USELF
Ukraine Sustainable Energy Lending Facility

Ukraine Sustainable Energy Lending Facility (USELF) Strategic Environmental Review

Final Environmental Report

September 2012

Prepared for:

European Bank for Reconstruction and Development

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ABBREVIATIONS

The following abbreviations are used in this Environmental Report:

AD	Anno Domini
amsl	Above Mean Sea Level
BC	Before Christ
CHP	Combined Heat and Power
EBRD	European Bank for Reconstruction and Development
EIA	Environmental Impact Assessment
EU	European Union
FEC	Fuel and Energy Complex
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GIS	Geographic Information System
GRP	Gross Regional Product
ICE	Internal Combustion Engine
IFC	International Finance Corporation
ILO	International Labour Organisation
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
KW	Kilowatt
LFG	Landfill Gas
MFE	The Ministry of Fuel and Energy of Ukraine
Mm^3	Million cubic metres
MPCs	Maximum Permissible Concentrations
MW	Megawatt
NAER	The National Agency of Ukraine for the Efficient Use of Energy Resources
NERC	The National Electric Energy Regulatory Commission
NGO	Non-Governmental Organisation
NJSC	National Joint Stock Company
NTS	Non-Technical Summary
OHS	Occupational Health and Safety
OVNS	Assessment of Environmental Impacts
PRs	Performance Requirements
PV	Photovoltaic
SCS	State Construction Standard
SEA	Strategic Environmental Assessment
SEI	Sustainable Energy Initiative
SEP	Stakeholder Engagement Plan
SER	Strategic Environmental Review
UNECE	United Nations Economic Commission for Europe
UNESCO	United Nations Educational, Scientific and Cultural Organisation
USELF	Ukraine Sustainable Energy Lending Facility
WEMMA	Wholesale Electricity Market Members' Agreement
WFD	Water Framework Directive

NON TECHNICAL SUMMARY

The non-technical summary for this environmental report is supplied as a separate document, available from www.uself-ser.com.

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1 INTRODUCTION

1.1 Background to USELF

To encourage businesses to pursue sustainable energy projects, the European Bank for Reconstruction and Development (EBRD) has launched the Ukraine Sustainable Energy Lending Facility (USELF). USELF aims to '*provide development support and debt finance to renewable energy projects which meet required commercial, technical and environmental standards*'. USELF not only provides tailor-made financing, but also provides technical assistance for businesses and local authorities based on information gathered and analysed by stakeholders to promote projects that are often challenging to finance and implement.

USELF is part of the EBRD's Sustainable Energy Initiative (SEI) which addresses the challenges of climate change and energy efficiency. Since the launch of the SEI in 2006, the EBRD has helped countries from Central Europe to Central Asia secure sustainable energy supplies and finance the efficient use of energy that will cut demand and imports, reduce pollution, and mitigate the effects of climate change.

In co-operation with the national authorities in Ukraine, EBRD has commissioned a Strategic Environmental Review (SER) for the USELF programme, focusing on renewable energy technologies in optimal areas of Ukraine. The EBRD is also working with the National Electric Energy Regulatory Commission (NERC) of Ukraine to review legislation and the regulatory framework which currently applies to renewable energy in Ukraine, and make recommendations for improvements to further encourage and facilitate renewable energy development in the country.

The renewable energy technologies reviewed in this SER include small hydropower, on-shore wind, solar photovoltaic, biomass, and biogas technologies. The SER will comply with the EBRD's Environmental and Social Policy and its Public Information Policy.

A location map is provided showing the major cities, provinces (known as oblasts), infrastructure and major watercourses of Ukraine, see Figure 1-1 (note: all figures in this document are located at the end of their relevant section). Figure 1-2 shows the eight regional electrical systems within Ukraine – Central, Crimea, Dnipro, Donbass, Northern, Southern, Southwestern and Western – and the oblasts that are located within each; as well as the distribution of the differing capacity transmission lines, various power stations and substations across Ukraine.

1.2 Purpose and components of the Strategic Environmental Review

The purpose of the SER process is to review the key environmental issues associated with the implementation of specific renewable energy development projects on a national basis. When specific projects are proposed under USELF, a project-level environmental review will be required. The outcomes of the SER will help to focus the scope of site-specific environmental assessment studies and provide relevant guidance for subsequent environmental reviews of specific renewable energy projects within Ukraine. The USELF project-level environmental reviewers will use the SER to identify mitigation strategies and adapt them for implementation at the project level.

The SER has three main components:

1. A SER Environmental Report that evaluates the general effects of developing renewable energy projects on environmental resources, communities, and the economy and identifies strategies to avoid, minimise, and mitigate those effects while moving projects forward. The Environmental Report will be valuable to developers and their consultants, as well as evaluators of environmental and social effects because it identifies key receptors that could be vulnerable in specific areas, in part through identifying constraints and opportunities, but also by compiling information and identifying information sources.
2. Five "Renewable Energy in Ukraine" Technical Reports; covering On-shore wind, Small hydropower, Solar photovoltaic, Biomass and Biogas. These five reports are the technical basis and project scenarios upon which the ER is based. These reports are available on www.uselfser.com. These documents provide guidance to developers and their consultants, as well as technical evaluators of proposed renewable projects by identifying areas of good potential and the nature and scale of technologies that can be applied in different parts of the country.
3. A Stakeholder Engagement Plan (SEP) that guides how USELF and individual projects will address the gathering and use of public input on the SER documents. The SEP is available on www.uselfser.com. Throughout the SER process, the project team has conducted, and will continue to conduct, public consultation to seek existing information and stakeholder input on environmental effects and mitigation measures. The SEP is summarised along with consultation feedback to date in Section 5.

1.3 Purpose and structure of this SER Environmental Report

This SER Environmental Report documents the assessment of environmental effects that may result from projects implemented under the USELF renewable energy scenarios, and identifies strategies to avoid, minimise, and mitigate negative effects. The SER Environmental Report has largely used existing information to describe the environmental setting in Ukraine and to identify areas and natural resources that could be impacted by renewable energy development. This is summarised in Section 6 and discussed further in the SER Environmental Topic Paper (Appendix E). The USELF renewable energy scenarios are discussed in detail in the five renewable energy technical reports.

This SER Environmental Report has been developed in accordance with Directive 2001/42/EC of the European Parliament and the Council on the Assessment of the Effects of Certain Plans and Programmes on the Environment ("the EU SEA Directive") and good practice guides, including the UK's 'A Practical Guide to the Strategic Environmental Assessment (SEA) Directive' (Office of the Deputy Prime Minister (ODPM), 2005) (as detailed further in Section 2). Table 1-1 details the structure of the SER Environmental Report:

Table 1-1 Structure of this SER Environmental Report

Section	Description
1. Introduction	Explains the purpose of the USELF SER and the SER Environmental Report.
2. SER Approach	Describes the SER framework, how it aligns with the EU SEA Directive, the SER methodology, and the SER Objectives.
3. Energy Production in Ukraine	Summarises the current energy production in Ukraine, the transmission network, existing and potential renewable energy production, as well as the obstacles and benefits to implementing renewable technologies.
4. Assessment Scenarios	Summarises the five renewable energy scenarios that are being considered as part of the USELF SER – onshore wind, small-hydropower, solar photovoltaic, biomass and biogas.
5. SER Consultation	Provides an overview of consultation on the SER to date, a summary of the scope and timeframes for the Stakeholder Engagement Plan.
6. Policy Context and Baseline Environment	Summarises relevant plans, programmes and environmental protection and enhancement objectives, as well as the key baseline conditions for each of the environmental topics considered.
7. Spatial Constraints Analysis	The sensitivity of each environmental receptor to the various renewable energy scenarios is presented and mapped spatially where feasible.
8. Likely Significant Effects on the Environment and Mitigation Measures	Summarises the methodology for the assessment of significant effects, the findings of the assessment, as well as measures to avoid, minimise, and mitigate negative effects at the project level.
9. SER Objectives Compliance	Assessment of the individual and combined compliance of the USELF renewable energy scenarios against the SER Objectives.
10. Implementation	Summary of recommended mitigation measures, policies, further environmental studies, and permit requirements for USELF projects.
Appendices (supplied as individual documents separate to this environmental report and available from www.uself-ser.com)	Appendix A – Renewable Energy Scenarios Appendix B – Spatial Constraints Analysis Appendix C – Assessment of Likely Significant Effects Appendix D – SER Objectives Compliance Assessment Appendix E – SER Environmental Topic Paper
Other components of the SER also available at www.uself-ser.com	Renewable Energy in Ukraine Technical Reports: Biogas, Biomass, Small Hydro, Solar, and Wind; Stakeholder Engagement Plan.

1.4 Authors of the report

This SER Environmental Report, and the supporting assessments of renewable energy opportunities in Ukraine, has been prepared on behalf of USELF by Black & Veatch Ltd (B&V). B&V has been supported by Ecoline EA Centre, which has led stakeholder engagement, and EcoSocial Solutions, which has led the assessment of socio-economic effects.

Figure 1-1 Location map

Ukraine Sustainable Energy Lending Facility Strategic Environmental Review

Basemap

Legend

- City
- National Capital
- Oblasts / Regions
- Airport
- Primary road
- Railroads
- Intermittent stream
- Perennial stream
- Water body

N W E S

0 50 100
Kilometers
1 cm = 60 km

USELF Ukraine Sustainable Energy Lending Facility

BLACK & VEATCH Building a world of difference.

GeneralBasemap J.Steurer 12/22/10

Data source: ESRI

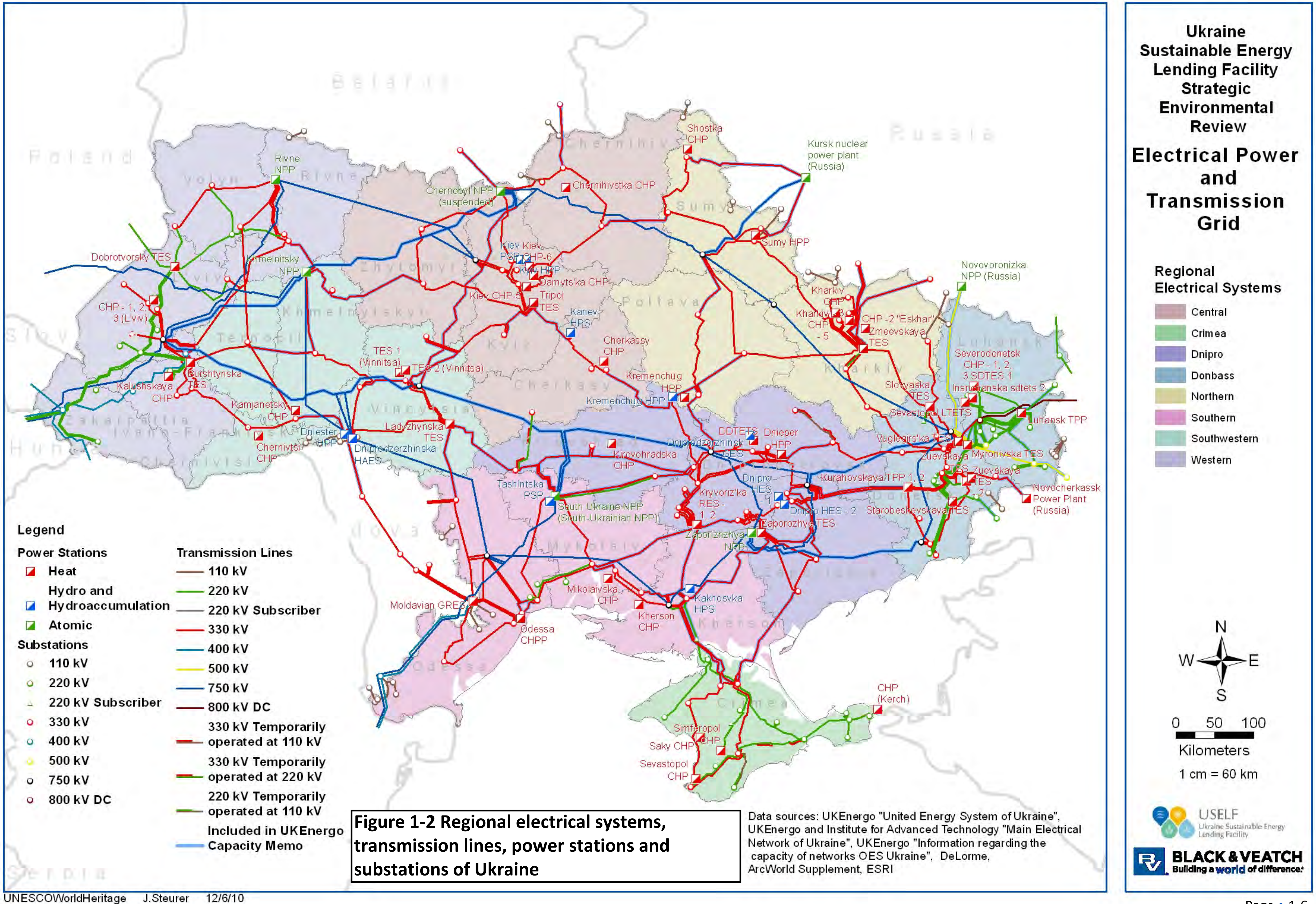

Figure 1-2 Regional electrical systems, transmission lines, power stations and substations of Ukraine

2 SER APPROACH

2.1 Scope and approach of the SER

2.1.1 Introduction

The SER has been guided by the European Union (EU) Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment (usually known as the SEA Directive) and the UK's Practical Guide to the SEA Directive (Office of the Deputy Prime Minister, 2005). Section 2.2 identifies how the SER aligns with the EU SEA Directive.

Building on standard SEA practice, the stages adopted for this SER are summarised below:

- **Stage A (Scoping)**: Setting the context and objectives, establishing the baseline, and defining the scope;
- **Stage B:** Developing and refining alternatives and assessing effects;
- **Stage C:** Preparing the SER Environmental Report;
- **Stage D:** Consulting on the draft plan or programme and the SER Environmental Report and,
- **Stage E**: Monitoring the effects and data gaps.

2.1.2 SER Stage A – Scoping

Stage A involved a scoping study to determine the scope of the USELF SER. A Scoping Report was published in February 2011 (www.uself-ser.com). The SER Scoping Report provided a framework for undertaking the USELF SER, and summarised the following:

1. The proposed SER process;
2. The renewable energy scenarios;
3. The SER stakeholder engagement process;
4. Other relevant plans, programmes, and environmental protection and enhancement objectives;
5. Key environmental conditions and issues; and,
6. The next stages in the SER process.

The Scoping Report was made publicly available for comment, to ensure that the proposed scope of the SER is acceptable to stakeholders, and to incorporate stakeholder concerns into the SER process where applicable.

2.1.3 SER Stage B – Assessing Environmental Effects

Stage B of the SER involves 'developing and refining alternatives and assessing effects'. As noted in Section 4, renewable energy scenarios have been developed and refined as part of the SER. The other main aspect of Stage B is to identify the 'likely significant effects' on the environment of the USELF renewable energy scenarios and their implementation. Further details on the steps that will be undertaken to complete the significance assessment process for the SER are provided in Section 8.1.

A first action in Stage B was to establish a greater knowledge of relevant policy information and baseline environmental conditions in Ukraine, to ensure a robust assessment of likely significant effects. The environmental topics considered in this SER Environmental Report include:

- Climate and Air Quality;
- Surface Water and Groundwater;
- Geology and Soils;
- Landscape and Biodiversity;
- Community and Socio-economics; and,
- Cultural Heritage.

An SER Environmental Topic Paper is a supporting document to this SER and has been produced to provide a more detailed version of the environmental baseline and policy information provided in the SER Scoping Report; this is provided in Appendix E. The SER Environmental Topic Paper provides details on the baseline conditions and relevant policies in Ukraine that need to be fully considered in undertaking the assessment of effects resulting from the renewable energy scenarios, including the sensitivity of each environmental receptor to the various renewable energy scenarios.

The criteria for determining the likely significant effects upon the environment principally relate to the nature of the effects from the renewable energy scenario. In determining the nature of effects, consideration has been given to the:

- probability, duration, frequency and reversibility of effects;
- potential for cumulative effects in relation to the future environmental baseline conditions and other policies, plans, programmes, and projects;
- potential for transboundary effects; and,
- predicted spatial extent and magnitude of a given effect.

Receptors are the key environmental features within each SER environmental topic, for example receptors for the water topic include: surface waters resources and quality, groundwater resources and quality, water resources, and flood risk.

An assessment of significance was made by reviewing the potential effects on each receptor against the above criteria. These assessments were based upon both quantitative and qualitative information, as well as expert judgement. The assessment considered location-specific and oblast-scale effects of each renewable energy scenario for the environmental topics where possible or applicable.

Mitigation measures to prevent, reduce, and/or offset significant effects were developed through the assessment process. The mitigation measures will be used to develop appropriate requirements at project level.

Each of the renewable energy resource scenarios was then assessed for compliance against the SER Objectives (the SER Objectives are listed in Section 2.3, and the assessment of compliance against the objectives is provided in Section 9), and then assessed against the SER Objectives in combination with each other to determine the potential for cumulative effects upon the environment. Where necessary, further mitigation has been developed to reduce any cumulative effects of the renewable energy scenario.

2.1.4 SER Stage C – Preparing the Draft Environmental Report

The main result of the SER process is this SER Environmental Report. The structure of the Environmental Report is laid out in Table 1-1.

2.1.5 SER Stage D – Consulting on the Draft Environmental Report

A Stakeholder Engagement Plan (SEP) maps out the strategies for engaging the various stakeholder groups and the public, by identifying key SER stakeholders, establishing communication methods, disclosing SER project information and, collecting comments and feedback. The SEP sets out how the Environmental Report will be consulted upon, including a series of written and face-to-face communication methods. Section 5 provides a summary of the processes and outcomes of stakeholder engagement as part of the SER process.

2.1.6 SER Stage E – Monitoring the Effects and Data Gaps

This stage involves monitoring the effects of the plan or programme, and identifying any data gaps. Section 10 identifies the key recommendations for environmental assessment and mitigation at a project level and recommendations for further audit or follow-up. These recommendations comprise the monitoring programme for this SER, appropriate for this level of assessment.

2.2 Alignment of the EU SEA Directive and the SER process

Ukraine does not presently have legislation or regulations that require the development of an SER for programmes such as the USELF. However, EBRD's Environmental and Social Policy (2008) requires compliance with both European Union directives and with national law for projects and programmes funded through EBRD. Therefore, the SER has been guided by the EU SEA Directive and the UK's Practical Guide to the SEA Directive (ODPM, 2005), as well as Ukrainian Laws governing OVNS (EIA) where appropriate.

It is important to note that it is not possible to define the locations and specific characteristics of the projects that will apply for funding to USELF. Consequently, the SER provides a high level overview of potential environmental effects, along with guidance for renewable energy development in Ukraine.

In European practice, five to ten year planning timeframes govern the revision of SEA findings and conclusions. In this way, uncertainties that have been identified in the SEA process can be clarified and minimised. SEAs are updated when the regional plans upon which the SEAs are undertaken are revised. Further information about SEA practice has been provided to stakeholders during the public consultation process, including case studies from the UK and Crimea.

Further information about this can be found in the presentations from the public consultation meetings, available at www.uself-ser.com.

Other sources of information available include the International Association for Impact Assessment (IAIA) (www.iaia.org); and the Institute of Environmental Management and Assessment (IEMA) (www.iema.net).

Annex I of the EU SEA Directive identifies a broad range of environmental and social topics that should be considered within an SEA. Therefore, it provides a benchmark for the scope of this SER. Table 2-1 shows how the topics in Annex I of the EU SEA Directive align with the six topics addressed within the USELF SER.

Table 2-1 EU SEA Directive environmental and social topics in the SER

SEA Directive Topic	Comparative USELF SER Scoping Report Section
Biodiversity	Landscape and biodiversity
Population	Community and socio-economics
Human health	Community and socio-economics
Flora and Fauna	Landscape and biodiversity
Soil	Geology and soils
Water	Surface water and groundwater
Air	Climate and air quality
Climatic Factors	Climate and air quality
Material assets	Community and socio-economics
Cultural heritage, including architectural and archaeological heritage	Cultural Heritage
Landscape	Landscape and biodiversity

As noted in Section 2.1.1, the SER comprises four stages, A, B, C and D. These stages are derived from the UK's Practical Guide to the SEA Directive, which breaks down the stages into sub-stages that mirror the requirements of the SEA Directive. Table 2-2 identifies in detail how this SER has complied with the various stages of the Practical Guide, and thereby align with the SEA Directive.

Table 2-2: Stages in SER process (based upon UK Practical Guide to the SEA Directive) and how they were undertaken in the USELF SER

SER Stages and Tasks	Purpose	USELF SER Outputs
Stage A: Setting the context and objectives, establishing the baseline and deciding the scope		
A1. Identifying other relevant plans, programmes, and environmental protection objectives.	To establish how the plan or programme is affected by outside factors, to suggest ideas for how any constraints can be addressed, and to help to identify SER Objectives.	Stage A tasks were largely undertaken during the Scoping stage of the USELF SER. Table 1.1 in the USELF Scoping Report sets out how these tasks were reported within the Scoping Report. During the Stages B-D, feedback received during the scoping consultation process was used to refine the information gathered during Scoping stages A1-A4. Further information is provided in Section 6.1 – 6.4.
A2. Collecting baseline information.	To provide an evidence base for environmental problems, prediction of effects, and monitoring; to help in the development of SER Objectives.	
A3. Identifying environmental problems.	To help focus the SER and streamline the subsequent stages, including baseline information analysis, setting of the SER Objectives, prediction of effects and monitoring.	
A4. Developing SER Objectives.	To provide a means by which the environmental performance of the plan or programme and alternatives can be assessed.	
A5. Consulting on the scope of SER.	To ensure that the SER covers the likely significant environmental effects of the plan or programme.	
Stage B: Developing and refining alternatives and assessing effects		
B1. Testing the plan or programme objectives against the SER Objectives.		
B2. Developing strategic alternatives.	To develop and refine strategic alternatives.	This process commenced as part of Stage A, with an evaluation of potential locations, feasible technologies, and operating conditions for the implementation of renewable energy scenarios (discussed in Section 4).
B3. Predicting the effects of the plan or programme, including alternatives.	To predict the significant environmental effects of the plan or programme and alternatives.	During Stage A, potentially significant issues associated with generic renewable energy scenarios were identified. During Stage B, the significance of environmental effects of the scenarios has been assessed fully in relation to each environmental topic. Where the risk of significant environmental effects has been identified, the implications for the SER Objectives have been considered. Further details of the SER assessment methodology and the likely significant effects on the environment are set out in Section 8. The performance of the renewable energy scenarios in relation to the SER Objectives is considered in Section 9.
B4. Evaluating the effects of the plan or programme,	To evaluate the predicted effects of the plan or programme and its alternatives and assist in the refinement of the plan or	At Scoping stage, potentially significant issues associated with generic renewable energy scenarios were identified. During the preparation of the

SER Stages and Tasks	Purpose	USELF SER Outputs
including alternatives.	programme.	SER, the significance of environmental effects of the scenarios has been assessed fully in relation to each environmental topic. Where the risk of significant environmental effects has been identified, the implications for the SER Objectives have been considered. Further details of the SER assessment methodology and the likely significant effects on the environment are in Section 8. The performance of the renewable energy scenarios in relation to the SER Objectives is considered in Section 9. The SER has identified potential measures to prevent, reduce and offset likely adverse effects. Measures identified are location or technology-specific where possible; where this is not possible, generic mitigation measures have been identified. Further details of mitigation and offsetting measures are in Section 8.4.
B5. Considering ways of mitigating adverse effects.	To ensure that adverse effects are identified and potential measures to *prevent, reduce, or as fully as possible, offset* those effects are considered.	
B6. Proposing measures to monitor the environmental effects of plan /programme implementation.	To detail the means by which the environmental performance of the plan or programme can be assessed.	Section 10 details high-level recommendations for elements of project level environmental assessments, including monitoring the environmental effects of the renewable energy scenarios under consideration.
Stage B tasks were completed and are reported in Stage C of the SER.		
Stage C: Preparing the Environmental Report		
C1. Preparing the Draft Environmental Report.	To present the predicted environmental effects of the plan or programme, including alternatives, in a form suitable for public consultation and use by decision-makers.	The structure and content of this SER Environmental Report has been agreed following consultation between the project team and representatives of the EBRD and is summarised in Section 1.3.
Stage D: Consulting on the draft plan or programme and the Environmental Report		
D1. Consulting the public and consultation bodies on the draft plan or programme and the Environmental Report.	To give stakeholders an opportunity to express their opinions on the findings of the Environmental Report and to use it as a reference point in commenting on the plan or programme. To gather more information through the opinions and concerns of the public.	The Draft SER Environmental Report will be issued for public consultation and feedback in accordance with the SEP, for example on the SER Objectives, key environmental issues, and cumulative effects etc.
D2. Assessing significant changes.	To ensure that the environmental implications of any significant changes to the draft plan or programme at this stage are assessed and taken into account.	Any significant changes that are made to the renewable energy scenarios arising from consultation will be taken into account within the Final SER Environmental Report.

2.3 USELF SER Objectives

'Objectives' are a recognised tool for describing, analysing, and comparing the environmental effects of alternative options. In this case, the SER Objectives will need to satisfy the overall aim of USELF; 'to provide development support and debt finance to renewable energy projects which meet required commercial, technical and environmental standards'.

SER Objectives have therefore been developed for each SER environmental topic: climate and air quality, surface water and groundwater, geology and soils, landscape and biodiversity, socio-economics and cultural heritage – see Tables 2-3 to 2-8. Scoping consultation helped to inform the development of the SER Objectives which have subsequently been refined through further stakeholder consultation and a review of baseline characteristics.

Table 2-3: SER Objectives for Climate and air quality

SER Topic	Does the proposed development of the renewable resource...
Climate and Air Quality	• Lead to reductions in greenhouse gases or progress toward Ukrainian greenhouse gas emission targets? • Minimise the risk of potential effect on air quality?

Table 2-4: SER Objectives for Surface water and groundwater

SER Topic	Does the proposed development of the renewable resource...
Surface Water and Groundwater	• Avoid adverse effects upon surface water and groundwater resource? • Minimise adverse effects upon fisheries, water quality, recreation, and commerce associated with rivers and lakes?

Table 2-5: SER Objectives for Geology and soils

SER Topic	Does the proposed development of the renewable resource...
Geology and Soils	• Minimise adverse effects upon soils? • Minimise adverse effects to land and infrastructure from erosion and from landslides in high slope areas? • Minimise the risk of potential mobilisation of anthropogenic contaminants during construction? • Avoid the removal of high value soils (Mollisols) from productive use?

Table 2-6: SER Objectives for Landscapes and biodiversity

SER Topic	Does the proposed development of the renewable resource...
Landscapes and Biodiversity	• Minimise the risk of potential effects on landscape character and visual amenity of the Ukrainian landscape? • Avoid adverse effects upon internationally designated nature conservation sites? • Avoid adverse effects upon nationally designated nature conservation sites? • Minimise adverse effects upon important habitats and species?

Table 2-7: SER Objectives for Community and socio-economics

SER Topic	Does the proposed development of the renewable resource...
Community and Socio-economics	• Minimise the involuntary economic or physical displacement of people? • Minimise adverse effects upon the health and well being of human communities? • Have the potential to contribute towards direct or indirect employment? • Minimise the risk of potential adverse effect on other sectors (conventional tourism, hunting, eco-tourism, etc.)? • Minimise adverse effects upon existing land uses such as agriculture and forestry? • Minimise adverse effects upon important material assets and infrastructure?

Table 2-8: SER Objectives for Cultural heritage

SER Topic	Does the proposed development of the renewable resource...
Cultural Heritage	• Avoid adverse effects upon Ukrainian and World Cultural Heritage sites? • Minimise adverse effects on unknown cultural heritage sites? • Minimise adverse effects on intangible cultural heritage?

2.4 Difficulties encountered in compiling information or carrying out the assessment

Difficulties encountered in compiling information for the SER and carrying out the assessment are described below, with further explanation provided in the SER Environmental Topic Paper (see Appendix E). Assumptions, limitations and uncertainty associated with determining the baseline environment are set out in Section 6.4 and the assumptions, limitations and uncertainty associated with determining the significant environmental effects are set out in Section 8.3. Section 10.5 indicates the type of specific project-oriented environmental studies that should be conducted for review of a renewable energy project funded by USELF.

3 ENERGY PRODUCTION IN UKRAINE

3.1 Current energy production in Ukraine

The "New Energy Strategy of Ukraine to 2030", which was approved by the Cabinet of Ministers in March 2006, set a goal of achieving 19% of primary energy supply[1] by 2030 from alternative and renewable energy sources.[2] One driver for setting this goal is to reduce the country's level of energy dependence on imported energy supply, such as oil, natural gas, and nuclear fuel. It is estimated that Ukraine imports about 55% of its primary energy supply. Ukraine's level of energy intensity per unit of GDP is 2.6 times higher than the world's average. This is mainly attributed to excessive consumption of energy resources per unit of product output.

While the 2030 goal covers all primary energy supply, for purposes of the USELF SER, the focus is only on renewable energy options for electricity production (power) and not on other energy sources.

According to the Energy Strategy of Ukraine to 2030, Ukraine's electricity consumption in 2005 was 176 900 GWh and is expected to increase to 395 100 GWh by 2030, more than doubling its demand in 25 years.

Overall, the majority of the power generation capacity (defined in terms of megawatts or "MW") in Ukraine is thermal power plants (64%). Nuclear power plants account for 26% of the capacity and large hydropower for another 9%. Renewable energy capacity (excluding large hydropower) consists of less than 1% of the current generation capacity in the country.

Ukraine currently has significant excess power production capacity, as power generation has dropped considerably following the dissolution of the Soviet Union. A significant amount of power generation capacity is centralised in the Dnipro and Donbass Electric Power Systems. Ukraine also exports electricity to neighbouring countries, though export volumes have been dropping over the past few years as the regional economy has declined. Its thermal plants have been operating well below historical load factors and there are plans to retire some of the less efficient units.

3.2 Energy transmission in Ukraine

In the mid-1990s, the Ukraine government re-structured the power sector to allow for competition between electricity producers. The ownership and management of the sector was split into generation assets, the transmission network, distribution assets, and the power market (Energorynok). The state transmission company, Ukrenergo, owns and operates the transmission grid, and is independent of the generation and distribution companies. Ukrenergo collaborates closely with the market operator, Energorynok, but the two entities are separate.

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[1] Primary energy supply refers to all forms of energy consumed in the country, including fuel for heating and transportation, as well as electricity generation.

[2] Alternative and renewable energy sources include off-balance energy sources, such as coal bed methane, as well as renewable energy sources. The Strategy identifies the most promising areas for alternative/renewable energy development in Ukraine are with biofuels, extraction and use of coal bed methane, use of secondary energy resources, off-grade fossil fuel deposits, wind and solar energy, thermal energy present in the environment, and economically viable development of hydropower generation capacity associated with small Ukrainian rivers.

Ukrenergo operates the central dispatch centre in Kyiv and the high-voltage transmission lines across Ukraine, and is also responsible for maintaining and upgrading those lines as necessary[3]. The national system is divided into eight regional electric power systems as follows:

- Central;
- Crimea;
- Dnipro;
- Donbass;
- Northern;
- Southern;
- Southwestern; and,
- Western.

Further details of the transmission system, are included in an appendix to the Technical Reports, titled 'Interconnection and Transmission Considerations in Renewable Energy Development in Ukraine'. A map showing the distribution network is provided above as Figure 1-2.

3.3 Renewable energy production in Ukraine

Historically, renewable energy development in Ukraine has been focused on large hydroelectric generation, with over 4 000 MW of conventional hydropower and 750 MW of pumped storage (an additional 650 MW of pumped storage is under construction). There are a number of small hydropower projects (<10 MW) in operation in the country that were built approximately 50-90 years ago. The Ukrainian Wind Energy Association reports that, as of December 31, 2011 the total on-shore wind installed capacity is 151.1 MW. The first biogas combined heat and power (CHP) project in Ukraine, utilising cow manure at the Ukraine Milk Company, came on-line in 2009 with 625 kW of power and 686 kW of thermal capacity. Aside from these projects, there are limited examples of other renewable energy power projects operating in Ukraine. Photographs of some example renewable energy schemes in Ukraine are provided below:

		
The Sutisky hydropower plant.	The Vinnysia hydropower facility and impoundment on the Buh River.	Donuzlovskaya on-shore wind farm, near the town of Novoozerne.

[3] "Ukraine Energy Policy Review 2006," International Energy Agency. 2006.

To support the goal of achieving 19% of primary energy supply from alternative and renewable energy sources by 2030, a Green Tariff for electricity generated from renewable energy sources was established by the National Electric Energy Regulatory Commission (NERC) in 2008 and was amended with higher prices in 2009.

Green tariffs are an important factor in alternative energy investment decision making. Nations seeking to incentivise renewable energy investment, such as European Union countries and Ukraine, have established higher electricity sales prices (and therefore revenues) for alternative energy power compared to traditional fossil fuel-based power. Green tariffs provide higher revenues for renewable energy power projects and assurance of a long-term revenue stream, which allow otherwise less-competitive projects to be more attractive to investors.

The Green Tariff in Ukraine is available to eligible projects until 2030, thus providing long term assurance to organisations that may wish to fund such projects. Projects that come on-line by 2014 will receive the full Green Tariff amount. The Green Tariff is reduced for facilities put into operation (or upgraded) after 2014, 2019 and 2024 by ten, twenty and thirty percent respectively from the 2009 prices. The types of renewable energy projects that are eligible and their associated rates are listed in Table 3-1.

Table 3-1: Minimum Green Tariffs and the latest Green Tariffs[4]

	Minimum Green Tariff (NERC Resolution 857)		**Green Tariff for Jan 2010 (NERC Resolution 1591)**
Type of Renewable Energy	**kopek/kWh (excl VAT)**	**€ct/kWh**	**kopek/kWh (excl VAT)***
On-shore wind farms (below 600kW)	70.15	6.46	
On-shore wind farms (above 600kW and below 2 000 kW)	81.84	7.54	
On-shore wind farms (above 2 000 kW)	122.77	11.31	129.71
Power plants on biomass	134.46	12.39	142.07
Solar photovoltaic modules on ground	505.09	46.53	
Solar photovoltaic modules on roofs (above 100kW)	484.05	44.59	
Solar photovoltaic modules on roofs (below 100kW)	463.00	42.65	
Small hydropower facilities (<10 MW)	84.18	7.75	88.94

**** Note:*** *Green Tariff resolutions issued by NERC are intended to set individual tariffs for each facility qualified for the Green Tariff. As an example, in January 2010, there were three categories of tariffs established – on-shore wind farms above 2 000 kW, small hydropower and biomass generators. All producers within a category get the same tariff, which must not be below the "minimum" tariff fixed by the NERC Resolution 857. The fixed minimum value of the green tariff shall be established by converting the rate of the green tariff into Euro calculated as of 1 January 2009 at the official exchange rate of the National Bank of Ukraine for the stated date.*

[4] Source: EBRD (2010) *Investment in Electricity Production from renewable Energy Sources in Ukraine: Developer's Handbook.* EBRD Pr ID 25329 / 909-489

Biogas and municipal landfill gas projects currently do not qualify for Green Tariff, but legislative changes to the green tariff criteria are being considered.

It is clear that Ukraine's new Green Tariff has attracted foreign investor interest despite the present financial downturn. According to Ukrenergo, over 14 000 MW of wind projects have been proposed with 1 150 MW having received technical requirements[5] from Ukrenergo. Table 3-2 shows the oblasts where interconnection to the national grid has been requested for on-shore wind projects. Furthermore, at least 300 MW of solar photovoltaic projects are being planned in Crimea. Not all of these proposed projects will progress fully through the development process to completion, but the sheer volume of proposals demonstrates the effectiveness of the green tariff.

Table 3-2: Total On-shore wind project interconnection requests by oblast[6]

Oblast	MW
Crimea	5 279
Donetsk	1 620
Zaporizhzhya	3 045
Kyiv	100
Lugansk	250
Mykolaiv	2 500
Odessa	900
Kherson	400
Total	**14 094**

3.4 Potential issues and benefits to implementing renewable technologies

An initial review of literature on renewable energy in Ukraine and of existing legislation supporting renewable energy has been carried out, and preliminary discussions have been held with stakeholders. Some common technical and economic issues and benefits have been identified:

General Renewable Energy:

- The Law of Ukraine on Amendments to Electricity Law No.1220-VI of 1 April 2009 (Green Tariff Law) states that electricity suppliers who carry out the transmission of electricity by means of their own electricity networks: 1) may not refuse renewable energy producers access to such networks; 2) should provide for the costs incurred by connecting renewable energy producers to their networks and NERC should include such costs in full when approving the submitted investment programmes (Art.24 Section 7). Currently developers experience problems in obtaining connections. This is mainly due to the restrictive implementation of network tariff methodologies, which do not allow,

[5] 'Technical requirements', as determined by the grid operator, typically include the specific technical solutions required for connection, the terms and conditions for connection, and the estimated cost. These requirements are developed after a feasibility study for connection of the project has been completed.
[6] Source: Ukrenergo, Black Sea Regional Transmission Planning Project, 2010

in practice, for network companies to recoup the investments needed for connecting renewable energy producers (EBRD, 2010). Therefore, developers are currently covering the cost of connection until they are able to recoup costs from transmission owners;
- Depending on the size of renewable energy projects, the cost to interconnect to the grid may be proportionally high relative to the cost of the project, resulting in some projects being economically non-viable;
- Stakeholders are concerned that there is insufficient compliance monitoring in place for projects that receive the Green Tariff, which may undermine the programme; and,
- It is challenging for small developers /projects to obtain the equity needed to qualify for USELF assistance.

On-shore wind projects:

- Though there are many wind projects in the transmission interconnection queue, it is unclear how many of the projects will proceed through to completion. Furthermore, potential transmission constraints resulting from high-penetration of wind development system-wide have not been studied by Ukrenergo; and,
- Stakeholders are concerned about the operation and reliability of the grid as on-shore wind development increases in the country.

Solar photovoltaic projects:

- Ukrainian solar panel manufacturers could benefit from the development of solar projects in the country; and,
- There is some concern with competing uses for arable land.

Small hydropower projects:

- In general, there is considered to be good potential for a large number of small hydropower developments in Ukraine; however, given the <10MW Green Tariff limit for small hydropower, the overall installed capacity would still be modest. There are no obvious technical obstacles (being availability of equipment, design and construction capability, the range of necessary data for design, etc) for small hydropower development in the country, but at this time the interest expressed at most levels is on larger projects; and,
- There is a state programme for small hydropower rehabilitation, which is targeted towards rehabilitation of the Soviet-era small hydropower (<1 MW) facilities. Small developers could potentially interact with this, and it may be possible for USELF to be linked to it.

Biogas projects:

- Currently, biogas projects do not qualify for the Green Tariff, so there is uncertainty regarding the economic viability of these projects. Changes to the biomass definition under the Green Tariff are being reviewed by the legislature, so it is possible biogas could be included in the future;

- To maximise the better economic benefits, biogas projects are often configured as CHP with relatively higher thermal energy production compared to electricity production. It is uncertain whether these projects would qualify for the USELF programme; and,
- Due to the size of these projects (usually less than 5 MW), the cost to interconnect to the grid may be proportionally high relative to the cost of the project.

Biomass projects:

- Biomass fuels have competing end uses (heating, export, biofuel production, power production, and fertiliser) which affect the cost and availability of the biomass material for electricity production in the long-term;
- There is significant potential in the agricultural sector to grow energy crops, but currently no subsidies available to promote it; and,
- Biomass fuels have the potential to be derived from non-sustainable sources.

4 ASSESSMENT SCENARIOS

4.1 Identifying the renewable energy scenarios

Stage B of the SER process required the identification and development of scenarios for renewable energy under the USELF programme (see Section 2.1). The SER Environmental Scoping Report identified areas with good potential for renewable energy development in Ukraine and a short-list of technologies likely to be deployed in the near-term under USELF or other programmes. The identification of a short-list is not intended to preclude or limit the future development of other renewable energy resources or technologies that have not been identified for review; the short-list is simply within the scope of this SER whilst others are outside of the scope.

In identifying the types of renewable energy resources and technologies to be assessed through the SER, projects that may apply or be eligible for the USELF programme were given special consideration. Since the lending facility seeks renewable energy projects that are technically and economically viable, similar parameters were taken into account in developing the list of technologies for the SER. Factors considered include that:

- Smaller projects are likely to apply to USELF due to its focus on smaller schemes (with the exception of on-shore wind which potentially includes larger-scale projects, see Table 4-1);
- Primary energy production must be electricity, rather than as thermal energy (space heating, hot water, etc.). Some thermal energy production is permitted, but cannot be the primary energy output[7];
- Projects should qualify for the Green Tariff under present or future legislation so there is a guaranteed revenue stream to support the project;
- To qualify for Green Tariff, projects must sell the electricity output to Energomarket, who is obligated to purchase all renewable energy not sold elsewhere at Green Tariff rates[8]. In order to sell to Energomarket, the project must be interconnected to the transmission grid[9];
- To be technically and economically viable in the near-term, projects are more likely to use available technologies with proven performance records in commercial application; and
- Projects are owned or primarily owned by private companies. Government entities are not eligible, except as partial owner only.

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[7] Cogeneration or CHP projects, where thermal energy production is the primary output and electricity production is secondary, are not the key focus of the USELF program.

[8] Energomarket is the Wholesale Buyer/ Wholesale Supplier of electricity in Ukraine and is a state enterprise. Projects under 20 MW are not obligated to sell to Energomarket, but Energomarket is required to purchase electricity from renewable energy projects at Green Tariff rates, which is typically higher than alternative avenues.

[9] To sell to Energomarket, generators must obtain a generation licence (issued by NERC), sign the Wholesale Electricity Market Members' Agreement – WEMMA (the multi-party contract which specifies the rules of trades and settlement), and sign an electricity purchase-sale agreement with Energomarket (template contract, approved by NERC).

Having initially defined the short-list of technologies, further study has been undertaken in order to:

- Define scenarios of renewable energy development that will form the basis of the SER 'assessment of effects' stage, including the technology characteristics and likely construction activities (as detailed Section 4.2); and,
- Identify geographic areas of good potential for renewable energy development given resource quality, geographical constraints, existing infrastructure, and transmission considerations (as detailed in Section 7).

4.2 Description of the renewable energy scenarios

4.2.1 Description Overview

Based upon current renewable energy opportunities in Ukraine and the USELF Programme considerations, five types of renewable energy resources have been reviewed as part of this SER. These have been termed 'scenarios' for the SER to distinguish them from specific projects. The five renewable energy scenarios are categorised as:

- On-shore wind;
- Small hydropower (<10 MW);
- Solar photovoltaic;
- Biomass:
  - using wood residues;
  - using agricultural residues;
- Biogas[10]:
  - using gas generated from municipal landfill sites; and,
  - using gas generated from animal manure.

The following technologies are **not** included in the SER because they are not currently listed as eligible types under the Green Tariff, and are not being considered for future inclusion under the Tariff:

- Concentrating solar thermal power;
- Geothermal power;
- Co-firing of biomass with conventional fuels; and,
- Incremental hydropower at existing facilities (increase in installed capacity).

Technologies that are in development stages or that are not commercially available on a wide-scale, such as biomass gasification, are not included in the SER because they are assumed to be less likely to be developed in the near-term. Furthermore, offshore wind is not included in the SER because of the availability of more cost-effective wind options on-shore that could be developed first. Additionally, the Green Tariff for wind is insufficient to support offshore wind projects in the near-term (for further details refer to the SER Environmental Scoping Report (www.uself-ser.com)).

[10] Although biogas projects currently do not qualify for the Green Tariff, they have been included within the SER because legislative changes to include them are being considered.

Scenarios for each of the five renewable energy resource types (including two resource types for both biomass and biogas) have been developed to provide a basis for impact assessment in the SER using through the following steps:

1. Identification of areas of Ukraine in which the resources can technically and realistically be utilised (based upon a high level assessment) and exclusion of certain locations from further consideration (for example, where the available resource is insufficient to support the viable development of a project, where there is insufficient demand from neighbouring oblasts and / or where the existing transmission network is insufficient to carry further load[11]);
2. Characterisation of typical projects. For example, in terms of likely size, footprint and technologies utilised; and,
3. Determination of special factors that would influence the scale, grouping of projects, or type of development in these areas.

The determination of the scale for each USELF renewable energy scenario takes into account the overall estimate of potential energy generation (MW) of the renewable energy resource under consideration that would practically be exploited by the types of project under the consideration of the USELF SER. This means that the scenario scale is based upon near-term renewable energy development and therefore has assumed that existing constraints (such as geographical constraints, transmission network considerations, demand, resource quality and resource availability) will limit the level of potential for the USELF scenarios. 'Technical exclusions' have been defined to eliminate certain areas from consideration for specific renewable energy scenarios, so that the focus is on only those areas that are suitable. Were further study to be undertaken into such constraints, with the aim of facilitating *further* potential for the renewable technologies under USELF, then it is realistic that the scale of the current scenarios may be expanded; however, this is not within the scope of this SER.

Table 4-1 provides an overview of the renewable energy technologies that comprise each of the renewable energy scenarios that are considered in this SER. A more detailed table of the scenarios is provided in Appendix A – covering technology characteristics and likely construction methodologies associated with each. Full details of each of the renewable energy scenarios are set out in a series of five technical reports on renewable energy for the USELF SER (www.uselfser.com).

[11] For further details refer to an appendix to the Technical Reports, titled 'Interconnection and Transmission Considerations in Renewable Energy Development in Ukraine'

Table 4-1 USELF renewable energy scenarios

Resource scenario	Resource characteristics	Grouped Technologies or "Projects"	Areas with good potential	Technical Exclusions	Scenario scale
On-shore wind	Wind resources with wind density above 300 W/m^2.	Comprised of modern wind turbines of 2.0-3.0 MW each. • Small farms (<20 MW or 7-10 turbines) • Medium farms (20-100 MW or 10-50 turbines) • Large farms (>100 MW or >50 turbines)	Crimea, Southern Coastal Ukraine, Donbass region (Luhansk, Donetsk), Western Ukraine- foothills of the Carpathians (Lviv and Ivano-Frankivsk) being best wind resources in Ukraine, and Central Ukraine (Dnieper River).	• Power density <300 W/m2 • Slope >20% • Urban Areas • Major Waterbodies	Total Wind-only Development Scenario is 14 400MW across country. Combined Wind and Solar Development Scenario is 13 300 MW of wind and 2 600 MW of solar across the country.
Small Hydro	River Flow and Existing Hydro Project Sites	Small hydropower (<10 MW of capacity)[12] • Small hydropower with Impoundment • Hydropower Retrofit/Rehab at retired/existing hydropower sites (presumed at existing impoundments)	Carpathian area (Dniester, Tissa River Basins) and Central Ukraine area (larger tributaries of Dnieper).	• Areas away from existing watercourses • Very low head[13] • Low to intermittent stream flow • Protected areas (such as parks and recreational areas)	Total potential is 50-100 MW in Carpathian region. Potential capacities in other parts of the Ukraine are unknown.
Solar photovoltaic	Solar Insolation for Optimal Tilt and Tracking PV	Utility-scale, ground-mounted projects. • Small (1-5 MW) • Medium (5-20 MW) • Large (>20 MW)	Southern Ukraine (Crimea and Odessa) has highest insolation, though Green Tariff may allow for projects to be economic in most areas in Ukraine (with the exception of the westernmost	• Low solar insulation areas • Slope >5% • Major Waterbodies • Forested land	Total Solar Only Development Scenario is 9 900 MW across country. Combined Wind and Solar Development Scenario is

[12] Small-hydropower projects are constrained by this Green Tariff capacity criteria.
[13] Definition of 'head': vertical height of the water measured from upstream of the turbine, for example a reservoir or river intake elevation, to the elevation of water downstream or below the turbine, such as the tailrace or receiving water body.

