

**Looking past the present waste:  
path dependencies in municipal solid waste management in the US and  
European Union**

by

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## **Abstract**

Incineration of municipal solid waste practiced in Europe has been noted as a best practice, and if not for NIMBYism, it is one that the US could adopt more broadly. At present waste-to-energy technologies, such as incineration, are used to manage 24% of municipal solid waste generated per year in the EU, while the US incineration is used to manage slightly under 12% of municipal solid waste per year. Additionally, incineration in the EU has increased over the past 20 years whereas incineration in the US has been on a lingering decline over this same time period. However, the use of incineration was once greater in the US than it is today in the EU. This study analyzed the reasons for this divergence in incineration use through investigation of historical events beginning in the early 1800s in both regions. Identification and analysis of key drivers and critical junctures in the US and Europe are compared. Over time, these events created path dependencies which explain the evolution of municipal solid waste management in the US and Europe. Particularly important path dependent drivers of this evolution include local control, availability of funds, and availability of resources. The historical analysis indicates that European municipalities having a long history of local control, the financial capacity to fund infrastructure and service projects, and an awareness of benefits gained from waste-to-energy technology have resulted in the increased adoption of municipal solid waste incineration. Conversely, US municipalities had local authority eroded and constrained over time, had a lack of financial capacity and assistance to fund municipal projects, and also had access to relatively abundant land and fossil fuel resources. The result was the decline of reliance on incineration in the US since 1960. An understanding of the importance of path dependencies in shaping current renewable technology adoption, such as waste-to-energy, can better inform other policy discussions including climate change.

## **Preface**

The conceptual idea for the research proposed in this thesis was by Dr. Hadi Dowlatabadi. I conducted the literature review, compiled the data, and carried out the analysis under the direction of Dr. Mark Johnson, Dr. Hisham Zerriffi, and Dr. Hadi Dowlatabadi.

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## List of Acronyms

<b>APCA</b>	Air Pollution Control Act
<b>CAA</b>	Clean Air Act
<b>CERCLA</b>	Comprehensive Environmental, Compensation, and Liability Act
<b>EC</b>	European Commission
<b>ECSC</b>	European Coal and Steel Community
<b>EEC</b>	European Economic Community
<b>EPA</b>	United States Environmental Protection Agency
<b>ERDF</b>	European Regional Development Fund
<b>EU</b>	European Union
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>kg</b>	Kilogram
<b>MMT</b>	Million Metric Tonnes
<b>MSW</b>	Municipal Solid Waste
<b>MSWM</b>	Municipal Solid Waste Management
<b>NIMBY</b>	Not-in-my-backyard
<b>PURPA</b>	Public Utility Regulatory Policies Act
<b>RCRA</b>	Resource Conservation and Recovery Act
<b>RPS</b>	Renewable Portfolio Standards
<b>SEA</b>	Single European Act
<b>SLO</b>	Social License to Operate
<b>SWDA</b>	Solid Waste Disposal Act
<b>UK</b>	United Kingdom
<b>US</b>	United States
<b>WtE</b>	Waste-to-Energy
<b>WWI</b>	World War I
<b>WWII</b>	World War II



## **Acknowledgements**

I would like to recognize the support and guidance I received from my supervisor, Dr. Mark Johnson, and committee members, Dr. Hisham Zerriffi and Dr. Hadi Dowlatabadi. You all provided valuable insight, guidance, and support throughout the thesis process and I thank you for it. I have also have had the pleasure of attending classes taught by each of you, and the lessons from those courses and this thesis will be with me for the rest of my life. The discussions we had, many one-on-one, motivated and inspired me to approach a research topic I originally did not intend to. Your patience and mentorship were greatly appreciated.

My time at UBC would not have been possible if not for the financial support from the university. The opportunities to engage with other students and faculty in my program and beyond offered intellectual and social support. Lastly, to the staff at UBC, thank you for making my experience a great one, and in particular to the night staff at AERL. Your late-night company has been a pleasure.

## **Dedication**

This work is dedicated to my future self. Don't be too harsh when thinking of what you would have done differently.

## Chapter 1: Introduction

Interactions between humans and the environment they live in have been perceived as a relatively local issue for most of human existence. It is only recently, within the last several decades that the impact of human behavior on larger scales - regional, national, and global - has been appreciated by wider audiences. Resource management is no longer strictly a local concern, and international efforts to address issues related to pollution and climate change have been occurring for decades. There is now recognition that unrestricted growth and resource consumption will result in dire consequences for all of humanity. An important acknowledgement of this potential reality was the publication of *Our Common Future* in 1987 by the United Nations World Commission on Environment and Development<sup>1</sup> (United Nations, 1987). In this publication, often called the Brundtland Report, the commission focused on the concept of sustainable development.

The Brundtland Report recognized that the ethos of sustainable development was development which, “meets the needs of the present without compromising the ability of future generations to meet their own needs (United Nations, 1987:15).” Unrestricted growth results in the production, consumption, and disposal of material goods at an unsustainable level. Central to the idea of sustainable development is improvement in disposal of goods, often termed waste management. The importance of waste management practices is a concern of many governments. Initiatives such as the Sustainable Materials Management Program put forth by

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<sup>1</sup> Earlier examples of limits to growth include Thomas Robert Malthus’ attention to resource scarcity and population growth.

the US Environmental Protection Agency (EPA), and the Waste Framework Directive<sup>2</sup> established by the European Commission (EC), establish guidelines with the intent of reducing impacts from waste on the environment. Managing waste is a global concern, however, and as populations around the world continue to increase, and migrate from rural to urban areas, municipal solid waste management (MSWM) grows as a pressing challenge.

The challenges surrounding MSWM are shared by many cities and nations around the world, which is evidenced by the attention that waste management received by the 2007 Intergovernmental Panel on Climate Change (IPCC)<sup>3</sup>. The primary challenge centers on the increasing amount of waste being generated and the best way to handle this waste. Cities can be confronted with concerns over increased costs of handling the waste, but also concerns over where to dispose of the waste. This attention has also highlighted differences in MSWM practices, particularly the adoption of waste-to-energy (WtE) technologies in many EU countries whereas the same cannot be said for many parts of the US. Many leaders claim this difference is due to a lack of social license for WtE facilities to operate in the US.

New York City is one example of a city challenged by the task of managing 4 million tons of MSW a year (Rosenthal, 2010). In 2009, New York City spent \$307 million to ship MSW to landfills in States as far as Virginia, a distance of more than 250 miles. Former Mayor Michael Bloomberg, has cited WtE technology as a ‘best practice’, and one that should be

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<sup>2</sup> Environmental policy in the EU is typically conducted through regulations and directives. While both are somewhat similar in that they bind member-states to follow legislation, directives allow for flexibility in how to implement the legislation.

<sup>3</sup> For additional information see Waste Management, Chapter 10, in Contribution of Working Group III to the Fourth Assessment Report of the IPCC, 2007.

adopted in the US. However, no WtE projects are planned for New York City, and according the recently retired Mayor's office the reason is because, "it's a NIMBY issue."

The notion of not-in-my-backyard, or NIMBY, might not completely explain the difference in MSWM practices between regions of the world. It is important to understand how robust the NIMBY argument is when alternative reasons are explored.

## **1.1 Research Objective**

The objective of this research is to assess the role of historical drivers and path dependencies in explaining the lack of WtE technology adoption in the US as compared to the EU, and more broadly factors that influence change in MSWM policies.

## **1.2 Background**

The literature on the history of cities in the US and the EU is immense. Topics of interest include roads, lighting, water works, telecommunications, and construction materials. In contrast, the literature on solid waste management in the urban landscape has received little attention (Tarr, 1996). Additionally, the historical literature tends to neglect the cultural, economic, social, and other dimensions present in the urban environment (Stine & Tarr, 1998). This has been addressed more recently with scholars investigating literatures of other disciplines<sup>4</sup>. However, much of the literature on MSW and WtE technologies utilizes the adage that opposition to incineration in the US is due to disagreement in siting of facilities (i.e.

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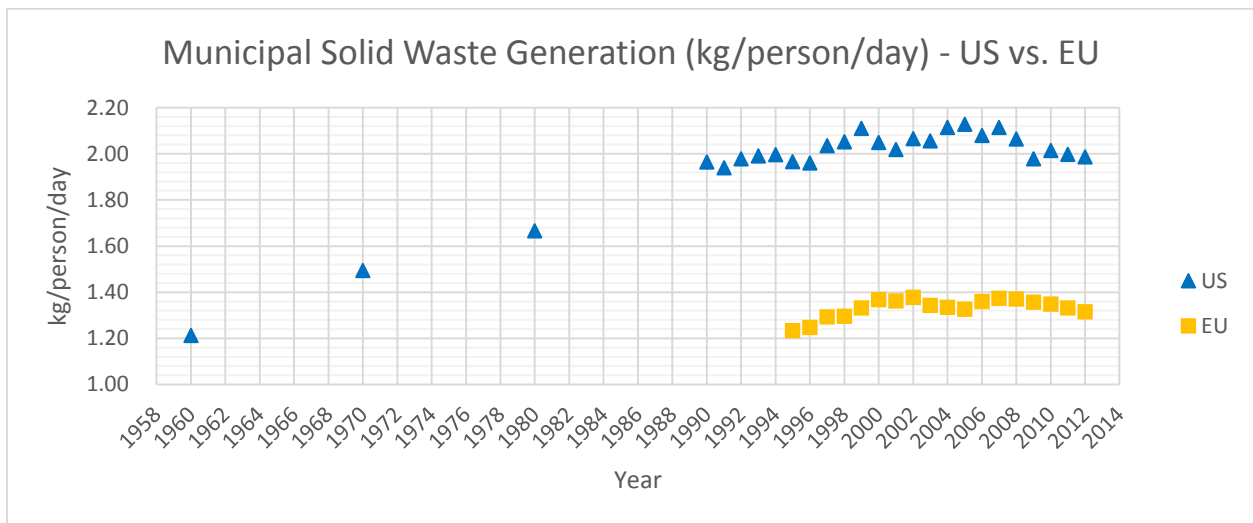
<sup>4</sup> A recent example of this is the book, 'Infrastructure Planning and Finance', by Elmer and Leigland. The text covers economic, social, environmental, and technical challenges in planning both in the present and the past.

NIMBY). Several academics have explored alternative motives for the lack of incineration adoption in the US. As Wolsink & Devilee (2009) presented, communities view the planning process as unjust in that they have a diminished right to participate in political and economic decisions compared to large developers. When discussing the “grassroots struggle” against incineration in the US, Shevory (2007), notes the importance of recent events, such as deindustrialization in the 1970s, the Energy Crisis in 1973, and the discovery of chemical waste at Love Canal in 1976. While these are important elements in describing the current attitude in the US, the previous research falls short in understanding the historical roots of this opposition. What follows is an overview of MSWM in the US and the EU, and literature related to the themes of public acceptance, path dependency, and technological change. The purpose is to summarize the current MSWM environment in the US and EU, followed by a review of public acceptance literature which has been used to support statements regarding opposition to incineration. Lastly, this section will close with a discussion on the theoretical framework that this study employs. The thesis then continues with a historical narrative and analysis on US and EU drivers related to MSW incineration.

### **1.2.1 MSW in the US & EU**

In 2012 the EU incinerated 58 million metric tonnes (MMT) of municipal solid waste, an 81% increase since 1995, and it is expected that this rate will continue to increase (Eurostat, 2014). One might expect similar trends to occur in other developed parts of the world, including the US. However, in 2012, the US incinerated 26.5 MMT, a volume that has not changed much since 2000 (US Environmental Protection Agency, 2014). Both the EU and the US have large population centers and confront similar problems of increasing urbanization and thus the amount

of waste generated by municipalities. Nevertheless, the EU and the US differ in how they manage municipal solid waste (MSW) with the EU operating 450 incinerators while the US operates only 86 (Confederation of European Waste-to-Energy Plants, 2011; US Environmental Protection Agency, 2011). Not only does the EU have a greater number of incinerators, but there is less garbage generated annually when compared to the US (Figure 1). The EU over nearly 20 years has generated less than 1.4 kilograms (kg) of trash per person per day. During this same time period, the US has fluctuated around 2 kg/person/day, nearly 70% higher than the 1.2 kg/person/day that the US generated in 1960.

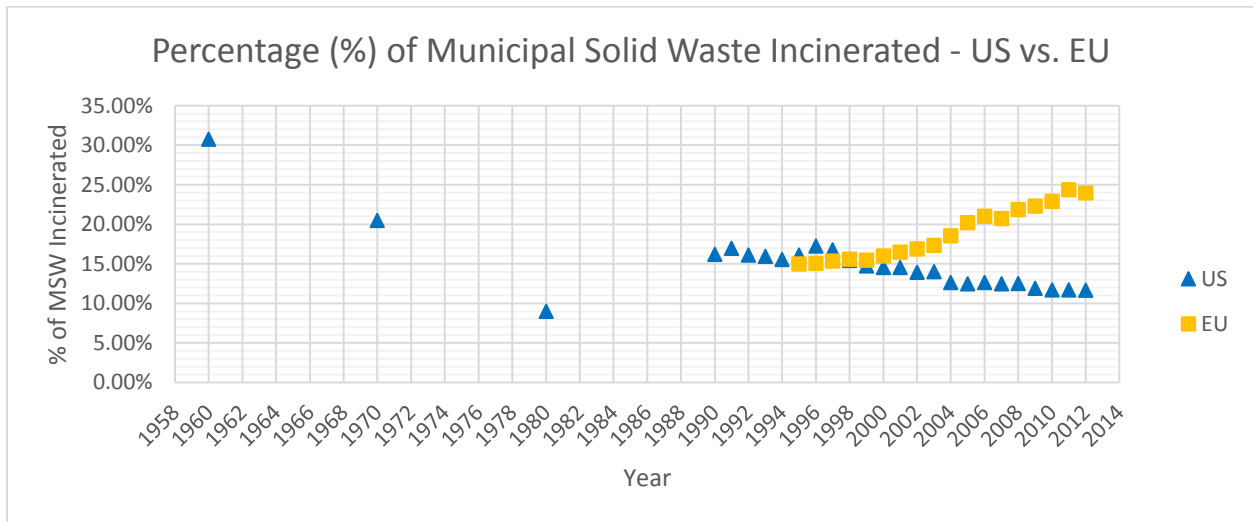


**Figure 1: MSW Generation in the US and EU Averaged by Annual Population.**  
**Source 1: EU data comes from (Eurostat, 2014). Data pre-1993 was not readily available. US data pre-1989 comes from (Franklin Associates, 1988) and US data post-1989 comes from (US Environmental Protection Agency, 2011, 2014).**

It is important to note that the term *waste incineration* encompasses a variety of MSW treatment options. Incineration largely falls into two categories: refuse that is combusted with energy being captured for useful work otherwise known as WtE, and refuse which is burned without energy recovery. The US EPA does not distinguish between the two approaches, and for accounting purposes incineration with energy recovery, and incineration without energy recovery

are treated homogeneously in data presented in this paper unless specifically stated. Additionally, incineration of either type is sometimes referred to as combustion.

