7 ‘The good garbage’
Waste-to-energy applications and issues in the insular Caribbean

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Introduction
Throughout the world, small islands not adjacent to larger landmasses experience several common problems related to infrastructure and public services. Aspects of the physical geographies of these islands – especially their insularity and remoteness – require that various infrastructural systems be designed to operate independently of larger grids and to fit the small scale. Among many challenges on such islands are those related to energy production, waste disposal, and water supply. Three related observations arise from knowing that such is the case.

First, according to the International Scientific Council for Island Development (ISCID), small islands are ideal sites for the testing and refining of sustainable energy production systems.

Second, the ISCID’s optimism is well-received in academic settings where the idea of the island as laboratory has gained purchase since at least the earliest days of biogeographical study (Sauer, 1969), those involved in many island governments and energy industries remain unconvinced. As noted by Notton et al. (2011, p. 652), ‘the most usable power plant for small islands is diesel engines’. This trend may be on the cusp of changing, however, as fossil fuel costs continue to increase, and as both islanders and tourists demand more sustainable solutions.

Second, an island’s capacity to handle its municipal and industrial waste is directly related to the size of its physical land area and to its population. On islands with extreme population density, such as Manhattan, the export of garbage seems the only option. People living on larger or more sparsely populated islands may relegate some of their land area to landfills. Incineration is also widely practised – both as centralised and household activities. Issues of air pollution are well-documented with regard to incineration. One major argument against the implementation of sustainable waste management solutions has been that landfills are relatively cheap and abundant in mainland settings and on large islands such as Britain (Reed et al., 1998). However, this line of reasoning applies less in small island contexts. By virtue of islands’ naturally limited land areas, islanders have added incentive to develop efficient methods of waste disposal.

Third, those living on small oceanic islands – especially those without significant surface water or groundwater reserves – can experience the plight of Coleridge’s Ancient Mariner: ‘Water, water everywhere / Nor any drop to drink.’ People living on small, dry islands often rely on rainwater catchment as their primary source of fresh water, which leaves little recourse during droughts and regular dry seasons – except for rationing, doing without, or importing fresh water. Climate change further exacerbates the uncertainty of supply. Desalination is an effective option on some islands, but many more are unable to provide enough water through this process, owing to the inherent expense – both in terms of finances and energy consumption. Yet, as Swyngedouw (2013) has noted, varied political-social issues affect the development of desalination facilities in mainland settings and there is no reason that one should not apply – and even amplify – his findings in island contexts.

Several island communities throughout the world have endeavoured to resolve these challenges by means of technological development and investment. The key to such solutions is often found in combining efforts to integrate technologies in order to solve multiple infrastructural goals at once. Waste-to-energy facilities are one salient example of such integrated technologies on small islands (Díaz, 2011). While many varieties of facility exist, most involve the capture and redirection of thermal energy released from incinerating municipal and/or industrial waste. This energy is then used to produce electricity or desalinate seawater, with scrubbers removing pollutants from the exhaust smoke of waste-to-energy facilities, albeit with varying degrees of effectiveness. Owing to their efficiency and capacity to address several sustainability challenges, then, waste-to-energy facilities are often seen as ideal for small island settings. Notwithstanding, these facilities are expensive and require large initial investments.

Wealthy island populations, or those with political ties to others residing in wealthy nations, are often in the best position to invest in waste-to-energy facilities and other sustainable technologies. Such is the case in St Barthélemy but not its ‘neighbour’, St Croix (Figure 7.1). As an overseas collectivity (collectivité d’outre-mer) of France, St Barthélemy benefits from cultural, political, and economic ties with France. Additionally, the island’s niche focus on luxury tourism brings foreign capital into St Barthélemy at a pace unrivalled by most of the island’s Caribbean neighbours. Indeed, the local government
of St Barthélemy has recognised its peculiar position within the region and sought to capitalise on the opportunities presented to serve as an example of sustainable development to the rest of the insular Caribbean, as evidenced by the government’s investment in waste-to-energy facilities. Currently, a combined waste-to-energy facility operates outside of St Barthélemy’s capital, Gustavia, providing thermal energy to the island’s seawater desalination plant and offsetting that normally energy-intensive industry’s electricity demand. By comparison, on St Croix – one of the United States’ Virgin Islands and an unincorporated territory of the United States – people have witnessed the failure of a proposed waste-to-energy facility and continue to struggle with issues of waste management and energy production.

This chapter investigates these two cases: one of measured – yet challenged – success, and one – at least thus far – of failure. That investigation is achieved first by examining the case history of the St Barthélemy waste-to-energy facility; then by considering the case of St Croix; and then by concluding with a comparison of the two islands: their geographies, current status, and outlook with regard to waste-to-energy technologies.

St Barthélemy

Located in the Leeward Islands of the Lesser Antilles, St Barthélemy (also called St Barthelemy or St Barts) is a small island of about 23 square kilometres (8.8 square miles) (17.9° N 62.8° W). It was sighted by Columbus in 1493 on his second voyage and named for the navigator’s brother, Bartholomeo. Prior to European discovery, St Barth had been known as Gwannfar by the Carib people who, owing to the island’s lack of fresh water, visited occasionally but made no permanent settlements. In retrospect, the lack of permanent indigenous settlement should have foreshadowed problems for the coming colonists.

