Wuppertal Institute
for Climate, Environment
and Energy

User-integrated development of sustainable product and service innovations – The Sustainable LivingLabs

Reducing energy demand through behavioural change?

LCS-RNet 6th Annual Meeting, Rome

October 1-2, 201

Julia Nordmann

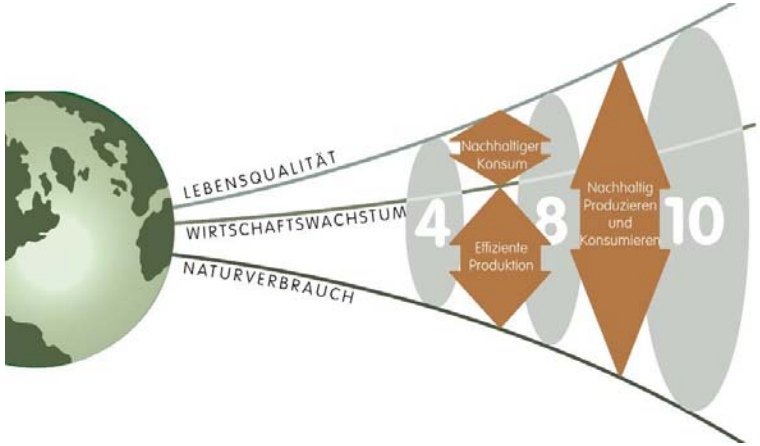
Research fellow, Wuppertal Institute for Climate, Environment and Energy
/ research group „Sustainable Production and Consumption“

Agenda

- Introduction
- Short project overview
- Results
- Conclusions

Introduction: Challenge

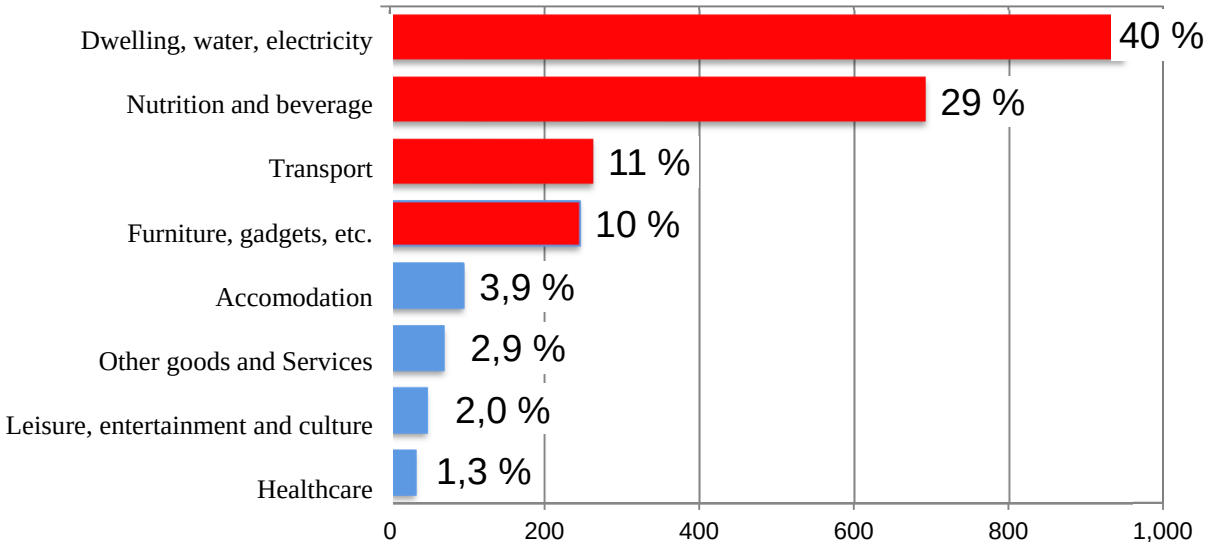
Necessary energy and resource transition



- Resource extraction:
  expected to double from 2000 until 2030

- Reducing resource consumption by a factor of 5 per capita (households in industrialised countries)

Resource usage by private households (TMR in Mio. t. and %, DE, 2005)



source: WI, FG3, 2011: Acosta/Schütz

Introduction: Focus on user's needs and user integration

Potential for social innovation

- Showering: technical improvements; amount of water used increased by 30% due to increased frequency and length of time

- Heating systems: Approx. 80% of all German heating systems are set up in an inefficient way; combined with optimising user behaviour, savings of 20-30% of heating energy are possible (Messerschmidt 2012)

- Loss of food: Global losses account for 20-75%, depending on the type of food (total volume: up to 1.2 billion tonnes); losses per capita in EU: approx. 180 kg per year (European Commission 2010).

Introduction: Why do we need Sustainable LivingLabs?

