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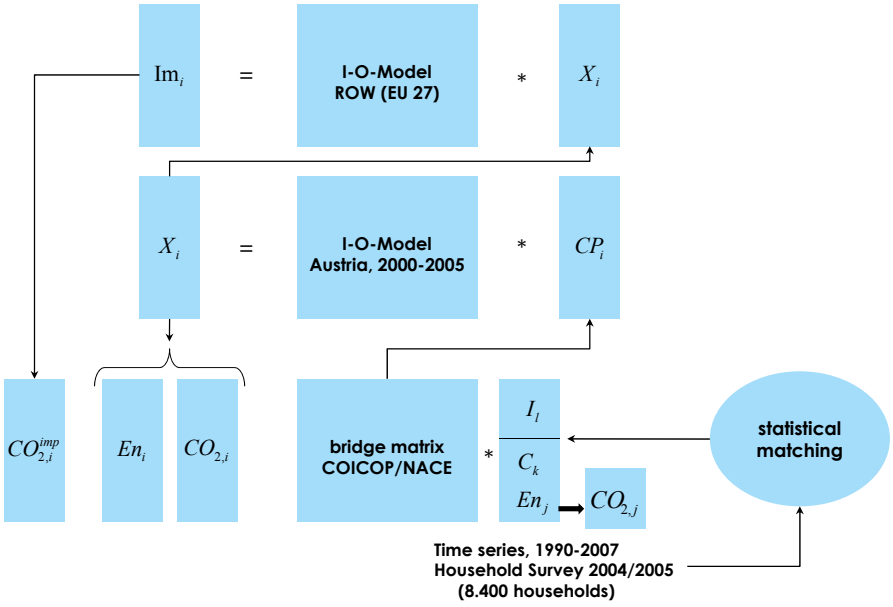
Household energy demand:
Model blocks und research outlook

Full energy/CO_2 impact accounting of households & spatial sustainability: model blocks

- Consumers' energy demand → direct environmental impact
- Other consumers' demand (food, cars...) → indirect environmental impact
- Direct and indirect imports for consumers' demand → imported environmental impact
- → *Future research within this project:* environmental impacts: land-use, ecological footprint, ...other aspects of spatial sustainability: transport & lifestyles

WIFO Environmental impact of consumption wrt. CO_2 emissions



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Time series model

→*budget share (prices and income)*

$$w_{it} = \alpha_i + \sum_j \gamma_{ij} \log p_{jt} + \beta_i \log\left(\frac{C_t}{P_t}\right)$$

The budget share in 2005 w_{it} is the sum of $w_{it,k}$ with k = number of households (8,400)

Identifying sustainable lifestyles:

Households with: (i) same income, (ii) same size and composition, (iii) living in the same region and for given prices (2005) use less energy than others

→ *statistical matching → household preferences towards energy/CO_2 demand*

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Statistical matching:

(i) identical households ("statistical twins") concerning the household characteristics (income, size, composition, region, etc.) → *different energy consumption (heating, electricity, private transport)*

(ii) Ordering identified households according to energy consumption per unit of income and taking into account region

(iii) Calculating the median of energy consumption and constructing two groups of households: "more sustainable" vs. "less sustainable"

WIFO Data sources, 2000 - 2005

National Accounts for Austria (private consumption):

Durables (energy & non-energy), food/beverages, clothing/footwear, gasoline/diesel, transport services, heating, electricity, other commodities.

Input-Output tables for Austria, 1995, 2000 and 2005:

60 industries (NACE), imported and domestic intermediates

Input-Output table for EU 27, 2000:

60 industries (NACE), imported and domestic intermediates

Statistics Austria, IEA: NAMEA energy & CO_2 emissions

Statistics Austria: Household Survey 2004/05, 3,500 households with socio-demographic characteristics

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Data Inputs for the simulation

	Households		
	Sustainable	Others	Sustainable in % of Others
	Budget shares in %		
Private Consumption	100.0	100.0	74.2
Disposible income	125.4	93.0	100.0
Food/beverage/tobacco	15.8	13.7	85.9
Clothing/shoes	5.7	5.9	72.3
Gasoline/diesel	2.0	5.1	29.1
Transport services	0.9	0.5	146.0
Electricity	1.6	1.9	61.0
Heating	2.0	3.1	46.7
Other goods & services	72.0	69.9	76.4

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Impact of consumption: CO_2 emissions by industry

CO_2 emissions in 1,000 tons

	Induced by private consumption					
	2000	2001	2002	2003	2004	2005
Products of agriculture, hunting and related services	657	592	623	563	513	492
Food products and beverages	685	680	801	632	518	571
Other non-metallic mineral products	553	563	590	562	566	602
Electrical energy, gas, steam and hot water	6,100	7,027	6,207	7,416	7,635	7,106
Land transport; transport via pipeline services	1,395	1,455	1,410	1,438	1,675	2,086
Air transport services	1,943	1,830	1,740	1,562	1,585	1,659

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Total impact of consumption in CO_2 emissions (direct, indirect and imported)

CO_2 emissions in 1,000 tons

	Induced by private consumption 2000	2005
CO_2 emissions, households	18,479	19,665
CO_2 emissions, production	15,185	16,683
in % of emissions in production	32.4	29.6
CO_2 emissions, imports	14,272	17,420
in % of imported emissions	29.7	27.6
TOTAL	47,935	53,769
in % of CO_2 emissions, TOTAL	73.4	70.8
CO_2 emissions, TOTAL	65,283	75,981

