Supplementary Materials – Questionnaire and Expert Responses

This document provides the method in which the questionnaire was conducted and what is the profile of experts questioned.

The questionnaires were sent via electronic mail. Some of the interviews were done face-to-face. All the questions and answers are presented in the following sections.

11 experts were interviewed – 5 experts in the environment protection field and 6 experts in waste management field. All the experts are Croatian, and their expertise is based on their previous experience in the aforementioned fields. All experts have over 8 years of expertise in their field of work – main sectors are following: environmental protection (soil, water, air), waste management (mainly mixed municipal solid waste), sewage sludge management, wastewater treatment, waste-to-energy, recycling, etc. Most of them are from the academic community and government agencies, while several are from the private sector (consulting companies, wastewater treatment plant operators, waste management companies, etc.). Due to experts' desire for anonymity, their identities will not be revealed, and will be marked as either Environment Expert 1, 2, etc. or Waste Management Expert 1, 2, etc.

Questionnaire

Wastewater treatment and sewage sludge management is a growing industry, where amount of sewage sludge is increasing each day. Therefore, specific sustainable technologies are needed, in order to manage the generated large quantities of sludge, while simultaneously utilizing the energy and material potential of the sludge.

For most of the technologies, there are determined technical, economic and environmental aspects – e.g. greenhouse gas emissions, capital and operational expenses, energy demand and production, efficiencies (electrical and heat), etc. However, for sustainable technologies, there is a lack of specific aspects, for which we require expert opinion.

For the purpose of conducting a research analysis on the topic of sewage sludge management, through sustainable methods and technologies, we would like to gather your opinion on specific technical, socio-economic and environmental aspects on sustainable technologies.

Therefore, you will be asked to rank, from 1 to 5 (1 being the lowest score, and 5 being the highest score), define Yes/No and quantitively specify, the specific segments of examined sustainable technologies of sewage sludge management. The observed technologies include the following: incineration, gasification, anaerobic digestion and material recovery (via struvite production).

The overall aspects questioned are following:

- **Understanding (1-5)**: Familiarity with using the technology: the extent to which experts are competent to perform tasks and use all of the capabilities offered by each technology.
- **Ecological footprint (1-5)**: Total environmental impact during the entire service life of the wastewater plant. The ecological footprint is a quantitative representation of the need for natural resources. The goal is to maximize this criterion, which indicates lesser negative impact on the environment and human health.
- **FiT/Premium model (Yes/No)**: Use of feed-in tariffs for supplying the generated electricity into the grid.

- **Energy demand (Quantitively)**: Thermal and electricity demand for operation (digesters, reactors, incinerators, aeration, pumping, thickening, dewatering, etc.).
- **Legal-administrative framework (1-5)**: The set of regulatory acts, bylaws and directives establishing the scope of work, the responsibilities, and the expectations from the wastewater and sludge treatment technology.
- **Jobs (Quantitively)**: Creating new job places.

Incineration

Understanding: 1 2 3 4 5

Ecological footprint: 1 2 3 4 5

FiT/Premium model: Yes No

Gasification

Understanding: 1 2 3 4 5

Ecological footprint: 1 2 3 4 5

FiT/Premium model: Yes No

Anaerobic digestion

Understanding: 1 2 3 4 5

Ecological footprint: 1 2 3 4 5

FiT/Premium model: Yes No

Material recovery

Understanding: 1 2 3 4 5

Ecological footprint: 1 2 3 4 5

FiT/Premium model: Yes No

Energy demand: Please insert an approximation/specific number with two decimals, based on your experience [MWh/year]

Legal-administrative framework: 1 2 3 4 5

Jobs: Please insert the number of employees working at the plant, based on your approximation and/or experience.