Resource scenario	Resource characteristics	Grouped Technologies or "Projects"	Areas with good potential	Technical Exclusions	Scenario scale
		Rooftop installations are not included in this resource scenario.	oblasts and mountainous terrain areas)		13 300 MW of wind and 2 600 MW of solar across the country.
Biomass [14]	Agricultural Residue (wheat, barley, straw, rapeseed straw, corn and sunflower)	Direct-fire in power-only or Combined Heat and Power (CHP) configurations. • Small Stoker CHP (<5 MW) • Stoker (20-50 MW) • Bubbling fluidised bed (20-50 MW) • Replacement boiler (50 MW)	Preliminary data shows good concentrations across most of Ukraine, and notably higher potential than wood residue.	Power generation will be competing with alternative uses for the biomass material, which will determine the availability and cost-effectiveness. For agricultural residue, additional competition for current uses of land application as fertiliser.	Total development potential of 1 114 MW for wood and agricultural residue combined across country.
	Wood Residue	Direct-fire in power-only or CHP configurations. • Small Stoker CHP (<5 MW) • Stoker (20-50 MW) • Bubbling fluidised bed (20-50 MW) Replacement boiler (50 MW)	Higher concentrations in northern Ukraine (Zhytomyr, Kyiv, and Chernihiv, and Zakarpattia).	No technical exclusions except that biomass fuels for power generation will be competing with alternative uses for the biomass material, which will determine the availability and cost-effectiveness of the fuel for power generation. Fuels should be sourced typically within 100km of site to be cost effective, or up to 300km away from high quality/very economic fuel	

[14] Co-firing biomass with non-renewable fuels does not qualify for Green Tariff.

Resource scenario	Resource characteristics	Grouped Technologies or "Projects"	Areas with good potential	Technical Exclusions	Scenario scale
				source.	
Biogas	Animal Manure	Anaerobic digester coupled with Internal Combustion Engine (ICE) (250 kW to 5 MW). Power only or CHP. Pending Green Tariff rule change to qualify biogas for tariff.	Where larger cattle, pig, and poultry farming operations exist. Higher density of animal population in north central and northwest part of country, as well as Dnepropetrovsk. Anaerobic digester may also have mixed wastes if different animal operations are in close proximity.	Less than 1 000 m3 of methane per day : Small to medium cattle operations (less than 2 000 head in one location) Small to medium sized pig operation (less than 6 000-8 000 head in one location). Small to medium sized poultry operation (less than 100 000 head in one location).	Total manure biogas potential is 160 MW across country.
	Landfill Gas (LFG)	Minimum size will be limited by available LFG at site. • Microturbines (30 – 250 kW) • Internal combustion engines (ICE) (500 kW– 3 MW) (most common) • Single-cycle gas turbines (>3 MW) Pending Green Tariff rule change to qualify LFG for tariff.	Landfills near high population centres with sufficient size.	Landfill sites that are too small for economic development are excluded. In general, LFG is more economically feasible at sites with >1 million tonnes waste, >10ha available for gas recovery, waste depth >12 meters and >60cm precipitation annually. -Landfills that cannot be capped or covered.	Total development scenario LFG potential is 48 MW across country.

Table 4-1 includes a short description of the main areas which show potential for the renewable energy scenarios under consideration. However, for a strategic-level review the most effective method of illustrating areas of potential for the different renewable energy scenarios is through the use of Geographical Information Systems (GIS). A series of figures have been produced, which are largely based upon GIS data-sources from organisations within Ukraine and international institutions[15]. In order to produce these figures, 'technical exclusions'[16] have been identified for the renewable energy scenarios. By defining these technical exclusions, certain areas are eliminated from consideration for specific renewable energy scenarios, so that the focus is on those areas that are suitable.

Indirect technical restrictions would arise from the proximity of the renewable energy project to seismic hazard areas. These areas have not been mapped in GIS, but are shown in Figure 3-16 of the SER Environmental Topic Paper (Appendix E). Depending upon the severity of seismic events and the nature of project facilities and operations, seismic events include interruption or shut down of electricity generation, which may reduce the overall capacity or supply of electricity to affected areas needing power to maintain critical infrastructure and respond to emergencies resulting from seismic events.

4.2.2 On-shore wind

This Section summarises areas with good on-shore wind resources (average wind power density) and associated transmission constraints that may limit overall development of projects in each region. Figure 4-1 depicts the wind resources and transmission infrastructure in Ukraine.

Mountainous terrain areas with steep slopes of greater than 20 degrees are considered technically challenging for development of on-shore wind and are shown in dark grey. These areas are found primarily in the Carpathian Mountains in western Ukraine and Crimean Mountains in southern Crimea. From the map, it is noted that the best wind resources in Ukraine are in the Carpathians, Crimea and southern coast of Ukraine, Donbass region, and windy areas along the Dniper River in Central Ukraine.

The regional development scenario represents the maximum development of wind in each region for SER assessment purposes. This assumes that no major transmission lines are developed. In total, this potential is similar to the level of proposed wind in the country. The regional development scenario is typically lower than the total development potential by oblast (as shown in Table 4-2) due to the regional transmission constraints or the regional load constraints. Most oblasts in Ukraine have excess generation capacity to export, and also have a large amount of transmission transfer capability with neighbouring oblasts. For oblasts with robust wind resources and large transfer capability, the primary constraint is the lack of demand within regional markets. In other regions, the limitation for on-shore wind development is the lack of good wind resource sites for development, or existing transmission constraints.

[15] For a list of GIS data sources utilized refer to the SER Environmental Scoping Report

[16] 'Technical exclusions' are geographical, topographical or meteorological limitations which limit the quality of a renewable resource or the viable development of that resource.

Table 4-2 Estimated maximum on-shore wind development

Regional Electric Power Systems	Oblast	Development Potential in Oblast (MW)	Regional Wind-Only Development Scenario (MW)	Regional Wind Development in Combined Wind and Solar Scenario (MW)
Central	Cherkasy	813	1 229	1 229
	Chernihiv	0		
	Kyiv	333		
	Zhytomyr	83		
Crimea	Crimea	2 839	2 839	2 129
Dnipro	Dnipropetrovsk	229	2 979	2 979
	Kirovohrad	646		
	Zaporizhia	2 104		
Donbass	Donetsk	1 521	3 526	3 526
	Luhansk	2 292		
Northern	Kharkiv	0	229	229
	Poltava	229		
	Sumy	0		
Southern	Kherson	1 979	1 281	961
	Mykolaiv	63		
	Odessa	833		
Southwestern	Chernivtsi	396	894	894
	Khmelnytskyi	250		
	Ternopil	3 149		
	Vinnytsia	0		
Western	Ivano-Frankivsk	3 878	1 408	1 408
	L'viv	12 083		
	Rivne	2 438		
	Volyn	0		
	Zakarpattia	0		
Total			**14 386**	**13 356**

In determining the best on-shore wind resources for development in Ukraine, the estimates by oblast include areas with wind power density of greater than 300 W per m^2 at 80m. This would result in projects that can be sustained with current green tariff prices. The capacity potential by oblast was further discounted based on the class of wind. Wind areas that are rated 300-350 (W/m2) are assumed to be 25% developable and wind areas that are rated >350 (W/m2) are assumed to be 50% developable. Thus, wind development could be much higher than shown in Table 4-2, but the constraints described were applied to limit the wind development in each region for purposes of SER review.

Since on-shore wind development in certain regions will be competing with solar development, Table 4-2 also shows the level of wind development if there is combined development of solar photovoltaic and on-shore wind. It is assumed there would be less development in certain regions due to competition with solar for transmission and load to serve.

As shown in Figure 4-1, Crimea is the most constrained transmission system due to the remote aspect of its electrical transmission grid. With approximately 2 500 MW of transmission export and import capacity, Crimea is limited, not by resource, but by transmission. The coastal region of Mykolaiv and Kherson are also transmission-constrained, but due to existing substation interconnection locations rather than due to existing transfer capability. If the power could be delivered along large distances at lower voltages to major substations, there would be adequate transmission to deliver the resources. This method, however, would incur heavy distribution losses.

The Western, Central, and Eastern regions of Ukraine have a strong transmission backbone running through them, with multiple opportunities for interconnection of wind resources, where these resources are available. The major constraint would be the regional load that can absorb the output for the region or the availability of resources. It is anticipated that there would be very little development in the Northern region of Ukraine.

Table 4-2 also estimates a combined on-shore wind and solar photovoltaic scenario, where on-shore wind development would be reduced if there is extensive solar photovoltaic development as well.

4.2.3 Small Hydropower

Economically and technically feasible small hydropower potential (<10 MW) in Ukraine is mainly in the Carpathian area (Dniester River Basin, Tissa River (tributary of the Dniester). Other regions have small hydropower potential that may be developable, for example in the Central Ukraine tributaries of the Dnieper River. Historically, there has been extensive development of both large and small scale hydropower, as well as pumped storage, in these major watersheds. However, there are still opportunities to develop new small hydropower facilities, as well as refurbishing/ rehabilitating disused or existing projects.

The existing hydropower projects are shown in Figure 4-2, along with major watershed areas. More specific areas and sites along these major tributaries with higher development potential still need to be identified and will depend on the level of information available. The high potential areas are also those with proximity to transmission lines and other upstream and downstream operating and planned hydropower projects. For purposes of the SER, it is assumed that the small hydro scenario consists of new hydro projects with impoundments and rehabilitation of existing facilities with impoundments. In select cases, there are micro hydropower projects (<0.1 MW) that do not utilise an impoundment structure. However, these projects are rare and are more economically feasible for on-site load and not for interconnection to the grid. Since the Ukrainian Green Tariff requires that projects be interconnected to the grid, these micro projects have been excluded from the small hydropower scenario.

4.2.4 Solar photovoltaic

There is limited solar photovoltaic development in Ukraine to date. With better resources, more output (higher capacity factors) are expected, so projects would be more economical. The Green Tariff for land-based solar photovoltaic projects is relatively generous and will likely support most utility-scale solar photovoltaic projects in the country. An initial exclusion for development includes areas with a slope greater than 5% where placement of solar facilities would not be optimal. These exclusions and the resource potential for solar photovoltaic power are shown in Figure 4.3.

There are many variations of solar photovoltaic technologies based on different types of solar cells (monocrystalline, polycrystalline, amorphous, thin film, etc.) and mounting structures (fixed tilt, tracking, etc.). From an environmental perspective, these variations are similar and, thus, treated generically as solar photovoltaic in this SER. Only utility-scale, ground-mounted projects greater than 1 MW are included. Smaller projects or projects on existing rooftops are not considered in the SER.

The better solar resources for solar photovoltaic development, based on solar insolation data in Ukraine, are located in Crimea and southern Ukraine[17]. Central and Eastern parts of Ukraine also have moderate solar resources for development, but economics, hilly/mountainous terrain and selection of technologies will need to be considered. In the western part of Ukraine, the combination of less favourable resources and more rugged terrain makes large utility-scale solar in this region challenging (see Table 4-3).

Crimea/Odessa:

Crimea and Odessa have similar solar resources and have large areas of relatively flat land for large-scale utility development. The southern portion of Crimea is mountainous and will likely not have the area of flat land required for 1+ MW solar photovoltaic installations. Similarly, north-western parts of Odessa are hilly, so development in southern Odessa is preferred. The greatest solar photovoltaic development potential is in these oblasts.

Eastern Ukraine:

The solar resources in this area are moderate. Development of solar photovoltaic projects in this area would need to be in relatively flat, contiguous areas. Since a part of eastern Ukraine is the agricultural centre of the country, development of solar photovoltaic projects may compete with land use for food production and pasture.

Central Ukraine:

Similar to eastern Ukraine, the solar resources in this area are moderate, but there are some opportunities, with the presence of flat, contiguous areas for large solar photovoltaic development.

Western Ukraine:

Opportunities for large-scale solar photovoltaic development are limited in western Ukraine oblasts such as Volyn, L'viv, Ivano-Frankivsk, Zakarpattia and Ternopil due to lower quality solar resource and the more rugged terrain.

[17] The potential of concentrated solar thermal power has also been evaluated, but the Direct Normal Insolation (DNI) in Ukraine was found to be insufficient for developing such projects economically. Furthermore, this type of technology does not qualify under the existing Green Tariff programme.

Table 4-3. Estimated maximum solar photovoltaic development

Regional Electric Power Systems	Oblast	Regional Solar-Only Development Scenario (MW)	Regional Solar Development Combined with Wind and Solar Scenario (MW)
Central	Cherkasy Chernihiv Kyiv Zhytomyr	1 800	571
Crimea	Crimea	2 839	710
Dnipro	Dnipropetrovsk Kirovohrad Zaporizhia	3 980	1 001
Donbass	Donetsk Luhansk	0	0
Northern	Kharkiv Poltava Sumy	0	0
Southern	Kherson Mykolaiv Odessa	1 281	320
Southwestern	Chernivtsi Khmelnytskyi Ternopil Vinnytsia	0	0
Western	Ivano-Frankivsk L'viv Rivne Volyn Zakarpattia	0	0
Total		**9 900**	**2 602**
Source: Black & Veatch analysis.			

4.2.5 Biomass

Areas of available wood residue[18] and agricultural residue[19] resources are identified in this Section. Estimates of maximum power capacity that the fuels can support are based on a representative biomass power plant. While there appears to be a significant amount of biomass potential from wood and agricultural waste, the quantities available for power generation are highly dependent on the cost of harvesting and transporting the fuel, as well as competing options for the use of the fuel. Ukraine is developing its biomass energy sector for a number of purposes including: heating fuel, export fuel, and power generation/cogeneration. Agricultural residue can also be used as fertiliser in fields and feed for animals. Therefore, biomass fuels for power generation will be competing with alternative uses for the biomass material, which will determine the availability and cost-effectiveness of the fuel for power generation.

[18] Wood residues include material of primary and secondary wood processing (and firewood) from cutting area.
[19] Agricultural residues include wheat, barley and other grains such as straw, rapeseed straw, and residues of corn and sunflower

The biomass renewable energy scenarios assume that all biomass fuel-sources will be managed in a sustainable manner and the SER excludes consideration of effects resulting from production of biomass fuel resources.

To manage transportation costs, the sources of the fuels should be in close proximity to the power plant, typically within 100 kilometres (km). The area covered by a 100 km radius approximates the area of many of the oblasts in Ukraine (although some are smaller or larger). Thus, the biomass potential is summarised by oblast in Table 4-4. When assessing the fuel availability for developing a project in a specific area, it is prudent to have about 3 to 4 times the fuel requirement available within a 100 km radius so there is assurance of sufficient fuel supply. Therefore, even if the total potential development capacity may appear high, the reasonable amount of power development of an oblast would be one-third or one-fourth of the potential estimated.

Table 4-4 Maximum biomass potential for power projects[20]

		Wood Biomass			Primary Agricultural Waste			Maximum Potential	Scenario
Electrical System	**Region**	**Mtce**	**PJ**	**MW***	**Mtce**	**PJ**	**MW***	**MW***	**MW****
Central	Cherkasy	0.04	1.1	10	0.90	26.4	253	263	66
	Chernihiv	0.12	3.7	35	0.45	13.2	127	162	40 (BR)
	Kyiv	0.17	4.9	47	0.61	17.9	172	219	55
	Zhytomyr	0.22	6.5	62	0.20	5.9	56	119	30
Crimea	Crimea	0.02	0.5	5	0.19	5.6	53	58	15 (CHP)
Dnipro	Dnipropetrovsk	0.02	0.6	6	1.21	35.5	340	346	87
	Kirovohrad	0.03	0.8	8	1.14	33.4	321	328	82
	Zaporizhia	0.01	0.3	3	0.90	26.4	253	256	64
Donbass	Donetsk	0.03	0.8	7	0.84	24.6	236	244	61 (BR)
	Luhansk	0.04	1.1	10	0.52	15.2	146	156	39 (BR)
Northern	Kharkiv	0.06	1.8	17	0.97	28.4	273	290	72
	Poltava	0.03	0.9	8	1.30	38.1	366	374	93
	Sumy	0.08	2.4	23	0.51	14.9	143	166	42
Southern	Kherson	0.03	0.9	9	0.59	17.3	166	175	44
	Mykolaiv	0.01	0.3	3	0.76	22.3	214	216	54 (BR)
	Odessa	0.02	0.5	5	0.88	25.8	247	253	63
South western	Chernivtsi	0.10	3.0	29	0.14	4.1	39	68	17 (CHP)
	Khmelnytskyi	0.04	1.2	11	0.40	11.7	112	124	31
	Ternopil	0.02	0.6	6	0.32	9.4	90	96	24
	Vinnytsia	0.07	2.1	20	0.91	26.7	256	276	69
Western	Ivano-Frankivsk	0.07	2.0	19	0.08	2.3	22	42	10(CHP)
	L'viv	0.12	3.5	34	0.12	3.5	34	67	17(CHP)
	Rivne	0.10	2.9	28	0.11	3.2	31	59	15 (CHP)
	Volyn	0.06	1.9	18	0.06	1.8	17	35	9 (CHP)
	Zakarpattia	0.17	5.1	49	0.07	2.1	20	68	17 (CHP)
Total		**1.67**	**49.1**	**471**	**14.18**	**415.6**	**3 987**	**4 458**	**1 114**

**Capacity potential estimate assumes power conversion factor 14 GJ/MWh and 85% capacity factor for plan operation*
***Potential scenario development potential assumes biomass fuel availability must be 3-4 times what is needed for a project to support the project.*
CHP = Combined Heat and Power Plants and BR = Boiler Replacements

[20] Source: IET, NAS, 2010. The Energy Potential of Biomass in Ukraine and B&V Calculations

Biomass (wood residues)

Based on analysis developed by the National Academy of Sciences (NAS) Ukraine, the estimated amount of economic wood residue potential by oblast can hypothetically support about 470 MW of biomass power generation. In that case, projects relying on wood residue alone may be able to develop smaller projects of about 20 MW in Zhytomyr and perhaps Zakarpattia. Some of the remaining oblasts, such as the Western, Southwestern, and Northern oblasts, may be able to support one or two 5 MW CHP projects per oblast, if fuelled by wood residue alone (see Table 4-4). As shown in Table 4-4, the oblasts which have the potential to support a 5 MW or greater CHP system (fuelled by wood residue alone) are: Chernihiv, Kyiv, Zhytomyr, Sumy, Chernivtsi, Vinnytsia, L'viv, Rivne and Zakarpattia. The remaining oblasts – including Crimea, the Dnipro oblasts, the Donbass oblasts, and the Southern oblasts – do not have sufficient wood residue fuel to support even a 5 MW CHP system. These areas would need to use blended biomass fuel that would consist of both wood residue and agricultural residue. The economic wood residue potential for biomass power generation, differentiated by oblast, is shown in Figure 4-4.

Biomass (agricultural residues)

The agricultural residue potential in Ukraine is substantially higher than available wood residue. However, agricultural residue, due to the variation of the sources of the material, can be challenging to use for power generation. Systems that utilise agricultural residue need to be properly designed to address the issues associated with handling and firing agricultural residue.

Like wood residue, it is more cost effective to obtain agricultural residues (as fuel) from within 100 km of the project location. Using the same metric as wood residue, where 3 to 4 times the fuel requirement should be available in a given area, Crimea and the Western oblasts would have very limited biomass fuel available for even a single 20 MW project per oblast, so CHP applications are preferred. The remaining oblasts could support one or two projects of 20-50 MW in capacity, but most of the projects would need to be designed to utilise large amounts of agricultural residue, since there would not be sufficient amount of wood residue alone. The economic agricultural residue potential for biomass power generation, differentiated by oblast, is shown in Figure 4.5.

4.2.6 Biogas

The two biogas project fuel sources examined are generated from the decomposition of organic waste in landfills and from the anaerobic digestion of animal manure.

Biogas (landfill)

Gas production at a landfill is primarily dependent on both the depth and the age of waste in place and the amount of precipitation received by the landfill. In general, municipal landfill gas (LFG) recovery may be economically feasible at sites that have more than one million tons of waste in place, more than ten hectares available for gas recovery, waste depth greater than 12 meters, and at least 60cm of precipitation annually. It is necessary for a landfill to be covered and to have a gas collection system in order to capture and utilise the methane. The life of an LFG resource is limited. After waste deliveries to a landfill cease and the landfill is capped, LFG production will decline. In Ukraine, 10 to 12 M tonnes of municipal solid waste (MSW) are generated every year[21], 95% of which is disposed in landfills. There are approximately 700 landfill sites in Ukraine, of which it has been estimated that only 100 have the potential for recovery and utilisation of the LFG generated.

For the USELF SER, 25 landfill sites have been investigated for power and heat conversion potential. These 25 sites are associated with 19 cities with high populations (as shown in Figure 4-6). These sites have been investigated as population is directly related to the amount of waste generation and amount of waste in place for LFG production (see Appendix A for further details). The capacity potential estimate is based on the waste in place data, but as indicated above, LFG production varies extensively depending on factors such as age of landfill, annual deposits, precipitation in the area, composition of landfill, depth of landfill, and collection system. Without modelling each landfill site separately, an approximation using waste in place is used to estimate the capacity potential of these sites. The total for these higher-probability landfill sites is about 48 MW, but individual capacity potential ranges from 600 kW to over 5 MW depending on the site. The sites identified as having potential for LFG production are shown in Figure 4-6.

Biogas (animal manure)

Manure, particularly from commercial dairy operations, provides substantial opportunity for biogas production in Ukraine. Dairy manure offers a consistent and reliable substrate with high-resource availability. Other sources of manure include pig and poultry farming operations. Manure creates stable process conditions and liquid slurry manure management systems can allow for ease of waste handling. In general, large dairy operations with high animal head counts represent the greatest potential as economies of scale greatly favour these operations. Facilities utilising concentrated animal feeding operations (CAFOs) may also capitalise on economic advantages associated with collection of manure. Co-digestion (utilising multiple substrates, for example animal manure mixed with food waste) offer opportunities for increasing biogas production.

Figures 4-7 to 4-9 depict the population of cows, pigs, and poultry by oblast in Ukraine. Areas of greater populations are more likely candidates for biogas development.

Based on the biogas production estimates developed (discussed in supporting documents), a minimum sized cattle operation would require about 1350 head of adult cattle to support daily methane production of 1 000 m3 per day. For pigs, the headcount would require about 3 400 in one location to support 1 000 m3 per day of biogas production. Poultry operations would need to have populations of over 68 000 poultry in a local area, though poultry litter can be transported more readily to a centralised location for processing. These would need to be industrial scale operations.

The maximum potential of all of the animal waste is equal to a total of 634 MW, which assumes 4 000 m^3 per day of biogas per MW of generation capacity. However, not all of this could be

[21] Matvee, Yuri, "Experience in the Implementation of LFG Projects. Prospects for Development," Institute of Engineering Thermophysicsof NASU, 6th International Conference on BIOMASS FOR ENERGY (September14-15, 2010)

realistically developed due to the economics of smaller farms. Unfortunately, there is no data available to assess the breakdown of farm sizes in Ukraine. As a conservative estimate, it is assumed that the maximum development is about 25% of the maximum potential, which is approximately 160 MW.

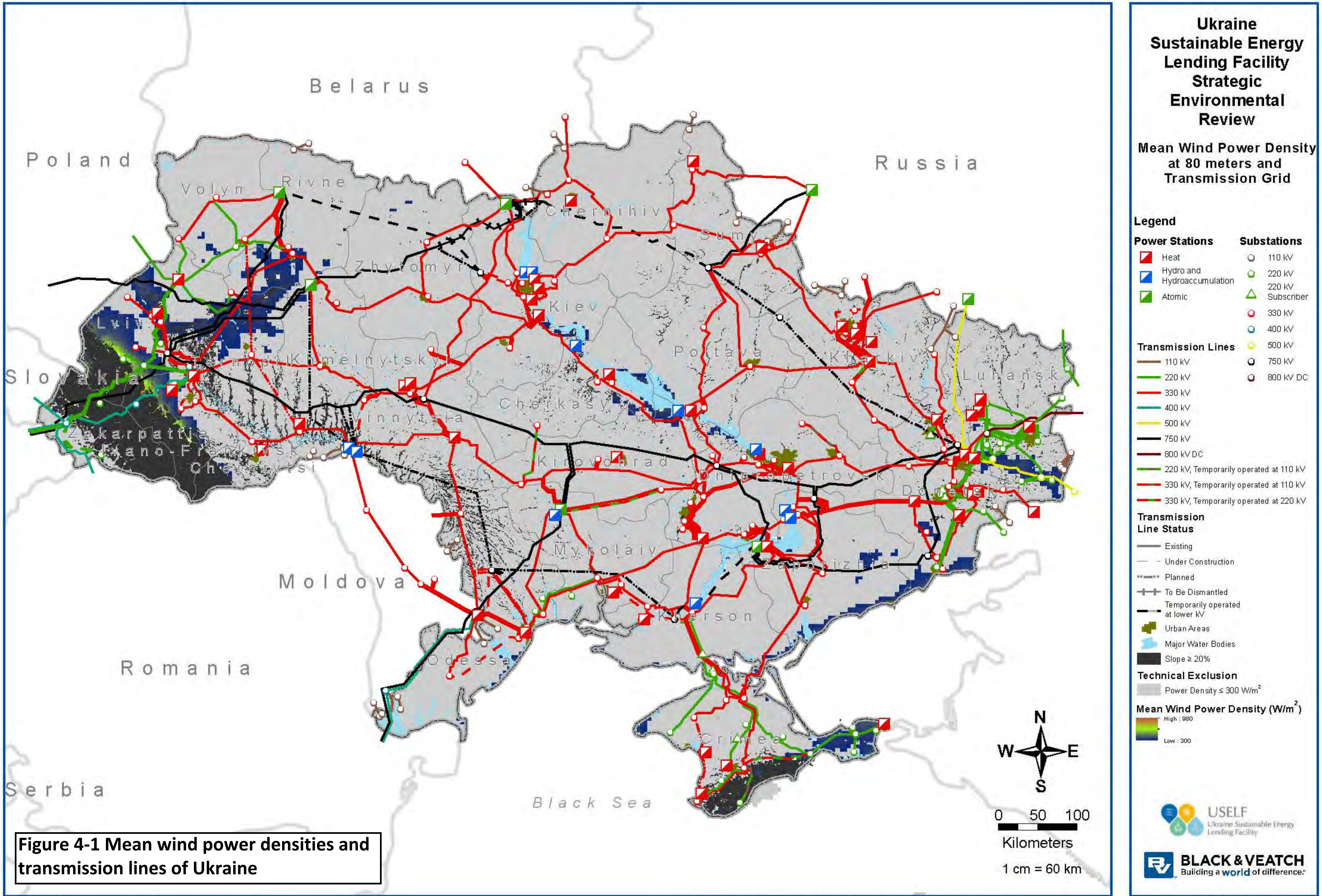


Figure 4-1 Mean wind power densities and transmission lines of Ukraine

WindResourceAndTransmission vX.mxd | C.Holmgren, J.Steurer | 3/1/2011

Sources: UKREnergo; 3Tier, International Centre for Tropical Agriculture (CIAT), DeLorme, ArcWorld Supplement, ESRI.

Figure 4-2 Existing hydropower projects in Ukraine and watershed areas

Hydro Resource vX.mxd | C.Holmgren | 9/13/2011

Data sources: UDI and EBRD Renewables Website; National Atlas of Ukraine; ESRI

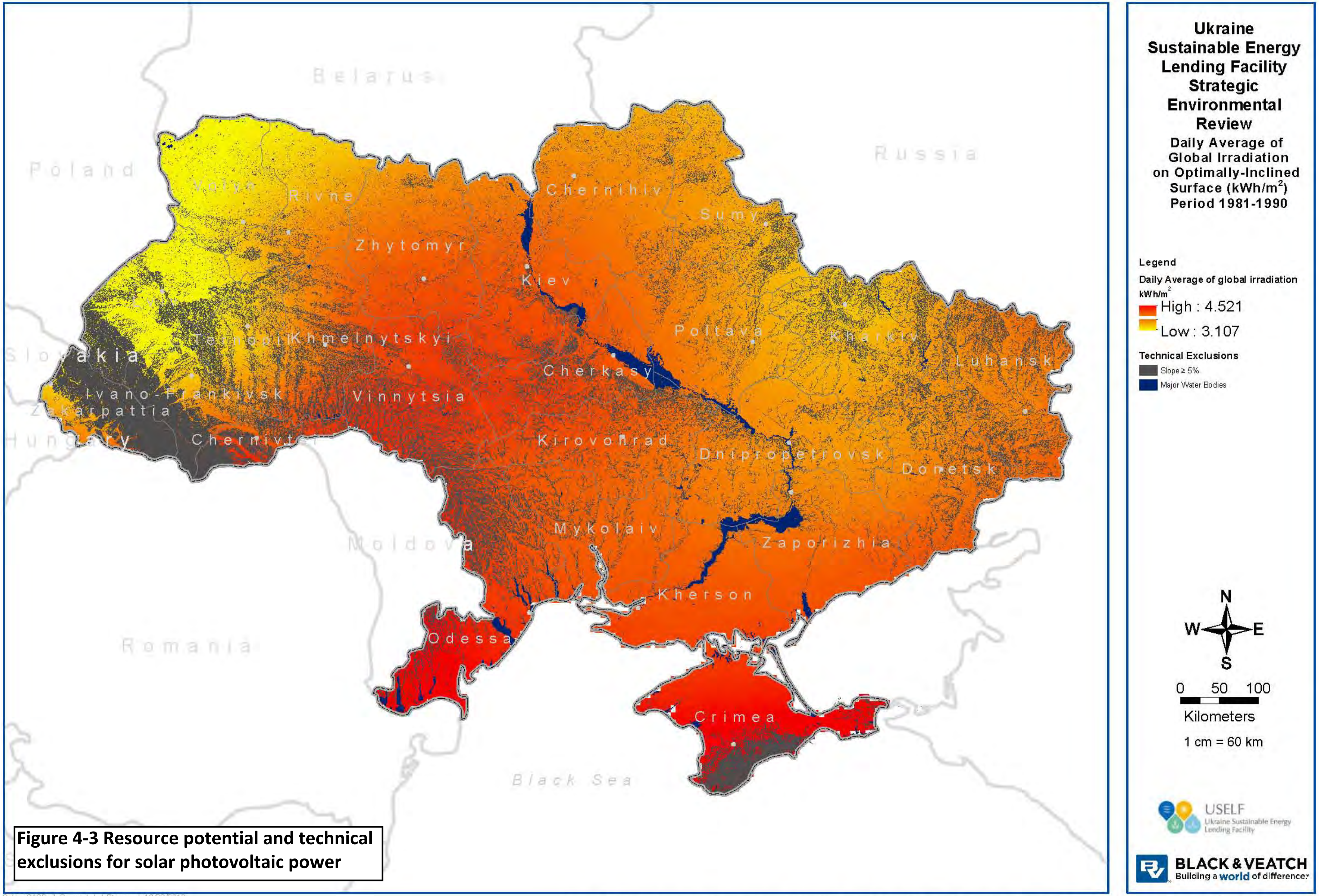


Figure 4-3 Resource potential and technical exclusions for solar photovoltaic power

Solar_G13DailyOp.mxd | J.Steurer | 12/28/2010

Sources: PVGIS © European Communities, 2001-2008, International Centre for Tropical Agriculture (CIAT), DeLorme, ArcWorld Supplement, ESRI

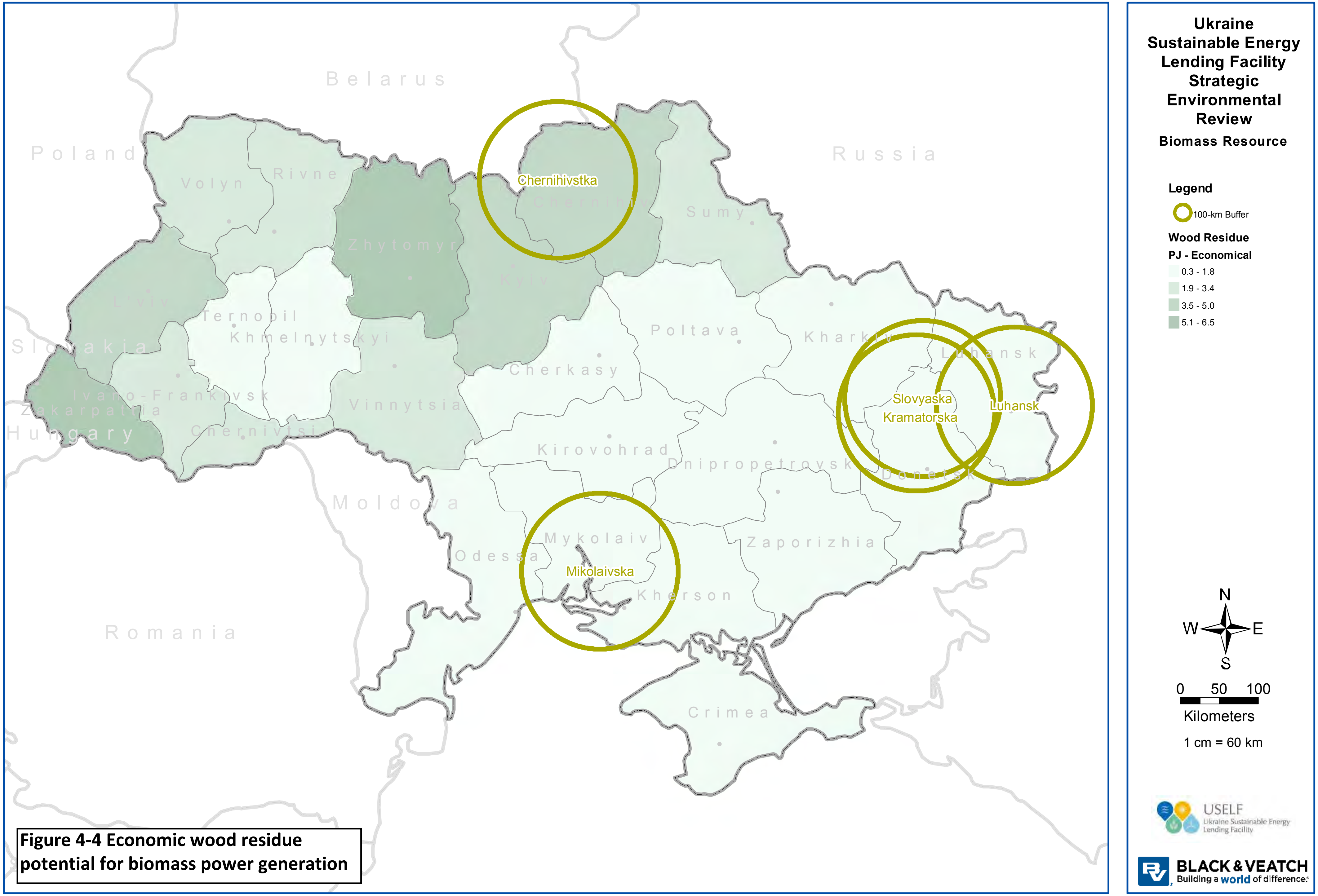
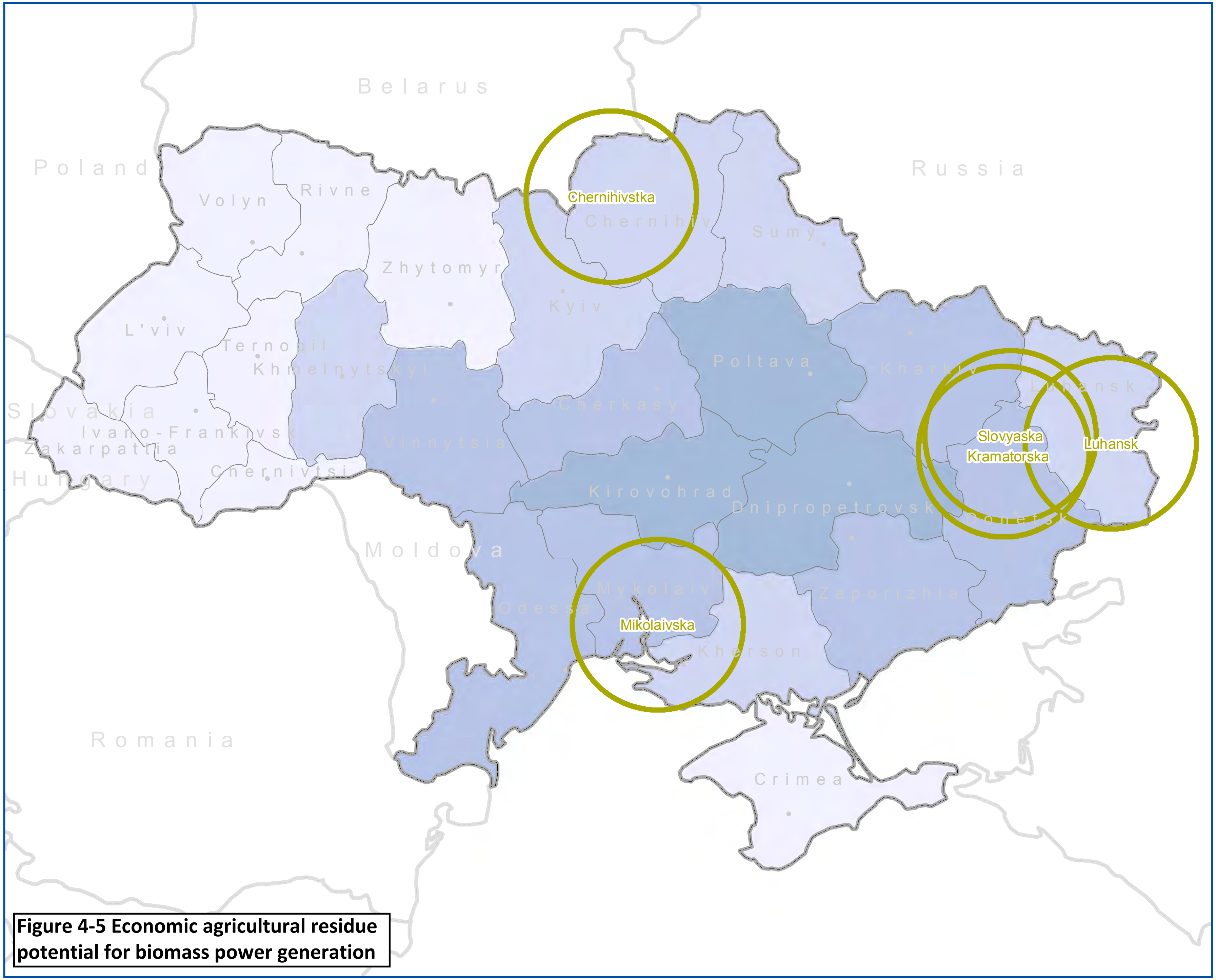


Figure 4-4 Economic wood residue potential for biomass power generation

BiomassResource_Wood | J.Steurer | 2/18/2011

Data source: ESRI; derived from Institute of Engineering Thermophysics, NASU, 2010. Assessment of biomass potential in Ukraine, Biomass Energy Europe Project. FP7.



Ukraine Sustainable Energy Lending Facility Strategic Environmental Review

Biomass Resource

Legend

100-km Buffer

Primary Agricultural Waste PJ - Economical

- 1.8 - 10.8
- 10.9 - 19.9
- 20.0 - 29.0
- 29.1 - 38.1

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Figure 4-5 Economic agricultural residue potential for biomass power generation

BiomassResource_AgWaste | J.Steurer | 2/18/2011

Data source: ESRI; derived from Institute of Engineering Thermophysics, NASU, 2010. Assessment of biomass potential in Ukraine, Biomass Energy Europe Project. FP7.

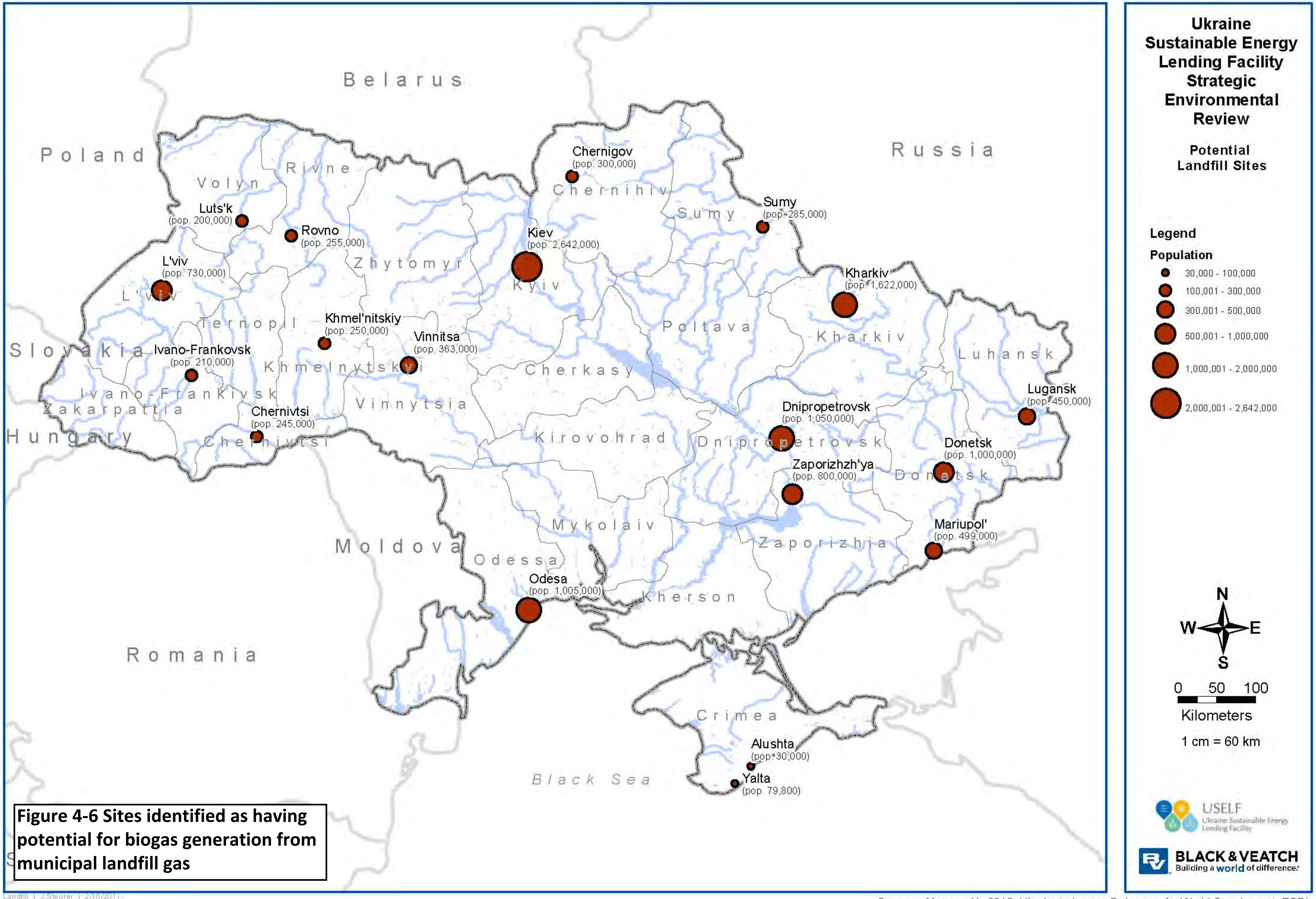


Figure 4-6 Sites identified as having potential for biogas generation from municipal landfill gas

Sources: Matveev,Y., 2010; Ukrainetrek.com; DeLorme; ArcWorld Supplement; ESRI.

