Economic Analysis of Research Infrastructure Projects

Programming Period 2014-2020

Davide Sartori

Riga, 2016

Economic analysis as part of the CBA

1. Socio-economic, institutional and political context
2. Definition of objectives
3. Project identification
4. Technical feasibility & Environmental sustainability
5. Financial analysis
6. Economic analysis
7. Risk assessment

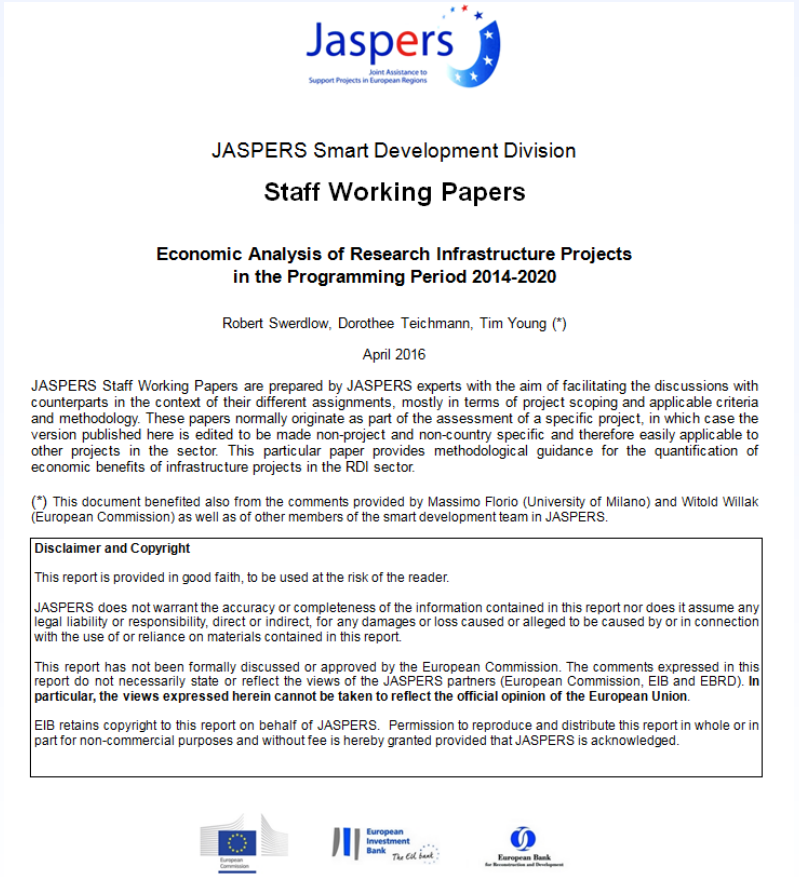
Basic principles of economic analysis

- While financial analysis determines whether project needs an EU grant, the economic analysis is about measuring in "money terms" all the **benefits and costs of the project to society**

- **Principles**:
  - Based on financial analysis
  - Discounted method - Social discount rate for LV: 5% real
  - Incremental approach
  - Reference period: 15-25 years (including construction phase)

JASPERS Working Paper

- **Simplified** approach for the quantification of economic benefits
- Builds upon Chapter 7 of the EC Guide to provide **practical guidance** for project promoters
- Addresses each of the benefits described in annex III of IR (EU) 2015/207



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Staff Working Papers

Economic Analysis of Research Infrastructure Projects in the Programming Period 2014-2020

Robert Swerdlow, Dorothee Teichmann, Tim Young (*)

April 2016

JASPERS Staff Working Papers are prepared by JASPERS experts with the aim of facilitating the discussions with counterparts in the context of their different assignments, mostly in terms of project scoping and applicable criteria and methodology. These papers normally originate as part of the assessment of a specific project, in which case the version published here is edited to be made non-project and non-country specific and therefore easily applicable to other projects in the sector. This particular paper provides methodological guidance for the quantification of economic benefits of infrastructure projects in the RDI sector.

(*) This document benefited also from the comments provided by Massimo Florio (University of Milano) and Witold Willak (European Commission) as well as of other members of the smart development team in JASPERS.

Project identification

- **Single-site facilities** => project identification becomes straightforward
- **Distributed facilities** => the project can be identified as a self-sufficient project if there is a strong functional relationship among all of its parts
- **Investments aimed at fostering cooperation between a number of research facilities** => can be considered as a single project and a self-sufficient unit of analysis for the purpose of the CBA, as long as they create strong synergies, critical mass and achieve cost savings for each facility involved

Socioeconomic benefits for RDI projects

- Benefits to businesses:
  - establishment of spin-offs & start-ups
  - development of new/improved products & processes
  - learning by doing (additional)
  - knowledge spill-overs (qualitative)
- Benefit to researchers & students:
  - new research
  - human capital formation
  - social capital development
  - Academic consulting and contract research (additional)
- Benefits to the general public:
  - reduction of environmental risks
  - reduction of health risks
  - cultural effects for visitors
- Open access to research facilities (additional)


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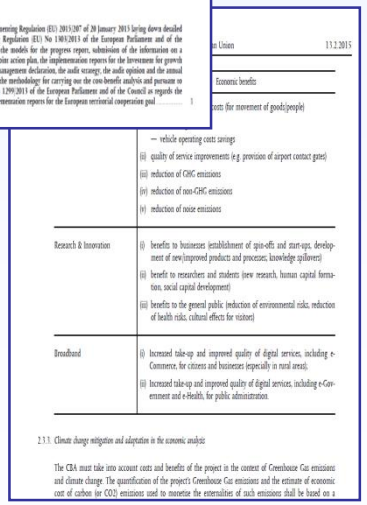

