

Update on the Scottish Case Study

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Outline

Case study – Cairngorms National Park – in the context of Scotland’s sustainable development – “an experiment”

Stakeholders - integration and coordination – CNPA

Trade-offs – between the three “major” axes but with a particular focus on how to bring in the land/land use elements (WVP4)

What done (WVP3) – systems diagramming, using SUMMA , MuSIASEM – familiarisation and data gathering – quite different approaches.

Research Questions

How does the system perform at different levels? (Analysis) (WVP3)

What are the implications of its current performance for possible future states? (Interpretation) (WVP4)

How can the toolkit inform and influence policy? (Process) (WVP5)

The Cairngorms National Park



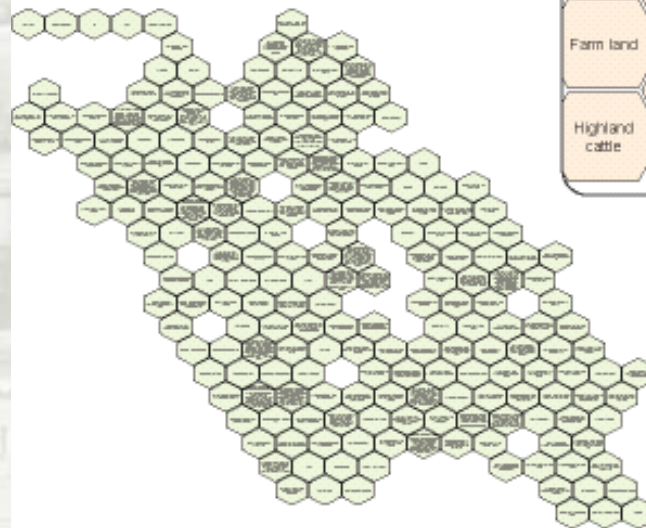
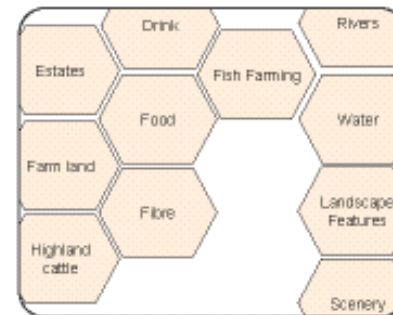
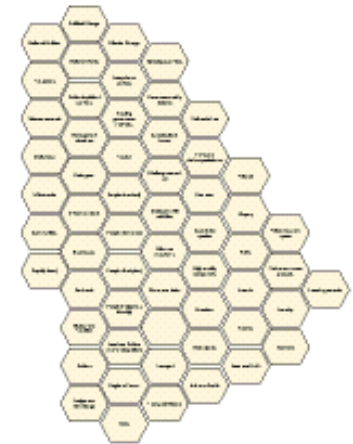
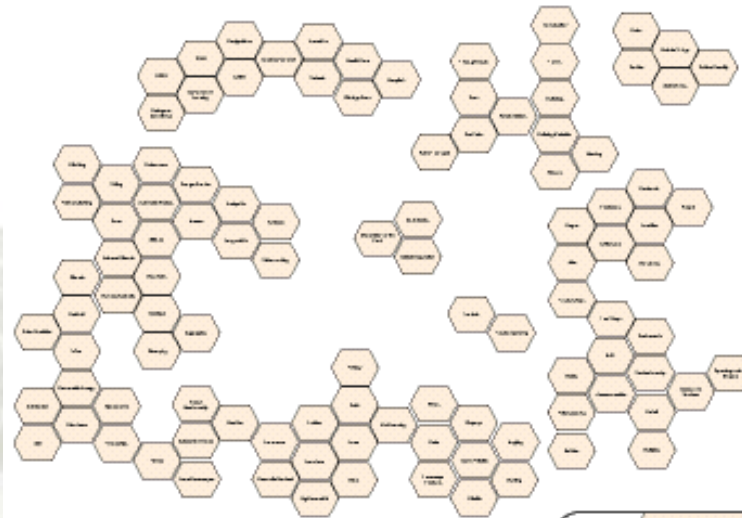
The Cairngorms National Park

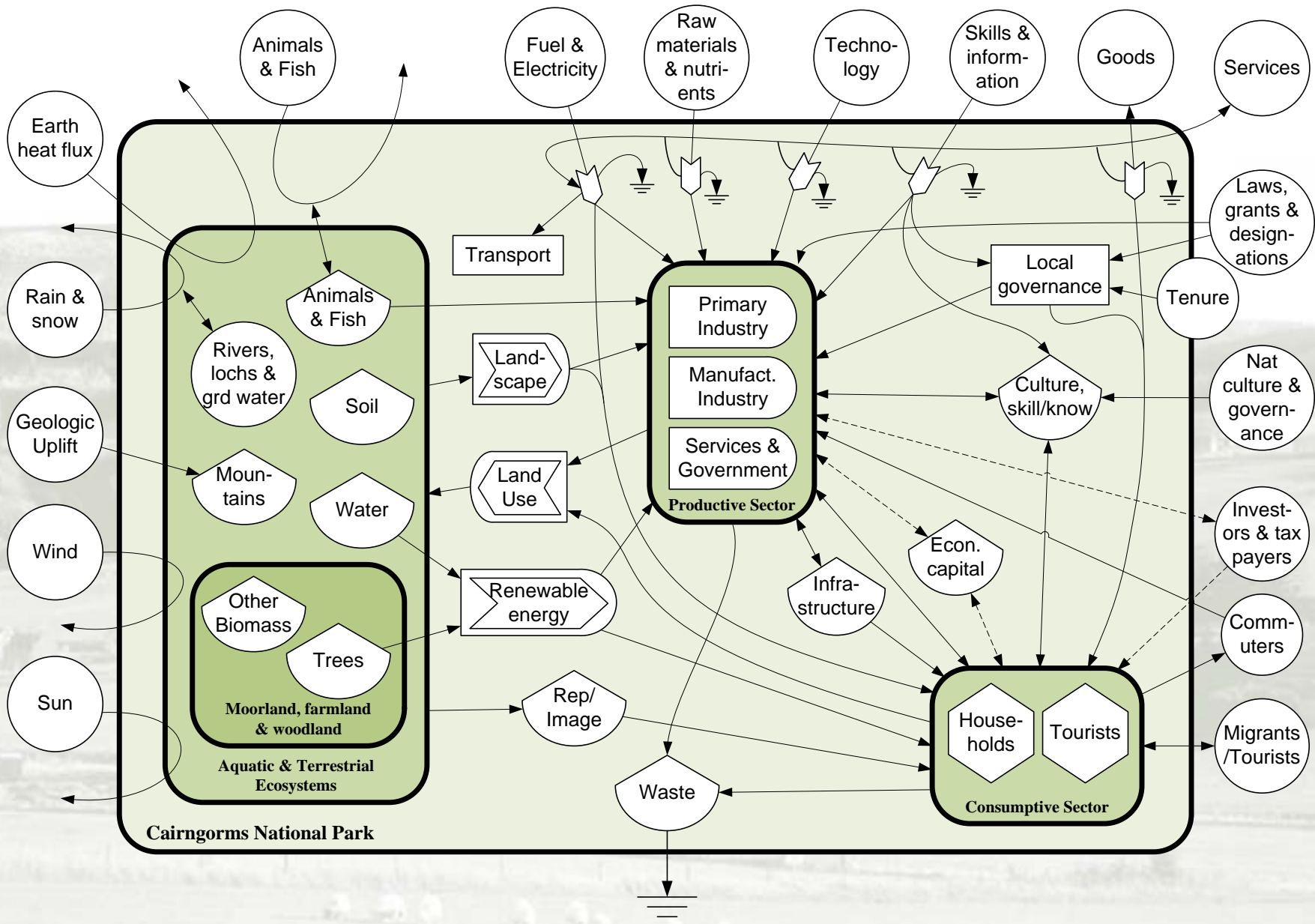


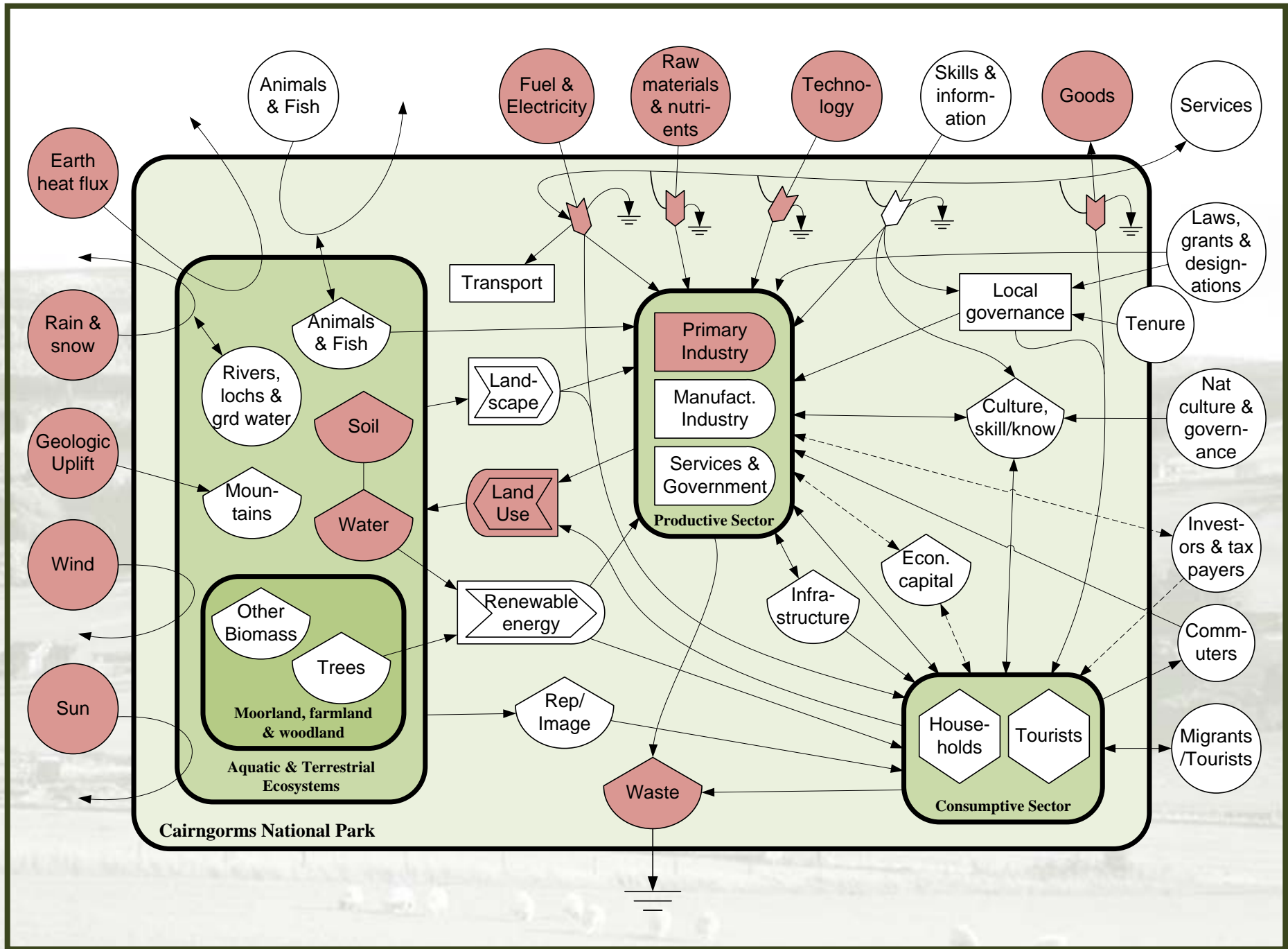
Four aims from the National Parks (Scotland) Act 2000