The island was colonised by the French in 1648, ceded to Sweden in 1784 in exchange for free trading rights in the port of Göteborg, and kept as Sweden’s only Caribbean territory until 1878, when it was returned to France. In St Barth today, one sees multiple references to the near-century of Swedish association, including the blue flag with a yellow Scandinavian cross, which flies from many of the island’s flagpoles. Printed text in some public and private establishments is translated into both English and Swedish, as a nod to the island’s history; many street signs in Gustavia present the French name as well as the Swedish; and Gustavia is paired with its sister city Pitesti in Sweden.

St Barth remained a poor colony for the first half of the twentieth century, isolated without an airport until the late Rémy de Haenen – one of the island’s most celebrated residents – cleared an airstrip that today remains one of the shortest and most difficult landings in the world. During the 1950s, St Barth was ‘discovered’ by American and European celebrities and millionaires. Some wealthy families established their presence permanently; the Rockefellers built a large house on the island’s west end, near Colombier, and the Rothschilds did the same on the east coast, by Grand Cul-de-Sac. Infrastructure provision began to catch up; electricity came in 1962 during de Haenen’s tenure as the island’s mayor. However, fresh water remained a problem. Each home relied on its own cistern and on two larger reservoirs on high points at either end of the island. During ensuing decades, more development gradually transformed St Barth from a small dry island known for duty-free port, fishing, and salt ponds, to a small dry island known for luxury tourism.

Consume and discard

With a population in 2011 of 9,057 (Cots, 2011), and visitors numbering in the tens of thousands annually, the infrastructure demands on St Barth are considerable, especially during the winter high season for tourism. Then, cars and motor scooters choke the island’s steep and narrow streets, and parking spaces along the boardwalk in Gustavia become as sought-after as the quayside berths where multi-million dollar yachts are docked.

Owing to its negligible agricultural and manufacturing outputs, St Barth imports nearly everything that residents and visitors consume. The luxury niche market targeted by those in the tourism sector has led to what Coulon and Chauvin (2013, p. 191) identify as ‘competitive consumption’. They also describe late-night revelries in which business magnates, celebrities, and other members of the super-rich class attempt to out-spend and out-consume one another, rewarded with exclusive (yet highly visible) seating in the island’s gathering places where they may consume imported beverages costing thousands of dollars per bottle.
Packaging and detritus associated with these commodities are collected at the island's waste disposal plant, located just outside Gustavia in what some maps identify as the Zone Industrielle. Fronted by a village called Public, this area is home to the commercial portal, where vessels not bearing tourists load and unload their wares. Here, enormous piles of solid waste are sorted into three categories: that which can be burned, that which must be sent off-island, and that which can be repurposed. This industrial zone features none of the sights and smells of the rest of the island. Decomposing organic garbage replaces the scent of frangipani, bougainvillea, and fresh-baked pains au chocolat, while separated piles of crushed glass, cubed aluminium, non-working appliances, and general garbage stand in stark relief to the rugged beach sand, quaint villas, and landscaped gardens of the St Barth that is seen by most visitors. Although the site remains largely unseen, residents and visitors alike experience its effects. Each day, a careful process unfolds in which industrial and municipal solid waste is brought to the facility, sorted into categories, and processed. In theory, sorting begins in the home or at the public garbage receptacle. An island-wide information campaign includes the provision of instructional flyers to residents and placards that urge tourists, in English, to put waste 'in the good garbage' in order to facilitate the sorting process that happens at the incinerator site.

When the waste is sorted, the first category includes items that can be recycled off the island. At the incinerator site, in the spaces allotted for the appliances, batteries, aluminium cans, and steel, stand neat stacks of similar things, all sorted under signs bearing their designations—here only in French, as there is no need to translate instructions into English and certainly not into Swedish. Vegetable-based oils and petroleum products stand in separate vats. All of this waste will be shipped to various ports in other places, Guadeloupe, Miami, France—where it will be recycled or turned into scrap.

The second category is made up entirely of glass, which can be repurposed locally on St Barth. After being separated by hand from all other forms of waste, glass is crushed into a fine powder for industrial use. Those whose job it is to sort the glass spend their shifts—heavily gloved—pulling corks from empty wine bottles, twisting off caps from expensive eaux minérales, and shaking burned-out sparklers from expensive bottles of champagne (Cousin and Chauvin, 2013). This glass powder will later provide insulation for water pipes and electrical conduit running under the island's roads and sidewalks.

The third category is combustible waste. All vegetal trimmings, paper products, and other organics, as well as most plastics are piled as fuel for the island's incinerator. One day of drying under the tropics sun is usually sufficient preparation for the combustibles. Once dried, the fuel is lifted into a chute where it feeds a constantly burning flame. The incinerator needs at least 28 tons of material per day to maintain its optimal burning rate; 15 tons per day is the maximum. Just enough material is produced to make incineration sensible. During the slow season of summer, when jet-setting tourists are more likely to be found in the Mediterranean than the Caribbean, the incinerator occasionally shuts down, owing to a lack of fuel. This seasonality reflects the absolute dependence of St Barth on its wealthy tourist clientele. Without them, or the waste they generate, the incinerator at the waste-to-energy facility stops burning. When the flame goes out, it can take days to return the operation to its optimal temperature.

