Available online at www.sciencedirect.com
ScienceDirect
Energy Procedia 00 (2010) 000–000
Energy Procedia
www.elsevier.com/locate/XXX

GHGT-10

Economic modelling of the capture–transport–sink scenario of industrial CO_2 emissions: the Estonian–Latvian cross-border case study

Alla Shogenova[a], Kazbulat Shogenov[a], Raisa Pomeranceva[b], Inara Nulle[b], Filip Neele[c] and Chris Hendriks[d]

[a]Institute of Geology, Tallinn University of Technology, Ehitajate tee 5, 19086 Tallinn, Estonia
Tel.:+372-620-3024; fax:+372-620-3011. *E-mail address*: alla@gi.ee.
[b]Latvian Environment, Geology & Meteorology Centre, Maskavas iela 165, Riga 1019, Latvia
[c]TNO Built Environment and Geosciences, P.O. Box 80015, 3508 TA Utrecht, The Netherlands
[d]Ecofys International Bv, P.O. Box 8408, 3503 RK Utrecht, The Netherlands

Elsevier use only: Received date here; revised date here; accepted date here

Abstract

Industrial CO_2 emissions and opportunities for CO_2 geological storage in the Baltic Region were studied within the EU GeoCapacity project supported by the European Union Framework Programme 6. Estonia produces the largest amounts of CO_2 emissions in the region, due to the combustion of Estonian oil shale for energy production. Owing to the shallow sedimentary basin containing mainly potable groundwater, the geological conditions are unfavourable for CO_2 storage in Estonia. Therefore the main Estonian power company Eesti Energia is searching for CO_2 storage options in the neighbouring regions.

The most favourable geological conditions for CO_2 storage in the Baltic Region are found in Latvia in the Middle Cambrian reservoir, sealed by Ordovician clayey carbonate rocks. The total CO_2 storage capacity of 16 largest structural traps exceeds 400 million tonnes (Mt). Two power plants close to the city of Narva, with annual CO_2 emissions of 8.0 and 2.7 Mt were chosen for the economic modelling of the capture–transport–sink scenario using the GeoCapacity Decision Support System (DSS) based on the GeoCapacity GIS database. Two anticlinal structures of Latvia, Luku-Duku and South Kandava with the area of 50−70 km^2 were selected for the CO_2 storage. The depth of the top of the Cambrian reservoir is 1020−1050 m, the thickness 28−45 m; permeability of sandstone is more than 300 mD, and the trap storage efficiency factor 40%. The conservative storage capacity of these structures 40 and 44 Mt of CO_2 respectively will be enough for 8 years. The estimated pipeline length required for CO_2 transportation is about 800 km. The oxyfuel capture technology is applied in this scenario. With a conservative storage capacity for 8 years of emissions, avoidance costs are rated at €37.4 per tonne of CO_2. The total cost of the project estimated by the Decision Support System using the GeoCapacity GIS is about €2.8 billion for 30 years of payment period.

Keywords: CO_2, Baltic, Cambrian, economic modelling, mineral carbonation

Introduction

Estonian–Latvian case study is the only one cross-border economic modelling of CO_2 capture–transport–sink scenario in the EU GeoCapacity project [1, 2]. This study was triggered by zero CO_2 storage capacity in Estonia and favourable for CO_2 storage geological conditions in Latvia [3, 4]. The possibility of such a scenario is proved by about 40−years−long successful exploitation in Latvia of the Inĉukalns Underground Natural Gas Storage, supporting Estonia with natural gas when necessary. Estonia does not have CO_2 storage options on its own territory because of location in the shallow part of the Baltic sedimentary basin including valuable potable water. Among neighbours of Estonia only Latvia, EU GeoCapacity project country, as a possible partner could be considered for the CO_2 onshore storage with transport by pipelines.

