Urban Mining in Malmö
An Investigative Study to Identify the Potential of Urban Mining

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Built Environment
One-year master’s programme
Urban Development: Sustainability and Management
15 credits
Spring semester 2018
Supervisor: Alexander Paulsson
Abstract

This master thesis depicts the topic of urban mining and its possibilities and challenges in the city of Malmö. Because of present day’s high consumption and construction our resources are becoming scarcer. In order to continue to build and consume the way we do, we need to look at other alternatives to obtain these resources. One sustainable alternative is urban mining which is based on society as a resource base where material accumulating over time is a metal storage that can be used through reuse or recycling. This thesis is limited to one type of urban mining which refers to unused cables and pipes that lie underground, so called hibernating cables.

The purpose of this thesis is to explore the possibilities and challenges with urban mining in the city of Malmö and to research the Kabel-x urban mining method and its implementation possibilities. To successfully understand the challenges and possibilities a qualitative approach was taken where semi-structured interviews were conducted to see attitudes towards urban mining as well as to identify stakeholders who would work with an urban mining project in the future. The qualitative approach was complemented by a literary research which built the theoretical framework with theories like urban mining, urban metabolism and material flow analysis and sustainability assessments. The empirical discoveries depict topics such as ownership, knowledge-gap or skepticism when it comes to urban mining as well as methods of extractions, but also point to high interest and economic incentives with are in concordance with sustainability aspects.

This lead to the conclusion that urban mining shows both possibilities and challenges in Malmö, which proves a challenging but worth implementation. Regarding Kabel-x method, its sustainability aspects and challenges with its implementation, it was concluded that on account of mostly skepticism and knowledge-gap stakeholders proved its implementation challenging but also interesting for urban development.

Keywords: urban mining, urban metabolism, sustainability, urban sustainability, metal recycling
Acknowledgements

I would like to forward gratitude to my supervisor Alexander Paulsson for the guiding, understanding and patience he presented during the whole writing process. I would also like to thank the supervision group for the rewarding feedbacks and pep-talks during our journey together.

Many thanks go to all the people in this thesis who have contributed either verbally or written. I truly appreciate their time and effort into giving their input to this study.

Lastly, many thanks and appreciation to the people around me for the support and for the constant encouragements to stick to my idea.
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1. Introduction

*Metals are gifts from the stars that were generated over billions of years; we should treat them with the awe and respect they deserve and devise ways to recycle them over and over.* – Thomas Graedel, 2011

1.1 Background

Today’s society and demand of products for consumption has grown bigger and more complex as ever before, but at what cost? Construction and infrastructure are the sectors that require the most resources. Our linear economy, our demands on consumption, as well as urbanization, globalization in combination with population growth generate enormous amounts of waste which are badly affecting the environment and the regeneration of the extracted natural resources (European Commission, 2016). This type of consumption has reached its peak and is more unsustainable than ever.

On the other hand, mining, minerals, and metals are essential resources that are important to people and their consumptions, as well as vital for a balanced economy (Dominish et al. 2017). Unfortunately, their extraction has been taken for granted and overused, which has caused several unsustainable environmental and social issues. According to Wallsten (2015) the processes of production and extraction of copper are considerably high on the grounds of the damaging effects on the ecosystem and the surrounding landscapes. These processes also entail environmental problems such as water pollution, threats to the livelihoods of local communities or to tourism due to the leaching of toxic heavy metals like for instance arsenic, molybdenum or lead from smelting (Ayres et al., 2002; Wallsten, 2015).

The built environment nowadays is responsible for using 40 to 50% of the raw materials and for 10 to 30% of the waste flow in the European Union (Uihlein & Eder, 2009). The usage of stocks of copper per capita varies from 30–40 kg per person in countries in the Global South to 140 to 300 kg per person in the Global North (Gerst and Graedel, 2008). In regards to Sweden, Wallgren (1992) assumed that 1% of the global use of heavy metals is used in Sweden, more exactly at 189 kg of in–use copper per person (Rauch, 2009) (Wallsten, 2015).

This consumption and construction generates a lot of amounts of construction waste per capita. Every citizen in Europe accumulates an extra 10 ton of construction material per year and in Sweden there is over 12 tones/capita of waste of electrical and electronic equipment. Other sources, such as data from Eurostat, mention that there is over 12 tons/capita of waste of electrical and electronic equipment) in Sweden, which ranks second in Europe after Norway (Eurostat, 2016).
Because of the high price instability on these resources and heavy pollution at the main production and extraction, recycling of these resources becomes mandatory. An essential element of sustainability as well as of circular economy, is that we must rely more on recycled materials, because of environmental, political and economic implications regarding resource scarcity. This recycling approach is called “urban mining”, which is the area of this study. By using secondary materials instead of primary resource extractions way less energy needs to be consumed in order to produce the needed material; it can very between 25–85% less energy (Wallsten, 2015).

Urban mining is based on society as a resource base where material accumulating over time is a metal storage that can be used through reuse or recycling. These metals can be extracted from e.g. buildings, infrastructure, landfills or underground, the so-called Anthropocene which represents the man’s sphere of life consisting of a complex system of energy, material and information fluxes (Baccini and Brunner, 1991). This works’ focus is mostly based on the infrastructure where there are old unused (hibernating) cabling, wires and pipes containing massive amounts of metals (such as copper) that could be extracted and recovered, recycled and reused. Depending on the type of cable and its usage, copper cables contain approximately between 20 to 65% copper. In average there is four kg of copper in one meter and the costs for one meter of copper is approximately 1000 kr (Dundas et al. 2013, Miljönytta, 2011). In a quantification study in Stockholm during the 90s, it has been discovered that there exist approximately 27000 tons of copper in the power cables in the infrastructure and buildings (Sörme et. al., 2000).

**Urban mining and sustainability**

Urban mining has a close relevance and relation to built environment where urban mining can be seen a solution within both the discipline of circular economy and industrial ecology, both disciplines having an impact on urban sustainability. Urban mining is also named in Sweden’s strategical research and innovations agenda on waste and waste management in Sweden (RE:Source, 2015). In the agenda it is named that the effective re-use of current infrastructures from older neighborhoods are disposed, which consequently represent aspects of urban sustainability.

Urban mining is a concept in which one reuses, refurbishes, recycles, recovers waste (in this case metals). For cities to develop more and more sustainably and for people to thrive in these cities, these processes mentioned above have to happen, so we do not use up our resources, but instead re-use them.

Circular economy is getting more and more used and renowned regarding sustainability issues around the world, which focuses on decreasing our present consumption and production patterns. Its main principle is to adapt the closing-the-loop production pattern within an economic system which would subsequently make more clever use of secondary resource usage by using urban and industrial waste (Ghisellini, et al. 2016). By using urban mining, the unused metals and materials...
from the obsolete infrastructures can potentially be returned to their material cycles, thus contributing to one of the key characteristics of a circular economy, in which all materials are reused and put back into the loop (Gladek et al., 2015).

One known and important urban mining project that is worth to mention here is the one from Norrköping, Sweden. The project is unique in a sense that it uses different sustainability assessments for mapping the metals from hibernating infrastructure (i.e. subsurface power grids, hibernating cables or pipes). The motivation for it is to extract the hibernating stocks for recycling (Wallsten, 2014, 2015; Krook, 2011). During this project it was discovered approximately 375 thousand tons of telekom cables that lie unused underground.

Krook et al. (2015) specify that on account of the similarities of all Swedish cities when it comes to infrastructure, the results found in that specific project can be applicable in other cities. They mention that the results, in theory could be applicable in any urban area around the world. However, a more thorough analysis and comparison research ought to be done if such project is persuaded.
1.2 Problem specification

Malmö city is particularly clever and developed when it comes to waste management, recycling and sustainability issues. It is one of the first cities that has signed the Agenda 2030/Sustainable development goals, which shows its willingness and hard-work towards sustainability (Malmö stad, 2018). One way that can help to reach these goals is urban mining and the Kabel-x urban mining method.

However, it seems that there exists a knowledge-gap within urban mining and Kabel-X method in this city, despite the fact that Malmö is very clever at waste management, recycling and sustainability issues. The area of concern is the usage and extraction of enormous amounts of raw materials. Both urban mining and Kabel-X method are crucial to waste management and recycling since they focus on recycling and re-using the secondary materials and not raw materials.

In response to this problem, this study proposes to further understand and investigate urban mining and the Kabel-X method in regards to Malmö city. It will also contribute to both built environment, industrial ecology and waste management and its spreading and implementation in Malmö city.

1.3 Aim and Research question

The purpose of this thesis is to explore and investigate the possibilities and challenges with urban mining in Malmö in order to seek understanding of both its absence and implementation in this city. By interviewing relevant stakeholders this thesis will also investigate the Kabel-x urban mining method and its possibilities and challenges in regard to Malmö city. Questions:

- What are the possibilities and challenges of working with urban mining in Malmö?
- In what way can the Kabel-X method be considered a sustainable urban mining method for urban development?
- What are the possible challenges for the implementation of the Kabel-X urban mining method in Malmö?
2. Method

This section will present the methods used for this thesis which includes two kinds of qualitative research. First, a literary approach was taken to find and analyze theories relevant to the thesis. Secondly, qualitative research was taken where semi-structured interviews were conducted in order to identify stakeholders and to explore the possibilities of urban mining in Malmö as well as to see attitudes and challenges regarding urban mining and Kabel-X method. Previous research on urban mining has mainly used quantitative methods when measuring the amount of metals, which is surely the most effective approach. However, given the purpose of this thesis, qualitative research was chosen, while some of the quantitative methods were used as theoretical framework.

