Legal barriers for Enhanced Landfill Mining Activities

in EU and Finnish Environmental Law

University of Eastern Finland
Law school
Master’s thesis for
Environmental and Climate
Change Law Major
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# ABSTRACT

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Legal barriers of enhanced landfill mining in EU and Finnish environmental law in the view of circular economy

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Enhanced landfill mining (ELFM) is the process of extracting waste from landfills and using it in energy production and as secondary materials. This study aims to determine the legal barriers for ELFM from EU and Finnish environmental law in the view of circular economy. ELFM is still at an experimental state in the EU, but interest around the subject is growing and in the future commercial projects could also surface. Legal studies on ELFM are limited to a few published articles. This thesis analyses how certain EU and Finnish law objectives are applicable to ELFM. In addition, Finnish national law is studied to determine what kind of permits would be needed in practice.

This paper introduces the interlinkage of ELFM and circular economy concepts from a legal perspective. The linkage has not often been clearly explained in previous research. This study shows that ELFM mostly aligns with circular economy action plan goals, but there is case dependent uncertainty if the climate impact of ELFM is positive or negative.

In both EU and Finnish law, the objective of landfill regulation is to shield the surrounding environment and human health from waste related environmental problems. The legislative intent is to keep the waste in the landfill, but most importantly in an environmentally safe way. If the environmental safety conditions of a landfill are met, then the intent of the legislator is completed and there is no good justification to open the landfill based on current landfill legislation. If the objective of environmental protection from landfill related harm is fulfilled, then ELFM will only increase the risk of environmental harm. ELFM of course aims, by its scientific definition, to mine waste as safely as possible, but the risks cannot be minimized to none. Therefore, mining safe landfills is not possible within the realms of the objectives of the landfill directive or the Finnish landfill decree.

However, if the landfill is considered unsanitary the situation is entirely different. An unsanitary landfill does not comply with the landfill directive. According to both national and EU landfill legislation actions need to be taken to assure that environmental damage is prevented. This can be achieved by remediation practices. ELFM could be combined with remediation projects of unsanitary landfills. Incorporating ELFM into remediation processes can even be considered desirable, because ELFM only makes the remediation process more effective in the view of circular economy objectives and follows the waste hierarchy more efficiently. By adding ELFM into landfill remediation, the circular economy objectives from the circular economy action plan are followed by sustaining material value, reducing volume of existing waste and increasing resource security. In addition, ELFM follows the waste hierarchy by removing waste from the lowest category of disposal up to other recovery and recycling categories. Incorporating ELFM to remediation practices is thereby supported through the circular economy objectives and the landfill directive.

In practice, ELFM paired with remediation would not need an environmental permit in Finland. As with existing landfill remediation cases, only a notice of cleaning contaminated soils to the regional environmental authority is needed. A notice would also be enough for ELFM. Existing guidelines say that during landfill remediation waste needs to be excavated and disposed with best efforts according to the waste hierarchy, which is exactly what ELFM would help to achieve.

According to these findings, existing environmental law introduces limits for ELFM but does not pose an obstacle for projects to begin. ELFM has a preliminary legal framework in existing environmental law to function within.

**Key words**

enhanced landfill mining, circular economy, landfill directive, waste hierarchy
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OFFICIAL SOURCES

Organisation for Economic Co-operation and Development,
Seoul, Korea, 28-30 November 2005

European Union Documents


Organisation for Economic Co-operation and Development,
Seoul, Korea, 28-30 November 2005,

European Commission


European Parliament


United Nations Documents

GA Res. 70/1, 21 October 2015. Transforming our world: the 2030 Agenda for Sustainable Development.


FINNISH NATIONAL LAW


Government Decree on Landfills (331/2013; amendments up to 960/2016 included), Unofficial translation, Ministry of the Environment, Finland

Government decree on waste (179/2012), Unofficial translation, Ministry of the Environment, Finland

Jätelaki (646/2011)

Valtioneuvoston asetus jätteistä (1390/1993)

Valtioneuvoston asetus kaatopaikoista (331/2013)

Valtioneuvoston asetus maaperän pilaantuneisuuden ja puhdistostarpeen arvioinnista (214/2007)

Valtioneuvoston asetus Ympäristönsuojelusta (713/2014)

Waste Act (646/2011; amendments up to 528/2014 included), Unofficial translation, Ministry of the Environment, Finland

Ympäristönsuojelulaki (527/2014)

SCIENTIFIC ARTICLES


LEGAL ARTICLES AND CONFERENCE PUBLICATIONS


UNIVERSITY PUBLICATIONS


REPORTS


VTT research: Kaatopaikkakaivos - Raaka- ja polttoaineita kaatopaikoilta. Power point presentation
Received by personal communication from Tommi Kaartinen (3.9.2017)

BOOKS

Allwood Julian, Ernst Worrell (ed.) and Markus Reuter (ed.): Handbook of Recycling, State-of-the-
art for Practitioners, Analysts, and Scientists. Chapter 30 – Squaring the Circular
Economy: The Role of Recycling within a Hierarchy of Material Management Strategies.

Calow, Peter P. (ed.): Handbook of environmental risk assessment and management. John Wiley &


Hervey, Tamara - Cryer, Robert - Sokhi - Bulley, Bal: Research Methodologies in EU and
International Law. Bloomsbury Publishing. 2011

Kingston Suzanne – Heyvaert Veerle and Čavoški Aleksandra: European Environmental Law.
Cambridge University Press. 2017

INTERNET SOURCES

Consortium for a Coherent European Landfill Management Strategy:
[https://www.interregeurope.eu/cocoon/] (10.3.2018)


EUR-Lex, Summaries of EU legislation, European Union directives: [https://eur-


European Commission, Community Research and Development Information Service, NEW-MINE


# ABBREVIATIONS

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<td>CEAP</td>
<td>Circular Economy Action Plan</td>
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<td>ELFM</td>
<td>Enhanced Landfill Mining</td>
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<td>EP</td>
<td>European Parliament</td>
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<td>EU</td>
<td>European Union</td>
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<td>LFM</td>
<td>Landfill Mining</td>
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<td>MEP</td>
<td>Member of the European Parliament</td>
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<td>MSW</td>
<td>Municipal solid waste</td>
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<td>OJ</td>
<td>Official Journal of the European Union</td>
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<td>SRM</td>
<td>Secondary raw materials</td>
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<td>SMM</td>
<td>Sustainable materials management</td>
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<td>SWM</td>
<td>Sustainable waste management</td>
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<td>TEC</td>
<td>Treaty Establishing the European Community</td>
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<td>TEU</td>
<td>Treaty of the European Union</td>
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<td>TFEU</td>
<td>Treaty on the Functioning of the European Union</td>
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<td>UN</td>
<td>United Nations</td>
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<td>WtE</td>
<td>Waste-to-Energy</td>
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<td>Waste to materials</td>
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1 INTRODUCTION

Enhanced landfill mining (ELFM) has been strongly linked to circular economy in previous research.\textsuperscript{1} The potential role of ELFM in the circular economy has even been recognized at an official EU level. The ELFM concept was adopted by the European Parliament on 14.3.2017 as amendment 34 in the Circular Economy Package proposal for a new landfill directive.\textsuperscript{2} Further on, in 18.12.2017\textsuperscript{3}, the ELFM amendment was removed from the proposed landfill directive in the provisional agreement that was reached between the European Parliament and the Council of the European Union.\textsuperscript{4} There has been strong pressure to include ELFM into EU’s circular economy related legislation, even though the interlinkage between ELFM and circular economy has not been clearly explained and the relationship between EU waste legislation and ELFM has been the subject of only two published studies.

Traditionally waste has been stored cost effectively in landfills as a final solution for waste disposal, but waste management in Europe has changed and is still changing towards a more sustainable option, where recycling and waste prevention are the cornerstones of waste management, instead of landfilling. This more sustainable waste management option is also called circular economy, which aims to keep the value of resources in the production cycle. Keeping the value of materials in the production cycle means re-using materials instead of them ending up as waste. To keep the value of materials in the production cycle, circular economy aims to: increase recycling, minimize landfilling, reduce the need for virgin materials and keep waste generation as small as possible, for example through eco design\textsuperscript{5}.

Circular Economy is being implemented into EU law with the circular economy strategy, including an action plan: 'Closing the loop'.\textsuperscript{6} The EU circular economy strategy includes changes in EU legislation, which are relevant in reaching the circular economy targets. The most relevant EU legislation has been addressed in the Circular Economy Package's Waste sub package, which consists of four legislative proposals on waste.\textsuperscript{7} The legislative proposals included the proposal on amending the Waste Directive\textsuperscript{8} and proposal on amending Landfill Directive\textsuperscript{9}, which are also the two

\textsuperscript{1} See for example: Jones – Geysen – Tielemans et al., Journal of Cleaner Production 2013, p. 45
\textsuperscript{2} European Parliament, TP8_TA(2017)0071
\textsuperscript{4} European Parliament: Provisional agreement resulting from interinstitutional negotiations, PE619.037
\textsuperscript{5} COM (2015) 614 final. pp.1-3
\textsuperscript{6} COM (2015) 614 final. pp.8-9
\textsuperscript{8} COM (2015) 595 final
\textsuperscript{9} COM (2015) 594 final
directives that this study focuses on. The waste- and landfill directives play a major role in reducing the amount of waste generated and volume of waste landfilled, which are both key goals for circular economy.

As landfiling has long been a primary method of waste disposal in Europe, there are thousands of old closed landfills. Old landfills that hold waste that has fallen out of the production cycle and circular economy's grasp. These old landfills can cause environmental pollution and health risks for the surrounding environment and humans. Old landfills can even be situated in the middle of cities that have grown around them over time due to increasing population growth in cities. There is tremendous public pressure to deal with the issues of polluted landfills especially at urbanized areas and that is why cleaning landfills through landfill remediation is a common practice in the EU.\textsuperscript{10}

Remediation of old landfills aims to reduce environmental pollution and health risks, as well as freeing the landfill space for other purposes. Remediation practices are enforced by the Landfill directive\textsuperscript{11}, which states that all landfills should have sufficient and environmentally safe structures and not harm the environment or human health.\textsuperscript{12} Nevertheless, the current academic estimate is that 90\% of closed landfills in the EU are still, 20 years after the landfill directive came into force, in breach of the landfill directive’s environmental regulations.\textsuperscript{13} These number of landfills that are in breach of the landfill directive is being reduced in the EU through landfill remediation practices.

Remediation of landfills concentrates on fighting environmental and health issues that originate from old landfills. Landfill remediation does not address the lost potential of materials that are buried within the landfill, but the concept of enhanced landfill mining (ELFM), introduces more drivers for landfill remediation. ELFM aims to work with current waste management by, not only decreasing the number of landfills and dealing with their environmental issues, but also taking advantage of the forgotten material and energy potential of landfills through material and energy recovery. Material recovery, or waste-to-material (WtM), means the extraction of landfilled materials for re-use. Energy recovery could mean energy recovery from landfilled waste in the form of waste-to-energy (WtE), for example through waste incineration.\textsuperscript{14} WtM and WtE processes promote ELFM in a way that can easily be associated with circular economy.

\textsuperscript{10} Krook – Svensson – Eklund, Waste management. 2012. pp. 513-516
\textsuperscript{12} 1999/31/EC, article 1 paragraph 1
\textsuperscript{13} Consortium for a Coherent European Landfill Management Strategy: “Estimates have revealed that 90\% of Europe’s 500,000+ landfills are “non-sanitary” landfills, which predate the EU Landfill Directive and have limited environmental protection technologies.” [https://www.interregeurope.eu/cocoon/] (10.3.2018)
\textsuperscript{14} Jones – Geysen – Tielemans et al., Journal of Cleaner Production 2013, p. 48
The potential role of ELFM in the circular economy has even been recognized at an official EU level. The ELFM concept was being integrated into new EU legislation in the Circular Economy package through the proposal for a new landfill directive. The proposal for amending the landfill directive (COM(2015) 594 final) was adopted on 14.3.2017 by the European Parliament on the first reading.\(^{15}\) The approved proposal version included a new paragraph proposing the commission to ‘examine the feasibility’ for a legislative framework for ELFM and measures to map the potential of ELFM in member states.\(^{16}\) The amendment passed the first vote in the committee but was excluded in the tribunals negotiations between the European Parliament and the Council of the European Union.\(^{17}\)

Excavating once lost materials from landfills with ELFM, and introducing them back into the production of materials cycle, as secondary materials and using the leftover energy, is said to be favorable for circular economy.\(^{18}\) This was even accepted by the European Parliament at first in the proposal for a new landfill directive. But the linkage between circular economy and ELFM is not that simple. Landfilled materials have already fallen outside the loop of circular economy. Excavating introducing them back into the cycle is filled with challenges, which are often overlooked in research. ELFM and circular economy concepts are often paired without thoroughly explaining the interlinkage between them. Because the interlinkage of ELFM and circular economy has not been explained, it can lead to neglect of possible problems when pairing the concepts, for example in EU legislation. Problems can be caused by the possible differences between the concepts. Therefore, the relationship of ELFM and circular economy should be thoroughly explained before pairing it with circular economy and especially before implementing it into the Circular Economy Package.

Additionally, there is little to no research of what legal EU norms are applicable and how they limit ELFM projects.\(^{19}\) Despite the uncertainties, there has been strong pressure to include ELFM into European Union law. This pressure has come from lobbiers from the scientific field as well as a few MEPs pushing the concept forward in the EU. Implementing ELFM in to EU legislation would most likely increase the potential of commercial ELFM projects. But because there is no comprehensive research on how EU law limits ELFM operations, how can we know if it is even necessary to implement the concept into EU legislation? The main driver has been to make ELFM easier through legislation, but could ELFM be performed within the existing norms as well? How would existing

\(^{15}\) European Parliament, TP8_TA(2017)0071
\(^{16}\) European Parliament, TP8_TA(2017)0071, Amendment 34
\(^{17}\) European Parliament: Provisional agreement resulting from interinstitutional negotiations, PE619.037
\(^{18}\) See for example: Jones – Geysen –Tielemans et al., Journal of Cleaner Production 2013, p. 45
\(^{19}\) Published research focuses on terminological differences between ELFM and EU law. See research by Römph (2015 & 2016).
legislation limit ELFM operations? More research needs to be done to conclude if existing norms are enough to provide a sufficient legal framework for ELFM operations to function within.

This study aims to shine some light in the differences and challenges of interlinking ELFM to circular economy and what current European and Finnish legal norms are applicable to ELFM. After these findings it can be better analyzed if implementing ELFM to EU law is even necessary at all. Analysis will conclude if current norms on EU and national level are sufficient to provide some preliminary legal framework for ELFM operations.

This thesis is divided into 5 chapters (Figure 1). The introduction chapter will present the concept and legal problem, followed by introduction of research questions and scope. The second chapter will provide a condensed view of the scientific background of ELFM. Explaining the scientific background is important for the reader, but most notably it is important for determining the borders and challenges when applying legislation to ELFM. The next part of the thesis is the analysis of relevant EU and Finnish national law in chapters three and four. The final chapter will then go through the results of the thesis and lastly provide some discussion about found results.

