
RE- PRODUKTIVE STADT

re-productive city

Holistic approaches for resource efficiency in polycentric Cities

Sven Wüstenhagen
UAS conference 2020

Aim of project

Gaining resource efficiency in polycentric Cities, to enable circular economy

- establishing »RealLabor«
 - analysis of existing process chains
 - Identifiing potential of new or improved process chains
 - Analysing constellation of Stakeholder
- Inspiering for action in »RealLabor«

Stakeholder group 1/3

project sponsor

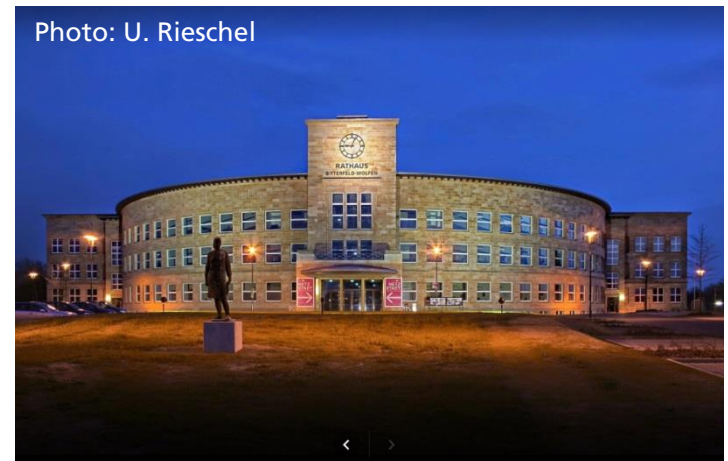
Cityadministration,
City development company,
Municipal housing company

direkct linked to:

- Municipal utility
- Municipal office for green areas
- School / communal services
- Processes of (city) planning
- Information to strategic (city) planning)
- Cadastre / GIS Data
- investors



Housing Company in Bitterfeld-Wolfen



Townhall Bitterfeld-Wolfen

stakeholder group 2/3

technology development / »scouting technologies«

BTU Cottbus, Dept. City-technologies

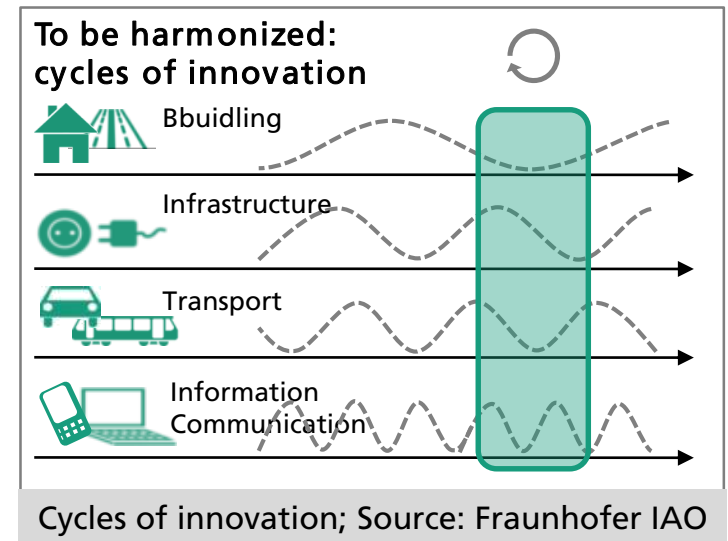
- F.i. competence in low temperature systems and district heating

Fraunhofer IMWS

- Use scenarios for hydrogen
- Technologies for adaptive Facade-systems and construction



BIENe System at University Cottbus (BTU)



Stakeholder group 3/3

social sciences

Sustainify GmbH

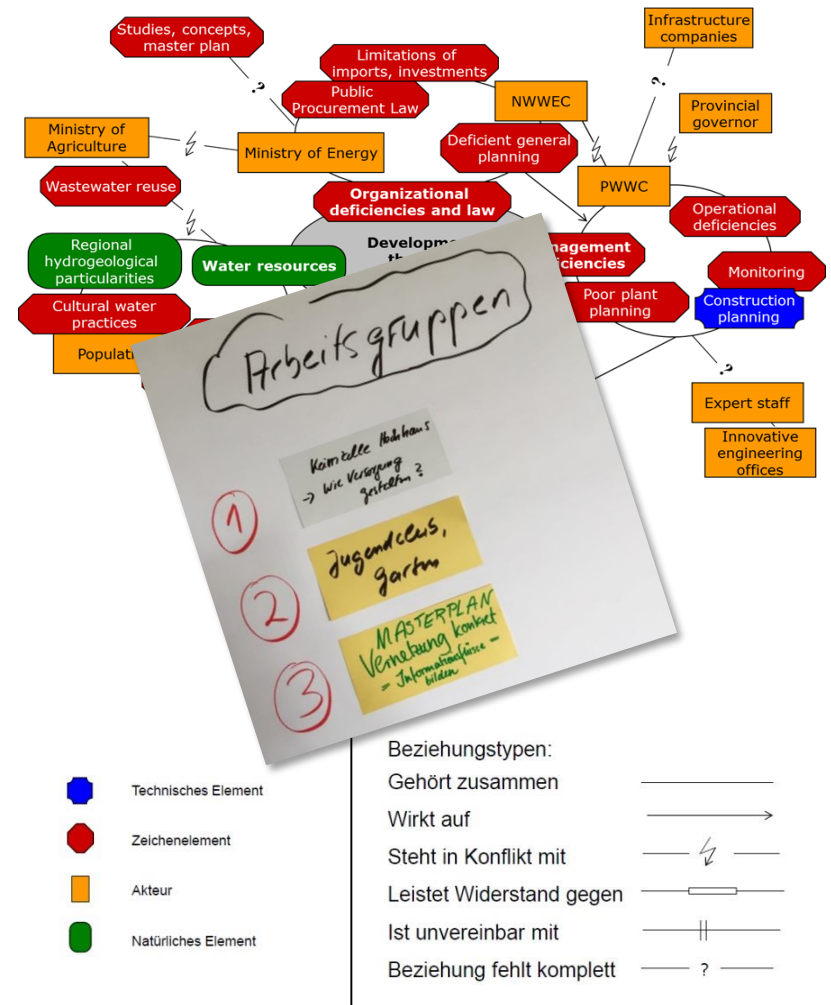
- Participative city planning
- Mindmapping, graphic record

Inter 3 GmbH

- Moderation
- Constellation Analyses

Energieavantgarde Anhalt e.V.