Need for a user-centred approach

Sustainable innovations often fail at the market

- technology push
- lack of user understanding

> rebound effects

> mismatch between societal & individual benefits

A **user-centred and value chain-oriented approach** is needed to better predict commercial value and sustainability impact

Short overview of the project

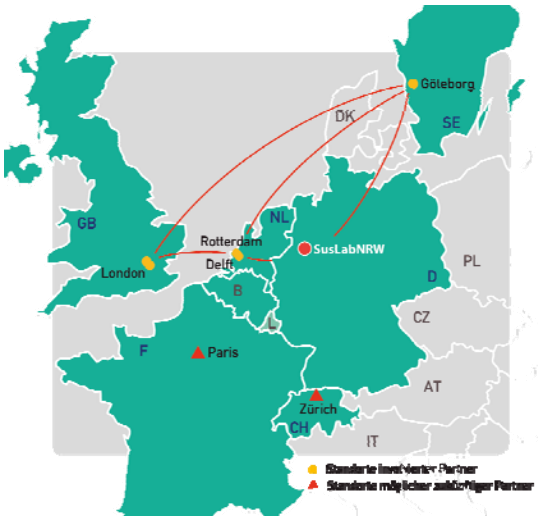
SusLabNWE

Facts

- Duration: 01/2012 – 04/2015
- Volume: 5.12 Mio. €
- Client: INTERREG IVB (49% financing), co-financed by NRW
- Involved partners: TU Delft (Lead)(NL), Imperial College London (UK), Chalmers University of Technology (SE), Wuppertal Institute, Hochschule Ruhr West, Innovation City Ruhr
- Companies: Vaillant, Telekom, WILO, Vivawest and others

Abstract

- Project aim is the implementation and piloting of a European science infrastructure for a user-integrated development of sustainable product-service-systems – focusing on sustainable building / habitation.
- Installation of an infrastructure to study products and technologies at four locations: Rotterdam (NL), Ruhrgebiet (D), London (UK), Gothenburg (SE)



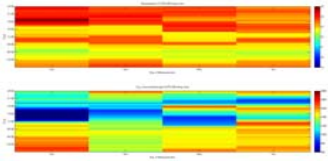
Impact

- Establishment of a knowledge network for sustainability-oriented LivingLabs including a new test infrastructure for companies, research institutes and decision makers
- Publication of the results (e.g. strategy, methodology, pilot testing) and presentations at conferences
- Collective pilot applications in the field heating / space heating in order to optimize the system

Project SusLab NWE

User observation: analysis of heating energy consumption

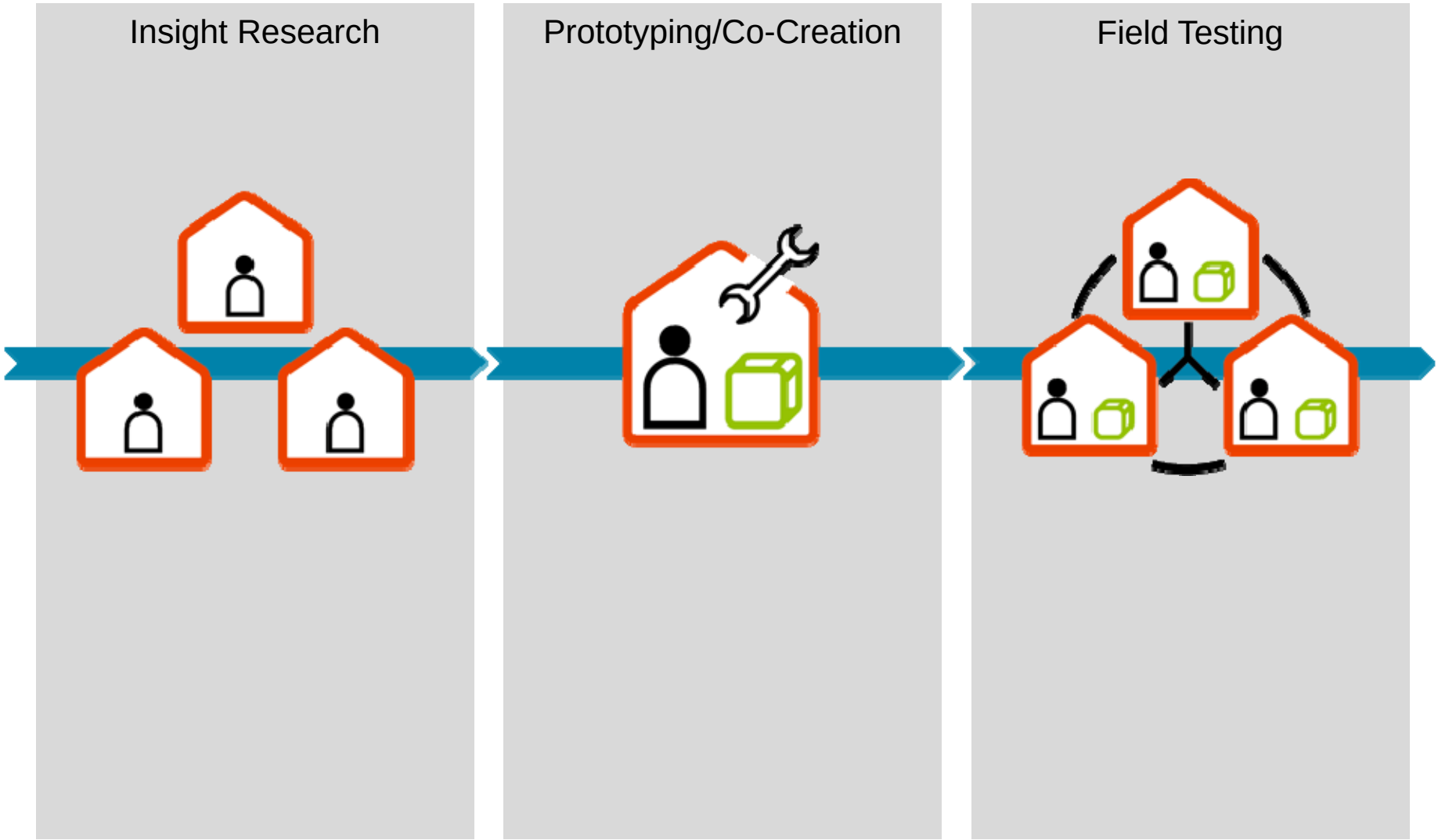
- How much heating energy do we need in households – when and where?
- What impact does our user behaviour have? What impact do we have on the heating energy in households?
- What measures can contribute to the reduction of heating energy - high and/or low-investive?
- What can be designed?



