Quelle: Google

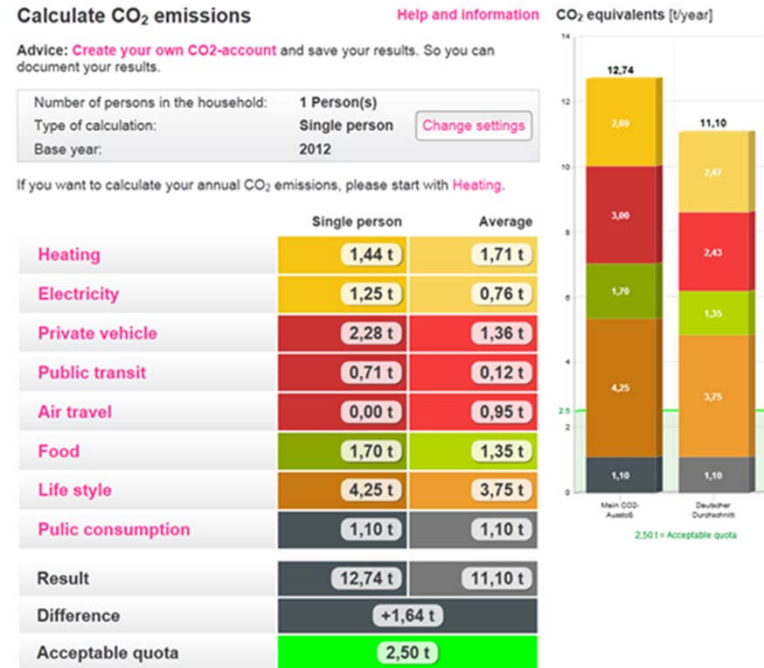# Eco-calculators for Energy and CO$_2$ developed in Germany

49th LCA Discussion Forum Sustainable Consumption Patterns
18. September 2012, ETH Zürich, GEP

IFEU Institut Hans Hertle

hans.hertle@ifeu.de

Part 1

Personal Carbon Footprint

(CO$_2$ Emissions)

Part 2

Scenario Tool for Citizens
(2000 Watt Society)

Waste Management | Education | Energy | Industry & Emissions | Agriculture | Sustainability | Life Cycle Assessment | Risk Assessment | EIA & SEA | Transport & Environment
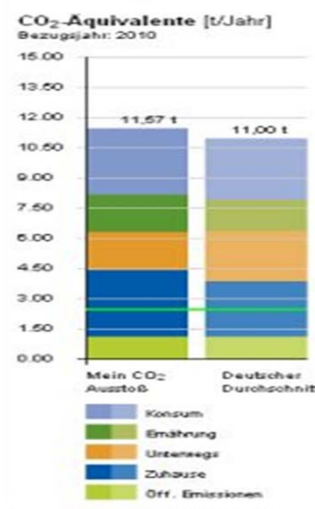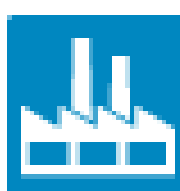
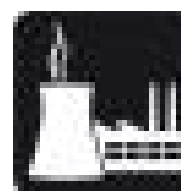# IFEU: Different perspectives on environmental impact

Consumption perspective and *Production* perspective

Carbon footprint / Energy Balance /   EMAS ….   /   LCA
of Cities   Industries   Products
SEAP

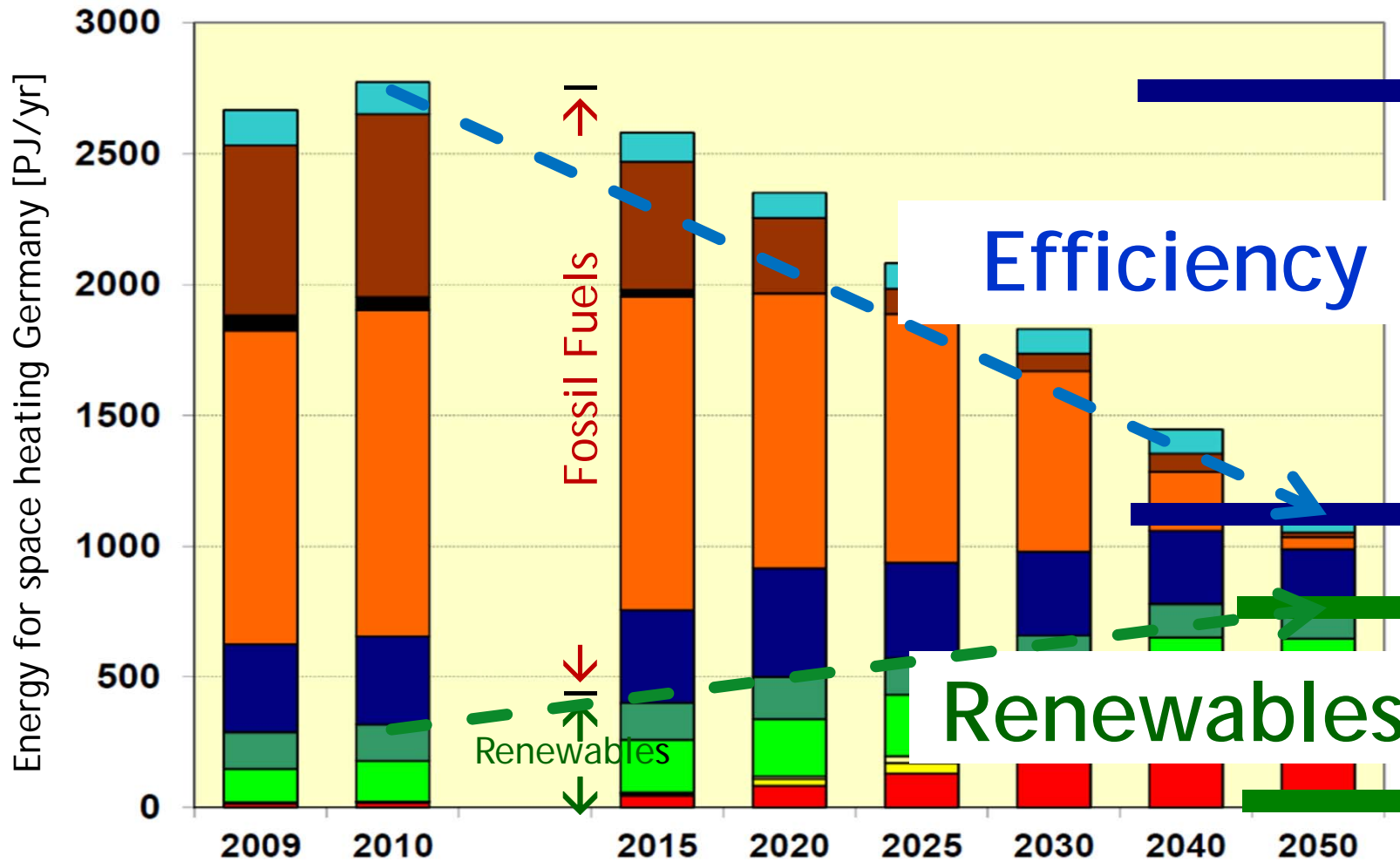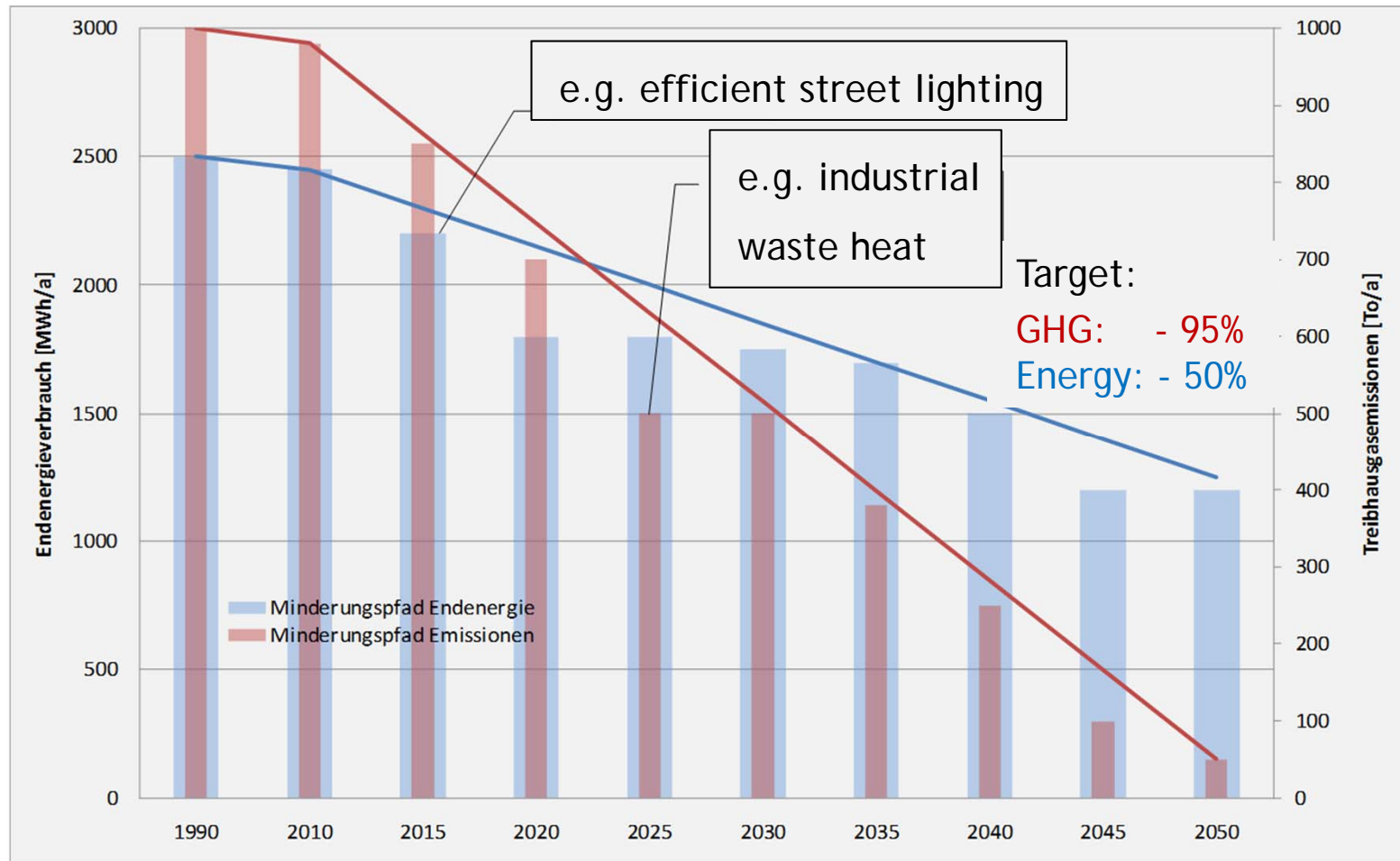Heidelberg

