Resources Saving ***Quarter Bedburg-Kaster***

one of three projects out of ‘Reallabor‘

Smart Quart

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E.ON Energy Solutions GmbH

Iea workshop: technologies & innovations for climate neutral cities 12. & 13.5.2025

Gefördert durch:

Bundesministerium für Wirtschaft und Klimaschutz

Aufgrund eines Beschlusses des Deutschen Bundestages

***Green, local, digital = quarter-concept of* Bedburg-Kaster: Proven as a role-model?**

Projektpartner: e·on gridX Hydrogenious VIESMANN

Assoziierte Partner: H2MOBILITY

RWTH AACHEN UNIVERSITY Stadt Bedburg STADT ESSEN Kaiserseich RWE GROUP

Resources Saving ***Quarter*** **Bedburg-Kaster** – a holistic approach:

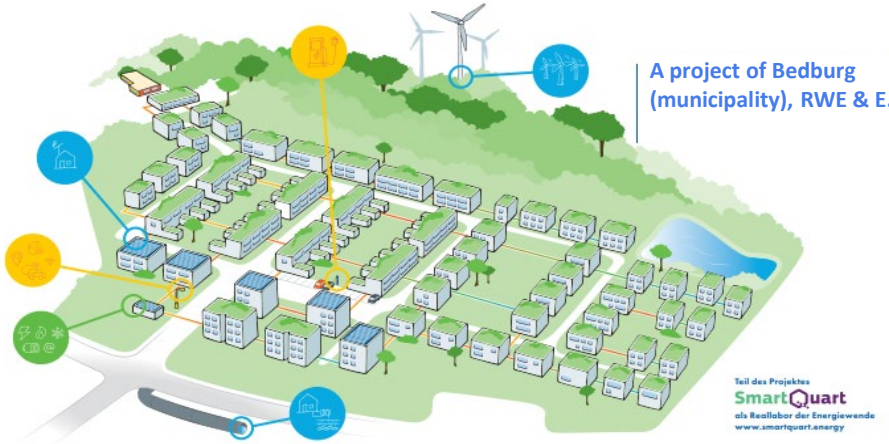
I. A decarbonised, sectorcoupling & local-power focussed energy supply concept with charm

II. Full real-time & bi-directional digitalisation of the energy system

III. A cradle-2-grave-approach to measure the CO_2-pollution of every building in the quarter

IV. Summary CO_2 minimization concept quarter Bedburg-Kaster

V. Final learnings from 'Real-Labor' funded project Bedburg-Kaster



A project of Bedburg (municipality), RWE & E.ON/ WE

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aufgrund eines Beschlusses des Deutschen Bundestages

I. A **decarbonised**, **sectorcoupling** & **local-power** focussed energy supply **concept** with charm

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aufgrund eines Beschlusses des Deutschen Bundestages

Development (since 2022) of app 130 housing units

- 5,2 ha
- 18 single detached houses
- 38 duplex houses
- 48 terraced houses
- 5 blocks of flats
- 1 Annex Forest Kindergarten
- → of this 105 houses marketed
- over 80 owners moved in already
- certified acc. to faktor X-priniclples with lifetime CO2-footprint for whole quarter

CO_2-Footprint

	Primär-energie	CO_2	Abiotische Rohstoffe
Bedburger Modell (kalte Nahwärme)	100%	100%	100%
Stromdirekt-heizung im Bedburger Modell	115%	178%	214%
Erdgas Brennwerttherme	716%	890%	61%

Facts, Figures & Details…

- Primary energy factor r (PEF) of < 0,4
- 0,22 kg CO2 emmisions per kWh use-energy
- CO2 savings ≥ 209 t/ a resp. . 54 % CO2/ a for total quarter (wrt to heat / temperature control, electricity, illumination, mobility)
- Heat losses < 4 % (!)
- Excellent (additional) ecological key figures (a-/ biotic materials)
- 100 % „green“ Quarter electricity
- Resource-optimized supply concept
- Diminished transmission losses due to lower ΔT to soil in comparison to high temperature grid
- Option of cooling / temperature control
- Innovative approach for energy supply
- Cost efficient energy supply
- Technical - economical acceptance and feasibility
- Usage of > 94% in local RE-electricity
- Interface of energy and data from the start => possibility for true and measurable sector coupling

…and it‘s smart technical concept!

