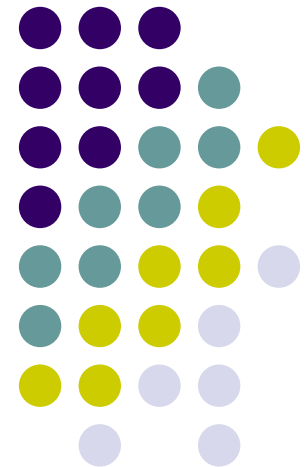


Economic and environmental assessment of processes and investments using LCA and LCC

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Introduction



- Concern for environmental issues is growing - this is especially true in the countries in transition, like Poland, where - to deal with the remnants of the previous regime - a new ecological policy was implemented in 1991.
- This had an impact on financial conditions:
 - The price of water, energy and other natural resources increased significantly to eliminate the unsuitable under-pricing policy.
 - Real financial instruments, such as environmental charges (fees and fines) were introduced to internalize external costs and promote incentives for sustainable development. The idea behind the charges was that every user of the environment should pay for it, since the resources are scarce.

Introduction



- Since these charges became an important cost factor, many companies started to look for ways to minimize this problem mainly by investing in more environment friendly solutions.
- Consequently, the emissions to the air and water have declined dramatically.
- During the past years a lot of Polish large and small companies have been developing environmentally friendly solutions through reduction of material and energy intensity, enhancing the possibility of material recycling, maximization of sustainable use of renewable resources, waste reduction.
- The improved environmental efficiency of Polish industry was achieved not only because of the introduction of the environmental charges but also due to better understanding of the damage that is done to the environment and also thanks to the increased availability of tools that allow care for the environment .

Non-ferrous metal mining in Poland



- In Polish non-ferrous mining there are three important metal producers:
 - KGHM Polska Miedź SA is the largest copper producer in Europe
 - Trzebionka SA – producer of zinc-lead concentrates
 - ZGH Bolesław – zinc producers.
- The non-ferrous metal mining industry in Poland: 4% in the economy in terms of production sold.
- The mining waste (tailings) share 25% of total industrial waste produced yearly.
- The environmental and social aspects of mining production are particularly important, from the company point of view as well as the whole economy.

LCA and LCC for non-ferrous metal mining in Poland



- Ecological and economic implications of mining are important from the company's perspective, especially due to costs associated with the environment:
 - protection of the environment,
 - rehabilitation/reclamation costs,
 - costs of using the environment (system of fees and fines),
 - company image, etc.
- Difficulties expressed by the decision makers who were facing the problem of meeting the environmental restrictions and economic goals at the same time.

Life Cycle Assessment



- The technique aiming at the estimation of environmental threats associated with the product system or process, both by identification and quantification of materials, energy and wastes and by assessment of the environmental influence of these materials, energy and wastes.
- Encompass the full life cycle of product or process – starting from extraction and processing of mineral resources, production process, distribution, use, reuse, maintenance, recycling, final disposal and transport.

Life Cycle Cost



- Life Cycle Cost (LCC) is defined as the total costs for analysed system (product, process or service) during its whole life cycle.
- LCC analysis should be performed at the second LCA stage – Life Cycle Inventory.
- Experts judge that 65-70% of total project or equipment costs is known at the moment of its selection. Another 20% depends on the quality. Only 10% of total costs can be influenced during use and operation.
- The main and sometimes sole criterion for equipment choice remains acquisition costs. This criterion is easy to use, but often misleading since total costs of operation, maintenance and disposal are usually several times greater than all other costs.

System of environmental and economic assessment



- Developed on the basis of LCA and LCC:
 - The structure created in LCA study allows for easy perception and estimation of the environmental impact of product, process or service during its entire life.
 - A natural supplement for LCA is LCC analysis which aims at creating cost effective model solution in respect to the estimated environmental impact of the particular product, process or service.
- System components
 - Environmental assessment – LCA
 - Economic assessment – LCC

