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Study: Implementation of ISO 50001 at municipal energy supply companies

About this Survey

For years, GUTcert has enjoyed great trust as a certifier on the part of municipal companies. Among our customers are municipal utilities from all regions of Germany. In their role as public enterprises with private-sector services, they are exposed to special challenges. Complex tasks and a mesh of legal and other requirements mean that municipal utilities actively apply management systems in order to be able to solve the variety of challenges in a targeted and systematic manner. They sometimes operate several management systems in an integrated manner: quality, environmental and energy management, EMAS, compliance and risk management. But IT security has also long been a fundamental issue for municipal utilities. With the Energy Industry Act, legislators have required most municipal utilities to implement a certified Information Security Management System (ISMS), e.g., ISO 27001. Recently, asset management, which deals with asset management and manages the investment and cost planning of fixed assets, has also moved onto the list of relevant certifications at some utilities, particularly in the area of networks.

Driven by our own interest as certifiers and trainers, we asked ourselves how the topic of energy management and thus also energy management systems are developing in the industry and what trends are emerging. To this end, we analyzed this time (previously: Stadtwerke und die Nachhaltigkeitsberichterstattung, White Paper) the pool of audit observations and findings available to us. What is exciting is that our municipal utility customers are very differently positioned in terms of the range of services, the organizational structure, the technical inventory and available budgets, and thus the challenges they face in the EnMS.

Our focus was primarily on auditor observations of the following key areas:

- Strengths and potentials
- Common energy performance indicators (EnPIs)
- Measures implemented

The published results can provide readers not only with a general overview of industry developments, but also enable a kind of benchmark in the field of energy management according to ISO 50001 and, if necessary, provide suggestions for the continuous improvement of energy-related performance.

The basis for the 2020 Survey is a large number of anonymized audit reports from municipal utilities on the implementation of energy management systems according to ISO 50001 in the period 2017-2019.

- The entire range of municipal players was represented: from smaller municipal utilities with up to 70 employees and an annual energy consumption of approx. 10 - 25 GWh to medium-sized and large municipal utilities with over 1,000 employees and energy consumption in the order of magnitude of over 100 GWh/year.

Your contact :
Jochen Buser, Energy Management
Mail: jochen.buser@gut-cert.de
Fon: +49 30 2332021-611

GUTcert AFNOR Group
GUT Certification Company
for Management Systems mbH
Environmental verifier
Eichenstraße 3 b, 12435 Berlin

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The core business of the municipal utilities surveyed is generally energy, heating and drinking water supply, network operation and wastewater disposal. Depending on the region and size of the company, these services are supplemented by the operation of public transport, bathing facilities and telecommunications.

Such a variety of company sizes and services enabled us to crystallize and summarize the focus areas of energy efficiency improvement for main technical processes and facilities at the municipal utilities as part of this evaluation.

Important note: This survey makes no claim to completeness of results and only provides an insight into the development of energy management systems according to ISO 50001 at municipal utilities from the auditors' point of view.

1. Ways to the energy management system

The municipal utilities come to the certification-ready EnMS from quite different directions: on the one hand, the path was already taken since 2013 with ISO 50001:2011 for tax reasons in order to claim the peak compensation according to SpaEfV (Peak Compensation Efficiency System Ordinance) and on the other hand, the national implementation of the EED (Energy Efficiency Directive of the EU) in the Energy Services Act introduced the energy audit obligation for non-SMEs (small and medium-sized enterprises as defined by the EU Commission) from 2015. Some municipal utilities introduced an EnMS as early as 2011 out of conviction, as they wanted to increase energy efficiency and thus reduce costs.

Interestingly, by the end of 2019, virtually none of the municipal utilities certified by GUTcert had switched to the revised ISO 50001:2018 standard, even though the prerequisites for this were largely created by the influence of ISO 50003 requirements on the certification process in recent years and the gap for conversion is generally rather manageable. For this reason, the evaluation refers to ISO 50001:2011 (ISO 50001 in the course of the text). In the comparisons to the 2018 standard, the year of publication is shown accordingly.

2. Results of the report analysis

The analysis of the reports clearly shows that all the companies studied have developed a high level of technical competence and good knowledge of the technical installations and systemic requirements - regardless of the path to a certified EnMS according to ISO 50001.

As a result of the evaluation, we have summarized, categorized and ordered the strengths and the potentials from the reports. The following list reflects these results in a generalized form.

2.1 Auditors emphasize the following strength in their reports:

The technical expertise of the energy team, with its recognition of the systemic potential that still exists, was highlighted as a strength in more than three-quarters of the audit reports examined. Many potentials for increasing energy efficiency have therefore been uncovered and tapped over the years.