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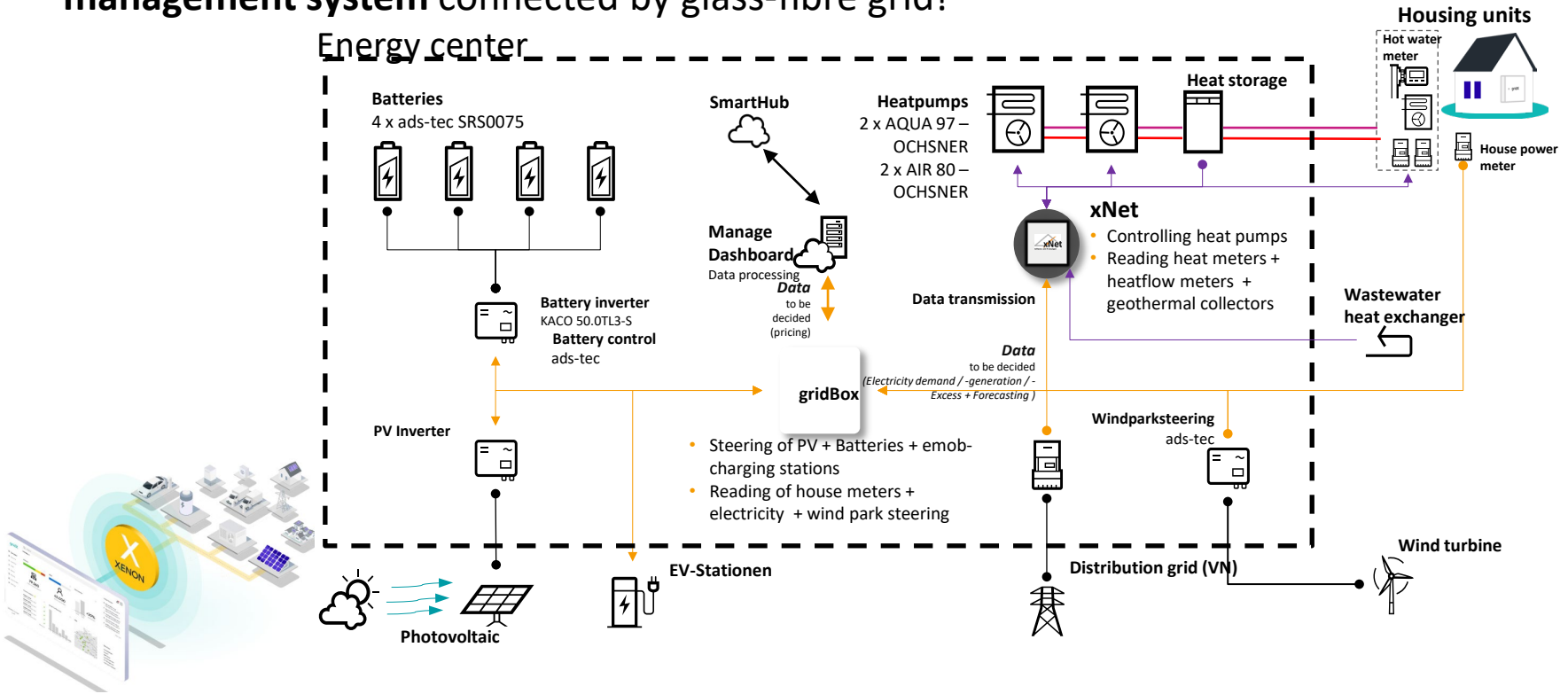
Heat-/ Cooling	• **central heat generation** via central air-source **heat pump** (5 systems of app. 80 kW_{th}) • **central heat-buffer-storage** (app. 14.000 liter total capacity) • **central wastewater-heat-usage** (main sewer line) • **central geothermalcollector area** (app. 400 m²) • Distribution of heat /temperaturcontrol via **LowEx-heatgrid** with sliding flow temperaturs (15 - 40 °C; app. 1.880 m route length) • **decentral** temperaturraising through **heatppumps** (à 8 kW_{th}) **integrated** into ca. 113 transfer stations
Electricity	• quarter-electricity concept via **customer system** i.s. of § 3 Nr. 24a EnWG • integration of **local PV-systems** • integration of wind power from local **Windturbine** (5,7 MW, Ø 17 GWh/year) • **central battery storage** (ca. 249 kWh total storage capacity)
Digital & Mobility	• **concept for e-mobility and charging infrastructure** (establishing public charging infrastructure incl. eCar- & Bike-Sharing) • **SmartHome**-Integration possible for private customers • **laying FTTH** in the quarter/ to each house • inclusion of **digital quarter management system**