2.1 Literary research

In order to acquire a better understanding of the concept of urban mining as well as of theories relevant to it and to the problem formulation a literary research was conducted. The literature that was used in this study’s theoretical framework was acquired through a literature research which has at its core to obtain the information, gather, evaluate and synthesize data from other researchers’ books, dissertations, journals or academic publications (Halvorsen, 1992). This was done with the help of MAU library database and Google scholar, as well as literature suggestions from my coordinator and one of the interviewees who works as a researcher within the field. Searches such as “urban mining”, “hibernating cables”, “urban metabolism”, “sustainability assessment” or “material flow analysis” were done in these databases where the found articles were sorted after relevance and content. The found articles were journal articles, scientific books as well as research papers or journal publications. From one of the interviews, it was discovered that theories such as urban mining, urban metabolism and material flow analysis can be relevant to this thesis since he used the same when they researched and worked with urban mining in some projects.

This also provided the foundations for the theory section as well as helped identify important factors and data that complements the information obtained from the semi-structured interviews. The reference lists in related academic texts were also used to find more texts relevant to this thesis’ topic. Hart (1998) argues that a researcher shall use what others have written in order to show what else can be done and that is why other researchers’ works were looked at. I have used what other researchers have written in order to write this thesis and to investigate the novice concept of urban mining.
2.2 Qualitative research

Besides the literary research, the data for this thesis was collected through a qualitative approach where semi-structured interviews, telephone interviews and email exchange have been done. According to Bryman (2012) there are five main methods that are associated with qualitative research: ethnography (participant observation), qualitative interviewing, focus groups, discourse or conversation analysis and collection and qualitative analysis of texts and documents. This thesis uses two of these main methods and those are collection and analysis of literature and qualitative interviewing.

Qualitative research is an inductive approach where the researcher first collects data and then attempts to obtain and acquire results from those data. As such, qualitative research tends to be more exploratory, seeking to provide insight into how individuals, organizations, groups, etc. understand different aspects of a specific phenomenon (Bryman 2011; Bryman, 2012; Widerberg, 2012).

The qualitative approach can give a different insight to a study since it can provide information on real-life situations and behaviors that normally cannot be interpreted from a quantitative study (Bryman, 2011). By qualitative approach, Widerberg (2012) means that the researcher seeks to elucidate a phenomena’s character or characteristics and also seeks after the phenomena’s meaning and signification. It is used to gain an understanding of underlying reasons, opinions, and motives. It also provides insights into the problem and is used to uncover trends in thoughts and opinions. Widerbergs (2012) statement in relation to this thesis is that this study aims to gain an understanding of the reasons, motives, attitudes and motives from the interviewees and public and private sector representatives in regards to a future implementation on urban mining.

Qualitative research has emphasis on words rather than on numbers, it is inductivist, constructionist and interpretivist. This applies to this thesis as well since all three aspects were used in the analysis. This type of research is also more descriptive in comparison to quantitative which entails that is concerned with explanation. (Bryman, 2012).

Furthermore, qualitative research is conducted in more than one setting which can be helpful in identifying different aspects and how something influences behavior or way of thinking (Bryman, 2012:402). This aspect also applies to this thesis since all the interviews were done in different settings such as face to face, skype, telephone or email. All these settings provided different insights to this study which bring an understanding in the process of implementation of urban mining in Malmö.

Information, as well as contacts of stakeholders was gathered through email as well as from telephone conversations from different actors, from interviews and from online searches on either the companies’ websites or through Google.
The stakeholders were from both from public and private sector, such as Malmö city (municipality), Miljöförvaltningen (Environmental Administration office), E.ON (Malmö's gas and electricity supplier), Sysav (Southern Skånes waste company), VASyd (regional water and drainage company which also works with waste management), and Stena Metall (recycling company that processes metals, paper, electronics, hazardous waste and chemicals).

2.2.1 Semi-structured interview

The literary research segment is followed by semi-structured interviews with relevant stakeholders in order to understand and identify the possibilities and challenges with urban mining in Malmö city for future implementation. The purpose of the interviews is to identify and to acquire information on attitudes towards urban mining as well as to acquire more knowledge and data regarding ownership, attitudes, challenges, costs, benefits, risks, critique, knowledge gap and so forth. Furthermore, it was chosen to conduct a qualitative research because in comparison to a quantitative research, a qualitative one can give the researcher insights on attitudes, gestures or how people react to the urban mining concept in order to later be able to interpret it for the possibilities and challenges and criteria of the future implementations.

“A semi-structured interview. The researcher has a list over fairly specific themes that will be [touched] (they are often called interview guides), but the interviewee has the freedom to form the answer his/her own way. The questions do not need to come in the same order as the interview guide. Questions that are not in the interview guide can also be asked, which the interviewer can connect to something the interviewee had said. Overall the questions will be asked in their original order and with their original wording...” (Bryman 2011:415) (Translated from Swedish)

A semi-structured interview is an interview and/or meeting in which a respondent uses a set of questions that are not followed in their entirety in order to gather qualitative data. An interview is closely associated with words, sounds, feelings or emotions; such cannot be encountered in quantitative researches. It also helps the researcher to see and understand why and how the interviewees experience the phenomena, in the case of this thesis about how they feel about future implementation, how they react to the concept itself, from that the researcher can deduct a possible implementation in the future.

This approach was also taken in this thesis in order to ensure greater level of depth of understanding, to see reactions and to understand how and if such concept is of worth of implementing in the future in Malmö.
Below (table 1) will be presented a list of all the people that were contacted, either through email or telephone, as well as the persons who have been interviewed. Their profession, type of communication, duration and knowledge about the topic or urban mining is also presented.

<table>
<thead>
<tr>
<th>Persons</th>
<th>Where/what they work</th>
<th>Type of communication</th>
<th>Duration</th>
<th>Knowledge about urban mining</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hitomi Lorentsson</td>
<td>Project leader Stena Recycling</td>
<td>Telephone</td>
<td>Ca 30 min</td>
<td>Intermediate</td>
</tr>
<tr>
<td>Björn Wallsten</td>
<td>Researcher Linköping University</td>
<td>Skype</td>
<td>35 min</td>
<td>Vast</td>
</tr>
<tr>
<td>Sarah Pan Larsson</td>
<td>Sustainable City development E.ON</td>
<td>Face to face</td>
<td>25 min</td>
<td>Little</td>
</tr>
<tr>
<td>Patric Karlsson</td>
<td>Environmental Coordinator E.ON</td>
<td>E-mail</td>
<td>-</td>
<td>Little</td>
</tr>
<tr>
<td>Person 1</td>
<td>Gatukontoret</td>
<td>E-mail</td>
<td>-</td>
<td>No</td>
</tr>
<tr>
<td>Person 2</td>
<td>Gatukontoret</td>
<td>E-mail</td>
<td>-</td>
<td>No</td>
</tr>
<tr>
<td>Person 3</td>
<td>Sysav</td>
<td>E-mail</td>
<td>-</td>
<td>Little</td>
</tr>
<tr>
<td>Person 4</td>
<td>VASyd/MAU</td>
<td>E-mail</td>
<td>-</td>
<td>Little</td>
</tr>
<tr>
<td>Per Arne Nilsson</td>
<td>Head of the Environmental Strategy Department - Miljöförvaltningen</td>
<td>Face to face</td>
<td>32 min</td>
<td>Intermediate</td>
</tr>
</tbody>
</table>

Table.1. Interviewee list

The interviews were recorded as well as transcribed right after. The interviews followed three different informal interview guides which contained a set of prepared questions, which were not followed sentence by sentence as in a structured interview, but they were steering the interviewee as well as conversation into a more open discussion when it felt appropriate. The complete guides from all the three interviews that were conducted can be found in the Appendix 1, 2 and 3. There was also personal communication with some stakeholders through phone and email. Some of the questions I have prepared and asked during the interviews were:

- What knowledge they had about urban mining (if they had)
- If they see the potential with urban mining in Malmö
- If they know about the alternative Kabel-x method
- Questions about ownership and data on cables and pipes, about costs, benefits, risks, policies, social issues (these were mostly asked at E.ON, Miljöförvaltningen, Gatukontoret)
- Description of the urban mining project (in the case of the Linköping University researcher)
The environments of the interviews varied as one of the interviews was done during Skype from home, and the other two in person at the interviewees’ offices, at E.ON respectively at Miljöförvaltningen. The interviewees usually see an interview as a positive thing since they can contribute with knowledge. This was also the case of the interviewees from this thesis since everyone was happy and eager to help when they were asked for an interview.

2.2.2 Telephone interview and email exchange

The rest of the data collection, besides the face-to-face interviews, were conducted through personal communication, more specifically through telephone communication and email exchange with the stakeholders as well as with the interviewees. These two means of interviewing have been used within social sciences and qualitative research because of their easiness to conduct. Since the emergence of internet more and more people opt for email exchange or online communication and even telephone communication (Bryman 2012; Walker, 2013). Both of these methods can be done from the comfort of one’s home or even on a bus, train, restaurant etc. since all the advances in technology in recent years.

One of the main reasons for conducting these types of interviews were to primarily obtain contacts of stakeholders, actors and possible future interviewees for face-to-face interviews. Since not all the contacted persons were able to meet face-to-face then we opted for continuing communicating through email (such as with E-ON representative, Patric Karlsson and the representatives from Gatukontoret, VA-Syd or Sysav). In the contact emails there was used a standard email for most of the contacted persons in which there was described who I am, where I study and what was the purpose of my study.

