

Comparing the socio-economic impacts of spatial planning options with their potential for decentralised green technologies

Tony Hargreaves

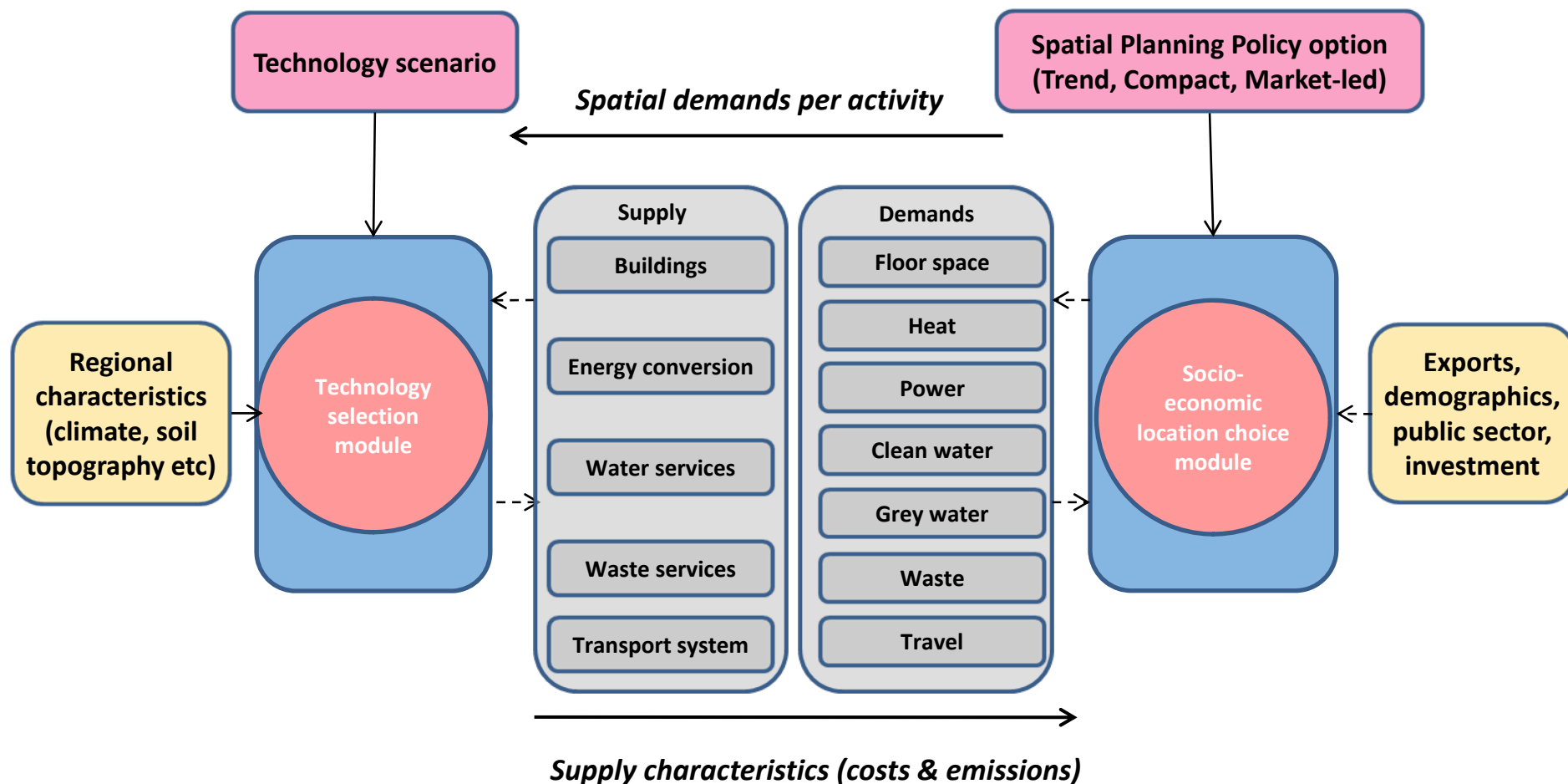
