Topic 3.1: Valuing the Environment: Concepts

3.1.1 Economic value → 3.1.2 Cost-Benefit Analysis

3.1.1 Economic value

What does "**Economic value**" mean?

Economics = the study of how to efficiently allocate limited resources to meet unlimited wants. As resources are scarce, decisions to allocate resources to some activities imply sacrifices of resources for other activities. So, there are "**Opportunity costs**" (=the best alternative value forgone) in any economic decisions. For examples, the use of river, mountain, etc.
Environmental policies could imply economic sacrifices. (e.g., the use of energy tax to reduce CO_2 --> costs to economics vs. benefits to environment)

Key economic principle: "the value of something is dependent on what we are willing to give up."

Economic value = the value defined over "a change", an increase/decrease of the goods and services being provided. The environmental values can be measured by the concept of "willingness to pay (WTP)" and "willingness to access (WTA)" which allow monetary value to be placed on an environmental gain or loss based on an estimate of the underlying utility gain or loss for an individual.

Willingness to Pay (WTP)	Willingness to Accept (WTA)
• Maximum WTP **to increase** environmental quality (for the gains) • Measures in terms of the sacrifice (e.g., income) that people are willing to make to have it (e.g., better air quality, climate change protection, improved biodiversity)	• Maximum WTA to **forgo/lose** environmental quality (for the loss) • Measures what compensation a person would accept to give something up (e.g., construction of new airport runway nearby houses, building a dam, etc.)

Graph – WTP vs. WTA

Theoretically, the difference between WTP and WTA should be small, however; evidence revealed that the difference is large for "no-close substitute" goods. This is because people value what they already have (WTA for "loss") larger than what they could acquire (WTP for "gain").

Question: Which one to choose WTP or WTA? – depends on **property rights**. (e.g., steel case).

3.1. 2 Cost-benefit analysis (CBA)

Cost-benefit analysis = a practical application of a decision-making rule to decide between different policy options or projects in terms of their net contribution to social well-being

CBA identifies the impacts of a project or policy, value these impacts and then compared benefits and costs in monetary terms.

As developed from welfare economics**, Kaldor-Hicks compensation test** refers to the basis on which the difference between benefits and costs (measured using the principals such as WTP and opportunity costs) can be viewed as a proxy for the underlying change in net social welfare. This basis for evaluating contribution to social well-being could mean the acceptance of the following:

i. All relevant benefits and costs can be expressed in the same units (monetary units)
ii. Benefits and costs can be compared with each other, so any cost can always be compensated by some offsetting benefits.

Steps to conduct CBA

1. **Define project or policy**: set out what is being analysed; whose welfare is being considered and over what time period.
2. **Identify impacts of the project/policy:** identify outcomes of resource allocation implications (such as labor used, additional electricity production, land used, etc.) in physical magnitudes. This could be anything that impacts on the quantity or quality of resources, or on their price, or on the well-being of the relevant population. Non-market value changes (such as better air quality) are also relevant if they affect people's utility.
3. **Value the impacts:** value all relevant effects/impacts in monetary values in terms of marginal social cost or marginal social benefit. Assuming that the impacts of the project are not large enough to change market prices, then market prices are a good first approximation to the values of the benefits and costs. For some environmental goods such as biodiversity and river water quality that do not have market prices, different valuation methods (discussed in next topic 3.2) can be employed to estimate the values.

4. **Discount cost and benefit flows to present values:** convert all benefit and cost flows into present value (PV) terms, considering the time value of money, or time preference.
5. **Apply the net present value (NPV):** apply NPV as a decision criterion to test if the sum of discounted benefits (gains) exceeds the sum of discounted losses.

$$\text{NPV (Net Present Value)} = \sum_{t=0}^{n} \frac{B_t}{(1+i)^t} - \sum_{t=0}^{n} \frac{C_t}{(1+i)^t}$$

Accept if NPV>0, deemed as an improvement in social welfare.

6. **Conduct sensitivity analysis**: Recalculate the NPV when the values of certain key parameters are changed (due to uncertainties or inaccurate predictions of future flows)

An example of CBA: A project to build a small-scale wind farm in a scenic area.