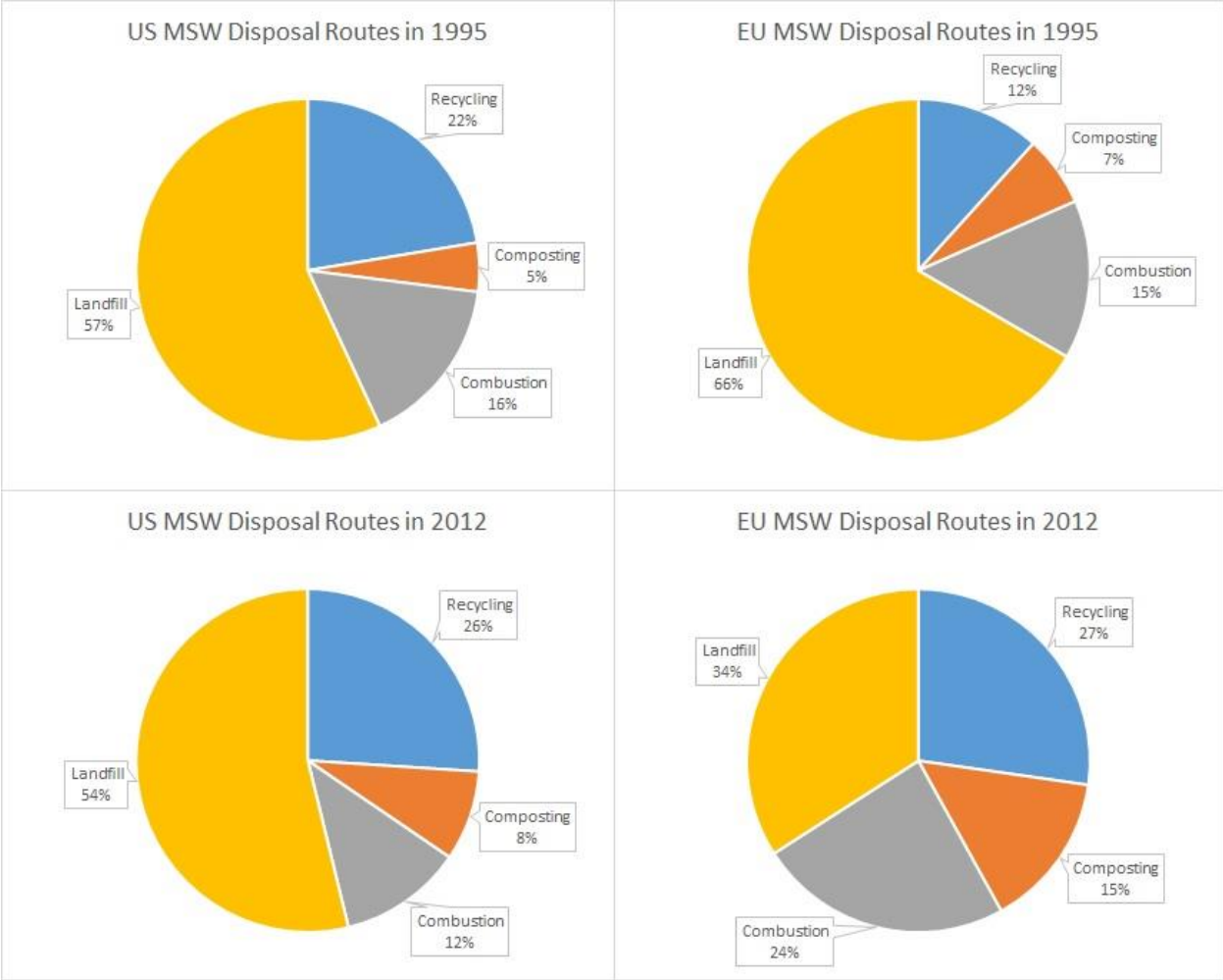
The statistics and Figure 1 above fail to explain the evolution of incineration use in the US and EU. As Figure 2 shows, incineration was much higher in the US previously than it is today, and in the early 1960s over 30% of MSW in the US was incinerated. Some of this waste was being incinerated as fuel for heating, but some was incinerated without any energy recovery. The use of incineration declined until the early 1980s when adoption of the technology saw a resurgence as a result of federal legislation. After the mid-1990s the use of incineration once again began to decline, and now only treats approximately 10% of MSW in the US. Unlike the US, adoption of incineration for treating MSW has increased in the EU over the nearly two decades that data has been collected at the supra-national scale. Despite a steady increase in incineration rates in the EU from 1996 to 2012, the EU has yet to reach the 30% MSW benchmark the US set in 1960.



**Figure 2: Incineration as a Percentage of Total MSW Generated in the US and EU.**  
**Source 2: EU data comes from (Eurostat, 2014). Data pre-1993 was not readily available. US data pre-1989 comes from (Franklin Associates, 1988) and US data post-1989 comes from (US Environmental Protection Agency, 2011, 2014).**



When considering the entirety of MSWM, it is important to study alternative pathways of MSW disposal. In addition to incineration, there is also landfilling, composting, and recycling. In 1995, landfilling was the dominant form of disposal of MSW in the US at 57%, followed by recycling, combustion, and composting at 22%, 16%, and 5%, respectively (Figure 3). Landfilling was also the dominant form of MSWM in the EU in 1995, accounting for 66%. Combustion, recycling, and composting accounted for 15%, 12%, and 7% of MSW disposal. By 2012, Landfilling of MSW declined in both regions, but more so in the EU with a reduction from 66% to 34%. Combustion, composting, and recycling of MSW all increased substantially in the EU, with composting and recycling being doubled in rate and combustion experiencing a 9% increase. Meanwhile in the US, landfilling and combustion decreased from 1995 to 2012, while recycling and composting saw slight increases. The increase in all non-landfill MSW technologies in the EU indicates an integrated approach to MSW. In comparison, the US has changed relatively little with only modest gains in composting and recycling and small decreases in landfilling and incineration.



**Figure 3: US and EU MSW Disposal Routes in 1995 and 2012.**  
**Source 3: EU data comes from (Eurostat, 2014). US data comes from (US Environmental Protection Agency, 2011, 2014).**

Zooming in on the EU, it is unsurprising that MSW technologies are not homogenous across all member countries. Much of the share of incineration use in the EU can be attributed to two countries. Germany and France respectively incinerated 17 MMT and 11.5 MMT of the 58 MMT for all EU countries in 2012. However, as a share of the total MSW generated, Germany only incinerated 35% and France 33%. Incineration as a share of the total MSW generated, is much higher in other European countries. For instance, Norway, Denmark, and Sweden

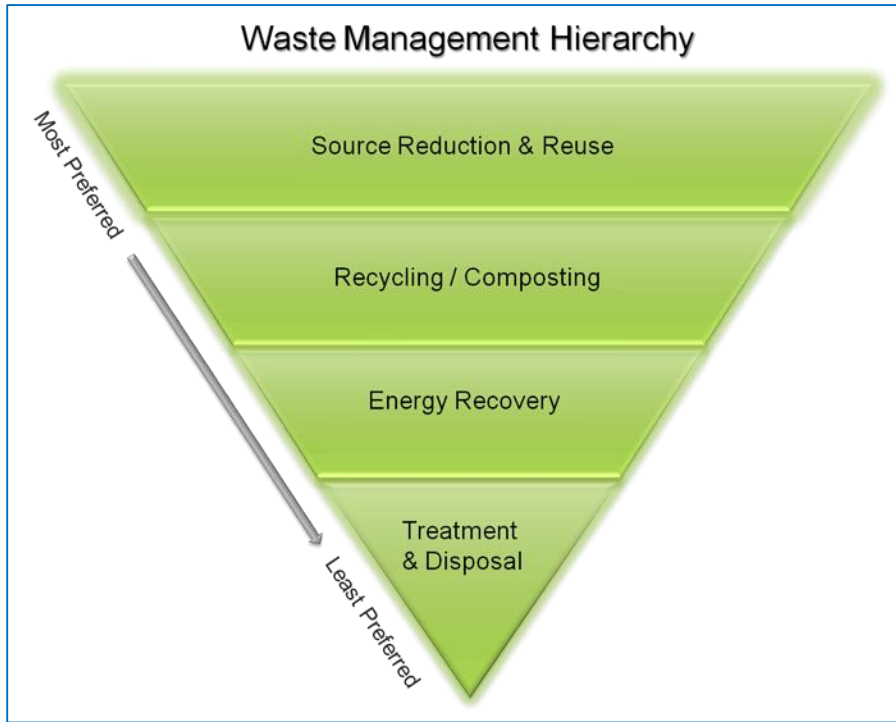
incinerated 57%, 52%, and 52% of the MSW generated in each country in 2012. Switzerland (49%), The Netherlands (49%), and Belgium (41%) also used incineration as the primary disposal method in 2012. The higher prevalence in 'northern' EU countries is offset by low adoption in several southern and former soviet bloc countries. These include; Spain (9%), Hungary (9%), Slovakia (9%), Poland (<1%), and Bulgaria (0%). One reason for the low adoption, particularly in eastern Europe, is a result of the association of incineration with the era of Soviet rule (Ericsson, 2009). These statistics reflect a broad spectrum of MSW strategies across the 28 EU members. Member states must adhere to certain legal acts, although with some flexibility in methods of achieving specified targets.

Heterogeneity exists in the US as well. Of the 86 incineration facilities operating in 2012: 40 were located in the northeast US, 22 in the southern US, 16 in the midwest, and 8 in the west (US Environmental Protection Agency, 2014). These 86 plants had a total operating capacity of 87,000 tonnes per day, or 31.7 MMT for the year in 2012. However, only 26.5 MMT was incinerated in 2012, exceeding the total weight incinerated by Europe's leading country, Germany, but accounting for less than half of the total amount of MSW the EU incinerated in 2012.

Despite the heterogeneity found in the EU and US states' management of waste, both the US and the EU have policy that sets the standard for MSW management. In the EU, this is set by the EC; and the US equivalent is the EPA. The EC and the EPA define waste hierarchies for their states; the waste hierarchy is a list of management approaches for MSW, in order of decreasing preference.

In the USA, the EPA first established a waste hierarchy in 1989 in the Agenda for Action (US Environmental Protection Agency, 1989). The reverse pyramid schematic in Figure

4 shows the preferred order of MSW disposal in the US. It is similar to the version for the EU (Figure 5) which was established in the Directive on Waste (European Commission, 2008).



**Figure 4: US EPA Waste Hierarchy.**

**Source 4: The figure is from the EPA Solid Waste webpage (US Environmental Protection Agency, 2013).**



**Figure 5: EU Waste Hierarchy.**

**Source 5: The figure is from the Waste Framework webpage (European Commission, 2014).**

While the waste hierarchy for the US and the EU give a preferential ordering of disposal options there are differences in both structure and implementation. The EU directive, unlike the US, is quasi-binding. In the EU, targets for MSWM must be met, but the methods taken to achieve these targets are the prerogative of the member states (Connelly & Smith, 1999). The Landfill Directive – Directive 99/31/EC (European Commission, 1999) establishes 1995 as a baseline from which member states must reduce the biodegradable portion of MSW sent to landfills by 25% in 2010, 50% in 2013, and 65% in 2020. Member states must achieve these goals, but can set their own methods using the waste hierarchy as a guideline. The targeted reduction of landfill waste encourages member-states to switch to more preferred MSWM practices.

In addition to the EU's Waste Directive binding all member-states to the MSWM targets, the EU has a Renewables Directive. Enacted in 2009 under Directive 2009/28/EC (European Commission, 2009), this act replaced a previous directive – Directive 2001/77/EC on electricity production from renewable energy sources. Whereas the earlier directive established voluntary targets (European Commission, 2001), the 2009 directive requires member-states to source 20% of energy production from renewables by 2020 (European Commission, 2009). The accounting for this target is done at the supra-national level, so as a whole the EU must meet this target. This allows for flexibility in that countries able to generate greater than 20% can do so to allow other countries to generate less than 20%. The Renewables Directive provides additional incentives to member-states to achieve the Landfill Directive targets by increasing the use of MSWM technologies like WtE. The Renewables Directive, in conjunction with the Landfill

Directive, guides all EU states toward increasing the use of MSWM technology that generates power, while allowing for flexibility in this transition.

Unlike waste hierarchy and targets set by the EC in the Landfill Directive, the American EPA lacks nation-wide policy directives to encourage the use of more preferred options in the waste hierarchy. In the US, rather, renewable portfolio standards (RPS) are established by individual states to encourage power generation from non-fossil fuel energy sources. RPS are designed to increase energy production from renewable sources. These sources vary between states, but typically include wind, solar, geothermal, and biomass. The regulation can be mandatory, as is the case for 29 states and the District of Columbia, or the regulation can be voluntary, which currently eight states have enacted (Database of State Incentives for Renewables & Efficiency, 2013). Some form of biomass is eligible in every state under the RPS, but several states have restricted the incineration of MSW. For instance, in Wisconsin, “garbage” or MSW is excluded as biomass. This is also true for Washington State, but food and yard waste are allowed. RPS can be an effective tool at the state level, but the US still lacks binding targets at the national scale, signifying a unified approach to MSWM.

The difference between the regulatory regimes in the EU versus the US creates different levels and types of incentives for adopting preferred MSWM technologies. While both the EU and the US are quite heterogeneous in terms of the member states approach to MSWM, the EU has overarching binding targets, where the US does not. This difference in regulatory approach to MSWM is likely an important factor in the trends shown above (Figure 2) of MSWM in the EU. Despite this, more attention historically has been focused on the difference in public acceptance of incineration that exists in the EU and the US.

