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# Impact assessment of Energy Data Feed Platform

Background study

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## Index

1	Background	3
2	General methodologies in impact assessment	3
2.1	Definition of impact assessment	3
2.2	Types of impact assessments	4
2.3	Challenges of impact assessment	4
2.4	Objectives for impact assessment	5
2.5	Impact assessment target groups	6
2.6	Selection of impacts to assess	7
2.7	Impact assessment methodologies	7
2.8	Selection of methodologies	11
3	Assessing the impacts of the EDF Platform	13
3.1	Scope, objectives, and methodologies	13
3.2	Key Performance Indicators	15
	References	18

# 1 Background

Elering AS is an independent electricity transmission system operator in Estonia whose main duty is to guarantee high quality electricity supply to Estonian consumers at all times.

Elering is leading a consortium to prepare a development project for a new innovative energy management service platform in Estonia, named *Energy Data Feed (EDF) Platform*. Elering has commissioned Gaia Consulting Ltd. to contribute to the project plan preparation by

- A. Conducting a market study to identify business opportunities for the EDF Platform; and
- B. Presenting an overview of project impact assessment and related methodologies focusing on environmental and socio-economic impacts as well as developing preliminary Key Performance Indicators (KPIs) for the project.

This report presents part B of the contribution, the overview of impact assessment. Chapter 2 gives a thorough overview in the theoretical background of impact assessment in general and the motivation for the selected methodologies. Chapter 3 provides a short summary and scoping of impact assessment focusing on the EDF Platform and on the Key Performance Indicators.

This report has been prepared by Julia Illman, Iivo Vehviläinen, and Mari Hjelt. The contents of this report will be revised based on comments received from Elering and the consortium before reporting is finalised as part of the project plan submission.

## 2 General methodologies in impact assessment

### 2.1 Definition of impact assessment

Impact assessment is primarily used to inform decision making related to policies, programs, plans and projects. It is both a technical analytical tool for analysis of consequences and a legal procedure often linked to, for example, environmental permit processes. Impact assessment in its simplest form is defined as the process of identifying the future consequences of a current or proposed action<sup>1</sup>. Here, impact is defined as the difference between what would happen if the action is implemented and if it is not implemented<sup>2</sup>. Impact assessment aims to<sup>3</sup>:

- Provide information for decision making that analyses the biophysical, social, economic and sometimes also institutional consequences of proposed actions.
- Promote transparency and participation of the public in decision making.

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<sup>1</sup> IAIA website

<sup>2</sup> IAIA 2009

<sup>3</sup> IAIA 2009

- Identify procedures and methods for the follow-up (monitoring and mitigation of adverse consequences) in policy, planning and project cycles.
- Contribute to environmentally sound and sustainable development.

As the aims listed above suggest, many different types of impacts can be assessed and the assessment itself can be used for a multitude of purposes. The following sections will elaborate on the types of impact assessments and the related challenges.

## 2.2 Types of impact assessments

Given the wide range of application of impact assessment, different approaches have been developed to deal with different types of impacts. The most established type of impact assessment is Environmental Impact Assessment (EIA), which emerged in the 1960s in the wake of rising concerns in developed economies about the impact of human activities on human health and on the biophysical environment<sup>4</sup>. EIA has since developed into a legal requirement in the majority of countries.

Environmental and Social Impact Assessment (ESIA) is an extension of the EIA that also includes social impacts. When economic impacts are also assessed, one can also refer to “Sustainability Assessment”<sup>5</sup>.

Impact assessments can be applied to a wide range of actions, for example, to the construction of an industrial facility, to the development of public policy intervention, or to the development of new business ventures. The types of methodologies used will therefore depend not only on the type of assessment but on the application. This report will focus on methodologies used for impact assessment of new business ventures.

## 2.3 Challenges of impact assessment

One of the main challenges of impact assessment is the multitude of impacts that can occur from one single action. Direct impacts (impacts immediately resulting from the action<sup>6</sup>) are often easier to identify and measure compared with indirect impacts (consequences of direct impacts<sup>7</sup>). For example, in the case of developing a new business, it is easier to identify and measure the revenues gained from the new business compared to the extent of benefits society as a whole will gain. Different methodologies exist for identifying different types of impacts, but the available data often limits the extent of impacts that can be included in an assessment.

In addition to the distinction of direct and indirect impacts, the time span of the action plays a critical role in impact assessment. The impact of some actions will be detectable immediately upon implementation and other impacts will take time to reveal themselves. Not only is it more challeng-

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<sup>4</sup> IAIA 2009

<sup>5</sup> IAIA 2009

<sup>6</sup> IAIA Glossary

<sup>7</sup> IAIA Glossary

ing to identify these slowly emerging impacts, but by the time they are observed and their scale fully understood, it is often too late to influence them. While the main reason to conduct an impact assessment is to identify future consequences, and assessment are often applied to enable decision makers to maximise positive impacts and avoid (or at least minimise) negative impacts, the ability to influence future impacts is limited. However, having conducted an impact assessment enables decision makers to better prepare for different possible futures and a wider range of potential impacts.