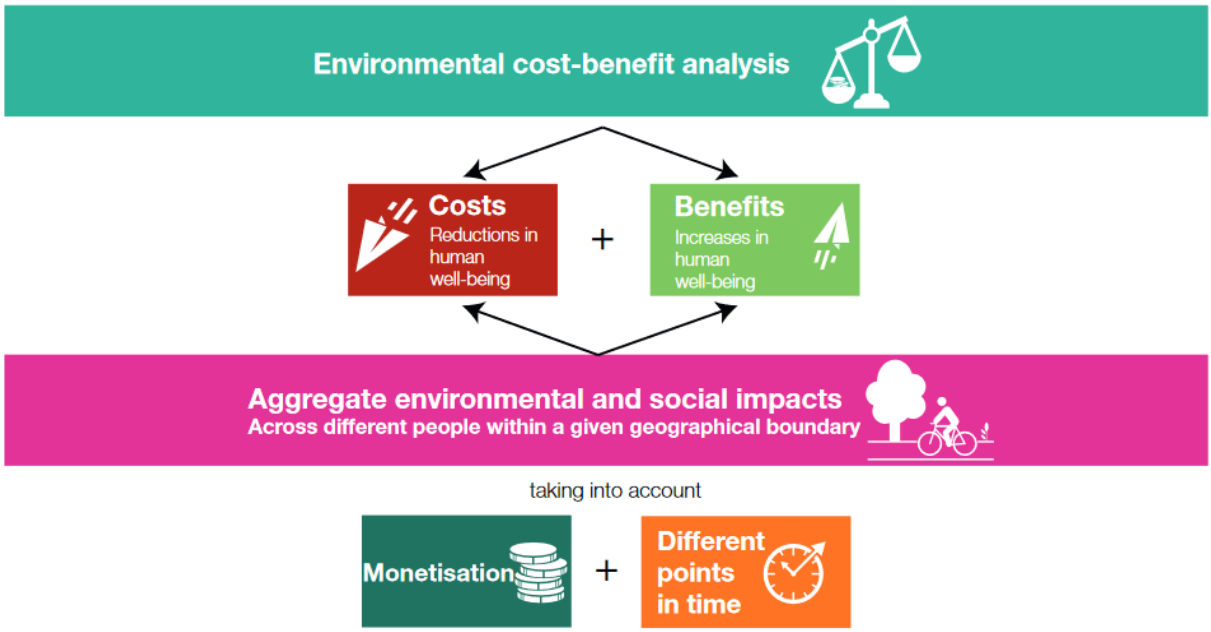
The initial construction costs of a small-scale wind farm are estimated at $750,000. The annual maintenance costs are expected at $5,000 throughout the 15-year lifespan of the plant. At the end of this 15-year period, the wind farm will be dismantled, and the site restored with an expected cost of $35,000. Every year after the initial construction year (year zero), the site will produce electricity with a market value of $150,000 (assume constant flow in real terms, ignoring inflation here). Following the concerns about the visual impact of the windmills, the government has commissioned a contingent valuation study of local residents. The study suggest that the mean annual compensation demanded by locals is $25 per household and there are 2,000 households are thought to be affected. Will this project pass CBA test? (Discount rate is assumed at 6%).

Economic values in a CBA depend partly on i) what people like (there preferences) ii) what they are willing to give up to have more of what they like (WTP) iii) What they can afford to pay (budget constraints).

CBA is used for assessing the impacts of several project appraisal context and environmental policies such as assessment of hydroelectric power in the USA, assessment of net benefits of alternative forest management regimes, assessing the costs to the economy of new government regulations such as setting stricter targets for recycling of waste.

Cost-benefit analysis and the Environment: Development and policy use (OECD, 2018)

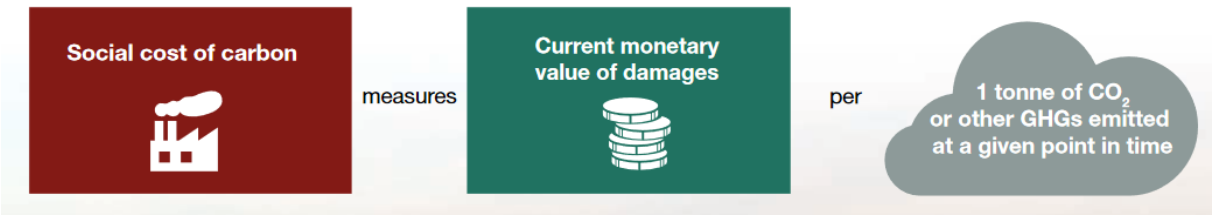
The framework:



Key developments:

1. **Climate economics and the treatment of impacts in the distant future**

The **social cost of carbon (SCC)** is added as a cost item for projects that induce carbon emissions, and as a benefit item for projects which induce a net reduction in carbon emissions. The SCC measures the present value in monetary terms of the damages incurred per an additional tonne of carbon (or any other Greenhouse gas).



