BEST ENVIRONMENTAL PRACTICES IN THE HEALTHCARE SECTOR

A GUIDE TO IMPROVE YOUR ENVIRONMENTAL PERFORMANCE

A PARTNERSHIP BETWEEN:

- Institute for Ecopreneurship (IEC), University of Applied Sciences Northwestern Switzerland (FHNW), School of Life Sciences (HLS)
- Sustainable Business Associate (sba)
- Royal Scientific Society (RSS)

WITH THE SUPPORT OF:

- Swiss Secretariat for Economic Affairs

FOREWORD – MINISTRY OF HEALTH IN JORDAN

Jordan has an excellent reputation in the Middle East and the Arabian Peninsula for providing advanced and high quality healthcare services. In order to maintain and further consolidate the achieved quality standard, we have to consider not only the medical treatment of the patients but also have to ensure that the services provided correspond to national and international environmental standards.

Topics such as energy efficiency or waste management are often at the forefront when talking about environmental health issues, but good housekeeping practices and good behavior of the staff and patients also have an influence on the environmental performance of the hospitals. Lacking of best environmental practices within our hospitals will impact on staff, patient and population's safety and will also lead to additional costs and overuse of natural resources.

It is therefore of high importance to improve the environmental management in the healthcare sector with a holistic approach and without decreasing the quality of services. At the time of sustainable development, the healthcare sector also has to demonstrate its commitment towards corporate environmental and social responsibility.

The Royal Scientific Society (RSS) in cooperation with the University of Applied Sciences Northwestern Switzerland (FHNW) and Sustainable Business Associate (SBA), are contributing to these efforts through the elaboration of this guide on Best Environmental Practices in the Healthcare Sector. This guide allows a first audit of the hospital while gaining an overview of the state of the art in the field. It is a first step towards greener hospitals and it is a tool to implement concrete actions. Thanks to the support and cooperation of two Jordanian hospitals, it was possible to incorporate practical case studies to this guide.

I am convinced that the guide will be well acknowledged by healthcare professionals and managers who are contributing to further pursue the excellence of the Jordan healthcare sector. I wish that their work will help implement better environmental practices in Jordan hospitals and neighboring countries and that Jordan can play a pioneering role in this field.

Dr. Nayef Al-Fayez
Minister of Health in Jordan

FOREWORD FROM THE SWISS STATE SECRETARIAT FOR ECONOMIC AFFAIRS

The healthcare sector and especially hospitals account for a massive, but often neglected or even ignored impact on the environment and face high costs for use of energy, water and disposal of material (waste). Other issues also influence safety and quality of services provided. In a recent paper , the World Health Organization (WHO) stated: „We know that climate change has the capacity to produce severe consequences for human health. We also know that the health sector can play a pivotal role in helping nations across the globe adapt to these serious consequences. This paper could not come at a more important moment." This statement demonstrates the importance and the international willingness to adopt Best Environmental Practices in the Healthcare Sector.

In the framework of the Cleaner Production project implemented in Jordan by the Royal Scientific Society as well as the FHNW and SBA, the SECO believes that the healthcare sector is an important field for improving resource management and minimizing negative impacts on the environment. There is hence a need for greener hospitals that are at the heart of the healthcare sector. Without cutting on patients' safety and comfort, many efforts can be made in the backstage by the hospital management through the application of best available practices and technological innovations.

This Guide is designed to be a practical tool for daily implementation. It fills the gap between commitments to sustainable development and the undertaking of concrete measures. By suggesting eco-efficiency practices and providing easy-to-implement tools, the Guide will enable hospital management to handle and benchmark the environmental aspects related to its business. Additionally, the Guide involves hospital staff as key greening actors and provides a good basis for integrated environmental management systems.

In a few years, it is certain that environmental protection will become a legal obligation for hospitals. Let's be proactive and start from this moment on! Those who act first will be able to anticipate the law and will acquire a competitive advantage. It is time for the healthcare industry to accept its environmental responsibilities to reduce the environmental impact of its operations.

H. P. Egler

Hanspeter Egler, Head of the Trade Promotion Division
Swiss State Secretariat for Economic Affairs

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CONTENT

0 GLOSSARY

ACTION PLAN A detailed plan identifying corrective actions, means, responsibilities, resources, and the time frame necessary for their implementation.

APPROACH The methods, procedures or processes used by an organisation to achieve its objectives.

BEP / BEPHS Best Environmental Practices / Best Environmental Practices in the Healthcare Sector are the most sustainable and environmentally friendly procedures available in a hospital.

CLEANER PRODUCTION (CP) CP is the continuous application of an integrated preventive environmental strategy applied to processes, products and services to increase efficiency and reduce risks for humans and the environment. (UNEP, 1990)

CONTINUOUS IMPROVEMENT A process of progressively enhancing the environmental management system to achieve improvements in the overall environmental performance in line with the hospital's environmental policy.

ECO-EFFICIENCY A concept that consists in offering competitive goods and services that meet human needs and guarantee quality of life, while at the same time progressively reducing the whole-life ecological impacts and resource demands of the products, until a level at least compatible with the earth's estimated capacity is reached.

ENVIRONMENT It is the natural area surrounding the organization, including air, water, soil, natural resources, flora, fauna, human beings, and their interactions.

ENVIRONMENTAL IMPACT Any modification of the environment whether negative or positive, total or partial, resulting from the activities, products or services carried out by the organization.

ENVIRONMENTAL MANAGEMENT SYSTEM Structure, organization and management methods implemented to meet the organization's environmental policy. The goal is continuous improvement.

ENVIRONMENTAL POLICY Organization commitments, orientations, and general objectives with respect to the environment as decided by management. Observing existing laws and regulations is an integral part of this policy, as well as the environmental improvement strategy.

FIRST-IN, FIRST-OUT TECHNIQUE Means that the oldest inventory items are used first. Applied to pharmaceutical or food stock this technique leads to less unnecessary disposal of goods due to expiring.

HAZARDOUS WASTE Waste which because of its quantity, concentration, or physical, chemical, or infectious characteristics may: pose a substantial present or potential hazard to human health or the environment when improperly treated, stored or disposed of, or otherwise mismanaged; or cause or contribute to an increase in mortality rate, or an increase in irreversible or incapacitating illness.

INFECTIOUS Bio-hazardous, which have qualities that may cause infection. It contains pathogens, including bacteria, viruses, rickettsiae, parasites, fungi or recombinant micro-organisms that are known, or reasonably expected, to cause infectious disease in humans and animals that are exposed to them.

IRRITANT It is a chemical, which may cause reversible inflammation on contact.

KEY PERFORMANCE INDICATOR (KPI) A specific expression, quantitative or qualitative, which provides information on the performance of a company or organization.

MEDICAL WASTE All waste that comes out from healthcare activities. It includes „no-risk" waste, medical risk waste and medical hazardous waste.

MINIMIZATION Actions to avoid/reduce or in other ways diminish the hazardous waste at their source. Recycling is not a minimization technique but is often included in such programs for practical reasons.

NON-HAZARDOUS WASTE Any waste having a nature and composition that are similar to those of household wastes. Furthermore, the handling and storage of such waste present no particular risks. Such waste may be generated by industry, commerce, workshops or agricultural activities.

POISONOUS A substance that adversely affects one's health by causing injury, illness, or death. These are often marked with skull and crossbones.

RECYCLING Recuperation of materials or products to reuse them either in their original form or as an input material in a manufacturing process.

STAKEHOLDERS An individual or a group concerned with or affected by the performance of an organization (employees, governmental authorities, NGOs, clients, neighbors, research centers, chambers of industry, suppliers, etc.).

SUPPLIER The provider of a product or service to the organization.

SUSTAINABLE DEVELOPMENT Development that meets present needs without endangering the ability of future generations to meet their own needs. Sustainable development is contrasted with other modes of development that lead to social and ecological damage, at both the local and global levels.

TOXIC Any substance producing a harmful effect on living organisms or the environment by physical contact, ingestion or inhalation.

1 INTRODUCTION AND CONCEPT

Best Environmental Practices in the Healthcare Sector (BEPHS) is a subject which is acquiring more and more consideration by healthcare professionals, public authorities and donor agencies. The healthcare sector and especially hospitals account for a massive, but often neglected or even ignored impact on the environment and face high costs for use of energy, water and disposal of material (waste). Other issues described in this guide also influence safety and quality of services provided. In a recent paper (Healthy Hospitals Healthy Planet Healthy People. Addressing climate change in health care settings WHO 2008), the World Health Organization (WHO) stated: *"We know that climate change has the capacity to produce severe consequences for human health. We also know that the health sector can play a pivotal role in helping nations across the globe adapt to these serious consequences. This paper could not come at a more important moment."* This statement demonstrates the importance and the international willingness to adopt Best Environmental Practices in the Healthcare Sector.

It is of high importance to notice that actions and measures towards *"greener"* hospitals must not be understood as restrictive practices or as a barrier to quality of service and comfort of patients but on the contrary as an enriching and challenging vision for leading hospitals. In fact, the implementation of best environmental practices goes hand in hand with the improvement of safety, quality, cost savings and improvement of staff and patient's health protection. BEPHS as a whole should be understood as a *"green package"* proposing a holistic approach for the healthcare sector. BEPHS allows identifying areas with improvement potentials and therefore leads to different kinds of positive impacts and benefits listed in table 1.

SAFETY BENEFITS

- Better handling of hazardous and toxic materials
- Awareness raising of the staff and patients
- Better and safer waste management
- Reduction of the number of accidents and injuries (e.g. needles)

ECONOMIC BENEFITS

- Improvement of efficiency (technological, energetic, building and staff, reduction of losses)
- Cost reduction (e.g. energy prices are and will continue increasing in the future, high costs of waste disposal)
- Improvement of management practices (e.g. green purchasing)
- Reduced turnover and higher productivity of staff

ENVIRONMENTAL BENEFITS

- Reduction of CO_2 emissions
- Better resources management
- Water shortage abatement
- Reduction of air pollution
- Climate change mitigation (e.g. a big amount of electricity in Jordan is gained from oil)

HEALTH AND SOCIAL BENEFITS FOR STAFF AND PATIENTS

- Improvement of health impact (e.g. air quality)
- Decreased length of stay in hospital
- Nosocomial infection reduction
- Awareness raising (e.g. trainings)
- Motivation increase through involvement of staff

Table 1: Benefits of Best Environmental Practices in the Healthcare Sector (BEPHS)

This guide for BEPHS is designed to facilitate the implementation of environmental management practices in healthcare facilities. It is a first step tool to implement Cleaner Production (CP, see section 1.3) in the healthcare sector. It provides the means to identify, in the different hospital departments, opportunities for optimizing hospital activities while reducing operating costs and environmental impacts. The BEPHS is intended to be simple and practical and has following objectives:

- To provide a simple overview of CP in hospitals as entry point for more detailed assessments
- To categorize and describe main subjects that should be considered in an environmental audit
- To foster environmental action in hospitals
- To stimulate awareness creation on CP potentials in healthcare facilities
- To support a first CP assessment with basic tools (checklists)
- To fulfill a function of platform (or entry point) for discussing the issue of green health at various levels of decision making and among different national and international organizations active in the sector.

The BEPHS guide can be implemented by hospital management, technical executives or qualified resource persons. Management must first adhere to the guide's objectives and involve the relevant staff. If internal expertise is insufficient for undertaking this task, the assistance of an external consultant can be sought. The target groups of this guide also include CP experts and public authorities.

1.1 STRUCTURE OF THE GUIDE

SECTION	CONTENT	OBJECTIVES / USE
1	Introduction of the BEPHS concept and how to use this guide	Awareness raising for the necessity and the benefits of implementing cleaner production.
2	Introduction to data collection and metering by applying KPI and MEFA	Provides a method to overview and understand the processes of hospital activities. It allows situating the hospital status against similar hospitals as well as monitoring progresses of BEP.
3	Presentation of the hospitals divisions	Introduction to the divisions` specificities and challenges concerning CP with "good practice examples" and references for further reading.
4	Focus on selected environmental issues	Description of relevant key issues with some examples and suggestions for improving the environmental performance.
5	Economic calculation as a decision-making tool	Description of calculations (with examples) to be realized before options implementation. It allows determining the required investments, costs savings and payback time.
6	Suggestions for a sustainable and successful CP implementation	Provides a list with tips and incentives to overcome typical obstacles and to help implement successfully sustainable measures in a hospital.
7	References	List of further information about BEPHS.
8	Two Jordanian and one international case study	The case studies are selected examples of two CP assessments in Jordan and of an implementation of BEP in a hospital in USA.
A1	Preliminary environmental audit questionnaire	Tables to be filled out for data collection before the first assessment.
A2	Checklists	The checklists are questions for a first field visit in a hospital. They can be used to identify the environmental problems and areas of improvement in each hospital department. The checklists are easy to use and can easily be photocopied.
A3	Matrix	Provides a table to be filled after field visit as a summary of outputs. It can be used as a basis for discussion with the management team of the hospital.
A4	Action plan	Providing action plan form that can be easily adapted for planning the implementation of selected measures.

Table 2: The structure of the guide

1.2 PROPOSED USE OF THE GUIDE

USE CASE 1:
AWARENESS RAISING ON BEPHS AND PROMOTION OF THE CONCEPT

Readers interested in these aspects should mostly use the first 7 sections of the guide as a basis for discussion and capacity building. The guide can also be handed over to interested parties to promote the concept of CP in healthcare sector.

USE CASE 2:
SUPPORT FOR A PRACTICAL ASSESSMENT OF A HOSPITAL, EITHER CONDUCTED INTERNALLY OR WITH SUPPORT OF CP-EXPERTS

The checklists and the different appendices of the guide allow a fast, complete and practical assessment of a hospital. For users of this guide (intern or extern) aiming at assessing a facility, the following methodology is proposed:

- Read the guide to learn about the different issues. You can always come back to specific issues and/or further information upon the needs identified during the assessment.
- Organize a field visit in the hospital of duration between one and two days, depending on the size and complexity of the facility. The visit should start with a meeting with managers of the hospital, who can then delegate the field visits to the different responsible persons.
- Before your field visit in the hospital, you can already transmit the Appendix 1 to the contact persons, so that they already gather the necessary data.
- During your field visit, try to answer all the checklists (in Appendix 2) keeping in mind your objectives, namely, measuring the environmental performance of the hospital and identifying potential areas for improvement. Also, during the field visit, systematically insist on the fact that you are not proceeding to an inspection. It is also advised to take pictures, if authorized.
- After the field visit, fill in Appendix 3 and discuss your outputs with the management of the hospital. Together you can identify areas where the implementation of BEPHS should be started.
- For selected areas, identify CP-options and proceed to the necessary calculation (see methodology in section 5). If everybody agrees, prepare an action plan as per format provided in Appendix 4.
- Make sure that the actions are monitored and that progress is measured and documented. If possible, accompany CP implementation with training sessions in order to inform the staff about what you are doing and why.

USE CASE 3:
REFERENCE DOCUMENT

The goal of the guide is to be easily accessible and easy to read with direct access to needed information, resources and reference. The guide should thus be a working tool for every healthcare professional with environmental concern.

1.3 CLEANER PRODUCTION

As a result of the non-sustainable development and rapid growth, considerable environmental problems and challenges emerged in different economical sectors. Given the increasing importance of environmental issues, appropriate strategies and adapted measures are needed. In that respect, investing in CP will prevent pollution and reduce environmental impacts. It is usually more cost-effective than continuing to rely on increasingly expensive 'end-of-pipe' solutions. In fact, CP is the continuous application of an integrated preventive environmental strategy applied to processes, products and services to increase efficiency and reduce risks for humans and the environment *(UNEP 1990)*. In other words, BEPHS is the application of cleaner production in the healthcare sector.

CP activities include measures such as pollution prevention, source reduction, waste minimization and eco-efficiency. This can be achieved in various ways. A division in five prevention practices is most common:

GOOD HOUSEKEEPING	Changes in operational procedures and management in order to eliminate waste and emission generation. Examples are spill prevention, improved instruction of workers and training.
PRODUCT MODIFICATIONS	Changes to the product characteristics, such as shape and material composition. For instance, the lifetime of the new product is extended, the product is easier to repair, or the manufacturing of the product is less polluting.
INPUT SUBSTITUTION	Use of less polluting raw and adjunct materials and the use of process auxiliaries (such as lubricants and coolants) with a longer service lifetime.
TECHNOLOGY MODIFICATIONS	Include for instance improved process automation, process optimization, equipment redesign and process substitution.
ON-SITE RECYCLING	Useful application of waste materials or pollutants at the company where these have been generated. This could take place through re-use as raw material, recovery of materials or useful application.

