TransAlta
VENTERRE

Montréal, le 5 avril 2011

Bureau d'audiences publiques sur l'environnement

Objet : Réponses aux questions de certains citoyens – Première partie
Parc éolien de Saint-Valentin

Monsieur le Président,

Veuillez trouverez-ci-joint la première partie des réponses de Venterre aux questions de quelques citoyens reçues le 29 mars dernier de la part de la commission.

En espérant le tout conforme, veuillez agréer, Monsieur le Président nos salutations distinguées.

Julie Turgeon

Julie Turgeon, ing.
Développement éolien
Venterre NRG, représentant de TransAlta

<u>Première partie de réponses aux questions de quelques citoyens reçues le 29 mars :</u>

1. TransAlta est-elle disposée à installer, à ses frais, une technologie radar qui permettrait que les balises de positionnement demeurent éteintes tant et aussi longtemps qu'aucun avion ne circule dans l'espace aérien ?

   Les systèmes de balisage doivent faire l'objet d'approbation de Transport Canada. Selon l'information dont dispose TransAlta concernant cette technologie radar nommée «OCAS», ce système serait un système d'urgence qui ne serait pas encore utilisé au Canada. Cependant, TransAlta s'engage à analyser l'aspect commercial, sécuritaire et économique d'un tel système afin de valider une possibilité de l'incorporer au projet du parc éolien de Saint-Valentin. Cependant, à ce stade-ci du développement du projet, il n'est pas possible de confirmer l'utilisation d'un tel système.

2. Est-il exact qu'une vaste majorité des citoyens de Tibbetts Point Road au Cape Vincent ont exprimé que les balises de positionnement représentaient une nuisance ? Si des rapports existent à ce sujet, veuillez les déposer.

   Aucune étude ou aucun sondage concernant le nombre de résidents s'exprimant sur le sujet n'a été transmis à TransAlta. Nous sommes au fait de certains articles de journaux mentionnant que des résidents de Cape Vincent aux États-Unis n'apprécient pas la présence des balises lumineuses sur les éoliennes du projet de Wolf Island en Ontario. La présence de balises lumineuses est une exigence de Transport Canada. Dans ses demandes d'approbation adressées à Transport Canada, TransAlta travaille toujours de concertation avec l'agence fédérale afin de réduire au minimum le nombre de balises.

3. Est-ce que TransAlta a fait l'objet de poursuite, de mise en demeure ou d'opposition à l'un ou à plusieurs de ses projets ? Si c'est le cas, veuillez détailler les raisons de ces situations.

   Étant le plus grand producteur d'énergie au Canada et actif depuis plus de 100 ans, TransAlta a effectivement déjà été impliquée dans certaines procédures légales. Cependant, peu de ces procédures étaient reliées à ses projets éoliens et aucune n'est liée à des recours collectifs. TransAlta travaille étroitement avec les communautés locales afin d'éviter d'avoir recours à de telles procédures et bénéficie généralement d'un appui majoritaire des communautés dans lesquelles les projets sont construits.

4. Est-il exact de prétendre qu'une des principales sources de plaintes des résidents de Wolf Island et des environs, tant au Canada qu'aux États-Unis, est que le projet modifie de façon irréversible le paysage de ce site reconnu par l'UNESCO ?

   Il est vrai d'affirmer que la construction du parc éolien à Wolf Island a engendré un changement du paysage sur l'île. La nature d'un tel changement est cependant subjective. Pour certaines personnes, ce changement est perçu de façon positive ou neutre, pour d'autres, il est perçu négativement. Cependant, nous confirmons que TransAlta reçoit généralement un soutien très positif de la communauté locale.

5. Est-ce que TransAlta a prévu un fonds de compensation pour les modifications au paysage pour le parc éolien de Saint-Valentin ?

   TransAlta ne prévoit pas de programme de compensation concernant les aspects visuels L'apparence visuelle de tout projet de construction, que ce soit des structures reliées à un projet éolien ou à des résidences, est règlementée par les autorités municipales. TransAlta respectera la règlementation en vigueur. De plus, TransAlta a effectué plusieurs photos simulations afin de bien informer les citoyens et de leur montrer à l'échelle réelle l'implantation des éoliennes de différents points de vues.

6. En considérant l'ensemble des travaux requis par la réalisation du projet, les transports ainsi que l'extraction, la transformation et l'utilisation de ressources naturelles, quelle serait l'empreinte carbone du projet ?

   Enercon, le manufacturier des turbines choisies dans le cadre du projet de parc éolien Saint-Valentin, a réalisé une analyse du cycle de vie pour les éoliennes E-82 (ci-joint). Cette analyse réalisée suivant la méthodologie ISO 14040:2006 permet d'estimer l'empreinte carbone approximative d'un parc éolien comme celui proposé à Saint-Valentin.

   L'analyse tient compte des différentes phases d'un projet éolien : la fabrication des éléments d'un parc éolien, tels que les composantes des éoliennes (fondations, mâts, nacelles, pales, systèmes électriques), le transport des composantes et des équipements jusqu'au site et la construction du parc, incluant les routes d'accès et le réseau collecteur. L'analyse tient également compte des activités reliées à l'opération du parc, telles que la maintenance et les réparations. Finalement, l'analyse inclut le démantèlement du parc, le recyclage des composantes et le traitement des déchets.

