



Quantifying and characterizing the Finnish building stock

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Background

- PhD study taken place 2012 – 2016
 - Now in pre-examination phase
- Bundle dissertation based on the following articles:
 - Huuhka & Lahdensivu (2016) Statistical and geographical study on demolished buildings *BRI*
 - Huuhka (2015) Vacant residential buildings as potential reserves *BRI*
 - Huuhka, Kaasalainen, Hakanen & Lahdensivu (2015) Reusing concrete panels from buildings for building: Potential in Finnish 1970s mass housing *ResConRec*
 - Kaasalainen & Huuhka (2016) Homogenous homes of Finland: 'Standard' flats in non-standardized blocks *BRI*



Research objects

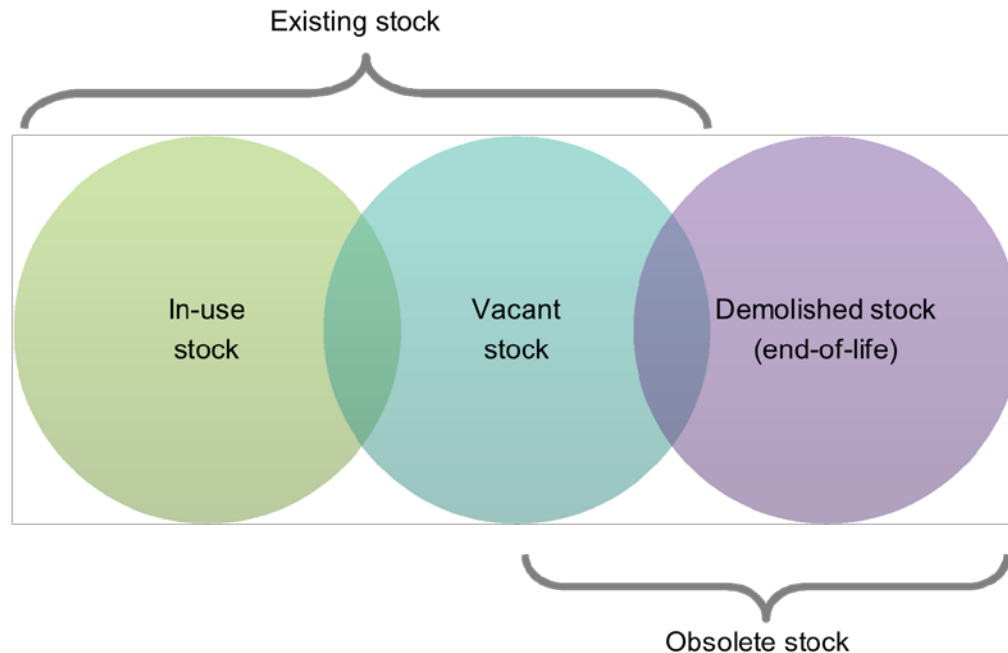


Figure 2. Conceptualization of the composition of the building stock and the relations between different parts thereof.



Research objects

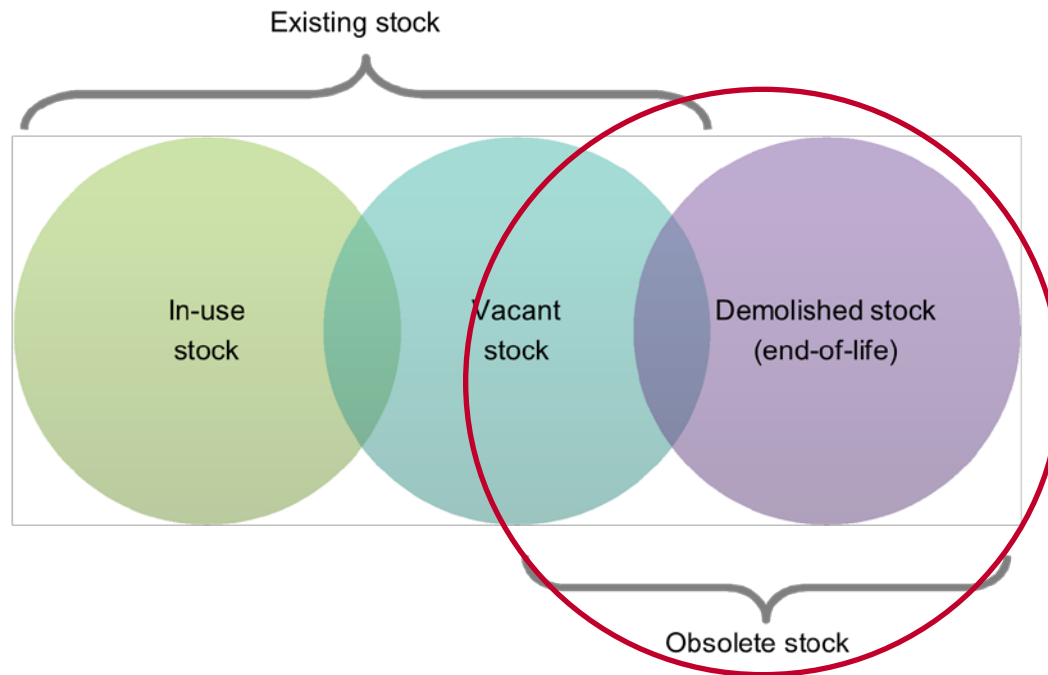


Figure 2. Conceptualization of the composition of the building stock and the relations between different parts thereof.

