



Meso-level eco-efficiency indicators to assess technologies and their uptake in water use sectors

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Deliverable 1.2
Technology inventory design and specifications

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Abstract

This report presents the structural design of the technology inventory, i.e. the template to be used when collecting information on the technologies relevant to the EcoWater Case Studies.

In addition to the generic database fields, the template holds fields for recording data on technology economic parameters, technology environmental parameters and technology efficiency parameters.

The actual technology inventory template is delivered in form of an Excel workbook, holding one sheet per EcoWater Case Study. Each Case Study worksheet follows the same template, but they differ in terms of which parameters are considered of importance to the technologies foreseen to be added.

In the work to follow after this deliverable, the technology inventory will be populated with data from the Case Studies. The final populated technology inventory (Deliverable 1.3) will then serve as input to the EcoWater toolbox development.

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1 Introduction

The purpose of EcoWater Task 1.2 *Technology inventory for eco-efficient water systems and use* is to design and populate an inventory format for technologies relevant to the EcoWater Case Studies (CS). To be included are the main environmental, cost and efficiency parameters associated with the technologies. It is worth noting that the term “efficiency parameter” refers to technology efficiency when used in the context of T1.2. It is different from the eco-efficiency indicators developed in Task 1.1 *Review and selection of eco-efficiency indicators according to Case Study specificities*.

This deliverable is the first of two from T1.2 and it reports on the template design and parameter specifications. The deliverable consists of two parts; this document, which describes the parameters used in the inventory, and the actual technology inventory template (Excel-file). The finalised populated inventory is scheduled for delivery in October 2013.

The populated inventory will serve as a database of technologies to be used by the EcoWater tools developed in T5.3 *Development of toolbox for meso-level eco-efficiency of systems/products*.

2 Methodology

In view of that the template will serve as a database later on in the project, it was considered suitable to use Excel during the development phase. A first draft of the template was composed by IVL, taking into account a technology database structure previously used in the European project OPTIMA¹ and the specific needs of the EcoWater project. The technology inventory template was then further developed through discussions in the working group of T1.2.

The group decided that a good way to pinpoint the important technological parameters was to add a few example technologies to the first draft of the template. Adding example data for those technologies would help specifying the parameters. The members of the working group provided input on example technologies and specific parameters relevant to the EcoWater case study each member is linked to. The Case Study leaders have also been consulted, some of which are not part of the working group of T1.2. Discussions following that exercise helped streamlining the interpretation of parameters across the working group.

The currently included parameters are the result of the approach described above. They are not carved in stone. On the contrary, parameters are likely to be added (and deleted) during the continued work in T1.2, i.e. the inventory population phase of the project, see Section 5 Future work.

3 Description of the technology inventory template

The EcoWater technology inventory template consists of an Excel workbook holding a front page and subsequently one worksheet per Case Study. It has been kept in mind that the resulting technology inventory will eventually serve as a database. Therefore, the structure of the CS worksheets is the same across cases, although technology economic/environmental/efficiency parameters sometimes differ between the CS. The general format of the CS inventory tables (worksheets) is presented in Table 1. Information on technologies will be entered as records (x) in the rows of the worksheet. Each row will hold the information on one registered technology.

Table 1: Generic structure of the technology inventory tables

| Common database fields | | | | Technology performance parameters | | | Technology economic parameters | | | Technology environmental parameters | | | Technology efficiency parameters | | | Additional information |
|------------------------|---|---|---|-----------------------------------|-----|------|--------------------------------|---|-----|-------------------------------------|------|-----|----------------------------------|-----|-----------|------------------------|
| | | | | Group | | ... | Group | | ... | Group | | ... | Group | | ... | |
| Name | | | | ... | ... | Name | | | ... | ... | Name | | ... | ... | | |
| Unit | | | | ... | ... | Unit | | | ... | ... | Unit | | ... | ... | Narrative | |
| x | x | x | x | x | x | x | x | X | x | x | x | X | x | x | x | x |
| x | x | x | x | x | x | x | x | X | x | x | x | X | x | x | x | x |
| x | x | x | x | x | x | x | x | X | x | x | x | X | x | x | x | x |
| x | x | x | x | x | x | x | x | X | x | x | x | X | x | x | x | x |