- In more than a third of the reports evaluated, the driving role of management in EnMS development was particularly emphasized. This involves, among other things, a close link between the energy officer and the management, very informative and effective management assessments, and the integration of energy targets as components of business planning.

Your contact :
Jochen Buser, Energy Management
Mail: jochen.buser@gut-cert.de
Fon: +49 30 2332021-611

GUTcert AFNOR Group
GUT Certification Company
for Management Systems mbH
Environmental verifier
Eichenstraße 3 b, 12435 Berlin

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- Based on their own demand for service quality, more than half of the municipal utilities involved make extensive annual investments to modernize technical equipment and infrastructure. Many reports emphasize that there is an annually available innovation budget that can also be applied to energy-related measures.
- In the majority of the companies evaluated, management documentation is praised, for example:
  - The documentation system is mostly managed and maintained digitally on the Share Point basis.
  - energy-relevant operational processes are recorded, evaluated and controlled by means of procedural, operational and work instructions, managed and transferred into the employees' daily routine.
  - Company wikis related to energy-related processes, procedures and templates have also been named as best practices.
- Predictive maintenance planning and maintenance activities, as well as consistent and meaningful documentation for monitoring technical equipment (especially often the CHP units), are also emphasized as an integral part of day-to-day operations, as noted in various reports, for example, as follows:
  - Maintenance work is carried out decentrally in the individual departments, partly using the SAP module but also Excel lists. Maintenance work is properly carried out and documented in accordance with the maintenance plans. Operational procedures, also for energy-saving operation of the plants, are regulated in the organization manual and in operating instructions.
  - Maintenance activities are logged for each area and recorded with maintenance books. New are tablet solutions with which the employees fill in checklists on site, which are then filed in the central office. Maintenance is demonstrably carried out on a daily basis with energy considerations, e.g. filter cleaning and slide valve functions as well as pump monitoring. External companies are bound with maintenance contracts for all plants and equipment.
  - The data sheets used contain all details on maintenance and repair of the respective technical unit. Interactions with design, legal requirements and procurement are described and implemented in practice.
- The majority of the evaluated reports show a high degree of metrological recording of main energy users or main consumer groups (significant energy users, SEUs), which is largely due to the requirements of ISO 50003 for metrological transparency as a basis for the certification audit. The traceable increase in transparency in the last three years is largely due to the expansion of metering or the use of mobile measuring devices. The following audit observations illustrate this:
  - The recording of energy consumption and its documentation is regulated in a process instruction and the applicable document "Meter Data Flow". The meters are either read continuously or monthly according to the instructions. The EDL control center, for example, permanently monitors EDL systems from the control center. A mathematical plausibility check is performed by comparing the sum of the submeters with the respective billing meter. Tests and calibrations are carried out by the state-approved test center and documented in SAP.

Your contact :
Jochen Buser, Energy Management
Mail: jochen.buser@gut-cert.de
Fon: +49 30 2332021-611

GUTcert AFNOR Group
GUT Certification Company
for Management Systems mbH
Environmental verifier
Eichenstraße 3 b, 12435 Berlin

- The company has a large number of permanently and systematically recorded meters. The further procedure for the systematic increase of the energy consumption transparency should be promptly and conceptually more strongly included in the measurement planning. At present, the measurement planning includes electric, gas and heat meters as well as temporary measurements.

- The use of software-based energy controlling has increased by quite a bit in the last ten years. However, the auditors' advice is often important at this point: the rapidly developed energy master data must also be *evaluated in order* to create the promised transparency and a basis for further optimization. "Data graveyards" are harmful for companies - both economically and in terms of the motivation of those responsible. A constantly growing mountain of data without a smart evaluation system has an overwhelming effect. Less data, but meaningfully defined, is more effective than "more and more" measurement data.
- According to the evaluated reports, municipal utilities work in the EnMS with a large number of the process and plant relevant energy specific performance indicators (EnPIs) according to the bottom-up approach - some examples of this in section 2.3. The survey shows: Regardless of company size, similar key performance indicators are formed and applied for the main processes. e.g., for electricity and heat generation, network losses, wastewater treatment plants, waterworks, baths, conversion plant utilization rates, buildings, vehicle fleet, etc.
- Relevant influencing factors are also named more often and their influence calculated, as the following examples from the audit reports illustrate:
  - The influencing factors are defined for each consumption point. Each consumption point is monitored over a period of years, EnPIs are continuously calculated and monitored with a traffic light function. In the event of "red" EnPIs (= deterioration), readjustments are made.
  - In the case of drinking water supply facilities, the EnPIs and the EnMS-relevant objective for water supply services are set in relation to the legal and QM-relevant requirements, and all decisions are made only in this mesh of requirements.
  - The determination of the influence of the height of the water column on the performance of the deep well was comprehensibly constructed and determined.
  - Wastewater treatment plants are operated under specific operating conditions. The load, temperature and biodegradation as well as the wastewater volumes are recorded. From these factors, various models can be worked out to evaluate aeration/activation.
  - The technical equipment is subject to wear and tear, which, as expected, leads to a deterioration of the relevant EnPIs. The deterioration has been demonstrably mitigated by maintenance and servicing measures as well as by replacement procurement.
  - For pool operations, the following influencing factors were identified, among others: Outside temperature (district heating sales/driving mode CHP and boiler), calorific value of the supplied gas (driving mode CHP and boiler), precipitation values (pumping of drinking water), number of users in bathing operation.
  - In the case of the heating system, in addition to the weather and maintenance, the fluctuations in the heat difference between the flow and return must be taken into account.