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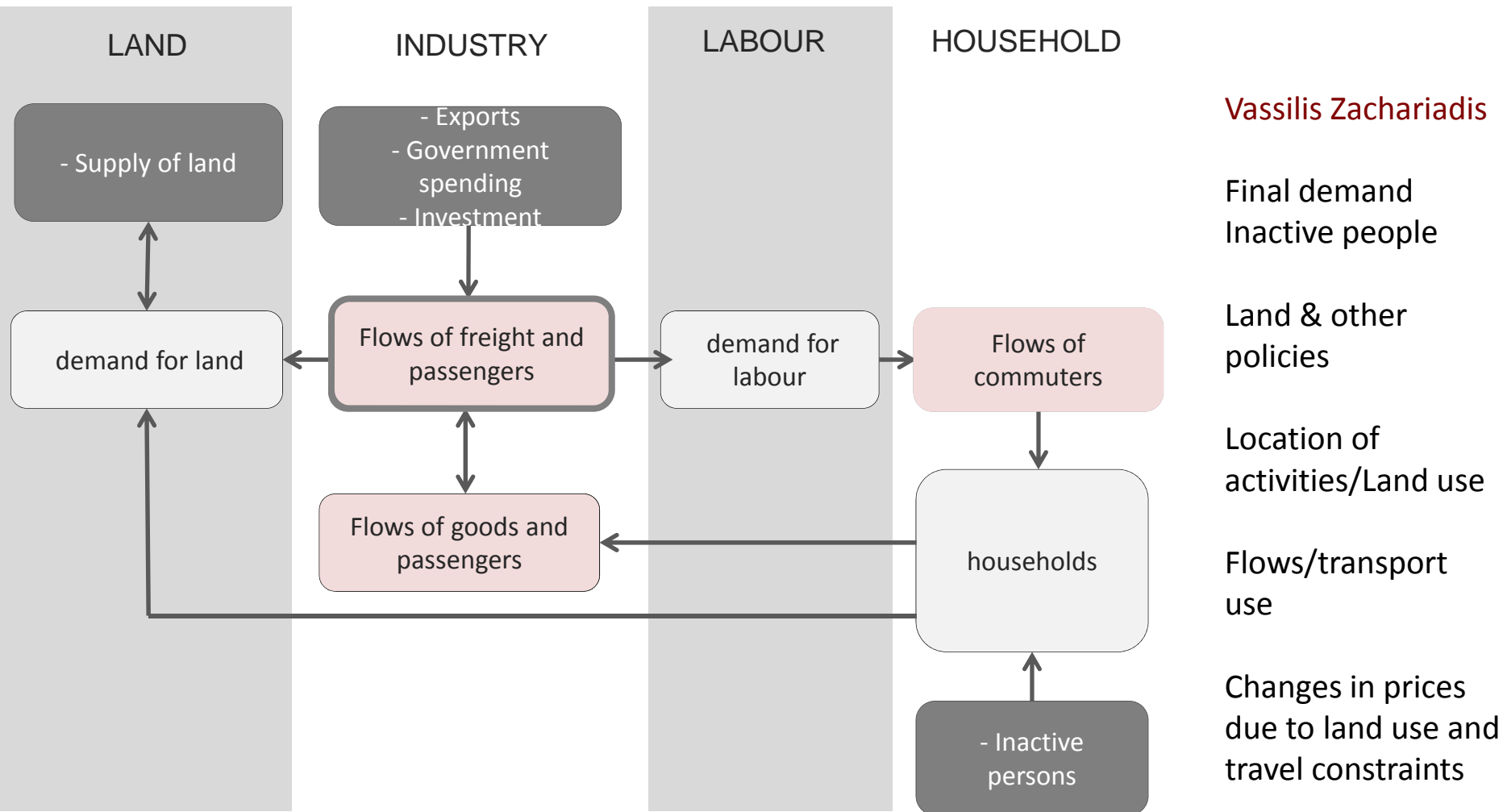
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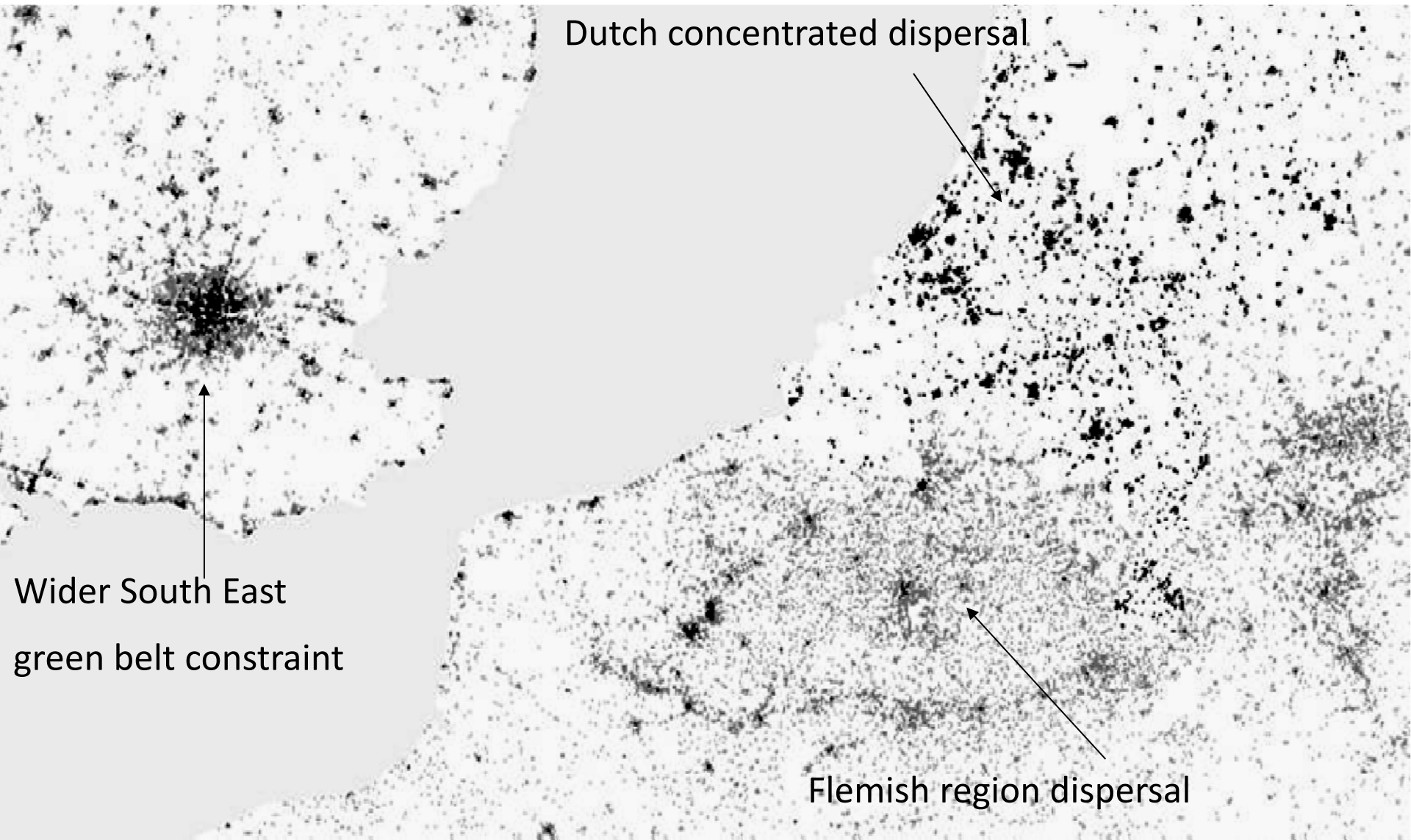
Overall Integrated Modelling Framework