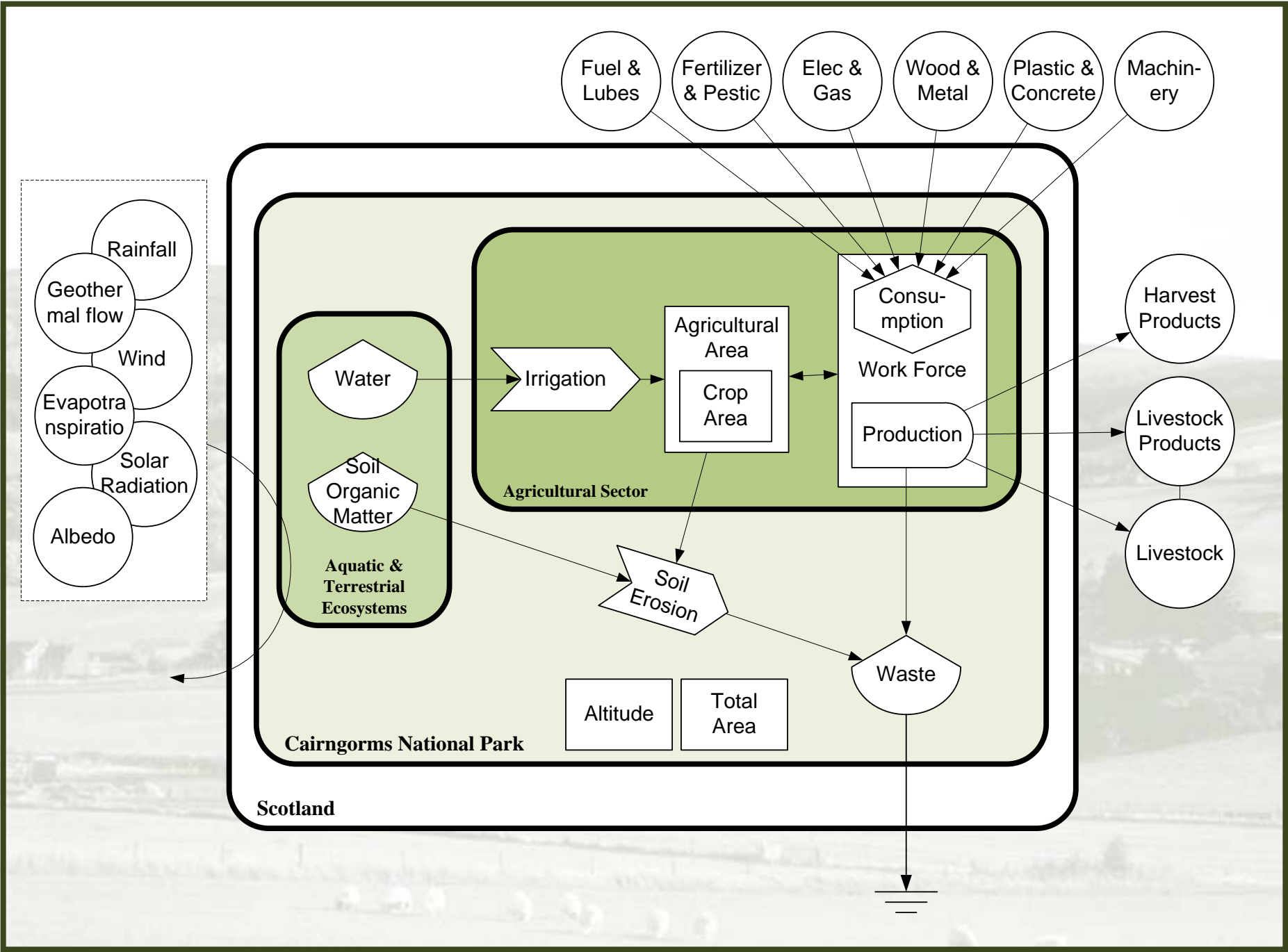
- To conserve and enhance the natural and cultural heritage of the area;
- To promote sustainable use of natural resources in the area;
- To promote understanding and enjoyment (including enjoyment in the form of recreation) of the special qualities of the area by the public;
- To promote sustainable economic and social development of the area's communities.

Systems Diagramming









Data needed to perform the SUMMA method to the agricultural sector of the Scottish Regional Park.

Item	Value	Unit (example)	Scotland			CNP		
			1991	2001	2007	1991	2001	2007
Total area of the unit		m ²	80,235,624,381	80,235,624,381	80,235,624,381			3,816,539,820
Total agricultural sector area		m ²		39,158,210,800	41,477,275,500		179,439	205,707
Area of the main crops productions within the Park (barley, wheat, ecc.)		m ²						
Maximum altitude		m	1,343	1343	1343	1,304	1304	1304
Minimum altitude		m	0	0	0	137	137	137
Average altitude		m	105	105	105	521	521	521
Albedo of the land use categories		%	16	16	16		16.5	22.94
Solar radiation		kcal/m ² /year				661,684		
Wind energy on land		J/m ² /year						
Total Rainfall in one year		mm/year	1402	1307	1575	883	910.75	893
Geothermal flow at land surface		mW/m ²	37-40	37-40	37-40	37-40	37-40	37-40
Evapotranspiration rate from land		joules per year				7.12344E+15		
Erosion rate of the soil		g/m ² /year						
% organic matter in soil		%	23.13	23.13	23.13	27.97	27.97	27.97
Water for irrigation (volume of water used)		m ³ /yr		5,230,000		na	na	na
Water for irrigation, price		£/ha/mm		3.5	3.5	na	na	na
Fraction of irrigation water that is evapotranspired		%		40%		na	na	na

Fuel									
Gasoline for agricultural purpose		l/yr							
Gasoline price		£/l	0.4540.755		0.95				
Diesel for agricultural purpose		l/yr	228,697,453	214,092,727	191,575,138				
Diesel price		p/l	0.149		0.2		0.39		
Lubricant for agricultural purpose		l/yr							
Lubricant price		£/yr	489,957	486,904	389,350				
Electricity for agricultural purpose		kWh/yr							
Electricity price		£/kWh	0.000758	0.000809	0.001215				
Gas (if any) for agricultural purpose		m3/yr	427994318.2	1167704097	1033976755				
Gas price		£/yr	0.699p/unit						

Fertilizers used for the whole agricultural sector:

Nitrogen (N)		tonne/yr	194,733	227,000	138,000	2612	2835	2028
Nitrogen (N) price		£/kg	0.36	0.35	0.47	0.36	0.35	0.47
Phosphate (PO4)		tonne/yr	61,250	81,000	49,000	851	873	696
Phosphate (PO4) price		£/kg	0.34	0.32	0.43	0.34	0.32	0.43
Potassium (K2O)		tonne/yr	71675	94,000	61,000	977	1019	808
Potassium (K2O) price		£/kg	0.19	0.2	0.27	0.19	0.2	0.27

Pesticides used for the whole agricultural sector:

Fungicides		kg/yr	1,100,462	680,457	746,083	2,451	1,393	1,810
Fungicides price		£/kg	94.41	94.85	101.31	94.41	94.85	101.31
Growth regulators		kg/yr	269,552	192,647	180,165	856	580	667
Growth regulators price		£/kg	95.41	94.85	101.31	95.41	94.85	101.31
Herbicides		kg/yr	983,135	753,194	676,878	11,606	5,520	2,397
Herbicides price		£/kg	92.33	94.81	105.00	92.33	94.81	105.00
Insecticides		kg/yr	59,646	37,024	26,083	339	257	2,054
Insecticides price		£/kg	91.93	79.81	95.98	91.93	79.81	95.98
Molluscicides		kg/yr	4,226	17,314	14,332	13	26	26
Molluscicides price		£/kg	95.41	94.85	101.31	95.41	94.85	101.31
Others		kg/yr	4,354,979	5,177,252	1,813,238	88	105	35
Others price		£/kg						

Machinery:

Number of tractors	number	19,818	22,702	42,218	167	191	355
Average weight of tractors	ton	3	3.71	3.79	3.71	3.71	3.79
Total weight of tractors	ton	73,514	84,211	160,170	619	708	1,348
Other machineries	number	187,640	214,942	399,719	1,579	1,808	3,363
Average weight of other machineries	ton	1.37	1.37	1.40	1.37	1.37	1.40
Total weight of other machineries	ton	256,371	293,673	558,571	2,157	2,471	4,699
Average life time (for each kind of machinery)	year	c10-15yrs	c10-15yrs	c10-15yrs	c10-15yrs	c10-15yrs	c10-15yrs

Materials:

Plastic (for instance for greenhouse and land cover) used for the agricultural sector	ton/year						
Steel (for instance for crop support or small building) used for the agricultural sector	ton/year						
Wood (for instance for crop support or small constructions) used for the agricultural sector	ton/year						
Concrete (for instance for small construction) used for the agricultural sector	ton/year						
Total cost of the above materials	€						

Work:

Total Farm worker (only the work for agricultural production avoiding the work related to the industrial transformation of agricultural products)	n° persons	60,075	68,816	67,155	505	579	565
Total applied labor	hrs/year	91,509,331	91,635,049	84,497,400	866,127	867,317	799,760
Unit labor cost	£/hr	4.36	6.27	7.54	4.36	6.27	7.54

Sheep

Market sales		ton/year	84,200	72,000	63,400		1,916	1,638	1,443
Energy content as food calories		MJ/yr	880,732,000	753,120,000	663,164,000		20,039,188	17,135,648	15,088,890
Economic value on the local market that year		£/year	103,380,480	110,080,000	130,600,000		2,352,204	2,504,637	2,971,526

Cattle

Market sales		ton/year	190,100	158,710	190,300		2,236	1,867	2,238
Energy content as food calories		MJ/yr	1,988,446,000	1,660,106,600	1,990,538,000		23,387,469	19,525,646	23,412,075
Economic value on the local market that year		£/year	315,011,061	275,960,000	383,600,000		3,705,060	3,245,754	4,511,781

Poultry

Market sales		ton/year	114,500	136,800	96,200		10	11	8
Energy content as food calories		MJ/yr	674,405,000	805,752,000	566,618,000		56,038	66,951	47,081
Economic value on the local market that year		£/year	62,332,680	92,610,000	74,100,000		5,179	7,695	6,157

Pigs

Market sales		ton/year	58,100	64,700	60,400		17	19	18
Energy content as food calories		MJ/yr	531,615,000	592,005,000	552,660,000		157,155	175,008	163,377
Economic value on the local market that year		£/year	60,954,015	57,770,000	55,600,000		18,019	17,078	16,436

Eggs

Product A, harvest		number	703,000,000	725,000,000	831,000,000		58,414	60,242	69,049
		ton/year	40,774	42,050	48,198		3	3	4
Product A, energy content as food calories		MJ/yr	243,013,040	250,618,000	287,260,080		20,192	20,824	23,869
Product A, economic value on the local market that year		£/year	27,800,000	24,400,000	30,600,000		2,310	2,027	2,543

Milk

Product A, harvest		litre/year	1,236,591,479	1,200,000,000	1,273,000,000		634,043	615,282	652,711
Product A, energy content as food calories		MJ/yr	33,882,607	32,880,000	34,880,200		17,373	16,859	17,884
Product A, economic value on the local market that year		£/year	246,700,000	245,100,000	264,200,000		126,492	125,671	135,464

Wool

Product A, harvest		ton/year	11,280	9,000	8,000		257	205	182
Product A, energy content as food calories		MJ/yr	N/A - Wool is not food!						
Product A, economic value on the local market that year		£/year	6,500,000	4,000,000	2,400,000		147,894	91,012	54,607

Main Crops

Barley	Area (ha)	329,114	316,400	320,600	1,327	1,276	1,293
Product A, harvest	ton/year	1,676,000	1,915,700	1,678,000	7,270	8,310	7,279
Product A, energy content as food calories	MJ/yr	21,486,320,000	24,559,274,000	21,511,960,000	93,205,902	106,536,125	93,317,126
Product A, economic value on the local market that year	£/year	145,500,000	198,400,000	222,900,000	631,167	860,643	966,922
Wheat	Area (ha)	109,675	108,900	102,700		5.87	5.91
Product A, harvest	ton/year	824,000	617,000	832,100			
Product A, energy content as food calories	MJ/yr	9,673,760,000	7,243,580,000	9,768,854,000			
Product A, economic value on the local market that year	£/year	75,600,000	63,400,000	96,700,000			
Oilseed Rape	Area (ha)	49,895	36,400	36,300		119.74	146
Product A, harvest	ton/year	161,000	105,900	137,100			
Product A, energy content as food calories	MJ/yr	1,735,580,000	1,141,602,000	1,477,938,000			
Product A, economic value on the local market that year	£/year	38,600,000	24,700,000	31,400,000			
Potatoes	Area (ha)	27,032	29,300	29,100		6.92	-
Product A, harvest	ton/year	1,000,000	1,131,900	1,415,700			
Product A, energy content as food calories	MJ/yr	2,980,000,000	3,373,062,000	4,218,786,000			
Product A, economic value on the local market that year	£/year	80,200,000	126,000,000	208,300,000			
Oats	Area (ha)	27,235	21,300	20,900	71	56	55
Product A, harvest	ton/year	125,000	114,600	123,600	327	299	323
Product A, energy content as food calories	MJ/yr	1,297,500,000	1,189,548,000	1,282,968,000	4,187,701	3,839,284	3,352,690
Product A, economic value on the local market that year	£/year	11,900,000	13,100,000	12,700,000	31,097	34,233	33,188



SUMMAry

Systems diagrams – are we losing too much richness to make the analysis practical?

SUMMA – data intensity is very challenging – 4 weeks, 4 staff full time – still not complete – some severe compromises – and this for the sector argueably with the most data collected.

What will we get in the end?

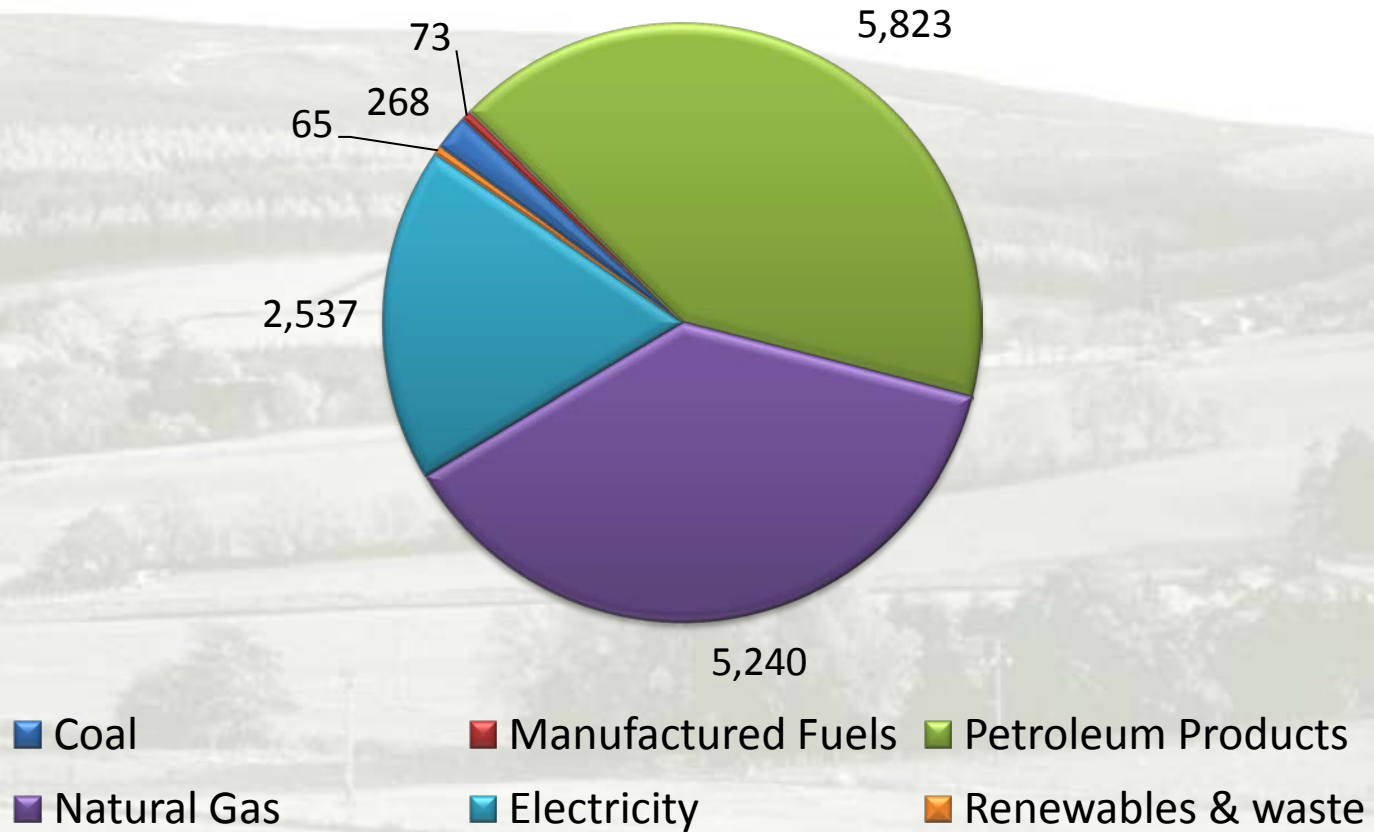
What will the data allow the stakeholders to do that they can't do now?

Can we explain it to the stakeholders?