Ⓓ Ambitious national targets for GHG Reduction: -80% until 2050! e.g. German space heating scenario

Within the 100% Masterplan project 19 Ⓓ communities want to reduce 95% GHG until 2050

But even citizens
have to
hit the target!

TAKE THE
FOOTPRINT
CALCULATOR!

But which one?

I WANT YOU TO CHANGE YOUR LIFESTYLE

Basic problems and intention

- **Problems occured 2005**: There had been lots of German-language calculators with very different results calculating one single person (e.g. 3 to 30 tons CO_2 because of different sectors, emission factors or system boundaries).
  Atmosfair (M: only aviation) / AVERATEC L&M / BP D&M / CO_2[O]L (D&M: only private cars and aviation) / DB (M: Comparison with cars and train) / Ecocheck D&M&N / Ecospeed D&M&N&C/ Energiecheck EA NRW D: only white goods / Energiediät D&M&N&C / FH Bielefeld CO2paket D&M&N&C / Greenpeace D&M&N / IWR D&M / Klimabalance D&M&N / LFU Bayern D&M&N&C / NewTree M / PrimaKlima D&M / Proclim D&M /SEIN D&M&N&C
  D: Dwelling area; M: Mobility; N: Nutrition; C: Consumption

- Intention: To develop a scientific based methodology for Personal Carbon Footprint Tools

- To develop an established German-language calculator that can be used by all kinds of institutions.

Research Project: Carbon Footprint of Citizen

- initiation, scientific support

- Freiburg

- Umwelt Bundes Amt scientific and financial support

- klimAktiv programming, distribution

- LFU Bayern calculator (basis for the design)

Publikationen des Umweltbundesamtes

Die CO_2 Bilanz des Bürgers

Recherche für ein internetbasiertes Tool zur Erstellung persönlicher CO_2 Bilanzen

Forschungsprojekt im Auftrag des Umweltbundesamtes FuE-Vorhaben Förderkennzeichen 206 42 110

Juni 2007

Umwelt Bundes Amt
Für Mensch und Umwelt

Katharina Schächtele
Hans Hertle

Basic objectives: Changing individual behaviour (feedbacktool)

Origin of all anthropogenic emissions lies in meeting the needs of people

short term

User behaviour and short-term spending behaviour:
- Saving electricity
- Saving heat energy
- E.g. daily buying, no-carb(on) diet

middle term

- Sustainable mobility and purchasing eco cars
- Choosing location for holiday
- Purchasing white goods
- Decicion for personal diet in principle

long term

- Choosing high standard buildings for living
- Where to live (city / rural area)
- Using eco energy e.g. green electricity

Database of average German footprint*

- ■ National statistics
  - > GHG inventory
  - > Umweltökonomische
    Gesamtrechnung
  - > AG Energiebilanzen

- ■ Emission factors
  - > IFEU TREMOD (transport sector)
  - > IFEU electricity / DH
  - > GEMIS (heating)

- ■ CO_2-equivalent (CO_2e)
  - > CO_2, CH_4, N_2O

- ■ Acceptable quota: 2,5 t CO_2e

CO_2 equivalents [t/year]   Base year 2012

		My footprint	German average	
	11,10			Private Home
	2,47			
	2,43			Mobility
	1,35			Nutrition
	3,75			Private Consumption
1,10		1,10	1,10	Public Consumption