Table 3: Prevention Practices of Cleaner Production

1.4 CONCEPT OF BEST ENVIRONMENTAL PRACTICES IN HOSPITALS

In healthcare facilities, the CP approach will contribute to lowering water and energy consumptions and will improve the waste management. Applying CP know-how means also improving efficiency and adopting better management techniques. CP depends only partially on new or alternative technologies. It can also be achieved through improved management techniques, different work practices and many other 'soft' approaches. CP is as much about attitudes, approaches and management as it is about technology.

In fact, CP requires changing attitudes, responsible environmental management and evaluating technology options. For successful implementation, the concept must be effectively communicated within the organization. Employees at all levels, including top management, should be actively involved.

The focus of this guide lies in operations and maintenance of hospital facilities and not in planning, design and construction of new facilities, although these issues are also relevant to the aim of Cleaner Production. The reason of focusing on existing facilities is the high potential, for example, in the field of energy efficiency. In already existing buildings in Switzerland, for example, over 12% of energy can be saved without substantial investments only through optimization, technical control and the improvement of work processes.

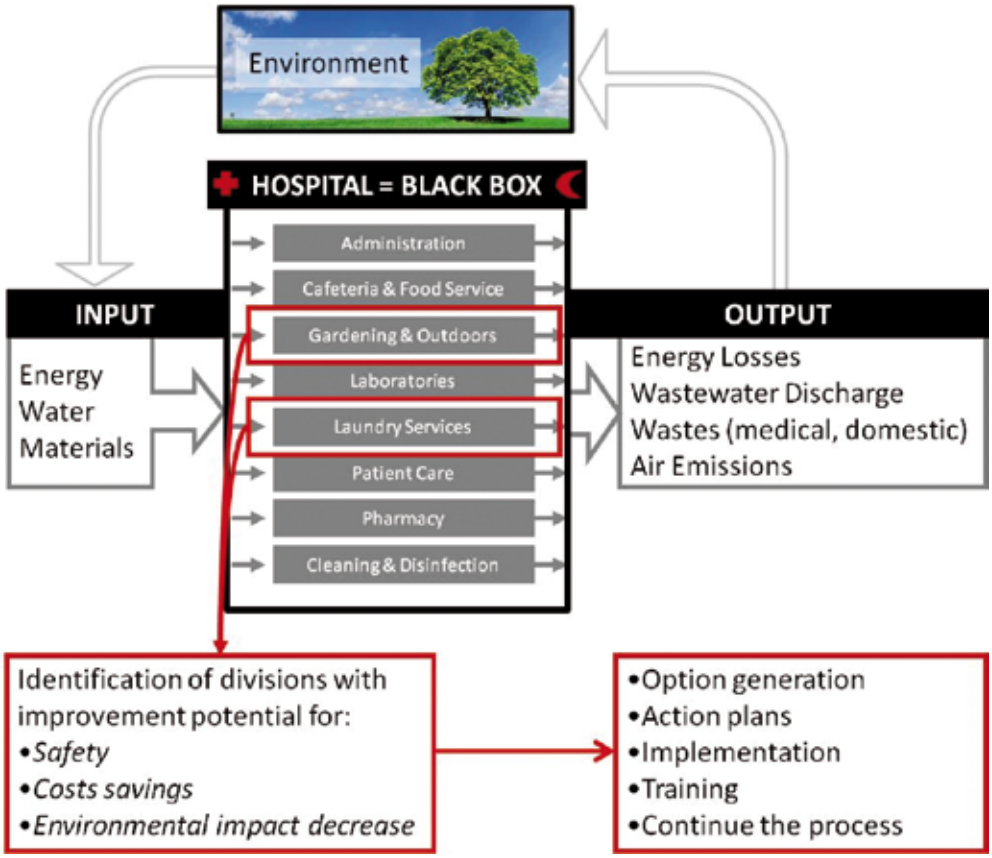

Figure 1: The concept of best environmental practices in hospitals

1.5 DESCRIPTION OF RELEVANT STAKEHOLDERS AND ASSOCIATIONS

HEALTH CARE WITHOUT HARM (HCWH)

HCWH is an *international coalition* that guides the healthcare sector to make environmentally preferred practices and policies, without compromising patient care or safety, so that it is ecologically sustainable and no longer a source of harm to public health and the environment.

HCWH provides technical assistance, product research, support, advocacy, and education. Its goals include safer products, materials and chemicals; alternatives to incineration; green building and operations; sustainable foods and food systems; and safe and healthy places for workers and patients, so that the healthcare sector can become a true healing environment.

www.hcwh.org/europe

PRACTICE GREENHEALTH

Practice Greenhealth is a US networking organization for institutions in the healthcare community, formed out of *Hospitals for a Healthy Environment* (H2E), the *Healthcare Clean Energy Exchange* (HCEE) and the *Green Guide for Health Care* to provide tools, education and recognition on environmental sustainability in the healthcare sector. The following web based tools available are open source but developed according to US standards.

Energy Impact Calculator (EIC) is for measurement of the health impacts and costs of a hospital's energy use, and enables energy purchasers to make business decisions on energy efficiency projects and renewable energy purchases based on a fuller understanding of energy's true costs.

HCEE also operates a healthcare focused, *web-based clean energy and environmental commodities* reverse auction platform to help healthcare facilities contain or reduce their energy costs, lock in more stable pricing, and be good environmental stewards.

www.practicegreenhealth.org

SUSTAINABLE HOSPITALS

Sustainable Hospitals is a project which provides technical support to the healthcare industry for selecting products and work practices that reduce occupational and environmental hazards, maintain quality patient care, and contain costs. The website offers access to many documents classified in different categories.

www.sustainablehospitals.org

WORLD HEALTH ORGANIZATION (WHO)

WHO claims that the health sector can play a leadership role in mitigating climate change. Climate mitigation can contribute to public health and save health care systems money. WHO and HCWH suggest that policy-makers, health facilities and health professionals around the world should consider opportunities for action to place the healthcare sector at the forefront of global climate change mitigation.

www.who.int/topics/environmental_pollution/en

MINISTRIES OF HEALTH & ENVIRONMENT

For a successful implementation of BEPHS, it is important to involve public authorities, such as ministries of health (MoH) and environment (MoEnv). Their involvement will increase the commitment of hospitals and the acceptance of a sustainable development vision. Furthermore, the ministries can have an impact on existing or new policies. The ministries can also bring BEPHS forward and within the national strategies. They can also enable access to financing means for the implementation of best practices.

1.6 WHAT MAKES A HOSPITAL SPECIAL FROM THE CP POINT OF VIEW

Originally the concept of Cleaner Production gives guidance in optimizing industrial production processes. The main aims of CP are to increase productivity by ensuring a more efficient use of raw materials, energy and water in the first place and to promote better environmental performance through reduction at source of waste and emissions in the second place. Thus CP is keen about economic profitability and environmental benefits.

Hospitals have specific and complex structures that do not belong to the industry but rather to the service sector. What makes hospitals special is that the most important issue in the healthcare sector is safety: hospital processes have to be safe for patients and the staff. The second main concern in hospitals is their profitability as they have to be led economically. Finally, the environmental concerns can be tackled. It is thus the challenge of the CP concept in the healthcare sector to take into account the three above mentioned dimensions as shown in figure 2.

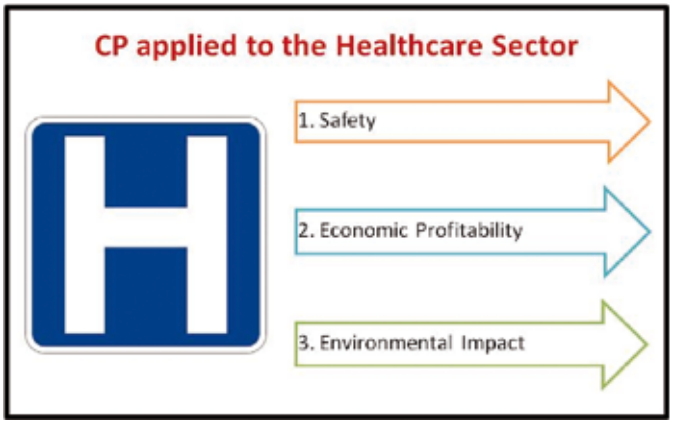

Figure 2: Relevant aspects for the application of CP in the healthcare sector

Furthermore, the implementation of CP in hospitals will not decrease the quality of services or comfort of patients, but rather offer a "green package" improving the three dimensions all together.

The second challenge about CP in hospitals is the implementation of the concept. Often the responsible person for the environmental issues is the same as the one for safety, logistics, maintenance or engineering. Besides the lack of human resources the staff has little training in CP or environmental issues. This fact results in behavior patterns which are not always oriented to best environmental practices. Other obstacles are the lack of control and a missing financing system. Keys to address these issues and to overcome other practical barriers are given in section 6 of this guide.

2 KNOW THE FACILITY

2.1 DATA COLLECTION AND METERING

„Data is a powerful tool. If you don't know what you have, how can you prioritize your action plans, justify your programs, or report on your success?"

Hospitals for a Healthy Environment

Data collection is considered an essential step in order to gain an overview of hospital activities, to understand the processes involved, and to analyze the environmental impacts associated with the different processes. In comparison with normal domestic consumptions, hospitals are big consumers of water (Jordanian average: 38 m^3/bed/month), electricity (average (Jordan): 5'208 kWh/bed/month) and fuel energy (average (Jordan): 245 liters of diesel/bed/month). They also generate important quantity of medical waste (average (Jordan): 1.5 kg/bed/day) (data from Farouq Omari 2010).

Data concerning food consumption, medical supplies as well as other raw materials can be gathered from the financial or from the purchasing department. Water consumption, diesel and electricity consumption in relation with boilers, air conditioners, chillers, heaters and refrigerators can be gathered from the maintenance and from the financial departments.

In certain cases, the installation of metering devices will be required in order to undertake measurements regarding water quantities, temperature or electricity consumption in specific sections of the hospital. Such measurements will help to better understand processes involved. Similarly, the number of patients and the occupancy rate in the hospital can be collected from the registration officer. These data will be useful for CP teams to calculate the key performance indicators (KPI) for each material and supply. KPI can then be monitored on a monthly or seasonal basis.

2.2 MATERIAL AND ENERGY FLOW ANALYSIS (MEFA)

After the completion of data collection and metering (if needed), a material and energy flow analysis shall be made in order to get an overview of energy, materials, water and waste that may flow through the processes of the hospital. This will allow identifying the areas for potential improvements. An example of MFA is presented in this guide for water flow in the section 4.3 (figure 8).

Conducting a MEFA provides an in-depth understanding of the processes. It clarifies detailed process steps, quantifies material and energy consumption, identifies the sources of waste and emissions, and describes the amount of each raw and waste material. MEFA can be used to describe inefficient points in the process, to define measures for CP optimization, and to create a data baseline for assessing the improvements linked to the adopted CP measures (i.e. by comparing the situation before and after the implementation of the CP measure).

MEFA CONSIST OF FOUR STEPS:

1. **System analysis:** Definition of system boundaries in order to focus on auditing areas and to define reference period (month, season and year). Description of the system; i.e. designing a detailed material flow chart for processes within the system boundary in order to represent the process steps or unit operations by arrows and boxes.
2. **Data definition and identification:** what data do we need, how and where can we obtain it (e.g. measurements, existing records, estimations, calculations) and who is responsible to collect or elaborate the required data and until when. In this respect, it is important that data are expressed in the adequate units preferably SI units. The quality and reliability of the data should also be assessed in order to base decision making on accurate information.
3. **Calculation of material flows (Input and Output):** This step implies keeping principle of mass conservation, i.e. what is coming in is going out.
4. **Interpretation and conclusions:** Using fish bone diagrams is useful to identify the causes and effects of main problems throughout the processes.

2.3 KEY PERFORMANCE INDICATORS (KPIS) AND KEY FIGURES

KPIs are a suitable tool to inform, monitor, control and plan all environmentally relevant activities of the hospital. KPIs can also be used for external communication as well as for internal actors within the hospital. KPIs mostly have two objectives:

- **Compare your hospital with key figures** coming from other similar hospitals in order to situate your environmental performance (regional, national or international). Unlike in other industries, this objective is difficult to attain, as every hospital has its own specificities, making a relevant comparison not easy. However, such comparisons can already provide good information and should not be neglected.
- **Monitor your progress towards best environmental practices** by comparing your KPI at different times. (e.g. before and after implementation of CP measures) This can help pursuing the continuous process of CP by showing the top-management that BEPHS works in your facility.

Tables 4 and 5 show how to calculate KPIs for electrical energy, water and diesel consumption, generation of medical and domestic waste.

REQUIRED DATA	SYMBOL	UNIT
Electricity consumption	E	kWh/month
Water consumption	W	m^3/month
Diesel consumption	D	liter/month
Medical waste generated	MW	kg/month
Domestic waste generated	DW	kg/month
Total number of beds	total beds no.	beds
Occupancy rate (for one month)	occ. rate = no. occ. beds / total beds no.	–
Number of days[1]	no. days	days/month

Table 4: Required data in order to calculate KPIs defined in table 5

MATERIAL	KEY PERFORMANCE INDICATOR (KPI)	UNIT
1. Electricity	KPI= E / total bed no. / occ. rate / no. days	kWh/occ. bed/day
2. Water	KPI= W / total bed no. / occ. rate / no. days	m^3/occ. bed/day
3. Diesel	KPI= D / total bed no. / occ. rate / no. days	liter/occ. bed/day
4. Medical waste	KPI= MW / total bed no. / occ. rate / no. days	kg/occ. bed/day
5. Domestic waste	KPI= DW / total bed no. / occ. rate / no. days	kg/occ. bed/day

Table 5: How to calculate typical Key Performance Indicators for the healthcare sector

It has to be mentioned that the use of KPI and benchmarking is not very common in the healthcare sector due to different reasons. One of these is the difficulty to compare hospitals with different specialties and between different countries, as standards differ highly. However, the following table presents key figures which can already give some idea to determine where your facility situates in comparison with different countries.

[1] This will be used to calculate the KPI per day. As consumption is generally given per month, it needs to be divided by the number of days of the selected month. Then, the KPI can be either calculated for a selected month (value of 28, 29, 30 or 31 for the number of days) or can be calculated from yearly data. In this case the value for the number of days will be 30.

INDICATORS	TYPICAL VALUE	COUNTRY
Total solid waste (kg/bed/day)	4.80	Australia
	8.46 USA	
	0.14–3.50	Middle East, Asia and Africa
	1.00 –4.50	Latin America
Medical waste (kg/bed/day)	1.50 –2.00	France, Belgium and England.
	1.10	USA
	0.01–0.20	Middle East, Asia and Africa.
	0.25–1.13	Latin America
Total water consumption (m3/bed/day)	0.20	Eastern Europe
Consumption of electricity (kWh/bed/day)	max. 6.60	Austria

Table 6: International KPI in Sector Guide Cleaner Production: Hospitals, Clinics and Health Centers, 2001

ASSESS THE FACILITY – THE DIFFERENT DIVISIONS
2.4 ADMINISTRATION

The administration of a hospital usually manages and supervises the healthcare services. In this division CP potentials can be applied to the office areas that often use large amounts of energy and produce substantial volumes of waste.

RELEVANT POINTS TO BE CONSIDERED FROM THE CP PERSPECTIVE

- **Office equipment**
  Office equipment, such as computers, printers and others consume electric power even when they are not in use. Encouraging staff to turn computers off at night and on weekends is the most effective way to reduce electricity consumption. Activating the standby feature when the computer is not used for a short period of time can save up to two thirds of its energy consumption.

- **Lighting**
  The issue of lighting is not only relevant to the administrational sector and is therefore also considered in the Chapter „Energy Efficiency" of this guide.
  > Good Practice Example
  „Lighting can be adjusted to the actual needs through usage of time switchers, occupancy and movement sensors as well as day-light or temporal dimming. These measures altogether can save up to 70% of electricity." (Source: Klinergie 2020, Energy Efficiency in German Clinics)

- **Waste**
  Office waste mainly consists of paper. Reducing the amount of paper being used, recycling and using recycled paper are low-cost and easy measures to make administration processes more sustainable.

- **Heating and air conditioning**
  Heating and cooling are the biggest energy consumers in buildings. This consumption can often be reduced through operation optimizations which do neither require significant investments, nor lead to a loss in comfort or hygiene. Such measures and many further advices are given in section 4.1.
  > Good Practice Example
  By applying such measures a hospital in Langenthal (Switzerland) managed to cut its energy consumption after five years by 13.2% and to save an equivalent of 90'000 USD of energy costs per year. (Daniel Hänny, energho)

FOR FURTHER INFORMATION

It's easy to be green: A guide for environmentally conscious office. M.J. Bradley & Associates Inc. www.mjbradley.com/

2.5 CAFETERIA & FOOD SERVICE

Most hospitals operate areas for cooking and cafeterias for staff and guests. Usually the food for patients is also prepared in-house. Food preparation consumes a great deal of energy and water. Food Service also produces a lot of waste, which can be prevented, minimized or recycled.