Source: Wuppertal Institute 2013, HRW 2013

Project SusLab NWE

User- and stakeholder-integrated development



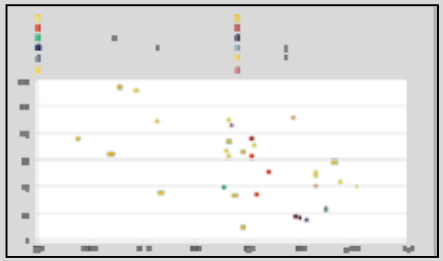
Project SusLab NWE

SusLab Bottrop: Socio-technical innovations

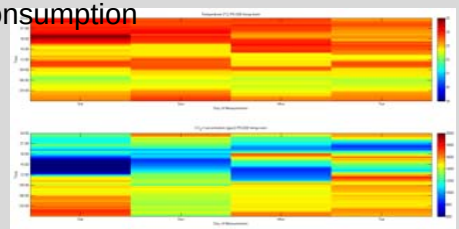
User insight research

80 households/ 700 reference values

Analysis of heating behaviours



Variance in heating energy consumption



Heat map

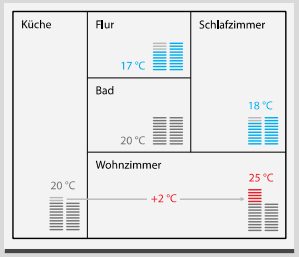
Prototyping/co-creation

Companies