- Interview / participation
- Coordination of inter-disciplinary projects



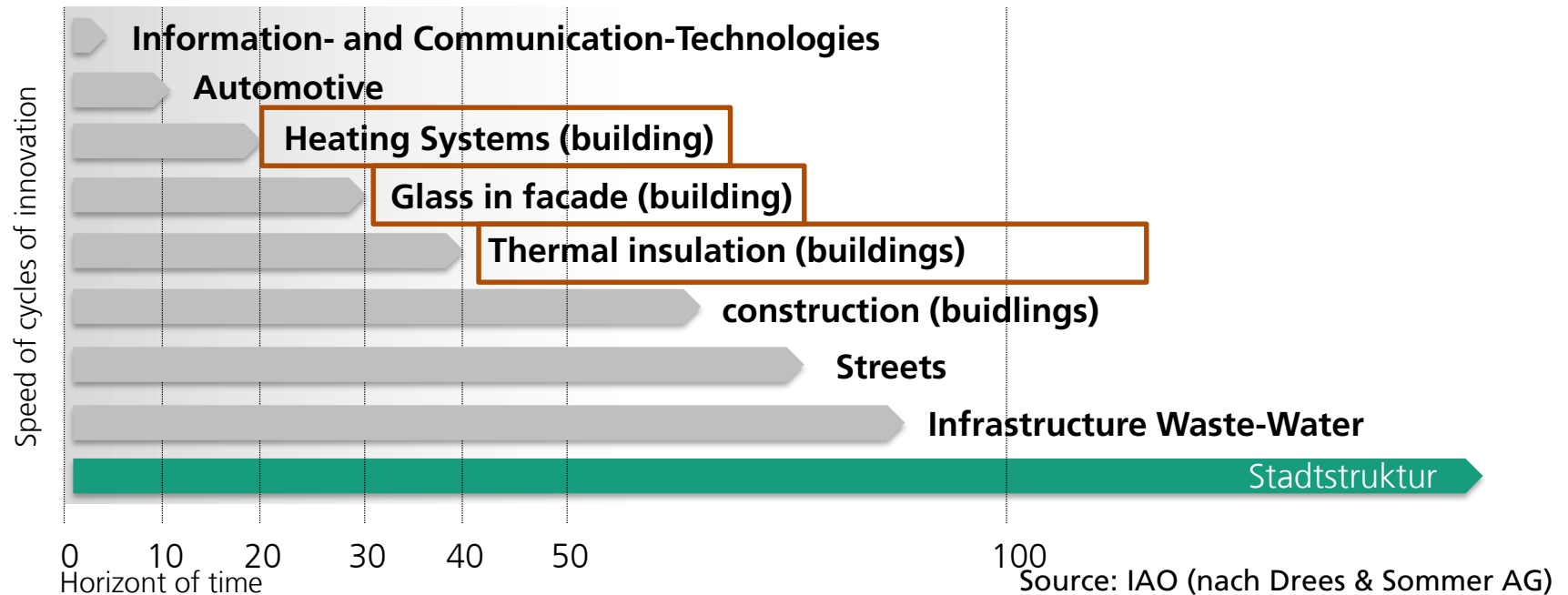
Instance for constellation analysis

motivation

fostering use of new technologies in construction

Need of planning and consensus grows with life-span of investments.

Earnings from technology are determined by quality of planning and user behaviour.



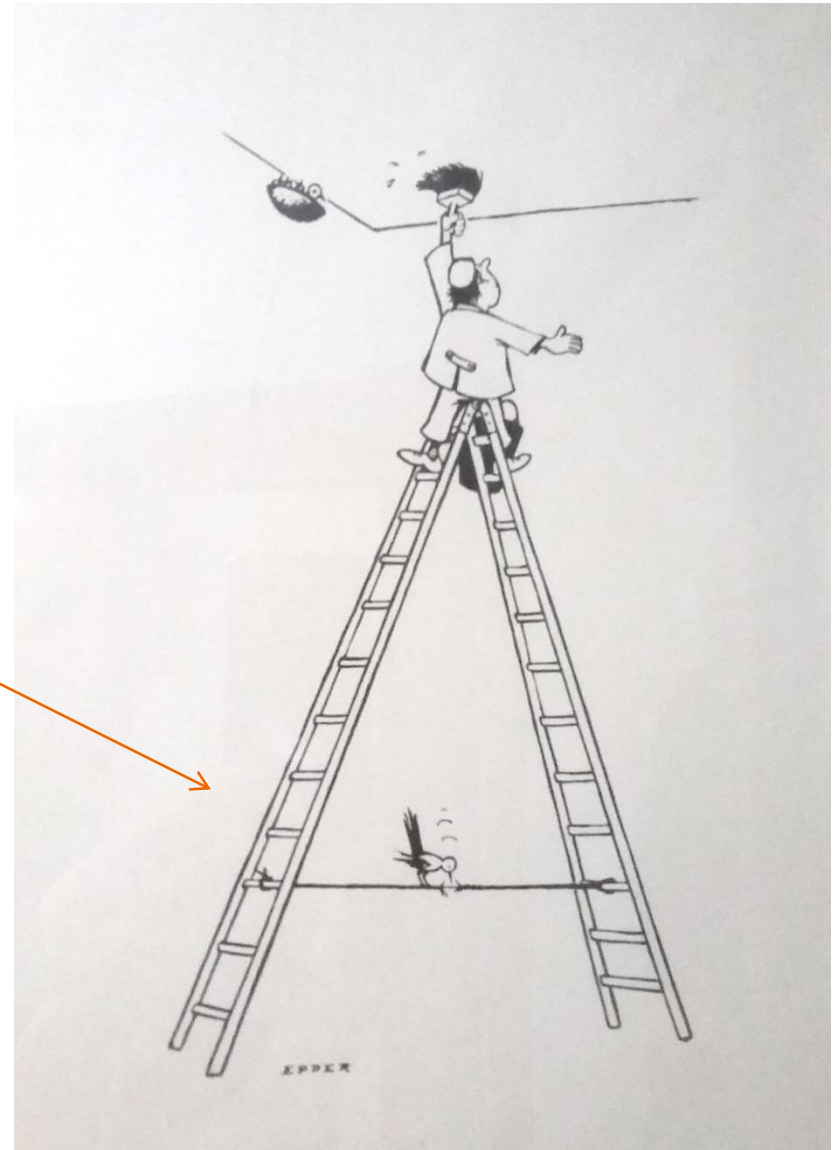
motivation

make it a better place ...

»smallest as possible intervention«*
promises big changes

Cartoon, found in a »Citizen-meetup-Cafe«
Halle-Neustadt, Hemingwaystraße

* Lucius Burkhardt, Schlüsselwerke der
Stadtforschung, Springer Fachmedien, 2017



motivation

Quotes from municipal utilities

»**Maintainance of existing networks** for district heating and power supply has to meet on top the needs f.i. to power supply for e-mobility.«

»In district heating **weakest user is steering the efficiency** in whole net, what means, low temperature heating in building needs island solutions.«

»**Climate friendly housing** as a unique selling point, f.i. e-Mobility included in housing or combining the protection of environment and historical building«

»As a municipal utility we aiming **regional based Energy-products**.«

»Moderated development of so called **Prosumer**.«

RealLabor in Bitterfeld-Wolfen

work definition »RealLabor«

»RealLabor« consists of 4 quarters (»scalability« and »maximum bandwidth«).

