On the natural advantages of a ropeway project. Hangursbanen, Voss - Norway

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Summary.

The natural advantage of placing the lower station of an aerial ropeway project literally right next to a busy railway station is estimated to be EUR 200,000 each year. In a 50 year life-span perspective the present value of the benefit due to reduced emission of greenhouse gases is estimated to be EUR 4.5 millions or about 20% of the estimated ropeway construction cost.

The Ecosystem Approach.

Ecosystem services and their contribution to human welfare is a huge and challenging topic. By the turn of the century several studies on this issue were accomplished, the more significant ones were Millennium ecosystem Assessment (MA) and The Economics of Ecosystems and Biodiversity (TEEB), an initiative of a.o. the European Commission.

The value of ecosystem services and biodiversity is a reflection of what we, as a society, are willing to trade off to conserve these natural resources (TEEB 2010). Economic valuation of ecosystem services and biodiversity can make explicit to society in general and policy making in particular, that biodiversity and ecosystem services are scarce and that their depreciation or degradation has associated costs to society. If these costs are not included, then policy would be misguided and society would be worse off due to misallocation of resources.

ECOSYSTEM SERVICES	
Supporting services • Photosyntheis • Primary production • Soil formation • Nutrient cycling • Water cycles • Evolutionary processes and ecological interactions	**Provisioning services** • Food • Fresh water • Wood and fiber • Fuel • Genetic resources • Medical resources • Decorating resources
Regulating services • Air quality regulation • Climate regulation • Flood regulation • Erosion protection • Water purification and waste treatm. (decomposition and detoxification) • Disease regulation • Pest regulation and biological control • Pollination • Soil maintenance	**Cultural services** • Recreation, outdoor activities and nature-based tourism • well-being and aesthetic values • Spiritual enrichment • Religious values • Inspiration and symbolic perspectives • Knowledge and learning • Nature heritage

Figure 1 Different types of ecosystem services. Source: Millennium Ecosystem Assessment.

An asset is scarce if its use carries opportunity costs. That is, in order to obtain one additional unit of the good one must give up a certain amount of something else. In economic terms, quantifying and valuing ecosystem services are no different from quantifying and valuing goods or services produced by humans. In practice, however, valuing ecosystem services is problematic. There are reasonable estimates of the value of many provisioning services (figure 1) – in cases where well-developed markets exist – but there are few reliable estimates of the value of most nonmarketed cultural and regulating services (Carpenter, 2006, Barbier et al., 2009)

From an economic point of view, biodiversity and ecosystems can broadly be seen as part of our natural capital, and the flow of ecosystem services is the "interest" on that capital that society receives (Constanza and Daly, 1992). Just as private investors choose a portfolio of capital to manage risky returns, we need to choose a level of biodiversity and natural capital that maintains future flows of ecosystem services in order to ensure enduring environmental quality and human well-being (Perrings et al., 2006).

The "Ecosystem Approach" (UK NEA 2013) is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way (CBD 1993). The Ecosystem Approach is much more than accepting ecosystems as the core of environmental management. It recognizes that people and society are integral components of ecosystems and their management and conservation. This necessitates a way of working and decision-making that cuts across traditional policy and institutional boundaries. It brings consideration of natural, economic and social sciences into a single methodological framework.

Ecosystem services and aerial ropeways.

The step going from ecosystem services to aerial ropeways is not a very huge one. As has already been pointed out, there is a diversity of ecosystem services which interlink with all kind of life and trades including the aerial ropeway business. Whether we like it or not, we are all dependent of these services from nature in everyday life. We take them as granted and seldom reflect on the fact that most of these services are offered us for free.