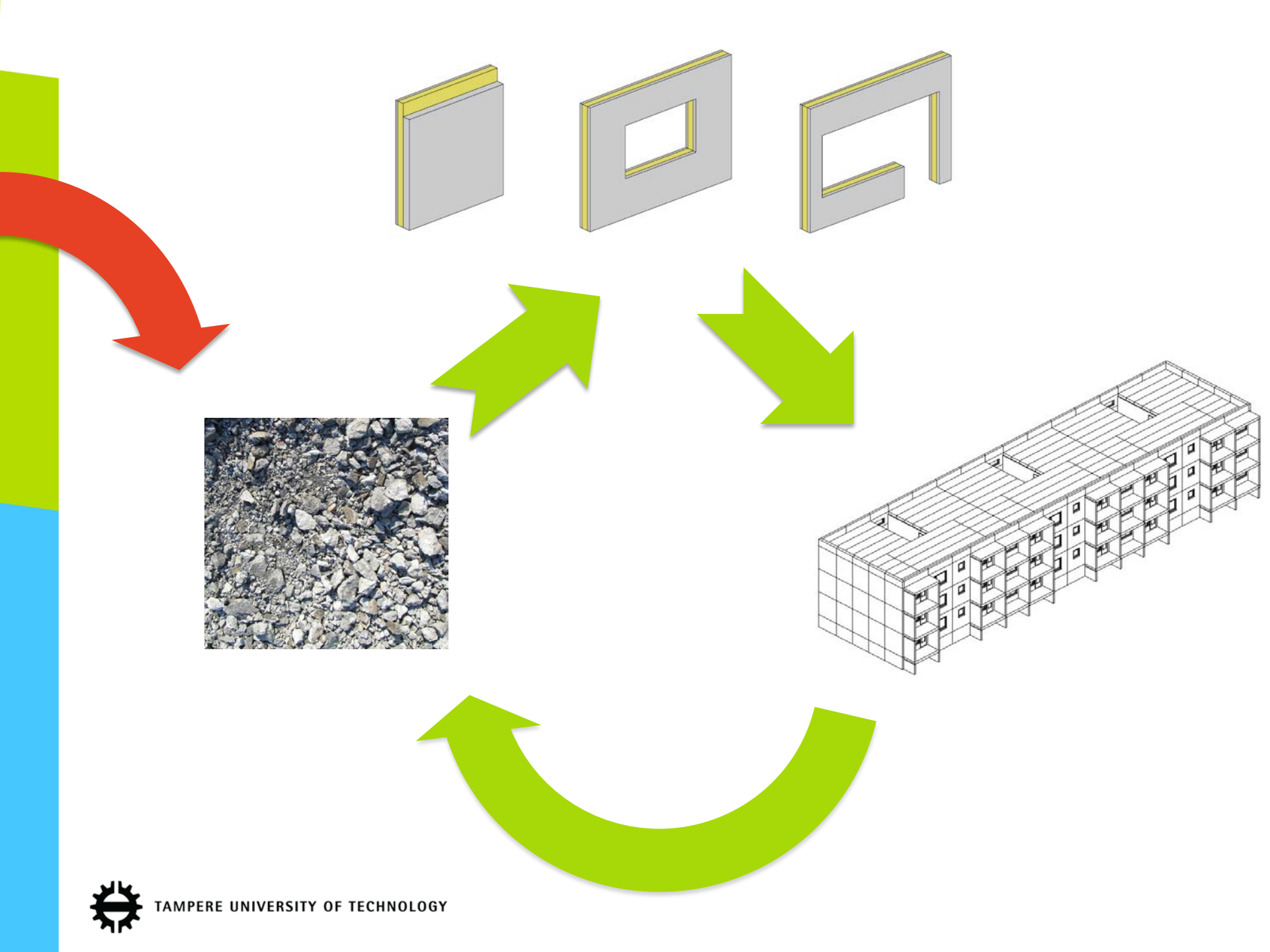


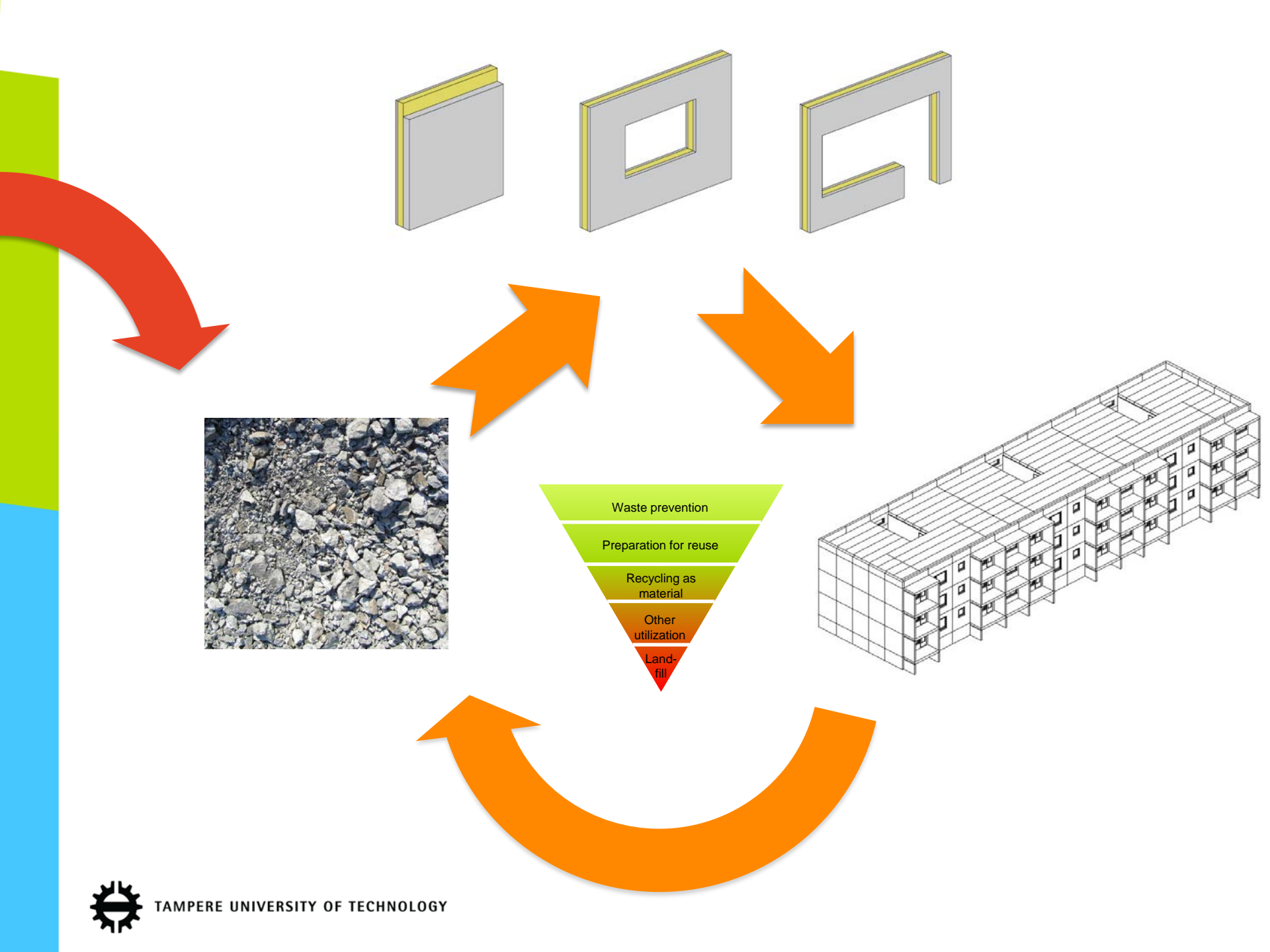
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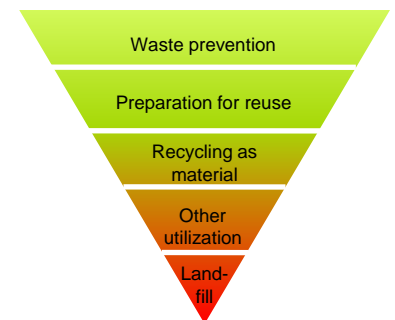
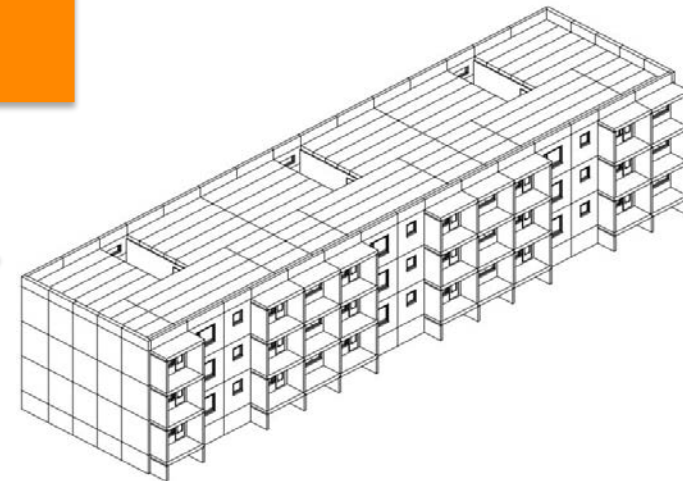
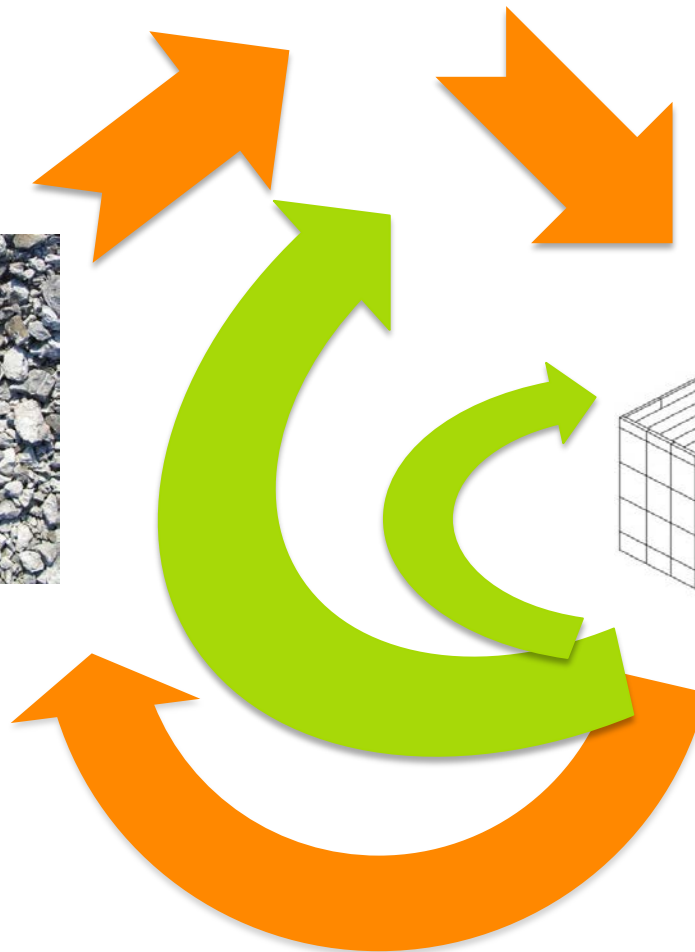
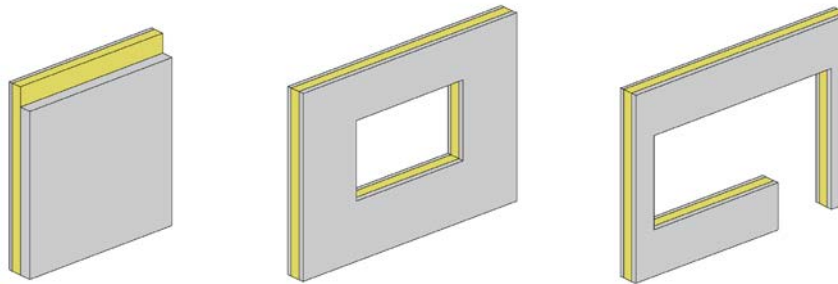
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Top-
down









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Top-down

Bottom-up



Finnish Building and Dwelling Register (BDR)

– Established 1980

- Part of the Population Information System
- Includes both residential and non-residential buildings
- Pre-1980 buildings recorded based on owner surveys
- Since 1980 buildings recorded by building inspection authorities based on building and demolition permits
- Buildings are retained in the registry even after demolition



