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WP 2 D.2.1: Market Gap Analysis

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Table of Content:

STEP 1: INTRODUCTION-THE TOPIC

This report on market gap analysis for Växjö city in Sweden prepared under INNOVATE project. The market gap has been analyzed based on the authors perception of the existing market situation as well as on an online questionnaire survey of 7500 homeowners in Kronoberg County. The survey was carried out in spring 2017 by Linnaeus University. This report is intended to serve as a background/ baseline document for developing business model and possible financing plans for one-stop-shop renovation of detached houses in Sweden. Linnaeus University is a learning partner within this INNOVATE project and it coordinates with Växjö municipality to develop up a one-stop shop business model model (integrated EE service package) for renovation of single family house.

Partner	Experienced partners	Learning partners	Existing Target	Will upgrade / re-organise their existing EE services	New Target	Develop new integrated EE service package
Linnaeus University	no	yes	\	\	Single-family housing	yes

STEP 2: THE CURRENT STATE

Building stock

Växjö municipality with a population of 89 000 in 2016 is located in South of Sweden. The city claims to be the "Greenest city in Europe". The composition of dwellings is presented in Table 1. Privately owned individual houses (One and two family houses according to Statistic Sweden) constitute about 37% of the dwelling units. Of these, 46% are located in rural areas and 54% in urban areas

Table 1: Composition of dwellings in Växjö municipality as of mid-2017 (Source: Växjö municipality).

Type of houses	**Type of ownership**		
	Privately-owned	Tenant owned cooperative	Rented
Individual house	16242	1210	1345
Multi-family houses	15	4745 (condominiums)	13462
Other houses	0	364	964
Special housing	0	23	5272
Total, number	16257	6342	21043

%	37%	15%	48%

The distribution of individual houses in 2017 according to their year of construction is given in Table 2. About 79% of the houses were built before 1980, which means they are more than 35 years old and probably need renovation. About 47% of the houses were built during the housing boom period of 1960-80.

Table 2: Percentage of individual houses in Kronoberg from different construction periods

Geographical area	**Construction year**				
	< 1940	1941-60	1961-80	1981-2000	>2001
Kronoberg county (own survey; No. of respondents 963; see below)	18.8	13.2	47.0	14.1	6.9
Sweden (Swedish Energy Agency)	27.8	14.6	35.3	15.5	6.9

Energy use

Sweden is a cold climate country with strong dependence one energy for space heating and hot water purposes. The Swedish residential and service sector accounted for about 29% of the national final energy use in 2015, of which 54% (equivalent to 76.4 TWh) was used for space heating and hot water purposes [[1]]. Of this, 41% was used in the single-family houses (one- and two family houses according to the terminology used by Statistics Sweden). In summary, the Swedish single-family houses used 32 TWh for space heating and hot water use, which is about 9% of national final energy use. The average energy use for space heating and hot water purposes of houses built during different construction periods is shown in Table 3. The Swedish policy aims to reduce specific energy use in buildings by 50% by 2050 [[2]] compared to 261 kWh/m^2 in 1995 [[3]].

[1] Swedish Energy Agency, 2017. Energy in Sweden: Facts and Figures, http://www.energimyndigheten.se/en/facts-and-figures/publications/.

[2] SOU, 2008. Ett energieffektivare Sverige, *Slutbetänkande av Energieffektiviserings-utredningen,* SOU 2008:110, Stockholm.

[3] Boverket, 2007. Energianvändning i byggnader, Delmål 6 – Underlagsrapport till fördjupad utvärdering av God bebyggd miljö 2007, November 2007, National Board of Housing, Building and Planning, ISBN: 978-91-85751-59-4.

Table 3: Use of energy, per dwelling and per square meter, for heating and hot water in one- and two-dwelling buildings in Sweden in 2014, by year of completion (source: Energy statistics for one- and two family houses, 2014 and 2015)

Construction period	No. of houses (1000)	MWh/house	kWh/m^2
Average all houses	1929	16.0	107.3
–1940	536	19.4	127.0
1941–60	281	16.8	118.1
1961–70	266	16.2	107.3
1971–80	414	13.9	91.0
1981–90	201	13.6	96.7
1991–2000	98	13.2	96.4
2001–2010	112	13.3	83.2
2011–2013	21	11.7	69.6

It can be seen that older buildings have a higher final energy use than newer buildings. However, one should note that the final energy does not usually consider the conversion losses. For example, a newer building with electricity heating system can have lower final energy than an older building with wood boilers, because in the later case the energy content of wood before the conversion losses in the boiler is reported in the statistics. In Sweden, many houses from 1960-80 have electric heating systems including air-source heat pumps. Statistics on type of heating systems and energy use (kWh/m^2) for individual houses built during different construction periods is not available for Växjö municipality.

Own survey in 2017

We at Linnaeus University in Växjö conducted an online questionnaire survey of homeowners in Kronoberg county in Spring 2017. The survey was sent to ca 7500 customers of the insurance company Länsförsäkring Kronoberg in Kronoberg county, in which Växjö is the most populated city. The response rate was 13.5% (or 971 homeowners), which is normal for such kind of surveys. The aim of the survey was to collect data to understand the attitudes and interests towards renovation in general. Most of the information below is reported from that survey (from here onwards "own

survey") with complementary information from elsewhere. The results are applicable for Kronoberg county, but also for Växjö as it is the most populated area in the county.

Construction standards of the houses

The details of the construction standards of the existing houses according to our survey is presented in Table 4 to Table 6.