Vaillant, ERFURT, Deutsche Telekom, ELEKTRO GERHARDT, VIVAWEST, wilo

70-80 households

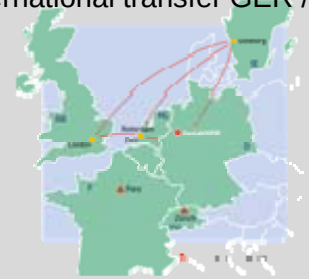
Transformational product



Field testing

> 50 - 500 households

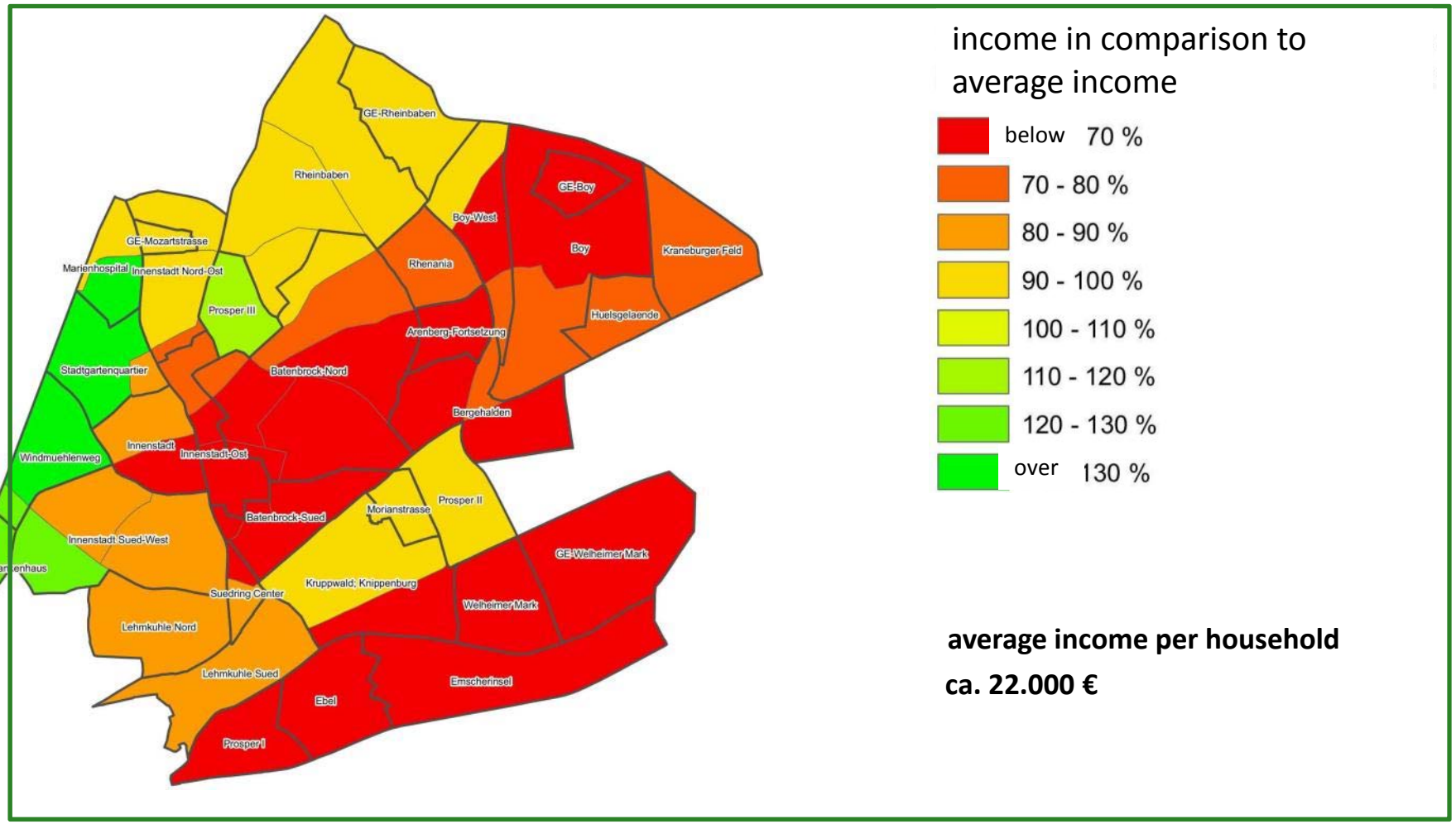
International transfer GER / EU



Pilot region Innovation City

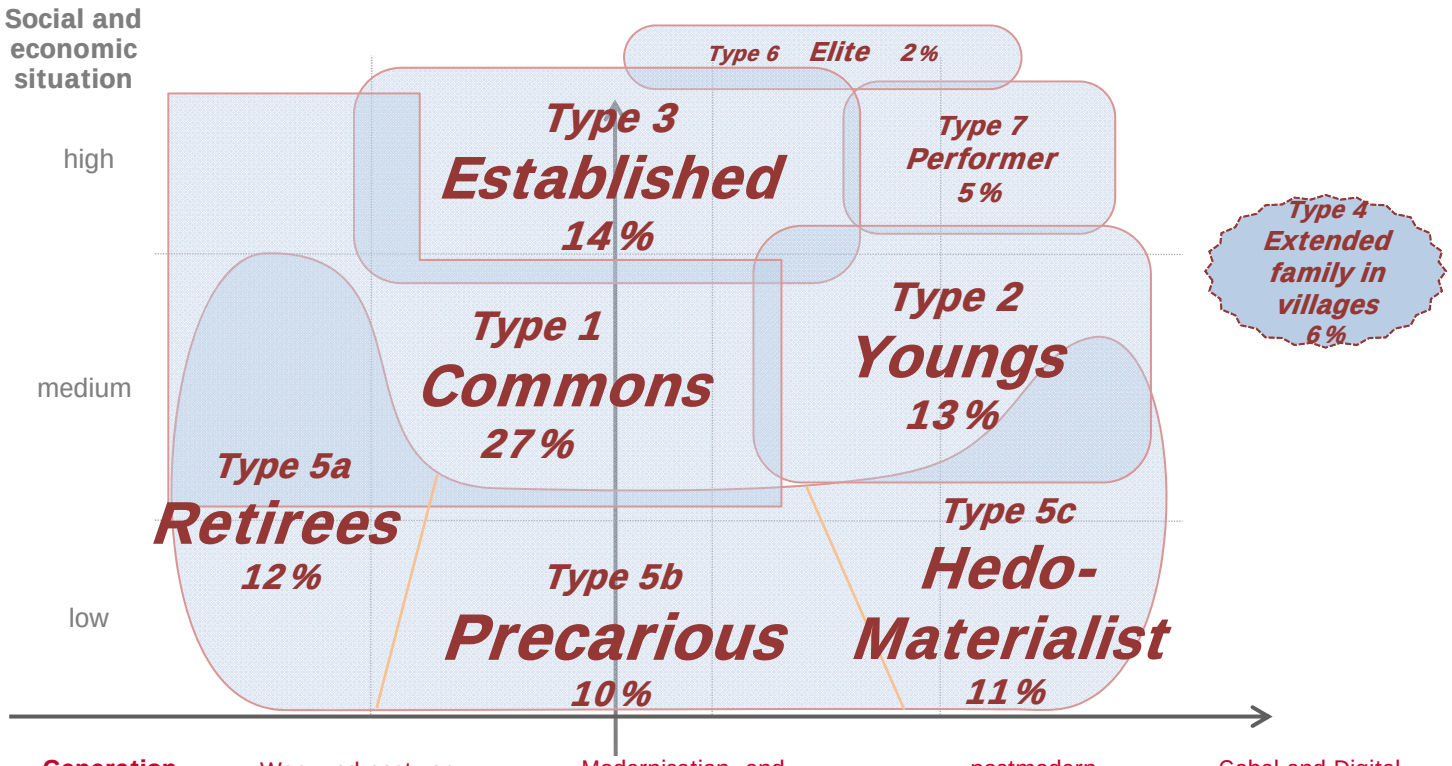
Project SusLabNRW

Pilot area Innovation City: social analysis – income rate



Project SusLabNRW

Mapping a typology of households: user observation networks



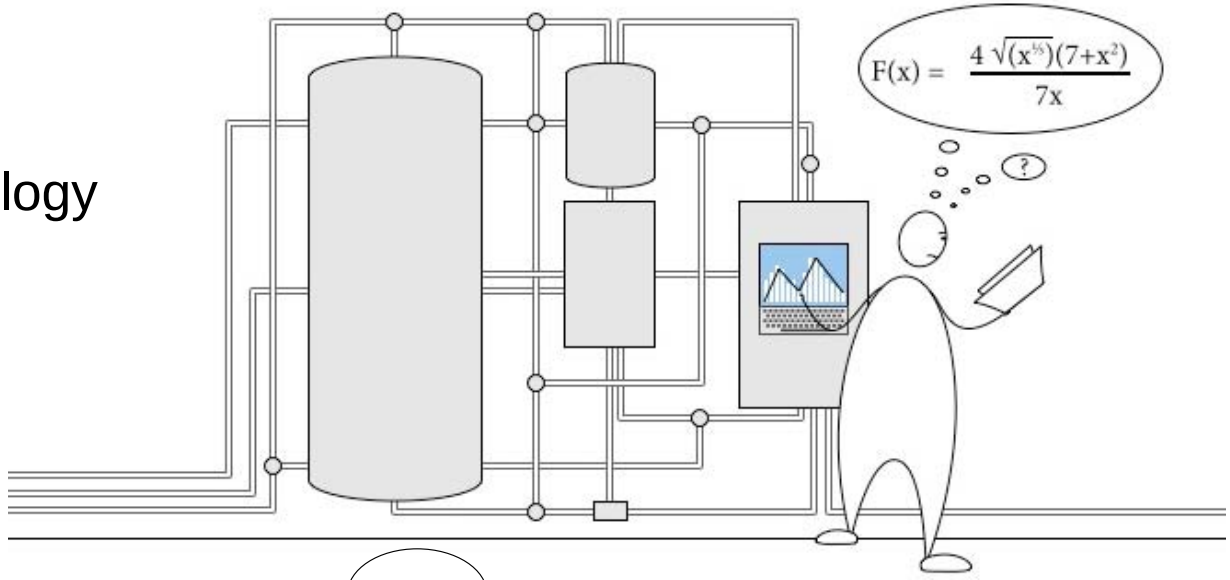