Original format = excel table

Excel Arkisto Muokkaus Näytä Lisää Muotoile Työkalut Tiedot Ikkuna Ohjeet

A2 fx 00440200020022V001

Tulokset 20130422 PURETUT.xlsx

Uusi Avaa Tallenna Tulosta Tuo Kopioi Sijoita Muotoile Peru Tee uudelleen Summa Lajittele A-Z Lajittele Z-A Valikoima Työkaluryh... Zoomaa Ohje

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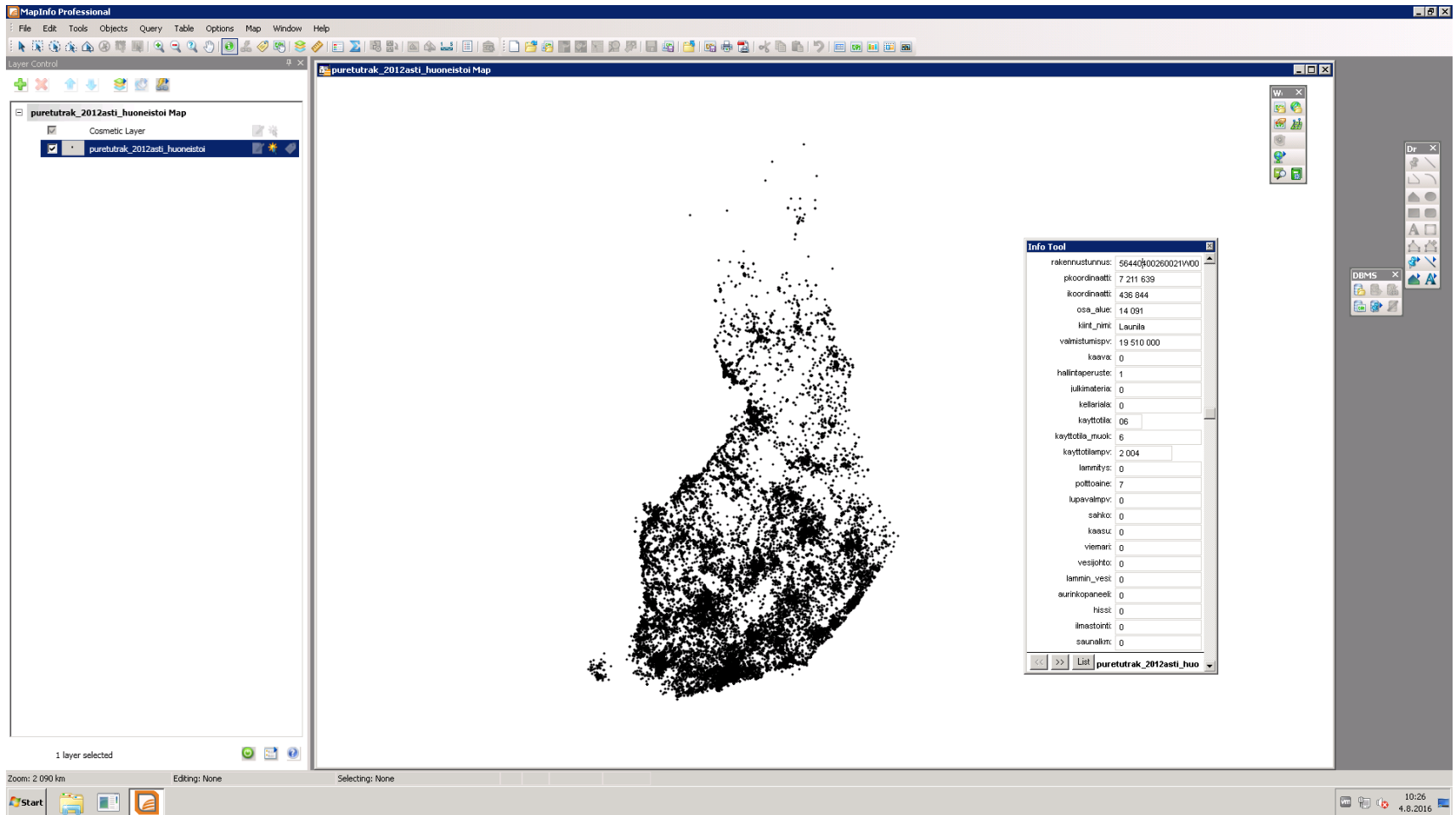
1 rakennus 3 osoite 4 omistaja 5 huoneisto Saate

Normaali näkymä Valmis

Summa=0 VIER ISOT NUM



Processed format = GIS map



Building-level variables

Field	Specifications
Building identification code	
Coordinate zone	
North coordinate	
East coordinate	
Precision of coordinates	
Map leaf	
Neighbourhood	
Voting area	
Other identification number	
Name of estate	
Parcel	yes / no
Construction date	
Existence of urban plan	detailed plan / shore plan / master plan / no plan
Tenure type	owned / rented
Main facade material	concrete / bricks / metal / stone / wood / glass / other
Floor area	
Number of floors	
Brutto area	
Volume	
Basement area	
State of usage	permanent residence business premises holiday residence other temporary residence vacant demolished due to new construction demolished for other reasons destroyed abandoned due to decay unknown other
State of usage registration date	
Building type	(see Appendix I)
Heat distribution method	hot-water heating / warm-air heating / electric heating / fireplace / no heating
Heat source or fuel type	district heating / light fuel oil / heavy fuel oil / electricity / gas / coal / wood / peat / geothermal / other
Last building permit completion date	
Construction material	concrete / bricks / steel / wood / other
Construction method	prefabricated / in situ built
Electricity	yes / no / not known
Gas	yes / no / not known
Sewer	yes / no / not known

Water supply	yes / no / not known
Warm water	yes / no / not known
Solar panels	yes / no / not known
Elevator	yes / no / not known
Ventilation	yes / no / not known
Number of saunas	
Number of pools	
Capacity of bomb shelters	
Connection to sewer network	yes / no / not known
Connection to fresh water network	yes / no / not known
Connection to electric grid	yes / no / not known
Connection to gas network	yes / no / not known
Connection to cable television network	yes / no / not known
Reason for deviation permit	
Floor area, residential spaces	
Floor area, nursing spaces	
Floor area, assembly spaces	
Floor area, other spaces	
Floor area, shop spaces	
Floor area, educational spaces	
Floor area, office spaces	
Floor area, production spaces	
Floor area, warehouse spaces	
Renovation date	
Last registration date	
Number of homes	
Number of business premises	
Area of business premises	
Funding source, new construction	state-subsidized / municipality-subsidized / not subsidized or unknown
Funding source, renovation	state-subsidized / municipality-subsidized / not subsidized or unknown
Date of issue, new construction loan	
Date of issue, renovation loan	
State-subsidization of housing	state-subsidized rental housing / state-subsidized right of occupancy housing / previously but no longer subsidized / not known
Previous building identification code	

Source: Västörrekisterikeskus, 2011



Building-level variables

Field	Specifications
Building identification code	
Coordinate zone	
North coordinate	
East coordinate	
Precision of coordinates	
Map leaf	
Neighbourhood	
Voting area	
Other identification number	
Name of estate	
Parcel	yes / no
Construction date	
Existence of urban plan	detailed plan / shore plan / master plan / no plan
Tenure type	owned / rented
Main facade material	concrete / bricks / metal / stone / wood / glass / other
Floor area	
Number of floors	
Brutto area	
Volume	
Basement area	
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Floor area, shop spaces	
Floor area, educational spaces	
Floor area, office spaces	
Floor area, production spaces	
Floor area, warehouse spaces	
Renovation date	
Last registration date	
Number of homes	
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Area of business premises	
Funding source, new construction	state-subsidized / municipality-subsidized / not subsidized or unknown
Funding source, renovation	state-subsidized / municipality-subsidized / not subsidized or unknown
Date of issue, new construction loan	
Date of issue, renovation loan	
State-subsidization of housing	state-subsidized rental housing / state-subsidized right of occupancy housing / previously but no longer subsidized / not known
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Floor area, warehouse spaces	
Renovation date	
Last registration date	
Number of homes	
Number of business premises	
Area of business premises	
Funding source, new construction	state-subsidized / municipality-subsidized / not subsidized or unknown
Funding source, renovation	state-subsidized / municipality-subsidized / not subsidized or unknown
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Date of issue, renovation loan	
State-subsidization of housing	state-subsidized rental housing / state-subsidized right of occupancy housing / previously but no longer subsidized / not known
Previous building identification code	

Source: Västörrekisterikeskus, 2011



Building types (76 types)

Building type
One dwelling houses
Two-dwelling houses
Other detached and semi-detached houses
Row houses
Terraced houses
Balcony-access blocks
Other blocks of flats
Free-time residential buildings
Shopping halls
Shops, department stores and shopping centres
Other wholesale and retail buildings
Hotels etc.
Holiday, rest and recreation homes
Rental holiday cottages and flats
Other hotel buildings
Residences for communities etc.
Other residential buildings for communities
Restaurants and other similar buildings
Office buildings
Rail and bus stations, air and harbour terminals
Vehicle depots and service buildings
Car parks
Communications buildings
Other transport and communications buildings