The telephone interview, which was done with the Stena Recycling representative, was first and foremost an introductory and scouting interview since I was still in the early phases of the thesis. Contact was first made through email and later on we had decided on a telephone call which lasted approximately 30 minutes. The main reason for this type of conversation was the distance. Emails, telephone and video calls have the main advantage since they can be conducted with participants from all around the world without the extra costs of traveling.

Participants usually answered at their own convenience which can both be an advantage and disadvantage compared to face-to-face interview. These advantages and disadvantages will be discussed below in subchapter 2.2.4 (Strengths, Weaknesses and Trustworthiness).
2.2.4 Strengths, Weaknesses and Trustworthiness

As with any academic work, strengths and weaknesses were encountered along the way. One weakness, as Bryman (2011) depicts is that a qualitative research method is often criticized for being subjective, meaning that, the discoveries are based on my own perceptions of what is important and significant. However, it is important to mention that the qualitative method does not aim for generalization to a population, but rather seeks for the quality of one part of it (Bryman, 2011). One weakness was finding contacts who would have information on the cables. Subsequently it was discovered that the reason for this is because “there's been lot of organization and reorganization beyond our energy company, Malmö energy and water and sewage company were part of the city and now they are a company of their own” (P.A. Nillson, personal communication, 7 May 2018). Another weakness was the lack of contacts within my personal network circle. And finally, another weakness encountered was some technical problems with Wallsten Skype interview. After the interview was finished, the saved document became distorted which made it hard to understand during transcription; therefore, many words or expressions were lost. Luckily, I was taking notes during the interview, which helped me in the end to complement the transcription.

On the positive side, strengths were also encountered. As Holme and Solvang (1997) describe, one of the qualitative method’s strengths is that one can see and get the overall picture of a specific situation or issues, as well as it gives a more comprehensive understanding of the researched phenomenon. In the case of this thesis it was noticed that most of the interviewees were excited and interested within the topic which confirmed the interest of such phenomenon in the future. For instance, Wallsten (B. Wallsten, personal communication, 7 March 2018) had often repeated during the interview what already had been discovered during the qualitative research for this thesis. However, it is likely because he is a researcher within the topic, he was explaining the issues with much enthusiasm and detail.

Regarding the personal communication through email some of the strengths that were identified and encountered were that it is less costly (sometimes researchers can travel long distances in order to interview someone; a convenient and practical alternative to overcome geographical barriers and financial concerns that hinder face-to-face interviews (Walker, 2013)); a clear example here is the interview with Björn Wallsten with whom I have first communicated through email and then through Skype which had saved us both time and money. A second advantage with emailing is that is a fast exchange of communication (if the interviewee answers quickly); a third another advantage and strength is the researcher does not have to transcribe in comparison to face-to-face interviews since the emails are already in written form (Bryman, 2012).

As for the weakness of this type of personal communication is that the interviewing time through email can be extended up to several weeks or months, but this can also be an advantage since it can give time to the researcher to clarify and analyze the data. A further weakness encountered is
the respondent can answer short and uninformative answers which can hardly be helpful or that the respondent can even interrupt the email exchange, such as my case with Person 1 from Gatukontoret. Email also lack the social interaction one receives in a face-to-face interview as well as misses the chance to interpret different actions or interactions, hesitations, tones or grimaces (Bryman, 2012; Walker, 2013); here it can be named as an example the email exchange with the E.on representative in which was easy to misunderstand the attitude towards the topic since I didn’t have live contact with the interviewee; from the text the attitudes were interpreted in a way that showed arrogance and superiority even though the person showed kindness and helped in every email. Another weakness that can occur is that the respondent can lack knowledge and comfortability with internet and technology, which can lead to slow and short answers, even no answers, but thankfully this was not the case in this study (Bryman, 2012).

In regard to telephone communication the encountered strengths were that it is a Cheap and quick type of communication such as emails, easy to supervise since they can be recorded for later assessment and analysis with data protection and confidentiality in mind. It also removes biases such as class, ethnicity, age etc, but at the same time this can be a weakness since the interviewer cannot observe how the persons mimics some reactions. When it comes to weaknesses, it can happen that the interviewee has low or no reception, can have a hearing impairment, or is just simply hard to reach. Lastly, one weakness with telephone interviews is that it can easily be interrupted, and they are unlikely to exceed 25 minutes (Bryman, 2012:2015).

To ensure the trustworthiness of the interviews, they have been recorded as well as the receiver (me) took notes to provide a better understanding and validity for this study. One can take into account and seek out differences and similarities between the interviews as well as include a careful record keeping to ensure the trustworthiness, validity and reliability of a study. Validity usually is associated with measurement and quantitative studies (Bryman, 2011). This is not the case for this study, since it is a qualitative study. Reliability is often related to consistency which can be seen and shown through taking notes during the interviews on both what the interviewees had said as well as on how they reacted to the questions. Reliability means that a researcher needs to be consistent in his/her work which would consequently lead others to arrive at the same or similar conclusion (Holme et. al., 1997; Bryman, 2012). It is believed that the gathering of the data for the interviews, which was done by recording and taking notes, is sufficient to show reliability and consistency within the study.

The ethical aspects are also important to consider and use when conducting interviews since personal communication and interaction is involved (Bryman, 2011; Holme and Solvang, 1997). The interviewees were asked beforehand for permission and consent to be recorded. The audio record of the interview was consented verbally before the recording was started as well as after the recording started. The interviewees were informed about the purpose of this thesis as well as presented how the information will be used, if used. Regarding the confidentiality of the interviewees the identities of the interviewed persons is used in this thesis while the ones from
the email communications have been excluded. The interviewed persons have given their consent which subsequently can be interpreted as permission to use their names. The exclusion is based on the fact that since the communications were not always consistent (some of the persons were only emailed once) the identity issue was not been brought up. Therefore, in order to not hurt those specific persons in any way I chose to exclude their names and exact profession. Therefore, it is believed that no interviewee will endure consequences because of this thesis.

2.3 Delimitations

This section will present general delimitations that have been done within this thesis.

The geographical delimitation of the thesis is Malmö, Sweden. Since urban mining is a broad concept and is divided into several different types, this thesis will only focus on one part of it which is the unused (hibernating) cables and pipes found underground. A second delimitation that was chosen for the thesis is the specification and narrowing down to one metal, which is copper. One last chosen delimitation is that this thesis is only describing two types of urban mining working/extraction methods even though there exist more. Because such a study can be done one other metals too, the analysis of all existing metals would be impossible. This study is not a quantitative study where the amount of metals is quantified, but rather a qualitative one where attitudes, insights and understandings are looked at in order to see if a possible future implementation of such a project can happen.
3. Theory

This section of the thesis will focus on going through theories within the topics relevant to this thesis which will according to Hart (1998:27) “provide a clear and balanced picture of current leading concepts, theories, and data relevant to the topic or matter that is the subject of the study”.

3.1 Urban mining

The term urban mining has been defined by several scholars along the years of its research. However, this thesis will concentrate on the following definition which is put forward by Brunner (2011): the concept of urban mining has at its core to reuse, refurbish, recycle, recover the accumulated amounts of minerals and materials in produced products, energy, anthropogenic mines, waste generated from urban catabolism and built structures (Brunner, 2011:339).

The interesting thing about the concept is that it is rather new and not as known and researched as one would think it is. However, the whole process is already being mentioned a few decades ago when issues regarding the environment as well as sustainability started to arise. One important influential, whose work impacted urban planning and who first mentions the process is Jane Jacobs. She said that “in the highly developed economies of the future, it is probable that cities will become huge, rich and diverse mines of raw materials. These mines will differ from any now to be found because they will become richer the more and the longer they are exploited” (J. Jacobs, 1970:110). Her predictions turned out to be true since scholars and researchers have started to investigate the possibility of urban mining around the world.

Urban mining can be categorized in four categories which have at their core to recuperate the resources existing within:

(i) Urban mining the hibernating pipes and cables. This category involves the mining of cabling and pipes that exist underground (under buildings and roads) which are not in use anymore. This is the most researched and used category in Sweden where researchers from Linköping university, within the project “Staden som gruva” (City as a mine), see the following as worth recycling and recovering (Miljönytta, 2011): different types of pipes such as stainless steel pipes, water and drainage pipes of copper, cast iron and steel and abandoned gas pipes which contain steel and copper.; and several types of cables such as lighting cables which contain copper and aluminum (for both high and low voltage), telekom cables containing copper.

(ii) Landfill mining. This category is defined by Krook et al. (2012), as a process for extracting materials from waste materials that previously have been disposed buried in the ground. Although it may sound like it should me an individual category, it is considered part of urban mining. It involves mining the landfills of a city, which usually are placed outside of an urban
area in the peripheries. It has a strong connection to the urban areas, therefore can be categorized as urban mining. According to Franke & Mocker (n.d.) urban mining covers all types of anthropogenic created deposits of material resources and is thus not only limited to exclusively cities. Landfill mining is regarded as a waste while (i) and (iv) are not. Materials worth recycling from landfills vary from minerals, plastics, metals, glass, non-ferrous metals (Franke & Mocker, n.d). Landfill mining is the most used category within urban mining, both in Sweden and other countries such as Germany, Austria, India or Australia (Brunner, 2011; Franke & Mocker, n.d; Arora et. al 2017; Dominish et. al, 2017).

(iii) Urban mining the WEEE (waste of electrical and electronic equipment). This category refers to electronics that are not used anymore and the metals from them can be extracted, recycled and reused. In Europe, this category is the most common, especially in western area, since recycling of electronics is a very common practice (European Commission, 2018).