A closed-loop system for evaporation and condensation of water is connected to the incinerator. Once water is heated by the combustion of waste, steam is sent to the nearby desalination plant, where its thermal energy is used to power the production of fresh water. During the summer low season, the steam alone provides enough energy for the production of fresh water through evaporation. When demand is high, an electricity-powered reverse osmosis process is added. Imported diesel serves as the fuel to generate electricity.

Critics of waste incineration often focus on the air pollution inherent in the process. The incinerator on St Barth certainly introduces chemicals and particulates to the atmosphere, although scrubbing processes are in place to limit both. Nevertheless, more independent research is needed to quantify the concentrations of these pollutants; this gap represents a remarkable opportunity for an atmospheric chemist to conduct serious and necessary research in a breathtakingly beautiful setting. However, when evaluating the costs and benefits of a system such as that on the island, it is important to consider the processes that are being replaced. In the case of waste management on St Barth, the incinerator largely replaces two methods of waste disposal once common on the island. According to long-time residents Alexandra Deffontis and Bruno Magras, most residents either burned household waste at home or simply dumped it directly into the sea. Each of these people, participants in my research, now plays a direct role in the waste-to-energy program on St Barth.

In another conversation with me, Magras—a St Barth native and the island's political leader (Président de la Collectivité d'Outre-Mer de Saint-Barthélemy) — has reflected on the gravity of his position: 'I'm concerned about my island, my future, my kids' future. I'm not out to destroy what I received' (personal communication, 19 March 2013). While the building of the current waste-to-energy incinerator in 2002 was based on a decision by the French government, Magras takes credit for the island's original municipal incinerator that did not result in 1979. This first incinerator did not produce electricity or energy for desalination, but it did serve to centralise waste disposal, and offered an alternative to the then-current practices of household-scale garbage burning and nearshore dumping. Magras's approach to renewable energy production is nuanced, however. He is against wind power—the large, offshore turbines would be 'too ugly'; against large-scale solar energy—open land is too scarce; and against a proposed undersea cable supplying power from nearby St Martin—a plan that would increase the island's dependence as well as its vulnerability to hurricanes. Magras does support the capture of solar energy at the household level; however he worries that installation of photovoltaic cells atop the famous red tile roofs of Gustavia would reduce a
popular aesthetic. Magras's dedication to the (perhaps illusory) notion of an 'unsullied' island environment that turns him away from wind and solar development has not dissuaded him from the development of waste-to-energy technology, perhaps by virtue of its 'hidden' nature, tucked away in a corner of the island usually unseen by tourists.

Deflèttant, another St Barth native, now works as an official at the incinerator (her title, Directeur du Service de Propreté), and she praises its effectiveness in dealing with the 'biggest problem' faced by the island during the high tourist season - the availability of fresh water. According to Deflèttant (personal communication, 20 March 2013), hotels and rental villas are given priority in the distribution of municipal water. Prior to desalinisation, when rainwater catchment was the primary source of the island's fresh water, households would carefully measure the reserves in their dwindling private cisterns as wealthy tourists lounged by 'infinity pools' and dockhands washed their employers' yachts along the quay. Today, water is more readily available, but only inasmuch as combustible garbage is produced on the island. As examined below, several challenges threaten to disrupt this precarious system.

**Challenges to waste-to-energy effectiveness in St Barthélemy**

While the incinerator does appear to have achieved a form of equilibrium in St Barth, the system is not without challenges. Here, I discuss three issues related to the effectiveness of the incinerator that are most commonly mentioned on the island.

**Hurricanes**

St Barth is often in the path of Atlantic tropical cyclones. In recent times, major storms to make landfall on St Barth include Hurricane Earl in August 2010, and Hurricane Gonzalo in October 2014. The French authorities on St Barth use the colour-based French tropical cyclone scale as opposed to the Saffir-Simpson Scale used throughout much of the English-speaking Caribbean and North America. This Table des Ailures Cycloniques ranks tropical cyclones by colour, based on average windspeed over a ten-minute interval, and was developed by Météo-France (2013), originally for use in the southern Indian Ocean to monitor storms near La Réunion. The incinerator is able to maintain operation during less-powerful storms (classified as yellow and orange). It must stop during larger hurricanes (red).

**Lack of public compliance with waste management procedures**

When the incinerator began operation in 2001, islanders were asked to sort their garbage at home. Prior to that time, no sorting had been necessary. Some residents refused to participate when the sorting regime began - and in some cases maintained this resistance to this day. Garbage collectors would find metals and plastics in bins meant to contain only organic waste or they would find all of a household's waste combined in the same receptacle. These small acts of civil disobedience were interpreted as statements against the regulation of waste disposal and the continued modernisation of the island. They may even represent the dissenting voices of islanders who are not completely in favour of the accommodations being made for a growing population, driven mainly by the continual increase of the tourism sector. However, the lack of compliance continually puzzles the incinerator's managers, especially considering the multiple grassroots environmental protection campaigns created on and in St Barth, which range from one promoting homemade cigarette disposal stations at many of the island's beaches to others championed by St Barth Essentiels, an organisation started in 2009 to preserve natural and cultural heritage.