### **1.2.2 Public Acceptance**

The context in which public acceptance is most often discussed in relation to MSWM is NIMBY, or not-in-my-backyard. The notion of NIMBYism is rooted in the economic principle of rational-choice theory (Soland, Steimer, & Walter, 2013). The basic premise is that individuals are motivated by self-interest. The term NIMBY is used by proponents of development initiatives to describe local opposition as being motivated by self-interest. From this point of view it is not that the opposition is against, for example a coal power plant that provides electricity for homes, but they are against the power plant being in their ‘backyard’. Given a choice between having a power plant nearby or further away, under the NIMBY logic, the individual would choose having the power plant further away.

There have been several critiques regarding the use of NIMBY and its use in discrediting the opponents of development projects. Concerns revolve around procedural and distributive justice in the decision making process (Klinsky & Dowlatabadi, 2009). Procedural justice advocates that all stakeholders, especially those that are burdened by impacts, should have representation in decision making. Additionally, distributive justice emphasizes the importance of equal share of the burdens associated with development projects. Furthermore, research indicates there is no empirical evidence that supports the concept of NIMBY (Devine-Wright, 2011a). Critics of the NIMBY concept note how the term is used to depict opposition as lay people who are ignorant and unwilling to engage in discussion (Devine-Wright, 2011b; van der Horst, 2007). Additionally, incentives to communities whether presented as benefits-in-kind and establishing community funds can be perceived as a form of bribery or compensation depending on the timing of the offer (Cass, Walker, & Devine-Wright, 2010).

An example of NIMBYism with regard to renewable energy development is that of wind power in the United Kingdom. Policy makers pushing forward with offshore wind farms were surprised to encounter local opposition since a recent survey showed that the community was favorable towards renewable energy (Wolsink, 2007). With these favorable survey data, policy makers set about developing a wind energy plan in the UK. Once they approached the community to inform them about the area they had chosen, the community began to push back. The policy makers thought this was a NIMBY reaction and held firm in their belief that attitudes were U-shaped; projects are favorable when not in their 'backyard', bad when announced, and good again after some reasonable time post-construction. In fact, the community was resistant because of what they saw as a top-down, technocratic approach to power planning. There was no consultation, and the community was critical of what they saw as unfair decision making, that others had placed the burden of the power project upon them.

The NIMBY concept has been used in some cases to avoid substantial community engagement with respect to a proposed project. Instead, when dealing with concerns of opponents, proponents have employed economic oriented approaches such as reimbursement (Wolsink & Devilee, 2009). Some experts make the economic argument that any opposition the community expresses is a rational response from assuming an uninsured risk, for example a power plant operating nearby, and economic compensation can remediate this risk (Soland et al., 2013). In this way past development practices have thought compensation is adequate to appease community members (Wolsink & Devilee, 2009). This approach is taken by the technocratic decision making model, maximizing energy output and return on investment while avoiding deliberation or consultation with communities.



Further research has found that NIMBYism does not fully capture the nuance of opposition, and efforts to engage communities and opponents in development projects can better be described in terms of social license to operate (SLO). SLO is both a goal and a set of rules that are inherently complex, have multi-faceted interactions, are time and context specific, are dynamic, and are reflective of the local social and environmental conditions with varying community priorities and expectations (Prno & Slocombe, 2012). Unlike an application to build that a developer might submit to local authorities, SLO is not a physical document, it is something more akin to a handshake – an agreement built on perceived legitimacy, credibility, and trust. Efforts have been made to standardize the process of building a SLO through impact and benefit agreements, but a formalized process is difficult to construct since community perspectives change over time. While the concept of SLO has been lauded for increasing the social profile in discussions, it has also been critiqued for falling short in continuing the dichotomy of developer and community, instead of moving towards a concept of one community (Owen & Kemp, 2013).

Recently, the concept of SLO has become quite popular in the context of proposed development projects. The NIMBY concept is still used by some, but community engagement and acceptance of development projects is becoming an increasingly important factor in determining the success of proposed developments. This is encouraging because under the SLO concept there should be some consultation with the community and a realization that support and approval are not guaranteed forever. But just as the NIMBY concept, upon further investigation, proved not to capture the entire picture of community opposition to development projects, SLO cannot completely explain the divergence in MSWM between the US and the EU.

The acceptance of MSW incineration in the US and the EU are quite different. While both governmental regions have renewable energy incentives, and preferred waste management disposal pathways, their implications differ because of how the current environment was shaped. As Uyarra & Gee (2013) discuss, the transformation of a socio-technical system is shaped by inertia and path dependency. The argument made in this study is that while SLO is an important element in development of MSW incineration in the US and EU, the current MSWM practices in the two regions are shaped by a long sequence of social, economic, environmental, and political events. The decisions made during these events can have long lasting effects and lead towards path dependency.

### **1.2.3 Path Dependency**

In describing path dependency, Karl wrote, “the impact of decisions made in the past persists into the present and defines the alternatives for the future (1997:11).” Path dependency is a scholarly topic in many disciplines: history, economics, political science, and sociology. For this study, the theoretical approach as practiced in political science will be used. Path dependency can be applied to the adoption of particular pieces of technology or to large-scale institutions. Within political science there are two dominant schools of thought which impact the application of path dependency theory (Pierson, 2004). The first is a rational choice approach. This application of theory focuses on the micro-level interactions among actors. The second school of thought is historical institutionalism, which focuses on macro-level interactions such as constitutional arrangement or major policy structures. Pierson, advocates for the use of both in investigating path dependencies. It is this combined view of micro- and macro-level phenomena which will be stressed in this study.

One of the more common allegories of path dependency is that of a branching tree (Verba, 1971). The branch is a representation of how past choices limits future choices that can be pursued, in this case nearby branches. Pierson (2004) lists several key elements of path dependency. The first of these is timing and sequence. Timing and sequence of events matter, and earlier events matter more-so than later ones. The second element, multiple equilibria, recognizes that starting from similar conditions there are a range of possible outcomes, and relating back to the first point, the impact of an event can be lesser or greater depending on timing. The next element, contingency, reflects the idea that large consequences can result from small events. Lastly, inertia, refers to the principle that once started, chosen courses and actions can be hard – if not virtually impossible – to reverse. These important origin events are known as “critical junctures” (Collier & Collier, 1991), and as Nooteboom (1997) notes feedback, self-reinforcement, or lock-in produce a particular institutional pattern. Path dependency can be used to understand how historic events can influence current day outcomes.

Path dependency recognizes that there is unpredictability in possible end-states that decisions will lead to, inflexibility in returning to an earlier state, non-ergodicity or the breakdown of similar outcomes, and lastly the potential for path inefficiency or that the chosen path may lead to a less profitable outcome than a foregone alternative (Arthur, 1994). These concepts are important in explaining how path dependency can address the complexities and uncertainties present in social systems.

In explaining path dependency, especially as it relates to institutions and not individuals, Mahoney (2000) describes four explanations. The *utilitarian* explanation posits that an institution is reproduced through rational cost-benefit analysis. The *functional* explanation is that an institution is reproduced if it serves some function important to the operation of the

overall system. The *power* explanation is that an institution is reproduced because it is supported by a small group of elite entities. Finally, *legitimation*, is when institutions are reproduced because entities believe it is morally just. Although these explanations are useful, not all institutional systems can fall neatly into one of these categories.

Care should be taken when using path dependency to investigate outcomes. Applications of this theory have been critiqued for selection bias in which events are used to support reasoning for a particular outcome (Clark, Tracey, & Smith, 2002). Additionally, when using path dependency as a unit of analysis, researchers have equated firms as beneficiaries thereby overlooking covert actions by the institution. Another concern is the identification of early path dependencies with sensitivity to initial conditions (Page, 2006). Sensitivity in this case refers to deterministic dynamic processes that are outcome-dependent. For example, the process in early England for elected town office was outcome-dependent. Men in the villages alternated holding elected office, and the identity of the incoming office-holder depended on who held the office previously. So, the incoming office-holder was already determined. This is different from early path dependence that refers to random events which impact, but do not determine potential future histories. An example given by Page (2006) is case law, where the doctrine that precedent is a powerful guide for deciding cases, but as Buchanan (1987) noted, once a precedent is no longer considered relevant decisions can be overturned and new ones made.

Path dependency is the study of how previous events persist into the present to shape outcomes and constrain future paths, similar to a branching tree. Recognizing that outcomes are unpredictable and inflexibility exists in returning to a previous state are useful tools employed by path dependency in understanding complex systems. This can be applied at the micro-level and macro-level and through identification of critical junctures. There are many lenses through

which a path dependency analysis can be implemented, and care must be taken to avoid selection bias and choosing initial conditions that may be sensitive to earlier conditions.

### **1.3 Conclusion**

The US and the EU differ in the management approach for MSW. The reason for this difference is often cited as NIMBY responses or more broadly as a lack of public acceptance. These conclusions cannot fully explain the current MSWM environment in the US and the EU when one considers the historic use of incineration in the US to treat MSW. Additionally, these explanations represent the current MSWM environment in the US and the EU as vacuums with no connections to past practices, experiences, or choices. Understanding how MSWM practices came about in the EU versus the US from a path dependent perspective can lead to insights in regards to other types of policy, including climate change.

The following chapter covers the methods, data, and results of this study. The results will be presented as a chronology of events, where events and responses taken will be highlighted to illuminate the paths chosen. Particular attention will be fixed upon drivers of change adapted from Lohri et al. (2013). These include societal, economic, environmental, and political interests.

## **Chapter 2: Methods and Data**

The previous chapter demonstrated the rise and fall of incineration in the EU and the US respectively over the past several decades. Recognizing that the EU is a supranational government comprised of individual countries, the analysis primarily focuses on six countries. The reason for this was in part due to the availability of data from these countries, and also the significance of these countries within the European community. These countries have a long history of cooperation, and have a significant influence on EU policy. These countries include The Netherlands, Denmark, Germany, France, Sweden, and the United Kingdom. While additional European countries are discussed, the availability of data for these countries was limited.

### **2.1 Methods**

In order to investigate reasons for the current practices in the US and the EU, a comparative case study was conducted. The purpose of this comparative case study was to investigate historical events that resulted in path dependencies leading to a divergence in use of MSW incineration. For the purposes of this analysis, the definition of case study was taken from Yin as, “an empirical enquiry that investigates a contemporary phenomenon... and relies on multiple sources of evidence (1994:13).” The chosen theoretical framework for this study, path dependency, contextualized, framed, and acted as an explanatory organization of MSWM policy. The case studies were analyzed as a process, and not a singular event, under the application of path dependency as suggested by Pierson (2004). In this investigation both micro-level and macro-level interactions were examined.

The results are presented as a chronology of events, where events and their associated responses are highlighted to illuminate the paths chosen. Particular attention was fixed upon drivers of change adapted from Lohri et al. and categorized as *societal*, *environmental*, *economic*, and *political interest* drivers (2013). *Societal* drivers include public awareness such as the public being informed on public health concerns related to the release of emissions from incinerators. *Environmental* drivers include elements of resource recovery or the destruction of aquatic habitats from contaminated landfill leachate. *Economic* drivers include financial considerations, and lastly, *political interest* drivers pertain to the type of legal system and priorities of the government. It is important to note that regulations are an important element in this analysis, but regulations are a product of the drivers listed above. Why they were developed, how they have changed, and how they are applied are a product of the four driver categories.

The analysis begins around the year 1800. The reason for this is partly as a result of the dates for which information was available, but also because of the significance of the early 1800s in Europe and the US. At this time, Europe was emerging from the French and Napoleonic Wars. The Congress of Vienna brought European leaders together with the purpose of recovery from the wars with the theory that bringing greater equilibrium to the power of European countries would create more balance and encourage peace. The Holy Roman Empire had also atrophied and formally dissolved in this time period. Concomitantly, the US was beginning to grow as a new country. Most importantly, the industrial revolution was beginning to spread in both Europe and the US, spurring migration from rural areas to urban centres. The increase in people also resulted in an increase in MSW. The year 1800 provides a starting point for the growing pains that municipalities would face.

## **2.2 Data**

The data for this comparative study was collected through textual analysis of primary and secondary sources. Primary sources included official government documents. Secondary sources comprised academic literature from peer-reviewed journals and texts. Multiple sources of data were collected to verify the same premises. The use of these data sources was carried out to reinforce the validity and reliability of the data.



## **Chapter 3: Results**

The results are presented in a chronological-narrative for the two case studies. While actions and the responses taken can be categorized in social, environmental, economic, and political terms, the cataloging of the results in such fashion would remove events from the timeline, and thus the context of their origin. Discussion of the significance of the results presented in this chapter will examine the significance of the results for the social, environmental, economic, and political themes.

### **3.1 Europe**

The first point to make about MSW incineration in Europe is that it is not supported by all countries. There is much conflict among countries that make up the European Union about approaches to MSWM, which is important because regulations passed by the EU must be adhered to by the member states. In northern Europe there is wide support for incineration and recycling, while in Southern Europe, controlled landfills are the favorite MSWM approach (Magrinho, Didelet, & Semiao, 2006). Countries like Spain and Portugal would prefer landfilling, but since the EU has established a waste hierarchy, they must adhere to the directive from Brussels, which restricts the amount of landfilling allowed and mandating a reduction in landfilling over time. This directive encourages resource recovery (e.g. recycling, incineration with energy recovery), but despite these regulations, there has been significant reluctance to adopt MSW incineration in parts of the EU, such as the UK and Eastern Europe although this was not always the case (Miranda & Hale, 1997).

### **3.1.1 1760 – 1951: The Industrial Revolution Spreads**

The combustion of MSW for energy has been a management practice in Europe for over a hundred years. The first recorded mass-burn incineration occurred in the UK in 1874 (Vergara & Tchobanoglous, 2012). The use of incinerators quickly spread, with an early WtE incineration facility, Frederiksberg, being built in Denmark in 1903 (Kleis & Dalager, 2004). The impetus for building this facility was a lack of available land for landfilling, but also provision of heat to the nearby hospital. With the facility being located within the city, ‘soot pockets’ and flu gas cleansers were used. These rudimentary technologies captured approximately 80% of the fly ash and were some of the first efforts made in controlling emissions. By 1948, the first publically owned district heating facility was built in Sweden and operated by the first of many publically owned MSW incineration plants (Ericsson, 2009).

