Federal Ministry for the
Environment, Nature Conservation
and Nuclear Safety

RECOGNISING THE POTENTIAL
OPTIMISING PROCESSES
CREATING ADDED VALUE

Zero emissions

EMISSIONS

IMPRINT

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1. MANAGEMENT CONCEPT

1.1. ZERO EMISSIONS

From vision to strategy

The basic idea behind any ”zero emissions strategy“ is to close material and energy cycles completely. There are two ways of achieving this aim: a) using materials as the basis for new products, within relevant industrial / business / life cycles, and b) returning materials – completely – in natural form, to their natural substance cycles (for example, returning clean, unpolluted water to the water cycle).

Any optimisation and restructuring of material and energy cycles needs to take account of all levels and sectors of our economic system, throughout a full spectrum that includes product and product design, companies and municipalities and regions. Only a holistic, regional perspective, taking account of all stakeholders – including companies, households, the public sector, the agricultural and forestry sectors, etc. – can capitalise on all available synergies and options. With such a perspective, problems turn into potential, and expenditures become investments.

In such a perspective, a relevant existing system – such as a city or an entire region – is viewed as a ”company“, with many different products, processes, stakeholders and material streams. In each case, the aim is to manage such a ”company“ in such a way that enhanced resources-efficiency boosts added value in the system (city or region) in question. The necessary technologies for optimising the material streams in such systems are available. The issue is not one of whether ”zero emissions“ systems are technically feasible; it is one of why, in so many cases, such systems are not yet being actively sought. The task of implementing a zero-emissions strategy is thus primarily a management problem.

New management concepts are needed, therefore. Key basic approaches are already available, from the areas of environmental and quality management (EMAS, ISO 9000, TQM, etc.), that can be applied to material-flow analysis and to relevant documentation. They are built around the idea of ”zero errors“ as the aim of a continuous improvement process. Zero-emissions strategies apply that idea as well.

A range of authors have described the basic foundations for implementing such strategies. McDonough and Braungart[1], for example, emphasise the advantages of an economy whose organisation covers the spectrum ”from cradle to cradle“. In such an economy, everything is reused or recycled, and misdirected resources are integrated within suitable cycles. ”Added value“ is generated from everything. Gunter Pauli[2] formulates the idea of an emissions-free economy, i.e. an economy of closed production cycles that may be likened to the natural substance cycles in our ecosystem.

In the 1980s, the idea of ”industrial ecology“, applying to industrial sectors and entire industrial parks, was developed in the U.S.. One example of a model project that applies that idea is the eco-industrial park in Kalundborg (Denmark), in which all material streams – especially those between all companies – have been optimised. For biomass material streams, the Güssing region in Austria provides a good example. That region has achieved near perfection in generating regional value creation via intelligent material-flow management.[3]

1 McDonough, William/ Braungart, Michael. „Cradle to Cradle: Remaking the Way We Make Things”. North Point Press, 2002.

2 Pauli, Gunter. „UpCycling: Wirtschaften nach dem Vorbild der Natur für mehr Arbeitsplätze und eine saubere Umwelt“. Chronik Verlag im Bertelsmann, LEXIKON Verlag GmbH, 1999.

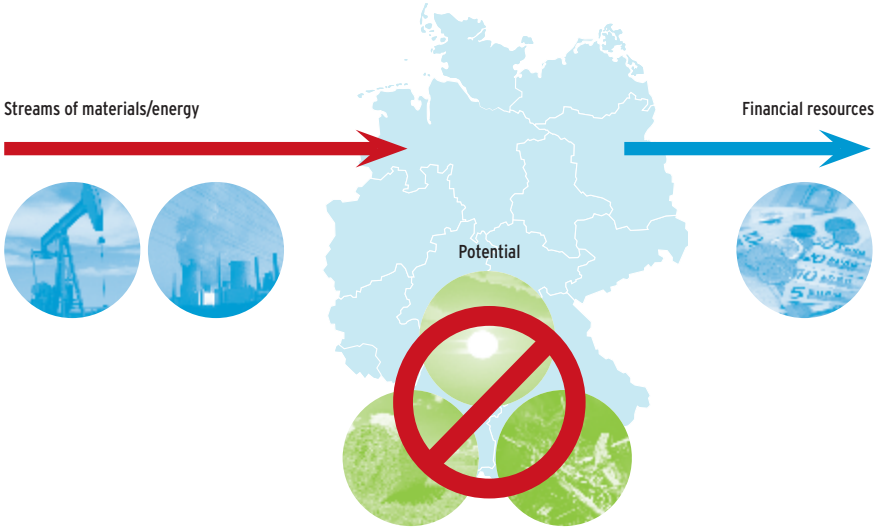


Fig. 1: No „material-flow management" – regional value creation does not stay in the region

The concept of a "zero-emissions village"[4],which originated with the Institut für angewandtes Stoffstrommanagement (IfaS; Institute for Applied Material-Flow Management), highlights the opportunities for implementing zero-emissions strategies in complex systems such as municipalities, cities and regions. The aim of "zero emissions" thus provides the basis for innovative management concepts – for companies, and for all relevant levels, from individual companies to industrial / commercial parks and to entire municipalities, cities and regions.

1.2. RECOGNISING THE POTENTIAL

Material-flow analysis

Regional considerations of material and energy streams, especially those outside of population centres, often produce the same general result: many of the products and fuels required by the region in question are delivered from outside (from national and international sources), and little relevant value creation takes place in the region. For example, the region's energy sector depends on expensive imports, making far too little use of the region's own pertinent potential and resources.

Zero-emissions strategies call for recognising regional available potential. Such potential can include potential for reducing consumption, for closing existing production cycles and for using renewable energies.

To be successful, relevant management must be based on a precise understanding of the applicable framework and processes. Such management thus must be based on analysis and assessment of the material and energy streams within the system in question (in its current state).

Such analysis considers aspects such as:

- Waste and residual materials produced by households, industry and commercial operations,
- Wastewater, and substances resulting from wastewater treatment, such as sewage sludge,
- The many types of biomass produced in agriculture and forestry, and in landscape management, and
- The relevant fuels and energy sources, including fossil fuels, and including renewable energies such as solar energy, wind power and waste heat.

