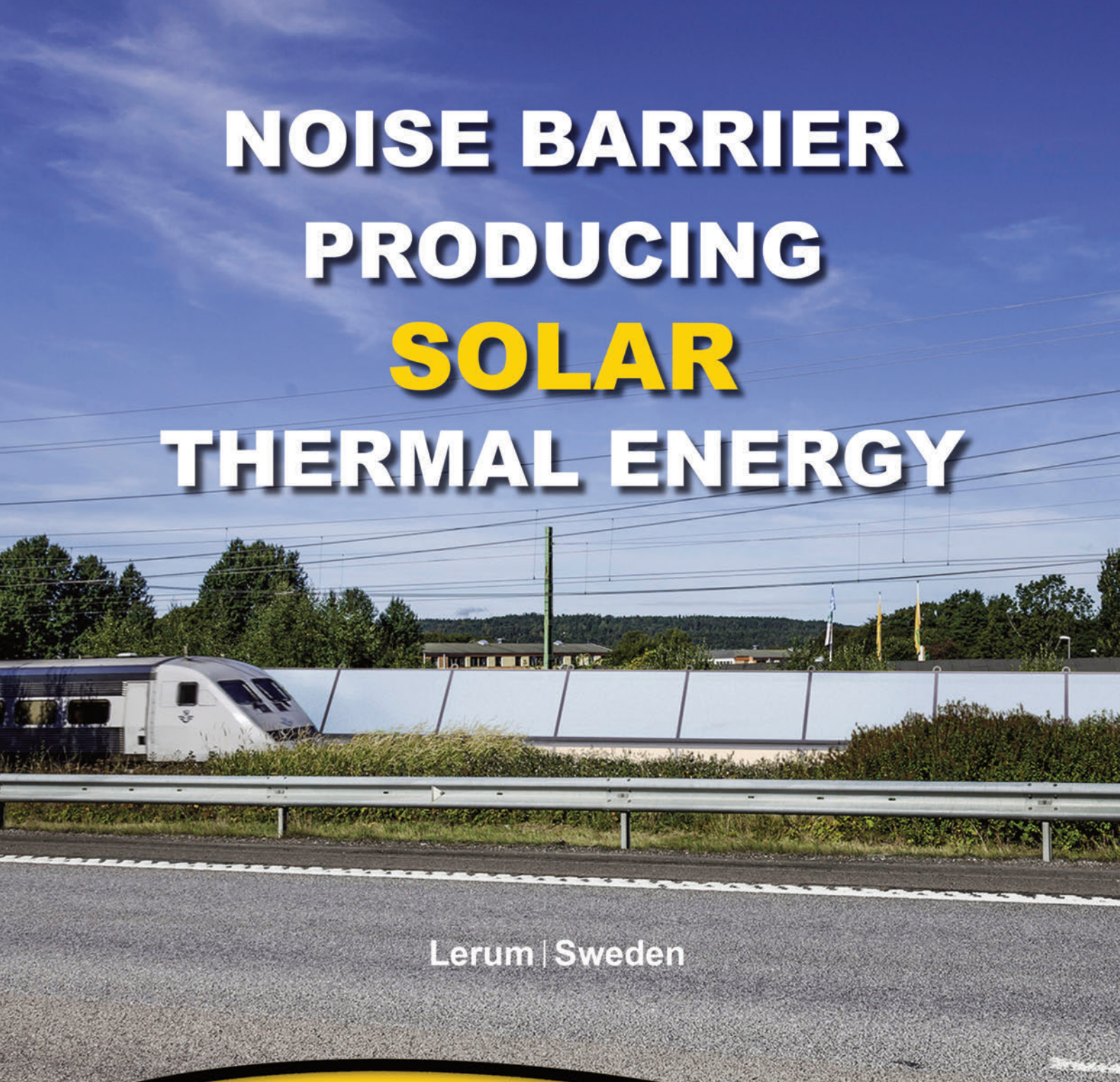
NOISE BARRIER PRODUCING SOLAR THERMAL ENERGY



Lerum | Sweden

NOISUN

LERUM
mer än du tror

The road to carbon reduction

European Commissioner for Energy, Günther H. Oettinger details his proposals for the Energy Roadmap 2050 and how it will influence Europe's energy strategy...

