PALDISKI WIND FARM

JI Project Design Document

Draft: June 30, 2003
Revised: July 14, 2003 and August 22, 2003

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Acronyms/abbreviations used in the document:

AAU	Assigned Amount Units
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CFBC	Circulating fluidised bed combustion
GHG	Greenhouse Gas
CHP	Co-generation of heat and power
CO_2	Carbon Dioxide
CO_2 eq	Carbon Dioxide Equivalent
COP	Conference of the Parties to the Framework Convention on Climate Change
EIA	Environmental Impact Assessment
ERU	Emission Reduction Unit
ERPA	Emission Reduction Purchase Agreement
FBC	Fluidised bed combustion
GWP	Global Warming Potential
IE	Independent Entity
JI	Joint Implementation
MOP	Meeting of the Parties once the Kyoto Protocol has been ratified
MVP	Monitoring and Verification Plan
PDD	Project Design Document

PIN	Project Idea Note
RES	Renewable Energy Sources
UNFCCC	United Nations Framework Convention on Climate Change
WTG	Wind Turbine Generator

Enclosure B	Kyoto Protocol listing of the Annex I Parties with their commitments to emission reductions
Enclosure I	UNFCCC Annex I. List of countries that have committed themselves to a quantitative GHG emissions reduction target (OECD members plus most Central and Eastern European Countries)
Baseline	Scenario that reasonably represents greenhouse gas emissions that would occur in the absence of a JI project
Determination	Determination by an independent entity whether a JI project fulfils the relevant validation requirements of the JI programme
Emission Reduction	Reduction of greenhouse gas emissions or enhancement of carbon removals as a result of a JI project in relation to a defined baseline
Monitoring	Systematic surveillance and measurement of aspects related to the implementation and performance of a project which enables measurement or calculation of Emission Reductions
Validation	Process of independent appraisal of a JI project by an operational entity against the requirements of the JI on the basis of the Project Design Document
Verification	Periodic review and ex-post determination by an independent entity of the monitored Emission Reductions that have occurred as a result of a JI project during the verification period

1 EXECUTIVE SUMMARY

The current Project Design Document (PDD) includes the information required in order to implement the Paldiski Wind Farm project as a JI project within the Dutch ERUPT Programme.

The PDD contains project information, description of the environmental impact and information about stakeholder involvement, a baseline study and calculation of emission reduction, an assessment of additionality as well as the proposed monitoring and verification plan.

The project foresees installation of 22 units of Nordex N90 wind turbines at Pakri peninsula at the Southern coast of Gulf of Finland. The project would contribute to alleviation of global warming, security of energy supply and sustainable development. The project is in an advanced stage of development and is expected to be commissioned by end of 2004. The site is considered ideal for wind energy generation due to good wind conditions, nearby technical infrastructure, and no environmental or other restrictions due to past military activities in the region. The risks of implementing the project are low due to local municipality support, agreement with the electrical utility for grid connection, guaranteed purchase of green electricity in accordance with the Electricity Market Act of Estonia and supplier's experience from current implementation of a neighbouring 20 MW wind farm. Due to the prevailing renewable energy policy in Estonia the financial income from the sales of carbon credits under the Joint Implementation programme is of utmost importance for the realization of the project.

The project developer is an Estonian limited liability company AS Tuulepargid which is owned by the Danish wind power development company Global Green Energy ApS.

By introducing modern state-of-art wind energy technology in Estonia an important step is taken in the local energy scene away from the present massive usage of oil shale, which is currently the basis for the generation of ca. 93 % of Estonia's electricity, contributing to ca. 67% of the country's CO_2 emissions. During the 1990s, Estonia's CO_2 emission per capita has been one of the highest in the World.

Total emission reductions between 2005 and 2012 are estimated to be 1 131 930 tCO_2eq. Of these, 730 594 tCO_2eq are ERUs. Emission reductions will be achieved through production downgrade at the most inefficient and polluting production units at Balti Power Plant which part of the state owned vertically integrated electricity monopoly.

The PDD is based on the Operational Guidelines for Project Design Documents of Joint Implementation Projects of the Ministry of Economic Affairs of the Netherlands, on the Marrakech Accords of the UNFCCC and previous experience of the Supplier. The project has been endorsed by the Government of Estonia (Enclosure 1). The PDD has been prepared in co-operation with researcher Inge Roos from the Estonian Energy Research Institute and with reference to all relevant legislation, policies and development plans of the Republic of Estonia related to energy, environment and climate change, as well as official plans of Eesti Energia AS.

2 PROJECT INFORMATION

2.1 Project characteristics

2.1.1. Project participants

Party involved	**Legal entity project participant (as applicable)**	**Please indicate if the Party involved wishes to be considered as project participant (Yes/No)**
Republic of Estonia (Host Party)	*Paldiski Tuulepark OÜ*	No
Republic of Estonia (Host Party)	*Eesti Energia AS*	No
Netherlands	*NL Agency*	No

<u>*Supplier's name and address:*</u>

2.1.2 OÜ Paldiski Tuulepark

OÜ Paldiski Tuulepark is an Estonian limited liability company that has been established by AS Tuulepargid as a project company for the implementation of the Paldiski Wind Farm project. AS Tuulepargid is an Estonian limited liability company and it holds 100% of the equity of OÜ Paldiski Tuulepark.

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Date of registration: 25.09.2002

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Bank::

Union Bank of Estonia (Eesti Ühispank)

Tornimäe 2, 15010 Tallinn

SWIFT Code: EEUHEE2X

Reg. no.: 10004252

Other parties involved:

2.1.3 AS Tuulepargid

AS Tuulepargid holds 100% of the shares of OÜ Paldiski Tuulepark. AS Tuulepargid is an Estonian limited liability company established in 2000 which sole activity is the development of larger grid connected wind power plants in Estonia. AS Tuulepargid belongs to the Danish wind power development company Global Green Energy ApS. AS Tuulepargid is today in the process of developing and implementing several large-scale wind power plants in Estonia among them the Pakri 20 MW Wind Farm project which is located in the close vicinity of the planned Paldiski Wind Farm and which will be implemented by early 2004. The project has obtained grant support from the EU Fifth Framework Programme and is expected to sign a contract for delivery of carbon credits under the Finnish JI/CDM Pilot Programme.

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2.1.4 Global Green Energy ApS

Global Green Energy was established in 1999 and it is owned by Danish private investors – JPA-Consult ApS, Winwin ApS and GGE Invest ApS. The company has long-term international experience and extensive knowledge in development, financing and implementation of grid connected wind power plants, obtained from development of several hundred MW in Denmark, Spain, Italy, Sweden, Poland and other countries.

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Deriving from the corporate strategy, Global Green Energy / AS Tuulepargid are currently seeking to enter into a strategic partnership with companies interested in co-development, ownership and operation of the Paldiski Wind Farm. Negotiations are being held with several companies, among them the Dutch-based energy company NUON.

In addition, the following companies and organisations have been involved in the development of the Paldiski Wind Farm project:

- Nordex Energy - potential wind turbine supplier
- Energi- og Miljödata - has performed third party wind resource assessment and energy production estimate
- Entec AS - Estonian environmental consulting company that is preparing the Detailed Land Use Plan for the project
- Paldiski City Government - local authority which has authorized OÜ Paldiski Tuulepark to carry out the Detailed Land Use Plan and will issue the Construction Permit
- Owners of neighbouring land-units and other local stakeholders - involved in the Detailed Land Use Planning process
- Estonian Land Board - representative of the Republic of Estonia regarding contracting for use of the state owned land at the wind farm territory.
- Eesti Energia AS - national electricity utility which has approved the grid connection of the wind farm at a nearby substation
- Harju Environmental Department, Institute of Geology of Tallinn Technical University, Estonian Ornithology Association and other local and national environmental organisations - consultations regarding the environmental impact
- Estonian Ministry of Environment - focal point for Joint Implementation projects
- Ms. Inge Roos, researcher at the Energy Research Institute - consultant for the Baseline Study and MVP
- KPMG Certification - chosen validator of the JI project

Several other local companies and organisations are or will be shortly involved in the development and realisation of the wind farm project, incl. local consulting engineers, construction companies, financial institutions, etc.

2.2 Project abstract

Project title: Paldiski Wind Farm

Abstract: The project's purpose is to install a large-scale wind power plant in Paldiski, Estonia, thus contributing to alleviation of global warming, improving security of energy supply and sustainable development. Paldiski Wind Farm with a planned capacity of 50,6 MW is in an advanced stage of development and is expected to be commissioned at the end of March 2005. The site is considered ideal for wind energy generation due to good wind conditions, nearby technical infrastructure and no environmental or other restrictions due to past military activities in the region. The risks of implementing the project are low due to local municipality support, achievement of an agreement with the electrical utility for grid connection, guaranteed purchase of green electricity in accordance with the Electricity Market Act of Estonia and Supplier's experience from current implementation of a neighbouring 20 MW wind farm. Due to the prevailing renewable energy policy in Estonia the financial income from the sales of carbon credits under the Joint Implementation programme is of utmost importance for the realization of the project.

Project location:

Pakri peninsula at the Southern coast of Gulf of Finland, Paldiski municipality, about 50 km west from Tallinn

Project starting date:

The project is already in an advanced stage of development

Construction starting date:

July 2004

Construction finishing date:

March 2005

2.3 Background and justification

Following many years of market research and market monitoring assisted by the Danish Embassy and other local partners, Pakri peninsula located in Paldiski municipality was chosen in autumn 1999 among several other potential wind sites to start up project development activity. As of today, a number of different project development activities have been carried out towards the realization of the Paldiski Wind Farm project. See chapter 2.7 for details. As the result of the above activities, all preconditions for the establishment of a large-scale wind farm at Paldiski exist.

Development of the project in Estonia and specifically on the Pakri peninsula would enable the project sponsors to gain from experience and economies of scale deriving from the earlier development and current implementation of the neighbouring Pakri 20 MW Wind Farm, which will be implemented by early 2004 and that has been approved by the Finnish JI/CDM programme.

At the moment no modern operating wind farms have been established in Estonia on a commercial basis. Two small-scale demonstration wind power plants have been set up under Danish and German bilateral assistance. By introducing modern state-of-art wind energy technology in Estonia an important step is taken in the local energy scene away from the present massive usage of oil shale, which is currently the basis for the generation of ca. 93 % of Estonia's electricity, contributing to ca. 67% of the country's CO_2 emissions. During the 1990s, Estonia's CO_2 emission per capita has been one of the highest in the World amounting to 10,2 tons/capita in 1999[1].

The share of renewable sources in Estonia's net electricity consumption is today only ca. 0,2%. Wind energy resources have by far the largest potential when compared to other renewable energy sources (RES) in Estonia, with technical potential amounting to 400-500 MW[2].

The National Environmental Strategy from 1997 envisages as one of the priorities the reduction of negative effects of the energy sector and improvement of air quality. According to the Long Term Development Plan for the Estonian Fuel and Energy Sector one of the main strategic goals of the Estonian Government is to promote wider use of renewable energy. The draft new Long Term Development Plan for the Estonian Fuel and Energy Sector further prioritizes the development of the renewable energy sector.

Changes introduced to the *Estonia's Energy Act* in 1998 established a fixed price at which electricity from RES should be purchased by the distribution system operator. The new *Electricity Market*

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[1] According to IEA. The equivalent figure was on average 8,2 for EU countries and 5,2 for EU applicant countries

[2] Draft Long Term Development Plan for the Energy and Fuel Sector. Ministry of Economic Affairs. 2003

Act, adopted by the Estonian Parliament in February 2003, foresees further harmonization of the legislation with that of the EU, incl. liberalization of the electricity market and wider use of RES. The draft Electricity Market Act foresees an obligation for network operators to purchase electrical energy produced from green sources. The draft act links the feed-in tariff of RES to the sales price of electrical energy from Narva Power Plants (approved by Energy Market Inspectorate, periodically adjusted) in a way that the feed-in tariff is constituted by multiplying Narva Power Plants energy price with factor 1,8. The act also notes that any incentives to RES producers will end in December 2015 which means that renewable energy plants that start commercial operation soon will maximize their income from the governmental support scheme.

Furthermore, a national indicative target in accordance with the EU directive 2001/77/EC has been recently agreed between the European Commission and Estonia which aims to reach a 5,1% share of renewable energy in final electricity consumption of the country by year 2010. It is a challenge for the country to meet the target as no concrete activity plans have been adopted and the Electricity Market Act sets an insufficient subsidy to develop RES projects on a commercial basis.

