* 20, no. 2 (2008): 233–65.

9 "Masdar Students' Energy and Water Use Monitored," http://www.thenational.ae/news/uae-news/technology/masdar-students-energy-and-water-use-monitored, accessed March 14, 2016.

10 "Big Brother? Masdar Monitors Student Energy & Water Consumption," http://www.greenprophet.com/2011/08/masdar-students-energy-water/, accessed March 14, 2016.

11 See Peebles, "Inverting the Panopticon."

12 Also see François Ewald, "Two Infinities of Risk," in *The Politics of Everyday Fear*, edited by Brian Massumi (Minneapolis: University of Minnesota Press, 1993), 221–28.

13 Jonathan Parry and Maurice Bloch, *Money and the Morality of Exchange* (Cambridge: Cambridge University Press, 1989), 19–21.

14 Bill Maurer, *Mutual Life, Limited: Islamic Banking, Alternative Currencies, Lateral Reason* (Princeton, NJ: Princeton University Press, 2005), 4.

15 Ergos is not the only energy currency proposal that has been put together in the early twenty-first century. DeKos, for instance, understood as "a method for securing a more stable value currency via the central bank portfolio using electricity delivery assets," is also an attempt at fixing financial problems and energy problems at once. For more information on DeKos, please see http://papers.ssrn.com/so13/papers.cfm?abstract_id=1802166, accessed March 17, 2012. Also, in 1999, Richard Douthwaite, a philosopher and economist, came up with *ebcu*, meaning environment-backed currency unit, which would enable one to buy goods from other countries in addition to the right to produce carbon dioxide. For more information, on ebcu, see R. J. Douthwaite, *The Ecology of Money* (Totnes, UK: Green, 1999). For more information on the conference, see http://teslaconference.com/, accessed April 2, 2012.

16 For a recent biography of Nikola Tesla, see W. Bernard Carlson, *Tesla: Inventor of the Electrical Age* (Princeton, NJ: Princeton University Press, 2013).

17 Jem Bendell and Ian Doyle, *Healing Capitalism: Five Years in the Life of Business, Finance and Corporate Responsibility* (London: Greenleaf, 2014), 14.

18 See Douthwaite, *The Ecology of Money*, and Bernard Lietaer, *The Future of Money: Beyond Greed and Scarcity* (New York: Random House, 2001).

19 Sarah Elvins, "Scrip, Stores, and Cash-Strapped Cities: American Retailers and Alternative Currency during the Great Depression," *Journal of Historical Research in Marketing* 2, no. 1 (2010): 86–107.

20 C. H. Chatters, "Appendix E: Is Municipal Scrip a Panacea?" *Annals of Public and Cooperative Economics* 9, no. 2 (1933): 323–25, 324.

21 Loren Gatch, "Local Money in the United States during the Great Depression," *Essays in Economic and Business History* 26 (2008): 47–61, 57. Also see Loren Gatch, "Tax Anticipation Scrip as a Form of Local Currency in the USA during the 1930s," *International Journal of Community Currency Research* 16 (D) (2012): 22–35.

22 Leslie White, "Energy and the Evolution of Culture," *American Anthropologist* 45, no. 3 (1943): 335–56, 338. For a review of ideas on energy in anthropology, please see Dominic Boyer, "Energopolitics: An Introduction," *Anthropological Quarterly* 87, no. 2 (2014): 309–33.

23 For more information on the gold standard, please see Barry J. Eichengreen, *The Gold Standard in Theory and History* (New York: Methuen, [1985] 1997). Also see the *Planet Money* podcast titled "Gold Standard R.I.P.," http://www.npr.org/sections/money/2011/02/18/133874462/the-friday-podcast-gold-standard-r-i-p, accessed May 22, 2017.

24 There was disagreement among the participants regarding whether an energy currency was a political project attempting to generating a more ethical economic system. One group explicitly stated, "We understand that if there is a more stable currency, then people may plan more in advance. In this way, energy currency will help economic development and may contribute to fixing inequalities, but this is not our direct goal." However, others had started working on energy currencies with the specific goal of creating a fairer economic model. This debate ensued throughout the conference.

25 Keith Hart, "Money in an Unequal World," *The Memory Bank*, 2000, http://thememorybank.co.uk/papers/money-in-an-unequal-world/, accessed December 22, 2014.

26 Marc Shell, *The Economy of Literature* (Baltimore: Johns Hopkins University Press, [1978] 1993).

27 Bill Maurer, "Does Money Matter? Abstraction and Substitution in Alternative Financial Forms," in *Materiality*, edited by Daniel Miller (Durham, NC: Duke University Press, 2005a), 141.