Figure 1: The outline of the thesis with the main sections of the thesis separated.
1.1 Background

The exact number of landfills in EU and in Finland are unknown. The estimates of all landfills, closed and operational ones, in the EU range between 150 000 and 500 000 landfills.\(^{20}\) In Finland the number of closed landfills has been growing, not only because active landfills have closed down, but because state officials keep locating dumpsites that have been outside known statistic records. In 1992 Finland had 1015 registered closed landfills, and by 2005 the number had grown to 1666 known closed landfills.\(^{21}\) As seen from these estimates and numbers, there is a lot of uncertainty about landfills. The reason why there is so much uncertainty is that landfills have not been monitored very well historically. Only after the landfill directive\(^{22}\) set regulations to landfills, monitoring and environmental standards for landfills became a norm in the EU. Landfills that closed before the 1999’s landfill directive have not had the same environmental regulation as landfills closed following the 1999 landfill directive. Because old landfills lacked sufficient environmental legislation, there are many environmental problems associated with them.\(^{23}\)

Although most of operational landfills in the EU are up to date on the recommendations of the landfill directive, closed landfills largely fail to meet the landfill directive’s environmental standards. Currently the academic estimate is that 90 % of closed landfills in the EU are in breach of the landfill directive’s environmental regulations.\(^{24}\) According to the estimate of the number of landfills in the EU, this means that there are 135 000-450 000 landfills that do not comply with the landfill directive. These landfills are called ‘unsanitary landfills’ or ‘dumpsites’. Non-sanitary landfills pose a threat to the surrounding environment and humans, for example through risks of groundwater- and soil pollution.\(^{25}\) This is a huge issue for the EU, which has stated in its environmental action programme that one of its three key objectives is to "safeguard the Union’s citizens from environment-related pressures and risks to health and well-being".\(^{26}\) The environmental harm that landfills cause is not only breaching the landfill directive but also against one of the main environmental policy targets that

\(^{22}\) 1999/31/EC on the landfill of waste
\(^{23}\) Uudenmaan ELY-keskus, Maria Arola, Selvitys käytöstä poistettujen kaatopaikkojen pinta- ja pohjavesitarkkailusta Uudellamaalla, 6/2011, Abstract and pp. 5-7
\(^{24}\) Consortium for a Coherent European Landfill Management Strategy: “Estimates have revealed that 90% of Europe’s 500,000+ landfills are “non-sanitary” landfills, which predate the EU Landfill Directive and have limited environmental protection technologies.” [https://www.interregeurope.eu/cocoon/] (10.3.2018)
the EU has committed to. Due to this projects that can enforce remediation of unsanitary landfills are of particular interest for the EU. This includes ELFM concept, which received a Horizon research grant for the 'EU Training Network for Resource Recovery through Enhanced Landfill Mining'.

Non-sanitary landfills with their environmental and health risk pose a threat that need to be dealt with. Old landfills go through remediation processes where the waste is dug out and either the structure of the emptied landfill is updated to meet modern standard or the waste is transported to a modern landfill. Old landfills are landscaped into parks and golf courses or other outdoor recreation areas, with the waste still within the landfill. ELFM could be included in remediation projects. Enhanced landfill mining is the process of mining waste from landfills and recovering it as secondary raw materials and energy. Instead of burying the waste and masking it into a golf course, ELFM could utilize the waste for materials and energy. If remediation projects for old landfills are obligatory, why not do the job as efficiently as possible?

1.2 Problem statement

There has been a growing interest in the field of ELFM which has been shown for example by the increase of academic publications in the last decade. The number of landfills in the EU would provide a platform for ELFM projects to last for up to 20-30 years. This would increase: resource security through secondary material retrieval, waste fuel flow for waste-to-energy (WtE) projects and provide new job opportunities within the projects.

WtE projects utilize energy from waste and because recycling is intensifying there is less and less waste to be exploited. Rapidly advancing recycling means that energy production from waste will decrease in the near future, because more waste is recycled and re-used, rather than exploited as electricity and heat in WtE-plants. Thus, there is simply less waste for WtE to exploit. In some countries, like the Nordic countries, WtE is a major source for heat and energy production. There is a conflict between increased recycling targets and current energy production methods in countries that have invested in WtE. The problem has been noted also by the EU, which published a communication about ‘The Role of Waste-To-Energy in The Circular Economy’. The communication determines that the EU is searching solutions for the conflict between waste reduction targets and

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28 For example, Mankkaa landfill turned into a golf course in Finland. [https://www.sito.fi/tyot/mankkaan-kaatopaikan-sulkemenen-espoo-2009-2014-valvonta-ja-riippumaton-laadunvalvonta/] (7.4.2018)
30 Jones – Geysen – Tielemans et al., Journal of Cleaner Production 2013, p. 54
31 COM (2017) 34. final p.6
countries that are more invested in WtE. For WtE ELFM provides extended operational time, because EU’s ambitious circular economy waste reduction policies are phasing out WtE projects. ELFM could provide WtE operations with additional waste fuel by digging up waste from landfills and using it as fuel in WtE-plants.

ELFM is a combination excavating waste, WtM- and WtE-practices. The only one of these three areas that is directly related to circular economy is WtM. How ELFM fits into the circular economy action plan’s objectives as a whole, needs to be determined before pairing it with circular economy.

ELFM is still at an experimental level and it is not commercially practiced in the EU. The problem is that in order for companies to actually start proceeding with ELFM, policies and laws should be supportive or at least clear towards the new technology. Thorough research in the field of environmental law and permits would clarify legal issues around ELFM and potentially lower the risks for upcoming projects, which is one reason why the legal aspects of ELFM should be studied.

Another important reason to study law and ELFM is that the ELFM concept was being implemented into EU legislation in the proposal for a new landfill directive. It should be important to examine how current EU law frames the operational limits for ELFM before deciding that there needs to be more specific legislation. After determining what kind of structures existing EU law provides for ELFM, then it can be also seen what kind of limits existing law poses and how to deal with them.

This thesis aims to analyze how ELFM fits into existing EU environmental law objectives, that are mentioned usually in the first articles of legislation. Specifically, this thesis will analyze how ELFM fits into the circular economy action plan objectives, since the new landfill directive is part of the Circular Economy legislative package. In addition, the objectives of the landfill directive and the waste directive are compared to ELFM. To get a full view of the picture, national Finnish law will also be analyzed to determine what the challenges are at a national level. Finnish law analysis will look at legislation on landfills and determine what kind of permits are needed. Extending the research to national legislation will not only provide more practical results for future referencing, but also determine if there are differences between EU and national law results.

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32 COM (2017) 34. final pp.7-8, 10-11
34 European Parliament, P8_TA(2017)0071, amendment 34
1.3 Research questions and methods

This thesis will answer the following research questions:

1. What circular economy related legal objectives are applicable to enhanced landfill mining?
   a. Circular Economy Action plan’s goals?
   b. Landfill directive’s objectives?
   c. Waste framework directive’s objectives?
   d. Finnish landfill decree and waste act’s objectives?

2. How does the analyzed legislation limit ELFM?
   a. Are there gaps or challenges when applying the objectives of environmental law to ELFM?
   b. What permits are needed in Finnish national legislation?

3. Is there a framework for ELFM operations within the existing EU and Finnish legislation?
   a. Is there a need for additional legislation?
   b. Are there differences between EU and Finnish law?

Researching these questions will provide an overview on how current legislation can be applied to ELFM, which is something that has not been researched a lot. This study will be mainly carried out with a doctrinal approach, by analyzing relevant EU and Finnish environmental legislation. Due to the multidisciplinary and evolving nature of the subject, this study will also overview recent scientific research articles to get a good scope of the problems and benefits associated with enhanced landfill mining. The scientific background is important because it determines the issues that need to be accounted when analyzing the relationship of ELFM to current environmental legislation. The scientific knowledge thus determines the scope of legislation that need to be accounted for in this study. The combination of scientific findings and legal research perspectives together will determine, if circular economy action plan goals can be paired with ELFM. The multidisciplinary approach will help to assess how supportive legislation is towards ELFM and how legislation limits the scope of operations.

The legal research is conducted by following the norm hierarchy from top to bottom, starting from EU law and moving to Finnish national law. The focus in the research is analyzing the objectives of selected legislation. Legal objectives guide how regulation should be interpreted and implemented.
into national legislation.\textsuperscript{35} Since legal research on ELFM is limited, it was logical to choose a top-down approach to provide a broad overview about how environmental legislation is applicable to ELFM.

Carefully chosen research questions, along with the gathered data, enable a platform for the legal research of this study. The pathway to end-results must be carefully considered. All the research phases are needed to reach comprehensive end-results.\textsuperscript{36} The first stage of this thesis concentrates on finding scientific information about ELFM in order to make legal analysis based on scientific facts. The second phase defines key legal sources and provisions of EU and Finnish environmental law that are associated with landfill mining. The third stage will look deeper into the key provisions to provide a clearer understanding of the intent of the legislator, regulatory gaps and possibility for a legal framework.

1.4 Objectives and societal relevance

This study focuses on determining if there is a legislative framework for ELFM in the existing circular economy legislation. This is done by evaluating the objectives of relevant legal norms to the ELFM process. According to ELFM amendment in the proposal for a new landfill directive, the feasibility of a legislative framework for ELFM was to be assessed by The Commission. Although the amendment was cut in the following proceedings, researching the legal framework is a topic that is both current and relevant. Researching the legal framework will also shine some light into the existing norms that would regulate ELFM.

Based on the literature review for this study, an observation was made: while ELFM and circular economy are strongly interlinked, the linkage is often not clearly explained. Analyzing this linkage is important because assuming that ELFM fits into circular economy can result in disregarding possible difficulties when pairing the two concepts.

One of the ways to study this interlinkage is to research, from a legal perspective, how does ELFM fit into circular economy context. Studying the issue from a legal perspective is valuable, because ELFM was being implemented into EU legislation.\textsuperscript{37} Differences between EU’s circular economy goals and ELFM can cause uncertainties in establishing a legal framework for ELFM within existing

\textsuperscript{36} Hervey - Cryer – Sokhi - Bulley: Research Methodologies in EU and International Law, Bloomsbury Publishing, 2011, p.8
\textsuperscript{37} P8_TA(2017)0071, amendment 34
legislation. While analyzing how ELFM pairs with circular economy, this study will also highlight the possible problems that pairing ELFM and circular economy pose.

Another aim of this study is to achieve some clarity to the way existing Finnish circular economy related environmental law can be interpreted to ELFM. To get an ELFM site running the permits and their demands should be clear, and at the moment the permits are unclear. The goal of this thesis is to interpret the current legislation in a way that will help predict what actions companies have to take when starting a commercial ELFM-project and determine whether or not there is a need for further legislation. The environmental problems with unsanitary landfills in the EU also need to be addressed and ELFM could help in landfill remediation processes. Therefore, researching the legal framework of ELFM is topical and societally important.
2 DETERMINING THE SCOPE OF LEGISLATION THROUGH SCIENTIFIC BACKGROUND ANALYSIS OF ELFM

In this chapter the scientific background of ELFM is explored and the concept is explained in more detail. The scientific facts of enhanced landfill mining determine the boarders and challenges that need to be taken into account in environmental legislation. This is why explaining the scientific background is important, even though this is a legal study.

This chapter will focus on the current state of ELFM in Europe, through an overview of recent scientific publications. The analyzed publications are of a multidisciplinary nature. The overview provides the reader with some background knowledge of the subject: challenges, societal factors, the state of research and discovered positive and negative impacts of ELFM.

2.1 Drivers behind ELFM

Landfill mining (LFM) and enhanced landfill mining (ELFM) are two different concepts. Landfill mining is a more traditional concept that first emerged in the 1950’s, but only gained popularity later in the 1990’s mostly in North America.\(^{38}\) Since then mining the landfills has been on hiatus until recent years following emergence of enhanced landfill mining. Landfill mining is defined as “a process for extracting minerals or other solid natural resources from waste materials that previously have been disposed of by burying them in the ground”.\(^{39}\) The definition of landfill mining talks only about extraction, not necessarily using the waste materials as secondary resources and freeing space from landfills. LFM projects in the 90’s were carried out mostly because landfills had to be moved or remediated due to changes in environmental legislation or pressure from city planning in urbanized areas. Thereby material recovery was usually not a driver behind landfill mining projects. In addition, opening new landfills became more difficult with the new legislation and LFM was used as an effort to free space for new waste, i.e. prolong landfills’ lifespans.\(^{40}\)

The concept of enhanced landfill mining (ELFM) surfaced in 2008 to distinguish the modern technique and objective of mining landfills from the old traditional landfill mining. Enhanced landfill mining is defined as the “the safe conditioning, excavation and integrated valorization of (historic and/or future) landfilled waste streams as both materials (Waste-to-Material, WtM) and energy (Waste-to-Energy, WtE), using innovative transformation technologies and respecting the most stringent social and ecological criteria”.\(^{41}\) The goal of enhanced landfill mining is to utilize the mined


\(^{39}\) Krook – Svensson – Eklund, Waste management 2012, p. 513

\(^{40}\) Krook – Svensson – Eklund, Waste management 2012, p. 513-516

\(^{41}\) Jones – Geysen – Tielemans et al., Journal of Cleaner Production 2013, p. 48
materials and use them for energy production and secondary materials as efficiently as possible. Efficiency means leaving behind the least amount of waste as possible and keeping emissions as low as possible during material and energy recovery. ELFM can be triggered by the same factors as LFM, for example due to pollution prevention or landfill space remediation.\textsuperscript{42} However, the objective of LFM is usually singular, such as claiming space from landfills, but ELFM has usually multiple objectives. ELFM combines targets such as: freeing valuable land space, utilizing secondary raw materials, producing energy and tackling possible environmental concerns. Thus, enhanced landfill mining differs from traditional landfill mining in the form of efficiency and minimizing impact to the environment and maximizing social benefits.

The figure below (Figure 2) explains the difference between landfill mining (LFM) and enhanced landfill mining (ELFM) through the difference in drivers. LFM includes only traditional reasons, with the occasional exception of the re-use of metals. ELFM includes both energy recovery and re-use of materials in addition with various traditional reasons.\textsuperscript{43} The modern drivers for mining landfills have surfaced next to traditional reasons for a variety of reasons. Traditionally the pressure for mining landfills has come from urbanization around a landfill, which has resulted in municipalities wanting to zone landfill areas for other purposes. Urbanization around landfills has also traditionally increased pressure to deal with the environmental issues that originate from landfills.\textsuperscript{44} The traditional issues are still present but modern drivers of energy- and material recovery have risen next to the traditional drivers of mining landfills. For example, material recovery from landfills is an idea that has approached partly because the demand has grown for many raw materials, like metals. The prices of raw materials are higher due to higher demand while the availability of some materials is descending due to their growing rarity in the bedrock. \textsuperscript{45}

\textsuperscript{42} Jones – Geysen – Tielemans et al., Journal of Cleaner Production 2013, p. 45-49
\textsuperscript{43} VTT research. List of drivers for landfill mining. 2014. pp. 6-7. Personal communication from Tommi Kaartinen. Received (03.09.2017)
\textsuperscript{44} Krook – Svensson – Eklund, Waste management 2012
\textsuperscript{45} VTT. 2014. pp. 6-7. Personal communication from Tommi Kaartinen. Received (03.09.2017)
Interest in the energy exploitation of landfilled waste has risen due to increased recycling, which has resulted in the decrease of waste-fuel for waste-to-energy operations. In addition, the ideology of circular economy, where all materials are used as efficiently as possible, sees landfilling as wasting of materials. In conclusion, the focus of mining landfills has shifted from the traditional problem based thinking to an idea where landfills are seen as a source of resources for materials and energy.

