Green FORCE

FOSTER RESEARCH EXCELLENCE FOR GREEN TRANSITION IN THE WESTERN BALKANS
PROJECT 101059411

Introduction to environmental economics

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29/06/2022

What is it?

- Working definition:
  - “That part of economics which deals with inter-relationship between environment and economic development and studies the ways and means by which the former is not impaired nor is the latter impeded.”

- How economists understand it-Topics:
  - Microeconomic aspects
  - Economic instruments
  - Case studies

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Microeconomic aspects

- Market:
  - Demand and Supply.
- Missing markets:
  - Externalities:
    - Negative>overproduction>higher society costs>not sustainable.
    - Arthur Cecil Pigou> Pigou taxes.
- Economic instruments
- Finance and economic aspects

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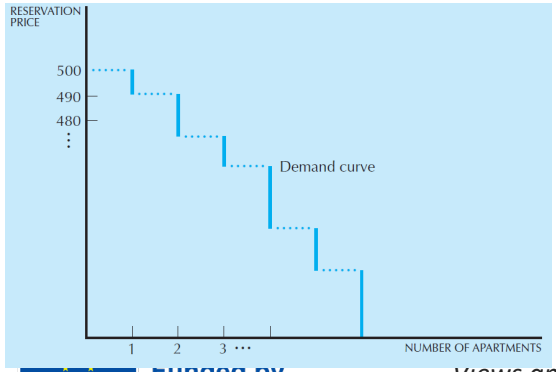
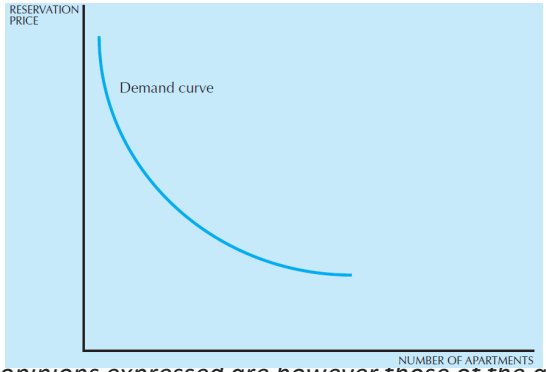
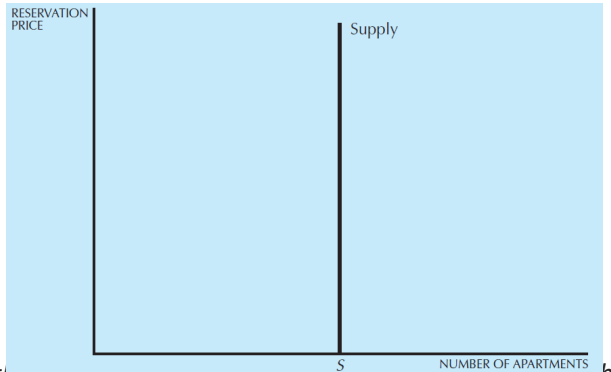
Market: Demand and Supply

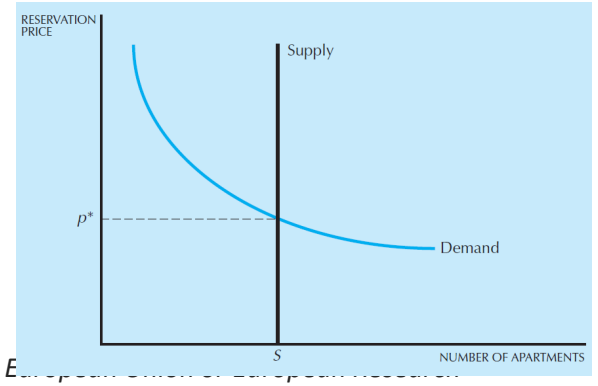
Two basic principles:

1. **Optimization**: People try to choose the best patterns of consumption that they can afford.
2. **Equilibrium**: Prices adjust until the amount that people demand of something is equal to the amount that is supplied.
3. **Efficiency**: Full information is available to all actors.