Energy is one of the biggest challenges Europe is confronted with today. While being at the helm of the fight against climate change, our economic competitiveness fully depends on a reliable energy supply at an affordable price. And in turn, this depends on adequate infrastructure. Until the end of the 1990s, boosting demand was more important than energy efficiency and energy suppliers primarily served national markets. From now on, energy systems need to be designed to run on variable renewable and low-carbon fuels at continental level. Is Europe ready and able to take up the challenge? Will Europe be able to reduce greenhouse gas emissions by at least 80% by 2050 and maintain competitiveness? The European Commission launched the debate with the publication of the Energy Roadmap 2050.

What does the Energy Roadmap 2050 say?

Through an analysis based on scenarios, the Roadmap 2050 indicates possible pathways to achieve the decarbonisation of the EU energy system. The purpose is not of choosing one over another, rather of identifying the common emerging elements that support long-term approaches to investments. The real world will never look like these models, but the conclusions drawn from them give fundamental signals for our future policy.

The main conclusion of the Roadmap is simple: transformation of the energy system is technically and economically feasible – if we make the right choices.

Five key lessons can guide us in making the policy choices to shift our energy system towards a more sustainable future.

(1) Energy savings are crucial

There is a vast amount of untapped potential to save energy. Significant energy savings would need to be achieved in all decarbonisation scenarios. Primary energy demand drops in a range of 16% to 20% by 2030 and 32% to 41% by 2050, as compared to peaks in 2005-2006. Thus, energy efficiency is crucial for the energy system transformation – at the stages of production, supply and end use. To this end, the EU has adopted a new energy efficiency directive which obliges Member States to implement binding measures such as an obligation scheme for energy companies to cut down energy consumption at customer level, and an obligation for Member States to renovate annually 3% of the central government's building. It also encourages energy audits for SMEs and an obligation for large companies to assess their energy saving possibilities.

But we must be more ambitious. In the long-run, higher energy efficiency in new and existing buildings is crucial. Nearly zero energy buildings should become the norm. Products and appliances should fulfil the highest energy efficiency standards. In transport, efficient vehicles and incentives for behavioural change are needed. All this requires more action both at EU and Member State level.

(2) The share of renewables rises substantially

The analysis shows that the biggest share of energy supply technologies in 2050 comes from renewables. In 2030, all decarbonisation scenarios suggest growing shares of renewables of around 30% in gross final energy consumption. In 2050, renewables will achieve at least 55%, up 45 percentage points from today's level. This is both a huge change and a challenge. Renewables will play a central role in Europe's energy mix, from technology development to mass production and deployment, from small-scale to large-scale, from subsidised to competitive. All these shifts require parallel changes in policy. Incentives in the future have to become more efficient, create economies of scale, and lead to more market integration.

(3) Building the necessary infrastructure is key

With electricity trade and renewables' penetration growing up to 2050 under almost any scenario, adequate infrastructure at distribution, interconnection, and long-distance transmission levels becomes a matter of urgency. The existence of adequate infrastructure is a condition sine qua non. In the long-run, the extension of the current planning methods to a fully integrated network planning for transmission, distribution, storage and electricity highways looking at a potentially longer timeframe will be needed. And above all, we need to develop more intelligent electricity grids, able to deal with variable generation from many distributed sources, allowing for new ways to manage electricity demand and supply.

(4) The European energy markets needs to be fully integrated

A European market offers the right scale to assure access to resources and to provide the huge investments needed. The single energy market must be fully integrated by 2014. An additional challenge is the need for flexible resources in the power system, as there will be more variable renewables. Access to flexible supplies of all types (e.g. demand management, storage and flexible back-up power plants) has to be ensured. Another challenge is the impact of renewable generation on the wholesale market prices. Whatever the answer, it is important that market arrangements offer cost-effective solutions to these challenges. The cross-border impact on the internal market deserves renewed attention. Now more than ever, coordination is required. Energy policy developments need to take full account of how each national system is affected by decisions in neighbouring countries.

(5) Investing in low-carbon technologies

Carbon pricing can provide an incentive for deployment of efficient, low-carbon technologies across Europe. The ETS is a necessary condition for the energy system transformation, but it is not sufficient. Higher public and private investments in R&D and technological innovation are also crucial in speeding-up the commercialisation and the modernisation of all low-carbon solutions, whatever the sources are. In particular, Europe will certainly have to develop further Carbon Capture and Storage (CCS) from around 2030 onwards in the power sector in order to reach the decarbonisation targets.