2,50 t = Acceptable quota
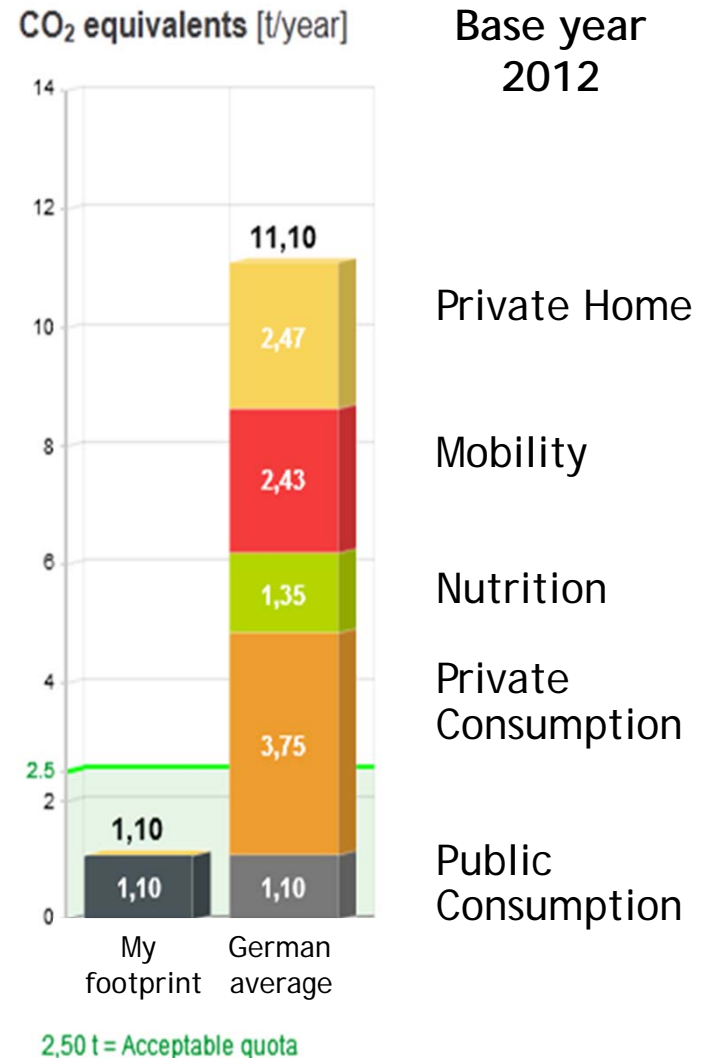
Welcome page of calculator*

klimAktiv

CO_2 Rechner

Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit

Home

Welcome to the CO_2 calculator by KlimAktiv.de

Calculate your annual CO_2 emissions and find out how these can be reduced by simple measures.

Simply follow the steps of the CO_2 calculator. You will be guided through the areas **Persons**, **At home**, **Travelling**, **Food** and **Life style**. Try to estimate your consumption and habits as precisely as possible.

The bar diagram next to the entry mask accompanies you as you make your entries and shows your personal emissions in comparison with the German national average. Find out what areas you are already making a contribution towards climate protection and where potential is still hidden. **Notes** on improving your personal CO_2 balance will be provided after you have entered all data.

For **help and information** on individual areas, select the designated links in the entry mask.

Start calculation

CO_2 equivalents [t/year]

My footprint

German average

2,50 t = Acceptable quota

Balancing your own CO_2e emissions

- Calculation of single person or household

- Comparison with German average and acceptable quota

- Balancing even for single fields of needs

- Public consumption is fixed on the short run

- Yearly updating and recording possible

- Offline version for scientific project available
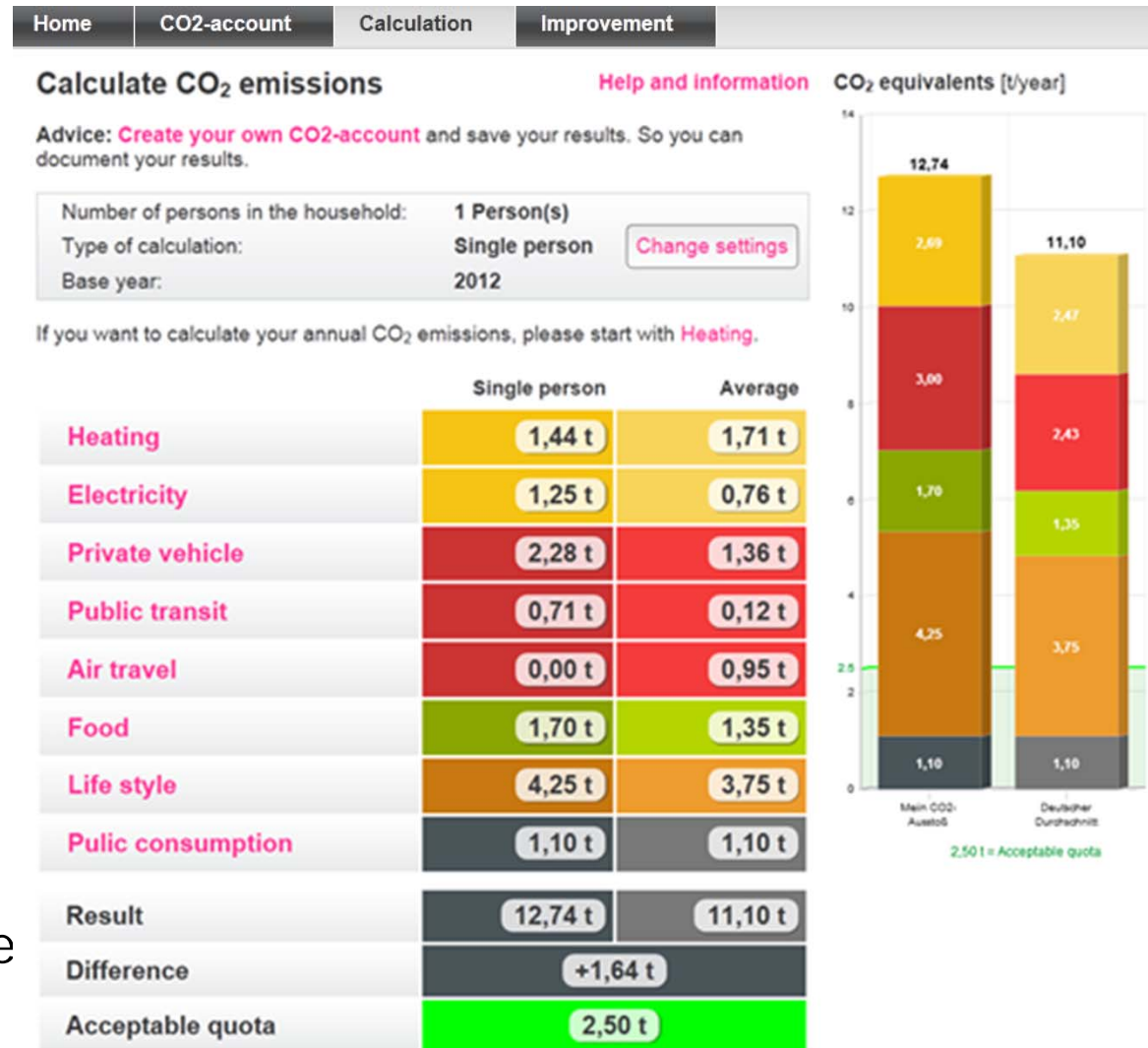
Total balance of German GHG emissions
(CO_{2e} = CO_2, CH_4 and N_2O)

directly in Germany   plus imports   minus exports   = German consumption

[million tons CO_{2e}]

indirekt

380,1

1 382,8 Mill. Tonnen insges.

