This project is implemented through the CENTRAL EUROPE Programme co-financed by the ERDF.

4.1.1 Comparative analysis of existing Energiemanagement-Systems

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1 Automatic consumption data

1.1 General Terms of Reference

Function of energy controlling is the timely collection of energy, water and other consumption, the analysis by comparison with previous values of the building and other buildings with specific characteristics and the transmission of this information to building occupants and building operators.
So far, energy controlling is mostly done on the basis of calculations of the energy utilities and manual reading of the meter readings, for example by the maintenance staff. The resulting data is manually entered into simple software programs and evaluated.
Thus, neither the determination of load curves nor the quick detection of possible accidents is possible.

The ICT systems to be used (referred to in German as energy management systems or energy-controlling systems) have to be adaptable to the profiles of the utility company and the existing technology structure to the municipal buildings and any existing evaluation software .
Therefore a system is needed for the long-distance transmission of meter data with many functions in the area of tariff analysis and integration of telecontrol installations.

The main tasks are summarized in the following points:
- meter reading transmission of billing data for electricity, heating, water, gas and possibly oil or other energy sources.
- Display and analysis of meter readings and load curves.
- Import, processing and analysis of data from external systems
- Collection and transmission of measured values, alarms from transfer stations, cogeneration and independent power producers (e.g. photovoltaic systems, wind turbines) to control center systems and / or notification services such as SMS, e-mail or fax.

- Transfer of operating conditions of industrial plants.

The system to be established must offer the option of being integrated into the existing data processing system and network of the utility company or the municipality . The conditions must be assessed in advance.

1.2 Target

The central energy data communication system (ICT) system integrates the query capabilities of meters and remote meter reading devices from different manufacturers, leading to the existing data or to create new processing systems.

It is important that the required data protocols are supported, depending on existing conditions. This is a prerequisite for the system functioning properly.

Since only a few or no standards have been available in Europe up to now, there might also be several different protocols within one building; these need to be supported by the devices.

1.3 Data acquisition

In principle, almost any meter (electricity, gas, heating, water) can be converted to automatic metering.

Existing conventional meters must be provided with an interface.

electric power meter gas meter heating meter hot water meter cold water meter

All major electrical, heating and water meters are equipped with pulse outputs and switched to a data logger. The necessary technology is generally reliable and immune to interference.
For new installations or planned changes electronic meters or at least M-Bus compatible meters should be used.

1.3.1 Possibilities of data collection

1. Automatic data acquisition on pulses or M-Bus interface
All existing media at the field level meters which have a pulse output or an M-Bus interface can be queried via an M-bus data concentrator. The pulses are transferred via a S0/M-Konverter in the M-Bus protocol. The advantage of this variant is that the pulses are converted into a meter reading close to the meter. Thus the risk is minimized that impulses are lost over a long distance through external influences such as electric fields.

2 semi-automatic data acquisition
In the semi-automatic data acquisition meter reading protocols are transferred from the energy data collection and analysis software (EEAS) to a Pocket PC or laptop, and entered directly as part of the subsequent meter tour. After completing the readings, data from the handheld is synchronized with the EEAS.

3 manual data entry
There is (still) no way to detect the meters automatically or semi-automatically , meter readings carried out on-site can be entered via an data list or directly on the user interface in the EEAS.
Data lists can be automatically sent to specified e-mail addresses. For the data lists, the meter readings need to be recorded manually prior to that. The user needs to enter the meter readings via an Internet connection.

1.3.2 Cabling

For pulse outputs the meter needs to be connected to the data logger with a cable. The pulse transmission works with a cable lengths of up to
300 m without difficulty. Bus systems also need cables. These can be up to several km long.

1.3.3 Data Logger

The selection of the data logger is subject to various conditions and local requirements.


source: compeny Görlitz, Koblenz

The data logger stores the meter readings at predetermined time intervals (e.g. every fifteen minutes), and sends them (usually once a day) to the control center.
This can be done via:

- Telephone network (public, analog and ISDN)
- company phone network
- personal cable network (fiber optic, telephone cables, etc.)
- Low voltage network (DLC, PLC, etc.)
- radio coupling
- Mobile network
- Broadband cable network
- Water and gas pipes

It is strongly recommended to monitor the read data for limit violations before they are stored in a database.