Due to the improving governmental policy, an interest for the development of wind power and other RES projects in Estonia is increasing. A number of small hydro power plants have been renovated and a few small-scale wind power and biomass-based CHP projects are under preparation. The development of large-scale wind farms in Estonia is limited to a very few sites, which also includes Pakri peninsula. The chosen site meets all necessary criteria for wind power utilization: good wind conditions, presence of a strong power grid, absence of environmental or other restrictions, acceptance by local authorities and small value of the site for alternative economic activities.

The level of the feed-in tariff and risks related to the support mechanism (predictability of the feed-in tariff) will be the main factors impeding the development of the wind energy sector. Therefore, all projects implemented in the medium term future should involve financial assistance.

Estonia has an extremely favorable investment climate, which is proven by international credit rating agencies. Estonia has risen to a shared fourth place in the Index of Economic Freedom[3]. The legal framework for private enterprises is largely in conformity with the EU and is further harmonized for EU accession in spring 2004. The political risk of carrying out large-scale investments in Estonia is small.

According to the Kyoto Protocol Estonia has agreed to reduce its greenhouse gas emissions by 8% calculated as an average during the period from 2008 to 2012 compared to the 1990 level. As the target has already been largely achieved as of today the Estonian government provides full support to implementation of JI projects, including trading of early credits. Estonia has ratified the Kyoto protocol and prepared an Action Plan for Reduction of Greenhouse Gas Emissions which foresees an establishment of the necessary institutional framework for implementation of

[3] Heritage Foundation / The Wall Street Journal 2002

JI projects. The draft national JI criteria gives top priority to the utilization of renewable energy sources. The recent EBRD study concludes that Estonia is among the most successful reformers in the region and has at least in the short term much to offer to JI investors.[4]

The attitude of the Estonian Government towards the Paldiski Wind Farm project is extremely positive. As such, the country has signed the Letter of Endorsement prior to conclusion of a Memorandum of Understanding between Estonia and the Netherlands.

2.4 Project purpose

2.4.1 Purpose

The project's purpose is to install a wind power plant in Paldiski, thus contributing to the objectives of national and global energy and environmental policies including alleviation of global warming, security of energy supply and sustainable development. The wind farm would be the largest wind power plant in the region.

2.4.2 Specific local & global environmental and socio-economic benefits expected

Implementation of the Paldiski Wind Farm project would serve as a perfect project to demonstrate the long-term potential of wind energy as a tool to efficiently reduce the greenhouse gas emissions, to diversify and to increase the security of local energy supply. In addition to greenhouse gas emissions reductions, the increased application of renewable energy in electricity generation would enable to reduce other pollutant emissions caused by the oil shale based electricity generation in North-East Estonia (SO_2, solid particles, ground water pollution, etc.).

Establishment of modern wind farms in Estonia would also enable to reduce network losses and improve the quality of electricity in rural Estonia. Network losses and own power consumption of the Estonia's oil-shale based electricity sector amount to 30-40% of final electricity sales.[5]

The project would have a positive impact on local economy also due to technology transfer, tax income and employment related to project development and construction, operation and maintenance of the wind farm. Also WTG towers and other subcomponents may be

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[4] p. 24, The investment climate for climate investment: Joint Implementation in transition contries, EBRD, Jan. 2003
[5] Eesti Energiasektori Jätkusuutliku Arnegu Võimalused. TTÜ Eesti Majanduse Instituut. 2002

manufactured in Estonia. Paldiski wind farm, supplemented by the special history of the area and closeness of picturesque Pakri bank, is also very likely to become a tourist attraction.

In a longer-term perspective, upon further integration of the electricity and green certificate markets, experience gained from the project would also enable to start an export of green electricity from Estonia for the benefit of Estonia's balance of payments.

Specific global benefits expected with the implementation of the project include:

- alleviation of global warming through CO_2-reduction
- reduction of the cost of wind energy and impact on international R&D
- meeting of the growing demand for electricity in the Baltic Sea region

2.5 Technical description

The project foresees an erection of 22 units of Nordex N90 2,3 MW turbines with a total nominal capacity of 50,6 MW. These wind turbines are well suited for the site's wind conditions as they enable to maximise the green electricity output from the site. Negotiations with the mentioned wind turbine supplier for the delivery of WTGs have not been finally concluded and usage of other technology is thus not excluded. Please see draft layout of the wind farm in enclosure 2 and the power curve of the wind turbine in the N90 product brochure in the product brochure in enclosure 3.

The N90 wind turbine is a result of decades of continuous product development of wind turbines, where mentioned wind turbine is the latest and most energy efficient product of Nordex. The chosen turbine offers the highest annual energy yield at the given site and wind conditions.

Thanks to the pitch control the machine is able to optimize the energy yield at all wind speeds and ensures that the wind turbine meets the network and noise demands.

The planned hub height of the wind turbines is 80 meters and rotor diameter 90 meters. In addition, all elements of the turbines have been designed and constructed to comply with EU and IEC norms. Based on turbine class and certification, it is concluded that the choice of turbine is compatible with the site and its wind conditions, and that this choice is a viable option. Please find more technical details for the N90 wind turbine in enclosure 4.

In order to determine the best possible location for the WTGs within the site, computer programme WindPRO has been used to optimise the location, taking determinants such as wind speed distribution, wind turbine characteristics, terrain characteristics as well as noise and shadow limits into consideration.

A full-scale wind resource assessment study has been completed by an independent third party (Energi og Miljödata). Wind measurements have been carried out on the site since October 2000 with the help of a 40 m wind measurement mast with anemometers at two heights. The study took into account also long and short-term wind data from nearby meteorological stations and from another 40 m wind measurement mast of AS Tuulepargid at Türisalu former Soviet rocket bases. Furthermore, NCAR reanalysis data from National Center of Atmospheric Research (USA) has been used. The conclusion of the above study is that the site very suitable for a wind farm project. Wind conditions of the site can be compared with the wind conditions of good wind sites in Denmark and other European countries. Based on the measured wind data, net annual energy production of the project is estimated at 135 GWh.

Conditions for grid connection to a nearby 110 kV substation have been agreed with Eesti Energia Main Grid business unit and the wind farm would use all available grid capacity at the Paldiski 110/35 kV substation. According to law Eesti Energia is obliged to provide grid interconnection if adequate capacity exists on the grid. Rights to grid interconnection and sales of electricity will be secured in accordance with legislation and by conclusion of the following agreements with Eesti Energia: Grid Connection Agreement, Operating Agreement And Power Purchase Agreement.

The wind turbine supplier will be contracted to construct the wind turbine generators on a fixed-priced basis, according to an EPC contract. Local civil construction companies are anticipated to be sub-contracted for construction of project infrastructure. Technical operation and maintenance will be take care of by OÜ Paldiski Tuulepark in cooperation with Estonian sub-contractors. The expected technical lifetime of the wind turbines is 20 years.

2.6 Economic and financial information

As the project is still in the development phase, the budget estimate is based on parameters from similar projects in Estonia and other countries. The final financial structure of the project, which is a mixture of equity funding, project debt financing and JI support, has not been finalised. The total project costs are estimated to be 59 million Euros.

Global Green Energy will be the coordinator of project financing and will be one of the equity holders. Remaining finance will be sought from additional investors and commercial bank loans.

The rights to the wind farm have been transferred to a special purpose company, OÜ Paldiski Tuulepark, which has been established with the sole intention of developing, implementing, operating and owning the wind farm. This single-purpose company has been incorporated as an Estonian limited liability company with AS Tuulepargid as its founder and main shareholder.

The equity subscription of Global Green Energy and co-investor(s) is proposed to constitute minimum 20% of the total project financing. GGE expects to raise the equity subscription through equity paid-in cash and equity in-kind as well as pre-paid cash during project preparations. Prepayment from the JI project will be used as part of equity.

Commercial lenders or other financing institutions working with financing of environmental projects in Eastern Europe shall finance the credit portion (e.g. NEFCO, commercial banks). Negotiations will be held with the Danish Export Credit Find (EKF) which can offer a financial guarantee against political and commercial risks in Estonia.

The project is supposed to be financed with a non-recourse construction loan and on completion of the construction of the project, the project company will be re-financed with non-recourse term loans. The loans shall be structured according to the prospective cash flows, the operating expenses and refurbishment plus an additional safety cushion. The technique of project financing is able to raise finance under such conditions at a relatively low cost to the benefit of the financing institutions and the shareholders alike.

A third party research report has been prepared in order to forecast the oil-shale based electricity cost price development at the Estonian electricity market which is the basis for the feed-in tariff and hence income of the wind farm (enclosure 5).

2.7 Implementation plan

The activities that have been completed to date include:

- On-going wind measurements since October 2000;
- Wind resource assessment (incl. third party assessment)
- Geological survey (nearby Pakri wind farm);
- Preliminary assessment of the environmental impact;
- Positive opinion by the local government;
- Support by the Estonian Government (Letter of Endorsement, enclosure 1)
- Support from the Estonian Ministry of Environment for usage of state-owned land at the wind farm area
- Approval of grid connection by the national electrical utility AS Eesti Energia;
- Site layout (enclosure 2)
- Energy yield calculation (enclosure 6)
- Shadow and noise calculations (enclosures 7 and 8)
- Budget and cash-flow estimate (enclosures 9 and 10)

As the result of the above activities, all preconditions for the establishment of a large-scale wind farm at Pakri peninsula exist. The time-schedule for realization of the project with important milestones, current status, partners and responsibilities is given in enclosure 11.

All necessary permissions and agreements for construction, connection, operation and sales of electricity for the Paldiski Wind Farm are expected to be issued/signed by Q1 2004. Construction of the wind farm is expected to start in Q 3 2004 and the wind farm is to be commissioned by April 1 2005.

2.8 Project risks and risk mitigation

All activities that remain to be completed prior to commissioning of the wind farm have a low risk.

The completion risk will be mitigated with having the wind turbine supplier or any other well-experienced company as a turnkey contractor.

The risks related to the long-term cash-flows from electricity sales have been eliminated with the final adoption of the new Electricity Market Act of Estonia. The act obliges the distribution system operator to purchase all electricity generated from wind power at a fixed price for a period of 12 years. The price has unfortunately been set too low for the realization of wind power projects on a purely commercial basis due to which an extra income from the "sales" of carbon credits is necessary. The third party research report on forecast of the feed-in tariff development (enclosure 5) further mitigates the income risk of the wind farm.

3 ENVIRONMENTAL IMPACT

Everyone uses electricity, but rarely considers how it is generated or what effect it has on our environment. Wind power has unique characteristics for an energy technology. In some countries wind energy is already competitive with fossil and nuclear power even without accounting for the environmental benefits of wind power. The cost of electricity from conventional power stations does not usually take full account of its environmental impact (acid rain, oil slick clean up, the effects of climate change, etc).

Wind energy is considered a green power technology because it has only a minor direct impact on the environment. Wind energy plants produce no air pollutants or greenhouse gases. However, any means of energy production impacts the environment in some way, especially visually, in the case of wind turbines.

Elements that mostly influence the visual impact include spacing, design, and uniformity of the turbines. This means the most significant impact on the environment is the visibility of wind turbines. This is certainly a completely different negative impact when compared with the effects of acid rain, global climate change, radioactivity, land and water contamination and the other environmental problems associated with conventional energy sources. Global climate change resulting from the burning of fossil fuels is the most important environmental problem. Wind energy and other renewable energy sources can play a crucial role in reducing emissions of carbon dioxide (CO_2) and other greenhouse gases associated with global warming. A single wind turbine, by displacing power generated by fossil fuels, can prevent the emission of thousands tons of CO_2 into the atmosphere each year. Wind energy saves emissions of polluting gases because every unit of electricity produced by wind power replaces a unit of electricity generated by other means. It is why those people who support the move towards sustainable and clean energy production therefore see the visual effect of the turbines as an elegant and aesthetically pleasing symbol of a better future. Through sensitive planning and appropriate public consultation wind energy projects can form a new and welcome part of the existing environment.

3.1 Legislative framework

In accordance with the Estonian Environmental Impact Assessment and Environmental Auditing Act and the EIA Directive (85/337/EEC as amended by 97/11/EC) planning of wind farms does not need Environmental Impact Assessment. A full-scale EIA is needed only when predicted environmental impacts are significant - may exceed the environmental capacity of a location, cause irreversible changes to the environment, endanger directly human health or property. The Estonian EIA Act is in full conformity with respective EC Directives. The competent authority responsible for performing the duties of environmental supervision and post-project monitoring is Harju County Regional Environmental Department.