import

export

407,7

direkt

211,3   private households

791,4   production

975,1

Inländische Verwendung

Anlage-investitionen

128,0

Konsum des Staates   87,4

Konsum privater Organisationen   6,8

Konsum der privaten Haushalte   766,3

Vorratsverän-derungen   -13,3

Average German footprint from 2005 to 2010*

Year	2005	2006	2007	2008	2009	2010
Field of needs	[t CO_2e/p*a]	[t CO_2e/p*a]	[t CO_2e/p*a]	[t CO_2e/p*a]	[t CO_2e/p*a]	[t CO_2e/p*a]
At home	**2,72**	**2,75**	**2,48**	**2,65**	**2,63**	**2,48**
Heating	0,75	0,75	0,81	0,77	0,77	0,76
Electricity	1,96	2,00	1,67	1,88	1,87	1,72
Mobility	**2,44**	**2,42**	**2,42**	**2,43**	**2,41**	**2,40**
Private vehicle	1,48	1,43	1,41	1,44	1,41	1,39
Public transport	0,14	0,13	0,13	0,13	0,13	0,13
Air travel	0,82	0,85	0,88	0,85	0,87	0,87
Food	**1,52**	**1,28**	**1,48**	**1,43**	**1,41**	**1,46**
Life stile	**3,07**	**2,94**	**3,43**	**3,15**	**3,33**	**3,61**
Public consumption	**1,11**	**1,03**	**1,10**	**1,08**	**1,07**	**1,09**
TOTAL	**10,86**	**10,42**	**10,91**	**10,73**	**10,86**	**11,04**

* Using 3 years average of CO_{2e} emission for electricity and DH since 2010

German emission factor (electricity & district heating)

problem	Different fuel mix per year (e.g. lots of coal for power plants) will influence results of the personal calculation
solution	Since 2010 we take a 3 years average for the German emission factor of electricity and district heating (DH allocated by exergy factor)
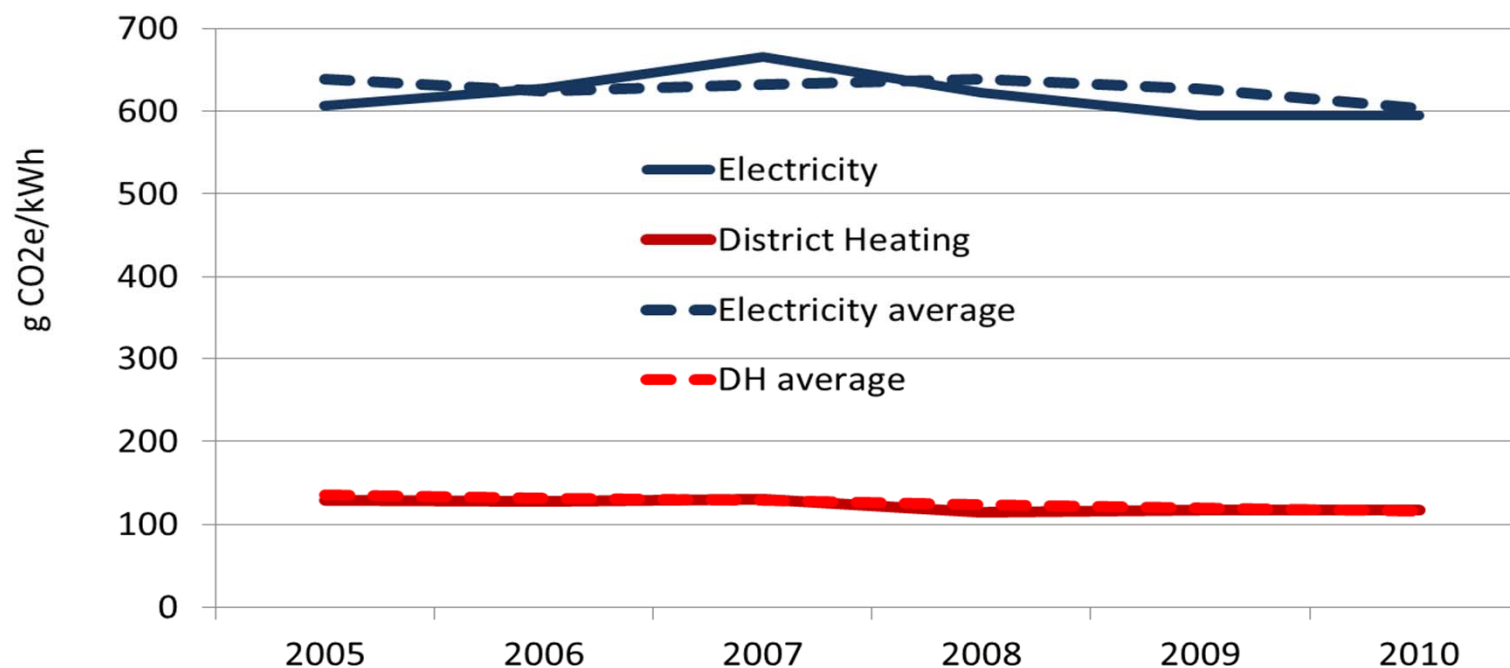
Green electricity

problem	Personal calculator wants to motivate citizens for changing from normal to green electricity. But: then there is no incentive for saving energy
solution	Low emission factor for green electricity. Additionally energy saving will be indicated at the end of the calculation

If utilities want to show their own emission factor it is for information only and will not be calculated within the tool.

FYI: If you want to balance CO_2 emissions of whole cities in Germany you should not include green electricity (for information only).

See: Environmental impact of green electricity
"Umweltnutzen von Ökostrom" - Diskussionspapier von IFEU et al.

http://www.ifeu.de/energie/pdf/DiskussionspapierOekostrom_%20ifeuOeko%20WI%20Oe2%20final1.pdf

At home

Emission factors (extract)
[g CO_2e/kWh]:

Electricity ($\varnothing$ DE) = 595

Natural gas = 240

Light fuel oil = 302

Wood pellets = 45
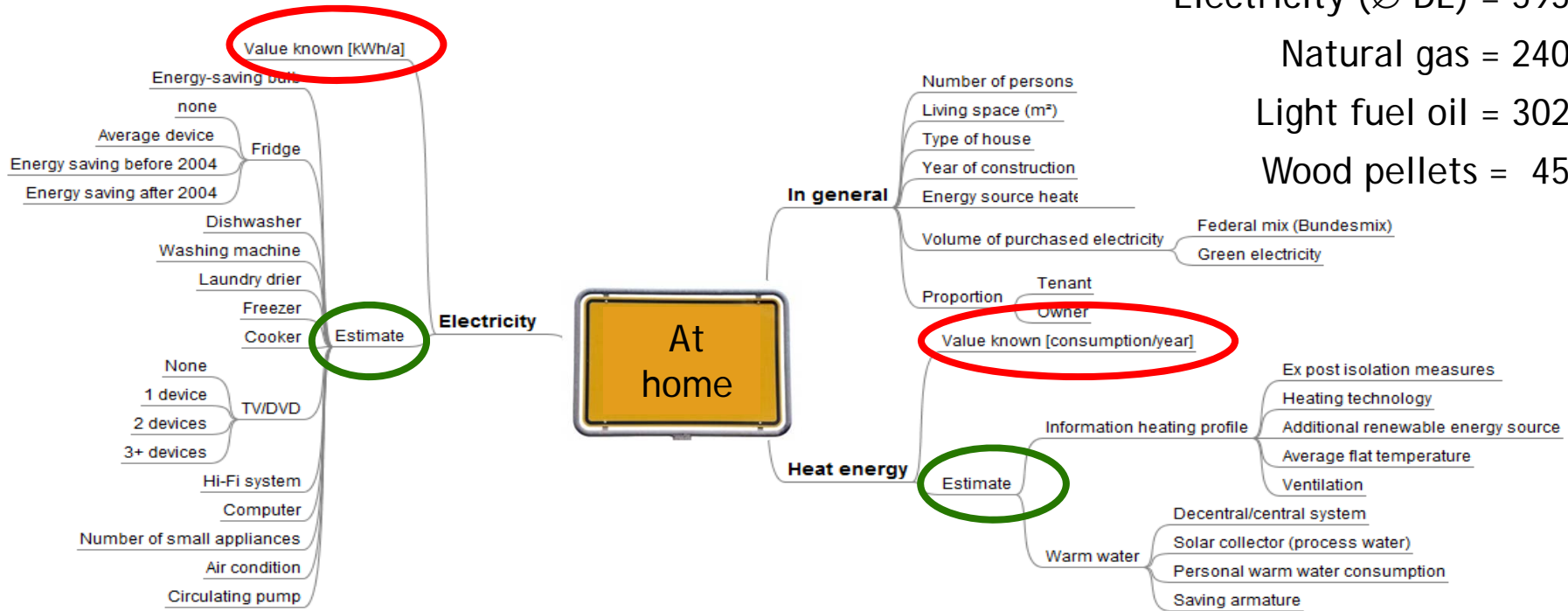
- Exact declaration or estimation of electricity and heating demand possible