Table 4: Percentage of individual houses in Kronoberg with different types of ventilation systems (own survey)

Construction year	**Ventilation system**					
	Natural	Natural with kitchen exhaust fan	Mechanical exhaust	Mechanical balanced	Other	Do not know
< 1940 (N=181)	14.4	70.7	3.9	3.9	1.8	5.5
1941-60 (N=126)	8.7	70.6	2.4	7.9	4.1	6.3
1961-80 (N=450)	7.1	62.2	10.0	11.8	2.4	6.4
1981-2000 (N=136)	2.9	13.2	36.0	44.1	2.9	0.7
>2001 (N=66)	0	24.2	22.7	50.0	0	3.0
Total (N=959)	**7.6**	**55.4**	**12.4**	**17.0**	**2.4**	**5.2**

Table 5: Percentage of individual houses in Kronoberg with different types of windows (own survey)

Construction year	**Types of windows**			
	2-glass	3-glass	2-glass with insulation	3-glass with insulation
< 1940 (N=181)	59	25	16	18
1941-60 (N=127)	46	40	15	20
1961-80 (N=453)	42	40	11	23
1981-2000 (N=136)	14	64	4	23
>2001 (N=66)	9	45	11	36

Total (N=959)	**39**	**41**	**12**	**23**

Note: sum of percentages may exceed 100% as several homeowners have more than one type of windows

Table 6: Percentage of individual houses in Kronoberg with different insulation thickness (own survey)

Construction year	**Thickness of *attic* insulation**			
	<200 mm	201-300 mm	> 300 mm	Do not know
< 1940 (N=180)	41	28	11	20
1941-60 (N=125)	26	26	13	35
1961-80 (N=450)	26	29	9	35
1981-2000 (N=134)	8	34	30	28
>2001 (N=65)	8	15	54	23
Total (N=959)	25	28	16	31
	***Outer wall* insulation**			
< 1940 (N=179)	54	24	3	19
1941-60 (N=127)	39	18	4	39
1961-80 (N=444)	44	16	2	38
1981-2000 (N=133)	26	32	8	34
>2001 (N=65)	17	38	22	23
Total (N=948)	41	22	5	33
	***Basement* insulation**			
< 1940 (N=161)	49	9	4	37
1941-60 (N=122)	46	6	2	46
1961-80 (N=336)	32	9	2	57
1981-2000 (N=78)	14	12	4	71
>2001 (N=46)	20	9	13	59
Total (N=743)	35	9	3	52

Following conclusions could be drawn with a broad classification of houses built before 1980 (older houses) and those built after that (newer houses).

- Older houses typically have natural ventilation with exhaust fan in kitchen, while newer houses have more balanced ventilation.
- Older houses typically have 2-glass windows, while newer houses have more 3-glass windows and with insulation.

A large proportion of respondents "do not know" about insulation thickness of their house. According to those who were aware, older houses predominantly have an insulation thickness of less than 200 mm, while newer houses have a relatively thicker insulation.

Heating system

Heating systems have a significant impact on energy and environmental performance of a building. Biomass-based heating systems, ground source heat pumps, wood pellet boilers are typically considered as environmentally friendly heating systems. However, electric heating systems are not energy and climate efficient due to their high primary energy use considering a marginal accounting perspective.

Table 7: Percentage of individual houses in Kronoberg with different types of heating systems used (own survey)

Construction year	**Heating systems**							
	Ground source heat pump	Air-source heat pump	District heating	Wood pellet boiler	Electric heating	Wood boiler	Fireplace	Other
<1940 (N=181)	35	31	15	8	23	18	33	27
1941-60 (N=127)	37	20	35	7	9	14	35	8
1961-80 (N=451)	22	29	41	4	28	5	32	10
1981-2000 (N=136)	17	39	23	2	31	10	27	14
>2001 (N=66)	18	21	55	0	9	8	20	15
Total (N=961)	25	29	34	5	24	10	31	14

N= No. of respondents to our survey; the sum of percentages may exceed 100% as several homeowners have more than one type of heating systems in use.

The distribution of heating systems in use in individual houses of Kronoberg County is presented in Table 7. About one-third of the houses in the survey area, mainly concentrated in the urban areas of Växjö and Ljungby, have district heating system fired by biomass and therefore, almost carbon-neutral. About 25% of the houses have ground source heat pumps and 5% of the houses with wood pellet boilers, which are also environmentally friendly heating systems. What is interesting from energy renovation point of view are the 24% of houses with electric heating systems (resistance boilers + electric boilers) even if many of them use air-source heat pumps. These heating systems are

not environmentally friendly and are mostly installed in houses built before 1940 or during 1961-2000. Primary energy use could be reduced by 70-80% by replacing these heating systems with biomass-based district heating system or ground source heat pumps [4, 5].

Urgency for renovation

Satisfaction with existing condition of the house

The urgency for renovation depends on the homeowners' (dis)satisfaction with existing condition of the building. On an average 88% of the respondent homeowners are satisfied or very satisfied with their "whole house in general", while only 2% are dissatisfied or very dissatisfied (Table 8). This explains why very few percentage of homeowners are interested to renovate their "building as a whole" by 2020 (Table 9).

A marginally higher proportion of the homeowners of houses built during 1960-80 or 1980-2000 are likely to be dissatisfied with their houses. However, the owners of houses built before 1940, compared to owners of other houses, are more likely to be dissatisfied regarding standard, construction plan, maintenance cost and energy cost of the building. Owners of the houses from 1960-80 are more likely to be dissatisfied with size, maintenance cost, energy cost and environmental impact, which are important from energy renovation point of view.

Table 8: Percentage of homeowners in Kronoberg with different levels of satisfaction with their house (own survey)

Construction period	N	Dissatisfied/very dissatisfied	Neither/nor	Satisfied/very satisfied
		Whole house in general		
-1940	178	1.7	14.0	84.3
1941-60	126	0.8	10.3	88.9
1961-80	453	2.0	10.8	87.2
1981-2000	136	2.2	7.4	90.4
2001-	65	0.0	4.6	95.4

[4] Tommerup H, Vanhoutteghem L, Svendsen S, Mahapatra K, Gustavsson L, Haavik T, Aabrekk S, Paiho S, Ala-Juusela M. Analysis of promising sustainable renovation concepts. Deliverable D1.2, Successful Sustainable Renovation Business for Single-Family Houses – SuccessFamilies; 2011.