   De façon générale et sur le cycle de vie complet d'une éolienne (soit de sa fabrication à sa construction, son opération et son démantèlement), Enercon évalue que l'énergie totale utilisée est l'équivalent de 2880 MWh par éolienne ou 72 000 MWh pour une parc éolien de 25 MW, comparativement à plus de 2 800 000 MWh que le parc produirait pendant 20 ans. Ceci correspondrait à l'émission de 902 tonnes de CO2eq[1]*, ou environ 23 000 tonnes*

[1] CO_2 équivalent (CO_2eq) désigne le potentiel de réchauffement global des gaz à effet de serre.

pour l’ensemble du parc éolien de Saint-Valentin, en se basant sur un système énergétique produisant de l’électricité à partir d’une diversité de sources énergétiques. Ceci correspondrait à environ 9 g CO2eq. / kWh, ce qui s’apparente aux calculs de l’Institut Pembina sur l’empreinte carbone d’un parc éolien qui évalue cette empreinte à 13 g CO2eq / kWh[2]*. À titre de comparaison, l’empreinte carbone d’un système de production électrique au gaz naturel est évaluée à 786 g CO2eq / kWh, donc plus de 60 fois l’empreinte d’un parc éolien.*

[2] McCulloch, M., Raynolds, M., Laurie, M. Life-Cycle Value Assessment of a Wind Turbine. Pembina Institute. Drayton Valley, Alberta, Canada. February 2000.

Report

LCA of an ENERCON Wind Energy Converter

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1. Introduction

Products and services are connected with environmental impacts along their life cycle. The standardized methodology of Life Cycle Assessment (LCA) is a technique that has been developed in particular to address these environmental aspects and potential environmental impacts (ISO 14040:2006).
The holistic approach of LCA aims at a systematic and comprehensive analysis of the whole life cycle of a product. This includes raw material acquisition, production, use-phase and the end-of-life treatment of the product. This approach is also known as cradle-to-grave.
According to the international standards ISO 14040 and 14044 an LCA is carried out in four phases:

1. the goal and scope definition phase,
2. the life cycle inventory (LCI) analysis phase,
3. the life cycle impact assessment (LCIA) phase, and
4. the interpretation phase.

ENERCON, one of the leading manufacturers of wind energy converters (WEC) worldwide and market leader in Germany, acknowledges that, despite providing products that produce almost carbon neutral energy and hence help to save resources and protect climate and environment, the production, use and disposal of wind energy converters have certain effects on the environment. Here, the LCA methodology is a tool that allows identifying these impacts on the environment and on top of this enables ENERCON to improve its environmental performance by identifying environmental hot spots.

2. Life Cycle Assessment of ENERCON WEC

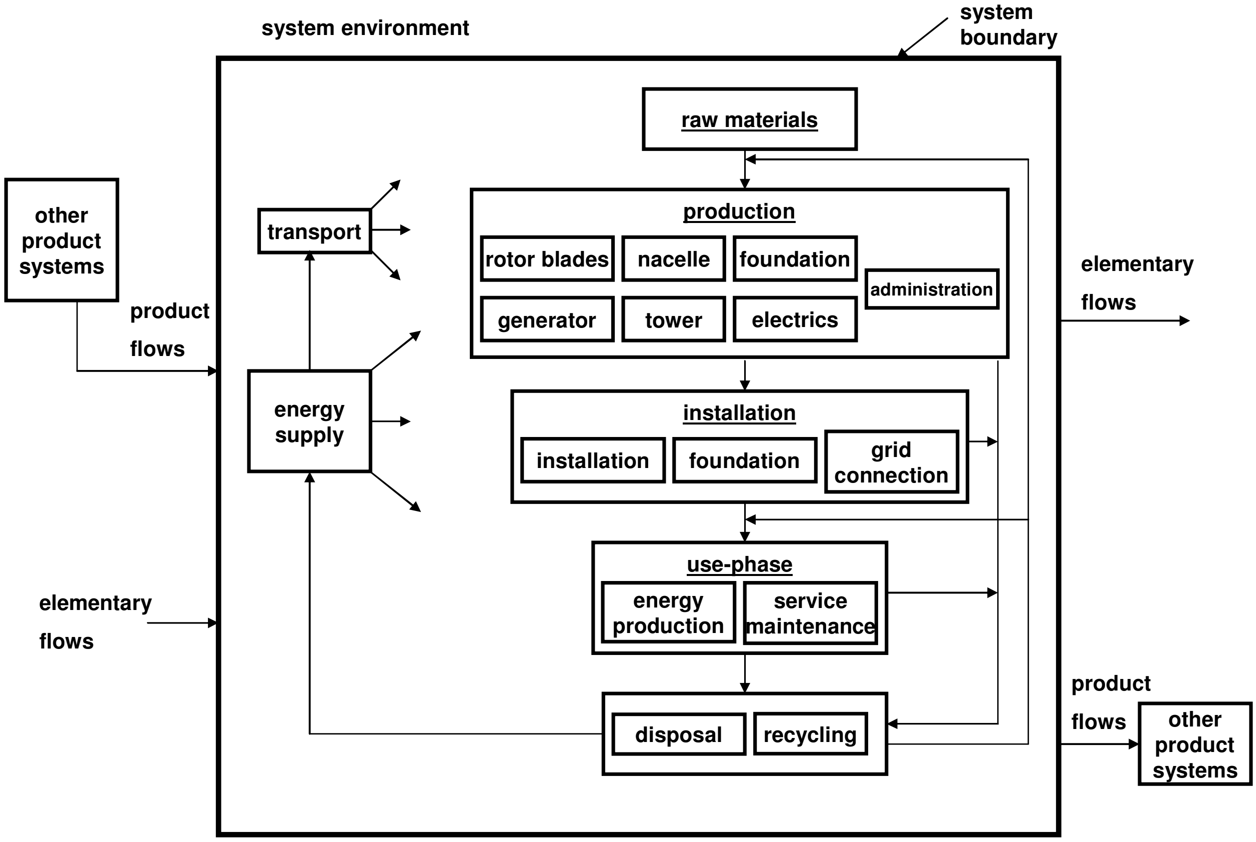
In this study an LCA of the ENERCON WEC E-82 E2 has been carried out. Main results of the study are the energetic payback time, the harvest factor and environmental categories like the global warming potential (GWP), the ozone depletion potential (ODP) and the acidification potential (AP).