### 2.2 Research and present state of ELFM projects

The number of academic publications about landfill mining has increased in the last decade. Most of the research conducted has been about technological aspects and analysis of excavated waste. There
is also some research about economic feasibility, policy and environmental risks, but published research focusing on regulation consists only of a few published studies and conference papers.

Technological studies are important to determine, whether or not waste excavation from landfills is possible. Technological studies include not only digging, but also sorting of the dug up waste, as well as studies of WtE processes. The separation of different waste types, mainly degraded separated from metals and burnable materials, is equally important to the actual mining process. Without sufficient separation techniques, it is not reasonable to utilize the excavated waste for energy using traditional waste incineration. Untreated landfilled waste has a great deal of degraded soil-type material that notably reduces the heating value and thus makes for an inefficient fuel for waste-to-energy processes. Studies have shown that separating the burnable waste from degraded soil-type materials and metals, will increase the heating value of landfilled waste.

The composition of municipal solid waste (MSW) landfills and analysis of excavated waste has been studied the most out of all landfill mining researches. In order to determine the feasibility of landfill mining projects, the characteristics of the landfill and dug up waste must be analyzed carefully. This means that the composition of excavated waste and chemical traits are categorized in order to determine whether or not enhanced landfill mining is sensible. Research has shown that there are considerable differences in waste composition between not only landfills but within the same landfill. For example, waste composition can differ due to the depth where the sample was mined and even sample from the same depth can differ in composition if they are taken from a slightly different location. The heterogeneousness of waste is due mostly because municipal waste has not been of standard composition ever, i.e. people produce a variety of waste. Landfilled waste composition varies in different depths because older waste lies deeper in the landfill. Due to increased regulation and recycling in Finland and elsewhere, older waste contains materials that nowadays do not belong in municipal solid waste, e.g. metals and glass. In addition, it is common that there is no accurate record of what kind of waste has been buried in different regions of the landfills. For these reasons, no landfill can be straightly compared to another and there are a number of uncertainties about the waste composition even within a singular landfill. Nonetheless there are some unifying approximate figures about the composition of landfilled waste in developed countries.

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47 See reference list for by Römph (2014, 2016)
48 See reference list for Hogland (2010)
The picture (Figure 3) presents an overview of Finnish landfill composition studies. These studies indicate how difficult it is to predict the exact volume of different waste categories at different landfills. Fines, i.e. soil and under 20 mm particles, have low heating value (2 MJ/kg) and contain the most pollutants, which makes energy exploitation and especially recycling difficult. Therefore, fine fractions need to be separated from the rest of the excavated waste to increase the burning potential. Fine fraction particles make up for about 50-60 % of landfilled mass and need to be purified for end placement. The most important fraction for energy recovery is the 20-30 % of combustibles, i.e. burnable material, such as plastics and cardboard. The rest of the waste contains about 10 % inorganic materials e.g. glass and 2-4 % of metals, which are opportunities for material recovery.

The excavated waste fuel entering the plant must be of required quality. In ELFM the quality of the waste depends on the age, composition and location of the landfill, as well as adequate treatment of the excavated waste. Provided that the above mentioned factors are taken into account, it is technologically possible to use waste from landfills at modern incineration plants together with fresh municipal waste.

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31 VTT: Tommi Kaartinen (VTT) - Kai Sormunen (Ramboll Finland Oy) - Jukka Rintala (TUT). Presentation at the International Academic Symposium on Enhanced landfill mining: Landfill Mining Potential Of Closed MSW Landfills In Finland. Source: Personal communication from Tommi Kaartinen (03.09.2017)
Older landfills often lack efficient protection structures that make the surrounding environment prone to environmental pollution, such as pollution of ground waters. ELFM could be carried out side by side with old landfills’ remediation projects, that aim to reduce the environmental risk factor. The trend for dealing with problems of old landfills nowadays is that the waste is dug out and transported to another better structured landfill. Another popular option is that after the necessary base structures are made to the old landfill, the waste is returned to the same landfill.

A contaminated soils survey was recently done in Finland. A great deal of contaminated sites are old landfills and junkyards. In total, out of 23 851 contaminated cases, 3226 were landfills or junkyards. At the moment remediation projects are pursued at a reasonably slow pace, but if the remediation also included a possibility to tap into forgotten resources this would make it economically interesting for a new group of actors. Economic potential of landfill remediation projects could benefit the environment as the volume of projects increased.

The methane produced in anaerobic conditions from organic waste in the landfill exhilarates global warming if it is released uncontrolled. Methane can be collected from landfills and used as biogas, but if it is not collected the landfill slowly releases all the methane into the atmosphere. In Finland and Sweden, landfills are the second biggest source of methane emissions after agriculture. Methane emissions have significantly dropped from the values of early 1990's. The volume of methane released from landfills has been declining steadily, but still landfills contribute to about 40% of the total methane emissions in Finland.

There are also other environmental pollution and contamination risks at landfills. Modern landfills are constructed so that leakage to ground waters and soils is prevented. Gases are caught to produce bioenergy. If the landfill structure is compromised, there is a vast list of potential risks to the surrounding environment and human health. The most noticeable environmental pollution from landfills are noises, scenery, smells, overall decrease in air quality and of course visible trash. There is also contamination that is not that evident to the naked eye: soil and groundwater pollution through run-off waters. Effects can be carried further through air dispersion and the pollution also disrupts the

57 Johansson, Linköping University 2016, p.19
ecosystem with effects that can only be seen in the long-term in the surrounding environment and people's health.  

Landfills cause pollution through methane emissions, but on the other hand so does mining landfills. There can be risks of chemicals dissolving into the ground and air pollution, as well as release odor detrimental during the opening of the landfill. The formation of methane and other explosive and poisonous gases in the anoxic conditions deep inside the landfill introduce instability and safety risks to the mining process. Therefore, it would be safer to mine landfills where there is little or no methane production left, i.e. the older the landfill the less methane production. This means that landfills have to be carefully selected to avoid the release of methane that is generated within the landfill. With appropriate technology risks can be minimized, but for example odor pollution is something that cannot be fully prevented.

Comparing the pollution from landfill mining versus leaving the landfill alone, is a way to analyze the climate impact of landfill mining operations. The trade-off between emissions from secondary materials utilization and mining of virgin materials could even be negative for climate change, due to energy required to separate, purify and recycle materials from waste streams. Traditional material production pollution comes from using virgin materials. Whereas landfill mining would replace the virgin materials with secondary materials from landfills. Virgin material extraction produces pollution but ELFM also emits through methane evaporation during material excavation, transport, sorting, material recycling and energy recovery. Although there has been some controversy whether or not ELFM is a climate protection act, there are other environmental benefits from ELFM: if the waste is dug out, there is no more source for landfill based point pollution.

As for economic potential of ELFM, there are a few problems at the moment. Performing ELFM solo does not seem to be a feasible choice in the light of current evidence. In fact, current research has estimated that ELFM can most likely currently be feasible only as a collaboration operation. A collaboration in this case could mean that ELFM would be carried out with multiple operators to lower the risk included in embarking a novel technology. Another way to make ELFM profitable would be to include the state or municipality as a collaborator. The last and most beneficial scenario,

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62 Allwood Julian, Handbook of Recycling 2014, p.446
63 Laner - Cenic - Svensson et al. Environmental Science and Technology, 2016, pp. 6888-6891
would be if the state had conducted policies that would offer support towards new ELFM projects.\textsuperscript{64} Although some factors effecting economic feasibility have been assessed there is no general tool to estimate the economic costs of ELFM. This means that evaluating costs is very complex and case specific, which makes it difficult to predict the economic feasibility of individual ELFM cases.\textsuperscript{65} In comparison to traditional landfill remediation projects, ELFM projects are more expensive. This is for instance because the excavated waste is also sorted and processed instead of just buried again in a landfill. But even though ELFM is more expensive than plain landfill remediation, the long-term benefits are higher with ELFM. Benefits include, not only the economic benefits from energy production and re-use recovered materials, but also environmental and social benefits when the waste is completely removed from the old landfill site.\textsuperscript{66}

\textsuperscript{64} Fraendegard — Krook — Svensson. Waste Management. 42. 2015. pp. 137-147
\textsuperscript{65} Hermann - Baumgartner - Sarc et al. Waste Management & Research, 32. 2014. pp.48-58.
\textsuperscript{66} Hermann - Baumgartner - Sarc et al. Waste Management & Research, 32. 2014. pp.48-58.
3 Limiting factors for ELFM in EU legislation

This chapter will broaden the concept of circular economy and narrate the reader through recent developments and provisions in the EU, by focusing on defining circular economy goals and analyzing the objectives of the Landfill directive and the Waste directive to ELFM. This chapter aims to define how the goals and objectives of said legislative texts can be applied to ELFM. Determining if there is a legal framework for ELFM within existing EU legislation is analyzed and the application of ELFM to circular economy is explored. Once the primary objectives of waste management in relation to Circular Economy law are defined this study will then see if ELFM fits into that existing framework.

The legal acts that are analyzed in this study are chosen based on previous studies on the subject where legislation has been researched, either as a main subject or a side note. Most relevant legislative texts that concerned Circular Economy were included, so that it could be analyzed how ELFM fits into the circular economy context. Key legal texts besides treaties, directives and regulations include communications, action plans and staff working documents. In addition, this thesis examines the few legal studies that have been published. The relevant legal texts included in this study are: The Treaty on the Functioning of the European Union67 (TFEU), Landfill directive68, Waste framework directive69, The Circular Economy Action Plan (CEAP)70, The Role of Waste-To-Energy In The Circular Economy71 and the newly proposed landfill directive72.

This study will focus on the environmental side of circular economy legislation. This means that the economic side of legislation is not included. Regulations considering traditional mining are left out because previous research has shown that it is not applicable to ELFM. Mining is the extraction of minerals, which are defined in the mining waste directive as naturally occurring deposits in the earth’s crust.73 Waste is not a mineral and it is not mined from the earth’s crust, therefore mining regulation does not apply.

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67 OJ 7.6.2016 C 202, pp. 47-199
68 1999/31/EC
69 2008/98/EC
70 COM/2015/0614
71 COM/2017/34
72 COM/2015/0594
3.1 The legal basis of EU environmental legislation and how it relates to ELFM

The legal basis for EU environmental legislation, including waste management legislation, comes from the Treaty on the Functioning of the European Union (TFEU) articles 191, 192 and 193. The environmental objectives laid down in article 191 of the TFEU, previously art.174 of Treaty Establishing the European Community (TEC), are to be emphasized in the interpretation of the waste framework directive. The environmental objectives include preserving the environment, protecting human health and the environment, using natural resources in a sustainable way and committing to the fight against global environmental issues such as change.

Another target of the TFEU is to help EU change into a recycling society, which is explained as a society that avoids waste generation and uses waste as a resource, such as in a circular economy. In particular, the sustainable use of natural resources, is applicable to circular economy. Sustainable material use could also be applied to ELFM through the recovery of metals for secondary raw materials and combustibles for energy from old landfills. The objectives of protecting the environment and human health from waste related environmental problems could be applied to ELFM in cases where an old landfill is polluting the surrounding environment. Although, it does depend on the landfill, whether or not ELFM has a negative or a positive effect on the climate, ELFM could in some cases help in lowering emissions.

3.2 Waste hierarchy and ELFM

The waste framework directive sets down rules for the prevention of the impacts of waste; from generation of waste, to management of waste and resource efficiency. The objective of EU’s waste policy is to reduce negative effects to people and the environment, and decrease the overall use of materials by recycling and using these recycled materials in production as secondary raw materials. The use of secondary raw materials promotes EU’s self-sufficiency in materials production. In this chapter the waste framework directive is studied and analyzed in relation to ELFM.

One of the main drivers behind ELFM is the aim to re-use salvageable materials from landfills, e.g. metals. The waste directive defines ‘re-use’ as: ‘any operation by which products or components that

75 Consolidated version of the Treaty on the Functioning of the European Union. OJ C 202. 7.6.2016, pp. 132-133
76 2008/98/EC, preamble, part 9
77 Treaty on the functioning of the European Union, art. 191, par. 1
78 2008/98/EC, preamble, part 29
80 2008/98/EC, art. 1
81 COM (2011) 13 final, introduction
82 2008/98/EC, preamble, part 6-8
are not waste are used again for the same purpose for which they were conceived”. Naturally, all materials buried in the landfill are considered waste. Therefore, the waste directive poses a problem for the re-use of landfilled materials, since it defines ‘not waste’ products as the only materials suitable for re-use purposes. ‘Waste’ is defined in the waste directive as something that is “discarded or intended or is required to be discarded”.

Other important concepts are also defined in the waste directive. The most important defined concepts for ELFM being; recovery, preparing for re-use, recycling and disposal. ‘Recovery’ in legal terms means any part of an operation where waste transforms into a valuable material and fills a ‘useful purpose’. ‘Recovery’ means that waste is excavated and used as a valuable secondary material or for example efficient energy generation.

Re-use is possible only for ‘not waste’-materials, recovery of waste includes a step where the waste is re-defined as not waste. Re-defining waste is transformed into a useful material is possible through the waste directive’s end-of-waste article. Article 6 of the waste directive is called ‘End-of-waste status’. ‘End-of waste’ specifies the conditions for liberating material from its waste status, thus making it possible to legally re-use said material. Specific criteria for end-of-waste status has been developed for iron, steel, aluminum, glass and copper. Excavated and recovered waste metals from landfills could be re-used through the end-of-waste status.

Re-use is categorized as checking, cleaning or repairing operations, which enable the material to be qualified as re-usable again. Recycling in terms of the waste directive withholds reprocessing waste materials in ‘products, materials or substances’ and the reprocessing of organic material, but excludes excavation for energy recovery purposes. Any process where waste is turned into energy is considered as disposal and falls into the category of ‘other recovery’. In the eyes of EU waste legislation, ELFM is thereby considered both recovery and disposal. ELFM is considered as recovery in terms of materials that are possible to use as secondary materials, e.g. metals, but for example plastics might be too contaminated to be used as secondary materials without intensive purification, and could be economically more viable to incinerate them for energy.

83 2008/98/EC, art. 3, part 13  
84 2008/98/EC, art. 3, part 1, modified quote  
85 2008/98/EC, art. 3, part 15  
86 2008/98/EC, art. 6  
87 2008/98/EC, art. 3, part 16  
88 2008/98/EC, art. 3, part 17  
89 2008/98/EC, art. 3, part 19
3.2.1 Waste hierarchy

The waste framework directive introduces a waste hierarchy for the EU. The waste hierarchy is designed to guide waste prevention and management throughout EU policies and legislation. The priority order of waste prevention and management is presented in the figure (Figure 4), with prevention being most favorable followed by preparing for re-use, recycling, other recovery (including energy recovery) and the least favorable option being disposal. Enhanced landfill mining fits in the waste hierarchy because it removes waste from the disposal category and relocates waste into the categories of recycling and other recovery.