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Externalities = missing markets

- Consumption externality:
- If one consumer cares directly about another agent's production or consumption. For example, I have definite preferences about my neighbor playing loud music at 3 in the morning, or the person next to me in a restaurant smoking a cigar, or the amount of pollution produced by local automobiles.
- Production externality:
- When the production possibilities of one firm are influenced by the choices of another firm or consumer. For example a fishery cares about the amount of pollutants dumped into its fishing area, since this will negatively influence its catch.

- **The crucial feature of externalities is that there are goods (or bads) people care about that are not sold on markets.** There is no market for loud music at 3 in the morning, or drifting smoke from cigars, or a neighbor who keeps a beautiful flower garden, or market for pollutants in water and/or in air. It is this lack of markets for externalities that causes problems.

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Externalities = missing markets

- Up until now we have implicitly assumed that each agent could make consumption or production decisions without worrying about what other agents were doing. All interactions between consumers and producers took place via the market, so that all the economic agents needed to know the market prices and their own consumption or production possibilities.
- We will relax this assumption and examine the economic consequences of externalities.
- **However, there are other social institutions such as the legal system, or government intervention, that can "mimic" the market mechanism to some degree and thereby achieve Pareto efficiency.**

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Externalities = missing markets

- Production externalities:
- Profit maximization of steel producer: $\max_{s,x} \; p_s s - c_s(s,x)$
- Profit maximization of fishery: $\max_{f} \; p_f f - c_f(f,x)$
- Profit maximization for steel producer and for the fishery:

$$p_s = \frac{\Delta c_s(s^*, x^*)}{\Delta s}$$

$$0 = \frac{\Delta c_s(s^*, x^*)}{\Delta x}$$

$$p_f = \frac{\Delta c_f(f^*, x^*)}{\Delta f}$$

- Maybe to introduce so called Pigouvian tax (t instead of zero)=>increase cost

1. The fishery cares about the production of pollution but has no control over it.
2. The steel firm looks only at the cost of producing steel when it makes its profit-maximizing calculation; it doesn't consider the cost it imposes on the fishery.
3. The increase in the cost of fishing associated with an increase in pollution is part of the **social cost** of steel production, and it is being ignored by the steel firm.
4. In general, we expect that the steel firm will produce too much pollution from a social point of view since it ignores the impact of that pollution on the fishery

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Externalities = missing markets

- Pollution vouchers e.g., introducing markets for emission permits
- Everyone wants a clean environment thus, government sets up an emission reduction targets .
- Even if we reach a consensus on how much we should reduce pollution, there is still the problem of determining the most cost-effective way to achieve the targeted reduction.
- One emitter may find it relatively inexpensive to reduce its emissions of this pollutant, whereas another may find it very expensive.
- What if both are required to reduce the emission of pollution by the same physical amount, by the same proportional amount, or by some other rule.

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Externalities = missing markets

- Suppose there are two firms, different emissions but total pollution is targeted to-X.

$$\min_{x_1,x_2} \; c_1(x_1) + c_2(x_2)$$
$$\text{such that } x_1 + x_2 = X.$$

- How can we achieve this outcome?
- If the government regulators had information on the cost of emissions for all firms, they could calculate the appropriate pattern of production and impose it on all the relevant parties.
- But the cost of gathering all this information, and keeping it up-to-date, is overwhelming.
- It is much easier to characterize the optimal solution than to actually implement it!
- The best way to implement the efficient solution to the emission control problem is to use a market:
  - Set up a quota-say 10% reduction
  - If firm's emission higher than quota => fines or penalties
  - If firm's emission lower than quota <= firm can sell the right for extra emission to the other firm
  - Thus, a market has been created for optimal pattern of emissions

