EUSEW - European Union Sustainable Energy Week

18 - 22 June 2012

Harald Rapp
AGFW | Energy Effency

WÄRME I KÄLTE I KWK

» Welcome to EUSEW

Dipl.-Ing. Dipl.-Wirtsch.-Ing. Harald Rapp

Head of Urban development and KM departement

Maniging Director of AGFW Project GmbH

Expert in several National and international Commitees:

National Expert group for urban development

Project Coordinator for several national and international R&D Projects

University lecturerChairman

German Committee on Eastern European Economic Relations Energy group: Romania and Bulgaria

WÄRME I KÄLTE I KWK

» AGFW - Who we are – Members, international Projects and Knowledge Management

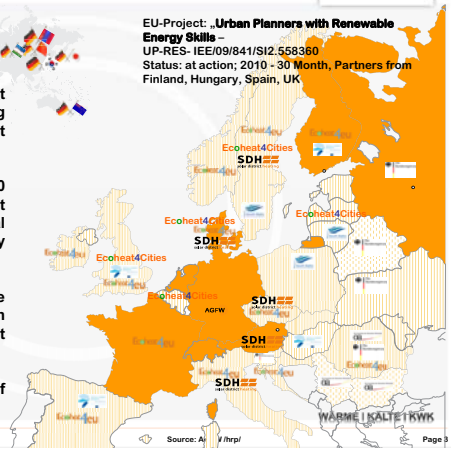
» AGFW is the efficient, independent and impartial association promoting (district) heating, cooling and CHP at national and international levels

» AGFW reunites round about 450 (regional und municipal) district energy suppliers and industrial operators of this industry in Germany and Europe

» AGFW represents over 95% of the heat load connected to German district heating systems – the largest scale in Western Europe

» AGFW means over 40 years of experience in this field

EU-Project: „**Urban Planners with Renewable Energy Skills** –
UP-RES- IEE/09/841/SI2.558360
Status: at action; 2010 - 30 Month, Partners from Finland, Hungary, Spain, UK



WÄRME I KÄLTE I KWK

» AGFW - Who we are

AGFW promotes the development and extension of energy-efficient district heating, cooling and combined heat and power in Germany and internationally.

» Our key strength is skilled work on a technical, economical and juridical level for the complete sector.
» Professional and competent contact for policy makers – developing and formulating extensive recommendations together with representatives of the political field
» Knowledge for safe and cost – effective operations within the sector/setting engineering standards and rules
» Preserving specialist knowledge as well as qualifying the sector´s employees
» Basis for guaranteed quality standards and certain juridical, operational and organizational structures of the companies
» New ideas are developed and research conducted to coordinate national and international tasks in the field of research and development
» The interface between the local urban, energy- and invironmental concepts and the longt term (business) energy concepts of the utillities are part of the urban development departement.
» The sector´s communication centre - providing information of the complete spectrum.

WÄRME I KÄLTE I KWK

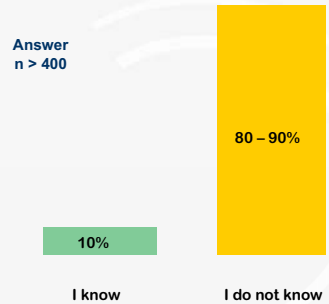
» Introduction to the problem

A simple question to start!

What was your private thermal energy consumption (Heating and / or hot water) in the last heating season?