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Jochen Buser, Energy Management
Mail: jochen.buser@gut-cert.de
Fon: +49 30 2332021-611

GUTcert AFNOR Group
GUT Certification Company
for Management Systems mbH
Environmental verifier
Eichenstraße 3 b, 12435 Berlin

- The energy consumption in the customer centers is influenced by the outside temperature, opening hours and the number of visitors.

2.2 Auditors point out the following potentials:

In addition to the strengths, the audits also uncover other key areas of development. Experience has shown that these form the solid basis for the ongoing improvement of both energy-related performance and the management system itself.

- One of the points of criticism on the part of the auditors clearly lies in the further development of the measurement and verification process.
  - On the one hand, it is about the further development of metrological data acquisition, where not all SEUs are measured yet and the transition from manual reading to automated solutions has not been implemented consistently.
  - Second, not all action plans are populated with the information on planned before-and-after measurements and the method of verifying success.
- Another focus is the further development of the methodology for normalizing the EnPIs and, if necessary, the standard-compliant comprehensible adjustment of the output bases. As part of the conversion of the EnMS to the 2018 version, it is required to observe and measure the relevant variables in SEUs and evaluate them for correlation to the corresponding EnPIs.
- The organization of internal communication has also been named as a potential in many of the companies studied, for example in the following:
  - while executives and management show a good understanding of the EnMS in the audit, it is noted during the analgen inspection that the employees surveyed at the lower levels were only poorly informed. As a result, those responsible were recommended to get employees more on board. In addition to intensified instruction at the specific workplaces, internal communication could be revitalized with the help of notices on the presentation of EnMS targets and the degree of target fulfillment and a well-organized suggestion scheme.
- There is also often potential for improvement in the area of legal conformity/compliance. In many of the companies studied, the legal register is based on Umwelt-Online and is supplemented by other sources on legal regulations (e.g. specialized law firms or associations). For the most part, the legal cadastre is maintained in compliance with standards. However, a formal standard-compliant internal evaluation of the compliance status in both the internal audit and the management review remains a challenge for some companies:
  - A compliance assessment has not been integrated into the project documentation, which means that the assessment has to be shifted to another process and later point in time, which is not optimal.
  - The evaluation of the compliance status must be carried out with a higher degree of transparency, as it cannot be derived consistently.
  - A review of compliance with legal obligations and other requirements as a basis for the management assessment in the management review did not take place.
  - The application of defined procedures shows potential to align the procedures closer to the lived process.

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Jochen Buser, Energy Management
Mail: jochen.buser@gut-cert.de
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Environmental verifier
Eichenstraße 3 b, 12435 Berlin

2.3 SEUs: Excerpt of common energy indicators

The SEUs are usually defined in the industry as main consumer groups and their number is usually not very high here. They are, for example, CHP units, large pumps or pumping stations, but also larger blowers, systems for heat generation, e.g. boilers, networks - and here the network losses to be considered - transformer stations, substations, switchgear, systems in the infrastructure, e.g. traffic stations, lanterns, etc. For these, energy indicators are formed and checked in the audit.

The examples of energy indicators given below are frequently shown in the reports evaluated. They have been categorized and summarized by us and are of course only an excerpt for orientation.