Economic benefits
Research & Innovation
Broadband

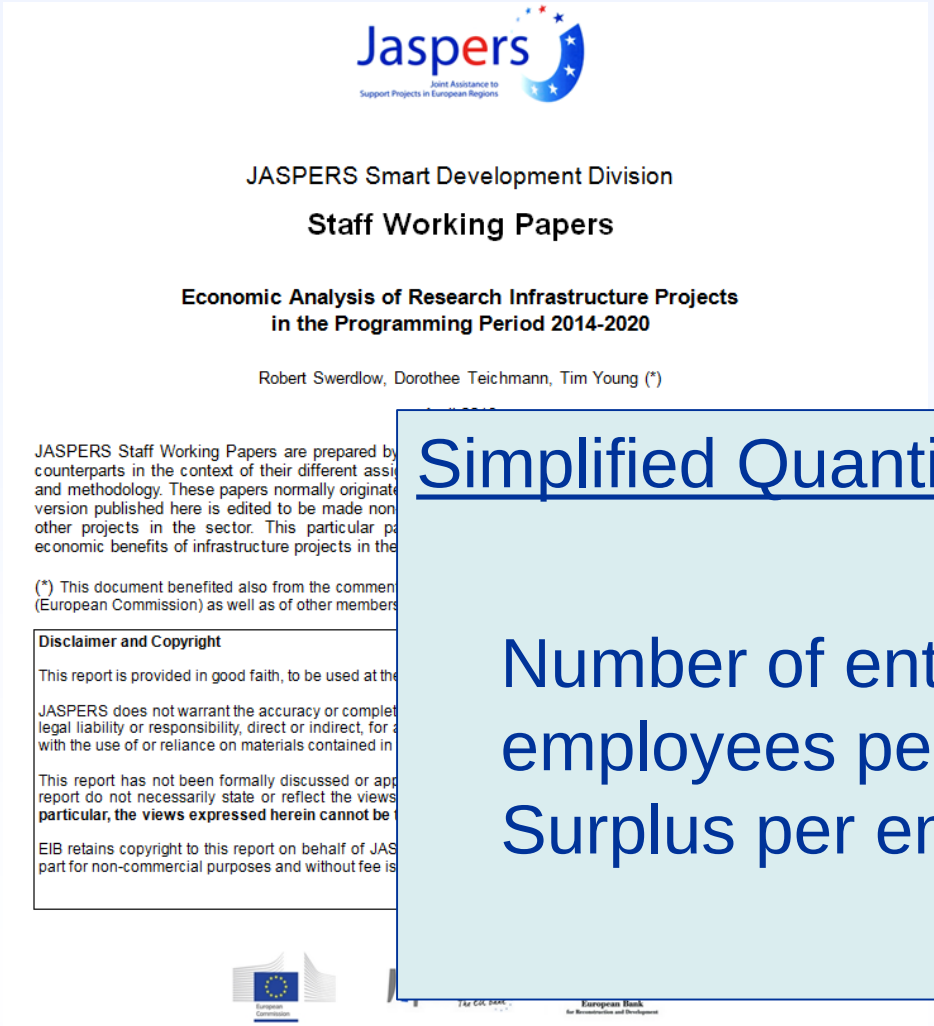
Economic analysis: benefits to business I

Establishment of spin-offs and starts-ups

- Spin-offs and starts-ups considered under the same typology of benefit for the purpose of CBA
- Economic value of spin-offs and start-ups assessed as the **expected shadow profit** generated by the business during its lifetime, as compared to the counterfactual situation.

But.. Predicting annual profits ex-ante is challenging

Establishment of spin-offs & start-ups



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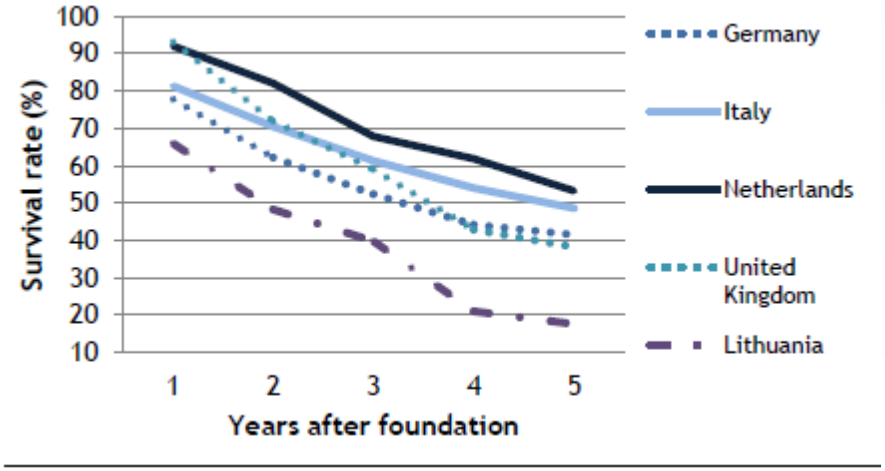
Simplified Quantification method

Number of entities * Number of employees per entity * Gross Operating Surplus per employee in R&D *(NACE sector M72)*

Establishment of spin-offs and start-ups

Practical guidance from JASPERS

- To estimate quantity - historical track record of the project promoter
- To mitigate benefit double counting and take into account survival assumption – No growth in the employment of businesses, i.e. **the number of employees stays constant**



Economic analysis: benefits to business II

Development of new/improved products and processes

The changes in the profit expected from the sale of marketable goods and/or processes associated with the relevant research and development activity can be proxied by **value of patents** licensed.

