

RE: SOURCE

Rapport inom projekt Fördjupad analys utbildning

Master and PhD theses in waste and resource management at Swedish universities 2010-2016

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Analysis of higher education

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Förord

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Sammanfattning

Examensarbeten på mastersnivå och doktorsavhandlingar på temat avfalls- och resurshantering som publicerats vid svenska universitet och högskolor under 2010-2016 sammanställdes för att samla den nuvarande kunskapsbasen. Urvalskriterierna uppfylldes av 618 examensarbeten och 153 doktorsarbeten.

Examensarbeten identifierades vid 22 lärosäten och doktorsavhandlingar vid 17. De största lärosätena för examensarbeten var KTH (27%), Lunds universitet (22%), Chalmers (15%), Linköpings universitet (6%) och SLU (6%). De största lärosätena för doktorsavhandlingar var KTH (25%), Chalmers (18%), Lunds universitet (15%), Högskolan i Borås (8%) och Luleå tekniska universitet (7%).

Ämnen: De största temaområdena för uppsatserna och avhandlingarna var återvinning, energiutvinning ur avfall samt lean. Inom energiutvinning ur avfall var de flesta examensarbetena inriktade på biogasproduktion, medan doktorsavhandlingarna hade lika stor inriktning på utvinning av biobränslen och elektricitet från avfall.

De flesta examensarbetena hade en teknisk/naturvetenskaplig eller systemanalytisk inriktning. De flesta doktorsavhandlingarna hade en teknisk/naturvetenskaplig inriktning på processoptimering och behandlingsmetoder.

Uppsatser och avhandlingar med en systemanalytisk inriktning var främst inriktade på att utvärdera produkter och processer utifrån miljöaspekter eller ekonomi. Det fanns ett mindre antal arbeten inriktade på sociala aspekter av avfallshantering.

Skala: Examensarbetena var i större utsträckning inriktade på ett bredare perspektiv av avfalls- och resurshantering jämfört med doktorsavhandlingarna som i större utsträckning fokuserade på processnivån.

En större andel av examensarbetena utfördes i samarbete med företag, jämfört med doktorsavhandlingarna som främst utfördes experimentellt i universitetslaboratorier.

Rapportens resultat kan användas som en grund för framtida arbete inom RE:sources utbildningsverktyg för att stärka kompetensen inom avfalls- och resurshantering.

Summary

The master thesis and PhD theses related to waste and resource management published by Swedish universities between 2010 and 2016 were reviewed for gathering current knowledge base. The selection criteria were fulfilled by 618 master theses and 153 PhD theses.

Master theses were identified at 22 universities and PhD theses at 17 universities. The universities with the largest number of master theses were KTH (27%), Lund University (22%), Chalmers (15%), Linköping University (6%) and the Swedish University of Agricultural Sciences (SLU) (6%). The universities with the largest number of PhD theses were KTH (25%), Chalmers (18%), Lund University (15%), University of Borås (8%) and Luleå University of Technology (7%).

Topics: Theses, both at masters and PhD level, were largely found to be carried out on Recycling, Waste to Energy and Lean. In the Waste to Energy topic, majority of the master theses focused on biogas generation, whereas the PhD theses focused equally on the conversion of waste into biofuel and also conversion of waste into electricity.

Approach: Most of the master theses were carried at the technical/ scientific and from systems analysis point of view. The PhD theses were mainly focused on technical/ scientific research related to process optimisation and treatment methods.

Master theses and PhD theses published from systems perspective, assessed or evaluated products and process mainly from environmental and economic perspectives. The assessment of social aspects related to waste were few in number compared to the other two pillars of sustainability.

Scale: The master theses related to waste were largely carried out from a broader perspective compared to the PhD theses where the research was to a larger extent performed at a process level.

More of the master theses were performed in companies compared to the PhD theses where the research was mainly conducted at in laboratories in universities.

The results of this report can serve as a baseline for further work related to the training coordination activity of RE:Source.

Introduction and Background

In the Strategic Innovation Programme RE:source, which aims at a resource efficient society, sustainable supply of materials and a sustainable energy system, education is one of the components in focus. The final parts of higher education, which contribute with new knowledge and with young professionals to the sector, are Master theses and PhD thesis. These were therefore selected for a deeper analysis, as an add-on to part of the initial analysis of education on waste and resources at higher education institutions in Sweden that was done in RE:source in 2016. The task performed and reported here was an evaluation of master and PhD theses related to waste and resources conducted by students in higher education institutions in Sweden.

Aim and objectives of the study

The aim of the present study was to assess the contemporary education and research by students and researchers within the field of waste and resources in Swedish institutions of higher education, in order to identify gaps and potentials to contribute to the design of an innovative and internationalized educational offer and infrastructure in this field in Sweden.

The objectives of this study are listed as follows:

- Identify and select thesis projects at the master and PhD level within the area of waste and resources conducted by students/researchers in Swedish higher education institutions.
- Characterize the selected thesis projects to disentangle the main rehearsed topics, approaches, scopes and stages within the overarching area of waste and resources.

Delimitation of the boundaries of the study

The study assesses theses at the master and PhD level within the area of waste and resources, conducted during the period 2010-2016 in the 42 higher education institutions in Sweden (UHR 2017). The subject of waste and resources encompasses the social, organizational, technological and scientific aspects throughout the overall waste and resource arena.