WÄRME I KÄLTE I KWK

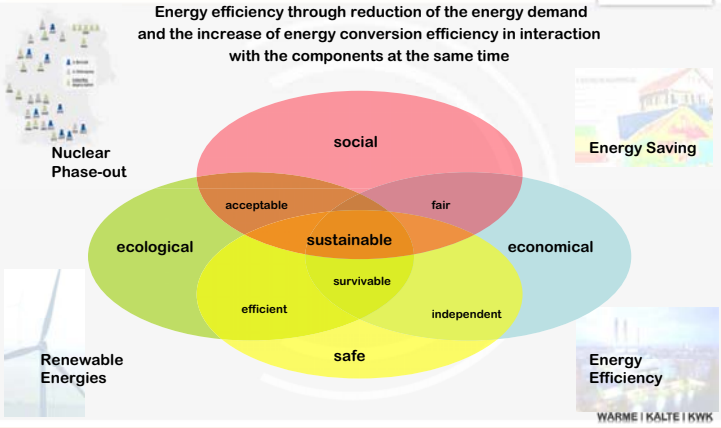
» Introduction to the problem



WÄRME I KÄLTE I KWK

» Principle of Sustainability in the Overall Context – Political Objectives – Pillars of the Energy Turnaround

Energy efficiency through reduction of the energy demand and the increase of energy conversion efficiency in interaction with the components at the same time



WÄRME | KÄLTE | KWK

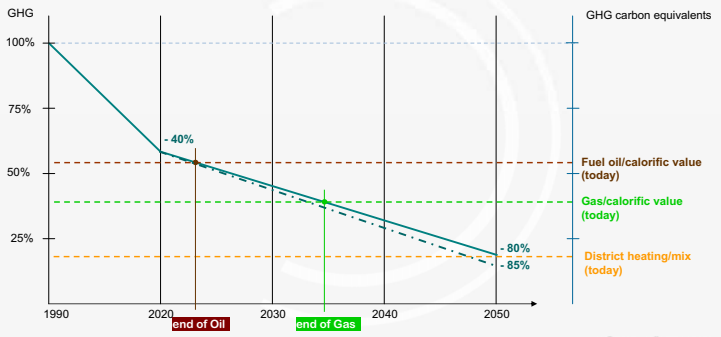
» German Energy Policy - Political Targets of the government

	Climate	Renewables			CHP	Energy efficiency			
	GHG Base 1990	Share Electr.	Share Heat	Share overall FEC	Share Electr.	Primary-energy	Electr.	Energy-productivity	Building renovation
2020	-40%	35%	14%	18%	25%	-20%	10%	increase to 2,1%/a	-20%
2030	-55%	50%		30%					Renovation rate from 1% to 2% p.a.
2040	-70%	60%		45%					
2050	- 80-95%	80%		60%		-50%	25%		-80% PEC and RES

WÄRME | KÄLTE | KWK

» The Phase-out Curve of Technologies

Reduction of GHG emissions according to the "Energy Scenarios for an Energy Concept of the German Government" (Project 12/10)



WÄRME | KÄLTE | KWK

» National Urban Development

» EU: 'Leipzig Charta' on sustainable European Cities (2007): Integrated urban development as a process

» Germany: National Programme of Urban Development Policy (2003) Laws, grants, assistance, R&D

» Saxony: Urban Development Strategy Concept (2007) Grants, laws, assistance

» Local Municipal: (started 1973) Implementation Energy and Environmental Concepts Integrated Urban Development Concepts

WÄRME | KÄLTE | KWK

» Urban Development Strategy Saxony for 2020

Guidelines:

» Inner development takes precedence over external development

» Living (and business) in the inner city - for young and old

» Heritage (building conservation) has priority (identity)