II. Full real-time & bi-directional digitalisation

Digitalisation by all-encompassing **quarter digital energy management system** connected by glass-fibre grid!



III. The grave-2-cradle-approach monitored by

Factor-X Calculation: Role-Model for Assessing new builds?

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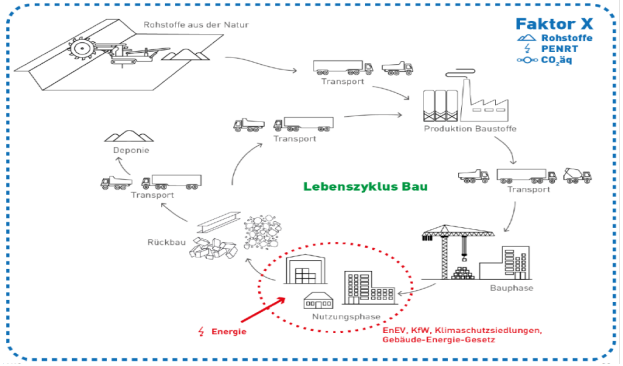
Buidling:

Simply Number Houses x Factor X!

What is Factor X? → **true climate and resource protection,** i.e. for the entire life cycle of a house (50 years), a Factor x house needs 1/x in energy, CO_2 and non-renewable raw materials (e. g. 50% less than required / standard)



Berechnung

- bezogen auf eine Lebenszeit von 50 Jahren

Gesamtergebnis des Hauses

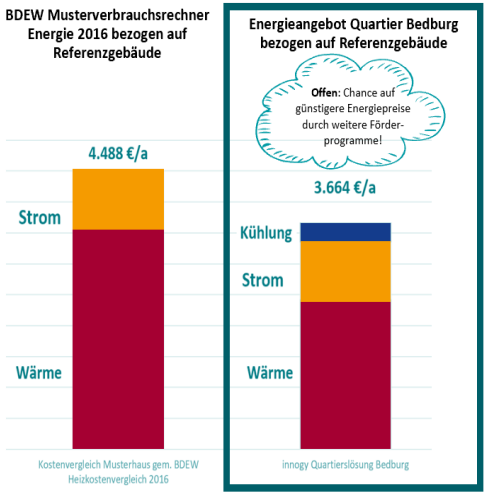
Referenzhaus: Testhaus Bedburg

Legende: ☺ Faktor 2 erreicht | ☹ Faktor 2 nicht erreicht

Ohne Energieverbrauch	Gewicht [kg]	*PENRT* [kWh]	*GWP* [kg $CO_{(2)}$-Äq.]	*RI A* [kg]	*RI B* [kg]
Mein Haus (absolut)	208.390,60	141.087,81	-1.533,68	297.856,31	112.070,51
Mein Haus (pro m^2 beheizte Wohnfläche)	1.776,56	1.202,79	-13,07	2.539,27	955,42
Referenzhaus (pro m^2 beheizte Wohnfläche)	2.511,32	1.454,47	534,79	4.591,70	13,49
Vergleich Mein Haus - Referenzhaus		☹ **1.2**	☹ **-40.9**	☹ **1.8**	**-70.8**