[5] Joelsson A, Gustavsson L. District heating and energy efficiency in detached houses of differing size and construction. Applied Energy 2009; 86: 126-134.

Total	958	1.7	10.4	87.9
		Size		
-1940	181	4.4	14.4	81.2
1941-60	127	2.4	14.2	83.5
1961-80	452	5.3	10.4	84.1
1981-2000	136	4.4	11.8	83.1
2001-	65	6.2	7.7	84.6
Total	961	4.7	11.7	83.4

		Standard		
-1940	181	5.0	27.6	67.4
1941-60	126	3.2	19.8	77.0
1961-80	452	2.9	16.6	80.3
1981-2000	134	2.2	10.4	86.6
2001-	65	0.0	9.2	89.2
Total	958	3.0	17.7	78.9
		Construction plan		
-1940	181	8.3	26.0	65.7
1941-60	125	4.8	28.0	67.2
1961-80	449	4.7	18.7	76.4
1981-2000	136	3.7	15.4	80.9
2001-	65	1.5	7.7	87.7
Total	956	5.0	20.1	74.6
		Aesthetics		
-1940	181	3.3	22.1	74.0
1941-60	127	7.9	28.3	63.8
1961-80	451	4.9	30.2	64.3
1981-2000	135	3.0	17.8	77.8
2001-	66	3.0	13.6	81.8
Total	960	4.6	25.5	69.2
		Indoor environment		
-1940	181	0.6	23.2	75.1
1941-60	127	2.4	19.7	78.0
1961-80	451	2.2	19.7	77.4

1981-2000	136	2.9	14.0	83.1
2001-	64	1.6	6.3	90.6
Total	959	2.0	18.7	78.7
		Market value		
-1940	180	7.8	29.4	46.7
1941-60	127	7.1	21.3	57.5
1961-80	452	7.3	24.6	59.5
1981-2000	135	7.4	18.5	63.7
2001-	66	3.0	6.1	75.8
Total	960	7.1	22.9	58.5
		Maintenance cost		
-1940	181	11.6	49.7	37.0
1941-60	127	5.5	35.4	56.7
1961-80	450	6.0	37.8	53.6
1981-2000	136	2.2	31.6	66.2
2001-	65	0.0	21.5	75.4
Total	959	6.0	37.7	54.1

		Energy cost		
-1940	180	15.0	45.0	39.4
1941-60	127	9.4	44.1	45.7
1961-80	449	13.1	41.4	44.8
1981-2000	136	11.0	30.1	58.8
2001-	64	4.7	32.8	60.9
Total	956	12.1	40.3	47.0
		Environmental impact		
-1940	180	2.2	30.0	48.9
1941-60	126	1.6	32.5	40.5
1961-80	450	4.0	25.8	44.9
1981-2000	136	1.5	24.3	55.1
2001-	63	3.2	15.9	65.1
Total	956	2.9	26.6	47.9

N= no. of respondent. If the sum of percentages does not add up to 100%, then the missing proportion of respondents have answered, "do not know".

Planned renovation by 2020

We have asked the respondents to our survey about their plan for renovation by 2020. Results presented in Table 9 shows that the about 20% of the homeowners of houses built up to 2000 have no plans to renovate at all, which corresponds to the 20% dissatisfied homeowners. Older houses are more likely to renovate than newer houses. More than 70% would like to renovate few parts of the building. About 5%-8% have planned to renovate the whole house in stages, while only a less than 1% have planned to renovate at a time.

Table 9: Percentage of individual houses owners in Kronoberg planned to do some renovation by 2020 (own survey)

Construction period	Type of renovation			
	No renovation at all	Whole house will be renovated at a time	Whole house will be renovated gradually	Some parts will be renovated
-1940 (N=179)	17.9	0.0	7.8	74.3
1941-60 (N=125)	19.2	0.8	5.6	74.4
1961-80 (N=443)	22.6	0.7	5.0	71.8
1981-2000(N=135)	24.4	0.0	3.7	71.9
2001- (N=65)	53.8	0.0	0.0	46.2
Total	23.7	0.4	5.1	70.9

Building components planned to be renovated

The percentages of homeowners planning to renovate different types of building components by 2020 is presented in Table 10. Not surprisingly, a higher proportion of older buildings are likely to be renovated than newer buildings. People are more likely to renovate the indoor surfaces (e.g. painting and wallpaper), windows, kitchen and bathroom that improve aesthetic of the building than energy improving additional insulation of attic, basement or external walls. A large proportion also likely to renovate the façade, which is both an aesthetic and physical improvement of the building.

Table 10: Percentage of individual houses owners in Kronoberg planned to renovate different building components by 2020 (own survey)

Component planned to be renovated	Construction period					
	<1940 (N=181)	1941-60 (N=127)	1961-80 (N=451)	1981-2000 (N=136)	>2001 (N=66)	**Total (N=961)**

No renovation at all	18	19	23	24	54	24
Kitchen	35	31	29	26	20	29
Bathroom	33	27	32	31	17	30
Indoor surface	48	47	46	43	32	45
Sewage	25	25	20	12	8	20
Windows	38	34	33	15	15	30
Roof	19	25	27	15	8	23
Facade	35	24	27	26	26	28
Additional insulation - attic	18	20	14	4	6	14
Additional insulation - basement	12	12	8	2	5	8
Additional insulation - wall	13	9	8	1	6	8
Drainage	12	20	10	3	6	11
Heating system	20	17	17	13	11	17

N= No. of respondents to our survey; the sum of percentages in each column may exceed 100% as several homeowners have reported to renovate more than one type of component.