Although wind power facilities are not stated as objects of significant environmental impact according the Directive and the mentioned Estonian legislation, a general information regarding the environmental compatibility of the project with regard to the landscape, nature, land, water and air, waste products, erosion risks and land stability etc is needed. When the laws do not demand a compulsory study of the environmental impact and the project is not located in an environmentally sensitive area (zones protected by national laws), a specific environmental chapter of detailed plan or project design documentation is required, where further environmental requirements and mitigation measures should be stated according to the Planning Act.

All general requirements for construction works, building materials, construction products, building design documentation and construction works, construction supervision etc are regulated by the Building Act. All construction works shall be designed and carried out according to good construction practices and pursuant to legislation concerning construction and construction design documentation, and shall not be a threat to the life, health or property of persons or to the environment. Despite that an EIA is not required for this project, all respective measures should be considered and updated if any new additional information concerning environment becomes evident.

The construction works shall not be a threat to life, health or property of the occupants or other people or to the environment. The spread of noise or emission to humans, pollution of the water or soil and solid or liquid waste related to the construction works shall also be prevented.

3.2 Visual impacts

It is obvious that establishing number of wind turbines together as wind farms has much smaller overall visual and environmental impact than single wind turbines scattered over all the coastal landscape. The advantage of powerful wind turbines together in a compact wind park has possibility to produce more green energy. Larger wind turbines also rotate slowly leading to reduced noise levels.

The dominance of wind turbines in landscape can be reduced with the suitable colour of the wind turbine towers and blades. Wind turbines should not be located so close to residential areas that they unreasonably affect the amenity of such properties through noise, shadow flicker, visual domination or reflected light. The possible shadow effect may take place only during operation of the turbines and in case of sunshine. Shadow problems results when the rotor blade ”cuts the sunlight”. In clear weather shadow effects can appear at distance of several hundred meters. Extension of the shadows are largest during sunrise and sunset in spring and autumn. The chosen site and layout of Paldiski wind power plant excludes the possible shadow effect on nearby housing even in case of a worst case scenario which assumes that wind turbines are always operating and sun always shining. No new residential buildings have been planned in the area where the negative shadow effect may appear. Please see enclosure 7 for the shadow calculation.

3.3 Noise

Like any other mechanical systems, wind turbines produce some noise when they operate. Noise reflection or absorption depends largely from the relief of landscape and height of surrounding trees. The noise level is much lower upwind of wind turbines.

Noise was more significant issue with some older wind turbine designs, but it has been largely eliminated as a problem through improved engineering. The sound made by the gearbox and generator is minimised through efficient engineering and any remaining noise is contained within the nacelle by sound insulation and isolation materials.

Aerodynamic noise has been reduced by adjusting the thickness of the blades trailing edges and by orienting blades upwind of the turbine tower. Some noise is generated by the mechanical components of the turbine. Infrasound has been minimized in case of modern wind turbines and could be issue only within a close radius of the turbine. Anyway, mostly for safety reasons an area of 80-100 meters (rotor diameter) from the turbine should be remain as a safety zone.

The most important is that the equivalent noise level in the nearest living area should not exceed permissible limits (both day and nighttime). Noise calculation for the Paldiski Wind Park has been performed using the WindPro programme and the conclusion of this calculation is that the noise near the closest residential areas does not exceed the noise limit according to Estonian standards. The advisable distance between residences and a proposed development will depend also on a variety of factors including local topography, the character and level of local background noise. Please see enclosure 8 for the noise calculation.

3.4 Vegetation and fauna

Paldiski wind farm is planned partly to the forest area which is anyway affected by former military activity. Significant impact on trees and other vegetation occurs only during the construction phase. Despite of the fact that the wind farm will be located close to Pakri Landscape Reserve and some objects on natural interest (for example Neosti Erratic Boulders, Ubaniidi Stone Field). No endangered / rare plants or animals are registered so far on the planned area according official information from

Nature Register held by Information Centre of the Ministry of Environment. Anyway, as some protected plants have been found in neighborhood, assessment of flora on the planning area is advisable and will be carried out in close cooperation with nature protection authorities and organisations. The project should not result in loss of valuable habitat or adverse impact on protected species.

3.5 Birds

Birds often use to collide with any high constructions as high voltage overhead lines, masts, poles etc. The power lines, including power lines leading to wind farms, are a much greater danger to birds than the wind turbines themselves. No overhead power lines will be built to realize the Paldiski wind farm.

Some birds get accustomed to wind turbines very quickly, for others it takes longer time. The possibilities of erecting wind farms next to bird areas therefore depend on the species in question. Pre-construction surveys and monitoring can indicate whether birds or other living resources are likely to be affected by wind turbines. It is obvious that wind farms have some disturbing effect on the birds nestling, food searching and also collisions. A special study has been performed by Estonian Ornithology Association for the first phase of Paldiski wind farm which is situated closer to Pakri Landscape Reserve and Important Bird Areas (IBA) of the Baltic Sea. Even though no special negative impact on birds has been discovered there, a future cooperation with ornithologist has been planned including post-project monitoring and more detailed identification of migratory routes. The migratory birds usually do not collide with wind turbines and they are also capable of changing their flight route before the turbine and pass above the turbine at a safe distance. However, they also most usually migrate at altitudes above the turbine blades. Anyway, more detailed information concerning the birds will be taken into account when agreeing on the final placements of the wind turbines during detailed planning.

3.6 Geological conditions

The geological conditions at the site will be further examined to ensure that construction of the foundations for the wind turbines, the erection of the machines and the provision of access roads have minimal environmental impact. It may be necessary to investigate any previous activity on the potential site that could influence the location of the turbines and their infrastructure.

The Institute of Geology has advised additional investigation of the geological and geophysical conditions of the area since cracks in the limestone are found in Pakri peninsula this issue needs investigation and site layout will be changed if necessary. Close to planned territory there is the Intermediate Depository of Radioactive Waste situated at a former military reactor facility. There is a need to clarify whether legislative limitations exist concerning activities nearby the depository which may create vibration.

3.7 Tourism and recreational effects

The planned territory has a potential for recreation and sightseeing. Since this wind power plant will probably be the first large-scale wind power plant in Estonia, the place will probably become a secondary tourist attraction. Although the wind farm extends over a large area it can be freely used for other purposes, such as farming or recreation. Public rights of using the area afterwards will be identified and clearly explained to public during the planning procedure. The parties involved can determine jointly where the problems are and how they can be solved. Changes to the original project design will be regularly discussed with the involved parties.

4 STAKEHOLDER COMMENTS

According to the Planning Act (effective since January 2003), the planning system in Estonia consists of four levels – National planning, County planning, (Municipal) Comprehensive planning and Detailed planning. On the one hand the planning system is hierarchic, i.e. the more detailed plan has to observe the valid more general plan. On the other – interactive, i.e. in case a more detailed plan requires modification of a more general plan, the necessary change comes into effect with enforcement of the more detailed plan.

The Comprehensive Plan of Paldiski Municipality is currently under preparation and the establishment of the wind farm is in coherence with the comprehensive plan.

A detailed plan is a plan that is prepared for a smaller par of a town municipality and is the basis for building activities in the short term. The local municipality organises the production of the plan and communication with the public during the planning process. The municipality can transfer organisation and financing of detailed planning to the owner of the land under planning or to a person interested in plan preparation with conclusion of a contract. That is common practise and this is also the case with Paldiski Wind Farm where the Council of Paldiski Municipal Government has authorized and entered into a contract with OÜ Paldiski Tuulepark to prepare the Detailed Land Use Plan for the establishment of a wind farm at the chosen site in Paldiski. OÜ Paldiski Tuulepark in turn has entered into a contract with AS Entec, a local environmental consulting company, for preparation of the plan.

The preparation of the detailed plan is public. It has to be produced in cooperation with the owners of immovable property and inhabitants of the area as well as other stakeholders. Preparation of the plan includes minimum one public discussion and a two-week public display after the adoption of the plan by the local government. In addition, the plan requires approval of corresponding sectoral authorities. Any written suggestions and comments during the public display will be answered by the local municipality, which in this case will also organise a new public discussion. Possible planning disputes will be settled by the county governor. If no objections to the plan arise during the public display, the plan will be enforced by the municipal council.

Arrangement of public discussions has to be pre-announced in the newspaper selected for official announcements by local municipality. The first public discussion for Paldiski Wind Farm was held in June 2003. The meeting was attended by a local environmental NGO (Pakri Looduskeskus), the Geology Institute of Tallinn Technical University and a senior member of the Estonian Parliament in addition to representatives of the municipality, AS Entec and the project developer. . The following was observed and discussed at the meeting:

- It is advised to study the geological and geophysical conditions of the area due to possible existence of cracks in the limestone bank. Also possible limitations to the nearby surrounding from the intermediate deposit of radioactive waste has to be identified.
- The project is in line with the policies of Estonia and the EU regarding renewable energy sector development, climate change mitigation and security of energy supply

OÜ Paldiski Tuulepark will account and deal with all relevant comments received during the first public discussion. Direct consultations with the project stakeholders will continue.

5 BASELINE ASSESSMENT AND CALCULATION OF EMISSION REDUCTION

5.1 Project boundaries and GHG emissions

5.1.1 Definition and Guidelines followed

GHG emissions (and sinks) of projects can be generally divided into four categories as follows:

- Direct on-site emissions resulting from burning and handling fossil fuels in the actual heat and power generation facilities;
- Direct off-site emissions, which may be "upstream emissions" connected with the production, transmission and distribution of fuels, or "downstream emissions", which are connected, for instance, with off-site heat production capacity that the project is replacing;
- Indirect on-site emissions, which may be, for instance, changes in heat demand due the project;
- Indirect off-site emissions, which can be any changes in emissions or sinks, which occur from parallel activities, that can be considered to occur indirectly due the existence of the proposed project (for instance, the project will increase the gas consumption over a critical threshold to justify the gas network expansion also for other consumers).

The Marrakesh Accords of the UNFCCC (UFNCCC 2001) provide basic definitions for baseline issues:

The baseline…is the scenario that reasonably represents the anthropogenic emissions by sources …of greenhouse gases that would occur in the absence of the proposed project. A baseline shall cover emissions from all gases, sectors and source categories…within the project boundary".

"The project boundary shall encompass all anthropogenic emissions by sources and/or removals by sinks of greenhouse gases under the control of the project participants that are significant and reasonably attributable to the project".

"Leakage is defined as net change of anthropogenic emissions by sources of greenhouse gases which occurs outside the project boundary and that is measurable and attributable to the project".

The Marrakesh Accords provides also some more detailed rules for constructing an emissions baseline:

" A baseline shall cover emissions from all gases, sectors and source categories listed in Annex A and anthropogenic removals by sinks within the project boundary.

A baseline shall be established:

a) On a project-specific bases and/or using a multi-project emission factor

b) In a transparent manner with regard to the choice of approaches, assumptions, methodologies, parameters, data sources and key factors.

c) Taking into account relevant national and/or sectoral policies and circumstances such as sectoral reform initiatives, local fuel availability, power sector expansion plans and the economic situation in the project sector.

d) In such a way the ERUs cannot be earned for decreases in activity levels outside the project activity or due to force majeure.

e) Taking into account of uncertainties and using conservative assumptions.

f) Project participants shall justify their choice of baseline".

5.1.2 Project boundary

The principle of this study in the definition of the project boundary has been to adopt practical (i.e. easy to monitor) yet conservative (i.e. emission reductions are rather underestimated than overestimated) approaches.

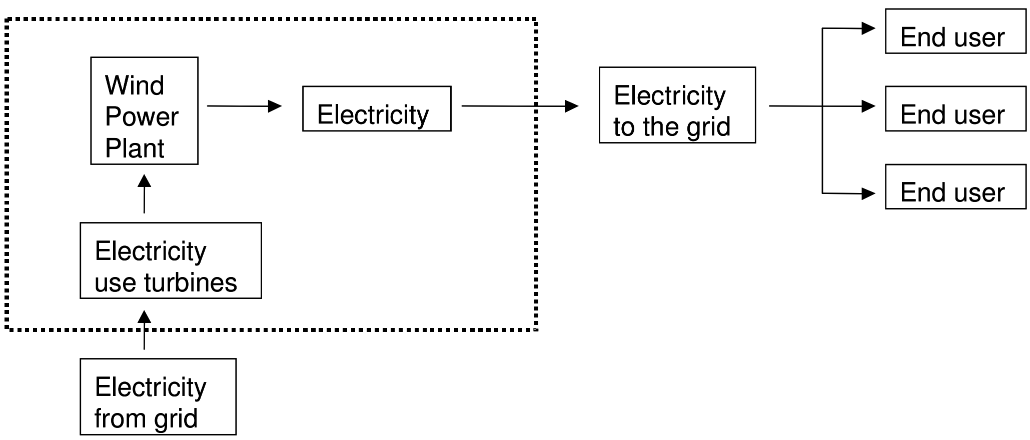

Figure 5.1 Flow chart of the Paldiski Wind Farm project, dashed line indicates project boundary

The project will emit no carbon dioxide (CO_2) or other greenhouse gases (methane-CH_4; nitrous oxide-N_2O; perfluorocarbon-HCFs; hydrofluorocarbon-PCFs and sulphur hexafluoride-SF_6).