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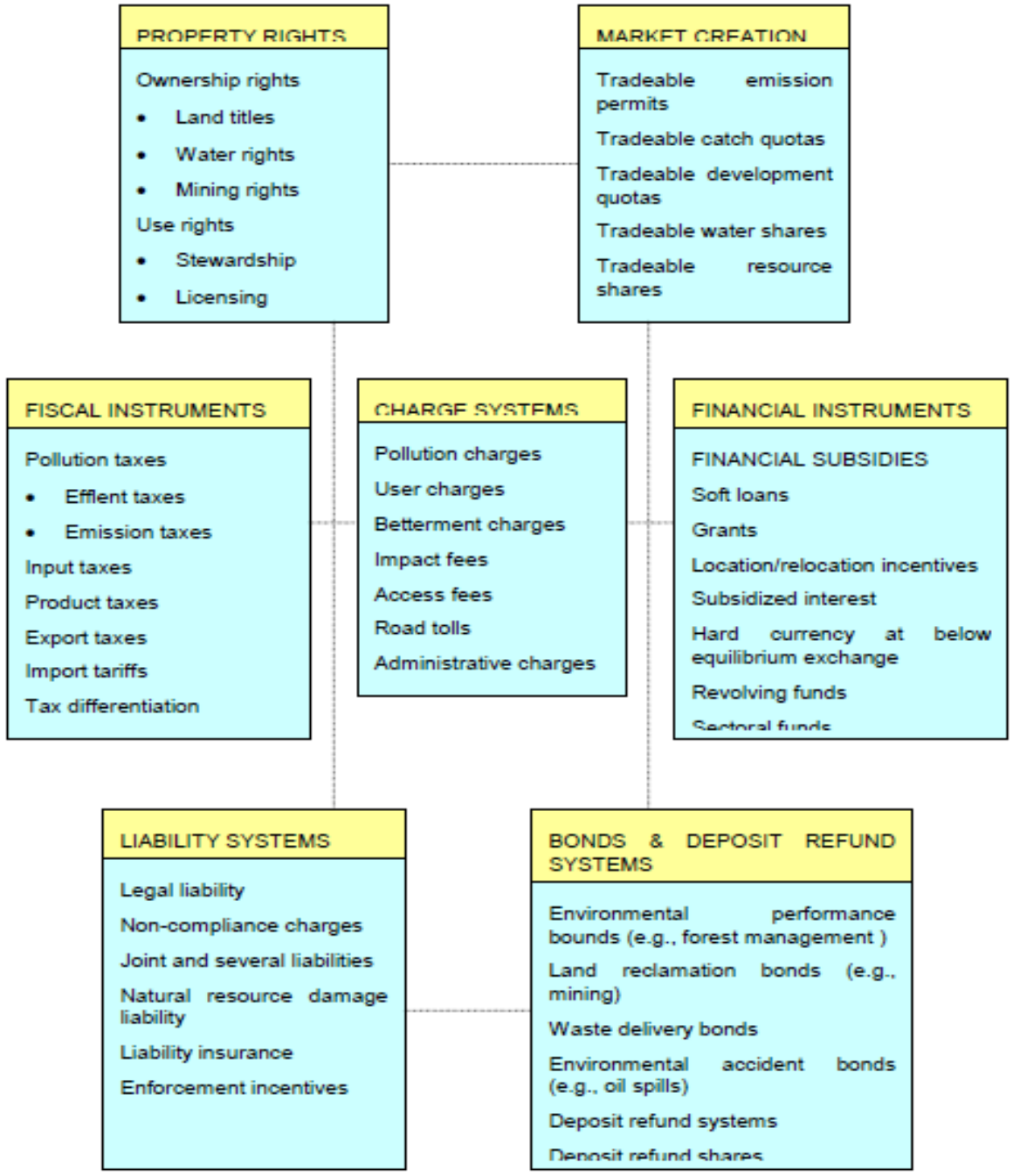
Green FORCE Economic instruments

