ExcellenceNRW
Cluster North Rhine-Westphalia

EnergyRegion.NRW
Cluster North Rhine-Westphalia

Testimonial of Hydrogen Technologies in Smart City Concepts – Example of North-Rhine Westphalia (NRW) in Germany

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Agenda

- Motivation for North-Rhine Westphalia (NRW)
- Smart City Project Examples
  - Bottrop (Innovation City)
  - Herten
  - Cologne
- Summary

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Introduction to NRW

NRW = „The Energy Region No. 1” …

… in a phase of transition

Energy

Shift from coal to renewables

Shift from centralised to distributed (renewables and CHP)

Transport

Increase of electric mobility (hybrids, battery and fuel cells)

Industry

Shift from coal mining and steel to technology, ICT, service and logistics

- Population: 18 million
- GDP: #1 in Germany, #17 worldwide
- 33 % of German power generation and German CO_2 emissions
- Coal mining (black and lignite)
- 1.1 million employees in engineering, power generation, mining industry and energy intensive industry

Challenge Renewables

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Power Grid

Power Plants

Solar, Wind, *Biomass*

(Decentralised) CHP

Power Supply System

Demand

Demand Side Management

Natural Gas Grid

Storage & New Markets

Battery

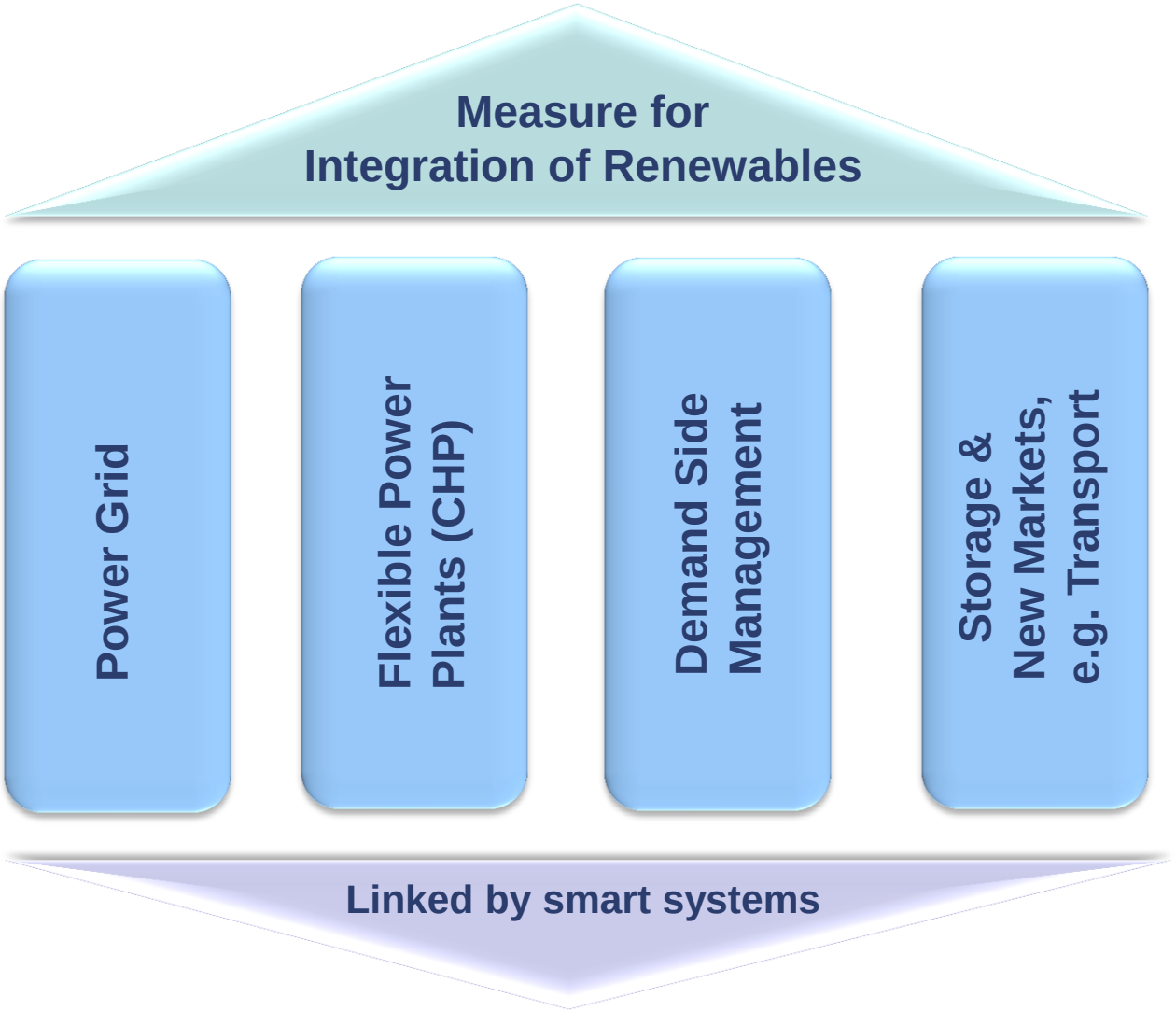
Electrolysis/ Hydrogen

Transport

Energy Use: Re-electrification, UPS, special vehicles
Material Use: Chemical Industry, Refineries etc.

Sources: LBST, CFCL, RWE, Total, Vaillant

Measures for Integration of Renewables



EnergieAgentur.NRW

Neutral, independent and non-profit organisation on behalf of the State of North-Rhine Westphalia.

Point of contact for enterprises, municipalities and private persons in the field of energy efficiency and renewable energies.