The following table shows the most significant parameters of the product system under assessment.

WEC type	E-82 E2
Rated power	2,3 MW
Tower	97m concrete precast tower
Foundation	Flat foundation
Average full load hours	3.100 hours per year - coast 2.500 hours per year - near-coast 2.170 hours per year - inland
Life span	20 years

The product system under assessment includes all relevant stages of the WEC's life cycle. This includes production, transport, installation, use, dismantling and final disposal of the WEC. For this primary data have been collected directly in the manufacturing sites. Additional data required were adopted from (PE, LBP 2008). ENERCON's high in-house production depth allowed a detailed primary data collection for the various WEC components (blades, generator, nacelle, electric, tower) ensuring a high quality and reliability of the data used in the study.

The following figure shows a schematic overview of the included processes and the system boundaries.



2.1. Performing the LCA

The ENERCON E-82 E2 wind energy converter is specially designed for medium wind speeds and guarantees excellent yields with 2.3 MW rated power. The WEC under assessment with a tower height of 97 meters has a total height of about 140 meters. All major components of the WEC like rotor blades, nacelle, tower and parts of the electronics are produced in-house by ENERCON, ensuring high-quality and durability of the product. Recyclability and re-usability are of great importance in the design of the product.

Even though wind energy converters already play an important role in the production of clean energy ENERCON works on the continuous improvement of the environmental performance of their products.

The modelling of the product system according to the functional unit, i.e. the E-82 E2 with 97m precast concrete tower, has been done in accordance with the ISO standards 14040 and 14044. Based on the data collection a material flow model has been built in the LCA software GaBi 4 (PE, LBP 2008).

For the different components manufactured by ENERCON the consumption of electric and thermal energy has been taken into account. Where necessary economic allocation has been used to allocate the energy consumption to the different products. The actual power grid mix that ENERCON obtains has been modelled using GaBi datasets (PE, LBP 2008). The energy consumption as well as other expenditures of the production of the raw and operating materials that ENERCON purchases are included in the (PE, LBP 2008) datasets that have been used here.

Besides energy consumption all materials and wastes that are listed and could be allocated to the product have been considered.

The treatment of production waste has been modelled by the method of system expansion. Internal information and data on the best techniques available (IPPC 2010) have been used to model the waste treatment. Most materials are recycled or incinerated with energy recovery.