RELEVANT POINTS TO BE CONSIDERED FROM THE CP PERSPECTIVE

- **Waste**
  Disposable dishes and eating utensils are often used in hospitals. Most of the waste typical of Cafeteria & Food Service can be prevented by using washable plates, cups, glasses and eating utensils for staff and visitors cafeterias and for patient service.
  > Good Practice Example
  In a Swiss hospital in Bülach a flexible ordering of meal sizes (half portion, quarter portion) is practiced in order to prevent leftovers. The meal orders are taken each day in advance by trained service staff. Such measures save money when purchasing food as well as when disposing kitchen waste.

- **Energy**
  Food preparation needs large amounts of energy, especially when kitchen appliances are electric. Switching to gas and teaching kitchen staff in energy-efficient behavior will help to save energy and costs.

- **Water**
  Water in hospital kitchens is mainly used for cooking and cleaning. A reduction of water usage can be achieved through using efficient equipment such as high pressure, low volume nozzles and again, through training staff in water efficiency.

FOR FURTHER INFORMATION

Sustainable food procurement in the NHS (National Health Service), Sustainable Development Commission, 2001.

Case Study: Green Cafeterias, EPA / EPP,
www.epa.gov/epp/pubs/case/cafeteria.htm

2.6 GARDENING & OUTDOORS

Attractive hospital grounds can be utilized to speed up patient recovery, increase patient satisfaction and please staff. Such landscapes need maintenance which can be provided in a more or less environmentally sound way. The processes of gardening often involve intensive irrigation, use of fertilizers and pesticides and cause substantial landscaping waste.

RELEVANT POINTS TO BE CONSIDERED FROM THE CP PERSPECTIVE

- **Water**
  Water is a valuable resource. Efficient use of water does not only mitigate water stress, but also saves costs. Irrigation for gardening can be organized in a more efficient way by adjusting the irrigation schedule for seasonal changes, watering either early in the morning or in the evening and installing a drip system. Leaking water lines, valves and pumps account for water wasting and should therefore be eliminated. Water is often used for cleaning of outdoor areas, where dry cleaning can be just as efficient.
  > Good Practice Example
  At the University Hospital in Freiburg (Germany) rainwater from roofs is not being led in the public drainage but is being collected in a pond in front of the hospital building. Hence, the rain water enriches the ground water reserves. In addition, rain water is collected for watering the green grounds, which not only saves precious drinking water, but again, helps to sustain ground water. (Practiced environmental protection at the University Hospital Freiburg, 2002)

- **Waste**
  The outdoor wastes are mostly grass clippings, leaves and trimming of the gardening operations. Often these wastes are neglected in the process of waste management in hospitals because of being generated outside the facility. Composted gardening waste is a good soil additive.

FOR FURTHER INFORMATION

H2E 10-Step Guide to Composting in Healthcare Facilities, Hospitals for a healthy environment, 2003.

2.7 LABORATORIES

There are several types of laboratories in hospitals. Among these are laboratories for research and teaching, chemistry, hematology, pathology, microbiology, immunodiagnostic, gross pathology and necropsy laboratories. Numerous laboratory operations in hospitals are sources of hazardous waste. There are various measures which can be taken to prevent and minimize this waste and offer it's adequate treatment.

RELEVANT POINTS TO BE CONSIDERED FROM THE CP PERSPECTIVE

- **Management practices and training for waste management**
  An important task in hospital laboratories towards cleaner production is to manage laboratory waste in an environmentally sound way. For this purpose, policies are often not enough but the input should come from the management in order to involve the staff in this ongoing process, mostly by training them on how to handle waste and why it is important to take care of it.

- **Solvent recovery equipment**
  For many solvents, it makes sense from an economic and environmental point of view to recover them, either by distillation or by special equipments. The good practice example below tells more about this issue.

- **Favor environmentally friendly products**
  Nowadays, laboratory equipment requires tailor-made kits and the products used are in these cases difficult or impossible to change. However, there are other products used in laboratories (e.g. cleaning products for labware) that can be exchanged for environmentally friendlier products (e.g. mercury-free, formaldehyde-free).

> Good Practice Example

"Dr. Russell Mankes, Associate Professor of the Albany Medical Center points out that Formaldehyde is an EPA regulated hazardous waste (RCRA-U122) if it is in the original container or is not spent. Waste from tissue processors or spent fixative may not be RCRA regulated, but in most areas cannot be discharged to sewers as it adversely affects the bacterial sewage treatment. Besides, Dr. Mankes asks, why would you want to pour money down the drain? Formaldehyde for fixation of tissues is expensive. The Albany Medical College has been recycling formalin since 1995. Between 1995 and 2004, they recycled ~40,000 pounds of formaldehyde waste in one 5 gallon capacity recycling unit. The original equipment cost of ~USD 10'000 resulted in avoiding USD 185'000 in disposal costs and USD 142'000 in chemical purchase costs. Even for a small hospital, this is economically beneficial."

Source: Sustainable hospitals website

FOR FURTHER INFORMATION

The sustainable hospitals website provides good information on its Laboratory Chemicals and Equipment section:
www.sustainablehospitals.org/cgi-bin/DB_Report.cgi?px=W&rpt=Cat&id=18

2.8 LAUNDRY SERVICES

Laundry Service plays an important role in hospitals since it contributes not only to comfort and aesthetics but also assists with infection control. The negative side effects of laundry are the large consumption of energy, water and chemicals. In addition, a great potential is often wasted for discharge of rinsing water that can be used for other purposes.

Figure 3: A sewing department in a private Jordanian hospital

RELEVANT POINTS TO BE CONSIDERED FROM THE CP PERSPECTIVE

- **Energy and Water**

  Many tips for efficient use of water and energy for laundry services are given in sections 4.1 and 4.3 of this guide. But possibly the most efficient measure to save energy, water and also costs is to reduce the amount of laundry to be washed. This can be achieved by changing towels and linens of patients upon request rather than on a routinely basis. Also reducing the amount of linen used for a standard patient bed or for example using under pads only when necessary to cut the volume of laundry and save energy and water.

  > Good Practice Example

  At the University Hospital in Freiburg (Germany) the weight of a stand bed lining has been cut in half by omitting unnecessary items. Handling about 50'000 patients annually, the amount of laundry has been reduced by 130 t per year. This saved over 2 million litres of water and 286'000 kg of steam. (Practiced environmental protection at the University Hospital Freiburg, 2002)

- **Chemicals**

  Many chemicals which are used in laundry detergents are toxic to aquatic organisms. Even after wastewater treatment, these chemicals are often released into the environment. To reduce the environmental impact of detergents, the toxicity of chemicals should be minimized by an increased biodegradability of the product.

FOR FURTHER INFORMATION

Environmental Improvements in Laundry Equipment and Products, Hospitals for a Healthy Environment, 2006.

2.9 PATIENT CARE

Patient care in hospitals causes large volumes of waste. When these wastes are being incinerated or landfilled, potentially toxic pollutants may be released into the air, soil and ground water. In both departments, patient-care and medical supplies, usage of reusable instead of disposable supplies can help reduce the volume of waste considerably.

FOR FURTHER INFORMATION

List for Alternative Products, Sustainable Hospitals,
www.sustainablehospitals.org/cgi-bin/DB_Index.cgi

RELEVANT POINTS TO BE CONSIDERED FROM THE CP PERSPECTIVE

- **Patient-Care Supplies**
  Using reusable products in patient care can save large amounts of money. The main obstacle on the way to convince hospital staff to switch to reusable products is the question of hygiene. Often these concerns are not legitimate as washing in most cases is enough to eliminate bacteria, provide sufficient level of hygiene, and in addition, costs less than buying new disposable products. In the Appendix 2 of this guide you will find a list with reusable alternatives for disposable items of patient-care supplies.

- **Medical Supplies**
  As with patient-care supplies, switching from disposable to reusable medical instruments is the best way to reduce waste and costs. Moreover, there are for example, surgical packs containing unused items which must be thrown away once a pack is opened or items which cause the whole pack to outdate early. In such cases the purchasing departments of hospitals play an important role and should contact the manufacturer to adjust these packs to the needs of the users.
  > Good Practice Example
  „Legacy Health Systems (Portland, Oregon) eliminated rarely used items from custom packs of surgical supplies, saving more than 30'000 Dollars per year."
  (Source: Saving money and saving the earth, Down in the dumps? First Moves Magazine, 2004, Vol. 1 No. 12)

- **Lighting & Bathrooms**
  A reduction in the use of electricity and water in patient care areas can be achieved by installation of water saving devices and energy efficient equipment as described in section 4. Moreover, this consumption can also be reduced by involving staff and encouraging patients to save water and electricity. An increased use of available day lighting for example will not only save energy but may also make a contribution to the recovery of patients.

2.10 PHARMACY

From the perspective of Cleaner Production, the problem of pharmacy divisions in hospitals is the generation of pharmaceutical waste. It includes for example outdated pharmaceuticals, their packaging, their preparation, partially used vials and syringes, spills and breakages of medications.

RELEVANT POINTS TO BE CONSIDERED FROM THE CP PERSPECTIVE

- **Pharmaceutical Waste**
  Many pharmaceuticals present a threat to people and the environment because of their persistence, bioaccumulation and toxicity. Therefore, outdated pharmaceuticals should ideally be returned to the distributor for adequate disposal. Furthermore the problem of outdated pharmaceuticals can be solved by the consistent application of the first-in, first-out technique. A reduced inventory helps also to decrease the probability of expired pharmaceuticals as well as delivery in appropriate quantities.

FOR FURTHER INFORMATION

Preventing damage to the environment from pharmaceuticals: A primer, A fact sheet by Healthcare Without Harm Europe, 2007.

Managing Pharmaceutical Waste: A 10-Step Blueprint for Health Care Facilities In the United States, Hospitals for a Healthy Environment, 2006.

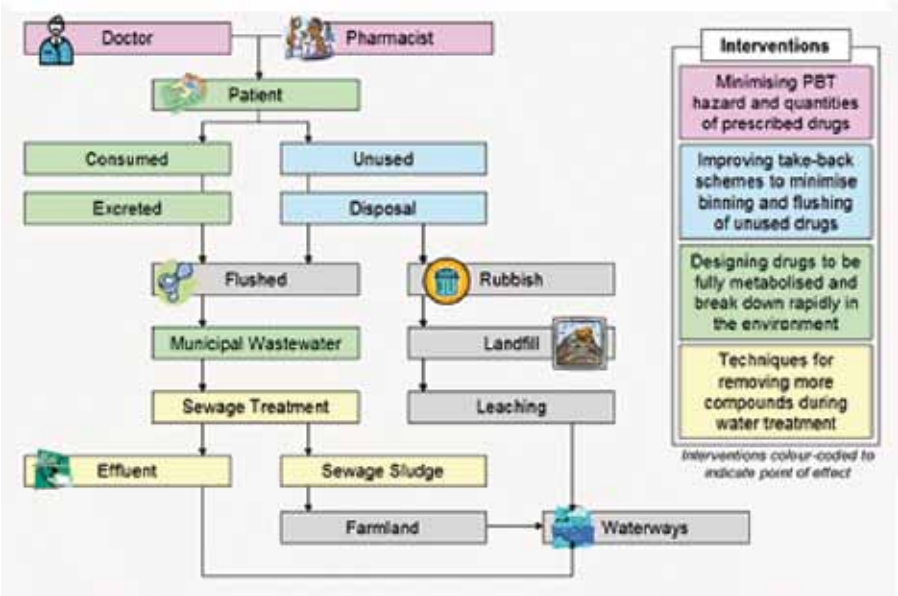

Figure 4: Interventions for reducing the quantities of human pharmaceuticals in the environment. Source: HCWH, Issues: Pharmaceuticals, 2010

2.11 CLEANING & DISINFECTION

Cleaning and disinfection in hospitals play an important role for infection control and sanitation. Reducing the amount and the toxicity as well as packaging of chemicals being used for cleaning purposes will cut the environmental pollution in this sector as well as the costs.

RELEVANT POINTS TO BE CONSIDERED FROM THE CP PERSPECTIVE

- **Water**
  In hospitals the amount of water used for cleaning can be as large as 10% of overall water consumption. Water use for cleaning purposes is a question of good housekeeping and staff's behavior. Therefore staff should be trained to use water efficiently.

- **Cleaning Materials**
  Regarding the quantity of cleaning materials, the first thing to recognize is that using more does not necessarily mean achieving better results. Cleaning chemicals should be used and mixed in appropriate amounts as suggested by the instructions of use. Concerning the quality, less toxic cleaning materials should be used. This will have a positive impact not only on the environment, but also on air quality and therefore on patients and above all on staff, who handle it. By buying in bulk and by using refillable dispensers, packaging waste of cleaning material can be reduced. All these measures will save costs of purchasing, waste disposal and handling the negative impacts of cleaning chemicals.

- **Disinfection**
  Disinfection chemicals used in hospitals are often toxic and cause negative health effects such as occupational asthma and hypersensitivity syndrome. The negative effects can be reduced by using less toxic disinfectants, ensuring proper disinfectant dilutions and adjusting the necessary level of disinfection for different areas. Again, training of staff and posting the procedure for disinfectant use at dispensing stations are necessary.

FOR FURTHER INFORMATION

Cleaning Chemical Use in Hospitals. Fact Sheet. In: Going green: A Resource Kit for Pollution Prevention in Health Care, Healthcare Without Harm, 2001.

Risks to asthma posed by indoor health care environments. A guide to identifying and reducing problematic exposures, Healthcare Without Harm, 2006.

3 FOCUS ON SELECTED ISSUES
3.1 ENERGY EFFICIENCY

While fossil fuel consumption in hospitals has been on a downward trend for the last 20 years, electricity consumption has been growing steadily. Electricity already accounts for around 18% of a hospital's delivered energy consumption and it represents over 50% (international average) of a hospital's energy costs. By reducing a hospital's energy consumption, it is possible to achieve the twin benefits of saving money and ensuring a less polluted environment for the local community.

General aspects

- Monitor regularly energy consumption by checking the electricity meters at least once a month
- Identify areas/equipments having high energy consumption
- Implement measures such as installing energy-efficient equipments

"In a typical hospital, the amount of energy consumed each year is equivalent to 16 tons of CO2 per bed space or, in total, about 8'700 m3 of CO2, which is enough to fill over 60 six-bed wards".

Source: Efficiency Best Practice program - UK Government's Energy.

Heating and air-conditioning

- Inspect or install a combined heat and power system
- Use solar collectors for hot water
- Use night-time temperature lowering thermostats
- Install several small boilers instead of one large boiler for load-dependent operation
- Install double glazed windows
- For air-conditioning, check specific room parameters (temperature, humidity, air exchange)
- Check air flow reductions are in place in unused rooms
- Clean and change the air conditioner filters regularly

"Combined heat and power system is 70-95% more efficient than conventional power production. Cogeneration systems are available from as small as 30 kW to more than 100 MW. By making continuous use of both electricity and thermal energy, customers can save up to 35% on overall energy costs."

Sources: Elisa Wood, Environmental-experts.com - Cummins Power Generation Inc.

Lighting

- Reduce general lighting during daytime and make sure that exterior lighting is switched on only at night
- Use energy-saving bulbs, especially in high consumption areas
- Install timers and movement detectors to reduce lighting time

"Bellin Hospital, in Wisconsin, U.S., saved USD 21'000 per year by using variable speed drives in hot water pumps, eliminating exhaust in unnecessary areas, and recovering boiler heat."

Armin Reller, Greener hospitals: improving environmental performance.

Cafeteria & food services

- Invest in high-performance cooking units and refrigerators when replacing equipment
- Defrost refrigerators and clean the door seals monthly

Laundry services

- Use heat recovery to warm up clean incoming water
- Avoid wasting energy from over-drying the laundry by fitting humidity sensors to dryers
- Use direct firing of gas for tumble dryers and finishing equipment
- Plan to use laundry equipment during periods of low consumption (off-peak hours)
- Use low temperature washing programmes

"Every dollar saved on energy costs is a dollar that is devoted to improving medical care for our patients."

Source: Dr. Herbert Pardes, President of New York Presbyterian Hospital.