The government responded to the public's failure to thoroughly sort household waste by streamlining the waste management system and marketing it using bilingual flyers and placards. The campaign features a stylised pelican reminiscent of the birds on either side of the official seal of St Barthélemy reminding residents that they need to manage 'ONLY 2 GARBAGE BAGS!'' ('2 Poubelles suffisent!'). One bag is for combustibles, the other for recyclables. The campaign met with limited success but its advocates persist in seeking to raise awareness about the benefits of waste management. Their efforts include placing receptacles in visible public areas; distributing instructional, bilingual literature that stresses the ease and importance of separating household garbage; and publishing news articles urging compliance (see Anonymous, 2009). While some parallel English slogans are found on the literature, only the French side proclaims that 'Trier c'est Gagner! Sûrement c'est dérange!' ('Sorting is winning! Reftaining is destroying!').

**Composting**

The government on St Barth has been exploring the possibility of introducing an island-wide composting program. While composting is usually seen as an environmentally beneficial activity, incinerator managers worry both that the program will divert combustible organic material away from the incinerator, and that they may fail to receive enough fuel to keep the operation going efficiently. At time of writing, for want of fuel, incineration is occasionally halted during the slow winter season. The establishment of a new waste management stream may divert enough material away from the incinerator to make its operation inefficient at best, and impossible at worst.

Further, it is unclear what the ultimate use and usefulness of composting will be given the limited presence of agriculture on the island - beyond, perhaps, the occasional household garden. Certainly, the kitchen garden has long provided household self-sufficiency in the Caribbean (Fielding and Mathewson, 2012; Kimber, 1966; Richardson, 1963). However, with its dry climate and rocky soils, St Barth has not supported small-scale agriculture
at a level comparable to some of its Caribbean neighbours. Still, in March 2013 the government acquired a piece of land adjacent to the incinerator to be used for composting. The site has since been constructed but plans to host a municipal composting operation remain uncertain. When the composting program will begin, how it will be received, and what its results will be remain unknown. The threat that the scheme poses to the supply of fuel for the waste-to-energy facility underscores the island’s tenuous reliance on imported goods. It also raises the possibility of importing waste destined specifically for the incinerator to overcome future shortages, due either to competition for the waste itself or to seasonal slowdowns in tourism sector. While, to my knowledge, St Barth has not considered such options, it is a strategy that has worked in other locations such as Sweden (Olofsson et al., 2005).

Application to St Croix of lessons learned in St Barthélemy

St Barthélemy is by no means unique as an island that has a complicated relationship to waste-to-energy technology. Throughout the Caribbean, one finds islands where governments have considered, built, or started to build such facilities. One island where waste-to-energy technology has been discussed but not implemented is St Croix (17.7° N, 64.7° W).

Sustainability and bird strikes

Currently, the majority of the waste produced on St Croix is dumped in the Anguilla Landfill, a large, open, unlined dump, located on a small peninsula on the island’s south coast, adjacent to the Henry E. Rohlsen Airport. Note that, despite its name, the landfill is located on the island of St Croix, not on the nearby island called Anguilla. This facility is problematic owing to the large flocks of birds that the landfill attracts. For aircraft taking off to the east or approaching from the east to land, flocks of birds can be present in the flight path. Produced by Jeppesen Incorporated, and known by pilots as a ‘Jepp chart’, an information diagram for this airport includes a bold warning near the top of the page: ‘Birds in vicinity of airport.’ The chart also includes a displaced landing threshold for aircraft approaching from the east, where the landfill is located, to keep them at higher altitude until past the landfill (Figure 7.2). According to the Wildlife Strike Database maintained by the United States Federal Aviation Administration, there have been 46 documented bird strikes involving aircraft taking off or landing at this airport since 1992. The reporting of bird strikes is voluntary and as such, this figure probably represents less than the total number of incidents that have occurred in St Croix.

Aware that this problem will likely increase as the Anguilla landfill expands in size and use, the Federal Aviation Administration has toughened its stance in relation to St Croix. According to Collins (2003), and corroborated by reports employed by other news outlets, owing to the hazard presented by the accumulation of birds near the runway’s east end, the Federal Aviation Administration has suspended its annual grants to the Virgin Islands Port Authority, the ‘semi-autonomous agency that owns and manages the two airports and the majority of the public seaports in the [United States Virgin Islands] (Virgin Islands Port Authority, 2013, n.p.). This suspension of grants is intended to last until the Anguilla landfill is closed and the bird problem is mitigated. Without the funds supplied by these annual grants, it is doubtful that the Virgin Islands Port Authority will be able to properly maintain the physical plant of the Henry E. Rohlsen Airport to the standard required by the Federal Aviation Administration for airports handling commercial flights. In this case, commercial flights would be suspended and passengers would only be able to arrive in St Croix by sea or by private aircraft; undoubtedly such circumstances would have an enormously detrimental impact on...
tourism in St Croix. According to the United States Virgin Islands Bureau of Economic Research (2013), 132,958 tourists arrived in St Croix by air in 2013. Tourism is the major industry in the United States Virgin Islands, and has become increasingly important on St Croix since the 2012 closure of the Hovensa oil refinery, once the largest private employer in the Islands. Any potential disruption to air traffic into St Croix would further affect the island’s already weak economy.