The above figure (Figure 4. Waste hierarchy and ELFM.) demonstrates the relation of ELFM to the waste hierarchy according to Article 4 of the Waste Directive, where prevention is most favorable and disposal is the last option for waste management. Enhanced landfill mining moves waste up in the waste hierarchy, from the least favorable category disposal to categories of other recovery (e.g. energy recovery) and recycling.

The other recovery-category includes WtE processes that are self-sufficient and can be used enough in energy production, i.e. not just burning waste as a form of disposal. Energy recovery operations must have an energy efficiency of 65% for facilities that have been permitted after 31.12.2008. In short, recovery operations usually require a combined heat and power facility to reach the standard EU values of energy efficiency. These values can be achieved with modern WtE facilities quite easily. For example, in Northern Europe, where it is especially profitable for WtE plants to produce both electricity and heat due to colder climate, the average energy efficiency is 86%, which is significantly lower.

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90 2008/98/EC, art. 4, part 1
91 2008/98/EC
92 2008/98/EC, annex 2
higher than the Annex required 65%. The energy efficiency does not change with the heating value of incoming waste, the better the heating value the more energy but the efficiency stays the same. This means that ELFM could introduce lower heating value combustibles into existing waste fuel, but it would not influence the annex required energy efficiency.

ELFM does not move waste to the category of prevention. The definition of prevention is explained in Article 3 par.12: “‘prevention’ means measures taken before a substance, material or product has become waste”. Therefore, prevention cannot be paired with enhanced landfill mining, because landfilled material is categorized as waste in the landfill directive.

Waste hierarchy helps implementing the circular economy and reducing the consumption of resources by prevention of waste formation and ensuring that resources are rather re-used and recycled than disposed of. Not all materials recovered through ELFM are possible to reclaim as secondary materials, because decades of decomposition and accumulation of chemicals into the materials make it extremely hard to salvage and purify the left over recirculates. In the case of ELFM, purification of some materials can be too expensive and too demanding technically. This could classify for an exception from the waste hierarchy to allow incineration of waste for energy instead of recycling it. The preamble of the waste directive states that sometimes departing from the waste hierarchy for specific waste streams can be justified due to “inter alia, technical feasibility, economic viability and environmental protection”- causes, all of which can be applied to scenarios of material recycling in enhanced landfill mining where WtE is paired with ELFM.

### 3.2.2 How could landfilled materials be re-used?

The process of waste turning into a resource is called end-of-waste. The end-of-waste criteria defines what waste is qualified as a secondary resource. To help the transition from waste to secondary raw materials, the commission is clarifying existing norms for end-of-waste. EU’s waste management and circular economy targets mention the decrease of raw materials as one of their goals. The Commission is willing to endorse any novel technologies that would help in utilizing the potential of secondary critical raw materials. Enhanced landfill mining could help find lost materials from landfills and increase the volume of secondary raw materials, including critical raw materials, entering the production markets.

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94 2008/98/EC, preamble, part 31
95 COM (2015) 614 final, p. 11
96 COM (2015) 614 final, p. 16
Article 6 of the Waste Framework Directive introduces the conditions for when waste ceases to be waste. The main conditions for end-of-waste status are, that waste has been through a recovery operation and that the waste complies with the end-of-waste criteria made for the specific type of waste, e.g. scrap metals. These specific criteria include limits for pollutant values to ensure that secondary materials entering into material production are safe. Specific end-of-waste criteria has been constructed for glass and scrap metals, such as iron, steel, copper and aluminum. In addition to the waste specific criteria, the end-of-waste article lists the following conditions that applicable for all end-of-waste products: the material must be commonly used and there is a demand for the material, the material must also fulfil the technical requirements for said material and not cause environmental or health effects.

End-of-waste legislation provides some limits to what materials can transform from waste to secondary raw materials. Contaminated materials cannot be re-used due to impurities and hazardousness. Even if the material isn’t contaminated, it can still contain chemicals that are considered risks to health and environment. The use of chemicals is updated to restrict the use of newly found dangerous chemicals. Despite the fact that newer products do not contain dangerous chemicals, they still exist in older products that used dangerous chemicals in the production before they were banned by renewed legislation. Thus, old landfilled waste most likely contains banned chemicals that will make re-using materials technically and economically difficult. Therefore, landfilled plastics and other mixed materials might be better utilized as energy in WtE processes. Separation of certain chemicals from landfilled waste to produce better quality secondary raw materials would use far more energy and be far more expensive. In this case, ELFM for WtE processes would utilize combustibles as energy and mainly metals would be cost-effective to separate due to lesser contamination.

3.3 Landfill directive

Council Directive 1999/31/EC on the landfill of waste entered into force on 16.7.1999 and was implemented by the member states by 16.7.2001. The landfill directive aims to minimize and prevent negative effects on human health and the environment from landfilled waste. This includes preventing local pollution to soils, groundwaters and surface waters, but also fighting against climate change. The landfill directive aims to prevent these negative effects through the whole life-cycle of the waste.

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98 2008/98/EC, art. 6
99 2008/98/EC, art. 6, part 1
100 COM (2015) 614 final, p. 12
landfill, meaning both operational- and closed landfills. In other words, the objective is to prevent environmental harm locally and globally and prevent risks to human health through better operational and technical requirements for landfills. The protection of ground and surface waters, soil, air and fight against climate change are emphasized as an objective through the word choice of “in particular”.

It is stated in the preamble part 3 of the landfill directive, that the directive is in line with waste prevention, recycling and recovery. It is also stated that re-using recovered materials and producing energy is recommended for the purposes of sparing natural resources and avoiding wasteful use of land. Closed landfills without any remediation are wasteful use of land because due to pollution risks nothing can be built on them and they cannot be used for recreation. In essence closed landfills are just closed lots of land. Remediation is needed to for closed landfills to provide some form of usage for the land area. Re-using recovered materials and producing energy from waste, rather than landfilling them, are objectives that could be achieved by introducing ELFM. Thus, ELFM paired with remediation could achieve the guidelines presented in the landfill directive's preamble.

The definition of a landfill in the landfill directive is important for this study, because it defines what a landfill is in legal terms. The definition for landfill goes as follows: “(g) "landfill" means a waste disposal site for the deposit of the waste onto or into land (i.e. underground)”\(^\text{103}\). This definition excludes the temporary storage of waste.\(^\text{104}\)

According to the landfill directive a landfill is considered a ‘disposal site’. The permanent state of waste at the landfill makes its use as a resource difficult, which has also been noted in recent policy research about landfill mining.\(^\text{105}\)

### 3.3.1 Existing legal research on the relation of ELFM and the landfill directive

One of the few legal articles published about enhanced landfill mining is Römph’s “Terminological Challenges to the Incorporation of Landfill Mining in EU Waste Law in view of the Circular Economy”\(^\text{106}\). As the title suggests Römph focuses on terminology by the legal literal interpretation method. Römph identifies the relevant terms for ELFM from the landfill directive and analyses the legal definitions of relevant words in relation how they fit to ELFM and circular economy. Römph’s study focuses on relevant wording from the waste framework directive and landfill directive, which

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\(^{102}\) 1999/31/EC, article 1 paragraph 1  
\(^{103}\) 1999/31/EC, article 3, part g  
\(^{104}\) 1999/31/EC, article 3, part g  
\(^{105}\) Römph, 2016, European Energy and Environmental Law Review  
\(^{106}\) Römph, 2016, European Energy and Environmental Law Review
are: ‘landfill’, ‘recovery’ and ‘temporary storage’. Römph analyses the terminology and their legal meaning and then compares the terminology to the scientific meaning to formulate results. The results in Römph’s study conclude that all the terms; ‘landfill’, ‘recovery’ and ‘temporary storage’, are more or less against ELFM. The term ‘landfill’ is considered as a permanent disposal site, therefore excluding the option of excavating waste. ‘Recovery’ in EU law means that the waste is serving a useful purpose and replacing other materials. Römph considers this as partly in favor and party against the purpose of ELFM, because in the future recovery could be more efficient. More efficient recovery means that a higher percentage of waste could be used as secondary materials and volume of incinerated and disposed residue from the excavated landfilled waste would be lower. Due to the previous statements leaving the waste in the landfill and waiting for better technologies would result in better efficiencies and achieving ‘recovery’ better. The term ‘temporary storage’ in law means waste that has been stored maximum 3 years. The ELFM definition would rather have the temporary storage definition also include all landfills. These findings are visualized in the table below (Table 1).

The legal terms are compared to the scientific meaning of ELFM. However, the scientific meaning for ELFM has only existed for a few years and there is still debate going on about the definition. Römph has analyzed the scientific definition, but the definition of landfill mining has also available in at least two legal texts at the time: European Parliament resolution on resource efficiency: moving towards a circular economy\(^\text{107}\) and the report on an effective raw materials strategy for Europe\(^\text{108}\). Legal definitions determine ELFM as the “retrieval of secondary raw materials that are present in existing landfills”\(^\text{109}\) and as “recovering raw materials through landfill mining”\(^\text{110}\). Even though these explanations are far less specific, legal analysis should be first and foremost based on a legal definition, rather than comparing the scientific explanation to law. At the moment, another source for a legal definition for ELFM has surfaced within the process of amending the landfill directive. The report on the proposal for a directive on the landfill of waste explains ELFM as the “recovery of valuable materials which can be brought back into the cycle, but also allows for recovering land area”\(^\text{111}\). Since there are legal explanations available, a follow up study for ELFM terminology is needed that is based on the legal definition of ELFM.

\(^{107}\) EP P8_TA(2015)0266
\(^{108}\) EP A7-0288/2011
\(^{109}\) EP P8_TA(2015)0266, par. 40
\(^{110}\) EP A7-0288/2011, par. 34
\(^{111}\) EP P8_TA(2017)0071, amendment 34, justification
Environmental law needs to be analyzed in view of a broader context, which includes considering the primary environmental targets and legal hierarchy. Rømph mentions in his text the ‘intent of the legislator’ when explaining the concept of a landfill. Rømph argues that the landfill is intended to serve a purpose of final storage and therefore it would be contradicting to perform actions where waste is excavated. The legislative intent is to keep the waste in the landfill, but this is to be done in a way that the environment is protected. Environmental protection is the driver for this piece of legislation, which is evident from the objective of ‘shielding the surrounding environment and human health from waste related environmental problems’. The landfill directive’s objective is in line with the TFEU environmental law basis. If the environmental safety conditions of a landfill are met, then the purpose of the landfill directive is fulfilled and there is not a good justification to open the landfill. However, if the landfill is considered an unsanitary landfill and it does not comply with the landfill directive, then actions need to be taken to assure that environmental damage is prevented. When the

113 1999/31/EC, article 1
114 1999/31/EC, article 1
landfill presents environmental risks then the landfill directive’s aim is to prevent environmental harm from happening. Prevent environmental harm can be done by landfilling the waste again correctly or by another solution. In the case of unsanitary landfills, the intent of the legislator changes, from the landfill directive’s ‘keeping the waste safe in a landfill’ to a broader goal from the TFEU: ‘prevention of environmental harm’. The prevention of environmental harm, can be achieved with various solutions: by re-landfilling safely or remediation of the said landfill. These results show that the terminological challenges exist but when analyzing the landfill directive’s terminology from a bigger perspective the results are different. The terminological challenges do not stop traditional remediation practices. If ELFM was combined with traditional remediation the terminological differences would not matter. If the main goal would be to minimize the environmental impact from a landfill, then ELFM would only help achieve this goal. When interpreting the impact of terminology from this kind of broader perspective there does not seem to be a terminological problem.

3.4 Circular economy

The EU has been a forerunner with sustainable development, so it is no surprise that the region is also a pioneer in incorporating circular economy. The 2015 Circular economy action plan, published by the European Commission, introduces targets for municipal and package waste recycling, as well as landfilling reductions. The targets are to be achieved by more sustainable changes to: product design, consumption, waste management and secondary raw material usage and production.\(^{115}\)

Waste management in the EU is evolving in line with sustainable development. According to sustainable development, economic growth should not be achieved on the expense of nature or human health. Development should be accomplished in such a way that future generations maintain the same possibilities as we do today.\(^{116}\) Sustainable development determines the way we use natural resources, both regenerative and non-regenerative, within the earth’s renewing capacity. Circular economy is closely linked to sustainable development.\(^{117}\) In a circular economy, it is essential that resources keep their value as long as possible and waste production is minimized. The value of materials is maintained by recycling and using recycled materials again in new products. Old products are repaired or re-used instead of thrown away.\(^{118}\) When we are using recycled materials again they are called secondary raw materials (SRM). The circular economy action plan identifies secondary raw materials as “materials that can be recycled and injected back into the economy as new raw materials.

\(^{115}\) COM (2015) 614 final, pp. 2 -3
\(^{116}\) GA (2015) Res. 70/1, pp. 2-3
\(^{117}\) WCED Rep. 42/427, Chpt. 2, IV. Conclusion
\(^{118}\) COM (2015) 614 final, p. 2
thus increasing the security of supply”\textsuperscript{119}. Using resources efficiently reduces material based environmental impacts and conserves natural resources. This way of conserving the material value is called sustainable materials management (SMM)\textsuperscript{120}.

Sustainable development goals are presented in the UN resolution Transforming our world: the 2030 Agenda for Sustainable Development. The sustainable development goals set out ambitious targets to be achieved by 2030 worldwide and to promote sustainable development in the world. The goals are of economic, social and environmental nature, for example promoting gender equality. Circular Economy will mainly promote to Goal number 12: “Ensure sustainable consumption and production patterns”.\textsuperscript{121} The sustainable consumption and production goal is also mentioned in the circular economy action plan as a guiding legal text for the action plan. Implementing the sustainable development goal number 12 in the circular economy action plan shows that the EU is taking measures in fulfilling the commitment to the UN sustainable development goals.\textsuperscript{122}

Circular economy aims to create sustainable business models that produce the least amount of waste, while re-using old materials and products as long as possible. Our society is largely based on a ‘take-make-dispose’ idea that is not sustainable. A linear model, where most resources end up as trash, is being challenged by circular economy where resources stay ‘in the loop’, thus are collected from old products and re-used again as secondary materials.\textsuperscript{123} Circular economy addresses every stage of a product’s life cycle, starting from product design and manufacturing, all the way to consumption and waste management. As a result of materials staying in the loop, municipal waste recycling will become more advanced and decrease the amount waste generation.\textsuperscript{124}

According to the commission, circular economy could also help in the fight against climate change. The argument is that utilizing secondary raw materials through recycling requires less energy than gathering virgin materials, which are often mined demanding lots of energy in the process.\textsuperscript{125} However, there is some controversy among researchers whether or not circular economy contributes to the fight against climate change. This is for instance because, purification and sorting of secondary materials also requires a lot of energy.\textsuperscript{126}

\begin{itemize}
\item \textsuperscript{119}COM (2015) 614 final, modified quote, p.11
\item \textsuperscript{120} Organisation for Economic Co-operation and Development, ENV/EPOC/WGWPR/RD (2005)5/FINAL, p.3
\item \textsuperscript{121} GA (2015) Res. 70/1, p.1-14
\item \textsuperscript{122} COM (2015) 614 final, p.3
\item \textsuperscript{123} Ellen MacArthur Foundation, 2013, p.27
\item \textsuperscript{124} COM (2015) 614 final, p. 7
\item \textsuperscript{125} COM (2015) 614 final, p. 2
\item \textsuperscript{126} Geissdoerfer et al., Journal of Cleaner Production 2017, p.765
\end{itemize}
Circular economy could help accomplish higher biodiversity through sustainable material use. When materials are used sustainably it puts less pressure on the environment, forests are not over harvested and primary ore related mining pollution is avoided.\textsuperscript{127} This means that habitats are spared and pollution decreases, which benefits biodiversity.