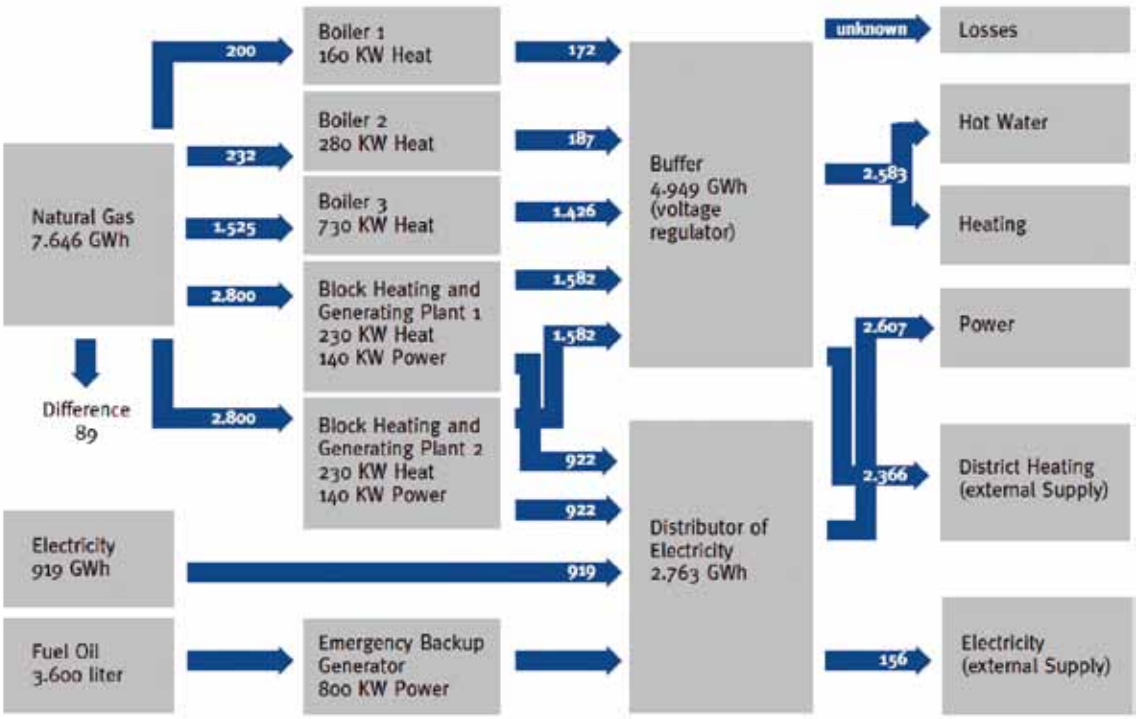

Figure 5: Typical energy flows through a hospital (Hospital Tulln, Austria, 1999)

Source: Greener hospitals: improving environmental performance University Augsburg – Bristol-Myers Squibb Company

Figure 6: A solar water heater on the roof of the building of a Jordanian private hospital

3.2 WASTE MANAGEMENT

Hospitals generate up to around 8 kg of waste per bed per day (in USA, see section 2) if not properly managed. Medical waste incineration is a leading source of dioxin, mercury and other dangerous pollutants that threaten human health and the environment. It is important to minimize the amount and toxicity of waste generated by the healthcare sector, to ensure the proper management and segregation of medical waste and to eliminate the dangerous practice of incineration by promoting and implementing alternatives, such as non-incineration treatment. Recycling and composting can also be a valuable solution for waste valorization.

General aspects

- Elaborate a waste management plan to establish a framework of policies and procedures with an overgoal of zero waste
- Understand waste categories and segregation: domestic wastes (paper, glass, plastics, etc.); regulated medical waste (biohazardous waste, potentially infectious medical waste, biomedical waste, etc.); hazardous waste; low-level radioactive waste
- Implement non-incineration technologies: thermal, chemical process, irradiative or biological processes
- Promote waste recycling: paper, plastics, glass, batteries, etc.
- Encourage composting wastes, such as grass, leaves, flowers, etc.
- Track the treatment and disposal costs of waste from individual sections and departments

"A hospital's waste disposal costs ranged from 44 to 68 USD per ton, according to the Joint Commission on Accreditation of Healthcare Organizations."

Source: The Joint Commission

Laboratories

- Promote recycling of paper, X-ray films and solutions, packing material, etc.

"The Philippine follow-up Measles Campaign 2004 and provided measles vaccines to about 18 million children in the country, and thus generated an estimated 19.5 million auto-disable syringes. The used syringes were collected in safety boxes and treated in autoclave or microwave facilities, buried in waste pits or encased in concrete vaults."

Source: Philippine Health Secretary Manuel Dayrit

Patient care

- Reprocess single-use devices, such as arthroscopic shavers, blood pressure cuffs, soft tissue ablators, scissors and staplers, etc.
- Separate bags used for the regular solid wastes and recyclables
- Donate or resale surplus
- Monitor waste management, and educate staff

"Reprocessing single-use devices provides a cost savings compared to purchasing new devices for each use (up to 50%) and reduce the amount of waste both in terms of product and packaging."

Source: Association of medical device reprocesses

Pharmacy

- Regulate pharmaceutical wastes: regulate entering products (green purchasing, appropriate dose packaging, etc.) and modify management practices

"A hospital pharmacy generally stocks between 2'000 and 4'000 different items, each of which must be evaluated against state and federal hazardous waste regulations before being thrown away."

Source: Hospitals for a Healthy Environment (H2E)

Medical Waste		Group A	waste like municipal waste		
	Medical Risk Waste	Group B	waste with a risk of contamination and/or injury		
			B1 waste with a risk of contamination	B1/1	anatomical waste
				B1/2	waste with blood and body fluid
			B2 waste with a risk of injury (sharps)		
			B3 pharmaceutical waste		
			B4 cytotoxic waste		
		Group C	**infectious waste**, incl. waste from microbiological labs		
Non-Medical Waste		Group D	all other kinds of hazardous wastes		
		Group E	radioactive waste		
			E1 waste with t1/2 < 60 days	E2	waste with t1/2 > 60 days
		Group F	dead animals		
			F1 contaminated and/or infectious	F2	radioactive

Figure 7: In Switzerland, all waste that comes from healthcare activities is called medical waste. Medical wastes include: "No-Risk" waste which is comparable to household waste; and Medical risk waste / Medical hazardous waste. (Schelker, Raymond, 2010)

3.3 WATER CONSERVATION

Many parts of the world are water stressed, and the ever-increasing population intensifies the problem. Prudent use of this invaluable natural resource is essential from a resource conservation perspective. Water use is driven by the number of inpatients and outpatients, equipment used, facility size, number and types of services, facility age and maintenance requirements. Other contributors include steam sterilizers, autoclaves, medical processes, heating ventilation and air conditioning, sanitary, x-ray equipment, laundries and food services. It is recommended that all these areas be evaluated to identify activities to help reduce water consumption.

General aspects

- Check the water supply system for leaks and turn off unnecessary flows
- Install automatic water volume controls that operate independently of the water pressure to control the amount of water
- Read water meters monthly in order to identify leaks
- Recycle and reduce water use wherever possible, consistent with health requirements.

""Reducing the time the water runs from three minutes to one minute results in savings of about 16 liters of water per hand-wash."

Source: Guide of Best Environmental practices

Cafeteria & food services

- Wash only full loads in the dishwasher
- Reuse the rinse water from the dishwasher as flush water in garbage disposal units
- Upgrade equipment with water-efficient model
- Turn off the continuous flow used to wash the drain trays of the coffee/milk/soda beverage

"The use of flow regulators on shower heads saves 40 liters per 5 minutes shower, which amounts to more than 10% of water consumption per day."

Source: Guide of Best Environmental practices

Gardening and outdoor

- Water early in the morning or in the evening
- Consider using low-volume irrigation, such as a drip system
- Adjust the irrigation schedule for seasonal changes

Laundry services

- Investigate a treated rinse water system to reuse rinse water for other purposes or recycle it in the wash cycle
- Instruct cleaning crew to use water efficiently for mopping
- Wash only full loads

"A rinse water reuse system was installed in its laundry: It has been estimated that it will reduce water consumption in the laundry process by 6.8 million litres annually."

Source: Newton-Wellesley Hospital

Heating & Cooling

- Adjust boiler and cooling tower blow down rate to maintain total dissolved solids at levels recommended by manufacturers' specification
- Return steam condensate to the boiler for reuse
- Shut off water-cooled air conditioning units when not needed, or replace water-cooled equipment with air-cooled systems

"Cooling can account for up to 53% of the water use in a hospital."

Source: South West Florida Water Management District

Laboratories & patient care

- Install automatic valves on film processing or X-ray equipment to stop water flow when equipment is not in use
- Determine shorter hand-wash cycles
- Reduce flow to surgical vacuum pumps to acceptable minimum level and maintain proper operation
- Overhaul faulty steam traps on sterilizers

Bathrooms & restrooms

- Shut-off the water supply to equipment and areas that are unused
- Install electronically controlled valves
- Replace toilets with low-volume models
- Install low-volumes showerheads

"A leaking toilet can waste more than 190 litres of water each day, and a dripping faucet or showerhead can waste up to 3'800 litres per week."

Source: Guide of Best Environmental practices

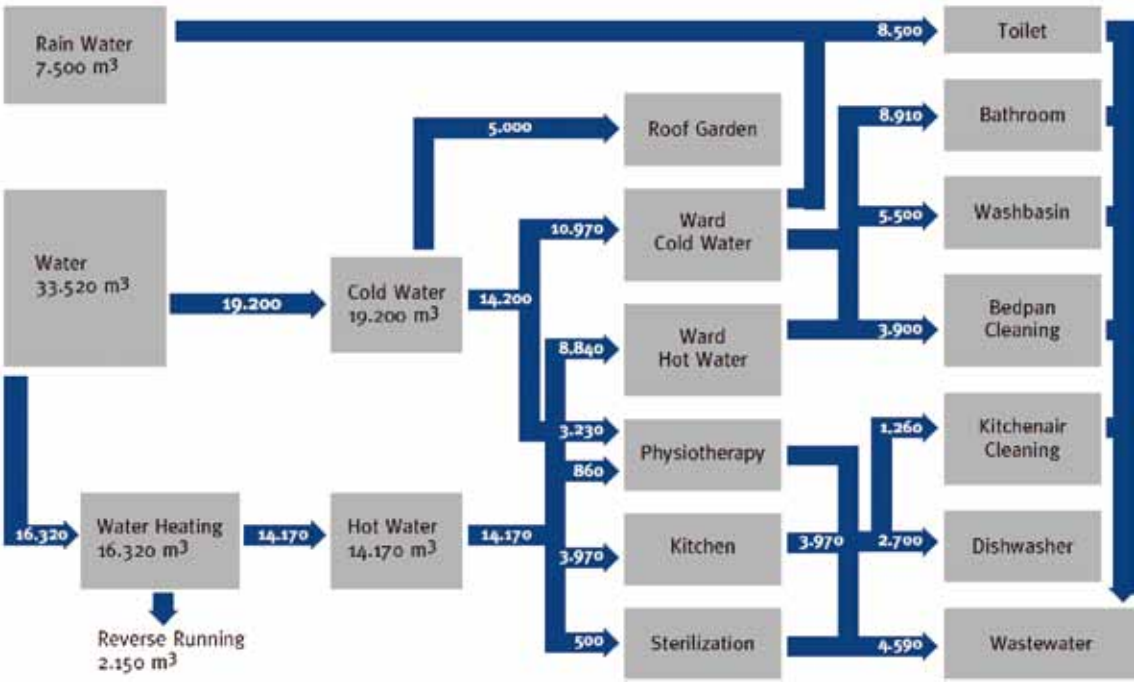

Figure 8: Water flows in a small hospital (Hospital Tulln, Austria, 1999)

Source: Greener hospitals: improving environmental performance University Augsburg – Bristol-Myers Squibb Company

3.4 GOOD HOUSEKEEPING & BEHAVIOR

Cleaning in hospitals is an important issue. For example, many nosocomial infections occur in hospitals (hospital-acquired). Thus, hospital staff and administrators often react anxiously to suggested changes in cleaning practices. Nevertheless, cleaning products are a major contributor to indoor air quality issues in closed environments. Many contain high levels of volatile organic compounds (VOCs) which can give rise to respiratory irritation, headaches and other symptoms for workers and building occupants. All disinfectants are intentionally toxic to microorganisms, and none can be accurately qualified as "green". However, best practices can assure that disinfection is highly effective without involving unnecessary exposure for workers, staff, and patients.

General aspects

- Adopt a cleaning products protocol as part of your hazard management plan
- For each product in use, determine if there is a "less-toxic" substitution that will perform the same task
- Use the most modern equipment
- Limit the use of disinfectants

"An estimated 35% of conventional cleaning products can cause blindness, severe skin damage or damage to organs through the skin."

Source: Strategies for a better environment , INFORM

Equipment

- Replace dust mops and cotton cloths with microfiber
- Purchase vacuum cleaners equipped with high-performance filters
- Vacuum before mopping
- Use advanced technology mop buckets to reduce the redistribution of dirt during cleaning

"The use of microfiber mops can reduce significantly the amount of chemical and water used. Additionally, they appear to be easier and more comfortable tools for the workers, which could reduce work injuries, lost work time and compensation claims."

Source: Are microfibers mops beneficial for hospitals? – Sustainable Hospital Project

Cleaning

- Clean before disinfecting
- Use the appropriate product for target microorganisms
- Use products at the appropriate concentration and for the proper residence time
- Be sure to follow the instructions carefully, and comply with the recommended "dwell" time or time it takes for the biocide to effectively eliminate the targeted organisms (the dwell time is generally 10 minutes)
- Read your product's label and comply with the instructions

"Hospitals that have transitioned to greener cleaners have not had an increase in nosocomial infection rates as a result of greener cleaners."

Source: Green Cleaning Implementation, H2E

Disinfecting behavior

- Determine where to use disinfectants by carefully dividing your facility into risk areas
- Identify those areas that need the highest level of disinfecting and separate them from areas that can simply be thoroughly cleaned or that need to be sanitized (food service areas)
- Identify the organisms you need to eliminate, such as those in blood and vomit or general pathogens
- Use the least toxic antimicrobials to disinfect or sanitize

"Working with or being exposed to toxic chemicals is the single largest contributing risk factor associated with occupational illness and injury in healthcare."

Source: US Bureau of Labor Statistics

3.5 TOXIC MATERIALS

Healthcare institutions regularly use an important amount of highly toxic materials. These toxins affect patients, hospital staff, and hospital visitors. The management of these materials is an essential part of a hospital's day-to-day activities. Proper registration, handling, and training are necessary to guarantee a safe workplace and to prevent potential risks to employees, patients and the environment. Many of these toxins are defined and regulated by federal, state and local laws. Others are used daily but are hardly regulated. They include carcinogens, materials that damage the skin and organs, and materials that corrode, irritate, or release other toxins in the course of normal use, storage, transportation or disposal.

Potentially toxic materials[2] used in hospitals may include halogenated and non-halogenated organic compounds (e.g. solvents), inorganic compounds, caustic materials (acids/bases), prescription pharmaceuticals, disinfectants or other compounds that may be carcinogenic, mutagenic, or reproductive toxins. This section focuses and provides tips on four toxic materials: mercury, PVC and phthalates, flame retardants and pesticides.

General aspects

- Institute a comprehensive chemical management policy
- Establish a framework of policies and procedures to reduce and eliminate the use and improper disposal of toxic materials
- Examine all hospital departments and functional areas for the presence and use of toxic materials
- Evaluate and approve all potentially toxic materials before using it
- Replace highly hazardous substances (benzene, chromosulphuric acid, mercury, chrome VI compounds, and hydrazine) with less hazardous ones whenever feasible
- Train the staff on how to safely use potentially hazardous substances
- Develop written procedures for receiving, handling, storage and disposal of toxic materials

"The xylene distillation and nitrogen elimination projects alone save the hospital 8'000 USD annually."

Source: Saint Barnabas Medical Center, Department of pathology.

Toxic and chemical waste disposal

- Establish special disposal procedures for certain chemicals, such as solvents, halogenated solvents, acids, rinses/washes (saline solutions, buffers, formaldehyde solutions, aqueous dye solutions), alkaline, old disinfectants and cleaning agents, etc.
- Check with pharmaceutical companies for specific information on proper disposal of expired pharmaceutical products

"Healthcare facilities have the potential to use a variety of products and devices that contain varying types of radioactive materials (used radiopharmaceutical products and vials, Tc-99m eluate vials, lyophilized drug pr oduct vials containing Tc-99m)."

Source: Greener hospitals: improving environmental performance.