Estonia is the largest CO_2 emitter in the Baltic Region. Nine large (emitting more than 0.1 million tonnes (Mt) of CO_2) industrial sources of CO_2, registered in 2005 in the EU Emission Trading Scheme, produced 11.5 Mt of CO_2 [3, 4]. In 2009 Estonia had already 13 large sources with the total CO_2 production of 22.7 Mt. The two largest Estonian power plants, Eesti and Balti produced respectively 7.7 and 2.25 Mt of CO_2 in 2005. Large emissions are explained by the use of local Estonian oil shale for energy supply. CO_2 emissions produced during combustion of oil shale are higher than those from other fossil fuels. The owner of the power plants, the national company Eesti Energia also exports energy to the Baltic region and Finland. Energy production grew notably in 2009 due to the closure of the Ignalina Nuclear Power Plant in Lithuania in 2009 and significant increase in the Estonian electricity export to Latvia and Lithuania. For these reasons Estonian CO_2 emissions per capita are among the highest in Europe and in the world. The power company Eesti Energia is searching for CO_2 storage options in the neighbouring regions. The construction of the new power plant units at the premises of the largest Eesti Power Plant is to be ready in 2016. According to EU directives, the new units have to be “capture ready”. This has forced Eesti Energia Company to find technological and geological solutions to the CCS (CO_2 capture and storage) problem. According to the EU CCS directive [5], the Ministry of Environment of Estonia has to create Estonian regulations for CO_2 storage in the nearest time.

The GeoCapacity GIS and DSS

Data for the economic modelling were collected into the Geographic Information System (GIS) in the frame of the EU GeoCapacity project [1, 2, 6]. The GIS database includes locations of large CO_2 sources, potential aquifer storage sites and injection points, hydrocarbon fields and injection points, coal fields and potential injection points, the existing pipelines and pipeline terminals and natural sources of CO_2. All data were mapped by the project partners from 26 countries and integrated into the GIS in the same format to ensure data consistency. The objective of the GeoCapacity GIS was data visualization and access and input for the economic Decision Support System (DSS).

Figure 1 Estonian–Latvian case study. Eesti and Balti Power Plants are shown by green–blue symbols, storage sites by red symbols. The proposed CO_2 pipelines (along with natural gas pipelines) are shown by a red line.

The DSS was developed in the EU GeoCapacity project to evaluate the technical and economic feasibility of CO_2 storage in the subsurface [2, 7]. The economic tool developed in the EU GESTCO project was updated and improved to extend its functionality. The new economic tool can be used to define CO_2 capture, transport and storage systems, consisting of a selection of CO_2 sources and sinks and the connecting pipeline network. The DSS uses the database of CO_2 emission points and storage locations in Europe (GeoCapacity GIS) [4, 5]. The system is a combination of an internet application, which visualises the data and allows the user to select sources and sinks and create a pipeline network, and an application to be run on a local computer, which performs a stochastic analysis of the costs of a CO_2 capture, transport and storage system.

CO_2 Sources and Capture System

The two largest producers of energy and CO_2 emissions in Estonia and in the Baltic region, Eesti and Balti Power Plants, were selected for this scenario (Fig.1). The Eesti Energia Narva Power Plants Company (including Eesti and Balti Power Plants) is the largest producer of electrical energy in Estonia and one of the most important power producers in the Baltic Region. The company supplies electrical energy to Estonian consumers and heat to the city of Narva, and exports electricity to the Baltic States and also to the Nordic power market through the Estlink undersea cable. An average of 9−13 Mt of oil shale is delivered from two underground mines and one open pit to the Narva Power Plants by rail each year. A power plant produces electricity in energy production units. Each energy production unit consists of two boilers, a turbin**e** and 7 km of pipes.