Another challenge is the identification and validation of cause-effect relationships: For example, how can environmental improvements (e.g. a reduction in energy consumption) be traced back and attributed to the provision of a new service by a company? Many different types of methodologies have also been developed for mapping these relationships (see section 2.7). However, these are often complex analytical studies and theoretical approaches always have their limitations when applied to the “real” world. Impacts often also result as consequences from several different types of actions. It can be challenging to argue what the specific contributions of individual actions have been to the final impact. For example, a reduction in energy consumption may be the result of a new tax incentive, an increase in energy prices, or improved access to consumption data for the consumer, or a combination of these actions/events.

The impacts of an action also vary depending on the phase of implementation. For example, the impacts of planning a project are very different from those of the pilot, implementation, monitoring and closing phases of a project. Each phase involves a different group of stakeholders that more or less willingly will influence the impacts. This makes impact assessment a dynamic and iterative process – impacts identified at the planning phase are likely to significantly differ from those of the implementation phase. This is also why the aim of identifying procedures and methods for follow-up are important.

## 2.4 Objectives for impact assessment

As with any analysis exercise, clear objectives must be set at the beginning for an impact assessment. This includes a statement of the purpose of the impact assessment. For example, objectives of an environmental impact assessment could include<sup>8</sup>:

- To ensure that environmental considerations are explicitly addressed and incorporated into the development decision making process;
- To anticipate and avoid, minimize or offset the adverse significant biophysical, social and other relevant effects of development proposals;
- To promote development that is sustainable and optimizes resource use and management opportunities.

The set objectives will guide the process and help to evaluate whether the impact assessment was successful. More concrete objectives for the impact assessment for the EDF Platform are proposed in Table 1.

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<sup>8</sup> IAIA 1999

## 2.5 Impact assessment target groups

In defining the impact assessment target groups, it is important to ensure these provide a balanced view of the various impacts. This includes including target groups with different interests in the assessment. It should also be noted, that not all target groups will benefit from the actions. However, including them in the assessment can provide valuable insight on what kinds of disadvantages may result from the actions.

Table 2 presents a generic overview of target groups that may be relevant for EDF Platform actions. Depending on the action, not all will be relevant. Therefore, a first step is to define the relevant target groups for the action being assessed. This will provide a long-list of possible target groups and it is suggested that this is further prioritised in order to refine the scope of the assessment.

**Table 2:** Potential target groups for EDF Platform actions<sup>9</sup>.

Target group	Target sub-group
<b>Public authorities</b>	National authorities / ministries Regional, local and municipal authorities Nordic/Baltic authorities (NordREG) Regulators (Konkurentsiamet, NVE)
<b>Policy makers</b>	Support scheme managers (Kredex) Market analysts and modellers (SKM, Montel) Statistics offices (Statistikaamet, Statistisk sentralbyra)
<b>Utilities</b>	Distribution System Operators (Elektrilevi OÜ, Hafslund) Transmission System Operator (Elering, Statnett) District heating companies (Dalkia, Statkraft Värme) Energy Service Companies (ESCOs) Power plants (Eesti Energia, Statkraft) Renewable energy providers
<b>Investors</b>	Financial institutions Project developers
<b>Civil society</b>	End users of energy, multisite users (e.g. retailers, banks) NGOs, associations Education system
<b>Buildings</b>	Building services engineers Building managers/administrators Public building owners / homeowners
<b>Manufacturers</b>	Manufacturers of smart meters (Echelon, Ericsson) Product distributors
<b>Industry</b>	SMEs Technology developers (Ericsson) Service providers (CGI) Industry associations (ETL, Energi Norge)
<b>Standards bodies</b>	Estonian Centre for Standardization
<b>Media</b>	Daily newspapers (Eesti Päevaleht) Blogs

<sup>9</sup> Intelligent Energy Europe (IEE) II Programme evaluation report used as a guide: Chalsège et al. 2011. Some stakeholders in Estonia and Norway are named as examples.

## 2.6 Selection of impacts to assess

The broad categories of impacts to assess in EDF Platform development are environmental impacts and socio-economic impacts. Both of these contain a myriad of different types of impacts that can be assessed. For scoping the impact assessment, a more refined selection of impacts is needed.

A helpful starting point is identifying the environmental, social and economic objectives of the actions. Table 3 presents some examples of these objectives.

In addition, impacts can also be categorised and scoped according to their nature (positive and negative impacts), timeliness (short and long-term impacts) and intent (intended and unintended impacts)<sup>10</sup>. For example, an impact assessment may be limited to short-term, intended, positive impacts. Of course any limitations made need to be aligned to the assessment objectives.