[2] Some examples: fixer and developer baths from X-ray departments; heavy-metal-based compounds containing silver, lead, copper, cadmium, chromium, mercury, or manganese; reactive/explosive substances such as acides and peroxide compounds such as hydrogen peroxide, perchloric acid, peracetic acid, and perborates; concentrates of disinfectants and cleaning agents, bleaches and detaching agents; substances from nuclear medicine/radiology (including radioactive substances and iodoorganic contrast media); etc.

Mercury

- Mercury is a potent neurotoxin that can harm the brain, spinal cord, kidneys and liver. It is used throughout health care in a variety of products including thermometers, sphygmomanometers, dental amalgam, laboratory chemicals and preservatives such as thimerosal, cleaning agents, and various electronic devices such as fluorescent lamps and computer equipment.
- There is up to 50 times more mercury in medical waste than in general municipal waste, and the amount of mercury emitted from general medical waste incinerators averages more than 60 times that from pathological incinerators.
- Ninety-nine percent of a typical hospital's mercury is contained in oesophageal dilators, sphygmomanometer services kits, and barometers.
- Total cost to replace mercury devices is modest, especially in light of the cost of spills. According to the Environmental Protection Agency of United States, mercury spill training and equipment costs around 649 USD. The Grand Rapid hospital in Michigan invested USD 6'000 for replacing all existing sphygs and oesophageal dilators containing mercury and instituting a policy banning the purchase of mercury-containing thermometers, sphygs, oesophageal dilators, and batteries.

Step by step

- *Make a commitment and establish a mercury-free team.*
- *Conduct a mercury inventory: create a baseline inventory of mercury-containing products in your hospital.*
- *Evaluate mercury-free alternatives in the context of your hospital.*
- *Set short-term and measurable goals that match your hospital's resources. Reasonable goals, such as the elimination of mercury sphygmomanometers within 2 years, are easily measured and proposed as part of a hospital's business plan.*
- *Institute Best Management Practices (staff training, mercury-free purchasing, etc.)*
- *Measure success using your mercury inventory.*
- *Keep the mercury out of your hospital.*

PVC and Phthalates

- PVC plastic is the most commonly used plastic in medical devices and has been used in a wide variety of other applications in the health care setting, such as disposable gloves, curtains and flooring. Unfortunately, this type of plastic creates a number of environmental health risks. The two main problems are:
- Dioxin: a known human carcinogen can be formed during an inadequate manufacture of PVC, and during the incineration or burning of PVC products. There are however also environmentally-friendly PVC on the market.
- DEHP (2-ethylhexyl phthalate): a phthalate used to soften PVC plastic that can leach from PVC medical devices; it is linked to reproductive birth defects and other illnesses. Medical devices made of flexible PVC, such as bags and tubing, can leach the phthalate DEHP into patients, resulting in some of the highest exposures to this toxic chemical.
- Fortunately, medical devices that do not contain vinyl plastic or phthalates are available for use and many healthcare facilities are switching to these safer alternatives.

Step by step

- *Perform audits to identify PVC and DEHP products (keywords for products containing DEHP: Polyvinyl chloride, PVC, and Vinyl).*
- *Identify and evaluate alternatives.*
- *Prioritize higher risk patient populations for product replacement (neonates, pregnant women, etc).*
- *Purchase PVC or DEHP free products of equivalent quality and performance.*

PVC and DEHP free?

- *Keywords for PVC-free products include: EVA (ethylene vinyl acetate), Polyurethane, Silicone, Polypropylene, PVC-free.*
- *Keywords for PVC products made without DEHP include: DEHP-free and TOTM (non-DEHP plasticizer).*

Flame retardants

- In order to meet fire safety standards, chemicals that act as flame retardants are commonly added to a wide range of products such as pumps, televisions, computers, hospital beds, waiting-room chairs and hospital privacy curtains. Unfortunately many of these flame retardant chemicals do not remain fixed in the product, and slowly leak into our air, dust and water, eventually entering our food and bodies.
- Many chemicals are used as flame retardants. They are called CFRs (chlorinated flame retardants) and BFRs (brominated flame retardants). Collectively, these are called halogenated organic flame retardants. The most commonly used as brominated flame retardants are polybrominated diphenyl ethers, or PBDEs (polybrominated diphenyl ethers).
- Evidence shows that BFRs bio-accumulate in people and cause adverse health effects in children. BFRs are found in many products: bedding materials, furniture cushions, lamp shades, curtains, drapery, electronic equipment, televisions (pulse oximeters, monitors, ventilators, pumps, computers, printers, fax and copy machines, etc.) and finally, in the infrastructure of the building (walls, roofing materials, floor tiles, carpeting, wiring, electrical switches, sockets, and insulation).

Purchasing recommendations

- *Purchasing recommendations*
- *Require the name and CAS number (chemical abstracts service registry number) of added flame retardants used in products you purchase.*
- *Choose products that meet flame retardancy standards without any added flame retardants or halogenated flame retardants.*
- *Tell your suppliers that you prefer products that do not contain toxic, persistent, bioaccumulative toxicants.*

Some halogenated flame retardants

- *Tetrabromobisphenol-A*
- *Hexabromocyclododecane*
- *Deca-BDE (Decabromodiphenyl ether)*
- *Octa-BDE (Octabromodiphenyl ether)*
- *Penta-BDE(Pentabromodiphenyl ether)*
- *Tris (2-chloroisopropyl phosphate) (TCPP)*
- *Tris(2-chloroethyl) phosphate (TCEP)*
- *Dechlorane Plus™*

Cleaners and pesticides

- Patients are particularly vulnerable to indoor air quality threats such as pesticides or chemicals, since many have compromised respiratory, neurological or immunological systems and/or increased chemical sensitivities.
- Many traditional cleaning products, floor strippers and disinfectants often contribute to poor indoor air quality and may contain chemicals that cause cancer, reproductive disorders, respiratory ailments (including occupational asthma), eye and skin irritation, central nervous system impairment and other human health effects. Hospitals also use a variety of methods to disinfect and sterilize surfaces and equipment. Some of the most commonly used products, however, such as glutaraldehyde and ethylene oxide, have been shown to cause serious health effects.
- Pesticides can also cause acute symptoms, including nausea, headaches, rashes and dizziness. Many are also linked to chronic diseases and conditions such as cancer, birth defects, neurological and reproductive disorders, and to the development of chemical sensitivities. The elderly, pregnant women, chemically sensitive individuals, infants and children are especially vulnerable to the toxic effects of pesticides.

Cleaning and disinfecting tips

- *Look for environmental friendly cleaning products.*
- *Don't disinfect areas not needing to be disinfected (e.g. offices).*
- *Work with infection control to divide the facility into areas that pose noncritical (low), semicritical (moderate) and critical (high) threats of infection.*
- *Reject cleaners that contain nonyl- and octyl-phenols.*

- *Integrated Pest Management (IPM)*
- *Select the least hazardous pesticides.*
- *Educate all hospital staff about the hazards of pesticides.*
- *Provide notification when pesticides are used in the hospital building or on the hospital's grounds.*
- *Provide pesticide-free areas.*

3.6 GREEN PURCHASING

Healthcare facilities purchase thousands of different products requested by dozens of different departments. As shown throughout this chapter, hospitals may purchase items that are toxic to workers or patients, or have serious environmental impacts. From eliminating unnecessary packaging, to seeking substitutes for products containing mercury or other toxic substances, purchasing decisions can have a major impact in providing environmentally friendly healthcare facilities. Purchased products must be considered in their totality (life cycle). Indeed, the different stages of the life of a product (manufacturing, marketing, use and disposal) all have an impact on the environment. The purchasing of green products helps to minimize these impacts.

General aspects

- Buy only what is needed (avoid unnecessary supplies)
- Buy in bulk rather than individually packaged items
- Buy recycled contents (office paper, paper towels, etc.)
- When purchasing new equipment, take their water and energy consumption into consideration
- Educate and train the purchasing department
- Use standard labels and choose the right suppliers
- Prefer reusable products to disposable products

Administration

- Buy reusable ink and toner cartridges
- Purchase paper with at least 50% recycled fibers or non-whitened or chlorine-free bleached paper
- Prefer rechargeable batteries

Cafeteria & food services

- Choose, whenever possible, organic products
- Choose seasonal fruits and vegetables
- Use fresh products with little or no preservatives and food-coloring and with as little packaging as possible
- Equip the kitchen with energy-efficient appliances

Laboratories, patient care, pharmacy

- Check for alternative for products containing Latex, PVC/DHEP, mercury, flame retardants, etc.
- Check for less packaging and reusable tools

Laundry service

- Equip the laundry room with machines in energy class A
- Avoid using detergents containing bleach (products of chlorine), phosphate, EDTA (ethylenediaminetetraacetic acid), NTA (sodium nitriloacetate), etc.
- Prefer low temperature detergents

Cleaning & disinfection

- For each product in use, check if there is a "less-toxic" substitution
- Purchase the least toxic antimicrobials to disinfect or sanitize

"Choosing products with a minimum amount of packaging can result in a large decrease in quantity of waste produced, especially when thousands of units are purchased per year (such as sharps and intravenous products – bags)".

Source: Green purchasing in healthcare, Health care without harm.

Local food procurement is beneficial for local economy: researchers from the New Economics Foundation in the UK found that 14 € spent with a local organic box scheme ultimately generated 36 € for the local economy, compared to only 19 € generated through spending in a local supermarket.

Source: Plugging the Leaks – Making the Most of Every Pound that Enters Your Local Economy.

Some goals examples: reduce packaging waste by 20% in 12 months; reduce the purchase of products containing PVC by 15% over the next three years; stop purchasing devices and products containing mercury in 2 years; etc.

"Substituting mercury thermometers with digital alternatives rewards investment by eliminating the hazardous waste disposal costs that come with throwing out mercury."

Source: Green purchasing in healthcare, Health care without harm.

4 DECISION-MAKING AND CORRECTIVE MEASURES

After having identified the actions to be implemented in your hospital, you can now calculate their return on investment. The table of economic calculations enables you to evaluate the costs of implementing corrective measures step by step, the potential savings and the expected return on investment. It is a decision-making tool that helps you assess the situation before and after the implementation of corrective measures. In other words, it estimates the return on investment of the targeted actions before they are actually implemented.

ELEMENTS OF ECONOMIC CALCULATIONS FORM:

Overall description	*Presentation of the set of problems and of the chosen corrective measure. This part encompasses the following elements:* • Concerned environmental domain • Department responsible for the corrective measure • Problem faced • Action to be taken (corrective measure) in order to solve the problem
Comparison of costs	*Comparison of costs before and after the implementation of the corrective measure:* • Annual costs before implementation (Ca): costs incurred before the implementation of the corrective measure (consumptions, losses of water, energy, raw materials, maintenance costs, costs of equipment upgrades, etc.). • Annual costs after implementation (Cb): recorded or estimated costs after the implementation of the corrective measure.
Investment	*Capital invested to acquire the means needed to implement the corrective measure. In most cases, the investment creates annual running costs to keep the measure working effectively and efficiently:* • Investments (Iv): capital needed to implement the corrective measure. If the measure included several investments, the various amounts should be added. • Annual running costs (Rc): additional running costs related to the implementation of the corrective measure. In some cases, there are no running costs.
Profit	*Savings resulting from the implementation of the corrective measure:* • Gross annual savings (Gs): annual savings obtained as a result of the implementation of the corrective measure. Gs = Ca – Cb. • Net annual savings (Ns): actual annual savings obtained as a result of the implementation of the corrective measure. Ns = Gs – Rc.
Return on investment	*Highlighting the economic efficiency of the chosen measure:* • Payback period (Pp): time needed for the hospital to recover the investment used to implement the corrective measure. It is expressed in years. After the payback period, the gross annual savings (Gs) become profit. Pp = Iv / Ns.

Table 7: Elements of economic calculations form

EXAMPLE OF CALCULATION

	GENERAL DESCRIPTION
Domain	Water
Facilities concerned	Taps and showers in the rooms
Problems addressed	High water consumption
Action to be taken	Installation of flow-regulated showerheads in each room Installation of water-reducing filters for taps in each room
	COMPARISON OF COSTS
Annual costs before action (Ca)	Shower water costs per year: Ca_1 = 9'566 JOD Tap water costs per year: Ca_2 = 7'653 JOD $Ca_{total} = Ca_1 + Ca_2$ = 17'219
Annual costs after action (Cb)	Shower water costs per year: Cb_1 = 4'252 JOD Tap water costs per year: Cb_2 = 3'401 JOD $Cb_{total} = Cb_1 + Cb_2$ = 7'653
	INVESTMENT
Investment (Iv)	Flow-regulated showerheads: Iv_1 = 1'050 JOD Water-reducing filters for taps: Iv_2 = 158 JOD $Iv_{total} = Iv_1 + Iv_2$ = 1'208 JOD
Annual running costs (Rc)	0 JOD
	PROFIT
Gross annual savings (Gs) Gs = Ca - Cb	Gs = 17'219 JOD – 7'653 JOD Gs = 9'566 JOD
Net annual savings Ns = Gs - Rc	Ns = 9'566 JOD
	RETURN ON INVESTMENT
Payback period (Pp) = Iv / Ns	Pp = 1'208 JOD / 9'566 JOD Pp = 1.5 month

Table 8: Example of calculation

ACTION PLAN

In order to get the financial return from such corrective measures, the hospital must set an action plan for the daily management of its activities. To identify the hospital's strong points, recognize its weaknesses, and define its perspectives there should be some kind of internal organization and a clear allocation of responsibilities. The development of an action plan enables the implementation of the corrective measures by specifying the means allocated (financial, technical, human, etc.) and the deadline for the actual implementation. Appointing qualified persons to implement the corrective measures is essential. At the same time, coordination between the departments that face the same problem (such as excessive consumption of water or energy, or inadequate waste management) is necessary for reaching the performance targets. The corrective measures and their results should be assessed and documented regularly in order to evaluate progress and plan possible additional improvements or corrective measures.

Objective	**Targeted action**	**Department concerned**	**Person responsible**
Implement Integrated Pest Management (IPM) to prevent and manage pest problems in the least hazardous manner possible.	• Regular inspection for pests, especially in food service areas • Identification of problem areas, education of engineering and environmental services staff on IPM methods cleanliness • Regular monitoring and evaluation • Program buy in from staff and patients	• Purchasing department • Food service • Gardening & outdoor • Cleaning & disinfecting	• Mr. X • Mrs. Y • Mr. Z • Mr. W

Table 9: Example of an Action Plan

Means	Deadline	Expected result	Iv (USD)	Rc (USD)	Ns (USD)
• Establish purchasing guide lines based on labels with preference for green products • Selection of products with a high degree of biodegradability • Selection of organic food	1 year	• Reduction of negative impact on environment • Improvement of 5% of the productivity of the staff (decrease of medical problems linked to chronic exposure to chemicals)	2'000	Normal labor cost	6'500

IMPROVEMENT, TRAINING AND PERSPECTIVES

STRENGTHENING AND CONTINUOUS IMPROVEMENT

Becoming an environmentally responsible hospital requires the adoption of a new corporate culture both within the hospital and among its stakeholders. To strengthen this commitment, changes should be implemented progressively within the hospital.

Organizational change

To obtain a lasting change in the hospital, clear objectives are needed and follow-up and evaluation measures must be implemented. A systematic approach can be adopted by establishing resource management plans and by communicating factual information. Therefore, appointing a *"task group"* made up of selected volunteers from among the staff will contribute to the implementation of concrete improvements in the BEPHS's main domains.

Behavior change

Influencing staff behavior in favor of more rational resource use has a direct impact on lowering the hospital's running costs. It is important to involve staff by giving them specific duties (realistic and suited to their competences) and by providing training.

Technological change

Within the framework of the strategic environmental actions, the hospital can, when changing equipment or renovating, choose more sustainable technologies that consume less water and energy. The aim of this is to become more eco-efficient and adopt a more responsible purchasing policy.

In addition, to sustain the efforts made in applying *"green"* measures, the hospital must institute corroborative and follow-up actions. This will support the hospital's environmental commitment and help monitor its performance.

FOLLOWING UP AND SUSTAINING THE CORRECTIVE MEASURES

Follow-up gives managers the necessary information to assess the impact and the progress of the action taken. It can provide an evaluation of the adequacy of the measures, judged against the hospital's environmental goals. Moreover, by using the annual follow-up results, managers can identify trends in performance (benchmarking) and, if needed, take corrective action. Using the BEPHS guide each year will give the hospital the data it needs to do this, thereby conforming to the principles of continuous improvement. The goal is to strengthen the environmental and economic efficiency of the hospital departments. After this initial approach to best environmental practices, the hospital can go further in its adoption of the principles of eco-efficiency by offering guests additional and personalized services while at the same time limiting environmental impacts and costs, and guaranteeing quality.