LUISA: Spatial Model



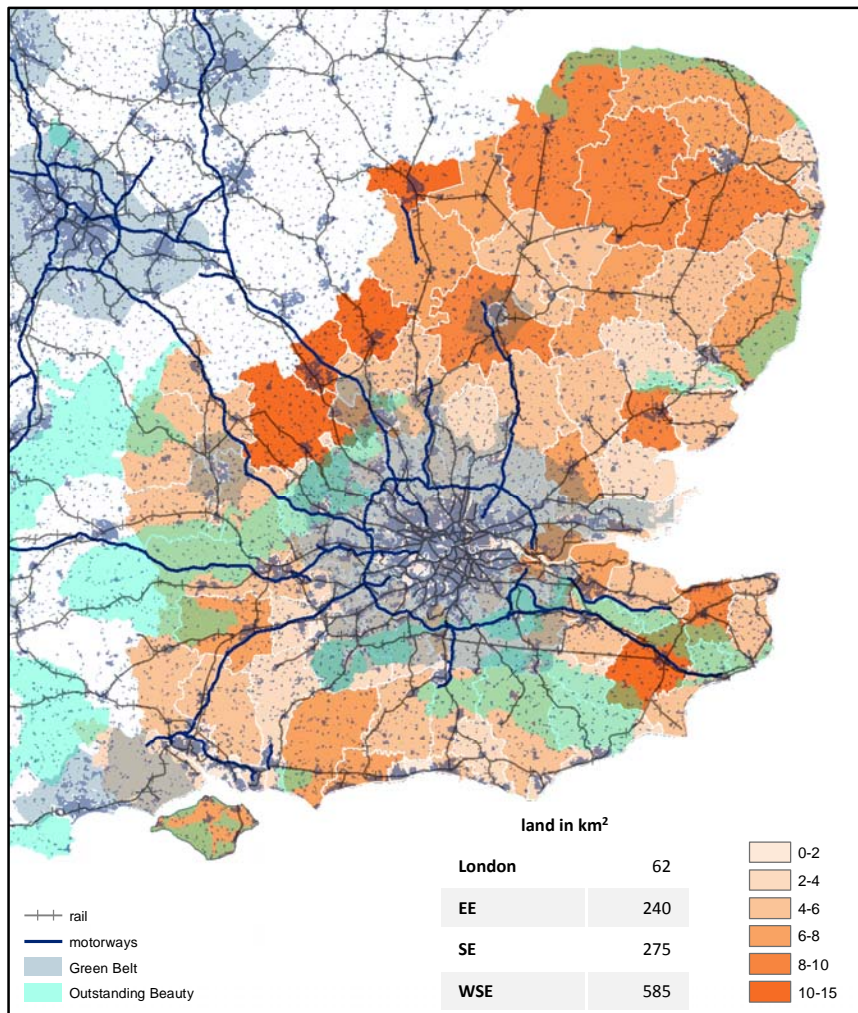




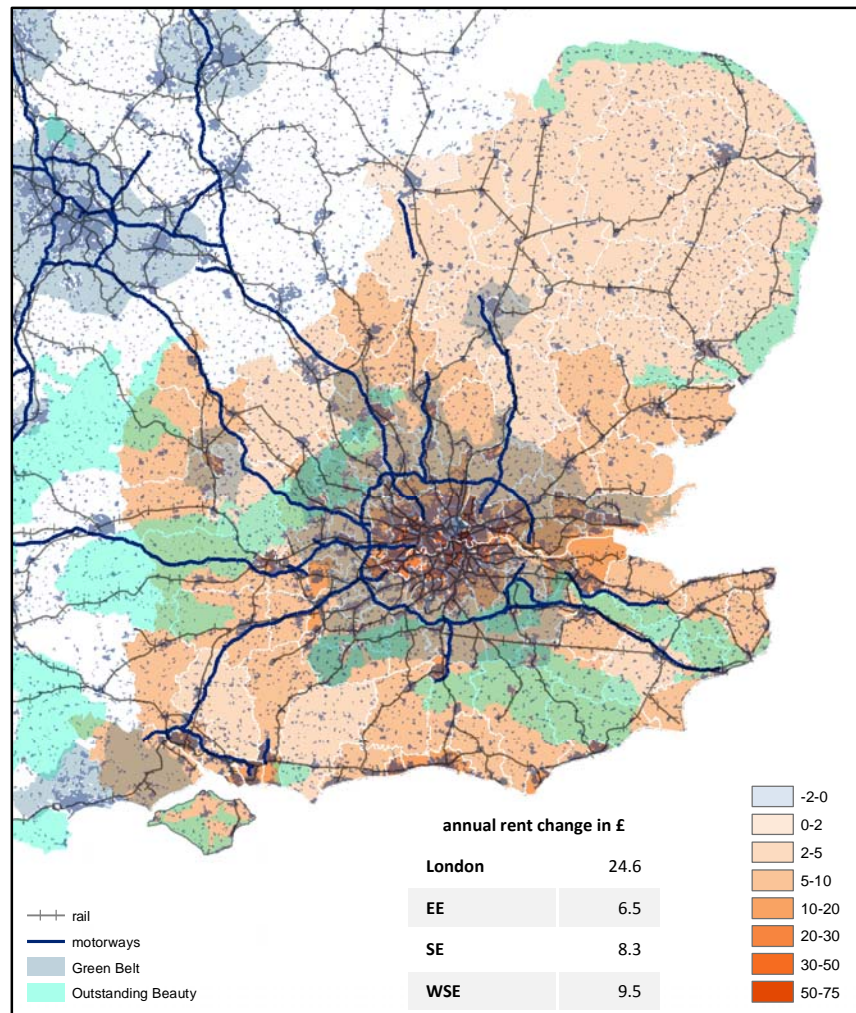
Domestic land change 2001-31

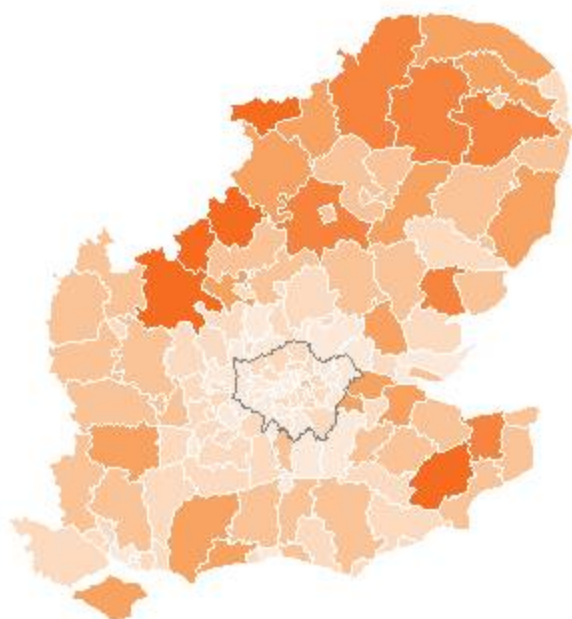
Trend

Domestic land added

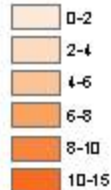
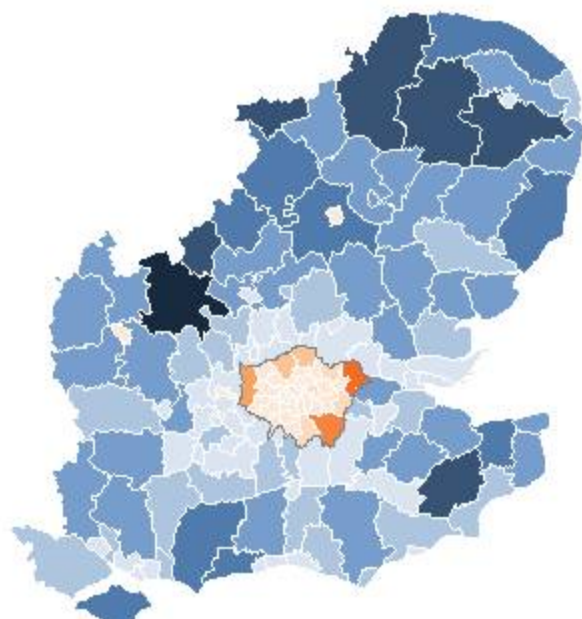


Annual rent change

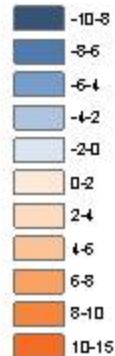
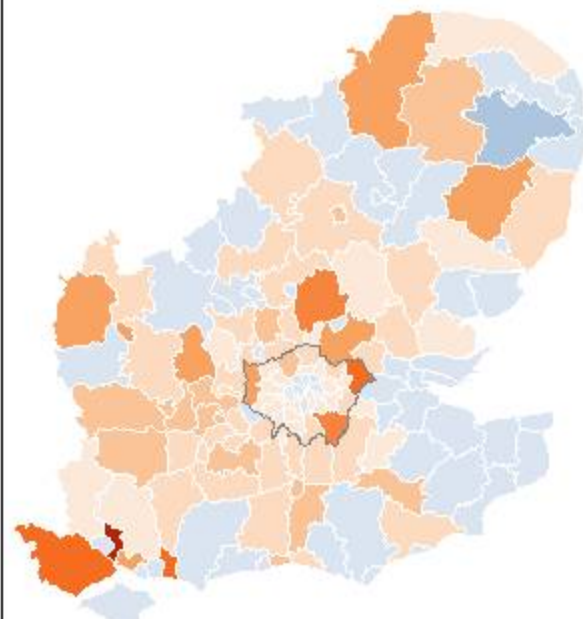