Experts' responses

Environment Expert 1:

Incineration

Understanding:	1	2	3	4	**5**
Ecological footprint:	1	2	**3**	4	5
FiT/Premium model:	Yes	**No**			

Gasification

Understanding:	1	2	**3**	4	5
Ecological footprint:	1	2	3	**4**	5
FiT/Premium model:	Yes	**No**			

Anaerobic digestion

Understanding:	1	2	3	4	**5**
Ecological footprint:	1	2	3	**4**	5
FiT/Premium model:	**Yes**	No			

Material recovery

Understanding:	1	2	**3**	4	5
Ecological footprint:	1	2	3	4	**5**
FiT/Premium model:	Yes	**No**			

Energy demand: **1,000.00 MWh/year**

Legal-administrative framework:	1	2	**3**	4	5

Jobs: **4**

Environment Expert 2:

Incineration

Understanding:	1	2	3	4	**5**
Ecological footprint:	1	2	**3**	4	5
FiT/Premium model:	Yes	**No**			

Gasification

Understanding:	1	2	**3**	4	5
Ecological footprint:	1	2	3	**4**	5
FiT/Premium model:	Yes	**No**			

Anaerobic digestion

Understanding:	1	2	3	4	**5**
Ecological footprint:	1	2	3	**4**	5
FiT/Premium model:	**Yes**	No			

Material recovery

Understanding:	1	2	**3**	4	5
Ecological footprint:	1	2	3	4	**5**
FiT/Premium model:	Yes	**No**			

Energy demand: **1,060.00 MWh/year**

Legal-administrative framework:	1	2	**3**	4	5

Jobs: **4**

Environment Expert 3:

Incineration

Understanding:	1	2	3	4	**5**
Ecological footprint:	1	2	**3**	4	5
FiT/Premium model:	Yes	**No**			

Gasification

Understanding:	1	2	3	**4**	5
Ecological footprint:	1	2	3	**4**	5
FiT/Premium model:	Yes	**No**			

Anaerobic digestion

Understanding:	1	2	3	4	**5**
Ecological footprint:	1	2	3	**4**	5
FiT/Premium model:	**Yes**	No			

Material recovery

Understanding:	1	2	**3**	4	5
Ecological footprint:	1	2	3	4	**5**
FiT/Premium model:	Yes	**No**			

Energy demand: **1,028.50 MWh/year**

Legal-administrative framework:	1	2	**3**	4	5

Jobs: **3**

Environment Expert 4:

Incineration

Understanding:	1	2	3	**4**	5
Ecological footprint:	1	2	**3**	4	5
FiT/Premium model:	Yes	**No**			

Gasification

Understanding:	1	2	3	**4**	5
Ecological footprint:	1	2	3	4	**5**
FiT/Premium model:	Yes	**No**			

Anaerobic digestion

Understanding:	1	2	3	4	**5**
Ecological footprint:	1	2	3	**4**	5
FiT/Premium model:	**Yes**	No			

Material recovery

Understanding:	1	2	3	**4**	5
Ecological footprint:	1	2	3	4	**5**
FiT/Premium model:	Yes	**No**			
Energy demand:	**1,100.00 MWh/year**				
Legal-administrative framework:	1	2	**3**	4	5
Jobs: **4**					

Environment Expert 5:

Incineration

Understanding:	1	2	3	4	**5**
Ecological footprint:	1	2	**3**	4	5
FiT/Premium model:	Yes	**No**			

Gasification

Understanding:	1	2	**3**	4	5
Ecological footprint:	1	2	3	4	**5**
FiT/Premium model:	Yes	**No**			

Anaerobic digestion

Understanding:	1	2	3	**4**	5
Ecological footprint:	1	2	3	**4**	5
FiT/Premium model:	**Yes**	No			

Material recovery

Understanding:	1	2	3	**4**	5
Ecological footprint:	1	2	3	4	**5**
FiT/Premium model:	Yes	**No**			

Energy demand: **1,023.50 MWh/year**

Legal-administrative framework:	1	2	**3**	4	5

Jobs: **3**

Waste Management Expert 1:

Incineration

Understanding:	1	2	3	4	**5**
Ecological footprint:	1	2	**3**	4	5
FiT/Premium model:	Yes	**No**			

Gasification

Understanding:	1	2	3	**4**	5
Ecological footprint:	1	2	3	4	**5**
FiT/Premium model:	Yes	**No**			

Anaerobic digestion

Understanding:	1	2	3	4	**5**
Ecological footprint:	1	2	3	**4**	5
FiT/Premium model:	**Yes**	No			

Material recovery

Understanding:	1	2	**3**	4	5
Ecological footprint:	1	2	3	4	**5**
FiT/Premium model:	Yes	**No**			
Energy demand:	**1,050.00 MWh/year**				
Legal-administrative framework:	1	2	**3**	4	5