» central places

» Innovative energy concepts have priority

WÄRME | KÄLTE | KWK

» CO_2-Equivalent of Selected German Cities – Municipal Objectives

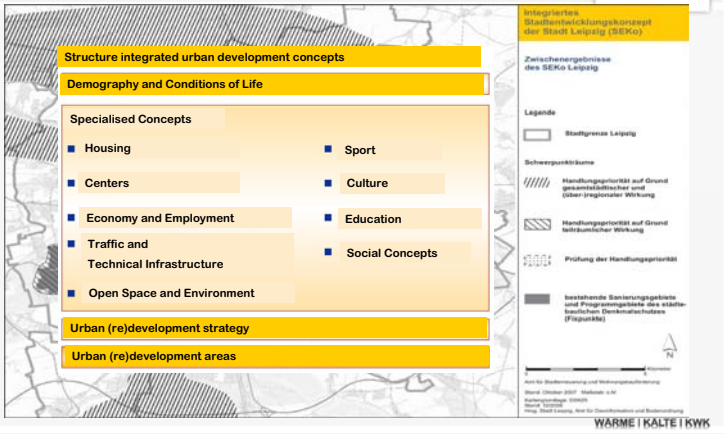
Pos.		inhabitants (2008)	t CO_2-equivalent /a/inhabitant*		defined objectives t CO_2-equivalent/a/inhabitant	share of DH in space heating	primary energy factor of DH
1	Berlin	3.431.675	6,45	(2005)	5,16 (by 2020) – 4,3 (by 2030)	27 %	0,56
2	Hamburg	1.772.100	9,35	(2006)	5,9 (by 2020)	19 %	0,21 - 0,57
3	Munich	1.326.807	7,1	(2006)	2,5 (long-term; -10% every 5 years)	25 %	
4	Cologne	1.019.328	8,1	(2007)	-10% (by 2020) – -50 (by 2030) (base 1990)	20% (city centre)	
5	Frankfurt /Main	672.667	6,5 (+traffic)	(2009)	-10% every 5 years	12%	0,54
11	Leipzig	515.619	5,75	(2008)	2,5 (long-term; -10% every 5 years)	38%	0,31
12	Dresden	512.234	9,8	(2010)	6,0 (by 2030; by 2010 -10% every 5 years)	46%	0,14
29	Chemnitz	243.880	7,5	(2011)	5,4 (by 2030)		
139	Herten	62.639	8,6	(2009)	-91.000 t by 2020 (base 2006)	29%	
	Average Germany		10,0	(2007)	-40% by 2020 (base 1990)	14 %	

* A comparison of the results of various computational tools shows deviation by a factor of 2 to 3. The reason for this are different calculation methods.

Sources: Stadtwerke Herten, Stadt Leipzig, ifeu, eins energie in sachsen, Umweltamt Dresden, Stadt Hamburg, Senatverwaltung Berlin, Stadt München, Stadt Frankfurt, Stadt Köln

WÄRME | KÄLTE | KWK

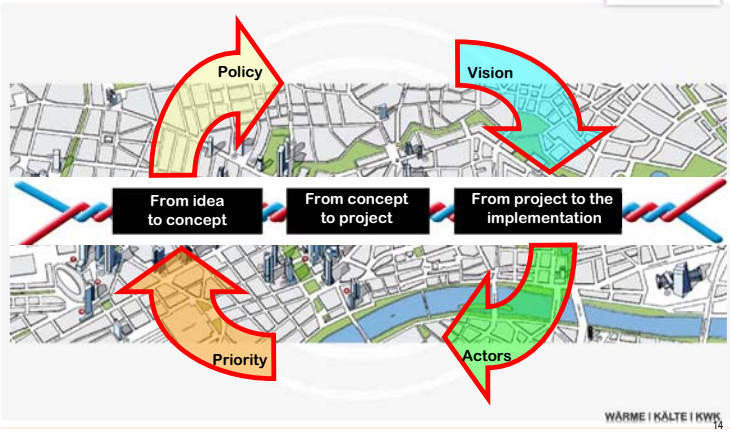
» Integrated Urban Development Concepts Leipzig



WÄRME | KÄLTE | KWK

Quelle: Stadt Leipzig

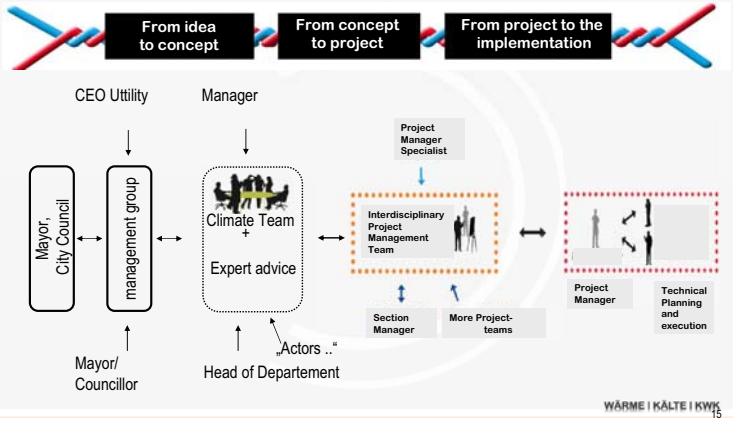
» Energy Efficient City – Process of Municipal Planning and Implementation