**Table 3:** Examples of impact objectives.

Environmental <sup>11</sup>	Social <sup>12</sup>	Economic <sup>13</sup>
Energy use	Cultural change	Outputs
Climate change	Communities	Value added
Air pollution	Demographic change	Wealth
Resource depletion	Health and wellbeing	Income (incl. wages)
Water Pollution	Infrastructure	Trade (import/export)
Sea-level rise	Human rights	Government revenues and expenditures
Biodiversity	Democracy	Competitiveness
Toxic substances	Governance	
Waste	Poverty	
Land use	Social capital	
Ecosystem services	Employment	
Noise pollution	Equality	
	Distribution of wealth	
	Safety	

## 2.7 Impact assessment methodologies

Based on the target group and the selected impacts, the appropriate methodologies should be selected. Criteria can also be established to aid in the selection of methodologies e.g. cost efficiency, appropriateness, comprehensiveness etc. Methodologies can roughly be grouped into four different categories, depending on what they are used for. These will be presented in the following.

<sup>10</sup> European Commission 2005

<sup>11</sup> Modified from Hunt et al.

<sup>12</sup> Modified from IAIA 2003

<sup>13</sup> Modified from Weisbrod and Weisbrod 1997

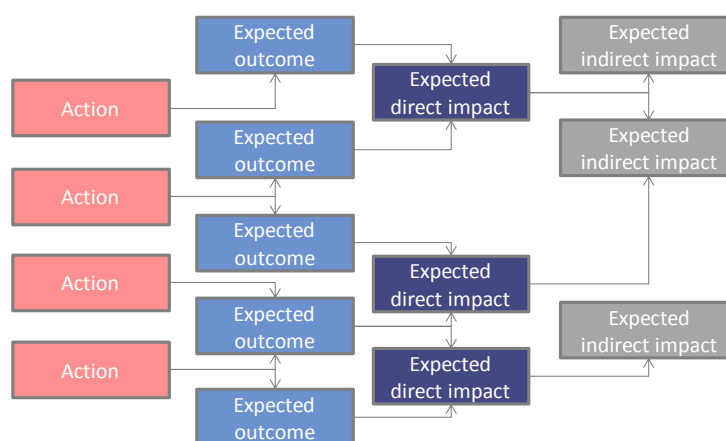


## 1) Defining impact mechanisms

This category contains methodologies used to clarify and validate cause-effect relationships. This is particularly useful at the beginning of the impact assessment helping also to identify what kind of data needs to be collected to prove the impact mechanisms. Methodologies are based on logical classification of objectives and impacts and results often form a diagram that helps to visualise complex relationships.

Drawing from research in the Evaluation field, the Effects Diagram can be a very powerful tool. It helps link actions to impacts by examining expected outcomes and impacts and relationships between these.

An illustration of the Effects Diagram is presented in Figure 1.



**Figure 1:** Illustration of an Effects Diagram.

## 2) Data collection and description of baseline

While the Effects Diagram helps to identify links between actions and impacts, it does not help in analysing the extent or significance of the impacts. For this purpose, data needs to be collected in order to gather more insight, determine baselines for the starting point and understand the impacts. Several different tools can be used for data collection.

Questionnaires and different types of surveys, when structured logically and designed to be comprehensive, can help gather a large amount of qualitative and quantitative information from different stakeholders. Surveys and questionnaires can also be easily combined with other tools such as interviews or focus groups. The advantages and limitations of using surveys are presented in Table 4.

**Table 4:** Advantages and limitations of surveys and questionnaires<sup>14</sup>.

Advantages	Limitations
Yields quantified and reliable data, enables surveying a large number of stakeholders	May require a lot of time to analyse the findings - depends on survey design
Useful to identify changes	Requires pre-existing data on the initial situation

<sup>14</sup> Modified from European Commission 2005



Enables the assessor to work on a target group and on a limited scale	May present difficulties if very only a very limited share of the target group(s) responds
Identifies the outcomes of projects/actions	Yields only a simplistic description of reality

Another approach is to develop a set of indicators that describe the impacts. Developing meaningful indicators requires profound understanding on the impacts. Indicators should be simple and easy to understand by the data collector as well as the stakeholder using the indicator. Indicators need to be measured regularly to ensure that they reflect changes and can be used to describe the development of the situation. The related advantages and limitations are presented in Table 5.

**Table 5: Advantages and limitations of indicators<sup>15</sup>.**

Advantages	Limitations
A way to quantify information, preferably in a standardised form, in order to make comparisons in time and space	It may be an overly simplistic explanation of the situation, which, in turn, becomes exaggerated
A way to simplify situations in order to better understand them	Errors of measurement may provide a skewed view of the situation
Elements that can be used as evidence for presentation	Problems with the availability of reliable and standardised data over a long period of time. Differences in the understanding of the meaning of an indicator between various users

Indicators can be formed based on documented data and information. Many times, however, documented data is limited, outdated and subject to interpretation and does not adequately reflect different points of view. Methodologies to overcome these hurdles include interviewing and using expert opinions or focus group discussions to complement documented data. As mentioned, these can also be useful (and sometimes necessary) to complement data gathered through surveys, in order to decrease the risk of incorrect interpretations.