Mit Energieverbrauch	Gewicht [kg]	*PENRT* [kWh]	*GWP* [kg $CO_{(2)}$-Äq.]	*RI A* [kg]	*RI B* [kg]
Mein Haus (absolut)	208.390,60	192.560,32	7.703,26	378.300,95	112.070,51
Mein Haus (pro m^2 beheizte Wohnfläche)	1.776,56	1.641,61	65,67	3.225,07	955,42
Referenzhaus (pro m^2 beheizte Wohnfläche)	2.511,32	2.811,08	1.147,44	6.780,40	52,45
Vergleich Mein Haus - Referenzhaus		☹ **1.7**	☺ **17.5**	☺ **2.1**	**-18.2**

Final results = high spendings & low CO_2 savings? **NO!**



Referenzgebäude

Grundstücksfläche:	300 qm
Wohnfläche:	130 qm
Anschlusswert Wärme:	6 kW
Jahresverbrauch Wärme:	6.150 kWh/a
Kühlungsbedarf:	2.500 kWh/a
Strombedarf:	3.000 kWh/a
Baukostenzuschuss	grds in Baukosten enthalten

Unterstellt: Strom-Anbindung Windkraftanlage in Kundenanlage

Building cost acc. Expectations / experiences so far::

- Factor-x-rated buildings are generally not/hardly more expensive than conventionally built houses
- Critical for total building costs are finishing trades and selected standard of equipment
- climate- and resource-saving develop-ment and efficiency increase need not be in opposition (first non-binding marke-ting conversations of factor-x rated houses don‘t show any buyer restraints, evidence over the next months!)

CO_2 savings in the Quarter through **energy concept with sector coupling:**

209 t CO_2 / a

(compared to electrity mix D : 0,254 kg CO_2 /kWh), of this heat: 84,46 t/a; housing: 114,30 t/a; illumination: 2,54 t/a; mobility: 6,35 t/a

or alternatively:

Each family drives

6.700 km by car/ a

less!

IV. Summary CO_2 minimization concept Bedburg-Kaster:

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life-time assessment buildings