While the first incinerator was built in the UK in 1874, the systematic management of MSW has a much deeper history among European communities, especially as it relates to the development of municipal infrastructure. MSW was largely seen as the “third pollution” in countries around the world (Elmer & Leigland, 2014). The first and second “pollution” was water, followed by sewage. This was often the sequence in which the “pollutants” were addressed. Cities in the 1800s would first develop infrastructure to deliver potable water and dispose of sewage. Infrastructure was an important concern for cities as they progressed through the industrial age. The first college for road and bridge engineers was opened in Paris in 1747. This led to the standardization of streets across Europe, and by 1793, the Society of Civil Engineers was established in England.

At the turn of the century, new nations were created and the practice of local control, in many parts of Europe, was instilled as law. The Prussian Municipal Charter of 1808 included

such a law called the “General Competence Clause”<sup>5</sup> (Wollmann, 2004). The purpose of the clause was to give municipalities the right to deal with local concerns in the fashion they felt best. There was to be no external entity claiming authority. This pattern of local government was already being practiced in many other parts of Europe, including Austria, but it was one of the first to be included in national edicts. From continental Europe, the strengthening of local governments spread to Great Britain.

The Municipal Corporation Act of 1835 allowed for the formation of local governments in England (Wollmann, 2004). These local governments were given a broad range of responsibilities and powers, including the appropriation of property taxes for infrastructure projects. This act was preceded by the Representation of the People Act of 1832<sup>6</sup> in Wales and England which had increased the level of procedural justice by redistributing seats in the British House of Commons. The trend towards greater local control, alongside increased trade with Asia and the US lead to increased financial capacity (Ardant, 1975). This allowed for the financing of infrastructure projects, such as roads, rail systems, and water and sewage systems some of which were private while others were publically owned.

Municipal enterprises flourished throughout Europe in the 1800s (Millward, 2011a). These enterprises were necessary to finance water, sanitation, and other infrastructure projects. Development of gasworks proved extremely profitable for municipalities, and led to increased

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<sup>5</sup> This clause was very important, and lasted through several stages in building the country of Germany as known today. This includes the unification movement in the late 1800’s, and the formation of Germany as a country in 1949. The clause was included in the Federal constitution in 1949.

<sup>6</sup> This act, colloquially known as the First Reform Act, applied only to England and Wales, the parliaments of Ireland and Scotland would each pass similar acts in the same year.

municipalization of services. To contain price increases, many governments set profit limits either at the local level, or nationally (Millward, 2004). In 1840, Great Britain passed national legislation on infrastructure that set price limits on services like gas, railways, and water.

The state or regional governing body would typically not be involved in infrastructure development, except in a few cases such as the price-cap mentioned above. Many private companies were operating throughout Europe during the early to late-1800s (Millward, 2004). There was greater municipal ownership of all types of infrastructure in northern Europe compared to southern European countries like Spain and Italy. However, even in countries like Germany, Sweden, and Belgium with high municipal ownership rates, state-governments were reluctant to get involved. Private companies began many infrastructure projects, but regional and state-level authorities would need to get involved in order to address disputes over right-of-ways. Additionally, state-governments would step in for geopolitical reasons, especially in controlling information such as through infrastructure for telegraphs and the flow of goods (Millward, 2011a). This was especially true for continental Europe, more so than it was for Great Britain and the US. This was in large part due to the relative isolation of these two latter countries compared to the closely situated continental European countries.

Even though private companies were active in the development of municipal infrastructure projects, municipalization was increasing. Gas networks which began to flourish in Germany in the 1860s were publically owned in 50% of municipalities by 1880, and by the early 20<sup>th</sup> century. 50 of the largest towns had municipally owned gas works (Millward, 2004). Scandinavia saw a similar surge in municipal ownership beginning in the 1860s and by 1870 nearly half were publically owned in Sweden and 71% were publically owned in Denmark. The introduction of gas networks would be followed by, and in many cases compete with, electricity.

In many of these cases, the early electrical networks were small and thus favored municipal ownership.

During this same time period, a major shift occurred in how public health was viewed and managed with the passing of the Public Health Act of 1848 in Great Britain (Louis, 2004). The Board of Health was created in this same year and later nationalized in 1879. During this time period anti-contagionists (i.e. those who believed water and sewage were primary sources of disease) lobbied municipalities across Europe for the removal of sewage and distribution of clean water. As public health theory moved from miasma to the germ theory of disease, municipalities also began to take on greater responsibility in managing the disposal of MSW. From 1870-1880 many municipalities in the Kingdom of the Netherlands didn't renew contracts with private companies to dispose of waste (Kalders & Hafkamp, 2000). Over the subsequent decades, Rotterdam in 1912 and Amsterdam in 1918 turned towards incineration of MSW for disposal, and other European cities started to do the same.

Paris began operating a municipal incinerator for MSW disposal in 1912, and this was quickly followed with the construction of two additional units. By 1928, the incinerators were providing district heating for Paris. The evolution of MSWM continued in Europe with intense rebuilding efforts following WWI and WWII. These rebuilding efforts were a boon to municipal enterprises. For example, in Germany there was a boom in post-WWII municipal ownership and operation of services including MSWM (Millward, 2011b). This was in part a continuance of earlier increases in municipalization, but even more so a result of distrust for state government. In addition to the "general competence clause" enacted in the Prussian Municipal Chart of 1808 and included in the German Federal Constitution in 1949, the 1949 constitution also forbade the state government from establishing regional or local field offices (Wollmann, 2004). The

proportion of federal, regional, and municipal employees exemplifies the support for greater local control. The majority of public workers in Germany, approximately 50%, are at the regional level. Only 6.5% of public workers are employed at the federal level, and the rest are employed at the municipal level. The regional level workers are predominantly teachers and police, and municipal level are predominantly fire and social service providers. The support of greater local control is also seen in Sweden where most public tasks (i.e. education, social services, and utilities) are fulfilled by local governments resulting in 60% of public workers being at the municipal level. As with Germany, local governments in Sweden can levy their own taxes.

As Europe began to rebuild post-WWII, state-level governments took a greater interventionist approach in reconstruction (Millward, 2006). This was partly a result of the targets set out in the Marshall Plan which promoted European integration<sup>7</sup>. While trade barriers were relaxed and state-level governments began rebuilding, the benefits of inter-municipal associations and inter-connections were endorsed. For instance, municipalities in Norway which had previously not been allowed to sell electricity beyond their locality, were spurred to connect and sell to the larger grid. Since speed in rebuilding was paramount, state-sponsored enterprises were found to be more effective in reconstruction and rebuilding networks. This resulted in even greater municipalization of MSWM and other services. Additionally, the European community adapted the importation of US institutions and policies post-WWII by introducing “shareholder value” management styles (Roy, 1997). In this managing style regardless of whether enterprises

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<sup>7</sup> The United Nations was also established post-WWII in 1945, to promote peace and cooperation. The UN replaced the League of Nations which was founded on similar principles following WWI with the Paris Peace Conference.

were public or private, strong labor and community participation were incorporated. Benefits to communities were also paramount in rebuilding and incineration units which had previously served as a volume reduction technology of MSW, were retrofitted with energy recovery during WWII recovery efforts (Buclet, Defeuilley, & Lupton, 2000).

### **3.1.2 1952 – 1973: The Beginnings of the Union**

Energy recovery through incineration of MSW was already substituting landfilling prior to WWI, but became even more prevalent with the boom of new homes built in the 1960s post-WWII (Ericsson, 2009). With communities being built in denser settlement patterns, district energy using MSW was seen as the solution for reducing the need for landfill while also supplying heat and electricity year round. The municipalization of MSWM using incineration increased, and with the profits from municipal enterprises in previous infrastructure projects; such as gas, water, and sewage, financing was not a great concern (Millward, 2011a). In fact, profits from municipal enterprises were a useful source of local tax relief.

While the European community had worked together previously, especially in reconstruction after WWII, the European Union as an economic and political union first began as the European Coal and Steel Community (ECSC) in 1952 under the Treaty of Paris of 1951 (European Coal and Steel Community, 1951). This was subsequently built upon under the Treaties of Rome in 1957 which formed the European Economic Community (EEC) (European Economic Community, 1957). This treaty brought together France, Germany, Italy, and the Benelux countries. It was this treaty that established the supra-national organization in which law, acts, and directives passed by the EEC took precedence over national law (Connelly & Smith, 1999). While this governance model depicts a top-down approach, in fact the national

and sub-national governments had authority over how mandates would be implemented and achieved. Furthermore, local governments also had a great amount of authority related to the direction of national policy. The use of *cumul des mandats*, which allows for public officials in France to hold multiple positions is an example of this power (Wollmann, 2004). This governance feature had been in practice since the 1800s, and has led to greater inter-communal cooperation between cities because mayors of municipalities have seats in national parliament. In 1971, the national French government tried to initiate territorial reform that would reduce the number of municipalities which were approximately 37,000 in number. The effort failed as a result of municipal officials having positions in the national parliament. Although this type of governance system is uniquely French, the influence of local government at the national and supra-national scale in Europe has been consistent as European countries have transformed throughout the centuries (Borraz & John, 2004).

### **3.1.3 1973 to Present: Focus on the Environment**

When the oil crisis arrived in 1973, many countries began to ration fuel and, in the case of Denmark, a high tax was implemented to discourage unnecessary consumption (Kleis & Dalager, 2004). Even when research into alternative fuels had shown progress and fossil fuel reserves in the North Sea were discovered, the high tax on fossil fuel consumption remained. As additional WtE incinerators were brought online, the waste managers in Denmark and many other European countries began designing, along with architects, ‘shells’ for these facilities. This effort was made to improve the visual appeal of these buildings, especially in rather flat landscapes such as Denmark. The introduction of these plants prior to the World Wars and the reliance upon these facilities for heating during the harsh recovery period following WWII meant



that people weren't divorced from MSWM. MSW was a valuable source of heat for much of Europe because of the lack of available coal and other fossil fuel energy sources forcing many communities to gather fly ash, which had previously been applied to the land, to burn again (Kleis & Dalager, 2004). MSW was part of the everyday reality for communities and for them MSW became seen as a resource to be used again rather than discarded into a landfill (Vergara & Tchobanoglous, 2012).

Concomitantly, the US National Environmental Policy Act of 1969 and the publication of *The Limits to Growth*<sup>8</sup> in 1972 led to increased interest on environmental concerns around the world. Concern for the environment had been mounting since the first environmental directive in 1967 by the EEC, but the oil crisis in tandem with these events caused a tipping point (Connelly & Smith, 1999). The European Council began passing a series of directives for environmental protection (Table 1).

<b>Directive</b>	<b>Purpose of the Directive</b>
67/548/EEC	Regulation of dangerous chemicals and substances
75/439/EEC	Strategy on prevention and recycling of waste
76/464/EEC	Reduce water pollution for drinking purposes
80/779/EEC	Limits on emissions of sulphur dioxide and particulate matter
84/360/EEC	Limits on emissions of pollutants from industrial plants
85/337/EEC	Introduction of environmental impact assessments
88/609/EEC	Limits on emissions for combustion plants
96/61/EC	Introduction of an integrated pollution prevention and control system
99/31/EC	Reduce the amount of biodegradable waste sent to landfills

**Table 1: List of Key Environmental Directives.**

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<sup>8</sup> Meadows, D.H. 1972. *The Limits to Growth: A Report for the Club of Rome's Project on the predicament of mankind*. New York: Universe Books.

As the European community coalesced into the European Union, the Single European Act of 1986 (SEA) (European Economic Community, 1986) amended the Treaties of Rome to increase local control. Included in this expansion of local power was the principle of environmental policy. Under Title VII of the SEA several objectives related to the environment were established. These include actions to preserve, protect, and improve the quality of the environment, to contribute towards protecting human health, and to ensure a prudent and rational utilization of natural resources. Furthermore, the SEA stipulated that environmental damage should be controlled at the source and expanded the application of the polluter pays principle. Lastly, the SEA stated that communities should control the implementation and achievement of these objectives prior to the EC being involved. This concept, known as subsidiarity, approaches issues with the ideal that decisions should be made as close to the citizens they impact as is possible (Connelly & Smith, 1999). The northern and middle European countries have a tradition of the subsidiarity model with a high value placed on self-government, local autonomy, and financial independence. The SEA constitutionally guarantees local self-government, and the subsidiarity model would be adopted by member-states.

Along with these early environmental policies, waste management policies were instituted. In 1975, the EEC passed Council Directive 75/442 on Waste which included language to encourage recovery options through use of waste as a fuel or to generate energy (European Economic Community, 1975). The preferred MSWM policy was prevention or reduction of waste followed by recycling and then energy recovery. This initial version of waste policy for the EEC was a reaction to the waste crisis in the 1970s, a concern that space in landfills was reaching capacity (Massarutto, 2007). In Germany, the first federal report on the waste crisis was in 1963 (Fischer & Petschow, 2000). This led to the formation of the Central Office for

Waste Disposal, and while they could not establish local offices as stipulated by constitutional law, they worked with municipalities and more importantly paid for costs of implementing MSWM policies that encouraged recycling, re-use, and energy recovery from waste. In 1967, there were 50,000 dumps and 130 sanitary landfills in Germany, but by 1982 this was reduced to just 439 sanitary landfills. The percentage of the Germany population served by incineration of MSW increased from 4.2% in 1965, to 14.4% in 1970, and reached 22% in 1975.

In the rest of Europe, the self-sufficiency principle<sup>9</sup> would prove to be just as important as the creation of a waste hierarchy. The injunction of the self-sufficiency principle occurred in Article 5 of the 1975 Directive on Waste (European Economic Community, 1975). This writ directs communities to develop an integrated and adequate network of disposal installations that utilize the best available technologies in moving towards self-sufficiency in waste disposal. Furthermore, the writ directs communities to design these systems in a manner that reduces transportation of waste to ensure a high level of environmental protection and public health. The addition of the self-sufficiency principle was a measure to avoid dumping of waste in neighboring regions, and encourage waste disposal to service the communities in which they operated (Fischer & Petschow, 2002). The idea of the proximity principle, that environmental damage should be addressed at the source, would greatly influence subsequent environmental and waste regulations set forth by the EEC and later the EU (Jans, 1994). These principles and

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<sup>9</sup> The concept of self-sufficiency as it relates to waste would later be challenged in the European Court of Justice Case C-2/90 – Commission vs. Belgium. The court ruled that waste was a “good”, but unlike other “goods” which could not be restricted to trade, waste could be restricted for the protection of environmental and public health. This ruling established the proximity principle in waste disposal.

concepts outlined in the 1975 Waste Directive would be implemented in the more robust Landfill of Waste Council Directive 99/31/EC (European Commission, 1999).