WÄRME | KÄLTE | KWK

Quelle: AGFW SE-PK1/Jung Stadtkonzepte

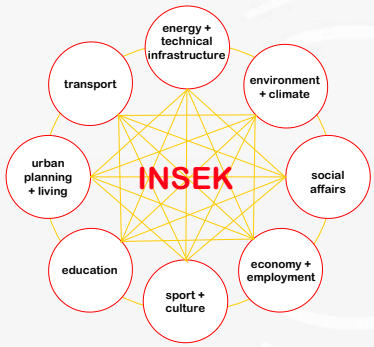
» Energy Efficient City – Process of Municipal Planning and Implementation



WÄRME | KÄLTE | KWK

Quelle: AGFW SE-PK1/Jung Stadtkonzepte

» Energy Efficient Urban Development – Instruments



General principle – (socio-)demography - circumstances – tendency of development - …

Current objectives:

1. Reduction of energy demand
2. Increase of energy efficiency
3. Use of renewable energies
4. Local added value

Fundamental individual concepts:

» Energy concepts (municipal)
» Energy supply concepts (utilities)
» Climate protection concept
» Housing market concepts

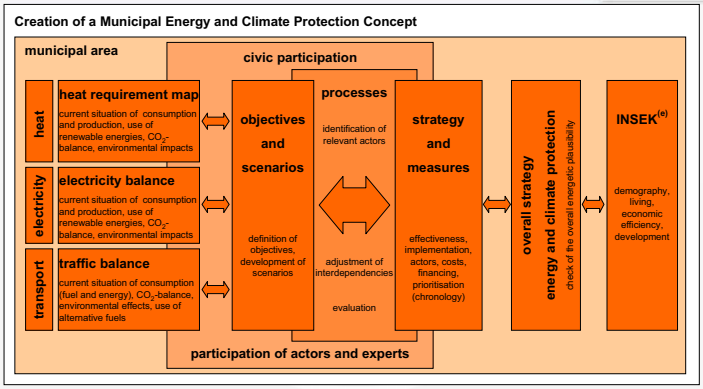
➡ INSEK^{e}

Check of the energetic plausibility in all sub concepts and their repercussion

WÄRME | KÄLTE | KWK

Source: AGFW, BTU

» Creation of a Municipal Energy and Climate Protection Concept



WÄRME | KÄLTE | KWK

Source: AGFW /hrp/

» Conclusion: key statements - overall view - community

» Creation of conceptual and instrumental basis for long-term and consistent implementation of formulated strategies (including preparation of integrated urban development concepts

» Consequent use of formal planning - IEKK)

» Control and implement adaptation as a continuous process

» Considering the overall balance, including interactions measures

» Differentiation of activities on suitability for specific settlement structures and districts ("priority areas")

» Continuous coordination between processes of urban development and planning of energy-related infrastructure

» View of action is the city district – not the complete city or the single house

» Consideration of the economics of action (most important requirement for the implementation), Local note value

» Grants geared to the overall efficiency

» Realize the model function of the community and create personal resources

» Assurance and coordination to transfer knowledge to relevant stakeholders and actors

WÄRME | KÄLTE | KWK

Source: AGFW /hrp/

» The Energy Efficient Urban Development Concept

Municipal actors under increasing pressure to act:

- » Budgetary situation – low options for action
- » Demographic development – different strategies are essential
- » Climate protection/ climate change – adjustment measures are necessary
- » Increase of energy efficiency – implementation of objectives and guidelines
- » Organisation and prioritisation – change, speed and und ideology

Same pressure on supply and disposal industry:

- » Lower number of customers and lowered consumption
- » Increasing costs per unit of product (increasing share of fixed costs, shortened working life of plants)
- » Technical problems: utilisation below capacity of infrastructure systems
- » Short-term interim solutions instead of investment cycles with 25+ years
- » Strongly changing overall context – competition, politics and society

WÄRME | KÄLTE | KWK

» Motivation and Challenges of the Current Urban Development

What is the motivation?