Direct on-site emissions	None
Direct off-site emissions	None
Indirect on-site emissions	None
Indirect off-site emissions	None

The power generated by the 50.6 MW wind farm will be added to the existing Estonian power system, as shown in Figure 5.1. The project indicated within the project boundary will reduce the equivalent electricity production capacity currently generated by Balti Power Plant.

The calculations of GHG emission reductions exclude emissions related to transportation and construction of the wind farm. These emissions are minor and also outside control, influence and measuring capacity of the project developer. The calculations include electrical losses and electricity use of the wind turbines related to operation.

5.2 Description of the current delivery system

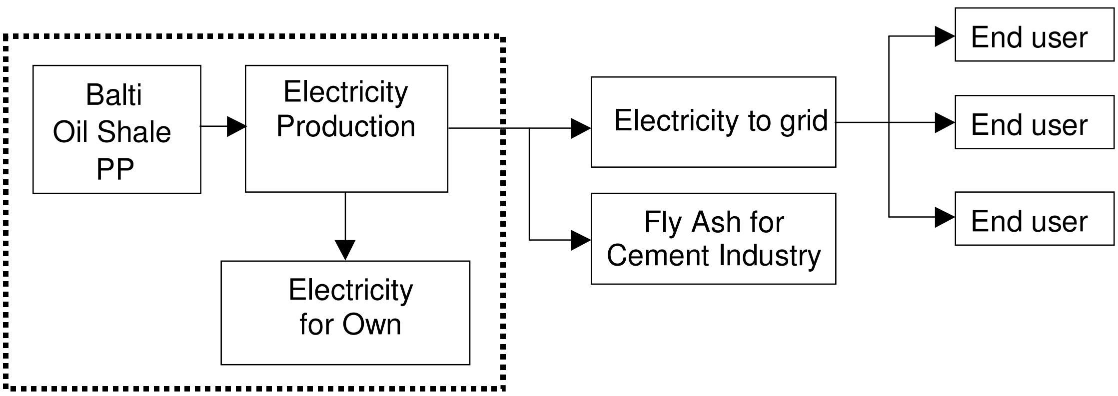

Figure 5.2 Flow chart of current delivery system of the Balti Power Plant, dashed line indicates system boundary

The primary fuel base for power production in Estonia is mainly domestic, including oil shale, shale oil and peat. In 2000, over 90% of electricity was produced from oil shale, 6.6% from natural gas, 0.4 % from shale oil, 0.2% from peat and about 2% from other fuels (generator gas and biogas).

Energy generation by fossil fuel power plants is the main source of GHG emissions in Estonia. In 2001, 9.6 TWh of energy was produced (7.3 TWh of electricity and 2.2 TWh of heat) and about 10 079 thousand tonnes of CO_2 was emitted into the atmosphere by AS Estonian Energy power plants[6]. In 2001, Estonia's total CO_2 emissions amounted to were 16 728 mega tonnes[7] (there are no figures yet for 2002).

In Estonia power is mostly generated in the oil shale fired condensing power plants – the Eesti PP and Balti PP. The installed power production capacity of the Eesti PP is 1610 MW and that of the Balti PP 1390 MW. At the end of 2002 the net production capacity actually used in these two plants was 1280 and 880 MW, respectively.

The Balti Power Plant is presently run with the minimum capacity to support the basic load. The units 3 and 4 of the plant operate in the CHP production mode and supply heat to the district heating network of the city of Narva: the small CHP units 3a and 3b are mainly used for supplying industrial steam to certain enterprises in Narva. Electricity production of these CHP units depends on the heat load (Enclosure 12).

The lifetime of Balti PP is over 35-40 years (commissioned in 1959-1966). The lifetime of the equipment of thermal power plants is defined with the condition of metal in the units working at high pressure (up to 13.7 MPa) and temperature (up to 540^{o} C). The estimated operation resource is 100,000 hours. However the metal of thermal engineering units in the Balti PP (the boilers TP-17 and TP-67 and respective turbines, see Enclosure 12) has resisted twice or even more times longer than its estimated lifetime. The situation has not been considered dangerous, because the actual working temperatures have been up to 30^{o} C lower than the designed temperatures (Eesti …,2002). The old TP-17-type boilers are in an extremely bad condition (units 1-8, see Enclosure 12), but according to the management, the newer TP-67-type boilers can be kept running still for 10-15 years. (50 000 -70 000 running hours).

The present technology based on oil shale boilers will not be in conformity with the future environmental requirements. The fly ash and SO_2 emissions from the Balti PP do not correspond to their emission rates in flue gases for the existing combustion equipment, which came into effect from January 1, 2003.

Only transfer to a new more effective technology would allow increasing thermal efficiency of boiler units and reducing environmental impact of the emissions. In the Balti PP refurbishment of the 11th energy unit has started. The existing 200 MWe

[6] Eesti Energia Environmental Report 2001

[7] Estonia's Third National Communication Under the UN Framework Convention on Climate Change, Estonia, November 2001

energy unit with a pulverized combustion technology based steam boiler will be replaced with a new circulating fluidised bed boiler (CFB) while the turbine, control panel and electric precipitators will also be modernised. The maximum capacity of the new unit will be 215 MW.

After commissioning the CFB unit in the Balti PP, the 8 presently running TP-17-type boilers, which are in a rather bad shape, will be demounted immediately.

5.2.1 Electricity production sector development in the period 2005 – 2012

The new National Fuel and Energy Development Plan up to year 2015 has been worked out in 2003. The plan includes some assumptions for energy sector developments during the period 2003-2015 and also estimations to year 2030. Considering electricity, there are prognoses estimated for possible increase in power consumption by 2-3.75% by year and production capacities. These production capacities (on oil shale) really exist today, but part of them are not satisfying of EU environmental (especially SO_2) requirements.

In the Plan there are presumed reconstruction of existing oil shale based power production units, two large reconstruction projects have already started (two units 430 MWe totally), and the rest depends on the results of ongoing reconstruction (535 MWe to the year 2010; and 535 MWe to the year 2015) (Long-term, 2003).

According to the Plan the lack of production capacities (from the year 2010) could be covered by building small CHPs (on gas, wood or peat), renovating small hydropower plants and/or building wind farms.

It is though most likely that until year 2012 the growing energy demand and stricter environmental regulations will still be met by renovating the next energy units in Narva Power Plants. See chapter 5.4 for an explanation (baseline selection).

This is also in line with the Position Paper - Acceptance of acquis 2001, Chapter 22, Environment. " In order to be in compliance with all the requirements of the Directive 1999/30/EC of 22 April 1999 (relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air) by 31 December 2015, Estonia intends to renovate its oil shale based generating facilities in accordance with the following intermediate targets:

By the end of 2004 -2 units (430MW); by the end of 2010 -another 2 units in the Narva PP and by the end of 2015 - another 3 units in the Narva Power Plants (665 MW). In order to replace the oil shale firing generating facilities, which are not in compliance with the Directive Estonia will need about 400 MW of new generating facilities using other fuels, by the end of 2015[8]. All future renovation plans are connected with Eesti Power Plant.

5.3 Key factors

5.3.1 Legal

The new *Electricity Market Act*[9] (enforced on 1 July 2003) stipulates the liability for network operator to purchase electricity produced from renewable energy sources (RT I,…)[10].

- A network operator is obliged to buy electricity produced from renewables within the network, which he owns or processes.
- A network operator pays the price for renewables based electricity that equals the product of the coefficient 1.8 and weighted average price of the electricity sold in the previous calendar year by the producer processing over 500 MW capacity (AS Narva Power Plants is the only producer today who satisfies these conditions).
- The wind energy based electricity shall be eligible for this feed-in tariff until the end of 2015 at which time all support schemes to renewable energy will be terminated. This means that only wind power plants that start operation at the beginning of 2004 will obtain maximum support.
- The sale of green certificates at the (yet emerging) international market is prohibited if the renewable energy plant sells electricity by using the national support mechanism.
- The act defines the balance sharing obligation of all electricity market players and stipulates that a market player has to enter into an open delivery contract with a respective seller. A market player that generates electricity from wind is not obliged to pay for the open delivery contract that he enters into with the network operator.
- Therefore, electricity generated by renewable resources (wind) can receive some financial support until end of year 2015.

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[8] Conference on Accession to the European Union - Estonia. Position Paper - Acceptance of acquis 2001, Chapter 22, Environment. Brussels,13 September 2002

[9] Electricity Market Act. (2003). *Riigi Teataja* (State Gazette) I 2003, 25, 153

[10] Renewable energy sources are wind, hydropower, solar, wave, tidal, geothermal energy, landfill gas, wastewater treatment gas, biogas and biomass.

[10] Käibemaksuseadus (RT I 2001, 64, 368; ...; 102, 669).

Value Added Tax Act[11]

As a rule, all fuels and energy types in Estonia are liable for taxation with the value added tax (VAT) of 18% (i.e. 15.3% of end-user price). There have been some exceptions which the Parliament has extended in recent years by one-year periods.

- Tax allowance (VAT rate of 0%) made by the Parliament in 1997 on VAT on electricity generated by hydro and wind turbines is in force up to Estonia's entry to the European Union (expected in spring 2004) which means that the support scheme cannot be used for the current wind farm project that is expected to become operational only in 2005.

Pollution Charge Act[12]

In February 1999 the completely new *Pollution Charge Act* was passed by the Parliament replacing the previous *Pollution Charge Act* (RT I 1994, 1, 2).

The Act provides rates of the charges to be paid for the release of pollutants or waste into the environment and the procedure for the calculation and payment of the charge.

For the first time in Estonia the Act introduced (since 01/01/2000) a pollution charge on CO_2 emission. The CO_2 charge has to be paid by all enterprises with total capacities of boilers over 50 MW, excluding those firing renewable energy sources.

The new Pollution Charge Act Amendment Act provides the higher rates of pollution charges up to the year 2005 (see below table 5.1).

Table 5.1. Rates of pollution charge for release of pollutants into ambient air, EEK/t

Pollutant	2000	2001	2002	2003	2004	2005
Sulphur dioxide (SO_2)	55.2	66.2	79.0	95.0	114.0	137.0
Carbon monoxide (CO)	7.9	9.5	11.0	14.0	16.0	20.0
Nitrogen oxides (as NOx)	126.4	151.7	182.0	218.0	262.0	315.0
Carbon dioxide (CO_2)	5.0	7.5	7.5	7.5	7.5	11.3

As can be seen in the table the rates of pollution charges are relatively low in comparison with the current EU member countries (i.e. CO_2 charge 7.5 EEK/t is only 0.48 Euro cents/t). When Estonia joins the EU by the end of 2004, it implies that the

[12] Saastetasu seadus (RT I 1999, 24, 361; 54, 583; 95, 843, 10.02.99) ja Saastetasu seaduse muutmise seadus (RT I 2001, 102, 667, 13.12.2001)

rate of CO_2 pollution charge will probably increase accordingly to the EU requirements. It means, that in long term perspective influence from pollution charge act could be "positive" to the project.

5.3.2 Economic

Market price for oil shale

The market price for oil shale mined by AS Eesti Põlevkivi has increased more than four fold since 1992 (36 to 133 EEK/t) leading to significant lowering of the price advantage ofver other forms of fuel. October 1, 1999 could be considered the beginning of new trend in the development of prices when an agreement between Eesti Põlevkivi and Eesti Energia was concluded where the former price of oil shale sold Eesti Energia (133 EEK/t) was lowered for 1.80 EEK. In the sales contract for the business year 2000/2001 of AS Narva Power Plants the price per ton of fuel oil shale was fixed 129 EEK (Eesti Energeetika…, 2001). The same price, 129 EEK (8.24 EUR) was contracted for the business year 2001/2002.