2.2. Description of the product system

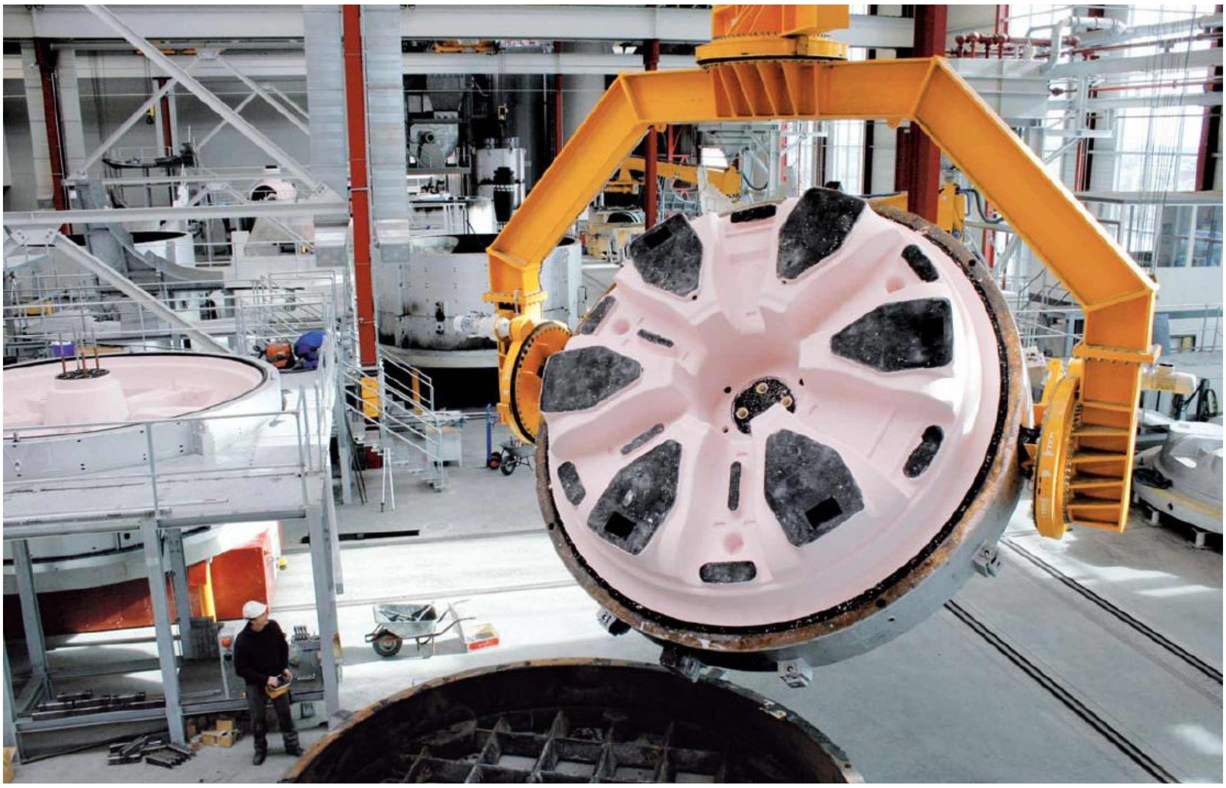
2.2.1. Manufacturing of rotor blades

ENERCON rotor blades are manufactured with a vacuum infusion process using the so-called sandwich technique. Glass fibre mats placed in the mould are vacuum-impregnated with resin by means of a pump and a hose system. In order to efficiently protect the rotor blade surface against weather elements such as wind and water, UV radiation, as well as erosion and bending loads, the rotor blades' protective finish is composed of gel coat, filler, edge protection and top coat using only solvent-free two-component polyurethane compounds in the entire system. The most essential materials used in the rotor blades are glass fibres and epoxy resin. On top of this more than 30 other materials are used in the production process and have been considered in the model.

2.2.2. Manufacturing of generator

ENERCON WECs use annular generators which are a key component in ENERCON's gear-less wind generator concept. Combined with the rotor hub, it provides an almost frictionless flow of energy, while fewer smooth running components assure minimal material wear. This ensures along life span and the ability to bear heavy loads.

The annular generator consists of a mobile part, the rotor, and a stator. Main components used in rotor and stator are copper wire and steel besides eight other materials that have been taken into account for the manufacturing of the generator.



2.2.3. Manufacturing of nacelle

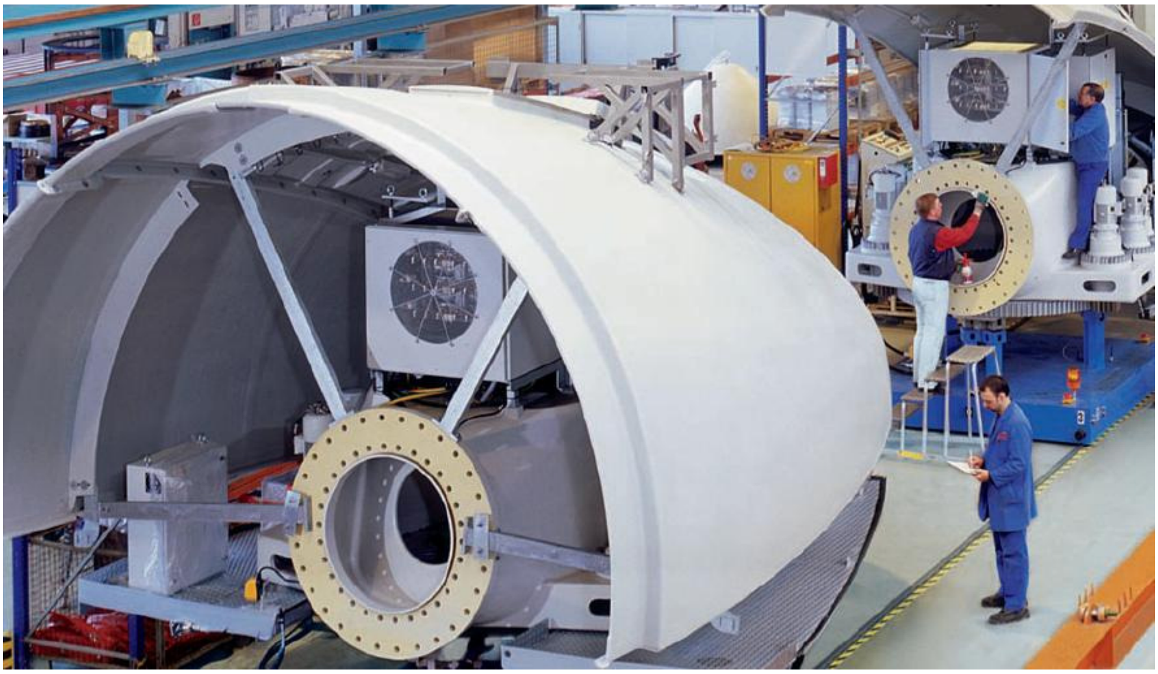
The nacelle of ENERCON WEC has a characteristic drop-like shape that has been designed by Sir Norman Foster and reduces turbulences hereby minimizing noise emissions.