General hospitals
Other hospitals
Health centres
Specialized health care buildings
Other health care buildings
Old-age homes
Children's homes, reform schools
Nursing homes for the mentally retarded
Other social welfare buildings
Children's day care centres
Social service buildings n.e.c.
Prisons
Theatres, opera houses, concert halls and congress centres
Cinema halls
Libraries and archives
Museums and art galleries
Exhibition halls
Association and club buildings etc.
Churches, chapels, monasteries, convents and prayer houses
Parish halls
Other buildings of religious communities
Indoor ice rinks
Indoor swimming pools
Indoor tennis, squash and badminton courts
Gymnasias and other sports halls
Other buildings for sports and physical exercise
Other assembly buildings
General education buildings
Vocational education buildings
University buildings
Research institute buildings

Educational buildings of organisations, unions, employers etc.
Educational buildings n.e.c.
Power stations
Public utility buildings
Manufacturing plants
Workshops for industry and small-scale industry
Other industrial production buildings
Industrial warehouses
Commercial warehouses
Other warehouses
Fire stations
Civil defence shelters
Other firefighting and rescue service buildings
Cowsheds, pig houses, hen-houses etc.
Animal shelters, harness horse stables, manèges etc.
Grain drying and storage buildings
Greenhouses
Fur farms
Other buildings in agriculture, forestry and fishing
Sauna buildings
Outbuildings
Buildings n.e.c.

Huuhka, S. (2016). Building 'post-growth': Quantifying and characterizing the Finnish Building stock (unpublished)



Building-level variables

Field	Specifications
Building identification code	
Coordinate zone	
North coordinate	
East coordinate	
Precision of coordinates	
Map leaf	
Neighbourhood	
Voting area	
Other identification number	
Name of estate	
Parcel	yes / no
Construction date	
Existence of urban plan	detailed plan / shore plan / master plan / no plan
Tenure type	owned / rented
Main facade material	concrete / bricks / metal / stone / wood / glass / other
Floor area	
Number of floors	
Brutto area	
Volume	
Basement area	
State of usage	permanent residence business premises holiday residence other temporary residence vacant demolished due to new construction demolished for other reasons destroyed abandoned due to decay unknown other
State of usage registration date	
Building type	(see Appendix I)
Heat distribution method	hot-water heating / warm-air heating / electric heating / fireplace / no heating
Heat source or fuel type	district heating / light fuel oil / heavy fuel oil / electricity / gas / coal / wood / peat / geothermal / other
Last building permit completion date	
Construction material	concrete / bricks / steel / wood / other
Construction method	prefabricated / in situ built
Electricity	yes / no / not known
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Water supply	yes / no / not known
Warm water	yes / no / not known
Solar panels	yes / no / not known
Elevator	yes / no / not known
Ventilation	yes / no / not known
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Capacity of bomb shelters	
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Connection to fresh water network	yes / no / not known
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Elevator	yes / no / not known
Ventilation	yes / no / not known
Number of saunas	
Number of pools	
Capacity of bomb shelters	
Connection to sewer network	yes / no / not known
Connection to fresh water network	yes / no / not known
Connection to electric grid	yes / no / not known
Connection to gas network	yes / no / not known
Connection to cable television network	yes / no / not known
Reason for deviation permit	
Floor area, residential spaces	
Floor area, nursing spaces	
Floor area, assembly spaces	
Floor area, other spaces	
Floor area, shop spaces	
Floor area, educational spaces	
Floor area, office spaces	
Floor area, production spaces	
Floor area, warehouse spaces	
Renovation date	
Last registration date	
Number of homes	
Number of business premises	
Area of business premises	
Funding source, new construction	state-subsidized / municipality-subsidized / not subsidized or unknown
Funding source, renovation	state-subsidized / municipality-subsidized / not subsidized or unknown
Date of issue, new construction loan	
Date of issue, renovation loan	
State-subsidization of housing	state-subsidized rental housing / state-subsidized right of occupancy housing / previously but no longer subsidized / not known
Previous building identification code	

Source: Västörrekisterikeskus, 2011



Research objects

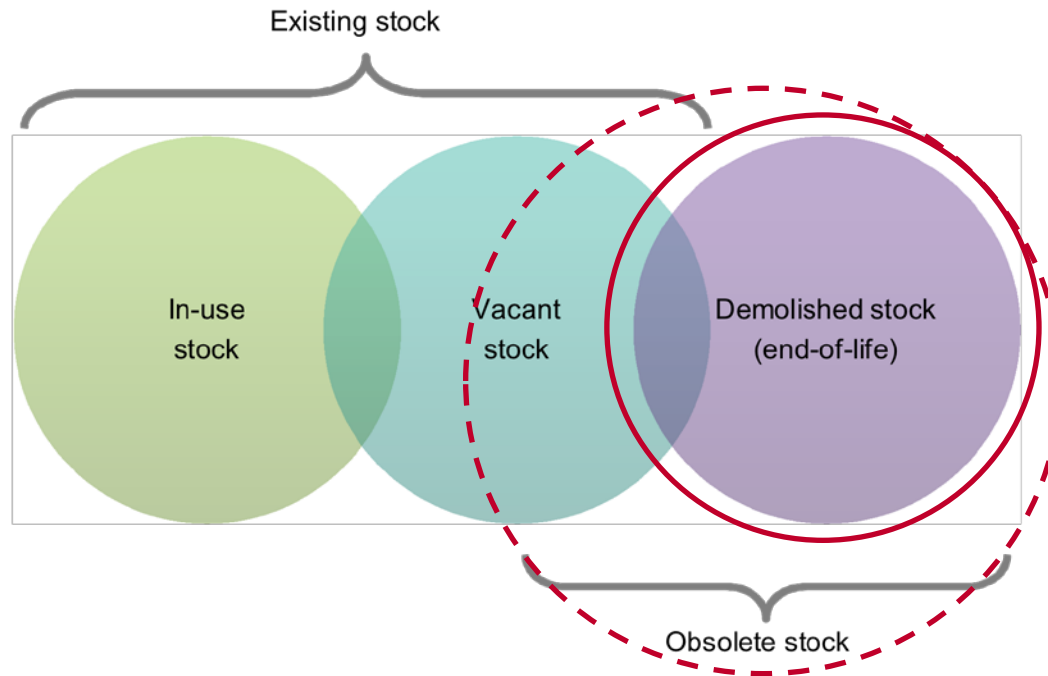
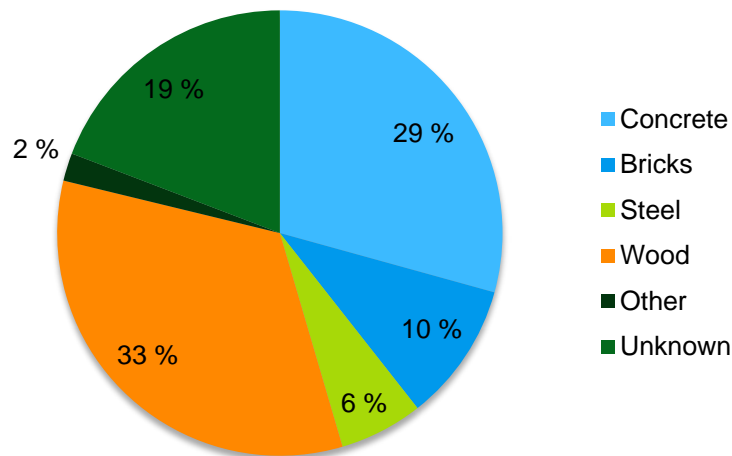


Figure 2. Conceptualization of the composition of the building stock and the relations between different parts thereof.