The Eesti Power Plant is the largest energy enterprise in Estonia and in the Baltic Region. It has eight energy production units with a total electric capacity of 1610 MW. **The Balti Power Plant** has four energy production units with a total electric capacity of 765 MW and a gas-fuelled reserve and peak load boiler unit with three boilers with an installed heat capacity of 400 MW. Each power plant has one new energy production unit that uses the circulating fluidised bed technology, while the rest of the units are older and burn pulverised oil shale. Before oil shale enters the boiler, it is ground into dust in oil shale mills. Pulverised oil shale is blown into the burners of the boiler. Heat is released as it burns and produces steam from water in the boiler. Steam is directed into a turbine where the kinetic energy of the steam rotates a turbine generator that produces electrical energy. The electricity generated has a voltage of 15.75 kV. Before this electricity can be transmitted into the power grid, its voltage is raised to 330–360 kV by transformers, in order to reduce electricity losses. The oil shale heating value is rather low, only 8.37 MJ/kg (2000 kcal/kg), while its ash content is about 45%. Oil shale combustion releases heat with the combustion core temperature rising up to 1500 – 1600°C. In the new circulating fluidised bed boilers, the finely ground fuel is burned in a stream of air directed into the combustion chamber from below, creating a so-called fluidised bed. Up to 10% of the combustion mass in the new circulating fluidised bed units is biofuel, which is burned together with the usual oil shale. The average annual production of renewable energy in the two new energy production units is 260–280 GWh, which covers nearly 4% of the total annual electricity consumption of Estonia. The circulating fluidised bed is more suitable for fuels with a lower calorific value or for mixed fuels, so that besides oil shale up to 10% of used fuel is made up of wood chips, which are a biofuel. In circulating fluidised bed boilers the combustion temperatures are lower than in pulverised oil shale boilers and a significant amount of sulphur is bound up during the combustion, meaning that no additional flue gas scrubbing is needed.

The Eesti and Balti Power Plants are the largest CO_2 emitters in Estonia and in the Baltic Region. In 2005 they produced, respectively, 7.7 and 2.25 Mt of CO_2, but these amounts increased up to 9.4 and 2.7 Mt of CO_2 in 2007 and up to 15.3 and 3.2 Mt of CO_2 in 2009. Large emissions are explained by composition of the oil shale commercial seams, which are interlayers in the Estonian Ordovician carbonate rocks. CO_2 emissions produced during combustion of oil shale are higher than those from other fossil fuels. The CO_2 content in the flue gas produced during combustion of Estonian oil shale can reach 15−25%. The CO_2 emissions produced by the Eesti and Balti Power Plants are higher than emissions of all large industrial sources in Latvia and Lithuania taken together [3, 4]. The oxyfuel technology was applied in the modelled CCS scenario. This involves the combustion of the fuel with pure oxygen, resulting in a gas flow with a high concentration of CO_2.

Storage sites

Only local structures in the Cambrian reservoir sandstone are prospective for CO_2 storage in the Baltic Region [3]. Faults and folds are widespread within the Caledonian complex in western and central Latvia. The depth of the Cambrian reservoir varies from 700 m in central Latvia to 1700 m in SW Latvia. All anticline structures prospective for CO_2 storage are situated in these regions (Fig. 2). Sandstone of the Cambrian aquifer prospective for CO_2 storage, the thickest reservoir in the Cambrian section in the western and central Latvia, belongs to the Deimena Regional Stage. (Deimena Formation and Cirma strata). The section is represented by sandstone, siltstone and claystone with sandstone, comprising up to 75−90%. Siltstone and claystone make up 10−30% of the section; their thickness varies from 0.2 to 3−4 m, somewhere reaching 10 m. The sandstone is light grey and white, quartzose, fine-grained. The siliciclastic part of the sandstone is well sorted and comprises more than 90% of the deposits. Among clastic material, quartz prevails (95−99%); the rest of the minerals is represented by pelitised potassium feldspar, muscovite and biotite. Cement of the sandstone is clayey and quartzose. In its top part, the cement is frequently kaolinite, secondary carbonate, locally gypsum-bearing. The Cambrian sandstone is loosely or medium cemented characterised by good filtering and volume properties. On most of the Latvian territory, the average effective porosity of sandstone is 20−25%, permeability reaches hundreds and thousands of mD, mineralization of groundwater 85−123 g/l and water temperature is 11−25°C. Thickness of the reservoir sandstones is 20−70 m.