(iv) Urban mining the building structures. Urban mining can also be seen as an opportunity for circular building since building structures can also be recycled and reused after demolition or renovation. But this method is not as preferred since the already used structures, the same as in hibernating stocks, get deteriorated and do not last as long as long as a new one would. Therefore, the builder and/or user often avoids it in the long run (B. Wallsten, personal communication, March 2018), which can be interpreted as controversial since it collides with the circular economy principles.

An important factor what needs to be mentioned regarding these four categories is that all four are and contain hibernating stocks, this meaning that the metals found in them are no longer in use, hence can be extracted and recycled (Wallsten, 2014; Wallsten, 2013).

Urban mining is a new and complex concept which can be an immense benefit and advantage to several aspects of the society and environment, if done right and carefully. One example of such method is Kabel-X, which uses an easy and environmental friendly way to extract the metals without disturbing the environment (Kabel-X, 2014).

As the concept is relatively new the study and research of the concept is not as wide as one might think. One of the first and leading researches within urban mining was in 1991 in Austria (Baccini and Brunner, 1991) and in 2000 in Stockholm (Bergbäck et. al. 2001; Sörme et al. 2000) where they prospected the metals from the infrastructures. These studies and projects focus on urban mining the metals from different environments such as infrastructures, electronics, landfills or stocks. They are looked at from a sustainable point of view which is the main aspect of this concept.
3.2 Sustainability and Urban Sustainability

The world’s population increases steadily as the years go by, which entails increased consumption, high waste generations and pollution emissions, land use changes and more problems which affect our environment and ecosystems services (MA, 2005). This brings the need for long-term solutions that not only solve the present problems but also future problems that will occur. One way that we can do is through sustainability and to plan our urban areas more sustainably.

Sustainability has today many shapes and forms and has been defined by several different scholars (Hedenfelt, 2013; Campbell, 1996; Pope et. al., 2004). However, the most know and general definition of them all is the one that can be found in the Brundtland report - *Our Common Future* (1987). In the Brundtland report - *Our Common Future* (1987) sustainable development is defined as “the development which meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987:30), while urban sustainability is portrayed as a place where “people want to live and work, now and in the future; where they meet the diverse needs of existing and future residents, are sensitive to their environment, and contribute to a high quality of life; where they are safe and inclusive, well planned, built and run, and offer equality of opportunity and good services for all” (ODPM,2006:12)

Even though the “sustainability” term has been at the same dead end since the Brundland report, it builds on the triple-bottom line or three pillar concept which Gibson (2001) defines it as a model that separates development issues into social and economic factors, emphasizing that “material gains are not sufficient measures or preservers of human well-being” (Gibson, 2001:7). This model (Fig. 2) can be interpreted as sustainable development since it places equal importance on environmental, social and economic considerations in decision-making. The model applies and can be used in urban development as well. As Campbell (1996) states, the goal with sustainable urban development is not to create a utopia, but to identify the conflicts that arise from the three dimensions of sustainability and create practical efforts and solutions to solve those conflicts together several different parties including public or private sector, society etc.
Fig. 1: The triple bottom line or sphere sustainability model (own creation, inspired from Hedenfeldt, 2013)

When talking about sustainability and urban sustainability one has to look at and understand all the three dimensions of sustainability which are the social dimension, the environmental (ecological) dimension and the economic dimension. The interrelation and proper function of these three dimensions form sustainable development (Fig 2). The social dimension refer to societies and the people within societies; how people should thrive in a sustainable societies having equity, good health, freedom and good habitat (Hedenfeldt, 2014). The environmental dimension refers to the environment, or as Hedenfeldt (2014) names it, to the carrying capacity of our planet; in environmental sustainability we must live in a way that allows us to feed ourselves on the long-term resources of nature without destroying the nature. Lastly, the economic dimension of sustainability is interconnected with the first two dimension in where it deals extensively with scarce resources, such as natural resources (natural capital) and labor (social capital) and the costs of them (Hedenfeldt, 2014). One important aspect of economic sustainability is circular economy. A circular economy is “an industrial system that is restorative or regenerative by intention and design” (EMF 2014:13). Circular economy “replaces the end-of-life concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse and return to the biosphere, and aims for the elimination of waste through the superior design of materials, products, systems and business models” (EMF 2014:15).

The understanding of sustainability and urban sustainability is essential in order to succeed with the development and improvement in our societies that was proposed in the Brundlandt report in 1986, not only for our present but for our future generations onwards. By working to improve all
three dimensions of sustainability we can provide that to the urban areas and the future generations.

Sustainability and urban sustainability have a close connection to urban mining since it fits in the circular economic principles, as well as is an environmental and socially sustainable concept.

3.2.1 Sustainability assessment

An important aspect within sustainability and urban development is not only awareness about the problem, but also a way to measure its actual level of sustainability in order to improve it. Measuring sustainability can be done in many ways and with the help of many tools and assessments that can contribute to the shift towards a more sustainable development (Hedenfeldt, 2014; Pope et. al. 2004). There are different types of methods to measure sustainability through, such as assessments, evaluations, monitoring, appraisals, measurements or analysis.

Sustainability assessments can be done on several levels, depending from macro levels to micro (global) level (product). These sustainability assessments are usually based on common indicators that can be about different parts of the city such as energy systems, flows, infrastructure, buildings, ecosystems, material flows and residents (Hedenfeldt, 2014). Also refers to methods for determining the sustainability of the city and urban development.

Assessments are usually done on: projects, individuals, households, organizations, infrastructure, energy systems, transport systems, buildings, districts, cities, regions, countries and continents etc. In common, the most sustainability analyzes are based on indicators of various kinds, which say something about state or change in the city and its development.

One way of doing this is through different types of assessments such as EIA or the sustainability assessment. Pope et. al. (2004), who quotes Devuyst (2001), defines the sustainability assessment as “a tool that can help decision-makers and policy-makers decide what actions they should take and should not take in an attempt to make society more sustainable” (Devuyst, 2001, p. 9)

One of the most used assessment in Europe’s sustainability work is the environmental impact assessment. The International Association for Impact Assessment defines environmental impact assessment as "the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made" (Senécal et. al., 1999:2).

The environmental impacts assessment contributes helping the long-term objective in ensuring a sustainable economic development that meets present needs without compromising future generations’ ability to meet their own needs. Therefore, the environmental impacts assessment is...
an important tool in the integrated environmental management approach in regard to plans, projects or policy implementations.

To the extent that urban mining and urban mining methods for instance are development proposals as well as processes, an environmental impact assessment would be fit to be done prior to its implementation, if that ought to happen. The understanding of such assessments is crucial to measure if an action or method are sustainable prior implementation or for improvement.

3.3 Urban metabolism

Urban metabolism can be defined as “the sum total of the technical and socio-economic processes that occur in cities, resulting in growth, production of energy, and elimination of waste” (Kennedy et al., 2007:35). In urban metabolism, according to Hedenfeldt (2013) energy and materials are in focus in a holistic way. Urban metabolism is part of the industrial ecology field. Industrial ecology combines a metaphor with a set of methods and models that help to “quantify the interactions of urban systems and the environment, particularly the consumption of nonrenewable natural resources, frequently imported from beyond the immediate urban boundaries, and the release of different types of wastes and emissions” (Ferrao & Fernandes, 2013:18).

The valuation of urban metabolism can be done through four quantitative tools which evaluate biophysical processes in urban areas: material flow analysis, substance flow analysis, energy flow analysis and environmental footprinting. These assessments carry out various scopes that for example can depend on one’s interest lies in flows of resources, substances or energy (Wallsten, 2015). These assessments help us understand the cities and by using a suitable assessment according to motive or situation, one can discover valuable information that can lead to suggestions in policy improvements.

The reason for choosing urban metabolism in the theoretical section is because to better understand urban mining, an urban metabolism perspective need to be pointed out. Urban metabolism usually has, according to Conke and Farreira (2015) four main purposes. The first one refers to assessment of materials and energy flows throughout a city; the second one is to quantify greenhouse gas (GHG) emissions; the third and fourth utilization uses material and energy evaluation to support decisions concerning public policy (Conke & Farreira, 2015). By evaluating the flows of materials and energies, as well as quantifying GHG for instance, the results would show more efficient and sustainable resource management, less environmental burden (pollution, sewage treatment, resource scarcity, water shortage), waste management, enabling a better awareness of how much impact human activity (social, economic and political) is causing in the natural environment which improves and makes public policy settlements easier to implement. With the help of the accounting models, which show the choices that best balance
the sustainability dimensions, advancements with lower ecological effects can be implemented (Conke & Farreira, 2015). For example, measuring resource consumption and by making recommendations based on the discovered data one can contribute with policy suggestions or targeted recommendations for reducing consumption or increasing access to specific resources (Musango et al., 2017).

The understanding of urban metabolism is essential in both urban sustainability and urban mining. According to Wallsten (2013) a city is interesting to look at from the urban metabolism perspective, because of all the materials that can be found within, materials people and other urban organisms consume and dispose, because of materials in the buildings and infrastructure of the urban fabric. All these materials and organisms will one day eventually end up as waste, most likely in landfills, some of which are harder to dispose, for instance plastics (1000 years to decompose) and metals (50, up to 500 years to decompose depending on the metal) (Eri, 2016). Therefore, recycling them is a sustainable solution than disposing of them is required. One solution being urban mining to recycle and re-use the metals found in urban areas.