Method

A qualitative assessment has been undertaken to tackle the aim of the study. For this purpose, the method is as follows:

1) Stage 1: Identification of waste management-related thesis studies at the master and PhD level

The identification has been done both in the DIVA web-portal¹ and in the library-related websites of the Swedish institutions of higher education that are not included in DIVA. Out of the 42 Swedish institutions of higher education, 29 are included in DIVA web-portal. Out of the 13 institutions that are not in DIVA, 6 were selected as relevant to be included in the present study; Chalmers University of Technology, Lund University, Malmö University, Swedish University of Agricultural Sciences, University of Gothenburg and Karolinska Institutet. However, the database for theses of Malmö University and Karolinska Institutet could not be extracted in an excel sheet due to unavailable feature in the university library webpage and therefore these institutions were excluded from the study. In all other cases, the search has been narrowed to the temporal, spatial and topic-related aspects described in the delimitation of the boundaries of the study. For these purposes, the search has been conducted through the following steps:

- a) Searches were made both in DIVA database and in the other university websites of master and PhD theses by using the keyword: “waste/avfall”, “recycl*/återvinning” or “circular/ cirkulär”. Specific filters (as mentioned in Appendix A) have been used both in the DIVA portal and in the different institutions’ websites according to the possibilities of each search tool. The specific aspects of each search are listed in the Appendix A for both doctoral and master theses. Even though second cycle (master level) studies in Sweden includes master, magister and “yrkesexamen” theses, the search has been narrowed to master theses (02 years of master program). Published doctoral theses (compilation) were selected for the review excluding the doctoral theses (monograph).
- b) From the excel exported list of theses from the above step, those containing² the following words in the abstract/ title/ keywords were identified and segregated for further analysis.
 - waste heat
 - waste water
 - mining
 - nuclear

¹ DIVA portal is a search tool for research publications and student thesis in 44 Scandinavian universities (DIVA 2017) (the majority of higher education institutions encompassed in DIVA are Swedish). Nevertheless, not all Swedish higher education institutions are included in the hereto portal.

² All topics related to waste and resources will be included in the search except for the cases of nuclear, waste water, waste heat, mining waste and articles not focused completely on waste. This follows specific delimitations defined by the partners of RE:SOURCE project.

These theses were later verified by reading the abstract to ensure that they are to be excluded (For example some theses that contained words: “waste water” could not be excluded as detailed analysis of the abstract showed that thesis was regarding the management of waste water sludge for converting into biogas which was interesting for the analysis). Mining and nuclear waste were excluded due to their exclusion from the Re:source programme.

The rest of the screened articles (without the above mentioned words) were later characterised as mentioned in the stage 2. However, some screened theses were still found to have words like circular but related to DNA, antenna research etc. (i.e. not related to waste). These theses were excluded in stage 2 during characterisation.

- c) Selection and description of the titles of the theses that include one or more keywords from the list placed above. The titles were classified in charts differentiating between doctoral theses and master theses in the corresponding pages of the Excel document (master page) and (PhD page). The following information from each thesis has been detailed in the charts:
- Title of the thesis
 - Abstract
 - Year of publishing
 - University
 - Faculty/Department/Program
 - Name of the author(s) (only where possible to extract from library)

2) Stage 2: Characterization of the selected master and PhD theses

The characterization process was conducted following a set of components of analysis that are listed below. These were progressively refined along with the development of the search and identification process. The components of analysis are as follows:

- a) **Topics:** The theses were characterized based on the main topic of the research work by reviewing the title and the abstract. The topics are briefly described in the below Table 1. From a life cycle perspective, these topics are placed in their respective zones as shown in Figure 1.

Table 1: Topics related to waste along with their brief description

Topics	Description
History of waste	Analysis & perspectives of the waste management systems and waste related aspects of the past

Topics	Description
Waste management systems	All activities required to manage waste starting from collection till the end of the resource flow loop from a systems perspective.
Social aspects of waste and resource management (stakeholder identification, participation and communication)	Identification, participation, perspectives and communication of stakeholders involved in waste management
Policy-making in the waste field	Analysis of existing laws and regulations for waste management. Identification of new laws, standards required for improving waste management
Waste prevention	Waste prevention is closely linked with improving manufacturing methods and influencing consumers to reduce waste (only material wastes considered)
Waste generation	Quantitative analysis of materials or products entering the waste stream before they are processed
Waste collection/ sorting	Analysis of different waste collection and sorting techniques and their benefits and drawbacks (including reverse logistics)
Waste dumping	Illegal disposal of waste in sea or land leading to sustainability issues
Landfilling	Practices of landfill design and operation
Waste to energy <ul style="list-style-type: none"> • Biogas (as subcategory) • Incineration (as subcategory) 	Methods of converting waste to energy: biogas generation, incineration to produce heat. The theses were initially categorized into waste to energy and later sub categorized based on the two processes.
Reuse	Analysis or assessment of reuse of materials/products for original purpose or for different function
Recycling	Assessment or analysis of converting waste materials/products into new materials/products
Circular Economy (CE)	Identification, analysis and development of framework and business models for

Topics	Description
	closing the material flow of an industry or economy.
Industrial symbiosis	Network of diverse organization in which the waste or by-products of one organization become raw material for other organization
Lean	Systematic method for waste reduction in manufacturing or a supply chain without sacrificing productivity. Mostly carried out at industrial process level. It analyses not only material-related waste but also waste of time and non-value added activities.