Generation location:	„War- und postwar generation“	„Modernisation- and value change generation“	„postmodern generation“	„Gobal and Digital Generation“
Age focus:	75+ years	45 – 75 years	25 – 45 years	- 25 years
Life situation:	Seniors-Households, 1 - 2 Persons	Empty Nester und Families with older children	Young families with younger children	Young couples and Singles

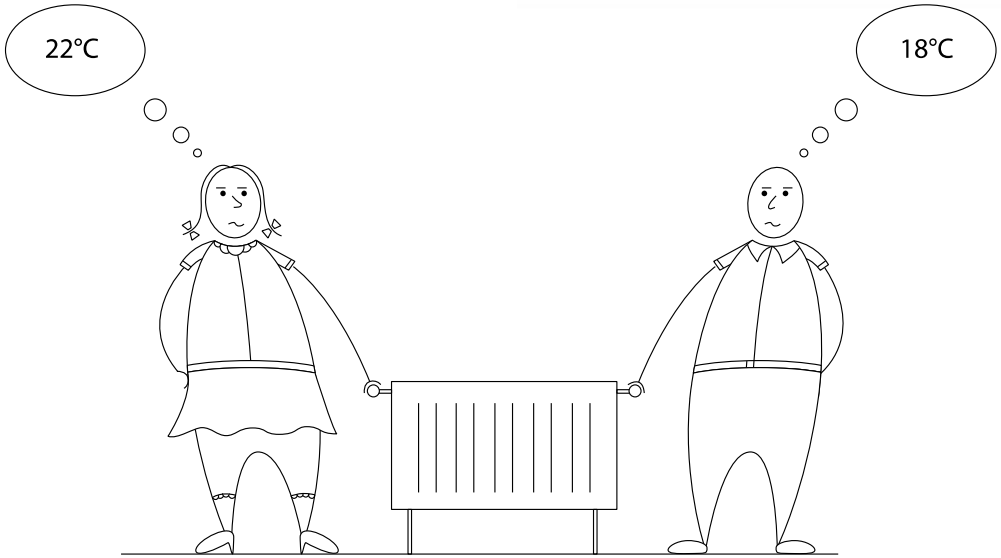
source: Wuppertal Institute 2013 / Sociodomensions

Results

What we have found in households ...