**Domestic land 2001-31****Trend***absolute change*land in km²

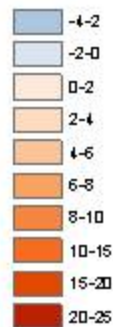
London	62
EE	240
SE	275
WSE	585

**Compact***difference to Trend*land in km²

London	73
EE	-187
SE	-202
WSE	-322

**Market***difference to Trend*land in km²

London	48
EE	83
SE	190
WSE	321

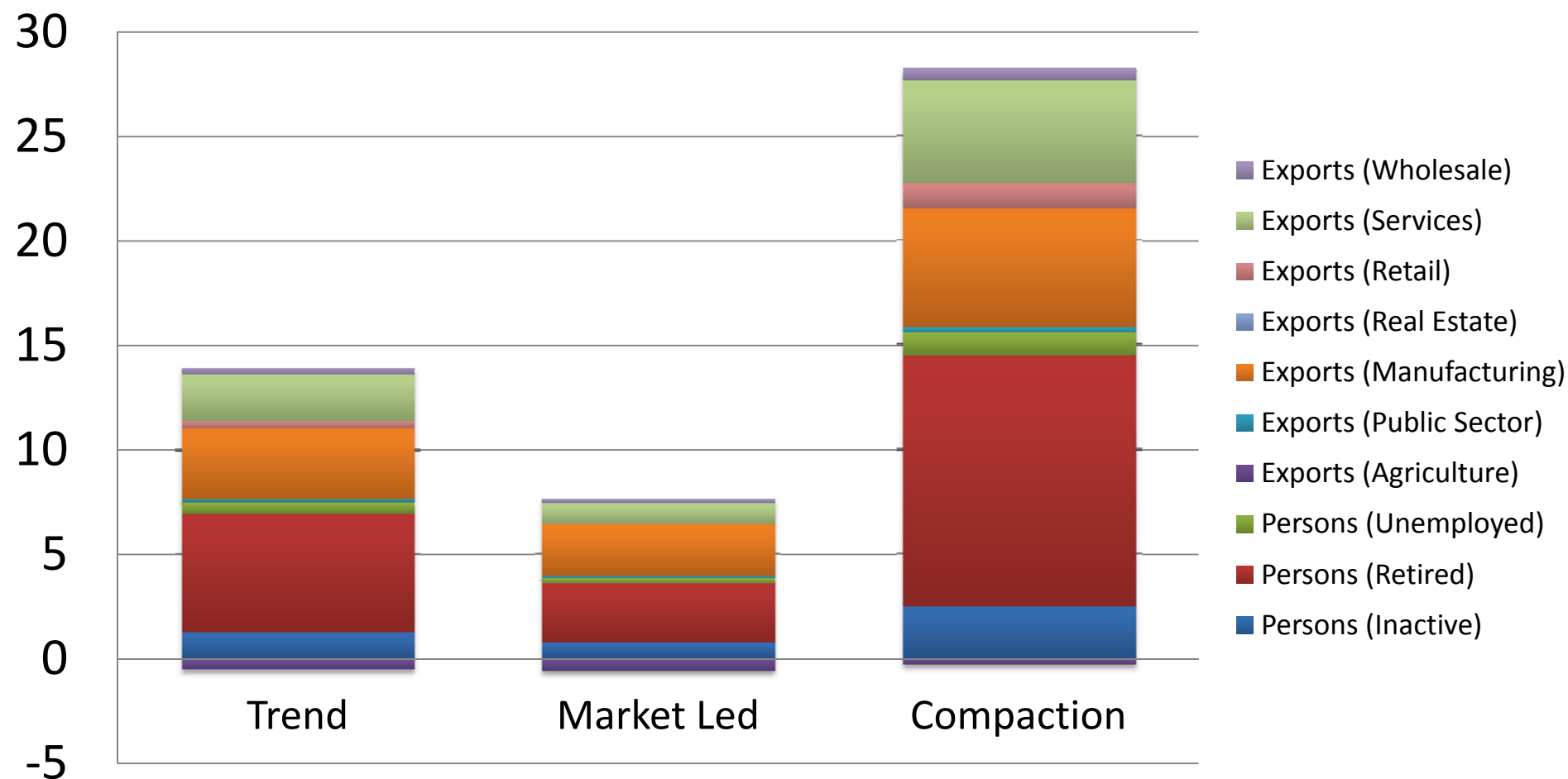


Assessment: Economic

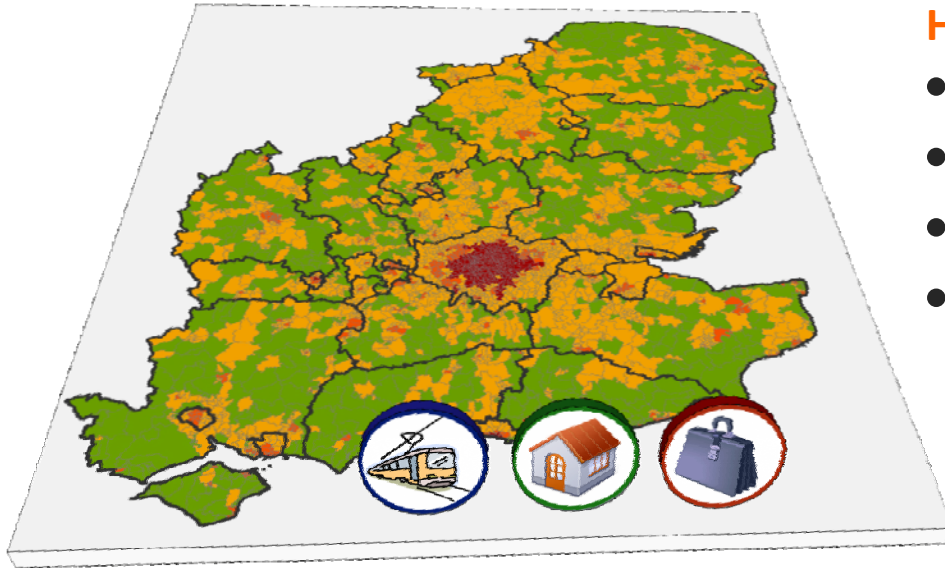


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Compensating Variation | Wider South East (cost in 2001 £bn/yr)



Linking Regional Planning to Neighbourhood Design



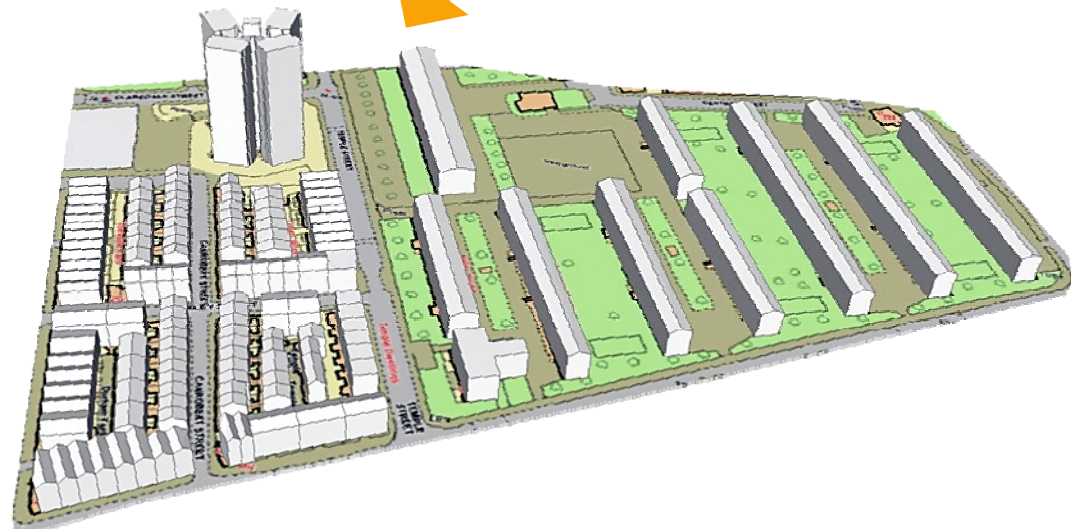
High level Planning:

- Growths (population, economic, etc.)
- Spatial development pattern
- Land Use and Transport
- Employment and Households



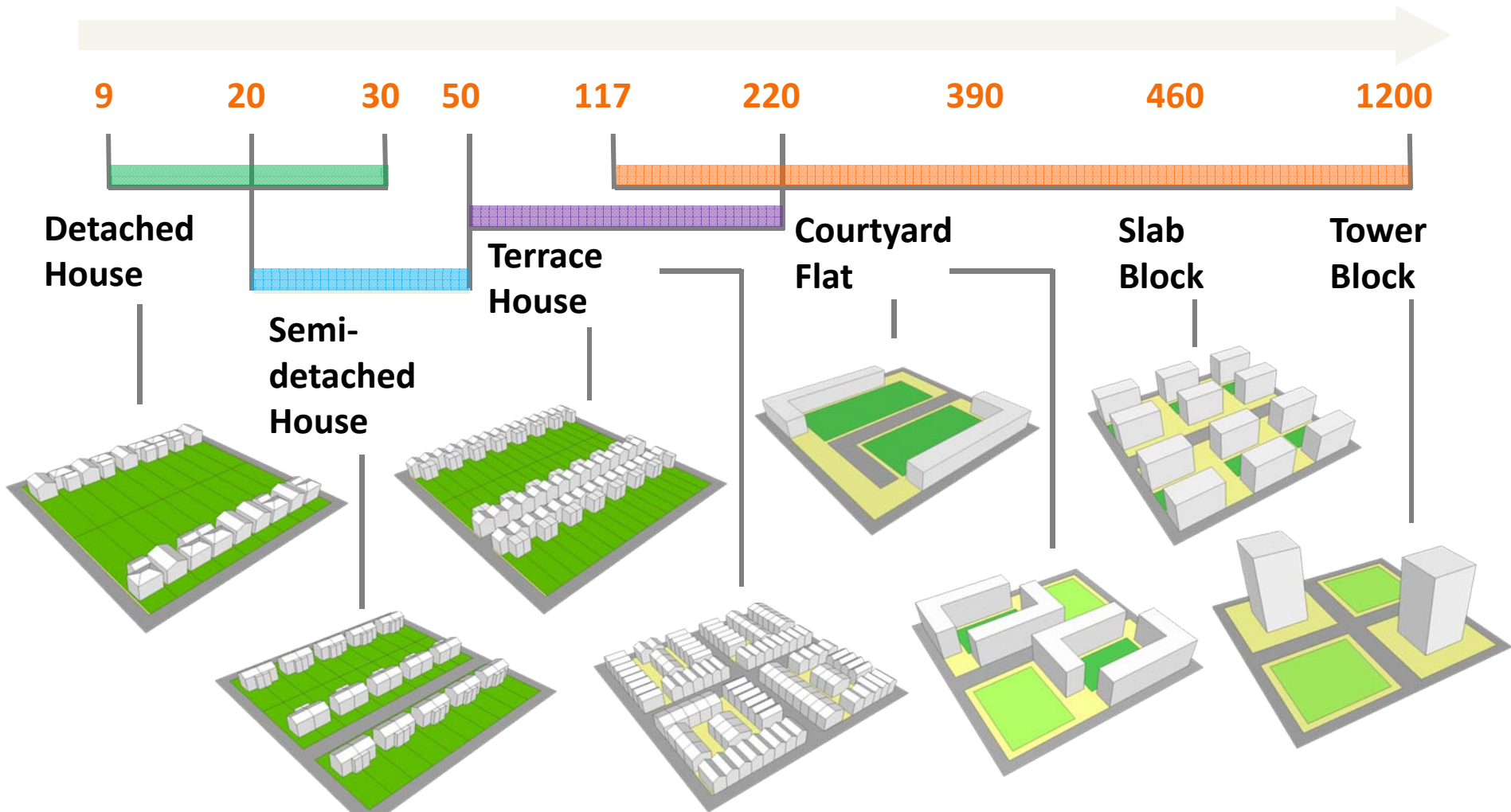
Local Decisions:

- Urban Form
- Infrastructural Design (energy, water, waste, etc.)



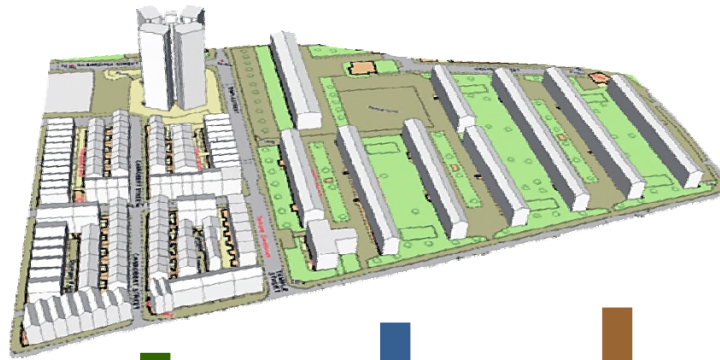
Generic Tiles, (each tile is 1 hectare)

Density of plots (dwelling per hectare)



Slide provided by Dr. Vicky Cheng

Integration of Infrastructural Design at Local Scale



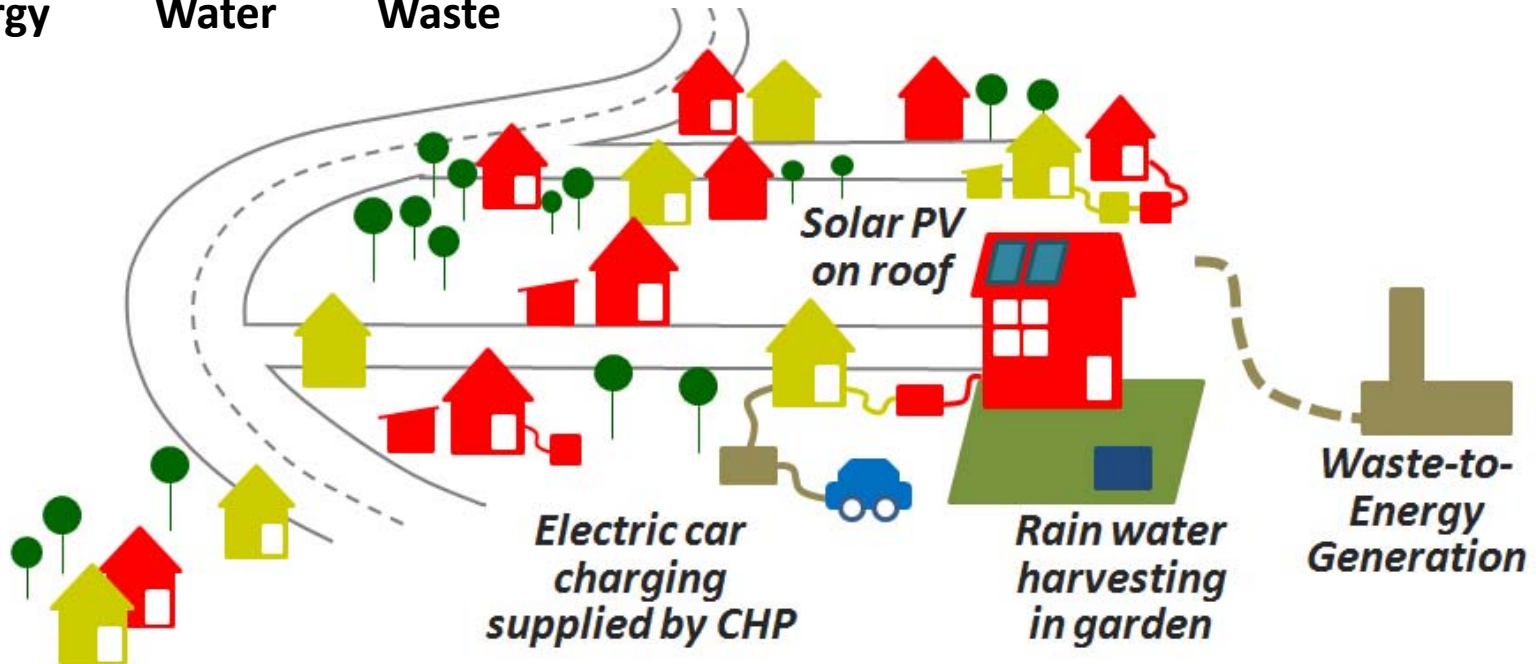
Local Impacts:

- Economy
- Environment
- Health

↓
Energy

↓
Water

↓
Waste



Domestic Tile Scale Energy Supply Model Results

Year of Reference 2009

Built Case Existing

Scenario Low Cost

Technology Up-take Low

Cost of Decentralised Energy Supply, k£/Yr

Ward Type	D1	D2	D3	D4	S1	S2	S3	S4
Central	2.28	2.88	4.82	5.52	2.89	4.51	5.98	8.44
Urban	4.34	5.15	8.08	8.53	5.42	7.61	9.88	12.87
Suburban	4.34	5.15	8.08	8.53	5.42	7.61	9.88	12.87
Rural	4.34	5.15	8.08	8.53	5.42	7.61	9.88	12.87

Cost of Decentralised Energy Supply, k£/Yr

Associated Reduction in CO₂, Ton/Yr

Ward Type	D1	D2	D3	D4	S1	S2	S3	S4
Central	21.48	27.14	45.48	52.01	27.03	42.27	56.01	79.03
Urban	11.20	13.29	20.85	22.00	13.71	19.27	25.00	32.39
Suburban	11.20	13.29	20.85	22.00	13.71	19.27	25.00	32.39
Rural	11.20	13.29	20.85	22.00	13.71	19.27	25.00	32.39

Associated Land Reqd, m²

Ward Type	D1	D2	D3	D4	S1	S2	S3	S4
Central	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Urban	72.00	126.00	270.00	360.00	144.00	252.00	360.00	540.00
Suburban	72.00	126.00	270.00	360.00	144.00	252.00	360.00	540.00
Rural	72.00	126.00	270.00	360.00	144.00	252.00	360.00	540.00

Ward Type	D1	D2	D3	D4
Central	1.70	2.14	3.60	4.12
Urban	4.42	5.59	9.49	11.04
Suburban	4.42	5.59	9.49	11.04
Rural	4.42	5.59	9.49	11.04

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
270.00	900.00	1440.00	1980.00	364.29	438.75	843.75	1148.94	2301.14	630.00	1012.50	1237.50								
270.00	900.00	1440.00	1980.00	364.29	438.75	843.75	1148.94	2301.14	630.00	1012.50	1237.50								
270.00	900.00	1440.00	1980.00	364.29	438.75	843.75	1148.94	2301.14	630.00	1012.50	1237.50								

Percentage of Decentralised Supply

Ward Type	D1		D2		D3		D4		He
	Heat	Electricity	Heat	Electricity	Heat	Electricity	Heat	Electricity	
Central	17.72	30.00	18.65	30.00	19.62	30.00	20.94	30.00	17.72
Urban	25.10	0.00	24.82	0.00	24.43	0.00	24.06	0.00	24.43
Suburban	25.10	0.00	24.82	0.00	24.43	0.00	24.06	0.00	24.43
Rural	25.10	0.00	24.82	0.00	24.43	0.00	24.06	0.00	24.43

	T3		T4		F1		F2		He
	Heat	Electricity	Heat	Electricity	Heat	Electricity	Heat	Electricity	
Central	20.14	30.00	19.70	30.00	23.79	30.00	25.18	30.00	25.18
Urban	23.79	0.00	23.54	0.00	23.55	0.00	23.22	0.00	23.55
Suburban	23.79	0.00	23.54	0.00	23.55	0.00	23.22	0.00	23.55
Rural	23.79	0.00	23.54	0.00	23.55	0.00	23.22	0.00	23.55

Percentage of Decentralised Supply

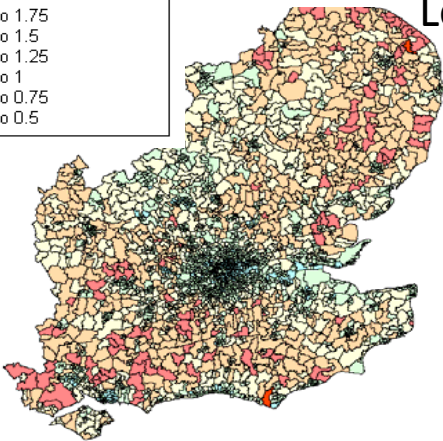
Ward Type	D1		D2		
	Heat	Electricity	Heat	Electricity	
Central	24.15	30.00	24.13	30.00	
Urban	24.60	26.49	24.03	27.36	
Suburban	24.60	26.49	24.03	27.36	
Rural	24.60	26.49	24.03	27.36	



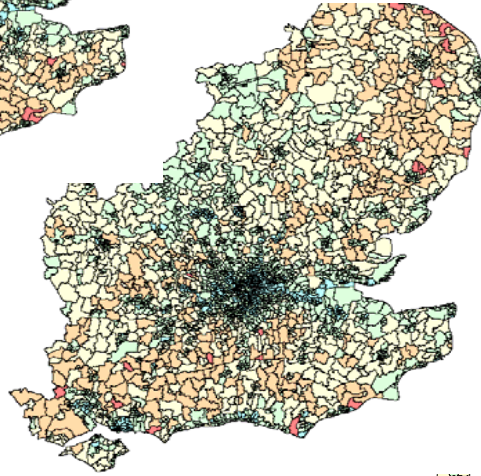
Trend_CO2 (tonnes per capita.yr)
Dwelling retrofit low cost scenario