28 Maurer, "Does Money Matter?" 141.

29 David Graeber, "Beads and Money: Notes Toward a Theory of Wealth and Power," *American Ethnologist* 23, no. 1 (1996): 4–24. Alexander also knew about David Graeber's work and cited his book *Debt: The First 5,000 Years*, specifically referring to his point about how credit arrangements have been part of commercial transactions for millennia, usually denominated in commodities like cattle and grain. These commodities were eventually formalized as currency. David Graeber, *Debt: The First 5,000 Years* (Brooklyn, NY: Melville House, 2011).

30 See Howard Scott, *Introduction to Technocracy* (New York: John Day, 1933).

31 William E. Akin, *Technocracy and the American Dream: The Technocrat Movement, 1900–1941* (Berkeley: University of California Press, 1977), 84.

32 As Akin states, "In the minds of the technocratic planners, the rationality of science and the harmony of the machine, not utopian virtues, would dictate organizational forms." However, the rationality of science and the harmony of the machine could only be achieved through specific social and psychological transformations. First of all, humans would have to accept that they are machines through precise conditioning methods. Akin writes, "Since the basic need of society was technical expertise, their education system would abolish the liberal arts, which stressed outmoded moralistic solutions to human problems. It would essentially replace the humanities with the machine shop. In the process, members of society would be conditioned to think in terms of engineering rationality and efficiency. Man, in short, would then be conditioned to assume the character of machines, to accept 'a reality understood in terms of machine-like functions.' In this way, the technocrats would eliminate religion, fine arts, and humanities along with all other possible kinds of intellectual activity. For them, these nonproductive acts had no function within the upcoming era of technical rationality, organized around an energy theory of value." Akin, *Technocracy and the American Dream*, 84, 142.

33 Mirowski, *More Heat Than Light*, 812.

34 For a history of energetics, from which neo-energetics derives its name, please see Mirowski, *More Heat Than Light*, 53–59.

35 Anthropology has also been one of the disciplines to underline the significance of energy theories of value, while providing an interpretation of its own. Mirowski highlights how, writing in *American Anthropologist* in 1943, Leslie White "proposed that all culture be conceptualized as a manifestation of "the amount of energy per capita per year harnessed and put to work." He continues, "This theme was taken up by many other anthropologists, such as [Leslie White's student, Richard Newbold] Adams." While their frame of analysis remained at the macro level, Leslie White and Richard N. Adams are commonly perceived as the first scholars to make energy a matter of concern in anthropology. White, "Energy and the Evolution of Culture."

36 Ernst R. Berndt, "From Technocracy to Net Energy Analysis: Engineers, Economists, and Recurring Energy Theories of Value," In *Progress in Natural Resource Economics*, edited by Anthony Scott, John Heliwel, Tracy Lewis, and P. A. Neher, 337–66 (Oxford: Clarendon Press, 1983), 342.

37 Robert Costanza, as quoted in Herman Daly and Alvaro Umaña, *Energy, Economics and the Environment: Conflicting Views of an Essential Interrelationship* (Boulder, CO: Westview, 1981), 167.

38 Scholarship in the anthropology of value examines the economy by studying the social transformations that take place within spheres of exchange. In doing so, many scholars, perhaps starting with Marcel Mauss's seminal work on the gift, argue that monetary exchange is shaped and defined by varying beliefs, affects, and cultural practices.

39 Rowan Moore wrote, "There is something spooky in the controls [Masdar] employs in the name of the environment—a touch of eco-Orwell or at least eco-Huxley. A hidden brain, for example, knows when you enter your building, so that your flat can be cooled before you arrive, while in public places flat screens broadcast uplifting news on the environmental performance of the complex." See Norman Foster, "Masdar City, Abu Dhabi: The Gulf between Wisdom and Folly," *The Guardian*, December 19, 2010, http://www.guardian.co.uk/artanddesign/2010/dec/19/norman-foster-masdar-city-review, accessed December 21, 2011. While on-site architects suggested that what they called "the intelligent system" would eventually enable such controls to be implemented, specifying that "when you're entering the building the entrance recognizes you and you walk into a room that's 24 degrees Celsius, and when you're out it goes up to 28 again," the system had not yet been put into use when my fieldwork at Masdar City ended at the end of May 2011. For an exploration of the BMS system at Masdar, please see Gökçe Günel, "Masdar City's Hidden Brain: When Monitoring and Modification Collide," *The arpa Journal*, inaugural issue on "Test Subjects," 2014, http://arpajournal.gsapp.org/masdar-citys-hidden-brain/, accessed July 14, 2014.

