



International Copper Study Group

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**Case Study of Regulatory Impacts on
Copper Use in Building Construction
within the European Union**

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Table of Contents

Executive Summary	4
1. Introduction	8
2. Methodical Background	9
2.1. Classification of Regulations	9
2.2. Regulations Potentially Affecting Copper Use in Building Construction	10
2.3. Types of Regulatory Impacts over the Product Life Cycle	11
2.4. Major Interest Groups Potentially Affected	13
3. Copper Use in Building Construction	14
3.1. Major Commodities and Applications	14
3.2. Selected Sectoral Data on Copper Use in Building Construction	16
3.3. Copper recycling from Construction and Demolition Waste	19
4. Identification of Impacts of Selected EU Regulations Affecting Copper Use in Building Construction	20
4.1. Case study 1 (Product Design): EU Harmonised Product Standards for Environmental Product Declarations and Building Assessment	20
4.2. Case Study 2 (Product Use): German Action Plan for Sustainable Water Management	26
4.3. Case Study 3 (Product End-of-Life Management): Working Document Management of Construction and Demolition Waste	30
5. Quantification of Regulatory Impacts	34
5.1. Methodical Challenges and Data Needs	34
5.2. Potential Sources of Data	34

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List of Figures

Figure 1: Potential points of impact of different types of regulations along the lifecycle of copper-bearing products illustrated for the EU building construction sector.....	12
Figure 2: Copper usage by end-use sector in Europe in 2001 [IWCC 2001].....	17
Figure 3: Share of Semis Production in Western Europe in 2000 [ICSG 2002].....	18
Figure 4: Estimated Share of copper semis in building construction in Western Europe 1998 [BME 2000]	18
Figure 5: Market trend in copper consumption for building construction in Western Europe [BME 2000] ⁴	19
Figure 6: Overview of potential regulatory impacts of EU harmonised product standards under the EU Construction Product Directive	24
Figure 7: Overview of potential regulatory impacts of the German Action Plan for Sustainable Water Management.....	28
Figure 8: Overview of potential regulatory impacts of the EU Working Document on Management of Construction and Demolition Waste	32

Executive Summary

The International Copper Study Group, at the request of its member governments and industry advisors, has been tasked to undertake a survey of regulations and initiatives that affect the use of copper products in major end use sectors. Benefits of this exercise include a better understanding of regulations in different countries and the identification of trends in regulation affecting copper-bearing products and applications. The objective of the case study is to identify impacts on product use as a result of regulations being introduced. The EU Building Construction Sector has been selected to develop and illustrate the approach exemplarily.

According to data from the International Wrought Copper Council, the sector of residential and non-residential building construction represented with a share of 46 % by far the most important copper end-use sector in Europe in the year 2001. In a recent study of Bloomsbury Mineral Economics (BME), it is estimated that copper use in building construction is expected to increase significantly from the 1990s level of around 1.8 Million tonnes reaching 2.6 Million tonnes in 2010.

Regarding copper recycling from buildings no reported official figures are available for Western Europe. According to the European Topic Centre on Waste and Material Flows, total Construction and Demolition Waste (C&D) amounted to 250 Million Tonnes in 1999. The ICSG Secretariat estimates the average copper content of C&D waste to be between 0.25 % to 0.30 % (including alloys). Total copper and copper alloy contained in C&D waste would then have been around 650,000 – 800,000 tonnes in 1999.

Case Studies

Three case studies are presented illustrating the methodical approach of the ICSG Secretariat for analysing the regulatory impact on copper-bearing products. For each regulatory case study a text box summary, a detailed description of regulation and associated impacts and a mapping of impacts over the product life cycle is provided. In the following, key issues affecting copper use are summarised. For a more detailed description and analysis of regulations please consult Chapter 4.