3.3.1 Material Flow Analysis (MFA)

The material flow analysis is a quantitative method that can answer and/or show how much materials and metals can be found in the Anthropocene, landfills, and buildings as well as in any other human or non-human entity in different regions or nations (Kennedy et. al. 2011). Hedenfeldt (2013) depicts it as a method to measure sustainability within the urban metabolism of a city while Wallsten (2015), depicts the material flow analysis as is to a large extent an accounting exercise aimed at quantifying the stocks and flows of a certain material in a certain geographically defined context and time period (Kennedy et al., 2011; Wallsten 2015).

It is important to mention that a material flow analysis is used as an assessment and evaluation of the urban metabolism of an urban area This assessment measure substances, flows, energies and the biological productive areas that people use and help both private and public actors better understand cities.

If public and/or private actors would find themselves using a material flow analysis to measure metals and materials in an urban environment, they shall first and foremost start by collecting the data for the material flow analysis. According to Wallsten (2013), this can be done by either a top-town or bottom up approach. The top-down approach follows the principle of input-equals-output, where the input flows of natural resources, energy flows, goods and materials inside a specific place and the output of the same flows of waste and emissions are compared (Wallsten, 2013).
Figure 2: Example of top-down material flow analysis framework. (Reproduced from Shafie et. al. 2016)

The bottom-up approach consists of records of components that contain the material the actor is interested in. In the bottom-up approach the materials are usually located in for instance buildings, infrastructure and electrical gadgets. The data could also influence political decision-making, underpinning policies for continued economic growth and sustainable development (Eurostat, 2017). Material flow analysis is an essential assessment within urban metabolism, without it, one cannot understand and measure urban metabolism in order to build and plan for urban sustainability, moreover, urban metabolism is essential for recycling processes and waste management for achieving sustainable cities.
4. Empirical Discoveries and Analysis

The background chapter (1.1) as well as the problem speciation chapter (1.2) contributed to problematize the concept of urban mining. This chapter however will present and demonstrate the complexity of these topics and further “dig in” to answer the research questions in concordance with the theory section from chapter 3.

4.1 Literary research

4.1.1 Kabel X vs. Conventional Method

During the literary research it was discovered that there exist several methods of extraction within urban mining. In this section it will be presented the Kabel-x method in comparison to the conventional one. The reason for choosing this method and not another is because this method is presented to be more advantageous in several ways. This section will look at that and analyze if the Kabel-X can be considered as a sustainable urban mining method.

Kabel-X is an Austrian company that developed a technology that goes by the same name, to recycle metals from buried cables while installing fiber optics in the old cables. This method is really cost effective since it does not require a lot of workforce (three to four people), as well as does not require a lot of time either (approximately four hours) (Miljönytta, 2011). According to the company’s specifications (Kabel-X, 2014) the technology is relatively simple which implies using an eco-labeled oil which is pumped into the cable between the outer layer and the cable core (Fig 4 & 5). The core later is pulled out with the help of a hydraulic winch and a fiber cable is inserted instead. In order to successfully proceed with this technique two access point are dug up (access could be done through a sewer cap) that are situated at an approximate distance of 150 m up to 400 m max where the cables are cut in order for the substance to be injected. (Kabel-X, 2014)

Fig. 3 & 4. Illustration on how Kabel-X method works (Kabel-X, 2011)
Krook et al., (2015) who cites Pochhacker and Furman, present the Kabel-X method as well as the conventional method of extraction in a comparative way where they present both the positive as well as the negative consequences of the two approaches. The traditional method of excavation is quite basic where machineries are used to dig up and disturb the infrastructure in order to reach the desired product, this case the cables. In order to do a traditional excavation method the traffic in the surroundings need to be shut down as well as several workforce needs to be hired to maneuver the machineries. This leads can lead to traffic congestion as well as extra costs for several parties. The table (Table 3) below will present both of the approaches so that they show relevance to this thesis.

<table>
<thead>
<tr>
<th>Urban Mining Methods</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Conventional Cable Extractions</strong></td>
<td><strong>Kabel-X Method</strong></td>
</tr>
<tr>
<td><strong>Pros</strong></td>
<td><strong>Cons</strong></td>
</tr>
<tr>
<td>Old, secure, tested method</td>
<td>Uncertainties with the method</td>
</tr>
<tr>
<td>Expensive</td>
<td></td>
</tr>
<tr>
<td>Complicated digging technology</td>
<td>Non-digging technology with no excavation</td>
</tr>
<tr>
<td>Non-pleasant visual aspect</td>
<td>No effect on visual aspect</td>
</tr>
<tr>
<td>Minimal workforce</td>
<td></td>
</tr>
<tr>
<td>Traffic rerouting</td>
<td>No traffic rerouting</td>
</tr>
<tr>
<td>Can be done in city center areas</td>
<td></td>
</tr>
<tr>
<td>Duration 5+ hours</td>
<td>Duration 1-5 hours</td>
</tr>
</tbody>
</table>

Table 2: Methods for urban mining extraction

According to Krook et al (2015), who analyzed the two methods for extracting hibernating copper cables, the one that does not implicate conventional extraction through digging is for obvious reasons more environmental friendly. Advantages with using Kabel-X is that it is more cost effective than compared to excavation and the time necessary to extract the cables is reduced. The equipment necessary is cheap and simple and more environmental friendly than the machines used for excavation. It reduces the amount of necessary planning and need for permissions since the impact on the land is reduced compared to excavation. (Larsson, 2013, who quotes Neuendorff, 2008).

Only issues with this method is that is still quite new and not a lot attempts have been done with in. The researchers from Linköping University are studying and working a few pilot projects with this method so it can be safely used later as an easy extraction method for recycling metals. In 2013, a pilot project was conducted with Kabel X method in Malmö, which, according to the few sources that were found (Dundas et. al. 2013, Westman Svenselius, 2016; Wallsten, interview, 8 March 2018) seemed to have been successful. Apparently, they successfully extracted 90 meters
of copper with a value of approximately 15,000 SEK in two days with no damage whatsoever to the environment or surroundings (Westman Svenselius, 2016).

Besides not being used so many times, there are of course disadvantages and challenges too that can occur with such a method which are important to look at. For instance, environmental issues are important to be aware of. An example of such an issue is that a leak from the pull out method can occur which can damage the groundwater which could lead to non-potable water due to hydrogen sulfide contamination.

All in all, it can be stated that this method is considered a sustainable urban mining method for extraction in urban areas, if a traditional method would be excluded or not considered as an analysis before a construction project. It favors all three dimensions of sustainability by not damaging the environment, being cheap, not disturbing the surroundings like a traditional excavation project would, by not damaging the habitat of the people and by contributing to the regeneration of the scarce resources as well as by putting the materials back into recirculation as in circular economic principles.

The method is sustainable based also on the sustainability assessment because if measured and assessed this method provides “decision-makers and policy-makers decide what actions they should take and should not take in an attempt to make society more sustainable” (Devuyst, 2001, p. 9). The fact that it contributes to both urban metabolism implicitly contributes to urban sustainable development because it is a processes that as according to Kennedy (2007) occurs in cities, resulting in growth, production of energy, and elimination of waste.

4.1.2 From Urban Mining to Urban Metabolism

For both implementing and succeeding an urban mining project, the interested actors, from either public or private sector, need to first and foremost understand the challenges as well as possibilities with urban mining in order to later do a material flow analysis. The material flow analysis helps the interested actor to measure the amounts of desired metal in the built environment without doing an excavation or a mining process. To be able to do a material flow analysis one needs to understand how the urban metabolism of a city works to subsequently extract the metal, this case copper. The circulation of metals in urban environments are essential to the society because they are the main material for products infrastructure, transport, food production, housing, water treatment, and energy generation which are essential to humans in both urban and rural areas (Dominish et. al. 2017).

Since urban mining is about extracting the resources from urban areas and, as Ferrao & Fernandez (2013) are saying that all societies have their own metabolism where they extract raw
materials from nature, natural goods, transform materials and energy within economic systems, provide goods for domestic and foreign demand, it’s certain that urban mining can be regarded as part of urban metabolism. Within urban mining then, urban metabolism will have four purposes (Conke & Farreira, 2015) which shall assess the materials and metal flows throughout a city and to use material and energy evaluation to support decisions concerning public policy. The results would show more efficient and sustainable resource management, less environmental burden and waste management. It would also enable a better awareness of how much impact human activity (social, economic and political) is causing in the natural environment which improves and makes public policy settlements easier to implement. In order to analyze and establish public settlements sustainability assessment can complement urban metabolism when urban mining. Since any project, policy implementation or plan needs an assessment of this kind, then it is expected that an urban mining, especially in an urban area proceed with such an assessment. Sustainability assessments as well as urban metabolism help private as well as public owners in decisions regarding policies for such a project (Conke and Ferreira 2015; Senécal et. al., 1999; Holder 2014). A material flow analysis on copper stocks (from for instance cables and pipes) can make recommendations based on the estimates, and recommendations can be sought for alternative methods for copper substitution within infrastructure systems, replacing it with other materials or the most likely scenario to improve the waste and recycling management regarding metals.