Environmental assessment – LCA



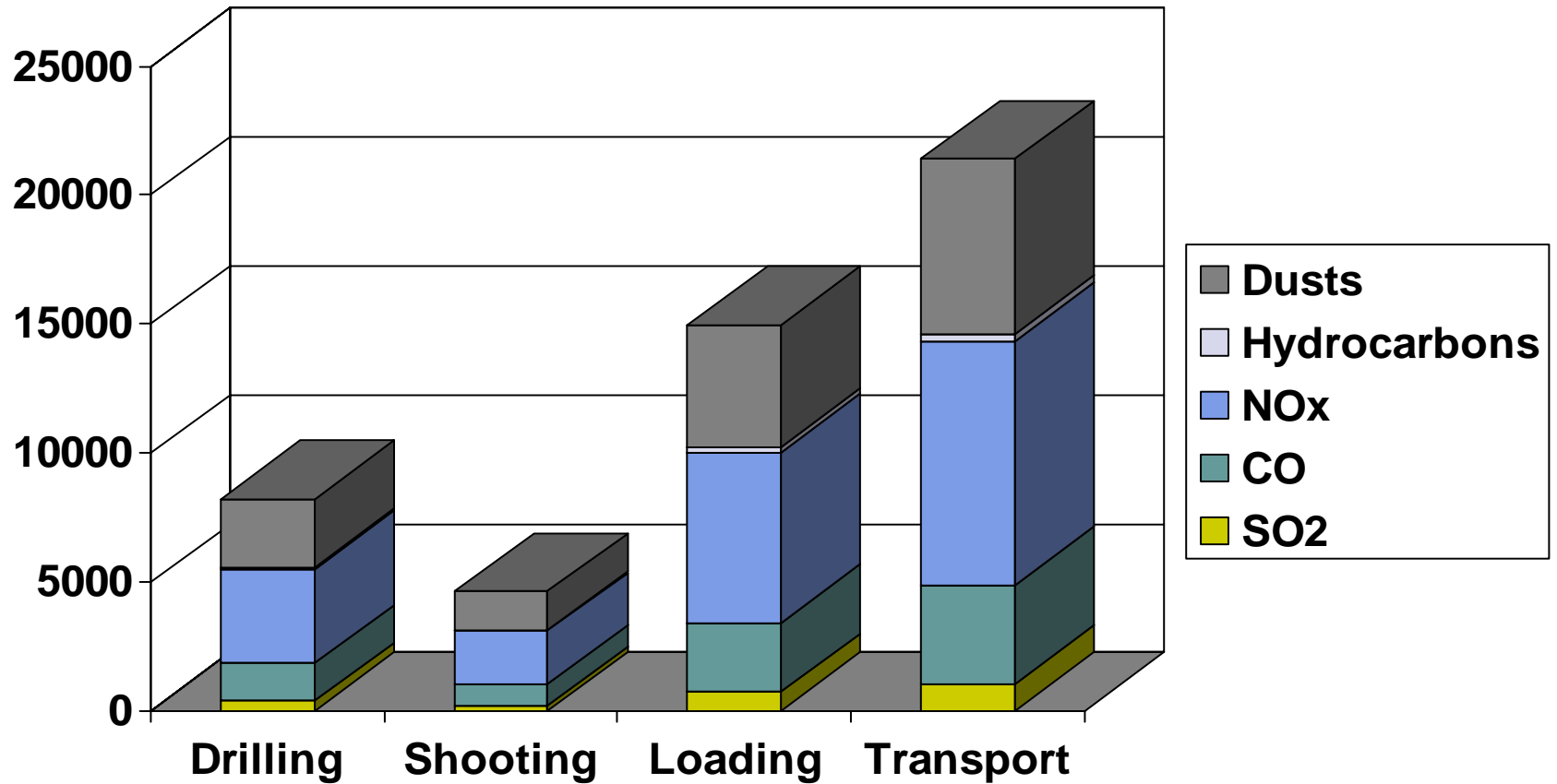
1. Goal and scope of the analysis
 - assessment of the environmental impact of the process of mining of the non-ferrous metal ore
 - functional unit – 1 t of ore
2. LCI – Life Cycle Inventory
 - data collected for each equipment
3. LCIA – Life Cycle Impact Assessment