Circular economy concepts, such as intensified recycling and sustainable production, will also result in decreasing waste streams.\textsuperscript{128} Eco-design will make it easier to recycle products, for example, with clearer markings that will simplify categorizing products for re-use.\textsuperscript{129} Reducing waste is a cornerstone of circular economy because it means that resources enter back into the material cycle, instead of being wasted.

Transformation from a disposable product economy to a circular economy will require innovative solutions in the field of product design and manufacturing.\textsuperscript{130} According to Ellen MacArthur Foundation\textsuperscript{131} circular economy will provide new jobs and boost the economy through new innovations and resource efficiency. Repairing and reusing old appliances instead of buying new ones will generate jobs in areas where repairing old products was not an option before.\textsuperscript{132}

Waste reduction and waste hierarchy targets are to be achieved by the circular economy package, which includes, not only the circular economy action plan, but also, four new legislative proposals on waste: Landfill Directive, Waste directive, Packaging and eco-design and electronics directive.\textsuperscript{133}

The European Parliament resolution of 9 July 2015 on resource efficiency: moving towards a circular economy (2014/2208(INI)), stresses important targets to reach circular economy by 2050. The targets include: sustainable consumption of resources, waste hierarchy application, closed loop for non-renewable resources and increasing renewables.\textsuperscript{134}

This chapter on the circular economy has identified the main environmental targets found in the: circular economy action plan, resolution on resource efficiency: moving towards a circular economy and sustainable development goals. These targets are: maintaining value of materials, minimizing generation of waste, sustainability through sustainable materials and consumption, resource security

\textsuperscript{127} United Nations Development Programme, Technical Note on Biodiversity and the 2030 Agenda for Sustainable Development (2016), p.15
\textsuperscript{128} COM (2017) 34 final, p.8
\textsuperscript{129} COM (2015) 614 final, p.4
\textsuperscript{130} COM (2015) 614 final, p.2–3
\textsuperscript{131} Ellen MacArthur Foundation, 2013, pp. 9-11
\textsuperscript{132} COM (2015) 614 final, p. 7
\textsuperscript{134}EP P8_TA(2015)0266, part 16
and lower emissions. Incineration of waste is not encouraged in circular economy, but the role of WtE in a circular economy is explored more in the next chapter.

3.4.1 Role of WtE and ELFM in a circular economy

The Commission’s report on 'The role of WtE in The Circular Economy", as suggested by the title, explores the relation of WtE to circular economy. Waste-to-energy is described by The European Commission as: “..a broad term that covers much more than waste incineration. It encompasses various waste treatment processes generating energy (e.g. in the form of electricity/or heat or produce a waste-derived fuel), each of which has different environmental impacts and circular economy potential”.135 This thesis will examine the relation of ELFM with incineration because it is the most common WtE process and the most common treatment method for municipal solid waste in Finland.136 A waste incineration plant is by definition of EU law a: “..stationary or mobile technical unit and equipment dedicated to the thermal treatment of waste, with or without recovery of the combustion heat generated, through the incineration by oxidation of waste as well as other thermal treatment processes, such as pyrolysis, gasification or plasma process, if the substances resulting from the treatment are subsequently incinerated”137. In other words an incineration plant is a power plant burning of waste for energy and sometimes heat.

The Commission’s report on “The Role of Waste-To-Energy in The Circular Economy”, states that The Commission acknowledges the important role of WtE in some countries, in particular the Nordic countries, and is trying to find a solution for the controversy between circular economy and WtE. The controversy is that according to the idea of circular economy; waste should be injected in production again as secondary resources rather than disposing of it through WtE electricity and heat production.138 According to the report, in the future WtE processes that have incorporated the waste hierarchy even further are endorsed, while processes that only incinerate waste for heat or electricity are less favorable. According to this alignment, the least favorable WtE processes are the ones that produce solely either electricity or heat. Second favorable are plants that produce combined heat and electricity. The most favorable WtE processes in the view of circular economy are the ones that also combine waste-to-material

135 COM (2017) 34 final, p.2
137 Directive 2010/75/EU, Art.3 par. 40
138 COM (2015) 614 final, p.8-10
(WtM) processes with energy production. Thus, WtE companies need to think outside the box to find ways to include WtM processes into their sphere of operations.

Circular economy policies will decrease the amount of waste fuel that is available to WtE. Waste reduction is the key target of circular economy. Reduction of waste generation is to be reached by, e.g. increased recycling. Reducing waste generation means less waste and less waste to burn in WtE processes. Thus, for WtE processes to keep functioning at the same level of efficiency there is a need for new ideas to replace the future gap in declining waste streams.

ELFM could be a solution for both, implementing circular economy into WtE and replacing the approaching gap in waste streams. ELFM would open up previously closed local landfills and dig up old waste for waste fuel and recyclables. ELFM could increase the waste supply for WtE without compromising circular economy waste reduction targets, because the waste would come from outside of fresh waste streams. Historical waste would not influence the recycling targets of current day waste. At the same time ELFM could increase the application of circular economy to WtE projects by the recovery of secondary materials from landfilled waste. The application of ELFM to WtE could be a solution to include WtE into the circular economy more efficiently.

The European Parliament has also noted that ELFM could play a part in accomplishing circular economy action plans targets. This is apparent from European parliament resolution on resource efficiency, where the Parliament calls The Commission to look into an ELFM framework and the possibility to retrieve materials from landfills. Most recently, ELFM was associated in circular economy through the proposal for a landfill directive, which will be the subject of the next chapter.

### 3.5 ELFM in the EU's circular economy package

The circular economy waste package includes the amendments to four EU waste management directives: landfill directive, waste directive, packaging directive and directive on end-of-life vehicles. One amendment in the landfill directive directly mentions ELFM. ELFM is mentioned in amendment 34, that proposes a new paragraph 7a. for article 5 of the landfill directive:

“The Commission shall further examine the feasibility of proposing a regulatory framework for enhanced landfill mining so as to permit the retrieval of secondary raw materials that are present in existing landfills. By 31 December 2025 Member States shall map existing landfills and indicate their potential for enhanced landfill mining and share information.”

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139 COM (2017) 34 final, p.8
141 European Parliament, P8_TA(2017)0071, Amendment 34
The amendment is the first time ELFM is mentioned in a EU directive's preliminary text. However, at first glance the wording of the proposal seems to exclude energy recovery by talking solely about the ‘retrieval of secondary raw materials’. The legal meaning of ELFM has not been analyzed before which is why it is also important to determine the legal definition. The legal definition of ELFM needs to be analyzed to determine what aspects it includes. Determining how the legal and scientific definition of ELFM relate can also strengthen the results of this thesis. The legal definition of ELFM is further investigated in the following text.

The justification for the ELFM amendment is written in a draft report of the proposal. The justification is listed as the following: “Enhanced Landfill Mining does not only enable the recovery of valuable materials which can be brought back into the cycle, but also allows for recovering land area, taking into account that a large part of the EU's 500,000 historic landfills are situated in a (semi-) urban environment.”. The important and emphasized words in the definition are ‘recovery of valuable materials which can be brought back into the cycle’.

Although it could be argued that here the cycle actually means material cycle, it is not specified. By looking at the circular economy targets and the whole picture of ‘not wasting resources’ as whole, it would be illogical to assume that the left over waste that cannot be recycled should be disposed of instead. If the material is too polluted and choices with available technology are to either recover the energy potential or dispose of it, then with the guidance of waste hierarchy the legitimate solution is to recover the energy potential.

The definition of when incineration is considered recovery can be found from the waste directive. Waste directive article 3 part 15: “‘recovery’ means any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy. Annex II sets out a non-exhaustive list of recovery operations”. High intensity energy recovery is listed in annex 2 as a recovery operation. The ‘other recovery’-category of the waste hierarchy includes WtE processes that are efficient enough in energy production, i.e. not just burning waste as a form of disposal. Energy recovery operations must have an energy efficiency of 0.65 for facilities permitted after 31.12.2008. In short recovery operations usually require a

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142 European Parliament, A8-0031/2017, Amendment 34, justification
143 2008/98/EC, preface, par. 20
144 2008/98/EC, Art. 3, par.15
145 2008/98/EC, annex 2, R1 and specifications provided in the superscript index.
146 2008/98/EC, annex 2
combined heat and power facility to reach the standard EU values of energy efficiency. These values can be achieved with modern WtE facilities quite easily. For example, in Northern Europe, where it is profitable for WtE plants to produce both energy and heat due to colder climate, the average energy efficiency is 0.86, which is significantly higher than the Annex required 0.65.\textsuperscript{147} Therefore, even though at first glance the amendment seems to exclude energy recovery from the definition of ELFM, it does not. ELFM paired with high intensity WtE incineration fits the recovery definition. Thus, ELFM includes both material and energy recovery. This also means that ELFM has the same scope of action in both legal and scientific definitions, since they both include WtE and WtM processes.

\textbf{3.6 Analysis of EU law}

Through the circular economy action plan and waste framework directive, the EU has made it clear that WtE is a better solution than landfilling. Economically it makes more sense to utilize the energy potential than throw resources away and it also fits into the ideology of circular economy through the waste hierarchy.

Terminological challenges in the landfill directive provide uncertainties, but when analyzing the terminology in the light of the landfill directive’s objectives; terminology is not an obstacle. ELFM is most limited by the landfill directive’s objective keeping the waste safe in a landfill, without causing environmental or health related harm. When this objective is achieved in a safe landfill, ELFM would only increase the risk of causing environmental harm and danger people’s health. Therefore, according to the precautionary principle, ELFM cannot be applied to a safe landfill.

On the other hand, ELFM could be applied to already polluting landfills. Unsanitary landfills that are a risk to the surrounding environment and people’s health, need remediation to comply with the landfill directive. Implementing ELFM into the remediation would only enforce the remediation process, by following the circular economy targets and waste hierarchy.

ELFM could also better help integrate WtE processes into circular economy. Although WtE is an important player in the energy sector and a preferable alternative to landfilling, the EU also has a clear opinion that the waste-to-energy sector should not come in the way of waste reduction targets.\textsuperscript{148} The EU’s acknowledges the importance of waste-to-energy sector to in countries that have invested in WtE, e.g. the Nordic countries,\textsuperscript{149} and is aware of the problems that decreasing waste flows will lead to for WtE. Enhanced landfill mining could be a feasible way to fill in the fuel gap in the WtE

\textsuperscript{147} Grosso - Motta - Rigamonti, Waste Management, 2010, pp. 1239-1240
\textsuperscript{148} COM (2015) 614 final, p. 8-10
\textsuperscript{149} COM (2017) 34 final, p.6
field. Using landfilled waste does not influence current waste streams because landfilled waste comes from outside of the present day waste flow. Thus, enhanced landfill mining would provide WtE facilities with additional waste fuel, without compromising circular economy waste reduction targets.

Working towards a circular economy is one of the EU’s main goals at the moment. Therefore, researching the legal implementation of technologies, such as ELFM, that might help reach circular economy targets, is topical and societally important. This paper introduces the interlinkage of ELFM and circular economy concepts from a legal perspective. The linkage has not often been clearly explained in previous research. This study shows that ELFM mostly aligns with circular economy goals that are presented in different levels of EU legislation. (Figure 5) The shared objectives of circular economy and ELFM introduce a legal basis for a regulatory framework for ELFM within the circular economy. The value of materials is recovered from landfilled waste and could be used in sustainable production as secondary raw materials, at the same time providing resource security. ELFM will not compromise the target of reducing the generation of waste, because landfilled waste comes from outside the target waste flow. In addition, ELFM could offer a solution for incorporating WtE into the circular economy by introducing an alternative fuel source and combining WtM into WtE projects.
Circular economy goals according to the EU action plan and Role of WtE in circular economy

<table>
<thead>
<tr>
<th>Value of materials is maintained</th>
<th>Generation of waste minimised</th>
<th>Sustainability</th>
<th>Resource security</th>
<th>Lower emissions</th>
<th>Job creation</th>
<th>Role of WtE in circular economy</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Not wasting resources</td>
<td>• Following waste hierarchy</td>
<td>• Sustainable production and consumption</td>
<td>• Protection against scarcity of resources</td>
<td>• Fighting climate change through resource efficiency</td>
<td>• Circular economy will provide more jobs</td>
<td>• Aim to increase prevention and recycling</td>
</tr>
<tr>
<td></td>
<td>• Reduce landfilling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Find solutions to countries that have invested in WtE</td>
</tr>
</tbody>
</table>

ELFM’s contributions to circular economy targets

- Material and energy recovery from wasted resources
- Moves waste from disposal category to recycling and energy recovery
- Potential to reduce the amount of existing landfills
- Provides secondary raw materials for production from consumption waste
- Replacing the use of fossil fuels with waste fuel
- Introduces secondary materials into the economy
- Provides energy from historic waste streams
- ELFM can possibly lower emissions in some cases: decrease mining of primary ores and by replacing fossil fuels with waste fuel.
- ELFM could provide jobs for decades.
- With the platform of up to 500,000 landfills in the EU, ELFM could provide jobs for decades.
- Increases waste supply for WtE without affecting recycling targets for current waste streams.

Figure 5: How ELFM fits into the circular economy action plan.
4 LIMITING FACTORS FOR ELFM IN FINNISH NATIONAL LEGISLATION

This chapter focuses on the Finnish national legislation concerning landfills and circular economy. The goal of this chapter is to analyze if there are possible problems of implementing ELFM on a national level. Analyzing how legislation applies to ELFM at a national level will provide a specified outlook on how projects would be regulated in practice. This thesis is done for a Finnish urban energy company. The company is interested in evaluating the potential of ELFM. The main interest for the target company is the practical side of ELFM. The urban energy company is specifically interested in what permits and laws need to be accounted for during a project, and thus these aspects need to be looked at in this thesis. The practical side also deepens the understanding of the thesis by providing a comprehensive analysis of ELFM framework: from EU law objectives to national law objectives and how they relate to the practical application of permits.


4.1 Objective of Finnish environmental legislation

The highest level of Finnish environmental protection law is in the constitution of Finland. Section 20 of the constitution states that everyone has the responsibility of the environment and biodiversity. The right for a healthy environment is also included in this section. Specifically, public authorities have a responsibility to oversee that environmental protection and a safe environment is guaranteed for citizens.\(^\text{150}\) The environmental protection responsibility applies to everyone and therefore guides also other legislation and all projects that interact with the environment, such as ELFM.