Specific solutions can be integrated on demand, such as :

• collection, transmission and analysis of load profiles

Plausibility checks (main, control count, reset count, limits, etc.), usually through complementary software modules

• Remote control of customer and public utilities facilities

• Implementation of control tasks

• Collection and transmission of alarm messages from CHP and Independent power producers

• Remote control of CHP and power-generating systems, with switching of the modes of operation (power-controlled heat-guided), and set values

• Transfer of operating conditions of industrial plants

• Preparation and delivery of billing data for a parent with a billing system interface program

1.4 Software for data acquisition and data analysis

There is a large number of software for energy metering and analysis available on the market. At present in Germany more than 50 versions exist.

They can be classified into 3 major groups:

- data acquisition based on MS-Excel (MS Access, MySQL, etc.)
- Energy controlling software based on management software (SAP, ORACLE)
- Utilization of separate energy control / energy management software

The individual programs can be hard to be compared.

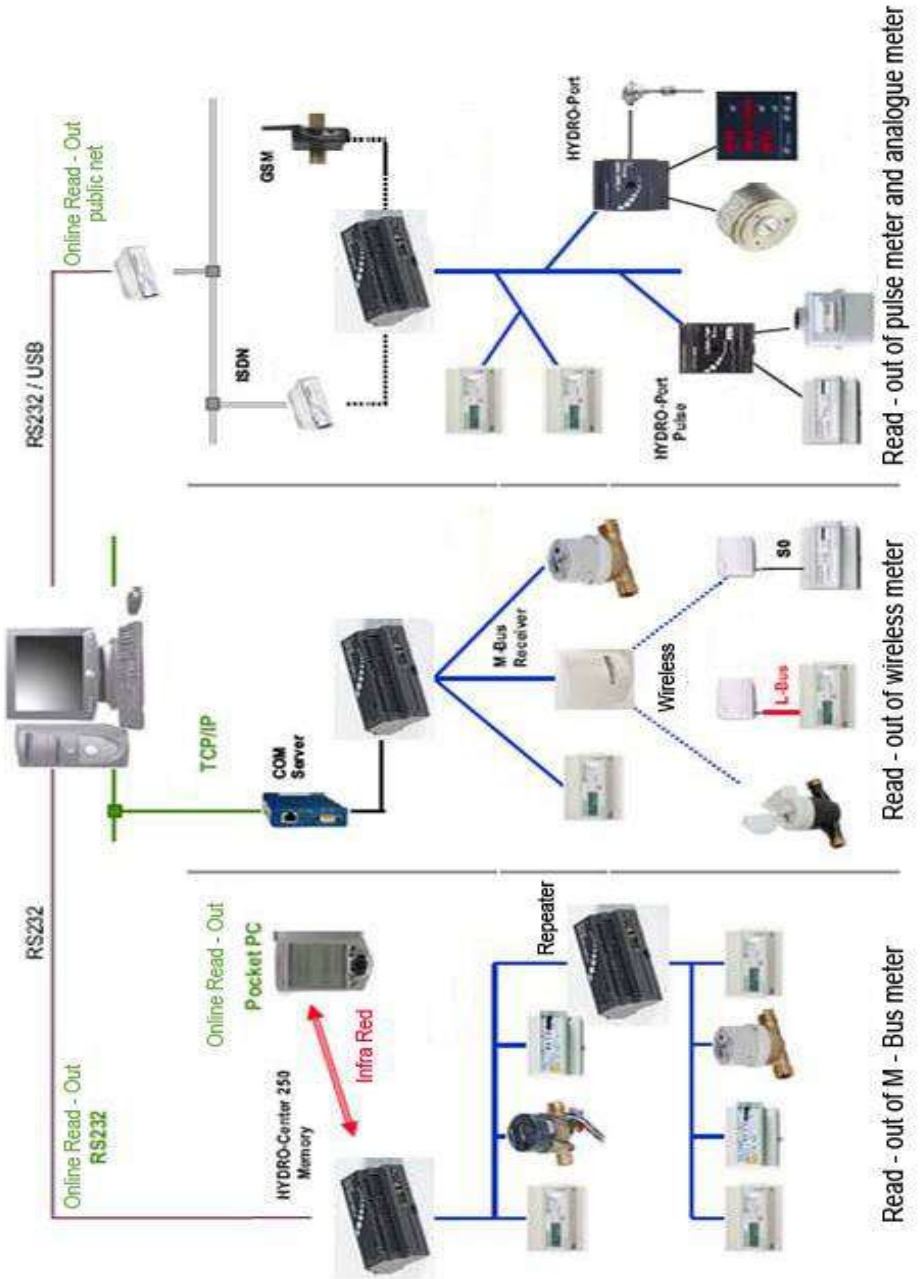
In the attachment you can find a spreadsheet in which some software programs are listed, used by municipalities and local authorities.