In addition to the risk presented by birds in the vicinity of the airport, the Anguilla landfill is reaching capacity. Problems related to the volume of garbage at the landfill include fires and collapse of enormous garbage piles—each a significant hazard in its own right, with the former producing smoke that presents further risk to aviation.

There are strong incentives to remediate the problems presented by the Anguilla landfill that include, but go beyond, aviation safety. Given its limited land area, St Croix faces infrastructural challenges similar to those experienced on St Barth. Populations on both islands must constantly make wise choices in land-use planning. Relegating an expanding portion of the limited space available to a landfill is not a sustainable solution. Further, as infrastructure demands continue to increase, especially with regard to fossil fuel consumption in the production of electricity for industrial and municipal use, renewable solutions become more attractive to the local population and government but also to tourists visiting the island. Those on St Croix have good reason to pursue solutions that include the closure of the Anguilla landfill, based on the Federal Aviation Administration mandate as well as broader principles of sustainability and good stewardship of the limited land area of this small island.

The reason for the delay in closing the Anguilla landfill seems to be that the island government has not implemented any alternative means of dealing with its waste. Currently, waste is baled—crushed, compacted, and bound—before being deposited in the landfill, a process that reduces the accessibility of the garbage to birds and maximizes the use of space but does not fully alleviate the problem. Rather than closing and covering the landfill—the Federal Aviation Administration’s recommended course of action—the Waste Management Authority of the Virgin Islands (the Authority) has recently petitioned the territorial government for permission to expand its area, allowing continued usage of the landfill for the next three to seven years. Even with the conversion from an open dump to a repository for baled garbage, the problems of birds in the vicinity of the airport and an increasing area on a small island being given over to waste-holding have not been fully remediated.

An attempted solution

St Croix is in need of an alternative, sustainable method of handling its waste—because of the hazards to aviation, which are significant, and to maintain the environmental integrity of the island, which is expected by tourists and residents alike; the territorial government of the Virgin Islands knows this and has been actively seeking a solution. In August 2009, after exploring multiple possibilities—including shipping garbage off-island, the Authority contracted Denver-based Alpine Energy Group, LLC to construct a waste-to-energy facility on St Croix. Just as on St Barth, waste-to-energy technology has been seen as an attractive solution to St Croix’s dual problems of waste disposal and energy production. On St Croix, waste-to-energy would have the added benefit of improving the safety of air travel as well. The Authority apparently believed that the project would be successful, as it was willing to commit to the project with an initial investment that exceeded US$10 million. Alpine Energy made a similarly substantial investment. Clearly both parties expected the project to succeed.

Yet, amid controversy, the waste-to-energy proposal was abandoned in 2012. The narrative of the failure of the St Croix proposal is one steeped in controversy. Local newspaper articles document the transition from hopefulness to doubt to mistrust to animosity to defeat. A sample of local headlines includes the following:

2009

2010
12 January Alpine Energy Officials Answer Public’s Concerns Monday Night
8 March Senators Garbage Alpine Energy Deal
22 October Alpine Energy nears close on St Croix WTE

2011
27 April Alpine Withdraws Application to Build St Croix Waste-to-Energy Plant
20 August Will It Be Alpine Energy After All?
2 December Alpine Energy Group Request Needs Greater Scrutiny
9 December Alpine’s Project Again Rears its Ugly Head
23 December Can a Waste-to-Energy Plant be Environmentally Safe?
9 February Senate Rejects Alpine Lease, Killing Garbage-To-Energy Plan

As these select headlines indicate, when talk of the planned waste-to-energy facility began it was viewed as a positive move toward sustainability and greater aviation safety, agreed upon by the St Croix government and the contracting company. However, this outlook deteriorated over the course of about two-and-a-half years. From the perspective of Don Hurd, president of Alpine Energy (personal communication, 24 October 2012), the proposal failed because of a lack of communication and cultural understanding between
his Colorado-based corporation and the public on St Croix. Local newspaper stories seem to corroborate this assessment, emphasising too the effects of mistrust inherent in geopolitical relationships that have characterised colonial histories such as that typifying the United States Virgin Islands.

Of St Croix's colonial history ... and the problems that remain

Variously claimed and settled by the Spanish, English, Dutch, and French, St Croix's colonial economy was tied to monocrop agriculture—primarily sugarcane—but also cotton and tobacco, and it was reliant upon slave labour instigated under Danish colonial rule, which followed the sale of the island by the French in 1733. The islands were then sold again to the United States in 1916 as part of the Treaty of the Danish West Indies.

The present-day United States Virgin Islands—St Thomas, St John, St Croix, and many smaller islets—now comprise an organised, unincorporated United States territory. Residents are United States citizens but cannot vote in federal elections and do not pay United States federal income tax. The economy of the islands is heavily dependent upon the United States, with tourism as the major industry. Petroleum had been a close second until the recent closure of the Hovensa refinery. As in many colonial or postcolonial geopolitical environments, there are significant levels of mutual distrust between the colonised and the colonisers (de Albuquerque and McElroy, 1999; Navarro, 2010). This distrust is evident in the feelings of local residents toward 'outsider scientists' (Grace-McCaskley, 2012, p. 85) and others attempting to establish changes for the sake of environmental protection and sustainability.