Owner Status

Table 11: Socio-demographic features of the house owners in Kronoberg county (own survey)

Age group (N=943)	%	Household income before tax (N=936)	%	Level of education (N=946)	%	Gender	%	Geographical location	%
< 36 yr	11.6	Up to 450000 SEK	27.5	Primary	10.9	Male	79.5	Small village or a community with less than 5000 people	46.0
36-45 yr	17.2	450001 – 600000 SEK	23.9	Upper secondary	40.8	Female	20.5	Community with 5,000-24,999 people	21.8
46-55 yr	19.1	600001 – 750000 SEK	23.4	University	48.3	Total	100	Community with > 25,000 people	32.2
56-65 yr	19.3	>750000 SEK	25.1						
>65 yr	32.9								

N= No. of respondents; €1= ca 9.5 SEK

Our survey results (Table 11) show that 33% of the homeowners are more than 65 years old and are likely to be retired. About 40% are middle-aged (46-65 year), while younger owners of less than 36 years are about 12%. Proportion of homeowners are almost equally distributed in different income categories. The largest share of respondents are male or university educated or lived in villages with a population of less than 5000. A cross tabulation of several variables show than the largest proportion of respondents are high school educated male living in villages with a population of less than 5000. A slightly lower proportion are university educated male, of which equal proportions live in villages with a population of less than 5000 and a community with more than 25000 inhabitant.

Table 12 shows the future plans for renovation of homeowners in different demographic groups. It can been seen that homeowners of more than 65 year age (40% of houses) are unlikely to renovate at all their houses. The most likely group to renovate are in the age group of less than 55 years, especially the youngest ones (<36 years). Also, homeowners with increased income and homeowners in urban areas are more likely to renovate.

Table 12: Percentage of households in different demographic groups with various plans for renovation by 2020

	No renovation at all	Whole house will be renovated at a time	Whole house will be renovated gradually	Few parts will be renovated
Owners' age				
< 36 yr (N=109)	5.5	1.8	18.3	74.3
36-45 yr (N=159)	18.9	0.6	4.4	76.1
46-55 yr (N=179)	15.6	1.1	4.5	78.8
56-65 yr (N=179)	20.7	0.0	3.9	75.4
>65 yr (N=307)	39.1	0.0	1.6	59.3
Total (N=933)	23.7	0.5	5.0	70.7
Household income before tax				
<450000 SEK (N=255)	31.8	0.4	6.7	61.2
450001-600000 SEK (N=223)	21.5	1.3	3.6	73.5
600001-750000 SEK (N=218)	18.8	0.5	6.0	74.8
>750000 (N=231)	19.5	0.0	3.5	77.1
Total (N=927)	23.2	0.5	5.0	71.3

Geographical location				
Small village or a community with less than 5000 people (N=436)	22.2	0.0	7.6	70.2
Community with 5,000-24,999 pop (N=204)	26.5	1.0	3.4	69.1
Community with > 25,000 people (N=304)	24.0	1.0	2.3	72.7
Total (N=944)	23.7	0.5	5.0	70.8

Table 13 shows that homeowners who are less than 36 years old are more likely to implement energy efficiency related renovations (additional insulation, windows, heating system etc.) than other category of younger homeowners below 55 years old.

Table 13: Percentage of houses owners in different age groups in Kronoberg planned to renovate different building components by 2020 (own survey)

Component planned to be renovated	Age of the homeowners					
	< 36 yr (N=109)	36-45 yr (N=159)	46-55 yr (N=179)	56-65 yr (N=179)	>65 yr (N=307)	Total (N=933)
No renovation at all	6	19	16	21	39	24
Kitchen	49	38	34	28	18	30
Bathroom	50	38	36	28	18	31
Indoor surface	62	50	53	47	34	46
Sewage	35	27	21	19	11	20
Windows	52	31	30	29	25	31
Roof	46	23	24	24	13	23
Facade	52	27	29	27	21	28
Additional insulation - attic	28	18	12	12	7	14
Additional insulation - basement	17	9	9	7	4	8
Additional insulation - wall	18	9	9	7	3	8
Drainage	27	12	12	7	6	11
Heating system	26	20	20	15	11	17

N= No. of respondents to our survey; the sum of percentages in each column may exceed 100% as several homeowners have reported to renovate more than one type of component.

Construction sector and real estate professionals

The Swedish construction sector (likely to be similar for Växjö) is dominated by very small companies with less than four employees (Table 14). These companies are usually craftsmen that are dominant actors for renovation of individual houses. They promote their own products and services, while lacking competency and/or resources to offer one-stop-shop renovation.

Table 14: Number of companies with different number of employees [6]

No. of employees	***No. of companies***					
	Building projects developer	Contractors for the construction of residential and non-residential buildings	Demolition and site preparation contractors	Contractors for electrical, plumbing and other construction installation activities	Contractors for building completion and finishing	Contractors for other specialised construction activities
0	280	13324	8429	9510	18407	6209
1-4	81	7341	4013	7132	8892	3226
5-9	8	1533	838	1732	1653	882
10-19	4	725	469	1014	726	521
20-49	0	415	235	500	313	238
50-99	2	109	50	98	61	45
100-199	1	32	8	27	12	17
200-499	0	14	2	11	4	2
500+	0	6	0	14	1	0

2.1 Interpretation of segmentation

The younger age owners of houses built before 1940 and during 1960-80 and those having direct heating are *could* be targeted for energy renovation. Once the process started, then other types of houses are likely to be renovated due to social influence. However, houses from 1960-80 with electric heating system *are* the primary target group for energy renovation due to following reasons

[6] Statistic Sweden, 2017. Enterprises (FDB) by industrial classification NACE Rev. 2, size class and year, http://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__NV__NV0101/FDBR07/?rxid=36d90597-e6e1-4201-82ff-bd871d59f7a5, accessed on 2017-10-25

- The energy standards of these buildings is poorer than those built after this period.
- Houses from this period have a largest share in the building stock
- A large number of these houses have electric heating systems, which provide considerable potential for energy and cost savings.