The analysis begins with the "large" material streams, sited on the regional level, and then moves gradually, in keeping with the relevant focuses, to lower levels, even down to individual processes.

The key aspect of the material-flow-management approach, in contrast to traditional environmental management approaches, is the extent of the analyses involved. Along with quantitative and qualitative identification of all relevant material and energy streams, the material-flow approach also calls for determining the relevant direct and indirect costs, causal interrelationships and responsible stakeholders.

3 For further information about the projects of the European Centre for Renewable Energy (EEE) in Güssing (southern Burgenland), cf. http://www.eee-info.net/cms/.

4 Heck, Peter. „Energie- und Stoffstrommanagement als Basis für eine CO_2-neutrale Verbandsgemeinde der Westpfalz: Zero Emission Village Weilerbach". In: Heck, Peter/ Bemmann Ulrich „Praxishandbuch Stoffstrommanagement 2002/2003", Deutscher Wirtschaftsdienst, 2002.

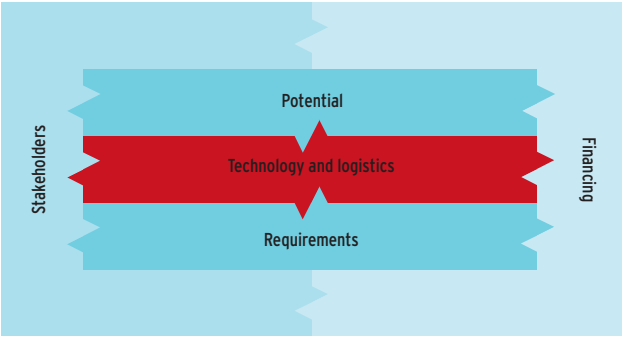


Fig. 2: Key elements of material-flow management

1.3. OPTIMISING MATERIAL STREAMS

Management approach

Once the relevant potential has been analysed, the management process turns to its real focus: the optimisation process, including preparation of a target concept. Like the material-flow analysis, the process must consider five main aspects:

- The material and energy requirements that are behind the material streams, requirements that manifest themselves primarily in measurable consumption of the materials being studied,
- Any relevant sources, whether used or not used (= potential), of material streams,
- The technology and logistics linking potential sources with requirements (existing and available),
- Directly or indirectly relevant stakeholders,
- The financial resources required for implementation, and all planning and organisational activities required to obtain them.

The results of this process are combined within a material-flow-management master plan. The master plan defines business plans for the various individual projects and measures, and it serves as a guide and navigator for a zero-emissions strategy. At the same time, the master plan is not a static construct; it is continually refined within the framework of an ongoing improvement process. This process especially clearly highlights the difference between efficient "administration" and active "management". The management process includes regular control cycles in which target achievement is reviewed and planning and measures are adjusted as necessary.

In contrast to environmental management, which is usually confined to the area of actions immediately related to operations, the management approach presented here is oriented to all processes and stakeholders in a region. On this level, the possibilities for influencing the various individual stakeholders are more complex and multi-layered than they would be in a company. For this reason, new pathways have to be taken: management and control are based on the co-operation and communication. Close co-operation between all relevant stakeholders is the basis for successful implementation.

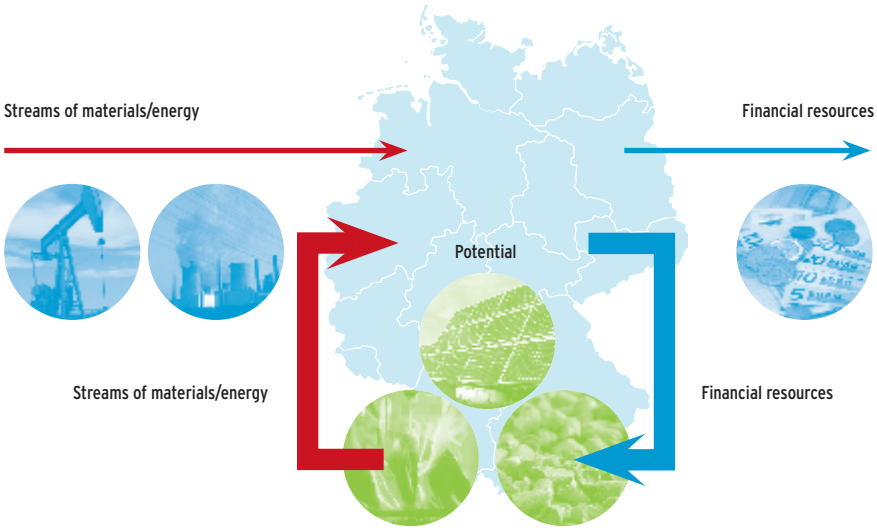


Fig. 3: Material-flow management – regional value creation stays in the region

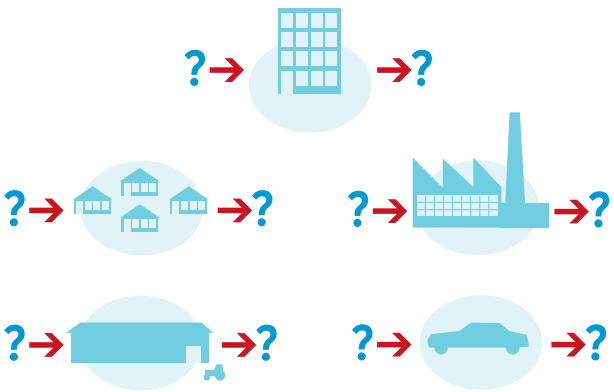
1.4. CREATING ADDED VALUE

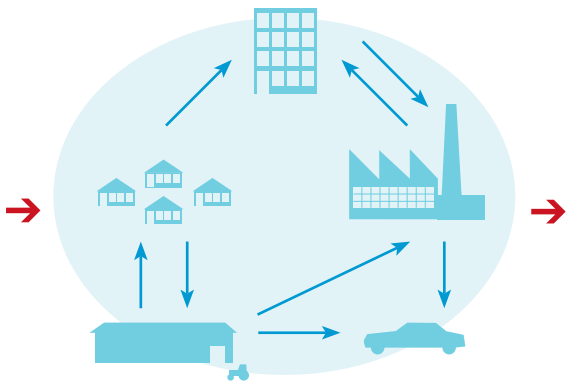
Regional value creation

Value creation is what drives our economy – and it is one of the pillars of the "zero-emissions" management concept. In a regional context, generated added value does not necessarily have to be in a monetary-only form. It can include aspects such as protection and sustainable development of our cultural landscape; innovation; image; and protection and enhancement of the quality of life, as basic conditions change (for example, under demographic change).