Topics with link to smart energy:

- Wind, Photovoltaics
- Storage and Grids
- Building and Housing
- Power Plant Technology
- Mobility (Fuels and Drives, Fuel Cell and H2)

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- **Non-profit organisation**, working on behalf of the NRW State Government, founded in 2000
- Regional **technology platform** to develop and commercialise fuel cell and hydrogen
- **Strategy** and **programme** development and implementation ("NRW Hydrogen HyWay")
- **Initiation** and support of co-operative **projects**
- More than 400 members, > 110 FC and H_2 projects with **115 million € NRW funding** and 190 million € expenditures initiated

+H2- Fuel Cell and Hydrogen Network NRW

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“Innovation City” Bottrop

InnovationCity Ruhr
Modellstadt Bottrop

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InnovationCity – Energy Turnaround *Bottom Up*

InnovationCity

Management

Sustainable, Holistic Modernisation of City Districts

Bottrop: Retrofitting the Building Stock

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37% of all CO_2 emissions are caused by buildings

Germany

Existing Buildings

3.400 Mio. m²

New Buildings

20 Mio. m²

Rate of Retrofitting**
in 2013 = 0,8 %

Model Town Bottrop

Pilot Area:

- 70.000 Inhabitants
- 14.500 Buildings
  - 12.500 Residential
  - 2.000 Commercial

Rate of Retrofitting**
> 2013 = 7,82 %

* IWU Institut Wohnen und Umwelt GmbH

** Leibniz-Institut für ökologische Raumentwicklung

„Die Modernisierungsrate bezieht sich auf den gesamten Wohngebäudebestand und ist der durchschnittliche Anteil (prozentual), der jährlich durchgeführten baulichen Verbesserungen die zu einer Einsparung von Energie und/oder Wasser führen. „