AWARENESS-RAISING AND TRAINING OF STAFF

Just as investments are required to maintain or replace a hospital's equipment, an investment in staff awareness-raising and training is essential to improve the human capital. Environmental commitment is an opportunity for the hospital to involve its various coworkers. Staff training must be centered on the hospital's environmental impacts. For the training to be adequate, training and awareness-raising must also be relevant to the target groups and be related to their daily activities. Employees should be invited and encouraged to respect the environmental measures that have been implemented. Finally, because of the high turnover rates in the healthcare facilities, training curricula should be revised to include the BEPHS principles in the induction training provided for new employees. Awareness-raising and training can be implemented in the different departments of the hospital. Sessions should be organized at times of less activity, and should last one to two hours. Practical demonstrations increase the effectiveness of the training. In addition, other media can be used in the departments, such as posters, information notes, brochures, bulletin boards, and films.

EXTERNAL COMMUNICATION AND PERSPECTIVE

A hospital's position regarding environmental issues can increase its competitiveness. Information on this topic should, above all, be addressed to public sphere, but also to the other stakeholders. It is important to communicate well and get the message across without being sanctimonious. Other stakeholders can be informed of the hospital's practices by different means, among which are the annual report, the environmental charter, and the web site. Another way to show one's commitment is to describe the improvement measures that have been implemented and to explain their economic and environmental advantages.

The efforts undertaken by the hospital in terms of the environment can lead to a consideration of eco-labeling. Getting accreditation in this way requires meeting a number of mandatory and optional criteria. Investments may prove necessary to upgrade the hospital's equipment in order to meet the requirements of the label. Such certification is an important competitive advantage that can be used as a marketing tool.

5 HOW TO IMPLEMENT CP IN A SUSTAINABLE AND SUCCESSFUL WAY

This guide provides several tools for a practical assessment of a facility. It introduces divisions and relevant issues in a hospital, provides help and checklists for data collection as well as guidelines for economic calculation and the CP potential in different divisions and issues. Ideally an assessment results in an action plan as suggested in the previous chapter. Though, an assessment and an action plan do not necessarily result in a sustainable implementation of CP options in practice. This chapter will provide some ideas and suggestions to implement cleaner production in a sustainable and successful way.

Implementing cleaner production often means internal restructuring of processes. Possible ways to do that are by awareness raising, external consulting and redevelopment of corporate structures or building of Cleaner-Production-Teams. The three typical obstacles on the way to a cleaner hospital are usually: no time, no money and no motivation.

Below you will find a list with tips and incentives which can possibly help implement sustainable measures in your hospital.

- To gain time a hospital should generate human resources. Name one person responsible for the task of cleaner production or environmental management only.
- Better management can lead to time saving.
- As it has been stated earlier in this guide, at the bottom line, implementing cleaner production saves money. Once this has been proved, it is unlikely that the processes and actions turn back to more expensive manners. Even more if technological change has taken place.
- Use cleaner production as a marketing instrument. An environmentally friendly hospital will be more attractive for patients and employees and therefore increase its competitiveness. Use your progresses for external communication by describing your environmental and economic benefits, for example in annual reports or on your web site.
- Seek for external financing through partnerships and collaboration.
- Commit the management. This is the first and necessary step to cleaner production. No substantial change can happen without the commitment of hospital managers. Ideally managers do not only set goals but also act as role models.
- Raise awareness of staff. Invest in educational and training programs. The behavioral change towards a more efficient use of resources will have a direct impact on lowering the hospital's running costs.
- Involve management, staff and patients. Use posters, information boards or stickers to remind people to switch off the lights, not to print unnecessarily, use water efficiently etc.
- Foster the cooperation of the workforce by organizing an idea competition.
- Reward staff for saving costs by refunding a percentage of saved money to them or by giving other non-material incentives.
- Build a green team. Involve committed and competent employees from different divisions to address the environmental issues.
- Communicate concrete goals and desired action clearly.
- Communicate environmental progress and saved costs internally by division.
- Try to generate first results as quickly as possible to keep the motivation level high.

A big challenge for cleaner production is the development of a sustainable structure for best environmental practices. This can be fostered by follow-up actions and by monitoring development through repeated audits.

6 CASE STUDIES
6.1 JORDAN PUBLIC HOSPITAL

Best Environmental Practices in the Jordanian Healthcare Sector
Case Study: Public Hospital

PUBLIC HOSPITAL

The Royal Scientific Society (RSS) in cooperation with the University of Applied Sciences Northwestern Switzerland (FHNW) and Sustainable Business Associate (SBA) are contributing to improve the environmental management in the healthcare sector with a holistic approach and without decreasing the quality of services. The aim of this first CP audit of the hospital was to gain an overview of the environmental performance of the facility, to identify areas with CP potential. This hospital was also used as a pilot one in order to further develop adequate tools presented in this guide's appendices (checklists, matrix, etc.). It is a first step towards greener hospitals and it should lead to implement concrete actions.

In addition, the aim of the project was to raise awareness about CP and thus to motivate the hospital to improve saving raw materials and energy, reducing the waste emissions and improving the environmental conditions in order to improve the ecological and economical performance (eco-efficiency).

GENERAL INFORMATION

Enterprise	The second largest public hospital in Jordan
Sector	Healthcare sector
Employees	1000
No. of beds	400
Water consumption	4200 m^3 (2009)
Electricity consumption	620'000 kWh/month (2009)
Diesel consumption	10000 m^3 (2009)
Medical waste	3300 kg (2009)

FACILITIES

Departments	Administration, kitchen & cafeteria, laboratories, laundry, pharmacy, patient care and housekeeping.
Material	Water, soap, cleaning and disinfection agents, foods, medicines, laboratory materials and medical materials.
Energy sources	Electricity and diesel.
Waste and emissions	Wastewater, domestic solid waste and medical waste.

RESULTS

After the field visit and discussions, the following matrix presenting areas and divisions with CP potential could be filled in:

	Energy Efficiency	Waste Management	Water Conservation	Good Housekeeping & Behavior	Toxic Materials	Green Purchasing	Priority	Comments
1. Administration	XX	XX	0	X	0	X	1	• Lighting
								• Paper recycling
2. Cafeteria &	X	XX	XX	X	0	X	2	• Water saving
Food Service								• Waste management
								(oil and organic waste)
3. Gardening &	0	0	XX	0	X	0	3	• Reuse of grey water
Outdoors								• Awareness raising
4. Laboratories	X	XX	X	XX	XX	X	2	• Waste management
								• Training and awareness raising
5. Laundry Service	XX	X	XX	X	X	X	2	• Detergents
								• Reuse of rinse water
								• Ironing management
6. Patient Care	0	XX	XX	XX	0	X	1	• Cleaning
								• Training and awareness raising
								• Water saving
								• Waste Management
7. Pharmacy	XX	X	0	0	0	0	3	• Air conditioning
								• Packaging recycling
8. Cleaning &	0	XX	XX	XX	XX	X	1	• Awareness raising and trainings
Disinfection								• Waste management

XX	High potential	X	Small potential	0	No potential
1	High priority	2	Medium priority	3	Small priority

Many CP options have been identified for the hospital, with following expected benefits upon implementation of the CP options. These will bring economic savings, environmental benefits as well as increase safety for staff and patients.

- Reducing raw material and energy consumption
- Reducing waste and emission at the source
- Improving the eco-efficiency

FOLLOWING ARE SOME SUGGESTED CP AND GOOD HOUSEKEEPING OPTIONS:

OPTION	DOMAIN
Option 1: Install water saving equipment for taps and showers and use dual flushing system in public and patients toilets	Reduce fresh water consumption for domestic use Reduce wastewater generation
Option 2: Re-use of treated grey water from kitchen and laundry for irrigation	Reduce fresh water consumption Reduce wastewater generation
Option 3: Re-use of steam condensate into the steam boiler	Reduce fresh water consumption
Option 4: Place timers / occupancy sensors to control the lighting in the corridors	Reduce electricity consumption
Option 5: Install solar heating system to provide hot water	Reduce diesel consumption Reduce air pollution emissions
Option 6: Improve air conditioning in the storage areas for all medical supplies	Reduce electricity consumption
Option 7: Install sun shade on the glazed-roof to mitigate high temperature inside the building during the summer	Reduce the electricity consumption by air conditioners
Option 8: Improve domestic waste management (segregation and recycling) in offices, kitchen, patient care and pharmacy	Reduce the amount of domestic solid wastes
Option 9: Collect biodegradable organic waste to be utilized in the composting or to be treated in a biogas plant	Generate electricity from biogas Reduce the quantity of waste

HOSPITAL FACILITIES

Administration



Cafeteria and Food Service



Laboratories and Pharmacy




Laundry Services




Patient Care




Cleaning and Disinfection


Waste Management




6.2 JORDAN PRIVATE HOSPITAL

Best Environmental Practices in Healthcare Sector in Jordan
Case Study: Private Hospital

In this case study, the results achieved from conducting a CP audit in a private hospital are summarized. The information demonstrates how best environmental practices can be implemented in the Jordanian healthcare sector.

PRIVATE HOSPITAL

The Royal Scientific Society (RSS) in cooperation with the University of Applied Sciences Northwestern Switzerland (FHNW) and Sustainable Business Associate (SBA) are contributing to improve the environmental management in the healthcare sector with a holistic approach and without decreasing the quality of services. The aim of this first CP audit of the hospital was to gain an overview of the environmental performance of the facility, to identify areas with CP potential. This hospital was also used as a pilot one in order to further develop adequate tools presented in this guide's appendixes (checklists, matrix, etc.). It is a first step towards greener hospitals and it should lead to implement concrete actions.

In addition, the aim of the project was to raise awareness about CP and thus to motivate the hospital to improve saving raw materials and energy, reducing the waste emissions and improving the environmental conditions in order to improve the ecological and economical performance (eco-efficiency).

GENERAL INFORMATION

Enterprise	A private acute care and community health hospital
Sector	Healthcare sector
Employees	150
No. of beds	44
Water consumption	2600 m^3 (2009)
Electricity consumption	27'500 kWh/month (2009)
Diesel consumption	150 m^3 (2009)
Medical waste	1800 kg (2009)

FACILITIES

Departments	Administration, Kitchen & cafeteria, laboratories, laundry, pharmacy, patient care and housekeeping.
Materials	Water, soap, cleaning and disinfection agents, foods, medicines, laboratory materials and medical materials.
Energy sources	Electricity and diesel.
Waste and emissions	Wastewater, domestic solid wastes and medical waste.

RESULTS

After the field visit and discussions, the following matrix presenting areas and divisions with CP potential could be filled in:

	Energy Efficiency	Waste Management	Water Conservation	Good Housekeeping & Behavior	Toxic Materials	Green Purchasing	Priority	Comments
1. Administration	X	XX	0	X	0	X	1	• Lighting
								• Paper recycling
2. Cafeteria &	XX	XX	XX	X	0	X	2	• Water saving
Food Service								• Waste management
								(oil and organic waste)
3. Gardening &	0	0	X	0	0	0	3	• Reuse of grey water
Outdoors								• Awareness raising
4. Laboratories	0	XX	X	X	X	X	2	• Waste management
								• Training and awareness raising
5. Laundry Service	XX	X	XX	X	0	X	2	• Detergents
								• Reuse of rinse water
								• Ironing management
6. Patient Care	XX	XX	XX	X	0	X	1	• Cleaning
								• Training and awareness raising
								• Water saving
								• Waste Management
7. Pharmacy	XX	XX	0	X	X	0	1	• Air conditioning
								• Packaging recycling
8. Cleaning &	0	X	0	X	0	X	2	• Awareness raising and trainings
Disinfection								• Waste management

XX	High potential	X	Small potential	0	No potential
1	High priority	2	Medium priority	3	Small priority

Many CP options have been identified for the hospital, with following expected benefits upon implementation of the CP options. These will bring economic savings, environmental benefits as well as increase safety for staff and patients.

- Reducing raw material and energy consumption
- Reducing waste and emission at the source
- Improving the eco-efficiency

FOLLOWING ARE SOME SUGGESTED CP AND GOOD HOUSEKEEPING OPTIONS:

OPTION	DOMAIN
Option 1: Install water saving equipment for taps and showers and use dual flushing system in public and patients toilets	Reduce fresh water consumption for domestic use Reduce wastewater generation
Option 2: Re-use of treated grey water from kitchen and laundry for irrigation	Reduce fresh water consumption Reduce wastewater generation
Option 3: Re-use of steam condensate into the steam boiler	Reduce fresh water consumption
Option 4: Place occupancy sensors in the corridors to automatically switch on the light	Reduce electricity consumption
Option 5: : Improve the solar heating system for hot water	Reduce diesel consumption Reduce air pollution emissions
Option 6: Use of refillable dispensers instead of soap in order to comply with occupational and patient health and safety	Improve the hygienic status for patients and workers Reduce the domestic solid wastes
Option 7: Collect biodegradable organic waste to be utilized in composting or to be treated in the bio-reactor	Generating of electricity from biogas Reduce the quantity of waste

HOSPITAL FACILITIES

Administration


Cafeteria and Food Service



Laboratories

Laundry Services



Patient Care


Cleaning and Disinfection

Waste Management



6.3 INTERNATIONAL CASE STUDY

This case study was developed by Hospitals for a Healthy Environment (H2E) with approval and guidance from Bronson Methodist Hospital. It was published in October 2004 and is reproduced in this guide as an example of an award-winning international project. For more information about the H2E program and awards, visit www.h2e-online.org.

WASTE MINIMIZATION, ENERGY CONSERVATION, TOXICS REDUCTION AND OTHER ENVIRONMENTAL PROGRAMS

BRONSON METHODIST HOSPITAL

The hospital

Bronson Methodist Hospital is located in downtown Kalamazoo, Michigan, USA. It is the flagship of the Bronson Healthcare Group, a non-profit healthcare system serving all of southwest Michigan and northern Indiana. With 380 licensed beds and all private rooms, Bronson Methodist Hospital provides care virtually in every specialty (cardiology, orthopaedics, surgery, emergency medicine, neurology and oncology).

By implementing Environmental Programs (waste minimization, energy conservation, etc.), Bronson reduced its RMW from 194'693 to 192'102 pounds in 2003, thus reducing RMW by 2'591 pounds even with an increase in patient days of 5'608 (467 patients per month). This waste minimization/energy conservation program runs through each department of the hospital, including Contract Management, Materials Utilization, Materials, Property Management, Environmental Services, Facilities and Food Services.

Waste Reduction

Solid waste increased by 8% because of the following factors:

- 5 % increase in patient days
- 8.7 % increase in Emergency Room and Express Care visits
- 1.7 % increases in outpatient surgeries
- full occupancy of the Medical Office Pavilion
- A new Cardiac Cath Lab
- A new Post Procedure Unit
- 11 % increase in Food Services

Cost Savings per year

- Savings from opening a company store to reuse office supplies saved the hospital USD 1'360.
- 1'100 pounds of medical supplies donated to the mission saved USD 220 in landfill expenses.
- Savings from a service agreement with Stericycle with a standard monthly fee. Bronson reduced its Regulated Medical Waste (RMW) enough to qualify for a total rebate of USD 9'870.
- Savings from reduction in chemicals purchased after upgrading the chemical feed system on the north building boiler unit resulted in approximately USD 2'000.
- Savings from switching to E3 AstralLites was USD 2'953 annually.
- Savings from monitoring water usage for chiller systems was USD 4'700 annually.
- Savings from adding an Aquatrac boiler controller was USD 10'500 annually.
- Savings from reprocessing single use devices – SDC Sleeves and EP Catheters – was USD 137'700.
- Savings from conversion to reusable packs was USD 9'744.

Environmental Benefits

Bronson Hospital has an environmentally preferable purchasing policy of buying items that have a recycled content if the cost and quality are similar to the original products. In 2002 Bronson's recycling program saved 4'420 trees, 1'820'000 gallons of water, 15'600 pounds of air pollution effluents, 1'066'00 kWh of energy, 780 cubic yards of landfill space and USD 4'940 in waste disposal.

Bronson Hospital does not purchase latex and PVC items, items containing mercury unless there is no alternative, and marks items that contain recycled ingredients. Bronson's green purchasing means the health care facility is less toxic, less polluted and more energy efficient, thereby making it safer and healthier for patients, workers, and the environment.

Bronson Hospital opened a Company Store which was used to store excess office supplies and unused office furniture. New units are only purchased when the company store is out of stock. This practice reduced the amount of solid waste disposed of and is a convenient way to recycle.

A cytology tech is introducing an alcohol recycling system to both cytology and histology departments in order to reduce the amount of alcohol decanted into the sewer system, the amount of alcohol kept on site and the amount of alcohol purchased annually.