Main components of the nacelle are nacelle casing, rotor hub, axle pins, blade adapter and the main carrier. The annular generator is addressed separately. The electric components within the nacelle are accounted for together with the other electric components in the WEC.

The mechanical processing of nacelle casing, rotor hub, axle pins, blade adapter and the main carrier are modelled based on primary data. Material and energy consumption as well as waste amount have been considered here.

For the rotor hub a PE dataset for cast iron parts has been used due to lack of data.

The assembly of the nacelle, including electric and annular generator, is also an in-house process and primary data has been used in the modelling of this process.



2.2.4. Manufacturing of tower

The WEC under assessment uses a 97 meters precast concrete tower. ENERCON precast concrete tower are made using specially developed prestressed steel reinforcement. The individual tower sections and foundation are assembled to form an inseparable unit with prestressing tendons running through jacket tubes in the core of the concrete tower wall. The tower sections themselves are manufactured entirely at the precasting plant. Specially constructed steel moulds assure manufacturing precision for each individual concrete section.
Based on the primary data about 25 materials have been considered in the modelling of the tower.

2.2.5. Manufacturing of electrics

Electric components in ENERCON WEC fulfil a variety of functions like yaw and pitch control, temperature, air gap, vibration and acceleration sensoring or control of grid connection. Therefore a great variety of different electric components is used. To model the electric primary data for the power cabinets and E-moduls has been collected. For the actual electric components like printed wiring boards etc. average datasets from (PE, LBP 2008) have been used. The transformer has been modelled using a combination of primary data and data from (Briem et al. 2004).

2.2.6. Manufacturing of foundation, crane hardstanding, road-building and grid connection

The foundation transmits any load on the wind turbine into the ground. ENERCON foundations have an optimised circular form. Depending on the site and the characteristics of the ground different foundation types can be chosen. For the WEC under assessment a flat foundation has been chosen. This flat foundation mainly consists of concrete and reinforced steel.

In addition to the foundation the construction of a crane hardstanding is required. A size of 50x50 meters and a depth of 0.5 meters are assumed here. For the access roads to the site and the connection to the substation a generic distance of 150 meters has been chosen.

For the construction of foundation, crane hardstanding and access roads the material consumption has been considered directly. Wastes and the consumption of operational materials are included in the expenditures of the service.

2.2.7. Construction and installation

For the construction and installation of the WEC at the site the expenditures had to be estimated due to lack of data. These estimations have been done following older studies for ENERCON WEC (Pick, Wagner 1998) with consideration of WEC specific figures like height and weight. Waste and consumption of materials on the construction site are included in the expenditures of the service.

2.2.8. Administration & Research and Development

The expenditures of administration and research and development are also considered in this study. These expenditures have been allocated by the number of installed WECs to the single converter. A differentiation between different types of converters has not been applied.

2.2.9. Transports

The transport of the WEC to the site is carried out by a combination of different means of transport. Distances of 300km by train and 400km by truck have been used in the model.

2.2.10. Service & Maintenance

Throughout the use phase the continuous operational readiness of the WEC requires regular service and maintenance. Here, an average of five service and maintenance trips per year with a distance of 150km to the service station has been used in the study. Also, average values for the consumption of operating materials and spare parts have been considered.

2.2.11. Use-phase

In the use phase electric energy is generated by the operation of the WEC. On the other hand, at standstill the WEC consumes energy from the grid to ensure that its control systems, pitch motors, yaw motors, obstruction lights, etc. continue to operate. Both, energy production and energy consumption strongly depend on the location and the prevailing wind conditions on the site.

The E-82 E2 is a 2.3 MW WEC. In this study three different sites – coast, near-coast and inland – have been assessed. Average numbers of full load hours (2.170, 2.500 and 3.100) have been used here. This corresponds to a net energy production of between 5.1 GWh per year for the inland site, 5.8 GWh for the near-coast site and 7.3 GWh for the coast site. The energy consumption of E-82 WECs varies between 800 and 4000 kWh per year. Here, a rather conservative assumption of 3500 kilowatt hours per year is used in the study.

2.2.12. Dismantling

For the expenditures of the dismantling the same figures as for the construction have been used due to lack of data.

2.2.13. Recycling and Disposal

Throughout the life cycle wastes arise from production, installation, service, maintenance and final disposal. In this study waste treatment is modelled by system expansion, which means the product system receives credits from recycling and thermal treatment.