- German average at home*: 2,41 tons CO_2e; 1.230 kWh electricity; 560 Liter oil equivalent

Mobility

Emission factors (extract):

Petrol = 2,72 kg CO_2e/Liter

Diesel = 2,89 kg CO_2e/Liter

Public transport = 0,07 kg CO_2e/Pkm

Long distance plane = 0,27 kg CO_2e/Pkm
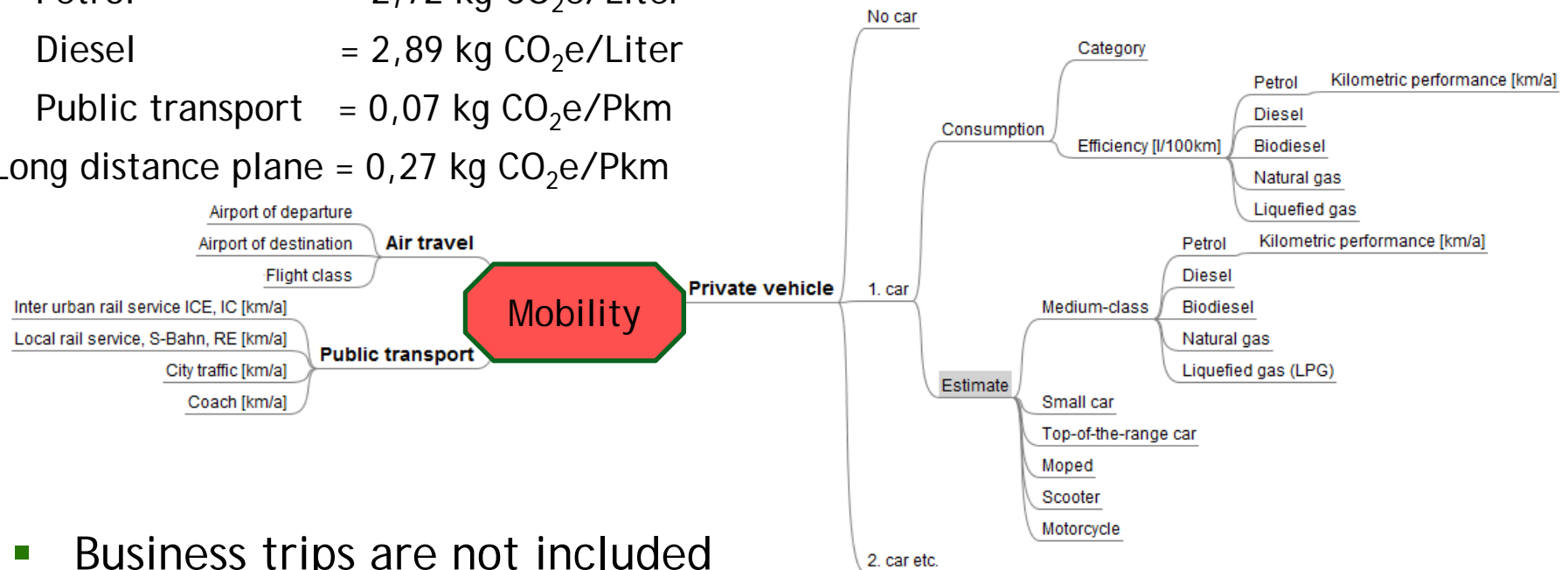
- Business trips are not included
- Database: TREMOD (www.ifeu.de/tremod)
- German average* Mobility: 2,38 Tonnen CO_2e
  5.900 km middle class passenger car; 1.900 km public transport and 2.800 km long distance plane

Nutrition
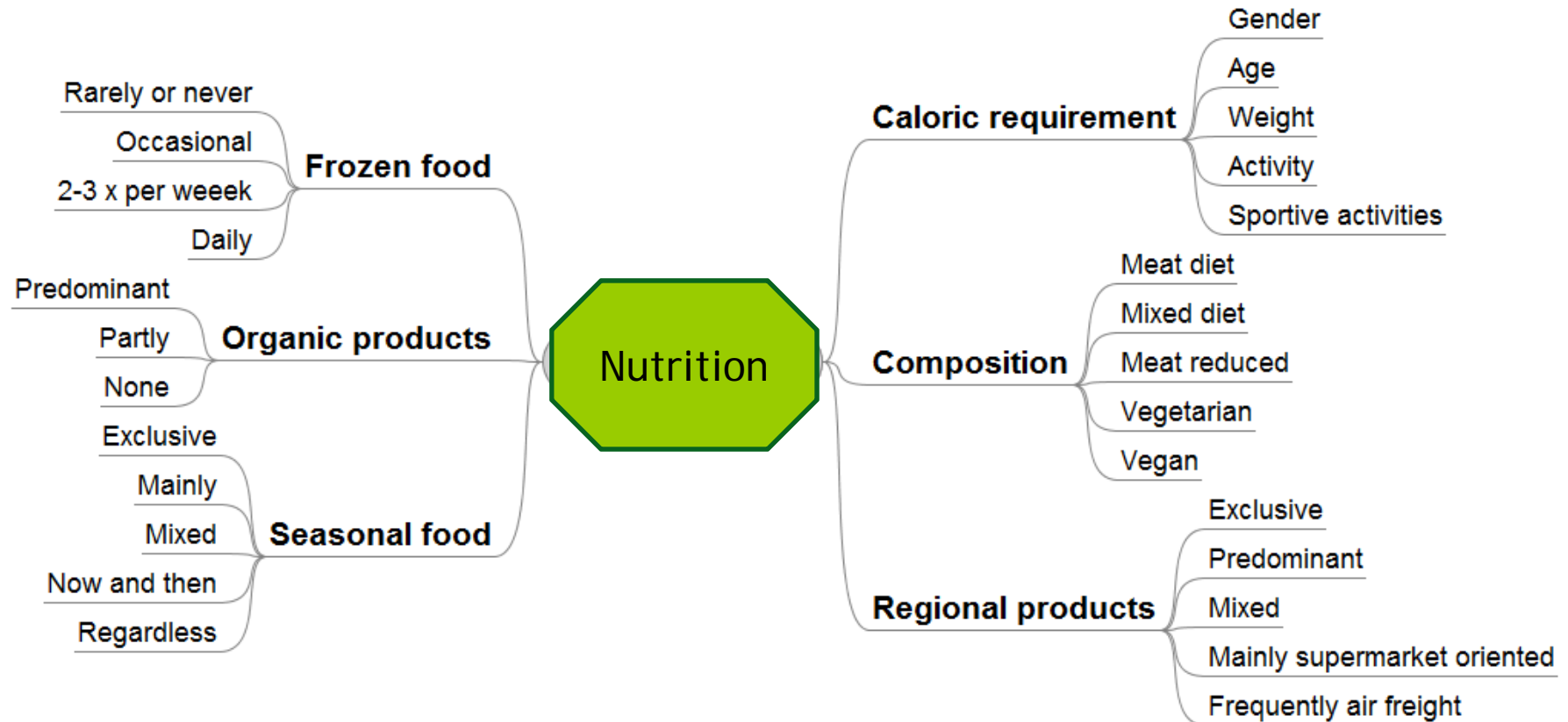
- German average Nutrition: 1,35 tons CO_2e
  2.600 kcal per day and mixed food (160 g meat per Tag)