In conducting interviews and focus group discussions, the key is to design the right questions and select the suitable interviewees. Interviewees should represent different stakeholders in order to maintain a balanced view. It is also worth thinking about the order in which interviews will be conducted, for example, is there some information needed from one group of stakeholders that is needed before another group can be involved? The difference between the two methodologies is that interviews are mainly used to gather views from one respondent, while focus groups can involve several respondents. Focus groups can better facilitate collective analysis and discussion about impacts, which might be particularly beneficial in situations where impacts are hard to identify, much less analyse. Interviews and focus groups are generally better methodologies to be used in gathering qualitative data.

The related advantages and limitations are presented in Table 6.

<sup>15</sup> Modified from European Commission 2005

Finally, case studies can be used to collect data on a more detailed level about certain impacts. They are especially useful when quantitative data are scarce or unavailable<sup>16</sup> and when aiming to understand the reasons for and development of impacts, rather than their scale. Case studies can be used to, for example, highlight impacts from the point of view of specific stakeholders. It should be noted, that case studies require that actions have at least been piloted, before they can be constructed to provide any insight. The related advantages and limitations are presented in Table 7.

**Table 6: Advantages and limitations of interviews and focus groups<sup>17</sup>.**

	Advantages	Limitations
<b>Interviews</b>	<ul style="list-style-type: none"> <li>• Effective tool to improve understanding of quantitative data</li> <li>• Relatively quick to conduct, easy tool to use</li> </ul>	<ul style="list-style-type: none"> <li>• A limited number of respondents can be reached</li> <li>• The limited representativeness of the respondent may skew the results</li> <li>• Relies on respondents verbal expression skills</li> </ul>
<b>Focus groups</b>	<ul style="list-style-type: none"> <li>• A means to interview numerous respondents</li> <li>• Facilitates discussion on difficult issues</li> <li>• A source of creativity if group dynamic is controlled</li> </ul>	<ul style="list-style-type: none"> <li>• More complex and time consuming to organise and prepare for</li> <li>• Some participants may not want to share their views openly with others</li> </ul>

**Table 7: Advantages and limitations of case studies<sup>18</sup>.**

Advantages	Limitations
Case studies can provide a lot more detailed information on an impact It is easily communicated	Data gathering for a case study often requires the use of other tools as well (e.g. interviews) By default, case studies are not representative of the whole situation, requires that case studies are selected and used carefully in order to give an unbiased view
It can provide practical examples and illustrations helping to clarify complex action-impact chains	Hard to generalise impacts based on single case studies  Case studies often do not provide insight extending over significant periods of time (rather they are snapshots of impacts in a certain time and context)

### 3) Methodologies for analysis

Once data has been gathered, it needs to be analysed in order to be useful to the assessor. Here is where the expertise of the assessor plays a significant role. Analysis relies heavily on the ability of the assessor to connect data gathered using different tools and methodologies and to make justified

<sup>16</sup> European Commission 2005

<sup>17</sup> Modified from European Commission 2005

<sup>18</sup> Modified from European Commission 2005



conclusions. However, methodologies also exist to help in analysis. One example is cost-effectiveness analysis which compares the impact of the action with the cost for the stakeholders concerned<sup>19</sup>. This analysis includes evaluating the costs of the action (both direct and indirect) and the impacts that can be derived from results and outcomes of the action. The related advantages and limitations are presented in Table 8.

**Table 8:** *Advantages and limitations of cost-effectiveness analysis*<sup>20</sup>.

Advantages	Limitations
A simple and effective tool which compares different actions with identical objectives	Cost-effectiveness analysis focuses on the main direct impact of the action. When an action generates indirect impacts, the use of cost-effectiveness analysis may be irrelevant or counter-productive
A communicational tool which summarises the outcomes using a single quantifiable indicator	Analysis of the effectiveness, not the relevance of the action
Provides visibility of the action's effectiveness	The data collection for costs and impacts is difficult

Several tools also exist to help with data structuring, for example, once data has been gathered, the Effects Diagram can be refined and impacts can be grouped in tables according to stakeholders that are affected.

#### **4) Separate research projects**

In addition to the methodologies and tools presented above, a whole host of separate research projects can be carried out to focus in on certain impacts. For example, with regards to environmental impacts, carbon footprint calculations can be conducted to analyse the impacts on greenhouse gas emissions. However, these kinds of approaches require substantial quantitative data and often have to rely on estimations in order to provide a holistic view of emissions impacts. Nonetheless they can be useful to demonstrate environmental benefits of new services.