40 See, for instance, Shengwei Wang, *Intelligent Buildings and Building Automation* (London: Spon, 2010).

41 Catherine Fennell, "'Project Heat' and Sensory Politics in Redeveloping Chicago Public Housing," *Ethnography* 12 (2011): 40–64, 42.

42 Bryan Walsh, "Masdar City: The World's Greenest City?" *Time*, January 25, 2011, http://www.time.com/time/health/article/0,8599,2043934,00.html#ixzz1pGgoZ1Dg, accessed March 14, 2016.

43 "Masdar City—A Glimpse of the Future in the Desert," *The Guardian*, April 26, 2011, http://www.guardian.co.uk/environment/2011/apr/26/masdar-city-desert-future, accessed March 14, 2016.

44 In an article on dummy thermostats, Checket-Hanks argues: "Some HVAC experts acknowledge what millions of office workers have suspected all along. A lot of office thermostats are completely fake—meant to dupe you into thinking you have altered the office weather conditions. Fifty-one of seventy respondents to an informal survey on the *Air Conditioning, Heating and Refrigeration News* web site replied that they had installed 'dummy' thermostats. HVACR engineer Joe Olivieri has compared the fake thermostat to a placebo, a fake pill given by doctors to patients who have imaginary

aches and pains. If a contractor decides that use of a nonfunctioning thermostat is justifiable, it is critical that he tells a decisionmaker such a thermostat is part of the plan. Dan Int-Hout, chief engineer for Krueger, says that placebo thermostats can sometimes satisfy chronic complainers. However, sooner or later, he says, they figure it out." In an editor's note to *Engineered Systems* magazine, Beverly discusses how a fake thermostat positively affects the behavior of people inside a room. Please see B. Checket-Hanks, "Placebo Stats," *Air Conditioning, Heating and Refrigeration News* 218, no. 13 (2003), https://www.achrnews.com/articles/92414-placebo-stats, and R. Beverly, "Editor's Note: Your Thermostat: Trusty Friend or Two-Faced Double Agent?" *Engineered Systems* 20, no. 4: 8.

45 Michelle Murphy, *Sick Building Syndrome and the Problem of Uncertainty: Environmental Politics, Technoscience, and Women Workers* (Durham, NC: Duke University Press, 2006).

46 Beverly, "Editor's Note."

Chapter 4: An Expensive Toy

1 "Masdar City: The World's Greenest City?" *Time*, January 25, 2011, http://www.time.com/time/health/article/0,8599,2043934,00.html#ixzz1pGg0Z1Dg, accessed March 14, 2016.

2 This was the 2010 sequel to the original *tron* movie of 1982. The desire to remake a movie from 1982 in 2010 speaks for the hold of these sci-fi scenarios in the imagination—they continue to have a grip on the imagination because their worlds are, as "science fiction," never realized.

3 A consultant from Systematica told me that decision-making regarding the PRT project usually depended on the number of people a company was able to send to the meetings. For instance, Foster + Partners would send five to twelve architects to each meeting, depending on the importance of the issue, in order to have the power to enforce their demands. Systematica was able to appoint one or two people to each meeting, putting them in a minority position, and therefore had trouble convincing the client regarding their perspectives.

4 Initially, the PRT consultants at Systematica proposed a system of stations that could be reached within 250 meters of maximum walking distance from any point in the city. This meant about three minutes' walk, at a relaxed pace. Based on this measure, there would be about fifty to fifty-two stations in the city. However, Masdar executives requested that the maximum walking distance be reduced to 150 m (2 min), claiming that 250 meters was unacceptable in the Abu Dhabi climate. This resulted in

nearly doubling the number of stations, adding significant complexity and cost to the design.

5 The existing PRT system between the Masdar Institute building and the parking lot consists of ten passenger and three freight pods, which are stationed at two passenger and three freight stations connected by approximately a one-mile track. The system remains in operation eighteen hours a day, seven days a week, serving the Masdar Institute students, faculty, and visitors.

6 Bruno Latour, *Aramis, or the Love of Technology* (Cambridge, MA: Harvard University Press, 1996), ix.

7 One of his critiques regarding the PRT project is about how it is constructed as a "complete object" (1996: 119) by the engineers in charge. *Aramis* underlines that there is rarely a fatal inherent flaw to technological projects. "Such is the heroic narrative of technological innovation," Latour suggests (1996: 119), "a narrative of light and shadow in which the original object is complete and can only be degraded or maintained intact—allowing, of course, for a few minor adjustments."