All CS inventory tables start with a set of common database fields with the purpose of setting the context of the recorded data. The fields should be filled in for each technology of the database and the interpretation of those fields is as follows:

- Technology name:
Descriptive name of the technology, e.g. Disinfection by chlorination.
- Type 1:
Identification field to indicate if the technology is part of Business As Usual (BAU) or if it is a new technology (T). Each registry shall also include a technology unique serial number, e.g. BAU1, BAU2, T1, T2, etc.
- Type 2:
Identification field to indicate if the technology is used as substitution for a BAU technology or as an additional technology. The record should show either the Type 1 record for the substitute BAU (e.g. BAU3) or 0 (for technologies used in addition to BAUs).
- Source/Reference:
The source/reference of the data entered in the inventory for this particular technology, e.g. scientific literature, data from technology supplier.
- Author:
Name of the person who made the first entry of the technology in the inventory.

- **Creation date:**
Date when the technology was added to the inventory.
- **Last modification date:**
Date of the latest modification of the records for the technology.
- **Modified by:**
Name of the person who made the latest modification of the technology in the inventory.
- **Short description:**
Text describing the technology. It should be short but longer and more informative than the “Technology name” field.
- **Node:**
The record should be the name of the node in the value chain where the technology is (or can be) applied, e.g. Abstraction, Water Treatment, Water use.
- **Reference unit:**
The technology reference unit for which the subsequent parameter values apply, e.g. one piece of XX equipment with YY capacity, or make and model if relevant.

After the common database fields follows a couple of technology performance parameters. They are important technology parameters that do not fall within any of the three parameter categories economic/environmental/efficiency. Currently listed performance parameters are:

- Technology lifetime
- Reliability

What follow after is, in turn, the technology economic parameters, the technology environmental parameters and the technology efficiency parameters. Since the number of parameters within each category is quite large, they have been clustered into groups for simplification. The currently used parameter groups are:

- For economic parameters
 - Cost
 - Value
- For environmental parameters
 - Emissions to air
 - Water quality influence
 - Water use
 - Resource use
 - Solid waste

- Indirect impactsⁱ
- For efficiency parameters
 - Energy
 - Monetary
 - Physical

The inventory format allows for using groups within the performance parameter category as well, should it be needed in the future development of the technology inventory.

The last column of the technology inventory template holds a narrative field for Additional information. It can be used to record any qualitative information about the technology, such as:

- Complexity of the technology
- Acceptance of technology by stakeholders/actors involved or affected by its actual implementation
- Foreseeable barriers for introduction of technology (cultural, regulatory or other)
- Foreseeable drivers for introduction of technology (cultural, regulatory or other)
- Lessons from previous use of technology in other fields of application.

4 Parameter specifications

For practical reasons parameter names used in the technology inventory must be relatively short. The technology performance, economic, environmental and efficiency parameters need to be specified and described so that users of the technology inventory can understand what the recorded data represents.

For enhanced readability of this report, the actual specifications of parameters are presented in Appendix 1. It holds the longer, more descriptive, definitions and specifications of the parameters. The appendix is thought to serve as a look-up section when seeking information on a particular parameter from the technology inventory.

The report and in particular Appendix 1 can be viewed as a reference document to accompany the inventory template in an attempt to avoid confusion on what the listed parameters represent.

The parameters currently included in the inventory are the starting point of further development (as described in Section 5, Future work in task T1.2) and it can be expected that revisions are made following the progress of the Project. Therefore, parameters are not individually described in Appendix 1. Instead, groups of parameters are described collectively, following the overall structure that was presented in Section 3 above.

ⁱ There is currently a discussion on whether to only include narrative information on this or to collect data (supposedly as standard LCA data for resources used by the technology).