Figure 2 Major Cambrian aquifer structures (CO2 storage potential exceeding 2 Mt) of Latvia and Inčukalns underground gas storage [8, 9]. The dashed line shows gas pipelines.

The Inčukalns underground natural gas storage was established in the largest Cambrian structure in 1968. The main criteria used for identification of the prospective structures are: a local high determined by seismic data, the size and depth of the trap, reservoir properties and reliable cap rock. On the basis of these criteria, 16 prospective structures were revealed: Dobele, North Blidene, Blidene, Snepele, South Kandava, Degole, Luku-Duku, Kalvene, Vergale, Edole, North Kuldiga, Viesatu, Aizpute, Usma, Liepaja and North Ligatne (Fig. 2). The structures of the first group (Kalvene, Luku-Duku, North Blidene, Blidene, Dobele and North Ligatne) are situated within the Liepaja–Saldus ridge and are represented by near-fault brachyanticline folds. Their area is about 14–50 km^2, and the amplitude 55–80 m. The effective thickness of the reservoir is more than 30 m. The depth of the Cambrian reservoir in the Kalvene, Luku-Duku, North Blidene and Dobele areas is 950–1050 m, while that of the North Ligatne area is about 700 m.

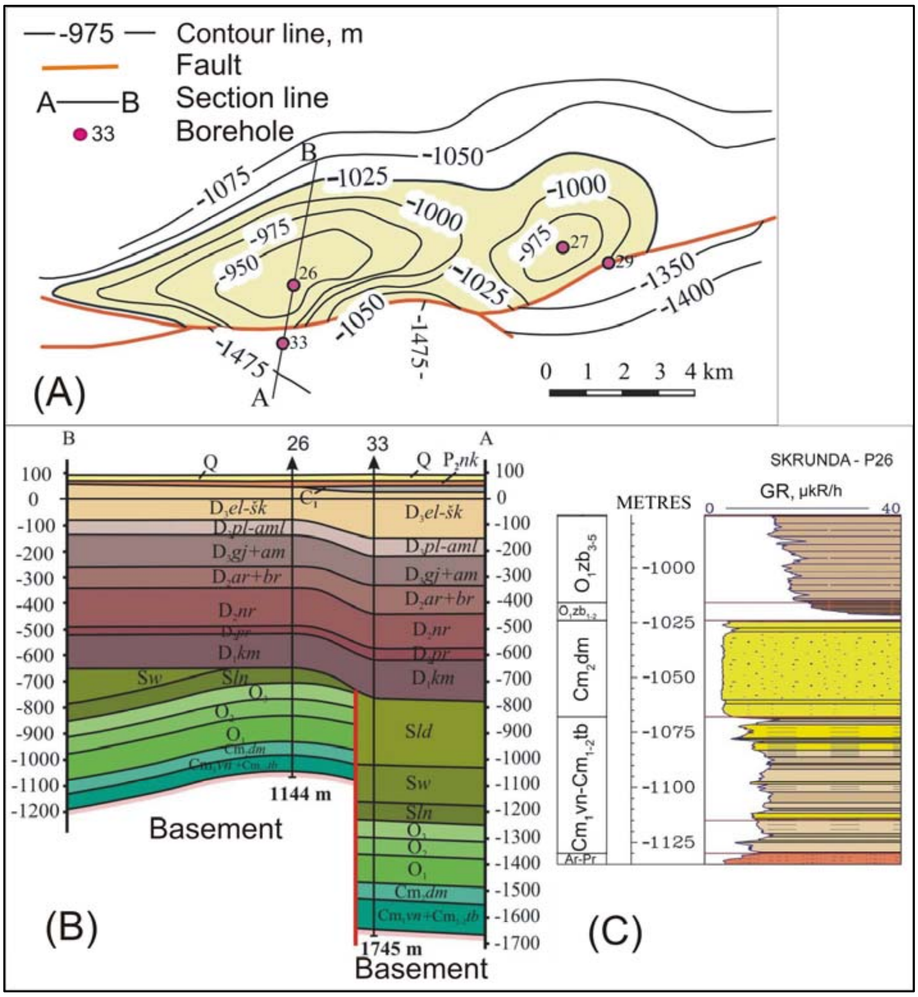

Figure 3 (A) Structural map of the top of the Cambrian reservoir sandstones in the Luku-Duku structural trap. (B) Geological section along the line A–B. (C) Geological section of the Cambrian reservoir and Ordovician cap rocks in the Skrunda–P26 borehole (26 in parts A, B).