8 There has been other scholarship focusing on the study of how grand projects fail, pointing out the role of incompleteness and potentiality. James Holston's great book *Modernist City*, which studies the design and construction of Brazil's capital city Brasília, shows how city dwellers in Brasilia materialized and enacted the incompleteness of the plan through their various interventions in the buildings, and eventually by occupying the city in ways that were never intended by the designers. Brasília, like any other city, would always remain an incomplete aggregate, never 'finished' in any way. In his book *Seeing Like a State*, James Scott (1998: 311–41) explores the idea of metis, which encapsulates the dynamic and plastic nature of knowledge practices, where expertise is born out of developing a "feel" for the task at hand, requiring every actor to "complete" the work in his or her own unique way. There is an openness and an incompleteness to metis, which allows for mutuality in the making of these projects, and which indicates perpetual potential. See James Holston, *The Modernist City: An Anthropological Critique of Brasília* (Chicago: University of Chicago Press, 1989), and James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven, CT: Yale University Press, 1998).

9 For some images of the exhibit see http://www.flickr.com/photos/imresolt/3209978452/in/photostream/, accessed February 1, 2012.

10 Federico Parolotto, "Sustainable Mobility in Action," in *Ecological Urbanism*, edited by Mohsen Mostafavi and Gareth Doherty (Baden, Switzerland: Lars Müller, 2010), 401.

11 Parolotto, "Sustainable Mobility in Action," 401.
12 "Zagato's PRT Pod a Huge Hit at WFES," http://alternate-power.org/zagatos-prt-pod-a-huge-hit-at-wfes/, accessed March 14, 2016.
13 See the brochure for "Highways and Horizons" exhibit, http://ia600308.us.archive.org/12/items/generalmotorshigoogeddrich/generalmotorshigoogeddrich.pdf. Also see "Magic Motorways" by Norman Bel Geddes, the industrial designer who introduced the automated highway concept, which was exhibited at Highways and Horizons: http://ia600208.us.archive.org/10/items/magicmotorwaysoogeddrich/magicmotorwaysoogeddrich.pdf, accessed February 6, 2012.
14 For a discussion of automated transit, also see Keller Easterling, *Enduring Innocence: Global Architecture and Its Political Masquerades* (Cambridge, MA: MIT Press, 2005), 108–13.
15 U.S. Department of Housing and Urban Development, Office of Metropolitan Development, Urban Transportation Administration, *Tomorrow's Transportation: New Systems for the Urban Future* (Washington, DC: U.S. Government Printing Office, 1968), 60–65.
16 Taking inflation into account, in 2012 this amount would roughly translate to $2 billion.
17 William F. Hamilton II and Dana K. Nance, "Systems Analysis of Urban Transportation," *Scientific American* 221, no. 1 (1969): 19–27.
18 See more about the Morgantown PRT project at Sean D. Hamill, "City's White Elephant Now Looks Like a Transit Workhorse," *New York Times*, June 11, 2007, http://www.nytimes.com/2007/06/11/us/11tram.html?_r=1&oref=slogin, accessed March 14, 2016.
19 The Aerospace Corporation built a PRT model in 1978: https://www.youtube.com/watch?v=N6wFacwBMZE&ab_channel=sktavdr, accessed January 7, 2016.
20 "America's One and Only Personal Rapid Transit System," http://www.governing.com/topics/transportation-infrastructure/personal-rapid-transit-system-morgantown-west-virginia.html, accessed May 30, 2017.
21 The French PRT network Aramis had also been displayed in a World's Fair in Paris in 1989. See Latour, *Aramis*, 34.
22 For a comparative analysis of intelligent transportation systems in United States, Japan, and Europe, see Hans K. Klein, "Institutions, Innovation, and Information Infrastructure: The Social Construction of Intelligent Transportation Systems in the U.S., Europe, and Japan," PhD diss., Technology, Management, and Policy Program, MIT, 1996.
23 For an overview of the ULTra PRT system, please see http://www.ultraprt.com/heathrow/, accessed February 9, 2012.