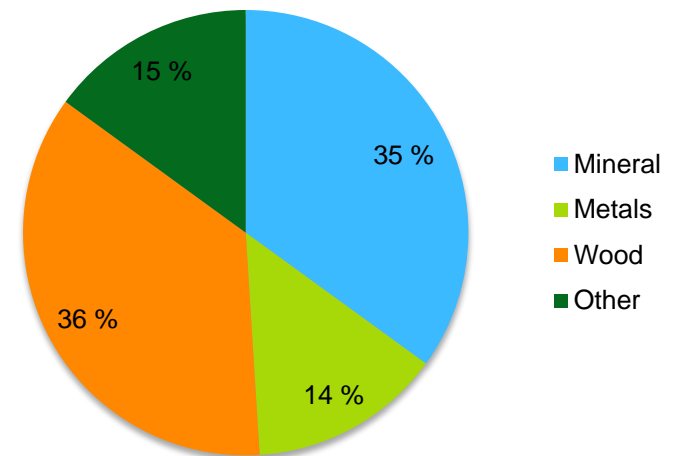
Demolished buildings: construction materials

Demolished floor area,
construction material



Huuhka, S. & Lahdensivu, J. (2016) Statistical and geographical study on demolished buildings

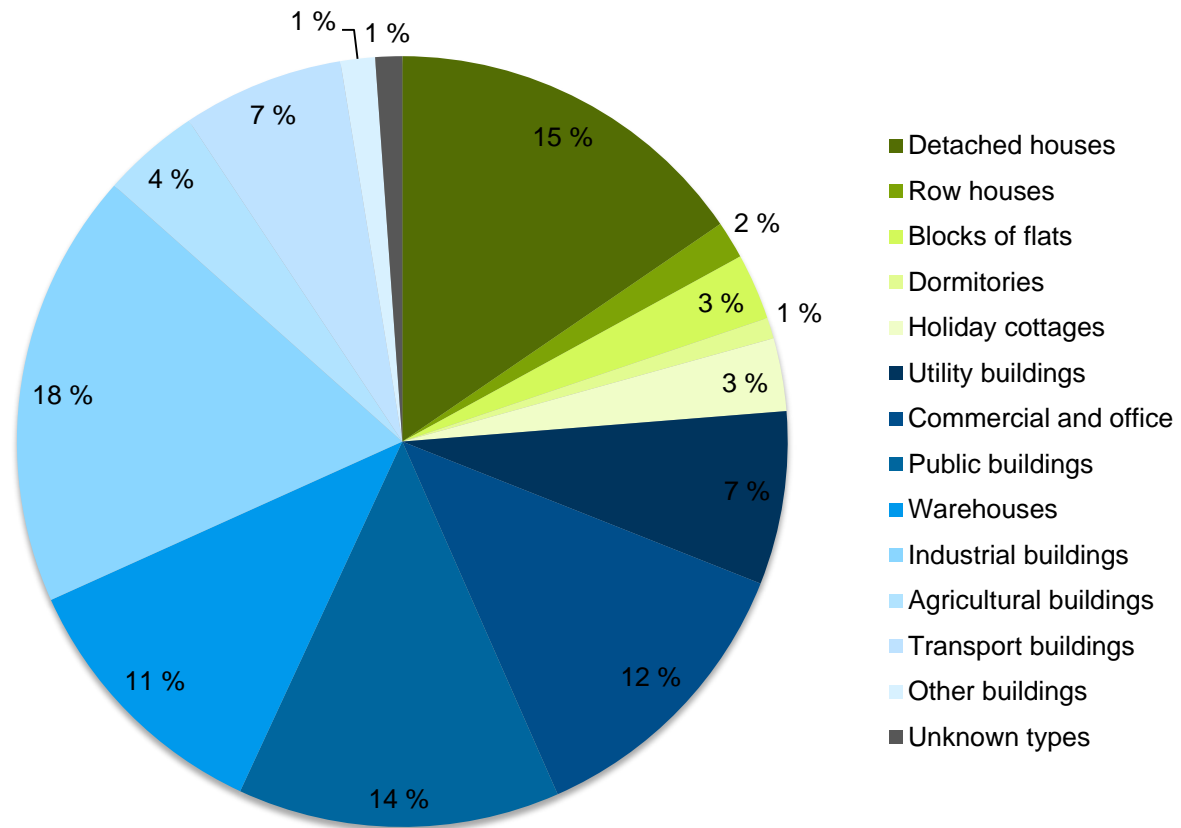
C&D waste composition,
estimation 2012



Meinander, M. & Mroueh, U.-M. (2012). Directions of future developments in waste recycling (VTT Technology 60)