Based on internal data and data from databases and literature (PE, LBP 2008, IPPC 2010, Worldsteel 2008, VAR 2010, vkn 2010) a disposal scenario for the treatment of all arising wastes has been developed. In this scenario waste from production phase and use phase is treated the same while the end-of-life disposal of the product is treated differently.

The following disposal scenario has been applied:

Material	Treatment
Production waste	
Household and commercial waste	Incineration with energy recovery
Waste Oil	70% recycling
Plastics	80% recycling
Steel	90% recycling
Cast iron	90% recycling
Aluminium	95% recycling
Copper	95% recycling
other metals	70% recycling
Wood	Incineration with energy recovery
Paper	80% recycling
Electronic waste	Incineration with energy recovery
Glass fibre reinforced plastics	Incineration with energy recovery
End-of-Life	
Rotor blade	Incineration with energy recovery
Tower	Use as filling material, e.g. in road building
Electrics	Reuse: 60% for electric components, 93% for cabinets etc.
Nacelle	
- Steel parts	80% recycling
- Cast iron parts	80% recycling
- Aluminium parts	95% recycling
- Copper parts	95% recycling

3. Results

Based on the life cycle inventory the potential environmental impacts of the product system have been examined. The CML methodology has been applied here. Besides the energetic performance the global warming potential (carbon footprint), the ozone depletion potential and the acidification potential have been assessed.

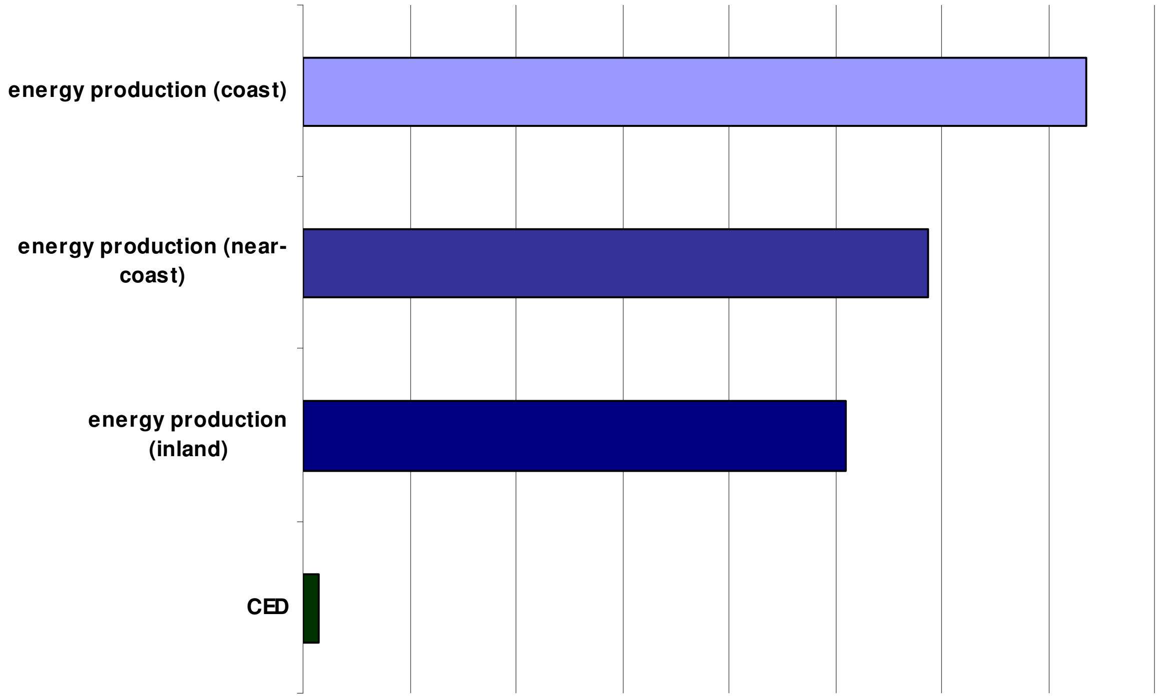
3.1.1. Energy Balance

The primary energy consumption (cumulated energy demand, CED) of the WECs under assessment throughout the life cycle is 2,880 MWh for the different sites. The main contribution arises from the production of the different components of the WEC. The use-phase, including service and maintenance as well as energy consumption needed to operate the WEC, contributes 8 percent while installation (<5 percent), dismantling (<1 percent) and transport (2 percent) contribute only little.

In contrast to this there is a net energy production in the WEC's use phase of 101,990 MWh for the inland site, 117,500 MWh for the near-coast site and 147,000 MWh for the coast site.

This results in harvest-factors of 35.4 for the inland site, 40.8 for the near-coast site and 51 for the coast site. This means the E-82 E2 wind energy converter produces 35.4 times more energy during its use phase than it consumes throughout the entire life cycle at an inland site, almost 41 times more energy than it consumes at a near-coast site and around 51 times more energy at a coast site.

The following figure shows the ratio of energy production and consumption for the different scenarios.