- New to establish multifamily housings in areas of mixed use
- Retrofit of industrial buildt houses (large panel construction)
- Renovation existing multifamily housings (in so called »Gartenstadt«)
- urban wasteland to be revitalised

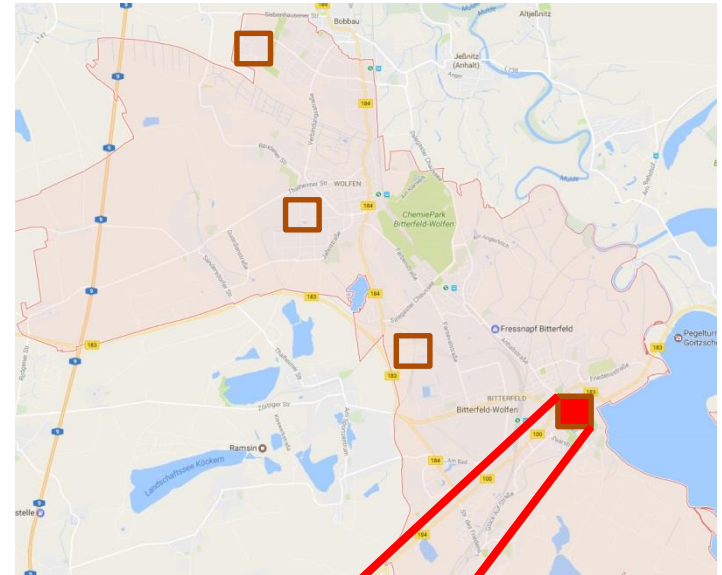
»ThinkLabs« are comparable to thought experiments – theoretically possible constellations of technologies and user-behavior will be examined.

- oriented on methods of city planning

Quarter 1/4 urban wasteland to be revitalised Am Plan, in Bitterfeld

- Formerly known as a »dead end«
direct contact to opencast mining
- Today good situated (Lakeside)
- Actual uses resulting from history:
 - car parking
 - possible use as touristic attraction

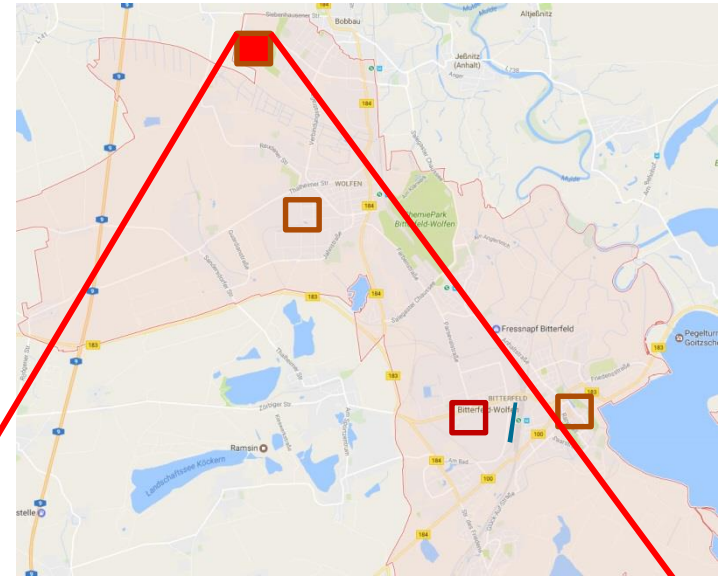
- Which compromises are serving
urban development?



»Am Plan« now good access to lakeside

Quarter 2/4 retrofit industrial buildt houses Wolfen-Nord

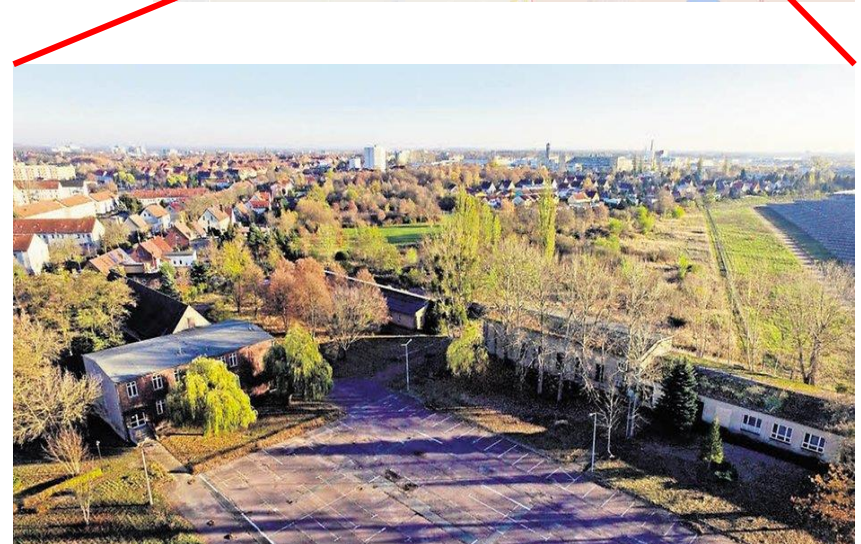
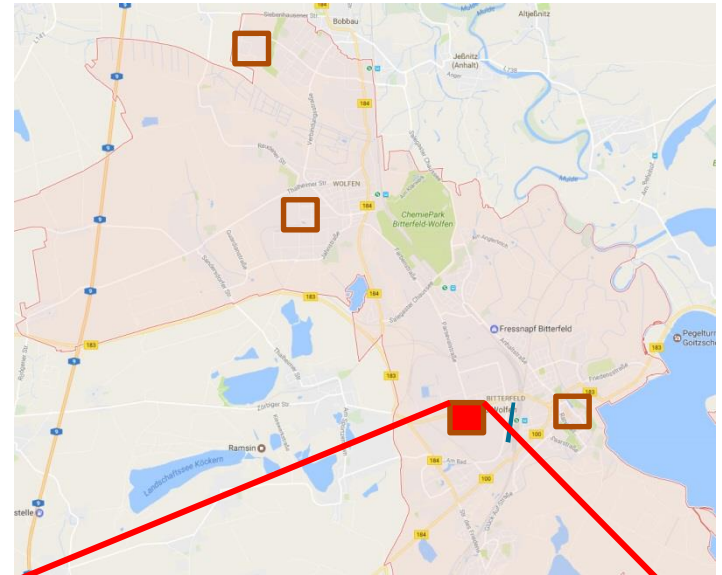
- Conform to building law the planning sign »experimentelles, durchgrüntes Wohnen« is chosen – so all planningoptions and forms of use (living and work) possible
- »energetic islanding« happens by unmoderated dismantling of houses
- 1990: 6.500 housing units
2000: 5.800 housing units
2010: 3.700 housing units
costing of empty housings: 700 T€ / a
Old depts from construction till 2034
- Can bring »ecological approaches« a chance for Wolfen-Nord?



Free areas in Wolfen Nord

Quarter 3/4 newly to be build houses Alte Kaserne, in Wolfen

- Private investor plans one- and multi-family houses and business
- Solarpark in own operation: 38.500 Solarmodule, 10 MW (energy for ca. 2.500 living units)
- Conform to building law the combined use (living and business) enables »Energy partonages« theoretically
- Cooperation with municipal utilites possible?