When a region's material and energy streams are closed, the region's related financial streams remain within the region. The innovative technologies needed for using regional potential call for additional workforce capacities – often, highly qualified persons – and thus tie up capital. But with efficient management of regional material streams, products and services can usually be offered more reasonably, with no job losses and with higher capital in-flows. Savings resulting from reduced energy consumption, for example, directly benefit regional economic cycles.

"Zero emissions" is thus much more than just a new approach in environmental and climate protection. "Zero emissions", and the related idea of a complete close-cycle economy, provide the basis for sustainable economic and industrial policies, and for promotion of innovation-related modernisation, with a special focus on small and medium-sized enterprises (SMEs).





2. NATIONAL PROJECT EXAMPLES

A number of highly ambitious and exemplary "zero-emissions" projects have emerged in Germany (all of these projects may be termed "zero-emissions" projects, even though not all of them are explicitly oriented to a goal of "zero emissions"). The following section presents a number of these projects. Others are listed in the annex, for readers interested in conducting research of their own.

2.1. THE BIRKENFELD ZERO-EMISSION CAMPUS

The Birkenfeld Environmental Campus, a branch location of the Trier University of Applied Sciences, is among the most successful conversion projects in the state of Rhineland-Palatinate. Along with an ecologically oriented construction concept, the "Zero Emission Campus" has CO_2-neutral energy, heating and cooling systems and state-of-the-art building services systems.

All (100 %) of the Campus' basic energy needs are met through renewable energies (organic waste from two administrative districts). In addition, extensive use of ecological construction materials was made in conversion of the facility's former hospital structures and in new construction.

Rainwater is collected in troughs and infiltration ditches and used for toilets, air-conditioning systems and wet biotopes.

Many additional energy-saving and energy-generation technologies have been integrated within the concept:

- Large photovoltaic systems, mounted on building rooftops and on facades,
- A large solar-thermal system on the roof of the "central new building" ("Zentraler Neubau"),
- A central ventilation system, with integrated heat recovery, and with air preheating using earth-mounted collectors,
- "Transparent heat insulation" in the "central new building",
- Energy-saving lighting systems, with motion sensors,
- Waterless urinals, in sanitary facilities, that help minimise water consumption,
- Energy-efficient dormitories meeting "low-energy-use" ("Niedrigenergie-") and "passive-house" standards, etc..

Numerous additional measures have been approved for 2009 (thin-film photovoltaic modules for east and west roofs, LED lighting systems, electromobility, etc.). Under the direction of the IfaS (Institut für angewandtes Stoffstrommanagement – Institute for Applied Material-Flow Management), which is located on campus, an innovative, sustainable waste-management and wastewater-management system is to be implemented for the campus.

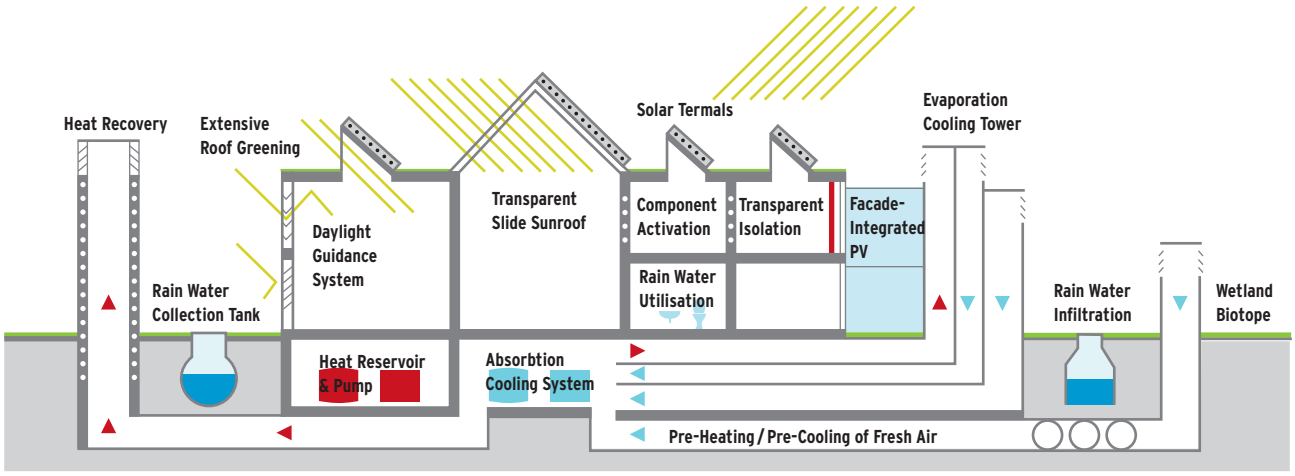


Fig. 4: Design, function and technology– schematic overview of the green building-services systems for the Umwelt-Campus

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2.2. THE JUWI GROUP: ZERO-EMISSIONS OFFICE BUILDING

With annual revenue of some EUR 400 million (2008), the juwi Group is a leading company in the area of renewable energies (wind energy, photovoltaics, biomass systems, water power and geothermal energy). juwi, with a global workforce of some 550 people, covers the entire value-creation chain in its services sector – including site acquisition, planning, project engineering, financing, implementation and operational management (both commercial and technical).