Copper as material is the third most popular metal in the world since it is used metal within electronics since it is a good conductor of electricity (Wallsten 2015). Wallsten (2015) depicts several environmental arguments for copper recycling such as water pollution due to the leaching of toxic heavy metals from traditional mining such as arsenic, molybdenum and lead, and airborne sulfur dioxide emissions. Wallsten (2015) also names that “half of the copper that is estimated to be estimated to be produced and used has already been extracted” (sustainability perspective). Since the demand of copper is increasing and is expected to increase in the future (fig. 2) and the scarcity of copper is getting more and more usual since the prices have been rising since 2000 (fig. 3), the necessity for copper recycling must be considered and implemented in order to meet the principles of all three dimensions of sustainability and for our future generations to actually have resources left.
Fig. 5 – Copper mining – Global demand to 2080 – approximate end-of-life of copper. *Source: thebusinessofmining.com*

Fig. 6 Historical copper prices and price chart. *Source: infomine.com*
4.2 Interviews

4.2.1 Attitudes and Insights on Urban Mining
In order to provide an understanding of the potential and challenges of urban mining and Kabel-x urban mining method Malmö, this section will present and analyze the interviewee’s different understandings and attitudes of both the urban mining and Kabel-X method. These understandings will help provide a well-grounded analysis help answer the research questions.

Knowledge-gap
What is both interesting, challenging and worth researching with the concept of urban mining is that it less knowledgeable to world. There seems to mostly be knowledge about this concept and methods to implement and carry through an urban mining project mostly within the academic sector and within its research field. Wallsten (interview, March 2018) was the only interviewee who has knowledge about the topic and about the Kabel-x method and who also works within the field. When asked about this issue he confirmed the existence of a knowledge-gap, especially in the public sector. He stresses that “it can depend on the knowledge gap and it can also be related to the Swedish industrial sector. We used to rely quite a lot on the industrial efforts, […] there's forestry, mine extraction, water power, wood and stone/rocks. These are the basic components of the Swedish economy that made it prosperous in relation to the industrial revolution. That's what a lot of politicians think they need to focus on” (Wallsten, 7 March 2018). This can be understood as a challenge in regards to several aspects of an urban mining implementation because a knowledge gap can affect not only policy usage and implementation about urban mining, but also the attitude towards an implementation.

Even though he now works with both public and private sector within urban mining projects Wallsten (interview, March 2018) emphasized the fact that it was a long and hard process to convince the stakeholders that are presently involved into taking on such a project. “There were hesitations if you put it that way since the project would be included in everyday work of infrastructure, maintenance and up-keeping. There are difficulties with extracting cables and engaging these projects in a very real and tangible practice related sense” (Wallsten, interview, March 2018). To convince the authorities and the stakeholders would in this case depend on the lack of knowledge about the topic. By knowledge gap here it can be understood as lack of information regarding the circular loop or the re-usage of the already used products, the so called hibernating cables.

According to Wallsten (2018) there is a need for change regarding policies about this concept, ergo about waste management which makes it consequently difficult if there is no knowledge about the topic. “On the other hand, from my point of view, it has everything to do with how the
infrastructure is organized and that is something we can't make decisions about. And we if can rearrange it by staging different ways that incorporate such ideas such as this, which I believe that there are good arguments for a rearrangement” Wallsten (interview, March 2018).

In regards to the Kabel-X method there exist of course disadvantages and challenges too. The knowledge gap that was mentioned by Wallsten (interview, March 2018) seems to reoccur in regards to Kabel-X method too. This can be understood as a challenge towards this method since people have little or almost zero knowledge about it.

On the other hand, when P.A Nillsson (P.A. Nillson, interview, 7 May 2018), S.P Larsson (interview, 27 April 2018), Person 3 and 4 were asked about the topic they had very limited knowledge about the topic. The only information they had about urban mining was that they heard of it but had slightly any idea what it actually is. The same is about the Kabel X method. The contact person from Sysav (Person 3, personal communication, 24 April) had knowledge about the urban mining concept, but he confirmed that their business does not work with urban mining. However, he also named that they have businesses regarding landfill mining, which demonstrates that there is work and potential for metal extraction and recycling. That is considered positive since landfill mining addresses to problems such as long-term methane emissions, local pollution concerns, settling issues and further urban development (Krook et. al. 2012).

The rest of the persons who were contacted in relation to this thesis had no idea whatsoever about the topic, but as P.Karlsson (P. Karlsson, personal communication, 9 May 2018) for instance or the representatives from Gatukontoret, were willing to answer questions after the concept was briefly presented to them. Although, when asked through personal communication Person 1 and 2 answered that they do not know about the topic and they don’t see themselves as stakeholders, then redirecting me towards energy companies such as E.ON (Person 1, personal communication, 13 April 2018; Person 2, personal communication 21 May 2018).

According to Wallsten (2018, interview, March 2018) in order to be able to implement such project it has to be integrated in a country’s waste management as well as into politics. Although he disappointedly mentions that swedes take this for granted and that due to this it becomes problematic because “as it comes to resources and resource management/politics, it's clear that we (swedes) are less ambitious than many other countries”.

The fact that there exists a knowledge-gap makes it challenging for one to implement an urban mining project or to use a Kalbel-X method, but at the same time not impossible. Most of the interviewees had some kind of knowledge about the topic, even if it was really limited, which shows potential for implementation and interest.
Interest and Skepticism

A second interesting aspect that has been noticed during the interviews was that interviewees showed a great deal of interest within the topic despite the fact that they had little knowledge about the topic. On the other side they had also shown skepticism regarding its implementation and the usage of the Kabel-X method.

The fact that the interviewees were skeptical makes it a challenge for implementing urban mining and using kabel-x method, but at the same time it makes it also a possibility since people work better when skeptical, work more carefully, the double check stuff. For instance, E.ON representative P. Karsson (interview, May 2018) said that “if it is economically justifiable or that the environmental benefits outweigh the costs of taking up the cables, it can certainly be applicable” which proves the interest and possibility of working with urban mining in Malmö but with a tone of skepticism.

As named in the introduction urban mining is also named in Sweden’s strategical research and innovations agenda on waste and waste management in Sweden (RE:Source, 2015). However, this statement collides in a sense with Wallsten’s statement (interview, 7 March 2018) that Sweden is less ambitious when it comes to resource management in the sense that the agenda claims that the waste management is effective in Sweden while Wallsten does not. This can be understood that from a sustainability point of view Wallsten is quite skeptical about such an implementation within a waste management policies. This skepticism and this way of thinking could also be on the grounds that he is a researcher within the domain and his job is to look at the critique too but at the same time clashes with the fact that Sweden has signed the Agenda 21 (UNCED, 1992) and follows the sustainable development goals so that is why perhaps he means on a political level.

4.2.2 Sustainability Perspective of the Interviewees

In order to implement urban mining and Kabel-x in a sustainable way there is a need to look at it and plan it in a holistic way. This includes not just the economic incentives, which can be fairly considerable, but also social as well as environmental. One shall also think about what other processes such a project includes, for instance what happens with the extracted material after the process, where is it going afterwards, if it gets back into recirculation, social values and so forth. These issues have been discussed during one of the interviews with E.ON (S.P. Larsson, interview, 27 April 2018).

Urban mining represents the early stages of a circular economic loop since it does not necessarily end the loop, i.e. it does not end with the product after it is recycled. So, in those terms urban mining can be seen more like waste management within circular economy. Wallsten (interview, 3 March 2018) also names this during the interview where he finds circular economy problematic
as well as challenging in that sense: “one needs to determine such economy, because you need to think how long a circle is actually, how a circle extended in time can be. I mean it's one thing if you have the ambition to recycle the components for over like decades. In relation to that term you need to be more specific with what you mean, I mean how long does it take to close the loop, what is the geography of these, how big or small are they etc. And there’s plenty of things that are problematic in that sense. But on the other hand, I can absolutely support the sort the basic premises of circular economy, go from stocks to flows, if that makes sense, as long as you don't include toxic and poisonous material” (Wallsten, interview, 7 March 2018). This makes it challenging on the grounds that the concept of urban mining “is advertised” as a sustainable solution within circular economy when in fact the challenges of a holistic approach are either disregarded or not known.

He also stresses that urban mining can be used for material recycling or product reuse essentially, but then in case of infrastructures he discovered that no actor in such sector would reuse a cable that has been taken out of use in a sense that you repair it and then put it back in the ground. “Compared to a newly installed component which is top notch when you install it for the first time since you have this long time spans you want to be sure that it will actually deliver all those amounts of years” (Wallsten, interview, 7 March 2018) This can be understood as challenging if actors refuse to close the loop because it would mean a problematic implementation. “The actors want to be sure of the life span of the component, you want that the stuff you install to last years, they want this to be a condition. It’s like in their sort of view, when one updates it should be a new component” (Wallsten, interview, 7 March 2018). This point of view is totally understandable since companies would not want to invest in something that will not last. At the same time it makes it even more challenging towards circular economy because then the recycled products are not put back in the loop. At present day even E.ON owns such cables that have been recycled and are not used (P. Karlsson, personal communication, May 2018). The criteria for why this happens has not been discovered, but it can be stressed that one of the reasons for such attitudes towards usage of recycling cables if the certainty of a long life span as Wallsten (2018) stressed.

Aspects regarding social values or social impact of urban mining have been discovered during the interviews. Urban mining can both bring possibilities and challenges to the social dimension of sustainability (S.P. Larsson, interview, 27 April 2018; P.A. Nilsson, interview, 7 May 2018). Urban mining favors social sustainability, from worker safety and occupational health, to matters of community stability, cultural integrity and indigenous rights (Bridge, 2004). It can also create jobs which according to P.A. Nilsson (interview, May 2018) is a very positive aspect. He also mentions that it brings a unique and catchy image with it, which would bring positive aspects to the social factor. At the same time it can also take away jobs in the sense that, if successful, then there is less traditional mining ergo less jobs in mines. It also provides less jobs compared to traditional method where usually more workforce is needed to maneuver the machines. Urban
mining from a social sustainability point of view would, according to Wallsten (2015) decrease social conflicts such as mining projects which can provoke issues of ownership and exercise of rights to land and water, and the often conflicting legal and moral rights of affected local communities.