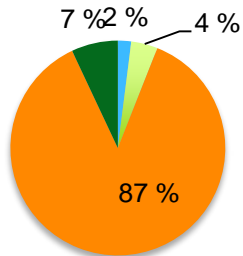
Demolished floor area by b. type



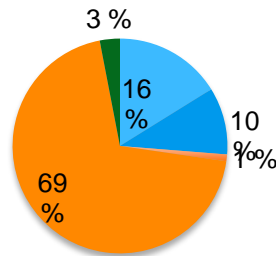
Materials by types



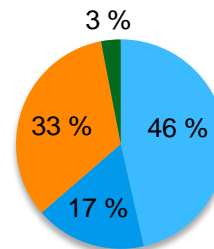
Detached houses



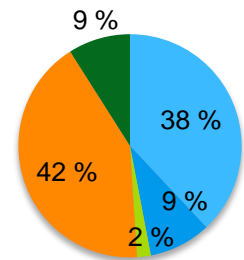
Row houses



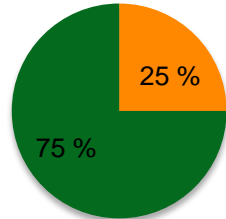
Blocks of flats



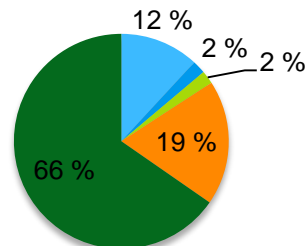
Dormitories



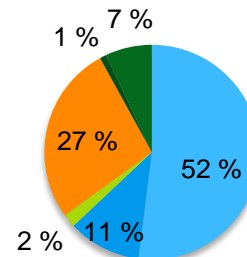
Holiday cottages



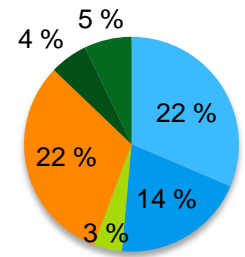
Utility buildings



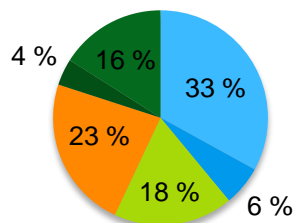
Commercial and office



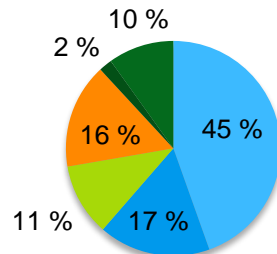
Public buildings



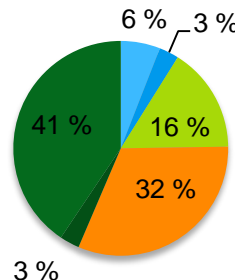
Warehouses



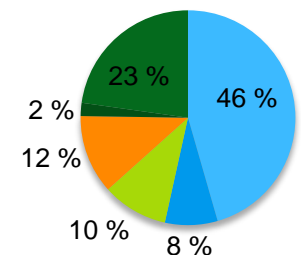
Industrial buildings



Agricultural buildings



Transport buildings



Type & decade → materials

Table 9 Building year by building type

Name of the group number of buildings and % floor area in m ² and %	–1899 (2%)	1900–09 (2%)	1910–19 (2%)	1920–29 (23%)	1930–39 (11%)	1940–49 (19%)	1950–59 (22%)	1960–69 (9%)	1970–79 (6%)	1980–89 (3%)	1990–99 (1%)	2000– (0%)	Total, known records (100%)
Detached houses	351 (2%)	315 (2%)	292 (2%)	3637 (23%)	1803 (11%)	2956 (19%)	3537 (22%)	1510 (9%)	893 (6%)	422 (3%)	145 (1%)	77 (0%)	15 938 (100%)
	32 088 (2%)	27 610 (2%)	26 376 (2%)	275 324 (19%)	138 640 (10%)	248 432 (18%)	315 038 (22%)	162 639 (12%)	103 969 (7%)	53 352 (4%)	20 025 (1%)	10 428 (1%)	1 413 921 (100%)
Terraced (row) houses	3 (1%)	3 (1%)	1 (0%)	33 (9%)	8 (2%)	31 (8%)	25 (7%)	81 (22%)	133 (36%)	41 (11%)	9 (2%)	0 (0%)	368 (100%)
	997 (1%)	669 (0%)	332 (0%)	10 011 (7%)	1 759 (1%)	10 402 (7%)	7392 (5%)	42 483 (29%)	55 752 (38%)	13 651 (9%)	3153 (2%)	0 (0%)	146 601 (100%)
Blocks of flats	8 (2%)	7 (1%)	9 (2%)	106 (22%)	66 (14%)	101 (21%)	86 (18%)	47 (10%)	39 (8%)	14 (3%)	1 (0%)	0 (0%)	484 (100%)
	2485 (1%)	1924 (1%)	1928 (1%)	24 806 (10%)	17 877 (7%)	30 115 (21%)	52 287 (20%)	51 001 (23%)	58 555 (23%)	13 161 (5%)	337 (0%)	0 (0%)	254 476 (100%)
Dormitories	18 (8%)	0 (0%)	1 (0%)	8 (3%)	9 (4%)	19 (8%)	9 (4%)	25 (10%)	66 (28%)	55 (23%)	20 (9%)	5 (2%)	235 (100%)
	5155 (6%)	0 (0%)	477 (1%)	1771 (2%)	2396 (3%)	5041 (6%)	10 502 (13%)	8374 (10%)	22 625 (28%)	12 698 (15%)	11 576 (14%)	1533 (2%)	82 148 (100%)
Holiday cottages	26 (0%)	47 (1%)	33 (0%)	520 (7%)	416 (6%)	664 (10%)	1426 (21%)	1496 (22%)	1286 (19%)	657 (9%)	285 (4%)	89 (1%)	6945 (100%)
	1651 (1%)	2715 (1%)	1974 (1%)	27 939 (10%)	17 589 (7%)	26 485 (20%)	49 651 (20%)	52 375 (20%)	46 455 (17%)	24 398 (9%)	11 187 (4%)	4239 (2%)	266 658 (100%)
Utility buildings	141 (1%)	296 (2%)	192 (1%)	837 (6%)	1028 (7%)	1797 (13%)	2557 (18%)	1536 (11%)	2532 (18%)	1528 (11%)	985 (7%)	401 (3%)	13 830 (100%)
	7049 (1%)	11 797 (2%)	7940 (1%)	39 174 (6%)	41 395 (7%)	73 456 (12%)	100 550 (16%)	117 800 (19%)	109 242 (18%)	60 439 (10%)	32 329 (5%)	13 850 (2%)	615 021 (100%)
Commercial and office buildings	9 (0%)	12 (1%)	10 (0%)	111 (5%)	91 (4%)	112 (5%)	222 (11%)	379 (18%)	459 (22%)	469 (22%)	187 (9%)	53 (3%)	2114 (100%)
	2269 (0%)	6360 (1%)	1564 (0%)	34 468 (3%)	52 191 (5%)	72 343 (6%)	121 404 (11%)	245 845 (22%)	400 537 (35%)	115 713 (10%)	56 925 (5%)	18 685 (2%)	1 128 304 (100%)
Public buildings	10 (1%)	10 (1%)	11 (1%)	76 (7%)	48 (5%)	70 (7%)	123 (12%)	166 (16%)	188 (18%)	181 (17%)	83 (8%)	77 (7%)	1 043 (100%)
	3554 (0%)	2106 (0%)	3723 (0%)	31 321 (4%)	26 676 (3%)	79 253 (9%)	136 304 (16%)	199 211 (23%)	162 569 (19%)	127 116 (15%)	63 553 (7%)	35 634 (4%)	871 020 (100%)
Warehouses	4 (0%)	15 (1%)	12 (1%)	63 (5%)	63 (5%)	92 (7%)	163 (12%)	170 (12%)	257 (19%)	303 (22%)	169 (12%)	67 (5%)	1 378 (100%)

(Table continued)



Type & decade → materials

Table 9 Building year by building type

Name of the group number of buildings and % floor area in m ² and %	–1899 (2%)	1900–09 (2%)	1910–19 (2%)	1920–29 (23%)	1930–39 (11%)	1940–49 (19%)	1950–59 (22%)	1960–69 (9%)	1970–79 (6%)	1980–89 (3%)	1990–99 (1%)	2000– (0%)	Total, known records (100%)
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(Table continued)

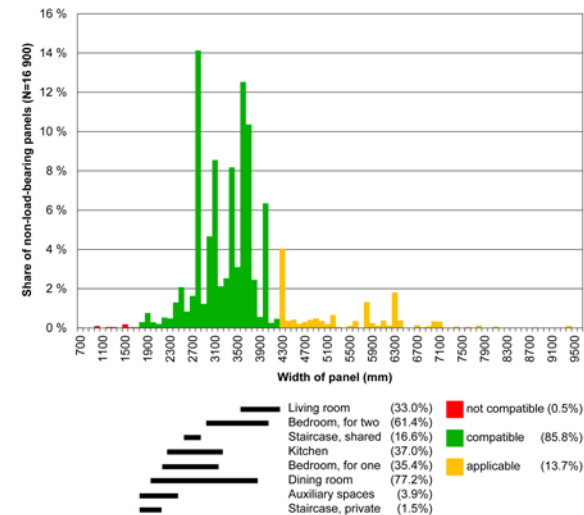
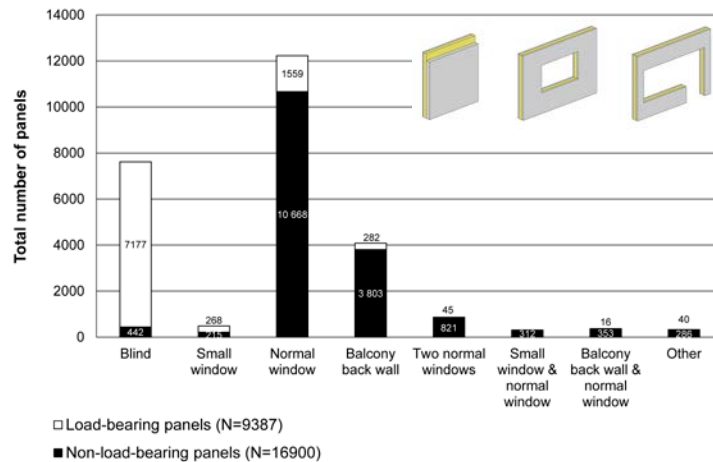
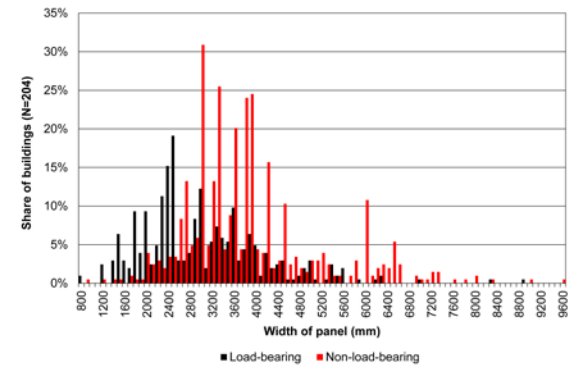


Age-use cohort: Component composition

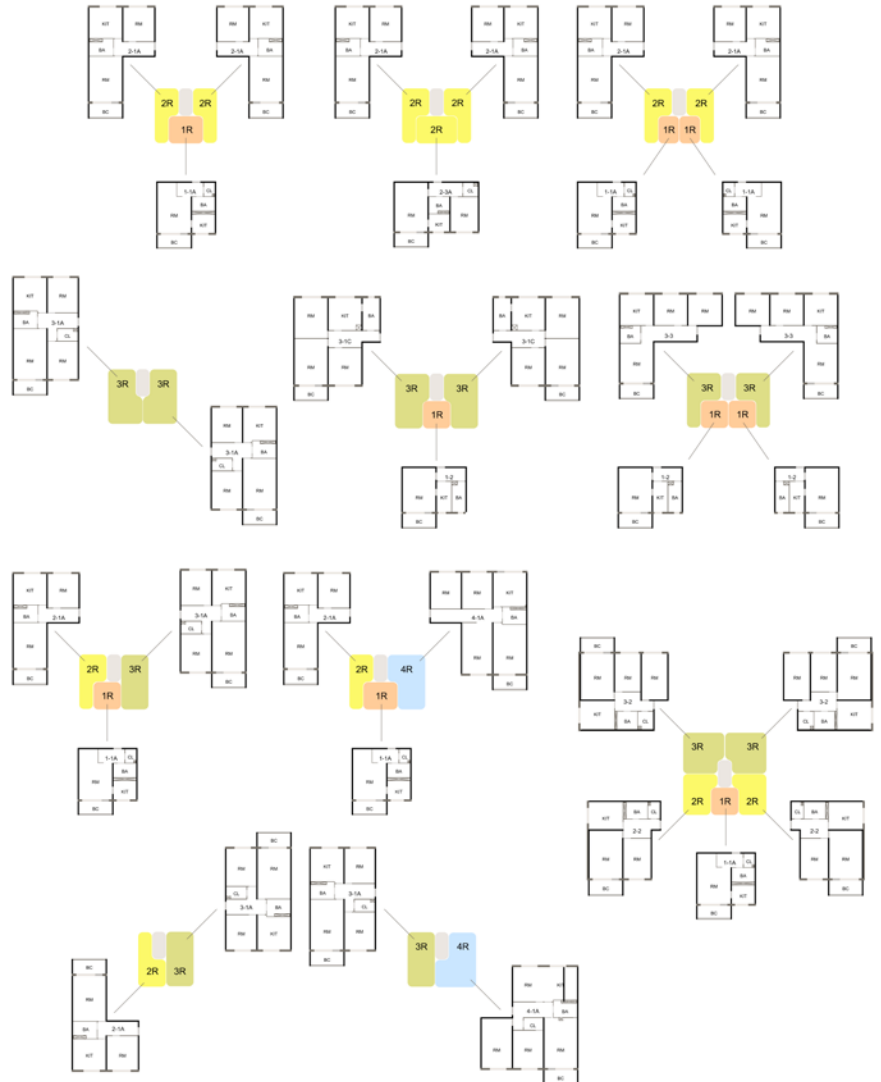
Part of building or component	Average or typical value
Prefabricated façade	12 040 m ² or 4300 m*
load-bearing	3360 m ² or 1200 m*
non-load-bearing	8680 m ² or 3100 m*
Façade panels	129 pieces
load-bearing	46 pieces
non-load-bearing	83 pieces
Different panels	3–6 types
load-bearing	1–2 types
non-load-bearing	2–4 types
Prefabricated floor	1410 m ² or 1175 m**
Prefabricated floor slabs	180 pieces

Table 4. Typical values in the age cohort (Article III).