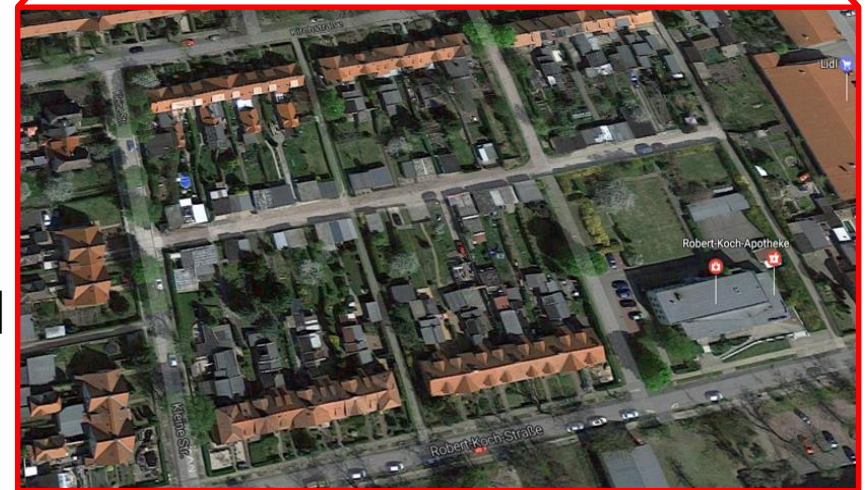
Development area „Alte Kaserne“, Bild: MZ

Quarter 4/4

Renovation existing multi family housings

Garden City, in Wolfen

- multi family houses, gas based heating
 - Multiple owner structure
 - Historical building substance
-
- Bringing »Gartenstadt« [garden city] in phase 2.0 (combining historical structures and technologies)?



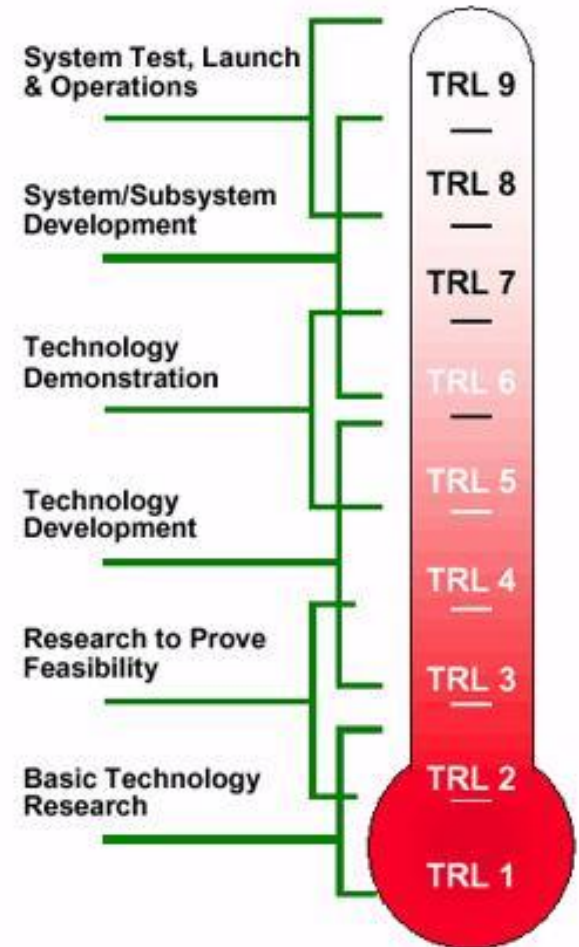
Gartenstadt Bitterfeld, Bild: google maps

Technologies

Technology Readiness Level are used for classification of potential usable technologies

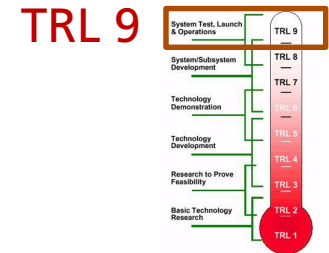
proposed technologies from 3 sources:

- R&D: Solutions developed at Fraunhofer IMWS and Fraunhofer CSP
- External: requests and proposal which came to municipality of Bitterfeld-Wolfen
- Established at market: f.i.: low temperature heating, photovoltaic on rooftop

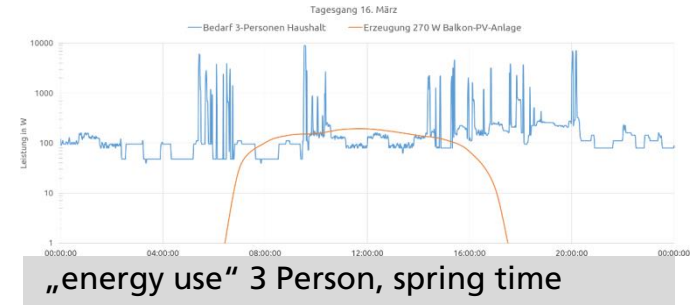


Technology 1/12

indielux GmbH – prosuming PV panel



- till 4m construction single glass PV-module
- over 4m glass to glass PV-module
- Conform to DIN 180081 or TRLV
- Overhead – constructions possible (f.i. winter-garden)

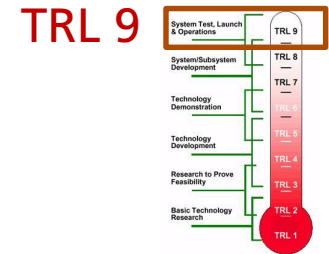


- Tought experiment at »RealLabor« :
Prosuming at facade and balcony



Technology 2/12

oeex – interconnection of prosumer (App)



- App for peer2peer Energy-Trading



Energieaustausch

In Zukunft wollen wir Dir einen automatisierten, nachbarschaftlichen Austausch von erneuerbaren Energien ermöglichen in der Community ermöglichen.

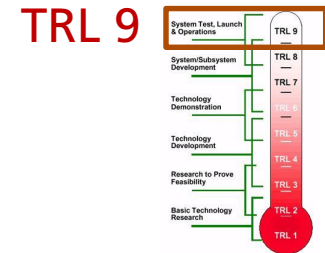
- Tought experiment at »RealLabor« :
Can prosuming serves the electricity grid?