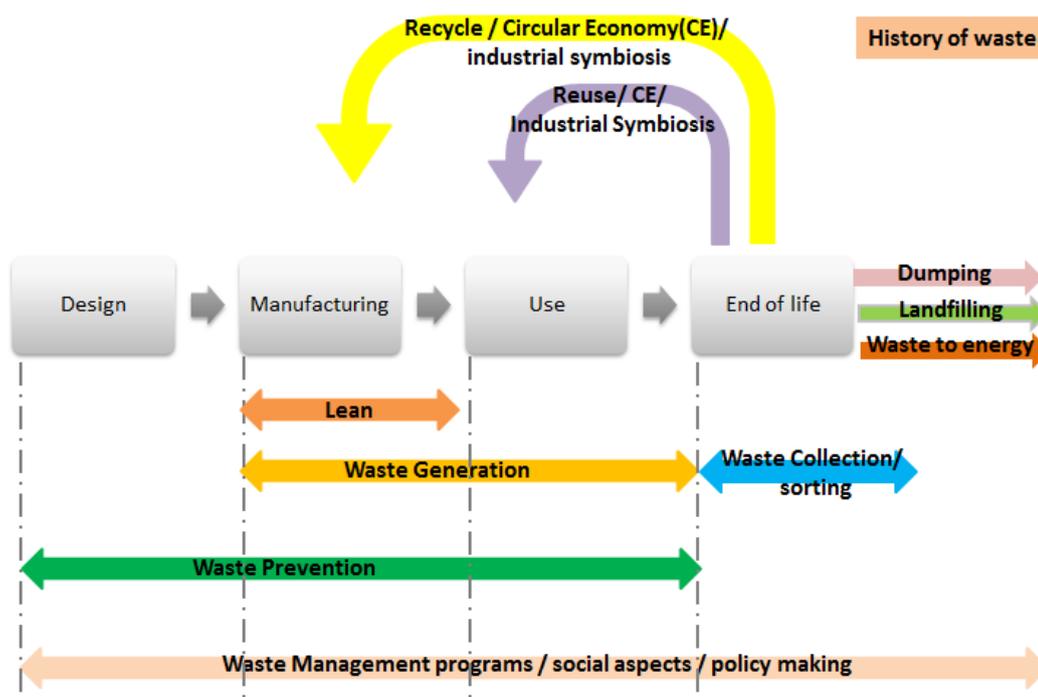


Figure 1: Topics related to waste management from a life cycle perspective

- b) **Approach:** The methodology or the approach used to carry out the theses was identified based on the abstract and the methodology as shown in Figure 2.
- Technological/scientific: treatment methods, material recovery procedures, technological applications, etc.

- Organizational/Institutional: protocols, procedures, regulations, policies for waste management, business models.
- Social/anthropological: participatory methods, governance strategies, social perceptions, culture/imaginary/habits and uses.
- Systems analysis: inter- transdisciplinary projects, complex problems.
 - i. Environment
 - ii. Social
 - iii. Economic

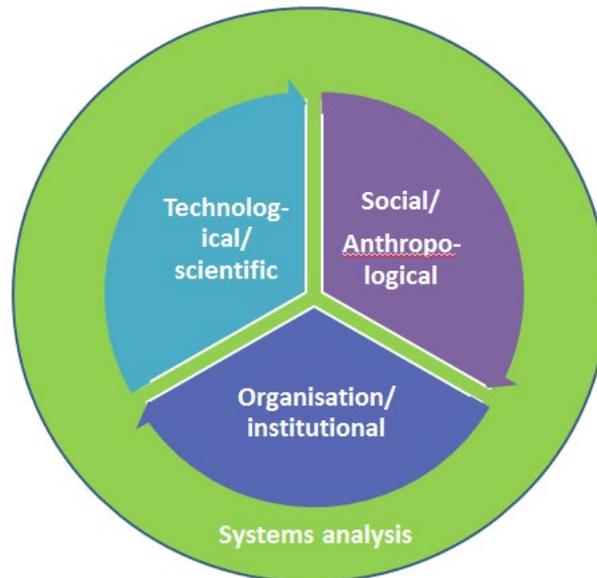


Figure 2: Approach of the research

c) Scope

- Level of aggregation of the study: The level of aggregation of the theses was identified as shown as in the Figure 3.
 - i. Process level, one side-one method thinking, detailed research on the parameters and technology of different processes.
 - ii. Broad scale: studies at the systemic level (configuration of actors, regulations, institutional frameworks, technological trajectories, overarching waste management strategies).

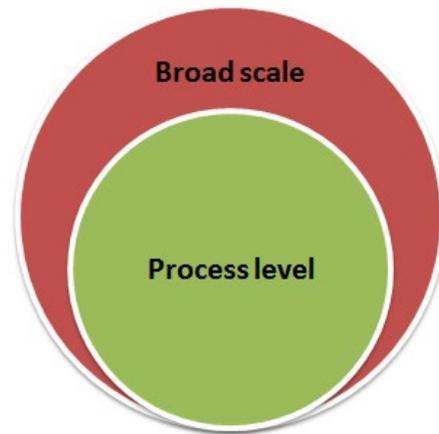


Figure 3: Level of aggregation of the study

- Scale of the study (identified as in Figure 4) :
 - i. Global
 - ii. International
 - iii. National
 - iv. Local/Municipal/ Neighborhood/District
 - v. Household (universities or others)
 - vi. Companies (could be at local scale or on multi-national scale)
 - vii. Not applicable (for example theoretical study like business models or frameworks)

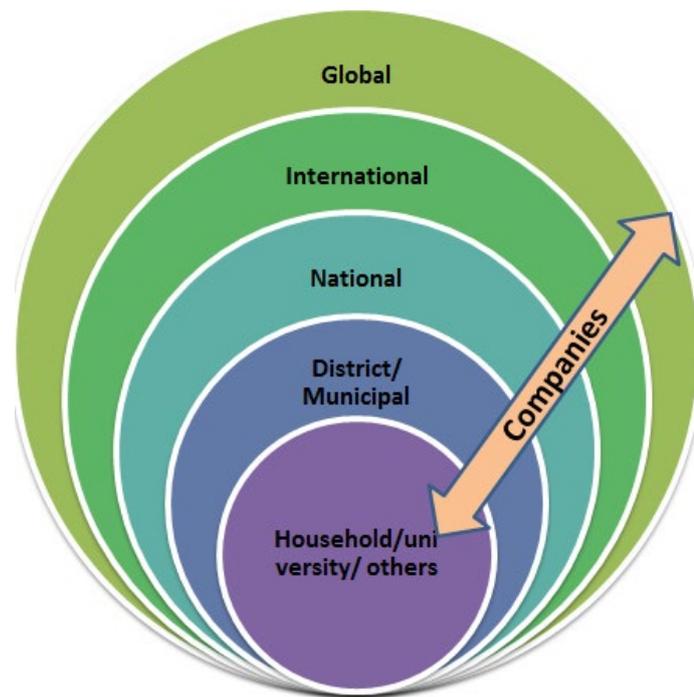


Figure 4: Scale of the study

d) Cooperation with other actors: The actors with whom the theses were carried out was identified from the acknowledgement or foreword and listed for each thesis. However, there is a limitation to identifying the actors with regards to the confidentiality maintained during the research.