Notes: *) 2.8 m high panels; **) 1.2 m wide slabs.



Age-use cohort: Spatial composition



Kaasalainen, T. & Huuhka, S. (2016) Homogenous homes of Finland:
'Standard' flats in non-standardized blocks

Huuhka, S. (2016). Building 'post-growth':
Quantifying and characterizing the Finnish Building
stock (unpublished)



Dynamics of the stock

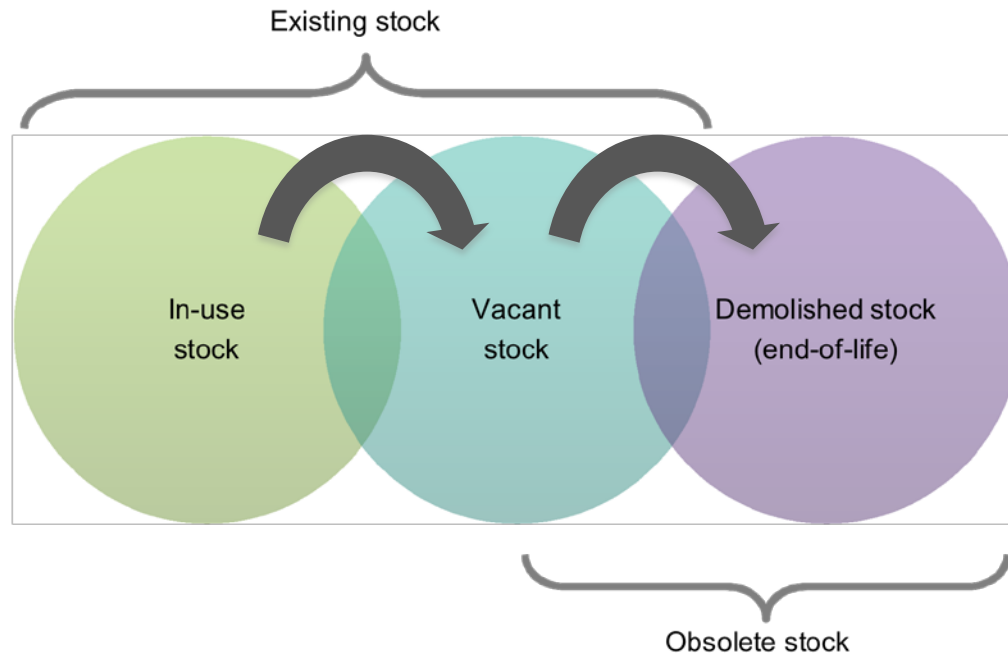
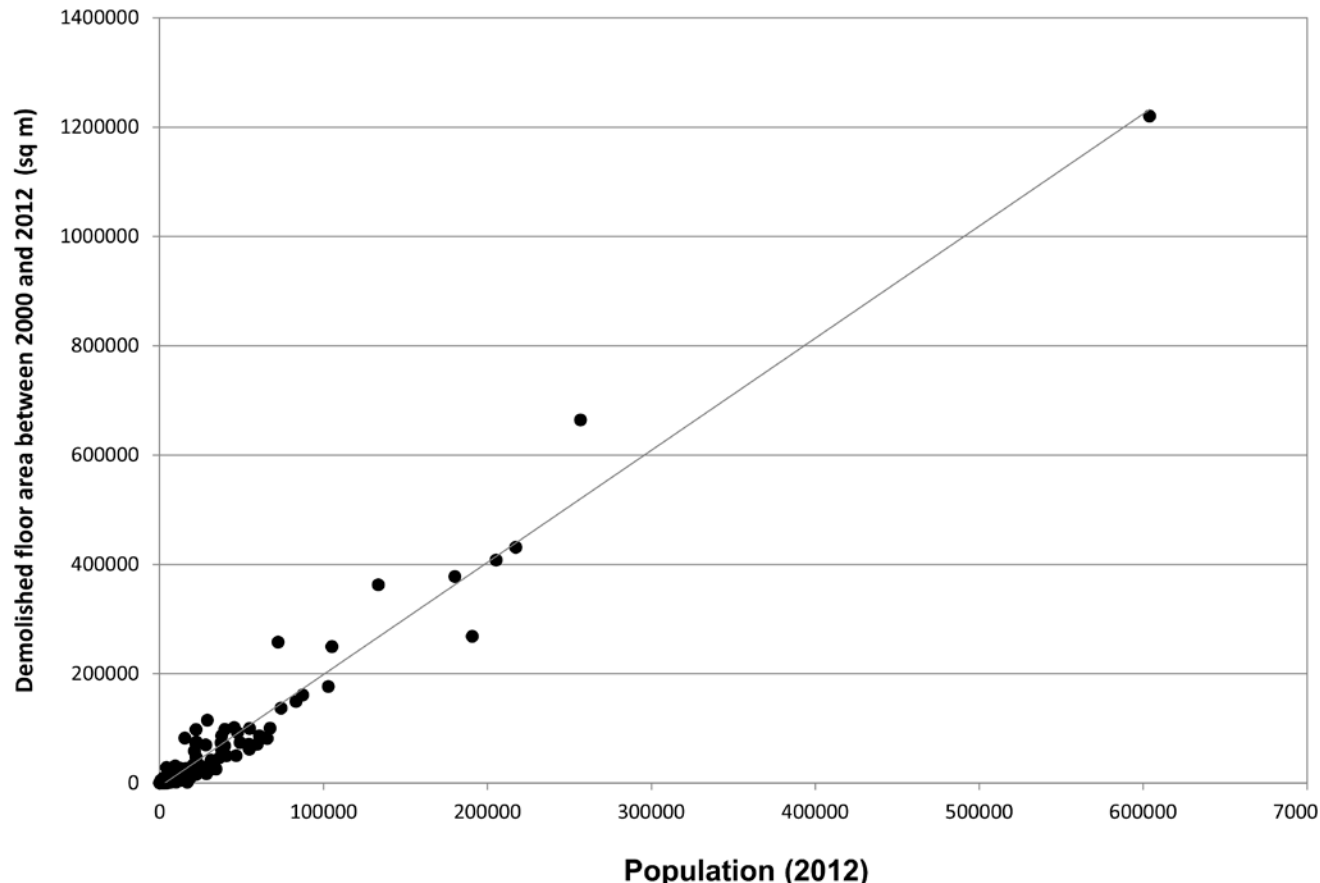


Figure 2. Conceptualization of the composition of the building stock and the relations between different parts thereof.