By using less toxic cleaning supplies, Bronson Hospital avoids contamination of the water supply when disposing of the dirt. An increased concentration of mercury in the upper part of the food chain is avoided. Furthermore, Bronson reduces the release of persistent bioaccumulative toxins (PBTs), a type of hazardous waste, which adds to environmental pollution during their manufacture, use and disposal.

Bronson hospital closed down its medical waste incinerator in 1996. Thus it reduced the amount of dioxin released into the air by medical waste being vaporized into the air during the disposal process. In 2003-2004 Bronson has also contracted a medical waste vendor to reduce the release of dioxins by using a combination of microwave and steam sterilization. Only trace chemotherapy and pathological waste is incinerated.

In 2003–2004, Bronson contracted the Retired Engineer Technical Assistance Program (RETAP) to assess a waste and energy management program for the hospital. With their advice, Bronson made simple improvements to conserve energy, such as removing lights from beverage vending machines, saving an estimated USD 600 annually.

Bronson Hospital has taken a first step in incorporating 'green building' standards by contracting BDN Industrial Hygiene company to handle materials uncovered and proper waste management during the destruction of the north tower. BDN helped with identifying asbestos and ensuring secure disposal of it. In total 21'000 tons of steel and 15'000 tons of concrete from general construction waste were recycled.

Health Benefits

By using mercury free alternatives Bronson Hospital helped reduce the mercury exposure to patients and staff, reducing their risk of damage to brain, spinal cord, kidneys and liver.

Bronson Hospital reduced the amount of waste in landfills by switching to reusable dinnerware and donating medical supplies to a mission. This reduced the amount of chemicals that could leach into groundwater or surface waters that may be used for drinking or bathing.

By closing down its incinerator, Bronson Hospital ensured a reduced risk of exposure to dioxin, a human carcinogen which can cause cancer, birth defects, learning disabilities, endometriosis, infertility, suppressed immune function, reduced IQ and hyperactive behavior in children.

By ending the purchasing of PVC items, Bronson reduced the risk of exposure to phthalates present in PVC devices, which can cause damage to the liver, kidneys, lungs and reproductive system, particularly the developing testes, according to animal studies.

By switching to less toxic cleaning supplies, Bronson helps reduce poor indoor air quality for patients and staff as well as reducing or even eliminating the exposure to chemicals causing cancer, reproductive disorders, respiratory ailments, eye and skin irritation, central nervous system impairment, and other human health effects.

Toxicity Reduction

Bronson Hospital's RMW were reduced from 9% of total waste stream in 2001 to 6% of total waste stream in 2002 even though there was a significant growth in both inpatient and outpatient services.

Solid waste reduction, recycling and reuse includes proper waste segregation and minimization of RMW. This action includes procedures to monitor instances of non-compliance.

Bronson hospital reduced the use of the following hazardous waste products: formalin, Xylene, and batteries including alkaline batteries.

Savings from reduction in chemicals purchased after upgrading the chemical feed system on the north building boiler unit resulted in approximately USD 2'000.

Bronson hospital is testing additional cleaning supplies in search for chemicals which are less harmful. A program has been introduced that ensures that housekeepers use the right chemical for specific items and Environmental Services are monitoring the amount of concentrate dispensed when mixing solutions – thus avoiding housekeepers' unnecessary overexposure to concentrate.

HOW TO IMPLEMENT SUCH A PROGRAM?

Planning: conduct annual waste audits and quarterly volume/cost analysis.

Create a unit specific development plan with the aim to reduce RMW, potential recyclables, confidential documents, pharmaceutical waste, and energy conservation and pollution prevention.

Start educational services. Bronson hospital includes training on elimination of mercury detailing how to identify mercury containing devices and how to clean up mercury spill and safety. In addition, posters providing practical information on waste minimization and energy conservation are hung in each solid utility room. Environmental Services and staff of Bronson Hospital receive annual training on correct waste segregation/energy conservation, "what is" RMW and proper handling and packaging of RMW.

Monitor your progress. For example, Bronson hospital holds weekly inspections of each unit, focusing on issues of safety, compliance and waste minimization/energy conservation. The unit managers are emailed the results of the monitoring, including photos where necessary. In addition, Environmental Services supervisors have an improper waste segregation form that they fill out that is sent to the appropriate unit manager and Facilities Services for follow up.

Establish a Green Team. Bronson created a Green Team that included members from each department in order to monitor and implement an energy conservation and waste management program. The Green Team makes monthly announcements in the hospital newsletter and at management meetings.

Opening a company store to reuse office supplies helps in the recycling initiative. Bronson, so far, is in general recycling the following items: fiber, wooden pallets, plastic, glass aluminum, batteries, computer monitors, hard drives and keyboards, formalin and xylene, medical supplies and furniture.

Create an organization-wide mercury elimination program. Bronson established a mercury elimination program in June 1996 and in May 1999 signed a pledge with the National Wildlife Federation to go Mercury Free. Bronson's mercury management policy includes protocols for safe handling, mercury spill clean up procedure, disposal procedure-recycling or regulated safe disposal to avoid disposal in waste stream mercury and its effects on human health and the environment. Bronson hospital even held a mercury thermometer exchange at a public health fair, in September 1999, giving out digital thermometers to the public. Additionally, Bronson replaced all of its sphygmomanometers and all known mercury containing stains or preservatives used in histology/pathology with standard zinc formalin ones.

Set up a battery collection site. Bronson recycled 334 pounds of batteries in 2002.

Focus on energy conservation. Bronson hospital purchased a 100 HP Air Handler to control frequency drives. Annual energy savings derived from new motor efficiencies and damper efficiencies was USD 339'335. Facilities are in the process of converting all exit signs to E3 AstralLites, saving Bronson hospital USD 2'953. Bronson also replaced the autoclave in microbiology with a more efficient (Steris) system reducing the pounds of steam per cycle from 64 to 21 per cycle. Bronson monitored water treatment and efficiencies in connection to chiller systems. Steam production reduced by 12.5% and boiler run hours decreased 28%. De-alkalized water usage decreased by b 46%.

Reprocess single use devices. Bronson worked with Sterimed to reprocess single use devices, starting with SDC Sleeves in 2002. In 2003 the program included also EP Catheters.

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APPENDIX 1 – GENERAL QUESTIONS, PRELIMINARY ENERGY AUDIT QUESTIONNAIRE

PRELIMINARY ENERGY AUDIT QUESTIONNAIRE

A GENERAL INFORMATION

Building name: _____

Address: _____ P. O. Box: _____

Tel: _____ Fax: _____

General manager name: _____

Contact person name: _____

Floor area (m^2): _____ No. of floors: _____

No. of rooms: _____ No. of beds (hospitals): _____

No. of employees: _____ No. of employees living on premises: _____

No. of shifts: _____

B QUESTIONS

1. Building age (includes date and floor area for each addition).
2. Brief description of the building (location, size, type of building, indoor area, outdoor area, pools, garden).
3. Describe any planned facility or equipment upgrades, retrofits, new construction projects, etc.
4. Describe any specific energy or water conservation equipment or initiatives already taken or planned.
5. Does the property have any kind of energy management system or other centralized control system?

YEAR:

MONTH	ENERGY CONSUMPTION								WATER		OCCUPANCY	
	ELECTRICITY				DIESEL		OTHER FUELS					(HOSPITALS)
KWH	KW/ KVA (BILLED)	KW/ KVA (ACTUAL)	PF/ VAR	USD	TONS	USD	TONS	USD	M^3	USD	AVAILABLE BEDS	OCCUPANCY
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												

D ENERGY & WATER SUPPLY & DISTRIBUTION

1. Brief description of the electricity supply and distribution system (includes the number and capacity of electricity meters/ service connections, rates the meters related to number and capacity of transformers, supply voltages, etc.).
2. Brief description of the diesel supply and distribution system (includes location of storage tanks, meters, and major end-uses).
3. Brief description of the gas/LPG or other fuel supply and distribution system (includes location of storage tanks, any meters, and major end-uses).
4. Brief description of the water supply and distribution system (includes the source of water, number and capacity of water meters/service connections, major pressure reducing valves, storage tanks, pressure boosting stations, etc.).
5. Has the property installed any water conservation equipment, such as flow-restrictors, low-flow faucets and shower heads, pressure reducing valves, water conserving toilets, or water reuse systems?
6. Does the property have any utility monitoring and tracking programs in place? If so, describe.

E LIGHTING

1. Brief description of the property's lighting. Includes: primary lighting types (incandescent, compact fluorescent, fluorescent, mercury vapor, etc.) and their estimated numbers.

FIXTURE TYPE	WATTAGE	NO.	OPERATION HRS.

2. How are outside lights controlled?
3. Are photocells, timers, occupancy sensors or other controls used? If so, describe.

F VENTILATION SYSTEMS

1. Brief description of the main ventilation systems on property. For each system include: type of system (e.g., natural ventilation, unit ventilators/split systems, packaged multi-zone rooftop units (RTUs), variable-air-volume (VAV) systems, dual-duct systems, etc.).
2. Areas served by each system
3. Hours of operation
4. Temperature setpoints
5. Capacity of system (fan size and/or air flow rate)
6. Cooling source (DX, chilled water)
7. Heating source if applicable (electric, gas, hot water)
8. Any special control systems or features (e.g., building automation or energy management system, pneumatic controls, DDC controls, etc.)

G LAUNDRY

1. Quantity or weight of items washed (per year, month, day, etc.). If possible, provide a separate estimate for each laundry type (e.g., towels vs. linens).

EQUIPMENT:

ITEM	NO.	NOMINAL CAPACITY (KW)	FUEL	DAILY OPERATING HRS.	ACTUAL OPERATION PERCENTAGE (%)	COMMENTS
Washers						
Dryers						
Presses						
Dry cleaners						
Irons						
Dedicated hot water heaters						
Heat or water recovery equipment?						

H KITCHENS, RESTAURANTS AND DINING ROOMS

1. Brief description of each kitchen, restaurant, dining room, etc. (include hours of operation, seating capacity, and air-conditioning. For kitchens, list major cooking equipment and their fuel consumption (electric or gas), quantity of entries in cold rooms, etc.).

APPENDIX 2 – CHECKLISTS

The following checklists are intended to serve as support to a first assessment in a hospital concerning cleaner production. The checklists are catalogues of questions, which are put around the divisions of a hospital, already introduced in Chapter 3 of this guide and main issues such as energy efficiency and water management. These questions should help to identify the environmental problems and opportunities for action in each division of a hospital.

These checklists were used and adapted by Farouq Omari during his Master thesis in order to assess three Jordan hospitals. However, they were first developed by Curtin University in Australia and the adapted checklists can be found in the following document: "Eco-efficiency in healthcare. Information sheets, Center of Excellence in Cleaner Production, Curtin University of Technology, 2003".

ADMINISTRATION

QUESTIONS	YES	NO	NOTES
GENERAL			
1. Are the electronic machines such as copiers and computers frequently left on, even when used only sporadically?			
2. Does the hospital use inefficient lighting, lighting accounts?			
3. Does the hospital have fully maintained heating and air conditioning equipment?			
4. Does the hospital have old, inefficient windows?			
5. Does the hospital have poorly insulated walls, ceilings, and pipes?			
LIGHTING			
6. Do you turn off lights when they are not needed?			
7. Does the hospital have incandescent bulbs? Ratio?			
8. Does the hospital have light emitting diode (LED) for exit signs? Where?			
9. Does the hospital have tubular fluorescent ballasts and lamps? Where?			
10. Does the distribution of the light consider the places where less light may be more adequate?			
11. Does the hospital install occupancy sensors in rooms? Where?			
12. Is natural light obstructed in certain areas, could it be improved?			
OFFICE EQUIPMENT			
13. Do you purchase energy-efficient office equipment?			
14. Are there any areas that are unused but are being air conditioned or heated? Where?			
15. Do you check your timers and thermostats always and which ones are not checked?			
16. Does the furniture or other obstructions block air flow? Where?			

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ADMINISTRATION

QUESTIONS	YES	NO	NOTES
WATER HEATERS			
17. Is the needed volume of heated water calculated well?			
18. Is the provided hot water at the lowest temperature that is acceptable for the task?			
19. Are the tank and pipes insulated? Efficiency?			
20. Does the hospital have timers to turn the water heater off at night and during the weekends?			
WINDOWS AND INSULATION			
21. Does the hospital have window shades?			
22. Do you install window films to help block radiant heat gains and losses?			
23. Have the insulation of the building been checked?			
24. Are the windows well sealed? Double-glazed?			
OFFICE PAPER			
25. Do you inventory your use of paper (letters, making photo-copies, forms, memos, and files as well as packaging materials)?			
26. Who in your office uses paper, what is it used for, and how is it being disposed?			
27. What is the type and amount of paper you are using?			
28. Is there a practice of paper reuse?			

GENERAL COMMENTS FOR THIS DIVISION:

CAFETERIA & FOOD SERVICES

QUESTIONS	YES	NO	NOTES
WATER			
1. Do you practice washing only full loads in the dishwashers? If not, how is it?			
2. Are the equipments water efficient models? Ratio?			
3. Do you use a high pressure, low volume nozzles that increase cleaning efficiency?			
4. Does the cafeteria reuse any type of water? Where? How?			
5. Are there water-cooled machines or air-cooled models?			
6. Do you pre-rinse dishes in a water basin?			
ENERGY			
7. Do you have electric appliances or gas?			
8. Do you cook with lids or covers?			
9. Do you consider the temperature of kitchen rooms when installing or relocating refrigerators and freezers?			
10. Do you defrost refrigerators and clean the door seals monthly?			
11. Do you implement appropriate temperature control of the cookers? How?			
12. Does the kitchen have steam cooking equipment?			
13. Do you maintain and clean cooking equipment periodically to remove lime deposits?			
14. Do you turn off the steam supply in steam cooking vessels when not actually cooking?			
15. Do you carefully monitor preheat times, cooking temperatures and maintenance checks?			

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CAFETERIA & FOOD SERVICES

QUESTIONS	YES	NO	NOTES
WASTE			
16. Do you use washable plates, eating utensils, glasses and cups for cafeteria and patient service?			
17. Are there any campaigns of the kind "think before you use" to decrease use of disposable items?			
18. Do you use a "first-in, first-out" inventory policy for raw materials?			
19. Do you buy in bulk?			
20. Do you buy locally to minimize transportation cost?			
21. Do you recycle, sell or store any used cooking oil, grease, and meat fat?			
22. Do you collect and send the used grease to a renderer?			

GENERAL COMMENTS FOR THIS DIVISION:

GARDENING AND OUTDOORS

QUESTIONS	YES	NO	NOTES
WATER USE			
1. How do you clean sidewalks, driveways, loading docks and parking lots? Use a broom or a hose?			
2. Did you investigate the availability of reclaimed water for irrigation?			
3. Is there an irrigation maintenance program? Do you routinely inspect all water lines, valves and pumps for leaks?			
4. Do you consider the water use in the early morning or in the evening when wind and evaporation are the lowest?			
5. Do you consider using low-volume irrigation, such as drip system?			
6. Do you use mulch around plants to reduce evaporation and weed growth?			
7. Do you clean with high pressure hoses? How?			

GENERAL COMMENTS FOR THIS DIVISION:

LABORATORIES

QUESTIONS	YES	NO	NOTES
GENERAL			
1. What are the types of laboratories? Numbers?			
MANAGEMENT PRACTICES			
2. Are there any storage areas like central storage of chemicals and wastes?			
3. Are there any inventory control programs to trace chemical usage?			
4. Are there any internal audits to minimize reagent accumulation and maximize recycling and sharing of surplus materials?			
5. Are there any incentive programs for waste reduction?			
PURCHASING POLICIES			
6. How are the hazardous chemicals being purchased? Is it in appropriate quantities, ensuring minimal waste?			
7. Do you minimize shelf stock to prevent waste due to surplus or shelf life expiration?			
8. Do you use "first-in, first-out" policy?			
9. Do you consider the quantity and type of waste produced when purchasing new equipment?			
10. Do you favor local products whenever possible?			
11. Do you favor biodegradable, recyclable or reusable products?			
12. Do you purchase appliances and other equipment that are designed for minimum water and energy consumption?			
13. Did you replace the paper towel dispensers in wash rooms with energy-saving hot air blowers?			
14. Do you buy compact, concentrated products and/or eco-refills to limit packaging wastes?			
15. Do you purchase paper with at least 50% recycled fibers, or non-whitened or chlorine-free bleached paper?			
16. Do you prefer rechargeable batteries?			