Consumption
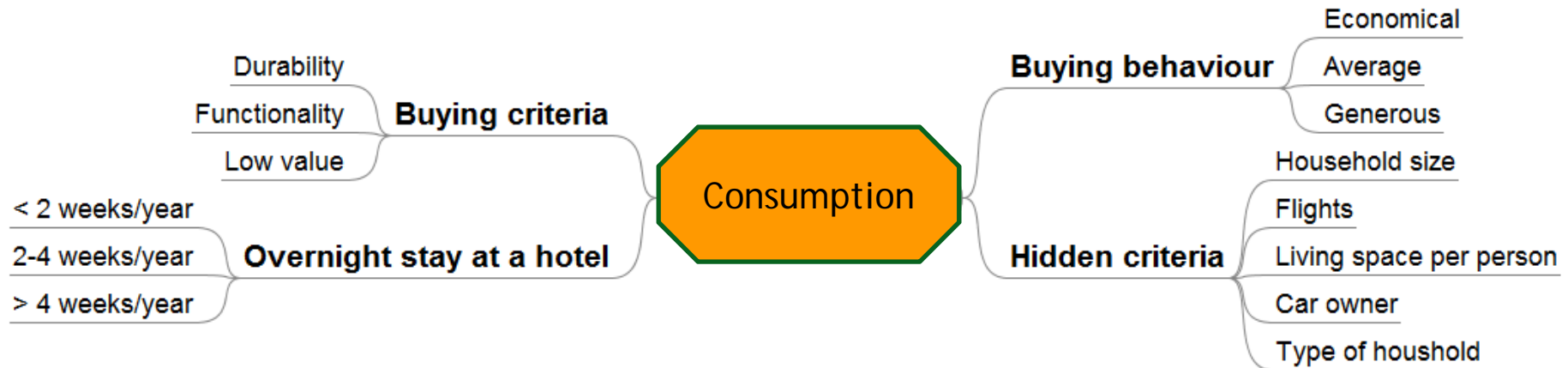
- Database is unsatisfactory

- Ambition is to indicate the big importance of personal consumption

- Within the tool not only open indicators but even some hidden ones will influence calculation of private consumption

- Hidden indicators e.g.: livin space per capita, no. of flights, size of first car, type of home

- German average of private consumption: 3,73 tons CO_2e

Range of carbon footprint

Improvement (example)

1. Person:	male, 30-59 years, 75 kg, activities of little movement, little sports **1,45 t**
Total	1,45 t · 1,45 t · 1,35 t

Possibilities of improving

- Other results by scroll bars =>

- Recommended measures e.g. green electricity (Freiburger CO_2-Diät)

1. Person

Type of eating habits: mixed diet

vegetarian

Meat and milk products have a considerable influence on one's personal balance. Growing animal feed and raising animals have become major sources of food-sector emissions. When purchasing meat products, keep an eye out for ecological production as these offer particularly large reduction potential.
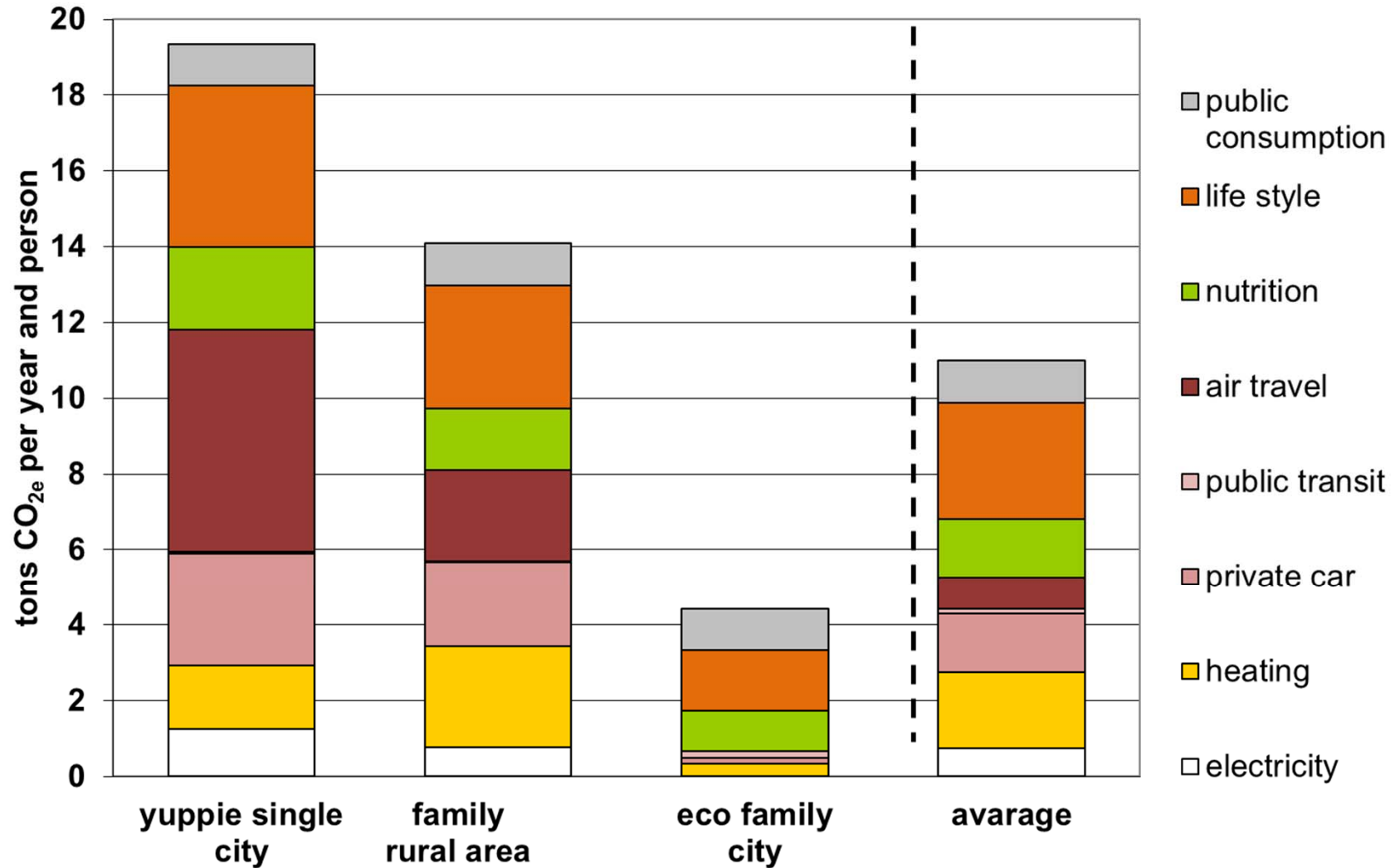
Regional products: mixed (reg./supermarket.)

mixed (reg./supermarket.)