New opportunities for Europe

Indeed, it is cheaper and easier for Europe to work together. The European market gives us the chance to make economies of scale and speed up new markets for low-carbon technologies. Between now and 2050, there must be a wide-scale replacement of infrastructure and appliances throughout the economy, including consumer goods in people's homes. Modernising the energy system will bring high levels of investment into the European economy. It can bring more jobs, more quality of life, and more growth. Decarbonisation can also be an advantage for Europe, placing itself as an early mover in the growing global market for energy-related goods and services. Energy system transformation also helps to reduce import dependency and exposure to the volatility of fossil fuel prices.

The Way forward

At EU level, we had set ourselves three targets for 2020 – a 20% share of energy from renewable sources, a 20% increase in energy efficiency and a 20% cut in CO_2 emissions compared to 1990 levels. Now, in 2013 we must look beyond this date and reflect what should happen in 2030. This is why we launched a consultation before coming forward with concrete proposals. We have to decide which climate and energy targets will be set, whether they are technology-specific, mandating a certain proportion of renewables for example, or if they shall be general emissions targets requiring Member States to curb their CO2 output using the technology they prefer. We must soon decide on the 2030 framework to allow Member States to prepare and to give certainty to investors in industry – because for investors, 2030 is already tomorrow.

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NOISUN
Sweden's most interesting environmental project

With plans for a 400m noise barrier that includes solar thermal collectors, the municipality of Lerum is considered to have taken on one of Sweden's most interesting environmental project. This is stated in a ranking of Swedish local environmental projects made by the Swedish journal Miljöaktuellt in June 2013.

The goal of the Noisun Project is to demonstrate an innovative noise barrier producing solar distributed to the district heating system. This will be achieved by installing and evaluating the specially adapted solar panels along the transport corridor through Lerum. The project will demonstrate that the technology is an easy solution to significantly reduce noise levels from both road and rail traffic in European cities, to get a more attractive local environment and at the same time produce useful energy to the local district heating network.

The project is a part of the LIFE+ programme, the EU's financial instrument to support environment projects throughout the EU. The project's partners are: the municipality of Lerum, SP Technical Research Institute of Sweden, Lerum Fjärrvärme AB and the Swedish Transport Administration.

The project comprises a decisive and crucial contribution to implement the environmental objectives set out by the European Commission.

Sweden's leading green municipality

Lerum aims to be Sweden's leading green municipality by the year 2025, or sooner. In addition to tackling noise pollution, the municipality aims to invest in energy-saving and renewable energy technology in order to cut its emissions of greenhouse gases.

Noisy Lerum

The Swedish municipality of Lerum is situated in the expansive Gothenburg region and is divided by a major transport corridor for both road and rail traffic, which means that noise, is one of the greatest environmental problems in Lerum.

In 2003 noise mapping was undertaken, and the 'Lerum study' concerning the health effects of noise from road, rail and air traffic was conducted in 2005. The study shows a higher incidence of hypertension and medication for hypertension with increasing road traffic noise among men, especially among those who had lived for more than ten years in their present homes. The results are adjusted for age, smoking, heredity factors, BMI and noise at work.

With additional noise mapping, the whole geographic area of Lerum is now covered according to noise pollution. Based on the noise mapping and the scientific study, a thematic complement to the general plan regarding noise was completed and needs for noise abatement was pointed out.

Energy matters

One of the most pressing environmental problems of our time is undoubtedly global warming with all its related consequences in both economic and ecological terms. Lerum's ambitions regarding energy are expressed in the Climate Strategy (2008) and the Energy Plan (2008). Lerum is working hard to improve the energy efficiency of the existing building stock, building eco-certified new buildings and convert warming from fossil fuels to renewable energy sources. In order to encourage more people to build energy efficient houses the fees for building permits are significantly lower for energy-efficient construction.

Noisun-project

In a unique and innovative approach, the municipality will build a 400m noise barrier with solar thermal energy production for the district heating system, the first of its kind worldwide. By doing this, Lerum takes care of the noise problem and gets an additional benefit; heat production.

The project will demonstrate production of solar heating in combination with noise measures adapted to a road and rail environment in northern European conditions. The project will also demonstrate a technical solution for connection to the district heating system.

With the innovative technique – to use solar thermal collectors as a noise barrier – empty spaces of no use along highways and railroads can get a value by producing renewable heat. This can motivate and speed up the noise reduction installations in Europe.

The noise barrier will produce renewable energy which reduces the need for burning fuels in district heating plants, which in Europe often is a fossil fuel, without competition about space in urban areas. Meanwhile the noise barriers provide positive effects on both public health and property values. This combination has not been installed elsewhere. Along highways, other heavily trafficked roads and railways there are usually empty zones that are restricted areas that cannot be used in a useful way in the urban society. Here we have found a use of those zones.