5 Future work in task T1.2

T1.2 continues after delivery of this report, D1.2. In its second phase the task's objective is to populate the inventory template with technologies and representative data on the technology parameters. The inventory will be updated continuously, following the pace of work in other EcoWater tasks which are linked to T1.2, see section 5.1. The final delivery, D1.3, is scheduled at the end of the second project year², i.e. October 2013.

5.1 Strategy for population of the technology inventory

For the future work in T1.2 it is expected that input from WP2-WP4 will provide info on what technologies to include, values on the representative data on the inventory parameters and/or help on where to find the sources of information to fill out the inventory with values. The inventory will be populated with data for currently used technologies (for Business As Usual, BAU, scenarios) as well as new technologies.

In particular, information and data will be gathered from the work on

- Value chain mapping, in tasks T2.1, T3.1 and T4.1.
- Baseline assessment, in tasks T2.2, T3.2 and T4.2.
- Identification of technologies for eco-efficiency improvements, in tasks T2.3, T3.3 and T4.3.

The gathering of technology information and data is foreseen to be accomplished in parallel to the work of WP2-4 mentioned above, with the help of WP leaders and Case Study leaders. Two intermediate deadlines for inventory population are proposed prior to the final version. Those updates to the technology inventory will also highlight any necessary amendments to the template.

- 1st intermediate population of inventory, deadline 30th Nov 2012.
- 2nd intermediate population of inventory, deadline 31st May 2013.

IVL will manage the technology inventory Excel-file and update it with values from the intermediate inventory population revisions. The workload of retrieving the data will be shared among the participants of T1.2, which are all more or less linked to the specific EcoWater CS. The following allocation of work is proposed², to address the collection of information on different technologies for:

- Water abstraction and storage (likely to be applicable to all CS) – Deltares
- Improved treatment and management in the agricultural sector – CIHEAM-IAMB, UPORTO, OU
- Industrial sector, energy – Deltares
- Industrial sector, textile – MITA
- Industrial sector, dairy – DHI
- Industrial sector, automotive – IVL
- Urban water systems – FHNW, UACEG, NTUA

Updated versions of the populated technology inventory will be posted on the EcoWater internal web page (under Working Documents/T1.2).

5.2 Strategy for updates and maintenance of the technology inventory template

As the EcoWater project proceeds, new ideas and necessary amendments to the technology inventory template might arise and needs to be handled. The following procedure for updates and maintenance is proposed:

- a. Suggestions for improvement of the technology inventory template should be communicated to the working group of T1.2 via the task leader Åsa Nilsson, IVL.
- b. The working group will discuss the applicability of the suggestion. Other concerned project participants will also be invited to the discussion.
- c. If the suggested revision of the template is approved, then it will be incorporated in the master version of the technology inventory template.
- d. The T1.2 task leader will manage the master version of the technology inventory and will be responsible for communicating updated versions within the working group and to all project members. Updated versions will be posted on the EcoWater internal web page (under Working Documents/T1.2).

Suggestions for improvements will be handled as they arise, so as to not delay further development in related parts of the project.

5.3 D1.3 Populated technology inventory

The next and final Deliverable of T1.2 is D1.3 *Populated technology inventory*, with deadline in October 2013.

The DoW² states the following: “D1.3) *Populated technology inventory: The populated technology inventory (information base) will include structured information on technologies for improving the environmental footprint of water use in agricultural, industrial and urban settings.*”

Similar to what was developed for this Deliverable (D1.2), the D1.3 deliverable will consist of two parts. One part is the actual populated technology inventory, provided as an Excel workbook. The other part is a report, similar to the present document, which contains an overview of the technology inventory structure and the specifications of the final list of parameters used by the Case Studies in the inventory template. The specifications will then be made for individual parameters, not groups of parameters, unless there are groups of parameters that can easily be described collectively.

The number of parameters in D1.3 is foreseen to be different from that in D1.2, due to the possible insight gained from further work with Case Studies during the inventory population phase. It is also fair to expect that the structure of the inventory template may be subject to changes, particularly when the work in T5.3 *Development of toolbox for meso-level eco-efficiency of systems/products* has begun and the feedback from that task can be taken into account.