Every kilogram of fruit or vegetables imported to Germany by plane causes about 10 kg of CO2. The season is the prime determinant for when products are brought by plane. You should thus avoid fresh fruit and vegetables such as strawberries or asparagus in winter and use seasonal produce instead. When in doubt, ask your greengrocer.

Seasonal products: mixed

mixed

A seasonally adjusted approach to food lessens emissions because the high amount of energy required for heating greenhouses also affects the balance negatively. In contrast, free range products cause 10 times less emissions on average. By buying seasonal and regional products you also prevent unnecessary transportation.

Results / conclusion (PCF calculator)

- Rather good feedback (more than 1 million clicks)
- Calulator can be used by every institution (adaption possible)
- Most other calculators are based on UBA-Calculator
- Nice to have for environmental touched people
- Good for scientific evaluation of human behaviour e.g. www.ifeu.de/emigma
- Facilitates public communication about climate change
- Standardisation of calculation procedure without ministerial directive possible

Scenario Tool for Citizens „Just for fun"

- **Intention:** Citizens built up their own energy future

- **Visualisation:** Huge display of an energy landscape

- **Input:** 10 Switches (2 general ones and 2 for each of the 4 consumption areas)

- **Characteristics:** Focus on long-run decisions and a combination of citizens <u>and</u> politicians perspective.

- **Field of application possible:** Energy fair or exibition, focus groups, schools, education …

- **Location:** At the moment there is only one installation free für bublic viewing (TECHNOSEUM, Mannheim, Germany)

History of Scenario Tool for Citizens

- Developed by IFEU Heidelberg (scientific background)
  and prototypen Berlin

- First installation of Szenario Tool for Citizens within the exibition

ENERGIE = ARBEIT

Max-Liebermann-Haus, Berlin, Stiftung Brandenburger Tor,
September 2010 to February 2011
sponsored by Bundesministerium für Bildung und Forschung

- In addition: Some touring exibitions

- At the moment part of permanent exibition
  at TECHNOSEUM Mannheim, Elementa 3

The truth about German „6000 Watt"

- Berlin (prototypen) asked us to develop an energy label and a scenario tool for an exibition based on the 6000 Watt concept of Switzerland

- **Based on our study „Die CO$_2$-Bilanz de Bürgers"**
  we calculated like this (database 2003):
PE in Germany	> 4.000 PJ
import (energy and goods)	+ 17.300 PJ
export (energy and goods)	- 8.200 PJ
Result (5.070 Watt/person)	**13.100 PJ**

- **Based on ARGE Energiebilanzen:**
PE in Germany	> 4.100 PJ
import (energy)	+ 17.700 PJ
export (energy)	- 2.300 PJ
Result (5.600 Watt/person)	**14.500 PJ**
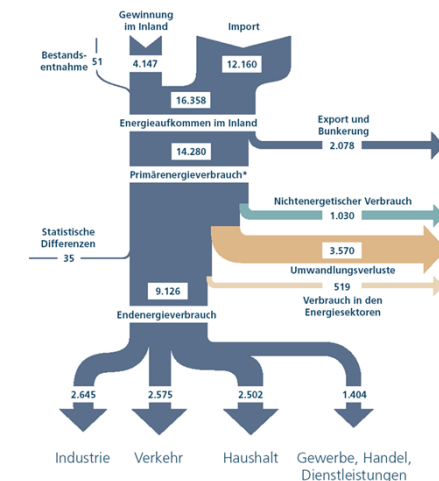
... but than it happened:

- Mario Schmidt 2009 (University of Pforzheim):
  Within embodied emissions of imported goods German footprint may rise to 15 tons CO_{2e} per capita.

- Edgar Hertwich and Glenp Peters (Trondheim / Oslo):
  "The footprint is strongly correlated with per capita consumption expenditure ($/capita)".
  Per capita GHG footprint of Germany 2001 is 15,1 tCO_{2e}/p.

- Jan C. Minx, TU Berlin 2011: Consumption of industrial nations cause increasing of (GHG)emissions in developing countries which ist five time as high as all the savings of industrial nations until 2008.

- **So we decided to take some more Watts and we put the score to 6000 Watt per capita (only for the citizens scenario calculator)**

The status quo at IFEU

IFEU / UBA 2012:
Indicators for the use of
raw materials in the context of
sustainable development in Germany
Download:
www.uba.de/uba-info-medien/4237.html

Based on our recent study we calculated
the comulative energy demand
as follows (base year 2005):
PE in Germany   > 3.663 PJ
import (energy and goods)   + 24.736 PJ
export (energy and goods)   - 14.399 PJ
Result (5.400 Watt/person)   **14.000 PJ**

| TEXTE | 01/2012

Indikatoren / Kennzahlen für
den Rohstoffverbrauch im
Rahmen der Nachhaltigkeits-
diskussion

Umwelt
Bundes
Amt
Für Mensch und Umwelt

Overview: German input-output calculation

Primary energy / cumulative energy demand (KEA) in Germany
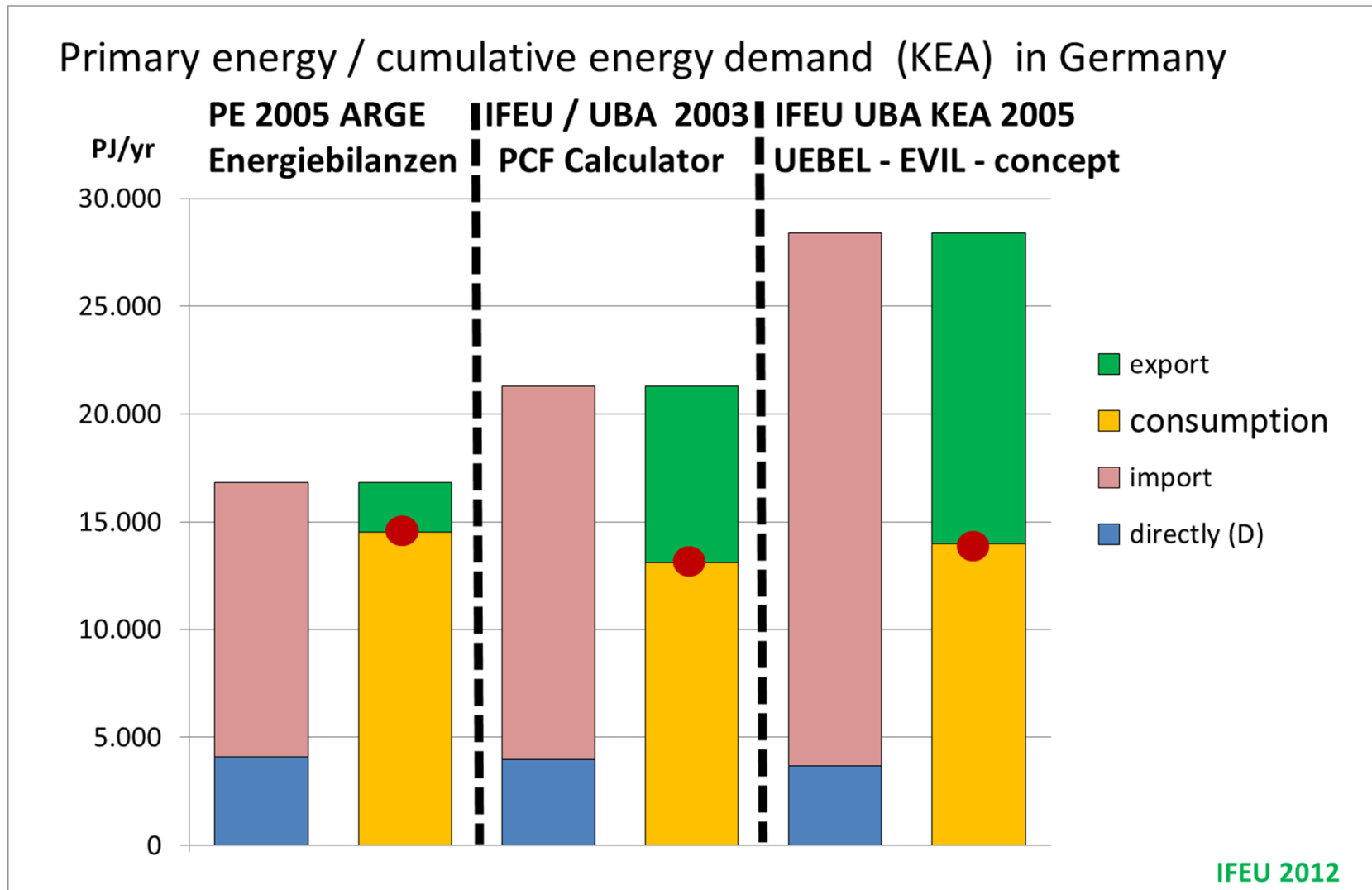
Scenario Tool for Citizens: Influence on Primary Energy and Renewables