24 A *Guardian* article from 2007 argues, for instance: "PRT is good for a closed network such as an airport, but there are indications that it could soon wend its way into our towns and cities. Several local authorities are looking closely at PRT, and the one furthest down the line is Daventry in Northamptonshire. Its population of 23,000 is set to expand to more than 40,000 by 2021 as part of the government's strategy to build lots of new houses within striking distance of London." "Welcome to the Transport of Tomorrow," *The Guardian*, October 11, 2007, https://www.theguardian.com/technology/2007/oct/11/guardianweeklytechnologysection.news1, accessed May 30, 2017.

25 "Abu Dhabi to Debut Personal Rapid Transit 'Podcars' Later This Year," http://www.treehugger.com/cars/abu-dhabi-to-debut-personal-rapid-transit-apodcarsa-later-this-year.html, accessed March 14, 2016.

26 "Abu Dhabi to Debut Personal Rapid Transit 'Podcars' Later This Year."

27 Isaac Asimov, "Visit to the World's Fair of 2014," *New York Times*, March 23, 1997, http://www.nytimes.com/books/97/03/23/lifetimes/asi-v-fair.html, accessed May 30, 2017.

28 For work that directly addresses the shift to driverless cars and investigates the technical, legal, and social challenges involved, please see Markus Maurer, J. Christian Gerdes, Barbara Lenz, and Hermann Winner, eds., *Autonomous Driving: Technical, Legal and Social Aspects* (New York: Springer, 2016), and Hod Lipson and Melba Kurman, *Driverless: Intelligent Cars and the Road Ahead* (Cambridge, MA: MIT Press, 2016).

29 In fact, the transportation planners and PRT subcontractors at Masdar did not necessarily understand this lack of speed as a problem. In an exchange in November 2014, one of the PRT consultants explained, "As for speed: one of the reasons that Foster's master plan won the competition is that it was the only one that considered a compact development which did not occupy the entire area of the plot. This was good for us because it reduced dramatically the distances between the points of interest. So we could use a very slow system without the fear that trips would be unacceptably long. Indeed, a higher acceleration and speed would be pleasant to have, but it would also have required much more energy: the relationship between energy and speed is a square curve: if you double the speed the energy required becomes quadruple. So going slow is one of the proper ways to sustainability." For the transport planners, this obsession with speed signaled how humans did not want to let go of the luxuries that the current fossil fuel economy made possible and demanded ways of extending the status quo.

30 For a discussion of "astonished contemplation," please see Ernst Bloch, *The Utopian Function of Art and Literature: Selected Essays* (Cambridge, MA:

MIT Press, 1988), and Jose Esteban Muñoz, *Cruising Utopia: The Then and There of Queer Futurity* (New York: NYU Press, 2009).

31 Nicolai Ouroussoff, "In Arabian Desert, a Sustainable City Rises," *New York Times*, September 26, 2009, http://www.nytimes.com/2010/09/26/arts/design/26masdar.html, accessed April 22, 2015.

32 For more details on the event, please see http://masdarcity.ae/en/75/resource-centre/press-releases/?view=details&id=84, accessed May 28, 2014.

33 Michael Taussig, *The Nervous System* (New York: Routledge, 1992), 1–3.

34 Although they did not come up in my conversations with Sylvia, there had been other occasions that seemed to define failure for PRT pods at Masdar City. First, the day when a committee from Switzerland came to visit the institute had been one of those times when the PRT failed. Following their site tour, the committee had been guided to the undercroft to take the pod cars to the parking lot, only to realize that the system was down. They had waited at the station for some time, but then were taken upstairs to take a regular shuttle bus to the parking lot. The tour guides apologized to the committee and explained that this was an experimental system, so it was only natural that it malfunctioned sometimes. Second, when Hillary Clinton paid a visit to the new Masdar Institute campus, Masdar authorities prepared for her to enter the building by taking the PRT. Clinton's security guards studied the PRT pods carefully and reported that she could not ride the experimental transit system. Eventually, she was taken to the institute by car. The security guards had not been able to figure out what it would mean for the emergent transit system to be safe and accordingly preempt its possible risks and uncertainties. In this case, it had proved more logical for the secretary of state to travel by car, a means of transport that the security guards were more familiar with. However, the Hillary Clinton story at times became bundled up with other stories of failure and became interpreted as one such incident.

35 According to Luca Guala, however, total breakdown was inevitable. Given its connectedness, the system was vulnerable and fragile. He continued, "Once again, the inflexibility of the 'complete object' renders it unable to cope with unexpected (yet not so tragic) environmental and social difficulties, and makes it easier to eliminate them rather than adapt the system to cope with them."

36 For more information on EPCOT, please see Steve Mannheim, *Walt Disney and the Quest for Community* (New York: Routledge, 2002).