Depending on the requirements on the inventory template, to be discussed with e.g. T5.3, it could be of interest to add information on parameter applicability in D1.3. An idea could be to assign each parameter with one out of three applicability classes:

- Generic parameter
- Sector specific parameter
- Case Study specific parameter

For sector specific parameters it should then be indicated which sector (Agricultural, Urban, Industrial) and for Case Study specific parameters it should be indicated which CS#.

5.4 Communication of results to T5.3

The populated inventory will serve as a database of technologies to be used by the EcoWater tools developed in T5.3 *Development of toolbox for meso-level eco-efficiency of systems/products*. The future work of T1.2 runs in parallel with T5.3, which is scheduled to start in May 2012. It is therefore important to communicate any changes of the inventory's structural design in order to verify that it can be used as intended (as a database to the EcoWater tools).

The most recent version of the technology inventory will be available to the project partners on the EcoWater internal web page. The task leader of T5.3 will be notified when a new version is available and provided with a summary of what changes have been made.

Feedback from T5.3 is also of importance, so development in T1.2 is driven in the right direction.

After its finalisation, D1.3 will also be provided directly to the task leader of T5.3.

6 References

¹ OPTIMA project website, www.ess.co.at/OPTIMA, visited Jan-2012.

² Annex I – "Description of Work", EcoWater, Grant agreement no:282882.

Appendix 1: Parameter specifications

The parameters are specified below. The headings are written in the form of “category”/”group”/”name” for parameters that are described individually or “category”/”group”/ for parameters that are described collectively. The order of parameters follows the overall structure of the technology inventory template, as described in Section 3.

Performance / - / Technology lifetime

Unit: years

Definition: Number of years from when the technology is put into use and until it no longer works or becomes obsolete.

Description: Performance parameters are as of yet ungrouped. They are a category of parameters that describe general performance (not efficiency) of the technology.

Representative data record: *(to be included in D1.3)*

Performance / - / Reliability

Unit: %

Definition: The parameter represents the % of time for a technology to function as intended. An estimated Reliability of 95% means one can expect malfunction during 5% of the operative time for the technology.

Description: Performance parameters are as of yet ungrouped. They are a category of parameters that describe general performance (not efficiency) of the technology.

Representative data record: *(to be included in D1.3)*

Economic / Cost /

Parameters: Technology interest rate,
Investment cost (CAPEX),
Operations cost: Total (OPEX),
Operations cost: Electricity,
Operations cost: Chemicals,
Operations cost: Water,
Operations cost: Farm management (production cost),
Operations cost: Irrigation delivery service paid by farmers,
Operations cost: Crop water needs proceedings,
Maintenance cost, Yearly financial costs of technology,
Financial costs to treat 1m³.

Units: %/year, €/year

Definition: (A definition of each parameter to be included in D1.3)

Description: Parameters representing a cost incurred from using the technology. The cost could be e.g. reported as a total cost or individually for the resources used when applying the technology.

Representative data record: *(to be included in D1.3)*

Economic / Value /

Parameters: Benefits for actors changing technology/substance/crop,
(Added/created) value of technology to product, Value from by-products (e.g. biogas)

Unit: €/year

Definition: (A definition of each parameter to be included in D1.3)

Description: Parameters representing a value created from using the technology.
The value could be e.g. added value of water, value from by-products or other value to the user of the technology.

Representative data record: *(to be included in D1.3)*

Environmental / Emissions to air /

Parameters: CH₄, CO₂

Unit: t/year

Definition: Substances emitted to air by the technology, affecting its quality.

Description: Can include a range of substances important for air quality or other environmental impact categories (e.g. GWP, Photochemical ozone creation potential, ...)

Representative data record: *(to be included in D1.3)*

Environmental / Soil quality influence /

Parameters: Salinization level, Alkalinization level, Infiltration rate, Drainage, Ion toxicity (Na and Cl), Organic matter

Unit: (to be defined)

Definition: Properties of soil quality that may be influenced by the use of technology in the water value chain.

Description: The parameter group describes the impact on soil quality that can be attributed to the technology in use.

