Supplementary Materials:

Spatio-Temporal Analysis of Resources and Waste Quantities From Buildings (As Urban Mining Potential) Generated by the European Metropolis of Lille: A Methodology Coupling Data From Construction and Demolition Permits With Geographic Information Systems

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Table S1. Classification of the Methods. Source: [3]. SV: Site Visit method; GRC: Generation Rate Calculation method; GIS: Geographic Information System; BIM: Building Information Modeling; VM: Variables Modeling method; CSA: Classification System Accumulation method; MFA: Material Flow Analysis approach; PL: Project level; RL: Regional level.

	Methods		Typical paper	Waste generation activity	Description	Scope
Basic methods	SV	Direct measurement	[7]	Construction of new buildings	Direct measurement of CDW can provide the most practical waste generation rates, which is the most basic information for CDW quantification. However, the direct measurement should first successfully seek the support from the contractors, and the consumption of time, money and labor is immense	PL
		indirect measurement	[36]	C&D waste	Indirect measurement can quickly supply general information of waste generation situation. However, the waste generation amounts derived from this method can only approximately reflect the fact	PL
	GRC	Per-capita multiplier	[8]	C&D waste	As CDW generation is more construction related, this method is not suggested if construction related statistics can be derived	RL
		Financial value extrapolation	[9]	C&D waste	This method is not suggested when the area of construction demolition activities can be directly derived	RL

		Area-based calculation	[37]	Demolition of old buildings	Area-based calculation is the most popular method in literature. It can be employed to estimate all kinds of C&D waste. However, The accuracy of this method is not high	PL
	GIS		[10,11,12,38]	Demolition of old buildings	define the questions, to state the aims and contents, and then import the DW-GIS database into GIS software	RL
	BIM		[16,37]	Demolition of old buildings	BIM allows multi-disciplinary information to be superimposed within one digital building model. System can extract material and volume information through the BIM model and integrate the information for detailed waste estimation and planning	PL
Comprehensive methods	**VM**	Grey Theory	[38]	C&D waste	The most widely used "grey prediction model" is the GM (1,1) model. It is based on the random discrete original time series, and after the time accumulating number is processed, it gets new and more regular. The grey prediction model is applicable to small sample demand, irregular data distribution, and no need for typical situations	RL
		Neural networks	[39]	C&D waste	Using the estimation coefficient to estimate the amount of waste generated, the obtained result is higher than the actual amount produced	RL
		System dynamics modeling	[15]	C&D waste	The model was established according to the identified interrelationships between each variable. The interrelationships were represented using casual loops, which is used to diminish the complexity of the system and reflect the changes of variables.	RL
	CSA		[16]	C&D waste	A classification system can be established according to existing systems, such as a regional project budget system or the European Waste List	PL RL
	MFA		[40]	C&D waste	MFA could examine the input and output of construction materials that come into service in given years and also figure out materials flows through the whole construction activity	PL RL

Table S2. Waste production indices (t/m²) according to the urban fabric of the MEL. FF: farm fabric; PF: Pavilion Fabric; AF: Activity fabric; SDGHF: Fabric of semi-detached or grouped houses; DCUF: Dense continuous urban fabric; TF: Townhouse Fabric; CF: Collective fabric; UTHF: Upper town house fabric; EF: Equipment fabric; UF: Undefined fabric.

Materials type	FF	PF	AF	SDGHF	DCUF	TF	UTHF	CF	EF	UF	Tot by materials
Bituminous mixtures (without tar)	408.52	0.00	11 603.79	0.00	0.00	0.00	0.00	0.00	7 039.78	1 042.11	20 094.19
Uncontaminated soil (excluding topsoil)	0.00	0.00	0	0	0	0	0	0	0	0	0
Concrete and stone	33 357	105 504	736 864.95	172 209.40	109 488	157 487.79	22 485.77	159 843.38	447 040.94	165 846.76	2 110 129.82
Tiles and bricks	25 195	7 190.83	261 962.61	371 879.16	241 134	344 624.87	49 204.80	93 642.65	158 927.37	152 201.64	1 705 964.07