In July 2008, the juwi Group moved into a new headquarters in Wörrstadt (in the Alzey-Worms administrative district). The new office complex, which has been built of certified spruce, has some 8,500 m^2 of floor space, enough for some 300 persons. All aspects of the building's design and furnishings are in line with criteria for energy-efficient construction. The building's heating-energy requirements, pursuant to the Passive House Planning Package 2007 (PHPP 2007), amount to 12.6 kWh/m^2. They are met with the help of highly efficient ventilation systems and highly effective thermal insulation.

All of the building's energy needs are met via renewable energies. A number of photovoltaic systems, mounted on the building's roof and facade, and on the facility's covered parking area, generate more energy – some 220 kW – than the facility needs. An energy-management system monitors the building's consumption at all times, and it activates and deactivates consumer systems as necessary, in accordance with a graduated management plan that reflects their assigned priorities. An "energy cabin", powered with both solar energy and bio-energy (wood pellets), provides environmentally friendly heating for the building complex, etc..

The facility's cooling water (about 115,000 l), which circulates within a closed system, can be fed to a sprinkler system if necessary in case of fire. Vacuum toilets also help minimise water consumption;– they require only about one-half litre per flush.
For mobility purposes, the facility relies on conventional, internal combustion vehicles, with low fuel consumption, and on electric cars, which can be recharged at the company's own "solar-power petrol station". Parking bays at the company's headquarters are equipped with carports whose roofs are covered with thin-film solar modules.

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2.3. SOLVIS: "ZERO-EMISSIONS FACTORY"

The firm of Solvis, located in Brunswick (Braunschweig), is the European market's technologically leading manufacturer of solar-heating systems and solar absorbers. In 2002, in the interest of making its production more environmentally friendly, the company built a zero-emissions factory.

The structure, with floor space of some 8,600 m², is rectangular, and laid out as a hall with integrated administrative areas. The roof and various pylons are used as supports for photovoltaic and collector systems. In addition, the structure has excellent thermal insulation: 12 cm for floors, 24 cm for outer walls and 36 cm for the roof. All windows, and all of the building's skylights, are triple-glazed. Those features, in combination with the building's layout, maximise daylight use, thereby further reducing power requirements.

The facility's energy needs are met via solar energy and a rapeseed-oil-fired combined heat and power (CHP) unit. The solar-energy system, which has a surface area of some 1,200 m², generates a total of 130 kWp. Most of the modules are mounted on pillars on the main building. Modules representing some 24 kWp of capacity are mounted on the roof over the bicycle parking area, while 20 kWp of capacity are mounted on 8 single-axis solar trackers. The remaining capacity, 100 kW, is provided by the CHP system, which also has a heating output of 160 kW. A total of 180 m² of flat collectors, affixed to the building's roof with the help of pylons, also help to meet the facility's heat needs. The overall ecological concept for the facility also includes controlled ventilation systems with heat recovery and vacuum drainage.

Original calculations called for the photovoltaic system to have an area of 560 m². In 2007, the system was expanded to meet additional power requirements resulting from use of laser-welding systems for absorber production. In 2009, a building addition measuring 5,400 m² was constructed. To meet the resulting increased power needs, the photovoltaic system was then enlarged by 2,000 m², and a long-term thermal storage system containing 100,000 litres was added to support the facility's heating systems. Those moves eliminated the need for an expansion of the CHP system. Currently, additional office space, and a training centre, are being built on a plot of some 1,000 m². In comparison with comparable conventional industrial structures, the facility's energy and water requirements have been reduced by some 75 %.

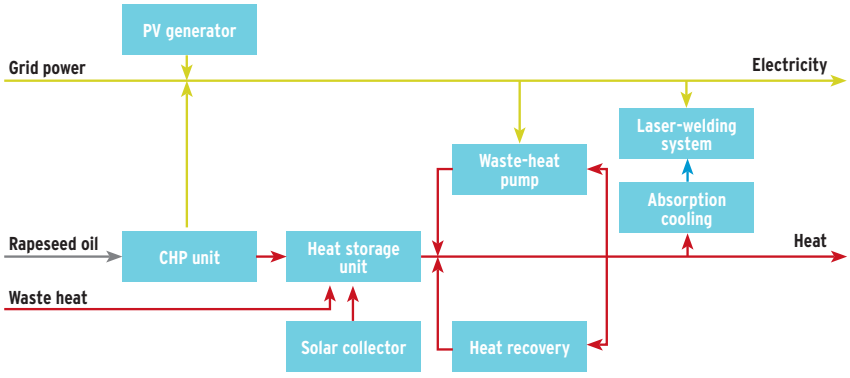

Fig. 5: Schematic overview of the energy-supply network for the Solvis facility

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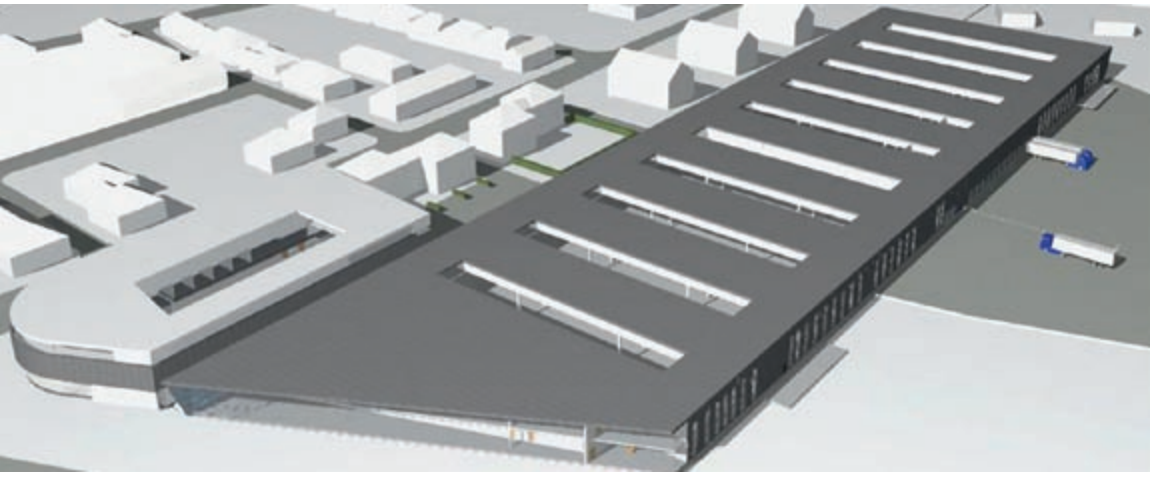
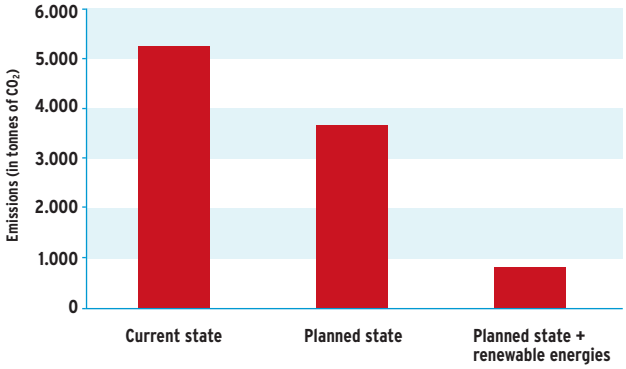