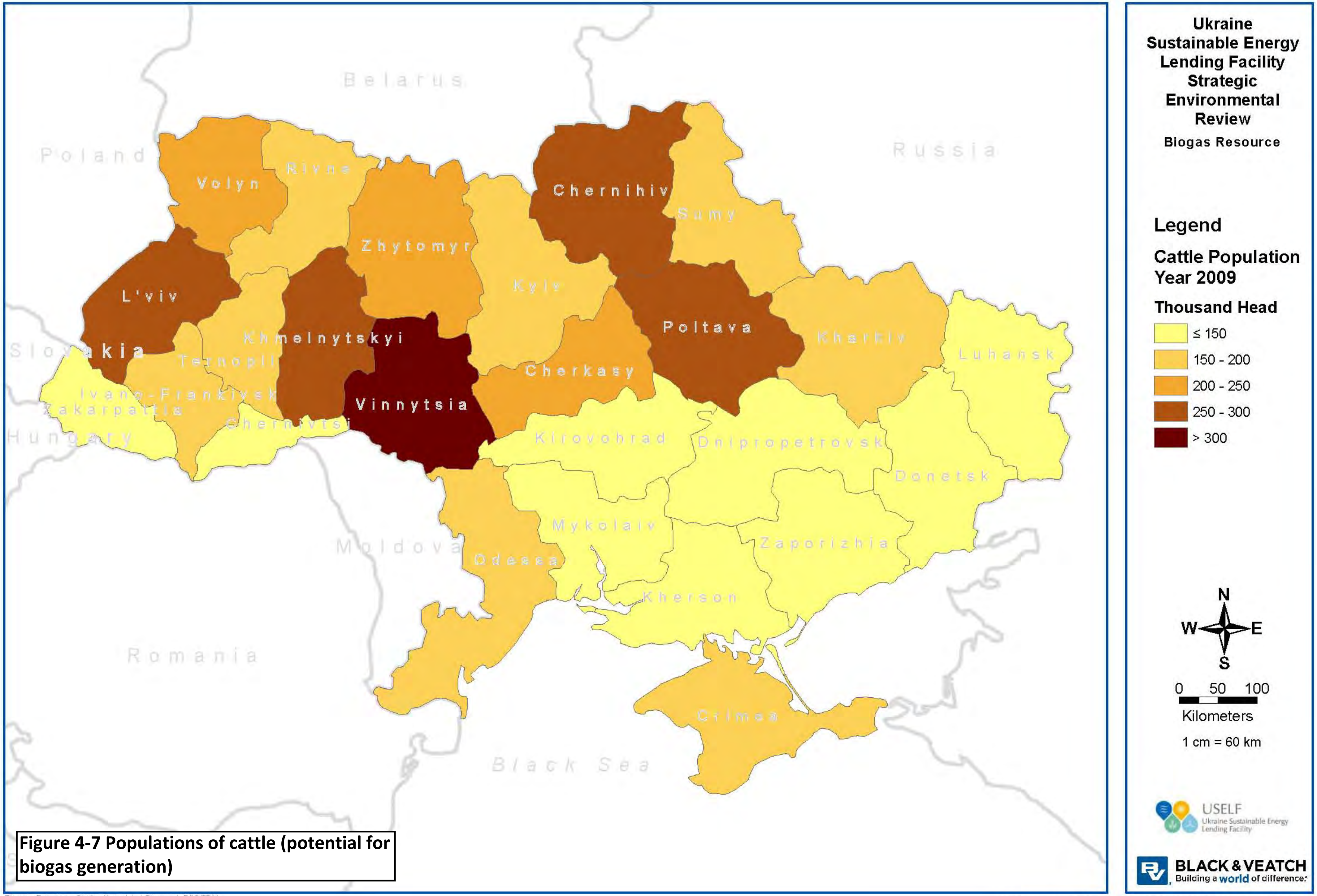
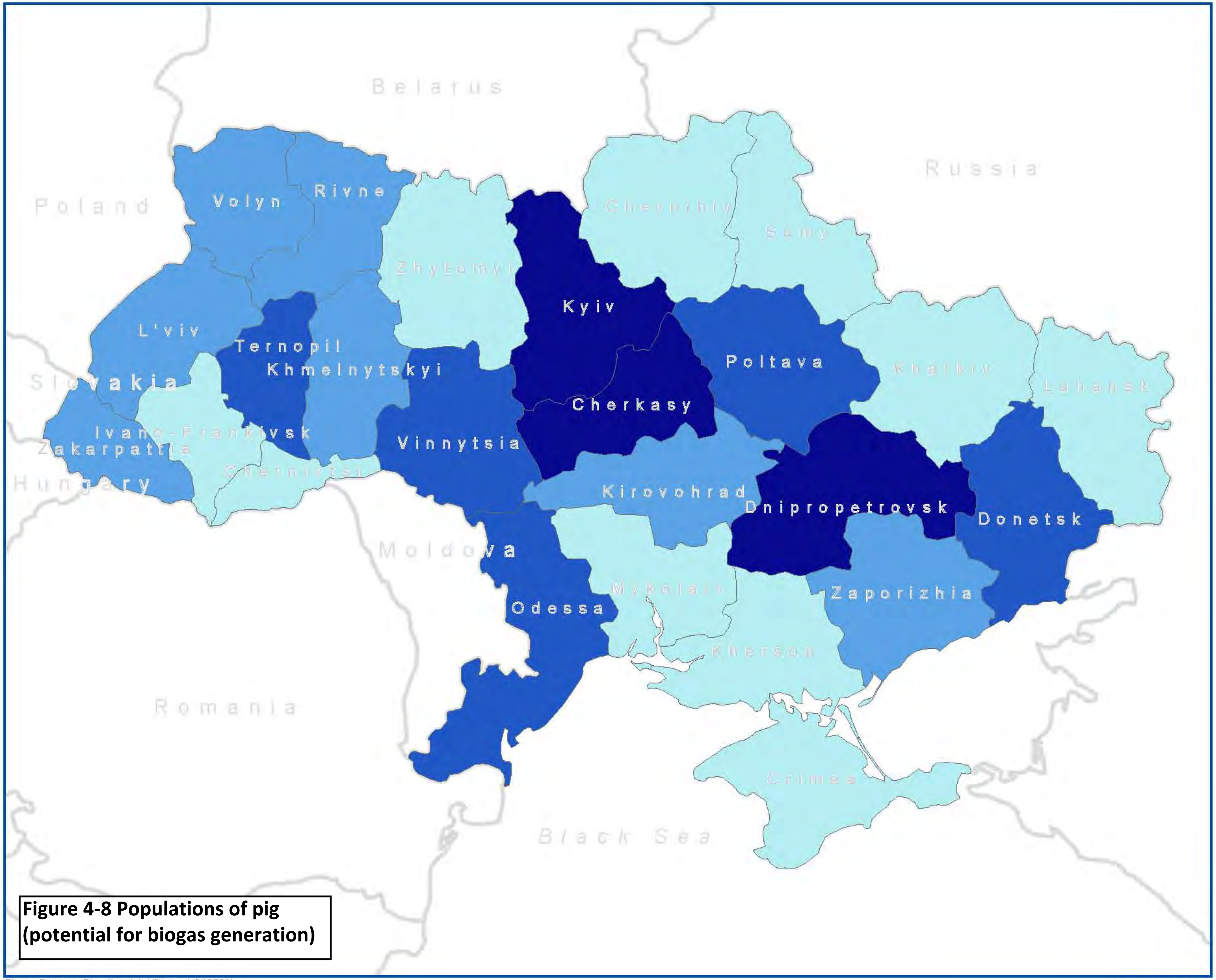


Figure 4-7 Populations of cattle (potential for biogas generation)

BiomassResource_Cattle vX.mxd | J.Steurer | 5/10/2011

Data source: ESRI; National Statistical Yearbook of Ukraine



Ukraine Sustainable Energy Lending Facility Strategic Environmental Review

Biogas Resource

Figure 4-8 Populations of pig (potential for biogas generation)

BiomassResource_Pigs vX mxd | J.Steurer | 5/10/2011

Data source: ESRI; National Statistical Yearbook of Ukraine

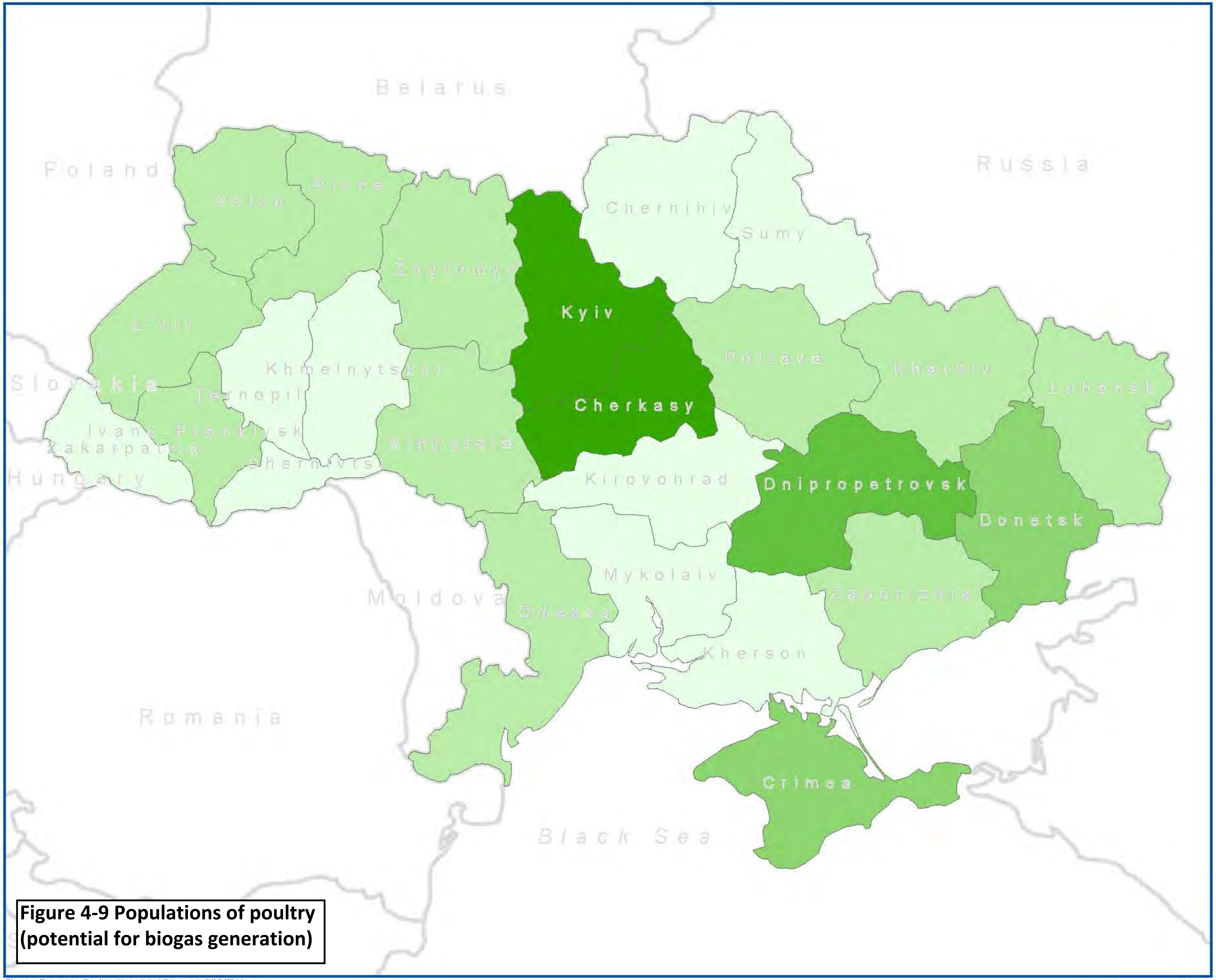


Figure 4-9 Populations of poultry (potential for biogas generation)

Ukraine Sustainable Energy Lending Facility Strategic Environmental Review

Biogas Resource

Legend

Poultry Population Year 2009

Thousand Head

- ≤ 5,000
- 5,000 - 10,000
- 10,000 - 15,000
- 15,000 - 20,000
- > 20,000

N W E S

0 50 100

Kilometers

1 cm = 60 km

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BiomassResource_PoultryvX.mxd | J.Steurer | 5/10/2011

Data source: ESRI; National Statistical Yearbook of Ukraine

5 SER CONSULTATION

5.1 Introduction

The SER has been developed in compliance with the EBRD's Environmental and Social Policy (2008) and its Public Information Policy (2008) as well as being guided by the EU SEA Directive. The stakeholder and public consultation process is specifically governed by EBRD's Environmental and Social Policy Performance Requirement 10 "Information Disclosure and Stakeholder Engagement" (PR10), which stipulates the requirements for information disclosure and stakeholder engagement.

In line with the requirements of PR10, a Stakeholder Engagement Plan (SEP) was developed, that set the scope and timescales for consultation throughout the SER from the earliest phases of the Scoping stage through to completion of the SER Environmental Report. The SEP document is available in Ukrainian and English at www.uself-ser.com.

Consultation has been undertaken with a range of stakeholder groups (including government ministries, renewable energy developers and non-governmental organisations) throughout the SER process, including meetings with 51 stakeholder groups at the SER Scoping stage.

Feedback from consultation has been useful in informing the draft SER document, which will be consulted upon for a period of 120 days.

5.2 Stakeholder consultations during Scoping

5.2.1 Introduction

The scoping consultation phase was carried out in two phases as follows:

- Preliminary Stakeholder Identification and Initial Consultation; and,
- Consultation on the USELF SER Scoping Report

The following Sections summarise the feedback received from stakeholders during these phases of consultation. Further details of the discussions held are included in the Draft SEP.

5.2.2 Stakeholder identification and initial consultations

A "Project Overview" flyer describing the USELF SER was circulated to key organisations in December 2010, along with a request for available data to inform the SER. The English-language version of the flyer is provided in the SER Environmental Scoping Report (available at www.uself-ser.com). The flyer was translated into Ukrainian and Russian.

Initial stakeholder consultations were undertaken from 22 November to 10 December 2010. The interviews, meetings, and consultations were performed by combined Black & Veatch and Ecoline EA Centre teams. All team members were engaged in the stakeholder meetings and interviews. In total, the team interviewed 51 stakeholders, including 12 stakeholders in Crimea and 11 in the western part of Ukraine (L'viv area). The Draft SEP contains a full list of stakeholders interviewed during initial consultation stage. Stakeholders were identified prior to the initial site visit, as well as via referrals during stakeholders' interviews.

The USELF SER stakeholders are represented by a number of groups, including central authorities, local and regional authorities, other regulators, NGOs, and academic institutions and organisations.

Several reoccurring topics were, explicitly or implicitly, discussed during most of the consultations. Comments on the political and technical obstacles and benefits of renewable energy are identified in Section 3.4. General comments, expectations and concerns in relation to the environmental and social issues surrounding renewable energy are summarised below.

General comments about USELF programme and USELF SER:

- In general, comments and attitudes towards renewable energy sources were positive;
- It will be necessary to take the interest of local communities into account when developing projects supported by USELF; and
- A systematic approach towards regional planning is needed to facilitate renewable energy projects in Ukraine.

Expressed expectations:

- Capacity building[22] and targeted information dissemination on EBRD procedures, practices, requirements is needed;
- Renewable energy projects could serve as focal points for underdeveloped rural or small urban areas;
- Projects supported by USELF might (indirectly) facilitate technological development; and
- The SER materials and reports should be made available to the professional community.

Expressed concerns:

- Possible negative environmental effects of renewable projects were raised, specifically:
  1. Wind projects: birds, bats, insects, local infrastructure (access), protected areas, noise;
  2. Small hydropower: fish migration and spawning, increased sedimentation;
  3. Biomass/biofuel: air pollution, loss of soil fertility, changes in vegetation type;
  4. Indirect and cumulative effects that are not covered by national procedures;
- Projects that fall under USELF criteria might not be economically feasible;
- Local investors (small and medium Ukrainian businesses) do not have sufficient funds to invest into renewable energy projects.

Expressed opinions:

[22] Capacity building refers to assistance that is provided to developing countries, which have a need to develop a certain skill or competence.

- Biogas is not included in the Green Tariff, which is seen as a disadvantage of the current regulatory system; otherwise, the regulations for renewable energy in Ukraine are well developed;
- It is necessary to support national production of equipment for the projects using renewable energy;
- Generation of electricity from renewable sources for on-site consumption has very big potential and it is unfortunate that it is not supported by Green Tariff;
- The current market situation is favourable towards renewable energy projects;
- The SEA process in general is potentially a very useful instrument for Ukraine;
- National grid connection is one of the biggest problems for all energy projects, including renewable energy schemes;
- Ukraine does not have, and will likely not have, deficit in electrical power in the near future, however, there is a deficit in heat availability.
- Renewable energy shall be developed according to Germany's or the United States' policies (the state buys the electricity produced on-site using Green Tariff and sells it back to the population at regular prices); and
- The national OVNS (assessment of effects on the environment) system provides for adequate level of environmental protection during construction and operation stages of renewable energy projects, but has certain limitations.

In general, almost all stakeholders expressed their interest in the USELF SER, as well as a willingness to participate in further stages of the stakeholder engagement process, and confirmed that they would like to receive project updates and other project-related materials.

5.2.3 Consultations on SER Scoping Study Report

The SER Environmental Scoping Report was published on the USELF SER website in April 2011, at www.uself-ser.com.

During the period of March-June, 2011, Ecoline EA Centre and Black & Veatch performed the second round of stakeholder consultations to present and discuss the Scoping Report that was prepared as a part of SER process. During these consultations, the stakeholders were asked to express their opinions and to submit their recommendations, comments and remarks on the Scoping Report.

The second round of stakeholder consultations involved telephone interviews and/or electronic communications to collect written comments and feedback. In addition to these communication methods, meetings have been organised and a public meeting was held with NGOs in Kyiv on 16th May 2011. Further, in cooperation with the USELF Technical Assistance Group comprising Fichtner, Imepower Consulting and Dewey & Le Boeuf, two additional public meetings were scheduled for late May-early June in the cities of Donetsk and Kherson. Additional comments and feedback are further expected from USELF SER stakeholder groups.

A total of 135 representatives of various stakeholder groups were informed of the publication of the SER Scoping Report, of which 48 representatives were interviewed. The initial list of stakeholders identified as a result of the preliminary stakeholder analysis has been expanded and amended to ensure that there is a sufficient focus on priority areas for of renewable energy development identified within the USELF Programme (in particular western Ukraine, Black Sea Region and Dnipro Basin). Special focus has been placed on the representatives of local authorities, manufacturers, developers and consultancies involved in the development/implementation of renewable energy projects in Ukraine.

A summary of the feedback received from stakeholders during the consultation on the Scoping Report is shown in the Draft SEP; along with explanations of how these comments have been dealt with as part of the SER. The table describes the stakeholder feedback and comments on the Scoping Report received through telephone interviews and in the form of written comments. The complete list of stakeholders that were contacted during scoping consultations on the Environmental Scoping Report is presented in the SEP.

Some issues of concern that have emerged from the scoping consultations on the Scoping Report appear to be common for all stakeholders. For example, many stakeholders expressed concerns over a great deal of bureaucracy involved in the licensing procedure under the Green Tariff. This causes indefinite delays in the project implementation process and exacerbates project risks. Also, many respondents shared a common opinion that bio-ethanol production projects should be also considered under USELF.

More detailed description of feedback received during the interviews is provided below.

General comments:

- In general, the Scoping Report is characterised as being of a high quality, and is a complete and professional document;
- The proposed SER scope and methodology are considered to be adequate to meet the objectives and goals of a high level SEA;
- It was noted that stakeholder views and opinions expressed during the previous stages in the consultation process have been taken into account;
- Interviewees have repeatedly emphasised the relevance and urgency of effort taken to support the development of renewable energy in Ukraine, especially in the context of the 25th anniversary of the Chernobyl disaster and recent accidents at the nuclear power plant in Japan.

Comments provided as recommendations for consideration in the SER:

- Add details of wind mills' that were in operation on the small rivers in the Western Ukraine (Styr, Zakhidny Buh, Horyn, Seret, Ikva, etc) until 1939.
- Amend the report by providing a comparative analysis of renewable energy equipment (batteries, generators etc.) manufactured by the Ukrainian and foreign companies;
- Update the legislative review to incorporate the most recent documents enacted in late 2010 to early 2011;

- Include the description of relationship/interaction with entrepreneurial entities in Ukraine;
- Update the list of stakeholders to include specific engineering companies working in the renewable energy field;
- Include a brief overview of regional programmes of action toward reducing emissions of pollutants and greenhouse gases.

5.3 Stakeholder Engagement Plan (SEP)

The primary objective of the SEP is to map out the strategy for engaging the various stakeholder groups and public in the activities of the USELF SER. The SEP will identify and describe key USELF SER stakeholders, public and other interested groups. It will also summarise the process of how consultation will work, how feedback and comments will be taken into account and how any grievances will be handled.

The USELF SEP has been developed to meet the standards and requirements of EBRD Environmental and Social Policy of 2008, including the requirements specified in EBRD Guidance Note on Stakeholder Engagement Plan (2009).

The applicable regulations and requirements for stakeholder engagement and public consultations are described at the front of the SEP document. In the following chapters, the SEP summarises previous and on-going stakeholder engagement and public consultation activities; identifies USELF SER stakeholders and describes communication methods with them; describes stakeholder engagement program and disclosure of information; describes roles and responsibilities for handling the SER consultation and information disclosure process; and defines a grievance mechanism by which feedback, comments, concerns and complaints may be communicated to SER developers and how these grievances and comments will be handled.

5.4 Stakeholder consultations during main SER

Stakeholder consultation has been ongoing throughout the main SER. It is expected that a formal 120-day USELF Draft SER report consultation period will start in November 2011. For the three month period of consultations, the following information will be available to the stakeholders and general public:

- USELF SER Draft Environmental Report (English and Ukrainian versions) published on the USELF SER website at www.uself-ser.com, or per individual request on a CD.
- USELF SER Technical Reports on Biomass, Solar, Small Hydro and Wind Potential and Renewable Energy Scenario Development in Ukraine (English and Ukrainian versions) published on the USELF SER website at www.uself-ser.com, or per individual request on a CD.
- USELF SER Environmental topic paper (English and Ukrainian) will also be publically available through the USELF SER website at www.uself-ser.com, or by an individual request on a CD.

- USELF Stakeholder Engagement Plan (SEP), which will also be publically available through the USELF SER website at www.uself-ser.com, or by a request on a CD. SEP will be available in English and Ukrainian.
- An updated USELF SER booklet, describing the SER process, its purpose, practical application and main outcomes (available in Ukrainian and Russian). The booklet will be distributed among key stakeholders electronically via email. It will also be available through the USELF SER website at www.uself-ser.com.

A range of communication methods will be employed during the USELF Draft SER reports consultations including:

- Publication of the USELF SER Draft Environmental Report, USELF SER Environmental topic paper, USELF SER Technical Reports and USELF SEP in Ukrainian and English at the USELF SER website: www.uself-ser.com;
- As noted earlier, CD copies of USELF SER documents will be available on individual request;
- Hard copies and CDs with documents will be available in target regions;
- Regional meetings with stakeholders (open room meetings);
- Technical workshops;
- Announcements in national and regional mass-media;
- Official correspondence with authorities; and,
- Email and phone communication.

Table 5-1 provides the key elements of the USELF SER stakeholder engagement and consultation programme.

Table 5-1: The USELF SER consultation process

Events/Activities	***Tasks***	***Information for disclosure***	***Timeframe***
1. Scoping stage (December, 2010-May, 2011)			
1.1.Individual consultations with identified key stakeholders (Annex A)	Gathering baseline information; presenting SER process	Initial USELF SER flyer (in English and Ukrainian)	December, 2010
1.2. Posting draft SER Scoping Report on the Internet and establishing interactive web-site communications	Presenting the document to public for discussion and comments	Draft SER Scoping Report (in English and Ukrainian)	February, 2011
1.3. Phone/email/mail correspondence with key stakeholders	Gathering feedback on SER Scoping Report from the stakeholders	Draft SER Scoping Report (in English and Ukrainian)	April – May 2011
1.4. Capacity building workshop in cooperation	Building dialogue capacity for USELF and its	Draft SER Scoping Report; hand-out materials (in Ukrainian)	June 2011

Events/Activities	*Tasks*	*Information for disclosure*	*Timeframe*
with USELF	applicants and local experts; introduction of SER approach		
1.5. Regional meeting in Odesa and NGO roundtable in Kyiv	Presentation of Draft SER Scoping Report	Draft SER Scoping Report (jn Ukrainian)	May, 2011
1.6. Capacity building workshop for USELF current and potential applicants	Increase awareness and facilitate capacity-building on SER outcomes application for the individual projects	Draft SER Scoping report, SEP	June 23, 2011
2. Second stage: Consultation on the USELF Draft SER report (November, 2011 - January, 2012)			
2.1.*Preparation for public information campaign*	Presentation of a SER process and outcomes	• USELF SER Environmental Report in Ukrainian • USELF SER Environmental Topic paper in Ukrainian • USELF SER Technical Reports in Ukrainian • Updated SER information booklet with outcomes	October–November, 2011
2.1.1. Release of Draft SER documents in Ukrainian	Translating SER documents into Ukrainian	• USELF SER Environmental Report in Ukrainian • USELF SER Environmental Topic paper in Ukrainian • USELF SER Technical Reports in Ukrainian	November, 2011
2.1.2. USELF SER information booklet distribution among stakeholders	Drafting the information booklet and presenting the SER process and outcomes	Updated SER information booklet. The booklet defines the purpose of the USELF SER, practical application of SER, major outcomes of SER	Booklet release: November, 2011 Distribution period: November, 2011 – December, 2012
2.1.3. USELF SER and public drafting the articles for publication in regional newspapers	Presenting the SER process and outcomes		14 days prior to each regional meeting
2.2. First round of discussions in the target regions. Presentation meetings with regional stakeholders – Donetsk – Lviv – Uzhgorod – Simferopol – Odesa	Presentation of Draft USELF SER documents, including USELF SER Environmental Report, USELF SER Environmental topic paper and USELF SEP.	• Draft SER Environmental Report • USELF SER Environmental Topic paper in Ukrainian • USELF SEP • USELF SER information booklet	November-December, 2011

Events/Activities	*Tasks*	*Information for disclosure*	*Timeframe*
2.4. Establishing locations where the public in target regions can review the SER documents, most likely public libraries (or other locations if advised by the authorities and other local partners)			November-December, 2011 *to be combined with the presentation meetings*
2.5. Regional round tables/by-invitation workshops in the target regions	• Making the Draft SER documents available for review and discussion • Obtaining feedback, comments, concerns and recommendations from regional stakeholders	• Draft SER Environmental Report • USELF SER Environmental Topic paper in Ukrainian • USELF SEP • USELF SER information booklet	December, 2011 – January, 2012. *Specific dates for meetings will be announced through SER and USELF public websites, and regional newspapers*
2.6. Roundtable with the NGOs in Kiev, if level of interest indicates the need for it	• Discussion of the SER results • Collecting feedback and comments from NGO groups	• Draft SER Environmental Report • USELF SER Environmental Topic paper in Ukrainian • USELF SEP • USELF SER information booklet	November-December, 2011
2.7. Collecting feedback and comments on Draft SER report	Discussion of the SER results	Draft SER report	120 day consultation period: November, 2011 – January, 2012 *Ongoing throughout project*
2.8. Closing of public comment period	Obtain public feedback	Draft SER report	At the end of the 120 day consultation period
2.9. Preparation of analytical report and final SER report			February - March, 2012

6 POLICY CONTEXT AND BASELINE ENVIRONMENT

6.1 Other relevant plans, programmes and environmental protection and enhancement objectives

A review of other relevant plans and programmes was undertaken as part of this SER to identify the environmental protection objectives of relevant international, national and regional (oblast) level plans and policies. The USELF SER Environmental Topic Paper provides a summary of this existing legislation and policy (see Appendix E). Key overarching energy and environmental policy that is relevant to alternative and renewable energy activities is summarised below[23].

6.1.1 Energy legislation and regulatory framework

The legislative and regulatory framework of Ukraine that regulates the usage of alternative and renewable energy sources includes the following levels:

- Laws of Ukraine that are adopted by the Verkhovna Rada (Parliament) of Ukraine. Verkhovna Rada is the only legislative body in the country. No local legislation in the form of laws exists in Ukraine. Autonomous Republic of Crimea has its own Parliament, but it only issues Decrees and Decisions;
- Decrees of the Cabinet of Ministers of Ukraine and of the Cabinet of Ministers of Crimea;
- Acts of the relevant sectoral Ministers; and,
- Regional (oblast) level programs of socio-economic development and sectoral regional programs (e.g., oblast program of energy efficiency).

The Ministry of Fuel and Energy of Ukraine (MFE) is the central executive authority responsible for managing the electricity generation sector in Ukraine.

The Law of Ukraine on the Electric Energy of 16 October 1997 (No. 575/97) defines the legal, economic and institutional framework for energy sector activities. In 2008, the Law was amended to incorporate the definition of the Green Tariff. The Law stipulates some guarantees for those electricity-generating entities that utilise alternative and renewable energy sources. However, the Law only sets the Green Tariff factors or establishes calculation methodologies for those facilities that generate electricity from wind power, solar power and hydropower plants with a capacity of less than 10MW.

The Law of Ukraine on Alternative Fuels of 14 January 2000 (no.1391-XIV) defines qualifying criteria for alternative fuels and the list of alternative liquid, solid and gaseous fuels. The Law stipulates the achievement of the alternative and renewable fuel usage target of 19% throughout Ukraine by 2020.

The Law of Ukraine on Alternative Energy Sources of 20 February 2003 (no.555-IV) provides the legal, economic, environmental and institutional framework for activities involving the use of

[23] Note: On December 9, 2010, the President of Ukraine announced significant changes to the organisation and responsibilities of energy-related national agencies and authorities. The information provided below is subject to change based on how the new structure is put in place. However, for most of the purposes of this SER, the description of pre-existing conditions is still appropriate.

alternative energy sources. It includes the provision that the output and consumption of alternative energy sources should be increased in a manner that is safe to the environment and to human health.

Ukraine's Energy Strategy for the Period until 2030 (2006) includes energy consumption projections showing that energy demand is expected to increase 123% between 2005 and 2030; and that, at present, 7.2% of the energy generation in Ukraine is from alternative and renewable energy sources (of that, 0.8% is from renewable energy sources). The Strategy identifies the most promising areas for alternative and renewable energy development in Ukraine; which include biofuels; wind energy; solar energy; and economically viable development of hydropower generation capacity associated with small Ukrainian rivers.

The Concept of the State Earmarked Scientific and Technical Programme for Promoting the Production and Use of Biofuels (2009) outlines four options for reducing energy reliance. Biofuels are considered to be amongst the most promising options for alternative and renewable energy development in Ukraine.

The Resolution of the Cabinet of Ministers of Ukraine "Issues Relating to the Organisation of Biogas Production and Use" (12.02.2009 No.217-r) sets out specific actions to be taken in order to promote the development and use of biogas.

The main principles (strategy) of *the State Environmental Policy of Ukraine till 2020* adopted by the Law of Ukraine (2010), identify main root causes of environmental problems of Ukraine and define strategic goals of national environmental policy. Implementation of the goal N6 would require increase of the share of renewable and alternative energy sources by 25% from base level till the year 2015 and by 55% till the year of 2020.

The National Environmental Protection Action Plan for the years 2011 – 2015 adopted by the Cabinet of Ministers of Ukraine decree as of 25/05/11 N 577-p outlines a list of measures on environmental protection. In particular, it foresees that the draft law on tax exemptions for economic entities using renewable and alternative energy sources to be developed in 2014.

The State Target Economic Programme on Energy Efficiency and Development of Energy from Renewable Sources and Alternative Fuel for the years 2010-2015, adopted by the Cabinet of Ministers of Ukraine decree N243 (2010) sets a goal to decrease the energy consumption per GDP unit by 20% compared to the level of 2008 during the Program duration (by 3.3% annually). The programme also stipulates that the share of energy sources developed from renewable sources and alternative fuel will in 2015 constitute not less than 10% of total state energy balance. The programme outlines ways and measures of attaining the goal and includes list of actions and tasks.

Ukraine has a number of national programmes that aim to support the development of alternative and renewable energy sources. At the regional level, relevant programmes exist only in some oblasts because the level of development and utilisation of renewable energy sources is relatively low. An analysis of regional (oblast) plans and programmes of specific relevance to the renewable energy scenarios and areas under consideration in this SER is provided in Appendix E (Section 2.4).

6.1.2 Environmental legislation and regulatory framework

The Ministry of Environment and Natural Resources is the main central executive authority responsible for environmental protection; sustainable management, reproduction and conservation of natural resources; control of the use and conservation of land resources; environmental safety, nature reserve planning and management, waste management; development, conservation and management of ecological network, and geological exploration and sustainable management of mineral resources.

The Law of Ukraine on Environmental Protection is the main piece of framework legislation in Ukraine; although there are also a number of resource-specific documents and codes, including: the Land Code, Water Code, Forest Code, Mineral Resource Code; the Laws of Ukraine "On Nature Reserves and Protected Areas", "On Ambient Air Protection", "On Animal Life"; and the Law of Ukraine "On the Environmental Review". In addition, there are numerous regulations issued by various executive authorities with environmental management functions and local self-governance bodies.

Ukrainian legislation requires an operator to obtain permits for various types of natural resource use, including in particular, emissions into the air, general-purpose and special water resource use, discharges to water bodies, and waste generation and disposal.

EIA of economic projects is required by the *Law of Ukraine on Ecological Review*. The Ukrainian EIA process includes two related procedures: (1) assessment of environmental impacts (Ukrainian abbreviation OVNS) carried out by the proponent, and (2) state environmental review that is a part of investment integrated expert review conducted by designated state authorities.

In February 2011 Ukraine adopted *The Law of Ukraine "On Regulation of Urban Planning*[24]*"*, which aims to streamline the permitting process in the building and construction industry. The new Law stipulates that only the following developments are subject to obligatory national EIA procedure[25]:

1. Those falling into the 'IV' and 'V' category of complexity, namely:
    a. designed for permanent stay of more than 300 persons and (or) periodic stays of more than 500 persons; or
    b. pose potential threat to more than 10,000 individuals beyond the development; or
    c. in case of failure, or in case further use is impossible (not feasible):

[24] Law of Ukraine "On regulation of urban planning" N 3038-VI as of 17.02.2011, Official Herald of Ukraine, 18.03.2011 - 2011., № 18, p. 131, art. 735, act code 55190/2011

[25] Very broadly, the national OVNS report – chapter of the project documentation titled 'Assessment of the impacts on the environment', plus the procedure of checking the OVNS compliance with national environmental standards, called environmental review, a part of project permitting process, are, for the purpose of this note, called 'national EIA'

i. may cause damages estimated as the amount of more than 15,000 minimum salaries;
ii. may lead to termination of the functioning of transport, communications, energy and infrastructure at regional level; or,
iii. may lead to loss of cultural heritage at a regional level.

2. Those falling under definitions by the Law of Ukraine "On the objects of increased potential hazard", namely, facilities where one or more hazardous substances or categories of substances are used, manufactured, processed, stored or transported to, in the quantities equal to or exceeding regulatory established threshold, as well as other facilities that pose real threat of development of the accident (emergency) of technogenic and natural character.

3. Those potentially having transboundary impacts.

The result of this new Law is that the majority of USELF-funded projects will not be subject to obligatory national EIA procedure (although in practice EIA may still be undertaken in some cases if requested of the developers). It should be noted that under the previous Law many renewable energy projects in Ukraine already fell outside of obligatory national EIA procedure; however, regional environmental authorities almost always required one (and had the authority to do so). In principle, under the new regulations, environmental authorities cannot call for EIA for development not falling under the above described categories. In practice, however, the inertia is still there and the projects currently automatically go through national EIA. However, it is likely that this situation will change in the near-future.

The implications of this new Law for USELF-funded projects are twofold:

1. The national permitting process is shortened and the developer does not need to spend time and resources on the EIA study; but,
2. Local EIA currently serves as the basis for developer's environmental and social action plans – required to comply with the EBRD environmental and social requirements. Absence of national EIA requirements could in principle lead to deterioration of local developers' and consultancies' capacity to meet EBRD performance standards.

In any case, as a result of this recent legal change, the role and potential impact of the USELF SER increases significantly. It is envisaged that this SER Environmental Report will be a valuable source of environmental information for potential USELF-funded projects.

Ukraine has signed and is preparing ratification of the SEA Protocol to the Espoo Convention. This will allow SEA to become a part of the strategic planning process in Ukraine. The European Union (EU) SEA directive is one of the four environmental directives whose requirements, according to the Ukraine – EU agreement, are to be incorporated into Ukrainian legislation in the nearest future. While these regulations do not directly apply to the USELF programme, the SER process is guided by the EU Directive (along with the EBRD policies) and the environmental report follows its requirements; as a result, there are not anticipated to be any significant implications of ratification upon the USELF programme.

In addition to complying with Ukraine laws, strategies and policies, the USELF SER conforms to the international finance institution requirements and principles contained in the *EBRD Environmental and Social Policy*; which includes the EBRD Performance Requirements, the EBRD Public Information Policy and the EBRD Strategy for Ukraine.

Further detail of Ukrainian environmental legislation; the EIA process of Ukraine; specific legal provisions and standards applicable to the six topic areas under consideration in this SER; and the international environmental and social requirements applied to the USELF SER, are described in detail in Appendix E (Section 2.5c).

6.2 Baseline environment

6.2.1 Introduction

The SER has identified the current state and characteristics of the environment of Ukraine, known as the 'baseline'. This baseline provides the basis for predicting and monitoring environmental effects. The SER also describes the evolution of the baseline environment according to major trends, known as the future baseline. Technically, this is also without the implementation of renewable energy projects funded by USELF up to 2040.

A range of information sources were consulted when identifying the baseline and future baseline for this SER. Information was primarily gathered from a combination of publically-available websites, documents and publications of official statistics. Key sources of information were the national reports on the state of the environment of Ukraine and the National Atlas of Ukraine.

Figure 6-1 provides an overview of some of the characteristics of the baseline environment of Ukraine. A summary of the baseline and future baseline for each environmental topic (as defined in Section 2.1) is provided below. Section 3 of the SER Environmental Topic Paper (see Appendix E) provides a more detailed explanation of the baseline and anticipated future baseline for each of the SER environmental topics; as well as an explanation of the data sources used, the quality of these data sources, gaps in data availability, and key constraints and opportunities for renewable energy in relation to each environmental topic.

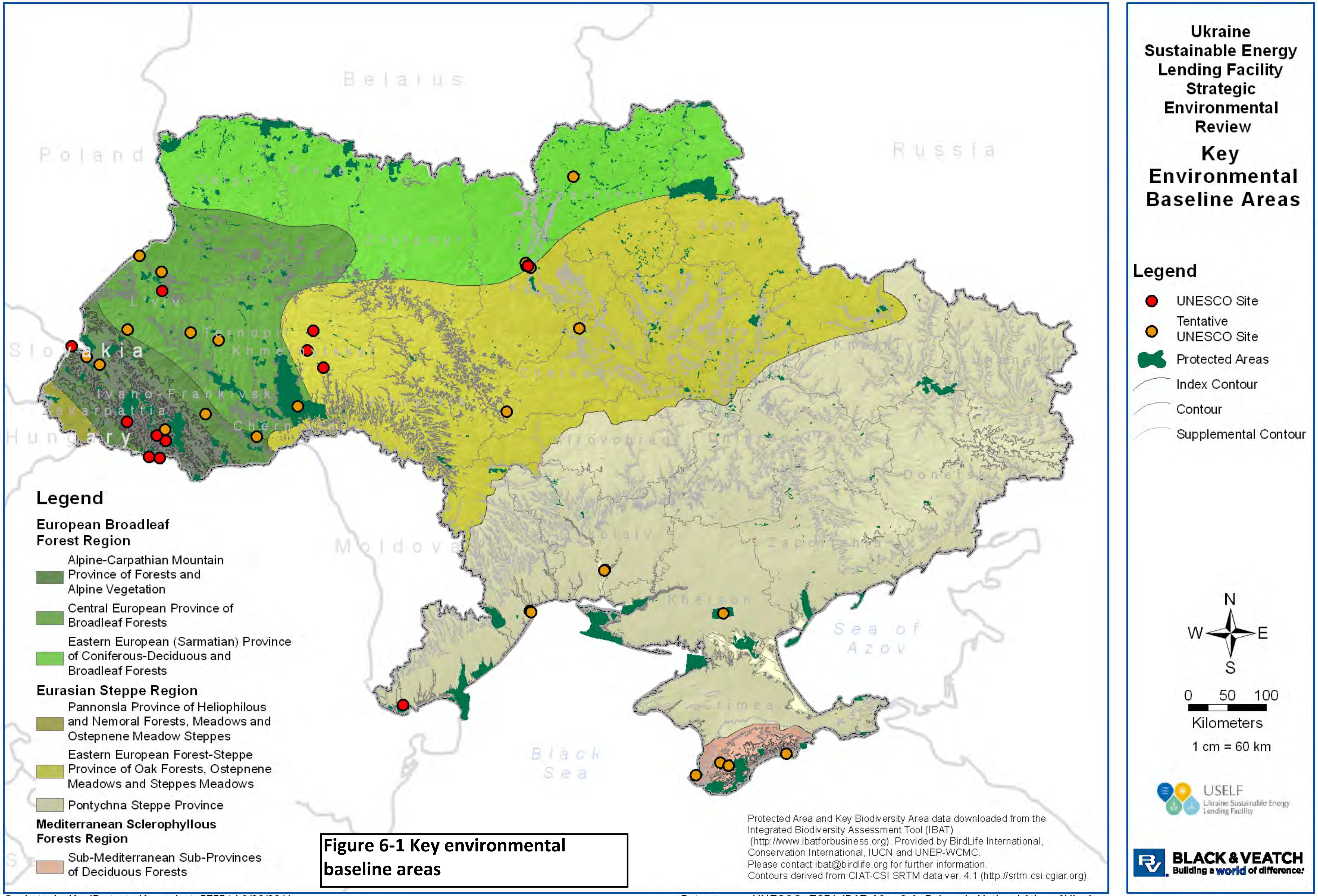

Figure 6-1 Key environmental baseline areas

GeobotanicalAndProtectedAreas | ste57554 | 9/26/2011 Data source: UNESCO, ESRI, IBAT, After C.A. Polyvach, National Atlas of Ukraine.

6.2.2 Climate and air quality

Baseline

The baseline climate for the majority of Ukraine is temperate continental; however, the south of the Crimean peninsula is subtropical. The weather in Ukraine is variable, due to frequently occurring cyclones and anticyclones. There are significant seasonal and regional variations in temperature, atmospheric precipitation, wind speed and sunlight hours. North and west generally receive twice the amount of atmospheric precipitation than the south and east of the country.

Due to prevailing westerly winds, the vast majority of the airborne pollutants are transported to Ukraine from central and eastern Europe, while air pollutant loads from Ukraine are mainly transferred further east to Russia. Fuel and Energy Complex (FEC) enterprises and metallurgy are the major contributors to local air pollution within Ukraine. The energy sector contributes approximately 70% of total domestic emissions of greenhouse gases (GHGs) in Ukraine and is the main source of carbon dioxide (CO_2) and methane (CH_4) emissions in Ukraine. Globally, Ukraine ranks 20th in the emissions of CO_2 from fuel combustion and 8th in energy-related CH_4 emissions, as further described in Section 3.2a of the SER Environmental Topic Paper (see Appendix E).

Future baseline

Future baseline climatic conditions in Ukraine are anticipated to show increased frequency and magnitude of winter floods, decreased water availability, increased variability in crop yields and potentially decreased crop yield with increased soil erosion, increased health effects from heat waves, and severe fires in drained peat-land[26]. Drought risk is also expected to significantly increase. It is not clear whether Ukraine will benefit from climate-change driven improvements in conditions for agriculture; since benefits could be offset by increased variability and extreme events[27]. Trends in air quality in Ukraine are contradictory; however it is clear that if financing is not secured for implementing air emission mitigation measures and the level of energy and heat generation does not drop, air pollution in industrialised part of Ukraine will continue to increase. This is explained further in Section 3.2b of the SER Environmental Topic Paper (see Appendix E).

6.2.3 Surface water and groundwater

Baseline

Ukraine has approximately 63 100 rivers, including nine large rivers (with a watershed area of more than 50 000 km^2), which are divided into three sea basins – the Black Sea, the Sea of Azov and the Baltic Sea. There is great variability in indexes of river network density[28] between major river basins and along the length of individual river basins (between the headwaters and lower basins). Despite considerable flood control infrastructure in Ukraine, flood risk is still considered to be high due to a number of factors, including inadequate levels of modernisation and uncontrolled construction in water withdrawal zones. Water availability per capita in Ukraine is amongst the lowest in Europe.

[26] IPCC (2007)
[27] World Bank (2009)
[28] Km of river length per sq km of area

Surface water resources are not equally distributed; and some oblasts, in particular those in the eastern and southern regions, experience freshwater deficits. The quality of drinking water often fails to meet national standards. A decline in drinking water quality, along with groundwater pollution and deterioration of the condition of main rivers, is reported in regions where coal and metal mining and raw materials processing are concentrated (the east and southeast regions of the country). Apart from the rivers of Crimea, all river basins in Ukraine were classified in 1999 as moderately or significantly polluted[29]. In particular, the Dnieper River, the primary source of drinking water for 60% of the Ukrainian population, is often cited as a classic example of non-sustainable usage; as explained in Section 3.3a of the SER Environmental Topic Paper (see Appendix E).

Future baseline

Future baseline conditions may see climate change modifying long term watershed and groundwater characteristics. Analyses of long-term surface water quality monitoring data indicate that the overall level of water pollution does not significantly change regardless of the economic situation and level of industrial output. Overloaded and poorly maintained sewerage systems and treatment facilities are the main reason for continuing water quality deterioration. This trend is likely to continue as the present water treatment infrastructure is unlikely to provide effective water treatment in the future in the absence of maintenance and reconstruction. During the last five years, the per capita water use in Ukraine has decreased, but industrial water consumption is constantly increasing. This trend is expected to continue unless steps to modernise industries are implemented. The quality of drinking water continues to deteriorate as indicated by sanitation, chemical, and bacteriological characteristics, with no indications or major initiatives to reverse this trend. This is explained further in Section 3.3b of the Environmental Topic Paper (see Appendix E).

6.2.4 Geology and soils

Baseline

Ukraine is situated in the south-eastern part of the Eastern European platform, and the mountain structures of Carpathia and Crimea that surround the platform. The mountain structures are part of the Alpine folding geosyncline region. Rocks of Precambrian, Palaeozoic, Mesozoic, and Cenozoic age form three structural levels. A variety of underground resources are mined in Ukraine and, according to the inventory of natural resources, there are more than 8 500 deposits of 97 types of minerals in Ukraine. Landslides are an important geological process in Ukraine. They mainly occur on the coasts of the Black and Azov Seas, as well as in the Carpathian region. The soil cover of Ukraine is diverse and tends to occur in latitudinal zones across the country. The most valuable soil type in Ukraine is Chernozems (Mollisols); which is humus-rich grassland soil used extensively for growing cereals or for raising livestock, usually found in forest steppe and steppe zones. Chernozems in Ukraine account for approximately 8.9% of the World resource of Chernozems. Sod-podsolic soils are typically found in sandr, moraine-sandr and alluvial plains, as well as in some parts of the forested terraces in the forest

[29] It should be noted, however, that water quality standards applied are in some cases stricter than those applied in EU countries.

steppe and steppe zones. A variety of other soil types are found across Ukraine, as detailed in Section 3.4a of the SER Environmental Topic Paper (see Appendix E).

Soil erosion is a significant problem in the country. Eroded soils cover 85% of total steppe and forest-steppe territories. About 100 000 hectares of fertile land is lost every year because of wind and water erosion. Soil degradation is an issue in Ukraine. Degradation has been caused by several factors; a) use of pesticides and fertilisers; b) soil and groundwater contamination due to storage of pesticides, and c) fertilisers or other hazardous chemicals. Although, a slow process of decontamination is underway, the latest available published soil data[30] shows that areas of north and central Ukraine still show signs of radioactive contamination following the Chernobyl nuclear power plant accident in 1986; which led to the abandonment of 180 000 hectares of arable land and 157 000 hectares of forest and the designation of a 'Zone of Alienation' around the town of Prypiat. Ukraine is situated in a seismic zone. The highest risk zones are situated in Crimea, the western Black Sea coast, and the Carpathian Mountains where earthquake intensity has been recorded as high as 7 on the Richter scale. Additionally, intensive mining operations can cause technogeneous earthquakes that are not as intense as natural events but, if in industrially developed areas, could lead to harmful and destructive results; as explained in Section 3.4a of the SER Environmental Topic Paper (see Appendix E).

Future baseline

The future baseline for geology and soils within Ukraine is likely to see the continuation of existing problems and observed long-term trends. Intensive mineral extraction activities have caused changes in the geology of affected oblasts and led to environmental degradation; such as changes in groundwater hydrology, deformation of geological bands, soil pollution and alkalinisation. This long-term trend is likely to continue, since no significant efforts have been undertaken to remedy the situation. There is a large-scale programme on prevention and mitigation of landslides and groundwater flooding of the most vulnerable areas in Ukraine. The programme has not been very successful to date and the rate of soil erosion is not declining. Lack of knowledge and skills, along with an absence of government incentives, make farmers unable to deal with the erosion issue. This is described further in Section 3.4b of the SER Environmental Topic Paper (see Appendix E).

6.2.5 Landscape and biodiversity

Baseline

The land use pattern in Ukraine is characterised by overuse of land resources for agricultural purposes. Agricultural land covers more than 70% of the total territory of Ukraine, including arable (54%), pasture (9.5%), hay-land (4.4%), and perennial plants (1.5%).