Ceramics (tiles, earthenware and sanitaryware)	206	497.65	4 396.04	1 212.85	3 143	3 399.33	485.35	9 362.27	2 666.99	3 397.90	28 768.92
Glass without joinery	24	45.15	693.18	9.48	0	2.85	0.41	321.57	420.54	136.22	1 654.24
Mixtures of the above listed waste materials without NHW	1 396	0	8 959.53	25 178.49	0	7 573.21	1 081.29	0	5 435.56	3 559.56	53 184.27
Other inert waste	284.99	2 119.02	6 013.89	1 702.41	0	512.05	73.11	157.57	3 648.50	1 111.00	15 622.54
Plasterboards and tiles	1 019	1 898.90	22 490.66	5 289.06	3 296.91	4 773.41	681.54	165.51	13 644.62	3 874.34	57 134.51
Gypsum plaster - inert substrate	274.11	0	7 158.65	509.18	0	153.15	21.87	0	4 343.01	698.61	13 158.58
Plaster-insulating compounds	81	4 521.99	1 807.53	403.08	0	121.24	17.31	3 784.12	1 096.59	1 728.61	13 561.45
Untreated wood	244.21	2 063.73	6 930.41	0	0	0	0	6 808.70	4 204.54	2 350.82	22 602.39
Low-additive wood	677.11	0	1 076.57	14 888.61	3 833.62	8 178.86	1 167.76	0	653.13	2 802.69	33 278.34
Windows and other glazed openings	47.82	495.39	940.29	342.17	0	102.92	14.69	0	570.45	204.31	2 718.05
Metals	1 373.50	173.01	33 460.81	4 529.45	0	1 362.37	194.52	3 722.76	20 299.99	4 286.71	69 403.12
Plastics-exPVC	12.91	0	362.02	3.56	0	1.07	0.15	697.56	219.63	174.8	1 471.70
Insulation-Mineral wool	88.84	0	2 284.86	194.1	0	58.38	8.34	0	1 386.18	226.44	4 247.13
Insulators-Foamed plastics (EPS, XPS, PU)	16.65	0	415.22	47.03	0	14.15	2.02	466.73	251.91	137.38	1 351.08
Insulation-Other	13.73	50.17	210.78	146.77	0	44.15	6.3	3.73	127.87	44.09	647.59
Tar-free waterproofing compounds	257.25	0	464.83	5 610.77	0	1 687.61	240.95	0	282.01	655.65	9 199.08
Floor coverings	15.43	166.55	370.08	55.72	0	16.76	2.39	12.38	224.52	69.56	933.41
Non-hazardous WEEE (2)	7.6	0	215.8	0	0	0	0	0	130.92	19.38	373.7
Mixtures of NHW	565.59	672.15	31.35	13 148.94	0	3 954.95	564.68	41.85	19.02	1 561.87	20 560.41
Plants	11.6	0	329.33	0	0	0	0	0	199.8	29.58	570.3
Topsoil	1 988.13	0	49.75	46 269.79	0	13 917.07	1 987.05	0	30.18	5 067.12	69 309.09
Other NHW	1 008.26	9 327.74	11 853.25	13 756.95	3 603.60	7 616.44	1 087.46	629.37	7 191.12	5 262.13	61 336.33
Asbestos bound to inert materials	441.41	5.02	4 382.88	6 684.52	549.74	2 541.25	362.83	0.37	2 659.00	1 280.35	18 907.37
Other types of bound asbestos(3)	222.41	41.64	2 916.04	2 787.16	0	838.33	119.69	3.1	1 769.10	574.4	9 271.86
Friable asbestos	42.97	0	1 219.36	0	0	0	0	0	739.76	109.51	2 111.59
Bituminous mixtures containing tar	0	25.08	0	0	0	0	0	1.87	0	4.55	31.5
Waterproofing compounds containing tar	0	0	0	0	0	0	0	0	0	0	0
Paints containing dangerous substances	0.1	0	0	1.78	0	0.53	0.08	0	0	0.19	2.69
Treated wood containing dangerous substances	2.44	0	0	42.68	0	12.84	1.83	0	0	4.67	64.46
Heating, air-conditioning or refrigeration equipment containing hazardous refrigerants	0	0	27.61	0	0	0	0	0	16.75	2.48	46.84
Light sources (fluorescent tubes, neon lights, discharge lamps, LED lamps)	300.75	0	8 450.18	69.69	6.13	26.88	3.84	0	5 126.55	768.24	14 752.26
Other WEEE (2) containing hazardous substances	10.89	47.16	161.91	51.1	30.67	44.97	6.42	3.51	98.22	37.31	492.15
Soil containing hazardous substances	0	0	0	0	0	0	0	0	0	0	0
Other HW	138.53	4.51	2 958.99	798.09	3.83	243.75	34.8	0.34	1 795.16	354.96	6 332.96
Total by urban fabric	**69 738**	**134 850**	**1 141 063**	**687 822**	**365 090**	**5 59 311**	**79 857.25**	**279 669.32**	**692 259.72**	**359 625.94**	