Urban mining favors environmental sustainability the most. Basically, urban mining is a more environmentally friendly alternative than traditional mining and traditional excavation method. In a realistic world the urban mining concept cannot completely take over copper production and usage of metals. Secondly, it favors environmental sustainability since the damage on the environment is not as great as with traditional mining (Wallsten, 2013;2014;2015; interview, 2018). The challenges of urban mining regarding the environmental dimension of sustainability have also been discussed with the Miljöförvaltningen representative as well as with the E.ON Energy Distribution representative where they both believed that it is essential to look at both the positive aspects as well as the difficulties regarding urban mining.

Karlsson (personal communication, May 2018) stresses that “if it is economically justifiable or that the environmental benefits outweigh the costs of taking up the cables, it can certainly be applicable. The method of using oil to pull out the metal feels a bit difficult depending on the location. Should a leak occur and the oil enters the groundwater, the decomposition will be anaerobic and then the water will be contaminated with hydrogen sulfide for instance which that would make it undrinkable” (P. Karlsson, personal communication, May 2018). The attitude towards the leakage was also discussed and mentioned during the Nilsson interview where he mentioned the similar issue when the Kabel-X method was discussed.

4.2.3 Ownership

One of the criteria to successfully implement an urban mining project in Malmö is the ownership of the cables. These issues need to be known and analyzed in order to understand possibilities and challenges of urban mining in such a city. In the interviews, through personal communication and from the existing research, it was discovered that both the private and the public sector are stakeholders and owners of these hibernating cables and pipes (P.A. Nillson, interview, 7 May 2018; P. Karlsson, personal communication, 9 May 2018).

In the case of Malmö city some of the identified owners of hibernating cables and pipes are E-on, Gatukontoret and VA-Syd (P.A. Nillson, interview, 7 May 2018; P. Karlsson, personal communication, 9 May 2018). According to the representative from E-ON, they own power cables that are buried underground, both in operation, discontinued or wrecked. Wrecked refers to cables that are scraped, discontinued refers to reusable cables (reconnected completely or partially). He also believed that the prices for raw materials would play a crucial role for one to consider such type of action and project, which is why one needs to be careful (P. Karlsson, personal communication, May 2018). Moreover, it was confirmed that E.ON own over about 380
km distributed on approximately 5600 cables underground in Malmö which are unused (P. Karlsson, personal communication, May 2018).

Previously, the cables were made out of and containing copper, but nowadays they are made of aluminum. Power cables are often located on sidewalks, walk paths or cycle paths. Newer cables often lie in protective pipes when crossing roads, but not otherwise. The cables are usually co-localized with district heating, cable TV, telecom cable, fiber, signal cables and water and sewage pipes, which places great demands and precautions on all work in the field (P. Karlsson, personal communication, 9 May 2018).

The extraction of hibernating cables is not economically feasible to implement on its own in urban areas to exclusively extract the cables. This was also confirmed by the E.ON representative, P. Karlsson (personal communication, 9 May 2018) who said that “this is probably not appropriate because it is likely to leave cavities which eventually causes soil settlements and damage to surrounding structures”. A feasible solution within urban areas is to implement such a project within another project, like for instance an archeological analysis, which happens beforehand. Although, this requires judicial aspects that need to be considered and improved. On the other hand, the representative from Malmö municipality, Per Arne Nilsson (interview, 8 May 2018) did not find this problematic. He was highly confident that this issue can be easily solved and dealt with the help of a lawyer which he even offered to invite for a meeting if such project would be presented. Quote: “I don't know if they are doing some work with these issues, because I suppose they have responsibility for the old cables and what's happening with them. I can imagine that there's a lot of cables everywhere. The question about responsibility is of course interesting and that could be looked at. If there's some issues about what the law says we have a very good jurist (lawyer) at out office that could help, we can ask her to take part in a meeting in the future” (P.A. Nilsson, interview, 7 May 2018).
5. Results

By analyzing the discoveries of the literary research and the interviewees’ different understandings and attitudes of both the urban mining and Kabel-X method, insights such as knowledge-gap, interest, skepticism and ownership occurred. Furthermore, urban mining and Kabel-X method have been discussed and analyzed from different perspectives such as sustainability and urban metabolism. All these discoveries and aspects put together helped provide answers to the research questions which have guided this thesis throughout the whole process.

Q. What are the possibilities and challenges of working with urban mining in Malmö?

Regarding the first research question, the interviewed stakeholders believed in the possibility and in the potential of urban mining and showed interest by confirming the existence of the metals that can be found in the infrastructure (P. Karlsson, personal communication, May 2018). However, they were also skeptical and mentioned that it would be challenging as well since such a project requires more than just an economic incentive (S.P. Larsson, personal communication, 27 April 2018). This makes it both challenging and possible since skepticism has positive aspects too such as working harder and more carefully, which would consequently lead to a proper implementation.

It would also be challenging because of the knowledge gap on both waste management, on the concept and on the method (B. Wallsten, interview, 3 March 2018). E.ON representative believed it would be too costly before knowing about the alternative method because it would cause unwanted interference with other infrastructure causes (P. Karlsson, personal communication, 9 May 2018) but after presenting the Kabel-x method the attitude towards urban mining shifted entirely. However, both Karlsson (personal communication, May 2018) and Nilsson (interview, 7 May 2018) remained skeptical about the environmental effects since they believed that if it’s not hundred percent sure than it could affect the groundwater. There was skepticism regarding the social aspects too where S.P. Larsson (interview, 27 April 2018) named the importance of the social dimension of sustainability; that one needs to look at it from a holistic way not only to present the economic incentive.

The ownership of the cables is also an important actor that needs to be considered regarding the implementation because it also shows a challenge. Identifying the right owners and stakeholders takes time, as well as to convince them about this process. In order to make it possible, the stakeholders as well as the owners need to be informed about the feasibility of the process as well as about economic incentives in order to start extraction.

Regarding the sustainability perspective the interviewees have showed and proved that there would be both possibilities and challenges when asked about the implementation of urban
mining. Urban mining, as Wallsten (interview, March 2018) depicts represents the early stages of a circular economic loop since it does not necessarily end the loop, i.e. it does not end with the product after it is recycled. So, in those terms urban mining can be seen more like waste management within circular economy, which is also an important aspect to consider when looking at urban development. This makes it challenging on the grounds that the concept of urban mining “is advertised” as a sustainable solution within circular economy when in fact the challenges of a holistic approach are either disregarded or not known.

Urban mining favors social sustainability, from worker safety and occupational health, to matters of community stability, cultural integrity and indigenous rights, decrease social conflicts. Urban mining favors environmental sustainability most since is a more environmentally friendly alternative than traditional mining and traditional excavation method. The challenges of urban mining regarding the environmental dimension of sustainability have also been discussed with the Miljöförvaltningen representative as well as with the E.ON Energy Distribution representative where they both believed that it is essential to look at both the positive aspects as well as the difficulties regarding urban mining. Some difficulties that occurred were oil leaks or water contaminations. Urban mining meets the circular economic needs and criteria since it does not compromise the natural resources, nor the environment that will be needed in the future, but instead embraces the urban infrastructures’ hidden and forgotten gems.

Recycling requires much less energy than actual mining which is the case of urban mining (Wallsten, 2014). This shows strong incentive and possibility since Malmö city already deals with several different kinds of recycling and waste management (P.A. Nilsson, interview, 7 May 2018).

**Q. In what way can the Kabel-X method be considered a sustainable urban mining method for urban development?**

In regard to the second question, the empirical findings have showed that Kabel-x is a sustainable urban mining method from several points of view. Firstly, the main aspect that shows the method is sustainable is that its main focus is to recycle the metals, which implicitly contributes to ecological sustainability by using secondary materials and not primary raw materials as well as complements traditional mining which consequently leads to less damage to nature. The method of extraction also uses an eco-labeled oil which is neutral to the environment and surroundings.

Regarding economic sustainability, Kabel-x would cost less as the production as well as maintenance costs are low, as well as it coincides with circular economic principles since it extracts and recycles a material that later will close the loop. Lastly, from social sustainability point of view the presented method is suitable since it could create jobs as well as it is providing worker safety and occupational health, to matters of community stability, cultural integrity and indigenous rights compared to traditional mining and traditional method.
Kabel-x method also contributes to urban metabolism, which is an important factor within urban sustainability because it is an urban mining method which is according to Kennedy (2007) part of the technical and socio-economic processes that occur in cities, resulting in growth, production of energy, and elimination of waste. Material flow analysis as a measurement assessment for this method helps to understand urban metabolism, ergo will lead to sustainability.

Based on Pope et. al.’s sustainability assessment, Kabel – X is sustainable method because it is based on different types of indicators which say something about state or change in the city and its development (Hedenfeldt, 2014).

Therefore, based on sustainability and urban sustainability theories, sustainability assessment, urban metabolism that were presented in the theory section (ch. 3) it can be said that Kabel-x method is sustainable.

**Q. What are the possible challenges for the implementation of Kabel-X urban mining method in Malmö?**

Lastly, regarding the third question the method entails challenges too which are important to understand. As the E.ON representative and Miljöförvaltningen representative (P. Karlsson personal communication, May 2018; P.A. Nilsson, interview 7 May 2018) mentioned environmental issues can occur, such as groundwater contamination for instance. Other challenges for implementing Kabel-x urban mining method in malmö are represented by the knowledge-gap and skepticism the interviewees and stakeholders showed towards it (Nilsson, interview May 2018; Larsson, interview, May, 2018; Karlsson, personal communication, 2018).