Ukraine's topography is characterised by flat lowlands and gently rolling uplands (generally referred to as plains or flatlands). The remaining 5% of the country is covered by mountainous and sub-mountainous regions; notably the Carpathian Mountains on the western edge of Ukraine and the Crimean Mountain range on the south-eastern coast of the Crimean peninsula. Approximately 60% of the hilly and mountainous terrain is covered by forest, consisting mainly of oak (*Quercus*), beech (*Fagus*), hornbeam (*Carpinus*) and pine (*Pinus*). The remainder of the

[30] Ministry for Environmental Protection and Nuclear Safety of Ukraine (1998)

country can be divided into four main geographic zones that can be described as roughly parallel 'east-west spread belts':

- The most northern part of the country is predominantly covered by coniferous, mixed and deciduous forests (referred to as the Northern Mixed Forest Zone);
- The forest-steppe and the western broadleaf forest (referred to as the Western Broadleaf Forest Zone and the Forest Steppe Zone) in the centre of Ukraine are predominantly agricultural and cover about 35% of the country;
- The remaining 40% of the country (the southern and eastern portions) lie within the predominantly Arable Steppe Belt.

These four geographic zones together with the Carpathian and Crimean Zones broadly align with the distinct landscape and biodiversity character areas that have been identified for this project. For a description of the landscape and key species supported within these areas see Section 3.5a of the SER Environmental Topic Paper (see Appendix E).

The biodiversity of Ukraine includes more than 72 000 species of flora, micro-biota and fauna. Estimates calculate that approximately one-third of these species, mostly insects and fungi, have yet to be described. The diverse geomorphology, climate, and topography of Ukraine account for much of the richness of flora and fauna. Ukraine is home to a high number of endemic and sub-endemic species, principally found in the Crimean Mountains and Carpathian Mountains, but also in the estuaries and marshes along the coastal zones of the Black Sea and Sea of Azov.

Ukraine has several important aquatic ecosystems, including rivers, wetlands and seas. The river networks include a variety of aquatic habitats that support a diverse assemblage of fish species. Many of Ukraine's rivers have been dammed for electricity, converted to fish lakes, or modified for irrigation. Wetlands associated with Ukraine's rivers cover about 5.3% of the country, and include coastal marshes, peat bogs, river plains, and forest swamps. The wetlands and marshes along Ukraine's Black Sea coast are among Europe's most important habitats for freshwater and marine fish. There are 3.4 billion hectares of reclaimed areas in Ukraine that were formerly wetlands. Only 957 100 hectares of wetlands remain based upon reported estimates.

There are more than 55 species of fauna protected under the Bern Convention throughout the territories of reserves, protected areas, and landscape parks all over Ukraine. Ukraine has 33 sites listed as wetlands of international importance under the Ramsar Convention on Wetlands and seven UNESCO Biosphere reserves. There are 542 species of fauna cited in the Red Book of Ukraine as protected under national legislation.

The Danube River Basin, which runs along the Ukrainian-Romanian border before emptying into the Black Sea, has been recognised as a Global 200 Ecoregion[31], based on selection criteria such as species richness, levels of endemism, taxonomic uniqueness, unusual evolutionary phenomena, and global rarity of major habitat types. Protected areas in Ukraine are maintained under the natural reserve fund of Ukraine. The fund includes 7 346 protected areas that cover 2 990 000 hectares (4.95% of total territory of the country). The structure of the

[31] WWF has identified the Global 200 as being the most biologically distinct terrestrial, freshwater, and marine ecoregions of the planet.

natural reserve fund includes 11 categories of territories and objects protected at national, regional, and local levels. Geographical distribution of reserve areas varies from region to region, as described in Section 3.5a of the SER Environmental Topic Paper (see Appendix E). The topic paper also provides details on the key species and assemblages of importance within the Ukraine; in particular: migratory birds, fish communities, migratory fish, introduced fish species, and invertebrates, as well as information on commercial fisheries.

Future baseline

The Government of Ukraine is planning a substantial expansion of the nature reserve fund of Ukraine by 2015. However, landscapes and biodiversity in Ukraine are under constant threat of uncontrolled land use for economic purposes (extraction of fossil fuels, residential development, recreational facilities and conversion for agriculture). A few large reserves are well managed, while many small reserves have no management at all. Poorly regulated hunting activities and uncontrolled collecting of wild plants pose serious threats to declining populations of native species. Conservation programmes at the local level are energised and dynamic, but suffer from inadequate management of natural resources. The non-governmental organisation (NGO) community does not often have the influence to be an effective partner with government and industry to address biodiversity and natural resources issues.

There are, however, certain positive tendencies in land use. There are trends towards increasing areas under conservation status (in average 400 hectares per year), expansion of forest areas, as well as towards reduction of non-vegetated areas and radioactively polluted lands. This is described further in Section 3.5b of the SER Environmental Topic Paper (see Appendix E).

6.2.6 Community and socio-economics

Baseline

Ukraine has a population of 45.8 million[32]. The end of the 20th century and beginning of the 21st century have been characterised by a process of depopulation. Population size declined by 7.5% in the period 1991-2001 and by 5.1% in the period 2001-2010. The aging population of Ukraine causes social and economic problems and an imbalance in the population structure, particularly amongst the rural populations of central Ukraine and the Donbass region (covering Donetsk and Luhansk). Although three quarters of the population are Ukrainian, there are also high numbers of people from other ethnic groups with Ukrainian citizenship within the country; notably Russians, Bulgarians, Slovakians, Poles and Czechs. However, there are strong regional variations in population make-up and density across Ukraine and the migration process is still very intensive, all of which is discussed in detail in Section 3.6a of the SER Environmental Topic Paper (Appendix E).

The birth rate is low in Ukraine and the population is declining at a rate of 0.42% per year. However, there is some variation in this; with positive natural population growth rates within three oblasts (Rivne, Volyn and Zakarpattia). Life expectancy, which shows little variation across the oblasts of Ukraine, is on average 10.9 years below EU member states. Due to high rates of alcoholism and heart disease exacerbated by smoking, men's life expectancy in Ukraine is 11

[32] Correct on the 1st December 2010.

years shorter than women's. Areas impacted by the Chernobyl disaster have slightly higher rates of tumours/cancer than national averages, but it cannot be clearly attributed to the nuclear accident there according to epidemiologists[33].

The overall rate of illness in Ukraine is increasing; which places significant strain upon the aging population. HIV/AIDS and tuberculosis are of particular concern, alongside high levels of heart disease[34], respiratory organs diseases and tumours. There is some variation in levels of illness across the oblasts, as detailed in Section 3.6a of the SER Environmental Topic Paper (Appendix E).

With the increase in privatisation that has occurred since 1991, there is an increase in income discrepancies with more wealth in the hands of a concentrated group, while the majority of the population has been subject to a decline in comparative wealth. Transport, financial activity and mining operations are the economic activities with a high level of remuneration of labour; although the highest salaries are in the dormitory settlements near nuclear power plants. There is a wide variation in the earnings of the oblasts as measured by Gross Regional Productivity per capita. This variation, as well as the variation in unemployment between oblasts, is described in Section 3.6a of the SER Environmental Topic Paper (see Appendix E).

The economy of Ukraine is largely centred around the agricultural central oblasts and the industrial oblasts of the east. A total of 40% of GDP is produced by the five oblasts of Kyiv, Donetsk, Dnipropterovsk, Odessa, and Zaporizhia. These five also share 59% of foreign direct investment. This investment trend continues to increase disparities between these oblasts and those that are lagging behind in development. The key industries for Ukraine are metallurgy, food and machinery engineering (see Section 3.6a of the SER topic paper (Appendix E) for further details). Transportation infrastructure in Ukraine focuses on industrial areas for rail, road, port and airfields; primarily in the western region and around Kyiv (see Figure 1-1). Although Ukraine has significant coal and natural gas reserves, the country has historically been dependant on Russia for oil and natural gas, and largely remains so. Overall, the majority of the power generation capacity in Ukraine is thermal power plants (64%). Nuclear power plants account for 26% of the capacity and large hydropower for another 9%. Renewable energy capacity (excluding large hydropower) consists of less than 1% of the current generation capacity in the country.

Heavy industrialisation, prior to changes in legislation and greater environmental awareness, and contamination of land (including that caused by the Chernobyl disaster in 1986) has had a significant impact on the natural environment of Ukraine. Despite this, abundant natural and recreational amenities remain. However, tourism has been slow to develop, due to lack of investment and a perception of instability, and has not yet reached its potential. There is tremendous tourism potential, if developed properly, as detailed in Section 3.6a of the SER Environmental Topic Paper (see Appendix E).

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[33] The Chernobyl Forum: 2003-2005 Chernobyl's Legacy: Health, Environmental and Socio-Economic Impacts and Recommendations to the Governments of Belarus, the Russian Federation and Ukraine, p.8 at http://www.iaea.org/Publications/Booklets/Chernobyl/chernobyl.pdf, Accessed 14 April 2011

[34] State Statistics Committee of Ukraine (2010) *Statistical Yearbook of Ukraine for 2009*, Kyiv Table 16.19 Death rates by major cause of death in 2009, by region, p.347

Future baseline

At the national level the demographic trend is an increasing elderly population and a declining number of births, combined with large outmigration of workers. This will put pressure on current and future working aged generations to provide support for a disproportionally large population of elderly on pensions. There is also potential for an increase in ethnic tensions in certain areas, due to changes in population dynamics. The current economic situation is worsening, industrial growth is irregular across Ukraine and some population redistribution is likely. Continued global demand for steel will continue to play an important role in Ukraine's economy and trade; whilst the need for more efficient technologies and fuel sources should serve to reduce waste and environmental impacts.

The human health situation in Ukraine is critical for continued economic development, by international norms; the death rate from cardiovascular disease, tumours, AIDS and tuberculosis is increasing and is unlikely to change unless mitigation measures and programmes become of high government priority. Climate-change driven trends of warmer climate and abundant precipitation have the potential to offer opportunities for expanding agricultural production in Ukraine; however, alongside this must come reductions in technological inefficiency and higher rates of agricultural productivity[35]. The population of Ukraine is increasingly aware of environmental issues. And this awareness, alongside pro-environmental projects, could assist in reversing negative perceptions of the country and increase its tourism industry, as explained in Section 3.6b of the SER Environmental Topic Paper (see Appendix E).

6.2.7 Cultural heritage

Baseline

Archaeological traces of humans in modern day Ukraine date back many thousands of years. Traces of human habitation date back 30 000 years to the end of the Quaternary or last ice age. Palaeolithic sites have been found along the shores of the Black Sea, Dnieper and Dniester Rivers. Archaeological finds from the Palaeolithic (Early Stone Age) and Mesolithic (Early Stone Age) include primitive stone tools, carvings from mammoth tusks, and arrow heads made from flint stone. Ukraine has been continuously settled since at least 5 000 BC, although this was a mixture of some sedentary settlements and agriculture and nomadic pastoralism. For a description of the prehistoric cultures and early civilisations that occurred in the modern territory of Ukraine; as well as the modern history of Ukraine, which is largely linked to Soviet control and military history, see Section 3.7a of the SER Environmental Topic Paper (see Appendix E). Ukraine became an independent state on August 24th 1991, following the dissolution of the Soviet Union.

There are several cultural UNESCO World Heritage Sites in Ukraine. Ukraine also has thirteen submissions on the UNESCO tentative list. For a description of the cultural heritage sites, archaeological monuments and objects that together make up the cultural heritage resource of Ukraine see Section 3.7a of the SER Environmental Topic Paper (see Appendix E).

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[35] World Bank Europe and Central Asia Region Sustainable Development Unit (2008) *Competitive agriculture or state control: Ukraine's response to the global food crisis*. Washington D.C. p.4

Future baseline

The preservation of the cultural heritage resource in Ukraine is dependent on the nature and scale of future development within the country, as well as the effectiveness of Ukrainian policy and legislation. Since the declaration of Ukrainian independence in 1991, there has been a decrease in public support for culture due to political instability, the economic crisis, and contradictions between democratic goals and market conditions. However, recent strategic priorities and administrative reforms have the potential to improve the situation, as explained in Section 3.7b of the SER Environmental Topic Paper (see Appendix E).

6.3 Existing environmental problems

The following have been identified as key existing environmental problems which are relevant to the renewable energy scenarios under consideration within Ukraine:

- *Air Pollution* – Emissions of greenhouse gases, largely due to the energy sector, are an environmental issue particularly concerning industrialised areas of Ukraine.
- *Climate change* – The impacts of climate change upon Ukraine are not clear. However, it is likely that as well as potential benefits upon agricultural productivity, climate change could cause environmental problems through such outcomes as increased flooding, decreased water availability, heat waves and fires. The migratory patterns and pathways of particular species are also vulnerable as the climate of Ukraine changes.
- *Drinking water quality* – The availability of clean drinking water is a major problem in Ukraine and quality of drinking water often fails to meet national standards.
- *Water resource* – Although per-capita water usage has decreased in Ukraine, industrial water consumption is steadily increasing.
- *Soil erosion* – Soil erosion is a significant environmental problem in Ukraine; with about 100 000 hectares of fertile land being lost every year.
- *Landslides* – Landslides are an important geological process in Ukraine. The challenge of mitigating for landslides is the subject of a large-scale programme.
- *Soil contamination* – There are still significant areas of north and central Ukraine which show signs of radioactive contamination following the Chernobyl nuclear power plant accident in 1986.
- *Mineral extraction* – Intensive mineral extraction activities have led to environmental degradation. This long-term trend is likely to continue.
- *Protection of landscapes and species* – Although Ukraine has an extensive network of protected natural areas, many reserves have little or no management; and landscape and biodiversity are under constant threat of uncontrolled land use for economic purposes.
- *Population dynamics* – Ukraine has a declining and aging population; which can cause social and economic problems, especially in rural areas.

- *Human health* – Ukraine has a high and increasing rate of illness which is reflected in low life-expectancy, particularly amongst men. Heart disease, respiratory organs disease, tumours, HIV/AIDS and tuberculosis are of particular concern.
- *Cultural heritage* – Due to conflicting priorities, support for the protection of cultural heritage has been lacking since the declaration of Ukrainian independence in 1991.

6.4 Assumptions, limitations and uncertainty

The assumptions, limitations and uncertainties associated with defining the baseline and future baseline environment that are common to *all* topic areas are described here. For *topic specific* assumptions, limitations and uncertainties refer to Section 3 of the SER Environmental Topic Paper (Appendix E).

- In defining the baseline environment for the different topic areas, there were variations in spatial coverage and the quality of information available. For example, there is limited information on air quality trends, emissions levels and water quality, especially in areas away from population centres. There is also limited information on some species and habitats – in particular fish and aquatic habitats – and where data sources do exist they can sometimes be inconsistent.
- In developing the future baseline, assumptions were made about environmental trends, and policy responses to these trends. It was therefore assumed that, in general, Government policies relating, for example, to water quality and biodiversity, would continue to apply into the future.

Further assumptions, limitations and uncertainties associated with the assessment of likely significant effects arising as a result of the renewable energy scenarios are detailed in Section 8.3.

Section 10 indicates the type of specific project-oriented environmental studies that should be conducted for review of a renewable energy project funded by USELF.

7 SPATIAL CONSTRAINTS ANALYSIS

Spatial constraints analysis has been carried out for all renewable energy scenarios and all topic areas under consideration within this SER; in order to provide a high-level overview of the general locations in which particular sensitivities are likely to arise, should a renewable energy scenario project be pursued.

Data collected to inform the baseline environment for each of the topic areas included a large volume of spatial data. This spatial data was generally suitable for analysis using Geographical Information Systems (GIS) and where the quality of the baseline data was sufficient it has been used as the basis for a series of spatial constraints figures. Spatial constraints analysis has been carried out in order to aid the visual interpretation and assessment of the likely sensitivity of areas of Ukraine to the renewable energy scenarios under consideration; and to inform the assessment of the renewable energy scenarios against the SER Objectives.

Two main steps were undertaken to produce the figures for the spatial constraints analysis:

1. it was necessary to define the spatial areas potentially susceptible to adverse environmental effects for each topic area. This was done by assessing the data-sets available for each topic area and deciding on which datasets best spatially represented the receptors under consideration. It was not always possible to spatially represent every receptor for every topic area in a way that would lead to accurate or useful examination. Where this was not possible this has been stated in Table 7-2;
2. with the baseline map for each topic area defined, it was then necessary to overlay the sensitivity levels for each mapped receptor within that topic area against each renewable energy scenario. These sensitivity levels were defined during the early stages of the SER and were based upon an assessment of the value and vulnerability of each receptor to each renewable energy scenario; as discussed in Section 7.1.

7.1 Receptor 'value', 'vulnerability' and 'sensitivity'

A summary of the process undertaken to define the value, vulnerability and sensitivity of receptors for this SER is reproduced below. The USELF Environmental Topic Paper provides this information alongside a series of tables detailing the value, vulnerability and sensitivity classification for each topic under each renewable energy scenario (see Appendix E, Section5).

Value, vulnerability and sensitivity of receptors

This SER has used expert judgement to determine the sensitivity of receptors based on the value of each receptor against the vulnerability of that receptor to changes resulting from each renewable energy scenario. The value, vulnerability and sensitivity of receptors are defined as follows:

Value: the value of a receptor (either high or low) is based on the scale of geographic reference, rarity, importance for biodiversity, social or economic reasons, and level of legal protection;

Vulnerability: the vulnerability of a receptor (either high, medium, low or none) is based on likelihood of a receptor being exposed to an environmental effect from the USELF programme, and the receptor's tolerance and resilience to a given environmental effect;

Sensitivity: the sensitivity of a receptor is determined as being either high, medium, low or none, based on the combination of the receptor value and vulnerability, as identified below in Table 7-1:

Table 7-1 Calculation of receptor sensitivity

		Value	
		High – receptor is rare, important for social or economic reasons, legally protected, of international or national designation	**Low** – receptor is common, of local or regional designation
Vulnerability	**High** e.g. potential pathways exist for environmental change in receptors as a result of USELF, receptor is in a declining condition, dependent on a narrow range of environmental conditions	High	Medium
	Medium *e.g.* few pathways exist for environmental change in receptors as a result of USELF, receptor is only expected to recover from disturbance over a prolonged period of time, if at all	Medium	Medium
	Low *e.g.* limited or no pathways exist for environmental change in receptors as a result of USELF, receptor is in stable or favourable condition &/ or dependent on wide range of environmental conditions	Medium	Low
	None e.g. no pathways exist between environmental changes and receptors, receptor is insensitive to disturbance	None	None

The assigning of a sensitivity classification for each receptor against each renewable energy scenario was the first stage in the SER assessment of environmental effects (described further in Section 9).

7.2 Levels of sensitivity

Spatial constraints analysis has been carried out in order to aid the visual interpretation and assessment of the likely sensitivity of areas of Ukraine to the renewable energy scenarios under consideration; and to inform the assessment of the renewable energy scenarios against the SER Objectives. Due to the large spatial scales upon which much of the baseline data is defined, this analysis is not intended to be interpreted as a definitive assessment of the sensitivity of specific locales; rather it is intended to be indicative of the likely sensitivities of broad areas of Ukraine (often at oblast level) to the different renewable energy scenarios (see also Section 7.3).

Table 7-2 lists all of the receptors within each topic area that have been considered during this SER. The sensitivities for those receptors which had suitable baseline data for spatial constraints analysis are also shown (the sensitivity of *all* the USELF SER receptors can be read in Section 5 of the SER Environmental Topic Paper, within Appendix E).

In order to display receptor sensitivity for the purposes of spatial constraints analysis, all figures show the sensitivity for each receptor that had suitable baseline data for spatial constraints analysis under each renewable energy scenario. A different colouring convention has been used to show the high, medium and low sensitivity categories for each renewable energy scenario under consideration.

The spatial constraints figures are grouped; with a letter given for their topic area and a number according to the renewable energy scenario under consideration. These figure references are also shown within Table 7-2. For example, Figure CA1 shows the spatial constraints analysis for Climate and Air Quality under the On-shore Wind renewable energy scenario.

Table 7-2 Spatial constraints figures produced for the USELF SER and sensitivity of receptors with suitable baseline data for spatial constraints analysis

Figure Ref. (*X*)	**Receptor**	**Sensitivity of receptor to renewable energy scenario**				
		On-shore	Small Hydro	Solar PV	Biomass	Biogas
		Figure (*X*)1	Figure (*X*)2	Figure (*X*)3	Figures (*X*)4 & 5	Figures (*X*)6 & 7
Climate and Air Quality						
n/a	Climate	*Not suitable for spatial constraints analysis due to lack of reliable spatial data and the imprecise nature of climate change projections*				
CA	Air quality	Medium	Medium	Medium	Medium	Medium
n/a	Odour	*Not suitable for spatial constraints analysis due to lack of reliable spatial data for analysis*				
Surface water and Groundwater						
SW	Surface water resource	Medium	High	Medium	Medium	Medium
	Surface water quality	Medium	Medium	Medium	Medium	Medium
	Flooding regimes	Medium	High	Medium	Medium	Medium
	Groundwater resource	Medium	Medium	Medium	Medium	Medium
	Groundwater quality	Medium	Medium	Medium	Medium	Medium
Geology and Soils						
n/a	Bedrock geology	*Not suitable for spatial constraints analysis due to the country-wide coverage of this receptor (no spatially discernable differences)*				
GS	Landslide hazard areas	Low	Medium	Low	Low	Low
	High value soils	Medium	Medium	Medium	Medium	Medium
n/a	Contaminated land	*Not suitable for spatial constraints analysis due to lack of reliable spatial data and the sensitivity of all areas to degradation from contamination*				
	Soil composition	*Not suitable for spatial constraints analysis due to lack of reliable spatial data and the sensitivity of all areas to changes in soil composition*				
Landscape and Biodiversity						
LB	Protected landscapes	High	High	High	High	High
	Protected biodiversity areas	High	High	High	High	High
	Aquatic ecosystems	Medium	High	Medium	Medium	Medium
n/a	Protected species	*Not suitable for spatial constraints analysis due to the wide range of protected species and the areas in which they occur; making meaningful spatial mapping impractical*				
	High quality unregulated	*Not suitable for spatial constraints analysis due to lack of reliable spatial*				

Figure Ref. (*X*)	Receptor	Sensitivity of receptor to renewable energy scenario				
		On-shore	Small Hydro	Solar PV	Biomass	Biogas
		Figure (*X*)1	Figure (*X*)2	Figure (*X*)3	Figures (*X*)4 & 5	Figures (*X*)6 & 7
	landscapes	*data on the defined landscape types*				
	Low quality landscapes	*Not suitable for spatial constraints analysis due to lack of reliable spatial data on the defined landscape types*				
LB	Unprotected remnant natural ecosystems	High	High	High	High	Medium
LB	Unprotected adapted ecosystems	Low	Low	Low	Low	Low
Community and Socio-economics						
n/a	Demographics	*Not suitable for spatial constraints analysis due to the country-wide relevance of demographic effects and lack of sufficiently detailed demographic data, making meaningful spatial mapping impractical*				
CS	Health	Medium	Medium	Medium	Medium	Medium
n/a	Employment/ earning	*Not suitable for spatial constraints analysis due to the country-wide relevance of effects on employment/earnings and lack of sufficiently detailed data, making meaningful spatial mapping impractical*				
n/a	Economic sectors	*Not suitable for spatial constraints analysis due to the country-wide relevance of economic effects and lack of sufficiently detailed data, making meaningful spatial mapping impractical*				
CS	Infrastructure	Medium	Medium	Medium	Medium	Medium
CS	Tourism and environmental amenities	Low	Medium	Low	Medium	Low
Cultural Heritage						
CH	UNESCO World Heritage sites and sites on the UNESCO Tentative list	High	High	High	Medium	Medium
n/a	Registered cultural heritage sites	*Not suitable for spatial constraints analysis due the large number and country-wide distribution of registered sites and lack of sufficiently detailed data, making meaningful spatial mapping impractical*				
n/a	Unknown or unregistered cultural heritage sites	*Not suitable for spatial constraints analysis due to the lack of specific sites/locations*				
n/a	Intangible cultural heritage	*Not suitable for spatial constraints analysis due to the lack of suitable data*				

7.3 Spatial constraints analysis

7.3.1 Approach to mapping of sensitivity

Spatial constraints figures are presented in Appendix B for each of the topic areas under consideration in this SER. These figures are presented separately for each of the renewable energy scenarios under consideration. Each figure contains a series of small maps showing the individual sensitivity of all areas of Ukraine for each receptor which was suitable for mapping (as described in Table 7-2). The large map within each figure shows only the highest level of sensitivity given across each spatial area. These means that where two receptors cover the same spatial areas, but have different sensitivities, only the highest sensitivity will be visible on the larger map (the individual sensitivities being shown in the inset smaller maps). Where an area of a map is showing an absence of shading this does not mean that that area would not be potentially sensitive for that topic area; rather it shows that the area is not sensitive for the receptors which it was feasible to spatially represent on a map.

Each figure also includes any 'technical exclusions' that are applicable for the renewable energy scenario under analysis. The technical exclusions for each renewable energy scenario are described in more detail in Section 4.2. and Section 7.4; however, for a full break-down and mapping of the different technical exclusions and how their applicability varies depending upon the location of each renewable energy scenario, see the five technical reports on renewable energy for the USELF SER (www.uself-ser.com).

All figures presented within Appendix B are accompanied by text describing the spatial constraints which are likely to be present if a renewable energy scenario were to be taken forward in particular areas of Ukraine. This supporting text includes consideration of the potential constraints arising due to the sensitivities of *all* of the receptors for a particular topic area (including those receptors for which the baseline data was not suitable for mapping).

7.4 Composite constraints

Composite constraints figures have been produced in order to provide an overall view of the technical exclusions *and* spatial constraints arising due to environmental and social constraints for each renewable energy scenario under consideration. Table 7-3 provides a summary of the technical exclusions that are applicable to each renewable energy scenario and have been incorporated with the relevant maps in Section 7.3 and 7.4 (this is a summary of information provided in Section 4.2). Spatial constraints have been discussed in detail in Section 7.3.

Table 7-3 Summary of technical exclusions for each renewable energy scenario

Renewable Energy Scenario	Technical Exclusions	Composite Constraints Figure Number
On-shore wind	• Power density <300 W/m^2; • Slope >20%; • Urban Areas; and, • Major Waterbodies.	Figure 7-1
Small hydropower	• Areas away from existing watercourses; • Very low head; • Low to intermittent stream flow; • Exclusionary areas (for example, parks and recreational areas); and, • Very steep terrain.	Figure 7-2
Solar photovoltaic	• Low solar insulation areas; • Slope >5%; • Major Waterbodies; and, • Forested land.	Figure 7-3
Biomass (agricultural residue)	• Chernobyl Exclusion Zone	Figure 7-4
Biomass (wood residue)	• Wood biomass potential fuel supply of 20MW – in order to allow for scenario potential of 5MW CHP plant (four times the fuel requirement available within a 100	Figure 7-5

	km radius is recommended to allow assurance of sufficient fuel supply).	
Biogas (animal manure)	• Chernobyl Exclusion Zone	Figure 7-6
Biogas (municipal landfill gas)	• 25 landfill sites have been investigated for power and heat conversion potential. These 25 sites are associated with 19 cities with high populations (see Section 4.2.6 for explanation).	Figure 7-7

Figures 7-1 through 7-7 show the technical exclusions and sensitive environmental receptors that have available GIS spatial data, represented by all topics for each renewable energy scenario. In order to aid interpretation, all technical exclusions have been presented as uniform grey shading in this section. For further discussion regarding technical exclusions and maps which differentiate between the different types of technical exclusions for each renewable energy scenario, see Section 4.2.

The development of a USELF project within areas identified as technically excluded or as being of 'high' sensitivity for that renewable energy scenario is highly likely to be precluded. The notable exception to this is for small hydropower projects (where surface waters are assigned a high sensitivity) as it will clearly be necessary for any small hydropower project to be sited within these high sensitivity areas. Any project proponent that seeks funding from USELF to develop in a high sensitivity area should be aware that this would only be considered where allowed by Ukrainian law; and furthermore that a high degree of certainty of impact prevention and mitigation, which is likely to require detailed study and analysis, would be required by USELF.

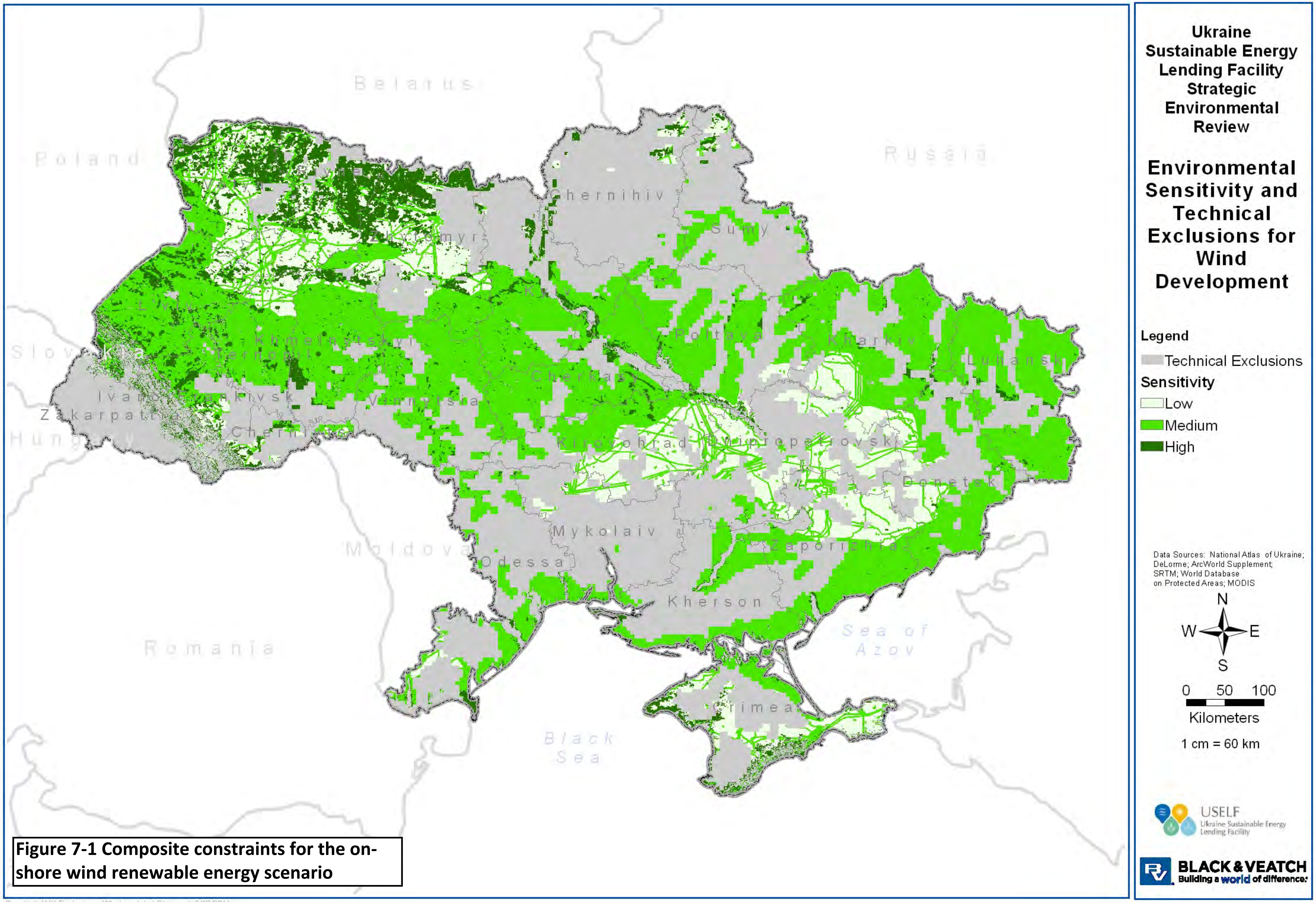


Figure 7-1 Composite constraints for the on-shore wind renewable energy scenario

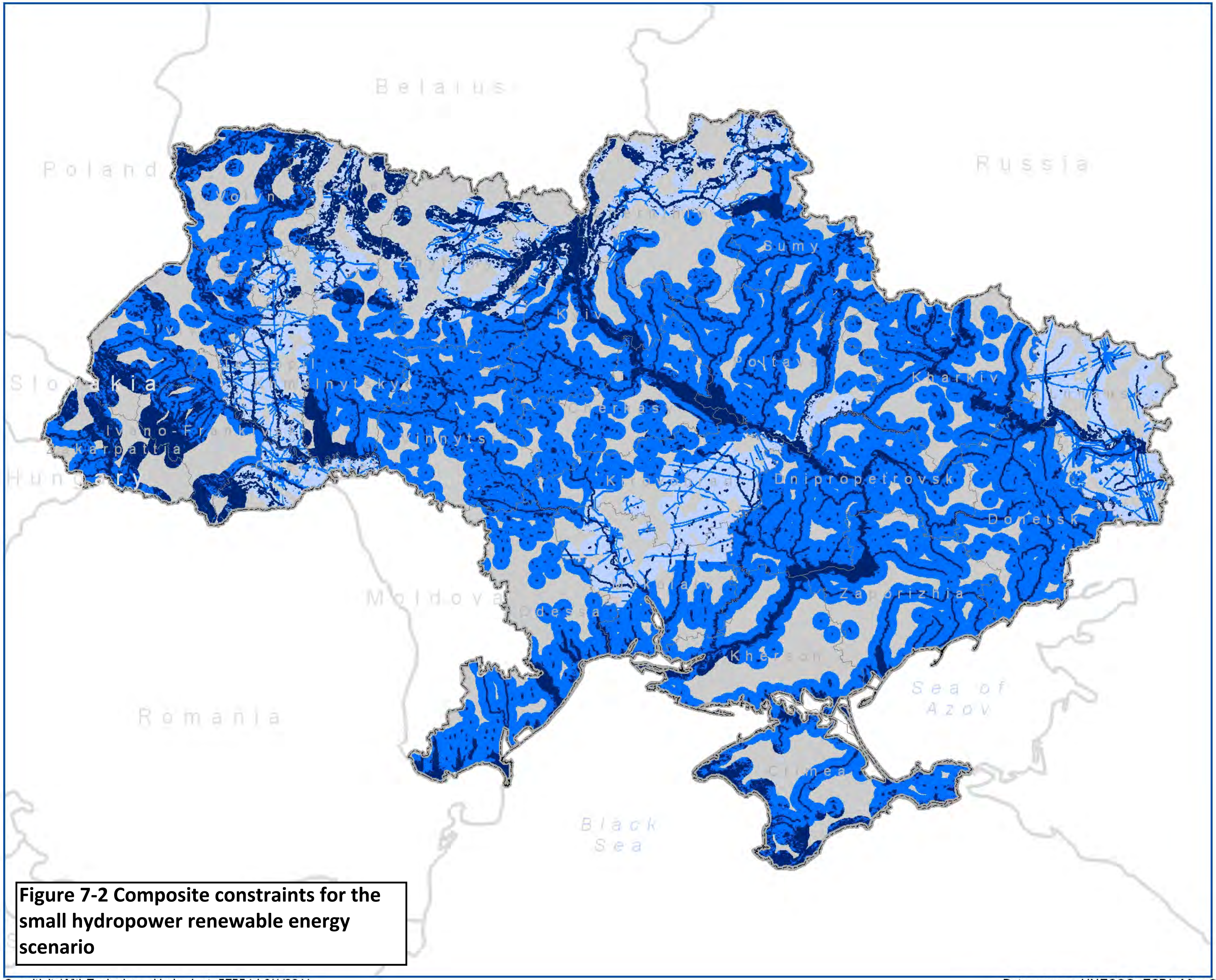


Figure 7-2 Composite constraints for the small hydropower renewable energy scenario

Ukraine Sustainable Energy Lending Facility Strategic Environmental Review

Environmental Sensitivity and Technical Exclusion for Small Hydro Development

Legend

Technical Exclusions

Sensitivity

Low

Medium

High

N W E S

0 50 100

Kilometers

1 cm = 60 km

USELF Ukraine Sustainable Energy Lending Facility

BLACK & VEATCH Building a world of difference.

SensitivityWithExclusions_Hydro | ste57554 | 6/1/2011

Data source: UNESCO, ESRI, After C.A. Polyvach, National Atlas of Ukraine.

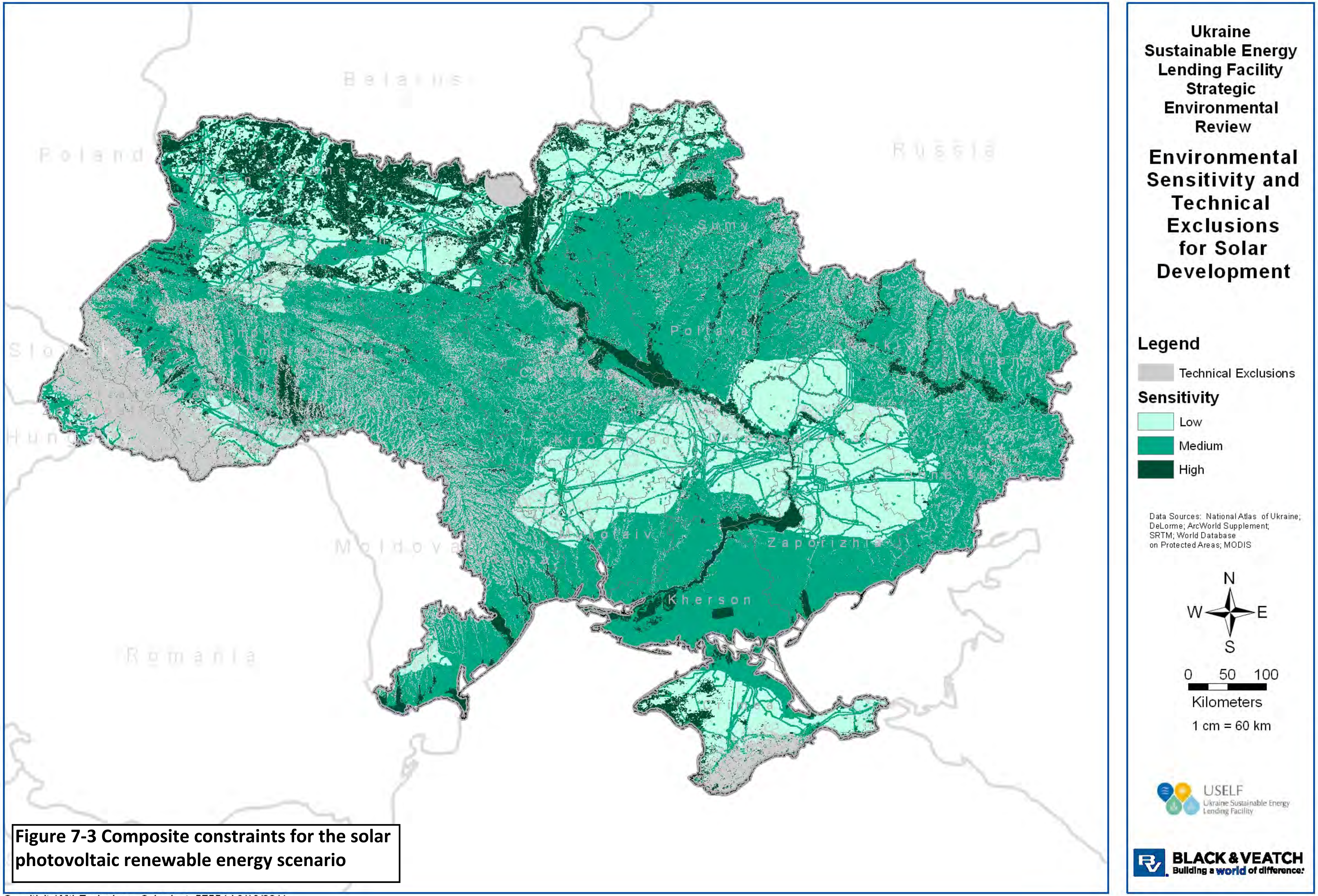
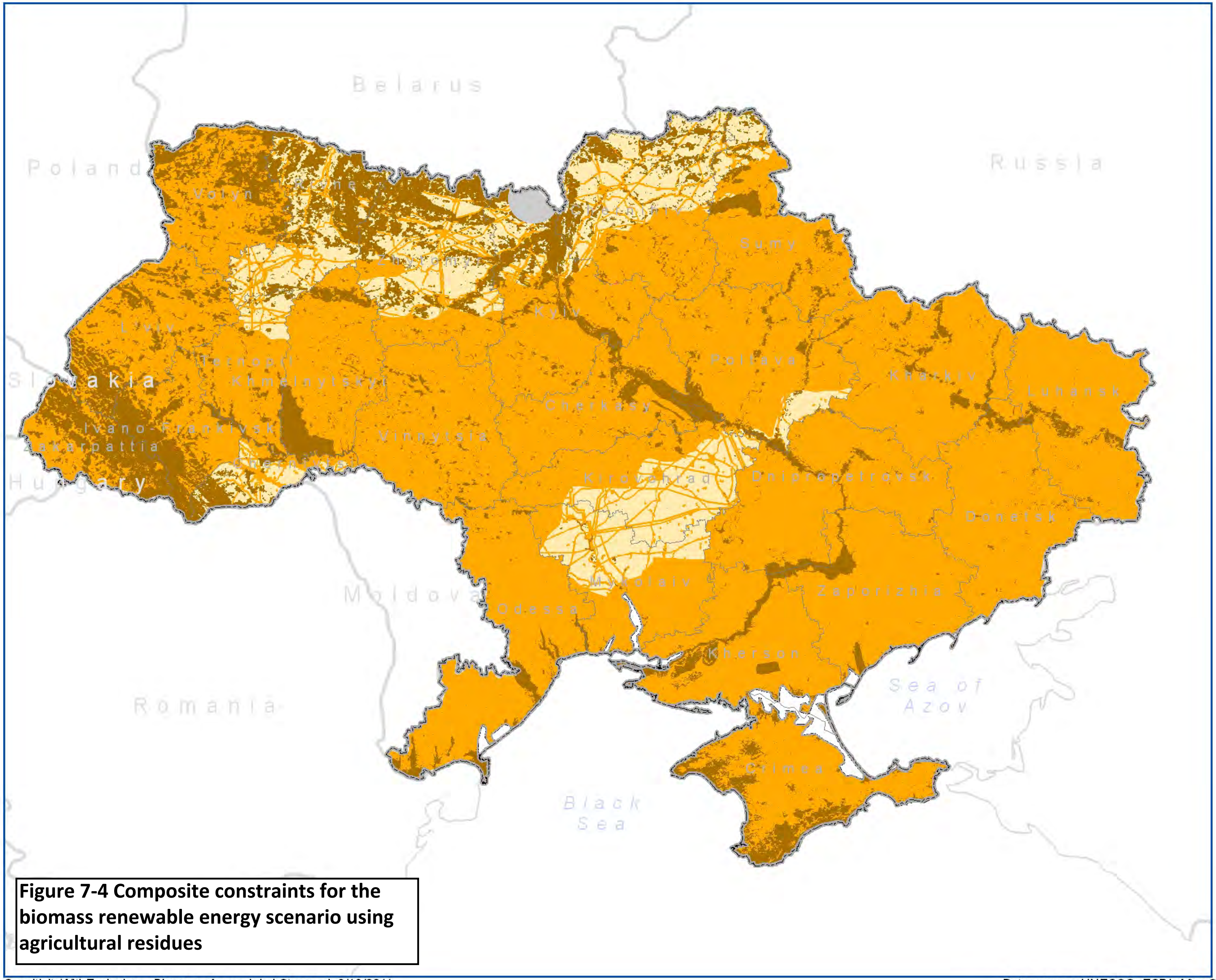


Figure 7-3 Composite constraints for the solar photovoltaic renewable energy scenario

SensitivityWithExclusions_Solar | ste57554 | 9/13/2011



Ukraine Sustainable Energy Lending Facility Strategic Environmental Review

Environmental Sensitivity and Technical Exclusion for Agricultural Residues Biomass Development

Legend

Technical Exclusion

Technical Exclusion

Sensitivity

Low

Medium

High

N W E S

0 50 100

Kilometers

1 cm = 60 km

USELF Ukraine Sustainable Energy Lending Facility

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Figure 7-4 Composite constraints for the biomass renewable energy scenario using agricultural residues

SensitivityWithExclusions_Biomass_Ag.mxd | J.Steurer | 9/13/2011

Data source: UNESCO, ESRI, After C.A. Polyvach, National Atlas of Ukraine.

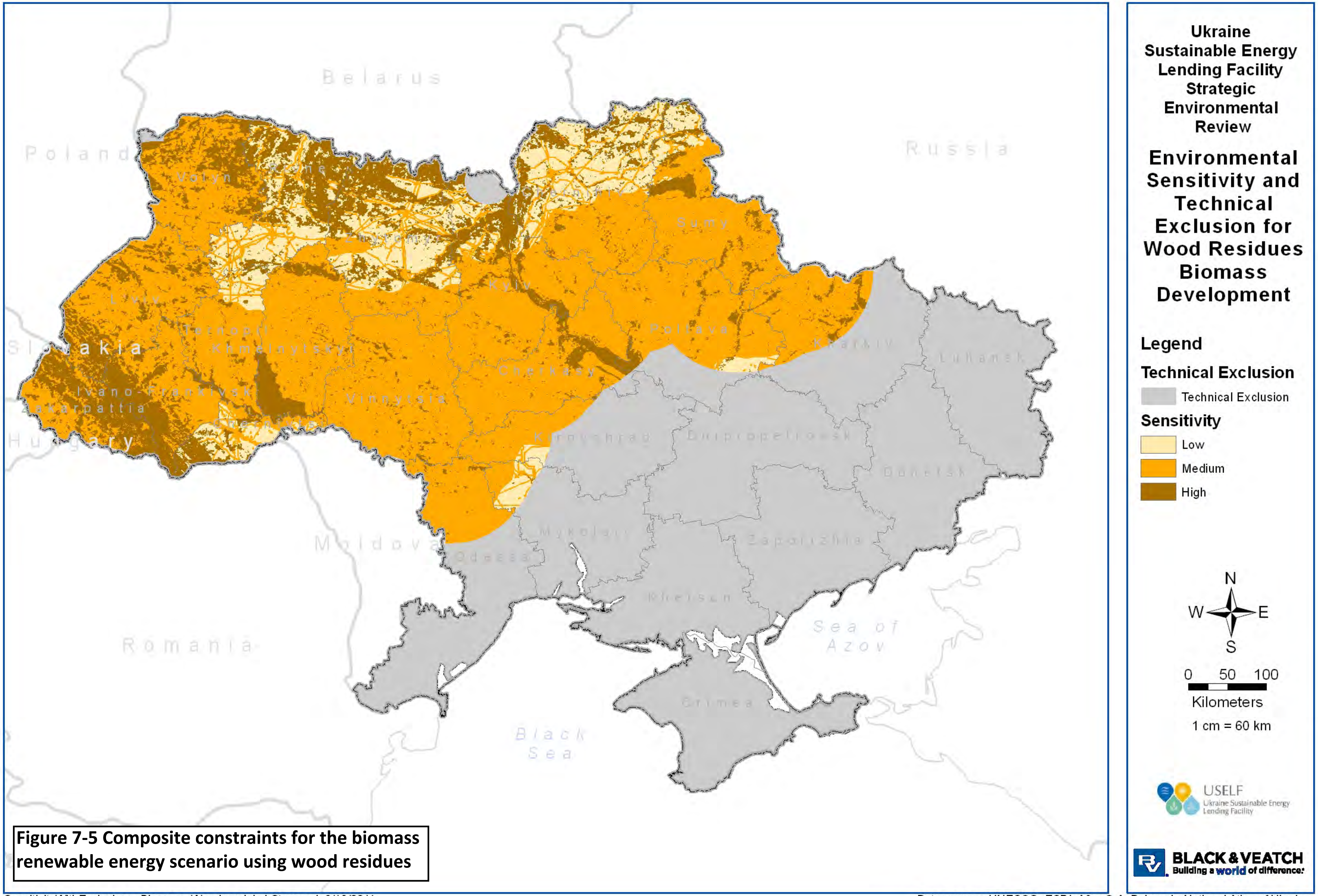

Figure 7-5 Composite constraints for the biomass renewable energy scenario using wood residues

SensitivityWithExclusions_Biomass_Wood.mxd | J.Steurer | 9/13/2011

Data source: UNESCO, ESRI, After C.A. Polyvach, National Atlas of Ukraine.