The structures of the second group (Snepele, Vergale, North Kuldiga, Edole, Usma and Aizpute) are situated in western Latvia and are associated with the Liepaja−Kuldiga−Talsi ridge. These structures are also represented by near-fault brachyanticlines. Their area is about 10−26 km^2, the amplitude 25−60 m, while the effective thickness exceeds 30 m. The depth of the reservoir is 950−1050 m.

The third group (Degole, Viesatu and South Kandava structures) is located in the Central Latvia. The Degole and Viesatu structures are represented by asymmetrical brachyanticline folds without faulting. The southern and northern flanks of the South Kandava structure are complicated by faults. The area of those structures is about 14−20 km^2, the amplitude 50−70 m. the thickness of the reservoir varies from 25 m at the South Kandava structure up to 50−55 m at the Degole and Viesatu structures. The depth of the reservoir is 1000−1050 m. Reservoir rocks are represented by Cambrian sandstone, cap rocks by Ordovician clayey carbonate rocks.

Two geological structures of Latvia have been proposed for CO_2 storage − Luku-Duku and South Kandava. These structures were determined by seismic investigations and studied by four (Luku-Duku) and five (South Kandava) boreholes. However these are not among the most prospective structures studied in Latvia, and they are not the closest to Estonia. Three most prospective in Latvia structures (best studied, with the largest capacity) have already been planned for natural gas storage and for storage of Latvian CO_2 emissions.

The Luku-Duku structure (Fig. 3) is situated within the tectonically dislocated zone of the Saldus−Sloka−Inčukalns high. The Luku-Duku local high is a near-fault brachyanticlinal fold about 50 km^2 in area. The thickness of reservoir rocks is 45 m, their top lies at a depth of 1024 m. Reservoir rocks are represented by sandstones of the Middle Cambrian Deimena Formation (Cm_2dm), underlain by sandstones with inter-layers of siltstones and claystones of the Lower Cambrian Ventava and Lower-Middle Cambrian Tebre Formations (Cm_1vn−$Cm_{1\text{-}2}tb$). Middle Cambrian reservoir sandstones are covered by argillaceous rocks of the Lower Ordovician Tremadocian Zebre Formation (O_1zb). The Zebre Formation consists of the Lutrini (O_1zb_1), Kumbri (O_1zb_2), Zirni (O_1zb_3), Kalvene (O_1zb_4) and Zante members (O_1zb_5). The Ordovician, Silurian and Devonian carbonate and siliciclastic rocks represented with total thickness of about 1 km overlie the cap rocks of the Zebre Formation. Reservoir sandstones of the Middle Cambrian Deimena Formation in the Luku-Duku structure have an average porosity of 22%, permeability more than 200−300 mD, reservoir water temperature 19° C and reservoir water salinity 103−105 g/l.