An important ecosystem service is the absorption of carbondioxide (CO_2) which is an important climate-regulating function. As part of the carbon-cycle, forests of different kinds are major absorbents of CO_2 as a vital part of the forest growing process. As greenhouse gases like CO_2 is produced by the mere presence of fossil fuels in the air, the amount of CO_2 has reached dangerous levels as nature itself (a.o. forests) has not been able to absorb the overall production. Measures to reduce the amount of fossil fuels used, and thereby the production of CO_2, are therefore welcome as a tool to retard the present development of temperature increase and climate change. We will have a closer look at this approach in a case applied to a planned ropeway and connecting infrastructure.

Figure 2 Overview of the lower station area, railway station and hotels.
Courtesy: Voss Resort Fjellheisar AS

The environmental impact.

Since 1963 the to and fro aerial ropeway had been bringing tourists and skiers to the top of Mount Hanguren, a much appreciated recreation and skiing area close to the village of Voss, Norway. Some years ago the ropeway required major reinvestments, and since the capacity no longer met the demand, it was decided to start planning a new ropeway at a slightly different place, but with much the same line profile.

Local- and regional authorities had already decided to establish “Junction Voss” by collocating the railway-, coach- and taxi-services in one single area. It was decided to include the lower station of the new ropeway into “Junction Voss” enabling passengers to walk directly from the platform of the railway station onto the gondola cabins. This opens up a huge market of skiers, who can be brought from the city center of nearby Bergen directly into the skiing area just in excess of one hour.

Ropeway data and characteristics (Asplan viak AS 2015):

Concept: Tricable gondola lift
Lower station at 58 meters asl. and the top station at 815 meters asl.
Profile length: 1,800 meters
Number of gondolas: 13. Each gondola capacity 34 people.
Distance between gondolas: 420 meters
Speed: 7 m/s.
Capacity: 1,500 passengers/hour one way
Number of towers: 3

Figure 3 A closer look of the ropeway lower station. Courtesy: Voss Resort Fjellheisar AS

To have a closer look at the magnitude of reduced CO_2-emission, due to the location of the ropeway´s lower station within “Junction Voss”, the following preconditions are assumed:
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1. 1,000 passengers each day in the weekend will travel with the more environmentally friendly railway rather than a car from Bergen to Voss.

2. Two persons in each car makes up to 500 cars less on the road on each Saturday and each Sunday. A similar number of people will utilize these facilities the rest of the week, i.e. altogether 1,000 people, which means an additional 500 cars less on the road, adding up to 1,500 cars less on the road for the whole of the week.
3. These conditions are valid for 17 weeks (skiing season) while for the rest of the year these conditions have no effect
4. The CO_2-emission of each car is on average 150 g/km, and the distance not travelled is 250 km (Bergen-Voss/return).
5. EUR 1= $ 1,06

Estimating the benefits of reducing Greenhouse gas emission.

Estimates of the social cost of greenhouse gases like CO_2 increases over time because future emissions are expected to produce larger incremental damages as physical and economic systems become more stressed in response to greater climate change. The social cost of CO_2-emission is meant to be an estimate of climate change damages and includes changes in agricultural productivity, human health, property damage from increased flood risk, and change in energy system costs. Different sources (Mdir 2017, EPA 2015) estimates that an additional ton of CO_2 emitted would cause EUR 35 worth of economic damage. According to recent studies (Nature Climate Change), however, the actual cost could be much higher, estimated to EUR 207 per ton. This figure also represent the value of damage avoided due to a small emission reduction, i.e the benefit of a CO_2 reduction.

Under these conditions a reduced CO_2-emission of 960 tons/year will result in an environmental benefit of EUR 200,000 each year.

Present value, shadow cost of capital

Assuming a ropeway lifetime of 50 years and a yearly benefit from reduced CO_2 emission, the present value describes how much a future sum of money is worth today.

Applying the standard value of economic discount rate (Circular R-109/14) for the first 40 years to be 4%, and 3% for the next 10 years, the present value of the economic benefit is calculated to be EUR 4.5 millions. This again represent an overall benefit from reduced emissions in the order of 20% the estimated ropeway construction cost.

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