Younger homeowners in urban areas with high income are more likely to renovate their houses, but mostly specific components. They could be targeted for deep renovation.

STEP 3: IDENTIFY THE MARKET FAILURE: THE GAP

We have used the template provided by the WP leader to prepare tables 15a -15c on barriers and drivers throughout the deep-renovation market sector. The analysis has been made looking at Technical, Financial, and Social and Contextual dimensions.

Table 15a. Technical Drivers and Barriers of Deep-renovation market

CATEGORIES	EXPLANATIONS	BARRIERS	DRIVERS	BOTH	COMMENTS
Urgency for renovation	win-wins between urgent or necessary renovations	yes	yes	yes	Most homeowners in Växjö municipality are happy with the condition of their house and do not see any need for deep renovation (barrier). However, those with some renovation needs may implement deep renovation (driver).
Availability of tailor-made stepwise approach for renovation	The option to stage the deep renovation into several phases over a longer period can be a convincing driver	Yes	yes	yes	No such service known to exist. Even if existed, then it would take several years for renovation, which may be too late from climate change mitigation point of view. However, more people are willing to renovate step-wise (driver).
Inconveniences and defects	People do not only choose for better energy performance, but also to experience the comfort of living in a house with reduced inconveniences	Yes	yes	yes	People mostly do comfort/aesthetic renovation, which provide opportunity for energy renovations (e.g windows). But, due to high cost, and lack of financing and incentives, there is low interest for renovation

	and defects.				involving insulation improvements.
Inconvenience linked to the renovation	A renovation which is feasible within a short timeframe is a driver, with the possibility to continue living in the house during the renovation. Some people just don't want to have any works in or around their house (avoid dust, noise etc.).	Yes, to some homeowners			Our survey showed that only few percentage of homeowners thought this was an issue
Energy performance	Energy performance of a house can be a driver if the EPC is bad, so the energy renovation is interesting to save energy and money. When the house has a good EPC, this can be a barrier.	Yes			EPC is mandatory for individual houses on sale, not for all houses. People buying an existing house give high priority to location and size of the house, not energy performance
Age of the house		yes	yes		Houses built during 1960-80 are 35-40 years old and in need for renovation. These houses have electric heating systems, which could be replaced by district heating, ground-source heat pumps and pellet boilers

Quality assurance	technical quality assurance	yes			According to Swedish regulation, there are always 1-2 year supplier guarantee on individual components of renovation, but long term guarantee on overall performance of an integrated innovation is rare or unknown.

Table 15b. Financial Drivers and Barriers of Deep-renovation market

CATEGORIES	EXPLANATIONS	BARRIERS	DRIVERS	BOTH	COMMENTS
Availability of financial possibilities to invest		Yes			High investment cost of energy renovations is often difficult for the homeowner to arrange. People prefer to use their own savings for aesthetic/comfort renovations over several years
Feel secure about investment & savings	Spending money is connected with a feeling of insecurity, which is a barrier. Homeowners need to feel confident that it is the right investment. Homeowners must feel confident that the solution is future-proof.	Yes			Changes in energy price and interest rate, and household behaviour can significantly alter the simulated energy saving predictions. But, for most people these are not major issues as most renovations are done for aesthetic/ comfort improvement or building components are old/dysfunctional.

Willingness to invest in energy efficiency vs competing products	In many cases if it is stated that there is a lack of funds for renovation, it may be more due to the lack of awareness or lack of interest for energy renovation. A cause can be the competition with other household needs	yes			Most people give low priority to energy renovation except for younger households (<36 years) who lack access to capital for the high investment cost. Currently, in Sweden there is no financial incentive for energy renovation.
Subsidies, financial incentives etc.		yes	yes		Subsidy reduces investment burden and encourages renovation. But, this may be barrier if people wait for such subsidies to be introduced and do not implement even cost-effective measures. Currently, in Sweden there is 30% tax deduction (max. 50000 SEK/person/year) on renovation of individual houses, but most people end of renovating kitchen and bathrooms.
Energy bill	Reducing the energy bill is a main driver for renovation. A low energy bill can be a barrier for a renovation	yes			Currently, energy cost in Sweden is not very high. For most households the energy cost is 3-5% of household income, which is not a strong incentive to save energy.
Cost for renovation	The high cost of a deep renovation can be an argument to stage the renovation into several phases. So a concept for a staged renovation might be a technique to tackle this barrier.	yes			High investment cost is a barrier. Renovation can be done in stages, where a real estate agent makes a valuation after each renovation to get a mortgage loan (85% of the market value of the house), which is most

					attractive for the homeowners.
Return on investment	Return on investment should be computed be computed on the extra-cost related to energy-efficient measures compared with normal market-practice measures.	yes			It is difficult to allocate the cost for normal renovation and energy efficiency measure.
Value of the house	The value of the house is secured after renovation; thus this is a driver, but there is uncertainty on the impact on the value.		Yes		In cities with demand for housing, there is possibility that market value of the house increases, at least equal to the cost of renovation. But, this may not be the case in rural areas.
Simplicity	simplicity of transaction, credit offer, ...		Yes		The simplest financing alternative is customers own saving, but usually that is not enough for deep renovations. Innovative financing models, e.g. payment in installments, low interest credit could be useful to overcome this barrier.
Fiscal support					No investment subsidy for renovation at present, except for 30% tax deduction (max 50000 SEK/person/year). People use this for renovation of bathroom and kitchen. Such subsidy encourage step-wise renovation, not integrated renovations.