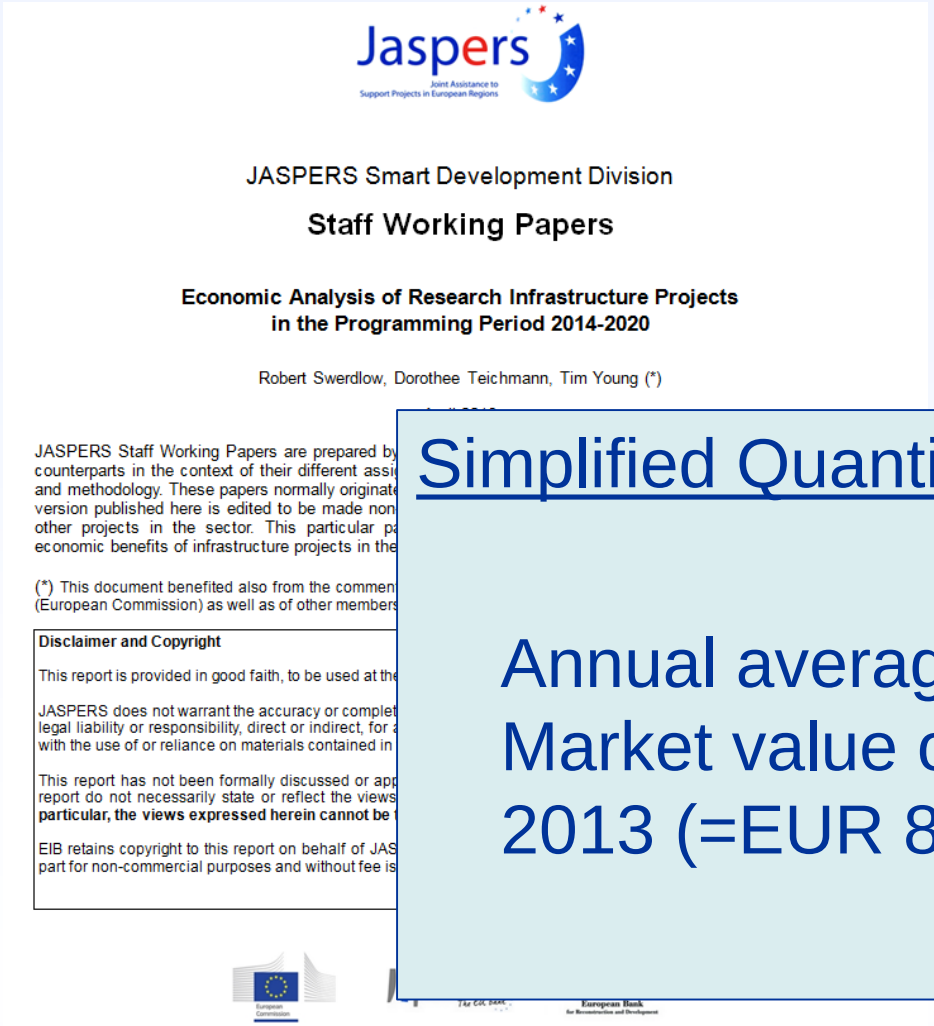
- **However…patent values vary significantly across sectors, technological fields and geographic areas...**

Table 5. Average patent values by country and technological area

Country	Average patent value (EUR thousands)	Median patent value (EUR thousands)	Technological area	Average patent value (EUR thousands)	Median patent value (EUR thousands)
Denmark	2,947	300	Pharmaceuticals, cosmetics	5,260	605
Germany	2,958	305	Macromolecular chemistry, polymers	3,980	449
Spain	3,029	307	Space technology weapons	3,854	414
France	2,922	293	Environmental technology	3,250	354
Hungary	3,647	408	Biotechnology	3,134	336
Italy	3,007	297	Semiconductor	2,555	284
The Netherland	2,788	285	Telecommunications	2,331	247
United Kingdom	3,355	332	Electrical devices, engineering, energy	1,938	211

Source: European Commission (2006).

Development of new/improved products and processes



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Simplified Quantification method

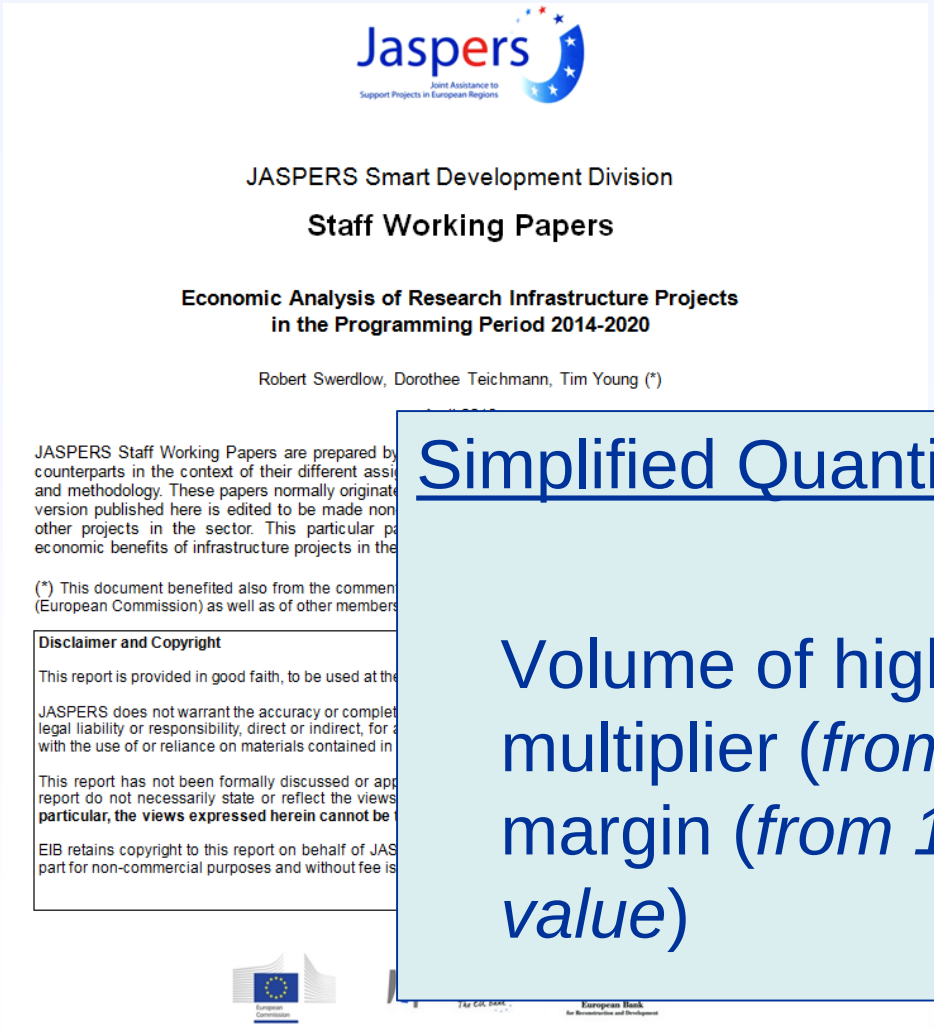
Annual average number of patents *
Market value of patent provided in EIB 2013 (=EUR 85,000)