Low cost retrofit



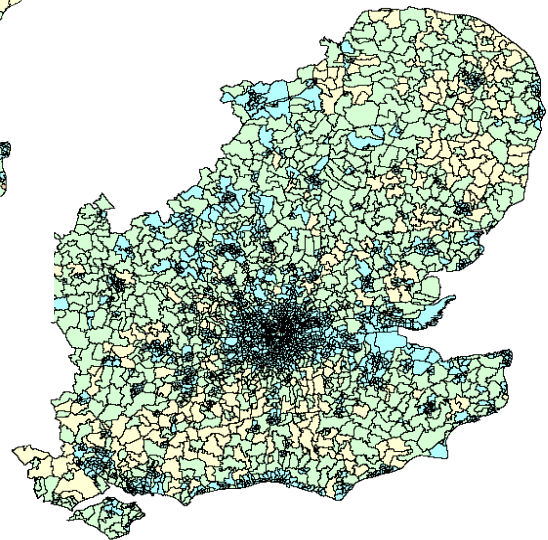
Low CO2 retrofit



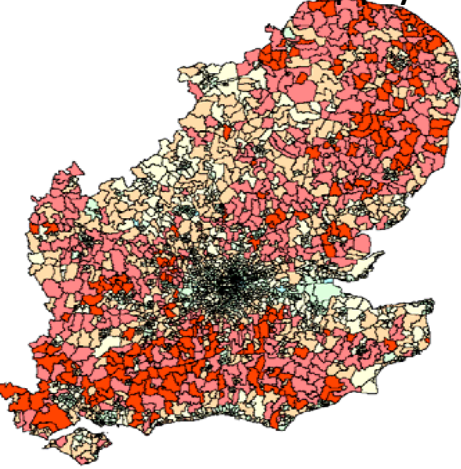
Low cost retrofit & supply



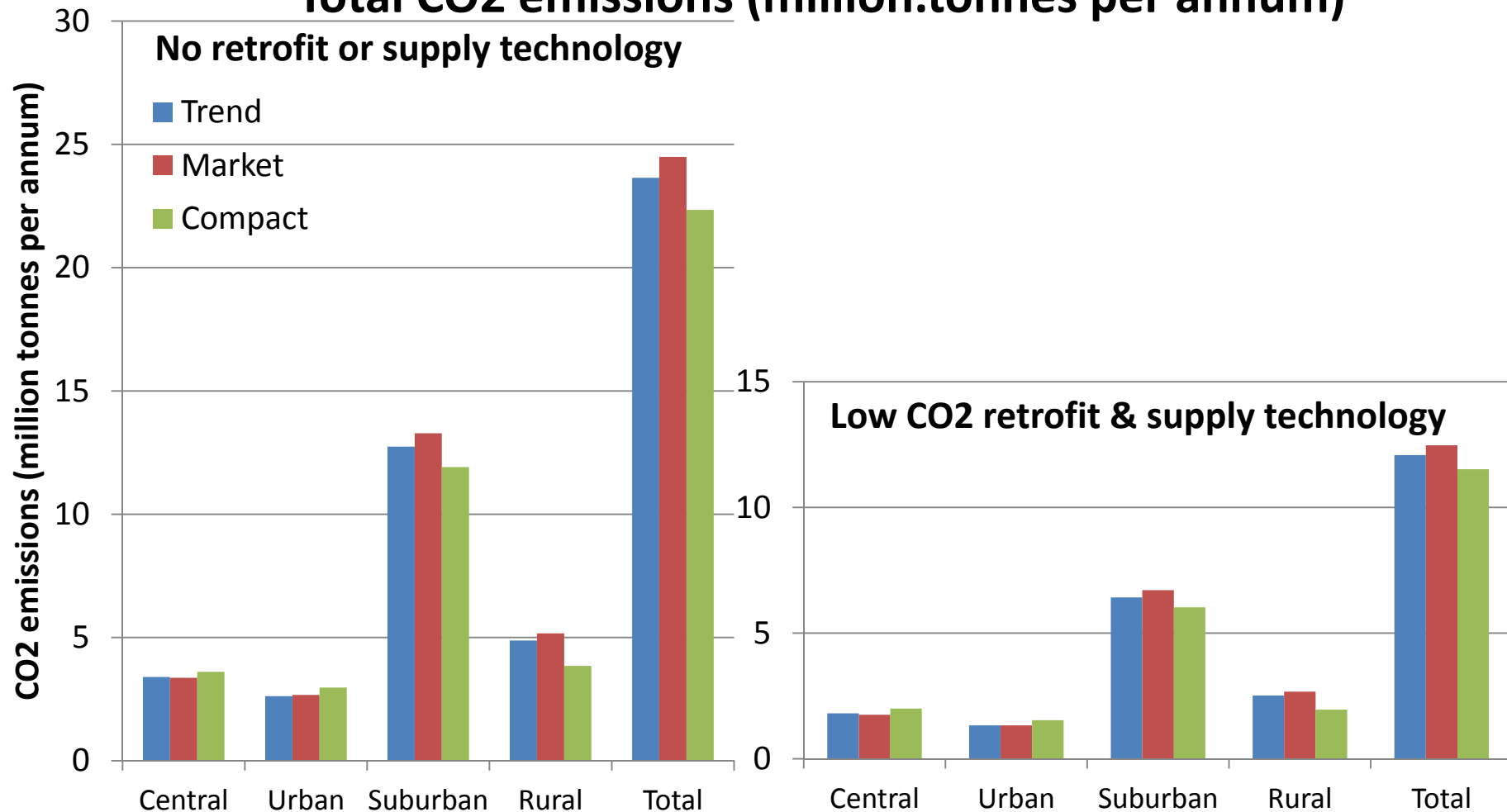
Low CO2 retrofit & supply



No retrofit or supply tech



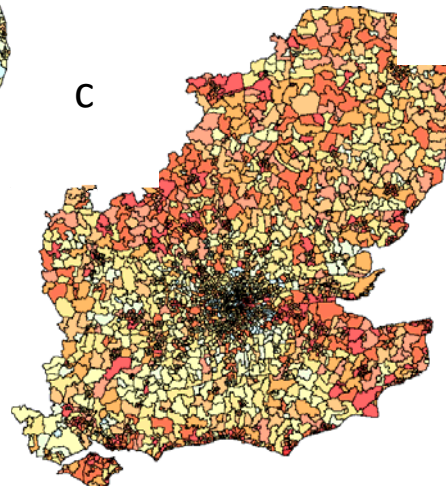
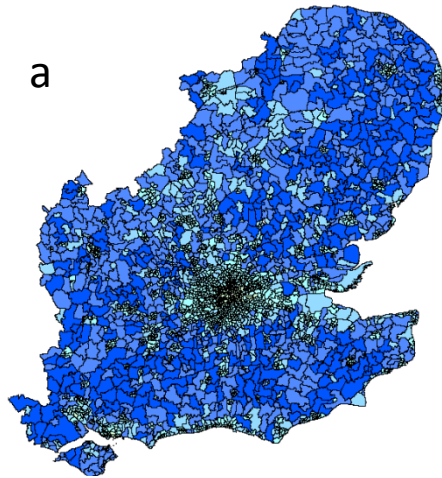
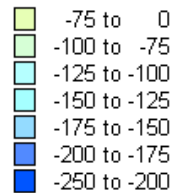
Total CO2 emissions (million tonnes per annum)



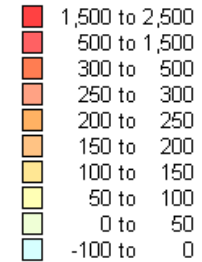
Spatial options make relatively little difference:- New dwellings more energy efficient and marginal change over 30 years is small

Decentralised supply and retrofitting of existing buildings has much bigger impact especially in suburban & rural areas