Table S3: Share of surface area built, renovated and demolished by municipality between 2013 and 2022.

Area by municipality			
Municipality	**New construction** **Area (m²)**	**Rehabilitations** **Area (m²)**	**Demolition** **Area (m²)**
Lille	**1 059 615**	**214 254**	**337 170**
Tourcoing	487 876	103 698	147 102
Villeneuve-d'Ascq	420 172	77 427	97 817
Roubaix	342 504	67 541	115 742
Marcq-en-Baroeul	280 609	35 611	59 753
Armentieres	265 858	43 599	67 916

Lambersart	221 283	14 423	23 457
Wattrelos	203 415	46 640	209 002
Croix	196 510	34 731	65 241
Wasquehal	181 955	16 255	55 770
Baisieux	175 226	27 385	9 087
Loos	171 045	4 911	2 289
Marquette-Lez-Lille	168 669	17 888	28 836
La Madeleine	160 576	17 377	46 235
Mouvaux	153 636	11 591	44 758
Wattignies	134 855	74 827	50 039
Faches-Thumesnil	130 326	21 653	46 807
Annoeullin	129 349	19 287	20 327
Erquinghem-Lys	124 550	26 649	23 103
Bois-Grenier	121 765	4 788	3 296
Chereng	120 458	12 442	7 895
Provin	118 291	7 453	14 055
Bondues	116 858	22 459	115 037
Lomme	113 693	20 041	48 577
La Chapelled'Armentieres	110 953	24 823	19 358
Aubers	109 966	25 576	54 780
Quesnoy-sur-Deule	107 571	28 184	7 398
Comines	**99 678**	**18 521**	**25 678**
Halluin	99 367	41 085	77 410
Santes	97 443	9 987	2 217
Hem	96 911	19 179	13 055
Mons-En-Baroeul	95 669	3 937	5 940
Ronchin	91 070	2 982	21 412
Lesquin	89 614	11 920	41 871
Seclin	89 490	9 088	29 584
Salome	82 822	6 486	6 724
Roncq	82 155	26 046	15 988
La Bassee	74 152	10 057	7 397
Wambrechies	71 628	11 103	15 105
Deulemont	70 792	5 659	12 915
Linselles	70 661	14 893	16 700
Templemars	68 968	3 679	19 096
Sainghin-en-Melantois	67 438	15 743	7 247
Leers	64 207	8 216	25 764
Perenchies	63 431	22 925	12 612
Fretin	63 213	27 239	24 361
Neuville-en-Ferrain	60 550	11 701	9 445
Fournes-en-Weppes	59 948	13 683	6 505
Wervicq-Sud	59 124	9 519	308 371
Sainghin-en-Weppes	58 055	4 017	2 723
Lys-Lez-Lannoy	54 135	15 994	16 078
Houplines	54 081	10 625	7 480
Wavrin	52 011	18 390	26 088
Radinghem-en-Weppes	48 423	3 428	2 170
Herlies	47 474	8 760	3 915
Allennes-Les-Marais	45 634	36 802	7 995
Houplin-Ancoisne	42 951	5 095	2 119
Bousbecque	39 289	6 158	10 299
Wicres	38 473	3 104	35 816
Fromelles	37 729	18 051	13 318
Bauvin	36 932	6 218	2 509
Capinghem	33 789	7 627	5 960
Anstaing	32 243	11 596	2 163
Don	31 396	1 074	1 242
Haubourdin	29 059	3 364	6 232
Sailly-lez-Lannoy	28 962	4 348	32 730
Sequedin	24 137	7 000	3 221