The miracle of technology



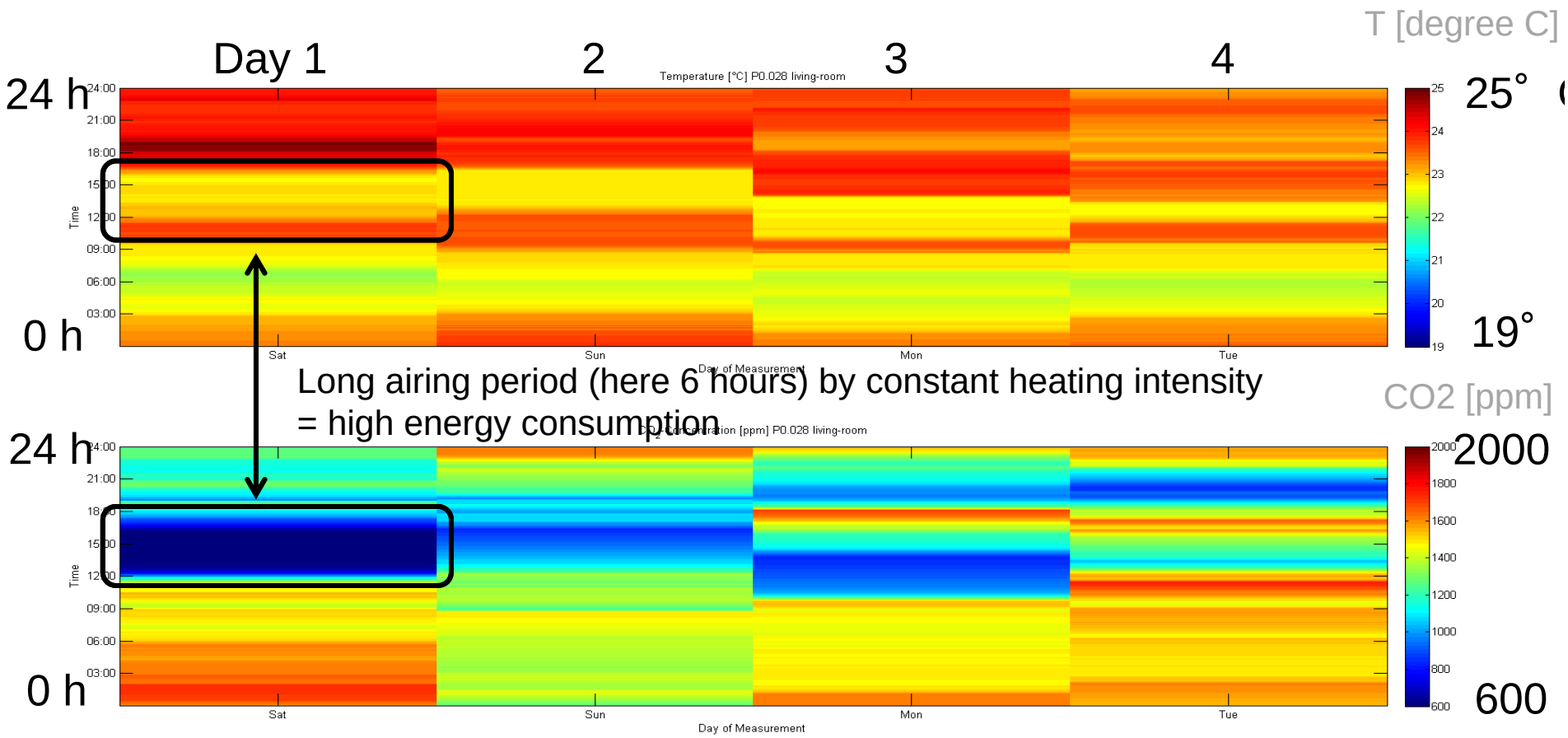


The aim of 4° C?

Results: user observation – heating and airing behaviour in a household

test person with above-average consumption

Source: HRW und Wuppertal Institute /RG4 2013



source: HRW 2014

Conclusions

Assumptions proven correct

- Support for hypothesis: often larger impact of user behaviour on heating energy consumption compared to high investment measures
- Predicted savings of such measures can partly not be achieved in practice

Apparent reasons:

- Heating system:
  - night setback often not working correctly (ca. 1/3 of participants),
  - Often wrong set-ups: i.e. heating pump set too high / heating characteristics set up wrong.
- User influence:
  - shorter periods of airing generally lead to lower energy consumption
  - automatically timed temperature adjustments for every single room: in tendency lower heating energy consumption

Conclusions

Possible savings from user behaviour

	natural gas heating	Oil-fired heating
prices 2013	6.52 cent/kWh	8.3 cent/kWh
typical dwelling size	70 m^2	70 m^2
average consumption per year	10,220 kWh	10,080 kWh
costs per year	666 EUR/a	837 EUR/a
GHG per year	2575 kg CO_2-äquiv./a	3003 kg CO_2-äquiv./a
savings (15 %)	103 EUR/a 386 kg CO_2-äquiv./a	129 EUR/a 450 kg CO_2-äquiv./a
pay-off period	9,7 a	7,8 a

source: own calculation and Techem

Housing society with 120.000 dwellings:

- Saving of costs between 12 and 16 Mio. EUR per year
- GHG-savings between 46.000 and 54.000 per year
- **In 10 years: up to 160 Mio EUR and 540.000 t CO2eq savings**

Conclusions

Possible savings from user behaviour

- The socio-technical potential for the energy transition is not used by far in the fields of housing, mobility, nutrition, communication/ICT

  → A single social practice – heating – already shows potential for reduction by factors of 2-3 or more as a contribution to the energy transition

- Avoid negative rebound effects → achieving positive rebounds through social interaction

- NRW as a pioneer of the energy transition from the bottom up → networking between actors

Product-Service-Systems must be designed in such a way that technology benefits both people and the environment

Aim: low resource consumption, high quality of life

Outlook

- Findings will now be advanced towards product-service-innovations
- open innovation process, integrating all relevant stakeholders along value chains
- Aim: tackle identified weaknesses in the value chain of heating/space heating:
  - i.e. service offerings to improve communication between manufacturers, handicraftsmen and the user.