Use of European funds					Unknown/not used
Energy prices	Energy prices (cost per unit of electricity, gas, oil, heat, wood) can be a driver (if rising) and a barrier (if they are too low, if prices go down).	Yes			Energy cost is not so high in Sweden, which is a barrier for energy renovations

Table 15c. Social/behavioral and Contextual Drivers and Barriers of Deep-renovation market

CATEGORIES	EXPLANATIONS	BARRIERS	DRIVERS	BOTH	COMMENTS
Renovation needs & intentions		yes			Most people are happy with the condition of their building and do not think energy cost is high.
Decision making, self-reliance & empowerment	Most of the decisions are not taken on the basis of rational arguments like energy savings, cost savings etc. and this is a barrier from a traditional economic point of view. A lack of leadership in the homeowner association is	Yes			Energy saving is seldom the motive for renovation

	a barrier.				
Advice & guidance	Assisting people in the many choices they make during the renovation process is a driver	yes	yes		In Sweden there are municipality energy advisers to provide free of cost independent advise to homeowners. But, they are not allowed to make home visits, which is crucial to make tailor-made advice. This could be improved or other measures implemented to provide tailor-made advice.
Awareness of energy saving potential		yes			Not many people are aware of the energy efficiency potential in their house. People are even unaware of the quantity and cost of energy used in their house, as it is very common that the energy bill is paid automatically from bank account.
Accurate, reliable & tailor-made information	The availability of independent, accurate and complete information that is trustworthy is a driver. The construction sector sometimes takes advantage of ignorance of homeowners by making offers that are overpriced and/or technically unsuitable.	yes	yes		

Momentums for renovation (why now?)	stages in life are drivers for renovation				Younger households (<36 years) have shown interest for deep renovation as they are likely to live in the house for several years, while older homeowners (>65 years) are least likely to renovate.
General knowledge level					
Neighborhood action, group action	A neighborhood approach or a group action has proven to be a big driver.		Yes		Such an approach exists for replacing electricity-heating systems with district heating. This could be a potential option for deep renovation.
Availability of time to manage renovation project					Usually a problem for working families. However, this was not revealed from our questionnaire survey, perhaps people do step-wise and aesthetic renovations mostly in summer vacation.
Values (ideas) & attitudes towards environmental issues, sustainability and climate					Swedes have very positive attitude towards climate change mitigation and sustainability, but they engage in habitual or low cost measures, not investment intensive measures.
Energy use patterns	A low intensive energy use patterns can be a barrier. a deep renovation is not an accurate answer to the needs. The return on	Yes			Most of the new houses and older houses with heat pump has this limitation

	investment will be low.				
Expected to own the house	If people consider they will not own the house for a long period, this might be a barrier				This might be an issue for older homeowners, but very few people are expected to know how long they will live in the house.
Technical knowledge level		yes			Homeowners usually lack deep knowledge on condition of the house. The carpenters are experts on their own field, but may not be on complete renovation
Split incentive barrier	The split incentives barrier can be considered as a financial barrier because there are financial implications. The problem arises when one person or organization owns a building and someone else uses it.				Not applicable for individual houses
Legislation & policy		Yes			There is no energy efficiency standard for existing buildings. Only houses on sale are obliged to do an energy audit and get an energy performance certificate
Multi-stakeholder issues	Various barriers exist where multiple owners and/or occupiers of buildings need to decide.				Not applicable for individual houses

Building sector readiness		yes			Companies usually promote their own products/service. They are not proactive to reach the customers and they seldom promote integrated solutions. There are few companies which do complete renovations, but at present there is construction boom in Sweden and these companies are too occupied with new constructions.

3.1 Interpretation of barriers and drivers

Energy renovation of individual houses is rather slow. In the 2001-2011 period, annually about 1.8%, 1.2% and 1.8% of the houses installed energy efficient windows, improved attic/wall insulation, and installed new type of heating systems, respectively [7]. Major share of such installations were done in houses built before 1940 and very little in houses from 1960-1980 [8]. Our survey of the Kronoberg region also shows that most of the homeowners have done some renovation during their lifetime in the house, but most of the measures are aesthetic/comfort oriented (including windows), not insulation improvements.

There are several demand (i.e., homeowners) and supply-side (i.e., companies) hindrances to energy renovation. Homeowners' investment decisions are constrained by factors such as their awareness and attitude towards energy efficiency, access to capital and convenience. A survey of about 3000 Swedish homeowners showed that most of them are more interested in non-investment measures, such as switching off lights or appliances, than in investment-oriented measures to improve energy standard of a building. Homeowners show greater interest to renovate kitchen or bathroom than to install energy efficient windows or solar panels.

[7] Energistatistisk för småhus, various years (Statistics Sweden/ Swedish Energy Agency)

[8] Swedish Energy Agency, 2009. Energy statistics for one- and two-dwelling buildings in 2008 [Energistatistik för småhus 2008], ES 2009:07.

Energy renovation and installation of solar panels require high investment, which is often difficult for the homeowner to arrange. Statistics on house sales show that young people are more likely to buy and elderly ones more likely to sale a house. Young families are more likely to be interested in energy renovation as they may live in a house for several years, but they use up the low interest bearing housing loan (85% of the property value) to buy the property and do not find additional financing at attractive interest rates for renovations. Older people may have an easier access to loans, as the original loan is likely to have been paid back already, but their lower income makes it difficult for them to get a loan for energy renovation. Moreover, they are less interested in energy renovations due to their perceived uncertainty of whether the investment will be paid back during their lifetime in the house.