- Tax (1.9% of GDP in Macedonia=217mln Euro; 326bln in EU=2.2% of GDP): Energy-67%; Transport-32%; Other-1%
- Subsidy (tax deduction, easy access to capital market and public procurement etc.).
- Tradable permits (securities> trading>overshooting of emission>CDM Kyoto protocol)
- https://core.ac.uk/download/pdf/48031478.pdf
- Macedonia do not collect IPPC (https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Integrated_pollution_prevention_and_control_(IPPC)):
  - https://telma.com.mk/2023/03/13/kje-se-istrazhuva-zoshto-ima-budzhetska-dupka-od-153-milioni-evra-vo-mzhspp/
  - https://dzr.mk/sites/default/files/2022-12/172_RU_MZSPP_Danoci_zivotna_sredina_KOMPLET_2022.pdf?fbclid=IwAR0Cc3PVnikor6_wNZh3Fo4x2D_O13wK_Gt25Zo8QwTgA9IaKqLxPw9u4ao

Figure 2. Economic Instruments for Environmental Protection and Natural Resource Management



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Case studies – Polluter pays

- Fairness requires that the costs are allocated in proportion to the damages caused by each polluter (which are considered proportional to emissions within the same airshed or watershed) and not according to their pollution control costs.
- A combination of efficiency and equity (with the polluter pays principle as the operative rule of fairness) dictates that pollution within a given airshed or watershed is (a) controlled up to the point where the marginal cost of control equals the marginal benefit, (b) that the control is carried out by those who have the lowest possible pollution control cost, and (c) that the cost of pollution control is paid by those who generate the pollution in proportion to their emissions (in the first instance the producers and ultimately both producers and consumers with their relative shares determined by the elasticity of demand).

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Case studies – Beneficiary pays

- According to this principle, those who expect to benefit from pollution control or conservation are expected to pay the costs according to the benefits they expect to derive.
- This may sound unfair and regressive because the layman's perception of polluters is that of large, wealthy corporations and multinationals, while the affected parties are perceived to be poor and helpless. (The classic example is the Bhopal disaster in India where wealthy, multinational corporations destroyed the lives of thousands of poor Indian workers).
- However, there are many counter-examples of poor “polluters” and wealthy affected parties (potential beneficiaries of pollution control).
- For example the case of irrigation and hydroelectric reservoirs that provide wealthy farmers, urban residents and industries with water and energy. Clearly in this case a “beneficiary pays principle” appears to be both fair and distributionally progressive.

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Case studies

- Cost benefit analyses for wind power plant
- Clean Development Mechanism
- Measurement: GDP (Gross Domestic Product) versus ISEW (Index of Sustainable Economic Welfare)

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Case studies

Country	Target (1990** – 2008/2012)
EU-15*, Bulgaria, Czech Republic, Estonia, Latvia,Liechtenstein, Lithuania, Monaco, Romania,Slovakia,Slovenia, Switzerland	-8%
US***	-7%
Canada,**** Hungary, Japan, Poland	-6%
Croatia	-5%
New Zealand, Russian Federation, Ukraine	0
Norway	+1%
Australia	+8%
Iceland	+10%

- Clean Development Mechanism-CDM
  - The Kyoto Protocol operationalizes the United Nations Framework Convention on Climate Change by committing industrialized countries and economies in transition to limit and reduce greenhouse gases (GHG) emissions in accordance with agreed individual targets. The Convention itself only asks those countries to adopt policies and measures on mitigation and to report periodically.
  - In its Annex B, the Kyoto Protocol (1992) sets binding emission reduction targets for 37 industrialized countries and economies in transition and the European Union. Overall, these targets add up to an average 5 per cent emission reduction compared to 1990 levels over the five year period 2008-2012 (the first commitment period of the conference of parties-COP. Second in Doha and third in Sharm el-Sheikh)
  - CDM, defined in Article 12 of the Protocol, allows a country with an emission-reduction or emission-limitation commitment under the Kyoto Protocol (Annex B Party) to implement an emission-reduction project in developing countries. Such projects can earn **saleable certified emission reduction (CER) credits, each equivalent to one tonne of CO2,** which can be counted towards meeting Kyoto targets.