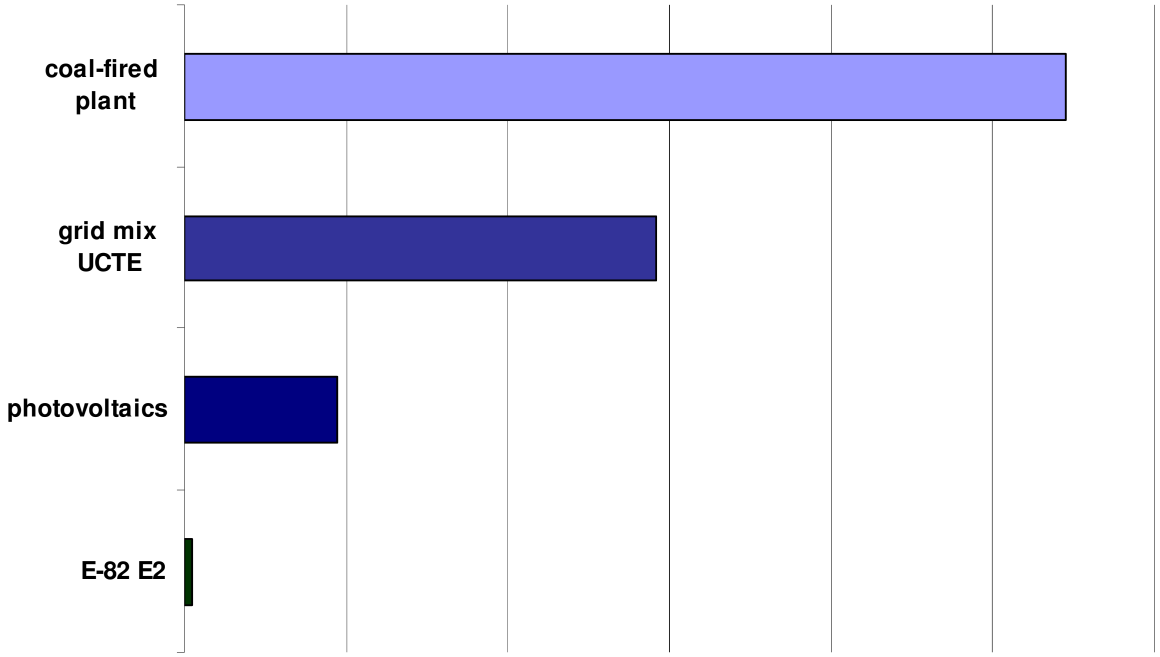
Energy consumption and production of the WEC result in an energetic amortisation time of 6.8 months for the inland site, 5.9 month for the near-coast site and 4.7 months for the coast site meaning that after this period of time the amount of energy produced equals the amount of energy consumed throughout the WEC's life cycle. The energetic performance of the converter is summarized in the following table.

	inland site	near-coast site	coast site
Cumulated energy demand	2,880 MWh	2,880 MWh	2,880 MWh
Net energy production	101,990 MWh	117,430 MWh	146,930 MWh
Harvest-factor	35.4	40.8	51.0
Energetic payback time	6.8 months	5.9 months	4.7 months

3.1.2. Global Warming Potential

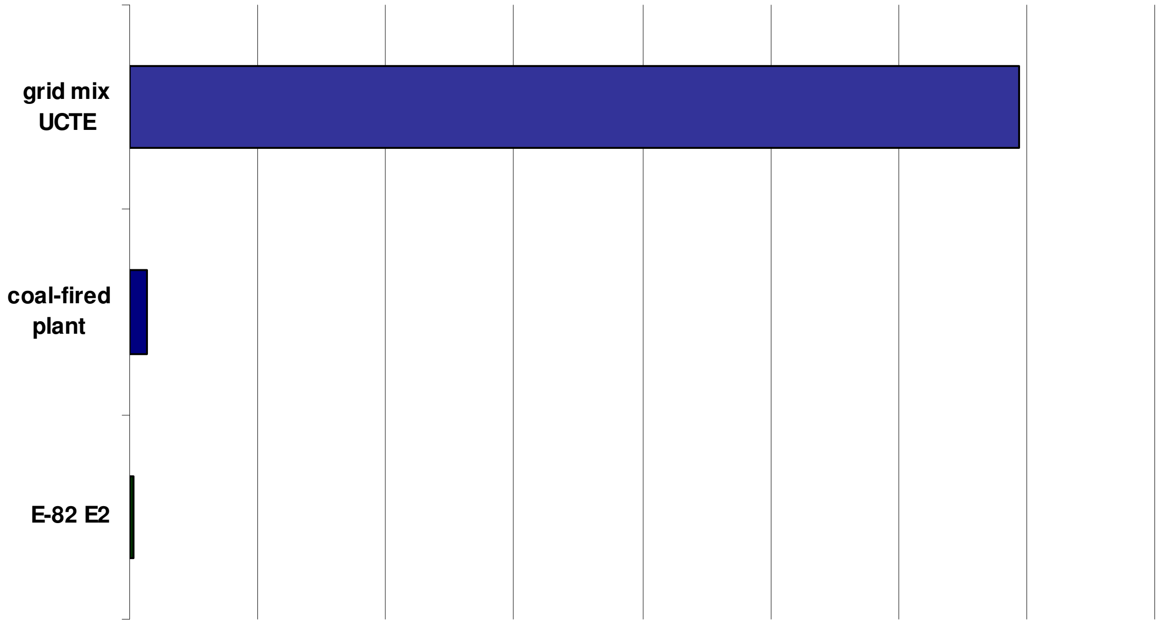
Over the life cycle of the E-82 E2 under assessment 902 tons of CO_2 equivalents are emitted. This results in a carbon footprint of 8.9 grams of CO_2 per kWh for the inland site, 7.7 grams for the near-coast site and 6.1 grams CO_2 per kWh for the coast site. This means over its life cycle the E-82 E2 spares the environment up to 85,000 tons of CO_2 compared to the European grid mix (UCTE) and up to 160,000 tons compared to a coal fired plant (emissions based on PE, LBP 2008). Even compared to power from photovoltaic over 25,000 tons of