A major issue is that the renovation market is fragmented and dominated by a craftsman-based approach with individual solutions. 90% of Swedish construction and installation related companies have less than four employees and many are located in rural areas. Most actors promote their own product(s) or service(s) and they lack expertise to undertake "energy efficient" renovations. Homeowners implement renovation measures in a piecemeal approach. This leads to the implementation of sub-optimal solutions, which may not be cost and energy efficient in the long run as compared to comprehensive solutions by a professional. When multiple measures are simultaneously implemented, the homeowner usually takes all the risks and responsibilities of coordinating several companies and the workplace related regulations. If a construction problem arises or the performance of the renovated house is below expectations, it would be difficult to establish which company is at fault.

STEP 4: HOW THE GAP SHOULD BE FILLED

4.1 Interpretation of the gap filled

One way to overcome some of the above-mentioned issues is to introduce one-stop-shop business models where a single actor offers full-service *holistic renovation packages including consulting, independent energy audit, renovation work, follow-up (indepen*dent quality control and commissioning) and, financing. One way to kickstart the market is to have a few demonstration projects bringing together actors interested in the one-stop-shop concept. To create customer interest in energy

renovation, the following regulatory, economic and informational measures are required.

1. **Regulation:** Energy audit report or energy performance certificate is mandatory for houses on sale. This regulation could be extended to cover all houses of certain age (e.g., those built before the 1980s). A joint audit by the energy auditors and building consultants might provide a basis for a set of recommendations to be implemented, either at a time or in steps, to improve the energy performance of the house.
2. **Financing:** The most cost efficient option to finance energy efficiency renovation of single-family houses is mortgage refinancing, which is difficult to get by young new-buyers and retired elderly homeowner. This could be addressed if government provides zero or low interest loans or subsidies to cover the investment cost. Banks may consider an energy efficient renovation plan prepared by an entrepreneur and ex-ante evaluate the post-renovation value of a house in collaboration with real estate agents. Based on this evaluation, banks could confirm the homeowner and the entrepreneur that certain amount of investment cost would be covered by mortgage refinancing. The rest may be covered by government sponsored soft loan or investment subsidies.
3. **Tax deduction linked to energy efficiency measures:** There is a 30% tax deduction (max 50000 SEK/person/year) for labour cost for home renovation. However, often this tax deduction is used for non-energy related measures such as improving kitchen, painting, a new or improved balcony, or house cleaning. An amendment to the tax deduction programs to incorporate specific requirements regarding energy efficiency of implemented measures may increase homeowners' interest in energy efficient renovation.
4. **Guarantee on energy savings:** A guarantee on energy or energy cost saving may encourage energy efficient renovation of houses. It should be also emphasised that the energy efficiency improvements bring along other benefits like improved thermal comfort or internal air quality.
5. **National information campaigns** where authorities encourage people to think holistically when doing a renovation of their houses. Messages such as "don't miss the opportunity to …" may be promoted in order to create a "pull-effect" in the market.

4.2 Actors mapping

The identification of potential actors, their possible role, their interest and level of motivations have been mapped in the following Table 16.

Table 16. Mapping of the actors, their role, interest and motivation

Characterization of actors	**1. Identification**			**2. Interests and motivation**						**3. Social in**
Type of stakeholder	name / description of actor	Position within the project	Description of actor's role	Expectations or concerns: motivation to participate	Motivation (high, medium, low)	Project activities	Resources that the actor controls	Replace-ability	Formal (f) and informal influence (i) on the project	Overlaps in roles. Which different roles the actor takes?
A. Private sector companies (business partners, financiers, competitors, etc.)	**Åseda Värme & Sanitet**	Potential contractor	HVAC company interested to offer one-stop-shop service	new operating area	medium	develoment of project	HVAC and knowledge of construction sector	medium	(f+i)	yes
	Susen AB	Support the project	Solar installer interested to learn about potential for solar	aims for economic prosperity	medium	develoment of project	market ressource	medium	(f+i)	no
	Länsförsäkring Kronoberg	Future actor	Insurance, bank and real estate company interested to offer renovation services		high	develoment of project	market ressource	medium	(f+i)	yes
B. Experts	**Linnaeus University**	consultant	Leader of research project on one-stop-shop development	improvement of project structure	high	organiser	Business model development	difficult	(f+i)	no
Characterization of actors	**1. Identification**			**2. Interests and motivation**						**3. Social in**
C. Public sector (administrators, politicians)	**Växjö municipality**	support the project	independent energy advisor	aims for energetic independence	medium	controller	administrative	difficult	(f+i)	no
D. Associations and NGOs (e.g., resident's associations, environmental	**Energikontoret Sydost**	consultant	An association of public and private actors promoting	aims for energetic independence	medium	organiser	permits	medium	(f+i)	no

organisations, ...)			energy efficiency in the south-east Sweden							
	Villaägarna Kronoberg	cooperative		aims for energetic independence	medium	stakeholder	market resource	difficult	(f+i)	no

4.3 Interpretation of the actors mapping

Energikontor Sydost, a public owned company to promote energy efficiency in South east Sweden, will coordinate the non-research actors, lead the one-stop-shop business model development and its application. They have long experience of energy efficient buildings.

Åseda Värme och Sanitet AB, member of Godahus, is a contractor providing total solutions for heating systems in one- and multi-family houses and localities for industries. The company has been a successful contractor for many years and has a high technology level with e.g heat pumps and solar cells.

SUSEN AB is a solar system installation company. They have more than eight years of experience of solar solutions for all types and sizes of roofs. They were project leader for solar energy installation in Växjö's first plus energy house as well as for Växjö's largest solar installation with 500 solar cell modules.

Villaägarna Kronoberg, the Kronoberg chapter of Swedish homeowners association, will share homeowners' perspective on energy renovation and will communicate the project results to Swedish homeowners.