Illies	23 814	8 149	15 117
Willems	22 575	5 395	11 588
Frelinghien	21 631	28 107	11 681
Lezennes	21 534	888	8 075
Toufflers	21 497	2 869	5 205
Hellemmes	20 781	51 037	30 863
Verlinghem	19 192	5 330	4 289
Erquinghem-Le-Sec	18 216	4 188	1 834
Beaucamps-Ligny	17 588	3 070	2 052
Carnin	16 166	27 096	26 371
Hallennes-lez-Haubourdin	12 726	14 416	3 397
Hantay	7 724	6 223	526
Marquillies	7 193	6 251	1 349
Warneton	6 966	226	
Lannoy	6 391	404	159
Noyelles-les-Seclin	5 209	3 341	6 800
Eringhem	4 901	1 144	115
Bouvines	4 858	2 042	10
Tressin	3 703	3 392	553
Lompret	3 402	2 574	33 718
Englos	3 387	5 047	429
Vendeville	3 132	3 057	676
Premesques	3 043	0	1 220
Le Maisnil	2 803	1 612	998
Gruson	2 558	6 548	3 246
Ferin	0	0	106
Hellesmes	0	0	1 962
Le Quesnoy	0	0	4 270
Peronne-En-Melantois	0	0	603
Total	**8 661 678**	**1 689 214**	**2 785 512**

Table S4: Volumetric breakdown of material requirements and available resources by municipality.

Locality	Available Materials	Materials Needs	Difference	Substitution %	Per Capita
Ferin	129	-	129	-	
Hellesmes	3434	-	3434	-	
Le Quesnoy	6790	-	6790	-	
Pernne-En-Melantois	982	-	982	-	
Wervicq-Sud	541,192	98,113	443,079	552	
Lompret	41,940	8677	33,262	483	
Wicres	64,054	52,264	11,789	123	
Bondues	219,205	208,214	10,991	105	
Wattrelos	375,406	361,702	13,705	104	
Carnin	54,730	57,318	−2588	95	
Sailly-Lez-Lannoy	46,326	50,172	−3846	92	
Noyelles-les-Seclin	10,817	14,164	−3347	76	
Willems	19,672	31,721	−12,049	62	
Lesquin	89,267	152,659	−63,392	58	
Aubers	106,982	184,806	−77,824	58	
Halluin	135,450	240,546	−105,096	56	
Illies	29,037	54,140	−25,103	54	
Hellemmes	59,642	115,744	−56,102	52	
Lezennes	17,112	33,927	−16,815	50	
Lomme	100,211	204,212	−104,001	49	
Wavrin	48,563	104,841	−56,278	46	
Gruson	6898	15,520	−8621	44	
Leers	45,479	107,516	−62,037	42	
Wasquehal	124,738	295,031	−170,294	42	
Premesques	1976	4915	−2939	40	