The main challenges for cities and municipalities are among others:

- » Demographic development
- » Climate adaption strategies
- » Reduction of energy demand, increase of energy efficiency and the use of RES
- » The tense financial situation

It is valid:

- » To use the experiences from the Urban Reconstruction East/West

Fundamentals are:

- » Integrated urban development concepts, energy and environmental concepts
- » Energy supply concept of the (most public) utility companies
- » Concepts of the housing industry

What are the challenges?

- » System-compatible analysis of developments
- » Networking of all actors with common "language" and goals
- » Coordinated and target-oriented actions depending on actual fundamentals of decision-making
- » Prioritisation, standardisation and sustainability
- » Easy and manageable implementation

WÄRME | KÄLTE | KWK

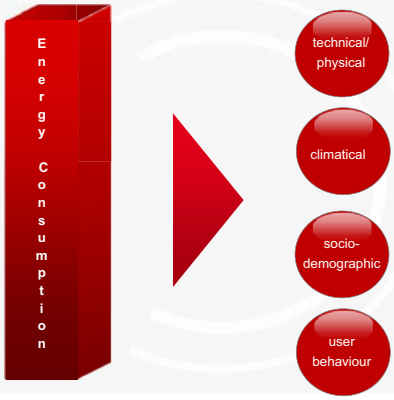
» Energy Efficient City – Process of Municipal Planning and Implementation

Basic points:

» Networking of main actors (Know-How) in the INSEK	→	process of coordination
» Common prioritisation and process oriented thinking	→	achievement of objectives and sustainability
» standardised assessment criteria	→	€/tCO_2
» efficiency oriented thinking in implementation measures	→	hydraulic compensation
» Consideration of the demographic change	→	age-appropriate housing
» adjustment measures	→	cooling and extreme weather conditions
» increasing acceptance	→	participation processes and architecture

WÄRME | KÄLTE | KWK

» Energy Consumption in private households - Structure



WÄRME | KÄLTE | KWK

» Energy Consumption - Structure

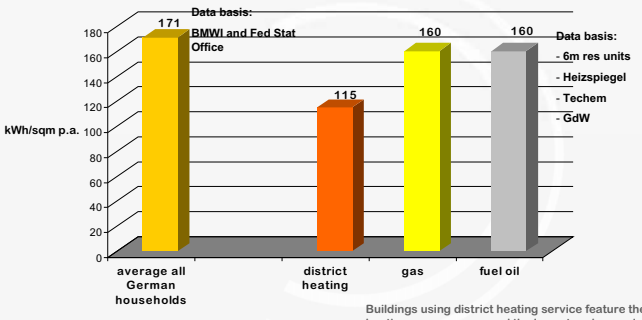
Approach	Influencing factor	Influence quantity
technical/ physical	▪ Building characteristics ▪ Energy systems	▪ Building type ▪ Year of construction ▪ State of refurbishment ▪ Thermal insulation ▪ Heating system ▪ Energy source …
climatical	▪ Season ▪ Climate development	▪ Mean annual temperature ▪ Days of frost in annual average ▪ Summer days …
socio-demographic	▪ Demographic trends ▪ Societal trends ▪ Economic trends	▪ Number of households ▪ Household size ▪ Age of the household ▪ Income ▪ Education ▪ Region …
user behaviour	▪ Habits ▪ Social values ▪ Motives / conviction	▪ Ventilation ▪ *"comfortable temperature"* ▪ Environmental awareness ▪ Attitude …

Private household

WÄRME | KÄLTE | KWK

» Energy consumption of residential buildings by type of service

Heating water and hot water consumption (only heating approx.15 – 30 kWh/sqm p.a., across all classes of buildings; years under review 2006 -2009, data basis > 6 million residential units (double counting possible))



Buildings using district heating service feature the lowest heating energy usage and the lowest carbon emissions in an all-German comparison!