Länsförsäkring Kronoberg is banking, insurance and Real Estate Company. They will share their competency in those areas to develop a one-stop-shop business model as a future business.

4.4 Services mapping

Different types of services in deep –renovation, potential service providers, and their existing status in Växjö are mapped in the following Table 17.

Table 17: Service Mapping

Services	Is the service currently provided to homeowners?	Who provides this service to homeowners?	What concretely does the provider offer?	Does service need to be developed / upgraded?	Who should provide the service?
Development of products adapted to consumers' concerns	Unaware			yes	Several SME renovation companies e.g. GBJ, Joncon can offer such service. Other companies can create a start up, e.g. Länsförsäkring Kronoberg, Åseda Värme & Sanitet.
Development of tailor-made products	Unaware			yes	
Independent advice and technical assistance.	yes	Municipality energy adviser	Free of change energy advice at the energy advisers office. The advices are not tailor-made as the energy adviser is not allowed to make home visits.	yes	Local energy agency Energy auditors Building inspection companies
Services	**Is the service currently provided to homeowners?**	**Who provides this service to homeowners?**	**What concretely does the provider offer?**	**Does service need to be developed / upgraded?**	**Who should provide the service?**
Tailor-made financial advice	no			yes	>see above

Long-term and affordable financing	no			yes	>City: grants for energy audit, bonus for deep renovation >National public banks, low or zero interest loans Banks: Ex-ante post renovation value of the house as a basis for mortgage financing

Services	Is the service currently provided to homeowners?	Who provides this service to homeowners?	What concretely does the provider offer?	Does service need to be developed / upgraded?	Who should provide the service?
Coordination of a chain of suppliers / contractors	yes	There are some companies who offer all types of renovation. Some companies coordinate different subcontractors e.g. GBJ, Joncon byggservice	They are very occupied with new constructions and do not show interest in renovation of individual houses	yes	Several SME renovation companies e.g. GBJ, Joncon can offer such service. Other companies can create a start up, e.g. Länsförsäkring Kronoberg, Åseda Värme & Sanitet.
Ensuring high quality standards	Unaware	It depends on the contractor, but it is common to have 1-2 year contract		yes	>see above

		on all types of renovations				
Ensuring high quality monitoring	no			yes		
Marketing & communication	no			yes	>Local energy agency >Renovation companies	

4.5 Interpretation of the services mapping

In the Växjö municipality, there exist few companies that offer complete renovation service. However, at present, they are too occupied with new multi-story constructions. Therefore, in the INNOVATE project we intend to involve other SMEs to develop a one-stop-shop business model.

The installation company Åseda Värme och Sanitet AB has shown interest to develop and test such a model. The company has competency in installation of heat pumps, ventilation system and all types of piping and drainage system. It plans to sub-contract other companies for other services. Financing is not clear, but discussion is going on.

The municipality energy advisor will act as an independent actor to cross-check the proposed solutions by Åseda Värme och Sanitet and monitor the energy savings.

The other actors in the project will provide expert advice on technical and non-technical aspects of renovation, and Linnaeus University will coordinate the project.

STEP 5: GENERAL CONCLUSIONS

The houses from 1960-1980 with direct electric heating are the target group to test our business model. We will especially target younger homeowners as they are more likely to show interest in energy renovation. Very few companies offer complete renovation packages and there is no incentive for homeowners to engage in such renovation. Most people implement individual renovation measures for aesthetic or comfort improvement purposes. The barriers for deep energy renovation include satisfaction with the existing standard of the house, high investment costs and lack of attractive financing, low energy cost, non-mandatory energy performance requirement, do-it-yourself culture, lack of awareness of energy saving potential, companies promote their own products/service, etc.

We are in the initial phase of the business model development. There are lot of barriers to overcome and we have very few strengths to work on (see table below). Up to now, we found a company and two homeowners interested in the one-stop-shop concept.

STEP 6: CHECK YOUR ACTION

6.1 SWOT Analysis

The strength, opportunity, barriers and risk associated with the deep-renovation market in Växjö has been evaluated using SWOT analysis. The summary of the SWOT analysis has been summarized in the table 18.

Table 18: SWOT analysis of Deep-renovation Market in Växjö

	Strengths	**Weakness**
Internal	• Several public and private actors have shown interest and joined force to develop a one-stop-shop business model • Project participants are well known in the local area • Potential contractor has strong competency on energy and building • Municipality energy adviser as independent actor to verify the renovation measures and the outcome • Identification of interested homeowners at university to kick-start the business model • The local bank/insurance/real estate agent company Länsförsäkring Kronoberg has shown interest in the concept	• University driven development project, not business driven • Lack of willingness or capacity of the homeowners to commit to high investment cost • No financing mechanism • Only one entrepreneur, who may opt not to participate at any time • Lack of strategic support from the local or national government • Cost of renovation may be higher than the increased market value of the house in rural areas • No marketing campaign
	Opportunities	**Threats**
External	• Positive attitude towards energy efficiency and sustainability • Swedish goal to reduce per square meter energy use for heating and hot water	• Promotion of individual products by competing companies • Boom in new construction which is why construction companies do not show

	by 50% by 2050 compared to 1990 level ● Växjö greenest city in Europe ● Significant energy saving potential of the houses from 1960-80 ● Renovation of individual houses could address lack of rental accommodation ● Homeowners will have a renovated house with better indoor environment, likely higher market value in urban areas, and lower energy cost and maintenance cost ● Societal benefit in terms of security of energy supply, efficient resource use and climate change mitigation ● Banks and insurance companies will have safer asset ● Lower insurance premium	interest in renovation ● Low energy cost ● Do-it-yourself culture ● A bad demonstration project may ruin the future of the one-stop-shop concept ● Lack of trustworthiness of the construction sector in general