- Companies
- Industrial sectors
- Local, regional, national governments
- Governmental and intergovernmental entities
- Communities
- Not known or not applicable

Result and discussion

The Master theses & PhD articles containing the keywords: waste/avfall OR recycl*/återvinning OR circular/cirkulär were identified: 33 universities (from Diva portal, SLU, Lund, Gothenburg, Chalmers library) for master theses & 33 universities (Diva portal, Chalmers, Gothenburg, SLU & Lund library) for PhD theses.

STAGE 1:

a) Master theses

An overarching assessment of the number of titles related to waste and resources both in DIVA web-portal and in the other library-websites has been conducted. This brought a total number of 1218 master thesis titles to further review and later potentially characterize. Of these, 618 were identified as theses to include in the characterization (Table 2).

Table 2: Master thesis related to waste from 2010- 2016: extracted, reviewed and characterised

Universities library	a) Total master thesis Keywords: waste/ recycl*/ circular	b)Reviewed master thesis not containing keywords: waste heat, waste water, mining, nuclear	c)Total master thesis related to waste
Diva Webpage	737	591	330
SLU	41	38	37
Lund University	202	183	135
University of Gothenburg	47	46	26
Chalmers University of Technology	191	145	90
TOTAL	1218	1003	618

b) PhD Theses

An assessment of the number of titles related to waste and resources both in DIVA web-portal and in the other library-websites has been conducted. This has brought a total number of 534 PhD theses titles to further review and then potentially characterize. Of these, 153 were identified as theses to include in the characterization Table 3.

Table 3: PhD thesis related to waste from 2010- 2016: extracted, reviewed and characterised

Universities library	a) Total PhD thesis with Keywords: waste/ recycl*/ circular	e) PhD thesis Not containing Keywords: waste water, nuclear, waste heat, mining	c)Total PhD thesis related to waste
Diva Webpage	329	259	94
SLU	8	7	6
Lund University	118	94	23
University of Gothenburg	21	18	2
Chalmers University of Technology	58	45	28
TOTAL	534	423	153

STAGE 2:

Characterization was completed for the theses from DIVA web-portal, Lund University, Chalmers University, Gothenburg University and the SLU library website. The theses in category ‘C’ of Table 2 & Table 3 were characterized on topics, approach, level of aggregation of study, scale of study. The following are the results of the selected masters and PhD theses related to the resource and waste.

Universities

The largest proportion of the master theses that were reviewed were from KTH Royal institute of Technology followed by Lund University & Chalmers University for both the master theses and PhD theses as shown in Table 4 & Table 5. Master theses were identified from 22 universities and PhD theses from 17 universities. There were 11 universities that had 10 or more master thesis and 5 universities that had 10 or more PhD theses.

Table 4: Universities where the waste related master theses were published from 2010-2016

No.	Universities	Total master thesis related to waste	Percentage
1	KTH Royal Institute of Technology	168	27%
2	Lund University	135	22%
3	Chalmers University	90	15%
4	Linköpings Universitet	40	6%
5	SLU	37	6%
6	Uppsala University	30	5%
7	Gothenburg University	26	4%
8	Mälardalen University	15	2%
9	Jönköping University, School of Engineering	14	2%
10	Karlstad University	14	2%
11	University of Borås	10	2%
12	Stockholm University	9	1%
13	Blekinge Institute of Technology	6	1%
14	Linnaeus University	6	1%
15	Luleå University	4	1%
16	Mid Sweden University	2	0%
17	Mittuniversitetet	2	0%
18	Örebro University	2	0%
19	Umeå University	2	0%
20	University College of Arts	2	0%
21	University of Gävle	2	0%
22	Konstfack, Institutionen för Design	1	0%
23	Not known ³	1	0%
	TOTAL	618	

³ The details of thesis such as university name, abstract and full report were not available in the Diva Portal. The characterisation was carried out based on the title of the thesis.

Table 5: Universities where the waste related PhD theses were published from 2010- 2016

No.	Universities	Total PhD theses related to waste	%
1	KTH Royal Institute of Technology	39	25%
2	Chalmers University	28	18%
3	Lund University	23	15%
4	Högskolan i Borås	12	8%
5	Luleå Tekniska Universitet	11	7%
6	Linköpings Universitet	6	4%
7	Stockholms Universitet	6	4%
8	Umeå Universitet	6	4%
9	SLU	6	4%
10	Linné Universitetet	3	2%
11	Mälardalens Högskola	3	2%
12	Blekinge Tekniska Högskola	2	1%
13	Mittuniversitetet	2	1%
14	Uppsala Universitet	2	1%
15	Gothenberg University	2	1%
16	Karlstads Universitet	1	1%
17	Örebro Universitet	1	1%
	Grand Total	153	

Trend

The number of master theses and PhD doctoral theses carried out in universities over Sweden pertaining to waste has an overall increasing trend as can be observed in the below Figure 5 & Figure 6.