Case Study 1 (Product design): EU Harmonised Product Standards for Environmental Product Declarations and Building Assessment (Under consideration in the European Commission DG Enterprise – Construction Unit)

- EPDs and building assessments are not intended to establish black or green lists of building construction products. Nevertheless, harmonised standards enable architects and constructors to assess environmental performance of different products and solutions.
- The inclusion of water quality criteria in product and building assessment tools such as heavy metal content may restrict the use of copper plumbing and roofing due to public procurement considerations and material choice of end users.
- To carry out LCAs of building products, generic data for building materials such as copper will need to be provided for metals and/or semi-fabricated products.
- For copper, it has to be assured that any assessment considers the use phase appropriately as many of the environmental benefits and challenges are associated with the use of the product.

Case Study 2 (Product use): German Action Plan for Sustainable Water Management (Action plan as proposed in a study commissioned by the Environmental Federal Agency in Germany)

The proposed measure in the Action Plan may affect future copper usage in Germany through

- Promoting use of PE, PP and stainless steel plumbing tubes versus zinc-coated steel pipes and copper tube
- Discouraging use of copper tubes for supply of drinking water from domestic fountains
- Discouraging use of lead, zinc and copper as outdoor construction materials including roofing
- Informing architects, construction companies, plumbers and consumers on competitive and health advantages of alternative materials such as plastic, aluminium and stainless steel

Whether or not the proposed measures will be followed up with, has not been announced, yet. The recently released Strategy paper on “Sustainable Water Supply Germany” recommends the reduction of inflows of nutritious and hazardous substances without presenting detailed measures on sectors or applications

Case Study 3 (Product End-of-life management): Working Document Management of Construction and Demolition Waste (Under consideration in DG Environment addressing construction & demolition waste as priority waste stream

- Limit use of dangerous substances (e.g. heavy metals lead, cadmium, mercury)
- Promote re-use of heating, ventilation and air-conditioning equipment
- Restrict or ban the landfill of construction and demolition waste
- Demands selective dismantling and waste sorting in the light of the techniques available and of the local recovery system
- Establishes target recovery figures
- Demands public procurement policy for promoting use of recycled materials and products

Quantification of Impacts

Besides identifying potential impacts of a regulation being introduced, in many cases it is also important to quantify the associated economic, environmental and social effects including both benefits and challenges. The main objectives of such a quantification include to:

- Identify and weight relationships and cross-impacts,
- Carry out a preliminary evaluation (“screening”) of impacts,
- Support any ongoing or upcoming discussion process on regulations as such and/or regulatory features and
- Set priorities for further in-depth analysis.

For this purpose, it is necessary to develop a set of transparent, acceptable and meaningful indicators. The arising set of indicators can then be used to assess the status-quo and then to build an impact scenario and a reference scenario without regulation being introduced.

Recognising the complexity of regulatory impacts, both qualitative and quantitative indicators are needed. Whereas some impacts such as those associated with the design phase, installation and maintenance issues and health and safety considerations are often difficult to quantify, others are more easily to assess in theory. However, the selection of indicators has to take into account the availability of data and any issues related to necessary commercial confidentiality and competitiveness.

Using the previously introduced regulatory impact matrix as a starting point, a draft set of indicators for measuring potential regulatory impacts on copper usage has been developed (see Table 1) **The most important key indicator in any case would be the total tonnage of copper products affected.**

However, the proposed set of indicators can only lead to a preliminary assessment and identification of issues. Therefore, it should always be complemented with a more practice-oriented in-depth analysis of impacts including the consideration of regional, product and sector specific issues.

Table 1: Draft indicator set for measuring potential regulatory impacts on copper use