Data sources: AGE, Federal Statistical Office and Techem study, GDW statistics, *Heizspiegel* *BMWI = Germany Ministry of Economics*

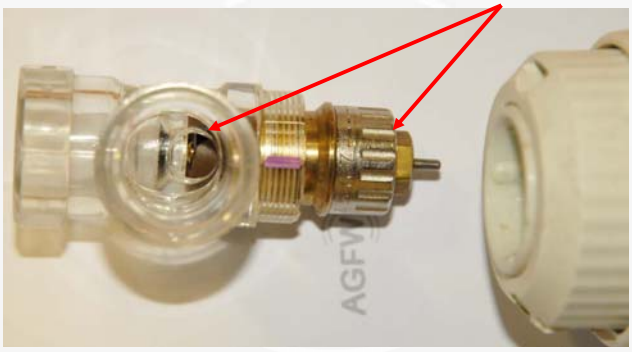
WÄRME | KÄLTE | KWK

» Most efficient climate protection measure within existing buildings

in Germany	Consumption/Saving per m²/a	Abatement costs per t CO_2 approx.	Equivalent energy price per kWh approx.
Unrenovated old building - basis	166 kWh		
Boiler replacement			
Low temperature boiler	- 5 kWh	200 €	0,33 €
Condensing boiler	- 18 kWh	- 20 €	0,11 €
Hydraulic balance	- 10 kWh	- 200 €	0,02 €
Insulation			
of facade	- 19 kWh	270 €	0,40 €
of roof	- 9 kWh	310 €	0,48 €
of top ceiling	- 9 kWh	- 20 €	0,13 €
of cellar ceiling	- 8 kWh	- 70 €	0,06 €
Replacement of windows	- 1 kWh	4000 €	4,70 €
Solar thermal installation	- 19 kWh	- 35 €	0,09 €

WÄRME | KÄLTE | KWK

» Examples of savings – Hydraulic balance, percentage of buildings



WÄRME | KÄLTE | KWK

» Energy Consumption - Structure

Approach	Influencing factor	Influence quantity
technical/ physical	▪ Building characteristics ▪ Energy systems	▪ Building type ▪ Year of construction ▪ State of refurbishment ▪ Thermal insulation ▪ Heating system ▪ Energy source …
climatical	▪ Season ▪ Climate development	▪ Mean annual temperature ▪ Days of frost in annual average ▪ Summer days …
socio-demographic	▪ Demographic trends ▪ Societal trends ▪ Economic trends	▪ Number of households ▪ Household size ▪ Age of the household ▪ Income ▪ Education ▪ Region …
user behaviour	▪ Habits ▪ Social values ▪ Motives / conviction	▪ Ventilation ▪ *"comfortable temperature"* ▪ Environmental awareness ▪ Attitude …

Private household: Energy Consumption

WÄRME | KÄLTE | KWK

» Impact of climate change – climate adption

Impact of climate change on the urban climate to moderate IPCC scenario

In the city of Frankfurt 2050:

- **The average annual number of summer days per year will increase from 44 days to 5-31 days.**
- **The summer half-year will be warmer every second to fourth day in Frankfurt as 25 ° C.**
- **Simultaneously, the average annual number of "Summer Nights" is that there are evenings where a 22 clock at least 20 ° C warm, increase by 5 to 33 days.**
- **The number of "hot days" with a maximum temperature of 30 ° C and the tropical nights with air temperatures fall below 20 ° C, will increase significantly.**
- **The changes do not differ significantly between tightly and loosely built-up districts. The heat load will increase so much alike, and in future there will be highest where it is today.**
- **The differences between the city and surrounding area will not get worse.**
- **The probability that the summer heat - such as in 2003 - will become more frequent, increases until the middle of the century.**