The noise barrier will be installed along the main road and railway line through Lerum in order to lower the number of people exposed to high traffic noise levels. Combining these with solar energy production will lead to better land use. The solar collectors will be placed close to the Western Main Line, to protect the residential area behind from noise generated by both the Western Main Line, trafficked by 190 trains per day and the freeway, E20, trafficked by 25,000 cars per day.

The solar thermal collector system will be connected to the flow line in the district heating system and supply solar energy via a heat exchanger. The solar collector system collects water from the return water from the district heating culvert and warms it up to the demanded temperature and sends it out into the flow line. Hence the size of a system like this can be adapted to the conditions and facilities can be made very large. The method is applicable decentralised (for connections in the network) or centralised (at the boiler plant).

Project progress

Find a suitable location

Based on the noise survey 'the Lerum study', the best location to build the facility was pointed out as the center of Lerum, taken into account e.g. noise levels, sun conditions, proximity to the district heating grid and restrictions in the area.

The solar collectors will be placed close to the main western railway line – only 5m from the nearest rail – and on parts of the stretch also very close to a local road. The height of the barrier will be some 3m above the rail head and the solar collectors will be tilted in 60 degrees angle to be able to reduce as much noise as possible. Thanks to the 60 degree angle, the barrier can be high enough while safety distance to the high-voltage parts is managed.

THE MUNICIPALITY OF LERUM

Lerum is located close to the E20 and the Western Main Line about 20km east of Gothenburg in the southwestern Sweden. The surroundings are characterised by beautiful countryside with many lakes. Lerum has an active culture and club activities, a bustling center with shops and service, good communications to the big city and closeness to Landvetter International Airport. Today nearly 39,000 people lives in Lerum.

Adaptation of the solar collectors

To obtain optimal sound reduction and to avoid sound leakage between the solar collectors, testing of a technique joining them together was carried out by the Technical Research Institute of Sweden, SP.

In order to determine the sound insulation of the noise barrier splice, a noise barrier splice consisting of bent aluminum profiles between two blocks has been tested. The two blocks is similar to solar thermal panels and consisted of two plywood boards on either side of a wooden frame. The space between the plywood sheets were filled with mineral wool.

The result of the test is that the noise reduction in the splice between the solar panels is adequate and the splice will function properly to assemble the solar collector panels.

Questionnaire study

A questionnaire study has been conducted in order to identify the current noise situation in the residential area before having the noise barrier protection, both measured and perceived. The questionnaire study is targeted to investigate the perceived noise impact.

The result of the study is used in planning the barrier, and a follow-up questionnaire will be performed after the noise barrier is erected, targeted to identify the noise situation.

Noise-exposed area

At the noise-exposed area there are different types of buildings – e.g. apartment buildings, terraced and detached houses, with approximately 680 residents. The selection was made by choosing an adult in each household to answer the questionnaire. The questions addressed the perceived existing noise situation, e.g. annoyance by noise from road, rail, air traffic or other.

The questionnaire was posed to 369 people, of which 280 responded, representing a response rate of 76%. The most important noise sources in the residential area are the rail and road traffic, with the next most important source being noise from neighbors.