## **2.8 Selection of methodologies**

Final selection of the methodologies to be used should be based on how suitable they are to achieve the objectives of the assessment. For a balanced impact assessment, several methodologies are often required. Not only to ensure different viewpoints are considered, but using several methodologies allows better validation of the assessment when conclusions are backed up by different methodologies.

All the above presented methodologies can be applied to both environmental as well as socio-economic impact assessment. Figure 2 summarises the different types of methodologies and their

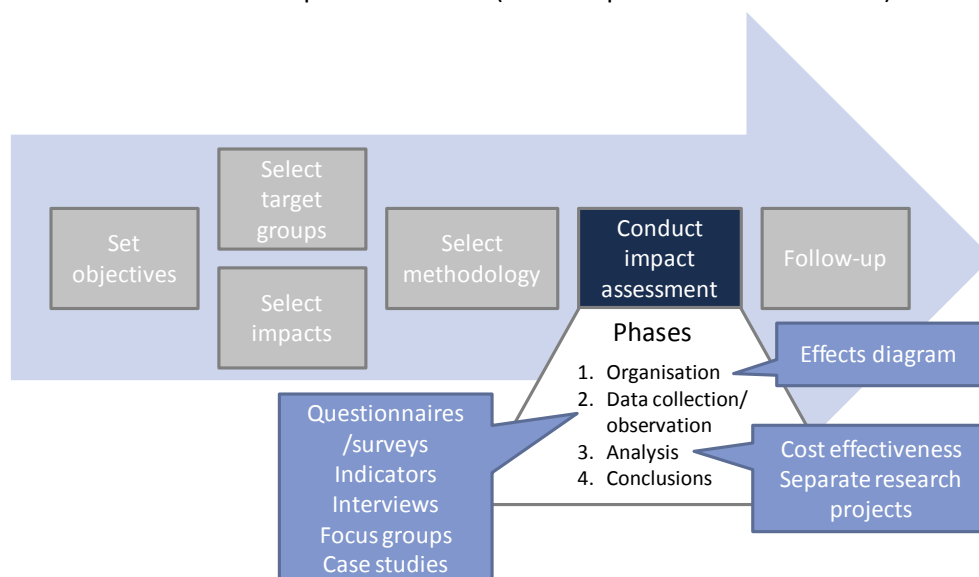
<sup>19</sup> European Commission 2005

<sup>20</sup> Modified from European Commission 2005



use in different phases of the impact assessment. Further, Key questions that need to be answered in order to select the right methodology have been presented in Table 9.

More detailed information on the application of each methodology (excluding the separate research projects) can be found in the EuropeAid database (see European Commission 2005).



**Figure 3: Impact assessment methodologies and tools**

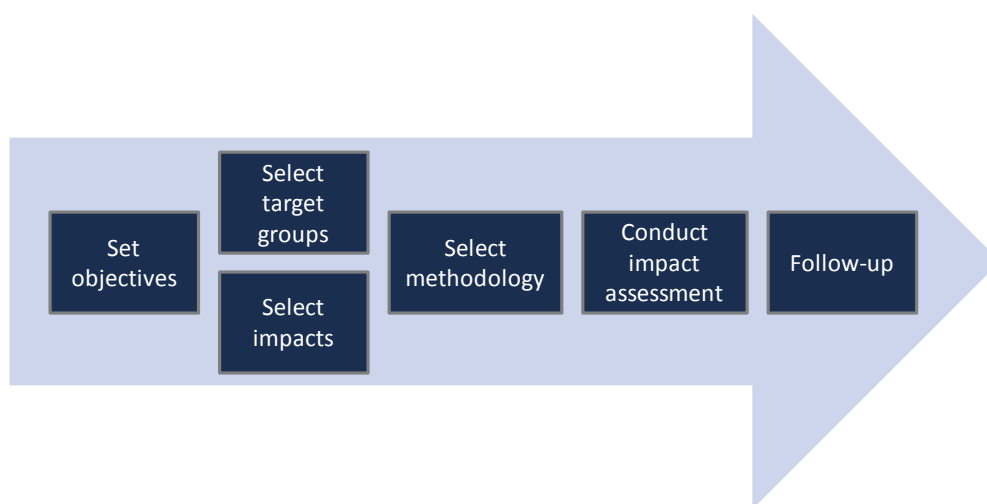
**Table 9: Key questions.**

Key questions to ask...	...to help determine:
What action(s) will be assessed?	Extent of assessment
Who should undertake the assessment?	Resources for assessment
Who should participate in the assessment?	Resources for assessment
What will the results of the assessment be used for?	Objectives of assessment
Are there any particular viewpoints that should be highlighted in the assessment?	Added focus and prioritisation to the assessment
What stakeholders is the action targeting?	Selection of target groups
Are these stakeholders willing and able to participate in the assessment?	Selection of methodologies and tools
What are the expected outcomes of the action(s)?	Selection of impacts
What do stakeholders want to know about the action(s)?	Selection of impacts
How are these impacts linked to the action(s)?	Establishing logical links for analysis
What kind of data exists about the outcomes or impacts of the action(s)?	Selection of methodologies and tools
What capabilities does the assessor have on the use of different tools and methodologies?	Selection of methodologies and tools
How much time is available for conducting the assessment?	Selection of methodologies and tools

# 3 Assessing the impacts of the EDF Platform

## 3.1 Scope, objectives, and methodologies

While the previous chapter provided an overview of impact assessment on a general level, a more defined scope is needed to select the most suitable methodologies for impact assessment of the Energy Data Feed (EDF) Platform. The entire impact assessment process is illustrated in Figure 1.