2.4. DEENET: CO_2-NEUTRAL FACTORY

The "CO_2-neutral factory" project has shown that the technologies and instruments needed for climate-neutral production – within an economically sound framework – are already available today. In the approach applied, energy-efficiency measures, innovative building services and renewable energies take precedence over measures to offset emissions.

Under the direction of the "Kompetenznetzwerk dezentrale Energietechnologien" ("Competence Network for Decentralised Energy Technologies"; deENet), located in Kassel, a consortium consisting of the University of Kassel's department for "environmentally compatible products and processes" ("Umweltgerechte Produkte und Prozesse"), the Zentrum für Umweltbewusstes Bauen e.V. ("centre for environmentally aware construction") and the firm of Seeger Engineering AG has developed a method with which companies can achieve CO_2-neutral production. The relevant procedure has been demonstrated in the construction of a new factory for photovoltaic inverters, for the firm of SMA Solar Technology AG.

Direct CO_2-emissions reductions can be achieved via efficiency measures within factories – such as measures oriented to their machines, to their buildings and to their buildings' energy-supply systems. Other measures focus on the areas of product development and purchasing. Companies can also make significant climate-protection contributions by selecting CO_2-efficient materials and preliminary products. Such selections can inspire suppliers and linked processors to operate in more climate-friendly ways. Unavoidable remaining CO_2-emissions can be offset via additional investments in renewable energies, via support for climate-protection projects and via voluntary participation in emissions trading schemes.



The efficient production processes in SMA's climate-neutral factory are powered solely by renewable energies. The basic concept includes a building skin meeting "low-energy-house" ("Niedrigenergiehaus") standards, an integrated photovoltaic system with an output of over 1 MW and use of biogas from a regional biogas facility. SMA also uses gas-fired combined heat and power (CHP) units to generate heat and electricity. In the summer, the CHP units' waste heat is used, via an absorption cooling system, for cooling purposes. In the winter and in transition seasons, process waste heat is used to warm fresh air circulated throughout the facility. In addition, natural ventilation systems, and natural and daylight-guidance lighting systems, are used.

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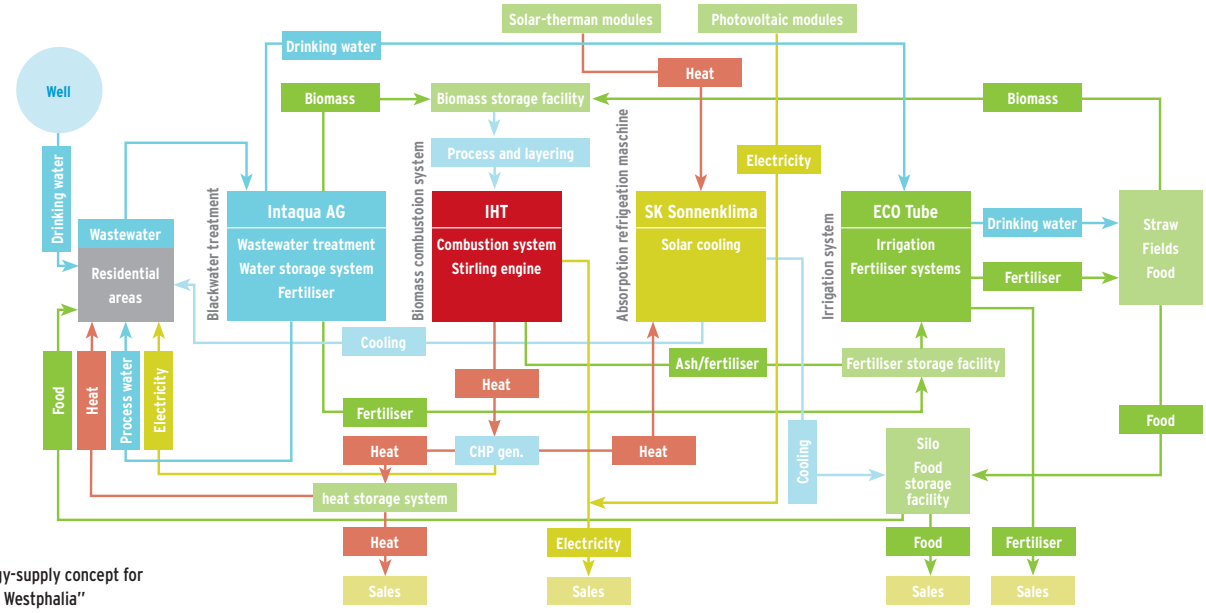

Fig. 6: Energy-supply concept for "Greenmine Westphalia"

2.5. GREENMINE WESTPHALIA: HIGH TECH FROM SMEs

For companies in the city of Ahlen, Zeche Westfalen, a coal mine in Ahlen that was decommissioned in 2000, has turned out to be the crystallisation point for innovative structural change. The "greenmine Westphalia" complex is being developed in accordance with the Zero Emissions Research and Initiatives (ZERI) approach to systemically networked, sustainable development. The SME association "Mittelstandsinitiative Ahlen GmbH" (MIA) and the ZERI Germany chapter of the ZERI network understand the term "zero emissions" to mean "zero waste of natural and human resources". They are aiming for "upcycling", i.e. higher resources productivity, greater value creation and higher employment. Via regional material-flow and cluster management, MIA is working to identify innovative zero-emissions project ideas and technologies and to review them for transferability. By encouraging relevant company affiliations and attracting relevant new companies, the region is growing stronger and positioning itself as a model region for Germany. The MIA company network is boosting regional economic structural change via high technology "Made in Germany".