Trend_Cost Effectiveness £ per tonne CO₂ reduction
Dwelling retrofit low cost scenario

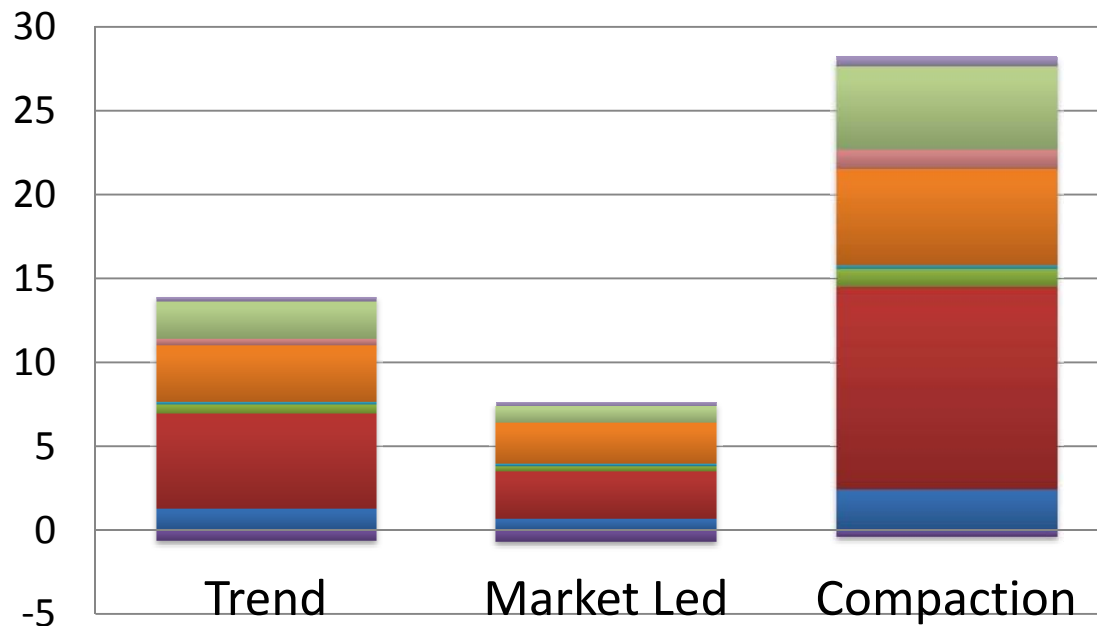


Trend Cost Effectiveness £ per tonne CO₂ reduction

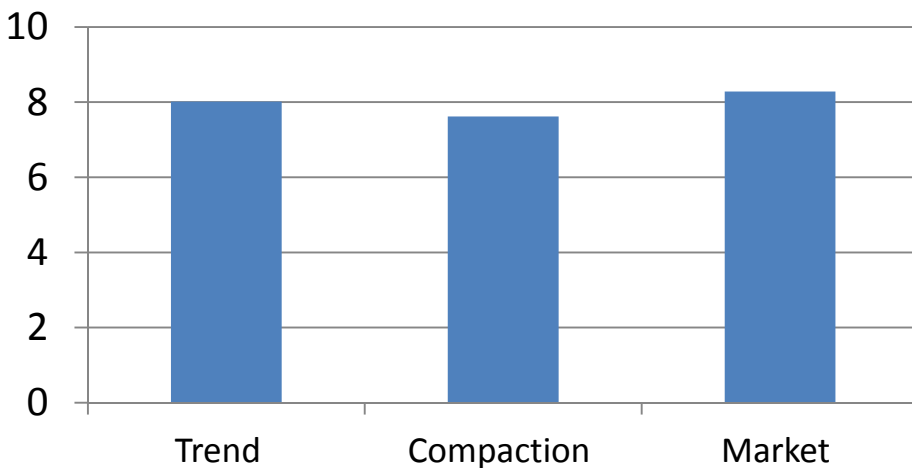


- a. Low cost retrofit has a positive rate of return on investment;*
b. The cost of 'Low CO₂ retrofit' options is of a similar magnitude to the value of the CO₂ savings
c & d. Options that also included decentralised supply technologies were not cost effective, unless the technologies become more efficient

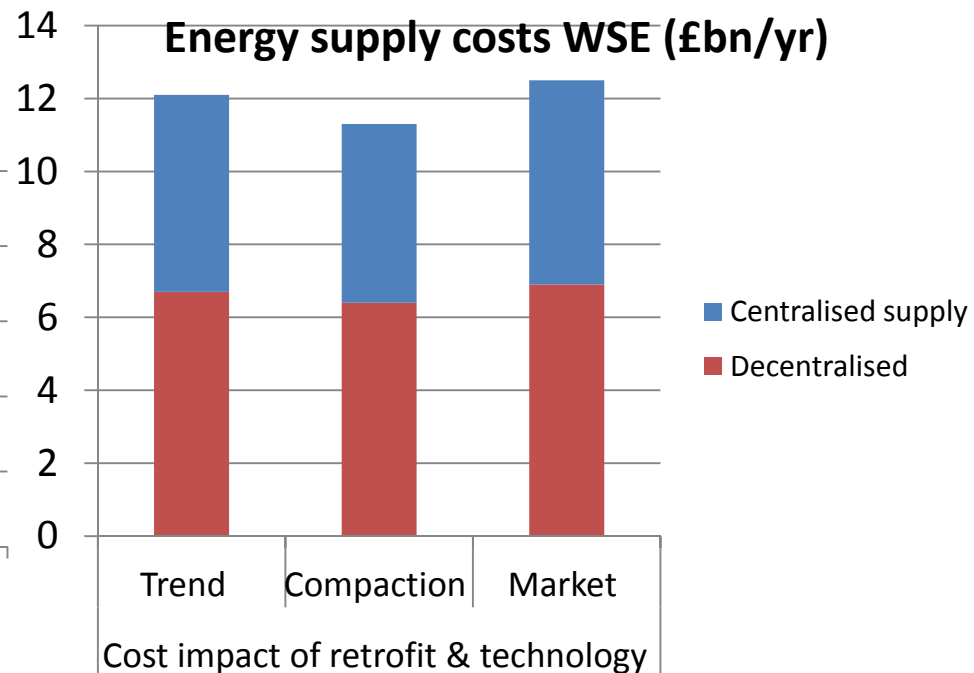
Compensating Variation (£bn/yr)



No retrofit or decentralised supply (£bn/yr)



Energy supply costs WSE (£bn/yr)



Conclusions

Developed an integrated modelling framework and tested the socio-economic and environmental impacts of spatial planning policies in combination with decentralised infrastructure technologies.

Extended the model using 'tiles' provides a 3-dimensional context for integrating neighbourhood scale supply and demand research

The spatial planning options have only around +/-5% impact on building energy CO2 emissions in UK over a 30 year period, providing that local planning controls are in place to avoid sprawl. Previous SOLUTIONS project found similar impacts on car travel.

Retrofitting and technologies have a far greater impact on reducing CO2 emissions than spatial planning (and could be implemented more quickly), although decentralised energy supply is generally not yet cost effective.

The socio-economic benefits of a market-led policy could be sufficient to subsidise these measures to mitigate the environmental impacts of building energy consumption.

Analysis is underway on the other infrastructure sectors before reaching final conclusions.