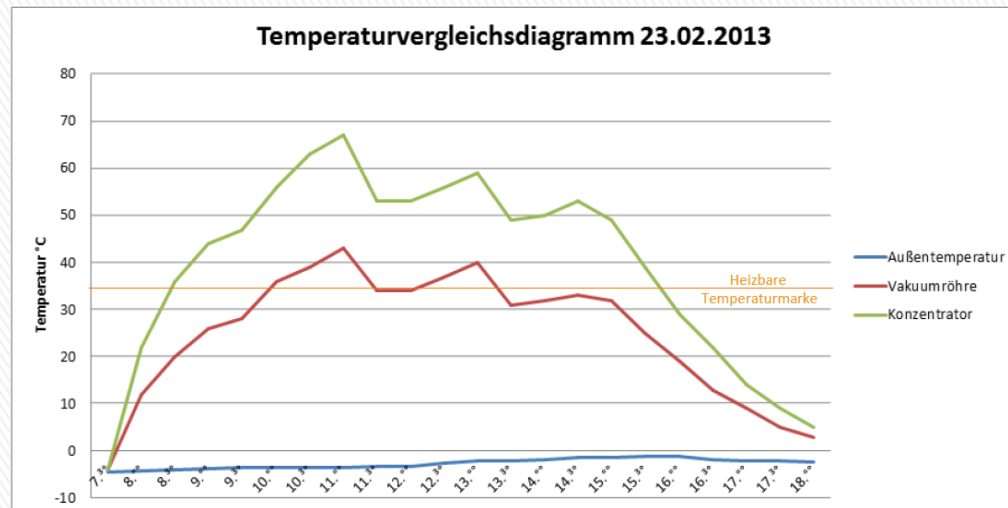
Source: oeex

Technology 3/12

Toback Solarkonzentratoren



- Optimized solar thermal energy



Temperature measured on outside (blue) inside vacuum tube (red) and on surface of concentrator (green)

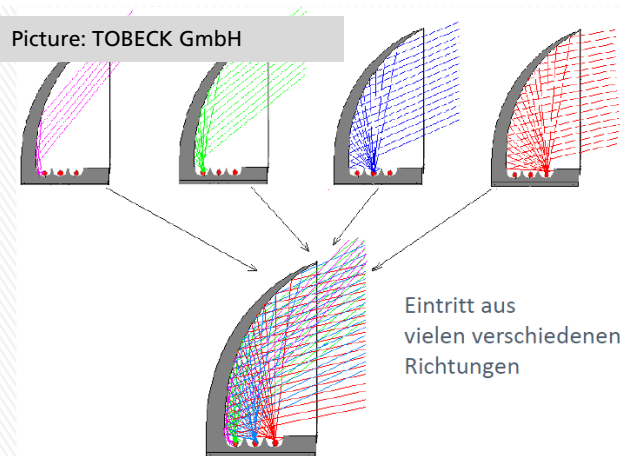
- Tought experiment at »RealLabor«:
Local use of solartharmal power

Picture: Schubert&Langenbeck Solarthermische Konzentratoren



Product

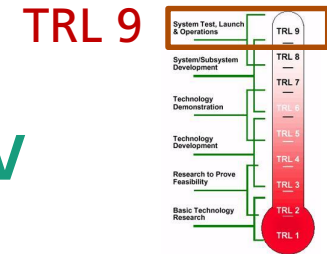
Picture: TOBECK GmbH



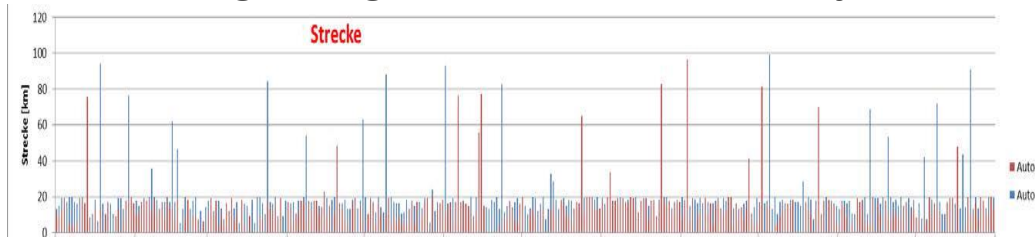
Reflector for use on latitude 45

Technology 4/12

ecological mobility chain/Building integrated PV



Building integrated PV for mobility use

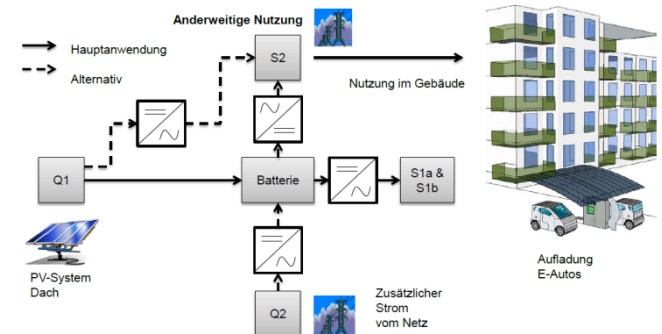


Model for driven distances of 2 personal cars (2*18 kWh / ca. 77000 kWh/a) in daily use

- 25 m² of rooftop installed photovoltaic is needed for 2 cars under normal daily use
- Tought experiment at „RealLabor“:
How BIPV can be used for grid-friendly energy feed-in?



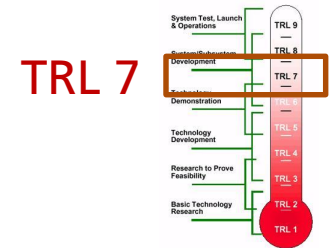
Standortanalyse



Local use of solar energy from BIPV

Technology 5/12

Thermo Catalytic Reforming (TCR)



- Anhalt- Bitterfelder Kreiswerke GmbH:
Biomass from green areas / Bio-waste
- »deep separation of biomass« and collection
result in community of Bitterfeld:
150 kg / Person / a
- Production capacity of 17 T t / a compost

- Tought experiment at »RealLabor« :
**Reforming greencut from urban areas
via TCR in to bioactive charcoal and
heat energy**



Anhalt-Bitterfelder Kreiswerke GmbH

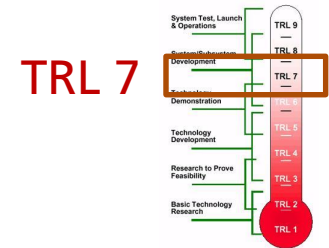
Picture: Fraunhofer UMSICHT



TCR-Reactor

Technology 6/12

Light Electric Vehicle (EU L7e)

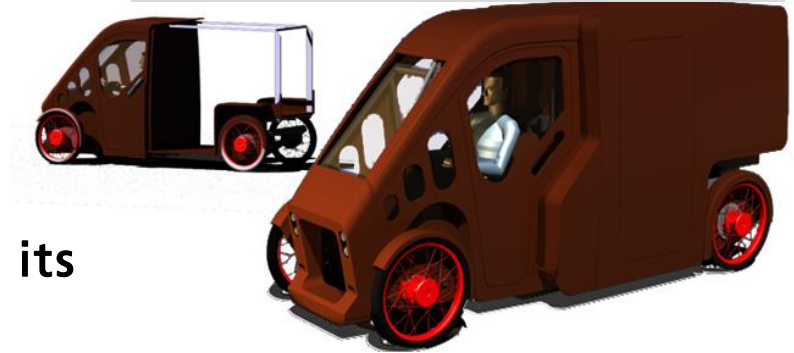


- Construction uses natural fibre composite
- Cargo and parcel delivery „Last mile“ (substitution of 50% „Diesel km“ possible [1])
- Transport of local produced food and other biomass



Cargo Cruiser Generation 1

- Tought experiment at „RealLabor“: Can municipal vehicle fleet reduces its „Diesel km“ down to 50%?