A first step toward conversion of the Zeche Westfalen complex into a zero-emissions facility was made by installing an ecologically compatible heating system for the facility's "innovation centre". A 300 kW wood-chip furnace supplies renewably generated heat for the building. The system, which is CO_2-neutral, supports regional agriculture and regional value creation.

MIA takes stakes in innovative companies and supports them in discussions with investors, in their strategic development and in global distribution of their

products. A case in point is the firm of SK SonnenKlima GmbH, located in the Zeche Westfalen complex. That firm has developed a solar-powered absorption-refrigeration machine that uses solar heat as energy for cooling. The system is suitable for completely stand-alone operation, and it produces no emissions. The machine has been tested in over two dozen pilot projects, covering a great range of areas and climatic conditions. Such machines are now being used to provide solar-powered cooling to facilities such as Berliner Ärztehaus am Rheineck, a medical-centre building listed in a historic register, and in the museum of the Haribo company's plant in Uzès, southern France. In those facilities, the system is demonstrating its capability to provide safe, reliable CO_2-neutral cooling even for highly demanding applications.

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www.mia-itc.de

2.6. THE WEILERBACH "ZERO EMISSION VILLAGE"

"Think globally, act locally" – that motto for sustainable development served as one of the guidelines for the Weilerbach "Zero-Emissions Village" project ("Zero-Emission-Village Weilerbach"; ZEV). In 2001, Weilerbach, an association of municipalities located in Germany's West Palatinate region, conceived the idea, in co-operation with Institut für angewandtes Stoffstrommanagement (IfaS; Institute for Applied Material-Flow Management) and the Landeszentrale für Umweltaufklärung (LZU; state centre for environmental awareness) of the Ministry for the Environment and Forestry of the state of Rhineland-Palatinate (Ministerium für Umwelt und Forsten Rheinland-Pfalz; MUF), of making the entire association's energy supply as CO_2-neutral as possible. It was seen that optimisation of the region's material streams, and efficient use of regional resources, would both contribute to global climate protection and enhance value creation in the region.

A project study carried out by IfaS from March 2001 to June 2003 showed that a CO_2-neutral, 100% renewable energy supply for the association's 14,700 inhabitants could be achieved solely with the region's own renewable energy resources and identified energy-saving potential. Backed by intensive public relations, and a network of regional stakeholders (the association, utilities, farmers, private persons, etc.), a diverse range of projects was developed and implemented, including the following:

- Five wind turbines (5 x 2 MW),
- Four district heating networks (for over 350 residential units) that draw their energy from biomass,
- Over 50 small combustion systems (burning wood in such forms as pellets, wood chips, and cord firewood) in private households,
- Over 100 photovoltaic systems, with a total output of some 650 kWp,
- A total of 250 solar-thermal systems, with a total collector area of over 2,200 m^2, and
- Energy-efficiency renovation of all primary schools, for average heat-energy savings of 50%.

Building on its success to date, the Weilerbach municipalities association continues to drive improvement in this area, in an effort to optimise its material streams in accordance with the "zero-emissions" ideal. Examples of relevant ongoing efforts include planning for numerous other co-ordinated projects, such as a biogas facility, additional district-heating networks, expansion of photovoltaic use and successive introduction of electromobility. Such planning is being supported numerous individual initiatives, as well as by start-ups such as a new "bioenergy farm" for providing energy from the agricultural and forestry sectors.

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Verbandsgemeinde-verwaltung Weilerbach

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2.7. KAISERSLAUTERN: "ZERO-EMISSIONS DISTRICT"

Over the past few years, the Kaiserslautern administrative district (Landkreis Kaiserslautern), inspired by an initiative of the Weilerbach municipalities association, has developed a "zero-emissions district" goal.

Since 2005, the district, working in close co-operation with regional energy advisors, has provided initial advising relative to climate protection and promoted energy savings by private households and building owners, etc.. The district has also been conducting a broad-based information and public-awareness programme.

In addition, the district has been promoting development of specific concepts for energy-saving and for energy efficiency in commercial facilities, in close co-operation with local stakeholders. The district works with local financial-services providers in developing financing instruments and incentives for promoting relevant projects (including instruments such as micro-contracting and regional energy funds).
In addition, the district is initiating the establishment of a "Zero-emissions Agency" (working title). The new agency will be charged with implementing and refining the district's "zero-emissions" strategy, a task that will especially include the following actions:

- Identify all planned, ongoing and completed measures and studies relative to climate protection, use of renewable energies and material-flow management, and summarise the resulting findings,
- Update the zero-emissions strategy on the basis of the latest findings, define short-term, medium-term and long-term goals, and plans for attaining such goals, and incorporate the results in a "zero-emissions master plan",
- Initiate implementation of mature project ideas, and support such implementation,
- Continually develop new project outlines and ideas,
- Build and guide local networks of stakeholders, etc..

Initial steps have been taken, in co-operation with the City of Kaiserslautern, the Donnersbergkreis district (a neighbouring district) and the municipalities associations in the Kaiserslautern district, to establish an energy-management system for municipal buildings and facilities.

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3. INTERNATIONAL PROJECT EXAMPLES

3.1. OSTIM GREEN BUILDING: PROTOTYPE FOR A ZERO-EMISSIONS PARK

The Ostim industrial park, located near the Turkish capital of Ankara, houses some 5,000 companies. The industrial park's management has announced an intention to convert the existing complex into a zero-emissions industrial park.