While some countries in Europe (e.g. Denmark, Sweden, and Germany) were already using incineration as an MSWM strategy, after the Landfill Directive, this approach became more widespread. This directive established a step-change process in reducing the amount of biodegradable material sent to landfills (European Commission, 1999). Compared to 1995 levels, the directive required member-states to reduce organics (by weight) sent to landfill by 25% within 5 years of adoption, by 50% within eight years of adoption, and by 75% within 15 years of adopting the directive.

While incineration of MSW was championed as a technology to meet these goals, there had been concern over the health impacts, especially dioxin, emitted from these facilities (Kalders & Hafkamp, 2000). This resulted in many of the council directives on emissions standards enacted by the EEC, but many countries had already acted to mitigate these emissions. For example, The Netherlands had, under the Waste Substances Act of 1977, required all incineration facilities to be retrofitted to the best available technology (Organisation for Economic Co-Operation and Development, 2003). Until installations had reduced their emissions, they were not allowed to operate. Focus wasn't only on reducing emissions from incineration facilities, but also on reducing the negative environmental effects of landfills by diverting waste to be used or disposed of in other ways.

The EU Landfill Directive<sup>10</sup>, passed in 1999, required member states to reduce the amount of biodegradable MSW sent to landfills and increased recycling and composting rates

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<sup>10</sup> [http://ec.europa.eu/environment/waste/landfill\\_index.htm](http://ec.europa.eu/environment/waste/landfill_index.htm)

(Burnley, 2001). Article 5 of this regulation established a timeline with a baseline year of 1995. Member states had to reduce the amount of biodegradable MSW sent to landfills by 25% in 2010, by 50% in 2013, and by 65% in 2020. This meant member states needed to find alternative technologies of which MSW incineration was the most viable option. This regulation is phasing out landfill use and, in combination with the waste hierarchy calling for resource recovery of power through incineration, WtE plants have experienced a boom in construction and older incineration plants that didn't recover energy have been phased out (Ericsson, 2009). To meet more stringent air pollution and energy recovery standards, countries like France had to come into compliance within a short period of time (Laurian & Funderburg, 2014). In 2002, France had 40 facilities that were not in compliance; by 2006 the number had shrunk to 13, and by 2008 all facilities were in compliance. The combination of regulations has effectively boosted the number of WtE incinerators in the EU while decreasing the amount of emissions. Community WtE facilities became widely popular; however, as mentioned earlier, the acceptance of incineration was not homogenous. Many parts of Eastern Europe were opposed to these facilities because of the association of these facilities with the era of Soviet rule (Ericsson, 2009).

In addition to the Landfill and Waste Directives, the EU also adopted the 'green dot' system under the Packaging and Packaging Waste Directive 94/62/EC that first became popular in Germany (European Commission, 1994; Magrinho et al., 2006). This initiative followed the producer pays principle, an extension of the polluter pays principle. The focus of the system was on decreasing the amount of MSW by requiring producers to recover the packaging used in consumer goods. Producers pay for the recovery and recycling of this waste and consumers can identify goods by the 'green dot' symbol. The idea is that producers will decrease the volume of

packaging used since the 'green dot' fee they pay will be lowered. The basis of the regulation came out of concern for the environment and the idea that producers could drastically decrease the amount of packaging waste.

As noted above, Denmark was not the only country to adopt MSW incineration prior to the imposition of the Landfill Directive. Sweden had undergone similar transitions as Denmark and passed an energy tax on fossil fuels in 1991 (Ericsson, 2009). Although Sweden had a robust network of dams for hydroelectricity, the passage of this tax reform increased the appeal of MSW incineration for heat and power generation. Prior to this energy tax, Sweden had also drastically expanded their district heating network, and after the oil crisis of the 1970s, in efforts to become more energy secure, invested heavily in other domestic sources such as wind, waste, and biofuels to back-up hydro power (M. Williams, 2011).

Additionally, European countries favor community-supported solutions to problems that are community wide and thus are less reliant on regional and national solutions (Ericsson, 2009). Part of this community wide approach with MSW incineration was the annual monitoring of plants. In Sweden this monitoring moves beyond regulation of air pollutants to include transparency in business and economic practices. If a plant is found to be transparent to the public in their business and economic dealings, which are reviewed and updated annually, the plant receives a 'Reko' permit, which translates to 'Fair'.

The most recent EU legislation on waste is Directive 2008/98/EC on Waste (European Commission, 2008). This amendment to the previous directive on waste includes additional recycling and re-use targets of MSW and a more clear waste hierarchy. The targets aim to achieve 50% (by weight) re-use or recycling of paper, metal, plastics, and glass from households

by 2020. The other recycling and re-use goal aims to reduce construction and demolition waste sent to landfills by 70% (by weight) by 2020.

While the objectives are the same, not all European countries have enacted recycling, reuse, and MSW incineration with energy recovery in the same manner. Modes of deployment in Denmark and Germany return more benefits to local communities, a deliberate localization of benefits to spur growth, which is quite different from the UK (Cass et al., 2010). Northern European countries have a history of more localized planning strategies, and in the case of Germany, local government powers are constitutionally guaranteed (John, 2001). These powers include local taxes, jobs, investment opportunities, and development of cooperatives. Furthermore, in efforts to curb the use of landfills, many localities increased ‘tipping fees’ or gate fee, which is a charge levied on the quantity of waste that comes into a landfill (M. Williams, 2011). For example, municipal landfills in Germany began collecting a tipping fee of €3/tonne in 1992 and increased this to €6/tonne in 1998 (Buclet et al., 2000). While this is a small amount, it was an initial effort to divert organics and recyclables from the landfill.

In the 1990s in the UK, there was, at first, community opposition to MSW incineration projects moving forward (Uyarra & Gee, 2013). Landfilling of MSW was a cheaper alternative and one that could be conducted outside the city limits. Additionally, landfilling instead of incineration was a practice that dated back to the 13<sup>th</sup> century when burning trash in cities was first outlawed (Petts, 1994). While the UK has since adopted the EU Waste and Landfill Directive, there has been a push for privatization, especially during the Thatcher administration (Wollmann, 2004).

This privatization push affected the UK more so than other European countries, however, Europe-wide, policies were adopted at multiple levels of government that encouraged greater

competition in what were traditionally municipally run services (Hafkamp, 2002). For example, post-1970s multi-utility municipalities began to emerge with the collection and transport of waste done by a private hauler, but with municipalities still owning and operating the disposal locations. While the push for privatization was theoretically the same in continental Europe as it was in the UK, and the US during this time period, the institutional outcomes were quite different (Bertossi, Buclet, Fischer, Kaulard, & Massarutto, 2002). Where the UK began to shift towards regional private operators for MSWM, continental Europe continued on a trend towards integration and standardization. Private companies were not able to achieve economies of scale that would have been appealing. The public sectors that proved to be more profitable for private companies were largely telecommunications, auto-manufacturing, and airlines (Elmer & Leigland, 2014).

As part of the trend in the EU towards integration, the EC began promoting community initiatives through the European Regional Development Fund (ERDF) (Murtagh & Mckay, 2003). Counter to the push for greater privatization, measurement, and efficiency, regional policies focused on demonstrating the value in public finance of infrastructure services (R. Williams, 1999). The emphasis was on community input and development of projects that returned benefits to the local community. Additionally, since the Treaties of Rome, funding has been made available for additional assistance in promoting community development through municipal banks and larger institutions such as the European Investment Bank and the EU, which alone contributed €10.45 billion to waste management infrastructure projects between 2000 and 20013 (McGuinn, Hernandez, & Wielenga, 2011). The largest recipients of this funding was Spain, followed by Poland and Greece.



Today, the EU is comprised of 28 member-states. The communities within these countries have substantial control over MSWM. There are stable policies and leadership which decreases the level of uncertainty that is essential in long-term planning. The system is characterized by publically controlled MSW operation at the local level (E. . Wilson, McDougall, & Willmore, 2001).

## **3.2 United States**

The first MSW incinerator in the US was built at Governor's Island, NY in 1885 (Walsh, Warland, & Smith, 1997). Over the next 25 years, 180 additional plants would be built. By 1963 there were 17,000 apartment buildings with incinerators and 22 municipal incinerators servicing New York City alone (Louis, 2004). At that time, MSW incineration was much more popular in the US than it is presently, and this change is reflected in the evolution of US cities.

### **3.2.1 1790 – 1840: The Formative Years**

For many coming to the New World, the absence of walls around cities, which offered protection for many European cities, would be the first indication of different urbanization patterns (Jackson, 2000). With neighboring cities so close in the Old World, walls bordering towns were constructed to offer protection from raids, but this also worked to increase density by encouraging residents to live within the walls. In the US, the expansive, open, and seemingly limitless land mass meant cities didn't need to compete for space. Over time, many of these cities would grow into vast urban metropolises that would dwarf most metropolitan areas elsewhere.

While some cities would grow into large urban metropolises, US cities in the early 1800s were dense settlements, similar to European cities, with little separation between where people lived and where they worked (Tarr, 1984). In one aspect, this was due to the slower forms of transportation of the day (i.e. horses); however, the role of the US government also played a role in these European-style dense cities. The role the US government had in developing infrastructure was focused largely on canals, lighthouses, and in some instances roads. Municipalities were beginning to install water and sewage networks, with the first large water system being built in Philadelphia in 1798 in reaction to a yellow fever outbreak. Typically, human excreta and household waste were disposed of in cesspools and privy vaults. These were located near homes and would be covered with dirt when full. Where canals, lighthouses, and roads were the focus of infrastructure development at the Federal level, municipalities focused on streets. For municipalities keeping streets drained was vital to encouraging commerce. In many cities, the filling in of privy faults, and landfilling of waste in general, was a common practice with the benefit of increasing land for development especially in coastal and swamp dominant areas (Tarr, 1996). One of the starkest examples of the “filling in land” practice was the decrease in surface area of the San Francisco Bay from 680 to 430 square miles between 1860 to 1960 (Vincoli, 1993). The local community dumped millions of tons of waste into the Bay to generate new land for development. Similarly, Davenport, Iowa used refuse to build levees along the Mississippi River (Peavey, Rowe, & Tchobanoglous, 1985). While these are one extreme example, it is an indication of waste being beneficial only for “filling in land”.

During this time in the US, it was believed that state and local government had the responsibility of stimulating commerce, and a popular method of carrying out this task was the creation of corporations by local and state governments (Roy, 1997). Corporations had a large

impact on financing of infrastructure projects. Corporations had been widely used, especially when projects required more capital than could be raised through taxes. However, the power and influence of corporations changed drastically in the early part of the 19<sup>th</sup> century. In 1789, there were only six non-bank business corporations, but by 1800 this had increased to 335 non-bank business corporations (Roy, 1997). Approximately 65% of these non-bank business corporations were created for the development of highways, but local service corporations had increased from zero to approximately 35 in this same time period. The growth of corporations during this time has largely been attributed to state intervention with the primary purpose of transportation improvements between municipalities, but also for development of municipal infrastructure and services (Wallis, 2000).

Municipalities in this early period were primarily concerned with developing and maintaining streets and bridges, but also installation of potable water and sewer systems. Elected officials would pursue such development goals, but not necessarily with great vigor. It wasn't until a transformation of voting rights within US states that "career politicians" would begin running campaigns based on promises to develop these municipal projects (Tarr, 1984). Typically, only white males who owned property, and in some instances practiced a particular religion (i.e. protestant, but not catholic) were allowed to vote. However, as the early 19<sup>th</sup> century progressed, an increasing number of states adopted universal manhood suffrage (Keyssar, 2000). This created a new group of citizens who had the right to vote, and this also lead to the shift from city councils to city mayors who would run on platforms that appealed to the electorate. The result was an expansion of more visible infrastructure projects such as water and sewer works, but also disregard for other services such as collection and disposal of solid waste.

Infrastructure projects were very expensive to finance and municipalities either raised general tax or property tax rates, sold municipal bonds, or turned to corporations to manage projects (Tarr, 1984). In the early years of the 1800s corporations were public institutions tasked by local governments to build infrastructure (Roy, 1997). Government felt at the time that private companies could not or should not be tasked with this responsibility because it was too risky, too expensive, or too public – that is, it wouldn't be rational for a businessman to be involved in a public project. This changed drastically after the US Supreme Court decision in *Trustees of Dartmouth College v. Woodward* in 1819. The ruling held that corporations could be made private, and be protected as a form of private property<sup>11</sup>.