Wuppertal Institute
for Climate, Environment
and Energy

Thank you for your attention!

SusLabNWE: Locations in the EU

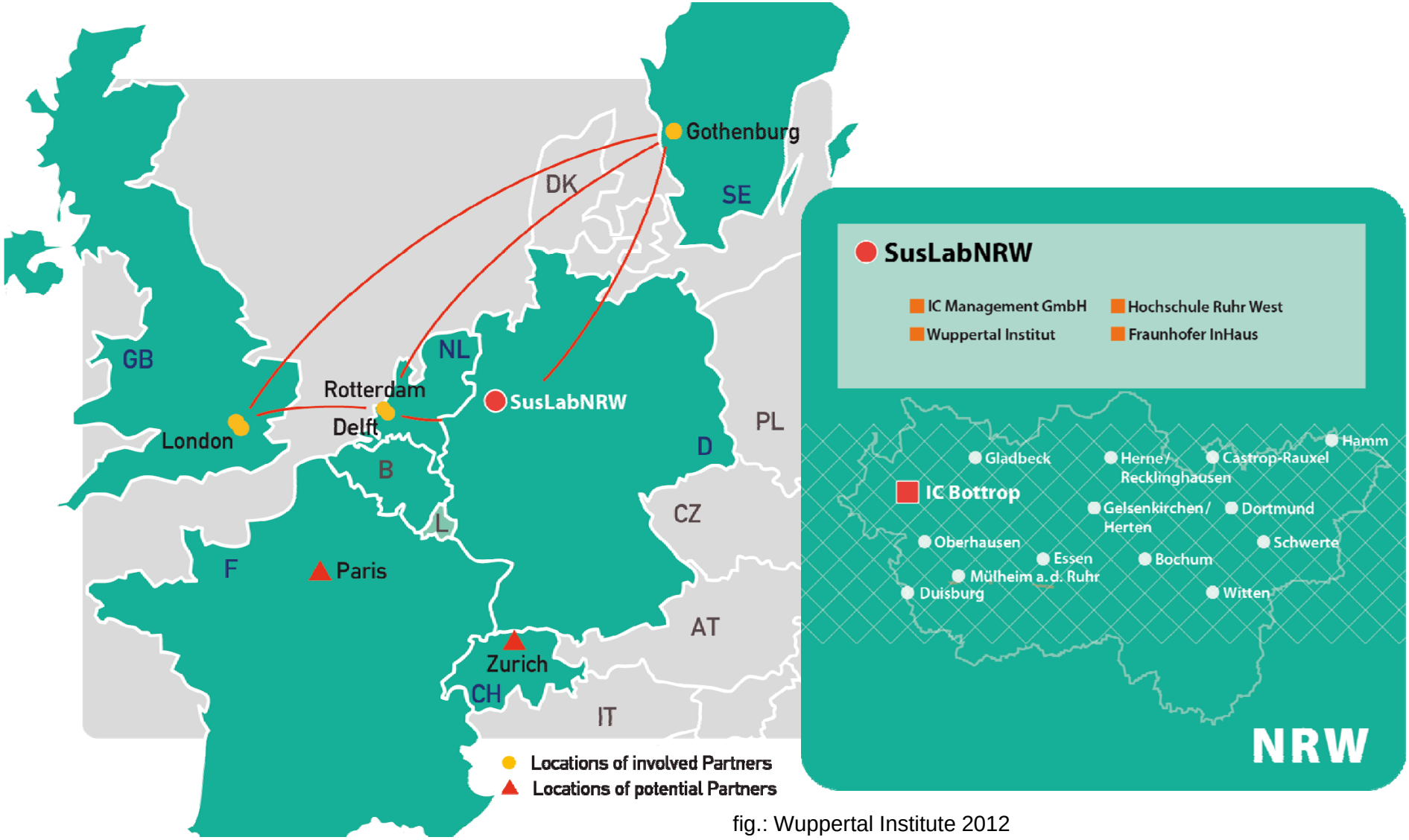


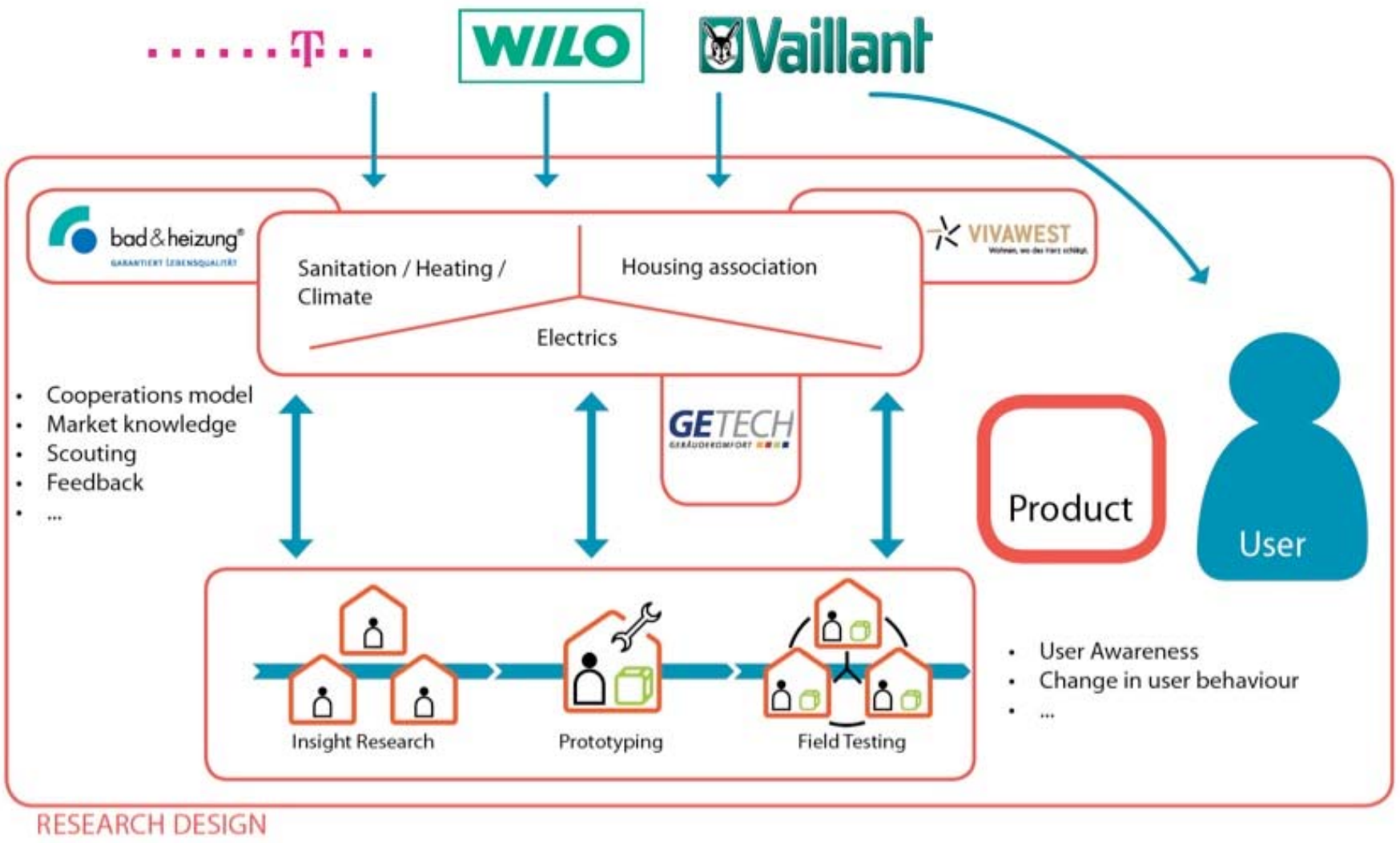
fig.: Wuppertal Institute 2012

SusLabNRW

German focus region and SusLab stakeholders in NRW

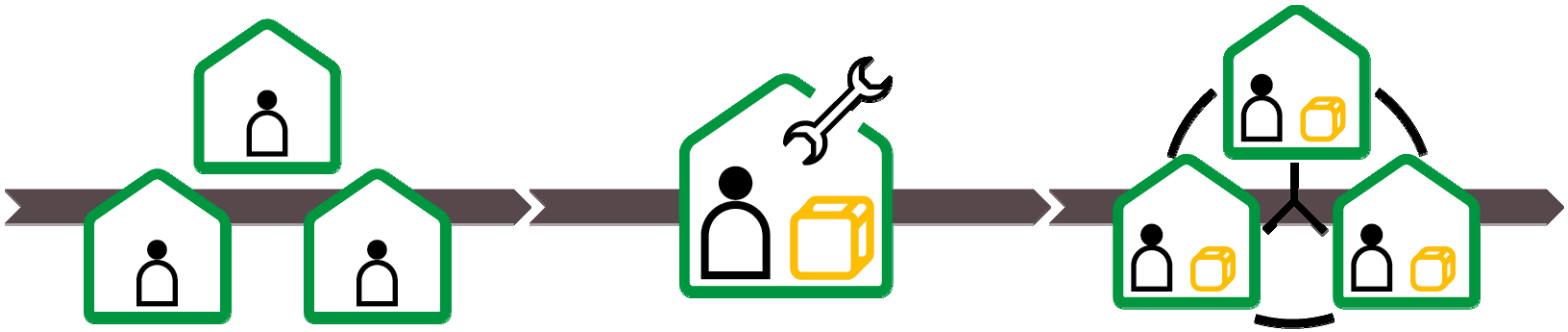
fig.: Wuppertal Institut 2012

Main business partners involved



Methodology

Sustainable LivingLab methodology (Three-Phases-Model of Research)



Research design:	**Insight Research**	**Prototyping**	**Field Testing**
Assignment	Household-analysis of material flows and patterns of actions in their context	Scenario- and prototype development in the LivingLab	Test and evaluation of the prototype in the field
Methods	Diaries, sensoric, observations, workshops, interviews, network and stakeholder analysis	Design-orientated scenarios (DOS), Co-Creation workshops, test runs, mock ups	Stakeholder analysis of diffusion, sensoric, diaries, interviews, workshops

Phase- and interstage-specific validation of energy-, resource-efficiency and sustainability potentials