Bottrop: Automated Energy Management

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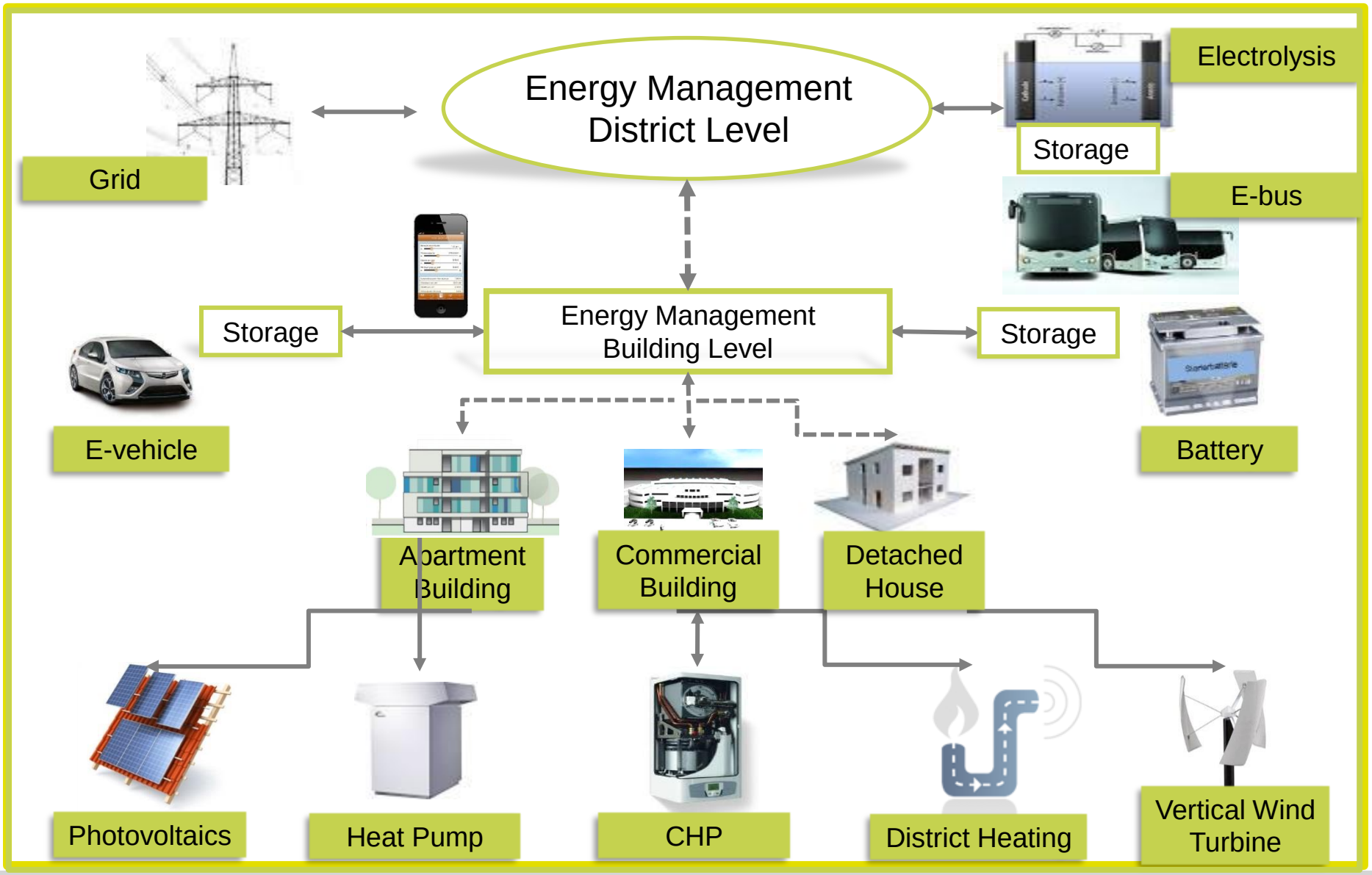

Bottrop: Extract Overview of Projects

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Retrofitting of Residential Areas	*Retrofitting of Companies*	*Regenerative Energy*	*Electric Mobility*	*Urban Development*
▪ PLUS-ENERGY-Model Houses: ▪ Detached House ▪ Apartment Building ▪ Commercial Building ▪ Social Housing ▪ Social Housing Plus Energy Building ▪ Manual Consultation Process Rheinbaben ▪ Living Lab ▪ District Management	▪ Hochschule Ruhr West ▪ Low Energy Gas-Station ▪ Welding with Solar Power ▪ Arche Noah Community Center ▪ Industrial Estates Knippenburg/ Kruppwald	▪ CHP Pilot Project ▪ Dual Demand Side Management ▪ Pumped Storage Hydro Power Station ▪ Warmth on Wheels ▪ CHP Model Municipality ▪ Smart Grid ▪ Biggest Natural Gas Heat Pump ▪ Energy system of sewage plant	▪ E –Mobility in the context of energetic district retrofitting ▪ Electric Public Transport ▪ Hydrogen buses ▪ E-Vehicles ▪ E-Trucks ▪ Rental System ▪ City Compatible Truck Routing ▪ Car-Sharing ▪ Quick Charging Station at Main Station	▪ Masterplan InnovationCity Ruhr ▪ Integrated Urban Development Welheimer Mark ▪ Photovoltaics Noise Barrier at A 42 Highway ▪ LED-Street Lighting ▪ Rain Water Management at BEST Area ▪ Cultivation of Facade Surfaces ▪ Boardwalks and Bicycle Routes

Approx. 200 Projects
Budget 235 M€

Bottrop: 100 CHP Systems

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gwi

Lab

100 Facilities installed: 85
CHPs + 15 Fuel Cells
November 2014
Budget: 6 M€

GWI
Model House

gwi

Manufacturers

CHP:
Stirling- / Otto Engine / Fuel Cell

Monitoring and Transfer

InnovationCity Ruhr
Modellstadt Bottrop

Field Test

District of Bottrop

Blueprint - from Micro to Macro Level

Ministerium für Klimaschutz, Umwelt, Landwirtschaft, Natur- und Verbraucherschutz des Landes Nordrhein-Westfalen

gwi Gas- und Wärme-Institut Essen e.V.