Despite the cross-cultural communication difficulties inherent in an off-shore dependent territory with such a multinational colonial history, the majority of stakeholders and residents on St Croix agree that something needs to be done about the Anguilla landfill. Besides the aviation risk presented by the large flocks of birds that the garbage attracts, the landfill has regularly been catching fire for over a decade (Anonymous, 2012; United States EPA, 2001). According to the United States Environmental Protection Agency, it is likely that the fire outbreaks actually stem from slow-burning subterranean fires that have been smouldering constantly for many years (United States EPA, 2001). These fires, with their lack of monitoring and control, emit unknown quantities of hazardous fumes and particulates into the atmosphere. The smoke from the fires presents its own hazard to aviation, as mentioned above. Additionally, rainwater that percolates through the landfill has the potential to leach hazardous chemicals into the groundwater and eventually the ocean, as the landfill is not lined with a waterproof or filtration layer. Thus, while a waste-to-energy facility would certainly introduce some level of pollution to the atmosphere and ocean, it would likely be orders of magnitude less than what is currently entering the environment through the uncontrolled burning and leaching at the Anguilla landfill. The waste that the facility would convert to electricity is already burning. A waste-to-energy-enabled incinerator would simply burn the waste in a controlled environment, where it would be converted to electricity, and the exhaust would be treated before release into the atmosphere. Unlike St Barth, St Croix has a ready repository of waste to be burned in addition to the waste its communities produce daily. Alpine Energy did not include 'garbage mining' as part of its waste-to-energy plan, but this is not to say that it could not be included in the design of a future system.

Both the Federal Aviation Administration and the Environment Protection Agency have issued clear directives that economic consequences, require that the Anguilla landfill be closed, and refuse to sanction a waste-to-energy facility. At present, St Croix's lack of compliance with those directives can be traced directly to a lack of alternative methods to handle the island's municipal and industrial solid waste. Meanwhile, the closure of the Hovensa refinery took away not only jobs from St Croix, but also the island's major source of fuel oil for its electricity generation plants. St Croix now imports fuel oil for its electricity generation (United States Energy Information Administration, 2013). For energy production on St Croix, the government of the United States Virgin Islands has then considered solar (Lewin, 2012), wind (United States Energy Information Administration, 2013), and biomass (Viaspave, Inc., 2013). Although each is feasible, none has the potential to alleviate the need to keep the Anguilla landfill open, nor to address the aviation hazard that the landfill presents. From the perspective of Alpine Energy, the fact that waste-to-energy and other methods of renewable energy generation have not been implemented on St Croix is due primarily to a failure to communicate effectively across cultures (Hurd, personal communication, 24 October 2013). Based only on this explanation, it follows that the successful waste-to-energy implementation on St Barth is due to better cross-cultural communication on that island. While communication related to the waste-to-energy facility development has been suboptimal on St Croix, the communication breakdown itself may stem from broader, historical differences in the islands' colonial relations with their respective mainlanders and the continuation of those relationships into today's tourism-based economies, which are being enacted against the backdrop of the current postcolonial paradigm.

Discussion and conclusions – Islands of differences

One key question that illuminates the complexity of the geographies of St Barth and St Croix remains unanswered: can a facility similar to the waste-to-energy facility on St Barth be established on St Croix to address that island's waste management and energy production needs, while providing relief to those pilots and air passengers who worry about bird strikes and flight paths obscured by smoke? On the surface there appear to be similarities between the two islands that would indicate a similar outcome: both are small, subnational islands in the Lesser Antilles. Each has a past touched by slavery,
was associated with the French and with a Scandinavian power, and now each is connected to a major Western power. Both islands experience a dearth of locally available or natural resources and have turned to imports to meet most of their material needs. Both island economies heavily depend upon tourism.

Arriving at each island by air requires a tricky landing.

However, there are some key differences, historically, economically, and culturally, that may have favoured the difference in outcome that exist between St Barth and St Croix. Despite the superficially similar French-Swedish histories, the economic, cultural, and political trajectories of St Barthélemy and St Croix diverge in important ways. St Croix was host to plantation slavery under the Danish regime and to a lesser extent under the French (Dookhan, 1994). While the Danes were the first Europeans to abolish the trans-Atlantic slave trade, slave ownership was not immediately forbidden in the colonies. Lofsdottir and Pålsson (2013, p. 45) presciently point out that, following the abolition of the Danish slave trade in 1802, although ‘property in people was no longer legal in Denmark, different principles applied in the colonies. Freedom, human rights, and dignity had their own geography.’ Today, according to the United States Census Bureau, 76 per cent of the population of the United States Virgin Islands identifies as Black or African American. The majority of the island’s current inhabitants can trace their ancestry to the enslaved African labourers brought to St Croix by European colonists.