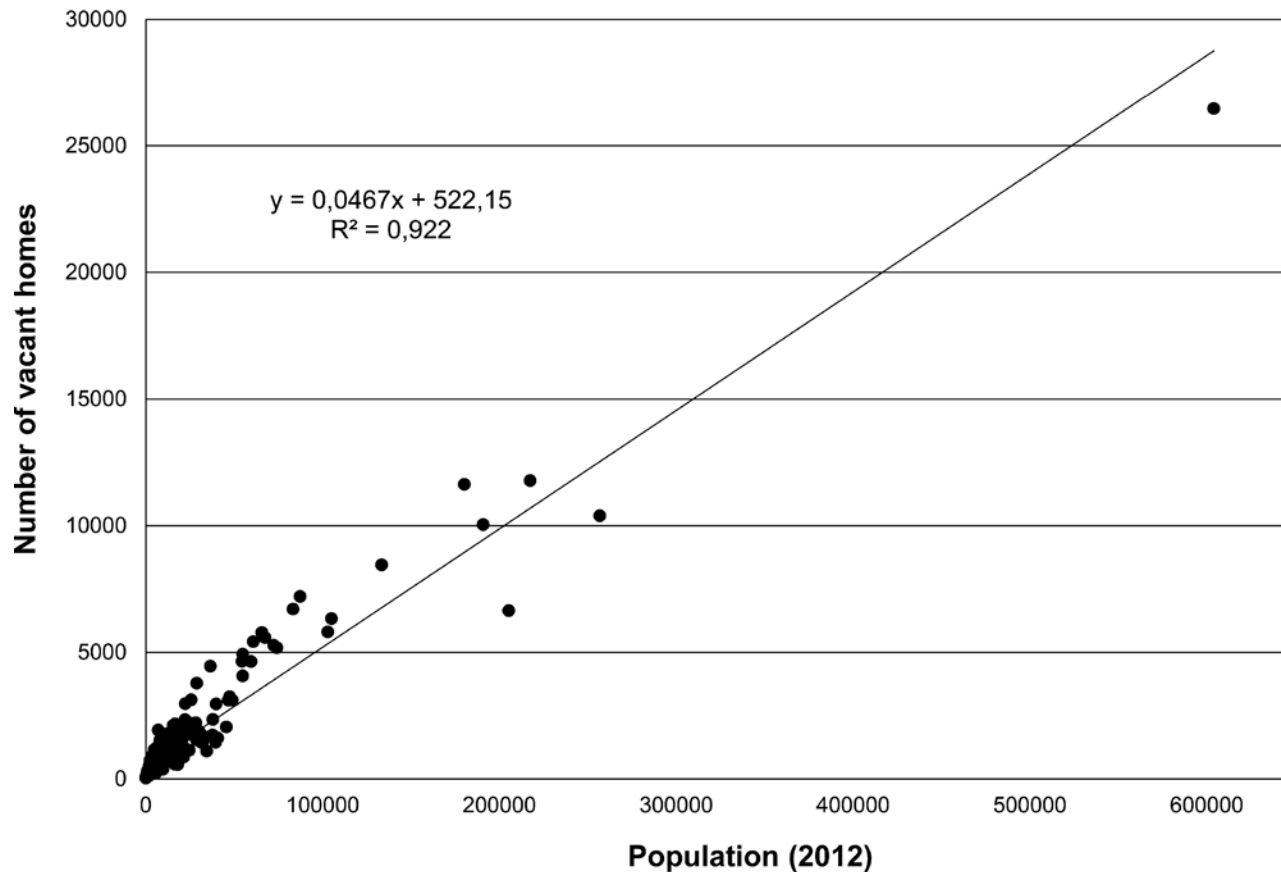
Correlation and regression analysis

a) population + demolished floor area



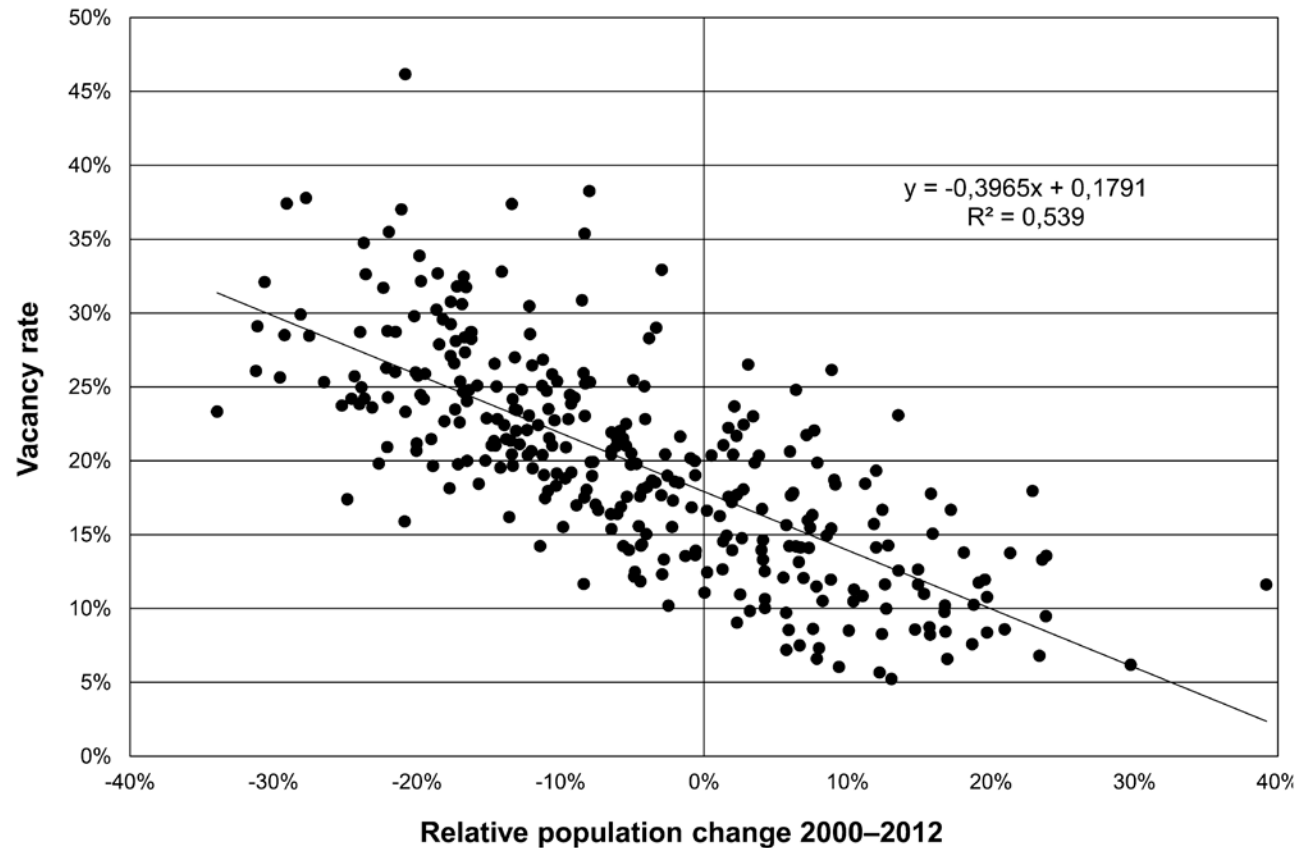
Correlation and regression analysis

e) population + vacant homes



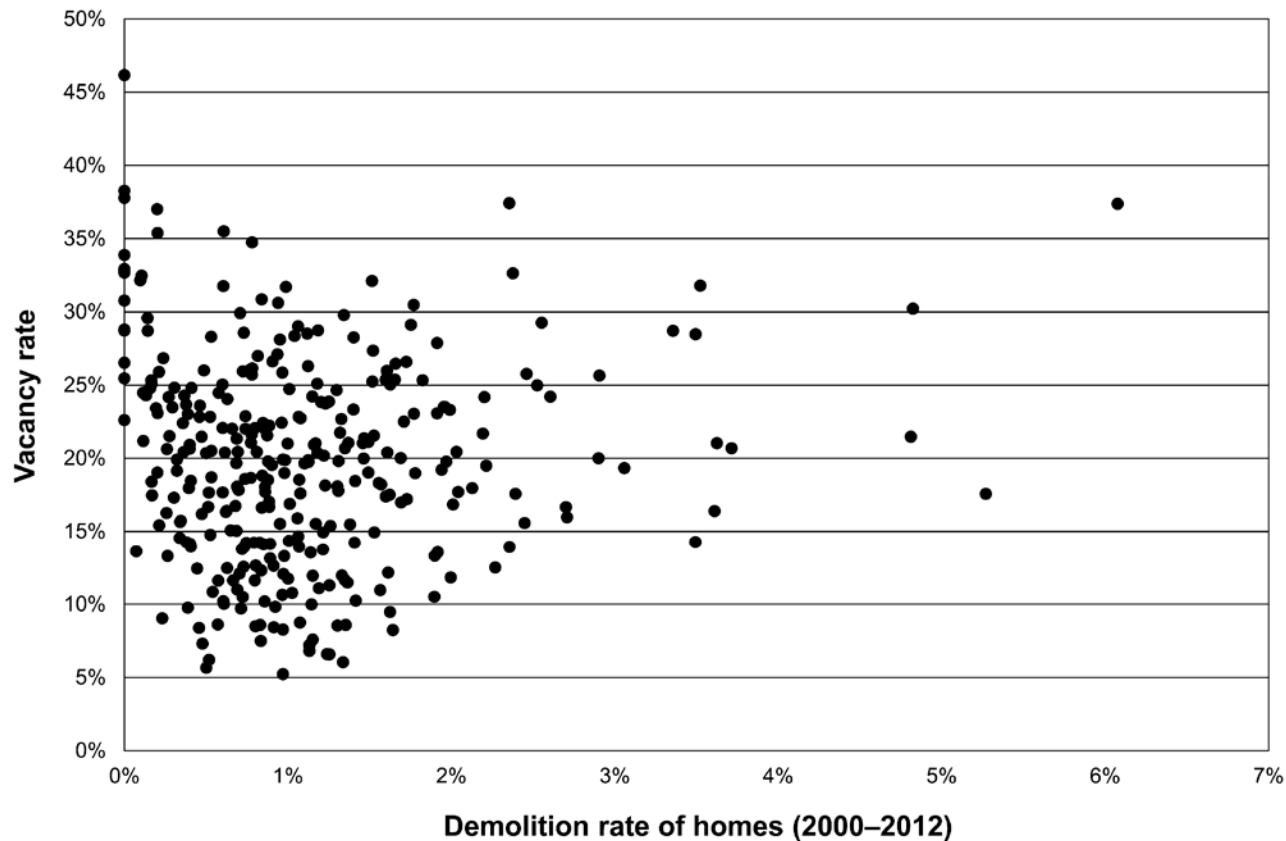
Correlation and regression analysis

b) population change rate + vacancy rate



Correlation and regression analysis

h) demolition rate of homes + vacancy rate





Thank you
for your attention!