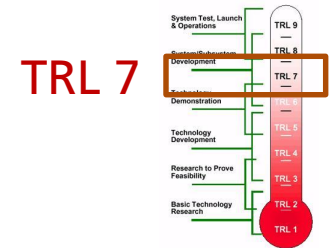


Cargo Cruiser Generation 2

[1] „Ich ersetze ein Auto“ DLR, 2017

Technology 7/12

“Load bearing insulation” – lightweight houses



- Temporary building uses sandwich-construction for combined thermal insulation and load bearing structure in lightweight
- Room modules are convertible
- Low energy technologies for air conditioning in real life test

- Tought experiment at „RealLabor“: Is there a fruitful combination of innovative construction demonstration and development of retail spaces on urban fallow land?



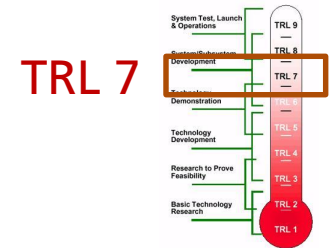
Temporaire building (Testfield of IMWS)



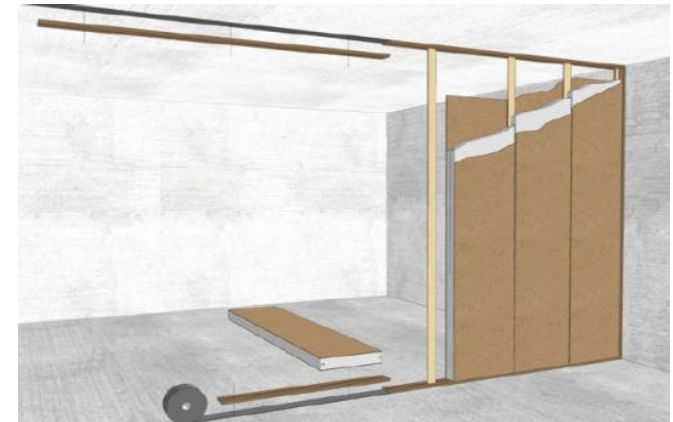
Insight in a „lightweight house“

Technology 8/12

retrofit of concrete slab buildings



- „Load bearing insulation inside“ (made from natural fibre composites)
- low exergy – air condition using capillary tubes inside wall - panel
- Load bearing sandwich construction „plug and play“ for temporaire walls, f.i. ambient assisted living



Principle sketch of interior wall

- Tought experiment at „RealLabor“:
Enables Natural Fibre Composite and ambient assisted living new potential für retrofit of concrete slab houses?

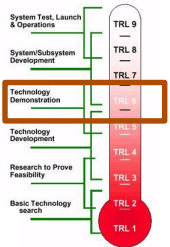


Test in concrete slab house, ready in 1h

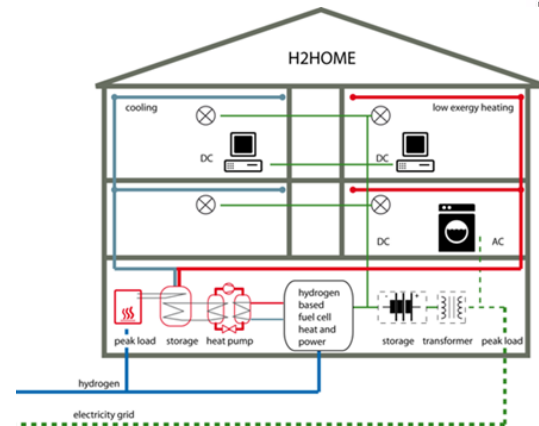
Technology 9/12

hydrogen based, combined heat and power station

TRL 6

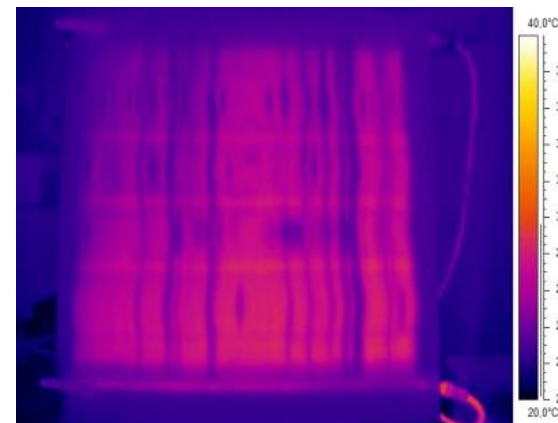


- DC power for light and electronic devices
- Use of low exergy heating systems (f.i. using capillary tubes inside wall – panel)



H2Home "Wasserstoff BHKW"

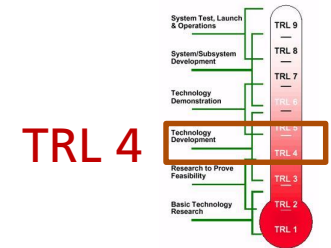
- Thinking experiment at „RealLabor“: Will hydrogen be accepted in air condition and electricity supply of housing?



Optimale thermische Ankopplung

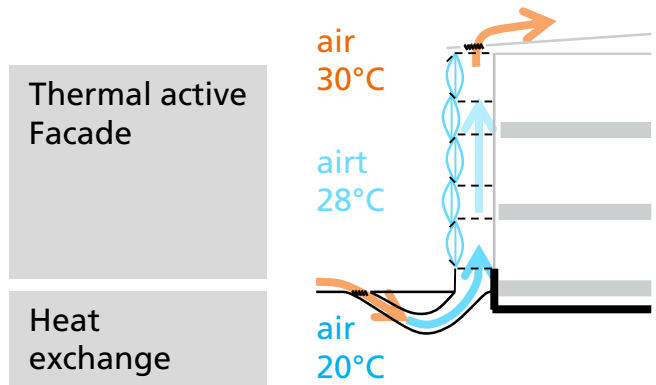
Technology 10/12

transparent thermal insulation

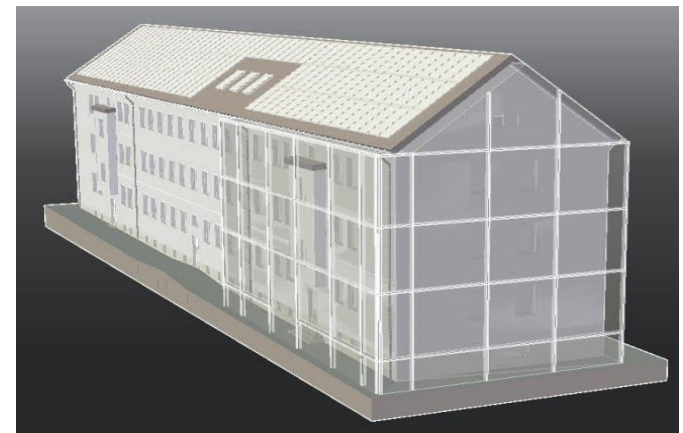


Ethylen-Tetrafluorethylen-Copolymer-film for Transparent thermal insulation

- Arcade as retrofit of buildings

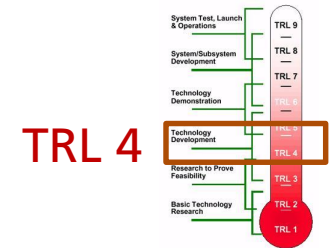


- Tought experiment at „RealLabor“: Transparent thermal insulation for retrofit in urban building?