A first step toward this aim has been taken via the construction of a new, highly energy-efficient administrative building. The OSTIM green administrative building was designed in accordance with "platinum-class" criteria for certification pursuant to the Leadership in Energy and Environmental Design (LEED) rating system and the ecological building-design criteria developed by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE). The platinum class is the highest of four LEED classes (platinum, gold, silver and bronze) that the United States Green Building Council (USGBC) uses for certification of energy-efficient buildings. Within the platinum class, the OSTIM green administrative building is to be assigned to the "major retrofit" category, which is applied to buildings converted into green buildings during their design phases.

The key criteria for classification in one of the four LEED classes fall into the following six categories:

- Characteristics of the region and of the construction site,
- Water efficiency,
- Energy efficiency and greenhouse-gas emissions,
- Construction materials and resources,
- Air quality in interiors of buildings, and
- Creativity and innovation in the design process.

The OSTIM green administrative building is Turkey's first commercial building built to the "low-energy" (Niedrigenergie) standard. The Ostim administration company, therefore, is expecting it to serve as a model for other commercial buildings in Turkey.

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Further information:
www.ostim.org.tr

3.2. MASDAR: OIL IS GIVING WAY TO THE SUN

Masdar-City, a planned development sited about 30 km east of Abu Dhabi, the capital of the United Arab Emirates, is to be the world's first zero-emissions city; it is being designed to produce neither CO_2 emissions nor waste.

The United Arab Emirates have long been well aware that their fossil energy resources are finite, and thus they have long been taking steps to prepare for a future with no oil. In the interest of staying in the energy business, they plan to convert themselves into a world-leading centre for clean energy. Along with the "Masdar Institute of Science and Technology", a technical university devoted exclusively to research and teaching in the area of renewable energies, Masdar-City will house the world's largest solar-thermal power station. That facility, which will cover an area equivalent to 500 football pitches, will supply the city's 50,000 inhabitants with environmentally friendly light and cooling.

Abu Dhabi began construction on Masdar-City in February 2008. The Arabic word "masdar" means "source", and the new city is expected to open the way to global success with renewable energy technologies "made in Abu Dhabi". The volume of investments in Masdar, which will cover an area of 6 km^2, amounts to some 22 billion US$.

Masdar is a prestige project designed to help Abu Dhabi become a global centre for renewable energies. Masdar is expected to bring together researchers, training programmes, investors and entrepreneurs, to be a sort of "Silicon Valley" for the field of renewable energies. And it will be built around the world's first technical university devoted exclusively to renewable energies. In addition, Masdar will seek to attract some 1,500 "green" companies to the local area.

In the transport sector, electromobility and a maglev (magnetic levitation) tram, connecting Masdar with Abu Dhabi, are planned.

In comparison to conventional cities, Masdar will have 50% lower water consumption. That achievement will affect the city's energy balance, since Gulf cities obtain their water from energy-intensive desalination plants.

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Further information:
www.masdaruae.com

3.3. DONGTAN: ASIA'S FIRST ECO-CITY

The world's first CO_2-neutral city is to be built by 2010, in a location some 40 km from Shanghai. Dongtan is situated on the south-eastern tip of Chongming Island, which lies 15 km northeast of Shanghai, in the Yangtze River delta. A first group of 5,000 people is expected to be living in the city in time for the Expo 2010 Shanghai China exhibition. The new city's population is expected to reach 80,000 by 2020, and 500,000 by 2050.

The city will meet its power and heating needs via wind turbines (meeting 20% of such requirements), and solar collectors and biogas systems (80%). All wastewater and waste will be recycled and used in helping to meet the city's energy needs. Houses in the city will be especially well-insulated and ventilated; their energy needs are expected to amount to only 30 % of those of conventional houses. A number of organic farms will provide fresh food for local consumption. Each citizen of the new city will also be allotted a 2.2 hectare plot for his or her own farming needs. The resulting organic waste will be used to fertilise areas under cultivation.

Like vehicles in Masdar, the eco-city's automobiles, trams and boats will be either electric or hydrogen-powered.

Arup, the British engineering company that is master-planning Dongtan, is also planning six additional eco-cities for China. By 2030, some 400 million Chinese will be moved into those cities. China's needs for state-of-the-art green technologies and concepts are growing rapidly as a result, thereby opening up numerous export opportunities for European companies.

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Weitere Informationen:
www.arup.com