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Case studies – wind power plant

	Financial	Economic
Perspective	financial profitability of a project	net benefit to society at large
Costs	financial costs	economic costs= financial costs adjusted to shadow prices (value of the foregone marginal social product in the informal sector minus the social value of the increase of income to the household in the informal sector)
Benefits	monetized observable revenue	economic benefits= financial benefits plus externalities

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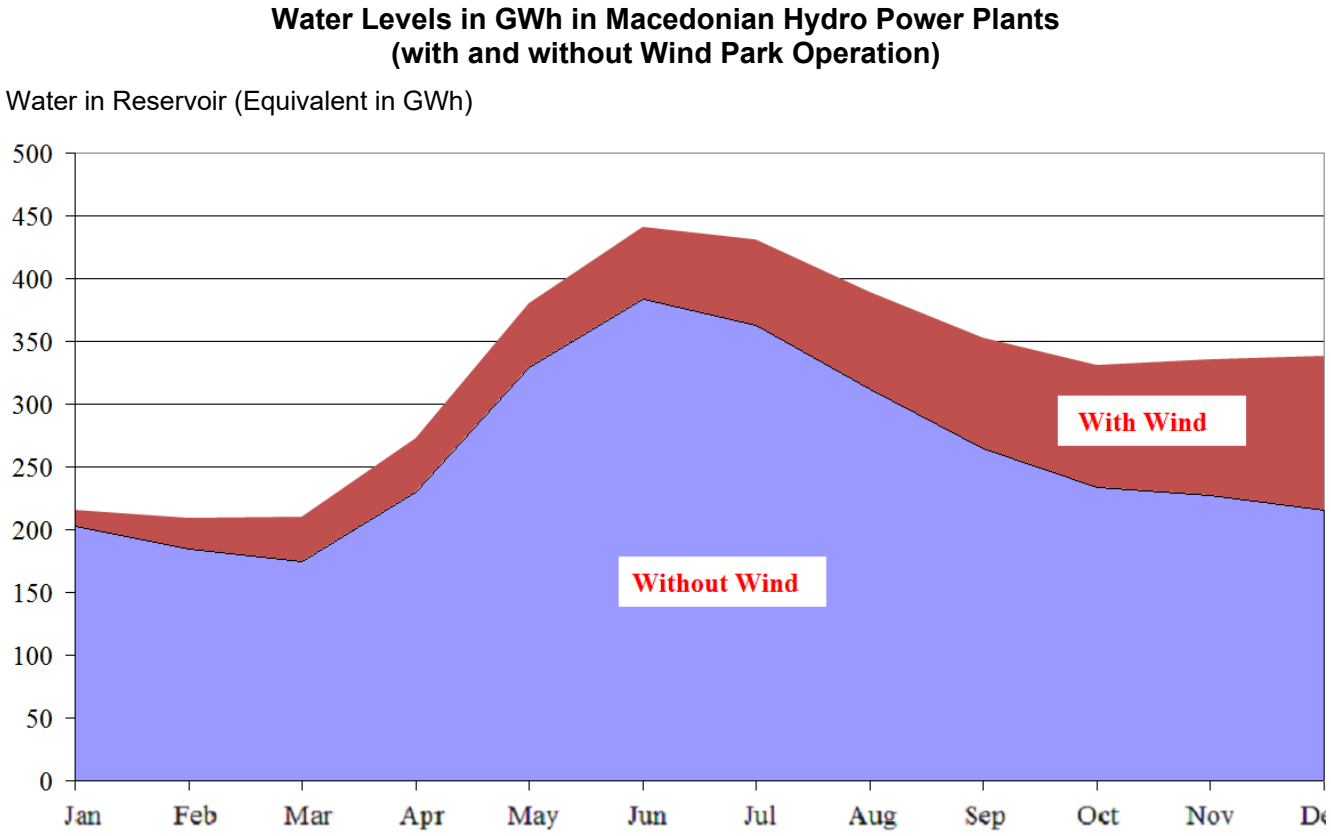
Case studies – wind power plant

Load Factor is the percentage of power production as a fraction of the nameplate capacity of the wind energy conversion system.

