The European Commission's science and knowledge service

Joint Research Centre

European Commission

Evaluation of economic energy efficiency potential in H&C sector

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Introduction

- EC promotes the use of Cost-Benefit Analysis (CBA) for structural funds because they are objective and verifiable
- CBA measures in money term all benefits and costs of project for society
- The basic rules of conducting CBAs are binding for all beneficiaries
- This presentation is not meant to be exhaustive of all topics of a CBA

- Several aspects resembles Member States assessments on efficiency potential in heating and cooling sector. Energy Efficiency Directive article 14.

Objective

- Explain main elements how to evaluate the economic energy efficiency potential for a Cost-Benefit Analysis supporting an application for EU structural funds
- **Example on waste incinerator with heat recovery**
- This type of assessments serves the TO4 (transition to low carbon economy). Not TO1.

Overview project appraisal steps

1. **Description of context**
2. Definition of objectives
3. Identification of project
4. Technical feasibility & environmental sustainability
5. Financial analysis
6. Economic analysis
7. Risk assessment

1. Description of context

Describe social, economic, political and institutional context in which project is implemented

A basis to verify the relevance of the project

1. Description of context – **example Waste Incinerator with Energy Recovery**

200 000 tonnes of mixed municipal solid wastes per year.

Co-generate heat and power of 40 MWth and 13 MWel.

Located in a region eligible for the Cohesion Fund with around 1.3 million inhabitants and total municipal waste generation of currently 585,000 tonnes per year.

A large part of this waste is currently sent to landfills without treatment, which is considered unsustainable.

Etc.

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2. Definition of objectives

Project objectives should be defined in relation to the needs, which are derived from the context (1).

Objectives should be quantified through indicators and targeted.

- identify the effects of the project to be further evaluated in the CBA
- relevance of project to region and Member State
- verify the project's relevance

2. Definition of objectives – **example Waste Incinerator with Energy Recovery**

Specific objectives were formulated for the project:

- to reduce the amount of total waste and biodegradable waste currently disposed of in landfills in the region;
- to recover materials and energy contained in the waste

In particular, the investment will contribute to the following OP output and result indicators:

	OP target 2023	Project (% of target)
Output indicator New capacity for residual municipal waste	1400	200 (14%)
Result indicator Amount biodegradable waste diverted from landfill (ktpa) Energy recovered from waste (TJ/y)	670 10700	96 (14%) 1530 (14%)

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3. Identification of the project

A project is clearly identified when:

- Where a project has several stages or phases, these are properly presented together with their respective costs and benefits
- Individual investment measures are bundled into one single project when these:
  - i) support the achievement of intended objectives and complementary from a functional point of view;
  - ii) implemented in the same impact area;
  - iii) share the same project promoter; and
  - iv) have similar implementation periods.

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4. Technical feasibility and environmental sustainability

Detailed information should be provided on:

- Demand analysis
- Options analysis
- Environment and climate change considerations
- Technical design, cost estimates and implementation schedule

4. Technical feasibility and environmental sustainability – **demand analysis & data collection**

- Current and future demand (macro- and socio-economic forecasts, alternative sources of supply etc.)
- Ensure optimal scale and utilization of project
- Some technologies requires more geographical information about supply and demand, e.g. DHC
- Individual technologies, e.g. heat pumps, can be more easily analysed together

4. Technical feasibility and environmental sustainability – **demand analysis** – **example Waste Incinerator with Energy Recovery**

- Forecast of municipal waste generation, collection and treatment for the region including:
  - historic waste generation
  - long-term demographic forecast
  - forecast on macroeconomic growth
  - progressive change in waste generation
  - improvements in source separation
  - etc
- The implementation of the waste-to-energy project with 200 ktpa capacity would allow the region to clearly meet the regional targets for landfilling of biodegradable waste for the years 2013 and 2020

4. Technical feasibility and environmental sustainability – **option analysis** – **example Waste Incinerator with Energy Recovery**

the option analysis included in the feasibility study assesses the following sets of options for the project:

- technological specifications of the waste to energy plant components;
- 3 locations of the waste to energy plant;
- general type of waste treatment technology.

4. Technical feasibility and environmental sustainability – **Project costs and revenues of selected option**– example Waste Incinerator with Energy Recovery

A breakdown of the investment cost for the selected project configuration, in constant prices of 2013.