Challenges such weather or not it is economically justifiable or that the environmental benefits outweigh the costs of taking up the cables were brought up (Karlsson, personal communication, 2018) as well as the fact that it can both take away jobs but also provides jobs compared in comparison and concordance with traditional mining. Holistic issues such as what happens with the extracted material afterwards were accounted for as challenging (Larsson, interview, May 2018). Lastly, the fact that companies often don’t want to use re-used products because they want to ensure longevity were also accounted as challenges in regards to this method (Wallsten interview, March 2018).

What remains questionable is that the usage of this method is why it did not continue with further extractions in Malmö even though it was successful. “The results and the outcome about the pilot study were quite beneficial, we made 3 attempts on 3 different cables in the central of Malmö and I think 2 out of 3 were successful. But this was a short cooperation, so I don't know if they developed a study, a scale to receive more, so I don't know how it is going for this company now or what are they doing” (Wallsten, interview, 7 March 2018).

All in all, the strengths of the results of this thesis are that there is great interest within such recycling and project as well there exist materials and cables underground that can be extracted.
The weakness with these results is that there exists a vast knowledge gap as well as skepticism within both the concept of urban mining as well as within the Kabel-x method among the interviewees and stakeholders.
6. Discussion and Conclusion

In this thesis the topic of urban mining was depicted and its possibilities and challenges in the city of Malmö as well as possibilities and challenges with the implementation of the Kabel-x urban mining method. Urban mining hasn’t been implemented yet, let alone heard much of in this city, which was the incentive and reason for writing this thesis. From the research it was discovered that the reason for that is little understanding about urban mining which depends on the knowledge-gap among stakeholders and actors, even though the recycling and waste management is very well known and implemented aspect within Malmö. All the dimensions of sustainability were looked at and analyzed and urban mining seems to most favor environmental and economic sustainability while social sustainability could use improvements. This meaning that the social aspects of urban mining needs to be highlighted and even looked at more, especially in concordance with the social sustainability aspects.

Since people, stakeholders and municipalities have little knowledge about the topic, it is believed that an implementation of such a concept within a building project for instance can be problematic at this stage. It is problematic because of the judicial aspects as well as because the knowledge gap. Although, if all the presented criteria are considered then an urban mining project can be implemented as such. On the other hand, the municipality and E.ON representatives seemed positive about the potential, which leads to the conclusion that if a robust and sustainable method, such as the one presented in this thesis, is used then urban mining can definitely be carried through in Malmö. It is believed that Kabel-x, because of its innovative, simple and sustainable process, can ease urban mining in Malmö, and make it more attractive to stakeholders, because it is more suitable from all three of sustainability’s aspects.

This thesis contributes to current research by researching its possibilities and challenges in Malmö city since it has not been researched before, besides the estranged Kabel-X pilot project. It is strongly believed that further research is needed since most of the global copper is considered to have been extracted already, which leads us to the challenge of only recycling what has been introduced in the infrastructure. In order to do that, a more concrete mapping of the copper should to be done which would show the exact amount of hidden gems in our societies’ infrastructures. Tools for valuing the recycling potential of secondary metals and minerals is missing (Gylesjö et al., 2015). This leads for a need for more research as well as knowledge dissemination about the topic, both in Sweden and around the world. Due to the fact that there is minimal knowledge about urban mining, both in Malmö and other European cities it is believed that it would be worth researching and improving where does this knowledge gap lie and why, so a better understanding of it can be portrayed.
7. References


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Figures and Tables:

Fig.1: The triple bottom line or sphere sustainability model (own creation, inspired from Hedenfeldt, 2013)


Fig. 3& 4 - Kabel-X. (2014, June 23). How Kabel-X Works. Retrieved April 26, 2018, from http://www.kabelx.co.uk/how-kabel-x-works/

Fig.5 - https://thebusinessofmining.com/2012/04/15/recycling-the-future-of-mining/

Fig.6 - http://www.infomine.com/investment/metal-prices/copper/all/


Personal Communication:

Hitomi Lorentsson – Project Leader - Stena Recycling

Björn Wallsten – Researcher - Linköping University

Sarah Pan Larsson – Sustainable city development – E.ON

Patric Karlsson – Environmental coordinator – E.ON

Per Arne Nilsson - Head of the Environmental Strategy Department - Miljöförvaltningen

Person 1 - Gatukontoret

Person 2 – Gatukontoret
Person 3 – Sysav

Person 4 – VASyd/MAU
Appendix 1 – Interview Guide Björn Wallsten – 07.03.2018

Ask if I can record the call/conversation for later analysis and transcribing

Describe what I do/study and explain what I wanna do with my research:

After that being said I would like to know more and get a better understanding of the concept of Urban Mining.

What is your take on mining out from buildings, landfills, and hibernating structured - which do you consider to be more profitable, less profitable and why?

Costs - Do you find UM as economically feasible/profitable? Do you think it would be economically feasible/profitable in Malmö? How can it be made more profitable?

Benefits - Could you give me examples of benefits when mining in urban areas (in this case hibernating stocks, since your dissertation has them in focus)

Risks - Can you give me some examples of risks that can occur when conducting an urban mining project

Critique from experts - have you experiences any critique while doing the project as well as your work?

Since we talk about projects, do you think you could talk a little about the project from Norrköpink and Linköping?

Could you talk about the KabelX project. why did the pilot project (KabelX) stop even tough it was sucessful? – no info since 2014/2015

In your work, the Urk world, you research political implications when it comes to the urk world. What is your take on political/judicial implications when it comes to urban mining? how do you think it could be better introduced in a local/national policy/agenda, for instance in a circular economy agenda or even on its own

In a previous interview your opponent asked about the socio-econ, and at the time you hadn’t looked at that aspect. Have you looked at it since then? If so, what are your insights on that?

Would the prospecting of metals be possible in Malmö? (this question might be too broad to ask; I don’t have enough knowledge to back it up)

Have we missed something you think is important? would you like to add something else in relation to the topic?
Appendix 2 – Interview Guide Sarah Pan Larsson – 27.04.2018

Ask if I can record the call/conversation for later analysis and transcribing

Describe what I do/study and explain what I wanna do with my research:

The purpose of this thesis is to identify and/or develop a method for investigating the potentiality and possibilities for urban mining in Malmö city by looking at previous and ongoing research and identifying relevant stakeholders. By doing this the thesis will also contribute with knowledge and suggest novel solutions within urban mining in order to highlight both benefits and/or risks that it can bring to the environment, society and economy.

Urban mining is based on society as a resource base where material accumulating over time is a metal storage that can be used through reuse or recycling. These metals can be extracted from e.g. buildings, infrastructure, landfills or underground. My work focus is mostly on the latter where there are old unused (hibernating) cabling and wires containing metals (such as copper) that could be extracted/recovered, recycled and reused.

Firstly, I would like to know if the concept of urban mining is known to you, if so, what do you know about it? [if the person doesn’t know then I will explain it]

Is E.ON working with urban mining? If so how? Did you know there is a possibility of recycling and reusing the hibernating cables from underground with urban mining?

I’m wondering about ownership of hibernating cables. Is it E.on that owns the hibernating cables that exist in Malmö?

Is there any info on these hibernating cables? How much is there? Where is it?

Do you think there could be benefits with urban mining of the hibernating cables in Malmö if a viable and working method would be developed and/or identified? Can you give me some examples. What about risks? What risks could occur?

Do you think an urban mining project would be profitable if a suitable method would be developed/identified? What is your take in this?

Do you see this concept/method as a potential way to mine the hibernating cables in order to extract more copper? Why?

Have you heard about Kabel-x? [explain what it is] what is your take on E.ON using this method if an urban mining project would be implemented to mine?
I’m wondering about policies regarding this … What is your take on political/judicial implications when it comes to urban mining? how do you think it could be better introduced in a local/national policy/agenda, for instance in a circular economy agenda or even on its own
Ask if I can record the call/conversation for later analysis and transcribing

I’m researching if there is a potential for urban mining in Malmö. One step is to identify relevant stakeholders that could both benefit as well as implement such project.

Firstly, I would like to know if the concept of urban mining is known to you, if so, what do you know about it? [if the person doesn’t know then I will explain it] As you probably know from Wallsten, Urban Mining has a rich potential as well as benefits. Why hasn’t it been developed in Malmö yet? It is after all within circular economy, and there are a lot new building projects ongoing.

Is Miljöförvaltningen working with urban mining? If so how? Did you do you believe an urban mining project that recycles and reuses the hibernating cables from underground with urban mining is possible? How?

What stages need to be taken for implementing such a project? What role would Miljöförvaltningen have in it?

I’m wondering about ownership of hibernating cables. who owns the hibernating cables that exist in Malmö? What relation does Miljöförvaltningen have to them?

Do you think there could be benefits with urban mining of the hibernating cables in Malmö if a viable and working method would be developed and/or identified for mapping the metals? Can you give me some examples? What about risks? What risks could occur?

If, let’s say, a suitable method would be presented do you think it would be used in Malmö? (the method would include both mapping amount of metals and be a method for extraction that is both profitable and env. friendly) -

Have you heard about Kabel-x? [explain what it is] you see this as a potential method for urban mining in Malmö?

I’m wondering about policies regarding this … What is your take on political/judicial implications when it comes to urban mining. How do you think it could be better introduced in a local/national policy/agenda, for instance in a circular economy agenda or even on its own

What so you see as the social aspects of such a project? How can urban mining affect as well as favor the society in your opinion?

Have we missed something you think is important? Would you like to add something else in relation to the topic?