Loss Of Load Probability (LOLP) is the probability that a Loss Of Load Event occurs.

Capacity Credit is the fraction of installed capacity by which the conventional power generation capacity can be reduced without affecting the loss of load probability.



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Case studies - CDM

- If electricity production from fossil fuel plants is dominant (North Macedonia) this situation makes projects that promote energy efficiency and the use and renewable energy highly attractive from a Clean Development Mechanism perspective (CDM)
- Combined margin (CM) emission factor for Macedonian electricity grid is estimated at 0.915 t CO_2/MWh (back in 2010). This means that a hypothetical renewable energy project (hydro, wind or geothermal) with expected annual electricity generation at the level of 60,000 MWh/yr can generate approximately 54,900 Certified Emission Reductions (CER) annually
- Usually, a two-step procedure for CDM project review and approval, whereby project developers have the option of submitting a short Project Idea Note (PIN) for initial feedback, often in the form of a letter of endorsement, before the complete project document is submitted for final approval. This two-tiered process reduces the risk to the project developer because he/or she will receive early feedback on the eligibility of the project before expending resources on preparing the full Project Documentation
- Thus, wind power plant project brings benefits of CDM and for the country to trade Green House Gas emission reductions

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Case studies – Tradable markets and CERs

- So, with an annual energy generation of 123.1 GWh the wind park will avoid an emission of 112,637 t CO2 per year or up to 2,252,730 tons of CO2 during the anticipated project life time of 20 years
- Combined margin (CM) emission factor for Macedonian electricity grid is estimated at 0.915 t CO2/MWh
- The prices per t of CO2 are from the European Emissions Trading System at the European Energy Exchange (EEX) based in Leipzig (Germany).

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Case studies - Tradable markets and CERs

- These prices have been volatile given the global crises. In 2005 the spot prices were between 20 and 30 EUR/t CO2, while at the beginning of 2009 the spot prices were below 10 EUR/t CO2

Annual emissions avoided	112,637 t CO_2
Total avoided emissions for the 20 year period	2,252,730 t CO_2
Average Price per t of CO_2 avoided	11 EUR/t CO_2
Annual monetary benefits from CDM	1,239,007 EUR

Emission Trading at EEX - CO_2 Spot Prices 2005 – 2009 in €/t

Source: European Energy Exchange (EEX), www.eex.com/de/, accessed on 28th of May, 2011

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Carbon Panic: https://cepr.org/voxeu/columns/collapse-clean-development-mechanism-scheme-under-kyoto-protocol-and-its-spillover

Case studies - Tradable markets and CERs

2023-02-28

Name	Market Area	Date	Time	Auction Clearing Price €/tCO2	Volume of Bids Submitted	Auction Volume tCO2	Cover Ratio	Number of Successful bidders	
EUA	EU	2023-02-28	11:18	96.33	4,744,000	2,409,000	1.97	17	
EUA	DE	2023-02-24	11:19	95.83	4,815,000	1,939,500	2.48	11	
EUA	PL	2023-02-15	11:17	87.75	4,761,500	2,676,000	1.78	16	
EUAA	EU	2023-01-25	11:17	78.29	1,160,000	775,500	1.50	10	
EUAA	DE	2022-10-19	11:17	68.62	1,178,000	586,500	2.01	4	
EUAA	PL	2022-05-18	11:18	87.25	488,000	109,500	4.46	4	