DVGW-
Innovationsoffensive

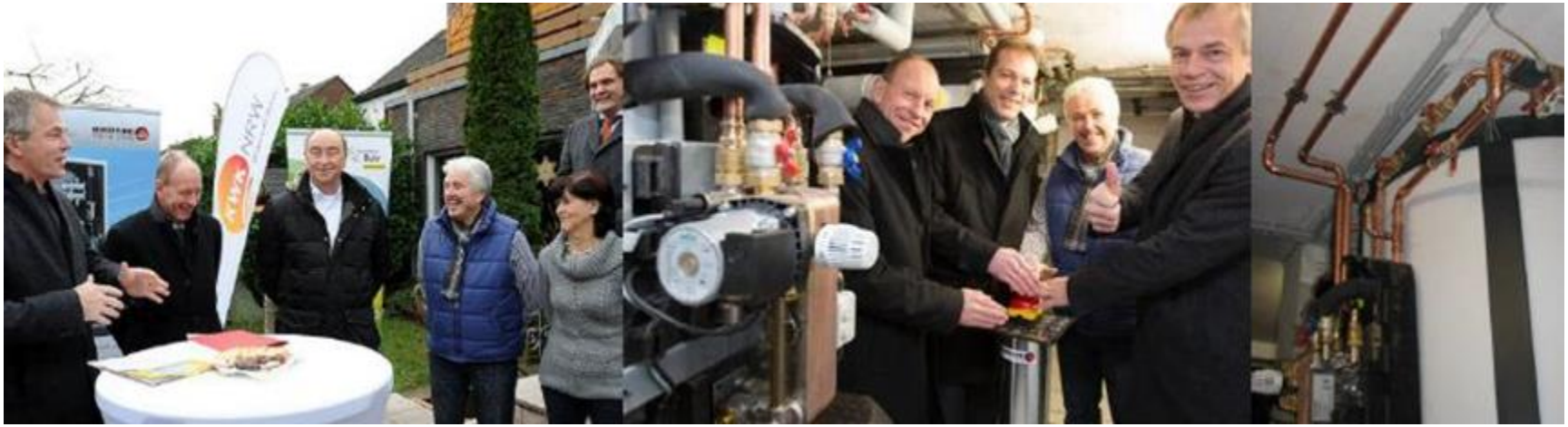
Bottrop: 100 CHP Systems – Fuel Cells

Example:

- Object: 2 families with small business
- Heating surface: 350 m²
- Year of construction: 1987
- Number of residents: 7 people
- Age of heating system: 13 years
- Energy demand before exchange: 40,000 kWh oil – 6,500 kWh power

Implementation:

- Type of system: BlueGen
- Manufacturer: Ceramic Fuel Cells
- Installer: Wilhelm Smit GmbH Heizungsbau San. Installation
- Initial operation: August 15, 2014
- Savings (calculated): reduction of CO_2 emissions by nearly 50 %



Bottrop: Hydrogen at Sewage Plant

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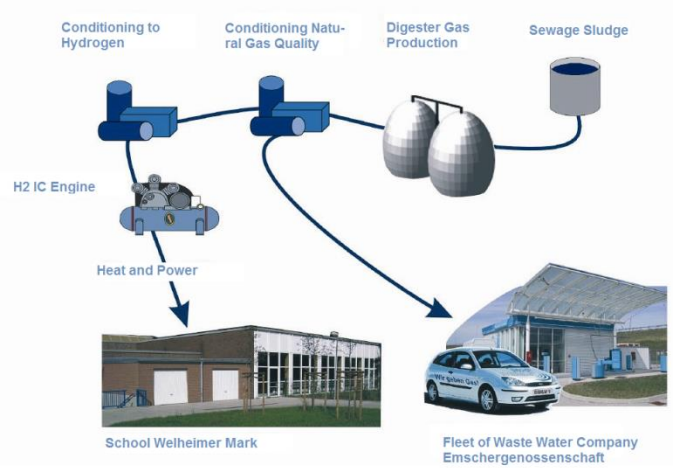
EMSCHER
EGLV.DE GENOSSENSCHAFT



EuWaK – Natural gas and hydrogen at sewage plants
Purification and reformer process
H2 production of 100 Nm^3/h
H2-ICE for school building
35 MPa refuelling station

Budget: 5.8 M€
Ongoing

Smart.Net – Smart Operation of sewage plant by using H2
3 wind power plants
H2 production by electrolyser
Power generation by H2
Link to EuWaK project