Number of master theses related to waste

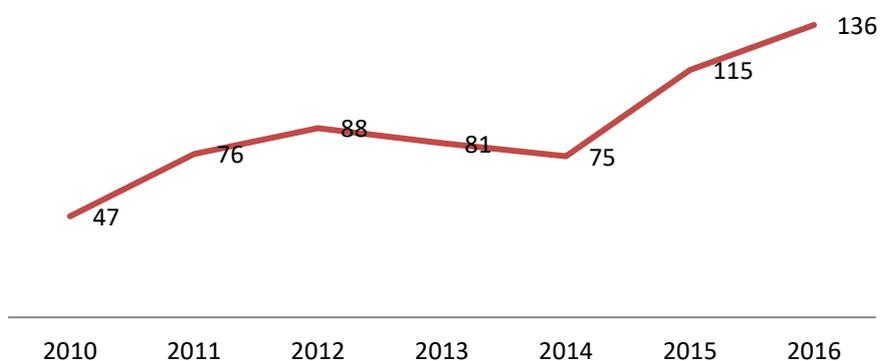


Figure 5: Number of waste related master theses published year-wise

Number of PhD theses related to waste

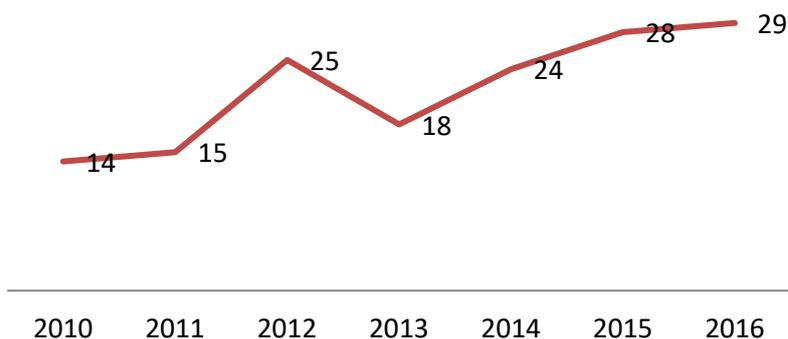


Figure 6: Number of waste related PhD theses published year-wise

Topics

The topics that were mainly focused on in the master theses published in Swedish universities from 2010-2016 were on Recycling, Waste to energy and Lean in the decreasing order as shown in Table 6.

Table 6 : Distribution of topics of the master level research study from 2010-2016 published in Sweden

Topics	Total number of master theses	Percentage
Recycling	127	21%
Waste to energy	124	20% (of which, 62% biogas; 31% incineration, 6% both)
Lean	110	18%
Waste management programs	75	12%
Circular economy	44	7%
Waste prevention	41	7%
Waste collection	26	4%
Social aspects of waste and resource management	17	3%
Landfilling	13	2%
Policy making in waste field	11	2%
Industrial symbiosis	9	1%
Reuse	8	1%
Waste sorting	7	1%
History of waste	4	1%
Waste generation	2	0%
Total	618	

The PhD thesis were mainly focused on waste to energy and recycling as in the master thesis as shown in Table 7, followed by the waste prevention.

Table 7: Distribution of topics of the PhD level research study from 2010-2016 published in Sweden

Topics	Total number of PhD theses	Percentage
Waste to energy	62	41% (of which 52% biogas; 48% incineration)
Recycling	44	29%
Waste prevention	13	8%
Lean	8	5%
Waste management programs	8	5%
Policy making in waste field	5	3%
Landfilling	3	2%
Social aspects of waste and resource management	3	2%
Waste collection	3	2%
History of waste	2	1%
Industrial symbiosis	1	1%
Circular economy	1	1%
Total	153	

More than half of the master theses that were reviewed related to waste to energy belonged to the biogas generation and 31% of the reviewed master theses were related to incineration and gasification.

However, the PhD theses were equally focused on both the waste to energy methods: Biogas generation and incineration/ gasification.

Approach

The approaches followed in the majority of the reviewed master theses were from a technological/scientific and systems analysis perspective. Fewer master theses were from an organization/ institutional & social/ anthropological perspective as shown in Figure 7.

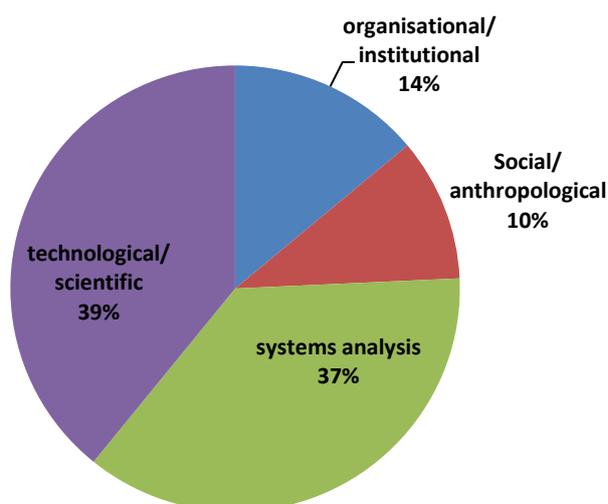


Figure 7: Distribution of the various approaches of the master theses related to waste published from 2010-2016 in Sweden

The PhD thesis mainly followed a technological/scientific approach compared to the other approach methods as shown in Figure 8.