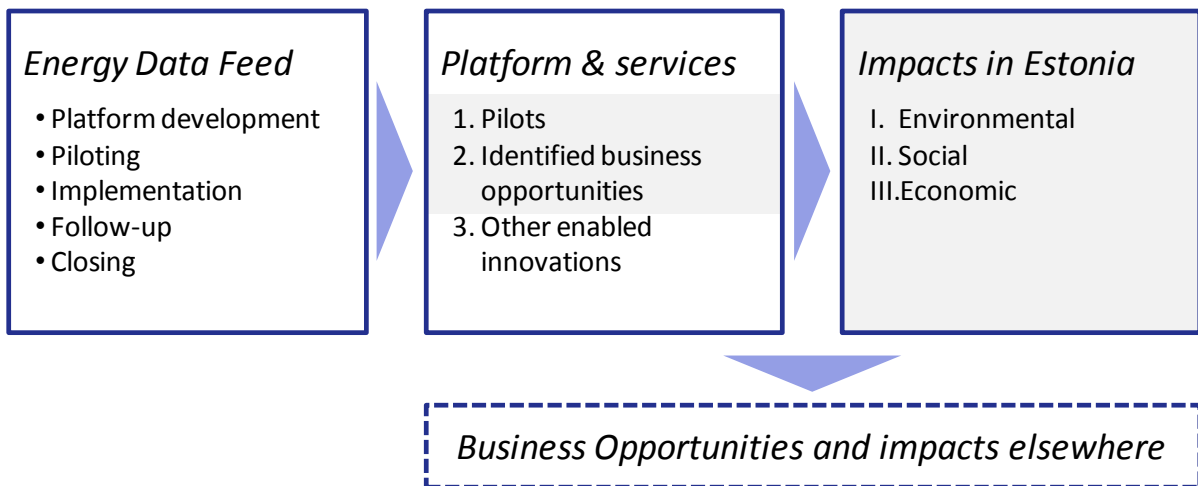
*Figure 3: Impact assessment process.*

The objectives of the impact assessment for the EDF Platform include the following:

- Clearly measure the environmental, social, and economic impact that can be achieved if the project is implemented.
- Enable selection of pilot cases with highest potential impact.
- Enable the follow-up of the successfulness of the project.

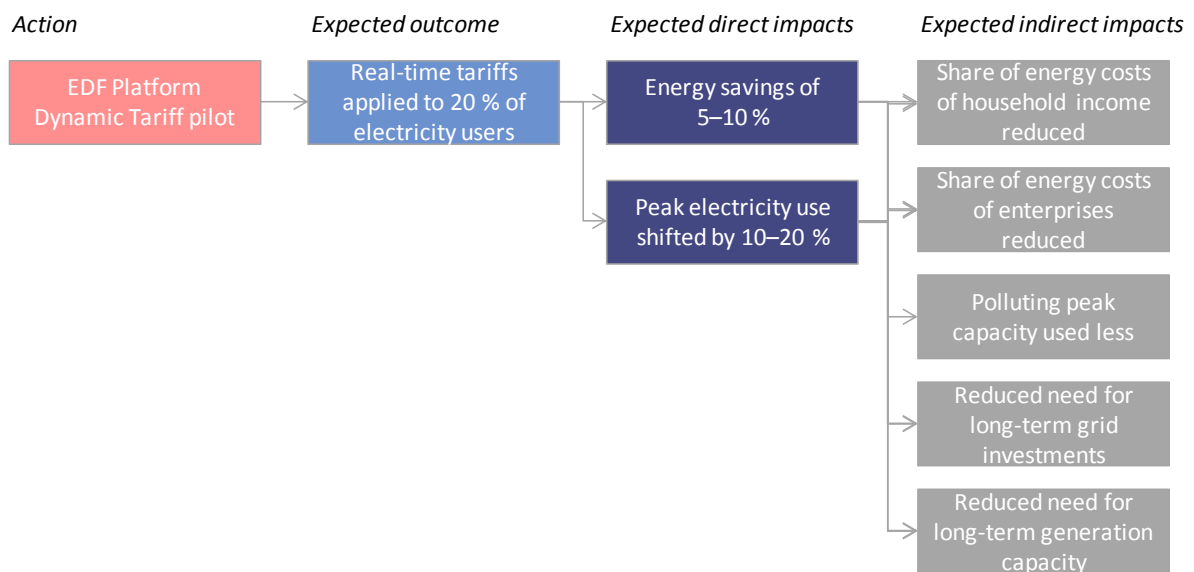
The scope of the impact assessment is based on selected impact of the platform in Estonia, as illustrated in Figure 4. The Energy Data Feed Platform Project creates the platform. On top of the platform various end user services are expected. These include pilots implemented during the project and other business opportunities, some of which have been identified in the Market Study (see separate report). At a later stage, it is possible that the EDF Platform expands to other countries. These impacts in other countries are more uncertain and their effects have not been estimated within the scope of this report.