Economic analysis: benefits to business III

Learning-by-doing benefits for the supply chain

- Benefits created for high-tech suppliers of non-off-the-shelf equipment that are involved in the design, construction or operation of the RDI infrastructure.
- Expected profit of suppliers can be proxied by the **volume of high tech procurement** (e.g. as share of the total investment cost)

Learning-by-doing benefits for the supply chain



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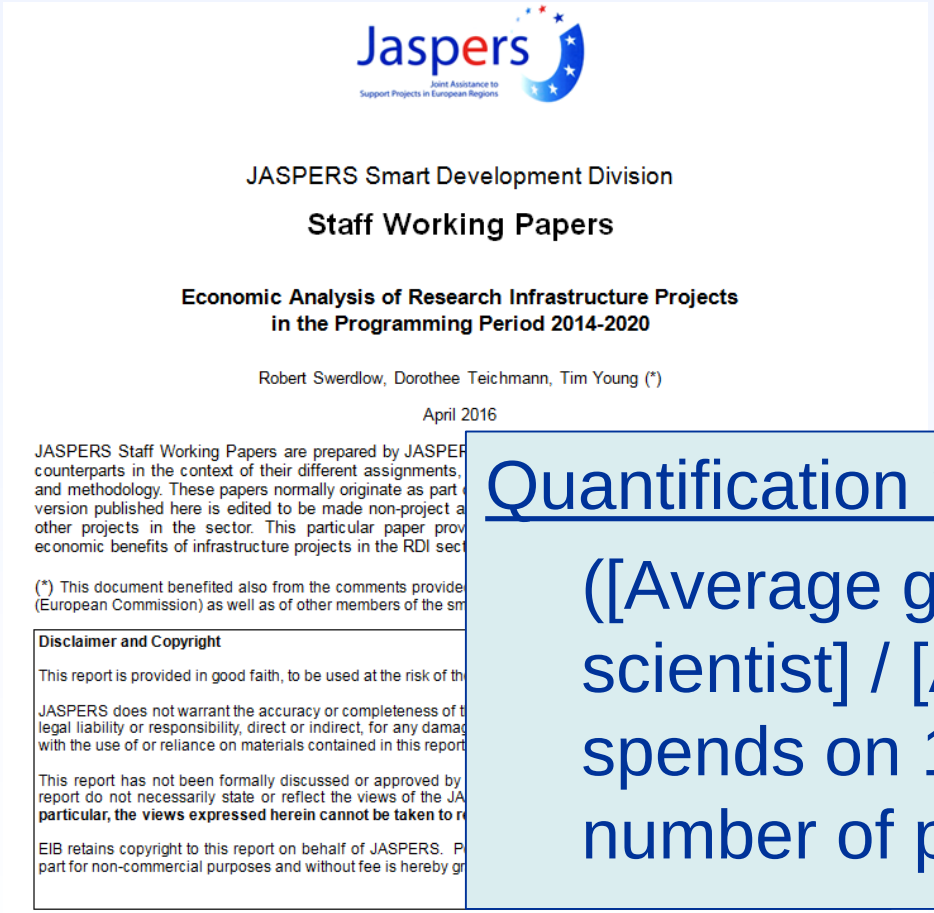
Simplified Quantification method

Volume of high-tech procurement * sales multiplier (*from 1 to 3*) * average profit margin (*from 1% to 10%, with 7% modal value*)

Economic analysis: benefit to researchers I

- **The benefit of "new research"**
- It is the value of new scientific publications of researchers who are users of the RDI project.
- **The value of new scientific publications** is estimated on their **marginal production costs** which is the salary of the author prorated by the time spent working on a publication.

Benefits due to “new research”



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Quantification method

([Average gross annual salary of scientist] / [Average time researcher spends on 1 publication per year]) * number of publications per year

Benefits due to “new research”

Data input and sources and calculation

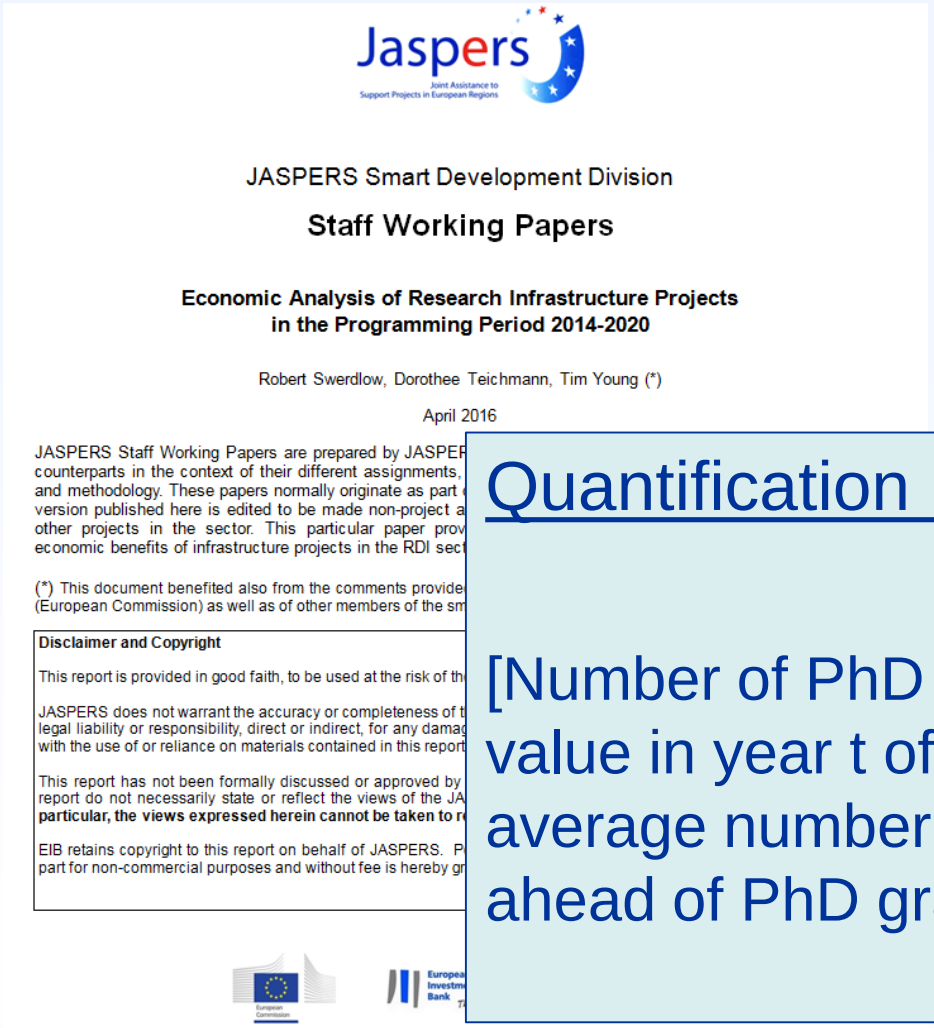
Data input	Unit	Sources	Values
Average gross salary of a scientist	EUR/year	Project specific	32,500
Calendar days required per average publication	Days	Project specific	90
Value of one publication	EUR	Calculation	8,008
Total average number of publications per year	Number	Project specific based on past track record of researchers	214
Total Economic benefit	**EUR**	**Calculation**	**1,713,712**