Fuel availability

The proved reserve in the mining fields of Estonian oil shale deposit is 728 million tons, including measured reserve 587 and inferred reserve 141 million tons. In 2001, 14 million tons of oil shale was mined.

The industrial mining and constant consumption of oil shale started in 1918. During the whole using time about 900 million tons of oil shale has been consumed. The oil shale consumption reached its peak in 1979, being about 32 Mt.

The biggest oil shale consumers are power plants In the business year 2000/2001 the demand of power plants was 9,935 Mt, shale oil industry 1,605 Mt and cement industry 0,199 Mt of oil shale. According to prognoses, in the period of 2003-2012 annually 9.2 Mt of oil shale will be used for electricity generation in average.

Since oil shale reserves are large, they will allow providing primary energy supply to energy industry for a long time (ca 20 years).

Increase or decrease in electricity consumption

Between 1990 and 1995 the consumption of electricity fell by about a quarter. In 1996 - 2000 the consumption stabilised. In 2001 the total consumption increased over 3% compared to 2000. The consumption of electricity in enterprises remained on the same level. At the same time the electricity consumption of households increased over 8%.

According to the assessment of specialists of the Department of Economy of Tallinn Technical University, electricity demand will increase between 25 and 50% from 2000 to 2012.

Development of the feed-in tariff

The single risk for the project feasibility during the obligatory purchase period of green electricity by the network operator derives from the development of the price of electricity sold by Narva Power Plants, which forms the basis for calculating the feed-in tariff for wind power electricity. The price will mainly depend on the extent of further renovation and efficiency of electricity generation at Narva Power Plants, electricity demand, level of pollution taxation and general inflation level. A respective third party opinion has been prepared (see enclosure 5) to ascertain the likely pricing..

5.3.3 Political

The State Assembly adopted *Long-term National Development Plan for Fuel and Energy Sector* in 1998, which treated energy development to the year 2005 (development trends to 2018)[13] and laid down the strategic objectives and trends of energy development. To the present time the primary situation and information about the perspectives have changed significantly. Estonia is to become a member of the European Union in 2004. Therefore the energy development plan must be specified with considering the new time perspectives of 2015 and 2030.

At the end of 2002 a new *Long-term National Development Plan for Fuel and Energy Sector to the year 2015 (inc the vision to 2030)* was prepared. The development plan has been forwarded to the State Assembly and will be adopted this year.

In order to provide uninterrupted performance and sustainable development of the national energy system, the draft development plan stipulates the following three key targets in energy production during the considered period:

- To preserve the level of generation capacity, in order to cover the Estonian electricity demand curve throughout the year;
- Along with refurbishing the oil shale power plants, to build suitable power plants for covering peak demand in the neighbourhood of big consumption centres (Tallinn, Tartu, Pärnu);

[13] RT I, 05.03.1998, 19, 295

- To preserve the production capacity of present CHP plants and construct new plants in the areas with sufficient heat load while channelling the investments to the reconstruction of existing DH networks;

- To expand the use of renewables (biofuels, wind, etc) for electricity production;

- To analyse flexibility of the Estonian economic space in a longer perspective when it proves necessary to build a condensation power plant with the approximate capacity of 500–600 MW based on an imported fuel (coal or gas) in the future (2015–2030).

In spite of the available reserves of generating capacity in the Estonian power system today, in the near future deficiency of available electrical capacity will emerge due the unsuitable (unbalanced with the load) structure, long lifetime, and tighter environmental requirements and thus construction of new production capacities will become highly relevant.

Eesti Energia AS will refurbish two energy units of the Narva PP (net total capacity 390 MW) based on the circulated fluidised bed technology (CFBC) to 2005. It will allow to generate ca 6.6 TWh (23.8 PJ) of electricity based on oil shale with keeping strictly to the limits of SO_2 emissions laid down in the Environmental Strategy. When just the old pulverized combustion will be used in the future, after 2005 only ca 3.7 TWh of electricity (in 2000 the net production of Estonian power plants was 7.6 TWh) would be allowed to produce (Kütuse ja…, 2002).

In the long perspective it seems reasonable to forecast the moderate growth of electricity production (2.0–3.75% a year). According to prognoses, the final electricity demand in Estonia will reach 7–9 TWh in 2015 and 9–15 TWh in 2030.

5.3.4 Approximation to EU directives and policies

As stipulated in the Treaty of Accession (Brussels 3 April 2003), Estonia shall take over and implement the *acquis* under the energy chapter as from the date of accession. However, some specific transitional arrangements were agreed on. These transitional arrangements are limited in time and scope, and accompanied by a clear plan for the implementation of the *acquis*. In the following, only aspects having some relation to electricity generation issues are considered.

As to Electricity Directive (96/92/EC), Estonia was granted a transitional arrangement until 31 December 2008 to implement the electricity market opening provisions. Furthermore a Declaration on oil shale and the Electricity Directive is agreed, in which the EU, while noting Estonia's reservations regarding future *acquis*, recognises in this respect the specific situation related to the restructuring of the oil shale sector which will require particular efforts until the end of 2012, and the need for gradual opening of the Estonian electricity market for non-household customers by that date. As a result, the pace of opening of electricity markets in Estonia will be very slow: at least 35 percent of the market will be opened by the end of 2008, and for all commercial consumers by the end of 2012.

The issue of gas market opening (Directive 98/30/EC) cannot be considered at present, as there is only one supplier of natural gas to Estonia – Russia – and there are no gas pipelines connecting Estonia with other countries supplying natural gas. The pipelines connecting Estonia with Latvia are used for supplying Russian gas as well giving also a possibility of using large underground gas storage in Latvia.

Regarding renewable electricity (RES-E; Directive 2001/77/EC) production, the projection of RES-E share in final electricity consumption in Estonia was provided at level of 5.1% for the year 2010. Reaching this level is a serious challenge for Estonia, as in 2000 the share was only 0.2%. In the new Electricity Market Act (in force since 1 July 2003) there are some measures (purchase obligation with a fixed feed-in tariff) supporting RES-E. Up to now, the relatively low penetration of RES in electricity production should be seen in the context of the difficulties for independent producers of entering the national electricity market dominated by one only company and too weak support mechanism for guaranteed purchase of electricity generated from RES-E.

5.3.5 Socio-demographic

Demographic developments might affect (increase of population) the amount of energy consumption and thus its GHG emissions.

The demographic development of the Estonian Republic at present is basically be in line with the trend that is observed elsewhere in Europe i.e. decreasing birth rates. The population decreased in the period between the 1989 and 2000 censuses by almost 12.3% (Statistical Yearbook, 2002). The possible future increase of immigration could stabilise the number of population.

It can be concluded, that socio demographic factors will not dramatically influence the project.

5.4 Baseline scenarios and additionality

The guidelines provided by the Marrakesh Accords (UN FCCC, 2001) and ERUPT guidelines (Senter, 2001) have been followed in the identification of the baseline scenarios.

The following theoretical baseline options have been identified:

Scenario 1: Current situation will continue in Balti Power Plant

Scenario 2: Balti PP will be closed and replaced with wind power

Scenario 3: Balti PP will be renovated (pulverised combustion replaced with CFBC)

Scenario 4: Balti PP will be partly renovated and partly closed

5.4.1 Scenarios

In the current situation, over 90% of electricity is produced in thermal power plants in Narva using pulverised oil shale combustion technology. The average efficiency of conventional pulverised coal fired power plants is about 33% (Sathaye and Meyers, 1995). Efficiency of the Estonian Power Plant is 29%, and the Balti Power Plant about 27%, both located in Narva. The low efficiency of oil shale fired power plants can be explained by the special characteristics of burnt oil shale.

When burning oil shale in power plants, the main problems are connected with high sulphur dioxide (10—20 g/kW h) and CO_2 (1 350—1 400 g/kW h) emissions, and large quantities of fly ash (12—20 g/kW h). NOx emissions are not serious due to a very low nitrogen content in the organic part of oil shale. As most of the energy in Estonia is generated in Narva, the CO_2 emissions per generated kWh are highly dependent on development in these power stations.

Logic behind selected JI scenarios is:

- Business-as-usual (1. option) assumed to be that Eesti Energi AS continues to produce the major part of power needed for the country in Balti- and Estonia Power Plants. Eesti Energia AS continues with the already decided upgrades of the power stations in Narva. The production costs in wind farms are significantly higher than in the mentioned Power Plants, so without further legal help no wind turbines will be commissioned.
- Eesti Energia AS has a monopoly in the energy market in Estonia and this means that Eesti Energia decides which power plants will be used for energy production.
- Balti power plant is the oldest, with the lowest efficiency and therefore, production costs are the highest in the system.

- About 830 MW generation capacity will remain in the Balti Power Plant after January 2005. Of this capacity, only a part is needed for the power demand in Estonia.
- During the EU accession negotiations Estonia has achieved a transition period for implementation of the EU LCP directive 2001/80/EC for Narva Power Plants, during which the the oil shale fired plants can continue full-scale electricity production until Dec. 31, 2015.
- Energy production from gas is not taken into account in this case, due to historical and political reasons.
- Possible EU membership of all Baltic countries and furthermore possible closing of the Ignalina nuclear power plant may increase power export possibilities for Estonia.
- Possible increase in electricity export has not been considered here, as Estonia would then fail to fulfil the obligation of SO_2 emission reduction, according to which Estonia committed itself to reduce SO_2 emissions by 80% by the year 2005 compared to the level of 1980. [14]

Scenario 1. Current situation will continue in Balti power plant

Estonia has overcapacity of installed power and could have a theoretical possibility to export to Russia or maybe to Finland when the 100 MW cable between the two countries is installed. Should this happen, the extra generation would come from energy produced in power plants with low efficiency and high relative emissions per produced kWh As Estonia will become a member of EU at the beginning of 2004, directives and regulations on the European level will regulate development of the Estonian energy market. Additionally, environmentally friendly generation is supported in the Estonian energy policy, which also means that the country may not support energy exports from old, low efficiency power stations. Values and development in Europe and globally (e.g., the Kyoto Protocol) are also changing towards sustainable development within the energy field. Even if it were possible for Eesti Energia AS to export power from Narva stations, this not likely to happen within the foreseeable future.

Scenario 2. Balti Power Plant will be closed and replaced with wind power

The Balti power plant supplies heat to the whole city of Narva and surroundings. It is the only source of heat and hot water for the municipality with a population of 85 000. In addition, it supplies process heat to industrial consumers in Narva.

[14] Estonian National Environmental Strategy. Approved by Parliament on 12 of Mach 1997.

Modernisation of one energy unit in the Balti PP has already begun. Two old pulverised combustion boilers TP-67 will be replaced with new efficient and environmentally friendly fluidised-bed boilers. Closing of the Balti power plant in the near future is not very realistic because of a long-term agreement between Narva Municipality and Baltic PP concerning the heat supply.

Scenario 3. Balti Power Plant will be renovated (pulverised combustion replaced with CFBC)

Initial installed capacity of the Balti PP was 1390 MWel 505 MWth. In the plant's prime (1975—1985) about 9 TWh_{el} and 2 GWh_{th} were produced. In 2001 the total output of electricity in Estonia was 8483 GWh (Balti PP 2134 GWh, Estonian PP 5469 GWh, the remaining part was covered by small power plants). Two reasons for the decrease in energy production could be outlined:

- restructuring of the economy
- export relations

Main reason not to renovate all units is economical, as the renovated units would not run base-load and this would significantly increase production costs. In addition, as Estonia does not need so much power, the only reason for reconstruction would be increasing export possibilities. Even if export of energy were possible, it is likely that power from a new power station would be more feasible than from an old and renovated Balti Power Plant. Evidently, it would not be reasonable to upgrade the power plant as a whole, considering the possible increase in energy demand in the future.

Scenario 4. Balti Power Plant will be partly renovated and partly closed

Plans by AS Eesti Energia include introduction of fluidised bed technology in the 11th energy unit of Balti PP and closing the older section (energy units 1—8). Reconstruction of Balti PP has already begun.

After renovation of the energy units, units 11 (two new CFBC boilers) and 12 (2 boilers TP-67) will be mainly in normal operation. Units 9 and 10 will be standby boilers (can replace unit 12 if necessary). Boilers TP-17 and all turbines of the older section will be closed and dismounted. Annual oil shale demand will be 2 287 million tons. Net output of the plant will be 1481 GWh/a. Number of running hours for a renovated boiler will be 8000 h.

The amount of CO_2 emissions depends on the oil shale consumption capacity and will decrease for CFB boilers by about 23% compared to that of pulverised combustion. In CFB boilers 0.7 tCO_2/t, for pulverised combustion in average 0.9 tCO_2/t, please see Enclosure 13.