Influence on =>	Private Home	Mobility	Nutrition	Private Consumption	Public Consumption	Renewables
Switch Primary Energy						
1 Value of energy	●	●	●	●	●	●
2 Renewables	●	·	·	·	·	●
3 Insulation standard	●				●	●
4 Saving electricity	●				●	·
5 Urban planning	●	●			●	·
6 Mobility		●			·	
7 Nutrition			●			
8 Meat consumption			●			
9 Production				●	●	
10 Consumption				●	●	
Scenario Tool TECHNOSEUM, Mannheim IFEU 2010						

●	very high
●	high
·	low
·	very low

Energy world today: 6000 Watt community

Switch No 1. energy price
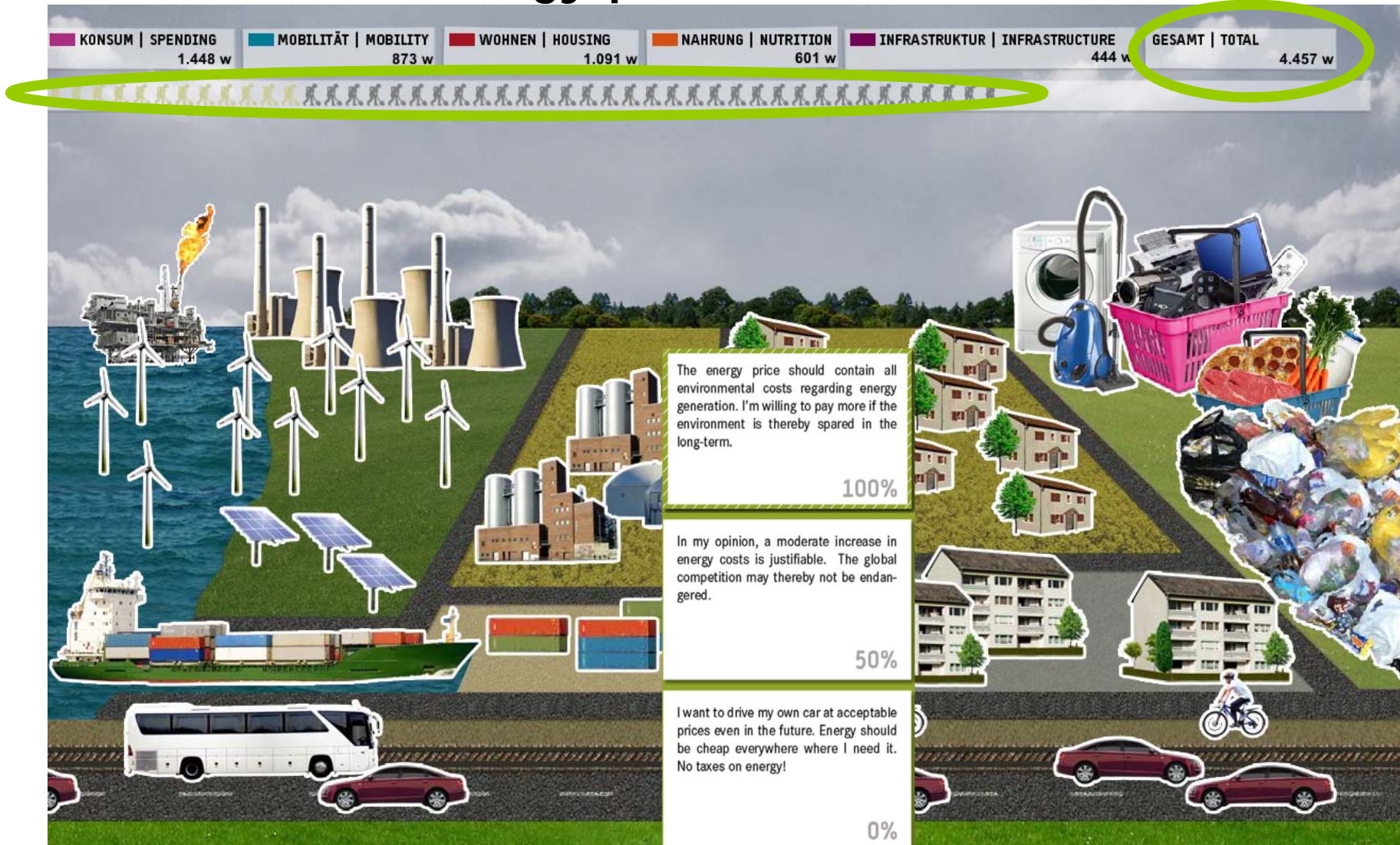
Switch No 2. renewables

Housing and energy consumption

Mobility

KONSUM | SPENDING	MOBILITÄT | MOBILITY	WOHNEN | HOUSING	NAHRUNG | NUTRITION	INFRASTRUKTUR | INFRASTRUCTURE	GESAMT | TOTAL
1.303	452 w	442 w	540 w	273 w	3.010 w

Urban Planning

In the future, most citizens should live in a city of short distances. This will enable them to change from bicycle, to public transport, or to a rental car without a problem.
100%

In the future, the public transport system should be expanded and more people lured back to the city. The people should use bicycle, bus, and train to cover most distances.
50%

Each citizen should be able to have a single-family house in the suburbs. Commuting to the city doesn't bother me.
0%

Mobility

In the future I won't need a car of my own. If I have to be flexibly mobile, a rental car or a shared car will be sufficient. I can do without overseas travel.
100%

I don't need my own car in the city. Car-sharing and public transport are good alternatives. But occasionally I do want to fly away on vacation.
50%

I want to have my own car parked in front of the door in the future too, so that I have no trouble getting to where I want to go. I need a vacation abroad every year to recharge my batteries.
0%

Nutrition

…and production/consumption > nearly 2000 Watt

Thank you for listening

Hans Hertle
ifeu - Institut für Energie- und
Umweltforschung Heidelberg GmbH
Wilckensstraße 3
69120 Heidelberg

Fon: +49 (0) 6221 / 47 67 – 0
Fax: +49 (0) 6221 / 47 67 -19
E-Mail: hans.hertle@ifeu.de