Many software programs have been developed for the industry. Often features are included, that are not needed for the collection and analysis of energy consumption.

Many programs can be customized. Some producers offer their products in English language as well, few of them also in other languages.

1.5 Example of ways to integrate different meters into a M-Bus System

This example shows the various possibilities offered by a bus system



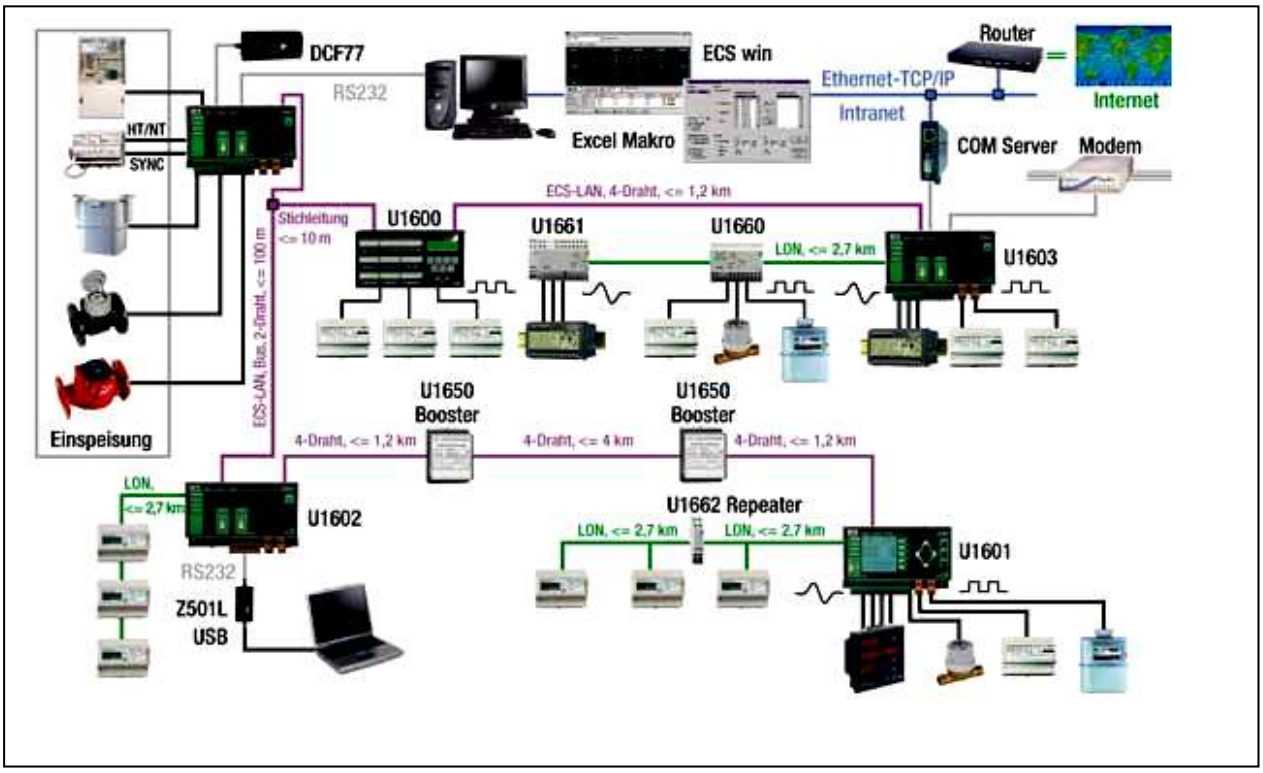
Source, company GOSSEN METRAWATT

1.6 Example: energy controlling system (ICT system)

The illustrated energy control system is the professional solution for energy data collection.