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Case studies – GDP vs. ISEW

- The ISEW is an adjusted economic indicator which attempts to incorporate costs and benefits not traditionally measured in monetary terms. It brings together a wide range of economic, social and environmental issues into one analytic framework.
- Positive and negative adjustments are made to this basis to account for a series of social, economic and environmental factors.
- For example, the values of household labor and volunteering are added to the index, together with public expenditure on health and education.
- On the negative side, the ISEW subtracts environmental costs associated with habitat loss, localized pollution, depletion of nonrenewable resources and climate change; social costs associated with crime, divorce, commuting and unequal income distribution; and the health costs of accidents on the road and in the workplace.

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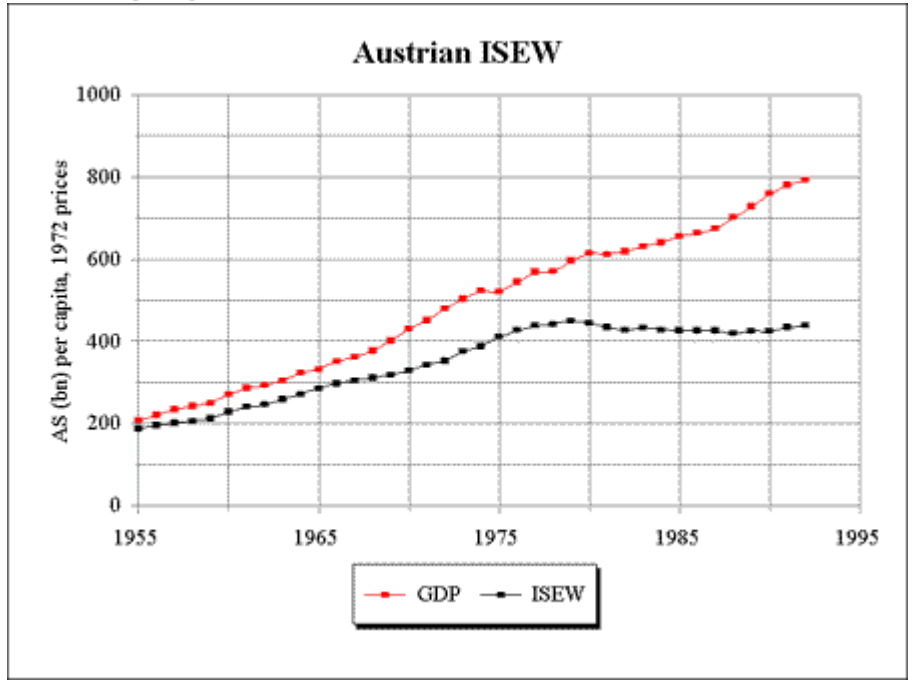
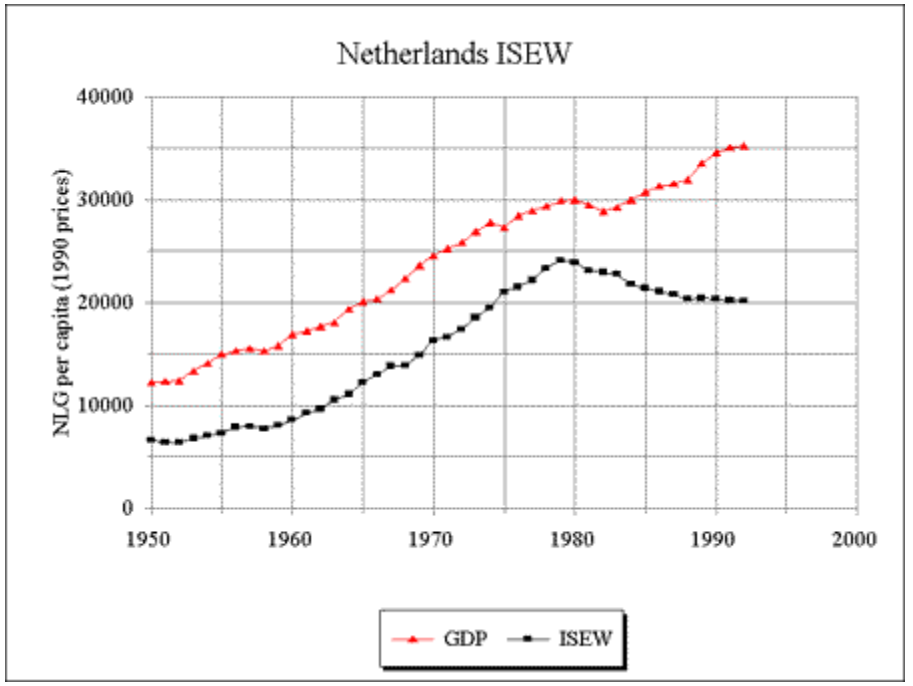
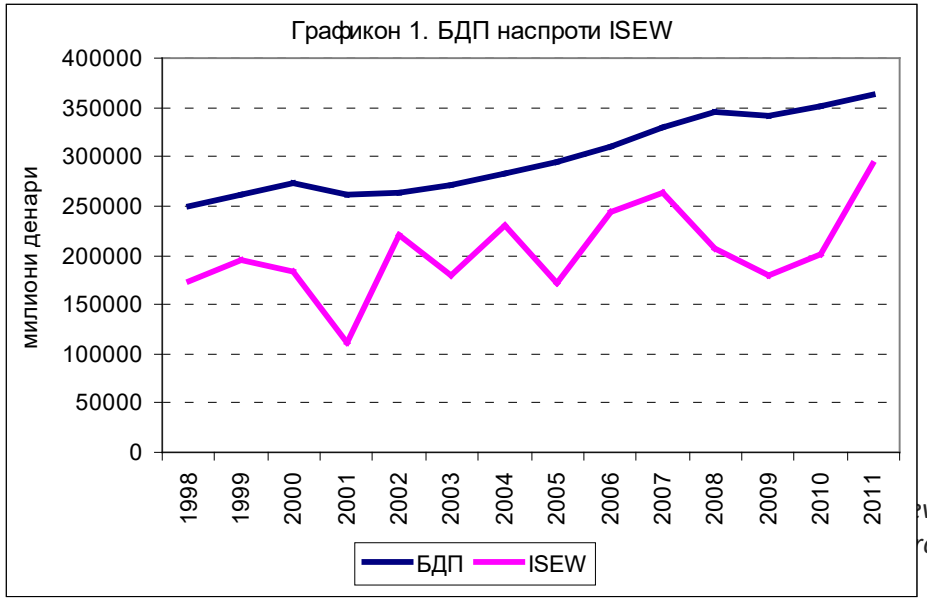
Case studies – GDP vs. ISEW







ISEW = Personal consumer expenditure
- adjustment for income inequality
+ public expenditures (deemed non-defensive)
+ value of domestic labour & volunteering
+ economic adjustments
- defensive private expenditures
- costs of environmental degradation
- depreciation of natural capital

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References

- About CDM: https://unfccc.int/process-and-meetings/the-kyoto-protocol/mechanisms-under-the-kyoto-protocol/the-clean-development-mechanism
- Economic instruments for environmental management and sustainable development (https://core.ac.uk/download/pdf/48031478.pdf)
- Economics unmasked: From power and greed to compassion and the common good paperback by Manfred Max-Neef and Philip B. Smith (https://www.amazon.com/Economics-Unmasked-Power-Compassion-Common/dp/1900322706)
- European energy exchange (https://www.eex.com/en/market-data/environmentals/eu-ets-auctions)
- Intermediate Microeconomics: A modern approach by Hal Varian (https://faculty.ksu.edu.sa/sites/default/files/microeco-_varian.pdf)
- UNFCCC (https://unfccc.int/kyoto_protocol).

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