In contrast, while slavery was practised on St Barth, there were no large, agricultural plantations. As such, it was primarily smallholder, subsistence agriculturalists who dominated the institution. The practices of these smallholders gave St Barth the reputation, according to the eighteenth-century anti-colonialist writer Abbe’ Guillaume-Thomas Raynal, as ‘the only one of the European colonies established in the new world where free white persons deign to share agricultural tasks with their slaves and to labor in the field alongside their subordinates’ (Robequin, cited and translated in Lavoie et al., 1995, p. 380).

To be sure, slavery on St Barth – as with everywhere it was implemented – was a degrading and deplorable practice. Its offence gave rise to at least one local slave rebellion, in 1736, which resulted in 11 deaths (Lavoie et al., 1995). Still, with its focus on smallholder agriculture and urban domestic labour, slavery on St Barth never led to the demographics and economics seen on other Caribbean islands. When slavery was abolished locally in 1846–7, many of the former slaves left the island in pursuit of better economic opportunities throughout the Caribbean and beyond. Today, the population of St Barth traces its ancestry more to the French settlers from Normandy and Brittany than to the African slaves whose descendents dominate the population of most other Caribbean islands (Maher, 2013). Even slight variations in ethnic diversity can be the source of much discussion and division in the postcolonial Caribbean.

The social and political differences between St Barth and St Croix did not end with emancipation. Citizens of St Barth today are full French citizens – able to travel, work, and vote as though they lived in Paris or Marseille. While people from St Croix may legally move to the United States where they will be afforded all the rights of American citizenship, those who remain in St Croix stay something of quasi-citizens: unable to vote and not required to pay federal taxes. Passengers arriving in the mainland United States by air from the United States Virgin Islands are required to show their passports. The same demand is not made upon arrival in the Islands.

Today, following these long histories of political, social, and economic inequality, St Barth and St Croix remain very different islands. Owing first to its status as a free port and in recent decades to its niche market for luxury tourism, St Barth has become an island of wealthy individuals with a per capita gross domestic product approximately 10 per cent higher than that of France as a whole (INSEE, 2005). By contrast, the per capita gross domestic product in the United States Virgin Islands is 70 per cent lower than that of the United States mainland. The economy on St Croix is the lowest within the territory and has accelerated its decline since the closure of the Havens revery in 2012.

Culturally, the two islands differ markedly with regard to the relationships with their respective mainland; this is exemplified by the issue at hand, the construction of waste-to-energy facilities. Amid a climate of little, if any, cross-cultural controversy, the facility on St Barth was built by Groupe TIRU, a Paris-based firm. The waste-to-energy facility proposed for St Croix was to be built by Denver-based Alpine Energy. Much of the direct action against Alpine Energy and its personnel emphasised their perceived otherness, according to Alpine’s management. Alpine’s proposal was seen as an incursion by an ‘outsider’ organisation expected to arrive, make a profit through exploitation, and depart (Hurd, personal communication, 24 October 2013) – a scenario not unlike that which played out on the island during the era of plantation slavery and continues to define much of the tourism-based development on St Croix. Postcolonial relationships based on exploitation are especially common on small, resource-poor islands (as evidenced by several cases in this volume). Indeed, such was the contrast in public reception that the current facility on St Barth remains online now, some 13 years after its construction, while the plans for the facility on St Croix appear to have been totally abandoned.

Here, by way of conclusion, I might posit that postcolonial relations with their respective mainland have contributed significantly to the differential reception of waste-to-energy technology in these two islands. The system of exploitation and economic dependence initiated by plantation slavery in St Croix continues through the dependency maintained by the oil- and tourism-based economy that carried the island into the twenty-first century. When the Havens revery closed, St Croix lost a major sector but still retains tourism. Both modern industries maintain the system by which profits flow from the island to the mainland and the islanders remain dependent upon the mainland for their livelihoods. A waste-to-energy facility developed by a mainland
American corporation would reasonably be seen as merely a further exacerbation of the long-standing inequalities and structures of economic dependence rooted deep in St Croix’s history. Further, the closure of the landfill is being demanded by the Federal Aviation Administration – an institution of the mainland United States government, not a St Croix nor even a Virgin Islands, government body. This example of outsider oversight must have further encouraged the islanders’ resistance to the waste-to-energy facility, regardless of the veracity of Federal Aviation Administration demands. No one can deny the environmental crisis and aviation hazard presented by the Anguilla landfill, nor could one reasonably argue that a waste-to-energy facility is not a more sustainable waste-management system than the landfill. It may be the case, though, that environmental protection and economic decolonisation in St Croix represent conflicting goals.

St Barth, on the other hand, with neither the land nor the rainfall required to establish plantation agriculture, was so economically insignificant to the French colonial government that the island was traded, not for another colony, but for trading rights in a Swedish port. Upon its return to France, St Barth remained poor and unproductive, its location and harbour being its chief assets well into the twentieth century. When tourism did arrive, it came first in the form of private development, initiated by a handful of wealthy families drawn to the island for its natural beauty, isolation and potential for exclusivity, and probably – to be honest – its ‘white population [is] very Catholic and deeply attached to France’. These socio-economic and demographic characteristics have been called by one researcher ‘the great originality of St Barthélemy’, who observes that the island’s ‘persistent quality of white population’ that ‘you won’t find its equivalent anywhere in the French Antilles’ (Lasserre, translated in Boudrin, 2012, p. 3).