**Figure 4:** Framework for the impact assessment.

Alongside selecting target groups, the impacts to be included in the assessment need to be selected. The focus is on environmental and socio-economic impacts of the end user services that are enabled through the EDF Platform<sup>21</sup>. The impacts are identified through effects diagrams for all the relevant business cases.



**Figure 4:** Example of the effects diagram for the Dynamic Tariff pilot.

These impacts are quantified to the extent possible. A time span of 2020 has been selected to illustrate the full potential of the platform and its services. Quantification of the impacts of a completely new business model, such as the EDF Platform, is rather challenging, as exactly similar services do not exist. However, it is possible to create preliminary *ex ante* estimates of the impacts on the basis

<sup>21</sup> Potential impacts to other parts of the society are not within the scope of this impact assessment.

of literature and case studies made in the Market Study (see separate report). For the purposes of the project follow-up and given the available resources for the impact analysis, these impacts are suggested to be followed-up through a set of indicators.

### 3.2 Impacts and Key Performance Indicators

Preliminary Key Performance Indicators (KPIs) for the EDF Platform project are presented in Table 10. They have been categorised according to environmental, social and economic indicators. Preliminary list of indicators has been selected on the basis of the review of the pilot business cases.

**Table 10:** Preliminary Key Performance Indicators.

Environmental	Social	Economic
Energy savings achieved (GWh, comparing situation prior to new service)	End users affected by the platform services (% of customers)	Additional revenues gained from new services (EUR)
Carbon emissions savings (tCO <sub>2</sub> -eq, comparing situation prior to new service)	Number of services on the platform	Operational savings (EUR)
Changes in share of renewable energy (% out of total production and consumption vs. fossil)	New jobs created (person-years)	R&D spending (EUR)
	Share of energy costs of the total household income (%)	Share of energy costs of the total enterprise costs (%)

The preliminary list of KPIs can be supplemented and adjusted during the actual implementation of the EDF Platform Project.

Summary of the values for the KPIs from the identified end user business applications are presented in Table 11. The monetary value created has been evaluated in the Market study (see separate report) to be from 18–35 M€. This would be divided to end user savings of 10–20 M€, and additional revenues to service providers of 8–15 M€. The total energy efficiency gains by 2020 could be from 0,8–1,6 TWh. Corresponding carbon emissions can be estimated to be in the range of 0,6–1,1 MtCO<sub>2</sub><sup>22</sup>. If all the services are implemented, the number of services would be 17, with 170 000 end users (households and SMEs) affected<sup>23</sup>.

<sup>22</sup> Assuming emissions of 700 gCO<sub>2</sub>/kWh, corresponding roughly to electricity condense generation from oil shale.

<sup>23</sup> New jobs creation, the R&D cost, share of the energy costs of the total household income and share of the energy cost of the total enterprise cost have not been estimated within the scope of this impact analysis.



**Table 11.** Summary of preliminary potential annual impacts of the identified business opportunities. Energy savings potential is calculated from all energy use per year. Coverage estimate describes the assumed potential adoption by 2020. Economic value creation takes coverage estimate into account.

		Environmental	Social	Economic
	Idea	Energy savings potential (TWh)	Users affected	Total value creation (M€)
ELECTRICITY DISTRIBUTION AND TRANSMISSION	Local grid system management	~0,1	140 000	0,5–1,1
	National grid system management	-	1 (TSO)	0,7–1,3
	Dynamic tariff structures	~0,1	140 000	1,3–2,6
	Combined metering	-	70 000	0,1–0,2
	Secure information sharing	-	5 (companies)	~0,5
DISTRICT HEATING	Network management	~0,1	100 (companies)	2–4
	Buildings as heat storage	-	3 000 (households)	~0,2
	Heat generation optimization	~0,1	40 (companies)	0,8–1,5
	Dynamic tariff structures	~0,1	40 (companies)	0,8–1,5
	Combined metering	-	70 000	~0,3
	Secure information sharing	-	100 (companies)	~0,5
RENEW-ABLES	Virtual power plants	-	10 (companies)	~0,5
	SCADA services	-	250 (plants)	~0,5
ENERGY END USE	Energy costs management	0,1–0,3	140 – 170 000	2–4
	Demand response	~0,1	70 000	0,7–1,3
	Weather data based heating	0,3–0,6	30 – 60 000 (households)	4–8
	Secure smart houses	-	12 – 30 000	3–7
	<b>Total</b>	<b>0,8 – 1,6</b>	<b>- 170 000</b>	<b>18–35</b>