The role of corporations grew, and with the little help from the Federal government, states and municipalities were left to finance infrastructure on their own (Tarr, 1984). As the US approached the mid-19<sup>th</sup> century, states and municipalities accrued massive debts rising from \$26 million in 1830 to \$231.6 million in 1843 (Roy, 1997). Much of this debt was owed to European banks and governments who held approximately \$150 million of the \$231.6 million. Disaster struck in 1837 with a financial crisis that crippled the US economy for nearly a decade (Rousseau, 2002). Business corporations, which had until this time some responsibility to the state, became fully privatized, thus eliminating accountability. The Johnson Committee Report by the US Congress found that the Federal government could not back these debts with interest payments alone being \$12 million per year (McGrane, 1935). In response, European investors

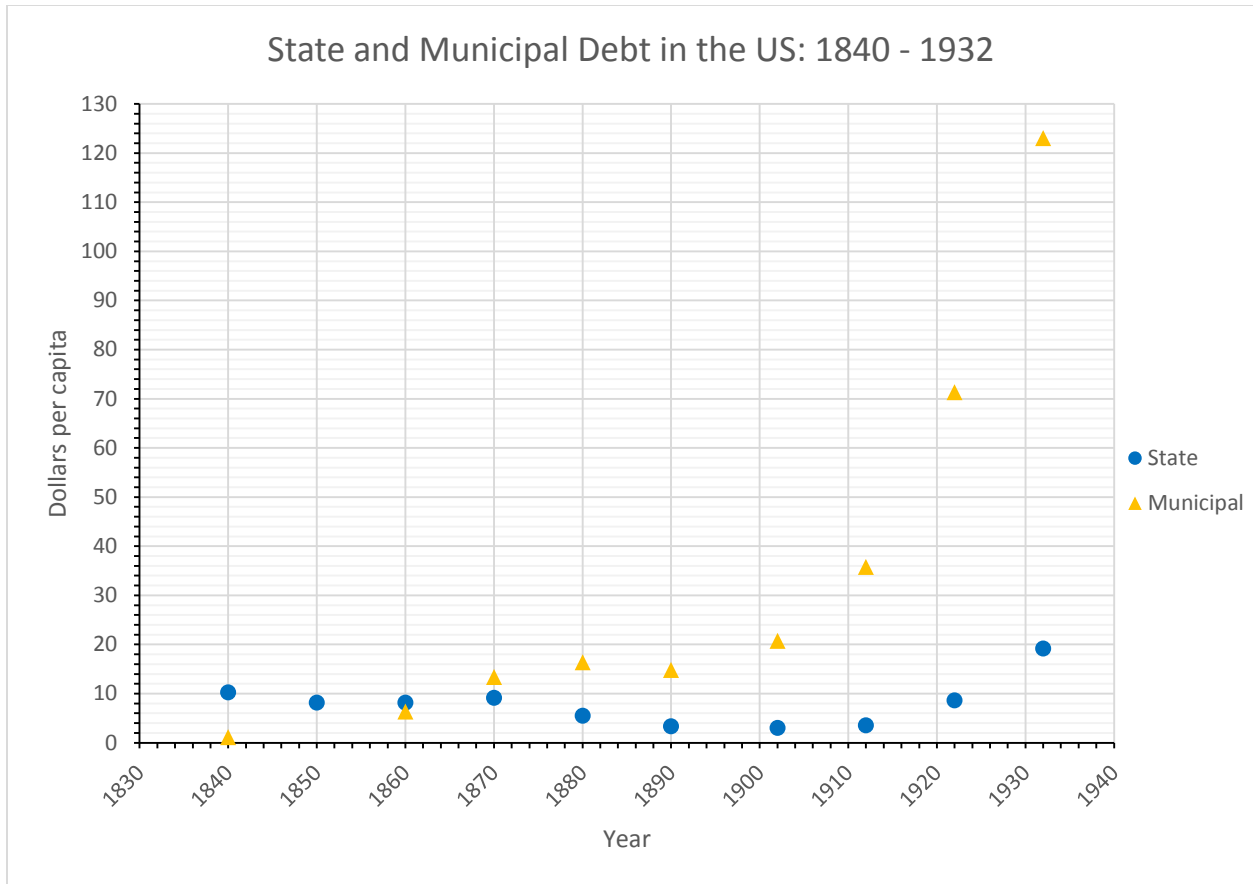
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<sup>11</sup> This would later be reaffirmed by the 14<sup>th</sup> Amendment to the US Constitution and in the US Supreme Court Case *Pembina Consolidated Silver Mining Co v. Pennsylvania* in 1888. These legislative and judicial findings are often termed “Corporate Personhood”.

blocked the US Federal government from European money markets in 1842. With the Federal government refusing to back the debts, the state became the primary regulator of sub-national capital investment (Sbragia, 1996). States quickly moved to create constitutionally binding limits on state spending towards public works (Roy, 1997). Prior to 1840, no state constitution had limits on state debt, but by 1857, 19 states had amended the constitutions to include credit restrictions, and states admitted into the Union after 1864 had language in the constitutions reflecting credit limits (Sbragia, 1996).

### **3.2.2 1841 – 1933: Deeper Into Debt**

With the Federal government offering no assistance, and states being constitutionally bound to credit limits, municipalities filled the funding gap and continued building (Sbragia, 1996). One large receiver of municipal funds were railroads. States and the Federal government had previously completed this work, but now that they weren't willing or able to, municipalities felt they had little choice in building rail in order to survive. Private companies, with financial incentives from municipalities, began building an assortment of lines, and the pace quickly picked up as cities began competing with one another for population, trade, and industry (Tarr, 1984). The relentless pace of growth resulted in municipal debt increasing from \$25 million in 1840 to \$821 million by 1880 (Sbragia, 1996). While state debt also increased, largely due to high interest payments, from \$175 million in 1840 to \$275 million in 1880, the per capita debt had been halved. Conversely, the per capita debt for municipalities grew from \$1.17 in 1840 to \$16.37 in 1880. Municipalities were increasingly left with the responsibility of infrastructure development as shown in Figure 6.



**Figure 6: State and Municipal Debt per Capita in the US from 1840 to 1932.**  
**Source 6: Data for US state and municipal Debt comes from (Hillhouse, 1936)**

Around the middle of the 19<sup>th</sup> century with increasing industrialization, cities quickly grew as more people moved from farms to cities and more immigrants arrived (Tarr, 1984). Along with these immigrants, the US continued to import technologies and new methods of urban planning, including early forms of waste management, from Europe. It was during the early 1850s that the first engineered sewer systems were constructed. Different from previous attempts where systems tended to service single streets, these new systems would service the wider public. Municipalities began to undergo a process of decentralizing as populations grew. The “walking city”, a compact and congested environment, was replaced with paved streets and

tramways. Private companies tended to own and operate these streetcars, along with steam powered elevated rail, gas distribution, and telephone or telegraph networks.

Municipalities, on the other hand, tended to own and operate services that were thought to boost commerce and capital. These included construction and operation of water and sewer systems, as well as bridges to induce trade. Additionally, cities began buying out the private operators of water and sewer service (Tarr, 1984). Cities began this municipalization of water and sewer services because private companies were reluctant to provide water for putting out fires, controlling pollution, and enlarging the networks to service the growing cities. The high capital cost for purchasing these networks and construction resulted in cities issuing bonds, as the state nor the Federal government were assisting with financing these projects, as discussed above and shown in Figure 6.

As a result of focusing on water and sewer systems, waste was simply applied to the land as cheap fertilizer, and very little of it was burned or discarded in a systematic manner (Louis, 2004). During this time, no single person in the US had as much impact on MSWM as George E. Waring, Jr., who was a firm believer in the ‘filth theory of disease’, that the presence of filth is what causes sickness. As the Street Commissioner in New York, Waring was influential in installing sewer systems and his innovative reforms spread to other cities around the country. Additionally, Waring was also influential in promoting recycling-he established the first recycling center in NY-and reuse as practices preferable to MSW incineration. When the cutting edge incineration technology that had spread across parts of Europe came to the US, Waring’s influence, as well as the disappointing operation of these facilities, was effective in suspending further adoption. The noxious fumes, low temperatures, and high costs of incineration systems proved an additional barrier. Additionally, many of these early systems were not installed with

the capacity to deliver heat to nearby homes since wood, coal, and oil were plentiful resources, and the availability of land deferred any capacity issues associated with land-filling (Walsh et al., 1997). This would continue as coal gas which, although it would be supplanted by natural gas later on, was a bountiful, domestic, and cheap fuel (M. Williams, 2011). Much of the public concern in the US was focused instead on sewage waste and so much of the city budgets for infrastructure were spent on efforts to improve drinking water and sewage removal (Louis, 2004).

At the end of the Civil War in 1865, many communities adopted the “home rule” governance model. This approach constitutionally granted municipalities the power to write and amend their own charters, effectively avoiding state interference (Sbragia, 1996). As cities filled in the gap of infrastructure financing left by states, there was little investment in MSWM and so cities continued using landfills (Louis, 2004). The adoption of “home rule” and the practice of landfilling meant that each municipality had its own landfill. Eventually, cities would form regional agreements to handle MSW but many of these were privately run and thus landfilling continued to be the cheapest option with the greatest profit (Kollikkathara, Feng, & Stern, 2009).

Financial disaster struck again with the Panic of 1873, which was in part due to defaults on municipal bonds, and in particular bonds for railway construction (Sbragia, 1996). The response by states was to place similar debt ceilings on municipalities that had been placed on the states in the previous Panic of 1837 (Elmer & Leigland, 2014). This intrusion by states into affairs of the municipality was unpopular. However, a ruling in the Iowa Supreme Court by John Forest Dillon would decide the matter often known as Dillon’s Rule (Sbragia, 1996). Dillon found “home rule” to be unconstitutional, stating that municipalities had intervened in economic affairs that were better left to private enterprises and narrowly defined municipalities as creatures



of the state. Dillon's rule would later be cited in several state Supreme Court decisions around the country, and ultimately be cited in a US Supreme Court decision, thus drastically restricting the ability of municipalities to make many decisions without consent from the state.

While Dillon's Rule and the later US Supreme Court decision would impact the ability of municipalities to make decisions, and fund projects without state consent, there were several cities that avoided these restrictions. This was done through increasing the municipal tax base through annexation and encouraging sprawl (Sbragia, 1996). However, by 1880, over half of US states had enacted debt limits on municipalities. Municipalities were forced to suspend construction and services (Tarr, 1984). Private companies increased the number of services they offered, in particular the more profitable ones such as electricity and telephones. With attention on extending services to a growing and sprawling population a large portion of MSW was still being applied to land in 1880 (Elmer & Leigland, 2014). Even with the establishment of the US National Board of Health in 1879, MSW was not seen as a health threat, and instead the filth theory of disease and the miasmatic theory of disease were the popular beliefs of the time (Louis, 2004). Eventually, cities would form regional agreements to handle MSW but many of these were privately run and thus landfilling continued to be the cheapest option with the greatest profit (Kollikkathara et al., 2009). In large cities mass production and population growth resulted in more MSW generation. Pittsburgh experienced an increase in MSW generation of 43% between 1903 and 1907 (Elmer & Leigland, 2014). Landfilling was seen as the pragmatic solution in minimizing costs and maximizing efficiency.

Meanwhile, water and sewer infrastructure became increasingly desired by many citizens. In 1890, Berlin had one bathtub for every 79 residents, however Springfield in Massachusetts had a ratio of one bathtub for every nine residents (Sbragia, 1996). Municipal ownership of

water and sewage systems increased, while the share of municipal ownership in electric stagnated. In 1880, 49% of water systems were municipally owned, increasing to 69% in 1915, and eventually 73% by 1932. Municipally owned electric utilities meanwhile had not increased, and by 1922 only represented 41%, most of which were small towns so the overall electrical generation of private systems is far more than the 59% share would imply.

Cities continued to grow and evade some state intervention to control debt. Between 1902 and 1912, \$1.7 billion was borrowed by municipalities in the US, increasing the debt per capita from \$53.08 in 1903 to \$77.78 in 1917 for the 146 largest US cities (Sbragia, 1996). This increased borrowing slowed down during the US involvement in WWI, but increased again in 1920 with renewed vigor. Much of the borrowing went toward road construction, as suburban, car-reliant suburbs formed (Tarr, 1984).

### **3.2.3 1934 to Present: Power of the Federal Government**

With previous efforts to circumvent the debt limits imposed by states, municipalities found themselves in increasingly dire financial situations. One alternative to debt restrictions which became increasingly popular in the 20<sup>th</sup> century were public authorities (Sbragia, 1996). Different from general purpose-governments, public authorities didn't have debt restrictions like municipalities had, and were able to generate their own revenue and accumulate their own debt. These authorities became particularly popular methods to circumvent debt limits during the Great Depression at the municipal and state levels, but also at the federal level with the creation of the Tennessee Valley Authority. During the post-WWI period, the concept of miasma was replaced with the germ-theory of disease (Louis, 2004). Once this transition began, sanitary engineers began to lobby quite successfully for the creation of Departments of Sanitation.

Prior to WWI, MSW incinerators were becoming increasingly popular across the US, with 180 built prior to 1910 (Very, 1936). After WWI, MSW incinerator adoption in the US continued to increase as new plants from Europe were introduced that decreased the amount of soot and ash byproduct (Walsh et al., 1997). MSW incinerator construction peaked in the 1920s with an estimated 500 plants constructed between 1911 and 1935 (Eliassen, 1949; Very, 1936). The use of incineration decreased during WWII in an effort to reuse materials, but quickly picked back up. Apartment building incinerators were quite popular during this time period as well. First introduced around 1910, there were an estimated 19,000 by 1958 (Fetherson, 1908; Sterling, 1960). These apartment building incinerators were predominantly in large dense cities with New York having an estimated 11,000 in 1960.

However, landfills were still the cheapest and most widely used MSWM practice. Additionally, municipalities began losing large numbers of citizens post-WWII to the growing trend of suburbanization (Tarr, 1984). For example, St. Louis County, which had 21 municipalities prior to WWII, had 83 by 1950. Municipalities had also started to cut back on spending, in part due to the adoption of public authorities, but also because of the reaction many citizens had to spending, as a result of high spending related to the New Deal. The New Deal also marked a shift in the federal government becoming more active. Between 1932 and 1940, municipalities would continue to spend on projects, maintaining an expenditure level totaling \$5.6 billion per year, but the New Deal spurred Federal spending to increase from \$4.3 billion to \$10.1 billion per year (Wallis, 1984). As part of the New Deal, federal authorities reacted to a revealing lesson of the Great Depression – the level of interconnectedness of the economy – by centralizing greater regulatory control over states, and in turn municipalities (Sunstein, 1987). This increased regulatory authority of the federal government first entailed national public works

projects and formation of the Federal Deposit Insurance Agency, but this exercise of power grew over the next several decades, in particular during the environmental movement.

In 1962, Rachel Carson ushered in a wave of environmental policy with her book *Silent Spring*. Following Carson's book in 1962, President Lyndon Johnson signed the first federal law regulating MSW (Louis, 2004). At this time, no state had a solid waste agency. The Solid Waste Disposal Act (SWDA) of 1965 encouraged states to form a waste agency, but even with the passing of this bill, cities were still the primary responsible party for MSWM. The SWDA also reviewed existing technologies and made recommendations that encouraged the closing of open dumps and opening of sanitary landfills (Walsh et al., 1997). In response to growing public concern on environmental pollution, these new landfills were created with a liner protecting contaminants from leaching out. Further changes occurred with the federal government passing the Air Pollution Control Act (APCA) in 1955, followed by the Clean Air Act of 1963 which was amended in 1970 while also creating the Environmental Protection Agency in the same year (Louis, 2004). Where the SWDA attempted to stir states to act, the APCA and CAA further shifted regulatory authority towards the Federal level. Since the New Deal, exercises of federal authority had been characterized as drastically limiting potential outcomes with regulations or actions that were highly rigid instead of allowing for flexibility (Sunstein, 1987). The APCA stated that air pollution was an environmental problem that should be controlled at the source, and the CAA established regulations on stationary and mobile sources. This forced the existing incinerators to install scrubbers to remove air pollutants, but many of these plants could not afford the high costs and thus shut down (Walsh et al., 1997).