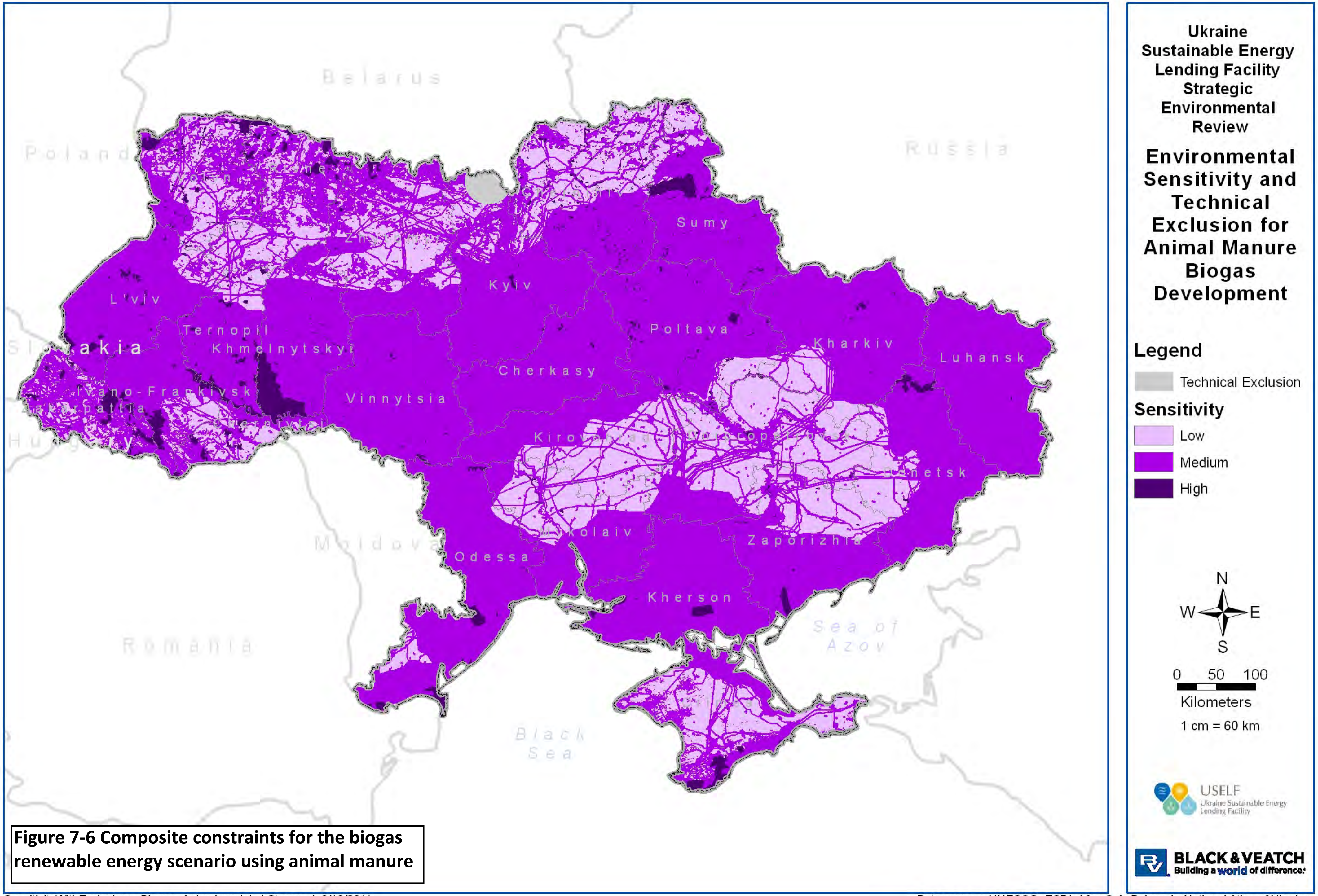

Figure 7-6 Composite constraints for the biogas renewable energy scenario using animal manure

SensitivityWithExclusions_Biogas_Animal.mxd | J.Steurer | 9/13/2011

Data source: UNESCO, ESRI, After C.A. Polyvach, National Atlas of Ukraine.

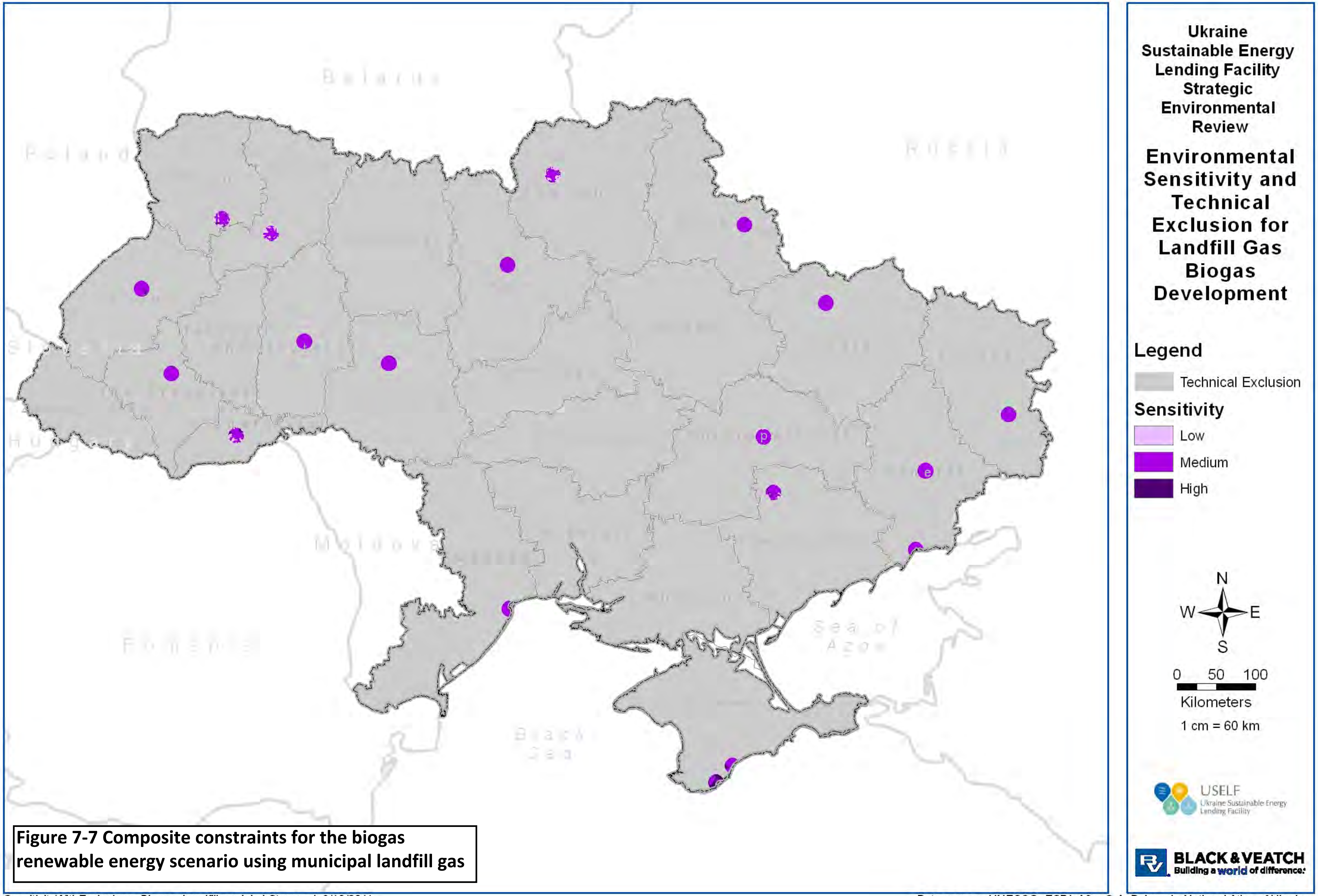

Figure 7-7 Composite constraints for the biogas renewable energy scenario using municipal landfill gas

SensitivityWithExclusions_Biogas_Landfill.mxd | J.Steurer | 9/13/2011

Data source: UNESCO, ESRI, After C.A. Polyvach, National Atlas of Ukraine

7.5 Limitations of spatial constraints analysis

Spatial constraints analysis has been carried out for all renewable energy scenarios and all topic areas under consideration within this SER; in order to provide a high-level overview of the areas in which particular sensitivities are likely to arise, should a renewable energy scenario project be pursued. It is important to note that although great effort has been invested to ensure that these spatial constraints figures are accurate and use the best scientific data currently available, the information presented here is not intended to be interpreted as an absolute categorisation. For example, where an area is not technically excluded and is shown as having 'High' sensitivity, this does not imply that the whole of that area will present major spatial constraints to development; rather, it is showing that any given location from within this area is considerably more *likely* to present spatial constraints to the particular renewable energy scenario under consideration than a location from within other locations. If a project proponent wishes to develop within such an area they should be aware of the risk that such development may be prohibited.

Given the large spatial scales on which much of the available baseline data is based, it is in all cases necessary to undertake further detailed analysis of environmental constraints for individual projects funded by the USELF programme. The information shown in these spatial constraints figures will help to guide the focus of such analysis.

8 LIKELY SIGNIFICANT EFFECTS ON THE ENVIRONMENT AND MITIGATION MEASURES

8.1 Approach to the SER assessment

Impact Assessment Methodology for the SER:

The EU SEA Directive lists the criteria that should be taken into account when determining likely significant effects to the environment (see Box 2). These criteria are only explicitly defined for the purpose of determining whether or not an SEA is needed. However, as they principally relate to the nature of the effects arising from the plan, and the value and vulnerability of the receptors affected, they are also applicable to the assessment of significant environmental effects and have thus been used for this purpose during this SER. This is recognised in the UK SEA Practical Guide.

Box 2: Criteria listed in Appendix II of the SEA Directive

When determining the likely significance of effects on the environment, the Appendix II of the SEA Directive includes the following criteria:

2. Characteristics of the effects and of the area likely to be affected, having regard, in particular, to

(a) the probability, duration, frequency and reversibility of the effects;
(b) the cumulative nature of the effects;
(c) the transboundary nature of the effects;
(d) the risks to human health or the environment (for example, due to accidents);
(e) the magnitude and spatial extent of the effects (geographical area and size of the population likely to be affected);
(f) the value and vulnerability of the area likely to be affected due to -
(i) special natural characteristics or cultural heritage;
(ii) exceeded environmental quality standards or limit values; or
(iii) intensive land-use; and
(g) the effects on areas or landscapes which have a recognised national, Community or international protection status.

An assessment of significance has been made by specialists in each environmental topic, by reviewing the potential effects on each receptor against the above criteria. These assessments were based upon both quantitative and qualitative information, as well as expert judgement and are reported within this SER Environmental Report.

The flow chart below summarises the steps that have been undertaken to complete the significance assessment:

1. Identification of **baseline** and **future baseline**

↓

2. Identification of receptor **value, vulnerability, and sensitivity**

↓

3. Identification of effects upon receptors for each alternative option

↓

4. Identification of whether an effect is **direct or indirect, far-field, cumulative** or a result of **consequential development**.

↓

5. Identification of the **probability** of an effect occurring (H/M/L/VL)

↓

6. Identification of **when** the effect occurs (*construction*, *operation* or *decommissioning* phase)
Identification of **how long** the effect will last for (L/M/S/VS term) and the **frequency** of the effect

↓

7. Identification of whether an effect is **irreversible/reversible** and/or **temporary/permanent**

↓

8. Identification of the **magnitude** of an effect (H/M/L)

↓

9. Identification of the **spatial extent** of the effect and whether the effect is **trans-boundary**

↓

10. Identification of whether the effect is **positive or negative**

↓

11. Statement of **assumptions, limitations and uncertainties** associated with assessment

↓

12. Use of all the information listed above to determine whether the effect is **significant.**

The following paragraphs explain in more detail how the steps set out in the flow chart above have been undertaken during the assessment of likely significant effects upon the environmental topics. The paragraphs below have been numbered to correspond with the numbers within the flow chart.

1. Identification of the baseline and future baseline

This is the approach taken to establish the characteristics of the area likely to be affected, or 'baseline', and its likely evolution in the absence of the proposed programme. Key to the approach is the development of an understanding of the baseline, as defined by a series of 'receptors'. A 'receptor' is an entity that may be affected by direct or indirect changes to an environmental variable. Relevant receptors were identified during the SER scoping stage.

2. Identification of receptor value, vulnerability and sensitivity

In forming a judgement on effect significance, it is necessary to assign the attributes of 'value', 'vulnerability' and 'sensitivity' to each receptor. For the purposes of this SER, the following definitions were used:

Value: the value of a receptor (either high or low) is based on the scale of geographic reference, rarity, importance for biodiversity, social or economic reasons, and level of legal protection;

Vulnerability: the vulnerability of a receptor (either high, medium, low or none) is based on likelihood of a receptor being exposed to an environmental effect from scenarios developed under the USELF, and the receptor's tolerance and resilience to a given environmental effect;

Sensitivity: the sensitivity of a receptor is determined as being either high, medium, low or none, based on the combination of the receptor value and vulnerability, as identified previously in Table 7-1:

3. Identification of effects upon receptors for each alternative option

During the Scoping stage, key constraints and opportunities in relation to the USELF resource scenarios were identified for each environmental topic. These have been used as the starting point for the assessment of significant effects in this assessment stage of the SER. In addition, 'key issues' associated with each scenario have been presented in relation to each environmental topic in the SER Environmental Topic Paper (see Appendix E). As the environmental topic assessments have progressed through the assessment stage of the SER, further key issues have been identified through research and feedback from consultation, and included within the SER Environmental Topic Paper.

4. Identification of whether an effect is direct or indirect, far-field, cumulative or a result of consequential development.

The EU SEA Directive specifies that the assessment of effects should include '*secondary, cumulative, synergistic... effects*' (Appendix I (f)). The UK Practical Guide to SEA recognises that some of these terms are not always mutually exclusive and for the avoidance of doubt, within this SER the following assessment approaches were undertaken.

- Indirect effects are those which are not a direct result of a USELF resource scenario, but occur away from the original effect or as a result of a complex pathway. This SER does not use the term 'secondary effects' as this is covered by indirect effects.
- There is the potential for effects to extend large distances from the USELF scenario locations. The assessments of these 'far-field' effects have greater uncertainty attached and this should be described alongside the assessment of effects.
- Cumulative effects arise, for instance, where several developments each have insignificant effects but together have a significant effect. For the SER, cumulative effects are dealt with through the consideration of each resource scenario in relation to

the future environmental baseline conditions and other policies, plans, programmes, and projects (detailed in Section 2 of the SER Environmental Topic Paper (Appendix E)) that are likely to act in combination with each USELF scenario to cause cumulative effects. Therefore, the assessment of cumulative effects is embedded within the assessment of effects.

- This SER has not used the term 'combined' effects, as these are considered to be included within cumulative effects, nor has it used the term 'synergistic' effects, as these are contained within direct, indirect and cumulative effects.
- A renewable energy scheme, such as a development considered as a component of the USELF resource scenarios, may facilitate or attract other developments, which may themselves pose significant environmental effects. These developments are described as 'consequential developments'. These consequential developments are not well-defined and only a high-level qualitative assessment of the likely effects is possible. It is noted that 'ancillary' developments, that are necessary for the functioning of each USELF scenario, should be considered as part of the scenario, a good example being transmission lines to connect the schemes into the transmission network.

5. Identification of the probability of an effect occurring (H/M/L/VL)

The probability of whether an effect will happen has been recorded as high, medium, low or very low. Table 8-1 sets out the guideline framework which was used for these classifications.

Table 8-1: Guidelines for determining probability of effect

	Probability of effect			
Classification	High	Medium	Low	Very Low
Guideline	**>90%**	**50-90%**	**10-50%**	**<10%**

6. Identification of <u>when</u> the effect occurs (construction, operation or decommissioning phase); <u>how long</u> the effect will last for (L/M/S/VS term); and <u>frequency</u> of effect.

The EU SEA Directive specifies that the assessment of effects should include '*…short, medium and long-term…effects*' (Appendix I (f)).

The timing of effects relates to the period of the project lifecycle during which time an effect will happen. This is described as either the construction, operation or decommissioning stage. The duration is the length of time that effect would last. Table 8-2 sets out the guidelines for describing the project phase and duration of effects.

Table 8-2: Guidelines for determining the period of the project lifecycle

	Duration of effect			
Classification	**Long Term**	**Medium Term**	**Short Term**	**Very Short Term**
Guideline	10+ years	3-10 years	1-3 years	<12 months
Project phase	Operation and Decommissioning	Operation	Construction (or part thereof)	Part of construction period

An indication of the frequency of predicted effects should be undertaken, through consideration of whether the effect will be continual or intermittent over the period of time identified.

7. Identification of whether the effect is irreversible / reversible and temporary / permanent

The EU SEA Directive specifies that the assessment of effects should include '…*permanent and temporary…effects*' (Appendix I (f)).

Effects have been described as **reversible or irreversible** referring to whether the effect could be removed if deliberate action were taken to do so. This judgement has been based on the timescale for a receptor's return to baseline conditions following removal of the source of the effect, in relation to a human lifetime. If the timescale for a receptor's return to baseline condition is greater than 50 years then it has been considered irreversible, if it is less it has been considered reversible.

Effects have been described as **temporary or permanent**, according to whether or not the effect is expected to last for an indefinite period of time. Note that it is possible for an effect to be reversible-permanent (such as the visual effects of a wind turbine, as it would be a permanent fixture that could be removed; which would thereby reverse the effect).

8. Identification of the magnitude of an effect

The assessment of the magnitude of an effect considers the percentage of the receptor affected and is categorised as high, medium, low or very low. Where no effect was predicted for a resource scenario, this has been recorded as 'no change'. The definitions for thresholds of magnitude of effect are classified as high, medium, low, very low or none, and are provided Table 8-3 below.

Table 8-3: Guidelines for determining the magnitude of effects

	Magnitude of effect				
Classification	High	Medium	Low	Very low	None
Guideline	Change to 90%+ of receptor	Change to 50-90% of receptor	Change to 10-50% of receptor	Change to <10% of receptor	No change in receptor

9. Identification of the spatial extent of the effect and whether the effect is trans-boundary

The spatial scale of the effect has been defined as whether the effect is local, unitary authority (i.e. oblast level), regional, national or international. Definitions of the spatial scales used within the SER are provided in Table 8-4. The area or location of the effect has been identified where relevant. Where there is a transboundary effect on an adjacent country, this has also been identified.

Table 8-4: Definitions of spatial scale

Spatial extent of effects	Definitions
International	Effects extending beyond Ukraine
National (Ukraine)	Effects within Ukraine but extending beyond region
Regional	Effects based on the eight electricity transmission areas (Figure 1-2)
Unitary Authority	Effects within an Oblast (Oblasts are shown in Figure 1-2)
Local	Effects confined to a local area, typically <1km from source

10. Identification of whether the effect is positive or negative

The EU SEA Directive specifies that the assessment of effects should include '…*positive and negative effects*' (Appendix I(f)).

A positive effect has been defined as one that is favourable or otherwise beneficial to the condition of a receptor. A negative effect is one that is unfavourable or otherwise adverse to the condition of a receptor.

11. Statement of assumptions, limitations and uncertainties associated with assessment

The EU SEA Directive also specifies that '…*a description of how the assessment was undertaken including any difficulties (such as technical deficiencies or lack of know-how) encountered in compiling the information*' is provided in the Environmental Report.

When undertaking assessments of likely significant effects arising as a result of the renewable energy scenarios it has been assumed that ancillary developments are included in the assessment. Ancillary developments are those developments that are necessary for the functioning of each USELF scenario, a good example being transmission lines to connect the schemes into the transmission network or access roads to allow connectivity to the road network.

Sources of fuel and technical components (such as solar panels, turbines, or biomass fuel-sources) have been excluded from consideration of effects, as it is not possible to reliably predict the location of these sources at this level of assessment. It is assumed that the production of these sources will be managed in a sustainable manner.

Where other assumptions had to be made, limitations observed, and/or uncertainty remained, this has been recorded. Confidence limits, or other suitable approaches, have been applied during environmental topic assessments to ensure that relevant uncertainties are acknowledged.

Environmental topic specialists used all readily available resources to make the most accurate assessments possible of the potential significant effects arising as a result of implementing a USELF resource scenario.

12. Use all the information to determine whether the effect is significant (Y/N)

This is the final stage of the assessment process. Environmental topic specialists have determined whether or not an effect on a receptor is significant based on all the preceding criteria, expert judgement, and feedback from consultation.

A conclusion was made as to whether a significant effect was likely, or not. Gradations of significance are not provided for within the EU SEA Directive. It should also be noted that the determination of significance of each USELF resource scenario is absolute and not comparative or relative to another USLEF resource scenario.

The individual and combined compliance of the USELF resource scenarios, taking into account the comparative scales of the different resource scenarios (as detailed in Table 4-1), has been assessed against the SER Objectives. The SER Objective compliance assessment is detailed further in Section 9.

8.2 Likely significant effects on the environment

8.2.1 Introduction

This Section summarises the likely significant effects of the USELF renewable energy scenarios (the characteristics of which are described in Section 4) upon the receptors considered under each of the six environmental topics (the receptors are tabulated in Section 7.2). A summary of the likely significant effects of each scenario is provided in Section 8.2.8 below. The full tabulated assessment of effects, detailing the characteristics of each effect is provided in Appendix C.

8.2.2 Climate and air quality

Implementation of carbon neutral renewable energy projects through USELF will have a positive effect locally and regionally on climate and air quality during operation, where these replace energy generation from traditional energy sources (i.e. coal, oil and gas). It is also assumed that the technology involved in generating electricity from renewable energy sources will improve over time and thereby avoid the need for the generation of traditional energy to increase at times of low renewable energy yield. The extent of development of renewable energy alternatives can vary depending on geography, resource availability and proximity of electric transmission infrastructure.

The air temperatures in Ukraine have been steadily climbing since the 1980s (the last two decades on the 20th century); specifically in the northern and eastern oblasts (further details are provided in the SER Environmental Topic Paper, see Appendix E). It may not be entirely coincidental that the same regions also have the highest air pollution density. Therefore, implementing renewable energy projects in these regions in place of traditional energy sources may have a net positive effect on climate and air quality, although this is unlikely to be a significant effect and would likely only be realised over a long period of time.

Onshore wind

The USELF on-shore wind scenario will have a positive, although likely insignificant effect on climate and air quality during operation. Other negative effects upon air quality would be emissions during the construction phase of the wind projects. These emissions and associated effects will be localised and temporary, and can be easily mitigated by following good construction practices (discussed further in Section 8.4). No effects from odour are anticipated. Table B1 (Appendix C) summarises the various receptors studied as part of this evaluation and the likely significant effects of the USELF on-shore wind scenario on those receptors.

Small hydropower

As for on-shore wind, the USELF small hydropower scenario will have a positive, although likely insignificant effect on climate and air quality, with temporary effects on air quality during construction. Localised effects during operation to workers and residents associated with odours from the plants may occur. Table B2 (Appendix C) summarises the likely significant effects of the USELF small-hydro scenario on climate and air quality receptors.

Solar photovoltaic

The effects of the USELF solar photovoltaic scenario upon climate and air quality will have a positive but insignificant effect during operation, with temporary negative effects on air quality during construction. Table B3 (Appendix C) summarises the likely significant effects of the USELF solar photo voltaic scenario on climate and air quality receptors.

Biomass (using wood residues)

The scenario based on USELF funded power plants generating electricity by combusting biomass from wood residues would have positive effects on climate, but could cause significant negative air quality effects. In addition to emissions that occur from construction activities (such as dust), air emissions will also occur during the normal operations of the power plant (which would be categorised as stationary source emissions), and during transportation of feedstock and raw materials (which would be categorised as mobile source emissions). Since the biomass plants that may be considered for USELF funding range from less than 2MW to not more than 20MW, most of the emissions will be relatively small when compared to large fossil fuel fired power plants. Consequently the emission effects though permanent, will be regional in nature. In addition to air quality and climate, the other receptor that could be affected is odour. Local odour issues can occur during transportation, storage, handling and energy generation from wood residues. Table B4 (Appendix C) summarises the likely significant effects of the USELF biomass scenario (using wood residues as a feedstock) on climate and air quality receptors.

Biomass (using agricultural residues)

The scenario of power plants combusting agricultural residues will be similar in size and type of effects to power plants combusting wood residues discussed above. Table B5 (Appendix C) summarises the likely significant effects of the USELF biomass scenario (using agricultural residues as a feedstock) on climate and air quality receptors.

Biogas (using municipal landfill gas)

The scenario of power plants generating electricity by combusting municipal landfill gas would have positive effects on climate. It is assumed that the landfill already emits methane during operation, and therefore changes in air quality are not anticipated during operation. If it is necessary to create a sterile lining for the landfill, it is possible that there will be short term increases in odours as existing landfills are excavated and re-filled. Additionally, air emissions will also occur during the normal operations of the biogas plant (which would be categorised as stationary source emissions). Since the municipal landfill gas combustion plants that may be considered for USELF funding will be much smaller than large fossil fuel fired power plants (the largest being about 3 MW in size), most of the emissions will be relatively small in comparison. Consequently the emission effects, though permanent, will be local in nature. The municipal landfill gas projects will have little or no odour related effects during operation. Table B6 (Appendix C) summarises the likely significant effects of the USELF municipal landfill gas scenario on the climate and air quality receptors.

Biogas (using animal manure)

The scenario of biogas projects utilising biogas generated from animal manure will be similar in nature to the projects utilising municipal landfill gas. Like municipal landfill gas projects, if it is necessary to create a sterile lining to manure ponds odour issues could be of concern and have potential for likely significant effects. Local odour issues can also occur during transportation, storing and handling of animal waste. Table B7 (Appendix C) summarises the likely significant effects of the USELF biogas scenario (from animal manure) on climate and air quality receptors.

8.2.3 Surface water and groundwater

Onshore wind

The USELF on-shore wind scenario has potential for significant environmental effects on surface water and groundwater receptors should they be sited in proximity to these. Temporary and reversible significant effects are likely to result from runoff of precipitation or excess construction related flows over disturbed soils on roads, construction of lay down areas, turbine foundation areas, transmission lines and ancillary facilities. Sediments entrained in the stormwater flows can ultimately be released to and deposited in local streams and groundwater, affecting water quality and resources. Such effects are likely to be significant during construction, but much smaller, and therefore not significant during operation. If projects under the USELF on-shore wind scenario are situated within a floodplain, there is potential for temporary changes to the flooding regime through vegetation clearance during construction, as well as permanent minor increases in flood risk within the catchment through the additional land take of turbines and ancillary facilities within the floodplain; these effects are not likely to be significant. Table B8 (Appendix C) summarises the likely significant effects of the USELF on-shore wind scenario on surface water and groundwater receptors.

Small hydropower

The USELF small hydropower scenario will have likely significant effects on surface water receptors and flooding regime, but no significant effect on groundwater receptors. Effects on surface water resource and quality are likely to occur during both the construction and operations periods, these have the potential to be transboundary, if the hydropower scheme is situated close to borders (for example in the Carpathian region). Upstream countries (Poland, Belarus, and Russia) could be impacted by flooding caused by impounded reservoir hydropower systems placed near the border and downstream countries (Moldova, Romania, and Hungary) could be impacted by run-of-river systems that effect downstream surface water flow (this is only the case if they include inter-basin transfer of water). During construction temporary and reversible effects on surface water resource and quality may occur through runoff of precipitation or excess construction related flows, increased siltation downstream through washout, construction of lay down areas, transmission lines and ancillary facilities. Effects of small hydropower operations upon surface water resources and quality are the result of changes in flows that lead to changes in erosion and sediment deposition processes. The extent of effect is dependent partly on the type of small hydropower facility designed but mostly on the construction techniques used.

A run-of-river hydropower operation is designed such that inflow to the facility is equal to outflow. All river flow for hydropower generation is taken from and returned to the river. When excess river flow is available it is spilled over a dam/weir; when excess flow is not available, it bypasses the facility intake. This type of operation has no significant effect on the surface and groundwater resource (effects to biota dependent on the surface water resources are described in Section 8.2.5). Some run-of-river hydropower facilities are designed with a long penstock to take advantage of increases in elevation change between the intake structure and tailrace. These installations have the potential to leave significant downstream lengths of natural stream channel with much less than normal river flow, especially during low flow periods, and can therefore have significant effects to the surface water resource (Table B9 (Appendix C)).

An impounded reservoir design stores the river volume behind an impoundment (i.e a dam and reservoir structure) and hydropower operations materially change the river inflow from outflow; this type of design may result in significant effects to the surface water resource.

Table B9 (Appendix C) summarises likely significant effects of the USELF small hydropower scenario on surface water and groundwater receptors.

Solar photovoltaic

The likely significant effects of the USELF solar photovoltaic scenario upon surface water and groundwater are very similar to those of the on-shore wind scenario, although the likely effects upon water resources and quality during operation will be slightly greater, due to the use of water to wash the solar panels; this effect is not considered significant. Table B10 (Appendix C) summarises the effects of solar photovoltaic development on surface water and groundwater receptors.

Biomass (using wood residues)

The USELF biomass scenario using wood residues will have no significant effect on groundwater receptors or flooding regime, although there are likely to be minor temporary effects upon these during construction as a result of land disturbance and land-take. Likely significant effects upon surface water resources and quality may result from land disturbance during construction (which would result in temporary minor effects) and during operation through the use of surface waters as cooling water, which could increase the total dissolved solids and temperature of receiving waters. Water would potentially be extracted from surface waters, thereby reducing the availability of the water resource, and would return to the watercourse at a higher temperature, which may have implications for water quality. Leachate through biomass storage areas could adversely affect groundwater quality. Table B11 (Appendix C) summarises the likely significant effects of the USELF biomass scenario (using wood residue) on surface water and groundwater receptors.

Biomass (using agricultural residues)

The likely significant effects of the USELF biomass scenario using agricultural residues upon surface water and groundwater are very similar to those of the biomass scenario using wood residues. Significant effects are anticipated upon surface water receptors during both construction and operation and effects on groundwater quality during operation, but minor non-significant effects upon other receptors during both construction and operation. Table B12 (Appendix C) summarises the likely significant effects of the USELF biomass scenario (using agricultural residues) on surface water and groundwater receptors.

Biogas (using landfill gas)

The likely significant effects of the USELF biogas scenario using municipal landfill gas biomass upon surface water and groundwater are very similar to those of the on-shore wind and solar photovoltaic scenarios, although the effects of this scenario will be less because the projects will utilise existing landfill sites. There would likely be somewhat greater adjacent land disturbance effects resulting from development of adjacent generation facilities and ancillary development such as transmission lines. Table B13 (Appendix C) summarises the likely significant effects of the USELF Biogas (Using Landfill Gas) scenario on surface water and groundwater receptors.

Biogas (using animal manure)

The likely significant effects of the USELF biogas scenario using animal manure upon surface water and groundwater are very similar to those of the on-shore wind and solar photovoltaic scenarios. Likely significant effects to surface water may potentially occur during operation, if the digestate waste from the biogas process is used as a liquid soil fertiliser and spread over land, or recycled in the process to dilute fresh water intake. Additionally, leachate through animal manure storage areas could adversely affect surface water and groundwater quality. Table B14 (Appendix C) summarises the likely significant effects of the USELF Biomass (Using Animal Residue) scenario on surface water and groundwater receptors.

8.2.4 Geology and soils

All of the USELF renewable energy scenarios have some similar effects to geology and soils. These generally consistent effects are discussed in the following sections before describing those effects unique to each scenario. Note that for all scenarios the risk of effects from seismic activities would need to be considered (although this is not considered here as part of the assessment of effects):

1. *Bedrock Geology* – Likely effects to bedrock geology will arise from site clearing, grading and excavation activities on a short term basis during construction activities. Depending on physical characteristics of selected project site, extent of levelling and landscaping needed, and excavation and foundation requirements for individual project structures, direct permanent irreversible alterations to underlying bedrock will be incurred by scraping, grading and possibly blasting if required in an area of shallow or exposed bedrock. Although these changes would be characterised as negative, they would be very localised in extent and very low in magnitude, and therefore, not significant.

2. *Landslide Hazard Areas* – Small-hydro is the only USELF renewable energy scenario that would routinely be developed in landslide hazard areas (i.e. areas with slopes greater than 20%). It has been determined to be technically unfeasible to construct any of the other USELF renewable energy resource scenarios on slopes greater than 20% percent (5% for solar photovoltaic schemes). Potential landslide effects would arise from alternation of natural landscapes in project development. Clearing of project sites, including removal of vegetation, along with changes in drainage arising from site grading and construction of project facilities could directly contribute to soil instability risks in landslide prone areas. These would be localised (to the vicinity of the project site) but long term risks would remain throughout the duration of project construction and operations; however, with site restoration, these would be reversible. It should also be noted that building any of facilities in areas located that could be impacted by landslides from unrelated issues could result in a risk of effects to the facilities themselves; therefore, special attention should be paid to this potential when siting facilities.

3. *High Value Soils* – Ukraine is fortunate to have many high value, agriculturally productive soils. In particular, humus-rich chernozem soils used extensively for growing cereals or for raising livestock are plentiful in Ukraine. Displacing agricultural lands with high value soils for renewable energy production presents direct, long term (throughout construction and

operation) negative effects localised to the project site. Losses from erosion created by site clearing and grading during construction, as well as runoff during operations, would be characterised as potential direct negative effects to such high value soils. By removing the most fertile topsoil, erosion reduces soil productivity, and where soils are shallow, erosion may lead to an irreversible loss of farmland. Even where soil depth is good, loss of the topsoil is potentially very damaging. Severe erosion is commonly associated with the development of temporary or permanently eroded channels or gullies that can fragment farmland. Locating renewable energy projects on lands with high value soils will serve to displace farmland cultivation and agricultural production.

4. *Contaminated Lands* – Project activities involving storage and handling of chemicals and petroleum products can, if released or spilled during construction or operations, contaminate soils as well as exacerbate pollution levels in already contaminated lands. Such releases or spills, whether or not accidental or unintentional, will directly contribute to further degradation of the receiving soils. These negative effects are usually locally confined to the spill area(s), and are reversible by means of remediation. It should also be noted that the construction of renewable energy sites that require construction of foundations could create pollution pathways for contaminants in areas that have been previously contaminated by other activities. Alternatively, the placement of renewable energy facilities on previously contaminated lands (e.g. brownfield sites) can provide a beneficial reuse of these lands if constructed using best management practices to prevent the spread of contamination during construction.

5. *Soil Composition*– Degradation of soils resulting from removal of vegetation, release of chemicals, deposition of pollutants and compaction under heavy equipment and facilities can result in changes to soils. Erosion and releases of chemicals are discussed immediately above. Soil compaction is a form of physical degradation resulting in densification and distortion of the soil where biological activity, porosity and permeability are reduced, strength is increased and soil structure partly destroyed. Compaction can reduce water infiltration capacity and increase erosion risk by accelerating run-off. The compaction process can be initiated by construction equipment (equipment wheels, crane tracks, rollers, etc) or by foundations, structures and facilities. These negative effects are direct to the site, and localised in spatial extent. Most of these effects are reversible with applied soils mitigation such as re-vegetation, ploughing and remediation.

Onshore wind

High Value Soils - Due to the limited footprint, height and spacing of wind towers, this is the one renewable energy scenario that may allow for concurrent land use with agricultural production or farmland cultivation. As a result, the likely negative effects of the on-shore wind scenario upon high value soils are low.

Table B15 (Appendix C) summarises the likely significant effects of the USELF on-shore wind development on the geology and soils receptors identified.

Small hydropower

Bedrock Geology – Construction of diversions and dams for hydropower will more likely involve excavation and blasting to bedrock due to its more favourable location in more mountainous terrain, although this negative effect is unlikely to be significant.

Landslide Hazard Areas – Inundation of soils from reservoir impoundments may particularly contribute to risks of landslides, although, because these are usually placed in terrain lower than surrounding areas, the effect is not likely to be significant. Construction of run-of-river types of hydropower facilities would typically occur in more mountainous terrain and activities in or near landslide prone areas could result in an increased risk of adverse effects related to landslides.

Table B16 (Appendix C) summarises the likely significant effects of the USELF small hydropower scenario on the geology and soils receptors identified.

<u>Solar photovoltaic</u>

Bedrock Geology – because solar photovoltaic sites are typically graded as level as possible, this may require additional excavation and removal of bedrock if constructed in areas of shallow or exposed bedrock. Overall, this would not be characterised as significant, as the negative effects will remain very localised to the site and very low in magnitude.

High Value Soils - Due to the levelling of the site, the scale of the projects, and the need to keep vegetation limited in height to avoid interfering with receipt of sunlight by the photovoltaic panels, this presents effects of higher magnitude than for the other renewable scenarios, through the removal of high value soils from agricultural productivity if sited in areas of high value soils.

Soil Composition – The need to continually wash the photovoltaic panels during operations presents the potential for additional effects from wash water and chemicals percolating into the soils and affecting its structure and condition.

Table B17 (Appendix C) summarises the likely significant effects of the USELF solar photovoltaic scenario on the geology and soils receptors identified.

<u>Biomass (using wood residues)</u>

Soil Composition – Potential acidification from deposition of air pollutant emissions (i.e. SO2, NO2 and CO2), as well as release of leachate to underlying soils from storage and disposal of biomass combustion by-products (ash or sludge) during operation presents an additional likely significant effect for these biomass scenario projects.

Table B18 (Appendix C) summarises the likely significant effects of the USELF biomass (using wood residues) scenario on the geology and soils receptors identified.

<u>Biomass (using agricultural residues)</u>

High Value Soils – Fuel supply for these scenario projects demand nearby agricultural production. Fuel supply is therefore an additional effect consideration that may either promote productive use of lands with high value soils that are not currently used, or displace other uses of the land.

Soil Composition – Potential acidification from deposition of air pollutant emissions (i.e. SO2, NO2 and CO2), as well as release of leachate to underlying soils from storage and disposal of biomass combustion by-products (ash or sludge) during operation presents an additional likely significant effect for these biomass scenario projects.

Table B19 (Appendix C) summarises the likely significant effects of the USELF biomass (using agricultural residues) scenario on the geology and soils receptors identified.

Biogas (using landfill gas)

High Value Soils – There is a lower likelihood that high value soils would be immediately adjacent to urban landfills, therefore lessening the probability of effects from this scenario upon high value soils to very low. As a result, there are unlikely to be significant effects upon high value soils from this scenario.

Soil composition – Due to the limited disturbance of soils required for the construction of biogas facilities at existing landfill sites, there are unlikely to be significant effects upon soil composition resulting from this scenario during construction. Nevertheless, combustion of municipal landfill gas presents an additional risk of potential acidification from deposition of air pollutant emissions (i.e. SO2, NO2 and CO2) from these projects during operation, which has potential for significant effects.

Table B20 (Appendix C) summarises the likely significant effects of the USELF biogas (using municipal landfill gas) scenario on the geology and soils receptors identified.

Biogas (using animal manure)

High Value Soils – There is a potential increased utilisation of nearby cultivation of animal feed or grazing from lands with high value soils to provide waste fuels for this scenario.

Soil composition - Handling, storage and land application of animal waste products present additional risks to soil composition and productivity from releases or land application in excessive quantities or concentrations, and may lead to significant effects. Excessive application, or if manure is applied on saturated soils with high rates, can create a condition in which more nitrogen and phosphorous are being applied than is being used by the crop, resulting in nitrogen losses. There are also additional risks of soil pollution by heavy metals and addition of soluble salts that originate from animal manure. Finally, there is an additional risk of potential acidification from deposition of air pollutant emissions (i.e. SO2, NO2 and CO2) from these projects.

Table B21 (Appendix C) summarises the likely significant effects of the USELF biogas (using animal manure) scenario on the geology and soils receptors identified.

8.2.5 Landscape and biodiversity

For all of the scenarios there are number of potential common effects on landscape and biodiversity that must be considered prior to selection of sites and projects. These common potential effects are:

- The adverse effect of new above ground structures associated with power generation devices, power houses and ancillary developments such a new linear new power lines and access roads on landscape character, setting and visual amenity. Such adverse effects may be exacerbated if viewed from elevated locations or if structures are sited on ridgelines. Such effects may be reduced if obscured by intervening features such as variations in landform, existing buildings or trees/forest;

- Habitat loss, fragmentation and or simplification associated with the development footprint of the renewable power development and consequentially potential adverse effects on protected species that utilise those habitats;
- Potential increase in bird and bat mortality, due to an increased risk of collision/electrocution where new ancillary power lines are located within bird migration corridors or bird and bat foraging areas.

Onshore wind

The introduction of wind farms will have significant negative effects on both landscape character (on a unitary authority scale) and visual amenity. Individual turbines, 100m in height, will be visible up to a distance of 30km. Dependent upon location there could be effects on bordering countries. They will register as new, unnatural vertical upright structures that will be out of character for most landscapes. In landscapes where there are intervening features (built, landform or forest) views may be reduced, however in flat, steppe/arable landscapes they will be particularly noticeable. It is worth noting that turbines will protrude well above the tree line so that forest will only block/filter views if close to the viewpoint. Protected and high quality landscapes and their setting may be particularly vulnerable to these effects.

Land take from wind farm arrays has the potential to lead to significant environmental effects due to habitat loss. Wind farm development within or adjacent to protected coastal wetland sites along the Black Sea, Crimea and Azov Sea coasts has the potential adversely affect important wetland and associated terrestrial habitats that provide support to nationally and international (Ramsar) important populations of migratory birds. Similarly development within or adjacent to freshwater wetland sites in the Western Broadleaf, Carpathian & Northern Mixed Forest Zones has the potential to adversely reduce the area of available habitat along important migratory routes on the Scandinavian - Black Sea – Mediterranean flyway and other regional and national migratory routes. In addition to the effects of habitat loss, the siting of wind turbines within or adjacent to habitats which provide important nesting, roosting or feeding sites for bird populations may increase the risk of direct mortality through bird strike; either through collision with the turbine blades or new connecting transmission lines. Birds of prey, passerines and other endemic species of bird are also vulnerable to similar affects associated with habitat loss and risk of turbine strike within in-country migration routes (such as the Dnipro river corridor).

There are two main ways in which windfarms can affect birds: by collision with the turbines themselves, and through disturbance from a zone around them. Serious problems with bird strike have been recorded at windfarms in some countries, notably with birds of prey. The evidence shows that birds and windfarms can coexist if the windfarm site is located appropriately. In particular, windfarm development should avoid areas: (i) with high-density raptor populations, where collisions could be significant; (ii) with high densities of other species vulnerable to a low level of additional mortality, and whose susceptibility to collision may be high; and (iii) where disturbance could potentially displace birds from important feeding or nesting habitats. It is vital to consider the potential problems of collisions and disturbance at windfarms on a case-by-case basis (Percival, 2005).

The development of wind farms within areas utilised by protected bat species has the potential to lead to significant adverse effects through loss of woodland, river corridor and meadow habitats used for foraging; whilst the loss of woodland may adversely affect the availability or access to important roosting sites. In addition, wind farm developments and the construction and use of new access routes has the potential to disrupt or bisect bat flight corridors, and potentially access to cave (particularly karst) habitats which have the potential to provide important roosting sites. The increased risk of collision with wind turbines and moving vehicles has the potential to lead to direct mortality and also discourage use and access of wider areas through the creation of behavioural barriers either due to new roads or changes in land cover. The most significant effects are likely in areas of particular importance for bat populations in the Crimea, Pollisia, Steppe and Carpathian Zones.

Wind farm development in deciduous or mixed forest and open grassland mosaics within the Carpathian, Western Broadleaf, Northern Mixed forest and Forest Steppe zones has the potential to reduce available habitat within the range of herding species such as the European bison (*Bison bonasus*). Broader scale habitat loss within woodland and grassland mosaics within the northern and western extents of the country will also potentially affect other wide ranging protected species such as the lynx (*Lynx lynx*), brown bear (*Ursus arctos*) and wildcat (*Felis sylvestris*).

Land take from wind farm arrays, new access routes and transmission lines has the potential to lead to the direct loss of forest, Yaila (alpine meadow) grassland and savannah habitats and associated reduction in ecosystem function. To a lesser extent there may be significant adverse effects on the ecology of cropland/natural habitat mosaic and croplands habitats due to land take from wind farm arrays, new access routes and transmission lines.

The most likely effects to aquatic communities would result from runoff of precipitation over disturbed soils on roads, construction lay down areas, turbine foundation areas, transmission lines and appurtenant facilities. Sediments entrained in the stormwater flows can ultimately be released to and deposited in local streams, affecting water quality, aquatic habitat, and associated life forms. Such effects are most likely to occur during construction.

Table B22 (Appendix C) provides a summary of the likely significant effects of the USELF on-shore wind scenario on landscape and biodiversity.

<u>Small hydropower</u>

Landscape effects will arise from the creation of new reservoirs up to 50ha in size, dams, powerhouses and other associated structures. They may be visible to people living within 20km and users of roads, tracks and trails passing within this visual envelope. The effects on protected and high quality landscapes and the setting of these landscapes can be expected to be negative and significant as they are likely to be valued for their existing landscape characteristics, which would be lost. In low quality landscapes, reservoirs may provide attractive new features which may improve landscape character on local level. Also, the effects of new dams and hydro facilities within river landscapes which are already heavily influenced by hydropower may reduce the overall effect of the new structures on the character of that area.

The damming of water courses may effect water dependent protected areas affecting their structure or function. This may be due to either reduced availability of water, modification of the flooding regime or permanent flooding and inundation of protected areas upstream of the dam. The clearance of vegetation and construction works for additional access to hydropower development may also lead to direct footprint losses within or adjacent to protected.

Outside of the protected areas the development of new hydropower facilities has the potential to lead to direct footprint losses. These can be within the newly impounded areas or through the development of new access roads that may lead to the loss of forest, riparian, Yaila and grassland habitats cropland -natural habitat mosaic and croplands.

Key effects on aquatic ecology are associated with the following:

- *Blockage of upstream/downstream migration pathways*'
- *Entrainment and impingement of aquatic organisms;*
- *Changes in erosion and sediment deposition processes*; and,
- *Changes in Habitat Conditions (Instream Flows, Water Quality, Physical Habitat, etc.).*

The introduction of new hydropower developments within sections of watercourse not previously exploited has the potential to adversely affect a number protected fish species within the main river catchments of the Dneister, Tissa and Dnieper Rivers and their tributaries. New dams may introduce new barriers to migration of such fish species and other aquatic organisms making river reaches important for functions such as reproduction, feeding, and seasonal movement inaccessible. In cases where several dams are located within the same basin or range of an affected species, significant cumulative effects can result.