Technology 11/12

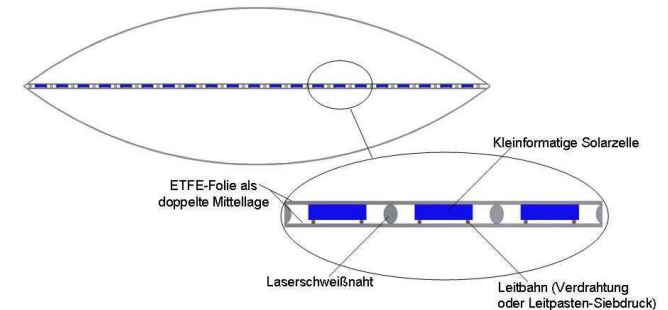
transparent thermal insulation with PV



ETFE for pressurised membranes (f.i. „Allianz Arena“ in Munich)

Functionalized with photo-voltaic

- robust
- Use photo-voltaic for air-pressure
- shadowing
- Tought experiment at „RealLabor“:
Can PV and transparent thermal insulation be combined for retrofit of urban building?



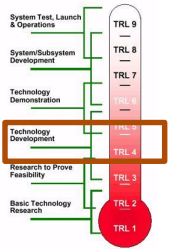
Schematic (use of PV inside the pillow)



ETFE-Membrane-pillow

Technology 12/12

Evaporative cooling, based on functional paper **TRL 4**

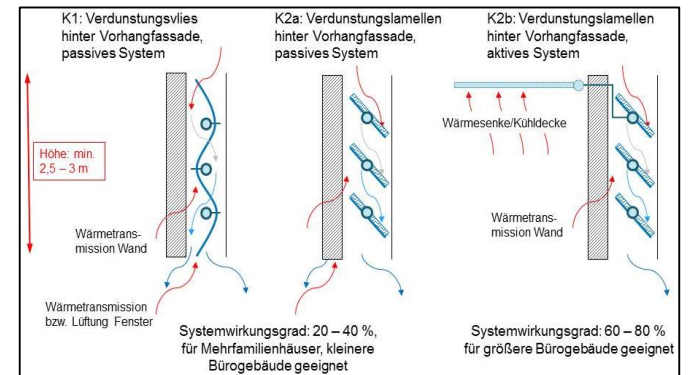


- Evaporation performance of functional paper (0,25 l/m²h) enable a cooling performance of 100 – 120 W/m² at facade in Central Europe under standard climate
- Air conditioning causes 14 % of electrical power- or 5,8 % of primary energy demand
- EU-Study: Air condition will rise its need for energy up to 225 % (base 1990 till 2020)
- Tought experiment at »RealLabor«:
Will evaporative cooling minimize waste heat from conventional air condition?

Picture: Harunori Noda



Sony City Osaka Building (shows TRL 9)



Principle of evaporative cooling

Participation and Use-Scenarios (ThinkLab)

Quarter »urban wasteland to be revitalised«

- Difficult investment planning, because of differing stakeholder interests – the citizens like the use as car-parking, tourism actual not in mind of residents
- Temporarily buildings should be installed for test up development of a business area, including tourist shops and a market place
- Real life experiment as basis for democratic chosen investments in concrete, which will happen, early or later
- Public demonstration of low energy technologies



Participation and Use-Scenarios (ThinkLab)

Quarter »urban wasteland to be revitalised«



Participation and Use-Scenarios (ThinkLab)

Quarter »urban wasteland to be revitalised«

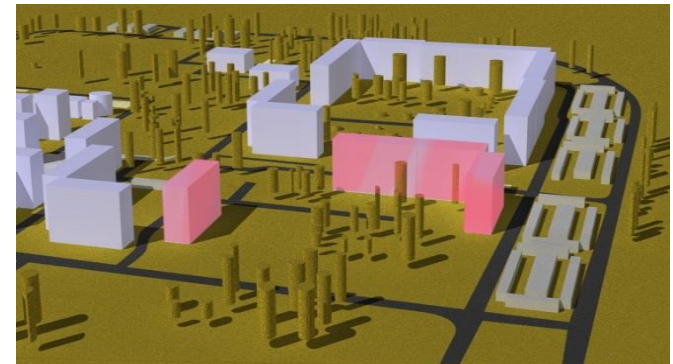


Participation and Use-Scenarios

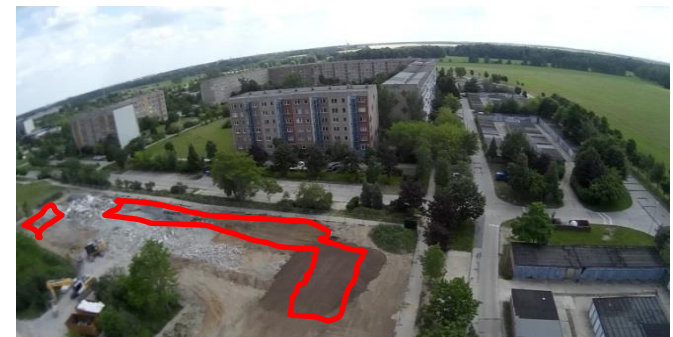
Quarter »Housing Complex 4/4 Wolfen«

- Interests of stakeholders:
 - STEG (value retention in quarter)
 - Housing cooperative (new housings?)
 - Municipal utility (managing shrink of heating-network)
 - „Herzengemeinschaft Wolfen“ (implement alternative forms of living)

- Tiny houses beside the concrete slab houses – alternative forms of living together



deconstruction „outside to inside“



Plan and reality (11.06.2017)