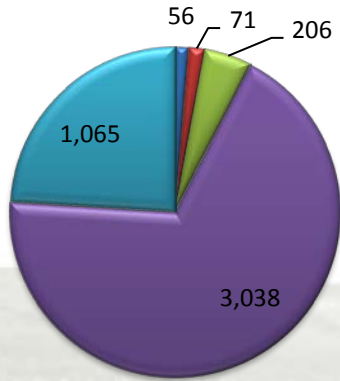
SUMMA expert and SYSTEM expert partnership – a recognised DS model, perhaps we can boot strap, but daunting challenge – issues of capacity/timings

■ Total Energy Throughput (TET)

Energy Mix - Scotland 2005 - All (Ktoe)

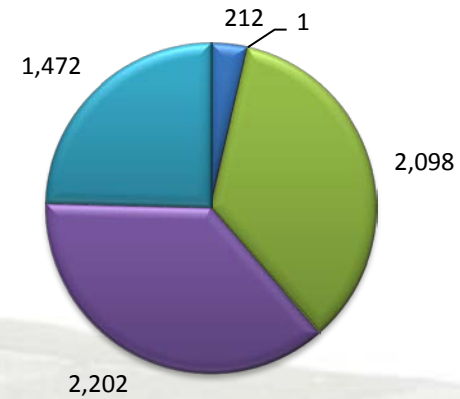


Energy Mix - Scotland 2005 - Domestic (Ktoe)



■ Coal ■ Manufactured Fuels ■ Petroleum Products
■ Natural Gas ■ Electricity ■ Renewables & waste

Energy Mix - Industrial/Commercial - All (Ktoe)



■ Coal ■ Manufactured Fuels ■ Petroleum Products
■ Natural Gas ■ Electricity ■ Renewables & waste

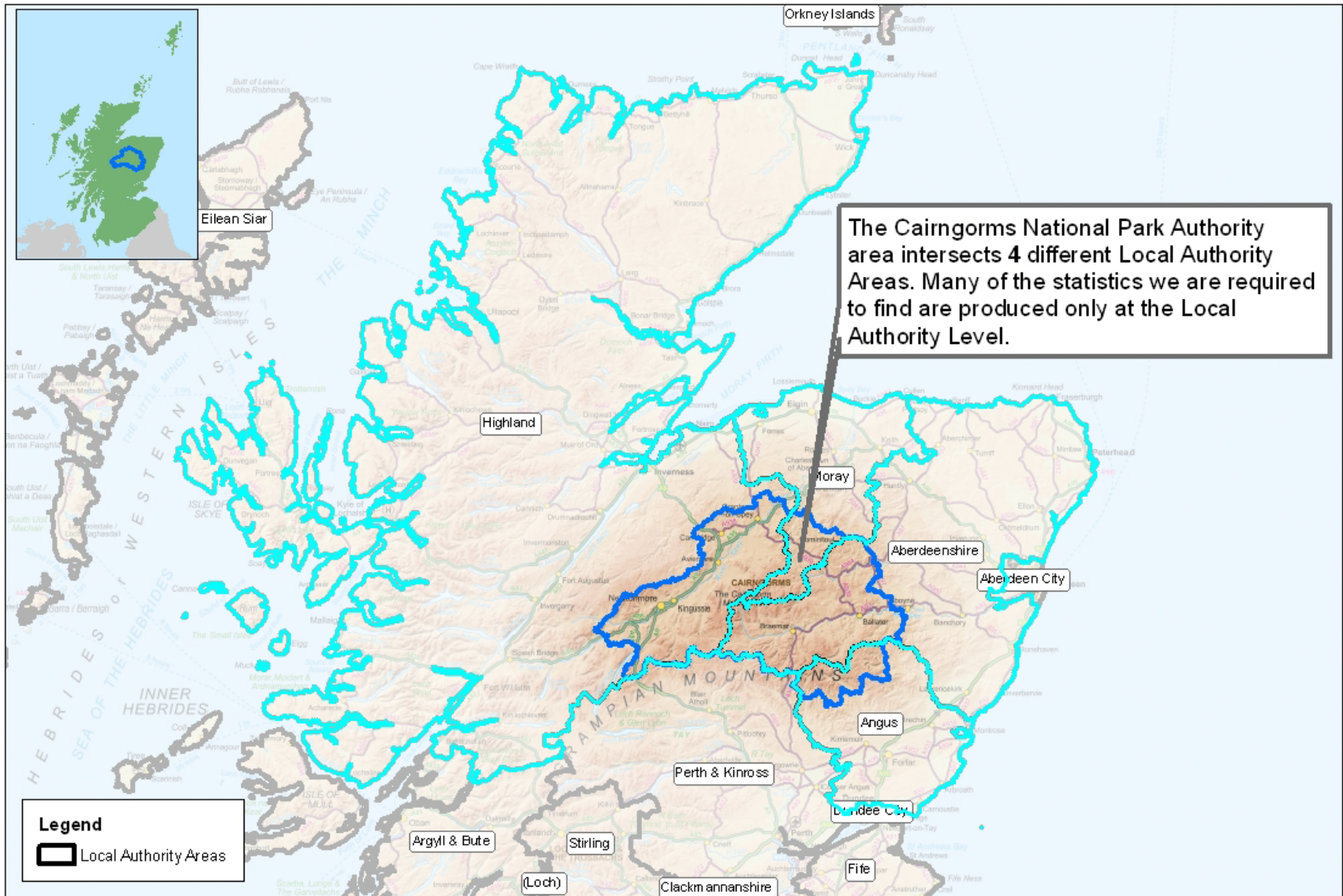
Petroleum Products in Transport - Scotland 2005 (ktoe)



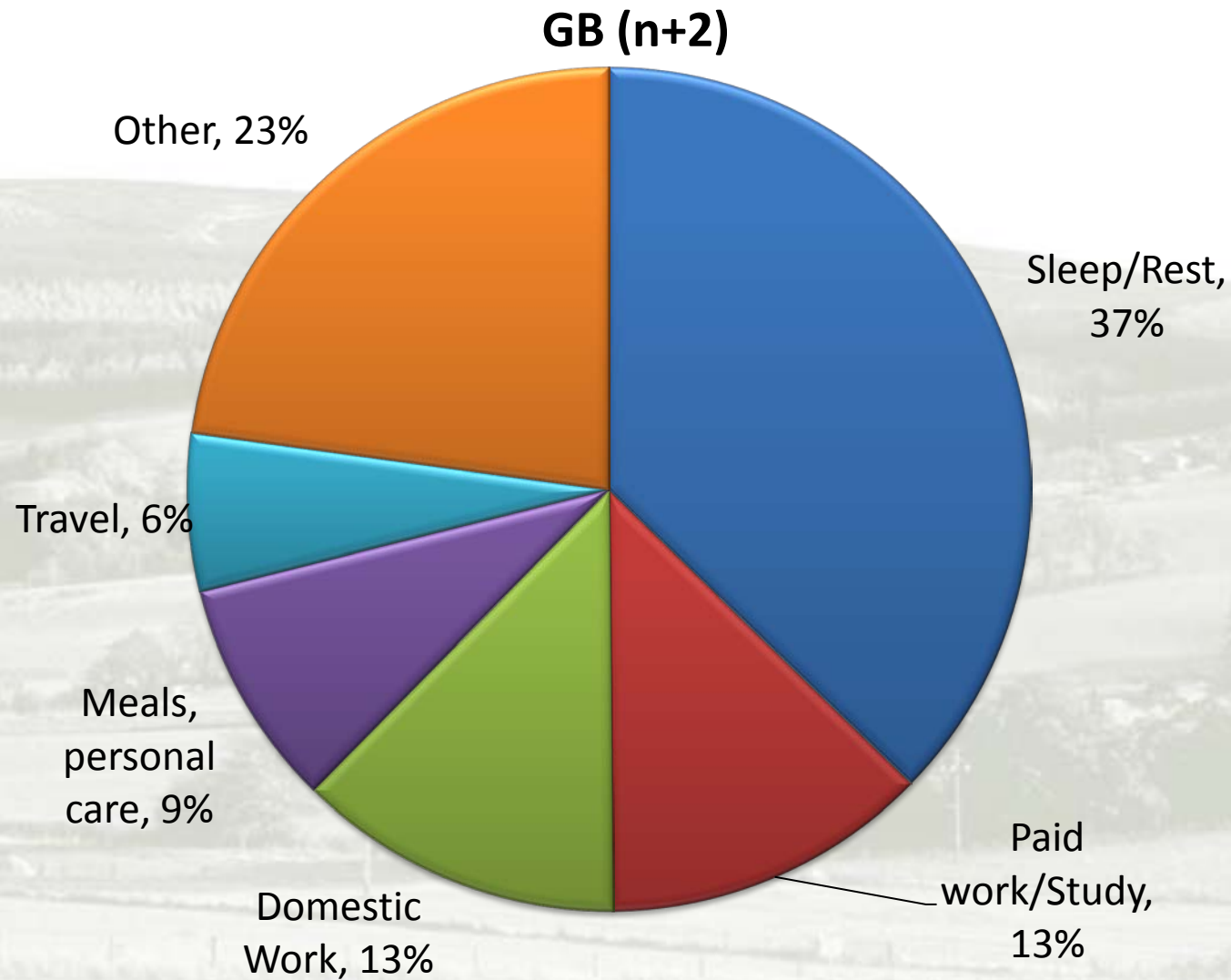
■ Road Transport ■ Rail

- Regional – to local authority
- Poor sectoral data published – domestic, industrial/commercial and transport
- “Final” consumption – both helpful and unhelpful
- Time series – 2005, 2006, 2007? – some work to go earlier (GB time series)

The Cairngorms National Park & Local Authority Boundaries



■ Total Human Activity (THA)