The operation of new facilities may lead to an increased risk of mortality or injury through entrainment and impingement to already vulnerable populations of fish, such as the various species of sturgeon, salmon and other anadromous fish found in Ukraine rivers. Existing hydropower developments already present significant barriers to migratory fish. New hydropower development within these areas may have limited effects on migratory species when considered in combination with historic hydropower installations.

Changes in erosion and sediment deposition can result from two sources; runoff from precipitation (most prevalent during construction), and fluctuations in water levels in the reservoir and in downstream river reaches during operation. Erosion and sediment deposition can degrade water quality by increasing turbidity and impeding the life cycles of affected organisms. Sediment deposition can suffocate fish eggs or immobile organisms that cannot escape the vicinity.

Entrainment occurs when aquatic organisms are drawn into a hydroelectric facility's intake, carried through the turbines, and ultimately discharged at the downstream end. Injury and mortality can result, typically due to pressure changes and physical damage. Impingement occurs when aquatic organisms are unable to escape the intake flows and are pinned against the face of the trash racks or screens at the intake entrance. Mortality typically results due to suffocation or physical damage. Entrainment and impingement mortality can be significant in areas that support important aquatic populations (e.g., fish spawning and rearing areas) and at particular times of year (e.g., periods of seasonal migration). Cumulative effects can also be significant if entrainment and/or impingement effects occur at multiple hydroelectric facilities on the same stream.

The development of a hydroelectric facility can result in significant changes in local aquatic habitat due to modifications in flow conditions, water quality, and physical habitat. These changes can occur upstream and downstream of the hydroelectric dam, as well as in the bypass reach. Impoundment converts upstream reaches of river from natural lotic (riverine) to lentic (lake) conditions resulting in decreased flow velocities, increased water depths, and overall changes in flow patterns. Water temperatures in the impoundment may increase over natural stream temperatures; concentrations of nutrients and pollutants may increase as the impoundment acts as a "sink" where constituents collect. As a result anoxic conditions may develop in the impoundment's lower depths, particularly during the summer months. Physical habitat in the reservoir basin can be modified as sediments, gravel, and other debris accumulate in the reservoir.

Bypass reaches or downstream reaches can likewise undergo significant changes in flow regimes as stream flows are reduced or regulated to reduce the drastic flow fluctuations that would otherwise occur naturally. Such conditions can be accompanied by changes in the natural riffle-pool-run characteristics of the stream and increased water temperatures. Natural erosion and sedimentation processes may be interrupted, affecting the quality and quantity of physical habitat in affected stream reaches. These factors can result in significant changes in resident aquatic communities, and interfere with the viability of migratory species.

Table B23 (Appendix C) provides a summary of the likely significant effects of the hydropower scenario on landscape and biodiversity.

<u>Solar photovoltaic</u>

The introduction of photovoltaic arrays and ancillary development over a wide area will affect landscape character by replacing existing scenic landscape with areas of dark panels which will register as expansive unnatural features. However, solar developments would most likely be low lying; therefore, the effect on visual amenity will be most apparent when viewed from an elevated positions or close locations. The effects on protected and high quality landscapes and their setting can be expected to be negative and significant. Protected and high quality landscapes and their setting may be particularly vulnerable to these effects.

Land take from solar photovoltaic arrays has the potential to lead to significant environmental effects due to habitat loss. Developments within or adjacent to protected coastal wetland sites along the Black Sea and Azov Sea coasts have the potential to adversely affect important wetland and associated terrestrial habitats that provide support to important populations of migratory birds. The locations of such developments may also lead to an increased potential for bird strike associated with ancillary power line development within or adjacent to Ramsar sites in the flat coastal areas of Odessa and Crimea. Birds of prey, passerines and other endemic bird species such as the great bustard (*Otis tarda*) may also vulnerable to similar affects associated with habitat loss and to a lesser extent, the risk of bird strike on new transmission lines within in-country migration routes.

The development of solar arrays within the flatter topography of the central and eastern of Ukraine has the potential to lead to the loss of habitat for foraging and roosting bats if associated with the clearance of vegetation from woodland, river corridor and meadow habitats. The creation of new access routes may also disrupt or bisect bat flight corridors. The increased risk of collision with moving vehicles has the potential to lead to direct mortality and also discourage use and access of wider areas through the creation of behavioural barriers either due to new roads or changes in land cover.

Land take from solar arrays, new access routes and transmission lines has the potential to lead to the direct loss of forest, grassland and savannah habitats and associated reduction in ecosystem function within the flat landscape areas of the Crimea, Steppe and Forest Steppe zones. Whilst to a lesser extent there may be significant adverse effects on the ecology of cropland/natural habitat mosaic and croplands habitats due to land take from solar arrays and ancillary development.

The most likely effects to aquatic communities would result from runoff of precipitation over disturbed soils on roads, construction lay down areas, foundation areas, transmission lines and appurtenant facilities. Sediments entrained in the stormwater flows can ultimately be released to and deposited in local streams, affecting water quality, aquatic habitat, and associated life forms. Such effects are most likely to occur during construction.

Table B24 (Appendix C) provides a summary of the likely significant effects of the solar photovoltaic scenario on landscape and biodiversity.

<u>Biomass (using wood residues)</u>
This type of development requires significant land take and may affect the character of scenic landscapes by replacing existing land cover and features with new buildings and tall structures, and associated transmission lines. New structures could be seen from up to 30km away. The effect is likely to be local with the potential to become international if visible from the Ukrainian border. Visual amenity may also be affected by the possibility of a high number of truck movements. Developments of this nature could have significant negative effects on protected and high quality

and landscapes and their setting. If existing coal plants are converted then effects will be greatly reduced and the developments are less likely to have significant effects.

Land take associated with the development of larger wood residue biomass schemes and associated footprint losses due to transmission and fuel delivery access has the potential to adversely affect protected woodland habitats in Carpathian Biosphere. However, the limited availability of wood residues within the country as a whole is likely to limit development to one or two schemes within the Zhytomyr and Zakarpattia oblasts, leading to a low probability of development being directly located within or adjacent to the protected areas.

There is the potential for significant effects on biodiversity associated with the requirement to transport large amounts of wood residue waste from within a 100km delivery area. The associated increase in vehicle movements and potential requirement to upgrade and extend the existing road network may lead to indirect effects on protected species and unprotected found within this area due to an increased risk in mortality and disruption of wildlife corridors.

The ancillary development of new transmission lines may also lead to a greater incidence of bird and bat strike if located within existing flight corridors.

The effect of land take and associated habitat losses from new Combined Heat and Power plants and ancillary development also has the potential to adversely affect protected areas and remnant natural ecosystems associated with woodland, Yaila and grassland in the Northern Mixed and Western Broadleaf Forest Zones, if development is unconstrained. However, the magnitude of such effects is likely to be limited due to the small scale nature of their development.

The effect of wood residue biomass resource development scenario is likely to have limited effects of the aquatic environment due to the scale and nature of the developments involved. Such effects are likely to be associated with:

- Erosion and stormwater runoff;
- Wastewater discharge to receiving streams; and,
- Water supply withdrawals.

Effects on aquatic communities would result from runoff of precipitation over disturbed soils on roads, construction lay down areas, foundation areas, transmission lines and appurtenant facilities. Sediments entrained in the stormwater flows can ultimately be released to and deposited in local streams, affecting water quality, aquatic habitat, and associated life forms. Such effects are most likely to occur during construction and, to a lesser extent, operation.

Wastewater discharges from biomass facilities may be high in total dissolved solids, temperature and, depending on the means of treatment, other constituents. Wastewater discharges that are released to surface waters can degrade water quality and, in turn, negatively affect the aquatic organisms inhabiting those waters. Wastewater discharge plumes can also impinge directly on slow-moving or immobile aquatic organisms and inhibit the movements of migratory species. These factors can shift the composition and distribution of local aquatic communities as less tolerant species decrease or disappear, and more tolerant species increase.

Water withdrawals from surface waters can effect aquatic communities by reducing natural stream flows and thus, affecting the quality and quantity of available habitat. Water withdrawals may also potentially result in the entrainment and impingement of aquatic organisms. However, the significance of such effects will be largely dependent on the scale of development and daily abstraction requirements, which in this scenario are considered to be limited,

Table B25 (Appendix C) provides a summary of the likely significant effects of the biomass scenario (using wood residues) on landscape and biodiversity.

Biomass (using agricultural residues)

The nature of significant effects are likely to be as for biomass using wood residues, however the resource scenario indicates that there is a much greater potential for development across the country due to higher levels of availability of agricultural residue biomass.

The development of biomass CHP plant fired on agricultural residues has the potential to lead to habitat losses within or adjacent to internationally, national and regional protected biodiversity areas in the Western Oblasts and Crimea, leading to potential significant adverse effects on the structure and function of such sites. There is however, a greater potential for habitat losses and fragmentation with protected areas and remnant natural or modified ecosystems through land take for the estimated potential development of two 20-50MW plants in each oblast within the central, northern, southern and south western regions. In comparison the effects associated with retro-fitting coal fired power stations will be limited to the expansion of fuel handling areas and are unlikely to be significant.

The effects on biodiversity and the aquatic environment associated with plant construction and operation, increased transport development and use and ancillary development of new power lines development for connection to the existing transmission network will be similar in nature to that for wood residue biomass development. However, the magnitude of effects associated with the development scenario is likely to be greater due to greater potential for development across the country.

Table B26 (Appendix C) provides a summary of the likely significant effects of the biomass scenario (using agricultural residues) on landscape and biodiversity.

Biogas (using landfill gas)

This type of development has a limited land take as existing landfill sites would be utilised. New buildings, structures and associated pylons/cables may affect local landscape character and visual amenity for a distance of up to 20km. It is unlikely that existing landfill sites are located within protected or high quality landscapes; however, it is possible that the height and mass of new structures and transmission lines could affect their valued setting, disrupting views and forming an unwelcome focal point. Landfill biogas facilities are likely to be close to high population centres; therefore, they have the potential to affect large numbers of people in all landscapes.

The effects of the landfill biogas resource development scenario on biodiversity are likely to be limited by the small scale nature of the development within an already heavily disturbed area. There may be the potential for limited land take leading to loss of natural or modified habitats, however such effects are unlikely to be significant as habitats on the edge of the landfill site are unlikely to be of high value. There may be the potential for an increased incidence of bird strike associated with the ancillary development of power lines;, particularly if sections of the landfill remain uncovered and attract scavenging bird species directly to the waste deposited.

The construction and operation of power plant facilities may lead to the potential for adverse effects on the aquatic environment. Such effects are likely to be associated with:

- Erosion and stormwater runoff.
- Wastewater discharge to receiving streams.
- Water supply withdrawals.

Effects on aquatic communities would result from runoff of precipitation over disturbed soils on roads, construction lay down areas, foundation areas, transmission lines and appurtenant facilities. Sediments entrained in the stormwater flows can ultimately be released to and deposited in local streams, affecting water quality, aquatic habitat, and associated life forms. Such effects are most likely to occur during construction and, to a lesser extent, operation. Considering the small amount of wastewater generated by a biogas facility, it is assumed that discharge to surface waters will be minimal or non-existent and are considered to be insignificant.

The effects to aquatic communities and protected aquatic species due to biogas-related water supply withdrawals are considered to be insignificant as little or no water will be required for project operation.

Table B27 (Appendix C) provides a summary of the likely significant effects of the biogas scenario (using municipal landfill gas) on landscape and biodiversity.

Biogas (using animal manure)

This type of development requires a relatively small land take (up to 5ha). New buildings, structures and associated transmission lines may affect local landscape character and visual amenity for a distance of up to 20km., The effect could be international if visible from the Ukrainian border.

The effects of the landfill animal manure resource development scenario on biodiversity are likely to be limited by the relatively small scale nature of individual developments within or adjacent to intensively farmed areas. However, there is the potential for habitat loss associated with land take if such areas border and location within protected biodiversity areas or areas of remnant natural ecosystems or diverse natural/cropland habitat mosaics. As with the other resource scenarios considered there is the potential for increased bird strike risk, dependent on location, associated with the development of new connecting power lines.

Table B28 (Appendix C) provides a summary of the likely significant effects of the USELF biogas scenario (using animal manure) on landscape, biodiversity, aquatic ecosystems and protected fish, and aquatic organisms and their habitats.

8.2.6 Community and socio-economics

For all of the USELF renewable energy scenarios there are common potential effects that must be considered prior to selection of sites and projects:

- Dislocation of communities or households as a result of the facilities, roadways or power transmission lines;
- Hazards to human health during construction, including dust, noise and dangers to workers, and exposure to electromagnetic fields if households are located too close to power transmission lines (note that odour effects are discussed under 8.2.2 above);
- Economic benefits of increased employment opportunities, improved energy reliability, but also possible loss of lands for other economic activities, including around power transmission lines;
- Pressure on existing infrastructure through increased traffic of heavy loads for construction, and need to expand existing power transmission lines; and
- The positive effect of improving the potential for eco-tourism marketing.

These effects are significant and early attention to these is critical to project success for any of the scenarios under consideration. The effects here are in addition to those specific to the scenarios outlined below.

The potential dislocation of communities or households as a result of the facilities, roadways or power transmission lines should be avoided, as this is disruptive to communities and can be costly. Forced or involuntary resettlement is extremely high effect, with lasting duration and it can have long term negative effects such as loss of social identity, loss of social networks, and economic hardships. If households or communities are willing to be relocated under voluntary conditions, and given acceptable resettlement and compensation, this is not considered an effect.

Effects on human health during construction include dust, noise and dangers to workers. The dust and noise come from grating of roads, site preparation and construction of buildings and power lines. The intensity of these will vary by scenario. The possibility of injury to workers is significant across all scenarios, as is working with heavy materials and hazardous materials such as solvents and paints. Working at heights and large-scale construction (which would be applicable to several of the USELF scenarios) also pose risks to workers. The additional risks to workers include working with active power lines and power transmission systems. The exposure to electromagnetic fields if households are located too close to power transmission lines can have human health effects, as prolonged exposure is hazardous to human health and development. Additional human health effects for specific scenarios are outlined below.

Positive economic benefits of increased employment opportunities would arise for construction, maintenance and operation of all the scenarios. The employment for construction will be higher than for operation and maintenance; however, in remote areas with few profitable opportunities, this will be beneficial for local communities, both directly and indirectly. The direct benefit stems from employment for construction, maintenance and operation, if local labour is suitable for these activities. The secondary employment opportunities stem from supporting economic activities, such as food supply, lodging of workers, and support to infrastructure. An additional positive effect would arise from the improved energy reliability in remote areas where power supply currently can be intermittent. There is a possible loss of land for other economic activities, including around power transmission lines; especially during construction activities. However once these are established for wind, and below transmission lines, these lands are suitable for agricultural use, emphasising the dual land use benefits.

For all scenarios, there is the effect of pressure on existing infrastructure through increased traffic of heavy loads for construction. In areas that are remote and do not have strong transportation infrastructure additional reinforcements will be needed to be able to use the existing roads and bridges. In all cases there will also be a need to expand the existing power transmission lines to connect the renewable energy facilities to the power grid.

The use of renewable energy scenarios has the positive long-term effect of improving the potential for eco-tourism marketing for Ukraine. This positive effect could serve to support other ecotourism marketing strategies for regional and international tourists.

<u>Onshore wind</u>

A primary concern for the effect of on-shore wind development is addressing the perception that the wind farms might be situated at the expense of non-Ukrainian ethnic minorities. In Crimea and Donets there are high percentages of non-Ukrainian ethnic groups; Mykoliav (Nikoliaev) has a smaller non-Ukrainian population. The on-shore wind scenario forecasts the highest levels of investment in wind developments in the Crimean and Donet regions; therefore, there could be a perception that one group is being given preferential treatment either in the siting and employment opportunities, or in land appropriated for wind farms. The effects of the ethnic tensions could be increased if the dual earning potential of agricultural lands serving as wind farms may be seen to be offered to one group and not others. The human health risks for wind power beyond those listed above include risks associated with working at extreme heights with large equipment in potentially high wind. There is an economically beneficial effect of being able to use land for both wind power generation and agricultural purposes simultaneously. The potential effects upon socio-economic receptors as a result of the USELF on-shore wind scenario are detailed in Table B29 (Appendix C).

Small hydropower

The likely significant effects on community and socio-economic factors from small hydropower will occur during construction, operation and decommissioning. There is a mix of both positive and negative effects. The effects on human health from noise, dust and vibrations during construction may be disruptive and may be considered to be more significant than that for the other scenarios given the extent of construction activity involved in this scenario. This can also have negative effects on tourism development in nearby areas during construction. There are also human health effects of potential threats to human health due to use of heavy construction equipment. The positive aspect for local communities may stem from labour during construction and operations. Construction will likely include the need to build or fortify roadways and bridges to support large equipment and materials transport. This will also largely be affected by the proximity of the hydropower facility to steel and cement production facilities. During construction a negative effect is the change in river flows during construction and operation due to filling for impoundment facilities, and operational changes in downstream river flows that may affect agricultural activities and mining operations. This effect may be compounded for trans-boundary rivers like the Tisa, as mining and agriculture activities are important in downstream communities in neighbouring countries.

During operations, there will be fewer effects on communities, downstream users, and tourism, but also a decline in employment opportunities. A potential negative effect from impoundment dams is the change in flow regimes thereby increasing economic and human losses due to flooding. Alternatively, creation of small reservoirs for retention based hydropower may also increase opportunities for recreation and fishing and associated benefits for economic development of these small tourism industries.

During decommissioning, if dams are decommissioned and replaced instead of rehabilitated, the effects are similar to those of construction with more potential negative effects on human health depending on the materials used in construction of the dam and associated buildings.

The potential effects upon socio-economic receptors as a result of the USELF small hydropower scenario are detailed in Table B30 (Appendix C).

Solar photovoltaic

The community and socioeconomic effects for the USELF solar photovoltaic scenario are dependent on the nature of the sites selected and include the potential for short term effects on human health, loss of arable land and potential for employment opportunities. Site selection may affect communities with farmlands if the lands are appropriated without voluntary agreement of those who own the land and those who use the land as tenants with or without clear title to legal rights. As identified in Section 4, the optimal oblasts for solar photovoltaic are Crimea, Odessa and Kiev. In both Crimea and Odessa there are large ethnic minority groups that may feel disadvantaged by sites selected or availability of employment opportunities, if the perception of preferential treatment of one group over the other emerges.

It sites for facilities are next to residential settlements there may be effects on human health from noise and dust during the construction processes, as access roads, grating and levelling of sites and assembly of frames and support buildings.

During construction there is a positive opportunity for short term employment of local community members. For operation it is anticipated that there will not be significant employment opportunities for more than a few local residents to clean panels and ensure that the facility is operating.

An important effect may be the loss of agriculturally productive arable lands, and loss of fertile top soils due to grading. The zoning requirements will determine which lands are zoned for agricultural use, but these are often the same fields that are best suited for solar photovoltaic facilities. It is therefore possible that there may be a negative economic effect on nearby communities.

The likely significant effects of the USELF photovoltaic scenario are detailed in Table B31 (Appendix C).

Biomass (using wood residues)

The community and socio-economic effects for the USELF biomass scenario using woody residues are potential health effects from off-gassing from operations and the dust and noise from increased traffic if the biomass supply or storage facility is not next to the biomass plant. There are potential human health effects for workers during operation, as there are risks from exposure to high temperatures in the processes. There may also be effects from the strain on local infrastructure (roads and bridges) through increased road traffic for transporting biomass materials. The positive effects are increased employment during construction, operation and decommissioning, including support for transportation and road maintenance in the case that the storage facility and sources of biomass are not proximal to the biomass plant and would involve considerable vehicle movements during operation. Another potential effect is the change in soil fertility for agriculture if waste ash or sludge is spread on fields. The potential effects upon socio-economic receptors as a result of the USELF biomass scenario using wood residues are detailed in Table B32 (Appendix C).

Biomass (using agricultural residues)

The effects of the USELF biomass scenario using agricultural residues on community and socio-economic resources are similar to those for biomass using wood residues (i.e. potential health effects from off-gassing from operations and dust and noise from increased traffic if the biomass supply or storage facility is not next to the biomass plant). The positive effects are improved human health and respiration due to reduced seasonal burning of agricultural residues in fields (as these would be used for biofuel instead), and increased employment during construction, operation and decommissioning, including support for transportation and road maintenance. This is based on the assumption that the storage facility and sources of biomass are not proximal to the biomass plant, and would involve considerable vehicle movements during operation. Another potential effect is the change in soil fertility from fields, as these would no longer be burned after harvests, which is the traditional practice in Eastern Europe. The potential effects upon socio-economic receptors as a result of the USELF biomass scenario using agricultural residues are detailed in Table B33 (Appendix C).

Biogas (using landfill gas)

The effects of the USELF biogas scenario using municipal landfill gas on community and socio-economic resources are very low, based on a series of assumptions that the site selection will be where landfills already exist, and that the odours will actually be more controlled with municipal landfill gas. If it is necessary to create a sterile lining for the landfill, it is possible that there will be short term increases in dust and blowing waste as existing landfills are excavated and re-filled. It is also assumed that there will not be a notable increase in traffic to the landfill during construction, as traffic to operational landfill sites is already high for most facilities. An important positive effect is the increase in employment opportunities for local labour during construction and operation. The potential effects upon socio-economic receptors as a result of the USELF biogas scenario using municipal landfill gas are detailed in Table B34 (Appendix C).

Biogas (using animal manure)

The effects of the USELF biogas scenario using animal residues on community and socio-economic resources are very low, based on an assumption that the site selection will be relatively close to where large farms and feed lots already exist. As with biogas using landfills, if it is necessary to create a sterile lining to manure ponds, the temporary odour could be quite strong for surrounding communities. There may also be an increase in insects such as flies as a result as well which would negatively effect human health conditions. It is also assumed that there will be a notable increase in traffic during construction and operation, through transportation of animal waste, if the power plant is located in a different location to the source of supply. An important positive effect is the increase in employment opportunities for local labour for construction and operations. It is also assumed that residual wastes will be applied as liquid fertiliser to fields for agricultural use, as is common practice with biogas using animal manure. The potential effects upon socio-economic receptors as a result of the USELF biogas scenario using animal manure are detailed in Table B35 (Appendix C).

8.2.7 Cultural heritage

There are two main types of effect on all of the cultural heritage receptors that may result from all the USELF renewable energy scenarios:

- Loss and/or damage to the cultural heritage resource from footprint of physical structures, including any associated infrastructure such as transmission systems. In addition, loss and damage can also result from associated construction activities such as site preparation, grading, earthworks, etc. These effects occur during construction and would result in the permanent loss or damage to the receptor. The magnitude of the effect is uncertain at this stage in the appraisal process and would depend on the extent of loss and/ or damage to the receptor. The spatial extent of the effect would depend on the importance (locally, nationally, internationally significant) and extent of the receptor, some cultural heritage sites and reserves cross national boundaries[36]. The effect is usually negative, although as part of the EIA process, there may be opportunities to discover and investigate new cultural heritage sites which would contribute to the historical knowledge of Ukraine. The effect is likely to be significant.

- Changes to the context/setting of sites due to physical presence of renewables development and associated infrastructure. Although the change occurs during construction, the main effect would occur for the duration of operation. If the development is dismantled during decommissioning, then the effect is often reversible. This effect would be greatest where the site is set within a cultural or historic landscape and the magnitude of the effect would depend on existing visual intrusion (e.g. within cities where there are likely to be other sources of visual intrusion), and the scale of the renewables development. The spatial extent of the effect would depend on the importance (locally, nationally, internationally significant) and extent of the receptor, some cultural heritage sites and reserves cross national boundaries. The effect is negative and likely to be significant, depending on the receptor.

In addition, there may be loss, partial loss, or disruption to intangible cultural heritage, including practices, knowledge, skills and traditions, in addition to the objects or cultural spaces associated with these. Although the change occurs during construction, the main effect would occur for the duration of operation and is unlikely to be reversible after decommissioning. Effects would occur on a local level and the magnitude would depend on the presence and effect of intangible cultural heritage in relation to the renewable development at a project level. If there is an effect on intangible cultural heritage, it is likely to be negative and significant.

Onshore wind

Table B36 (Appendix C) provides a summary of the likely significant effects of the USELF on-shore wind scenario on cultural heritage. Due to the requirements of wind power, cultural heritage sites associated with existing settlements are unlikely to be affected. However, upland, coastal and steppe sites such as those located in the western/south-western Ukraine (foothills of the Carpathians), Black Sea and Crimea, and central Ukraine have potential to be affected.

Sites of international importance, such as designated UNESCO World Heritage Sites or those on the tentative list, are well known and cultural sites (as opposed to natural sites) are often associated with the built environment, including monuments, settlements, fortifications etc. It is unlikely, therefore, that wind power would be developed on these sites. However, development may cause loss or damage to other known cultural heritage sites and reserves, and it may not always be possible to locate development away from these. Wind development can be extensive with 50+ turbines at a site. Wind turbine foundations are approximately 20m in diameter and 5m deep; therefore, they have the potential to destroy or damage known or unknown archaeological remains of local, regional and national importance (and in some cases international importance, if

[36] e.g. the Struve Geodetic Arc is a chain of survey triangulations stretching from Hammerfest in Norway to the Black Sea, through 10 countries and over 2 820 km.

previously unknown). Site preparation such as grading, laying access tracks and associated infrastructure such as underground cables may also destroy or damage cultural heritage sites.

Cultural heritage sites, particularly those located in remote steppe or upland areas, may be affected by changes to their visual setting. Turbines are large (100m tall), modern structures and this would be juxtaposed with the historic landscape associated with some sites, such as prehistoric stone stelae (an upright stone slab or column, often serving as a gravestone) and kurgan graves (a prehistoric burial mound or barrow typically found in southern Russia and Ukraine), hill-top fortifications, and remains of colonies on ancient trade routes.

Possible effects on intangible cultural heritage may occur where upland or rural wind development changes practices, such as inherited livestock grazing patterns, or turbine structures change valued places such as mountain peaks.

Small hydropower

Table B37 (Appendix C) provides a summary of the likely significant effects of the USELF small hydropower scenario on cultural heritage. Areas identified for potential hydropower comprise the Carpathian area (Dneister, Tissa River Basins) and Central Ukraine area (larger tributaries of Dnieper).

The location of hydropower along major rivers means that sites of international importance (UNESCO sites and those on the Tentative List) would not be directly affected, either by the footprint of the structures (depending on configuration – excavation for dam/diversion, powerhouse, penstock, intake, transmission lines) or construction. These sites are also unlikely to be affected by the larger visual components of these schemes, e.g. a dam or diversion structure, transmission lines and raised water levels due to impoundment.

There are many registered sites occurring along the Dneister, Dnieper and Tissa River Basins, within central Ukraine and the Carpathians (as detailed in the SER Environmental Topic Paper, Appendix E). There is similarly high potential for undiscovered sites along major river valleys, which were well placed for early settlements and agriculture, form major transport networks and administrative divisions. For example, the Sredney Stog culture was discovered on an islet northeast of Khortytsia during construction of the Dnieper Hydroelectric Station in 1927. Khortytsia Island is also the site of the Sich, the Cossack's principal stronghold. However, the relatively small scale of the hydropower scenario reduces the probability that cultural heritage sites and reserves would be lost or damaged by the footprint of structures or other construction activities (construction of access, grading of land, etc).

If new water impoundment and reservoir creation is required, cultural heritage sites may be affected by inundation. Access to existing sites may be lost if they are submerged. However, submergence and siltation may help preserve some sites by creation of anaerobic conditions. Due to the small size of reservoirs (7-10ha) in this scenario, the probability of sites being affected is assessed as low.

The historic or cultural setting of registered and unknown sites may also be affected due to the presence of new structures as described above. This would depend on the scale of the new development and its zone of visual influence in relation to sites.

Possible intangible cultural heritage which may be affected by this scenario includes traditional fishing sites, valued structures and viewpoints which may be affected by inundation. This would need to be assessed at a project level.

Solar photovoltaic

The likely significant effects of the USELF solar photovoltaic scenario on cultural heritage are summarised in Table B38 (Appendix C). Solar power may be economic in most areas of the Ukraine, with the greatest potential for solar power in southern Ukraine (Odessa and Crimea). Cultural heritage sites within urban areas would not be affected, but those along the Black Sea Coast (e.g. First Millennium trading colonies) and central steppe areas may be affected by this scenario.

Cultural (rather than natural) UNESCO sites and those sites on the tentative list have potential to be affected as their locations could coincide with solar development; the solar projects would have visual effects on their historic setting.

Although numbers of nationally important cultural heritage sites are not high in these regions, there are several registered sites within south western, central, southern Ukraine and Crimea and solar development has the potential for quite a large land-take (up to 90ha in this scenario). Although excavations would not necessarily be at depth, affecting deeply buried archaeological features, there may be loss or degradation of surface features through levelling or collectively from the many small foundations required. This would also apply to unknown sites.

Areas of photovoltaic development are likely to have a negative visual effect on the setting of registered or unknown heritage sites within historical or cultural landscapes. The extent of the effect would depend on the zone of visual influence of the solar power development in relation to the heritage site.

Intangible cultural heritage may also be affected, for example through changes in traditional land use and valued places or views.

Biomass (using wood residues)

Table B39 (Appendix C) provides a summary of likely significant effects on cultural heritage receptors of the USELF biomass scenario using wood residues. Due to the requirements of biomass, near sources of fuel and with a buffer from residential areas, cultural heritage sites associated with existing settlements are unlikely to be affected. It is unlikely that sites of international importance, such as designated UNESCO World Heritage Sites or those set out on the tentative list, would be directly damaged by biomass facilities.

However, biomass development in wood producing areas (e.g. Chernihiv, Kyiv, Zhytomyr Oblasts in the central region and Zakarpattia, L'viv in the western Region) may affect other cultural heritage sites. Both Kyiv and L'viv and their immediate surrounds are particularly rich in heritage sites, with approximately 1 500 years of continuous settlement, and being historically important centres of power and trade. Biomass facilities require up to 18-25ha, and construction activities, such as access roads, grading of land and excavation could destroy or damage cultural heritage sites. The foundations of buildings, boiler, cooling towers, underground utilities, areas of hard-standing, drainage, transmission towers and storage areas have the potential to destroy or damage known or unknown archaeological remains of local, regional, national importance (and in some cases international importance, if previously unknown). Use of existing coal-fired boilers would minimise or avoid loss or damage of cultural heritage receptors as new land take would be more limited.

The setting of cultural heritage sites may be affected by new biomass facility development. The facilities have tall components and are modern structures which would be juxtaposed with the historic landscape of some sites. Structures such as boiler stack and building could be up to 60m high (based on a 100 MW facility, although likely to be less than this height, as this scenario assumes facilities will have a maximum generating potential of 20MW electrical).

Intangible cultural heritage may also be affected, for example through changes in traditional land use and valued places or loss of structures.

Biomass (using agricultural residues)

Likely significant effects on cultural heritage from the USELF biomass scenario using agricultural residues are similar to wood residue and are summarised in Table B40 (Appendix C). Due to the requirements of biomass, near sources of fuel and with a buffer from residential areas, cultural heritage sites associated with existing settlements are unlikely to be affected. However, biomass development in agricultural areas over much of Ukraine, in particular along the Dnieper, central, northern, south and eastern agricultural plains and steppes, may affect cultural heritage sites. Remains of prehistoric civilisations including both agricultural and nomadic societies, are likely to be associated with agricultural areas and rivers, as are modern heritage sites. In addition there are historical battlefields in these areas. There is some uncertainty as to survival and damage to sites in agricultural areas, due to intensive agricultural land-use. Intangible cultural heritage is also less likely to be affected, due to location within intensively farmed areas, although this would need to be further assessed at a project level.

Biogas (using landfill gas)

Table B41 (Appendix C) provides a summary of likely significant effects on cultural heritage receptors from the USELF biogas scenario using municipal landfill gas. Biogas generation in this scenario relies on existing landfill sites, and ancillary works for treatment and energy recovery are relatively small scale – mainly limited to power generation, the transmission system and biogas collection system. This means the ground and any historic setting has already been disturbed and that there is very limited potential for encountering existing registered or any undiscovered cultural heritage sites.

Although some centres of population which meet the waste generation requirements for biogas are also UNESCO sites or those on the tentative list (e.g. Kyiv or L'viv), landfill sites are not located adjacent to these sites and they would not be affected by biogas development, nor visual intrusion. There are a few registered cultural heritage sites in other urban centres with capacity for municipal landfill gas (e.g. Luts'k, Khmel'nitsky, Zaporizhzh'ya and others), but there is a very low probability that these would be affected due to use of existing landfill sites and the small scale of modifications required. Similarly, there are not likely to be any effects on intangible cultural heritage.

Biogas (using animal manure)

Table B42 (Appendix C) provides a summary of likely significant effects on cultural heritage receptors of the USELF biogas scenario using animal manure. In this scenario biogas would be associated with existing large scale animal farms and therefore unlikely to coincide with cultural heritage sites. The biogas scenario is likely to be developed in north central and northwest parts of the country, as well as Dnipropetrovk. Poltava, Chernihiv, Kiev, Cherkasy Oblasts are rich in cultural heritage sites as well as having high animal populations for biogas development.

It is unlikely that sites of international importance, such as designated UNESCO World Heritage Sites or set out on the tentative list, would be directly damaged by biogas facilities. Similarly, the location of biogas facilities on farms, which are likely to have experienced intensive agricultural development, means that registered sites are unlikely to be affected. Land take required for biogas is relatively small (approx 5ha), although excavation for lagoons and tanks can be up to 2.5m, so there is very limited potential to encounter unknown archaeology. Biogas facilities would be associated with large scale farms, and components (e.g. boiler, anaerobic digester, power generation turbines) and would be within the context of existing utilitarian farm buildings. Biogas development is therefore unlikely to have a negative effect on the historic setting of any cultural heritage sites. Development within existing farms also means that effects on intangible cultural heritage are unlikely to be significant.

8.2.8 Summary of effects

Projects falling under all of the USELF scenarios have the potential for a range of likely significant effects upon environmental receptors. Generic effects that are common to *all of the renewable energy scenarios* are as follows:

- Cumulatively beneficial (although individually insignificant) effects on climate through reduction in greenhouse gas emissions where the renewable energy projects replace traditional forms of energy generation;
- Adverse air quality effects during construction works, through dust and combustion engine emissions;
- Risk of pollution of surface water during construction;
- Disturbance to soil composition during through compaction or pollution during construction;
- Loss of protected and natural remnant habitats and associated species through land take for renewable power development;

- Dislocation of communities or households as a result of the facilities, roadways or power transmission lines;
- Hazards to human health during construction, including dust, noise and dangers to workers, and exposure to electromagnetic fields if households are located too close to power transmission lines;
- Economic benefits of increased employment opportunities and improved energy reliability;
- Loss of lands for other economic activities, including lands around power transmission lines;
- Pressure on existing infrastructure through increased traffic of heavy loads for construction, and the need to expand existing power transmission lines;
- Positive effects of improving the potential for eco-tourism marketing;
- Loss and/or damage to the cultural heritage resource from footprint of physical structures, including any associated infrastructure such as transmission systems; and,
- Changes to the context/setting of sites due to physical presence of renewables development and associated infrastructure.

On-shore Wind

Likely significant effects specific to projects to be implemented under the USELF on-shore wind scenario are as follows:

- Dual use of land (i.e. agriculture and wind generation) during operation;
- Bird and bat strikes during operation;
- Landscape effects through the construction and operation of large-scale wind turbines, often in coastal or montane scenic landscapes;
- Effects on ethnic minorities, where there are significant communities, as most of the Crimea and Donetsk areas suitable for wind farms have a high percentage of minority groups; and,
- Worker accidents during construction from working at height.

Small Hydropower

Likely significant effects specific to projects to be implemented under the USELF small hydropower scenario are as follows:

- Increased risk of landslide in landslide-prone areas, as projects are likely to be built on rivers in areas of steep slopes;
- Downstream effects on surface water flows and quality resulting from construction and operations, as well as changes in flooding regimes in the local watershed, with resulting effects upon other industries in the catchment that utilise river flows (for example agriculture and mining); and,
- Effects on aquatic migratory species and aquatic ecology from construction of impoundments and alterations to existing hydrological and geomorphological processes.

Solar Photovoltaic

Likely significant effects specific to projects to be implemented under the USELF solar photovoltaic scenario are as follows:

- High land take would reduce availability of high value soils, and thereby a potential reduction in agricultural productivity; and,
- Effects on ethnic minorities, where there are significant communities, as many of the areas in Ukraine suitable for solar photovoltaic development have a high percentage of minority groups.

Biomass – Wood Residues

Likely significant effects specific to projects to be implemented under the USELF biomass scenario using wood residues are as follows:

- Release of air pollutants during operation, with resulting effects upon human health as well as potential deterioration in soil quality through pollutant deposition; and,
- Increased traffic volumes due to transportation of biomass, therefore increasing congestion, although infrastructure systems are likely to be improved as part of scheme development.

Biomass – Agricultural Residues

Likely significant effects specific to projects to be implemented under the USELF biomass scenario using agricultural residues are the same as for the USELF biomass scenario using wood residues, but additionally include the following:

- Effects on soil composition during operation as a result of pollutant deposition, or disposal of leachate or by-products; and,
- Potential improvements in health through reduced seasonal burning of agricultural residues, which is common practice in Eastern Europe (as the crops would instead be used for biofuels).
- Reduction in the quality of soils if the nutrients are not returned to the ground through burning.

Biogas – Municipal Landfills

Likely significant effects specific to projects to be implemented under the USELF biogas scenario using municipal landfill gas include the following:

- Release of air pollutants during operation, with resulting effects upon human health,
- Increased effects of odour during construction if the landfill needs to be lined, as this will require waste to be emptied and refilled; and,
- Effects on soil composition during operation as a result of pollutant deposition.

Biogas – Animal Manure

Likely significant effects specific to projects to be implemented under the USELF biogas scenario using animal manure include the following:

- Release of air pollutants during operation, with resulting effects upon human health as well as potential deterioration in soil quality through pollutant deposition;
- Increased effects of odour during construction if the manure pond needs to be lined, as this will require waste to be emptied and refilled; and,
- Effects on soil composition during operation as a result of pollutant deposition.

As noted above, there are several potential positive effects that may arise through implementation of projects under the USELF renewable energy scenarios. A particular positive effect of the projects would be the potential for minor beneficial effects on climate where the renewable energy projects replace traditional energy generation. There are also several socio-economic benefits through improved energy reliability and creation of jobs during construction and operation. The projects may also give opportunities for improved infrastructure (particularly in remote areas of the country), and opportunities for eco-tourism through visitors centres for example.

All of the USELF renewable energy scenarios have potential for negative environmental effects upon a range of environmental receptors. Onshore wind and small-hydropower have the greatest potential for disturbance to birds/bats and aquatic biodiversity respectively. Aquatic biodiversity may be particularly at risk given that the technically feasible locations for small-hydropower are often protected ecological areas such as the Carpathian Mountains. Wind power will also have implications upon the landscape setting of wind projects. Solar photovoltaic and wind projects are most technically feasible in areas of relatively high population density (Crimea, Donetsk, Odessa and Kiev (the latter for solar only), and with a higher percentage of minority groups (in Crimea and Donetsk) which may have implications upon demographics and human health through land take and construction activities. Solar photovoltaic projects in particular will have large land take, which will often be competing with agricultural land uses, which are highly prevalent in Ukraine. Other than land take, solar photovoltaic projects are likely to have limited negative effects upon environmental receptors, with the exception of perhaps landscape character depending upon their location. The more significant long-term negative effects of biomass and biogas scenarios largely relate to air quality and odour and the indirect effects of changes in these, whilst negative effects upon other receptors are generally restricted to the construction phase of projects.

It would be necessary to incorporate mitigation of various forms into all of the projects falling under the USELF renewable energy scenarios to reduce the likely negative environmental effects of these types of projects to acceptable levels. The mitigation identified to reduce these negative effects is identified in Section 8.4 below.

8.3 Assumptions, limitations and uncertainty

8.3.1 Introduction

This section summarises the assumptions, limitations and uncertainties that surrounds the assessment of potential significant effects. These assumptions, limitations and uncertainties[37] are also identified against each relevant receptor within the tables in Appendix C.

8.3.2 Climate and air quality

The climate and air quality baseline data for Ukraine is unreliable, because it is limited in extent and detail. There is a lack of reliable emissions monitoring systems and pollutants such as PM10 and PM2.5 are not monitored on a frequent basis in Ukraine.

As far as air quality is concerned, data gaps include reliability of baseline air quality data and an absence of records showing trends in air quality. In addition, there are no published target emissions levels for specific source categories such as biomass power plants.

8.3.3 Surface water and groundwater

The surface and groundwater resources of Ukraine are highly valuable and, in certain locations, effected negatively by industry, commerce, and urban development. Overall, when examining USELF potential alternative energy projects, knowledge of ambient and long term health of surface and groundwater resources are necessary (through sampling and regular monitoring) such that lifecycle effects from an energy facility does not materially or significantly effect these resources.

As a result of limitations in available baseline data, it will mean that developers will need to undertake project specific monitoring of baseline flows and water quality to inform the assessment of likely significant effects for each scheme.

8.3.4 Geology and soils

For the bedrock geology receptor, it was assumed that some excavation and/or blasting would be involved in constructing pile or pier foundations for wind turbines; constructing dam or diversions for hydro projects; and generally for other major building and structure foundation construction. For landslide hazard areas, it was assumed that there would be significant removal of existing

[37] When predicting the future evolution of the environment, the nearer term predictions are considered to be less uncertain than estimations into the future. Therefore, the future evolution of the environment during the construction phase has more certainty than that during the operational life of a scheme. The methods used to predict the likely significant effects of the renewable energy scenarios under consideration are consistent with the strategic nature of this study. Some uncertainty is therefore carried through the assessment, from the project assumptions made, to the specific parameters used for the spatial constraints analysis. Where there are uncertainties, these are acknowledged alongside the assessments.

vegetation in clearing the site for construction, as well as changes in drainage patterns and inundation from hydro impoundments that would contribute to potential landslide occurrences.

For high value soils receptors, it was assumed that establishment of hydro impoundment will eliminate productive use of underlying soils; that clearing and levelling of solar sites will alter drainage and require limitations of vegetative growth throughout operations; and for biomass and biogas scenarios the projects would need to be located in close proximity to concentrated animal and agricultural production to provide the required renewable energy fuel/feedstock. For already contaminated lands, it was assumed that additional spillage or release of contaminants could exacerbate existing level of contamination.

Regarding potential effects to soil composition, it was assumed that there may be sufficient downwash from wind turbines sufficient to affect soils; that increased moisture content from unlined impoundments could affect changes to soil composition; and that constituents of animal by-product land application could affect soil composition.

8.3.5 Landscape and biodiversity

Table 12-22 through 12-28 include the assumptions that were considered in assessing the effects to landscape biodiversity and aquatic ecosystems for each scenario.

It has been assumed that the development of power plants and ancillary infrastructure is unconstrained by the locations of internationally, nationally or regionally protected biodiversity and landscape areas, or remnant natural or modified habitats.

Regarding the low significance of the erosion-related effects, it was assumed that none of the scenarios would be located in areas with highly erodible soils. For the biogas and biomass facilities, it was assumed that water supply requirements and wastewater discharge volumes would be relatively small and that the appropriate treatment measures would be utilised.

For the hydroelectric projects, it was largely assumed that hydroelectric development would involve the development of facilities at a green-field location. The significance of the effects described would differ somewhat for hydroelectric development at existing facilities.

There are several limitations associated with the data, which results in some uncertainty of assessment:

- Although broad areas of potential for renewable development within Ukraine have been identified, at this stage of assessment the location of specific energy developments is not known.
- Consideration of the potential effects on protected species has been made in relation to certain keystone species and is illustrative. At this level it is not possible to consider every effect in relation to every species identified within the Red Book of Ukraine.

- Biodiversity data has been taken from the National Atlas of Ukraine and the Red Book of Ukraine. It is also not possible within the scope of this study to identify and geo-reference all protected areas, habitats and protected species.
- Data on the migration of certain species considered is limited to regional scale description representation, whilst the effects described for protected species is based on general habitat associations.

8.3.6 Community and socio-economics

For all scenarios there are common assumptions for community and socio-economic effects. The potential for both long and short term employment of local labour is assumed where practical, and available. It is also assumed that with regards to worker safety all laws of Ukraine will be closely followed. If the transportation infrastructure is not strong enough to support the increased traffic and weight, it is assumed that the developer will support the necessary reinforcements.

For all projects, connections to local power lines and transmission grids will be necessary.

8.3.7 Cultural heritage

There are several limitations associated with the data, which results in some uncertainty of assessment:

- Although broad areas of potential for renewable development within Ukraine have been identified, at this stage of assessment, the location of specific energy developments is not known.
- Cultural heritage data has been taken from the National Atlas of Ukraine.

Therefore the assessment is based on a visual comparison of mapped information showing both a potential for renewable development and high concentrations of cultural heritage sites and reserves.

It has been assumed that UNESCO sites and those on the Tentative List, being well known monuments often associated with tourism, would not be directly affected by the footprint renewable development, although in some cases there may be visual effects.

There is clearly uncertainty associated with the location of undiscovered or unknown historical and archaeological sites and this assessment has assumed that these are more likely to be encountered in areas where there are higher concentrations of heritage sites. It should also be noted that sites of importance in modern history, e.g. relating to the Soviet occupation in the 20th Century, may not be registered, but are nonetheless an important part of the Ukraine's journey to independence.

There is also a lot of uncertainty associated with intangible cultural heritage at the strategic level. The presence of intangible cultural heritage is only likely to be identified at a project level and therefore this assessment can only provide examples of effects which may occur.

8.4 Mitigation and offsetting measures

8.4.1 Methodology for developing mitigation measures

The EU SEA Directive requires that where significant environmental effects have been identified, measures should be described that prevent or reduce effects (mitigation), and offset effects (offsetting). The EBRD's Environmental and Social Policy stipulates that projects will need to be designed to comply with relevant EU environmental requirements as well as applicable national law. Therefore where likely significant environmental effects from the various renewable energy scenarios have been identified in Section 8.2 mitigation or offsetting measures have been identified to reduce these effects to an acceptable level. In situations where Ukrainian regulations differ from EU regulations, the more stringent of the two will need to be met.

The EBRD also stipulated that projects funded by the bank adhere to its Performance Requirements detailed in its Environmental and Social Policy. Therefore, the mitigation table below (Table 8-5) identifies which of the performance requirements are met through implementation of the various measures. In the absence of EBRD performance requirements or EU and Ukrainian regulations on mitigation of certain environmental effects, good international practice standards such as the World Bank Group Environmental Health and Safety Guidelines could be used. Compliance with recognised standards will ensure that best available techniques are used and that the proposed mitigation measures are effective.