Economic analysis: benefit to researchers II

Human capital formation

The premium is **the incremental lifelong salary** earned by young researchers and students over their entire work career, as compared to the counterfactual

Benefits due to Human Capital Formation



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Quantification method

[Number of PhD graduates in year t] * [Present value in year t of incremental gross salary over average number of years of working career ahead of PhD graduates]

Benefits due to Human Capital Formation

Simplified example calculation for year 10

Main assumptions	
Annual salary without PhD (EUR/year)	15,000
Annual salary with PhD (EUR/year)	24,000
Annual salary deferential	9,000
Average length of career	35
PhDs gained by project researchers per year	25

Basic calculations of salary differential over *1* researcher's career

	Y11	Y12	Y13	Y14	Y15	…	Y45
NPV (5%)	9,000	9,000	9,000	9,000	9,000		9,000

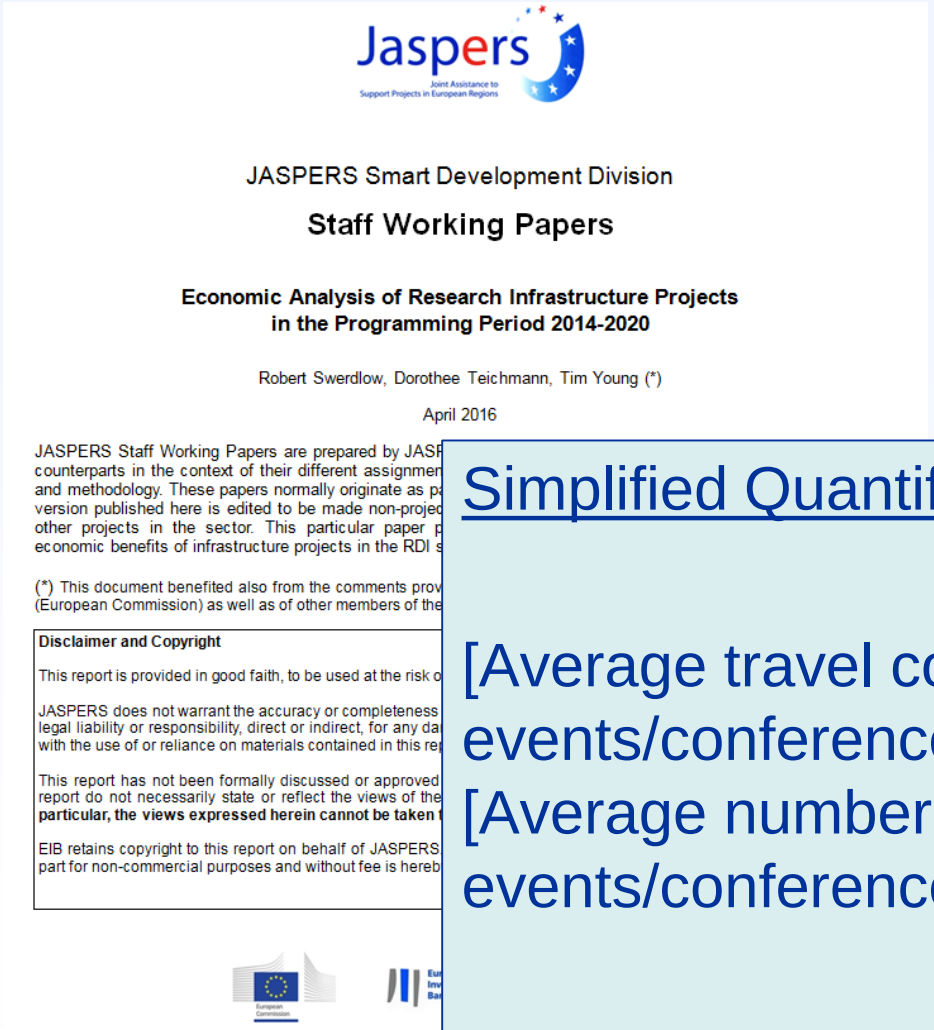
⇨ Multiply by 25

Economic analysis: benefit to researchers III

Social capital development

- Social capital in the context of research infrastructures as the **creation of networks between researchers and businesses**
- The value of the benefit can be proxied by the **Willingness to Pay of participants to attend events and conferences**

Benefits due to Social Capital Development



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Simplified Quantification method

[Average travel costs + Average events/conference fee paid by participants] * [Average number of attendees] * [N. of events/conferences organised per year]

Benefits due to Social Capital Development

Data input	Unit	Sources	Values
Average fee to attend networking event	EUR	Project specific	100
Average number of participants	#	Project specific	500
Average number of events per year	#	Project specific	3
Average travel cost	EUR	Project specific	150
Economic benefit in last year of reference period	**EUR**	**Calculation**	**375,000**

Costs necessary to organize the conferences are included in the operating costs of the project.