\(^{150}\) Suomen perustuslaki, 731/1999, §20, (eng. The Constitution of Finland)
4.1.1 Objective of the environmental protection act

The main legislative text for environmental protection is the environmental protection act (fin. Ympäristönsuojelulaki, 527/2014). The environmental protection act guides other Finnish environmental legislation through environmental protection objectives. The main objectives of the environmental protection act, that can be directly compared to ELFM actions, are; preventing and minimizing pollution and pollution risks, ensure a safe and healthy environment, prevent environmental harm, promote sustainable development, reduce the amount of waste, prevent and reduce the harmful effects of waste.\(^\text{151}\)

In the current environmental protection act, landfills are mentioned in sections 5 (par.15) and 10. The decree on landfills is based on the provisions of the previous version of the Environmental protection act (fin. Ympäristönsuojelulaki, 86/2000) sections 11, 12 and 16, and was left in force after the new environmental protection act came into force. These sections allow additional target specific environmental decrees to be declared by the Finnish government. Environmental decrees are usually legislative texts that specify legal acts and introduce specific environmental regulations and follow-up demands, to ensure that environmental protection is achieved.\(^\text{152}\) For example, decrees can be declared for high risk areas, such as the landfill decree for landfills, that have the potential to pollute and cause great environmental harm in the surrounding environment. Because the environmental protection act guides the landfill decree, it can be reasoned that the main objective of the landfill decree is to enforce environmental protection in landfills.

This chapter aims to assess how the concept of ELFM fits into these objectives. Similarly, as with the EU legislation on landfills, objectives for prevention of environmental- and health related harm can work both, for and against, ELFM. Prevention- and environmental damage control sides with ELFM.

This means that, if the landfill presents an environmental risk, ELFM can be performed to stop waste related pollution in the area. Environmental problems are associated most commonly with older landfills that are not complying with the landfill directive. On the other hand, if the landfill is quite new and in line with the landfill directive, then it most likely does not present an environmental risk. Landfills that have been closed down recently have followed standards set by the landfill directive. Recently closed landfills have used capping and other remediation practices, that reduce risks to the environment.\(^\text{153}\) Landfills that have sufficient protective structures comply with the objective of environmental protection. Preforming ELFM operation on an environmentally safe and stable landfill

\(^{151}\) Translated from Ympäristönsuojelulaki § 1 with the help of the translation of the previous version of the act: Environmental protection act (86/2000), Unofficial translation, Ministry of the Environment, Finland

\(^{152}\) Ympäristönsuojelulaki (86/2000) § 11-12

cannot be justified as an environmental act, because the ELFM activity itself can cause an environmental risk. Thus, when assessing the comparability of ELFM and the environmental objectives of Finnish environmental legislation, ELFM can be combined only with landfills that pose a threat to the environment. For example, opening a capped landfill for waste excavation is therefore not possible.

Enhanced landfill mining also promotes the environmental act’s objectives of; sustainable use of natural resources, reducing waste generation and preventing the harmful effects of waste. ELFM uses old waste for energy production and secondary materials, which reduces the loss of resources. At the same time, using waste instead of raw materials promotes the sustainable use of resources. ELFM also reduces the harmful effects of waste when removing source of pollution, waste, from the landfill.

4.1.2 Objective of Finnish waste act
The waste act\textsuperscript{154} statute one defines that the act’s main objectives are; to reduce and prevent waste and waste management related harmful effects to the environment and human health, support the use of materials in a sustainable way, provide functioning waste management and prevent littering.\textsuperscript{155}

These objectives guide the rest of the waste management legislation with the previously mentioned environmental objectives.\textsuperscript{156} All waste management operations should be in line with waste act’s objectives as well as the objectives of the environmental protection act.

The objectives of the waste act further promote the use of ELFM in cases where the landfill needs remediation procedures to comply with the environmental provisions. Performing remediation procedures, for example ELFM, on polluting landfills acts on behalf of the waste act objectives. This is because the outcome is an environmentally safe landfill. ELFM controls the pollution from landfilled waste and reduces harmfulness of landfills, by removing waste from the environment. ELFM also promotes sustainable use of materials and ensures a more functioning waste management through recycling and energy use of landfilled materials. To conclude, ELFM operations are not contradicting the objectives of the Finnish waste act, if ELFM operations are limited to unsanitary landfills.

Additionally, the waste hierarchy is also implemented in the Finnish waste legislation in section 8 of the waste act where the most preferred waste management option is the prevention of waste

\textsuperscript{154} Jätelaki (646/2011)
\textsuperscript{155} Jätelaki, 646/2011, §1, Unofficial translation, Ministry of the Environment, Finland
\textsuperscript{156} Environmental protection act §1
generation, followed by recycling, recovery and energy recovery and finally disposal as a least favorable option.\textsuperscript{157}

The waste priority order is implemented from EU waste framework directive. The implementation in Finnish law is the same as the original version in EU legislation. ELFM moves waste from the disposal category to other recovery and re-use, which complies with the waste priority order. Both the EU and the Finnish priority order can be interpreted in favor ELFM technology, because ELFM moves waste from landfills, a disposal category, to recycling and other recovery.

In conclusion the most relevant waste act objectives for ELFM, preventing environmental harm and littering as well as following the waste hierarchy, are all objectives that can work in favor with ELFM operations.

4.1.3 Objective of the Finnish landfill decree

The objective of the landfill decree is the final piece of Finnish legislation that is important to analyze for this study. The environmental protection act, waste act and the landfill decree together provide a comprehensive view of the objectiveness of landfills; from broad to landfill specific legislation.

The landfill decree lists its objectives in section one of the decree as: prevention of pollution to groundwaters, surface waters, soil and air. Controlling pollution in landfills also contributes to the other landfill decree objectives of: fighting climate change and preventing environmental impacts through the whole lifecycle of the landfill – from planning to closing. These objectives together contribute to the last objective: preventing, both short- and long-term environmental and health related harm.\textsuperscript{158}

The Finnish landfill decree's objectives are taken from the EU landfill directive. The EU landfill directive also lists the prevention and reduction of environmental pollution, especially to groundwater soil and air from landfills as primary objectives of the act.

In the Finnish landfill decree the long-term effects are especially highlighted. The highlighting can be seen in the chosen wording. It is emphasized that wastes should be stored in landfills in a way that they "will not" be a danger to humans or the environment. In addition, the decree even further emphasizes that endangerment cannot happen "even over a long period of time". Due to this emphasis, that is present only in Finnish landfill decree and lacks from the EU landfill directive, it can be argued that the long-term dangers are more emphasized in objectives of Finnish landfill

\textsuperscript{157} Jätelaki, 646/2011, §8 par.1, Unofficial translation, Ministry of the Environment, Finland

\textsuperscript{158} Kaatopaikka-asetus (331/2013), § 1, Unofficial translation, Ministry of the Environment, Finland
decree than the EU directive on landfills. It is not uncommon to have the member states enforce stronger regulations than the EU directives obligate.\textsuperscript{159}

Because the environmental obligations for the aftercare of landfills are more emphasized in the objectives of Finnish landfill decree, there is pressure from a legal perspective for the public sector to clean-up old unsanitary landfills, as the clause of prevention of environmental harm throughout the life cycle of the landfill demands. The objectives of the Finnish landfill decree are not contradicting with ELFM projects, if the projects are done to guarantee environmental safety at landfills.

The only limit to ELFM projects within all the above objectives of Finnish legislation is once again, that ELFM cannot be performed on an environmentally safe landfill, due to the potential environmental risks involved when opening up the landfill.

4.1.3.1 Definition of a landfill in Finnish law

Since the definition of a landfill has been identified as a terminological problem in previous research\textsuperscript{160} and was also addressed in the EU law section of this study, the issue is also relevant to go through in the Finnish law section of this study. This chapter will go through the Finnish legislation which focuses on defining the concept of a landfill. After explaining the definition of a landfill in Finnish law, this chapter will discuss the similarities and differences of the landfill concept in relation to EU law. The differences of EU and Finnish landfill-terminology will be highlighted with the help of Römph's study, where the terminological challenges of the landfill concept are identified.

The Finnish environmental act defines the term of a landfill. The term is defined in the environmental protection act because landfills are required to have an environmental permit. It is required to specify which operations are designated as landfills, so that the practitioners know they require a permit. The landfill is defined in section 5 part 15 in the environmental protection act as: "a final disposal site for waste, where waste is stored either on top of the ground or into the ground."\textsuperscript{161}

Another legal definition for a landfill in Finnish legislation is provided in the Decree of Landfills. The definition is provided in section 3 part 1 of the decree, and it defines a landfill as: a disposal site that stores waste above- or underground. This is the main definition but additional definitions of a landfill include: a waste storage for a production facility, waste storage in bedrock and a site where

\textsuperscript{159} Suzanne Kingston: European Environmental Law, Cambridge University Press, 2017, pp. 9-12
\textsuperscript{160} Römph: European Energy and Environmental Law Review. 2016
\textsuperscript{161} Translated from Ympäristönsuojelulaki §15 par. 15
waste is temporarily stored. The definition further indicates what is not considered a landfill: a site where waste awaits transport for further waste treatment a maximum amount of 3 years or less than a year waiting for final disposal.\textsuperscript{162}

The definition of a landfill, in the Finnish decree on landfills, is taken almost word to word from the EU's Landfill directive.\textsuperscript{163} The part which is unique to Finnish definition of a landfill, is part b of the Finnish landfill decree: "a mine or another site located deep within the bedrock where waste is deposited (underground disposal site)". This part is not included in the EU definition at all. ELFM at the moment is not aiming to extract resources from the bedrock, so it can be excluded from the analysis. Apart from part b, considering waste deposited in bedrock, it is quite straightforward to analyze the legal terminology of a landfill to ELFM, because it almost identical to the EU definition. Even if the context is now the Finnish legislation, it can be reasoned that the Finnish legislation is supposed to follow the European Union law.\textsuperscript{164} Therefore, the same terminological difficulties that were present in EU law are also present in Finnish national law.

In the previous section of this thesis (3.3.1 Existing legal research on the relation of ELFM and the landfill directive), Römph analyzes the terminological challenges of incorporating ELFM with the legal term "landfill". In the European legislation, a landfill is defined in law as a "final disposal site". This would suggest that digging out the waste would be against the purpose of the landfill, if we concentrate on analyzing the wording of the norm. The terminological issue is similarly present in Finnish definition of a landfill. The landfill is considered a "final disposal site" also in the Finnish environmental protection act. It would be against this definition to excavate waste away from its "final" placement.

It is not surprising that the result of terminological interpretation is so similar in EU and Finnish law, because member states must implement EU directives into their national law. This obligation of implementation is stated in the Treaty on the Functioning of the European Union.\textsuperscript{165}

Although terminological interpretation poses some challenges, the interpretation of objectives is in favor of ELFM. The objectives can be seen as the main guiding instruments of the legislation. If we use these objectives to interpret terminology, it can be reasoned that certain wording cannot prevent achieving the overall objective. According to Finnish environmental legislation it is essential

\begin{flushleft}
\textsuperscript{162} Kaatopaikka-asetus §3 par. 1, eng. Government Decree on Landfills, Unofficial translation, Ministry of the Environment, Finland
\textsuperscript{163} Landfill directive (31/1999), Art.2 par.(g)
\textsuperscript{164} Suzanne Kingston: European Environmental Law, Cambridge University Press, 2017, pp. 9-12
\textsuperscript{165} TFEU, 2012/C 326/01, art. 288
\end{flushleft}
minimize harmful effects of waste, thus we should perform remediation practices on contaminated sites, such as landfills. In a remediation situation, the waste is traditionally moved or reburied. Adding ELFM in the process does not change the outcome, which is a cleaned landfill site. For these purposes it can be reasoned that the terminological interpretation of a landfill does not pose a challenge for ELFM if it is performed within the previously mentioned environmental objectives.

4.2 Application of Finnish law in practice

The practical application of Finnish law to ELFM is studied in this chapter. The practicality is addressed to determine what specific environmental legislation needs to be taken into account in a Finnish ELFM project. The previously analyzed objectives of EU and Finnish environmental law have provided a preliminary framework. This preliminary framework determines where ELFM projects can operate. The preliminary framework has defined the list of specific legislation that needs to be analysed to address the applicability of Finnish environmental law. As previously stated the economic issues are outside the scope of this study.

4.2.1 Ownership of landfilled waste

Determining who owns the landfilled waste legally is slightly complicated, because nobody has really been interested in landfilled waste as a resource in Finland before. Landfill gas has been collected but the waste itself has been left inside the landfill. The ownership of landfilled waste is an important aspect for stakeholders that are interested in ELFM. If there is no access to landfilled waste, then ELFM projects are left at a standoff. Finnish waste legislation does not have a word for waste owner (fin. omistaja), but the word waste holder (fin. haltija) is used instead. The waste holder can also be interpreted as the owner, but there is some distinction in the words in the Finnish language. Legally the waste holder is responsible of the waste and must see that it is processed according to waste management legislation and waste hierarchy principles.

Finnish municipalities are obligated to assign a waste management authority for their area. The waste management authority must see that waste management is carried out within the municipality. The waste management authority arranges municipal waste management for the community through either the municipality or a company that is a federation of municipalities (fin. kuntayhtymä).

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167 Jätelaki, 646/2011, §6, par. 5
168 Jätelaki, §8, par.1
169 Jätelaki §23
170 Jätelaki §26
federation of municipalities is a company that is owned by joint ownership of neighboring municipalities, such as Helsinki Region Environmental Services Authority\(^\text{171}\) (HSY), in the capital region of Finland. HSY is owned by the municipalities of Helsinki, Espoo, Vantaa, Kauniainen and Kirkkonummi. HSY cares for the waste management of these municipalities. When waste management is transferred to a federation of municipalities, the federation is granted operational authority in waste management. This means that the federation is granted public service duties regarding waste management. The federations operational authorities include: waste reception, transport and processing, as well as related administrative duties and collecting waste management charges. Since the municipalities own the federation company, the municipalities keep the highest authority and supervise that waste management is achieved in the federation.\(^\text{172}\)

The ownership of the waste is explained through the definition of ‘waste holder’ (fin. haltija) in article 5 of the Waste act. Waste holder is defined as the producer of the waste, holder of the real estate where the waste is or other body who is in possession of the waste. The holder of the waste is responsible that the waste is processed correctly and must oversee that the waste does not cause harm to the environment or people’s health.\(^\text{173}\) When the holder of the waste turns the waste over to the regional waste management body, the waste exchanges ownership. After the waste is turned over from the consumer to the regional waste management body, the waste management body (municipality or company) becomes the waste holder. But since municipalities own the waste federation companies the highest authority and final owner of waste is the municipality. According to the waste act the municipalities have signed off only the operational authority to the waste federation company.\(^\text{174}\)

Because waste management is controlled by the municipality or federation of municipalities, Finnish landfills are usually owned by these same bodies. As the holder of the waste is defined as the holder of the real estate where the waste is located, the owner of the landfill is the holder of landfilled waste. Even if the landfill is owned by the federation, the federation is owned by municipalities and the highest authority in regional municipal waste management is the municipality. Therefore, municipalities are the owners because they have final authority over the federation of municipalities.