WÄRME | KÄLTE | KWK

» Parameters: cooling and heat market

Quantitative and Qualitative statements / effects for the technical infrastructure:

- **Minor effects on the interpretation of data on heating and cooling load**
  Risk of exceeding max. 0.2%
- **Design according to DIN 4710, in terms of absolute values, remain valid (DH-Connecting load)**
- **The annual output will change (+ cooling, - heating)**
- **Smoothing of the annual load duration curve is expected at a lower level**
- **Reduction of heat demand by about 1 -1,5% /a (depending on region)**
- **Air cooling demand increases strongly**

- **Provide of biomass-based renewable energy can change**
- **Extreme weather events will increase (rainfall, drought, wind, …)**
- **Loss of power by river cooled power plants in the summer months**
- **Electricity consumption is shifting in the summer months**

WÄRME | KÄLTE | KWK

» Energy Consumption - Structure

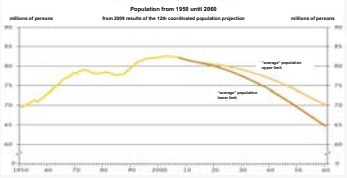
Approach	Influencing factor	Influence quantity
technical/ physical	▪ Building characteristics ▪ Energy systems	▪ Building type ▪ Year of construction ▪ State of refurbishment ▪ Thermal insulation ▪ Heating system ▪ Energy source …
climatical	▪ Season ▪ Climate development	▪ Mean annual temperature ▪ Days of frost in annual average ▪ Summer days …
socio-demographic	▪ Demographic trends ▪ Societal trends ▪ Economic trends	▪ Number of households ▪ Household size ▪ Age of the household ▪ Income ▪ Education ▪ Region …
user behaviour	▪ Habits ▪ Social values ▪ Motives / conviction	▪ Ventilation ▪ *"comfortable temperature"* ▪ Environmental awareness ▪ Attitude …

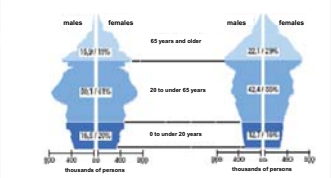
Private household: Energy Consumption

WÄRME | KÄLTE | KWK

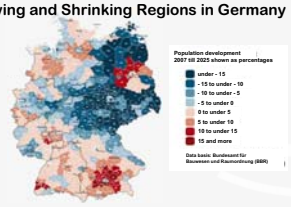
» Demographic Changes

There will not only be fewer of us but we will be older as well…

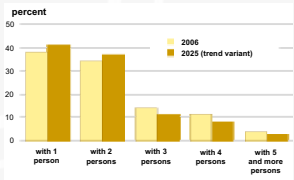




Growing and Shrinking Regions in Germany



Households are changing



Sources: Stat. Bundesamt/BBR

WÄRME | KÄLTE | KWK

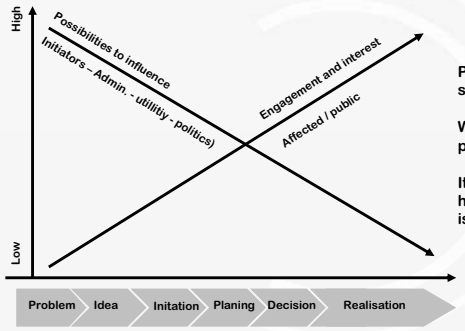
» Energy Consumption - Structure

Approach	Influencing factor	Influence quantity	Private household
technical/ physical	▪ Building characteristics ▪ Energy systems	▪ Building type ▪ Year of construction ▪ State of refurbishment ▪ Thermal insulation ▪ Heating system ▪ Energy source …	Energy Consumption
climatical	▪ Season ▪ Climate development	▪ Mean annual temperature ▪ Days of frost in annual average ▪ Summer days …	
socio-demographic	▪ Demographic trends ▪ Societal trends ▪ Economic trends	▪ Number of households ▪ Household size ▪ Age of the household ▪ Income ▪ Education ▪ Region …	
user behaviour	▪ Habits ▪ Social values ▪ Motives / conviction	▪ Ventilation ▪ *"comfortable temperature"* ▪ Environmental awareness ▪ Attitude …	

