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# moma: Smart City Mannheim

## Increasing energy efficiency and integrating renewable energy supplies, through a combination of real-time energy pricing and smart home automation

**The German "*Energiewende*" (energy transition) aims to transform the energy supply to incorporate clean, renewable energy sources. In moma, a consortium of scientists and engineers proposed an innovative, visionary E-energy project to address the practical issues this raises, and to turn the energy system of the future into a present day reality.**

Smart City Mannheim (moma - Modellstadt Mannheim) was chosen as a one of six projects to participate in Germany's E-Energy program in 2006. The program was established to meet the need for new ICT technologies in the energy industry. moma was recognised as a very innovative project designed to increase energy efficiency and integrate renewable energy supplies, through a combination of real-time energy pricing and smart home automation. A consortium led by MVV Energie AG combined the experience of energy suppliers with the knowledge of communications technology companies.

The project was divided into 3 phases, and in its third and final project phase up to 1,000 smart households were integrated. Results from the second phase field test on

| Project Summary | |
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| **Goals** | To demonstrate the intelligent incorporation of Renewables in a Smart City |
| **Solution** | "Energy Butler" home automation device connected to energy market data |
| **Product** | Broadband Powerline Communications across the whole network |
| **Results** | Consumers were able to base daily consumption decisions on market conditions, either manually or automatically |


200 households showed an overall load shift of 6-8 percent of daily energy consumption by manual load shifting. In the third field test the smart homes had access to more complex variable tariffs, from 10 to 40 cents per kWh.

### Energy savings on a plate: The 'Energy Butler'

The moma project recognised the need for a virtual market place to connect all participants in the energy economy together. The interface from the marketplace to the smart home was provided by the 'energy butler', which collected information about energy prices and the origin of supplies, and used it to support decisions about energy use. The energy butler helped to optimise energy consumption in the home according to the availability of renewable energy, either automatically or manually.

Energy prices were used to incentivise demand side management through smart home automation and the households themselves were used as virtual energy storage. The project was government-funded, and the aim was to use the results to influence policy, research, regulation and legislation, and to set standards for the future use of technology.

# An intelligent, bidirectional, real–time energy communication platform

**The moma project participants recognised very early on the need for a better ICT infrastructure in the 'dumb' distribution networks. Information about energy production, distribution and consumption would be needed, and in real–time, allowing grid operators and energy suppliers to understand and manage the energy supply to their consumers.**

An intelligent, bidirectional, real–time communication platform was the key technology in the project, and this was provided by Broadband Powerline (BPL) communications. Via BPL, all components and participants in the system, from energy production, to distribution, to consumption, were intelligently linked in real–time.

In the moma infrastructure, 'power cells' were created, each consisting of one transformer station and the connected household. Each cell acted individually, and is self–healing, but is connected over the ICT–infrastructure with all neighbouring cells to exchange information and power. The power grid itself becomes a self–operating unit.

The IP–based communication platform underpinned the whole project by using the grid itself to transport data for smart metering, power grid analysis and pricing and demand side management.

With this cellular approach, decentralised and distributed automation solutions allowed the operation of grid sections to be maintained even if adjacent sections failed. They also ensured, or even increased, supply security.

Another way in which the Smart Grid promoted supply security was through its dependence on a smaller number of centralised energy sources, resulting from distributed generation with many sources.

## Connecting the participants of the energy economy

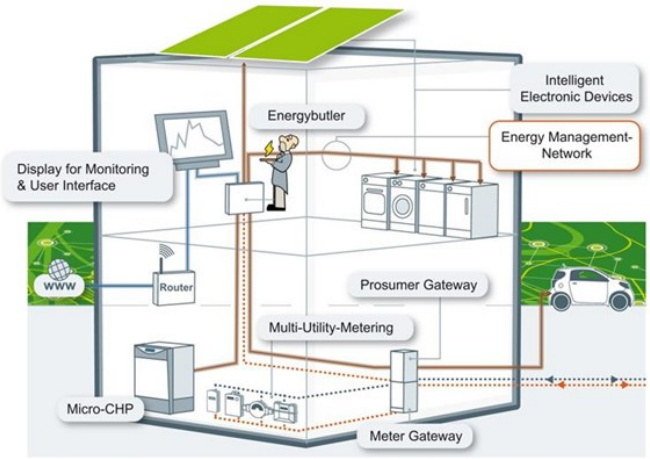
The underlying concept of moma is simple and effective. By connecting the participants of the energy economy energy prices can be communicated in real time, reflecting the actual situation of the energy market.

By applying variable tariffs based on real–time pricing, the smart home itself can choose to use renewable energy when it is in most plentiful supply, and at the lowest price.

In moma, an "Internet of Energy" was created in the city by using the electricity grid itself for data transmission. PPC, leading supplier of Smart Grid communications, provided the ICT infrastructure through BPL. BPL enabled smart metering by converting the power grid to an IP–based communication platform for real–time data transmission. Real–time data was essential for the Smart Grid to adjust supply and demand data and apply it to the home automation.

**Specific Smart Grid applications in E–Energy Modellstadt Mannheim:**

- Demand side management
- Power grid analysis and pricing
- Price communication via BPL to the smart home automation "Energy Butler"




The Energy Butler received price signals through the BPL network and could automatically switch white goods and power generation equipment on, at the most efficient times

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