Partial renovation of the Balti Power Plant and closing of the older plant is the most probable scenario for the foreseeable future in Estonia, where all new renewable power capacity will decrease energy production in the Balti Power Plant.

5.4.2 Selection of baseline

All of the most likely scenarios above consider the potential changes in the Baltic PP only. No natural gas or other fossil fuels have been seriously considered as a potential development option for the Estonian energy system. No scenarios include potential development or smaller CHP plants or the baseline for the average power mix of the whole Estonian energy system. The approach used in this calculation is based on the following reasons:

1. In Estonia over 90% of electricity is produced via oil shale combustion. In the Development Plan of the Estonian Energy Sector oil shale has long-term priority which has been accepted as Estonian special case by the EU Energy Commission.

2. This priority also depends on the Estonian social policy. A large reduction in oil shale based power production would cause a dramatic rise in unemployment in the East Estonian oil-shale-mining region.

3. Oil shale is not only an indigenous fuel to Estonia but also one of the cheapest fossil fuels in Estonia, much cheaper than imported heavy fuel oil or natural gas. Therefore, electricity production price of oil shale based power plants is more competitive at the moment.

4. Existing CHP plants have a competitive production price of electricity only if operating in co-production mode of heat and power. Therefore their power production share is limited by economical reasons and depends on heat production, i.e. on climate conditions. Therefore, limitation of their production share (due to the wind energy project) is impossible.

5. Of the two largest power plants, Estonian and Baltic PP, the main power load is on Estonian PP which, due to higher average efficiency, has lower production costs and higher production share.

6. Therefore all potential limitation of power production (due to wind energy) has to be carried by the Baltic PP.

7. Estonian Energy Ltd. is already considering reduction of Baltic PP power production due to wind energy projects.

8. Due to the above circumstances the most probable option is option number 4

To prove that the selected Balti PP option is a good and conservative representative for the whole electricity sector we carried out a comparison (see Table 5.1).

Table 5.1 Comparison of different baselines

	2005	2006	2007	2008	2009	2010	2011	2012
Baseline	t CO2eq/GWh							
Balti PP	1076.70	1078.00	1075.08	1091.05	1067.54	1078.26	1077.26	1075.39
Eesti PP	1187.72	1184.44	1182.93	1183.11	1192.73	1184.35	1182.09	1182.55
Narva PPs	1162.39	1160.17	1158.37	1162.01	1164.33	1160.16	1158.19	1158.14
National electricity sector[15]	1090	1080	1060	1040	1040	1030	1020	1010

Total emission reduction, t CO_{2eq}

	AAUs 2005 (9 months) – 2007	ERUs 2008 -2012	Total AAUs and ERUs
Balti PP	401336	730594	1131930
Eesti PP	441672	803161	1244833
Narva PPs	432798.1	787195.9	1219994
National electricity sector	400915	696772	1097686

There are additional baselines calculated for Eesti PP and Narva PPs (Eesti + Balti, see enclosures 19-22 for details). As we can see in the above table in both cases (Eesti PP and Narva PP) selected by us, the Balti PP baseline is more conservative (CO_{2eq} amounts per energy unit is smallest). Only baseline for national electricity sector gives (from the year 2007) smaller emission factors, but the methodology used by calculations is a little different (N_2O emissions are not included, some new RES plants (not existing jet) are taken into account, etc.

- To conclude, we can say that the CO_2 emission factor used in the model for Balti Power Plant is conservative and representative for the electricity sector, because about 93% of the electricity is produced in two power plants (Eesti PP and Balti PP), these plants have comparable technology and the same fuel (oil shale).

- The CO_2 emission factor used in the model for Balti PP is approximately 1077 tons CO_2 eq. / GWh. The CO_2 emission factor for Eesti PP is approximately 1184 and for Narva Power plants 1160 and tons CO_2 eq. / GWh.

[15] BASE project study:"NationalElectricitySector Baseline Analyses",AS EstIvo, 2003

- In the “National electricity sector baseline analysis”, the average CO_2 emission factor is about 1046 tons CO_2 eq. / GWh. Using these emission factor the total emission reduction would be 1097686 ton CO_2 that is 3.0% lower that the emission reduction proposed by selected scenario (Balti PP).

5.5 Estimation of baseline emissions

As stated above, scenario 4 has been selected as the most likely baseline to be used for this study.

For baseline calculation fuel consumption and electricity production prognoses compiled by AS Narva Power Plants have been used (see Enclosure 13).[16] CO_2 emission amounts emitted during the combustion of given fuel amounts have been calculated according to the IPCC methodology (IPCC, 1996, see Enclosure 14). As the prognoses of fuel consumption are given by energy units of the Balti PP, it is possible to use two different carbon emission factors (CEF) for calculation of CO_2 emissions. CEF for oil shale pulverised combustion (Units 1-10 and 12) is 29,1 tC/TJ (IPCC, 1996) and for fluidised bed technology (Unit 11) CEF=28.76 tC/TJ.

Carbon Emission Factor for circulating fluidised combustion of oil shale (new 11. unit)

$$\mathbf{CEF_{oil\ shale} = 10\ \frac{C^r_t + k(CO_2)^r_M\ 12/44}{Q^r_l}} \qquad \mathbf{(tC/TJ)}$$

where

Q^r_l	-net caloric value oil shale as it burned, MJ/kg;
C^r_t	- carbon content of oil shale as it burned, %
$(CO_2)^r_M$	- mineral carbon dioxide content of oil shale as it burned, %;
k	- decomposition rate of ash carbon part (k = 0.85 for circulating fluidised of oil shale)

$$\mathbf{CEF_{oil\ shale} = 10\ (19.88 + 0.85 \times 17.2 \times 12/44)/\ 8.37 = 28.76,\ (tC/TJ)}$$

[16] Source: Eesti Elektrijaama 8. bloki ja Balti Elektrijaama 11. ploki renoveerimisprojekti keskkonnamõju hindamine (2002). I osa ja II osa, Keskkonnamõju hindamise aruanne. Töö nr 26-02. EE. TPÜ Ökoloogia Instituut, Kirde Eesti Osakond. Jõhvi, 110 pp (in Estonian).

To identify the emitted amounts of N_2O, emission factor 0.0003[17] has been used. Calculated amounts of N_2O emissions are then multiplied with Global Warming Potential (GWP for N_2O=310) to get result in tons of CO_2 equivalent.

Achieved amounts of CO_2 and N_2O emissions (in CO_2 eq) have then been added and the sum has been divided by the electricity production. CO_2 special emission factor (tC/TJ) has been found for each concrete year of the period 2005-2012 (see Enclosure 15). As the fuel amounts and the respective amounts of CO_2 emission are different according to prognosis, difference can be observed also in the baseline value for each year.

Table 5.2 Estimated GHG emission reductions

Year	Baseline for electricity production of the Balti PP (tCO_{2eq}/GWh)*	Emission Reduction Units / Assigned Amount Units tCO_{2eq} **
2005 9 months	1076.704	109 467.4
2006	1078.004	146 138.6
2007	1075.077	145 741.7
2008	1091.047	147 906.6
2009	1067.536	144 719.5
2010	1078.263	146 173.6
2011	1077.259	146 037.6
2012	1075.395	145 784.9
Total AAUs 2005-2007:		**401 336**
Total ERUs 2008-2012:		**730 594**
Total ERUs and AAUs 2005-2012:* **		**1 131 930**

* See calculations in Enclosures 13-16

** Based on estimated annual energy production of 135 558,69 MWh at a nominal capacity of 50.6 MW

'*** Estimated total reduction by Eesti PP baseline -1,244,833 ; Narva PPs baseline -1219099 and by sectoral baseline - 1097686 t of CO_2 eq.

[17] an expert calculation

5.6 Estimation of project emissions

Based on the measured wind data, the net annual energy production of the project is estimated at **135.564 GWh.** A third party detailed wind resource assessment at Pakri peninsula has been completed by Energi- og Miljödata. The wind resource assessment and energy yield calculation (prepared by the potential wind turbine supplier Nordex) is considered to contain sufficient information in order for the Supplier to assess the feasibility of the project.

Net production of the wind farm has been estimated as follows:

Table 5.3 Estimated Annual Energy Production

Capacity of each wind generator (WG)	2.6	MW
Total capacity of wind farm	50.6	MW
Number of wind generators	22	
Gross production per unit	8311.55	MWh/year
Losses	Reduction factor:	
a) Array efficiency	0.849	
b) Electrical losses	0.985	
c) Technical availability	0.985	
d) Method uncertainty	0.900	
Total reduction factor	0.741	
Net average estimated annual energy production per unit	6162	MWh/year
Net energy for total wind farm	**135564**	**MWh/year**

5.7 Estimation of emission reduction and crediting time

The expected date for beginning the project is April 1, 2005 and its expected lifetime is 20 years. Project crediting period covers whole of the first commitment period of 2008—2012 and the early crediting period of 2005-2007. The baseline is suggested to be valid until the end of 2012, after which it could be re-assessed if used for future crediting periods.

Estimated emission reductions are as follows:

2005—2007	401 336 tons of CO_2 eq.
2008—2012	730 594 tons of CO_2 eq.
Total	**1 131 930 tons of CO2 eq.**

5.8 Evaluation of additionality

The Balti Power Plant was built in 1959-1969. It means, that the plant is 34-44 years old and in need of modernisation both to improve efficiency and allow Estonia to meet its goal of reducing CO_2 emissions. According to the renovation plans of Narva Power Plants of the AS Eesti Energia only one energy unit (11^{th}) will be renovated in Balti PP. All future renovation plans are connected with Eesti Power Plant (a newest one).

Due to this and the abundant availability of cheap domestic oil shale and existence of power generation facilities, market price of electricity will remain to be relatively low for a long time. Taken the current support mechanism for renewable energy and above described risks related to the development of the feed-in tariff, wind energy, even in sites with good wind conditions, cannot compete against this price level without additional financial support.

Regarding renewable electricity (RES-E; Directive 2001/77/EC) production, the projection of RES-E share in Estonia was provided at level of 5.1% for the year 2010.

Reaching this level is a serious challenge for Estonia, as in 2000 the share was only 0.2%. No concrete activity plans have been adopted to increase the share and the Electricity Market Act sets an insufficient support mechanism to develop RES projects on a commercial basis. Implementation of this project as a joint implementation project can thus contribute to reaching this target.

Also the financial additionality of the project is proven by the respective financial calculations of IRR, NPV and pay-back time.

6 MONITORING AND VERIFICATION PLAN

6.1 General monitoring approach

Monitoring plan is based on requirements of Marrakesh Accord (UN FCCC, 2001) and ERUPT guidelines (Senter, 2001).

The monitoring plan defines a systematic surveillance and measurement of aspects related to implementation and performance of the project which enables measurement or calculation of emission reductions. Every factor influencing project performance must be included in the monitoring plan. It should clearly identify frequency of, responsibility and authority for registration, monitoring and measurement activities. The indicators to be monitored may relate to actual project performance, validity of project performance, validity of project baseline or possible leakage effects.

Monitoring of project performance is crucial in ensuring that Emission Reduction Units can be claimed from a JI project. Monitoring must be conducted in such a way that the indicators related to GHG emission level from the project can be compared with the baseline emission scenario. Subsequently, the difference in actual and baseline emissions can be claimed as emission reductions. Monitoring and recording of indicators will also provide a foundation for verification of emission reductions by an independent entity, and ultimately end up in reporting of verified emission reductions to the parties involved in the project and towards the UNFCCC.

The only significant emission source identified in the baseline study relates to the generation of electricity. The amount of electrical output from the Paldiski Wind Farm project is therefore defined as the key activity to monitor.

6.2 Methodology to be used for data collection and monitoring

Emission reductions achieved in the project can be calculated as:

$$\Delta E = E_b - E_p,$$

$$E_b = Y_{el} * B$$

where

ΔE	-	total emissions reduction generated (t $CO_{2\ eq}$/ year)
E_b	-	baseline emissions (t $CO_{2\ eq}$/ year)
E_p	-	Project emissions (t $CO_{2\ eq}$/ year); $E_p = 0$
Y_{el}	-	electricity produced by wind farm (GWh/year)
B	-	baseline emission intensity for power (t $CO_{2\ eq}$/ GWh)

The produced GWh to the grid have a direct relation to the $CO_{2\ eq}$ reduction.