WÄRME | KÄLTE | KWK

» Citizens Participation - The right time is essential

Partizipation paradox: Less influence → larger interest → lager dissapoitment → larger protest → larger the overall damage



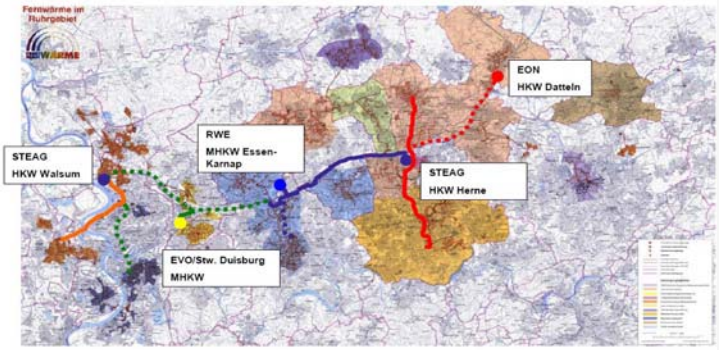
Public participation must be started early.

With the beginning of the process.

It should take place before a high level of (personal) affected is reached

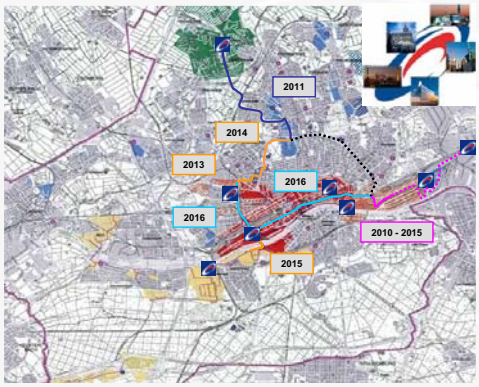
WÄRME | KÄLTE | KWK

» Develop DH-Connection of Metropolregions



WÄRME | KÄLTE | KWK

» Develop DH in Frankfurt – Several stand alone grids to network



Network grids:

- in use
- Planing
- in preliminary planning (steam to water)
- partially under construction in connection with road reconstruction
- Possibility of supply of heat from biomass
- ring closure

WÄRME | KÄLTE | KWK

» Develop DH – Building Level

» Silver Tower – Frankfurt am Main
» Complete renovation 2009-2011

» goal:
- » Reduction of carbon dioxide emissions and energy consumption by one third
- » Certificate of the German Sustainable Building in Silver

» Through the DH annually 600 tons of CO_2 annually

WÄRME | KÄLTE | KWK

» Develop DH – Heat and Cooling Storage Systems in Chemnitz

Hot Water

Cold Water

Storage characteristics – Exampel Hot water
Storage: Gravel-water
Storage volume: 8.000m³
Start of operation: 2000
Supply system parameters:
Solar absorber surface
540m² total heat demand from vacuum tube heating system:
First Phase: 573 MWh / a
Useful heat delivery solar system:
First Phase: 169 MWh / a
Solar fraction: 1 Phase: 30%
Cost solar system: 1./2. + Construction Phase:
1.4 million €
Solar thermal costs: 1./ 2. + Construction Phase:
€ 24-cents / kWh

WÄRME | KÄLTE | KWK

Thank you for your attention

Dipl.-Ing. Dipl.-Wirtsch.-Ing. Harald Rapp

You will find the presentation:

http://www.agfw.de/stadtentwicklung/vortraege/

For more information please contact:

AGFW | Der Energieeffizienzverband für
Wärme, Kälte und KWK e. V.

Stresemannallee 28
60596 Frankfurt/Main
Tel.: +49 69 6304-418
Fax: +49 69 6304-391
E-Mail: h.rapp@agfw.de
Internet:http://www.agfw.de

WÄRME | KÄLTE | KWK