Economic assessment – LCC

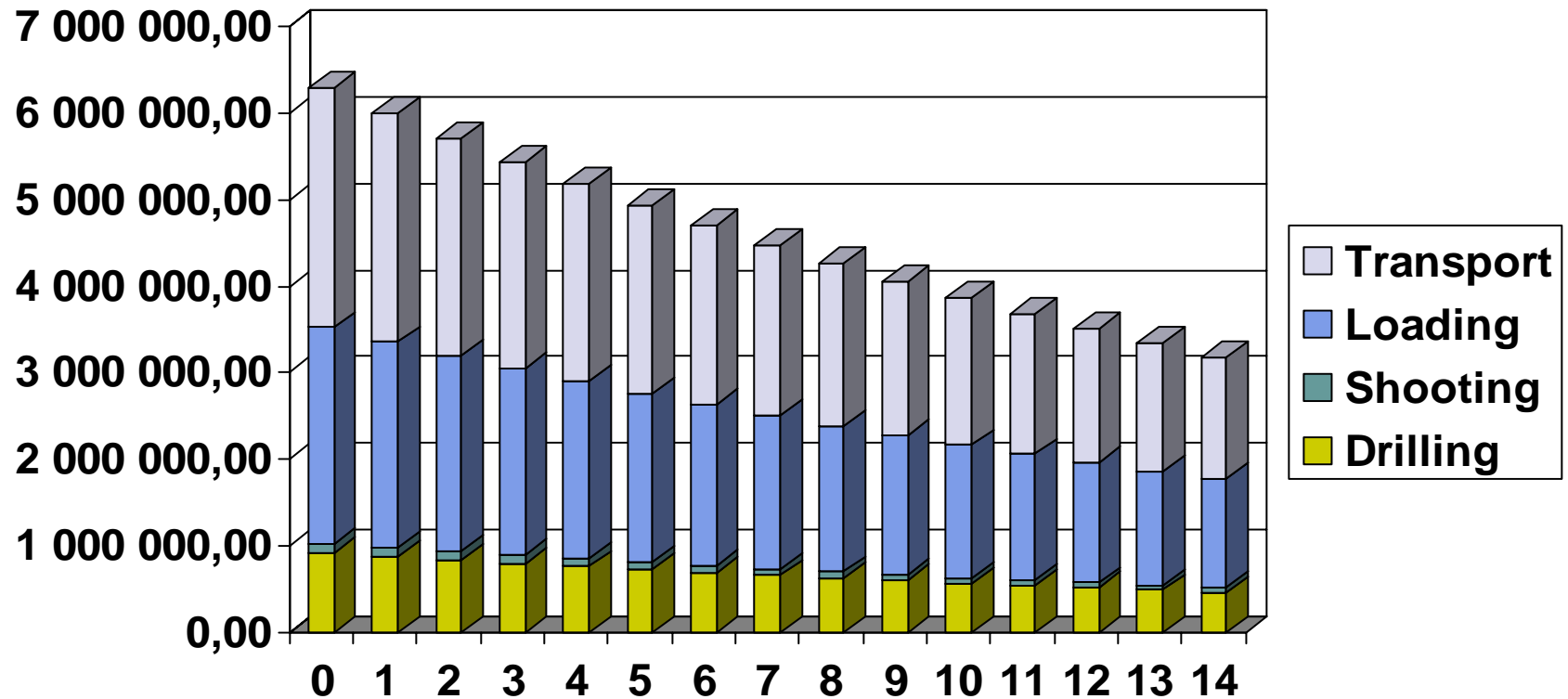


Cost type	Amount
Purchase (incl. freight and installation) [\$]	40,000.00
Power (fuel and electric) [\$/h]	15.00
Lubricants [\$/h]	0.04
Operator wages [\$/h]	5.00
Maintenance labor costs [\$/h]	5.00
Fines for CO emission [\$/10,000h]	0.63
Fines for NOx emission [\$/10,000h]	6.76
Fees for used lubricant disposal [\$/10,000h]	0.0117

Results - emissions



Discounted cash flow



Conclusions



- Combination of environmental goal expressed in LCA results with economic goal expressed with LCC should allow for finding and introduction of optimal – both ecologically and economically – solutions
- Thanks to such combination decision-making will become more effective, with the emphasis on the relation between investment activities and environmental effects
- Holistic approach to the environment protection and wise use in mining – the life cycle approach fits very well
- Although the system of environmental and economic assessment was developed especially for the copper ore mining it was designed in that way that it can be easily adapted to different processes and also to the extended (i.e. including environmental impact) assessment of the investment projects.