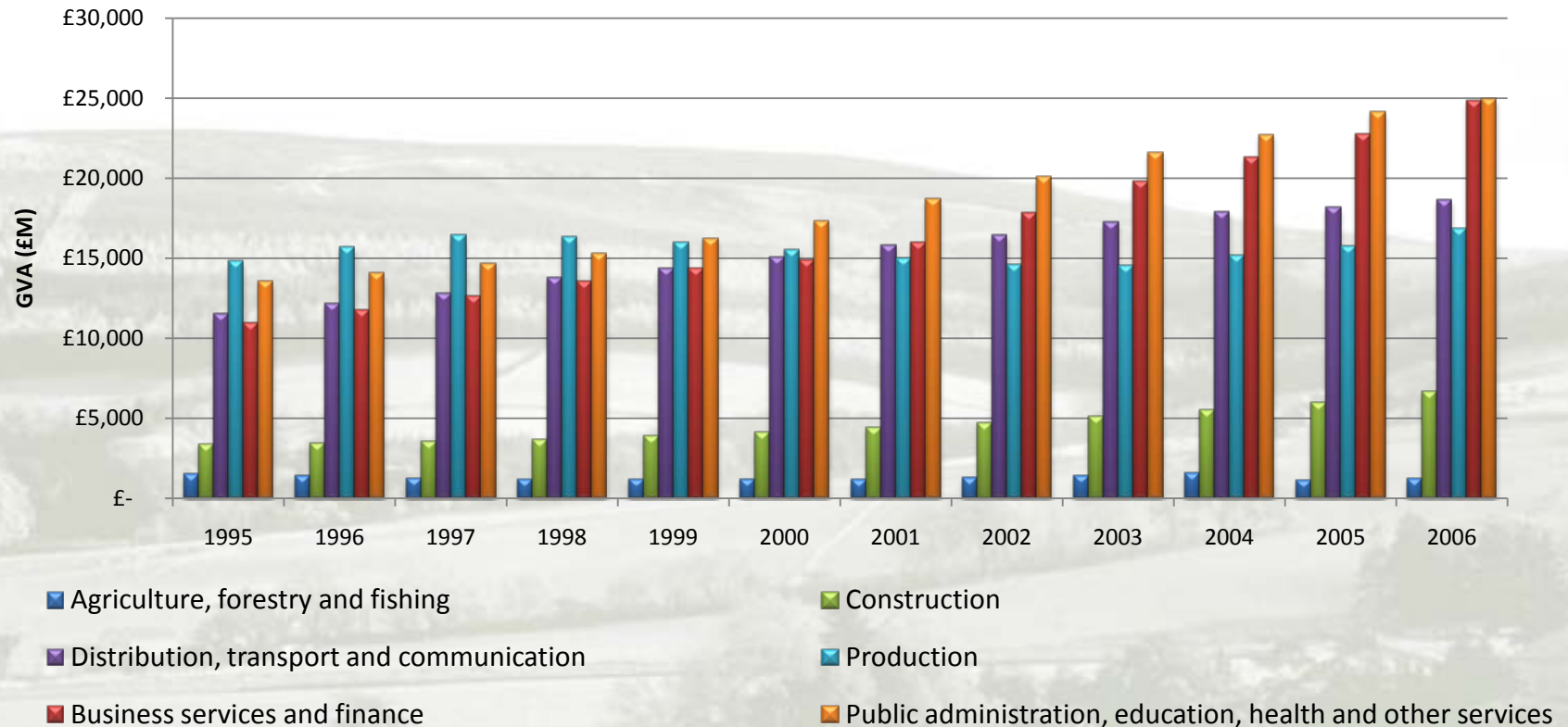


■ Total Human Activity (THA)

GB			2005		
Activity	All (min/d)	%	Activity	All (min/d)	%
Sleep	491	34.1%	Repairs/garden	17	1.2%
Paid work	170	11.8%	Other	14	1.0%
TV etc	157	10.9%	Washing clothes	11	0.8%
Travel	87	6.0%	Formal education	11	0.8%
Eat/drink	82	5.7%	Computer use	11	0.8%
Time w' family/friends at home	50	3.5%	Sport & outdoor	10	0.7%
Rest	46	3.2%	Care other children	9	0.6%
Personal Care	44	3.1%	Contact with friends/family	8	0.6%
Cook/wash up	41	2.8%	Pet care	7	0.5%
Shopping/appts	34	2.4%	Entertainment and culture	5	0.3%
Clean/tidy	31	2.2%	Recreational study	4	0.3%
Care own children	24	1.7%	Voluntary work	3	0.2%
Reading	24	1.7%	Religious/other meetings	3	0.2%
Going out with friends/family	24	1.7%	Care - adult - other household	2	0.1%
Hobbies	19	1.3%	Care - adult - own household	1	0.1%
				1,440	

GVA (GVAxx)

Changes in the Sectoral Balance of the Scottish Economy



National Stats – to regional (LA) level

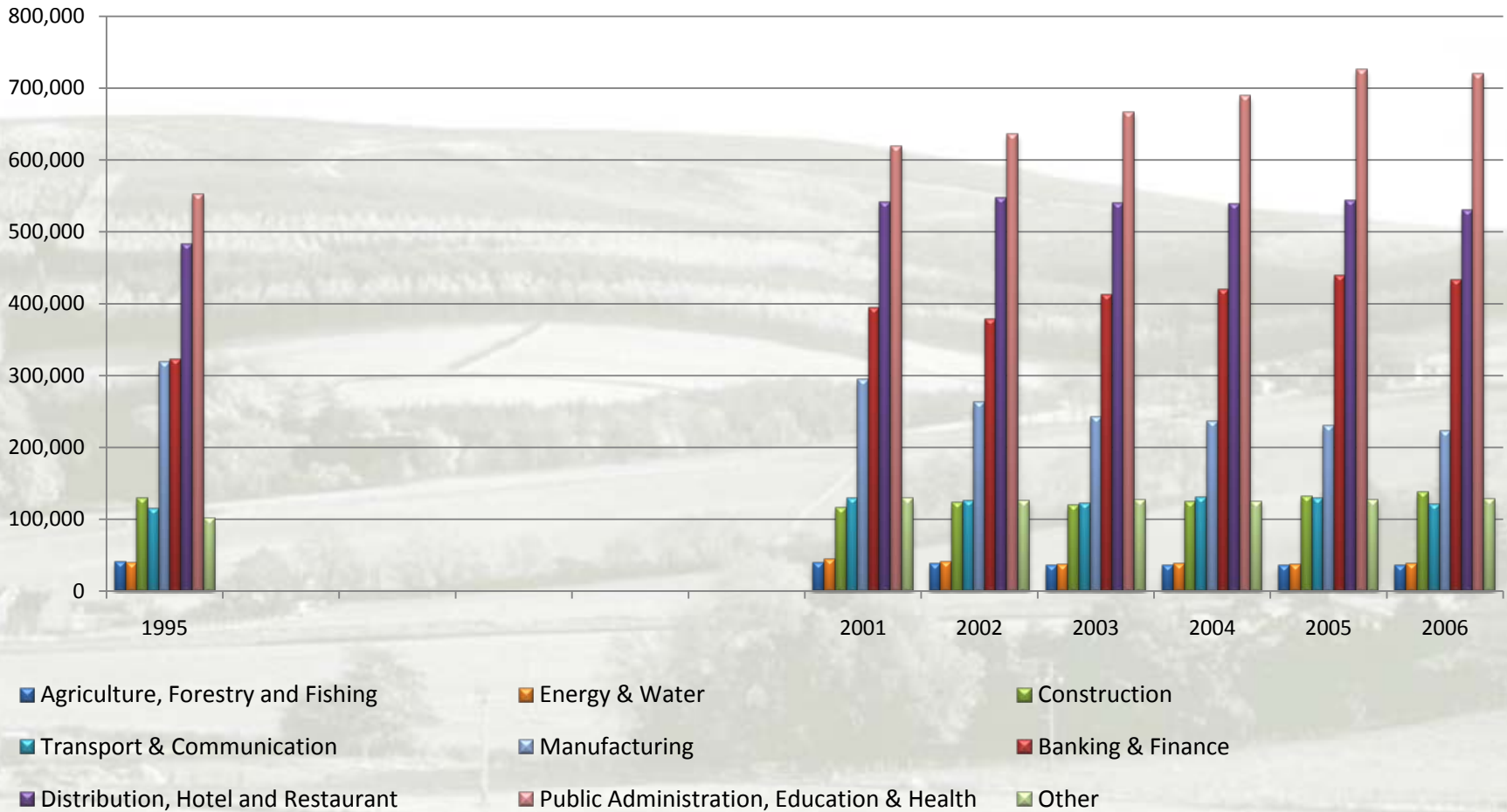
GVA with subsidies? Sectoral breakdown – AFF – added value figure too large.

Full I/O tables – but latest 2004, previous 2001 – earlier less easily available

Output (activity) – @ producer or consumer prices and Intermediate Consumption

■ Employment (HAxx)

Employees by Sector (Scotland – n)