Overall unit investment cost of around 756 EUR/tonne per annum of waste treatment capacity

Project revenues include sale of materials and energy recovered from waste as well as the gate fees charged to users, heat sold to district heating system

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5. Financial analysis

- Assess project profitability for project owner and key stakeholders
- Discounted cash flow analysis
- Only inflows and outflows of cash are considered
- Forecast should cover the economic life of the project.
- Analysis should be performed in constant prices

5. Financial analysis – Net Present Value

- ✓ The NPV integrates in a unique estimate the expected benefits minus the costs, both discounted:

$$NPV = \frac{Benefit_t - Costs_t}{(1+r)^t}$$

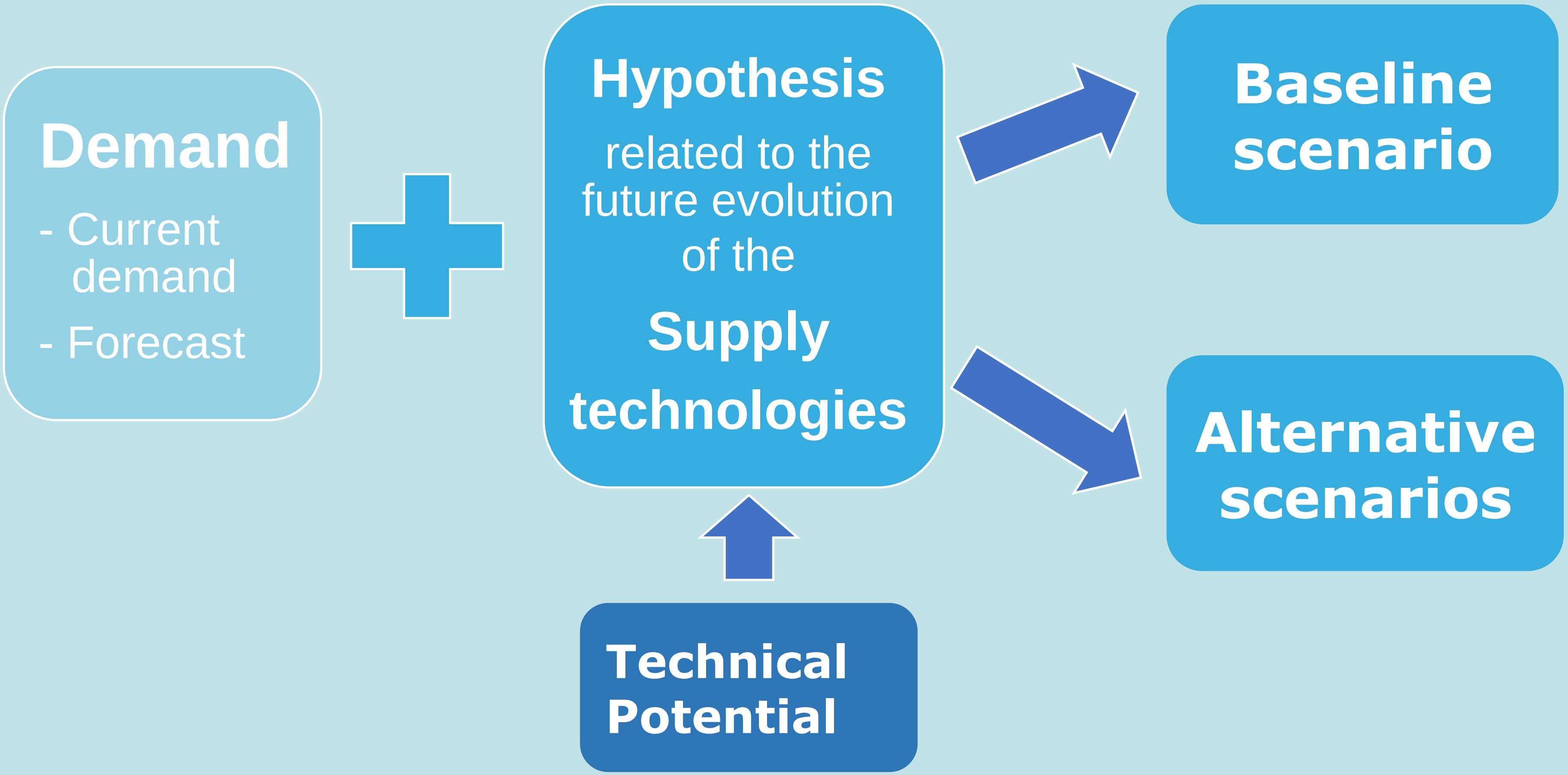
- ✓ Discount rate reflects value of future flows compared to present ones.
  - The financial discount rate reflects the opportunity cost of capital. The EC recommends a 4 % financial discount rate <u>in real terms</u>.
  - The social discount rate reflects the social view on how future benefits and costs should be valued against present ones. The EC suggests using: 5 % for the Cohesion countries and 3 % for the rest.