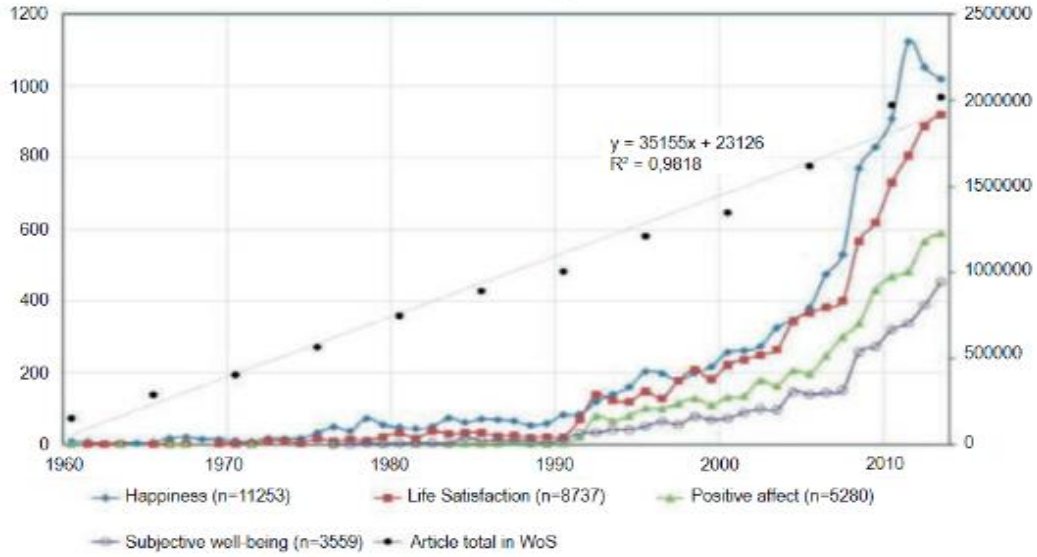
2. **The extension of valuation techniques to ecosystems**

The valuation of ecosystem services has become a crucial element in quantifying the contribution of ecosystems and biodiversity to human well-being. Challenges exist with spatial variability and complexities in the way that ecosystem services are produced. There is considerable debate remaining also about how to conduct decision analyses in those contexts where valuation and understanding of the natural world is likely to remain relatively uncertain.

3. The application of subjective well-being approaches

Subjective well-being (SWB) valuation is a newly developed method that differs from other non-market valuation methods (such as revealed preference methods and stated preference approaches). In SWB, values are based on how non-market goods impact on self-reported measures of well-being, such as life satisfaction.

Figure 1. **Published articles on subjective well-being in absolute numbers**



Source: Kullenberg and Nethans (2015).

4. The continued refinement of health valuation

The valuation of health risks is a long-standing area of both research and policy application. Increasing evidence of the global burden of disease and especially the role of environmental pollution as a determinant of this burden has added a further urgency to this work.

Reference:
[HSW] – Hanley, N., Shogren, J. and White, B., Introduction to Environmental Economics 2013 (2nd edition), Oxford University Press, Chapter 3.

OECD. Cost-Benefit Analysis and the Environment: Further developments and policy use, 2018, OECD Publishing, Paris. Retrieved from https://www.oecd.org/env/tools-evaluation/CBA-brochure-web.pdf

Other Materials:
Reynaud, R., Lanzanova, D. A Global Meta-Analysis of the Value of Ecosystem Services Provided by Lakes, Ecological Economics, Volume 137, 2017.

Cicatiello, L., Ercolano, S., Gaeta, G.L., Pinto, M. Willingness to pay for environmental protection and the importance of pollutant industries in the regional economy. Evidence from Italy, Ecological Economics, Volume 177, 2020,