Key Field	Life Cycle	Issue	Indicator	Unit
Market structure	Design	Promotion of use	Qualitative	
	Supply	Commodity sales	Market size of copper-bearing product	[t Product affected]
	Use	Intensity of use	Use intensity of copper-bearing product	[t Product/unit]
	End-of-life	Recycled tonnage	Recycling Input Ratio (RIR)	[%]
Competitiveness	Design	Reputation and image among product designers	Qualitative	
	Supply	Competitiveness of producers	Value added of producers	[€/t Cu]
	Use	Competitiveness of products (vs. substitutes)	Product price	[€/t Cu product]
	End-of-life	Competitiveness of recyclers	Scrap price	[€/t Cu scrap]
International trade	Design	Product differentiation	Qualitative	
	Supply	Access to world market (export)	Export of copper-bearing product	[t Product]
	Use	Access to regulated area (import)	Import of copper-bearing product	[t Product]
	End-of-life	Transboundary scrap flows	Scrap import-export balance	[t Cu scrap]
Social issues	Design	Acceptance and appearance to users	Qualitative	
	Supply	Employment level in production stage	Number of Employees for production/manufacture	[n°]
	Use	Ease of installation and maintenance	Qualitative	
	End-of-life	Health & safety in use & disposal	Qualitative	
Environmental issues	Design	Recyclability	Theoretical Recycling Availability	[%]
	Supply	Energy efficiency	Energy use (LCA approach)	[kWh/unit]
	Use	Prevention of dissipation	Copper emission	[kg Cu/unit]
	End-of-life	Recycling efficiency	Recycling Efficiency Ratio (RER)	[%]

1. Introduction

The International Copper Study Group, at the request of its member governments and industry advisors, has been tasked to undertake a survey of regulations and initiatives that affect the use of copper products in major end use sectors. Benefits of this exercise include a better understanding of regulations in different countries and the identification of trends in regulation affecting copper-bearing products and applications.

Aiming at identifying existing and emerging policies, regulations and initiatives affecting copper-bearing products, the Secretariat pursues the following activities:

- Participating in international workshops, conferences and other events addressing regulatory issues
- Sending out questionnaires to members on regulations affecting copper use
- Maintaining a database of product-specific legislations
- Informing members on emerging regulatory issues of interest to copper
- Providing a discussion forum for member countries

In addition to these activities, members suggested that a case study on a selected commodity area be conducted. The objective of the case study is to identify impacts associated with regulations being introduced. The case study focuses on topics, such as:

- Develop a methodical approach for policy analysis from the copper point of view
- Identify key features of existing and forthcoming regulatory approaches and potentially affected commodities
- Identify substitute products, and if possible, competitive advantages & disadvantages
- Identify major impact routes and cause-effect-chains
- Map out impacts on product design, manufacture, use and end-of-life management
- Identify major benefits and impacts for a country in general and the copper sector in particular arising from implementation
- Identify of sources of information for quantifying benefits and impacts

In the following, an exemplary case study on the building construction sector in the EU is conducted. The objectives of this exercise include the following issues:

- Focus on one of the most important end use sectors and markets of copper
- Focus on recent regulatory developments of interest to copper
- Develop a methodical approach for policy analysis from the copper point of view
- Illustrate the methodical approach through a sample sector

The case study intends to focus on developing a methodical approach for carrying out this type of analyses. The Secretariat does not aim at influencing or participating in any ongoing discussion on a particular regulation between governments and industry represented by its industry associations. Also, it is neither intended to carry out a detailed juridical analysis of jurisdiction (e.g. in-country compatibility with other national or international regulations) nor to analyse efficiency of instruments of choice for implementation.

2. Methodical Background

2.1. Classification of Regulations

For the purpose of analysing the building construction sector, six different classes of regulations can be distinguished:

1. National policies or strategies affecting copper-based products, such as:
 - Policy for risk assessment of metals
 - Chemical policy for reducing use/releases
 - Public procurement policy
 - Recycling/waste policy
 - Product labelling
2. Regulations concerning transport of copper-based products/scrap/waste, such as:
 - Transboundary/regional/national movement
 - Specific taxes/tariffs/restrictions on copper-based products/scrap/waste
3. Regulations promoting, restricting or banning copper in end use sectors, such as:
 - Drinking water supply systems
 - Other plumbing (tubes/valves/fittings, etc.)
 - Heat exchanger
 - Roofing and architecture
 - Electrical and power distribution
 - Telecommunication systems
4. Regulations affecting recycling of copper from end-of-life products, such as:
 - Building construction & demolition waste
 - Electric and power distribution
 - Telecommunication systems
5. Regulations concerning removal of copper from waste prior to:
 - Treatment
 - Incineration
 - Landfill
6. Regulations establishing environmental quality standards for copper, such as:
 - Drinking/tap water
 - Ground water
 - Surface watersheds

2.2. Regulations Potentially Affecting Copper Use in Building Construction

In the following text box, a non-exhaustive list of major regulations/initiatives both in force and proposed/under consideration affecting use of copper in building construction within EU is provided.