5. Financial analysis

BAU scenario that ensures basic functionality of assets, limited asset replacements etc.

If service cannot be continued without a certain level of capital investment, assume do-minimum scenario.

6. Financial analysis
Baseline + alternative scenarios



5. Financial analysis - **example Waste Incinerator with Energy Recovery**

Breakdown of funding components and total cost

O&M costs

30-year reference period

4 % financial discount rate

the 'funding gap method' was used to demonstrate the financing needs and proportionality of the state aid granted to the project

The 'funding gap rate' is 24.0 %, mainly due to low gate fees

The EU's project co-financing contribution (a non-reimbursable grant) results in EUR 29.4 million + other financing sources

Overview project appraisal steps

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6. Economic analysis

Appraise project's contribution to welfare of society from improved waste practices and material recovery

Correction factors of financial analysis are used for economic analysis

Costs of externalities, e.g. environment

Fiscal corrections

From market to shadow prices

6. Economic analysis

Economic performance is measured through:

- Economic Net Present Value (ENPV)
- Economic Rate of Return (ERR)
- Benefit/Cost ratio

6. Economic analysis - **example Waste Incinerator with Energy Recovery**

Counterfactual scenario used as a baseline is one with continued landfilling of untreated mixed residual wastes collected in the project's service area

The financial costs of the project are used as a basis to estimate its economic costs. Correction factors are used, e.g. unskilled labour

Socio-economic benefits – saved costs from less landfill space, avoided cost from alternative production of energy, avoided costs from less GHG

6. Economic analysis - **example Waste Incinerator with Energy Recovery**

Negative externalities of the project computed in the economic analysis are the fossil CO_2 emissions generated through the incineration of waste

With an estimated 10.6 % economic rate of return, a positive economic net present value of EUR 101.3 million and a benefit/cost ratio equal to 1.37

-> the construction of the waste to energy plant is expected to increase social welfare. Therefore, it is worth supporting with a grant from the EU.

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7. **Risk assessment**

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7. Risk assessment

Sensitivity analysis

Qualitative risk analysis

Probabilistic risk analysis

Risk prevention and mitigation

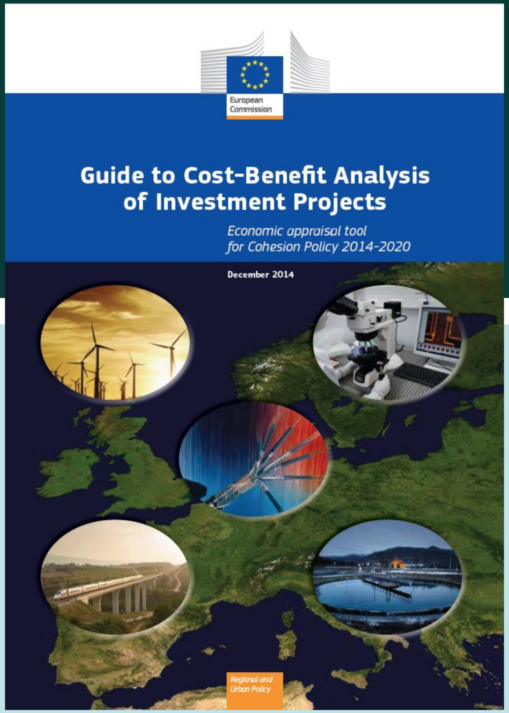
7. Risk assessment - **example Waste Incinerator with Energy Recovery**

Variables analysed: investment cost, O&M cost, waste input, gate fee, heat price, electricity price, CO_2 price

-> Only waste input, and to a lesser extent the investment and operating cost as well as the economic cost of heat and the shadow price of CO_2, constitute critical variables.

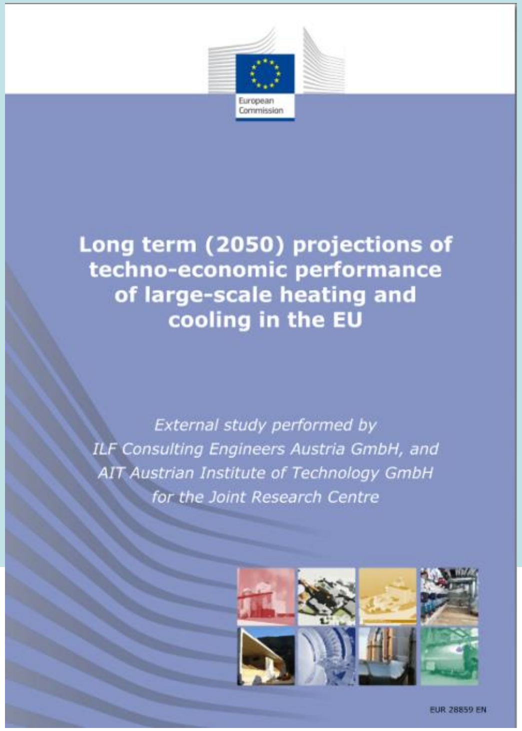
Useful documents

- EC, 2014, Guide to Cost-Benefit Analysis of Investment Projects
- EC, 2014, Best practices and informal guidance on how to implement the Comprehensive assessment at Member State level
- EC, 2014, Background report on best practices and informal guidance on installation level CBA installations