It provides the basis for the consumption and demand management as well as the differentiated energy consumption accounting.

Several consumer sites in a city are linked by bus systems. An external data access is possible over the Internet from any location.



source; company GOSSEN METRAWATT

The management of multiple sub-meters in a building is easily done, e.g. by partial letting of building sections to others tenants/users

2 Advantages and disadvantages

2.1 Utility meters

When choosing a meter, it must first of all be decided whether the meters are used for billing purposes (for example, between energy suppliers and municipal authorities), or only as a counter to record the energy consumption for analysis purposes.
The financial statement must be subject to legal meters used. The accuracy must be proved according to established procedures.
Some meters, such as gas meters, have no authorization for the automatic metering, and can only be used for transfer purposes not requiring calibration.
For new installations, use electronic and M-Bus compatible meters , if necessary pass on such demands to the energy supply companies.
Radio meters can also be used for larger distances .
For existing counters connectivity to a pulse count may be available. Is this not the case, the counter can be replaced.

2.2 Advantages and disadvantages of each system component

System-components	description	Advantages	disadvantages
meter	Conventional meter	• cheap • low interference	• only manual reading of the meter readings • high staff costs • no direct data sharing possible •
	Conventional meter with pulse gang	• cheap • low interference of data in case of power failure	• Automatic data acquisition • expensive
	Electronic meters M-BUS ready	• no data loss in case of power failure • Transfer of counts of data possible • Automatic data collection and transmission easy and reliable • Easy integration into existing building management system (BMS)	• Built-consuming • expensive • do not partially calibratable • Battery change required
	Meter with wireless modul	• no bond line required • Easy data transfer over long distances •	• expensive • possibly high running costs (mobile radio transmission)

			• prone to environmental influences • Data security • Battery change require
Data transfer M-Bus	M-Bus	• easy and reliable data transmission • High immunity • system setup easy • Standardised interfaces can be easily connected to devices from any manufacturer • Low cost	• device wiring required • putting cable below ground very expensive•
	GSM wireless modules	• No wiring required • Low-cost transmission over long distances • Direct transfer to the FTP server possible • Data transfer without phone line or Internet connection possible•	• possibly high running costs (wireless transmission) • prone to environmental influences • Data security
	Internet	• access to the data from any location • High reliability • No separate cable required	• high establishment costs • Internet access in buildings must be provided
	Data reading on the meter with a PDA, notebook, etc.	• Use less expensive counter possible • No wiring required	• No short measurement intervals possible • Risk of reading and transcription errors larger • Additional hardware and software required • Additional interfaces are required • Data loss on power failure • Personal income and greater skill
Data collection and data exchange valuation	Centralisation of data on a central PC and evaluation Using specially designed software from the Municipal Administration	• Permanent availability of standardized data • Possibility of fast intervention	• High investment costs for equipment and software • Possibly. extensive training of personnel in the software necessary •
	Use web-based software solutions through the Local Government	• Low investment costs • Continuous availability of direct data • Fast engagement option •	• Higher running costs • Possibly. extensive training of personnel in the software necessary
	Collection and analysis of data by a system provider of software and technology (Contracting)	• no personnel expenses in local government is required • No investment costs •	• No possibility of direct intervention by the community • High operating costs •
General software	data acquisition on MS-Excel-based (MS Access, MySQL, etc.)	• Very inexpensive • Simple operation • can be flexibly adapted to individual requirements	• Low evaluation possibilities • visualization options limited • prone to interference • Considerable set-up cost • Considerable data management effort • Can not be used in the collection of information at one-minute cycles
	Energy controlling software based on management software (SAP, ORACLE etc.)	• Energy data can be used in the same management software • Familiar user interface	• Possibly. additional high licensing costs • Low flexibility in adapting to individual conditions • Staff training required
	use separate energy Controlling software	• Very high flexibility in adapting to individual conditions • Excellent visualization is possible • use of data for system control usually possible	• High costs • Staff training required

3 Summary

Due to constant increasing energy prices, the decision to install an automatic energy metering system, is of increasing importance for local authorities.
Energy savings of an average between 5% to 20% can be realized only by analyzing the collected data and undertaking appropriate measures.
Typically, not all consumption points can be retrofitted at once. Hence, it is recommended, to start with the biggest consumers. Technology and software must allow a smooth and cost efficient extension.
The selection of components for automatic consumption record depends on many factors. It must reflect the existing conditions and requirements. Therefore, it is not possible, to give general recommendations.