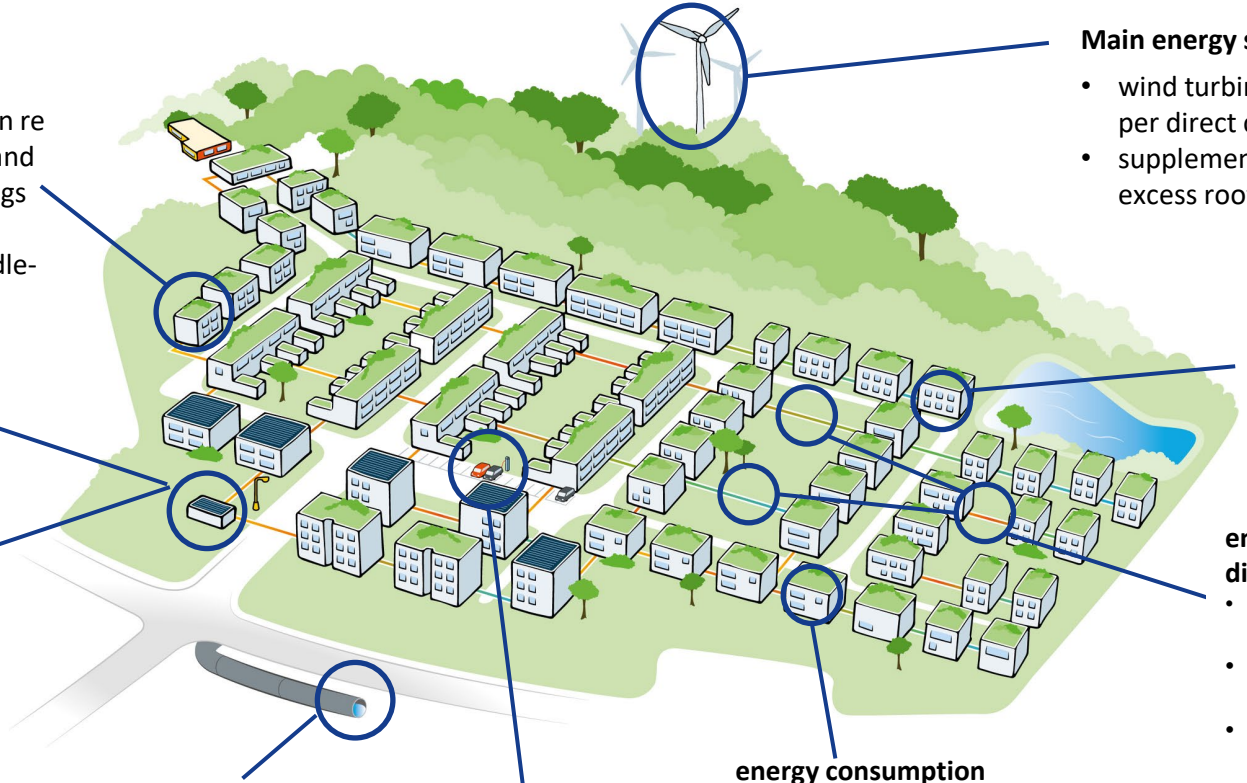
- 50% CO2 minimization re building, operation, and dismantling of buildings vs. defined reference building (grave-2-cradle-approach)

Heat source

- geothermal collector area

Energy Center

- battery storage
- transformer
- PV-system
- heat-buffer-storage
- heat pumps
- warm water storage
- digital Qqartermanagement
- fiber optic connection



Heat source

- waste water heat exchanger

E-mobility

- charging stations

energy consumption

- Monitored and steered via smart home systems connected to digital quarter energy steering system

Main energy source

- wind turbine connected to quarter per direct cable
- supplemented with PV-entry from excess roof PV collectors

decentral heatpump per house

- Enables flexible responses to local temperature needs per house

energy and data distribution

- quarter elctricity grid (customer system)
- Low temperature local heating system
- fiber optic grid

V. Final learnings from ‘Real-Labor‘ funded project Bedburg-Kaster

(as part of ‚Real-Labor‘ SmartQuart):

- Key premise: A **holistic & local approach** is essential for a successful project
- **‚Real-Labor‘ funding & process with PtJ is sufficient**, in addition scaling up by other tools (eg. BEW-funding) to fund rentability gap of future projects apparently feasible
- All stakeholders have to work **hand in hand** from the beginning
- Crucial: A **smart & locally focused technical design**
- Close **interface of energy and data** is mandatory
- **Collaboration**/ JV-structure etc. of local stakeholders and energy supplier combines diverse capacities & advantages as well customer trust
- A **grave-2-cradle approach is competitive** to short term oriented/ classical house building models
- **Collected data evidences better energy efficiency rate** than planned/ described in literature
- **Results** from similar new built projects can be **transferred** to existing properties to emphasize ‘**kommunale Wärmewende**‘

Your contact for smart housing and industrial zones:

One single contact partner

One complete solution

One community Gemeinschaft

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Back-up: Details Technical & concept figures *Resource Saving Quarter* Bedburg-Kaster