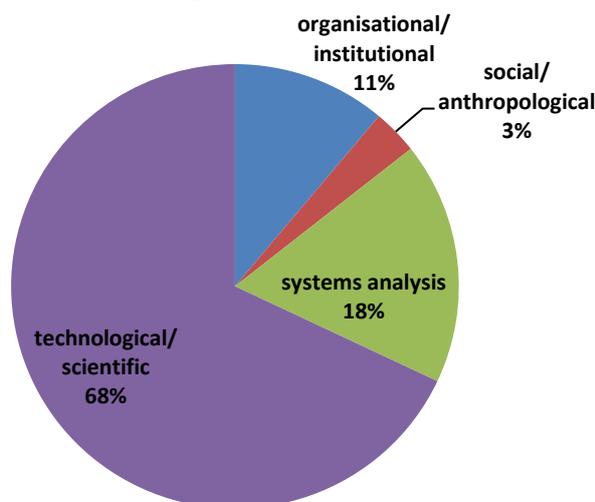


Figure 8: Distribution of the various approaches of the PhD theses related to waste published from 2010-2016 in Sweden

The systems analysis approach was further assessed to identify and segregate the study into the three pillars of sustainability: environment, economic or social level. Nearly 38% of master theses focused on all three pillars of sustainability, followed by the environment & economic aspects with 25% and only environment assessment at 19%. The number of theses focusing on the social aspects of sustainability was quite low as shown in Figure 9.

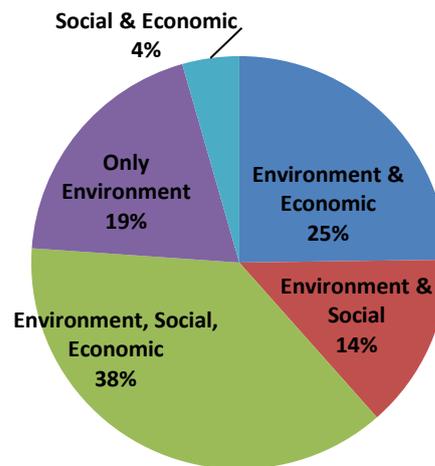


Figure 9: Distribution of the systems analysis approach aspects of the master theses related to waste published from 2010-2016 in Sweden

Although the number of PhD thesis with a systems approach was quite low, the distribution of the researches from the three pillars of sustainability can be seen in Figure 10. The focus on the social aspects was quite less in PhD theses as in master theses research.

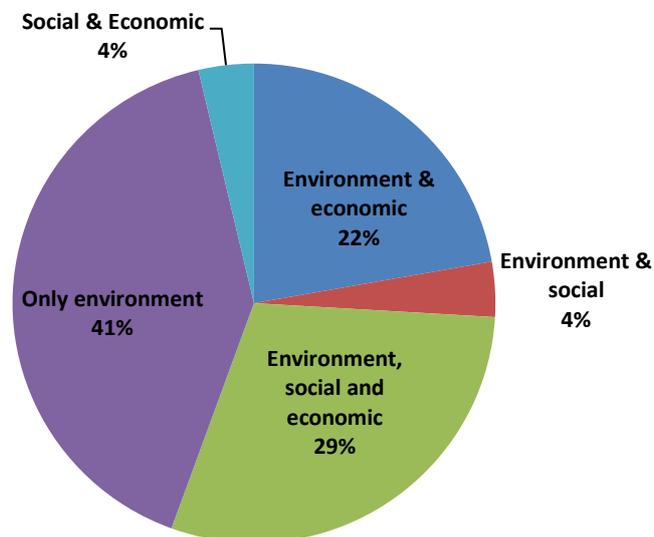


Figure 10: Distribution of the systems analysis approach aspects of the PhD theses related to waste published from 2010-2016 in Sweden

Scope

a) Level of Aggregation

The level of aggregation of around 61% of the master theses were on a broader scale at the systemic level discussing the configuration of the actors, regulations, institutional frameworks, technological trajectories etc. Approximately 39% of the master theses were related to process level study (Figure 11). PhD theses were to a larger extent focused at the process level (67%) than at a broader scale (Figure 11).

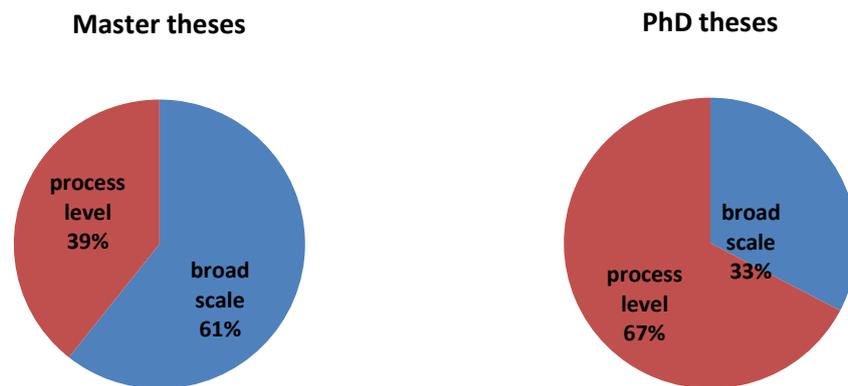


Figure 11: Level of aggregation of the master & PhD theses related to waste published from 2010-2016 in Sweden

b) Scale of the study

With respect to the scale of the study performed, ~40% of the master theses were performed on a company level, followed by municipal level and at national level as shown in Figure 12.

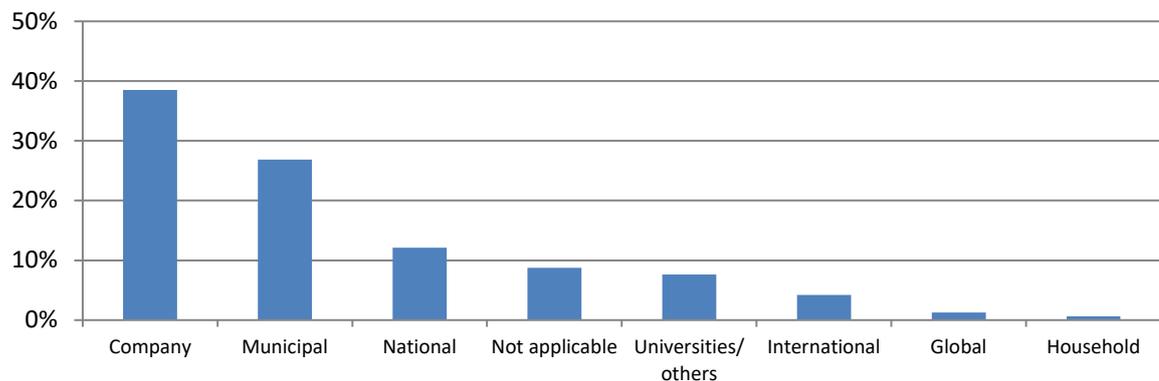


Figure 12: Scale of the master theses study related to waste published from 2010-2016 in Sweden

Most of the PhD theses that were analyzed were performed at the lab scale in university with more technological & scientific work at process level (Figure 13).