Impacts of the platform in other countries are more uncertain. The magnitude of impacts can be roughly estimated by scaling the impacts with the energy use or population. For example, in Norway, electricity and district heating use is around 8 times greater than in Estonia and population 3,8 times greater. The energy savings for the services by the EDF Platform Project in Norway could be in the range of 10 TWh and the amount of customers around 600 – 700 000.



**Table 12. Assumptions behind the estimates.**

	Idea	Assumptions in preliminary impact analysis
ELECTRICITY DISTRIBUTION AND TRANSMISSION	Local grid system management	Operative savings estimated to be 1–2 % of the distribution cost or 0,4–0,8 % of the total cost of electricity compared to situation with no smart grid functionality (e.g. Schwartz, 2010). Part of the savings through reduction in losses.
	National grid system management	Operative savings estimated to be 0,5–1 % of the transmission cost or 0,2–0,4 % of the total cost of electricity compared to situation with no smart grid functionality (e.g. Schwartz, 2010). Adopted by the whole transmission network.
	Dynamic tariff structures	Operative costs savings potential estimated to be around 1–2 % and adoption rate 20 % by 2020 (e.g. Schwartz, 2010).
	Combined metering	Operational cost savings from combined meters and infrastructure. Savings assumed to be 1–3 €/meter (e.g. Gaia 2012a) and adoption by 10 % of the ~700 000 customers. Service provider's uptake is 50 %.
	Secure information sharing	Operational cost savings from reduced need for ITC investments. Total savings estimated on the basis of alternative implementation cost (e.g. Gaia 2012a). Adoption by 5 large actors. Service provider's uptake is 50 %.
DISTRICT HEATING	Network management	Energy loss savings potential estimated to be around 1–2 % of total district heating (e.g. Gaia 2011). Part of the savings through reduction in losses.
	Buildings as heat storage	Cutting peak heat demand by 20 % by using around 5 % of the building stock results in savings in operational cost and investments (e.g. Kärkkäinen, 2003). Adoption rate 20 % by 2020.
	Heat generation optimization	Operative costs savings potential estimated to be around 1–2 % and adoption rate 20 % by 2020 (e.g. Gaia 2011). Part of the savings through reduction in losses.
	Dynamic tariff structures	Operative costs savings potential estimated to be around 1–2 % and adoption rate 20 % by 2020 (e.g. Gaia 2011). Part of the savings through reduction in losses.
	Combined metering	Operational cost savings from combined meters and infrastructure. Average saving 25 000 €/company/year for 20 companies out of 200 (see e.g. Gaia 2012a). Service provider's uptake is 50 %.
	Secure information sharing	Operational cost savings from reduced need for ITC investments. Average saving 25 000 €/company/year for 200 companies, 50 % of companies using (see e.g. Gaia 2012a). Service provider's uptake is 50 %.
RENEWABLES	Virtual power plants	Estimated potential 10 aggregated users with 50 000 €/user/year fees (estimate on the potential purchasing power of the plants). Service provider's uptake is 50 %.
	SCADA services	Estimated potential 250 renewable energy generating plants using the service with 2 000 €/plant/year fees (estimate on the basis of other SCADA applications and the potential purchasing power of the plants). Service provider's uptake is 50 %.
ENERGY END USE	Energy costs management	Estimated 20 % of energy use can be affected and 5–10 % savings occur. In total 1–2 % energy saving potential in electricity and district heating and 20 % adoption by 2020 (e.g. Gaia 2010).
	Demand response	Estimated 1–2 % cost saving potential in electricity and 10 % adoption by 2020 (e.g. Schwartz, 2010).
	Weather data based heating	Estimated 5–10 % energy saving potential in district heating and 20 % adoption by 2020 (e.g. Tampereen Sähkölaitos, 2013). Average district heat household consumption is estimated to be 10 000 kWh/year.
	Secure smart houses	Estimated that 2–5 % of 600 000 households invest 240 €/year for the new services. (e.g. Gaia 2010)

Energy savings potential indicates the total estimated potential if all users would adopt new services. Actual coverage of services is estimated for the period until year 2020. Value creation potential is estimated on the basis of actual coverage and 60 €/MWh cost for district heating (current end user prices 40–80 €/MWh, Estonian Competition Authority) and 100 €/MWh for electricity (current end user prices 80–100 €/MWh, Statistics Estonia).



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*See also references for the separate Market Study regarding the end user applications in Tables 11 and 12.*