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Simulation: Change in consumption induced by level-shift in lifestyles

Private Consumption, current prices

	Difference in % 2000	2001	2002	2003	2004	2005
Durable goods						
Purchase of vehicles	0.9	1.0	1.0	0.8	0.8	0.8
Appliances	0.9	1.0	1.0	0.8	0.8	0.8
Video/Audio/Computer	0.9	1.0	1.0	0.8	0.8	0.8
Other durables	0.9	1.0	1.0	0.8	0.8	0.8
Durables, TOTAL	0.9	1.0	1.0	0.8	0.8	0.8
Rents, housing	0.0	0.0	0.0	0.0	0.0	0.0
Vehicle operation	0.9	1.0	1.0	0.8	0.8	0.8
Non-durable goods						
Food/beverage/tobacco	8.3	8.4	8.4	8.3	8.2	8.2
Clothing/shoes	– 0.4	– 0.3	– 0.3	– 0.5	– 0.5	– 0.5
Gasoline/diesel	– 43.1	– 43.0	– 43.0	– 43.1	– 43.1	– 43.1
Transport services	33.9	33.9	33.9	33.8	33.7	33.7
Electricity	– 8.9	– 8.9	– 8.9	– 9.0	– 9.0	– 9.0
Heating	– 22.0	– 21.9	– 22.0	– 22.0	– 22.1	– 22.1
Other goods & services	2.7	2.8	2.6	2.4	2.4	2.8
Non-durables, TOTAL	0.9	1.0	1.0	0.8	0.8	0.8

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Simulation: Change in consumption induced by level-shift in lifestyles

Private Consumption, energy (in TJ)

	Difference in %					
	2000	2001	2002	2003	2004	2005
Heating	– 22.0	– 21.9	– 22.0	– 22.0	– 22.1	– 22.1
Electricity	– 8.9	– 8.9	– 8.9	– 9.0	– 9.0	– 9.0
Gasoline	– 43.1	– 43.0	– 43.0	– 43.1	– 43.1	– 43.1
Diesel	– 43.1	– 43.0	– 43.0	– 43.1	– 43.1	– 43.1
CO_2 emissions						
Difference in 1,000 tons	–5,897	–6,370	–6,369	–6,514	–6,571	–6,384
Difference in %	– 31.9	– 31.7	– 32.1	– 31.7	– 32.4	– 32.5

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Simulation: Change in gross output induced by level-shift in lifestyles

Gross output in basic prices (current prices)

	Difference in %					
	2000	2001	2002	2003	2004	2005
Products of agriculture, hunting and related services	6.4	6.5	6.4	6.3	6.2	6.1
Products of forestry, logging and related services	– 3.3	– 3.3	– 3.5	– 4.3	– 4.1	– 4.9
Fish and other fishing products; services incidental of fishing	11.2	10.4	10.2	8.9	7.9	8.0
Coal and lignite; peat	– 5.5	– 3.7	– 4.5	3.2	39.6	–19.8
Crude petroleum and natural gas; services incidental to oil and gas extraction excluding surveying	– 5.9	– 4.1	– 5.0	– 1.8	– 1.5	– 1.3
Coke, refined petroleum products and nuclear fuels	– 1.5	– 1.7	– 1.1	– 2.1	– 1.5	– 1.7
Electrical energy, gas, steam and hot water	– 7.1	– 7.1	– 6.4	– 6.4	– 6.9	– 7.0
Land transport; transport via pipeline services	3.4	3.3	3.3	3.4	4.0	4.2
Air transport services	10.2	10.0	11.0	12.2	9.0	9.6
Recreational, cultural and sporting services	2.0	2.1	2.0	1.7	1.8	2.0
Other services	2.4	2.4	2.2	2.1	1.9	2.3

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Simulation: Change in CO_2 emissions in industry induced by level-shift in lifestyles

CO_2 emissions in 1,000 tons

	Difference in 1,000 tons					
	2000	2001	2002	2003	2004	2005
Crude petroleum and natural gas; services incidental to oil and gas extraction excluding surveying	– 13	– 12	– 11	– 6	– 6	– 5
Food products and beverages	78	82	93	71	60	67
Coke, refined petroleum products, nuclear fuels	– 54	– 64	– 46	– 75	– 55	– 65
Electrical energy, gas, steam and hot water	– 739	– 935	– 780	– 957	–1,017	– 973
Land transport; transport via pipeline services	114	118	118	120	165	216
Air transport services	274	261	266	254	268	290

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Simulation: Change in total CO_2 emissions induced by level-shift in lifestyles

CO_2 emissions in 1,000 tons

	Difference in 1,000 tons	
	2000	2005
CO_2 emissions, households	– 5,897	– 6,384
CO_2 emissions, production	– 163	– 294
CO_2 emissions, imports	332	241
TOTAL	– 5,727	– 6,437
In % of CO_2 emissions, TOTAL	– 8.8	– 8.5
CO_2 emissions, TOTAL	65,283	75,981

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Conclusions

- **Total environmental impact of households** has a relevant share in total environmental impact based on domestic inventories & statistics
- ex post simulation (2000-2005) shows that a **shift in existing lifestyles** has a **significant influence on total environmental impact** of households
- **Economic indicators will** be complemented by physical measures in order to integrate impacts on land use and biodiversity within the interdisciplinary research