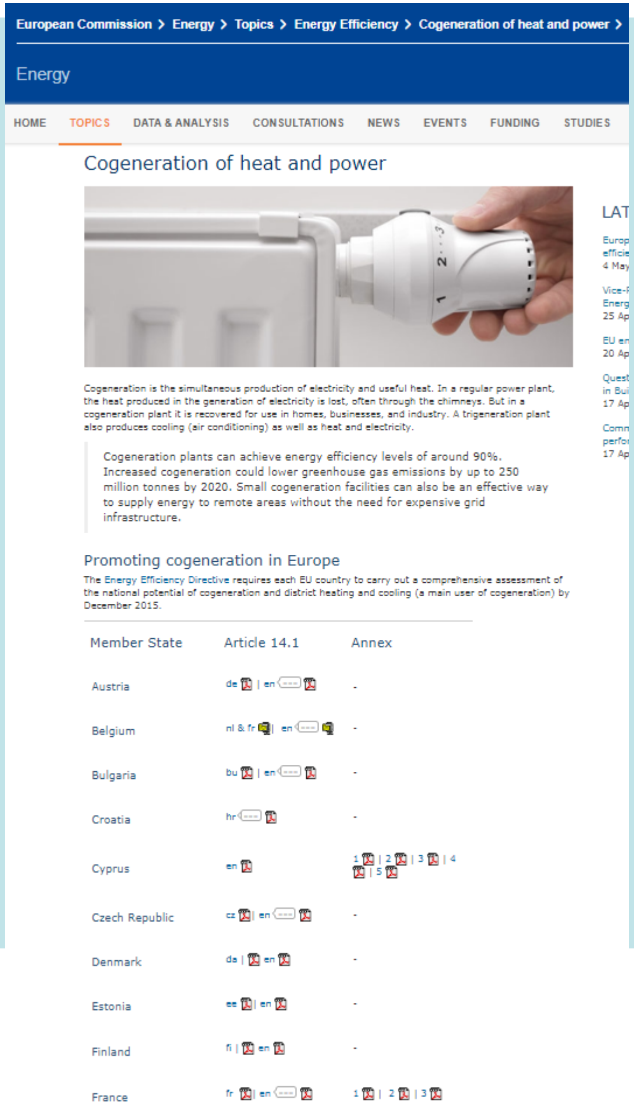
Useful documents

- EC, 2018, Cost development of low carbon energy technologies
- EC, 2017, Techno-economic projections until 2050 for smaller heating and cooling technologies in residential and tertiary sectors in the EU
- EC, 2017, Long term (2050) projections of techno-economic performance of large-scale heating and cooling in the EU



Useful documents

- Member States, 2015-2016, [National comprehensive assessments on energy efficiency potential in heating and cooling sector]
- Heat roadmap Europe, http://www.heatroadmap.eu/Useful-Resources.php



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Energy

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Cogeneration of heat and power

Cogeneration is the simultaneous production of electricity and useful heat. In a regular power plant, the heat produced in the generation of electricity is lost, often through the chimneys. But in a cogeneration plant it is recovered for use in homes, businesses, and industry. A trigeneration plant also produces cooling (air conditioning) as well as heat and electricity.

> Cogeneration plants can achieve energy efficiency levels of around 90%. Increased cogeneration could lower greenhouse gas emissions by up to 250 million tonnes by 2020. Small cogeneration facilities can also be an effective way to supply energy to remote areas without the need for expensive grid infrastructure.

Promoting cogeneration in Europe

The Energy Efficiency Directive requires each EU country to carry out a comprehensive assessment of the national potential of cogeneration and district heating and cooling (a main user of cogeneration) by December 2015.

Member State	Article 14.1	Annex
Austria	de | en	-
Belgium	nl & fr | en	-
Bulgaria	bu | en	-
Croatia	hr	-
Cyprus	en	1 | 2 | 3 | 4 | 5
Czech Republic	cz | en	-
Denmark	da | en	-
Estonia	ee | en	-
Finland	fi | en	-
France	fr | en	1 | 2 | 3

Any questions?

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