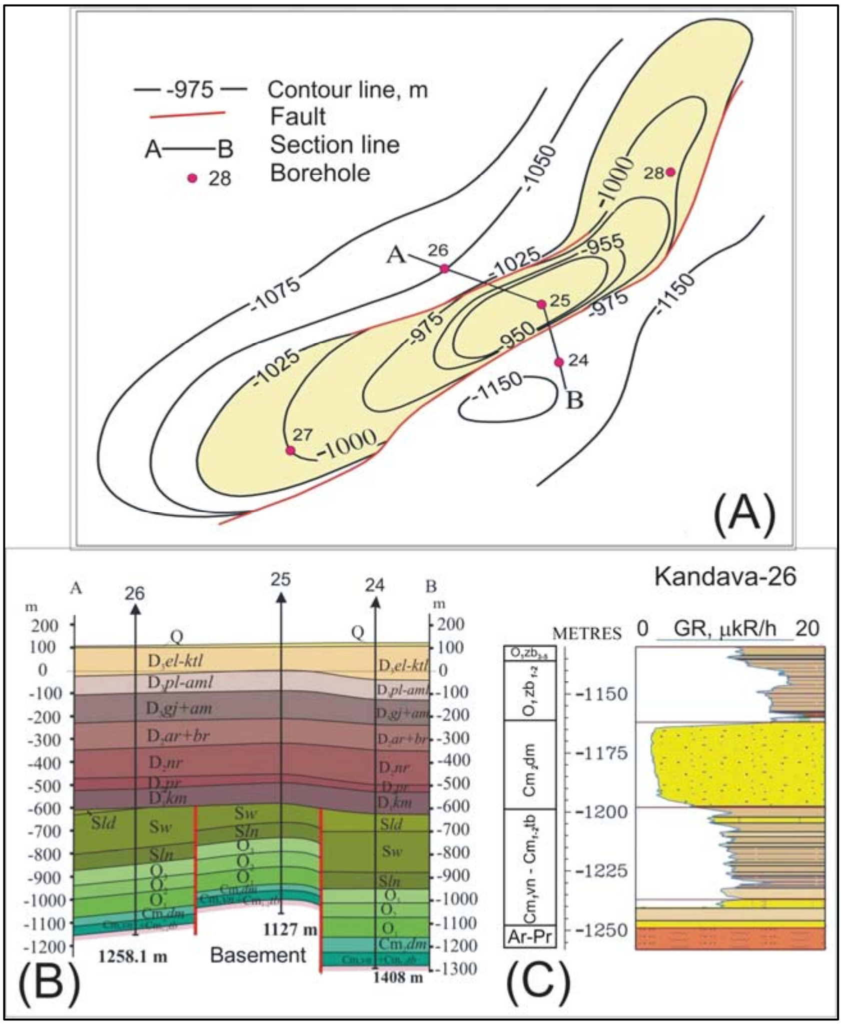

Figure 4 (A) Structural map of the top of the Cambrian reservoir sandstones in the South Kandava structural trap. (B) Geological section along the line A–B. (C) Geological section of the Cambrian reservoir and Ordovician cap rocks in the Kandava–26 borehole (26 in parts A and B).

The South Kandava structure (Fig.4) is a brachyanticlinal fold stretching from NE to SW located in the centre of Latvia. The south-eastern and north-western flanks of the fold are bounded by faults. Its area is about 69 km^2, the thickness of the reservoir is 25−36 m. The top of the reservoir rocks is represented by sandstones of the Middle Cambrian Deimena Formation located at a depth of 1053 m. Cambrian Deimena Formation in South Kandava structure has an average porosity of 20%, average permeability 300 mD, reservoir water temperature 11º C and reservoir water salinity 109−115 g/l.

The storage capacity of the structural trap was estimated by the formula [2, 9]:

$$M_{CO2t} = A \times h \times NG \times \phi \times \rho_{CO2r} \times S_{eff} \quad (1)$$

where M_{CO2t} is storage capacity (kg), A is the area of an aquifer in the trap (m^2), h is the average thickness of the aquifer in the trap, NG is an average net to gross ratio of the aquifer in the trap, ϕ is average porosity of the aquifer in trap, ρ_{CO2r} is the in situ CO_2 density in reservoir conditions, S_{eff} is the storage efficiency factor (for trap volume). The area of the structures was determined from contour maps of stratigraphic horizons near or at the top of the reservoir formation. The thickness, net to gross ratio and porosity were evaluated using data from exploration wells drilled on the structure (Table 1). The CO_2 density varies with depth, depending on pressure and temperature and is in the range of 600−750 kg/m^3 in Latvia. The aquifer systems surrounding and connected to the reservoir formations in the individual traps have been assumed to be open (unconfined) aquifers. The trap storage efficiency factor of 40% has been assumed corresponding to open high quality reservoirs (Table 1).