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LABORATORIES

QUESTIONS	YES	NO	NOTES
LABORATORY PRACTICES			
17. Do you evaluate laboratory procedures to see if less hazardous or non hazardous chemicals could be used?			
18. Is there any segregation in waste streams?			
19. Are there any cases of mixing hazardous with non-hazardous wastes?			
20. Do you segregate wastes containing valuable substances or precious metals for subsequent recovery?			
21. Are there full labeling systems for all incomings, used chemicals and containers?			
22. Are there storage areas for chemicals and wastes?			
STAFF TRAINING			
23. Is the waste reduction a part of employee training?			
24. Do you encourage employee's involvement and contribution in design and implementation waste reduction practices? Incentives? Is there a routine monitoring of waste minimization program?			
SOLVENTS			
24. Which are the main uses of chemicals in hospital?			
25. Which source reduction options for solvents you use?			
26. Are there any preferable chemicals than others to be used?			
27. Has solvent use decreased in your laboratories due to technological advances (solvent recovery)?			
28. Do you recycle any kind of chemical waste? How?			
29. Do you segregate the different types of waste, liquid and solid?			
30. Is there any chemicals drain in the sewage? What is also drained in sewage network?			

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LABORATORIES

QUESTIONS	YES	NO	NOTES
SOLVENTS			
31. Where does the waste water go?			
CLEANING GLASSWARE			
32. What is the physical cleaning method that you use?			
33. What may replace and reduce chemical cleaning requirements?			
34. Do you evaluate specialty detergents, potassium hydroxide, or sonic baths to replace chromic and sulfuric acid for cleaning glassware?			
35. Do you use biodegradable or aqueous detergents where possible?			

GENERAL COMMENTS FOR THIS DIVISION:

LAUNDRY SERVICES

QUESTIONS	YES	NO	NOTES
ENERGY AND WATER EFFICIENCY			
1. Do you wash in any load or full loads only?			
2. Are there any programs for repairing valves, sensors and other controls regularly?			
3. What is the water volume you use in partial wash?			
4. Do you reuse rinse water or is it going directly to the sewage?			
5. Do you install water saving devices on all water fixtures?			
6. Do you sort the laundry according to the degree of soiling?			
7. Do you wash towels and linen at the request of patients or every day?			
8. Is there any reuse of the rinse water from relatively unsoiled loads for the next cycle's prewash and wash?			
9. Can you use the equipment during periods of low consumption (off-peak hours)?			
CHEMICALS			
10. Do you use less hazardous laundry chemicals?			
11. Do you leave the detergent in humid places?			
12. Do you consult your suppliers in order to evaluate the optimal wash formula (product used, dilution factor)?			
13. Do you schedule washing loads per level of soiling to minimize the need to change chemical/detergent composition and machine variables?			
14. Are there automated liquid injection wash systems?			

GENERAL COMMENTS FOR THIS DIVISION:

PATIENT CARE

QUESTIONS	YES	NO	NOTES
PATIENT-CARE SUPPLIES			
1. Can you determine whether cloth towels can be used and later sold for rags?			
2. Do you have paper towels or air dryers?			
3. Did you install flow regulators on the showerheads in order to decrease water consumptions? (Some regulators decrease from 20 to 12 liters/minute (40% saving).)			
4. Did you install a dual flush mechanism in toilet (offering a choice of half- or full-cistern flushes)?			
5. Did you distribute any brochures and flyers, or post stickers and posters, inviting guests to save water?			
6. Is there refrigerator, television, air condition, any electrical equipment?			
7. Do you eliminate unused items from custom surgical packs (once a pack is opened, unused items are discarded)?			
8. Do you contact the manufacturer when one item in a surgical tray is causing the whole pack to outdate?			
9. Did you install refillable soap and lotion dispensers?			
10. Do you purchase washable surgical and isolation gowns and sterilization trays?			
11. Do you mend gown ties so they last longer?			
12. Do you convert surgical drapes into biopsy cloths?			

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PATIENT CARE

QUESTIONS	YES	NO	NOTES
ITEM ALTERNATIVES			
13. Did you try to replace patient care items as shown in the following table?			

ITEM	SINGLE-USE / DISPOSABLE	NOT USED	REUSABLE ALTERNATIVE	COMMENTS
Underpads				
Ambu bags				
Ventilator circuits				
Gowns				
Dishware				
Single-sided copy machines for paper copies				
Sharps containers				
Cardboard packaging				
Envelopes				
Bedpans				
Pillows				
Urinals				
Emesis basins				
Wash basins				

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PATIENT CARE

ITEM	SINGLE-USE / DISPOSABLE	NOT USED	REUSABLE ALTERNATIVE	COMMENTS
Bowls				
Alkaline batteries				
Wash cloths				
Pitchers and cups				

GENERAL COMMENTS FOR THIS DIVISION:

PHARMACY

QUESTIONS	YES	NO	NOTES
1. Do you encourage whole sale distributors to deliver smaller quantities of product more frequently in reusable totes?			
2. Do you return outdated pharmaceuticals to the distributor?			
3. Do you implement inventory management controls to protect against waste through outdated stock?			
4. Do you segregate waste?			
5. Do you segregate hazardous from non-hazardous pharmaceuticals?			

GENERAL COMMENTS FOR THIS DIVISION:

CLEANING AND DISINFECTION

QUESTIONS	YES	NO	NOTES
WATER			
1. Is there any awareness in regard to water efficiency practices during cleaning and disinfection?			
2. Do you clean the windows periodically or as required?			
3. Do you review the methods used to clean sidewalks, parking lots and other outdoor areas?			
CLEANING MATERIALS			
4. Can you reduce the number of cleaning agents?			
5. Does the hospital use refillable dispensers for cleaning chemicals? Where? Do you mix only the amount needed?			
6. Do you buy in bulk to reduce packaging?			
7. Do you deal with the suppliers who recycle and reuse the packaging?			
8. Do you buy only what you need and avoid unwanted materials?			
DISINFECTION			
9. Do you evaluate the need to disinfect in order to determine if a lower level of cleaning is sufficient in certain areas?			
10. Do you choose a disinfectant that is highly effective and least toxic to employees and the environment?			
11. Do you ensure the proper disinfectants dilutions?			
12. Do you regularly calibrate dispensing equipment and check for leaks?			
13. Do you label containers?			
14. Do you train the staff and clearly post the procedure for disinfectant use at the dispensing station?			

GENERAL COMMENTS FOR THIS DIVISION:

ENERGY EFFICIENCY

QUESTIONS	YES	NO	NOTES
LIGHTING			
1. What is the total energy consumption of your hospital?			
2. Do you know how much energy each department consumes?			
3. Do you use processes that optimize energy consumption?			
4. Did you try to increase the use of available day lighting? How?			
5. Can you limit decorative lighting? In which areas?			
6. Do you control exterior and parking area lighting? How?			
7. Do you reduce illumination levels in non-critical areas such as hallways, lobbies, waiting rooms, storerooms, mechanical rooms?			
8. Do you really turn off the lights when they are not needed? Do you have an awareness program for the employees?			
9. Does the hospital have incandescent bulbs? Ratio?			
10. Does the hospital have light emitting diode (LED) for exit signs? Ratio?			
11. Does the hospital have tubular fluorescent ballasts and lamps?			
12. Does the hospital install occupancy sensors in r ooms? Where?			
HEATING AND COOLING			
13. Does the hospital have shading devices or reflective windows on south & east facing windows?			
14. Do you plan landscape shading with fast growing trees?			

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ENERGY EFFICIENCY

QUESTIONS	YES	NO	NOTES
HVAC-SYSTEM (HEATING, VENTILATING, AND AIR CONDITIONING)			
15. For heating, what is the set point for thermostats?			
16. For cooling, what is the set point for thermostats?			
17. Does the setting of heating and cooling devices consider whether the rooms are occupied or not?			
18. How do you try to reduce the air-conditioning demands to cut high costs?			
19. If an area is too warm, do you check for air leaks, poor insulation, or heat gain from the sun?			
20. Do you consider programmable thermostats or timers?			
21. Do you lock your thermostats?			
22. Do you change air filters regularly?			
23. Do you clean filters regularly to keep dirt and dust out of fans and motors?			
24. Can you valve off or otherwise cut off seldom used areas and install local heating or cooling equipment to serve them?			
25. In a large boiler, do you install an automatic combustion control system, which monitors the composition of the exit gases and fine-tunes the amount of air taken in?			
26. Is the isolation system in pipes, air conditioning and boilers lines good enough?			

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ENERGY EFFICIENCY

QUESTIONS	YES	NO	NOTES
WATER SYSTEM			
27. Do you inspect leaks and damaged insulation of pipes? Is there a schedule?			
28. Do you train staff in more efficient operation of cleaning equipment in kitchen and laundry?			
29. Do you insulate hot water heaters and storage tanks?			
30. Do you install flow restrictors at hot water faucets and shower heads?			
31. Do you think that the pipe insulation thickness is suitable?			

GENERAL COMMENTS FOR THIS DIVISION:

WASTE MANAGEMENT

A – SPECIFIC HOSPITAL WASTE

QUESTIONS	YES	NO	NOTES
CLINICAL WASTE			
1. Do you conduct a comprehensive audit to identify what goes in yellow receptacles?			
2. What are the types of clinical waste you have?			
3. Do you try to increase the awareness of the need to reduce the amount of unnecessary waste placed in clinical waste containers? How?			
4. Where you dispose the hospital waste? Which incineration?			
5. What is the waste quantity?			
6. How much do you pay for this service?			
MERCURY			
7. Where is the mercury waste generated in the hospital?			
8. Where is the main danger of mercury?			
9. Do you segregate the wastes that contain mercury?			
10. How do you handle spilled mercury?			
RADIOLOGY WASTE			
11. Where are the radiology waste generated in the hospital?			
12. How do you deal with photographic chemicals and silver removed from the film during processing?			
13. How do you deal with scrap film such as purged from old files or generated from poor photographs?			
14. How do you deal with fixer solution?			
15. Does the storage environment consider the sensitivity of chemicals, photo processing, for light or temperature?			

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WASTE MANAGEMENT

QUESTIONS	YES	NO	NOTES
RADIOLOGY WASTE			
16. Do you recycle spoiled or used x-ray films?			
17. Do you recycle fixer?			
18. Did the hospital have any risks because of its waste?			

B – WASTE MINIMISATION

QUESTIONS	YES	NO	NOTES
GENERAL			
1. What is the cost of waste disposal and transportation in the hospital?			
2. Have you received any documents, legal instructions related to waste disposal?			
3. Do you know how much waste is generated by your hospital?			
4. Where do you dispose your waste?			
5. What are the fees and taxes?			
6. What are the labor costs?			
7. Can waste minimization reduce the current operating costs (raw material costs)?			
8. What are the storage space costs?			
9. How can waste minimization increase hospital productivity, improve environmental protection, and enhance community relations?			
10. For each occupied bed, what is the average amount of waste generated per day?			
11. Do you have a team consisting of people who are involved and/or responsible for environmental matters?			

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WASTE MANAGEMENT

B – WASTE MINIMISATION

QUESTIONS	YES	NO	NOTES
GENERAL			
12. Did the hospital conduct a waste audit to take account of everything that comes in and goes out and prepared a list?			
13. Did the hospital initiate waste segregation program and identified waste streams that could be reused or recycled?			
14. Are there contractors who handle the waste?			
15. Does the purchase department select reusable rather than disposable items?			
RECYCLING			
16. Do you recycle any of this waste l isted below?			

Office paper		Polystyrene		Silver	
Aluminum		HDPE		waxed paper	
Newspapers & magazines		LDPE		Films	
Steel cans		Cardboard		PET	
Toner cartridges		Glass		PVC	
Fluorescent tubes		Books		Batteries	

WASTE MANAGEMENT

QUESTIONS	YES	NO	NOTES
WASTE SEGREGATION			
1. Are there waste containers close to hand washing sink?			
2. Are there yellow containers intended for clinical waste?			
3. Are there "battery waste" collection containers in every department?			
4. Are there recycling bin containers beside every copier and printer?			
5. Do the suppliers take back pallets, empty bottles, spoiled?			
6. How is the labeling system? Do you distinguish containers by means of colors, labels, or symbols (pictograms) for each type of waste?			
MATERIAL INVENTORY AND STORAGE			
7. Is there computerized inventory storage?			
8. Do you use "JIT" or "Just in Time " ordering?			
9. Do you inspect raw materials to ensure they are not damaged?			
10. Do you use "first-in, first-out technique" for all materials?			
11. Do you label and date materials when received, used and disposed?			
12. Do you monitor materials storage well?			
13. Do you store materials in reusable containers?			
14. Do you return obsolete raw material to supplier?			
15. Does the storage have safety elements like a fire distinguisher, air conditions, alarm sensor, suitable light, leaching conservation area and separated area? Is it closed well?			

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WASTE MANAGEMENT

QUESTIONS	YES	NO	NOTES
MATERIAL INVENTORY AND STORAGE			
16. Do you discharge oils into sinks or toilets?			
17. Do you check and maintain regularly boilers and cooling equipment for emission level?			
18. Do you change the filters of air conditioning equipment regularly?			
19. Do you have old oil-fired burners or natural gas ones?			
20. Do you monitor leaks in refrigerating systems?			
21. Did you create non-smoking places in public areas?			

GENERAL COMMENTS FOR THIS DIVISION:

WATER CONSERVATION

QUESTIONS	YES	NO	NOTES
BUILDING/GENERAL			
1. Which are the most water consuming departments and equipment in this hospital?			
2. Are the employees aware about the importance and benefits of water conservation?			
3. Do you put signs in appropriate areas that promote and encourage water conservation?			
4. Do you check the water supply system for leaks, corrosion and problems?			
5. Do you turn off water supply to equipment and areas that are unused?			
6. Did you install water meters in each department?			
7. What is the total cost of the hospital's water consumption?			
8. What is the hospital's overall water consumption?			
9. Do you compare the results with the same period in the previous year?			
10. Do you check the water pressure?			
OPERATIONS AND EQUIPMENT			
11. What is the source of the water used by the hospital (public network, well, borehole, etc.)?			
12. Did you set up a system for staff to look and report leaks and faults? How?			
13. Do you consider using full loads in sanitizers, dishwashers, sterilizers and washing machines?			
14. Do you recycle steam condensate to heat water?			
15. Does the hospital use the single-pass cooling systems in ice machines, X-ray machines, CAT scanners, degreases, hydraulic equipment, vacuum pumps, condensers, air conditioners, etc.?			

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WATER CONSERVATION

QUESTIONS	YES	NO	NOTES
BATHROOMS/RESTROOMS			
16. Do you check regularly for dripping taps and leaking toilets?			
17. Do you have flow control fixtures where possible?			
18. Do you use domestic water efficiency techniques as low flush toilets, faucet aerators and low flush showerheads?			
HEATING AND COOLING			
19. How do you adjust boiler and cooling tower blow down rate?			
20. What is the best TDS level recommended by manufacturers specifications?			
21. Do you return steam condensate to the boiler for reuse?			

GENERAL COMMENTS FOR THIS DIVISION:

APPENDIX 3 – MATRIX

OUTLOOK OF THE CP POTENTIAL IN THE DIFFERENT DIVISIONS

This table shows what issues are more important in which divisions. Use the grading indications provided under the table. This evaluation is subjective and only aims at giving an overall impression of the facility. It should be understood as a help for decision-making between the first assessment and more detailed analysis.

After filling the white cells with the different levels of potential, evaluate the priority of the different divisions. In the comment column, you can already indicate key aspects to be considered.

At the bottom line, you can also evaluate the overall potential of the different issues and therefore select areas for action.

You will also find already filled matrixes in the two Jordanian case studies presented in this guide.

	ENERGY EFFICIENCY	WASTE MANAGEMENT	WATER CONSERVATION	GOOD HOUSEKEEPING & BEHAVIOR	TOXIC MATERIALS	GREEN PURCHASING	PRIORITY	COMMENTS
1. Administration								
2. Cafeteria & Food Service								
3. Gardening & Outdoors								
4. Laboratories								
5. Laundry Service								
6. Patient Care								
7. Pharmacy								
8. Cleaning & Disinfection								
Overall evaluation								

FILL IN THE TABLE WITH THE FOLLOWING SIGNS:		PRIORITY	
xx	High Potential	1	High
x	Small potential	2	Medium
0	No potential	3	Small

APPENDIX 4 – ACTION PLAN

OBJECTIVE	TARGETED	DEPARTMENT ACTION	PERSON CONCERNED	MEANS RESPONSIBLE	DEADLINE	EXPECTED RESULT	IV (USD)	RC (USD)	NS (USD)

EDITORS:

- Institute for Ecopreneurship (IEC), University of Applied Sciences Northwestern Switzerland (FHNW), School of Life Sciences (HLS)
- Sustainable Business Associate (sba)
- Royal Scientific Society (RSS)

GRAFIC DESIGN:

Ute Drewes, Basel