37 "Masdar City Abandons Transportation System of the Future," http://singularityhub.com/2011/03/01/masdar-city-abandons-public-transportation-system-of-the-future/, accessed March 14, 2016.

38 The quote referred to the science fiction movie *Fifth Element*. Please see "Why Masdar's Personal Rapid Transport Would Have Been Great," https://

www.greenprophet.com/2011/03/masdar-personal-rapid-transport/, accessed May 22, 2017.

39 Also see Latour, *Aramis*, 218.

40 Also see Paul Rabinow, *Designs for an Anthropology of the Contemporary* (Durham, NC: Duke University Press, 2008), 59.

41 Latour, *Aramis*, 122.

42 "Review: Masdar City Personal Rapid Transit," http://everythingexpress.wordpress.com/2011/12/29/review-masdar-city-personal-rapid-transit/, accessed March 14, 2016.

43 "Masdar and Heathrow PRT Still Not Happening," http://prtboondoggle.blogspot.com/2010/12/masdar-and-heathrow-prt-still-not.html, accessed February 9, 2012.

44 See, for instance, Richard Gilbert and Anthony Perl, *Transport Revolutions: Moving People and Freight without Oil* (London: Earthscan, 2008).

45 Vukan R. Vuchic, *Urban Transit Systems and Technology* (New York: John Wiley, 2007), 474.

Chapter 5: Subsurface Workings

1 CDM is a market-based "flexibility mechanism" that was initiated under the Kyoto Protocol with the intention of encouraging industrialized countries to invest in greenhouse gas emission reduction programs in developing countries, such as hydropower, wind energy, or solar energy projects. In this way, industrialized countries could meet their own emission reduction commitments while fostering sustainable development within host countries. Yet CDM projects had to satisfy the so-called additionality requirement, meaning the project proponents had to prove that the given project would not have been initiated without the additional CDM incentive from the UNFCCC. As such, the first step for starting a CDM application to the UNFCCC consisted of proving that the project would not have happened without this additional push. These project proposals would then be evaluated by third-party designated operational entities (DOEs) to guarantee that the project would instigate valid emission reductions. If the DOE gave approval to the project, the proposal would be submitted to the CDM Executive Board within the UNFCCC, waiting to be registered. "But the registration of hundreds of Clean Development Mechanism (CDM) projects at the United Nations Framework Convention for Climate Change (UNFCCC) only shows how successful the consultants that work within these procedures are, rather than proving the success of CDM as a program," a senior environmental consultant I worked with told me, thereby questioning the legitimacy of their policy infrastructure. Upon registration with the UNFCCC, the project

would start to produce carbon credits for the involved entities, based on the supposed emissions reduced by its implementation. In this framework, if China, a developing country under the UNFCCC guidelines, decided to build a solar power station with technology or expertise from a German company, rather than relying on lower-cost energy from coal plants, the reduced carbon emissions attributed to this investment could be credited toward the German company's emission reduction commitment, set by the Kyoto Protocol. The development of a solar power station would also contribute to sustainable development in China, or at least this is what CDM proposed. However, if carbon capture and storage were to be included under the CDM, China could build a coal-powered plant, provided that it is equipped with CCS technology, and still receive carbon credits for it. Accordingly, the inclusion of CCS in the CDM would mean that carbon credits would be issued for carbon dioxide sequestered through future carbon capture and storage projects undertaken in so-called developing countries, providing incentives for further investments in this technology.

2 A carbon credit is a permit that allows a country or organization to produce one ton of carbon emissions. In a cap-and-trade system, if a country's emissions fall below the permitted volume, that country can sell their remaining permits in a carbon market, in the form of carbon credits to others that have gone above their limits. The Kyoto Protocol, an international treaty signed in 1997 and entering into force in 2005, committed its signatories to internationally binding emission reduction targets, and set these carbon emission limits. The countries that have signed the protocol have trade carbon credits.

3 For a list of Non-Annex I countries, see http://unfccc.int/parties_and_observers/parties/non_annex_i/items/2833.php, accessed October 1, 2011. Please note that the United Arab Emirates is one of many other oil-producing countries included within the list.

4 These issues had been identified in United Nations Framework for Climate Change (UNFCCC) Decision 2/CMP.5, paragraph 29. Paragraph 29 specifically stated that the United Nations "*Recognizes* the importance of carbon dioxide capture and storage in geological formations as a possible mitigation technology, bearing in mind the concerns related to the following outstanding issues, inter alia: (a) Non-permanence, including long-term permanence, (b) Measuring, reporting and verification, (c) Environmental impacts, (d) Project activity boundaries, (e) International law, (f) Liability, (g) The potential for perverse outcomes, (h) Safety, (i) Insurance coverage and compensation for damages caused due to seepage or leakage."