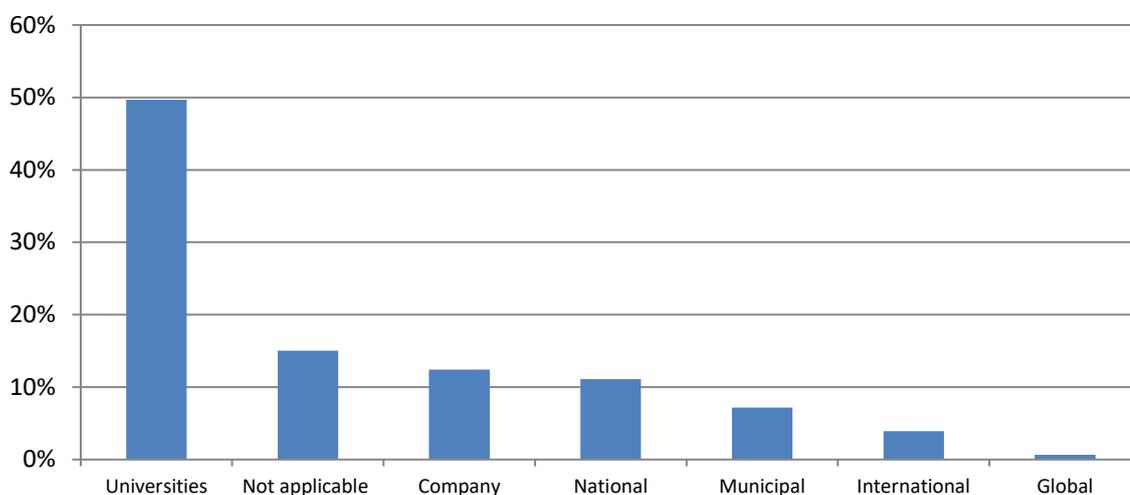


Figure 13: Scale of study of PhD theses related to waste published from 2010-2016 in Sweden

The master theses performed at the national and municipal level were further analyzed. Most of the theses were focused on waste technology or management in Sweden (44%) followed by Asia (19%) and Africa(16%), (Figure 14).

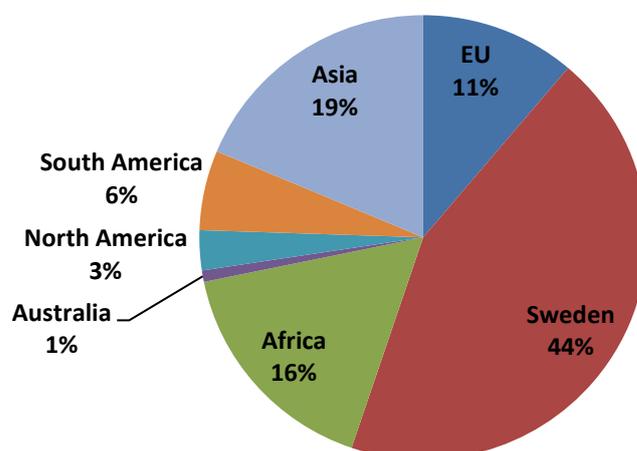


Figure 14: Geographical focus area of the master theses conducted at Municipal and national level

Most of the PhD theses were performed at the national and municipal level were mainly carried out for development of Swedish infrastructure and waste management

systems. Around 21% of the PhD theses were focused on developing waste management in Africa (Figure 15).

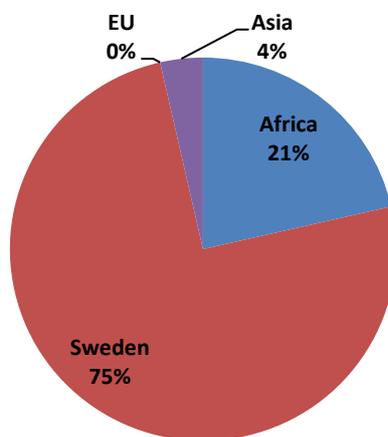


Figure 15: Geographical focus area of the PhD theses conducted at Municipal and National level

Discussion

For Sweden to become world leader in reducing and minimizing waste, a vision to have new technologies, business models and processes is required. RE:Source is a national strategic innovation program in the field of resource and waste management. Projects of the RE:Source program are mainly focused on developing knowledge and solutions for three main global societal challenges: Resource efficient society, sustainable material supply and sustainable energy system.

This report was developed in the project “Fördjupad analys utbildning”, which was mainly initiated to identify the areas of research carried out by universities in Sweden with regard to waste minimization and utilization. This project report is a part of the “*training coordination activity*” of RE:Source that aims to develop a roadmap to increase the level of competence in the area of knowledge on resource and waste management, by creating a platform where all actors involved in innovation can participate and coordinate with the education programs in academy. The results of this report can be utilized as a base line/ screening document to support further work in education; research and innovations; collaborations; business development etc.