The socioeconomic status and geographic and demographic preferences of these first St Barth tourists set the stage for what would be a measured development initiative, focusing upon a niche market geared toward the super-rich (Cousin and Chauvin, 2013). While the economic market for St Barth tourism has since expanded downward somewhat, the restricted growth plan has proven successful enough to avoid the reliance on mainland developers in many cases, and when mainland support is required, it has generally been received on the islanders’ terms and under the islanders’ direction as the waste-to-energy project exemplifies. This benign outcome is surely not indicative of French colonialism globally; rather, likely results from a combination of factors including St Barth’s peripheral status during the colonial period and its economic success as a place for exclusive, luxury tourism.

Epilogue – jewels of the sea

An analysis of energy production, waste disposal, and water supply in St Barthelemy and St Croix reminds us that the insular Caribbean is a dynamic region, full of diverse cultures and real-world sustainability crises – not merely places where carefree holidays are spent. Like the populations of many other practised tourism-based economies, St Barth’s residents and leaders have effectively addressed these crises in the background, providing water and waste disposal virtually out of sight to its visitors. The section of the island where the waste incineration powers water generation, ironically named Public, is least visited by the public. A high road bypasses the area, connecting Gustavia with the airport and the beaches of St Jean. Quietly industrial, the area of Public privately provides for the truly public areas of the island. Still, from the centre of the incinerator’s courtyard, with triaged recyclables stacked to one side and an enormous mountain of combustibles piled in front, it is still possible to look past the waste and glimpse the electric blue water of the Caribbean Sea. Somewhere under that bright surface lies an intake valve, where seawater is pumped onshore to be made fresh, in a process fuelled by the burning of champagne corks and trimmings of bougainvillea.

St Barth is mountainous but small. Clouds created by orographic lifting blow off the island west by the trade winds, beyond the island’s shore, their precipitation falling uselessly upon the surface of the sea. Even today, when fresh water can be made through desalination, rain falling on the roofs of St Barth is still seen as a godsend – fresh water received without the input of produced energy. I recall once ducking into a tiny jewellery shop called Bijoux de la Mer, ‘Jewels of the Sea’, during a rare cloudburst in Gustavia. The tourists in the shop waited out the shower by trying on expensive Tahitian pearls, but the shopkeepers – members of an old St Barth family – stepped out into the rain, hands raised, whispering ‘merci’ for the gift of fresh water. Upon reflection I was reminded of the lyrics to the popular French standard by Jacques Brel, ‘Ne Me Quitte Pas’: ‘Moi, je t’offrirai des perles de pluie venues de pays où il ne pleut pas! (I offer you pearls of rain from lands where it does not rain).’

The raindrops falling on the roof may have seemed to the islanders more precious than the pearls they were selling inside, but the most valuable commodity from the sea was being produced just over a small hill, through the unglamorous but indispensable process of waste-powered desalination. The same waste, accumulating as it is in the Anguilla landfill on St Croix, contributes to water pollution, not water production. Its attendant flocks of birds and smoke from uncontrolled burning present a risk to aviation and a point source for air pollution. The raw materials are similar. The infrastructural need is the same. The different outcome in waste-to-energy applications on these two islands is not due primarily to any technical barrier but to the discrepancies in culture, economics, and political histories that leave these two neighbouring islands so very far apart.
groups of islands [8] utilised and navigated in a manner that is fundamentally interconnected with and essential to social groups' habitation of land' (Hayward, 2012, p. 1).

Already Christian Fleury has written of the 'island/sea/territory relationship' (2013) and there is some discussion in Chapter 9 about 'wet ontologies' and about 'the sea as a source of connection'. This may be in 'prospect' but the sea was not always the barrier it seemed to become as modern transportation systems developed; it used to be the sea that was the highway.

What seems certain is that the fragilities (the previous chapter has 'vulnerabilities') of the island realm will stimulate interest, research, and publications. Baldiscchino has already edited Extreme Heritage Management: The Practices and Policies of Densely Populated Islands (2012) in which I had the opportunity to consider islands as miners' canaries potentially warning of more general impending doom (Royle, 2012). At greater length and depth is John Connell's Islands at Risk (2013). The impacts of climate change, especially sea level rise, is a massive part of such risk and seems sure to come within the purview of island scholars, be they geographers or from other disciplines. Another hot topic might be migration, now troubling many islands, such as those on the fringes of Europe. Other established topics will doubtless continue, including island tourism, but the once ready word association between 'island' and 'paradise' may be more difficult to sustain in what seems set to be an uncertain future.

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Bibliography


To the memory of Kate Stratford [née Whalley] (1925–97) and
Will Stratford (1926–99), from whom the editor first learned
both the value of higher education and the warmth emanating
from collaboration.

‘Islandness is an intervening variable that ... contours and condi-
tions physical and social events in distinct, and distinctly
relevant, ways.’ (Baldacchino, 2004, p. 278)

‘... there are many reasons why islands are and should be of
growing interest to geographers.’ (Mountz, 2014, p. 8)