5 The environmental consultants at Masdar, as well as the other participants in the preparation of the modalities and procedures submission, had

advanced engineering degrees. They came from various countries around the world, and mostly were in the UAE for temporary periods. The individuals who informed this chapter, through meetings, interviews, or informal conversations, specifically originated from Algeria, Germany, India, Iran, Lebanon, the United Arab Emirates, and the United Kingdom.

6 For another examination of CCS technologies, please see Gökçe Günel, "What Is Carbon Dioxide? When Is Carbon Dioxide?" *PoLAR: Political and Legal Anthropology Review* 39, no. 1 (2016): 33–45.

7 In addition to oil producers, technology developers, such as Japan's Mitsubishi, promoted the inclusion of CCS-EOR as a mitigation strategy. I will not engage more with this point here, but would like to suggest that these technology developers were perceived to be largely responsible for the positions that their governments held in the negotiations with the UNFCCC.

8 See Michael M. J. Fischer, *Emergent Forms of Life and the Anthropological Voice* (Durham, NC: Duke University Press, 2003).

9 Annelise Riles, *The Network Inside Out* (Ann Arbor: University of Michigan Press, 2000), 91.

10 Please see submission document, "Submission of Views from the United Arab Emirates on Addressing the Issues referred to in Paragraph 3 of FCCC/CMP/2010/L.10 in the Modalities and Procedures for the Inclusion of Carbon Dioxide Capture and Storage (CCS) in Geological Formations as Clean Development Mechanism Project Activities," 24, https://unfccc.int/files/methods/application/pdf/uae_submission_on_ccs_in_cdm_20110221.pdf, accessed May 2, 2017.

11 Later in the negotiations this provision would continue to be controversial, as government representatives would be reluctant to take over liability for carbon dioxide.

12 Here, the chemical behavior and porosity and permeability levels of carbonate and sandstone rock formations are argued to be different from each other, which may require differing levels of risk and uncertainty, as well as customized monitoring criteria. For more information on the differences between two types of reservoirs, please see S. N. Ehrenberg and P. H. Nadeau, "Sandstone vs. Carbonate Petroleum Reservoirs: A Global Perspective on Porosity-Depth and Porosity-Permeability Relationships," *AAPG Bulletin* 89, no. 4 (2005): 435–45.

13 Timothy Luke, "On Environmentality: Geo-Power and Eco-Knowledge in the Discourses of Contemporary Environmentalism," *Cultural Critique* 31 (1995): 57–81.

14 See Timothy Choy, *Ecologies of Comparison: An Ethnography of Endangerment in Hong Kong* (Durham, NC: Duke University Press, 2011), 84.

15 Geoffrey Bowker, *Science on the Run: Information Management and Industrial Geophysics at Schlumberger, 1920–1940* (Cambridge: Cambridge University Press, 1994), 32–33.

16 Spelled as Ain Salah in other transliterations, the name of this oasis town translates as "good well" or "good spring."

17 Other participants to the project are Lawrence Livermore National Laboratory, Lawrence Berkeley National Laboratory, Institut Française du Pétrole, European Commission, U.S. Department of Energy (DOE), Carbon Sequestration Leadership Forum (CSLF), and CO2ReMoVe. For an analysis of the project, conducted by Lawrence Livermore National Laboratory, please see S. J. Friedmann, *The Scientific Case for Large co_2 Storage Projects Worldwide: Where They Should Go, What They Should Look Like, and How Much They Should Cost* (Washington, DC: U.S. Department of Energy, 2006).

18 My interlocutors comfortably used phrases such as "saving the environment" or being "good for the environment." Although it is necessary to deconstruct what the circulation of these phrases implies for larger issues around climate change mitigation, I will not engage with these problems in the scope of this chapter.

19 According to a Global CCS Institute report, "at the end of 2010, a total of 234 active or planned CCS projects [were] identified across a range of technologies, project types and sectors," and indicated that twenty-one new CCS projects had been started in the year 2010. In many of these projects, major oil companies served as stakeholders. Please see report, "The Global Status of CCS 2010, http://hub.globalccsinstitute.com/sites/default/files/publications/12776/global-status-ccs-2010.pdf, accessed May 19, 2017.