The facilities that didn't shut down were soon replaced with new incineration facilities with the promise of waste-to-energy capability (Walsh et al., 1997). These new facilities met the

higher regulatory criteria and were seen as solutions to the 1973 Oil Crisis. What older incinerator plants that did remain encountered another hurdle with the passage of the Resource Conservation and Recovery Act (RCRA) of 1976 (Louis, 2004).

The passage of RCRA made it more costly for cities to manage their waste, which up to this point was largely via landfilling in open dumps. RCRA stipulated that open dumps must be closed within 5 years after passage, and so MSWM was handed over to private firms who closed the city landfills and opened regional MSW sanitary landfills (Louis, 2004).

In 1978, the dumping that had occurred, and the resultant health effects, made Love Canal, NY an environmental disaster (Walsh et al., 1997). As a result, the Comprehensive Environmental, Compensation, and Liability Act (CERCLA), more widely known as the Superfund Act, was passed in 1980. CERCLA deemed that the ash from incineration was hazardous waste and thus needed to be disposed of in monofills<sup>12</sup>. While this further increased the costs for incineration operators, new plants were being built through the 1980s largely as a result of the Public Utility Regulatory Policies Act (PURPA) of 1978 (United States Congress, 1978). This act ensured that electric utilities would have to purchase electricity generated from WtE facilities. Additionally, the Energy Tax Act of 1978, passed alongside PURPA under the National Energy Act of 1978, offered tax credits for production of renewable energy (Lazzari, 2008).

By 1980, 60 new plants with the capability of energy recovery were either online, under construction and by 1985 there were 200 such facilities (Walsh et al., 1997). At this point

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<sup>12</sup> Monofills have no legal definition, but generally refer to landfills that receive only once type of waste. Typically these wastes are regulated as hazardous, and require careful disposal.

however, the upward growth through the 1980s began to level off and only 202 of these newer plants were online, under construction or in planning. Under the Presidency of Ronald Reagan, private firms continued to take control over MSWM.

These new MSW incineration plants, although built with greater pollution controls and energy recovery, were mostly used strictly for incineration with very few offering some form of energy recovery. The continuing abundance of natural resources was enough to create little incentive for firms to explore energy recovery (M. Williams, 2011).

The focus for regulators and communities up to this point was on closing the open dumps that were scattered across the US (Walsh et al., 1997). Incinerators received little public attention and so developers encouraged by tax incentives, PURPA, and little public opposition began to build in whichever area met their criteria. While incineration facilities continued to be built, the increased regulations on MSW did draw greater attention to incinerators (Shevory, 2007). Once the open dump closures occurred, the environmental and citizenry groups that began to form in the preceding decades turned their attention from landfills to incinerators.

One of the most vocal critics of incinerators was Barry Commoner (Walsh et al., 1997). Early in his career as a researcher, Commoner highlighted the hazards associated with dioxin. When this was found to be a byproduct in some incinerators around the country, Commoner involved himself in a campaign to close incinerators. As an alternative, Commoner advocated for waste reduction and recycling. For he and other opponents, the use of incineration as a MSWM strategy could not work alongside recycling and source reduction initiatives. Additionally, further calls for closure and a growing opposition to incinerators came when in 1984, a State of California funded report on incinerator siting was leaked. The Cerrel Report (Cerrell Associates Inc., 1984), was a toolkit for incinerator developers and proponents to use in

foregoing community opposition by identifying least resistant communities. This report identified communities that had a poor, rural, conservative, and catholic populace as the least likely to oppose any installation. Seen as a 'polluter's secret plan', the newly formed Citizens Clearinghouse for Hazardous Waste, headed by a Love Canal housewife, began warning communities to oppose industry and government incinerator plans (Walsh et al., 1997).

The Cerrel Report, along with communication strategies from the Citizens Clearinghouse, created and extended the notion of industry and government working against communities (Walsh et al., 1997). The Citizens Clearinghouse, along with its supporters, warned against attempts to establish citizen advisory boards (CABs). This group along with many of the public felt that CABs were attempts by industry and government to maximize how much pollution (i.e. risk) communities would be willing to be subjected to (Steveron, 1991). The solution as the group saw it was to advocate not for a NIMBY approach but not-in-anybody's-backyard (NIABY). Groups similar to the Citizens Clearinghouse began to take root and spread. Other groups such as the Sierra Club, the Environmental Defense Fund, and the Natural Resources Defense Council, all well-established environmental groups in the US, came out against incineration and instead called for greater reuse and recycling (Reitze & Davis, 1993). Academics like Barry Commoner and Paul Connett broadened the concern over incinerator from noise and aesthetics to include public health hazards (Steveron, 1991). The uncertainty over how MSW and the ash waste from incineration should be classified, as special or hazardous, and how it should be disposed of, along with concerns over hauling waste from outside communities, in one case from across the US-Canadian border, left the public to form their own opinions. These alliances in opposition to incineration became increasingly powerful and were effective in running political campaigns against local office holders based on their support for MSW

incineration. Additionally, under RCRA, citizens were given the authority to stop developments that were seen to be a danger to the local community (Shevory, 2007). The lawsuits brought forth by citizen groups resulted in the withdrawal of nearly 250 incinerator proposals in the 1980s.

Concomitantly, tax credits to encourage MSW incineration with energy recovery were rescinded in 1990 and the development of larger, environmentally sound landfills made MSW incineration a less appealing option for managers (M. Williams, 2011). More recent legislation has helped the MSW incineration with energy recovery with the passage of the Energy Policy Act of 2005 (Elmer & Leigland, 2014). This legislation defined MSW as a renewable resource, and eligible to apply for new funding and legislations like RPS. However, only 33 states have passed RPS with no overarching Federal legislation in place despite the fact that the Energy Policy Act of 2005 defined MSW energy recovery as a renewable resource (Database of State Incentives for Renewables & Efficiency, 2013; United States Congress, 2005). The majority of the production tax credits have gone to solar and wind facilities (M. Williams, 2011).

The popular political ideology from the 1970s and 1980s was for privatization of municipal services and infrastructure as a means to mobilize capital and respond quickly to growth (Elmer & Leigland, 2014). In 1984, 83% of landfills were publically owned, this would decrease to 73% by 1997, 64% by 1998, and 64% in 2004. While as a whole, there were more publically owned MSW facilities, this only represented 33% of the total landfill capacity in 1998. Private landfills accounted for 67% of total capacity in 1998 and increasing to 83% of total capacity by 2004.

Since 1995, there have been no new MSW WtE facilities built and the US waste hierarchy established by the EPA is a reflection of the dominance of source reduction, reuse,



recycling, and composting have over incineration in the regulatory community (US Environmental Protection Agency, 2014). While situated above disposal in the EPA waste hierarchy, energy recovery, including incineration with energy recovery, is placed on the same level as landfilling.

The most recent figures established in 2012 show there were 86 MSW WtE facilities in 25 states in the US, which is a decline from the 102 that were in operation in 2000 (US Environmental Protection Agency, 2014). For comparison, in 2012 there were 1908 landfills accepting nearly 54% of MSW produced in the US annually while incineration handled only 12% of the annual MSW. The majority of states with MSW incineration facilities are in the northeast with 40 of the 86 facilities in operation. The future of MSW incineration in the US is uncertain. Even though proponents and opponents alike may have different ideas concerning MSWM, their end goals of living in a more sustainable manner appear aligned.

## **Chapter 4: Discussion**

This chapter presents a discussion of the previous chapter, and concludes with final remarks on the study, the limitations encountered, the contributions of this study to various fields, and what the future of MSWM will be in the US and the EU. The discussion focuses on key drivers and critical junctures of MSWM as presented in the previous chapter. Given the breadth of the information presented in the previous chapter, not all drivers will be discussed. Instead the focus will be placed upon the three drivers and critical junctures deemed pivotal in the fate of MSW incineration in Europe and the US. These drivers are; local control, availability of funds, and availability of resources. These drivers were chosen because their affects can be noted early on, their prevalence has been reinforced and maintained to the present day, and they offer a nuanced view of MSW incineration beyond a NIMBY prescription.

It is important to note that the discussion below, is presented in a generalized manner. The US and Europe are not homogenous entities, and the MSWM practices in one region are not necessarily applicable to a neighboring region or state. Additionally, the categories of drivers used are generalized in an attempt to construct a typology of MSWM drivers. As Wilson (D. C. Wilson, 2007) highlights, drivers of development in MSWM are varied and while environmental concerns may incite development in one instance, this may not be true for another instance.

### **4.1 Europe**

The proclamation that wider public acceptance is the reason for the higher rates of MSW incineration in Europe compared to the US, neglects important historical events and actions as presented in the previous chapter. Incineration of MSW in Europe with heat recovery has been

in practice for well over a hundred years, with the hospital in Frederiksborg, Denmark being one of the first to receive heat in this way (Kleis & Dalager, 2004). The use of incineration, including the use of incineration with heat recovery prospered and by 1930 incinerators in Paris were using MSW to provide district heating (Millward, 2011b). The most pressing driver for the development of district heating was due to environmental and economic factors of land availability and resource recovery. However, the adoption of mass-burn incineration in Nottingham, England in 1874 and then the integration of this technology with energy recovery is a result of earlier events. Path dependent behavior stretching back to at least the early 1800s encouraged communities in Europe to be less reliant on regional and national solutions to municipal issues such as MSWM (Ericsson, 2009).

#### **4.1.1 Local Control**

Local control and in some cases, municipalization of infrastructure and services resulted in a more favorable environment for the adoption of MSW incineration. The practice of local control existed prior to the development of the first mass-burn incinerator in 1874. This is best exemplified by the “General Competence Clause” in the Prussian Municipal Charter of 1808 (Wollmann, 2004). The concept of empowering local communities, and deliberate localization of benefits to spur growth were the norm (Cass et al., 2010). Many northern European municipalities have a history ownership of utilities and public services (Millward, 2011a). Since local communities, and not regional bodies, managed the waste, the economics of scale that might appeal to private businesses were not achievable and so there was little effort to privatize MSWM. This favoring of local government ownership and management predates the formation of socialist parties in Europe, and as such is indicative of path dependency (Millward, 2011a). It

is important to, again, note that private companies were operating throughout Europe, but the trend was towards public ownership and municipalization. This was the case for gas networks which flourished in Germany in the 1860s and by 1880, over 50% were municipally owned (Millward, 2004). This trend of local control would be continually reinforced through critical periods such as that following WWII.

During the reconstruction period after WWII, European countries used State and municipally owned utilities as a way to achieve the targets set out in the Marshall Plan (Millward, 2006). For example, the rebuilding of the electricity grid and telephone wires was seen as a State responsibility while MSWM was seen as a municipal responsibility. Instead of promoting a free-market environment where a plethora of private firms might begin operating with little oversight, government was seen as a more responsible party and one that could act swiftly in rebuilding.

During the rebuilding economic and political unions were forged between European nations. The Treaties of Rome formed the EEC in 1957. The formation of this supra-national organization was a critical juncture, and a test of local ownership. The directives passed by the EEC took precedence over national laws of the member countries, but local governments still retained substantial control by retaining authority over how these directives would be implemented. This meant that municipalities could retain control over waste disposal.

Subsequent legislation included elements of local control, termed self-sufficiency and subsidiarity, such as found in the 1975 Directive on Waste. Additionally, challenges to the inclusion of these writs would be challenged, and the European Court of Justice would continue to uphold the authority of local communities. During any of these critical junctures, challenges to local control could have resulted in rescinding past practice. Instead local self-government

and subsidiarity would be constitutionally guaranteed. The concept of local control was a practice well before the EU was even a concept.

#### **4.1.2 Availability of Funds**

Municipal ownership and operation of infrastructure and services requires large capital and operational expenses. While local control and public ownership was already in practice, the cost of roads, water, sewage, and waste systems would likely not be financed by local authorities if not for the increased trade between Asia and in particular the US (Ardant, 1975). European luxury goods were not widely popular in Asia, and for a time silver along with clocks, mirrors, and glassware. However, beginning in the early 1800s cotton and in particular opium were in high demand. This would eventually lead to the Opium Wars between 1839 – 1842 and 1856 – 1860, which increased the profitability of trade with China and other Asian countries. As European countries grew richer, municipalities continued to invest in local infrastructure projects. This created a cycle whereby the profits from existing municipal projects would be used to finance the implementation of additional projects.

Of particular local benefit were the proceeds from gasworks that that began in northern Europe in the 1860s (Millward, 2004). With increased capacity to invest in local projects, municipalities continued to finance these projects. The economic health of municipalities continued to increase, and as public health theory evolved from miasma to germ theory, municipalities were able to respond during this critical juncture because of the funding available to them from existing municipal enterprises. Where private companies had existed in offering disposal of MSW, municipalities in Europe began to municipalize these services as a result of the emerging germ theory of disease paradigm. Such examples include the 1857 Public Health Act

in Britain which required households to keep waste in a moveable receptacle that local authorities were responsible for emptying once a week. Moreover, government was seen as the agent through which public health should be practiced.

### **4.1.3 Availability of Resources**

The 1973 oil crisis is often noted as an example of the shock experienced when a resource or good is no longer available or the quantity is reduced. This critical juncture spurred development of renewable energy resources, but European countries had long ago been faced with the problems resource scarcity can pose.

Over the course of the 19<sup>th</sup> century several northern European countries, in particular Denmark realized that landfilling of waste could not continue forever, and in fact towards the end of the 1800s Denmark had run out of landfill space. Mass-burn incinerators had been developed in the UK in 1874, and Denmark saw these incinerators as the solution to the lack of available land. Furthermore, these incinerators were placed near buildings to route waste heat into the buildings, and this solved an additional resource problem – the lack of oil, gas, and charcoal for heating. Since Europe had been exploiting natural resources for so long, incineration proved useful. Following WWII fly ash that had previously been applied to land was re-collected and burned again because of the lack of other heating fuels. This is an example of the resource scarcity that was already a concern to many countries in Europe. The importance of resource scarcity was not disregarded during the formation of the EU.