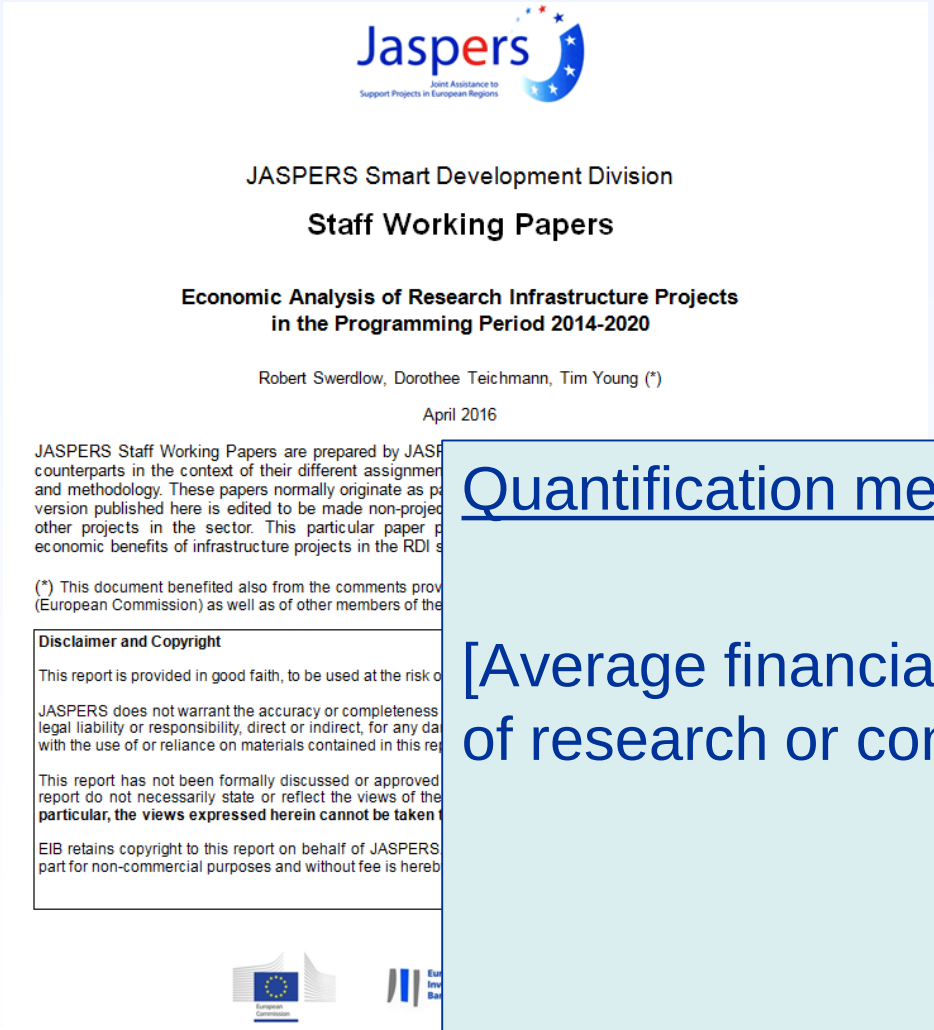
Economic analysis: benefit to researchers IV

Academic consulting and contract research

- It is increasingly common for universities to engage in **business orientated research activities** such as academic consulting and contract research.
- The value of the benefit can be proxied by the **financial revenues from these contracts with the private or public sector**.

WARNING: Attention to potential double counting with the value of patents granted!

Academic consulting and contract research



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Quantification method

[Average financial value per contract] * [Number of research or consultancy contracts]

Economic analysis: benefits to the general public I

- **Reduction of enviromental risks**

Some research infrastructures focused on programmes targeted at the reduction of enviromental risks (e.g. climate change, landslides, forest fires, etc.) and studing the mitigation measures.

- **Avoided fatalities and injuries** of the target population
- The estimation of **avoided damages to goods** incurred to repair or replace the damaged assets

The quantification of benefits related to reduction of enviromental risks is subject to high uncertainty

Economic analysis: benefits to the general public II

Reduction of health risks

Some research infrastructures focused on health related issues (e.g. hospital research laboratories, medical research facilities)

- As with standard health projects, the project's marginal benefit is **the reduction of mortality** or **morbidity rates**

The quantification of benefits related to reduction of health risks is subject to high uncertainty

Economic analysis: benefits to the general public III

Cultural effects for visitors

Some RDI infrastructures attract the interest of the general public and their management may have an outreach strategy to this end.

- The economic value of the benefit is the visitors' willingness to pay estimated via the **Travel Cost Method** *(including on site expenditures, e.g. bookshop, cafeteria, etc.)*

Open Access to the RI

By allowing external users to access the facility, research infrastructures promote the **mobility of researchers in the EU**.