Accessing landfilled waste is not only a matter of ownership. If the landfill is owned by the federation, they have operational authority on the waste. ELFM is the digging of waste from landfills, for

\(^{172}\) Jätelaki §43
\(^{173}\) Jätelaki §5
\(^{174}\) Jätelaki §43
recyclables and fuel, which can be considered a waste management operation. This means that accessing the waste for ELFM is considered an action that most likely falls under the federations operational duties, which include waste management. The ownership of landfilled waste is ultimately with the municipality but the federation decides how to carry out waste management operations. The municipality is overseeing that the waste management is carried out in the correct manner. If the federation sees that ELFM is not worth pursuing in terms of waste management, then that most likely puts an end to pursuing an ELFM project. Only if the municipality disagrees with the federation and sees that ELFM would greatly benefit waste management then the municipality could possibly influence the decision to counter towards ELFM. However, the federation is an expert on waste management so the municipality will most likely back-up the federation’s opinion.

Municipal waste management is guided by waste management policies. Waste management policies have a big role in enforcing ELFM projects. If waste policies acknowledge ELFM or even support the technology, then municipal waste management will more probably allow the excavation of landfilled waste for ELFM. Ownership of waste itself is not the problem: municipalities are in charge of the waste and could technically allow ELFM projects to excavate waste. Waste policies would merely encourage municipalities for this kind of behavior. Thus, national waste management policies play an encouraging role and increase the probability of ELFM projects starting.

4.2.2 Aftercare of a landfill

The aftercare of a landfill is regulated many different waste legislations. This is because applied legislation on landfills is dependent on the year the landfill was active. This means that if the landfill has closed before the current legislation on landfills came into force, then the previous legislation on landfills is the one that is applied for the case. This application of old legislation on old cases is based on the principle of legality and it’s ban of retrospective legislation principle, where old cases cannot be judged by new legislation that came into force afterwards.\(^\text{175}\)

The basis for applying older legislation to older landfills is included in the legislative acts. For example, landfills that have closed before 1994 are to comply with the older waste act (Jätelaki, 1072/1993). The basis for this is in the currently in force waste act (Jätelaki 646/2011) in section 149 where it states that application is limited to “landfills and other waste treatment facilities whose operations have been terminated before 1 January 1994, and to littering that has taken place before 1

January 1994.” And relatively the 1993 waste act’s 77.2 § then transfers all landfill related pollution to interpreted by the previous waste management act of 1978. In conclusion the § 77 of the current waste act (Jätelaki 646/2011) transfers the responsibility to clean-up old contaminated sites all the way to the 1978 waste act.

The difference with the 1993 waste legislation is that there is a provision in the section 77.2 which clarifies that even though previous legislation should be applied the contaminated soil can be ordered to be cleaned up by the Finnish Centre for Economic Development, Transport and the Environment (ELY). Which means that even if there is can be no conviction of an environmental crime based on old legislation, the polluted soil still needs to be cleaned-up.

According to resent cases of the Finnish supreme administrative court, the most important provisions of the 1978 waste management act in terms of responsibility for a clean-up are sections 8, 17, 32 and 33. Section 8 determines that the overall responsibility and supervising role of waste management is assigned to the municipality or the waste management committee of the municipality. According to § 17, the municipality must supervise and make sure that the waste management sites, for example landfills, are correctly taken care of. Sections 32 and 33 prohibit littering and determine that the person who litters is liable. Section 33 also determines that if the liable person cannot be found or held liable, then the clean-up for littering fall upon the municipality. This means that the final responsibility for landfills is within the municipality.

The most important provisions of the 1979 waste management decree (307/1979) in terms of responsibility for a clean-up are sections 7, 8 and 23. Section 8 states that after waste dumping to the landfill has ceased, the surrounding area must be covered, tidied and seen that it is esthetically fitting to the surrounding environment. An additional provision to § 7 was included in 1981 (118/1981), which specifies that the landfill must be designed, set up and cared for in a way that ensures the safety of the environment and people. It is prohibited by 7 § of the decree that, the landfill or incoming traffic, would cause considerable harm to the environment, damage surface- or ground waters, loss to the landscape, littering or any other kind of environmental harm. Section 23 of the 1979 waste decree determines that the landfill owner is responsible for the maintenance of the landfill. In addition, the waste management decree 23 § states that provisions from 8 § are used also to landfills which were active before the 1979 legislation. Section 23 orders that all landfills that closed before the

176 Jätelaki § 149, eng Waste Act, Unofficial translation, Ministry of the Environment, Finland
177 Jätehuoltolaki, 673/1978
178 Jätehuoltolaki / KHO:2013:187
179 KHO:2013:187
decree came into force must follow the environmental safety standards of section 8 within two years after the decree came into force. This means that the waste management decree is considered retroactive legislation, in other words applicable to cases before its time. Retroactive legislation is not common in Finnish law/ not generally allowed due to principal of banning retro activeness. These sections determine, that even though the landfills have stopped their operations before any waste specific legislation came into force, there is still a responsibility to see that closed landfills do not present a harm to the environment.

The application of the old legislation to current cases is further explained in the following section 4.3 with two cases of landfill cleanups from the years 2013 and 2016.

4.2.3 Soil Contamination and Remediation

The assessment for soil pollution of old landfills can be carried out with the help of current legislation. The Government Decree on the Assessment of Soil Contamination and Remediation Needs (PIMA, 214/2007) determines limit values for contaminants in the soil. The decree is used to evaluate whether or not there is a need for remediation to the soil. The Soil Contamination decree's legal basis is in the environmental protection act (86/2000) § 14, which states that the government can pass regulations on: the maximum content of harmful substances in soil, assessment on contamination levels and remediation needs, as well as monitoring and supervision of contaminated soils.

This legal basis for enacting laws to prevent soil contamination is based on the prohibition of soil contamination from the environmental protection act. The environmental protection act also includes a section on the prohibition of groundwater pollution. This is related to soil contamination, because soil contamination can naturally lead to groundwater pollution in groundwater areas.

The environmental protection act obligates landfill operators to be aware of the volume of pollution to the soil and evaluate the current state of the soils. The soil contamination decree guides landfill operators to perform soil examinations, if there is a risk for the activity to cause pollution to the soil. The decree therefore enforces the principle of preventing pollution, minimizes harmful impacts of waste and enforces landfill operator responsibility.

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181 KHO:2013:187 / Jätehuoltoasetus
182 Environmental Protection Act (86/2000), Section 14 (588/2011), Unofficial translation, Ministry of the Environment, Finland, amendments up to 728/2011 included
183 Environmental Protection Act (527/2014), Section 16
184 Environmental Protection Act (527/2014), Section 135
185 Environmental Protection Act (527/2014), Section 15
The decree itself states that it "lays down the provisions for the assessment of soil contamination and remediation needs" but excludes assessments or remediation of underwater soils. In the appendix of the soil contamination decree, the guideline limits for harmful substances are presented to help assess the level of contamination and remediation needs. More contamination will lead to a more urgent remediation need.

The environmental protection act and the soil contamination decree together, obligate landfill operators to be aware of remediation needs. If there is a chance that soils might be contaminated, operators are obligated to report the risk of contamination. The need to be aware of possible risks and contamination means that all closed landfills need to be monitored. The obligation to be aware of the contamination status of old landfills in Finland has resulted in hundreds of contaminated landfill sites being reported. In the view of ELFM, the list of contaminated landfill sites provides not only information where potential landfill sites are, but also of how urgently sites need to be remediated: i.e. the remediation priority order.

The soil contamination decree is therefore a useful tool for ELFM, because it provides information about potential ELFM sites. The environmental protection act requires reporting contaminated sites to the authorities, which must then be remediated according to Finnish law.

### 4.2.3.1 Notice of the cleaning contaminated soils

The Government Decree on the Assessment of Soil Contamination and Remediation Needs (PIMA, 214/2007) determines the obligation to be aware of the pollution status at a landfill site and the environmental act obligates to report contaminated sites to the authorities. The actual order to remediate contaminated soils is in the environmental act chapter 14 section 133. Section 133 obligates the party responsible of the contamination to perform remediation practices on contaminated soils and possibly ground waters. The obligation of awareness and clean-up, are strengthening norms for the prohibition of contaminating soils. The prohibition of contaminating soils is stated in the environmental protection act as: the ban of dumping waste or harmful substances in such way that will contaminate soils and cause danger or harm to the surrounding environment and people’s health.

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186 Government Decree on the Assessment of Soil Contamination and Remediation Needs (214/2007), Section 1, Unofficial translation, Ministry of the Environment, Finland
187 Environmental Protection Act (527/2014), Section 135
189 Environmental Protection Act (527/2014), Section 133
190 YSL §16
There are only two prohibitions in the environmental act: the soil- and the ground water contamination prohibitions. The obligation to remediate these contaminated soils and waters is in section 133 of the environmental act. To enforce the obligation of remediation the ELY-centre has legal authority to give instructions on the remediation process and authority to order a clean-up, if the remediation will not voluntarily take place.¹⁹¹

Contaminated soils at a landfill could be either top soils or soils underneath the landfilled waste. In either case, the landfill must be secured after the removal of said contaminated soils, so that it will not pose a threat to the environment again in the future. Depending on the landfill's structure this can be done in various ways, but most often, especially if groundwater pollution is a risk,¹⁹² the waste is relocated at another landfill. The remediation obligation of contaminated soils provides a window for ELFM. Incorporating ELFM into the remediation process would enable the waste to be handled according to the waste hierarchy. Processing the waste to separate recyclables, at least metals, and using the rest in energy production could replace the customary practice of relocating landfilled waste at another landfill. Although the section of fine fraction of waste might have to be relocated, ELFM would still decrease the amount of landfilled waste considerably.

Based on a visit at the Uusimaa Centre for Economic Development, Transport and the Environment (ELY)¹⁹³, the environmental officials are not opposed of the idea of digging up old waste from landfills. In fact, according to conversations with the regional supervisory authorities, the general understanding was that no more than a notice of cleaning contaminated soils would be necessary. The remediation would be similar; excavating of contaminated soils and waste, only the waste would not be buried again. The contaminated soils are categorized as waste and waste legislation should be applied to them. The excavated waste could potentially retain the same status as it had when it was dumped at the landfill in the first place. This would mean that landfilled municipal solid waste could be used as municipal waste fuel in incineration plants straight from the landfills. Of course, the combination of waste is different in different decades and WtE operators would have to make sure that the waste fuel would qualify set standards, e.g. pollution limits.

The notice of cleaning contaminated soils is to be transmitted to the regional ELY-centre in due time at least 45 days before the remediation operation begins. From the ELY-centre database it can be seen that landfill remediation practices have been handled with notice of cleaning contaminated soils. For

¹⁹¹ YSL §136 & §137
¹⁹² YMPÄRISTÖHALLINNON OHJEITA 1, Kaatopaikkojen käytöstä poistaminen ja jälkihoito 2008, p.66
¹⁹³ Visit occured in 04.09.2017, Opastinsilta 12, Helsinki. Communications with Elina Oinonen and her colleagues.
example, the cleaning of Loviisa landfill was handled with a notice to the ELY-centre. The ELY-centre decision on cleaning contaminated soils at the Loviisa landfill stated that the waste hierarchy should be applied to the remediation process. The Loviisa landfill site was located quite near to a residential area but still did not require an environmental permit. In landfill remediation cases where the waste is ordered to be dug up and waste hierarchy is to be implemented it sounds like ELFM would fit in the process quite well. The fact that the excavation during cleaning of soils can be done without an environmental permit is also a bonus, because permits require a lot more effort than plain notice to the regional environmental authority. 

The only case when landfill remediation processes would require an environmental permit according to the environmental act chapter 4 would be, if remediation can cause pollution of surface or groundwaters. Another reason for needing an environmental permit is if the remediation causes unreasonable strain to the neighbourhood. These would be the cases when ELFM would also need an environmental permit. Because of city planning, it would be unlikely that a landfill would be located too near to any neighbours or on top of groundwaters. Therefore, ELFM will not require an environmental permit in most cases.

4.3 Landfill remediation responsibility: two cases from the Supreme Administrative Court of Finland

The clean-up responsibility of old waste contaminated soils has been researched in Finland by Pölönen. In his study Pölönen addresses the retro activeness of the waste management legislation. In other words, to whom can the clean-up be ordered through 70's legislation - even if contaminated soils and their risks were not known back then? Pölönen argues that the responsibility of old landfill pollution will not be the responsibility of the new private owner, due to the polluter pays principle. The responsibility for the clean-up in most cases would probably transferred to the state and carried out by the municipality, due to the "clean-up obligation of the state"-provision stated in the 1993 waste management act's 35 §. § 35 is left into force in the new waste management act as well. Therefore, the municipality is the holds the final responsibility for the clean-up in cases of old landfills polluting. This can be seen from the following cases.

195 Ismo Pölönen, Lakimies 5/2001 s. 812–829
196 Ismo Pölönen, Lakimies 5/2001 s. 826–828
197 Ismo Pölönen, Lakimies 5/2001 s. 826–828
4.3.1 Applying 70's waste legislation to enforce the obligation to evaluate the level of contamination at a landfill

The Supreme Administrative Court of Finland had a case regarding the obligation to figure out if a clean-up is needed for an old landfill that closed before 1994. The question in the case was: Can the municipality be ordered to analyze the remediation needs of a landfill that closed around 1957?

For landfill related environmental problems, that are emerging decades after the operations ceased, the applicable legislation is the old legislation that was in force at the time the operations were going. For example, in this case the landfill was closed before 1994. The current waste act states that landfills closed before 1994 need to follow the previous waste act of 1993. In turn, the 1993 waste act states that, if the operations seized before 1993 waste legislation came into force, the applicable legislation is the previous waste management act and waste management decree. The 1978 and 1979 waste legislations are the first ones on waste so there is no previous legislation to fall back on. Therefore, waste related environmental problems that date to actions before 1993, are to be interpreted by the -78 and -79 waste legislations. Interpreting 70's waste legislation poses some problems in determining the responsible body for soil remediation. This is mainly because the 70's waste legislation does not acknowledge the term "contaminated soils". Therefore, it is difficult to univocally determine who is responsible.

In the case, the landfill is zoned in the city plan as an industrial zone. In addition, the landfill rests on top of a first-class groundwater reserve. These factors together make the area of the old landfill an important site where environmental pollution could have immense effects. Therefore, the ELY-centre demanded the municipality to evaluate the environmental effects and the need for a clean-up. The authority for ELY-centre to give demands is stated in the environmental act and waste management decree. Support for the evaluation of contaminated soils can be also found in the 1979 waste management decree's 8 § where it is stated that: it must be seen to best efforts that the area of the landfill does not present harm to the environment after it has been closed. In addition, the waste management decree states that: 8 § is to be applied also to landfills that have stopped their operation before the decree came into force. This means that according to the 1979 waste management decree it must be seen to

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198 KHO:2013:187
199 Jätelaki (646/2011)
200 Jätelaki (1072/1993)
201 Jätehuoltolaki (673/1978)
202 Jätehuoltoasetus (307/1979)
203 Ismo Pölönen, Vastuu ennen jätelain voimaantuloa pilaantuneista maa-alueista, Lakimies 5/2001 pp. 812-813, 827
204 Ympäristönsuojelulaki (86/2000)
205 Jätehuoltoasetus (307/1979)
that even landfills closed before the decree came into force do not present harm to the environment. In this case the responsibility to find out the environmental damage and remediation needs is justified through old waste legislation as well as more current environmental legislation.\footnote{KHO:2013:187}

### 4.3.2 Municipalities and their responsibilities with old polluting landfills

In this case\footnote{KHO:2016:3386}, the Finnish city of Porvoo appealed to the Supreme Administrative Court of Finland to undo a decision made by the ELY-centre. The ELY-centre had made a decision which ordered the city of Porvoo to clean-up an old landfill site. The Mätäjärvi landfill, had been the main landfill for the city approximately through the 1950's and 1960's. The landfill had closed before the 1978 waste management act\footnote{Jätehuoltolaki (673/1978)} came into force. The landfill is located on top of a class one groundwater zone, which highlights the importance of cleaning up the landfill. The property had belonged to Porvoo city during the time the landfill was active. The city of Porvoo argued that it could not be held responsible for the clean-up and demanded that the clean-up responsibilities should be assigned to the new owner of the property; the local parish.