Representative data record: *(to be included in D1.3)*

Environmental / Water quality influence /

Parameters: NO₃, NH₄, N total, PO₄, P Total, BOD, COD, Total pesticides, TSS, Microbiological contaminations, Micro pollutants, Nanoparticles, Mineral oil, PAH, Ni, Zn, Na, Cl, bicarbonates, B, Total extractable hydrocarbons, Dioxin, Furan, Cd, Pb, Hg, Cr, Cu, As, Se, Sb, Sn, Co, Mo, Temperature or emitted thermal load, Salinity, pH

Unit: Δmg/l , Δ degrees C, Δ dS/m

Definition: Substances (pollutants) in the water, affecting its quality.

Description: The parameter group describes the difference in concentration for the substances (parameters) before and after the technology step in the node. For example a filter absorbing PAH, will give a negative value since the concentration of PAH in the water is lower after the filter.

Representative data record: *(to be included in D1.3)*

Environmental / Water use /

Parameters: Total volume per year, Re-used water, Ratio abstracted to discharged, Water discharged after use of technology, Water lost (leakages), Surface water, Groundwater, Other water, Water abstraction/(total supply-minimum base flow).

Unit: m³/year, %

Definition: Water used and/or processed by the technology in that node.

Description: The parameter group describes different uses of water in the technology.

Representative data record: *(to be included in D1.3)*

Environmental / Resource use /

Parameters: Total energy, Energy – Electricity, Energy – Oil/gas, Energy – Transport fuels, Fertilizers, Pesticides, Chemicals, Other, Land use/claim/converted land

Unit: kWh/year; t/year; m² or ha/year

Definition: Resources used by the technology

Description: The parameters in the group describe different resource uses, e.g. electricity used by the technology, or fertilizers etc.

Representative data record: *(to be included in D1.3)*

Environmental / Solid waste /

Parameters: Solid waste for waste treatment, Solid waste for use/recycling

Unit: t/year

Definition: Solid waste stemming from use of the technology

Description: The parameters in the group are divided into waste that needs treatment with e.g. incineration or landfill, and waste that could be used as a resource, e.g. sludge as fertilizer.

Representative data record: *(to be included in D1.3)*

Environmental / Indirect impacts /

Parameters: Indirect impact from technology production (narrative), GWP, AP, EP, ODP, Formation of photochemical oxidants, Waste, Biodiversity

Unit: - / CO₂-eq. / SO_x-eq. / PO₄-eq. / CFC-11-eq. / C₂H₄-eq. /kg /- per unit of used resource

Definition: Indirect impacts caused during technology production or during production of the technology's consumable resources, i.e. not during technology use in the node.

Description: The parameters are standard LCA. The definition of "indirect" in EcoWater may be somewhat else, while this category must be precisely defined.

Representative data record: *(to be included in D1.3)*

Efficiency / Energy /

Parameters: Energy use per volume of water used, Temperature gradient 1, Temperature gradient 2, Ratio energy supply to demand, Energy produced per m³ cooling water, Reduction usage of gas for heating, Discharged amount of heat in recipient.

Unit: kWh/m³, {dT/dx} = C/m, {dT/dt} = C/t, Pth/Dth = J/J, J/m³, m³/year, J/year

Definition: (A definition of each parameter to be included in D1.3)

Description: Efficiency parameters relating to energy.

Representative data record: (to be included in D1.3)

Efficiency / Monetary /

Parameters: Ratio Supplied water to total cost of service, Cost for a reduction of micropollutants, Cost for a reduction of other pollutants.

Unit: m³/€, €/t pollutant

Definition: (A definition of each parameter to be included in D1.3)

Description: Efficiency parameters relating to cost of using the technology.

Representative data record: (to be included in D1.3)

Efficiency / Physical /

Parameters: Water use per area, Crop production per volume of water used.

Unit: m³/ha, t/m³.

Definition: "Water use per area" can be applied to both area of a specific crop, area of a specific irrigation technology and area of a specific production system.

Description: Efficiency parameters relating to the use of a resource or the production volume.

Representative data record: (to be included in D1.3)