- **Electricity/heat production:**
  - Utilization rate of CHP unit (net electricity generation + district heating feed-in/natural gas and fuel oil input)
  - Electricity consumption of the heating system per quantity of heat generated
  - CO_2 -emission factors
- **Power grids**
  - Mains loss, absolute value
  - Primary energy factor
  - Primary Performance Indicator, PPI
- **District heating incl. networks**
  - Grid pumps: Power consumption grid pumps/heat grid feed-in
  - Heat loss of district heating networks (loss MWh/pipe surface * degree day factor)
  - Heat loss district heating network, MWh/m² Pipe surface area
  - Heat loss quantity fed in relation to quantity sold
- **Gas networks**
  - Energy consumption/discharged gas quantity in kWh/Nm³
- **Waterworks:**
  - Total energy consumption raw water in kWh/m³ and €
  - Total energy consumption of pure water in kWh/m³ and €
  - Energy consumption/quantity of water pumped kWh/m³
- **Bathrooms:**
  - Heat demand and electricity demand per bather with/without climate factor
  - CHP: electrical efficiency and thermal efficiency with/without climate factor
  - Heat consumption per operating day in kWh/d
  - Electricity consumption per operating day in kWh/d
  - Energy costs per visitor per operating day in €/B/d
  - Energy consumption in kWh/m³ basin volume

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Environmental verifier
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- **Wastewater Treatment Plants:**
  - Electricity consumption/heat generation, el kWh th, el/kWh th
  - Electricity consumption for sludge treatment
  - Power consumption for sludge stabilization/digester
  - Power consumption for animation
- **Traffic:**
  - Vehicle fleet mileage in kWh/km driven
  - Vehicle fleet mileage in kWh/person-kilometer
  - Fuel consumption in kg biogas/100 km
- **Lighting:**
  - kWh/light point
- **Customer Area:**
  - Heat consumption in kWh/visitor
  - Power consumption in kWh/visitor

  Water consumption in m³/visitor

2.4 Some examples of optimization measures:

The verification in 2019 generally ran via the plausible and comprehensible presentation of the improvement in energy-related performance via individual measures. The kWh saved were verified in the audit and recorded in the report.

Here are some examples of the optimization measures per SEU:

- **Electricity/Heat Production:**
  - The use of natural gas for preheating in the new boiler
  - Replacement of the burners at the HP boiler plant
  - Adjustments to the controls of the heating pumps in the CHP unit and coupling to the boiler running times.
  - Demand-based use of the dehumidifiers in the booster stations
  - Conversion to a condensing boiler
  - Hydraulic balancing and energy optimization
  - Decommissioning of heating surfaces that are no longer needed
- **Transformers**
  - Replacement of transformers with improved efficiency
- **Waterworks:**
  - Use of new pump technology, FU-controlled
  - Pigging of the raw water pipe at the well in order to reduce the flow resistance and thus the required pump capacity due to an incrustation

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- **Bathrooms:**
  - Use of FUs controlled circulating pumps
  - The reconstruction of ventilation systems with the heat exchanger for changing rooms and the entrance area
  - Reconstruction of the not yet reconstructed parts of the facade of the main hall
    Conversion to LED in the swimming pool hall and changing rooms
- **Wastewater Treatment Plants:**
  - Use of service water instead of potable water by rebinding
  - Turbo blower installation
  - Sludge thickening by centrifuge was replaced by belt thickener
  - Installation of new agitators
- **District heating:**
  - Renewal of thermal insulation by double pipe
  - Conversion to frequency converters in connection with a "pump coordinator" and an electronic control system for district heating circulation pumps
  - Part of the pipeline was dismantled, which significantly reduced heat losses
    Heating center was converted to a decentralized solution, which saves district heating/a
- **Traffic:**
  - Installation of e-charging stations
  - Use of environmentally friendly vehicles
- **Lighting:**
  - Conversion of hall lighting, workshop, streets and entire buildings to LED
- **Administration Building:**
  - Energy renovation of facades, windows and roofs
  - Heating of the building with the return flow of the district heating network
  - Installation of a dedicated measurement infrastructure
  - Planning of further PV areas in connection with storage technology
  - Lighting of the building was completely converted to LED
  - Optimization of the local heating center through improved use of the existing CHP unit to utilize waste heat in summer

3. Conclusion of the analysis

The analysis of auditor findings leads us to conclude that the EnMS is already well integrated into the business processes of municipal utilities. This is evident at both the technical and systemic levels. A broad spectrum of optimization measures already implemented signals not only the energy optimization that has become evident in many cases, but also the willingness of the industry as a whole to invest.