CO_2 are saved throughout the life cycle (based on Marheineke 2002). The following figure shows the global warming potential of these technologies in comparison.



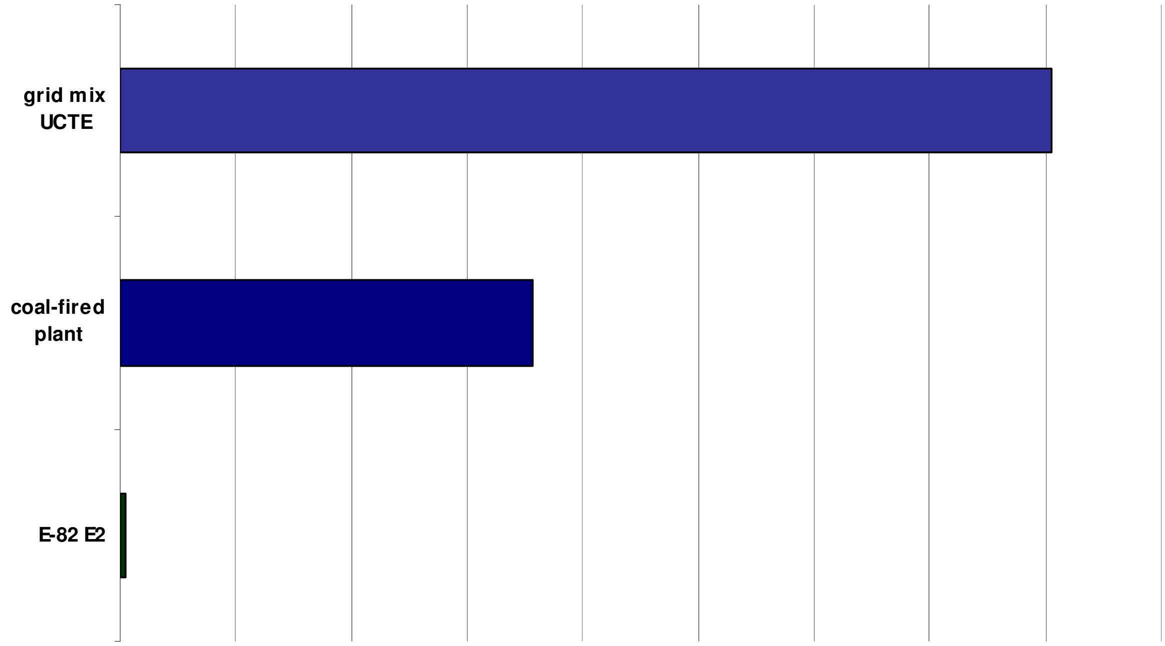
3.1.3. Ozone Depletion Potential

The ODP of the WEC over its life cycle is 0.0681 kg R11 equivalents. The following figure shows these emissions compared to the respective emissions of the European grid mix (UCTE) and energy from a coal-fired plant.



3.1.4. Acidification Potential

Over the life cycle of the WEC 2044 kg of SO_2 equivalents are emitted contributing to the acidification potential of the product system. This corresponds to an emission of less than 0.02 grams of SO_2 equivalents per kWh for the different scenarios. The following figure shows the acidification potential of the E-82 E2 in comparison the European grid mix and a coal-fired plant.



4. Interpretation & Outlook

The quality of the data used in the LCA has been estimated to be satisfactory and valid despite few assumptions made in the model. Therefore the results can be considered as reliable for the WEC in question. At the same time it must be noted that the data used in the model is updated continuously therefore the results may change over time.

These results show a good environmental performance of the WEC. On the assessed sites it produces between 35 and 51 times more energy than it consumes during its life span which was assumed to be 20 years. At top sites even a harvest factor of over 70 is possible. A further increase of the life span by five years enables the converter to produce 47 times the energy it consumes in the near-coast scenario and a life span of 30 years even increases this factor to up to 57. However, although a longer life span than 20 years is technically feasible, the experience has shown that due to the technological improvement a replacement of the converters after 20 years might make sense. This process, called repowering, allows a continuous improvement of the utilization of a site by increasing the installed capacity with a reduced number of converters.

The impact assessment clearly shows the environmental advantages of the WEC compared to the European grid mix or coal-fired power plants. This points out the huge potential of wind energy on the way to reduce anthropogenic emissions of greenhouse gasses and other environmental impacts.

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