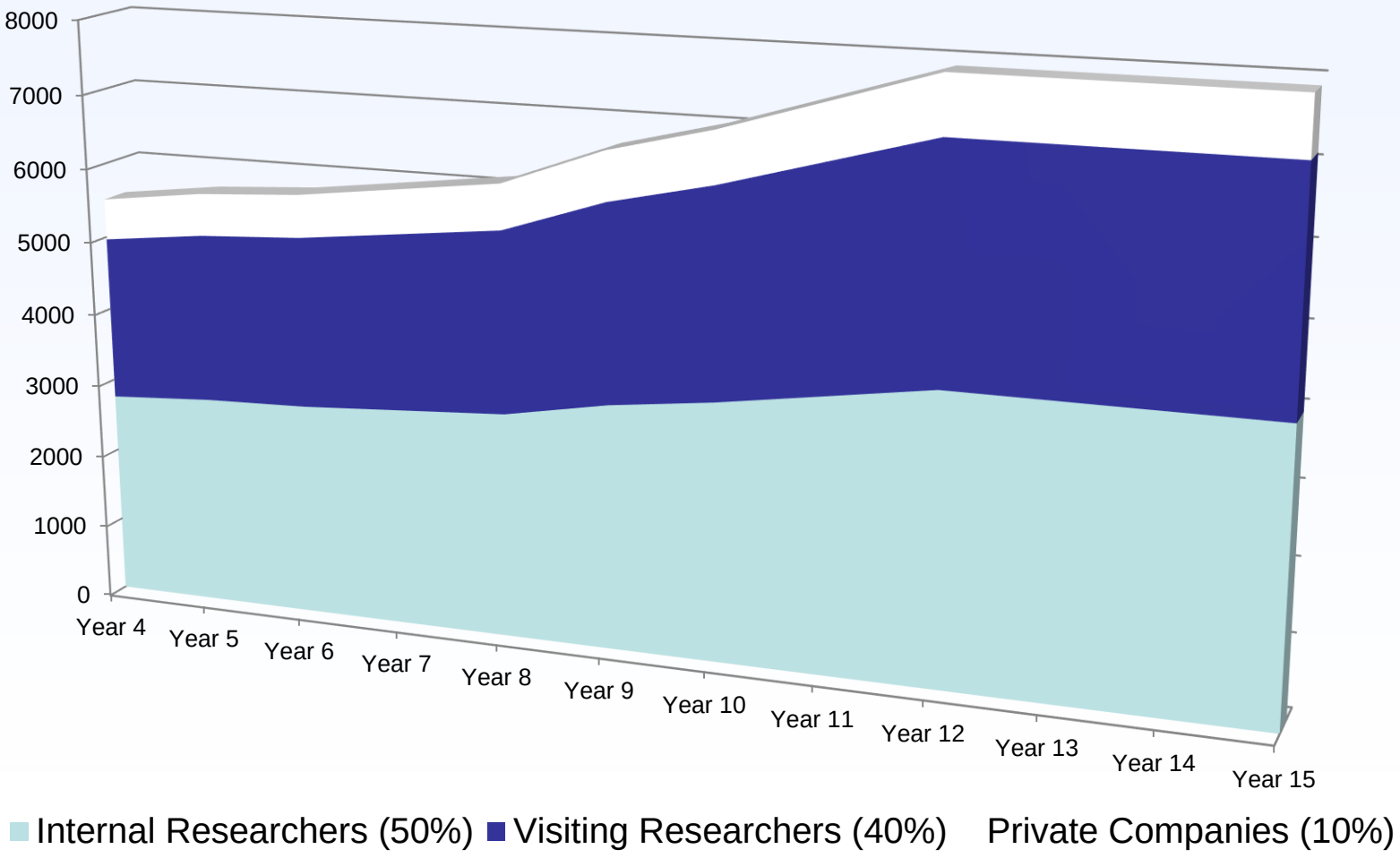
In order to quantify the economic benefits that arise from the access granted to visiting researchers, the **Use Value** of the research infrastructure needs to be quantified.

Two separate approaches for:

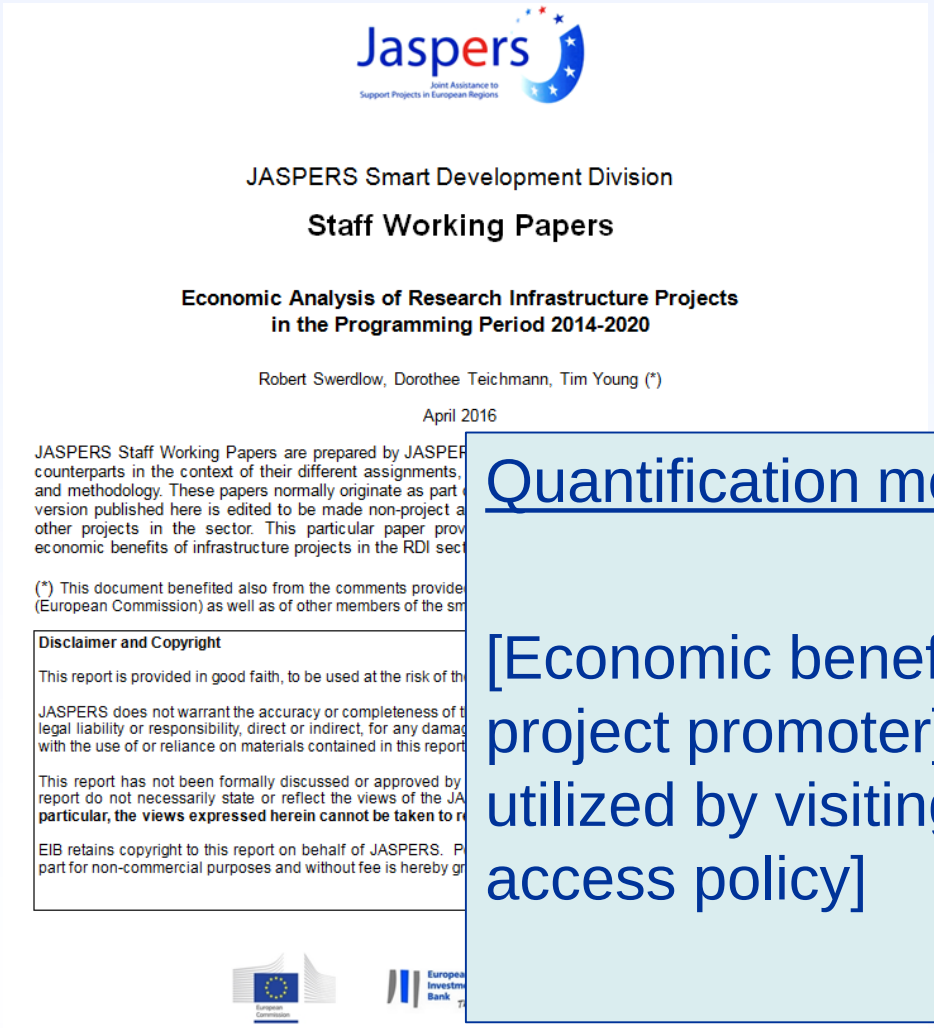
1. Public sector use of RI facilites (visiting researchers)
2. Private sector use of RI facilites (businesses)