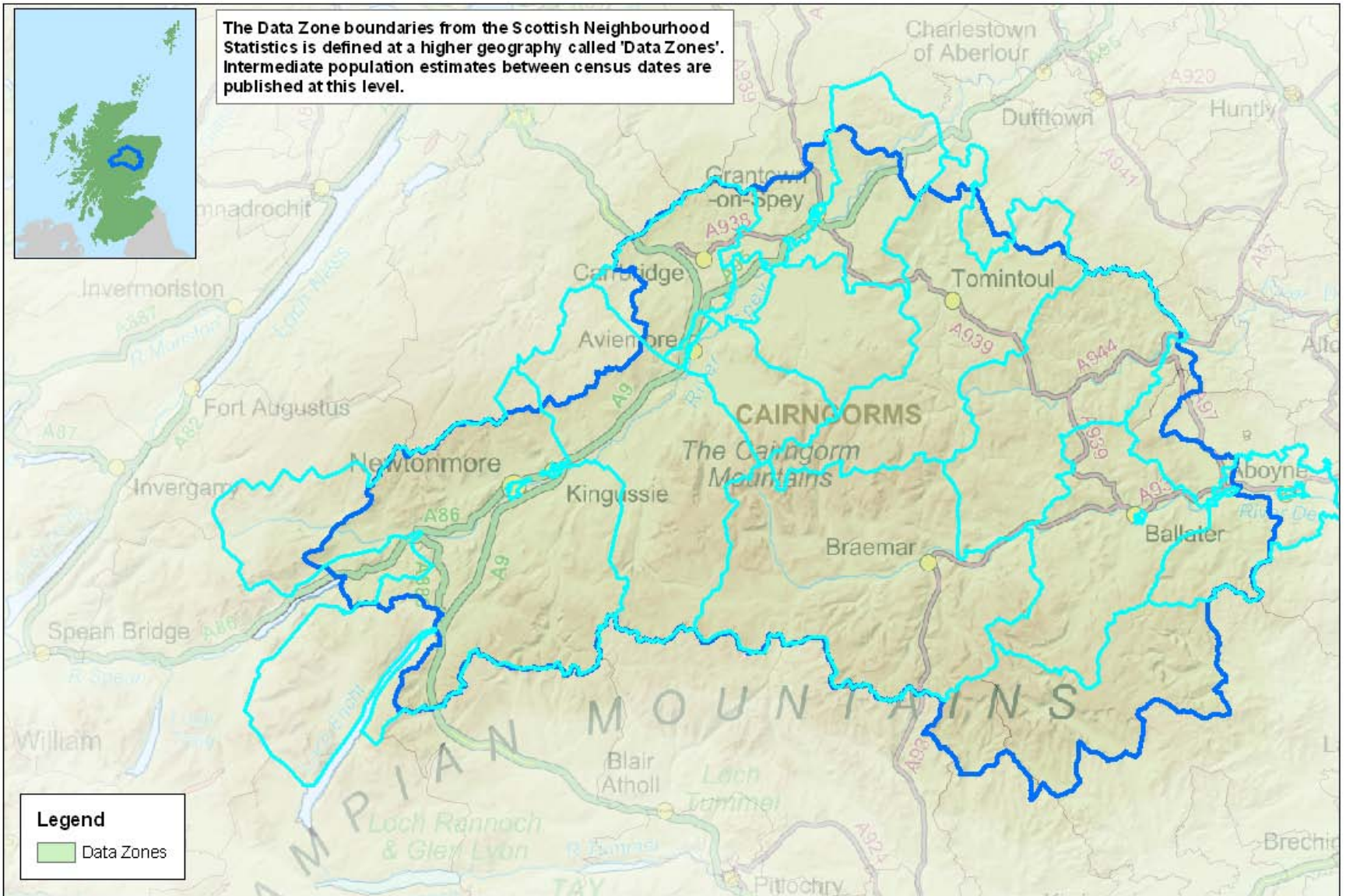


Scottish neighbourhood statistics – CNP specific good – but limited economics

The Cairngorms National Park & Data Zone Boundaries 2001



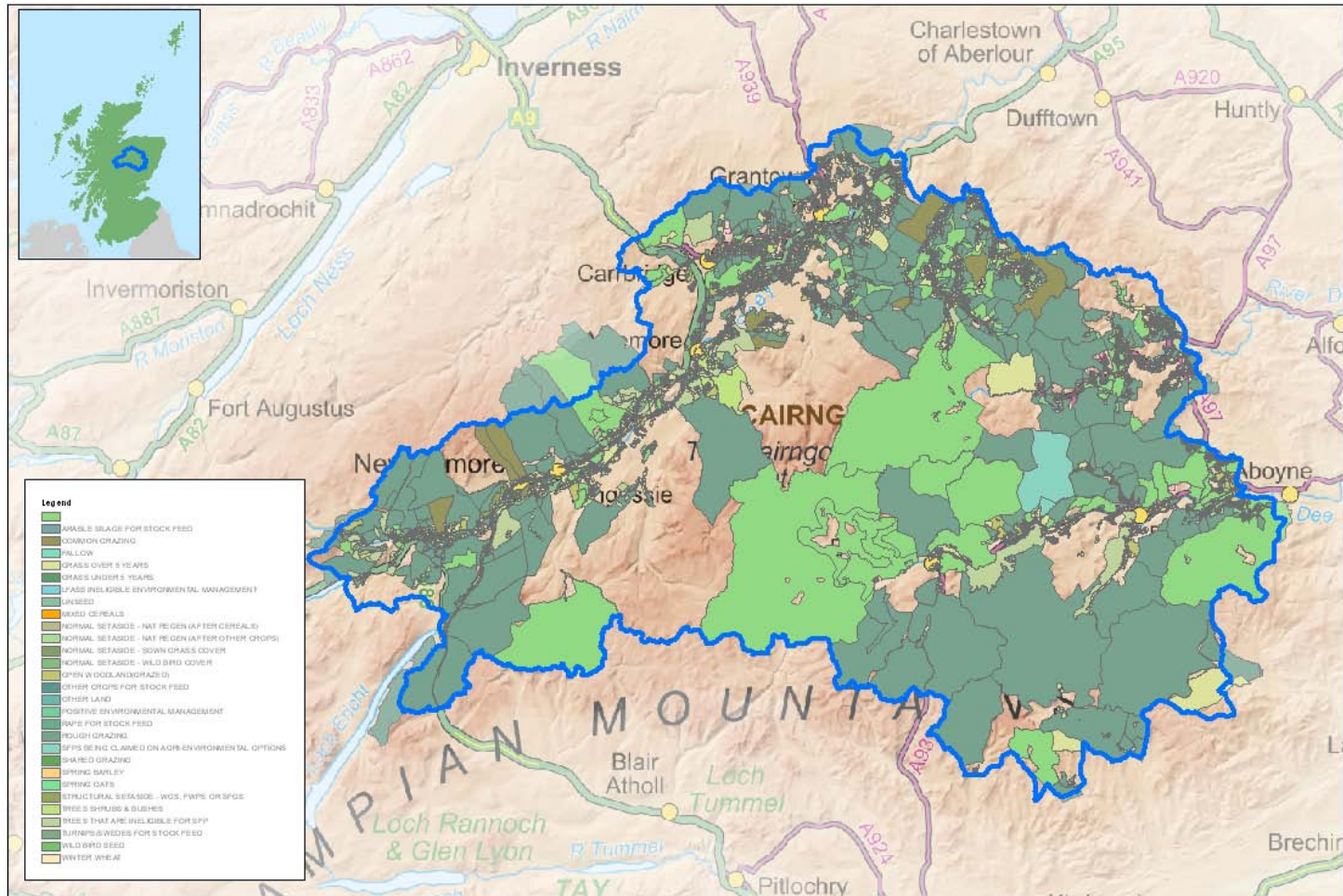
The Data Zone boundaries from the Scottish Neighbourhood Statistics is defined at a higher geography called 'Data Zones'. Intermediate population estimates between census dates are published at this level.



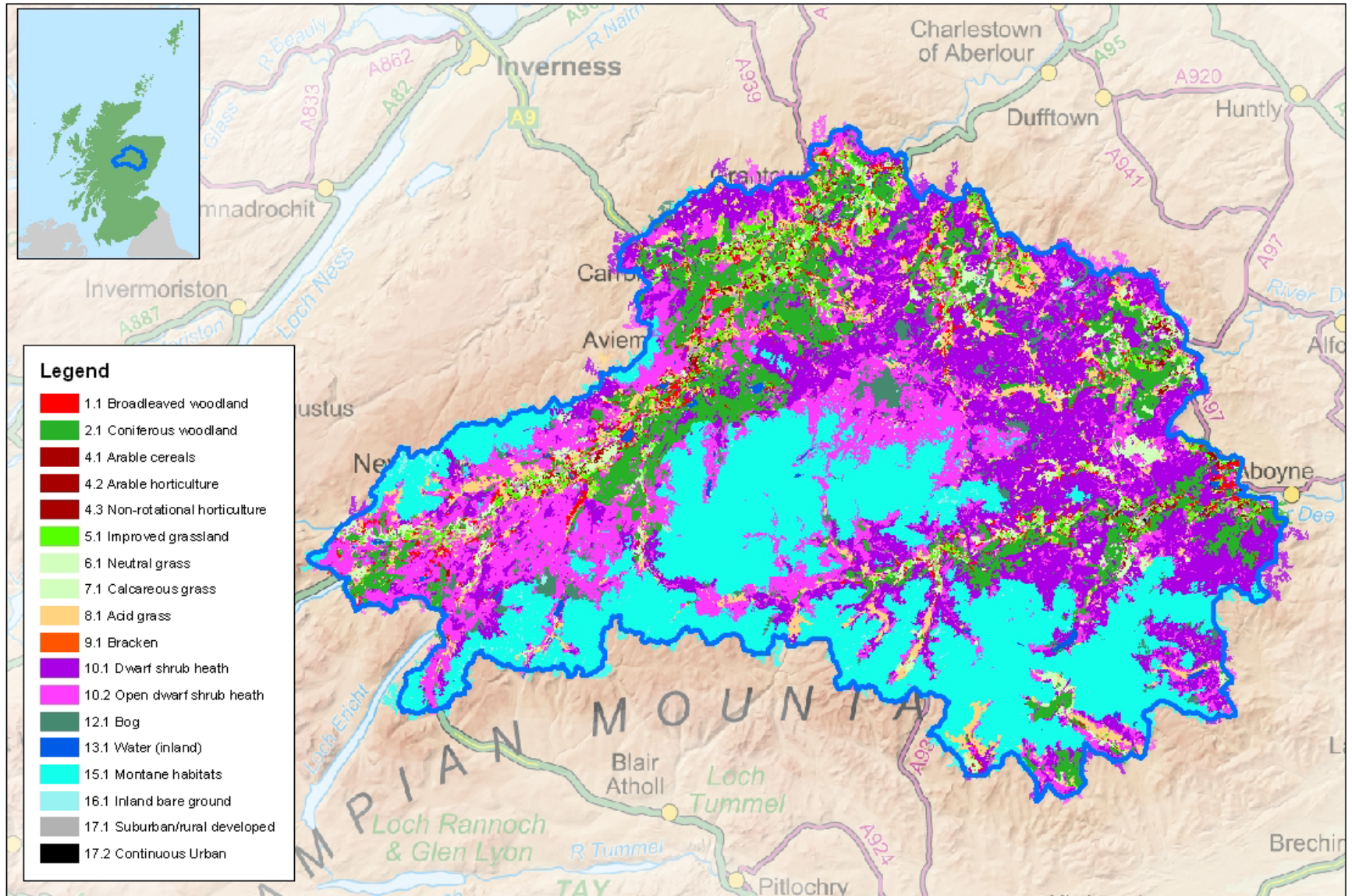
Total Available Land (TAL)