Transport

CO_2 is assumed to be transported through pipelines which could be constructed along the natural gas pipeline routes (Figs. 1, 2, 5). Natural gas is imported to Estonia from Russia and is supported from the Inĉhukalns underground gas storage in Latvia. The company Eesti Gaas has two gas metering stations on the border of Estonia, where the volumes of imported gas are measured. Gas is distributed to customers through gas pipelines, distribution stations and gas pressure reducing stations (Fig. 5). The total distance to the structures along available pipelines route is about 800 km. The construction of pipelines could be completed in three years with estimated costs of about €47 million. The transport cost of one tonne CO_2 transported is €5.3.

Figure 3 Map of Estonia with location of natural gas pipelines, stations (yellow circles) and metering stations (orange boxes). Courtesy−AS Eesti Gaas.

Results

The summary of the input parameters of the Estonian–Latvian scenario is given in Table 1. The output economic parameters of the calculated by the DSS scenario are given in Table 2. Preparatory works for this scenario could be started in 2012−2013 together with the construction of new power plant units. Estonian and Latvian CCS regulations could be ready by that time. Development/construction period of the site in Latvia could take up to three years, including geophysical exploration and drilling of boreholes at two sites. Taking into account the well injection rate of about 1.5 Mt/yr and total injected emissions of about 10.5 Mt/yr, at least seven boreholes with a minimum depth of 1070 m should be drilled. The total estimated cost of storage works including maintenance costs (€0.2 million per year per site) is €250 million. The possibility of reconstructing the conserved boreholes can reduce drilling costs. The estimated pipeline length required for CO_2 transportation is about 800 km. The storage sites could be ready to 2016 year, when new blocks will be built. With a conservative storage capacity for 8 years of emissions in two storage sites the total cost of the project is €2.8 billion for 30 years of pay out time. The most expensive in the scenario are capture (€1.9 billion) and transport costs (€0.45 billion). Capture cost makes 68% and transport cost is 16% of the total cost of the scenario. The total cost for one tonne of CO_2 avoided (75.8 Mt) is €37.4, including €25.5 for capture, €3 for compression, and €5.3 for transport and € 3 for storage of one tonne of CO_2 injected (84.2 Mt).

Table 1 Summary of the input parameters for storage in the GeoCapacity Model.

Sink Name	**Luku-Duku**	**South Kandava**
Sink type	aquifer	aquifer
Depth (m) (from the earth surface)	1024	1053
Current reservoir pressure (bar)	93.7	98.3
Maximum reservoir pressure (bar)	107.8	113
Reservoir radius (km)	8	5
Trap radius (km)	8	5
Reservoir thickness (m)	45	28
Porosity (%)	22	20
Connate water fraction	0.25	0.25
Net to gross ratio	0.8	0.8
Reservoir temperature (°C)	19	11
Permeability (mD)	300	300
Well radius (m)	0.15	0.15
Storage capacity ($MtCO_2$)	40.2	44
Well injection rate (Mt/yr)	2	2
Storage efficiency factor in trap (%)	40	40
Number of wells	3	4
CO_2 concentration	20	20

Table 2 Economic parameters of the Estonian–Latvian case study (NPV is a net present value, SRC NPV is a net present value for capture costs).

NPV	2835	€ million	NPV storage normalised	3.0	€/tCO_2injected
NPV capture	1928	€ million	Unit technical cost	37.4	€/tCO_2avoided
NPV compression	210	€ million	Pay out time	30	Yr
NPV transport	447	€ million	SRC NPV capture 0	1103	€ million
NPV storage	250	€ million	SRC NPV compression 0	162	€ million
NPV normalised	37.4	€/tCO_2avoided	SRC NPV capture 1	825	€ million
NPV capture normalised	25.5	€/tCO_2avoided	SRC NPV compression 1	48	€ million
NPV compression normalised	2.8	€/tCO_2avoided	SINK NPV storage 0	129	€ million
NPV transport normalised	5.3	€/tCO_2injected	SINK NPV storage 1	121	€ million