Budget: 0.6 M€
Ongoing (feasibility study)

Minibus Project Northern Ruhr area
2 Tecnobus/Hydrogenics
85,000 km; 3 to H2

Budget: 0.75 M€
Completed

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Herten: Energy System with Electrolysis

Wind power electrolysis in H2 Application Center Herten (NRW)

Quellen: h2-netzwerk-ruhr

Location: Herten (Ruhr area)

Budget: 3 M€

Duration: 2009 - 2025

Content: Net autonomous power supply of technology centre with wind energy via electrolyser, battery and fuel cell

Intelligent control and regulation for linked operation of system

Partners: City of Herten, University of Applied Science Gelsenkirchen, Evonik, Hydrogenics, Linde, Gustav Klein, Saft, Vako

Status: Operation started in 2013

Next: Gaining of experiences, optimisation of system, transfer to other applications

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Cologne: Smart City that “GrowSmarter”

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smartcity cologne

Stadt Köln

RheinEnergie

RVK
Regionalverkehr Köln GmbH

Location:	Cologne
Idea:	Smart City Cologne to reduce climate emissions and energy consumption
Major Project:	EU project **“GrowSmarter”** with Stockholm and Barcelona
Content:	Sustainable energy management, transport and mobility for environment and society linked by ICT Electric mobility, car sharing Energy storage Virtual power plants
Partners:	City of Cologne, local utility Rheinenergie
Status:	To be started in 2015
Comment:	H2 and FC buses already deployed in neighbouring cities → to be deployed in Cologne (?)

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Summary

Activities of EnergieAgentur.NRW:

- Strategical framework (renewable) energy, transport and their linkage
- Advice on technology, partner acquisition and funding

Perception of hydrogen and fuel cells:

- Hydrogen will become important: for energy strorage, as fuel, for other purposes
- Fuel cells are characterised by high efficiencies and allow flexible operation
- Positive impacts on climate change, energy consumption as well as economy

Concrete Suggestions for cooperation:

- Demonstration (and R&D) activities still needed
- Framework has to be improved, e.g. financial and non-financial incentives
- Increasing awareness on the role of HFC towards politics and the public

Thank you for your kind attention!

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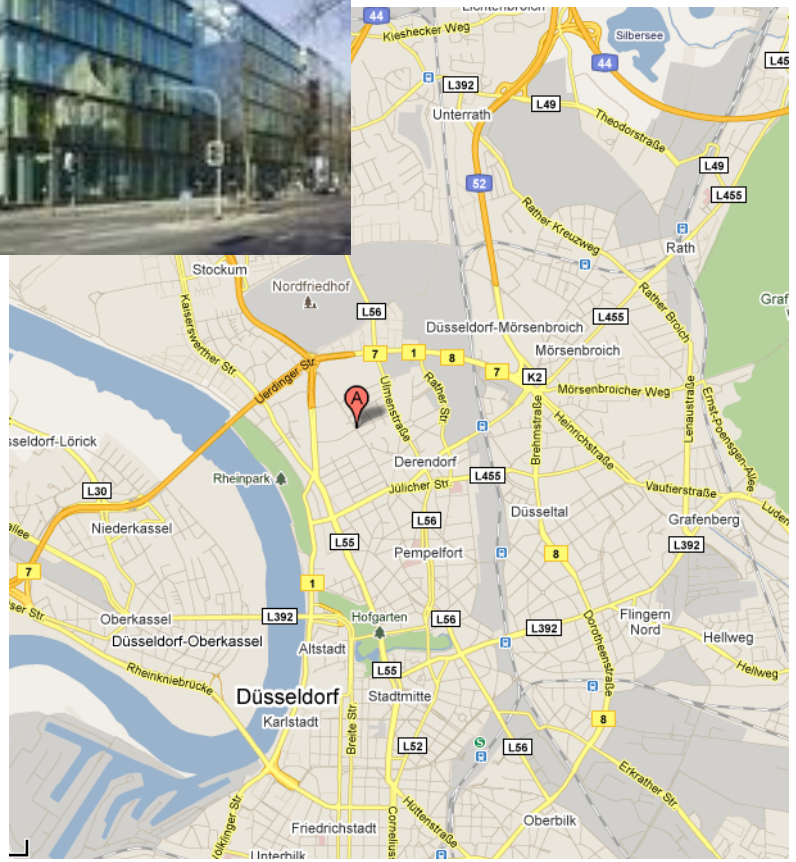

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