To identify the areas of research with regard to waste minimization and utilization, the master theses and PhD theses published publically in the university library webpages were chosen to be reviewed. These theses are an important part of the educational curriculum where the next generation of professionals are trained to work independently and acquire deep knowledge on a particular topic. In addition,

majority of the theses are performed with companies/ industries that strive to adopt latest technologies. Theses carried out at companies help in creating a network between universities and companies to share infrastructure, knowledge, and experience.

Due to technical constraints in some of the university library webpages (for example Malmö & Karolinska University), list of theses could not be extracted by filtering the search keywords and pertaining to the year 2010-2016. However, theses published in other universities webpages were reviewed, characterized and analyzed based on the methodology.

The highest percentage of master thesis and PhD thesis published between 2010-2016 was related to recycling & waste to energy which reinforces to develop innovate solutions for one of the three global societal challenges focused by RE:Source on sustainable energy systems. Lean is another topic which ranks the next highest in case of master thesis. Theses based on lean are carried out on manufacturing/ supply chain processes at industry level to reduce their waste activities (could be time, energy or material).

The number of theses on circular economy (CE) including its individual concepts (for example recycling, reuse) is increasing since the concept of CE evolved just few years back. Theses belonging to the topics reuse, recycling can also overlap with the topic Circular Economy (CE) as they are sub concepts of CE. However the theses have been characterized based on the major content of the theses. Theses classified into the circular economy topic (in Table 6 & Table 7) cover the possible business models/ framework and discusses/explores all the concepts of circular economy: reuse, remanufacture, recycle etc.

Another important observation from the results of the topic categorization is related to the number of theses on waste prevention. The number of theses related to research on waste after it is generated is larger than the number of theses related to waste prevention. As we all know waste prevention is at the top of the waste hierarchy and more sustainable than handling waste after generation.

The number of master theses carried out in companies is large, as the students consider it as an important experience to pre-professional life. Around 40% of the master theses are referred to as performed in companies in the acknowledgement section of the thesis report. However, the names of companies or industrial sectors, their size and location that have coordinated with the universities to perform the theses have not been identified and listed in this research.

Of the theses classified according to the country, the number of master theses performed in Sweden and internationally is equally distributed. This provides an opportunity to create networks across continents on global scale where the best technologies and experiences can be shared and businesses commercialized.

It is noteworthy that there were quite a few theses investigating waste and resource management in African countries (Figures 14 & 15; 40 master theses & 6 PhD theses). Many of these PhD theses are likely funded by the Sida bilateral programmes and reflect that these issues are seen as a priority by the African universities.

Conclusion, utilization and next steps

The results of this report provide an overview of the Master and PhD theses carried out at universities in Sweden regarding waste. The review was carried out on Masters and PhD theses published from 2010-2016 of most universities in Sweden, except for few of the universities due to technical constraints in extracting list of published theses. The theses were extracted based on three search keywords: waste/ avfall, recycl*/ återvinning, circular/ cirkulär. The extracted theses were further reviewed to exclude theses pertaining to waste water, nuclear, mining, waste heat. Characterization was performed on the reviewed theses based on topic, approach, level of aggregation, scale of study and cooperating actors.

The results of this report can serve as a baseline for further work related to the training coordination activity of RE:Source to increase the level of competence in the area of resource and waste management and also provide a platform where all actors involved in innovation and research can share their knowledge, experience and coordinate with academic sector.

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Appendix

A. Search criteria used for extracting master thesis from university webpage along with their web link

MASTER LEVEL	Search Criteria
Master level - DIVA search	Keyword: waste/ recycl*/ circular /avfall/ återvinning/ cirkulär Thesis level: independent thesis advanced level (degree of master (2 years)) Time period: 2010-2016
SLU	Keyword: waste/ recycl*/ circular/ avfall/ återvinning/ cirkulär Deposting date: 2010-2016 Level and depth descriptor: - Second cycle, A1E - Second cycle, A2E - Second cycle, A1N, A1F or AXX Student's programme affiliation: "all of these" Type: html, pdf, microsoft word
University of Gothenburg	Received extracted list of published thesis from the library support through email based on the following criteria Time period: 2010-2016 Master thesis Keywords: waste/ recycl*/circular Language of the thesis: English
Chalmers University of Technology	Received extracted list of published thesis from the library support through email. Time period: 2010-2016 Master thesis Keywords: waste/ recycl*/circular/ avfall / återvinning/ cirkulär
Lund University	A search has been made in the library web finder placing the filter of Master theses (02 years) and filtering the period 2010-2016. Keyword: waste/ recycl*/ circular/ avfall/ återvinning/ cirkulär
Malmö University	Not extracted due to technical constraint in the webpage
Karolinska Universitet	Not extracted due to technical constraint in the webpage

B. Search criteria used for extracting PhD thesis from university webpage along with their web link

PhD LEVEL	Search Criteria
DIVA search	Keyword: waste/ recycl*/ circular/ avfall/ återvinning/ cirkulär Thesis level: Doctoral (compilation)
SLU	Keyword: waste/ recycl*/ circular/ avfall/ återvinning/ cirkulär Publication type: doctoral theses
University of Gothenburg	Received extracted list of published thesis from the library support through email Time period: 2010-2016 PhD thesis Keywords: waste/ recycl*/ circular/ avfall/ återvinning/ cirkulär
Chalmers University of Technology	Received extracted list of published thesis from the library support through email. Time period: 2010-2016 PhD thesis Keywords: waste/ recycl*/ circular/ avfall/ återvinning/ cirkulär
Lund University	Search done by filtering by period of study: 2010-2016 and regarding doctoral theses category. Keywords: waste/ recycl*/ circular/ avfall/ återvinning/ cirkulär
Malmö University	Not extracted due to technical constraint in the webpage
Karolinska Universitet	Not extracted due to technical constraint in the webpage