Conclusions

Two planned new blocks of power plants with the expected capacity of 400 and 300 MW and annual CO_2 emissions 8 and 2.7 Mt were selected for economic modelling by DSS. Two anticlinal structures of Latvia, Luku-Duku and South Kandava with the area of 50-70 km^2, the depth of the top of the Cambrian reservoir of 1020–1050 m, the thickness of the Cambrian sandstones of 28–45 m, average porosity 20–22%, permeability of about 300 mD and conservative CO_2 storage capacity of 40 and 44 Mt of CO_2, which will be enough for 8 years, were selected for the scenario. Total costs of the project estimated by DSS as 2836 € million for 30 years of payment period. The cost of one tonne CO_2 avoided is 37.4 €, of which 68% is oxyfuel capture cost (€25.5). The total cost of transport (800 km) is €447 million. The transport cost of one tonne CO_2 transported is € 5.3. The storage cost for two sites together is €250 million, of one tonne CO_2 injected is €3.

List of References

- [1] Vangkilde-Pedersen T, Lyng Anthonsen K, Smith N, Kirk K, Neele F, van der Meer B, et al. Assessing European capacity for geological storage of carbon dioxide – the EU GeoCapacity project. Energy Procedia 2009;1:2663-70.
- [2] Vangkilde-Pedersen T, Kirk K, Smith N, Maurand N, Wojcicki A, Neele F, et al. FP6 EU GeoCapacity Project, Assessing European Capacity for Geological Storage of Carbon Dioxide, Storage Capacity, D42, GeoCapacity Final Report 2009; p. 1-63, http://www.geology.cz/geocapacity/publications.
- [3] Sliaupa S, Shogenova A, Shogenov K, Sliaupiene R, Zabele A, Vaher R. Industrial carbon dioxide emissions and potential geological sinks in the Baltic States. Oil Shale 2008;25:465−84.
- [4] Shogenova A, Sliaupa S, Shogenov K, Sliaupiene R, Pomeranceva R, Uibu M, Kuusik R. Possibilities for geological storage and mineral trapping of industrial CO2 emissions in the Baltic region. Energy Procedia 2009;1:2753-60.
- [5] Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No 1013/2006 (1). Official Journal of the European Union 2009; L140:114-35.
- [6] Kirk K, Wojcicki A, Shogenova A, Willcher B, Saftic B, Allier D, et al. Project no SES6-518318, EU GeoCapacity, Assessing European Capacity for Geological Storage of Carbon Dioxide, D8, WP1 Report, Inventories & GIS, 2009; p. 1-84, http://www.geology.cz/geocapacity/publications.
- [7] Neele F, Hendriks C, Brandsma R, Blomen E. FP6 EU GeoCapacity Project, Assessing European Capacity for Geological Storage of Carbon Dioxide, DSS and economic evaluations, D30, WP5 Report, 2009; p.1-55, http://www.geology.cz/geocapacity/publications.
- [8] Vangkilde-Pedersen T, Allier D, Anghel S, Bossie-Cordreanu D, Car M, Donda F, et al. Project no SES6-518318, EU GeoCapacity, Assessing European Capacity for Geological Storage of Carbon Dioxide, D16, WP2 Report, Storage Capacity, 2009; p. 1-166, http://www.geology.cz/geocapacity/publications.
- [9] Shogenova A, Sliaupa S, Vaher R, Shogenov K, Pomeranceva R. The Baltic Basin: structure, properties of reservoir rocks and capacity for geological storage of CO2. Estonian Journal of Earth Sciences 2009;58:259-67.

Acknowledgements

This article is a dissemination activity of CO2NetEast – a coordination action/project sponsored by Statoil, Schlumberger, Enel, Technology Initiatives, Alstom and Vattenfall. This research was done in the frame of EU GeoCapacity project (FP6–518318) and was partly supported by governmental target funding project No SF0320080s07 from the Ministry of Education and Research of Estonia.