June Census – 79.3% (non spatial), SIACS c. 65% (spatial), other datasets (90+ layers)

The Cairngorms National Park & SIACS Boundaries 2008

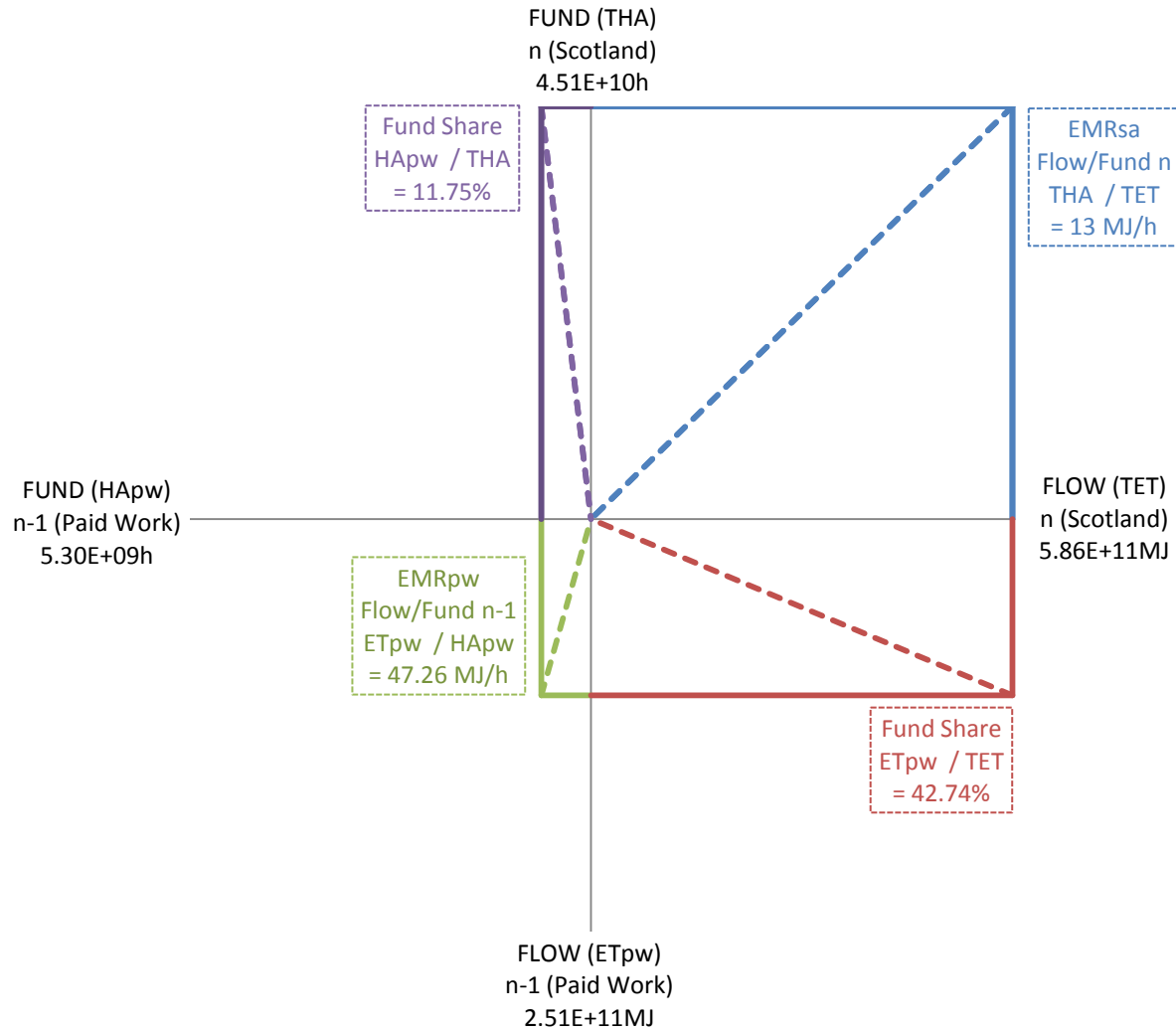


The Cairngorms National Park & Land Cover Map 2000

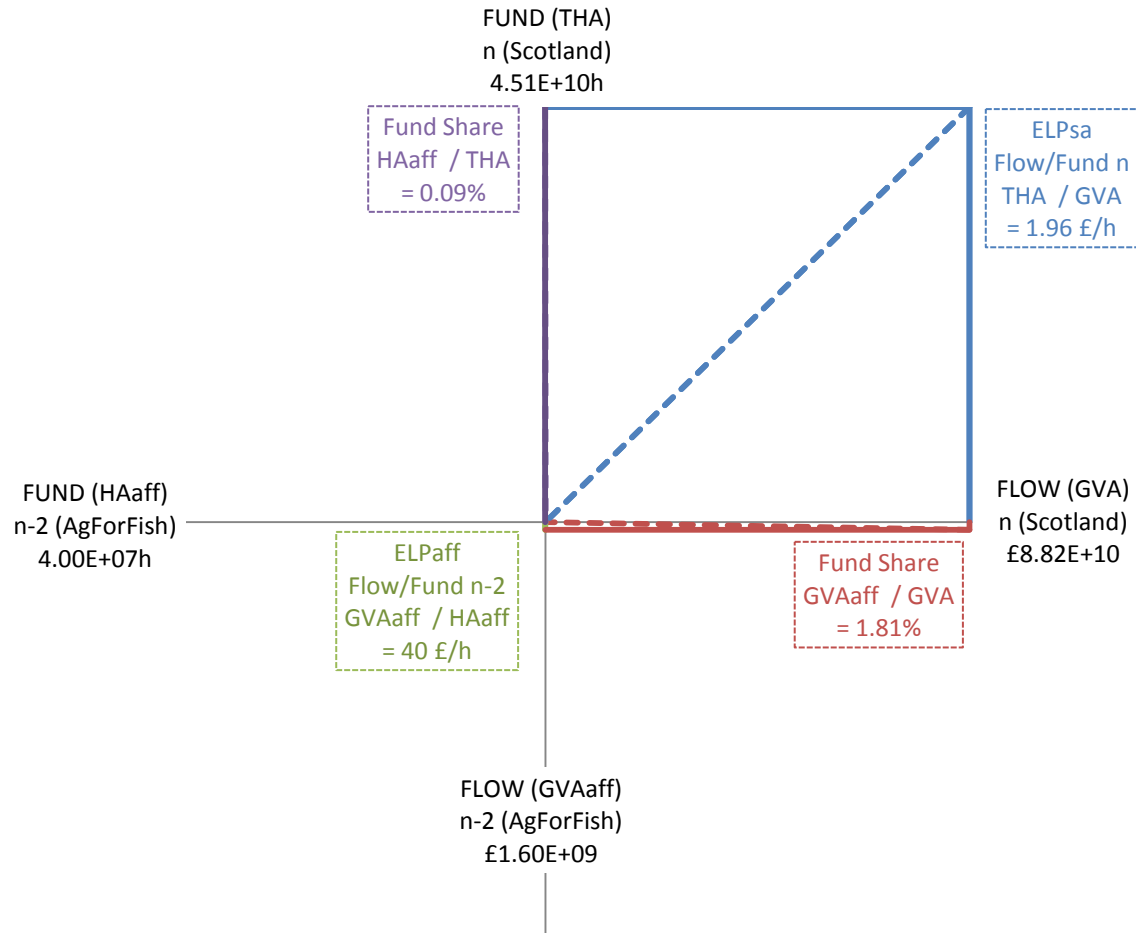


MuSIASEM Plots

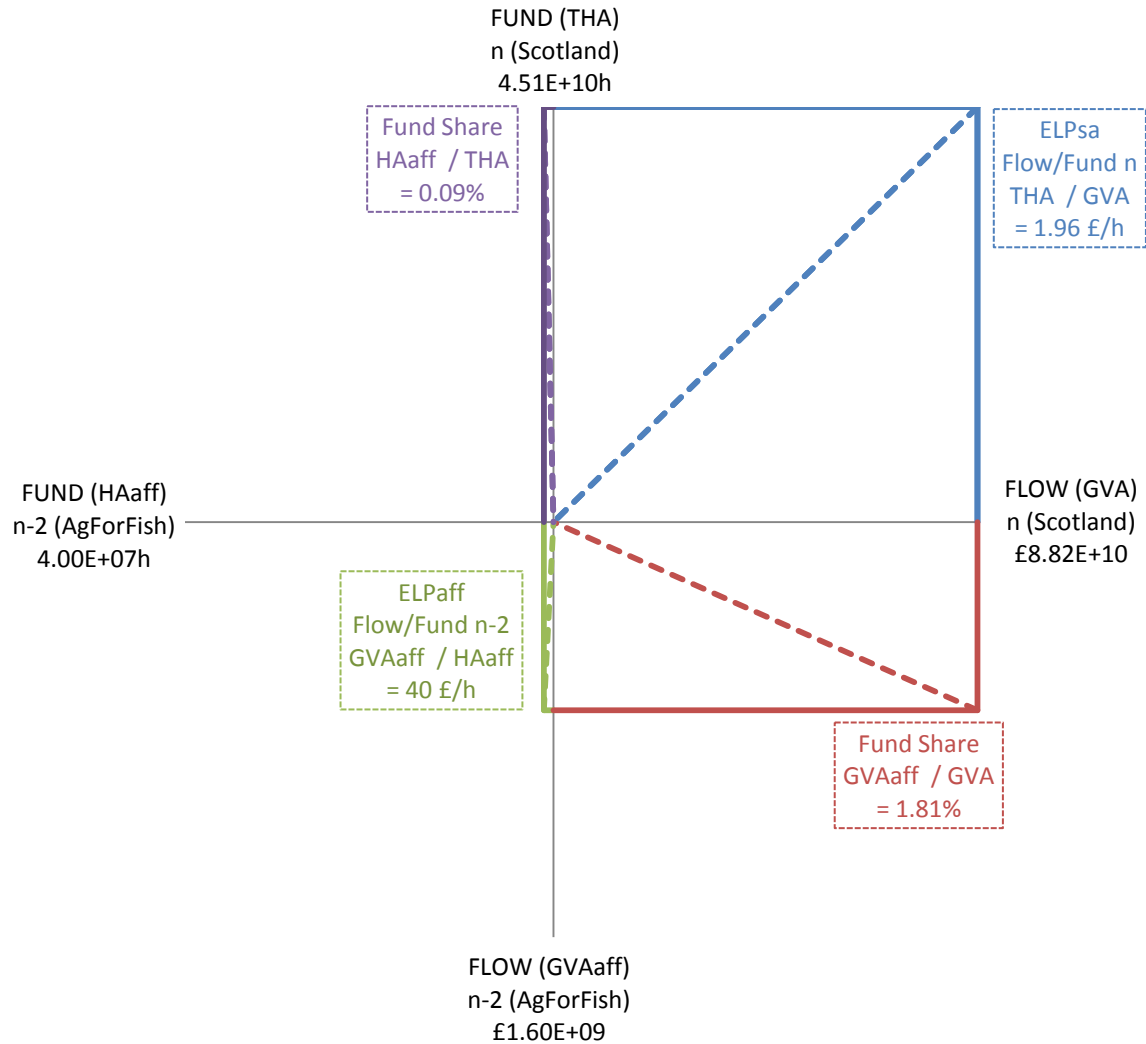
Human Activity and Energy



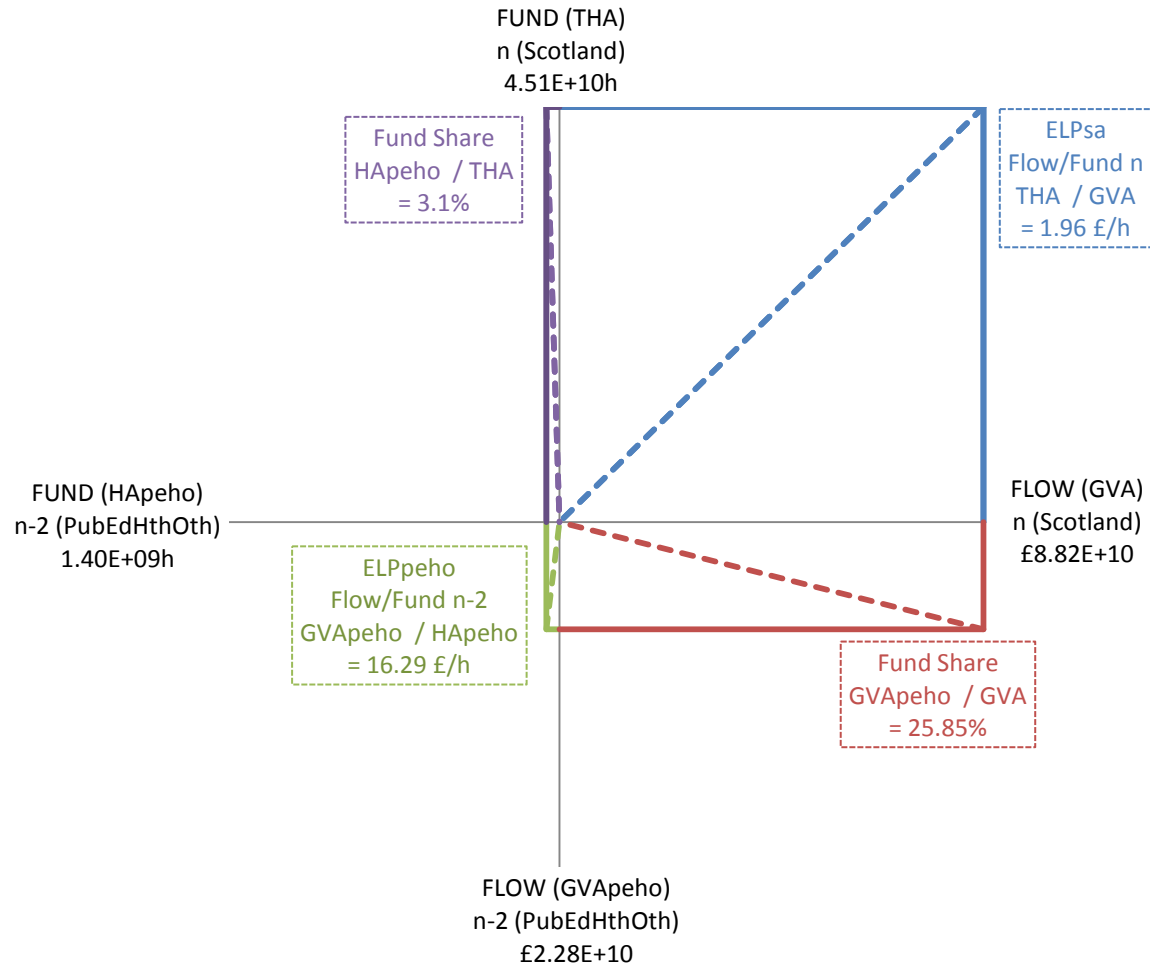
Labour Productivity (AgForFish)



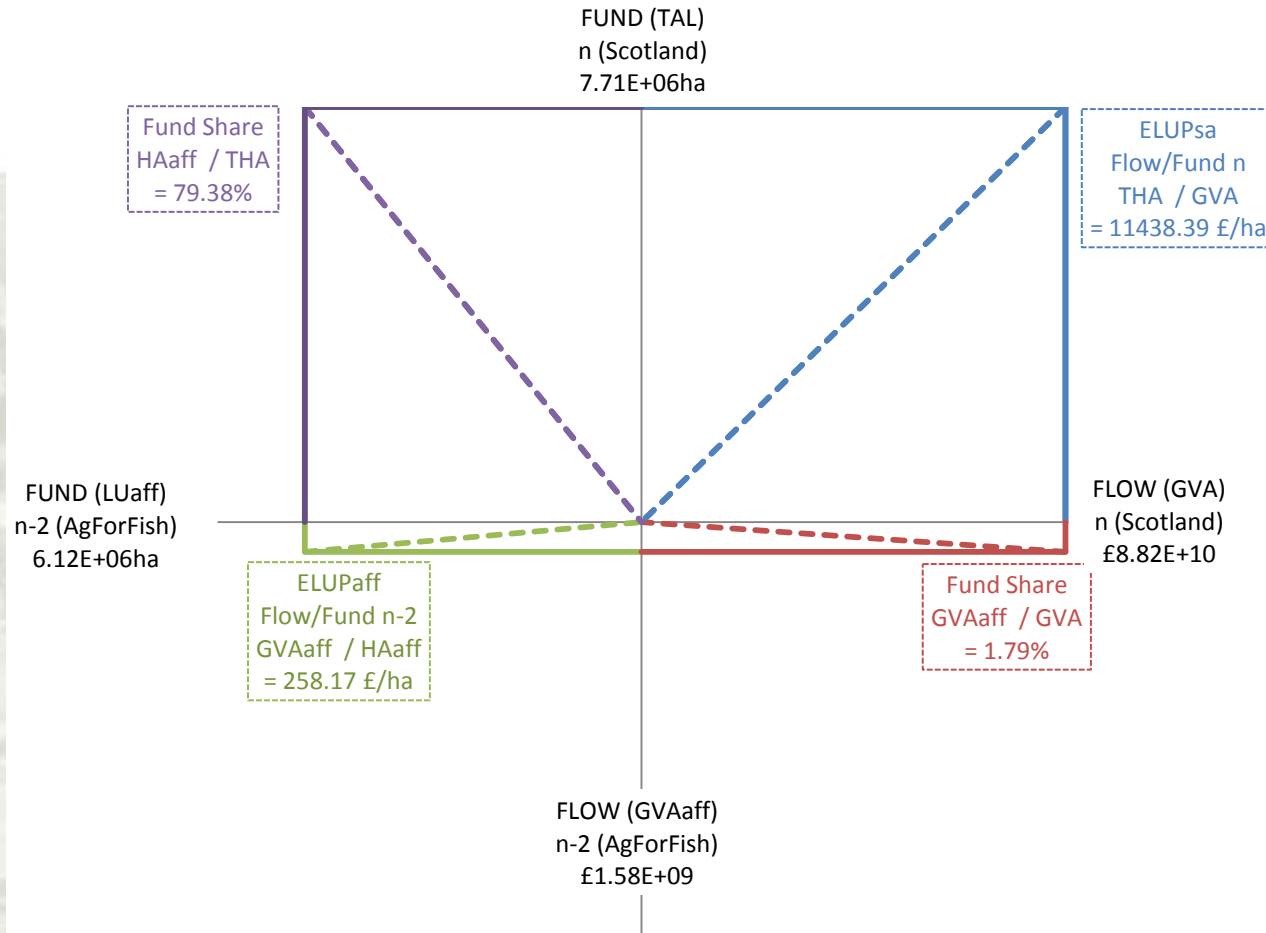
Labour Productivity (AgForFish)



Labour Productivity (PubEdHthOth)



Land Use Productivity



■ MuSIASEM summary

Coherence – OK but Impredictive Loop still not really understood

Mismatches in data classifications – better a million records than 100 badly classified

The “sudoku” effect – helpful but novices time consuming, prone to failure

TAL linkages – this is really challenging – easy to do for sectors that are economically unimportant (of themselves) – but environmentally decisive and may somehow support other sectors (directly: processing, services or indirectly through non-exclusive, non-diminishing “consumption” – e.g. tourism).

Does this break the metaphor of “metabolism” – is this resources a “catalyst”?