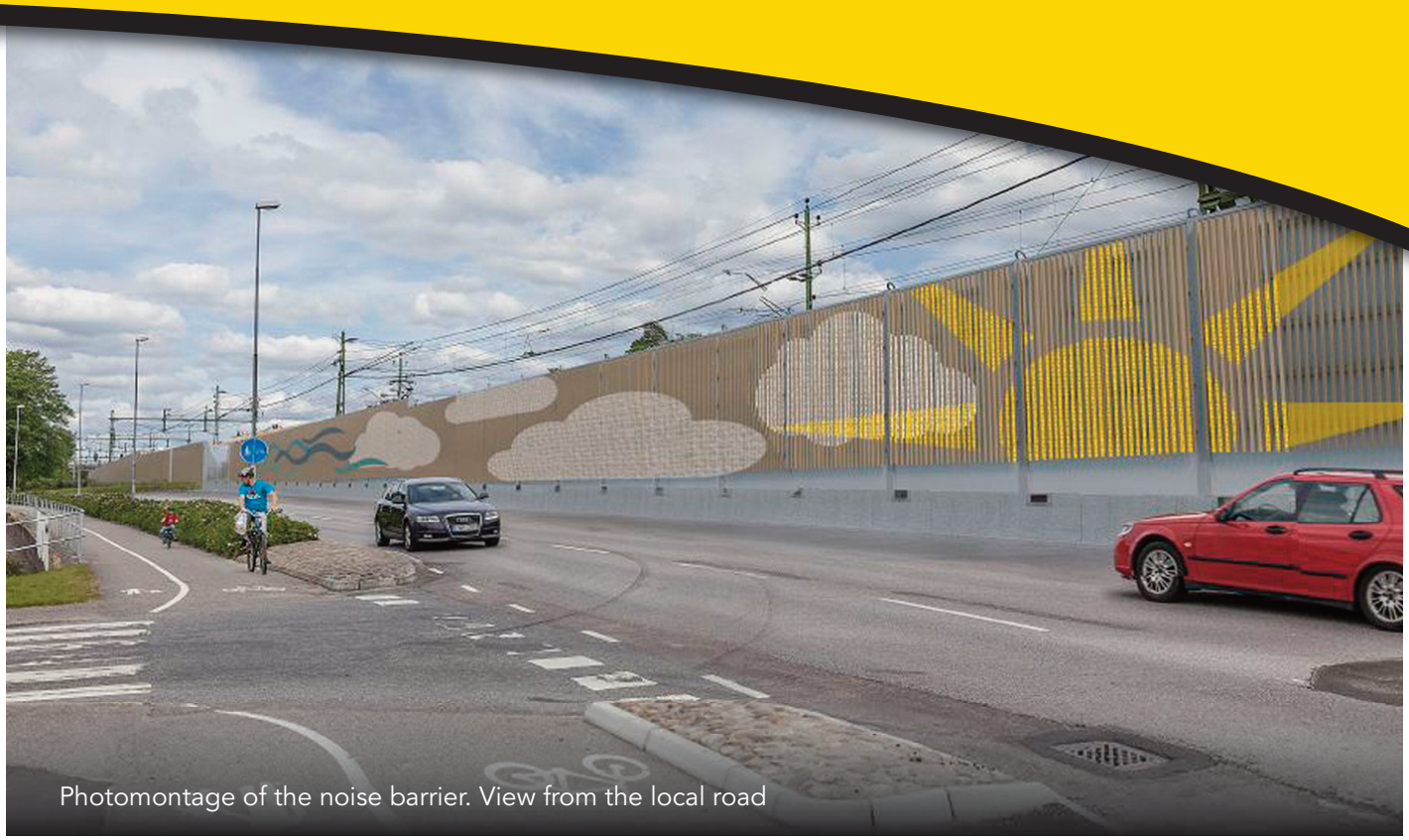
As a result of this, the creation of a barrier to reduce noise from the rail and road traffic will, to a large extent, diminish the impact of environmental noise in the studied residential area.

Construction work in May

The design of the noise barrier of solar collectors is now engineered and the project is now implementing the procurement of the contract. If everything works according to plan, construction work will commence in May 2014 and be completed in November 2014.

What's next?

To ensure the operation of the plant, optimisation and adjustments of both noise reducing capabilities and



Photomontage of the noise barrier. View from the local road

energy production will be performed. The noise reducing ability will be continually monitored and evaluated, including inter alia a follow-up questionnaire survey to the residents in the area, to evaluate how well the facility reduces noise and how the residents perceive the noise situation after measures have been taken.

The facility's energy producing ability will be continually monitored and evaluated, including a check against planned values. Finally an evaluation of the facility's economic and socio-economic impact will be performed. The NOISUN-project will be completed in May 2016.

Expected results

The project will lead to a number of primary quantitative environment improvements. The results will be as follows:

Noise:

- A 5-10 dB reduction in noise levels, from 65 dBA to 55-60 dBA (an 8-10 dB reduction is perceived as halving the noise level); and
- A 60-90% reduction in the number of citizens and properties experiencing sound levels above 55 dBA, in the project area.

Energy:

- Production of 250-400 MWh/yr of renewable energy;
- A saving of 275-440 m^3/yr of woodchips;
- A saving of 12,500-20,000 kWh of electricity (required to produce woodchips);
- A saving of 125-200 tons of CO_2 emissions – some 80-130 tons of biomass (trees) can remain in the forest and thus bind CO_2; and
- A saving of additional CO_2 by reducing the need for forestry and transportation of biomass.

Socio-economic:

- A reduction in the costs associated with noise of €245,000 per year; and
- As a result of reduced noise levels, an overall increase in the value of properties in the project area.

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