The decision of the supreme court was that the appeal from Porvoo city was rejected and the city had to perform the remediation of the landfill site as the ELY-centre previously ordered.

The legislation that was applicable at that time clearly states that the responsibility is within the owner of the site at the time, which in this case was the city. The supreme court stated that, according to the waste management decree\footnote{Jätehuoltoasetus (307/1979)} § 8, the operator of the landfill, in this case the city of Porvoo, is responsible to see that the landfill is closed accordingly by covering it and that it fits into the surrounding environment. An additional paragraph was added to waste management decree’s § 8 in 1981,\footnote{Addition to the waste management decree (118/1981)} which states that the safety of the surrounding environment must be ensured as well as possible. In addition, section 23 §, obligates landfills that predate the legislation to follow the environmental safety norms of 8§. According to these provisions the supreme court determined that the city of Porvoo is responsible for the clean-up. Furthermore, the healthcare-rule\footnote{Terveydenhoitosääntö (336/1927)} at the time can be interpreted as a predecessor of the prohibition to pollute ground waters. The healthcare-rule also obligates the city of Porvoo to determine the state of pollution at the landfill site.
There is a ban not to use retrospective legislation on cases. In this case the ruling of the supreme court was not based on the retrospective section 8 and 23 of the waste management decree. Instead the prohibition against polluting ground waters was found through the water act\textsuperscript{212} of 1961 and healthcare-rule\textsuperscript{213}, which states in section 37 that waters in wells, ground or other should not become polluted from landfills or cause any other health problems. The retrospective sections of the waste management decree were only enforcing norms in this case. The responsible actor for the clean-up and obligation to be aware of the state of pollution was found based on the above norms.

The legal basis for ruling the clean-up was found upon environmental protective legislation: the environmental protection act\textsuperscript{214} §84 and the implementing act for the environmental protection act\textsuperscript{215} § 22 and § 24. The environmental protection act section 84 gives legal monitoring authority to the ELY-centre. The same 84 §, is also referred to as the norm that gives the powers of administrative monitoring to the ELY-centre. This means that the ELY-centre can order the party which is breaching the soil contamination responsibilities to fix the situation. The authority of the ELY-centre includes ordering the responsible party to fulfill their duties accordingly and ordering the responsible party to remediate the ruined environment or remove the source of pollution from the area. The implementation act for the environmental act states that, even though in old cases the applied legislation is the one in force at the time, in hearings of the case the environmental protection act is applied. In addition, the Government Decree on the Assessment of Soil Contamination and Remediation Needs\textsuperscript{216}, which was given based on the environmental act\textsuperscript{217} section 14, is applied to older soil pollution that has happened before 1994. Decree on the Assessment of Soil Contamination and Remediation Needs is inspected in more detail in the next chapter.\textsuperscript{218}

4.3.3 Summary of Supreme Administrative Court decisions on the obligations with landfill remediation

In conclusion, the two cases explored here make a clear statement that there are strong binding norms in Finnish environmental law to assess and act upon soil and groundwater pollution at old landfill sites. The two cases are examples of how controversial it is sometimes to find the responsible actor to perform the remediation to old landfill sites. The responsible party is most often the municipality in the end. Since the healthcare-rule municipalities have been obliged to provide their inhabitants a

\begin{itemize}
\item \textsuperscript{212} Vesilaki (264/1961)
\item \textsuperscript{213} Terveydenhoitosääntö (336/1927)
\item \textsuperscript{214} Ympäristönsuojelulaki (86/2000)
\item \textsuperscript{215} Laki ympäristönsuojelulainsäädännön voimaanpanosta (113/2000)
\item \textsuperscript{216} VNA maaperän pilaantuneisuuden ja puhdistustarpeen arvioinnista (214/2007)
\item \textsuperscript{217} Ympäristönsuojelulaki (86/2000)
\item \textsuperscript{218} KHO:2016:3386
\end{itemize}
place to dump their trash. Even if the landfill pollution cases are inspected through legislation that was relevant during the operational period of the old landfills, the rulings have legal basis in current environmental protection legislation.

4.4 Analysis of Finnish legislation

The objectives of all three Finnish laws: Environmental protection act, Waste act and the Landfill decree, include the minimization of environmental risks and the landfill decree also specifies that the main objective is to store waste in an environmentally safe manner.

The objective of both EU and Finnish legislation for landfills is to dispose the waste without risking or causing environmental harm. Thus, safe landfills are not applicable for ELFM projects according to Finnish legislation. Unsanitary landfills, on the contrary, need operations to ensure that the legal environmental objective of an environmentally safe landfill is met.

The literal interpretation is that a landfill is a final disposal site and waste cannot be excavated. With unsanitary landfills the legal objective of minimizing waste related harm can be interpreted to overcome the literal interpretation, thus enabling remediation with and without ELFM. Due to the legislative intent that is to keep landfills environmentally safe, and ELFM can be performed as an environmental protective measure.

The analysis of application of Finnish law to ELFM in practice revealed that the requirement of an environmental permit is unlikely. Unsanitary landfills must be remediated to comply with the landfill decree. Most likely the regional ELY-centre would only demand a notice of cleaning contaminated soils, if ELFM was performed together with a remediation project. In addition, waste hierarchy should be applied as thoroughly as possible. In the light of the instructions, ELFM would only enhance these targets.

The obligation of who performs the clean-up of an old landfill is a bit unclear. The analysis of case of the Supreme Administrative Court of Finland revealed that usually the responsibility of cleaning old landfills falls upon the municipality.
5 ANALYSIS

This chapter will focus on answering the thesis questions that were presented in the beginning of this thesis.

This thesis has analyzed the objectives of relevant circular economy legislation. Analyzed objectives can provide a preliminary framework for ELFM to perform within. The objectives narrow the sphere of operations, but within these limits, according to the analysis of the objectives, ELFM is possible. ELFM is in line with most circular economy action plan goals. The goal of fighting climate change can be debatable because the climate impact of ELFM is case dependent and hard to estimate. The waste framework directive and Finnish waste act introduce the objective of following the waste hierarchy. ELFM can contribute to waste hierarchy objective by moving waste from the least favorable category of disposal to the categories of other recovery and recycling.

The landfill directive and the Finnish landfill decree pose the most restrictions to ELFM. Environmental legislation on landfills, both EU and Finnish national law, is not in all cases supportive of ELFM. Both EU and Finnish national law have the main objective of storing waste safely in a landfill. ELFM minimizes risks to landfills, but performing ELFM operations is never risk free. Thus, safe landfills fulfill the landfill directive’s objective and opening for ELFM them is against the objective of minimizing environmental risks at landfills. ELFM cannot be paired with safe landfills. On the other hand, unsanitary landfills that pose environmental harm need to be taken care of by remediation processes as the landfill directive obligates. ELFM could even enforce the landfill directive’s remediation obligation, because ELFM works together with circular economy plan’s goals and the waste hierarchy.

ELFM could additionally pass for the exception of recycling excavated materials further, due to too high costs and technical demand. This phrase could allow landfilled waste to be incinerated if the circular economy aspect would be too costly to achieve.

The terminological challenges explored in previous studies pose some uncertainties to ELFM. If terminology is interpreted in relation to the main objectives, terminology should not be an issue. If terminological challenges would be an issue, they would prevent even normal remediation practices. When interpreting the terminology through the objectives of analyzed environmental legislation terminology does not pose an obstacle for ELFM. However, different word phrasing would bring more uniformity when using different angles of interpretation, e.g. previously used literal interpretation and the interpretation uses in this study provided different results about how terminology limits ELFM operations.
If there is a need to perform ELFM on safe landfills at some point, then EU environmental legislation is limiting these operations. In the view of environmental law, introducing health and environmental risks by opening the landfill, when there is a safe option to leave the landfill be, is against the main objective of preventing environmental harm. Nevertheless, modern landfills now will not last forever and at some point, they too will need remediation practices.
6 CONCLUSIONS AND RECOMMENDATIONS

Working towards a circular economy is one of the EU’s main goals at the moment. Therefore, researching the legal implementation of technologies, such as ELFM, that might help reach circular economy targets, is topical and societally important. This paper introduces the interlinkage of ELFM and circular economy concepts from a legal perspective. The linkage has not often been clearly explained in previous research. This study shows that ELFM mostly aligns with circular economy goals that are presented in different levels of EU legislation. The shared objectives of circular economy and ELFM introduce a legal basis for a preliminary regulatory framework for ELFM within the circular economy.

The analysis reveals that current environmental legislation on landfills, both EU and Finnish national law, is not in all cases supportive of ELFM. In fact, when the name of the legislation suggests that it exists to store the waste inside the landfill, it is not a surprise that extracting waste from landfills has some legal limitation. Environmental protection is one of the main objectives for both the landfill directive and Finnish landfill decree. The objective for landfill related regulation in both EU and Finnish law is to shield the surrounding environment and human health from waste related environmental problems. The legislative intent is to keep the waste in the landfill, but most importantly in an environmentally safe way. If the environmental safety conditions of a landfill are met, then the intent of the legislator is completed and there is not a good justification to open the landfill. If the objective of environmental protection from landfill related harm is fulfilled, ELFM will only increase the risk of environmental harm. ELFM of course aims as by its scientific definition to mine waste as safely as possible, but the risks cannot be minimized to none. Therefore, mining safe landfills is not possible within the realms of the objectives of the landfill directive or the Finnish landfill decree.

However, if the landfill is considered unsanitary the situation is entirely different. An unsanitary landfill does not comply with the landfill directive and according to both national and EU landfill legislation; actions need to be taken to assure that environmental damage is prevented. This can be achieved by remediation practices. Traditionally remediation practices have included excavating the waste and repairing the structures to ensure safe storage of waste. After the structures have been fixed, the waste has been landfilled again correctly or moved to another landfill. ELFM could be combined remediation projects of unsanitary landfills. Incorporating ELFM into remediation processes can even be considered desirable, because ELFM only makes the remediation process more effective in the view of circular economy objectives and follows the waste hierarchy more efficiently than plain landfills. By adding ELFM into landfill remediation, the circular economy objectives from the
circular economy action plan are followed by sustaining material value, reducing volume of existing waste and increasing resource security. In addition, ELFM follows the waste hierarchy by removing waste from the lowest category of disposal up to other recovery and recycling. Incorporating ELFM to remediation practices is thereby supported through the circular economy objectives. The figure below (Figure 6) shows that more risks there are at a landfill, the more legally justified it is to open the landfill and implicate ELFM into the process.

Figure 6: The simplified relation of ELFM to environmental risks and pollution at a landfill

Terminological challenges provide uncertainties in legislation, but the general objectives of circular economy and ELFM mostly interlink. Although there is existing legislation that is applicable to ELFM, specific legislation on a national level could help, for example, ensuring that a high level of environmental protection is achieved within all ELFM projects. Ensuring similarity and high quality of all ELFM projects could also be achieved by soft law, such as guiding documents published by a government authority.

Legal research is basically interpretation, thus the research methodology, i.e. the perspective of analysis, is key. Findings about a similar topic can drastically vary between different methods and the scope of research. The aim of this study was to analyze if ELFM is in alignment with the ambitions of different levels of circular economy law, but ultimately valuing the higher law most, as the lex superior principle advises. Previous legal studies have been made using the traditional literal interpretation method, which has resulted in findings that propose terminological challenges for
proceeding with ELFM projects. While these results are agreeable when using the literal interpretation, they can be challenged by analyzing the issue from a target-orientated perspective of environmental protection. The objective of landfill legislation is environmental safety and applying that to interpret the term ‘landfill’ changes the results of interpretation. When the main goal is environmental protection, landfilled waste can be excavated if it provides environmental harm. If this would not be possible no remediation practices would be allowed, which would completely the opposite of what landfill legislation is made to accomplish: minimizing the effects of landfilled waste to the environment.

The analysis of Finnish legislation focused on the practical side of ELFM; what permits are needed for ELFM projects? Through the analysis it was found that Finnish national norms would support landfill mining processes in practice when combined with environmental problems at landfills. The Finnish environmental act (527/2014) together with the Government Decree on the Assessment of Soil Contamination and Remediation Needs (214/2007) support the remediation of old unsanitary landfill sites. This research concludes that there does not seem to be an obstacle within the Finnish environmental legislation to pair ELFM with landfill remediation projects.

There is no extensive definition of ELFM in the analyzed law although the concept pops up in preliminary legal documents, like the proposal for a landfill directive. But if ELFM was legally determined that would help unify the concept, e.g. determine the level of efficiency, environmental protection and technology used. This would enable the similarity and a regulated quality within all future ELFM projects. ELFM concept could be implemented, for example, into national soft law to provide some uniformity.

The scope of this study has been limited to the excavation process of waste from the landfill. More research needs to be done to determine if there are controversies within legislation on the consumption of excavated materials from the landfill. According to previous research, this could be a problem especially for reusable materials, such as landfilled metals, because secondary materials are heavily monitored. This means that materials which wish to become secondary materials need to fulfill certain limit-values, which is nearly impossible for homogenous landfilled materials. In addition, problems with the taxation of waste arise when waste turns into a fuel in waste-to-energy scenarios. The taxation of waste falls beyond the scope of this study, but provides an interesting topic for future research.

There are some problems with energy utilization from landfilled waste but those problems are more technological than legal. After the waste is excavated it’s status should legally stay the same as it
was when it was originally buried in the landfill. Therefore, landfilled municipal waste could be treated as municipal waste after excavation, which would enable the use of waste as fuel for energy. In such a scenario the waste would be disposed of according to its status and moreover at the same time following the waste hierarchy.

The figure below (Figure 7) shows all the legislation that was analyzed in this study and how it applies to ELFM. The figure also shows clearly in the start how the landfill directive is the most limiting factor for ELFM projects, because opening safe landfills is against the directive's objective storing waste safely. ELFM cannot decrease the risk of environmental harm to zero and so it would bring environmental risks to a safe landfill, which is why it cannot be done in the view of the landfill directive's main objective of environmentally safe and minimal risk landfilling. Other limiting or uncertain factors are the uncertainty of whether or no ELFM reduces emissions and the possibility that environmental permits might in some cases be needed.

Nevertheless, the conclusion of this study is that ELFM has more supportive legal instruments than expected. These supportive legal instruments can provide a preliminary legal framework for ELFM projects to function within. Naturally, more research needs to be done to determine if there are other legal barriers beyond the objectives of analyzed and other legislation. However, based on these results it might not even be necessary to implement the concept of ELFM into EU or Finnish national legislation, when there is already a preliminary supportive framework available.
Figure 7: Legislation that is applicable to ELFM and how it limits ELFM operations.