With the beginnings of the environmental movement in the mid-20<sup>th</sup> century, more attention was paid towards responsible resource management. When the oil crisis occurred in 1973, many European countries responded with regulations to prevent waste and incentives to

promote less consumption. However, waste was already seen as a valuable resource. Under the Single European Act in 1986, environmental objectives already practiced were put into law. As with the concept of subsidiarity, environmental concepts such as ensuring prudent and rational utilization of natural resources were formalized. This in part explains why there has been an increase in the percentage of MSW incinerated in the EU since 1996, which is the earliest record found in this analysis. Additionally, the amount of waste generated per person in the EU has remained relatively constant at 1.33 kg/person/day between the periods of 1995 and 2012 (Figure 1). This is well below other developed regions, such as the US with an average of 2.04 kg/person/day over the same time period.

## **4.2 United States**

For the US incineration of MSW, including heat recovery, was quite common pre-WWI, and in fact great effort was made to reduce the amount of waste sent to landfills with, in some instances, 70% being separated (Walsh et al., 1997). It wasn't until motorized vehicles became more common that collection and disposal in far-removed landfills became a wider practice. However, incineration still remained quite popular, especially in major cities where MSW was incinerated to provide heat to apartment buildings (Louis, 2004). In 1963, 17,000 apartment buildings in New York were using MSW for heating purposes in this way, and the city of New York had 22 incinerators in operation. From this period in the early 1960s the percentage of MSW incinerated in the US would decrease from 30.74% to 11.66% in 2012 (US Environmental Protection Agency, 2014). The drivers for this change can be identified in the early formation of the US, especially in the formation of relations between various levels of government, and how the role of the city was defined. As discussed below, incineration of waste was at one point more

common in the US than today, and the reasons for the present decline extend beyond NIMBYism.

#### **4.2.1 Local Control**

Municipalities in the US experienced dramatic growth following independence from Great Britain in 1776. By 1800 Philadelphia had installed the first large water system as a result of the growing population of the city (Tarr, 1984). A majority of the population growth during this time occurred in urban areas as new immigrants landed and people from rural areas moved to urban ones (US Bureau of the Census, 1990). The role of municipalities during this period of growth was to encourage commerce and private enterprise through services such as providing water and street cleaning (Tarr, 1984). Unlike Europe, the US was an emerging entity and as such municipal resources were focused primarily on boosting economic growth. While private enterprise was encouraged, much of the infrastructure and services were provided by municipal corporations. It was believed, that there were certain services that private companies should not and would not want to be involved with. The first critical juncture for the dominance of municipal corporations occurred in 1819 with the *Dartmouth v. Woodward* decision. Up until this point governmental bodies could alter private contracts, but after this decision, the government could no longer do this thus giving private companies greater authority. With municipalities and states having diminished rights over private corporations, a drastic increase in the number of private companies operating infrastructure and services at the municipal level.

The level of local control would again reach a critical juncture with the end of the Civil War. The popularity behind the practice of “home rule” was a result of municipalities trying to exert more control over local decisions. Dillon’s Rule held the “home rule” practice to be



unconstitutional stating that municipalities were not to interfere with private companies and furthermore that municipalities were entities of the State. The ability of municipalities to exert control or authority was effectively null without State approval. While landfilling was the dominant practice of MSWM, incineration of MSW still occurred, especially post-WWI with the peak of incineration construction in the 1920s. Although the number of private companies collecting and disposing of MSW increased, municipalities pursued incineration technology, especially in larger cities. Apartment incinerations were particularly popular with more than 19,000 in use by 1958. This partly explains why MSW disposal using incineration accounted for 30% of the total MSW generated in 1960. It wasn't until the latter part of the 1950s that government began to ban the burning of garbage in homes and backyards with the passage of the Air Pollution Control Act in 1955, followed by the Clean Air Act in 1963. With the passage of the Solid Waste Act in 1965, the ability of individuals and local communities to have refuse piles for burning was further restricted. Additionally, this legislation established Federal regulation over the collection, transport, and disposal of solid waste favoring the cheaper method of landfilling. As the number of private operators collecting and disposing of MSW increased, the use of sanitary landfills was further utilized.

Municipalities were confronted with a situation where their role under Dillon's Rule to not interfere with private enterprise, prohibited further continuation of municipal MSWM if private companies wished to contract for the service. Furthermore, municipalities in the mid-20<sup>th</sup> century were facing loss of tax dollars and decision making ability with the growth in suburbanization. The increase in suburbanization further complicated the ability of municipalities to offer services such as MSWM and to make decisions where scale of operations was a considerable factor in providing such services.

#### **4.2.2 Availability of Funds**

The infrastructure required to manage MSW collection and disposal is capital intensive. Many municipalities in the US during the early 1800s were focused primarily on building and maintaining roads and water networks. Municipal corporations were the dominant form of providing this infrastructure since municipal coffers were still immature. The inability of municipalities to draw upon savings, as well as the reluctance to raise taxes on the populace, resulted in US municipal debt skyrocketing. From a public health standpoint, MSW received little attention because the theory of miasma, the prevailing paradigm at the time, held that MSW was not a health threat.

States and municipalities continued to spend heavily on roads, water, and wastewater infrastructure, but with the economic crisis of 1837, States imposed constitutionally binding credit limits on themselves. However, this also affected municipalities that had to fill the funding gap in infrastructure left by the State credit limits. The further inability of public entities to finance projects off credit led to many public corporations becoming privatized as a precautionary measure. There were municipalization efforts following the 1837 panic, but largely consisting of water networks because private entities were reluctant to provide the service for putting out fires. With a majority of municipal capital spent on water and sewage projects, landfilling of MSW was the dominant management practice especially as municipalities grew less dense with the introduction of the automobile.

The ability of municipalities to finance projects, was hampered again after the financial panic of 1873 with States imposing credit limits on municipalities. This critical juncture would result in the formation of public authorities to circumvent some of the debt restrictions placed on

municipalities, and also further privatization of infrastructure and services such as MSWM. Municipalities were unable to finance capitally intensive projects such as MSW incineration even though energy recovered during the process would hold some benefit. The cheap costs of landfilling compared to incineration were too attractive for private companies and the municipalities that still managed MSW. Although municipalities were able to finance projects and in some instances evade debt limits imposed by the State, the funding available to them was reduced. Private companies began increasing profitable services like electricity and telephones, but also MSWM by increasing the scale of the service. Formerly a municipally governed service, the collection and disposal of MSW, was regionalized to reduce costs and maximize profits. With these restrictions in mind, municipalities chose to finance roads, water, and wastewater networks. There simply was not enough funding available to finance MSW projects as well since roads and water infrastructure were deemed priorities.

Incineration of MSW would receive additional financial support following the oil crises of 1973 with the Public Utility Regulatory Policies Act (PURPA) of 1978 and the Energy Tax Act of 1978, the growth in the number of these facilities seen between 1980 and 1990 could not be sustained. Additional legislation such as the Comprehensive Environmental, Compensation, and Liability Act (CERCLA) posed additional costs, and under the Resource Conservation and Recovery Act (RCRA) citizen groups were able to stem the growth in MSW incineration. This caused the stagnation in use and eventual decrease seen from 1990 onwards in the US as plants that had come online between 1980 and 1990 were decommissioned.

### **4.2.3 Availability of Resources**

For municipalities in the US, land has not impeded growth. In fact, suburbanization is a defining characteristic of US metropolises. However, suburbanization is a phenomena that has only occurred since the rise in the automobile. Prior to this US municipalities tended to be dense settlements commonly referred to as a “walking city” similar to European cities. It wasn’t until automobiles allowed for quick commutes over long distances did people begin to move outside of urban areas. As depicted with the St. Louis County example in the previous chapter, the creation of new municipalities exploded after WWII. Even still, US municipalities have generally not needed to compete with other municipalities for space. Rather, municipalities competed over with city had the larger infrastructure portfolio. This included railroads, highways, water and sewage systems, and MSW disposal and recycling.

Land was not the only resource widely available. Wood, coal, and oil were quite common and widely used as heating fuels. In particular coal was increasingly used during the US industrial revolution. Oil was also a dominant fuel source, especially during the latter half of the 19<sup>th</sup> century. Additionally, the US also had a vast supply of natural gas which was originally used for street lamps was instead used for heating and cooking once electricity became the dominant form of street lighting.

This availability of land and resources for heating and electricity generation meant that alternatives like waste-to-energy using incineration of MSW were less economically compelling. Even at critical junctures such as the Oil Crisis in 1973, while some support was instated for renewable energy production, the generation of traditional fuel sources continued. In fact, production of these resources has increased as new technologies have been developed. Additionally, landfills have increased in capacity as a result of land still being cheap and

abundant. With an abundance of resources, disposal of MSW to landfills has been a widely used practice since the early formation of the US. Drivers and decisions at critical junctures have only reinforced this practice. Furthermore, the waste generated per person in the US has increased since the 1960s from 1.21 kg/person/day to an average of 2.04 kg/person/day between 1995 and 2012 (Figure 1). During this latter time period, the EU generated on average 1.33 kg/person/day. This is indicative of the higher consumption and “throw-away” mentality of the US.

## Chapter 5: Conclusion

The divergence in use of incineration of MSW between the US and Europe can be attributed to many historical factors. One can argue these historical factors have shaped the emergent patterns of social license. The US and Europe share some of the same *societal, environmental, economic, and political interest drivers*, but with varying outcomes, especially at critical junctures such in US economic crises, US and European court decisions, US and European shifts in public health paradigms, US and European post-war growth, and the global oil crisis of 1973. Of particular importance to this path dependency are key drivers such as local control, availability of funds, and availability of resources. This results in two areas of the world that are increasingly divergent in the use of incineration as a MSWM practice.

European municipalities retain greater authority and control over decisions, in particular with MSW, as a result of self-sufficiency and subsidiarity principles. However, even before these edicts were issued by the EU, cities and towns in Europe had a history of local control. Conversely, municipalities in the US have had their authority eroded over time, driven largely by judicial decisions. In part due to this greater local control, European municipalities have been able to finance infrastructure and services thus making them public. The ability of local governments in Europe to choose MSWM practices that cost more, but also have additional benefits, may in part explain the increase of MSW incineration, but not fully. The increase since 1996 of incineration in Europe indicates that court decisions and EU directives were critical junctures for encouraging greater rates of MSW incineration. Compared to European municipalities, US municipalities have not been able to finance projects either due to economic or political constraints. Municipalities in both the US and Europe were tasked with providing

services, but US municipalities were also left responsible for additional infrastructure and economic development. European municipalities, unlike their US counterparts, had already undergone development and those local governments had more funding available for municipal projects. US municipalities on the other hand, not only had to quickly develop themselves into large cities, but had to do so while providing services in addition to being tasked with encouraging commerce. This resulted in US states, and later municipalities, taking on excessive debt in order to encourage economic development. Lastly, the scarcity of land and heating fuels in Europe created an environment where waste was seen as a valuable commodity. Over time, this has resulted in MSW incineration as a sensible and feasible solution in the EU, whereas in the US the abundance of resources and land created little incentive to pursue such practices. Post-WWII saw a large increase in the number of municipalities in the US, and also a continued transformation of urban areas into urban sprawl. This path dependent behavior has made it increasingly difficult for cities to implement resource recovery services like WtE.

The divergence in MSWM practices between the US and EU provides an interesting window into the history of these two regions. Where the EU landfilled most of their waste in 1995 compared to the US, drivers and critical junctures have since resulted in landfilling rates falling drastically with incineration being the emerging preferential practice. Meanwhile the US landfilling rates have only fallen slightly, with composting and recycling rates seeing increases. The divergence is a result of drivers with deep histories in both regions.

This analysis does not claim to falsify the notion of NIMBYism in explaining the low adoption rate of incineration in the US compared to the EU. In fact, this analysis shows that for European municipalities, waste is regarded as a resource and furthermore that local control could assuage concerns over siting through increased participation in the decision making process.

However, what this analysis does claim is that NIMBYism does not fully explain the varying rate of MSW incineration in the US nor the EU as shown in the Chapter 1.2.1. The argument that waste is treated as a resource in Europe and not in the US is a valid one, but one that is only understood through a historical perspective. Opposition to MSW incineration in the US is not a result of the current populace coming to a decision through current factors alone, but rather it is the result of a path dependency with roots that stretch as far back as the founding of the country. In addition to recognizing the differing acceptance of incineration, it should also be noted that neither the US nor the EU are homogenous entities. These are governmental bodies made up of member states, and each region within has differing preferences in regards to MSWM practices. Southern and Eastern EU countries for example are more reluctant to adopt incineration compared to their more Northern counterparts. This is also true for the US where a majority of MSW incineration facilities are found in New England relative to the rest of the country.

The evolution of MSWM practices in the US and Europe is reflective of the historical sequences of events beginning with the rule of law. Before the inception of the EU, European municipalities had great authority over local matters and with private enterprises. US municipalities also had some authority at over local matters and private enterprises, but this was curtailed through legislation and court decisions. This point deserves further consideration, in particular the role of the court in common law traditions in the US and civil law traditions in Europe. One important feature of path dependency is the increasing difficulty in altering course once set upon. Civil law, unlike common law, is based on legal code that is frequently amended thus possibly providing an environment for greater ability to alter path dependency. However, with common law the application of precedence is used to decide cases. If precedence is the deciding factor this may create additional barriers to altering path dependencies.



This analysis provides one example of path dependency. The primary point to consider from this is that reasons for current practices may not be as simple as prescribing them as a single driver response such as NIMBY. The introduction and identification of measures to be taken need to consider the historical perspective. The implementation of EU directives may not have been successful without municipalities retaining authority over how policies would be met.

By identifying the path dependent drivers and critical junctures, decision-making can be a more informed process. This allows for the inclusion of greater flexibility and adaptability where needed, especially relevant in a changing world. In particular, these concepts can possibly explain why some places are more readily adopting climate change mitigation/adaptation policies while others are not. Great effort has been expended in reaching a global agreement on an approach to climate change mitigation. While it is a global concern, this analysis indicates because of the divergent paths taken by the US and Europe in regards to MSW incineration, agreement on climate change mitigation and adaptation strategies between the two would be unlikely. For the most part, Europe holds local control in higher regard than the US, has had greater flexibility in funding municipal projects, and has greater experience with resource scarcity. The path dependence narratives of the US and EU illustrated in this analysis with respect to MSWM can be broadly useful for understanding why certain policies or technologies are adopted in some places, and not in others, and also how technology use changes over time.

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