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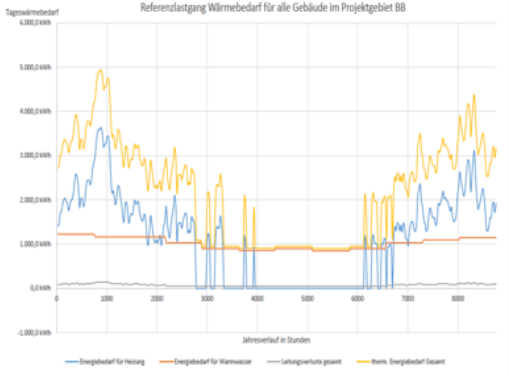
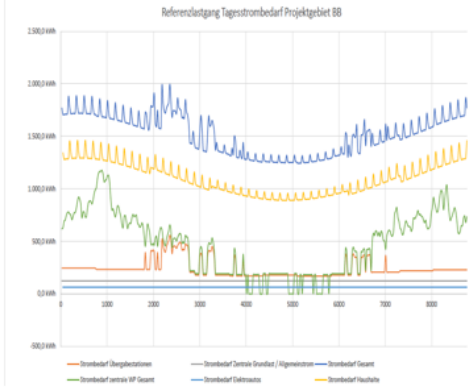
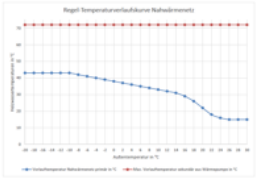
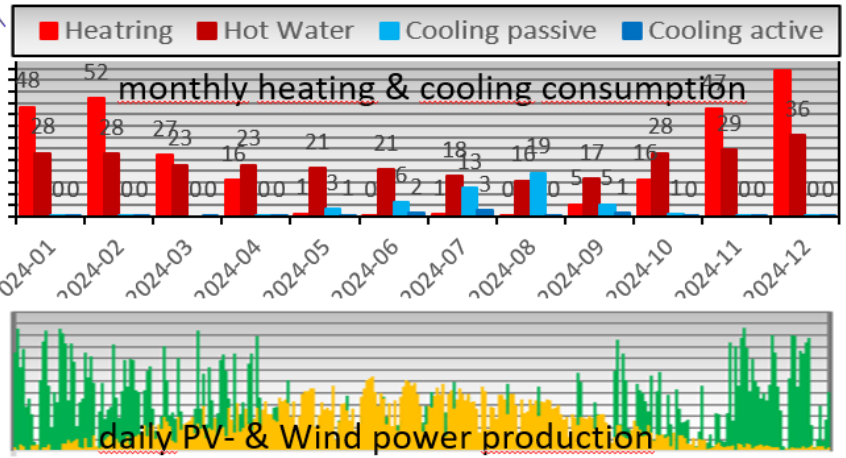
heat-/ cooling & Electricity Grid

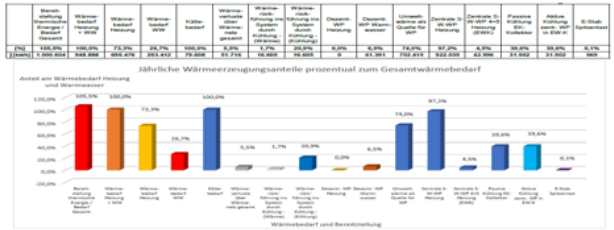
forcats load profiles energy production/ consumption

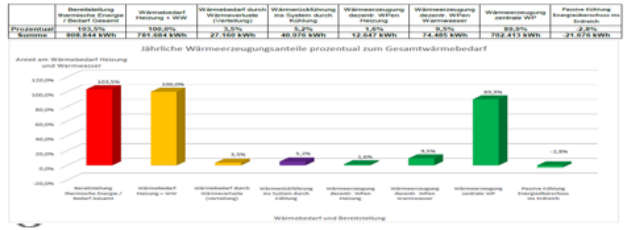












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