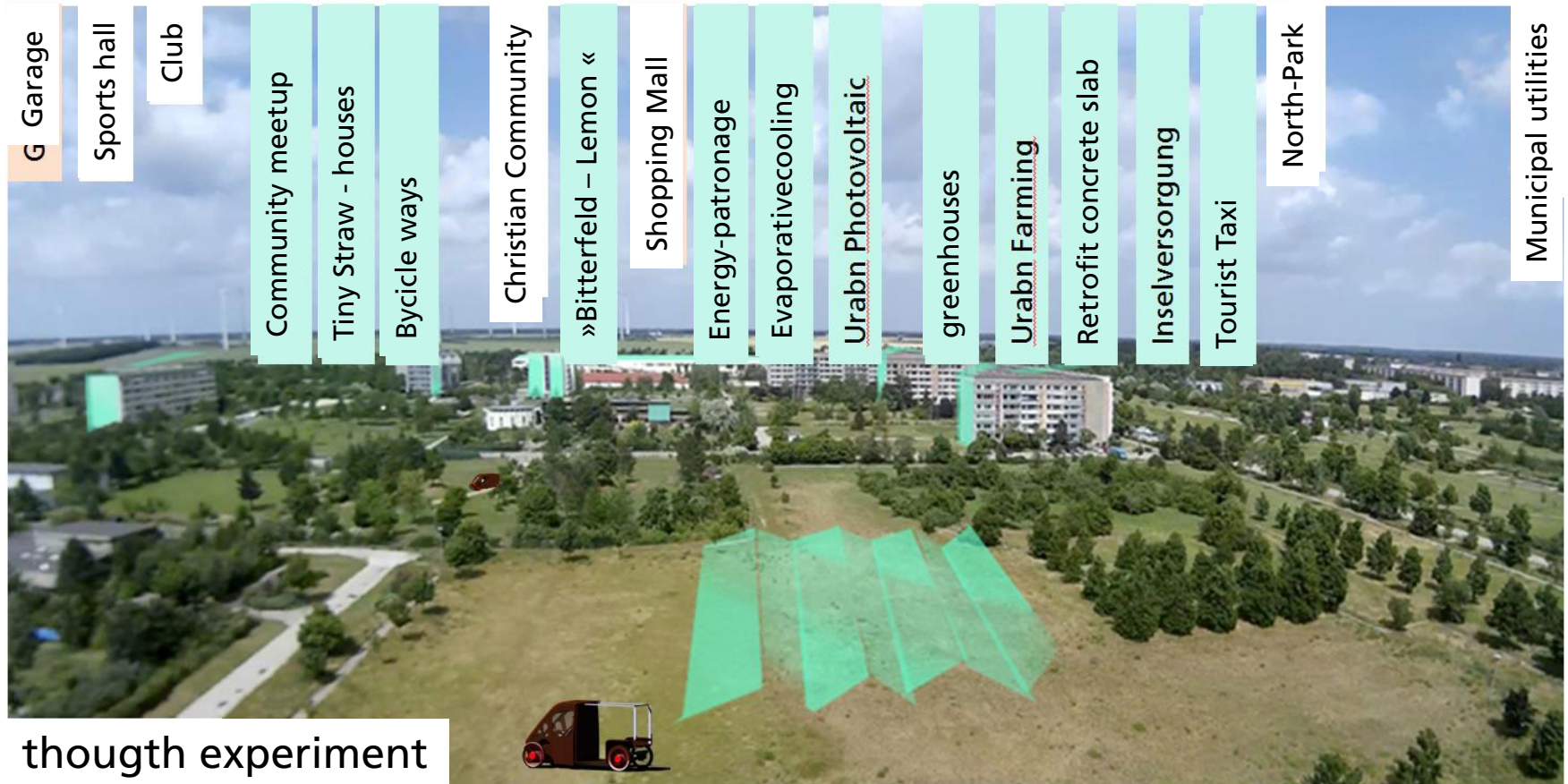
Participation and Use-Scenarios (ThinkLab)

Quarter »Housing Complex 4/4 Wolfen«



Participation and Use-Scenarios (ThinkLab)

Quarter »Housing Complex 4/4 Wolfen«



Participation and Use-Scenarios (Third Quarter) »Housing Complex 4/4 Wolfen«

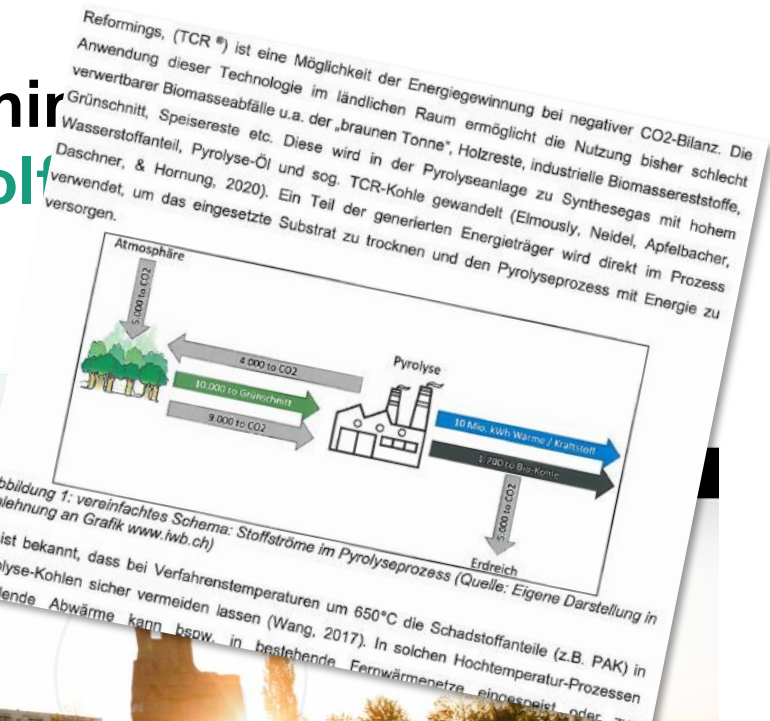


wolfen-nord.de

Startseite

~~We have a vision...~~
mission!

Wolfen Nord e.V.
Zukunft gestalten wo Vergangenheit Gegenwart ist.



Wohnen
Kredit für Wohnprojekte

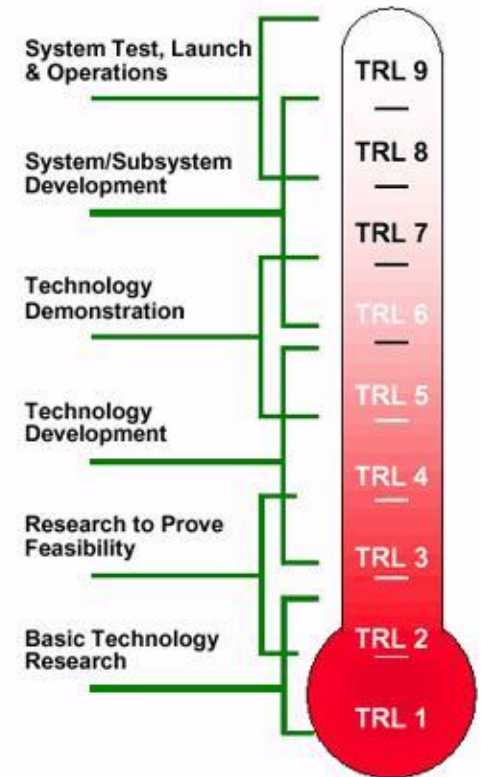
Arbeits
Unabhängig.
Arbeit, die sich nicht so anfühlt

Wie belebt man einen Stadtteil, der von Abwanderung und Rückbau geplagt ist?

Den ökologischen Fußabdruck verkleinern und Freiheit und

Conclusion

- Mostly accepted are technologies with TRL over 6
 - App for peer2peer Energy Trading
 - Solar System for balcony
 - Temporaire Buildings (revitalise wasteland and new forms of living)
- Below TRL 6 more time is needed
 - Thermal Catalytic Reforming – a R&D project with further communities is planned



- Re-produktive Stadt
- FKZ: 01UR1618D
- Projektträger: DLR Bonn