Your contact :
Jochen Buser, Energy Management
Mail: jochen.buser@gut-cert.de
Fon: +49 30 2332021-611

GUTcert AFNOR Group
GUT Certification Company
for Management Systems mbH
Environmental verifier
Eichenstraße 3 b, 12435 Berlin

The identified and named potentials are not serious deficiencies, but rather to be understood as a further stage of development. After so many years of operation of the EnMS, the continuous improvement in 2020 does not usually mean any greater improvements than "low hanging fruit". An ever deeper understanding of technical equipment and technological processes with the help of sufficient metrological transparency and statistical evaluation of data over the years have become the prerequisites for investment decisions for the improvement of energy-related performance - and for the award of certificates.

In view of the new ISO 50001:2018, it is elementary that companies move away from a single baseline (e.g., year) and form EnPIs as well as normalized baseline values for each SEU.

The EnMS development trend for the next few years lies primarily in a fundamental shift - away from reacting to external circumstances to consciously controlling technical equipment and processes - based on the energetic optimum under changing conditions. In addition, a quantitative adjustment of performance and verification of progress will become indispensable.

4. Outlook

Another upcoming step for municipal energy supply is the move from pure energy management to climate management. In line with the context analysis of the new ISO 50001:2018, it is more than necessary for a municipal company in Germany to take climate change into account as a future-driving issue for society as a whole.

In the context of the present 2020 evaluation, we were able to track the energy-related targets and their successful pursuit. In the area of climate management, efforts were unfortunately not yet evident across the board. Some municipal utilities already have targets for emissions reduction in energy supply and use corresponding KPIs in the evaluation of optimization measures. Others define measures for the expansion of renewable energies in the portfolio. However, the majority of the municipal utilities studied are rather at the beginning of the journey.

Our impression is reflected in the results of a 2018 survey by Statista.[1] 193 managing directors and board members of municipal utilities and energy supply companies from Germany, Austria and Switzerland were asked about the current issues for the industry. According to the survey, more than three-quarters of municipal utilities will focus on optimizing internal processes, CRM and, above all, digitization in the next 2 to 3 years. Fifty-four percent of respondents said that municipal utilities will focus strongly or very strongly on investments/measures in the area of renewable energies. 41% of respondents set goals for improving their own energy efficiency.

Even though the focus at many municipal utilities on energy efficiency measures and investments in the production of environmentally friendly energy has already been set, the active fight against climate change was not yet as strong on Germany's political agenda in 2018 as it has been since 2019 in the wake of Fridays For Future. At that time, digitization was actually more likely to rank first among the challenges facing the economy.

[1] Stadtwerke - Survey of Current Issues in Germany 2018, Published by A. Breitkopf, June 27, 2019), Statista https://de.statista.com/statistik/daten/studie/456110/umfrage/aktuelle-fragestellungen-fuer-stadtwerke-in-deutschland/, last accessed March 2020.

Your contact :
Jochen Buser, Energy Management
Mail: jochen.buser@gut-cert.de
Fon: +49 30 2332021-611

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for Management Systems mbH
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The year 2021 is the year of the changeover of the UN agreements regarding the fight against climate change from the non-binding Kyoto Protocol to the Paris Agreement from 2015, which is binding for the countries of the world. Germany also takes its responsibility seriously and sets the new incentives and prohibitions to further contribute to climate protection. Among other things, municipal companies play an important role in the German government's 2019 climate package. They have a dual responsibility: on the one hand as energy, heat and water suppliers and providers of local mobility concepts, and on the other hand as "advisors" to the population. The expansion of our own environmentally friendly performance, not only in electricity, but also in heat supply and transport, goes hand in hand with the innovative range of services for customers.

For these reasons, municipal utilities should take greater account of this new political trend now at the latest. An inventory with regard to greenhouse gas (GHG) emissions and strategic positioning with the introduction of climate management are indispensable here and are common practice. This is also about management and ISO standards. Therefore, we recommend the expansion of climate management on the foundation of an EnMS:

- A meaningful GHG accounting is a first step for further strategic decisions in terms of increasing climate friendliness. This task can be accomplished much more easily with the help of data collection from EnMS (at least for Scope 1 and 2).
- The organizational and communication structures in place in the EnMS will also help those responsible to open up new horizons.
- Furthermore, when mastering new tasks, the solid metrologically proven knowledge of one's own plants and processes is of great value.

In a nutshell: A well-functioning EnMS prepares a good basis for the expansion of a climate management. We will soon be explaining exactly how this path can be taken in a GUTcert guide "From energy to climate management".

Author: Yulia Felker, Leadauditor ISO 50001 and ISO 14001

Your contact :
Jochen Buser, Energy Management
Mail: jochen.buser@gut-cert.de
Fon: +49 30 2332021-611

GUTcert AFNOR Group
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Environmental verifier
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