In addition to this SER Environmental Report, the EBRD has also commissioned five Environmental and Social Action Plans (ESAPs) – one for each of the renewable energy technologies – to provide a template for further development at the inception of a given renewable energy project that is seeking funding from USELF (discussed further in Section 10). The ESAPs include the topic specific mitigation measures outlined below. The five ESAPs also include a number of more high-level actions – such as environmental, occupational health and safety, and social performance reporting – which companies must implement to plan and manage the environmental and social aspects of individual projects; these higher-level actions are not included below.

It is assumed that the mitigation measures proposed will be the subject of further development as part of subsequent project implementation stages (discussed further in Section 10). Any assumptions made on the effect and applicability of these measures will need to be verified as part of project level planning and design.

A series of criteria have been applied to aid the selection of mitigation measures for each resource scenario (see Table 8-5). These are intended to reflect the risks associated with the measures in terms of their effectiveness, policy and legal compliance, time needed for development and effects on other aspects of the environment. By showing how these factors have been taken into account, it is intended to demonstrate that reasonable measures have been selected.

Table 8-5 Criteria used to identify suitable mitigation measures:

Criterion	Definition
Effectiveness of measure	Assessment of how effective the measure is in addressing the effect. This is a high-level judgement on the efficacy of the measure and not a judgement on the ability of a measure to prevent the particular effects of a given renewable energy scenario.
Established practice	Extent to which measure has precedent, and established technologies, and is accepted as a prevention or reduction measure. Measures with an established precedent are more likely to be meet legal, policy and consenting requirements.
Development timeframe	Timescale that would be required to fully implement the measure. Measures should be achievable by the time schemes become operational.
Adverse effect on other environmental receptors	Extent to which a measure has adverse environmental consequences on other environmental receptors. Judgement is in strategic context.

The text on the four criterions listed in Table 8-5 has been colour-coded in the mitigation tables in this Section as follows:

(GREEN)	Measure clearly meets criterion
(AMBER)	Measure partially meets criterion or is capable of failing or meeting criterion depending on specific situation applied. Risk to successful implementation.
(RED)	Measure clearly fails to meet criterion. Risk to successful implementation.

In all cases where a significant adverse effect has been identified the primary objective is to seek measures to mitigate for that effect. However, where a suitable mitigation measure is not feasible, opportunities have been identified below to offset the effect. In addition, where applicable, enhancement measures have been recommended. Enhancement measures should not be viewed as an alternative to mitigation or offsetting, rather they are measures that have been identified for their potential to bring benefits to the project once all mitigation and offsetting is in place.

It is assumed that where applicable, mitigation identified in this SER will be carried through to individual USELF funded projects, and documented within an Environmental and Social Action Plan in accordance with EBRD requirements.

8.4.2 Climate and air quality

Recommended mitigation measures

Mitigation measures proposed to reduce effects upon climate and air quality are shown in Table 8.6 below.

Any add-on emissions control would be constructed as part of the project and the combustion system will be started up with the add-on emissions control equipment. Good combustion practices will be on-going as part of routine operations. Implementation of mitigation measures will not have an adverse effect on other environmental receptors.

Recommended offsetting measures

No offsetting measures are considered applicable to the climate and air quality topic.

Potential enhancement measures

No enhancement measures are considered applicable to the climate and air quality topic.

Table 8-6 Climate and air quality mitigation measures

Climate and Air Quality Mitigation Measures								
Likely significant adverse effect on the environment	**Receptor(s) affected**	Mitigation Measure	USELF Resource Scenario that the mitigation measure is applicable to	Effectiveness of measure (see Table 8.5 for description)	Established practice? (see Table 8.5 for description)	Development timeframe (see Table 8.5 for description)	Adverse effect on other environmental receptor? (see Table 8.5 for description)	Is the measure identified also required to meet EBRD Performance Requirements?
Emissions of vehicles during construction activity and delivery of feed-stock and raw materials.	Air Quality	Efficient usage of delivery vehicles – use of alternative and/or more efficient delivery methods (including for example rail or ships) during construction to optimise the emissions to atmosphere per payload.	All scenarios	Effective	Yes	No development time needed	None	Yes, as outlined in PR3(16)
Emissions from the combustion of biomass and biogas residues.	Air Quality	Good combustion controls and installation of add-on emissions control equipment to meet stack emission limits outline under EU standards and/or local Ukraine regulations	Biomass and biogas scenarios	Effective	Yes	Any add-on emissions control would be constructed as part of the project and the combustion system will be started up with the add-on emissions control equipment. Good combustion practices will be on-going as part of routine operations.	May be. Reagents used for emission control (for example ammonia for NO_x control) may have collateral environmental effects	Yes, as outlined in PR3 paragraphs 5 through 10 and 14 through 18
Fugitive dust emissions from material handling, storage and conveying	Air Quality	Haul road and storage pile dust suppression techniques such as water spraying, dust collectors and enclosures	Biomass and biogas scenarios	Effective	Yes	Any add-on emissions control such as enclosures and dust collectors would be constructed as part of the project. Haul road and storage pile watering	None	Yes, as outlined in PR3 paragraphs 5 through10 and 15 through 18

Climate and Air Quality Mitigation Measures								
Likely significant adverse effect on the environment	**Receptor(s) affected**	Mitigation Measure	USELF Resource Scenario that the mitigation measure is applicable to	Effectiveness of measure (see Table 8.5 for description)	Established practice? (see Table 8.5 for description)	Development timeframe (see Table 8.5 for description)	Adverse effect on other environmental receptor? (see Table 8.5 for description)	Is the measure identified also required to meet EBRD Performance Requirements?
						would be implemented during normal operations		
Nuisance odour from biomass and biogas projects	Odour	Enclosures and capture of odours and control using add-on control equipment	Biomass (using agricultural residues) and biogas scenarios	Effective	Yes	None – Equipment will need to be in place upon plant start-up	None	Yes, PR3(16)

8.4.3 Surface water and groundwater

Recommended mitigation measures

Mitigation measures proposed to reduce effects upon surface and groundwater are shown in Table 8.7 below.

Monitoring of water source conditions (surface and groundwater) on a regular basis serves to enhance the effectiveness of all pollution control and prevention plans and practices. Monitoring provides a reliable and effective feedback mechanism to warn construction management, operators, and owners of changing source conditions affected by facilities construction and/or operations that could lead to significant effects to surface and groundwater resources.

EBRD environmental and social policies are broadly presented so that developers will have facility design, engineering, construction, and operations that incorporate integrated, detailed, and applicable prevention and environmental protection plans. These protection measures are designed to prevent environmental degradation, preserve human health and safety, and support sustainable surface and groundwater usage for alternative energy development.

The major pollution prevention and abatement practices proposed to mitigate effects upon surface water and groundwater are summarised as follows:

- Runoff and Sediment Control: Procedures and practices to effectively control and minimise excessive precipitation runoff from disturbed land. Specific attention is required on sediment transport to minimise effects to surface and groundwater resources.

- Hazardous Materials Storage and Handling: Procedures and practices to safely storage, handle (use), and dispose of hazardous materials during construction and operations to minimise effects to surface and groundwater resources.

- Spill Prevention and Response: Procedures and practices to prevent the spill and discharge of hazardous chemicals, liquids, and materials that would effect surface and groundwater resource. Such procedures and practices require also need to be set out in Emergency Action Plans to ensure that a spill is quickly and effectively contained, controlled and removed thereby reducing the effect to surface and groundwater resources.

- Sampling and Monitoring: Quantity and state of health (quality) of surface and groundwater resources (sampled or measured data) in the local vicinity of a USELF project that could be affected by construction and operations of that facility. This data is made available to developers, construction managers, and operations staff to assist in making decisions about construction or operations to minimise abate and report on the condition of surface water and groundwater resources affected by USELF supported renewable energy facilities. This data should be available to all stakeholders.

Where schemes are proposed to be constructed within floodplains it may be necessary to implement measures to ensure that the flooding regime within the catchment is not effected and that the risk of extent of flooding is not increased. It will therefore be necessary to prevent and avoid or minimise the exacerbation of effects caused by floods, through improved flood protection measures and flood compensation within the floodplain if necessary.

Recommended offsetting measures

No offsetting measures are recommended for the surface water and groundwater topic.

Potential enhancement measures

No enhancement measures are recommended for the surface water and groundwater topic.

Table 8-7 Surface water and groundwater mitigation measures

Surface Water and Groundwater Mitigation Measures								
Likely significant adverse effect on the environment	**Receptor(s) affected**	Mitigation Measure	USELF Resource Scenario that the mitigation measure is applicable to	Effectiveness of measure (see Table 8.5 for description)	Established practice? (see Table 8.5 for description)	Development timeframe (see Table 8.5 for description)	Adverse effect on other environmental receptor? (see Table 8.5 for description)	Is the measure identified also required to meet EBRD PRs (PR and paragraphs provided)?
Changes in flows and quality of surface and groundwater during construction	Surface Water Resources; Surface Water Quality; Groundwater Resources; Groundwater Quality	Facility Design Environment and Social Action Plans to address runoff and sediment control, pollution prevention and abatement plans, hazardous materials storage and handling, spill prevention. Resource Sampling and Monitoring	All	Effective	Yes	No development timeframe needed	None	*PR3 (10, 11,12,13, 14, 16)* *PR3 (16)*
Effects on flooding regimes if facilities placed in floodplain	Flooding regime	Prevent and avoid or minimise the exacerbation of effects caused by floods, through improved flood protection measures and flood compensation within the floodplain if necessary.	All	Effective	Yes	Months (if month compensation needs to be created)	None	*PR4 (15)*
Changes in flows and quality of surface and groundwater during operation of small hydropower projects	Surface Water Resources; Surface Water Quality; Groundwater Resources; Groundwater Quality	Operations Plan for small hydropower generation and reservoir management (if applicable) that includes pollution prevention and abatement practices, hazardous materials storage and handling, spill prevention and response, emergency action plans, And Receptor sampling and Monitoring	All	Effective	Yes	No development timeframe needed	None	*PR3 (10, 11,12,13,14,15,1 6*

8.4.4 Geology and soils

Recommended mitigation measures

Mitigation measures proposed to reduce effects upon geology and soils are shown in Table 8.8 below.

Erosion control plan – Develop a plan to avoid and minimise erosion from land disturbance activities throughout a project. Beginning during the design phase, the plan should identify how to minimise removal of vegetation to the extent that this is feasible on site, as well as within all associated linear facilities (access roads, transmission line and pipeline corridors, etc.). This should include marking of areas to be preserved to prevent unnecessary excess vegetation clearance. Soil and rock removed from excavations and site clearing should be stockpiled in an area where runoff from precipitation events can be controlled. Stockpile rock and less fertile soils should be reused wherever feasible as fill, rip rap, road embankments, and other project civil works. The Plan should provide standards for minimum slopes to be incorporated into site grading, and identify design and location of functional support structures, drainage systems, and slope coverage to be implemented for soil conservation during construction. Scheduling of construction activities should be made to provide for exposing the smallest area of land for the shortest period of time feasible. Barriers, sediment traps and settling ponds should be installed around exposed areas to catch and filter sediment from storm water runoff. Following construction, areas used for temporary construction purposes (material laydown, concrete processing, worker camps, access roads, etc.) should be regraded with the appropriate slopes, terracing and contouring in accordance with the overall site plan to minimise erosion and promote plant growth during project operations.

Re-vegetation – As construction activities come to a close, land reclamation activities should be carried out. Efforts should be made to restore and green reusable areas, such as quarries, dumping grounds, material stocking grounds, processing areas of aggregate and concrete, temporary worker camps, temporary access roads. Stockpiled soils and spoil material should be replaced on these areas and graded to conform to natural topography and storm water runoff management plans. Areas should be seeded with grasses or shrubs of an appropriate native variety to stabilise the area. Trees may be replanted where they do not interfere with renewable energy operations.

During operation, project offices, buildings and residences should be carefully landscaped and greened with small shrubbery or gardens.

Site selection studies – Initial investigations to identify optimal areas for renewable project development should incorporate the presence of existing or potentially productive agricultural lands along with proximity to concentration of essential resources (wind, solar radiation, rivers and streams, biomass, animal waste, landfill, and transmission lines) in evaluating and selecting candidate project sites. Testing of soils at selected sites should include analysis of soil fertility. Consideration should be given to the amount of productive or potentially productive agricultural land that will be displaced by the proposed project. Alternative arrangement of facilities on site can be considered to lessen or avoid displacement of productive lands and soils.

Heavy construction management – Limit the areas where heavy equipment is located and used during construction to minimise soil compaction. Use geotextile mats wherever appropriate to minimise compaction and erosion. Areas not utilised after construction can be tilled to loosen soil and enhance its structure and composition for supporting vegetation.

Spill prevention and management – Develop and implement a spill prevention and control plan to provide procedures for safe storage and handling of petroleum and chemical products used during construction and operation. Plans should establish:

- passive design requirements (berms, curbs, walls, etc.) for containment and control of any unintended spills or releases from oil or chemical storage areas;
- procedures for operation and monitoring of transfer, handling, and refuelling of substances;
- protocols for tracking inventories, inspecting and monitoring the storage, use and consumption of substances to determine if any leakage or releases may be occurring;
- provide for appropriate spill response equipment to be readily available on site and for staff training in their proper use;
- reference documentation (such as material safety data sheets) to identify constituents, safe handling procedures, and neutralisation options for each petroleum or chemical substance stored or handled on-site; and,
- outline procedures and responsibilities for reporting, responding to and remediating spills and releases.

Implementation of spill prevention and control plans should minimise frequency and severity of accidental and unintended spills and releases of substances onto the ground that results in contamination of soils.

Waste management – Waste disposal plans should be developed to provide for appropriate management, conditioning and land application of solid and liquid wastes. All wastes from water treatment, sanitary collection, and effluent treatment sludge should be processed and treated to appropriate extent before being released onto or into the ground. Similarly, any land application of animal waste from biogas facilities should be applied at rate determined by the climate and soil at the site to provide appropriate nutrient levels to satisfy plant needs. Animal waste streams should be periodically sampled and analysed for nutrients and heavy metals, as well as having the receiving lands monitored for soil nutrient levels. Pre-treatment technology (such as composting) and processing should strictly be followed to produce a product that has appropriate component of nutrients and organic matters and minimise pathogens.

Minimising landslide risks – Where hydropower schemes have the potential to pose increased risks of landslides in hazard areas, it will be necessary to prevent and avoid or minimise the exacerbation of effects caused by landslides, through careful siting, land grading and planting.

Recommended offsetting measures

High value soils that are disturbed or otherwise to be paved over as part of project construction and operation can be removed, temporarily stock piled, then subsequently transported and relocated to lands lacking productive soils to provide for more successful cultivation and thereby offset the loss of agriculturally productive lands displaced by renewable energy project development.

Potential enhancement measures

Locating renewable energy projects on "brownfield" sites where contamination already exists can provide for productive use of what may otherwise be properties that are no longer suitable for other residential or agricultural uses. Additionally, removal and remediation of already contaminated soils by project developers may enhance the existing conditions of the site for future (post-project) use.

Table 8-8: Geology and soils mitigation measures

Geology and Soils Mitigation Measures								
Likely significant adverse effect on the environment	**Receptor(s) affected**	Mitigation Measure	USELF Resource Scenario that the mitigation measure is applicable to	Effectiveness of measure (see Table 8.5 for description)	Established practice? (see Table 8.5 for description)	Development timeframe (see Table 8.5 for description)	Adverse effect on other environmental receptor? (see Table 8.5 for description)	Is the measure identified also required to meet EBRD PRs (PRs and paragraphs provided)?
Erosion of soil from removal of clearing and removal of vegetation	High value soils	Erosion control plan during construction and operational activities.	All	Highly effective to extent designed and implemented	Yes	1 month to develop erosion control plan.	-	*Yes – PR3(10&11), PR4(15 & 16) and PR6(18)*
		Re-vegetation of cleared areas during operation	All	Highly effective to extent implemented and maintained	Yes	Re-vegetation may take months to years	-	*Yes – PR3(10), PR4(16) and PR6(16&18)*
Increased risks of landslides in hazard areas as a result of project construction	Landslide hazard areas	Avoid or minimise the exacerbation of effects caused by landslides, that could arise from land use changes due to project activities through careful siting, land grading and planting.	Small hydropower	Highly effective to extent implemented and maintained	Yes	Re-vegetation may take months to years	-	*Yes – PR4 (15)*
Removal of lands from agricultural production	High value soils	Project site selection and facilities arrangement to avoid or minimise displacement of productive agricultural lands	All	Highly effective to extent alternatives are objectively assessed	Yes	1 – 3 months to conduct site selection study	-	*Yes – PR3(10), PR4(16) and PR6(11)*
Degradation	Soil	Minimise areas used	All	Effective	Yes	Throughout		*Yes – PR3(10),*

Geology and Soils Mitigation Measures								
Likely significant adverse effect on the environment	**Receptor(s) affected**	Mitigation Measure	USELF Resource Scenario that the mitigation measure is applicable to	Effectiveness of measure (see Table 8.5 for description)	Established practice? (see Table 8.5 for description)	Development timeframe (see Table 8.5 for description)	Adverse effect on other environmental receptor? (see Table 8.5 for description)	Is the measure identified also required to meet EBRD PRs (PRs and paragraphs provided)?
of soils through compaction and contamination	composition	by heavy construction equipment.				construction period		*PR4(16) and PR6(18)*
		Implement spill prevention, control and countermeasures plans during project construction and operation	All	Highly effective to extent designed and implemented	Yes	1 month to develop spill prevention and response plan.		*Yes – PR3(13&14, PR4(16) and PR6(18)*
		Manage waste collection, treatment and disposal during construction and operation (to include consideration of solid and liquid wastes).	All	Highly effective	Yes	1 month to design waste management practices		*Yes – PR3(10-12), PR4(16) and PR6(18)*

8.4.5 Landscape and biodiversity

Recommended mitigation measures

Mitigation for landscape effects fall into three broad categories: avoidance, screening and design. Table 8.9 documents the proposed mitigation measures in relation to landscape and biodiversity.

Avoidance of development within an area or setting of designated or high quality landscapes is the most effective means of ensuring that the most sensitive landscape receptors are not significantly affected by renewable power development.

Screening of renewable power schemes provides a means of obscuring landscape effects through the use of planting or earth works, which allows the development blend into the surrounding landscape. However, the potential for screening mitigation is limited by the nature of the landscape in which development is proposed, the scale of the development and the screening structures used. Open, flat landscapes, by the nature of their character are less able to accommodate screening as a mitigation solution as the screening structure or vegetation will seem intrinsically out of context. Where the scale of structures (i.e. wind turbines or boiler housing) exceeds the height of available screen planting or earthworks, mitigation is likely to be only partially effective. The use of vegetation as a screen also requires a certain amount of time for it to become fully effective if the vegetation needs a number of years to grow to the required height.

Burial of power lines offers one potential way of reducing the effect that such linear development has in bisecting the landscape; however, there may be potential effects on other environmental receptors such as cultural heritage, as a well as cost, which may make this mitigation measure prohibitive.

The integral design of new renewable structures and buildings offers the potential for the mitigation of adverse landscape effects. Designs can be tailored to reduce the structure's visibility within the landscape through the choice of colours or materials that makes it stand out less when viewed from elevated positions or against an open skyline. Alternatively where the close proximity of settlements or industry provides limited opportunity to hide prominent structures, the design of a "landmark" structure may provide the opportunity to enhance the urban landscape.

The most effective mitigation measures associated with habitat loss due to renewable development will be to avoid the effects of habitat loss through careful site location of power plant facilities and ancillary development outside of the boundaries of protected areas and avoid development within remnant natural habitats.

The development of wind farms has the potential to directly affect the populations of birds and bats species where the development coincides with migration routes or frequently used flight corridors. The most effective measures would be to avoid such effects by siting turbine locations outside of such routes or corridors. With this in mind specific buffer zones should be considered around protected sites and unprotected natural/critical habitats which provide staging points for migratory and breeding birds to ensure such effects are avoided. No other mitigation measures can be considered to be effective.

The development of power lines also has the potential to lead to significant adverse effects on species of birds or bats where the location and height of above ground power lines has the potential increase the risk of mortality or injury due to collision. Survey of flight routes and careful siting or routing of power lines provides a means of avoiding such effects, whilst installation of underground power lines within such sensitive areas may also avoid such effects. Where sensitive routing or burial is not an option, due for instance to ground conditions or other risk factors, the effects may be mitigated by devices which make the power lines more "visible" to the target species or groups of species vulnerable to such effects.

The requirement to development new vehicular access routes and a consequential increase in traffic frequency and volume within sensitive areas may lead to adverse effects on wide ranging or endemic species due to an increase in road mortality. The most effective means of avoiding such effects will be to negate the increase of such risk through survey and careful routing of access routes. Where this is not feasible exclusion of target species from access to new roadways, coupled with the installation of the specifically designed crossing points, may provide an effective means of reducing the risk to such animals. Where this is not possible restrictions placed on vehicle movements during key periods of species movements either during the 24-hour cycle or during key migratory periods may provide an effective means of reducing the potential effect to an acceptable level.

In general, the most effective approach for mitigating the effects of renewable facilities on aquatic ecosystems and protected aquatic species is to avoid significant effects altogether. This can be accomplished by utilising less sensitive site locations or to a certain extent, implementing more "environmentally friendly" technologies or systems (e.g., using air-cooled condensers for cooling rather than surface water withdrawals). Where avoidance is not feasible, various measures can be incorporated into the project design which, if properly implemented, can significantly reduce environmental effects. Such measures are mentioned in Table 8.5 above and are briefly described below.

Erosion control and stormwater pollution prevention plan. A stormwater pollution prevention plan is typically developed and implemented for projects which are expected to result in a significant amount of ground disturbance and exposed soils or are developed in areas with highly erodible soils. Such a plan is developed for construction and operation, although erosion is typically more prevalent during the construction phase. In general, the plan includes site runoff calculations and describes temporary and permanent structural and non-structural measures to be implemented for controlling erosion at the site, such as silt fences, hay bales, and re-vegetation plans, and identifies locations and configurations of the measures. Riprapping can be done to control erosion along shorelines and stream banks, particularly those areas susceptible to erosion from stream flows or lake level fluctuations.

Fish passage facilities. A variety of upstream and downstream fish passage measures are available for hydroelectric facilities. Upstream fish passage alternatives include fish ladders, fish elevators, fish locks, and fish "trap-and-transport" systems that are designed to move fish over or around dams to upstream reaches. Conversely, downstream fish passage facilities are designed to safely transport fish to stream reaches below the dam. Downstream passage systems typically consist of a combination of fish protection and diversion facilities that protect the fish from being drawn into the intake while guiding them to discharge point below the dam. The proper design, location, and hydraulic characteristics of fish passage systems are critical to assisting fish in finding and utilising the facilities. Other mitigation measures may include artificial stocking to supplement or replace project-related losses to adult and young aquatic organisms.

Fish protection systems. Fish protection systems in the context of this document focuses on facilities which are designed to reduce or eliminate the entrainment and impingement of fish and other aquatic organisms. Numerous options for fish protection are available, but the more common are through-flow travelling screens, dual-flow travelling screens, wedgewire screens (flat panel and cylindrical), horizontal travelling screens, velocity caps, and restricting intake velocities to 0.5 foot per second. Thermal power plants (such as a biomass facility) can also use closed cycle cooling systems in addition to or in place of the measures mentioned above. Closed cycle cooling water systems recirculate cooling water, reducing the amount of water that is required for operation and thus reducing effects to fish and other aquatic organisms. The most favourable option for a given facility depends on a number of factors, including the environmental and hydraulic conditions at the site, the susceptibility of local aquatic resources to entrainment and impingement, the technical features of the power generating facility, costs of construction, operation and maintenance, and others. Other mitigation measures may include artificial stocking to supplement or replace project-related losses to adult and young aquatic organisms.

Stream flow releases and habitat enhancement. Most hydroelectric facilities are either required to implement, or voluntarily implement, a minimum flow release from the dam. The purpose of the minimum flow release is to maintain aquatic habitat conditions and facilitate other water uses (e.g., recreation; irrigation or water supply withdrawals; aesthetics; etc.) in bypassed or downstream stream reaches. Minimum flow release values are calculated based on historic flow conditions, water use requirements, the habitat requirements of key aquatic species, and other factors. At facilities which operate in strict run-of-river mode, the same amount of water that instantaneously enters the reservoir is instantaneously released from the reservoir. In cases where physical in-stream habitat is lacking or damaged, measures to mitigate damage to or enhance aquatic habitat may include hauling in materials (e.g., boulders; gravel; etc.) to supplement the existing substrate, contouring streambeds or banks to create additional riffle, run or pool areas, improving watershed areas, or others.

Wastewater treatment. Most industrial facilities, including thermal power plants, generate some type of wastewater which contains a variety of chemical constituents. Wastewater should be treated prior to discharge so as to meet any effluent limitations. The treatment method that is utilised may vary depending on the quantity and quality of the wastewater, the availability of a publicly owned treatment works, the proximity to suitable receiving waters, and other factors.

Water withdrawal limits. In cases where natural stream flows are limited and/or other demands for available water exist, it may be necessary to impose limits on the amount of water that can be withdrawn. If properly implemented, such limits allow for industrial development while facilitating the maintenance of downstream aquatic habitat conditions and accommodating the needs of other water users.

Recommended offsetting measures

The offsetting landscape effects may be possible if there are opportunities to restore areas of degraded landscape such as forest, steppe or savannah habitat. This would be most effective where the restoration of such landscapes links other areas of high quality landscape.

Offsetting of effects related to habitat loss requires the provision of replacement habitat or improvements to existing degraded habitats elsewhere. As discussed earlier, the effectiveness of such offsetting measures will be dependent on the loss of habitat and consequent adverse ecosystem effects replacement habitats are trying to address. In general, offsetting will be most effective if the habitat replaced does not require long regeneration period to provide the support to the ecosystem being adversely affected. It will not be feasible to replace habitats that require long regeneration times, such as natural forest, and therefore offsetting the loss of such habitat cannot be considered to be effective. In addition, replacement habitat can only be considered to be truly effective if it is functional before the adverse effects have been realised, and, if designed to provide a surrogate for the habitat being lost, it will need to be as close to the area being adversely affected as possible.

Small scale offsetting measures may also include provision of specially constructed roost sites or breeding dens for protected species in areas adjacent to sections of habitat that are lost. For instance bat or bird boxes could be provided in wooded areas to provide replacement roost or nesting sites, or artificial otter holts could provide alternative breeding dens to offset the loss of natural sites lost within the clearance of vegetation of river corridors.

Of the effects to aquatic resources that have been discussed in this document, those which probably hold the least potential for effective mitigation would be the effects associated with the development of a new hydroelectric reservoir. As discussed, the creation of a reservoir can result in drastic changes in physical habitat, water quality, and flow conditions which, in turn, affect the local aquatic communities. As waters rise behind a newly constructed dam, lotic habitat within the reservoir footprint is inundated and essentially lost. Such conditions are largely irreversible and cannot be mitigated. However, it is possible for these losses to be offset, at least in part, through the development of lake-based commercial or sport fisheries. Lotic habitat losses may also be offset by creating or enhancing aquatic habitat in other locations.

Potential enhancement measures

Enhancement measures should not be viewed as an alternative to mitigation or offsetting, rather they are measures that have been identified for their potential to bring benefits to the project once all mitigation and offsetting is in place.

Potential landscape enhancement measures associated with renewable power developments are limited in rural areas. However, the development of schemes which provide the opportunity to create “landmark” structures in urban or industrial settings may also open up wider regeneration opportunities to the wider area.

Potential biodiversity enhancement measures associated with the development of renewable power scenarios could focus on the improvement of wildlife corridors which could run in parallel with any new linear development created by the renewable power development. Many of the critical habitats identified within Ukraine have suffered from fragmentation due to a range of competing land uses, most notably agricultural. The creation of new linear mosaics of habitat will allow for the enhancement of the existing resource by connecting fragmented habitats and ecosystems.

As discussed, aquatic enhancement measures would largely consist of improving habitat in stream reaches and watersheds affected by a project, or at other locations. Artificial stocking can also be used in some circumstances to support aquatic communities.

Table 8-9 Landscape and biodiversity mitigation measures

Landscape and Biodiversity Mitigation Measures								
Likely significant adverse effect on the environment	**Receptor(s) affected**	Mitigation Measure	USELF Resource Scenario that the mitigation measure is applicable to	Effectiveness of measure	Established practice?	Development timeframe	Adverse effect on other environmental receptor?	Is the measure identified also required to meet EBRD PRs (PRs and paragraphs provided)?
Mitigation for Landscape effects								
Power lines forming new linear features in the landscape	Protected and high quality unregulated landscapes	Consider burial of power lines to reduce effect on setting. Area to be determined locally	All scenarios	Effective	Yes	Immediate	Potential effects on cultural heritage or geology	*Yes - PR8 (15)*
	All receptors	Power lines to follow existing linear features (i.e. roads, boundaries). Poles to be simple timber construction	All scenarios	Partially effective	Yes	Immediate	No	*Yes - PR8 (15)*
Access roads forming new linear features in the landscape	Protected and high quality unregulated landscapes	Consider putting roads in cutting where setting is important	All scenarios	Effective	Yes	Immediate	Potential effects on cultural heritage or geology	*Yes - PR8 (15)*
	All receptors	Screen using existing features (landform & vegetation) or embankments	All scenarios	Partially effective	Yes	Immediate	No	*Yes - PR8 (15)*
		Screen planting, in forested or well vegetated areas	All scenarios	Partially effective	Yes	Effectiveness, dependent on plant growth rate	No	*Yes - PR8 (15)*

Landscape and Biodiversity Mitigation Measures								
Likely significant adverse effect on the environment	**Receptor(s) affected**	Mitigation Measure	USELF Resource Scenario that the mitigation measure is applicable to	Effectiveness of measure	Established practice?	Development timeframe	Adverse effect on other environmental receptor?	Is the measure identified also required to meet EBRD PRs (PRs and paragraphs provided)?
Loss of landscape character and visual amenity due to new built structures.	Protected and high quality unregulated landscapes	Avoid development within receptor or within the visual envelope of receptor	All scenarios	Effective	Yes	Immediate	No	*Yes - PR8 (15)*
	All receptors	Earthworks to block/partially block views	All scenarios	Partially effective	Yes	Immediate	No	*Yes - PR8 (15)*
		Locate development where existing landform or vegetation(forest) blocks/partially blocks views	All scenarios	Partially effective	Yes	Immediate	No	*Yes - PR8 (15)*
		Screen planting to replicate local landscape features	All scenarios	Partially effective	Yes	Dependent on screen planting growth rate	No	*Yes - PR8 (15)*
		Use of good design (use of materials, colour and form) to integrate development into the landscape.	All scenarios	Partially effective	Yes	Immediate	No	*Yes - PR8 (15)*
		Design to make a landmark feature of new structures	All scenarios	Partially effective	Yes	Immediate	No	*Yes - PR8 (15)*

Landscape and Biodiversity Mitigation Measures								
Likely significant adverse effect on the environment	**Receptor(s) affected**	Mitigation Measure	USELF Resource Scenario that the mitigation measure is applicable to	Effectiveness of measure	Established practice?	Development timeframe	Adverse effect on other environmental receptor?	Is the measure identified also required to meet EBRD PRs (PRs and paragraphs provided)?
Mitigation for Biodiversity effects								
Land take from wind farm/photovoltaic array(s) leading to direct loss of habitat for migratory bird populations at Ramsar sites on the Black Sea – Crimea Azov Sea coasts.	Protected Biodiversity Areas	Avoid development within protected sites	Onshore wind, solar photovoltaic	Avoidance measure, therefore most effective	Yes	None required	No	*Yes -PR6 (6 and15).*
Bird strike from turbine operation and additional above ground transmission infrastructure leading to reductions in Ramsar site migratory bird populations.	Protected Biodiversity Areas	Avoid development in areas surrounding designated sites where migratory flight paths coincide with turbines	Onshore wind, solar photovoltaic, biomass-agricultural residue	Avoidance measure, therefore most effective	Yes	6-12 month survey period required to determine flight paths	No	*Yes, PR6 (6 and15).*
Land take leading to direct loss of habitat within National and Regional Nature Reserves	Protected Biodiversity Areas	Avoid development within protected sites	All Scenarios	Avoidance measure, therefore most effective	Yes	None required	No	*Yes - PR6 (6 and15).*
Additional damming of water courses may lead to changes in the hydrological regime of water dependent or flooding of terrestrial Protected Sites.	Protected Biodiversity Areas	Provide sufficient regulation of flows (sweetening flows to ensure hydrological balance within protected areas maintain site integrity	Hydropower	Effective minimisation measure,	Yes	None required	No	*Yes - PR6 (6 and15).*

Landscape and Biodiversity Mitigation Measures								
Likely significant adverse effect on the environment	**Receptor(s) affected**	Mitigation Measure	USELF Resource Scenario that the mitigation measure is applicable to	Effectiveness of measure	Established practice?	Development timeframe	Adverse effect on other environmental receptor?	Is the measure identified also required to meet EBRD PRs (PRs and paragraphs provided)?
Loss of habitat for foraging and roosting bats due to construction of power developments and access routes	Protected species (Bats)	Survey and careful siting of development site and access route alignment to avoid roosting and foraging habitat	All scenarios	Avoidance measure, therefore most effective	Yes	Within normal development timeframes	No	*Yes, PR6 (12)*
Bat strike and bird strike from turbine operation leading to reductions in the populations of protected species	Protected Species (Bats and Birds)	Survey, identify and avoid development within areas utilised as flight corridors by bats or birds	Onshore wind	Avoidance measure, therefore most effective	Yes	6-12 month survey period required to determine flight paths	No	*Yes, consistent with PR6 (12 & 14)*
Increased risk of bird or bat strike from new connecting power lines	Protected species (birds or bats)	Survey to determine risk, where significant bury new power lines	All scenarios	Avoidance measure, therefore most effective	Yes	None	Potential effects of cultural heritage	*Yes, consistent with PR6 (12 & 14)*
		Survey to determine risk, where potential effect identified attach bird / bat diverter tape or markers to power lines		Effectiveness dependent on target species	Yes	None	Landscape/ Visual	*Yes, PR6 (12 & 14)*

Landscape and Biodiversity Mitigation Measures								
Likely significant adverse effect on the environment	**Receptor(s) affected**	Mitigation Measure	USELF Resource Scenario that the mitigation measure is applicable to	Effectiveness of measure	Established practice?	Development timeframe	Adverse effect on other environmental receptor?	Is the measure identified also required to meet EBRD PRs (PRs and paragraphs provided)?
Increased mortality of protected species due to new roads/increased traffic	Protected species (wide ranging mammals – bats, otter, bears, bison)	Survey and identify key crossing points and risk to species. Design routes to avoid key crossing points	All scenarios	Avoidance, therefore most effective	Yes	None	No	*Yes, PR6 (12)*
		Survey and identify key crossing points and risk to species. Install aerial bat crossings / mammal underpasses / speed restricted crossing points and fencing Restrict vehicle movements during key migratory periods/ times of day.	All scenarios (new roads). Biomass (significant increases in traffic).	Effectiveness dependent on target species	Yes	None	No	*Yes, PR6 (12)*
Erosion and stormwater runoff degrades water quality of receiving stream and associated aquatic habitat and, in turn, effects aquatic life	Aquatic ecosystems; protected species (fish and aquatic organisms)	Avoidance of critical areas or time periods. Implementation of stormwater pollution prevention plan and associated measures. Riprap of exposed shorelines and stream banks.	All scenarios	Effective	Yes	None required	No	*Yes - PR3(10 & 11)*

Landscape and Biodiversity Mitigation Measures								
Likely significant adverse effect on the environment	**Receptor(s) affected**	Mitigation Measure	USELF Resource Scenario that the mitigation measure is applicable to	Effectiveness of measure	Established practice?	Development timeframe	Adverse effect on other environmental receptor?	Is the measure identified also required to meet EBRD PRs (PRs and paragraphs provided)?
Blockage of upstream and/or downstream migration of fish and aquatic species, resulting in reduced aquatic populations and changes in aquatic ecosystem	Aquatic ecosystems; protected species (fish and aquatic organisms)	Avoidance of critical areas or time periods. If not possible, then implementation of fish passage facilities. Artificial stocking may be effective in some cases.	Small hydro	Effective	Yes	None required, design as part of wider scheme design. Stocking through operation.	No	*Yes - PR6(12) and PR6(13)*
Entrainment/impingement of aquatic organisms	Aquatic ecosystems; protected species (fish and aquatic organisms)	Avoidance of critical areas. Implementation of fish passage facilities and/or fish protection systems. Artificial stocking may be effective in some cases.	Small hydro; all biomass scenarios	Effective	Yes	None required, design as part of wider scheme design. Stocking through operation.	No	*Yes - PR6(12) and PR6(13)*
Modifications to instream flows, water quality, and physical habitat; conversion of lotic to lentic habitat due to impoundment construction	Aquatic ecosystems; protected species (fish and aquatic organisms)	Avoidance of critical areas or time periods. Implementation of run-of-river operation and/or minimum flow releases; habitat enhancement.	Small hydro	Effective	Yes	Implementation during operating life of the project	No	*Yes PR6(12 and PR6(13)*

Landscape and Biodiversity Mitigation Measures								
Likely significant adverse effect on the environment	**Receptor(s) affected**	Mitigation Measure	USELF Resource Scenario that the mitigation measure is applicable to	Effectiveness of measure	Established practice?	Development timeframe	Adverse effect on other environmental receptor?	Is the measure identified also required to meet EBRD PRs (PRs and paragraphs provided)?
Wastewater flows degrade water quality and effect aquatic communities of receiving streams	Aquatic ecosystems; protected species (fish and aquatic organisms)	Avoidance of critical areas or time periods. If not possible, then treatment of wastewater to reduce physicochemical effects on receiving waters	All biomass scenarios	Effective	Yes	Installation during construction; implementation during operating life of the project	No	*Yes - PR6(12) and PR6(13)*
Water supply withdrawals effect stream flows and associated aquatic habitat and aquatic communities	Aquatic ecosystems; protected species (fish and aquatic organisms)	Avoidance of critical areas or time periods. Implementation of limits on water withdrawals	All biomass scenarios	Effective	Yes	Implementation during operating life of the project	No	*Yes - PR3(10 & 11), PR6(12) and PR6(13)*

8.4.6 Community and socio-economics

Recommended mitigation measures

Mitigation measures proposed to reduce effects upon community and socio-economics are shown in Table 8.10 below.

EBRD requirements for Social Requirements are very well detailed in the EBRD Performance Criteria. These require initial early assessment and consideration of effects on communities and socio-economic development. This includes effects on affected communities, stakeholders, labourers, economic activities, and minority ethnic groups. The high priority mitigation measure it to select sites for facilities to minimise effects on human communities, avoid involuntary resettlement or economic dislocation of residents. This is to be done through the initial Environmental and Social Action Plan (ESAP) in accordance with EBRD Performance Requirement 1, and through active and ongoing consultation with affected communities and stakeholders. The mitigation effort of compensation for loss of livelihood, involuntary resettlement and livelihood restoration are critical within the EBRD Principles and detailed in Performance Requirement 5: Land Acquisition, Involuntary Resettlement and Economic Displacement. Additionally, the Performance Requirement 7: Indigenous People applied here as well. The strict guidelines pertaining to these measures must be adhered to closely in order for EBRD funding to be made available, and a key mitigation point for both EBRD and all adherents to the Equator Principles.

The placement of power lines to connect to the grid shall also adhere to these requirements. Adequate time must be allotted to the public consultation plan for the ESAP, and throughout the process and a clear and accessible mechanism for grievances must also be agreed.

Another key mitigation measure is to hire local labour whenever possible for both short and long term positions, and to follow all Occupational Health and Safety (OHS) requirements at all levels of the project. This includes all contractors and subcontractors must adhere to these requirements outlined in EBRD Principles 1 and 2. This includes training on local laws and practices, national legal compliance, and compliance with EBRD OSH standards throughout the lifespan of the project, and implementation of monitoring and evaluation of these efforts to ensure worker safety.

In the event that trans-boundary rivers are being developed for small hydro, adherence to the notification and consultation measures of the UNECE Convention on Use of Non-Navigable Transboundary Rivers and Waterways.

Recommended offsetting measures

Offsetting of losses, both temporary and permanent to communities and socioeconomic conditions in the impacted areas may include compensation for loss. These offsetting measures may apply when there is a temporary loss of land use, such as loss of pastures during construction of wind turbine foundations and power transmission lines and towers. Most offsetting measures will be developed within the mitigation through development of the ESAP, ongoing public and stakeholder consultations, and if needed development of a Resettlement

Action Plan (RAP), project design, grievance mechanism, compensation plans for loss of property, livelihood and use of public amenities.

Potential enhancement measures

The Community and socioeconomic conditions have opportunity to benefit greatly from the implementation of the renewable energy scenarios under consideration. The most prominent benefit will be enhanced employment opportunities for local labour, through construction and operations of facilities. This can be increased by actively seeking to recruit and train local labour for both short term and longer term employment and operations. This may also have additional benefits for supporting employment for local industries including food preparation, transportation, small machine shops, etc. which would benefit from the development, construction and operation of SER projects.

The benefits to the health of the local population may also be enhanced as there is a decline in emissions from coal fire power plants, and an increase in reliable and sustainable energy. For homes reliant on gas, coal and wood for heating, more regular and reliable supplies of electricity for heating may also improve health, both by reliability and the lack of emissions of particulate matter. This may also have the enhanced benefit of reducing accidently fires as a result of burning coal and wood. Potential enhancement measures may be to provide assistance in conversion of rural homes to electric heat where applicable and appropriate.

The benefit to infrastructure is both the possible enhancement of transportation durability, and the more regularisation of electricity on the grid. The enhancement of the transportation infrastructure, through reinforcement of roads and bridges offers communities an opportunity to further develop economically through better roads for movement of goods and people. The more reliable electricity can also have a beneficial effect on small businesses, which currently are plagued with power outages, and fluctuations that can damage delicate electronic equipment such as computers. Until it is demonstrated that these have been minimised, provision of surge protectors and back-up generators through incentive programs or subsidies may provide additional benefits to these local users.

The benefit to the natural resource use comes through the increase use of alternate, sustainable energy sources that could provide a draw for some interested in eco-tourism. This could be enhanced through a targeted marketing campaign to help tourist reconceptualise Ukraine as a country taking steps to enhance its green image through using safe and reliable alternative energy sources. This could be done through grants or support to the Ministry of Culture, or whichever local, oblast or national organisations are active tourism promotion for Ukraine.

Table 8-10 Community and socio-economic mitigation measures

Community and Socio-economics Mitigation Measures								
Likely significant adverse effect on the environment	**Receptor(s) affected**	Mitigation Measure	USELF Resource Scenario that the mitigation measure is applicable to	Effectiveness of measure	Established practice?	Development timeframe	Adverse effect on other environmental receptor?	Is the measure identified also required to meet EBRD PRs (PRs and paragraphs provided)?
Disruption to communities, homes and livelihoods due to placement of facilities	Communities, farms and homes located near to facilities and beneath power lines	Avoid sites and establish buffer from sites within the site selection criteria	All scenarios	Most effective measure	Yes	Up to 1 year for full public/stakeholder consultation	Relocation of homes and communities would affect other receptors – biodiversity, land-use, landscape, cultural heritage	*PR1 (9,14)* *PR 5(1-23, 30 - 38)* *PR7* *PR 10*
Labourers working on project at risk from occupational dangers without due health and safety concerns	Labourers from local communities and specialised workers	Adhere to all international labour OHS (Occupations Health and Safety) standards, including OHS training	All scenarios	Most effective measure	Yes	Throughout the project	No	*PR 1 (19)* *PR 2 (13-16, 19)*
Loss of economic use of land during construction	Local business and farms in path of built roadways for construction, and fields used for cultivation	Avoid sites as possible, or compensate owners/users for temporary lost income	All scenarios, less of biogas on farms and landfills	Effective in reducing income loss effects, but not entirely mitigating effect. .	Yes	Allow 1 – 12 months (possibly more) depending degree of effect , Should be addressed in ESAP and within development of stakeholder engagement, and through public	Relocation of routes would affect other receptors – biodiversity, land-use, landscape, cultural heritage	*PR1 (9,14)* *PR 5(24 -29, 39-40)* *PR 10*

Community and Socio-economics Mitigation Measures								
Likely significant adverse effect on the environment	**Receptor(s) affected**	Mitigation Measure	USELF Resource Scenario that the mitigation measure is applicable to	Effectiveness of measure	Established practice?	Development timeframe	Adverse effect on other environmental receptor?	Is the measure identified also required to meet EBRD PRs (PRs and paragraphs provided)?
						consultation		
Dust, vibration and noise during construction	Disruption to daily life, due to dust blowing in, construction, vibration of ground, and noise from construction activities	Take all dust reduction measures, including watering unpaved roads, and only operating during agreed daylight hours	All, with increased duration for small hydropower	Most effective measure	Yes	Allow 1 – 6 months (possibly more) depending degree of effect and agree with impacted communities	Watering may negatively effect ground water, land us and cultural heritage	*PR4 (7-10, 16)* *PR 10*
Disruption of traffic and damage to roadway infrastructure during construction	Increased traffic on roadways for construction materials, and additional weight of vehicles straining roadways infrastructure including bridges, tarmac and road shoulders	Reduce unnecessary traffic during peak hours and for heavy vehicles select routes with strong infrastructure or pay for upgrading to minimise damages	All, higher with micro hydro	Most effective	Yes	1-6 months depending on degree of effect	May negatively effect biodiversity, ground water, land use and cultural heritage	*PR4 (10)* *PR5 (41)*
Disruption in water flow to irrigation during construction	During filling and diversion of rivers during construction of hydropower facilities flow disruptions may reduce water available for	Fill or divert during non-growing seasons to avoid competition for water resources/ Establish an emergency alert plan in the event of	Small hydropower	Most effective	Yes	6 months – 1 year depending on when project and construction are initiated	May effect biodiversity and land use	*PR 4 (10, 18-22)* *PR 10*

Community and Socio-economics Mitigation Measures								
Likely significant adverse effect on the environment	**Receptor(s) affected**	Mitigation Measure	USELF Resource Scenario that the mitigation measure is applicable to	Effectiveness of measure	Established practice?	Development timeframe	Adverse effect on other environmental receptor?	Is the measure identified also required to meet EBRD PRs (PRs and paragraphs provided)?
	irrigation, or possibly may increase potential for flooding	flooding or landslide events						
Loss of economic use of lands or property during operations	Loss of portions of land for agricultural use during operations	Compensate owners/users for loss of land, or loss of use	Wind, solar and small hydropower	Most effective	Yes	1-6 months depending on willingness of owners/users to reach agreement	No	*PR1 (9,14)* *PR 5(24 -29, 39-40)* *PR 10*
Noise during operation and maintenance that disturbs nearby residents	Noise from operation and maintenance of facilities that may disturb residents	Site away from residential areas, and perform operations only during agreed daylight hours	All scenarios	Most effective	Yes	1 -12 months, Can be determined during public consultation and ESAP phase of project	No	*PR 4 (1-10, 16)* *PR 10 (3,7, 15-17, 21 -26)*
Disruption to natural river course effects on tourism and recreation	Loss of income from tourism and recreation in areas near rivers with fishing	Avoid siting near tourism and recreational areas	hydropower	Most effective	Yes	During initial planning and ESAP	May effect landscapes, biodiversity, and cultural heritage	*PR 1 (14)* *PR 5(24 -29, 39-40)* *PR 10*
Increased traffic during operations	Increase in road traffic due to transportation of raw materials for biomass during collection and from storage facility	Reduce transport of materials during peak traffic hours and locate storage facility near to CHP	Biomass – both agricultural and wood based	Most effective	Yes	During stakeholder consultations and ESAP. May be up to 1 year	No	*PR4 (10)* *PR5 (41)*

8.4.7 Cultural heritage

Recommended mitigation measures

Mitigation measures proposed to reduce effects upon cultural heritage are shown in Table 8.11 below.