Data will be collected from monthly and annual operational statistics, i.e. from the activities related to sales of electricity. The operational staff of OÜ Paldiski Tuulepark will do the data collection, calculation data record keeping and trend analysis, while the manager has the overall responsibility. The manager has been trained in the aforementioned issues and will in turn train the procedure to other involved staff. The data will be booked on a spreadsheet form on a monthly basis, detailed in Enclosure 17, for audit purposes. The monthly billing meter reports and sales invoices will serve as backup documents to the annual form.

Measuring device accuracy will follow local regulations and standards. Monitoring of the Paldiski Wind Farm project will be carried out until 2012 if not otherwise degreed.

The monthly billing meter reports together with sales invoices will be archived in the company´s local office in Estonia. The manager for Paldiski Wind Farm is responsible for archiving all mentioned documents

6.2.1 Data requirements

The quality of measured data will be strictly defined by the power purchase agreement. In the power purchase agreement the quality, accuracy, calibration and verification is agreed in detailed. When Paldiski Wind Farm sells power to the grid according to the power purchase agreement, quality demands of the JI program will be fulfilled as well.

6.3 Justification of proposed monitoring methodology

The annual monitoring activities will be only focusing on the amount of produced electricity. The electricity production will be monitored from the billing meter. Baseline emissions should be calculated based upon measured power production times specific emission factor set for measured year.

6.4 Verification plan

Verification means a periodic review and ex-post determination by an independent entity (IE) of the amount of greenhouse gas emission reductions generated by the project. Independent verification will be used annually.

According to the rules for JI, host country itself may verify the amount of emission reductions resulting from the project provided that both the host and the acquiring country are eligible to use the First Track of JI. Independent verification of the amount of emission reductions, however, protects the interests of the investor as well as the project sponsor and transferring country.

Verification is based on data collected by project participants in accordance with the monitoring and verification plan. Manager of Paldiski Wind Farm shall on an annual basis submit to the verifier the archived monitoring protocol, trend analysis and sales invoices (as backup documents).

The ERUPT Programme finances a JI project in exchange for the right to emission reductions generated by the project. JI projects may begin as of the year 2000 but ERUs can only be issued for a crediting period during 2008-12. If both parties agree, emission reductions occurring before 2008 can be verified and transferred as Assigned Amount Units (AAU) through international emissions trading as defined in Article 17 of the Kyoto Protocol. For this reason, it is suggested that the monitoring results be verified annually.

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ENCLOSURES

Enclosure 1 – Letter of Endorsement

Enclosure 2 – Draft layout

Enclosure 3 – N90 wind turbine product brochure

Enclosure 4 – N90 wind turbine technical information

Enclosure 5 – Analysis and forecast of the oil shale based electricity cost price at the Estonian electricity market (confidential)

Enclosure 6 - Energy yield calculation (confidential)

Enclosure 7 – Shadow calculation

Enclosure 8 – Noise calculation

Enclosure 9 – Budget estimate (confidential)

Enclosure 10 – Cash-flow estimate (confidential)

Enclosure 11 – Project time-schedule (confidential)

Enclosure 12 - Balti Power Plant

Enclosure 13 - Prognoses of fuel consumption and electricity net production of the Balti Power Plant

Enclosure 14 - Calculations of GHG emissions from Balti Power Plant

Enclosure 15 - Baseline calculations for electricity production of the Balti Power Plant

Enclosure 16 - Calculations of GHG emission reduction by project

Enclosure 17 - Proposed annual monitoring protocol of Paldiski Wind Farm

Enclosure 18 N_2O emission factor from combustion of oil shale in Narva Power Plant boilers

Enclosure 19 - Prognosis of fuel consumption and net production of the Eesti Power Plant

Enclosure 20 - Baseline calculation for Eesti Power Plant

Enclocure 21 - Baseline calculation for Narva Power Plants (Eesti PP+Balti PP)

Enclocure 22 – GHG reduction by Paldiski Wind Farm project using the national electricity sector baseline

Enclosure 12 - The Balti Power Plant

The Balti PP - State of performance to January 1, 2003:

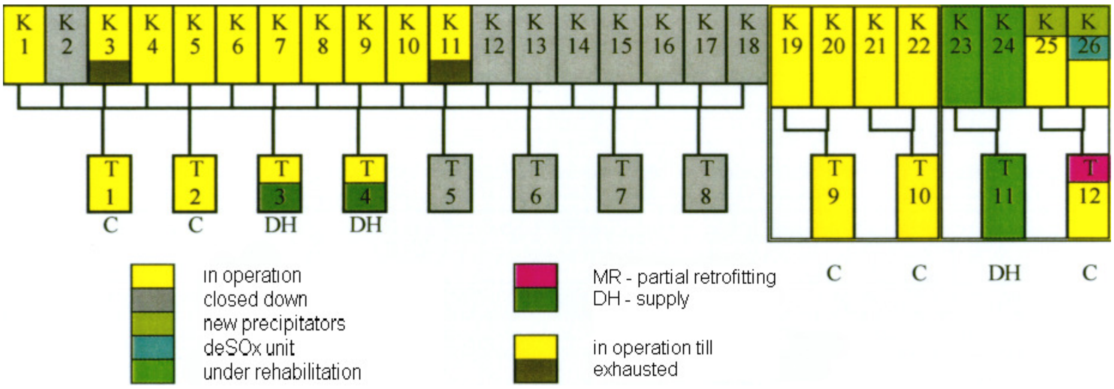

Figure 0.1 State of performance to January 1, 2003

The Balti PP – State of performance to January 1, 2005:

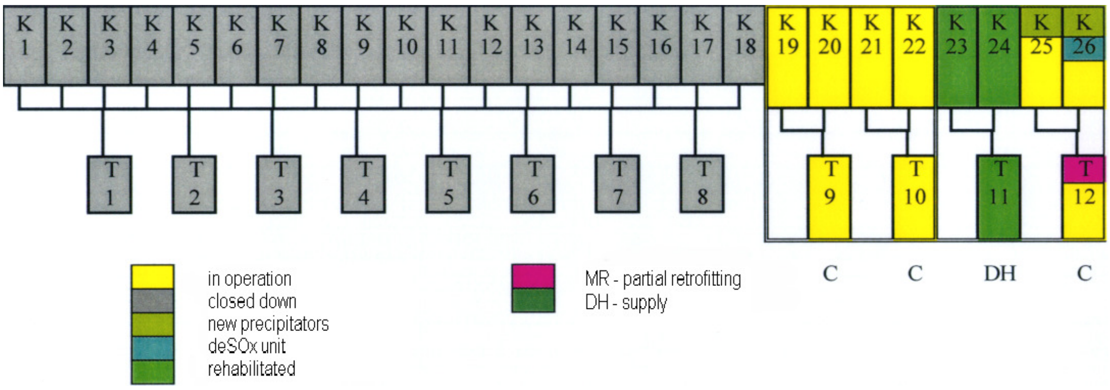

Figure 0.2 State of performance to January 1, 2005

Enclosure 13 - Prognoses of fuel consumption and electricity net production of the Balti Power Plant

Net electricity production by units, GWh/year

	2004	2005	2006	2007	2008	2009	2010	1011	2012
Unit No 1-4	950								
Unit No 9-10	0	0	0	0	0	0	0	0	0
Unit No 11	203	927	1041	1114	1111	1111	1111	1111	1111
Unit No 12	297	266	368	367	346	292	368	367	364
Electricity total	1450	1193	1409	1481	1457	1403	1479	1478	1475

Fuel consumption for electricity consumption

	2004	2005	2006	2007	2008	2009	2010	2011	2012
Unit No 1-4	1499	0	0	0	0	0	0	0	**0**
Unit No 9-10	0	0	0	0	0	0	0	0	0
Unit No 11	313	1130	1261	1349	1346	1346	1349	1349	1346
Unit No 12	431	392	538	537	537	429	540	537	533
Total, thousand tons	**2243**	**1522**	**1799**	**1886**	**1883**	**1775**	**1889**	**1886**	**1879**
Total, TJ	**18617**	**12633**	**14932**	**15654**	**15629**	**14733**	**15679**	**15654**	**15596**
Total-unit 11, (tons)	1930	392	538	537	537	429	540	537	533
Total-Unit 11 (TJ)	16019	3254	4465	4457	4457	3561	4482	4457	4424
Unit11, (TJ)	2598	9379	10466	11197	11172	11172	11197	11197	11172

Enclosure 14 - Calculations of GHG emissions from Balti Power Plant

CO_2 Emissions

Fuel type	A Consumption TJ	B CEF Factor tC/TJ	C Carbon Content tC	D Carbon Content GgC	E Part of Oxydized Carbon	F Real Carbon Emission GgC	G Real CO_2 Emission $GgCO_2$	H Real CO_2 - rebinding with oil shale ash
Oil Shale			C=AxB	$D=Cx10^{-3}$		F=DxE	G=Fx44/12	G-Gx0.02
2004	16019	29.1	466152.9	466.15	0.98	456.830	1675.043	1641.542
2004	2598	28.76	74718.5	74.72	0.98	73.224	268.488	263.119
2004	**18617**							**1904.661**
2005	3254	29.1	94691.4	94.69	0.98	92.798	340.258	333.453
2005	9379	28.76	269740.0	269.74	0.98	264.345	969.266	949.881
2005	**12633**							**1283.333**
2006	4465	29.1	129931.5	129.93	0.98	127.333	466.887	457.549
2006	10466	28.76	301002.2	301.00	0.98	294.982	1081.601	1059.969
2006	**14931**							**1517.519**
2007	4457	29.1	129698.7	129.70	0.98	127.105	466.051	456.730

2007	11197	28.76	322025.7	322.03	0.98	315.585	1157.146	1134.003
2007	**15654**							**1590.732**
2008	4457	29.1	129698.7	129.70	0.98	127.105	466.051	456.730
2008	11172	28.76	321306.7	321.31	0.98	314.881	1154.562	1131.471
2008	**15629**							**1588.201**
2009	3561	29.1	103625.1	103.63	0.98	101.553	372.360	364.912
2009	11172	28.76	321306.7	321.31	0.98	314.881	1154.562	1131.471
2009	**14733**							**1496.383**
2010	4482	29.1	130426.2	130.43	0.98	127.818	468.665	459.292
2010	11197	28.76	322025.7	322.03	0.98	315.585	1157.146	1134.003
2010	**15679**							**1593.294**
2011	4457	29.1	129698.7	129.70	0.98	127.105	466.051	456.730
2011	11197	28.76	322025.7	322.03	0.98	315.585	1157.146	1134.003
2011	**15654**							**1590.732**
2012	4424	29.1	128738.4	128.74	0.98	126.164	462.600	453.348
2012	11172	28.76	321306.7	321.31	0.98	314.881	1154.562	1131.471
2012	**15596**							**1584.819**

CEF for oil shale in old units 29.1 tC/TJ

CEF for oil shale in new unit 28.76 tC/TJ

N_2O Emissions

Oil Shale	Fuel, TJ	CO_2	N_2O, t*	N_2O, t in $CO_{2\ eq}$**
2004	18617	2170.890	5.59	1731.4
2005	12633	1283.333	3.79	1174.9
2006	14931	1517.519	4.48	1388.6
2007	15654	1590.732	4.70	1455.8
2008	15629	1588.201	4.69	1453.5
2009	14733	1496.383	4.42	1370.2
2010	15679	1593.294	4.70	1458.1
2011	15654	1590.732	4.70	1455.8
2012	15596	1584.819	4.68	1450.4
		14415.90	**41.74**	12938.7

* N_2O emission factor (for oil shale combustion) =0.0003 t/TJ

** GWP of N_2O= 310 (IPCC,1996)

Enclosure 15 - Baseline calculation for electricity production of the Balti Power Plant

	Unit	2005	2006	2007	2008	2009	2010	1011	2012
Electricity production	GWh	1193	1409	1481	1457	1403	1479	1478	1475
CO_2 emissions	t	1283333	1517519	1590732	1588201	1496383	1593294	1590732	1584819
CO_2 equivalent emission factor	t CO_2/GWh	1075.719	1077.018	1074.093	1090.049	1066.56	1077.278	1076.273	1074.454
N_2O emission	**t**	3.79	4.48	4.7	4.69	4.42	4.7	4.7	4.48
In CO_2 equivalent	t CO_{2eq}/GWh	1174.9	1388.8	1457	1453.9	1370.2	1457	1457	1388.8
N_2O equivalent emission factor	t N_2O in $CO_{2\ eq}$/ GWh	0.985	0.986	0.984	0.998	0.977	0.985	0.986	0.942
Baseline	t CO_{2eq}/GWh	**1076.704**	**1078.004**	**1075.077**	**1091.047**	**1067.536**	**1078.263**	**1077.259**	**1075.395**