Seclin	64,317	161,482	−97,165	40
Roubaix	240,068	606,714	−366,646	40
Faches-Thumesnil	100,728	256,450	−155,721	39
Fretin	57,769	153,964	−96,194	38
Lille	780,040	2,097,602	−1,317,562	37
Ronchin	50,612	141,112	−90,501	36
Mouvaux	82,670	232,947	−150,276	35
Tourcoing	322,925	932,236	−609,311	35
Wattignies	100,334	289,822	−189,488	35
Bousbecque	23,603	68,343	−44,740	35
Toufflers	11,262	32,653	−21,391	34
Croix	122,876	356,286	−233,410	34
Templemars	37,884	115,797	−77,912	33
La Madeleine	97,277	300,645	−203,369	32
Lys-Lez-Lannoy	34,670	108,471	−73,801	32
Le Maisnil	2423	7722	−5298	31
Linselles	41,558	133,456	−91,898	31
Comines	49,095	159,378	−110,284	31
Deulemont	29,370	97,849	−68,480	30
Villeneuve d'Ascq	216,837	729,640	−512,803	30
Frelinghien	25,563	87,771	−62,209	29
Armentieres	139,292	487,020	−347,728	29
Marcq-en-Baroeul	138,663	486,504	−347,841	29
Wambrechies	35,162	126,969	−91,807	28
Fromelles	27,557	99,999	−72,443	28
Haubourdin	15,439	59,648	−44,209	26
Verlinghem	10,749	43,961	−33,212	24
Erquinghem-Lys	56,543	232,546	−176,003	24
Capinghem	12,556	51,808	−39,252	24
Houplines	21,614	89,369	−67,755	24
Neuville-en-Ferrain	26,536	110,712	−84,176	24
Annoeullin	57,826	242,126	−184,300	24
Perenchies	31,494	132,175	−100,681	24
La Chapelled'Armentieres	44,107	186,033	−141,927	24
Marquette-Lez-Lille	66,618	281,801	−215,183	24
Hem	39,044	173,263	−134,219	23
Roncq	33,791	154,275	−120,485	22
Hallennes-lez-Haubourdin	10,220	47,010	−36,790	22
Provin	39,980	187,854	−147,874	21
Erquinghem-Le-Sec	5760	27,301	−21,541	21
Lambersart	73,054	359,842	−286,789	20
Sainghin-En-Melantois	23,534	117,964	−94,430	20
Marquillies	4226	21,342	−17,116	20
Vendeville	2312	12,020	−9708	19
La Bassee	25,591	136,495	−110,904	19
Allennes-les-Marais	24,121	130,777	−106,656	18
Tressin	2025	11,162	−9137	18
Chereng	29,043	163,488	−134,445	18
Fournes-en-Weppes	23,364	137,166	−113,801	17
Salome	22,522	134,096	−111,573	17
Beaucamps-Ligny	4595	27,368	−22,773	17
Sequedin	9170	55,295	−46,125	17
Mons-En-Baroeul	25,154	153,436	−128,282	16
Bauvin	10,642	66,604	−55,962	16
Englos	1932	12,214	−10,282	16
Herlies	15,022	96,838	−81,816	16
Baisieux	34,734	232,250	−197,516	15
Quesnoy-sur-Deule	31,177	209,913	−178,736	15
Radinghem-en-Weppes	12,251	82,556	−70,305	15
Anstaing	10,011	69,797	−59,786	14
Sainghin-en-Weppes	14,250	100,610	−86,360	14
Hantay	3176	23,362	−20,185	14
Don	7101	52,396	−45,295	14
Bois-Grenier	25,984	200,394	−174,410	13

Houplin-Ancoisne	11,239	86,837	−75,597	13
Eringhem	877	6872	−5995	13
Lannoy	1410	11,486	−10,076	12
Loos	26,317	227,431	−201,114	12
Santes	19,865	175,992	−156,127	11
Bouvines	1129	11,130	−10,000	10
Warneton	1177	11,766	−10,589	10
Total	5,951,870	15,825,817	−9,873,948	41

Table S5. Table of abbreviations.

Abbreviations	Full names
ADEME	Agency for the Environment and Energy Management
MEL	European Metropolis of Lille
C&D	construction and demolition
CDW	construction and demolition waste
CBMP	Construction and Building Materials Products
GIS	Geographic Information System
EPR	Extended Producer Responsibility
SV	Site visit method.
GRC	Production rate calculation method
BIM	Building information modeling
VM	Variable modeling method
CSA	Accumulation method of the classification system
MFA	Material flow analysis approach
LA	Lifetime Analysis method
NPRU	new urban renewal program
CERC	Regional Economic Unit for Construction
BNDB	building from the national building database
ADULM	Urban Planning Agency of Lille Metropolis
PEMW	