Before planning begins, a detailed assessment of current state must be done:
- Type of available energy metering
- Overview about the buildings (energy consumption points)
- Existing technology, networks, lines, etc. that can be used
- Instructions of local energy suppliers
- Regulations
- Specific consumptions
- Consumption Structure
- Future changes or extensions planned
- Existing qualified personnel
- The nature and scope of data analysis
- Objectives of the use of the results
- Cost / Benefit

There are several system suppliers in the European market existing. They provide all necessary system components, from the energy meters, transmission systems, data loggers to the appropriate software. Everything is customized to local needs and conditions. If requested, installation and commissioning are also realized. There is also

the possibility, to assort the various components according to the needs and to install them. This is usually much cheaper, but it requires considerable knowledge of the engineers or companies, entrusted with the installation.

Practically, the costs are usually the main criterion for selecting of the system components. Though, in addition to the equipment costs, the cost for installation and wiring, the cost for acquisition and analysis software as well as ongoing staff and operational costs for the facilities need to be considered.

The following costs can be taken into account as reference values:

- Investment costs per property	€ 2,500 - 8,000
- Hauling of data lines including laying in the ground/per object	€ 500 - 5,000
- Software for data acquisition and analysis	€ 5,000 - 100.000
- Set up and programming of collection systems (technology and software) including start up on the ground (at about 50 objects)	€ 25,000 - 100.000

(net cost detail, Sources City of Frankfurt, NRW Energy Agency, owner)

The technical components are functioning mostly solid, if they are adjusted properly to the local needs. This is demonstrated by operational experiences of several cities in Germany. The best technology seems to be useless, if the systems are not permanent monitored and the data are analyzed. For it,well-trained staff is needed.

4 Attachment:

4.1 The M-Bus: An Overview

The M-Bus ("Meter-Bus") is a new European standard for remote reading of heatmeters and it is also usable for all other types of consumption meters as well as for various sensors and actuators.

With its standardization as a galvanic interface for remote readout of heat meters this bus wins a great importance for the energy industry as relevant users.

The remote reading of heat meters can take place in different ways, beginnig with the classical method - manual reading by the personnel of the providers - up to the remotely controlled collection of all the meter values for a complete housing unit. The latter is a logical continuation/extension of the technical development of consumption meters and is realizable with the help of the M-Bus.

Here some substantial characteristics of this interface are mentioned regarding their new possibilities:

The data (e.g. heat consumption) are read out electronically

At one single cable, which connects to a building controller all consumption meters of a housing unit can be attached

All meters are individually addressable

Apart from the availability of the data at the controller also a remote reading is possible

A set of advantages arise, both for the supply enterprises, and for their customers:

The reading is fast and avoids reading errors

The data being present in machine-readable form makes the further processing easier.

A remote readout saves personnel expenditure, avoids unnecessary penetration into the private sphere of the inhabitants and permits to mount meters in places which are difficult to access.

Short reading intervals are possible, which reduces the problems with tenant change or tariff amendments

Due to the short reading intervals statistical data can be obtained, which can be used as a base for network optimization

The standardisation of the m-bus results in further technical possibilities. In particular devices of different manufacturers can be operated on the same bus; the users are free therefore in the choice of the manufacturer. On the other hand, a stimulation of the market can be expected, also regarding other m-bus based counters, so that with the very variable configuration options even difficult problems can be solved.

In the development of the m-bus also economic and technical aspects of the interface have been considered, that are relevant for everyday use. These are essentially:

- Large number of connectable devices
- Possibility for network expansion
- Fail-safe characteristics / robustness
- Minimum cost
- Minimum power consumption in the meters
- Acceptable transmission speed

None of the many already existing bus systems was able to fulfill all these constraints. Now with the M-Bus as a new standardized interface for the reading of consumption meters, an optimal compromise between price and performance can be offered.

4.2 Software: An Overview

Look at separate overview