20 For more information on the negotiation process at climate summits, please see Gökçe Günel, "A Dark Art: Field Notes on Carbon Capture and Storage Negotiations at COP 17, Durban," *Ephemera* 12, no. 1 (2012): 33–41.

21 Larry Lohmann, "Climate as Investment," *Development and Change* 40 (2009): 1063–83, 1078–79.

22 Lohmann, "Climate as Investment," 1078–79.

23 Elaine Shanklin writes: "In the night of 21 August 1986 Lake Nyos exploded. The 'good' lake, as the locals called it, the most beautiful crater lake in Cameroon's North West Province, exploded and sent down to the valley beneath a deadly cloud of carbon dioxide that killed most of the living things it touched—1746 men, women and children, more than 3,000 cattle, plus countless numbers of sheep, goats, birds and insects. Little or no damage was done to plants, crops or inanimate property. Houses, market stalls, village ovens and motorcycles stood untouched, while their owners lay dead nearby." Elaine Shanklin, "Beautiful Deadly Lake Nyos: The Explosion and Its Aftermath," *Anthropology Today* 4, no. 1 (1988): 12–14.

24 International Energy Agency, "Carbon Capture and Storage: Legal and Regulatory Review," 2011, www.iea.org/Papers/2011/ccs_legal.pdf, accessed September 28, 2011.
25 For a report on German CCS legislations, please see https://hub.globalccsinstitute.com/publications/dedicated-ccs-legislation-current-and-proposed/german-ccs-legislation, accessed May 5, 2017.

Epilogue: The Potential Futures of Abu Dhabi's Masdar

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2 "Eerie Video Shows Masdar City—The Sustainable City of the Future—Has No One in It," http://www.fastcoexist.com/3035446/eerie-video-shows-masdar-city-the-sustainable-city-of-the-future-has-no-one-in-it, accessed January 15, 2016.
3 This was perceived to be in contrast to the South Korean smart city Songdo, which relied on public institutions to ensure its growth.
4 See the HERM website, http://theherm.org/, accessed July 15, 2014. Also see http://ourstreamingplanet.com/tag/herm/, accessed July 15, 2014.
5 The modalities and procedures draft text that started the discussions in Durban is available at http://unfccc.int/resource/docs/2011/sbsta/eng/04.pdf, accessed December 8, 2011.
6 See Annelise Riles, *The Network Inside Out* (Ann Arbor: University of Michigan Press, 2000).
7 Perhaps the best-known instance of "constructive ambiguity" is the UN Security Council's Resolution 242 of November 1967. Referring to the six-day Arab-Israeli war of June 1967, it required the "[w]ithdrawal of Israeli armed forces from territories occupied in the recent conflict." It left unclear the question of whether Israel was obliged to engage in a complete or only partial withdrawal.
8 G. R. Berridge and Lorna Lloyd, *The Palgrave Macmillan Dictionary of Diplomacy* (Houndmills, UK: Palgrave Macmillan, 2012), 73.
9 Berridge and Lloyd, *The Palgrave Macmillan Dictionary of Diplomacy*, 73.
10 The London Protocol suggests: "disposal or storage of wastes or other matter directly arising from, or related to the exploration, exploitation and associated off-shore processing of seabed mineral resources is not covered by the provisions of this Protocol," and thereby does not provide any regulations regarding the transboundary flow of carbon dioxide for enhanced oil

recovery (EOR) purposes. For more information on the London Convention and CCS, please see the International Energy Agency (IEA) working paper entitled "Carbon Capture and Storage and the London Protocol: Options for Enabling Transboundary CO_2 Transfer," https://www.iea.org/publications/freepublications/publication/CCS_London_Protocol.pdf, accessed December 6, 2013.

11 "Majid Al Futtaim Plans to Open Masdar City Mall in 2018," http://www.thenational.ae/business/retail/majid-al-futtaim-plans-to-open-masdar-city-mall-in-2018, accessed January 25, 2017.

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13 "If the Foster + Partners–designed first generation of Masdar's vision was the architectural equivalent of a temperamental but finely tuned F1 car, with the Eco-Villa, Masdar appears to be aiming for the architectural equivalent of the Volkswagen, a national project that can be rolled out quickly, economically and en masse." "Masdar City's New Eco-Villa: Abu Dhabi's Residential Future?" http://www.thenational.ae/arts-life/home-garden/masdar-citys-new-eco-villa-abu-dhabis-residential-future#full, accessed January 25, 2017.

14 "Masdar City Free Zone," http://www.masdarcityfreezone.com/en/, accessed May 14, 2017.