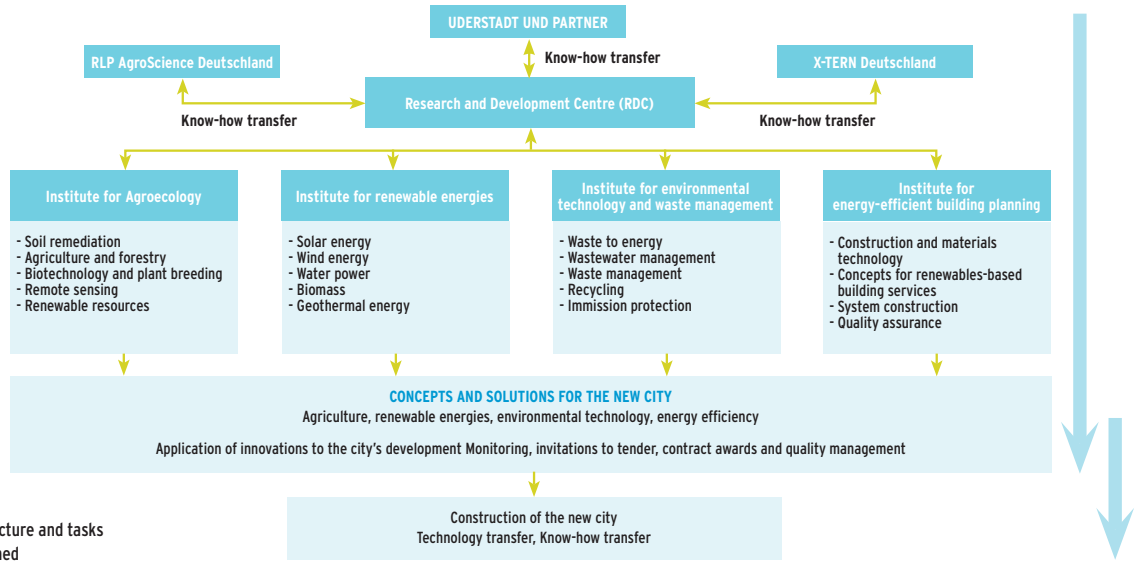

Fig. 7: The RDC's structure and tasks after it is commissioned

3.4. BOUGHZOUL / ALGERIA: "ZERO-EMISSIONS CITY"

The three firms RLP AgroScience GmbH (Neustadt), X-TERN International GmbH (Koblenz) and Uderstadt + Partner Architekten und Ingenieure (Worms) have jointly developed a concept for development of zero-emissions cities. The concept, which covers the areas of agriculture, environment, energy efficiency & renewable energies, is based on a viable and sustainable utility services and waste-management system, including energy-efficient buildings and infrastructure, for a new city in Algeria. A joint venture (JV), consisting of subsidiaries of the three companies in the partner region, is being founded to organise transfer of know-how from Germany to the new city. In a first step in project implementation, an international "Research and Development Centre" (RDC), including an agricultural experimentation centre, is to be built in the partner region within a year, as a "zero-emissions" building.

At the same time, a zero-emissions master plan is to be prepared that will serve as the key basis for the region's development.

Then, the institutes organised within the RDC will commence their work. The RDC's tasks will include know-how transfer, and training of scientists, engineers and students in the areas of agriculture, the environment, waste management, energy services, public infrastructure and construction technology and building services.

In a subsequent step, the zero-emissions city will be built on the basis of the master plan, and of the RDC's relevant findings, to state-of-the-art standards. Some 350,000 people are expected to be living in Boughzoul by 2025.

3.5. SAHEL LAKHIAITA: MOROCCO IS BUILDING A "NEW CITY"

The new city, Sahel Lakhiaita, is to be built some 25 km southeast of the economic centre Casablanca. By 2018, it is expected to be home to some 300,000 people, numerous public facilities and trading, commercial and services companies.

Currently, the IfaS is preparing a study aimed at showing the technical and economic feasibility of a zero-emissions concept for supplying the new city with renewable energy ("Ville à énergie positive") and for establishing sustainable waste-management structures. The study is expected to help promote development of closed-cycle economic infrastructures. With its non-fossil energy sector, the planned "zero-emissions city" will reduce the country's dependency on energy imports and have climate-friendly impacts. Along with energy efficiency and renewable energies, the focuses for the project include sustainable resources management and use.

The project concept covers such areas as identification of sufficiency and efficiency strategies for reducing overall energy requirements and design of suitably sized centralised and decentralised renewable-energies facilities (photovoltaics, solar thermal energy, wind power, biomass) for meeting the city's energy needs. Efforts to this end include development of a resources centre for recycling and energy recovery of/from materials, waste and wastewater. The centre is also to include an attached information and training centre.

Yet another important aspect of the project is its integration of efficient water-management systems and water-saving building-services systems for sustainable wastewater treatment (plant-based wastewater treatment facilities; decentralised wastewater separation and processing in public buildings; greywater recycling for irrigation of green roofs, etc.)

By developing a "zero-emissions concept", Lakhiaita could become a shining example of sustainable urban development, with a "lighthouse" function for other countries in the Maghreb.

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Further information:
www.stoffstrom.org

4. THE ZERO EMISSIONS RESEARCH NETWORK

AIM: ZERO EMISSIONS – JOIN AND ACT

The network, co-ordinated by the Institut für angewandtes Stoffstrommanagement (IfaS; Institute for Applied Material-Flow Management), was founded on 15 September 2008 under the auspices of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU).

The Zero Emissions Research Network brings together companies, municipalities and research institutions involved in developing and implementing zero-emissions projects. It is expected to become a self-sustaining forum for social innovations, to promote co-operation in development of forward-looking projects, to initiate new projects and to provide key impetus on all policy levels.

Along with information about the network itself, the network's Web site provides background articles about the "zero-emissions" mission, and relevant practical examples.

Exchanges of experience with environmental and quality management are expected to play an increasingly important role in efforts toward the aim of "zero emissions".

Currently, the network has 52 partners.

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Further information:
www.null-emissions-netzwerk.de

5. PROJECT LIST: OTHER ZERO-EMISSIONS PROJECTS

NATIONAL PROJECTS:

- Paul-Wunderlich-Haus Barnim: energy-efficient administration
- Handwerker Innovationszentrum Eifel (HIMO), Monschau (crafts innovation centre)
- Ham-Bau Bau- und Handels g.m.b.H., Hamm
- Ecologically oriented commercial park, Kürten-Unterossenbach
- Öko-Tech Park Windelsbleiche, Bielefeld (eco-technology park)
- Gewerbepark Loddenheide, Münster (business park)
- Verwertungsnetzwerk Oldenburger Münsterland (recycling network)
- Verwertungsnetzwerk Steiermark (recycling network)
- Verwertungsnetzwerk Pfaffengrund, near Heidelberg (recycling network)
- Zero-Emission-Gewerbegebiet Kaiserslautern (zero-emissions business park)
- Climate-neutral energy services for the municipality Nalbach, Saarland
- Null-Emissionsgemeinde Enkenbach-Alsenborn ("zero-emissions community")
- Climate protection concept for the city of Kaiserslautern
- Modellregion Landkreis Neckar-Odenwald (the Neckar-Odenwald administrative district as a "model region")
- "Climate protection managers" for the Barnim administrative district
- Climate protection concept for the Cochem-Zell administrative district
- Climate protection concept for the Oberhavel region

INTERNATIONAL PROJECTS:

- Kalundborg Industrial Symbiosis, Denmark
- Città delle Langhe, Italy
- Ökopark Hartberg, Austria (eco-park)
- Hessenpoort industrial area, Netherlands
- Eco bedrijvenpark annex woonpark Emmeloord, Netherlands (green commercial park and residential development in Emmeloord)

“Mindful of its responsibility toward future generations, the state shall protect the natural bases of life ...”

Germany’s Basic Law, Article 20 a

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