Jobs: **3**

Waste Management Expert 2:

Incineration

Understanding:	1	2	3	4	**5**
Ecological footprint:	1	2	**3**	4	5
FiT/Premium model:	Yes	**No**			

Gasification

Understanding:	1	2	**3**	4	5
Ecological footprint:	1	2	3	**4**	5
FiT/Premium model:	Yes	**No**			

Anaerobic digestion

Understanding:	1	2	3	4	**5**
Ecological footprint:	1	2	3	**4**	5
FiT/Premium model:	**Yes**	No			

Material recovery

Understanding:	1	2	**3**	4	5
Ecological footprint:	1	2	3	4	**5**
FiT/Premium model:	Yes	**No**			

Energy demand: **1,100.00 MWh/year**

Legal-administrative framework:	1	2	**3**	4	5

Jobs: **4**

Waste Management Expert 3:

Incineration

Understanding:	1	2	3	4	**5**
Ecological footprint:	1	2	**3**	4	5
FiT/Premium model:	Yes	**No**			

Gasification

Understanding:	1	2	3	**4**	5
Ecological footprint:	1	2	3	4	**5**
FiT/Premium model:	Yes	**No**			

Anaerobic digestion

Understanding:	1	2	3	4	**5**
Ecological footprint:	1	2	3	**4**	5
FiT/Premium model:	**Yes**	No			

Material recovery

Understanding:	1	2	**3**	4	5
Ecological footprint:	1	2	3	4	**5**
FiT/Premium model:	Yes	**No**			
Energy demand:	**1,100.00 MWh/year**				
Legal-administrative framework:	1	2	**3**	4	5

Jobs: **3**

Waste Management Expert 4:

Incineration

Understanding:	1	2	3	4	**5**
Ecological footprint:	1	2	3	**4**	5
FiT/Premium model:	Yes	**No**			

Gasification

Understanding:	1	2	3	**4**	5
Ecological footprint:	1	2	3	**4**	5
FiT/Premium model:	Yes	**No**			

Anaerobic digestion

Understanding:	1	2	3	4	**5**
Ecological footprint:	1	2	3	4	**5**
FiT/Premium model:	**Yes**	No			

Material recovery

Understanding:	1	2	3	**4**	5
Ecological footprint:	1	2	3	4	**5**
FiT/Premium model:	Yes	**No**			

Energy demand: **1,200.00 MWh/year**

Legal-administrative framework:	1	**2**	3	4	5

Jobs: **5**

Waste Management Expert 5:

Incineration

Understanding:	1	2	3	4	**5**
Ecological footprint:	1	2	**3**	4	5
FiT/Premium model:	Yes	**No**			

Gasification

Understanding:	1	2	**3**	4	5
Ecological footprint:	1	2	3	4	**5**
FiT/Premium model:	Yes	**No**			

Anaerobic digestion

Understanding:	1	2	3	4	**5**
Ecological footprint:	1	2	3	**4**	5
FiT/Premium model:	**Yes**	No			

Material recovery

Understanding:	1	2	3	**4**	5
Ecological footprint:	1	2	3	4	**5**
FiT/Premium model:	Yes	**No**			

Energy demand: **1,200.00 MWh/year**

Legal-administrative framework:	1	2	**3**	4	5

Jobs: **4**

Waste Management Expert 6:

Incineration

Understanding:	1	2	3	4	**5**
Ecological footprint:	1	**2**	3	4	5
FiT/Premium model:	Yes	**No**			

Gasification

Understanding:	1	2	3	**4**	5
Ecological footprint:	1	2	3	4	**5**
FiT/Premium model:	Yes	**No**			

Anaerobic digestion

Understanding:	1	2	3	4	**5**
Ecological footprint:	1	2	3	**4**	5
FiT/Premium model:	**Yes**	No			

Material recovery

Understanding:	1	2	**3**	4	5
Ecological footprint:	1	2	3	4	**5**
FiT/Premium model:	Yes	**No**			
Energy demand:	**1,300.00 MWh/year**				
Legal-administrative framework:	1	2	**3**	4	5

Jobs: **3**