The approach for cultural heritage sites is the same for all renewable scenarios. Preservation of sites in situ is the most desirable outcome and therefore avoiding sites through location of the facility or individual components is the preferred form mitigation. This also applies to location within the historical and cultural landscape (see also Section 8.4.5). Avoidance of effect should be undertaken for UNESCO Sites, those on the Tentative List, and sites and reserves of national importance. Where it is not possible to avoid sites of regional to local importance, or there is the potential for unknown archaeology, a staged approach should be adopted as set out below:

- A desk study should be undertaken to identify all known or potential sites of heritage value.
- Field studies should then be undertaken to verify the results of the desk study and further assess the potential for unknown sites. These can include field reconnaissance survey, field walking survey, geophysical survey, metal detector survey, auger survey, as required.
- Detailed evaluation and recording of targeted areas or sites, e.g. through recording of building, trial trenches and test pits, and detailed excavation where necessary.
- A watching brief can be undertaken of ground breaking activities where mitigation has been undertaken, but risk of encountering archaeology remains.
- The results of all studies should be archived and published, and where relevant exhibited to further the knowledge of the cultural heritage of the Ukraine.

Intangible cultural heritage would need to be identified at project level, through questionnaires, meetings and other participative techniques. Mitigation for intangible heritage cannot be specified at this stage as it would be very specific to the aspects affected, and would need to be developed with affected communities.

The scope of studies should involve suitably qualified cultural heritage expertise and be undertaken in agreement with the EBRD. Studies should also be conducted in accordance with international, national and local policy, legislation and best practise.

Recommended offsetting measures

Effects on cultural heritage cannot generally be offset as it is unique to its geographical location and context, so cannot be constructed or replicated elsewhere without losing its original value. No measures have been identified.

Potential enhancement measures

Enhancement measures for cultural heritage associated with all scenarios would involve furthering the knowledge of the culture and history of the Ukraine, for instance through publication of information gained during the project or public exhibitions (sites or intangible heritage may not necessarily be affected for these measures to be instigated). Restoration of sites in the vicinity of development, for instance historic or architecturally significant buildings, could also be undertaken.

Table 8-11 Cultural heritage mitigation measures

Cultural Heritage Mitigation Measures								
Likely significant adverse effect on the environment	**Receptor(s) affected**	Mitigation Measure	USELF Resource Scenario that the mitigation measure is applicable to	Effectiveness of measure	Established practice?	Development timeframe	Adverse effect on other environmental receptor?	Is the measure identified also required to meet EBRD PRs (PRs and paragraphs provided)?
Loss or damage to resource during construction.	UNESCO sites and those on the tentative list. Registered cultural heritage sites, zones and settlements.	Avoid site and establish buffer from site.	All scenarios	Most effective method.	Yes	No development time required	Relocation would affect other receptors – biodiversity, land-use, landscape, socio-economics.	*PR8 (12)*
	Registered sites which cannot be avoided. Unregistered or unknown sites.	Follow a staged approach to cultural heritage studies, involving qualified expertise and in consultation with the EBRD.	All scenarios	Effective method of recording and improving historical knowledge.	Yes	Allow 1 – 6 months (possibly more) depending on receptor.	Possibly on soils and geology, biodiversity, land-use.	*PR8 (13-14)*
Visual intrusion into historical/ cultural landscape.	All UNESCO sites, cultural heritage sites, settlements and reserves and unregistered/ undiscovered sites.	Avoid visual intrusion by location of renewable scenario outside visual envelope of heritage site.	All scenarios	Most effective method	Yes	No development time required	Relocation would affect other receptors – biodiversity, land-use, landscape, socio-economics	*PR8 (12)*
		Minimise visual intrusion, e.g. through scale of development, sensitive location of components, choice of building materials and planting screening	All scenarios	Effective in reducing visual effects, but not entirely mitigating effect. .	Yes	Can be undertaken during design stages of project	Linked to landscape, no adverse effects	*PR8 (15)*
Loss, partial	Intangible cultural	Identification of	All scenarios	Most effective	Yes	No	Relocation would	*PR8 (12)*

Cultural Heritage Mitigation Measures								
Likely significant adverse effect on the environment	**Receptor(s) affected**	Mitigation Measure	USELF Resource Scenario that the mitigation measure is applicable to	Effectiveness of measure	Established practice?	Development timeframe	Adverse effect on other environmental receptor?	Is the measure identified also required to meet EBRD PRs (PRs and paragraphs provided)?
loss or disruption to cultural practice or resource.	heritage	intangible cultural heritage and avoid effects through relocation or change to design.		method.		development time required	affect other receptors – biodiversity, land-use, landscape, socio-economics.	
		Undertake studies to identify effects and develop mitigation with affected community	All scenarios	May reduce effects but not entirely mitigate effects.	No – is often specific to situation	Allow 1 – 6 months (possibly more) depending on receptor.	May affect socio-economics or other environmental receptors depending on mitigation.	*PR8 (11, 13)*

9 SER OBJECTIVES COMPLIANCE

9.1 Performance of renewable energy scenarios in relation to the SER Objectives

The review of the USELF renewable energy scenarios is assessed against the SER Objectives, as set out below, in order to determine what the relative environmental performance of the scenarios across all the environmental topics is likely to be; this could be positive, negative or uncertain at this stage.

Although the use of Objectives is not a requirement of the SEA Directive, their use is a recognised good practice method of assessing effects on a strategic level. Consequently, this SER has adopted the approach to assess the compliance of the USELF renewable energy scenarios against the SER Objectives. The SER Objectives were included in the Scoping Report and have been refined following relevant feedback from consultees and through review of more detailed data gathered for inclusion in the SER Environmental Topic Paper, including: the review of environmental policies, plans and programmes, the baseline review and the identification of environmental issues.

SER Objectives are closely linked to receptors. The relative performance of the scenarios against each Objective has been assessment based on the proportion or number of receptors for which effects from the scenarios have been predicted, whether these effects are positive or negative, and significant or insignificant, as identified in the discussion on likely significant effects in Section 8.2.

In making the assessment of compliance against the SER Objectives, the assessment has taken into account the relative scale of each of the USELF scenarios under consideration (see Section 4.2.1) and has assumed the successful implementation of those mitigation measures identified in Section 8.4. As part of the assessment of objective compliance consideration has been to the four criteria used to identify suitable mitigation measures, namely effectiveness of the measure, whether it is an established practice, whether it has a short development timeframe, and whether it avoids adverse effects on environmental receptors. Where mitigation measures clearly meet the four suitability criteria, the text in the mitigation tables in Section 8.4 is coloured green.

Environmental effects on receptors can be both positive and negative and this has been reflected in the assessment of SER Objective compliance. There is usually some uncertainty associated with strategic level assessment. Those effects which are highly uncertain, either due to the lack of available environmental data or variability of effects associated with a particular scenario/geographic location, have been identified. A judgement on the environmental performance of each scenario against each SER Objective has been made as either 'no effect', 'major' or 'minor', and negative or positive, depending on the sensitivity of receptors, the numbers of receptors affected (cumulatively) and the significance of the effect predicted.

A summary of the results of the objectives compliance assessment is presented in Table 9-1 below, with more detailed justification of the extent of compliance provided in Appendix D, Table C1.

Table 9-1 Compliance of the USELF renewable energy scenarios against the SER Objectives

Env Topic	SER Objective: Does the proposed development of the USELF renewable scenario…	USELF Renewable Energy Scenarios: Onshore wind	Small hydro	Solar PV	Biomass: Wood residue	Biomass: Agri. residue	Biogas: Landfill gas	Biogas: Animal manure
Climate & air quality	Lead to reductions in greenhouse gases or progress toward Ukrainian greenhouse gas emission targets?	🟢	🟢	🟢	◐	◐	◐	◐
	Minimise the risk of potential effect on air quality?	○	○	○	🔴	🔴	🔴	🔴
Surface & groundwater	Avoid adverse effects upon surface water and groundwater resource?	○	○ or 🔴?	○	🔴	🔴	○	○
	Minimise adverse effects upon fisheries, water quality, recreation, and commerce associated with rivers and lakes?	○	🔴	○	○ or 🔴	○ or 🔴	○	○
Geology & soils	Minimise adverse effects upon soils?	🔴	🔴	🔴	🔴	🔴	🔴	🔴
	Minimise adverse effects to land and infrastructure from erosion and from landslides in high slope areas?	○	🔴	○	○	○	○	○
	Minimise the risk of potential mobilisation of anthropogenic contaminants during construction?	○	○	🔴	🔴	🔴	○	🔴
	Avoid the removal of high value soils (Mollisols) from productive use?	🔴	🔴	⬤	🔴	🔴	○	🔴
Landscape & biodiversity	Minimise the risk of potential effects on landscape character and visual amenity of the Ukrainian landscape?	⬤	🔴	⬤	🔴	🔴	○ or 🔴	○ or 🔴
	Avoid adverse effects upon internationally designated nature conservation sites?	○ or 🔴	○ or 🔴	○ or 🔴	○ or 🔴	○ or 🔴	○	○
	Avoid adverse effects upon nationally designated nature conservation sites?	○ or 🔴	○ or 🔴	○ or 🔴	○ or 🔴	○ or 🔴	○	○
	Minimise adverse effects upon important habitats and species?	🔴	○ or 🔴	🔴	○ or 🔴	○ or 🔴	○	○
Community & socio-economics.	Minimise the involuntary economic or physical displacement of people?	○ or 🔴	○ or 🔴	○ or 🔴	○ or 🔴	○ or 🔴	○	○
	Minimise adverse effects upon the health and well being of human communities?	○	🟢	○	○	○	○	○
	Have the potential to contribute towards direct or indirect employment?	🟢	🟢	🟢	🟢	🟢	🟢	🟢
	Minimise the risk of potential adverse effect on other sectors (conventional tourism, hunting, eco-tourism, etc.).	🟢	🟢	◐	🟢	🟢	🟢	🟢
	Minimise adverse effects upon existing land uses such as agriculture and forestry?	🔴 or ⬤	🔴	⬤	🔴	🔴	○	○
	Minimise adverse effects upon important material assets and infrastructure?	🟢	🟢	🟢	◐	◐	🟢	◐
Cultural heritage	Avoid adverse effects upon Ukrainian and World Cultural Heritage sites?	○ or 🔴	○	○ or 🔴	○ or 🔴	○ or 🔴	○	○
	Minimise adverse effects on unknown cultural heritage sites	🔴	◐ ?	🔴	◐ ?	◐ ?	◐ ?	◐ ?
	Minimise adverse effects on intangible cultural heritage	○ or 🔴?	○ or 🔴?	○ or 🔴?	○ or 🔴?	○ or 🔴?	○?	○?

Key to Table 9-1:

Performance is based on the number or proportion of receptors linked to each SER Objective for which significant effects have been predicted,			
Major negative performance against SER Objective	● or ◗ (large, red)	Major positive performance against SER Objective	● or ◖ (large, green)
Minor negative performance against SER Objective	● or ◗ (small, red)	Minor positive performance against SER Objective	● or ◖ (small, green)
No Effects	○	Uncertain	?

As can be seen in Table 9-1, the majority of the likely negative significant effects of the USELF renewable energy scenarios can be mitigated, so that the scenarios have only minor negative performance or no effects in terms of compliance against the SER Objectives. However, for the onshore wind and solar photovoltaic renewable energy scenarios, there remain a small number of SER Objectives there are anticipated to experience major negative performances; specifically for effects upon high value soils (Mollisols), landscape character and visual amenity, and existing land uses such as agriculture and forestry. The reason for the anticipated major negative performances of these two renewable energy scenarios against these SER Objectives is largely due to the fact that the USELF resource scenario scale for these two resources is considerably greater than the others (as detailed in Table 4-1) and; therefore, there are anticipated to be more of these types of projects (resulting in cumulatively larger impacts); however, it is also due to the large footprint and visual impacts of onshore wind and solar photovoltaic projects.

Several minor positive performances against the SER Objectives are observed for socio-economic receptors, in line with the potential positive effects posed the USELFs in relation to these. In addition, the scenarios have minor positive performance against the SER Objectives in relation to their ability to avoid adverse effects upon Ukrainian greenhouse gas emission targets. There is uncertain performance of the scenarios in avoiding adverse effects on unknown cultural heritage sites, as there is potential for negative impact but also opportunities to identify and study new archaeological sites.

The biogas scenarios offer positive performance or no effects against the most SER Objectives in comparison to the other scenarios. In particular the biogas scenario using municipal landfill gas only has negative performance against four SER Objectives, which is largely because this scenario would utilise existing landfill sites and therefore construction operation and direct and indirect effects resulting from new land take would be minimal. The extent of compliance against the SER Objectives of the small hydropower and biomass scenarios are relatively comparable.

At this strategic stage, uncertainties remain over the performance of the scenarios in relation to unknown and intangible cultural heritage, and effects upon important habitats and species; these uncertainties would be resolved through detailed assessments of the effects of scenarios at project level. Indeed, the specific characteristics of projects funded under USELF may vary from the overall compliance of scenarios identified here, and will therefore require more detailed appraisal through project level environmental assessments. Recommendations on the scope of the project level assessment are included in Section 10.

10 IMPLEMENTATION

10.1 Introduction

As noted in Section 1.2, the purpose of this SER is to review the key environmental issues associated with the implementation of the USELF renewable energy scenarios on a strategic, national basis. Whilst the outcomes of the SER will help to focus the scope and required mitigation of projects proposed under USELF, the effects and mitigation measures that are ultimately assigned to a subject project will be dependent on its particular design and site-specific environmental conditions. Consequently, for each project, it will be necessary for the proponent to consider the following site-specific issues (discussed further in the sections below):

- Siting considerations;
- National and international environmental requirements;
- Availability of baseline data;
- Additional monitoring required; and,
- Required mitigation.

An environmental implementation guidance document will be developed separately of this SER for use by the USELF as a resource for renewable energy projects. This guidance will incorporate the considerations addressed above and utilise the baseline, impact, and mitigation data developed in this SER to provide a streamlined policy compliance approach for prospective USELF projects.

10.2 Siting considerations

As identified in Section 7, there are a range of broad scale technical exclusions and environmental sensitivities that should be considered when considering sites for a proposed development under the USELF renewable energy scenarios. For example, the on-shore wind renewable energy scenario is largely confined to coastal and upland regions of Ukraine for technical reasons, as these have the greatest wind resource; nevertheless, these areas are generally more environmentally sensitive, as they hold landscape and biodiversity value, as well as often being associated with higher concentrations of inhabitants and tourist destinations, a prime example being Crimea. It is therefore recommended that the figures and text produced under Section 7 are consulted when considering potential locations for siting of projects under the USELF renewable energy scenarios. However, in order to provide a high-level overview of some of the key environmental issues and associated mitigation measures that are most likely to be required for the different renewable energy scenarios, Table 10-1 details three primary considerations for each scenario during construction and three primary considerations for each scenario during operation.

Table 10-1 Primary environmental constraints and mitigation measures during construction and operation

Renewable Energy Scenario	Construction		Operation	
	Construction-stage environmental issue	**Mitigation measure**	**Operational-stage environmental Issue**	**Mitigation measure**
On-shore wind	1. Footprint of construction works (including ancillary infrastructure) resulting in loss of habitat and risk to flora and fauna.	1. Ecological surveys, bespoke mitigation for species present and careful siting of project and ancillary infrastructure; careful timing of construction activities to avoid sensitive ecological times.	1. Risk of strike from turbines or ancillary infrastructure, such as transmission lines, resulting in the killing or injury of birds (including in particular migratory species and raptors) and bats.	1. Surveys to be undertaken to inform siting and orientation of wind turbines prior to construction; monitoring of anticipated impacts during operation. Where required, alteration of operating regime to minimise risk during sensitive time-periods (such as migration).
	2. Soil erosion and degradation as a result of stripping of working area for turbines and ancillary infrastructure.	2. Erosion control plan to be prepared and implemented during construction; to include measures to minimise exposure of soils and prevent surface water run-off.	2. Visual impact of turbine towers upon the landscape.	2. Avoid siting of wind turbines in visually sensitive landscapes (such as protected areas) and use natural (or artificial) screening where possible – such as tree-lines and natural gullies – for ancillary infrastructure where possible. Bury inter-turbine transmission lines.
	3. Nuisance (noise, dust, visual impact, traffic, etc) impacting local community and visitors.	3. Prior assessment; screening and considerate construction techniques (including timing of deliveries); as well as monitoring of impacts during construction and consultation with local community.	3. Complete or partial loss of land or land-use for existing owners / users.	3. Avoid siting of wind turbines on lands that are currently of significant use (such as agricultural lands); plan to improve or, at a minimum, restore the livelihoods and standards of living of any displaced persons to pre-project levels; and/or where required, provide compensation at just replacement value, as determined by court certified valuators.
Small hydropower	1. Risk of water pollution,	1. Water resource and quality	1. Prevention of passage to fish.	1. Studies of fish passage on the

Renewable Energy Scenario	Construction		Operation	
	Construction-stage environmental issue	Mitigation measure	Operational-stage environmental Issue	Mitigation measure
	including erosion and mobilisation of sediments, during construction of hydropower infrastructure (including use of concrete, installation of inlets and outlets from river channel, etc) and inappropriate storage of polluting materials near to water.	protection to be addressed in Environment and Social Action Plan to include provisions for preventative controls over sensitive construction activities, storage of potentially polluting materials and emergency remediation techniques in case of accidents.		watercourse and inclusion of appropriate fish passage mechanism in final design.
	2. Nuisance (noise, dust, visual impact, traffic, etc) impacting local community and visitors.	2. Prior assessment; screening and considerate construction techniques (including timing of deliveries); as well as monitoring of impacts during construction and consultation with local community.	2. Localised removal of baseline water flow impacting other uses of water resources (such as local communities).	2. Impact studies and provision of appropriate environmental flow rate.
	3. Footprint of construction works (including site compounds, storage areas and ancillary infrastructure) resulting in loss of habitat and risk to flora and fauna.	3. Ecological surveys, bespoke mitigation for species present and careful siting of project and ancillary infrastructure; careful timing of construction activities to avoid sensitive ecological times.	3. Risk of strike, or barriers to migration / movement, from ancillary infrastructure resulting in the killing, injury, or disruption to migration / movements of birds, bats and other wide-ranging species (including, otter, brown bear, bison, lynx and wildcat).	3. Surveys to be undertaken to inform siting and orientation of ancillary infrastructure prior to construction; monitoring of anticipated impacts during operation. Where required, alteration of operating regime to minimise risk during sensitive time-periods (such as migration).
Solar photovoltaic	1. Footprint of construction works (including site compounds, storage areas and ancillary infrastructure) resulting in loss of habitat and risk to flora and fauna.	1. Ecological surveys, bespoke mitigation for species present and careful siting of project and ancillary infrastructure; careful timing of construction activities to avoid sensitive ecological times.	1. Complete and extensive loss of land or land-use for existing owners / users.	1. Avoid siting of solar photovoltaic developments on lands that are currently of significant use (such as agricultural lands); plan to improve or, at a minimum, restore the livelihoods and standards of living of any displaced persons to

Renewable Energy Scenario	Construction		Operation	
	Construction-stage environmental issue	Mitigation measure	Operational-stage environmental Issue	Mitigation measure
				pre-project levels; and/or where required, provide compensation at just replacement value, as determined by court certified valuators.
	2. Nuisance (noise, dust, visual impact, traffic, etc) impacting local community and visitors.	2. Prior assessment; screening and considerate construction techniques (including timing of deliveries); as well as monitoring of impacts during construction and consultation with local community.	2. Visual impact of solar photovoltaic development upon the landscape.	2. Avoid siting of solar photovoltaic development in visually sensitive landscapes (such as protected areas) and use natural (or artificial) screening where possible – such as tree-lines and natural gullies – for ancillary infrastructure where possible. Bury intra-site transmission lines.
	3. Soil erosion and degradation as a result of stripping of working area for solar panels and ancillary infrastructure.	3. Erosion control plan to be prepared and implemented during construction; to include measures to minimise exposure of soils and prevent surface water run-off.	3. Risk of strike, or barriers to migration / movement, from ancillary infrastructure resulting in the killing, injury, or disruption to migration / movements of birds, bats and other wide-ranging species (including, otter, brown bear, bison, lynx and wildcat).	3. Surveys to be undertaken to inform siting and orientation of ancillary infrastructure prior to construction; monitoring of anticipated impacts during operation. Where required, alteration of operating regime to minimise risk during sensitive time-periods (such as migration).
Biomass using wood residues	1. Footprint of construction works (including ancillary infrastructure) resulting in loss of habitat and risk to flora and fauna.	1. Ecological surveys, bespoke mitigation for species present and careful siting of project and ancillary infrastructure; careful timing of construction activities to avoid sensitive ecological times.	1. Release of air pollutants during combustion and handling of biomass fuel.	1. Combustion control and emissions monitoring; good site practice for storing and handling materials.
	2. Nuisance (noise, odour, dust, visual impact, traffic, etc) impacting local community and	2. Prior assessment; screening and considerate construction techniques (including timing of	2. Impact on local road network of frequent deliveries of wood biomass.	2. Traffic and transport assessment prior to construction to consider most appropriate

Renewable Energy Scenario	Construction		Operation	
	Construction-stage environmental issue	Mitigation measure	Operational-stage environmental Issue	Mitigation measure
	visitors.	deliveries); as well as monitoring of impacts during construction and consultation with local community.		access routes; improvement to existing road network; careful timing of deliveries; monitoring of performance; consultation with, and where necessary compensation to, local communities.
	3. Risk of water pollution, including erosion and mobilisation of sediments, during construction and inappropriate storage of polluting materials near to surface water, or pathways to surface water (such as drains or gullies).	3. Water resource and quality protection to be addressed in Environment and Social Action Plan to include provisions for preventative controls over sensitive construction activities, storage of potentially polluting materials and emergency remediation techniques in case of accidents.	3. Intensive use of water resources.	3. Prior to operation, develop water resource plan to minimise the volumes of water used; implement techniques to operate the biogas generation without causing detriment to other users of water resources.
Biomass using agricultural residues	1. Footprint of construction works (including ancillary infrastructure) resulting in loss of habitat and risk to flora and fauna.	1. Ecological surveys, bespoke mitigation for species present and careful siting of project and ancillary infrastructure; careful timing of construction activities to avoid sensitive ecological times.	1. Release of air pollutants during combustion and handling of biomass fuel.	1. Combustion control and emissions monitoring; good site practice for storing and handling materials.
	2. Nuisance (noise, odour, dust, visual impact, traffic, etc) impacting local community and visitors.	2. Prior assessment; screening and considerate construction techniques (including timing of deliveries); as well as monitoring of impacts during construction and consultation with local community.	2. Impact on local road network of frequent deliveries of agricultural biomass.	2. Traffic and transport assessment prior to construction to consider most appropriate access routes; improvement to existing road network; careful timing of deliveries; monitoring of performance; consultation with, and where necessary compensation to, local communities.

Renewable Energy Scenario	Construction		Operation	
	Construction-stage environmental issue	Mitigation measure	Operational-stage environmental Issue	Mitigation measure
	3. Risk of water pollution, including erosion and mobilisation of sediments, during construction and inappropriate storage of polluting materials near to surface water, or pathways to surface water (such as drains or gullies).	3. Water resource and quality protection to be addressed in Environment and Social Action Plan to include provisions for preventative controls over sensitive construction activities, storage of potentially polluting materials and emergency remediation techniques in case of accidents.	3. Intensive use of water resources.	3. Prior to operation, develop water resource plan to minimise the volumes of water used; implement techniques to operate the biogas generation without causing detriment to other users of water resources.
Biogas using municipal landfill gas	1. Footprint of construction works (including ancillary infrastructure) resulting in loss of habitat and risk to flora and fauna.	1. Ecological surveys, bespoke mitigation for species present and careful siting of project and ancillary infrastructure; careful timing of construction activities to avoid sensitive ecological times.	1. Release of air pollutants during combustion of biogas.	1. Combustion control and emissions monitoring.
	2. Nuisance (noise, odour, dust, visual impact, traffic, etc) impacting local community.	2. Prior assessment; inclusion of suitable buffer from works area to nearest human receptors; screening and considerate construction techniques (including timing of deliveries); as well as monitoring of impacts during construction and consultation with local community.	2. Generation of waste by-products (including digestate).	2. Methods to process and reuse, or safely dispose, waste by-products (such as processing of digestate for re-use as fertiliser).
	3. Risk of mobilising pollutants and/ or odours during installation of biogas production / capture infrastructure.	3. Pollution prevention and abatement methods to be included in Environment and Social Action Plan, including methods to prevent escape of landfill waste and / or odour through wind, surface water run-	3. Risk of strike, or barriers to migration / movement, from ancillary infrastructure resulting in the killing, injury, or disruption to migration / movements of birds, bats and other wide-ranging species (including, otter, brown	3. Surveys to be undertaken to inform siting and orientation of ancillary infrastructure prior to construction; monitoring of anticipated impacts during operation. Where required, alteration of operating regime to

Renewable Energy Scenario	Construction		Operation	
	Construction-stage environmental issue	Mitigation measure	Operational-stage environmental Issue	Mitigation measure
		off or accidental entrainment on machinery and plant.	bear, bison, lynx and wildcat).	minimise risk during sensitive time-periods (such as migration).
Biogas using animal manure	1. Footprint of construction works (including ancillary infrastructure) resulting in loss of habitat and risk to flora and fauna.	1. Ecological surveys, bespoke mitigation for species present and careful siting of project and ancillary infrastructure; careful timing of construction activities to avoid sensitive ecological times.	1. Release of air pollutants during combustion of biogas.	1. Combustion control and emissions monitoring.
	2. Nuisance (noise, odour, dust, visual impact, traffic, etc) impacting local community.	2. Prior assessment; inclusion of suitable buffer from works area to nearest human receptors; screening and considerate construction techniques (including timing of deliveries); as well as monitoring of impacts during construction and consultation with local community.	2. Risk of pollution from escape of animal manure/ slurry during handling and processing as fuel for biogas.	2. Implement good practice controls over manure and liquid slurry management, including systems to ensure containment and prevention of ingress (or egress) of liquids; and carry out handling and storage of wastes away from surface water, or pathways to surface water.
	3. Risk of mobilising pollutants and/ or odours during installation of biogas production / capture infrastructure.	3. Pollution prevention and abatement methods to be included in Environment and Social Action Plan, including methods to prevent escape of animal manure and / or odour through wind, surface water run-off or spillage from vehicles and plant.	3. Risk of strike, or barriers to migration / movement, from ancillary infrastructure resulting in the killing, injury, or disruption to migration / movements of birds, bats and other wide-ranging species (including, otter, brown bear, bison, lynx and wildcat).	3. Surveys to be undertaken to inform siting and orientation of ancillary infrastructure prior to construction; monitoring of anticipated impacts during operation. Where required, alteration of operating regime to minimise risk during sensitive time-periods (such as migration).

As well as broad scale technical exclusions and environmental sensitivities, there would also be site specific issues that would need to be considered in siting of projects under the USELF renewable energy scenarios. These site specific issues would involve more detailed analysis of localised baseline data than has been possible for this strategic level SER. Siting considerations would include, for example:

- Examples of technical considerations:
  - Proximity to existing transmission network
  - Local availability of resources (are other interests conflicting for the same resource?)
  - Condition of existing infrastructure
  - Alternative allocations for use of land

- Examples of environmental sensitivities:
  - Proximity to residential dwellings, schools, emergency services etc?
  - Competition for use of water and land resources?
  - Is the local area known for and contamination or especially high quality soils?
  - Are there records of protected species using the local area?
  - Proximity to features of cultural importance, such as churches, areas of archaeological or landscape importance etc?

10.3 National and international environmental requirements

10.3.1 Overview

Project funded under the USELF renewable energy scenarios will be subject to the following environmental and social requirements, as stipulated by EBRD:

- Applicable requirements of Ukraine, including but not limited to those related with environmental impact assessments, environmental permitting, labour, public consultation, resettlement and compensation, occupational health and safety, community health and safety, and emergency response.
- The EBRD’s Environmental and Social Policy (2008) and its associated Performance Requirements.
- Relevant European Union Directives and requirements
- International best practices, including those promulgated by other international financial institutions, the International Labour Organisation, and others.

10.3.2 Applicable environmental requirements of Ukraine

Developers of USELF projects would need to conform to the national Ukrainian requirements for EIA. As noted in 2.5c of the SER Environmental Topic Paper (Appendix E), EIA of economic projects is required by the Law of Ukraine “On Ecological Review”, and under international obligations of the country (e.g. the Espoo Convention [1991]). The Ukrainian EIA process includes two related procedures: (1) assessment of environmental impacts (Ukrainian abbreviation OVNS) carried out by the proponent, and (2) state environmental review (SER) that is a part of investment integrated expert review conducted by designated state authorities.

The recent adoption, in February 2011, of The Law of Ukraine "On Regulation of Urban Planning" has limited the types of development which would require obligatory national EIA procedure[38] under Ukrainian Law in such a way that it is unlikely that USELF-funded projects would fall into this requirement (as discussed in further detail in Section 6.1.2). As a result of this recent legal change, the role and potential impact of the USELF SER increases significantly. It is envisaged that this SER Environmental Report will be a valuable source of environmental information for potential USELF-funded projects.

Other national environmental legislative requirements that would be applicable to USELF renewable energy scenarios projects are detailed in Section 2 of the Environmental Topic Paper (Appendix E), the key pieces of legislation being:

- The Law of Ukraine on Environmental Protection;
- The Land Code;
- The Water Code;
- The Forest Code;
- The Mineral Resource Code;
- The Law of Ukraine "On Nature Reserves and Protected Areas";
- The Law of Ukraine "On Ambient Air Protection",
- The Law of Ukraine "On Animal Life"; and,
- The Law of Ukraine "On the Environmental Review".

In addition, there are numerous regulations issued by various executive authorities with environmental management functions and local self-governance bodies.

10.3.3 EBRD requirements

Projects would need to adhere to the EBRD Environmental and Social Policy and its associated Performance Requirements, which cover the following areas:

- PR 1: Environmental and Social Appraisal and Management
- PR 2: Labour and Working Conditions
- PR 3: Pollution Prevention and Abatement
- PR 4: Community Health & Safety and Security
- PR 5: Land Acquisition, Involuntary Resettlement and Economic Displacement
- PR 6: Biodiversity Conservation and Sustainable Resource Management
- PR 7: Indigenous Peoples
- PR 8: Cultural Heritage

[38] Very broadly, the national OVNS report – chapter of the project documentation titled 'Assessment of the impacts on the environment', plus the procedure of checking the OVNS compliance with national environmental standards, called environmental review, a part of project permitting process, are, for the purpose of this note, called 'national EIA'

- PR 9: Financial Intermediaries (FI)
- PR 10: Information Disclosure and Stakeholder Engagement

Depending upon the scale of the USELF project, EBRD would require a series of environmental documents to be produced in order to gain EBRD funding. As noted in section 2 of the SER Environmental Topic Paper EBRD categorises proposed projects as A, B, C, or FI based on environmental and social criteria to: (i) reflect the level of potential environmental and social effects and issues associated with the proposed project; and (ii) determine the nature and level of environmental and social investigations, information disclosure and stakeholder engagement required for each project, taking into account the nature, location, sensitivity and scale of the project, and the nature and magnitude of its possible environmental and social effect and issues.

Required documentation is determined on a project by project basis, but it is usual to expect that Category A (and sometimes Category B) projects would require:

- An Environmental Report (in-line with EIA requirements), with a Non Technical Summary;
- An Environmental and Social Action Plan;
- A Stakeholder Engagement Plan;
- A Land Acquisition Plan (if land acquisition is required);
- A Resettlement Action Plan (if population displacement is required).

Due to the relatively small scale of the potential USELF projects, most would likely fall under Category B, as the potential adverse environmental and/ or social effects that they may give rise to are typically site-specific, and/ or readily identified and addressed through mitigation measures.

10.3.4 Relevant European Union Directives and requirements

EU EU EIA Directive (97/11/EC as amended)

In addition to compliance with national EIA legislation, as per EBRD funding requirements, it would also be necessary to comply with the EU EIA Directive (97/11/EC as amended) where a renewable energy scenario project funded under USELF is categorised (either under Annex I or Annex II of the Directive) as requiring a statutory EIA.

It is recommended that Environmental Statements produced for statutory project level EIAs follow the Requirements of EU EIA Directive Annex III, which are summarised in Table 10-2 below.

Table 10-2: Requirements of EU EIA Directive Annex III

	Requirement of EU EIA Directive Annex III
1	Description of the project, including in particular:
	Description of the physical characteristics of the whole project and the land-use requirements during the construction and operational phases,
	Description of the main characteristics of the production processes, for instance, nature and quantity of the materials used,
	An estimate, by type and quantity, of expected residues and emissions (water, air and soil pollution, noise, vibration, light, heat, radiation, etc.) resulting from the operation of the proposed project.
2	Where appropriate, an outline of the main alternatives studied by the developer and an indication of the main reasons for his choice, taking into account the environmental effects.
3	A description of the aspects of the environment likely to be significantly affected by the proposed project, including, in particular, population, fauna, flora, soil, water, air, climatic factors, material assets, including the architectural and archaeological heritage, landscape and the inter-relationship between the above factors.
4	A description (1) of the likely significant effects of the proposed project on the environment resulting from: • the existence of the project, • the use of natural resources, • the emission of pollutants, the creation of nuisances and the elimination of waste; (1) This description should cover the direct effects and any indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative effects of the project.
	The description by the developer of the forecasting methods used to assess the effects on the environment.
5	A description of the measures envisaged to prevent, reduce and where possible offset any significant adverse effects on the environment.
6	A non-technical summary of the information provided under the above headings.
7	An indication of any difficulties (technical deficiencies or lack of know-how) encountered by the developer in compiling the required information.

Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora, commonly known as the 'Habitats Directive'

Where a renewable energy scenario project funded under USELF has the potential to affect a site designated as a Natura 2000 site, it is standard practice to undertake a screening assessment to determine whether a full 'Appropriate Assessment' is required in accordance with Article 6 of the Habitats Directive to determine the potential effects of the scheme upon the site. Whilst the protected biodiversity areas of Ukraine are not currently designated as Natura 2000 sites, it is likely that those sites flagged as nationally or internationally important would have the potential for future designation. The sensitivity of protected biodiversity areas to the USELF renewable energy scenarios is flagged as high in the figures in Section 7. Therefore, developers that are looking to implement schemes in proximity to these highly sensitive biodiversity areas would need to ascertain whether there is a requirement for assessment against the Habitats Directive during the design phase of a USELF renewable energy scenario project.

Other Relevant EU Directives

The following EU Directives will also need to be followed and applied to the USELF renewable energy scenarios projects:

- EU Directive 2009/147/EC – Bird Directive on the conservation of wild birds the conservation of wild birds (amended version of Directive 79/409/EEC);
- EU Directive 96/62/EC – Air Quality Framework Directive;
- Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, in short, the EU Water Framework Directive.

The Water Framework Directive requires River Basin Management Plans to be drafted for all River Basin Districts across the EU. Where necessary, member states are required to implement mitigation measures to return waterbodies to 'Good ecological Status', or heavily modified waterbodies to 'Good Ecological Potential'. Whilst Ukraine does not yet fall under the EU, EBRD requires that EU Directives are adhered to. Furthermore, once Ukraine becomes part of the UE there will be an increasing requirement for the effects upon waterbodies to be considered in the context of wider catchments, and to ensure that USELF renewable energy scenarios projects to not compromise the conservation objectives implemented by government to improve the ecological status of the waterbodies.

10.3.5 International best practices

Several international organisations have developed best practice guidance which should be adhered to by developers in designing, constructing and operating renewable energy scenarios projects funded through USELF. Adherence to the following international guidance is recommended:

- International Finance Corporation Performance Standards
- International Labour Organisation,
- Equator Principles, and others.

10.4 Availability of baseline data and additional monitoring

As identified in the SER Environmental Topic Paper (Appendix E) and in Section 6, there is a general lack of Localised baseline data when considering the siting considerations and likely significant effects of the individual USELF renewable energy scenarios projects. It will therefore be necessary in most cases for developers to gather additional baseline data at project level, potentially including the implementation of environmental monitoring programmes prior to, during and post construction to track whether changes in environmental receptors are as a result of the USELF renewable energy scenario project. Potential monitoring programmes that may be required for the surface and groundwater topic and the socio-economic topic are identified below. Depending upon the specific location and characteristics of the USELF renewable energy scenario project, monitoring for other environmental topics may also be required, for example air and odour emissions, and surveys for protected species.

Surface and groundwater

Sites in Ukraine that are or will be recommended for development or rehabilitation often do not have any local receptor data. Ukraine's data collection network is significant; but as soon as a site or sites are identified, a short data collection project should be undertaken to provide more confidence in feasibility studies, particularly if the project requires significant volumes of cooling water or river flow for generation.

Another approach is to research and/or develop statistical tools to assist in assessing surface and groundwater resources in un-gauged watersheds. These tools may be available but were not identified during research or field visits to the Ukraine.

Community and socio-economics

Monitoring of community and socio-economic effects should be developed in concert with the stakeholder engagement plan and other stakeholder activities, including the employment of grievance mechanisms. These should include monitoring of demographic conditions, especially pertaining to resettlement or economically displaced communities, and inclusion of opportunities for ethnic minorities for all renewable energy scenarios.

Human health monitoring should be project specific and should include monitoring of negative effects, such as disturbances from dust, noise and vibration to determine what additional controls may be needed. Monitoring of noise levels should be conducted specifically during hours when households are resting or on holidays. Also worker health should be monitored so that accidents and exposure to toxins are tracked and avoided as much as possible.

Monitoring of local employment rates specific to the project should be tracked for future projects. In the event that there are economic dislocations due to loss of agricultural lands, whether short or long term, these should be monitored and compensation measures as well. Stakeholder satisfaction should also be monitored to add to a database of experiences with sustainable energy scenarios for future reference and additional projects under USELF.

10.5 Required mitigation

Following the assessment of likely significant effects of each of the USELF renewable energy scenarios, measures have been developed under Section 8.3 which aid to prevent or reduce effects (mitigation), or offset effects (offsetting). Developers implementing projects under the USELF renewable energy scenarios will need to incorporate these measures where necessary, and expand upon them to ensure that they are targeted to the actual project site.

It may be that characteristics of specific projects will warrant mitigation measures that are not identified in Section 8.3. Project proponents would therefore be expected to develop additional suitable mitigation based upon good practice guidance, including the EBRD Environmental and

Social Policy (and associated Performance Requirements), the IFC Performance Standards, and national and international legislative requirements (discussed further in Section 6).

10.6 Supporting documentation to assist USELF projects

To assist project proponents in meeting the EBRD requirements, the findings of this SER have been used to form the basis of a series of template documents to be completed during environmental and social due diligence of individual schemes:

- Environmental and Social Action Plan templates for projects falling under each renewable energy scenario (incorporating applicable mitigation identified through the SER process);
- A Stakeholder Engagement Plan template (based on standard EBRD requirements and recommended activities specific to USELF schemes);
- A Non Technical Summary template identifying the key environmental impacts and proposed mitigation associated with an individual USELF scheme.
- Environmental and Social Due Diligence questionnaires for projects falling under each renewable energy scenario, to be completed by project proponents when applying for USELF funding.

A GIS tool has also been developed to enable USELF project proponents to identify key environmental constraints in proximity to their proposed project locations.

USELF will need to be confident that project proponents are taking appropriate steps to reduce potential environmental effects to acceptable levels in order to approve funding of Projects. It is envisaged that this SER Environmental Report will be a valuable source of environmental information to assist in this process. It is also anticipated that the mitigation and consultation measures outlined in the SER report and associated template documentation will form the basis for project-level environmental and social documentation that eventually becomes a part of USELF loan agreements.

11 GLOSSARY OF TERMS

The following definitions are provided in order to clarify some of the more technical terms used within this Environmental Report:

Term	Definition
Agricultural Residue	By-products of agricultural crops such as wheat, barley and other grains such as straw, rapeseed straw, and residues of corn and sunflower.
Anaerobic Digester	A controlled environment in which micro-organisms break down biodegradable material in the absence of oxygen.
Ancillary development	Works that are additional to the primary focus of the USELF renewable energy scenario, but which are necessary for the functioning of the scenario. An example of this is transmission lines which are required for the scenarios.
Anthropogenic	Processes or materials that are derived from human activities.
Appropriate Assessment	A process required by the Habitats Regulations (SI 2010/490) to avoid adverse effects of plans, programmes and projects on Natura 2000 sites, and thereby maintain the coherence of the Natura 2000 network and its features.
Biogas	Gas produced by the biological breakdown of organic matter.
Biomass	Energy or fuel derived from biological material.
Bubbling Fluidised Bed	A type of technology that can be used for firing biomass for power generation. The technology uses a heated inert medium, such as sand, to create a “fluidized” bed to heat the biomass fuel. The bed is able to absorb fluctuations in fuel conditions with little to no change in performance.
Co-firing	Combustion of two different types of materials, such as biomass and coal, at the same time.
Combined Heat and Power	A facility designed to produce both heat and electricity from a single heat source.
Concentrating Solar Thermal Power	Systems that use mirrors or lenses to concentrate a large area of sunlight, or solar thermal energy, onto a small area. Electrical power is produced when the concentrated light is converted to heat, which drives a heat engine (usually a steam turbine) connected to an electrical power generator.
Cumulative effects	Effects that arise, for instance, where several developments each have insignificant effects but together have a significant effect, or where several individual effects of a plan have a combined effect.
Decommission	To dismantle, deactivate or remove something from service.
Direct effects	The original effect as a result of an alternative option (see indirect effects).
Distribution	The portion of an electric system that is dedicated to delivering electric energy to an end user, usually at a lower voltage than transmission lines.
Effect	Used to describe changes to the environment as a result of an alternative option (see also direct effects, indirect effects and

	cumulative effects).
Future baseline	Baseline environment in 2040 (without implementation if USELF funded projects).
Geothermal power	Electrical power generated from harnessing thermal energy stored in the Earth and converting the thermal energy to electrical energy.
Green tariffs	A fixed price for energy paid to a “green” project over a certain contract term.
Impoundment	A structure that is built across a river used to support a variety of water related purposes. Dams and diversions are different types of impoundments.
Indicator	A measure of variables over time, often used to measure achievement of objectives.
Indirect effects	Those effects which occur away from the original effect or as a result of a complex pathway.
Interconnection	Process to allow a generator or transmission owner to connect its project to the transmission grid.
Internal Combustion Engine (ICE)	An engine where the fuel is burned or combusted with oxygen inside the engine instead of an external furnace, such as a reciprocating engine.
Landfill Gas	Landfill gas (LFG) is produced by the natural decomposition of the organic matter contained in municipal landfills.
Landscape	An area, as perceived by people, whose character is the result of the action and interaction of natural and/ or human factors.
Landscape impacts	The likely effects on landscape character or components due to a development proposal or change in land management. The can therefore affect the way in which the landscape is experienced. Impacts can be positive (beneficial) or negative (detrimental; and can also be cumulative.
Microturbines	Smaller gas turbines, typically 30 to 250 kW.
Mitigation measures	Measures to prevent or reduce any significant adverse effects on the environment.
Natura 2000	The European Union-wide network of protected areas, recognised as ‘sites of Community Importance’ under the EC Habitats Directive (Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora).
Negative effects	Effects which are unfavourable for a receptor. Can sometimes be referred to as ‘adverse’.
Network Tariff	Usually refers to the fees charged for use of the transmission network to delivery energy.
Offsetting measures	Measures to as fully as possible offset any significant adverse effects on the environment. Such measures would aim to make-good for loss or damage to an environmental receptor, without directly reducing that loss/damage.
Power Generation Capacity	The amount of electric power delivered from a generator, measured in megawatts (MW).

Ramsar site	Ramsar sites are designated under the International Convention on Wetlands of International Importance 1971 especially as Waterfowl Habitat (the Ramsar Convention).
Receptor	An entity that may be affected by direct or indirect changes to an environmental variable.
Reliability	Electric system reliability has two components--adequacy and security. Adequacy is the ability of the electric system to supply to aggregate electrical demand and energy requirements of the customers at all times, taking into account scheduled and unscheduled outages of system facilities. Security is the ability of the electric system to withstand sudden disturbances, such as electric short circuits or unanticipated loss of system facilities. The degree of reliability may be measured by the frequency, duration, and magnitude of adverse effects on consumer services.
Scoping	The process of deciding the scope and level of detail of an SER, including the environmental effects and alternative options which need to be considered, the assessment methods to be used, and the structure and contents of the Environmental Report.
SER Objective	A statement of what is intended, specifying the desired direction of change in trends.
SER Target	SER targets set out a desired outcome, often bound to a specific timescale. They are used in SEA to help compare options and evaluate the significance of a plan's environmental effects.
Significant environmental effects	Effects on the environment which are significant in the context of a plan or programme. Criteria for assessing significance are set out in Annex II of the SEA Directive (Council Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment).
Single-Cycle Gas Turbines	Type of internal combustion engine with continuous combustion. It has an upstream rotating compressor coupled to a downstream turbine, and a combustion chamber in-between.
Solar Insolation (Irradiance)	Solar radiant energy arriving at a specific area of surface during a specific time interval on earth.
Solar photovoltaic	Method of generating electrical power by converting solar radiation into direct current electricity using semiconductors.
Stoker	A common boiler technology that has been used historically in biomass applications that is characterized by the way fuel is fed to the furnace and by the type of grate used.
Strategic Environmental Assessment	The term used to describe environmental assessment as it applies to policies, plans and programmes. 'SEA' is used to refer to the type of environmental assessment required under the SEA Directive.
Strategic Environmental Review	The term used to describe the environmental review undertaken for this USELF programme, which is non-statutory, but nevertheless has been guided by the SEA Directive.
Transboundary effect	An environmental effect upon another (usually neighbouring)

	country.
Transmission Network (Grid)	An interconnected group of electric transmission lines and associated equipment for moving or transferring electric energy in bulk between points of supply and points at which it is transformed for delivery over the distribution system lines to consumers, or is delivered to other electric systems.
Utility-Scale Solar	Large-scale solar projects that are interconnected to the grid.
Wind Power Density	Calculation of the mean annual power available per square meter of swept area of a turbine, and is tabulated for different heights above ground.
Wood Residue	Byproducts of primary and secondary wood processing (and firewood) from cutting area.

-- End of document --

Please note that the following appendices are provided as separate files available from www.uself-ser.com:

Appendix A – Renewable Energy Scenarios

Appendix B – Spatial Constraints Analysis

Appendix C – Assessment of Likely Significant Effects

Appendix D – SER Objectives Compliance Assessment

Appendix E – SER Environmental Topic Paper