Enclosure 16 - Calculations of GHG emission reduction by project

		I period			II period				
	Unit	**2005 9 months**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Electricity produced by wind farm	GWh	101.66902	135.55869	135.55869	135.55869	135.55869	135.55869	135.55869	135.55869
Baseline	**tCO_{2eq}/ GWh**	**1076.704**	**1078.004**	**1075.077**	**1091.047**	**1067.536**	**1078.263**	**1077.259**	**1075.395**
GHG reduction	**t $CO_{2\ eq}$**	**109467,4**	**146132,8**	**145736,0**	**147900,8**	**144713,8**	**146167,9**	**146031,8**	**145779,2**

Total AAUs 2005-2007 401336,3 tons of $CO_{2\ eq}$

Total ERUs 2008-2012 730593,6 tons of $CO_{2\ eq}$

Total AAUs and ERUs 2005-2012 1131930 tons of $CO_{2\ eq}$

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Enclosure 17 - Proposed annual monitoring protocol of Paldiski Wind Farm

PROJECT CONSTANTS	Unit	Year							
		1 2005	2 2006	3 2007	4 2008	5 2009	6 2010	7 2011	8 2012
Baseline emissions for power	tCO_2eq	1076.704	1078.004	1075.077	1091.047	1067.536	1078.263	1077.259	1075.395
ACTUAL DATA	Unit	1 2005	2 2006	3 2007	4 2008	5 2009	6 2010	7 2011	8 2012
Power production (net)	MWh								
Actual emissions reduction	tCO_2eq								
Cumulative emission reduction 2005-2012	tCO_2eq								
Cumulative emission reduction 2005-2008	tCO_2eq								

Enclosure 18 N_2O emission factor from combustion of oil shale in Narva PP boilers

Calorific value of oil shale: Q_l = 8.3 MJ/kg (1982 kcal/kg) and excess air rate: λ =1

$$N_2O \rightarrow NO_X$$

Emission Factor of $N_2O = V_{NOx} * k$

k -- 0.0035 (IPCC)

V_{NOx} -. amount of NOx in flue gases[18] = 100 ppm[19] ± 20 = 205 mg/nm^3

Amount of air $V_o = 1.1 \text{ x } Q_l$

$$V_o = 1.1 * 11982 / 1000 = 2.18 \text{ nm}^3/\text{kg}$$

Amount of flue gases $V_g = V_{go} + (\lambda - 1) \text{ x } V_o$

$$V_{go} = 1.15 \text{ x } V_o$$

where

V_o - amount of air for combustion of 1kg oil shale, nm^3 (at λ =1)

V_g - amount of flue gases, nm^3 (at λ =1.5)

$$V_g = 1.15 \text{ x } 2.18 + (1.5 - 1) \text{ x } 2.18 = 3.59 \text{ nm}^3/\text{kg}$$

Amount of N_2O in flue gases

$$V_{N2O} = 0.0035 \text{ x } 205 = 0.17175 \text{ mg/ nm}^3$$

$$3.59 \text{ x } 0.7175 = 2.5758 \text{ mg/kg}$$

$$2.5758 / 8.3 = 0.3 \text{ mg/MJ} = 0.0003 \text{ t/TJ}$$

N_2O Emission Factor =0.0003 t/TJ

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[18] the current value is measured by the Laboratory of Ecology of the Department of Environmental Protection of Estonian Energy Ltd .

[19] Conversion factor from ppm to mg/nm^3 is taken from "User Manual of gas analysator IMP 3000B, Version PN3, 16/09/1991

Enclosure 19. Prognoses of fuel consumption and net production of the Eesti Power Plant

Net production, GWh/year

	2004	2005	2006	2007	2008	2009	2010	1011	2012
Unit No 1	510	467	455	452	351	474	487	398	452
Unit No 2	510	443	459	351	455	474	487	398	433
Unit No 3	498	468	356	452	455	474	487	398	451
Unit No 4	396.4	467	440	449	454	472	487	303	452
Unit No 5	743	1022	1007	1003	751	1007	1017	999	772
Unit No 6	1055	1010	1001	738	1005	956	777	1005	1009
Unit No 7	510.2	467	333	454	455	474	487	398	340
Unit No 8	927.4	1064	1140	1220	1216	866	1216	1220	1216
Heat	100	100	100	100	100	100	100	100	100
Electricity total	5150	5408	5191	5119	5142	5197	5445	5119	5125
CO_2 emissions, t	6129280	6417365	6142819	6049926	6078002	6192966	6442915	6045622	6055048
tons CO_2/GWh	**1190.151**	**1186.643**	**1183.359**	**1181.857**	**1182.031**	**1191.642**	**1183.272**	**1181.016**	**1181.4728**
N_2O emissions, t	17.980	18.830	18.030	17.760	17.840	18.160	18.910	17.740	17.770
In CO_2 eq	5573.80	5837.30	5589.30	5505.60	5530.40	5629.60	5862.10	5499.40	5508.70
tons N_2O in $CO_{2\ eq}$/ GWh	**1.0823**	**1.0794**	**1.0767**	**1.0755**	**1.0755**	**1.0832**	**1.0766**	**1.0743**	**1.0749**

Fuel consumption for electricity consumption

	2004	2005	2006	2007	2008	2009	2010	2011	2012
Unit No 1	728	666	649	645	501	676	695	569	645
Unit No 2	728	632	655	502	650	676	695	569	618
Unit No 3	711	668	508	645	650	676	695	569	644
Unit No 4	566	666	628	641	648	674	695	432	645
Unit No 5	1046	1438	1418	1412	1057	1417	1432	1406	1086
Unit No 6	1484	1421	1409	1039	1415	1345	1093	1414	1420
Unit No 7	728	666	475	649	650	676	695	569	486
Unit No 8	1169	1341	1437	1538	1533	1094	1533	1538	1533
Heat	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**
Total, th t	**7220**	**7560.7**	**7239**	**7131**	**7164**	**7294**	**7593**	**7126**	**7137**
Total-unit 8, (tons)	6051	6219.3	5802	5593	5631	6200	6060	5588	5604
Total-Unit 8 (TJ)	50223	51620	48157	46422	46737	51460	50298	46380	46513
Unit 8, (TJ)	9703	11134	11927	12765	12724	9080	12724	12765	12724

Calorific value, 8.3 **GJ/t**

Enclosure 20 Baseline calculation for Eesti Power Plant

	Unit	2005	2005 9 months	2006	2007	2008	2009	2010	1011	2012
Electricity production	GWh	5408	4056	5191	5119	5142	5197	5445	5119	5125
CO_2 emissions	t	6417365	4813024	6142819	6049926	6078002	6192966	6442915	6045622	6055048
CO_2 equivalent emission factor	t CO_2/GWh	1187	1186.643	1183.359	1181.857	1182.03	1191.64	1183.27	1181.02	1181.47
N_2O emissions	**t**	18.830	14.122	18.025	17.756	17.838	18.162	18.907	17.744	17.771
N_2O emissions	t N_2O in $CO_{2\ eq}$	5837.3	4377.9	5587.8	5504.4	5529.9	5630.2	5861.0	5500.5	5509.0
N_2O equivalent emission factor	t N_2O in $CO_{2\ eq}$/ GWh	1.079	1.080	1.077	1.075	1.07553	1.08324	1.0766	1.07431	1.07487
Baseline	**t CO_{2eq}/GWh**	**1187.722**	**1187.722**	**1184.436**	**1182.932**	**1183.106**	**1192.726**	**1182.091**	**1182.548**	1182.55

Calculations of GHG reduction

			I period			II period				
	Unit	**2005**	**2005 9 months**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Electricity produced by windfarm	GWh	135.559	**101.669**	135.559	135.559	**135.559**	**135.559**	**135.559**	**135.559**	**135.559**
Baseline	**$tCO_{2\ eq}$/GWh**	**1187.722**	**1187.722**	**1184.436**	**1182.932**	**1183.106**	**1192.726**	**1182.091**	**1182.548**	**1182.55**
GHG reduction	**t $CO_{2\ eq}$**	**161006**	**120754.6**	**160560.6**	**160356.8**	**160380**	**161684**	**160549**	**160243**	**160305**

Total AAUs 2005-2007 **441672.0 tons of $CO_{2\ eq}$**

Total ERUs 2008-2012 **803160.6 tons of $CO_{2\ eq}$**

Total AAUs and ERUs 2005-2012 **1244833 tons of $CO_{2\ eq}$**

Enclosure 21. Baseline calculation for the Narva Power Plants (Eesti PP+Balti PP)

	Unit	2005	200 9 months	2006	2007	2008	2009	2010	1011	2012
Electricity production (Eesti PP)	GWh	5408	4056	5191	5119	5142	5197	5445	5119	5125
Electricity production (Balti PP)	GWh	1193	596.5	1409	1481	1457	1403	1479	1478	1475
Total	GWh	6601	4652.5	6600	6600	6599	6600	6924	6597	6600
CO_2 emissions (Eesti PP)	t	6417365	4813024	6142819	6049926	6078002	6192966	6442915	6045622	6055048
CO_2 emissions (BaltiPP)	t	1283333	641667	1517519	1590732	1588201	1496383	1593294	1590732	1584819
Total	t	7700698	5454690	7660338	7640658	7666203	7689349	8036209	7636354	7639867
CO_2 equivalent emission factor (Eesti)	t CO_2/GWh	1187	1187	1183	1182	1182	1192	1183	1181	1181
CO_2 equivalent emission factor (Balti)	t CO_2/GWh	1076	1076	1077	1074	1090	1067	1077	1076	1074
CO_2 equivalent emission factor for Narva[20]	t CO_2/GWh	1162	1162	1160	1158	1162	1164	1160	1158	1158
N_2O emissionsn (Eesti)	t	18.83	14.123	18.025	17.756	17.838	18.162	18.907	17.744	17.771
N_2O emissions (Balti PP)	t	3.79	1.895	4.48	4.7	4.69	4.42	4.7	4.7	4.48
N_2O emissions (Narva)	t	15.521	11.432	15.045	14.883	14.945	15.138	15.781	14.874	14.847
N_2O emissions	t N_2O in $CO_{2\ eq}$	4811.572	3544.06	4664.037	4613.994	4633.152	4693.03	4892.149	4610.947	4602.581

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N_2O equivalent emission factor	**t N_2O in $CO_{2\ eq}$/ GWh**	1.059	1.059	1.056	1.055	1.058	1.060	1.056	1.055	1.046
Baseline[21]	**t CO_{2eq}/GWh**	**1163.298**	**1163.298**	**1161.021**	**1159.204**	**1162.853**	**1165.184**	**1161.009**	**1159.028**	**1158.974**
Calculations of GHG reduction										
			I period			**II period**				
	Unit	**2005**	**2005 9 months**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Electricity produced by windfarm	GWh	135.559	101.669	135.559	135.559	135.55869	135.559	135.5587	135.559	135.559
Baseline	t$CO_{2\ eq}$/GWh	**1163.298**	**1163.298**	**1161.021**	**1159.204**	**1162.853**	**1165.184**	**1161.009**	**1159.028**	**1158.974**
GHG reduction	**t $CO_{2\ eq}$**	**157695**	**118271**	**157386**	**157140**	**157635**	**157951**	**157385**	**157116**	**157109**

Total AAUs 2005-2007 432798.1 tons of $CO_{2\ eq}$

Total ERUs 2008-2012 787195.9 tons of $CO_{2\ eq}$

Total AAUs and ERUs 2005-2012 1219994 tons of $CO_{2\ eq}$

[21] weighted average

Enclocure 22. GHG reduction by Paldiski Wind Farm project using the national electricity sector baseline

			I period			II period				
	Unit	**2005**	**2005 9 months**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Electricity produced by windfarm	GWh	135.559	101.669	135.559	135.559	135.559	135.559	135.559	135.559	135.559
Baseline	$tCO_{2\ eq}$/GWh	1090.000	1090	1080	1060	1040	1040	1030	1020	1010
GHG reduction	**$t\ CO_{2\ eq}$**	**147759**	**110819.2**	**146403**	**143692**	**140981**	**140981**	**139625**	**138270**	**136914**

Total AAUs 2005-2007 **400914.8 tons of CO_2**

Total ERUs 2008-2012 **696771.7 tons of CO_2**

Total AAUs and ERUs 2005-2012 **1097686 tons of CO_2**

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