Benefits due to Open Access to the RI

Use of facility (hours per year)



Open Access for visiting public researchers



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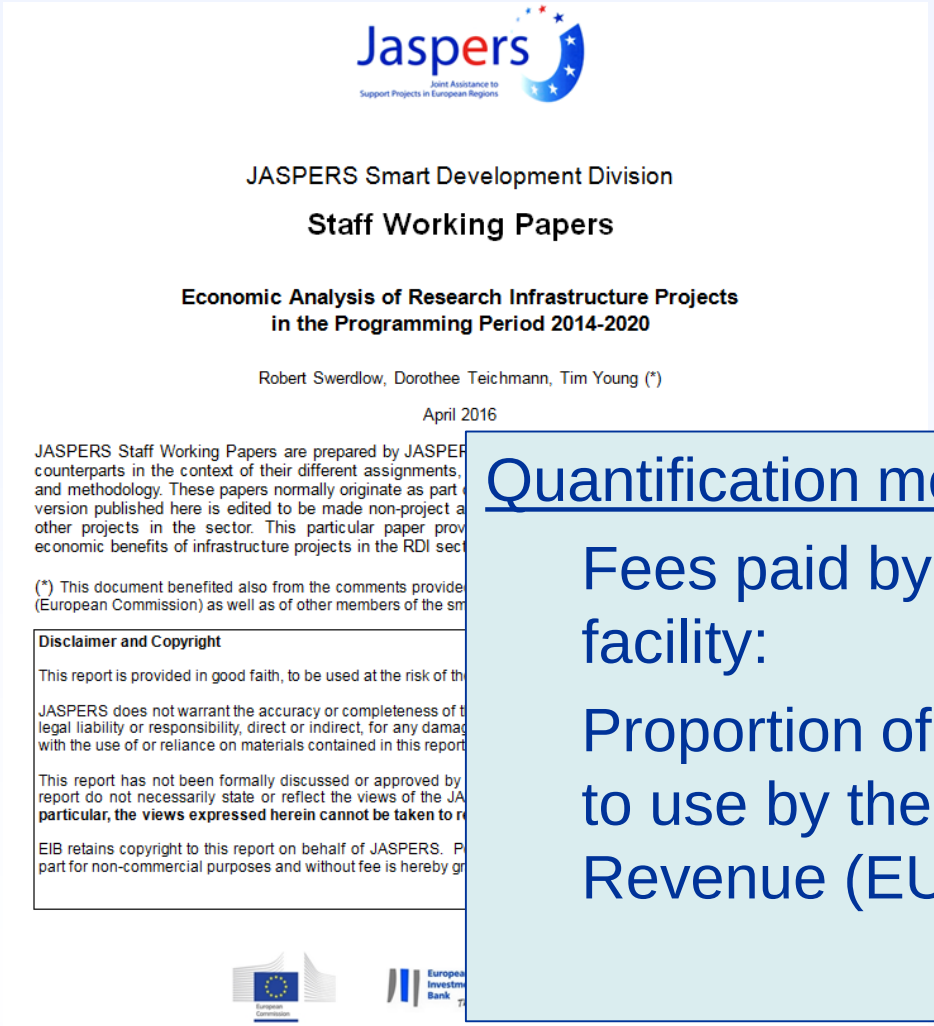
Quantification method

[Economic benefits per unit of capacity used by project promoter] * [Units of capacity to be utilized by visiting researchers under open access policy]

Open Access for visiting public researchers

Calculation for last year of reference period	
% of use by internal researchers	50%
% of use by additional visiting researchers	40%
Economic benefits created by internal researchers (publications and human capital development) in last year of reference period	EUR 9.8 million
Additional economic benefits created by visiting researchers in last year of reference period	EUR 7.9 million

Access to RI by private sector



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Quantification method

Fees paid by private sector for access to the facility:

Proportion of the facilities capacity devoted to use by the private sector (n. of hours)*
Revenue (EUR/h)

Climate Change and CBA Requirements

Inclusion of climate change in the CBA is required by Annex III of the Implementing Regulation;

1. **Mitigation and GHG emissions**:

   – CBA should take into account the costs/benefits related to GHGs emitted by the project

2. **Adaptation:**

   – Costs of measures aimed at enhancing the resilience of the project to climate change impacts included in the economic analysis; and
   – Benefits of those measures should be described qualitatively

Climate Change and CBA Mitigation

For RI projects, GHG emissions normally due to the building's use of **heat and electricity**. Calculation required:

1 2

Cost of GHG Emissions = [**Volume of GHG emissions**] * [**Unit shadow price of tCO2e**]

1) GHG emissions - follow The EIB Carbon Footprint Methodology:

CO_{2e} per year (in t) = Electric Energy Use * Country Electricity Grid Emissions Factor + Heat Energy Use* Project specific heat emission factor

2) Value for each tCO2e - follow the unit shadow price of carbon in CBA Guide

Economic Costs and Benefits Related to Climate Change

Mitigation

Data input	Unit	Sources	Values in last year of reference period
Cost of CO2 and other greenhouse gases	EUR/tCO2 equivalent	CBA guide, EIB data	35
Volume of emissions WITH PROJECT	tCO2 equivalent	Project specific	5,088
Volume of emissions WITHOUT PROJECT	tCO2 equivalent	Project specific	0
Change in greenhouse gas emissions attributable to projects	tCO2 equivalent	WTP	5,088
INCREASE - building-related COSTS	**EUR**	**Calculation**	**179,003**

Thank you!

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