Box 1: Non-exhaustive list of regulations affecting copper use in building construction within EU jurisdiction

In force:

- EU New Drinking Water Directive including national regulations transposing the EU directive into national jurisdiction.
- EU Risk Assessment Policy (new and existing substances)
- EU Technical Guidance Documents for risk assessment of new and existing substances
- EU and member states recycling/waste policies
- EU Construction Products Directive
- Sweden: Stockholm regulation on ban of copper in roofing
- Denmark: List of undesirable substances of the Ministry of Environment and Energy (including copper compounds for wood treatment and copper pipes for drinking water systems).

Proposed/under consideration:

- European Agreement Scheme for products and materials in contact with drinking water (in the context of the Construction Products Directive)
- Guidelines and Recommendations concerning Sustainable Construction (e.g. EU, Germany)
- EU Harmonised Product standards for Environmental Product Declarations (EPD) of building products and building assessments
- EU Working document on Management of Construction and Demolition waste
- EU Water Framework Directive (establishing environmental quality standards for lead; revision of list of priority substances in 2004)
- EU New Chemical Policy
- Proposed Directive on Energy Performance of Buildings
- Germany: Action Plan Sustainable water management ("Maßnahmenplan Nachhaltige Wasserwirtschaft") including recommendations for restricting use of copper tubes and roofing.
- The Netherlands: NEN standard on Material based Environmental profile for Buildings - MEPB ("Materiaalgebonden Milieuprofil van Gebouwen - MMG")

2.3. Types of Regulatory Impacts over the Product Life Cycle

Figure 1 illustrates exemplarily the points of impact within the lifecycle of a copper-bearing product. Whereas some regulations mainly focus on a particular lifecycle step, others address simultaneously different lifecycle stage. Many regulations can be classified according to whether they promote or challenge the use of copper through direct or indirect impact routes. However, it is worthwhile mentioning that a number of regulations include features that can be both detrimental and beneficial for copper usage in a particular end use sector.

Considering the variety in type and nature of impacts of regulations, Table 2 provides a classification scheme grouping key issues for each potential impact by key field and lifecycle step. Please note that the intended case study focuses on products and not processes. Therefore, regulations and corresponding impacts associated with production of copper, copper semis and/or end product manufacture are generally not included here. However, the sectoral contribution to the overall employment and the issue “energy efficiency” are included under the category “product supply”. The former is often used to describe one of the key social impacts of a product. To be meaningful in the context of products, the latter needs to follow a life cycle approach including production, use and end-of-life management of products. Regarding the environmental benefits and impacts of the use phase, the prevention of dissipation of copper into the environment is often used as an argument against copper use and should therefore be taken into account, here. Health and safety of building products is an important issue for both use phase and end-of-life management. Usually construction products are extensively tested for health and safety in use before admitted for sale into the market. In contrast, health and safety issues associated with recycling and disposal are less frequently taken into account. Therefore, regarding health and safety particular emphasis is placed on the end-of-life management stage in the proposed impact matrix.

Table 2: Matrix classifying impacts of regulations on copper use in an end-use sector

Lifecycle step: Key field:	Product design	Product supply	Product use	End-of-life management
Market structure	(promotion of use)	(commodity sales)	(intensity of use)	(recycled tonnage)
Competitiveness	(reputation & image)	(producers versus competitors)	(products versus substitutes)	(recycling versus disposal)
International trade	(product differentiation)	(access to world market: export issues)	(access to regulated area: import issues)	(transboundary scrap flows)
Social issues	(acceptance & appearance)	(employment level)	(installation & maintenance)	(health & safety)
Environmental issues	(recyclability)	(energy efficiency)	(prevention of dissipation)	(recycling efficiency)

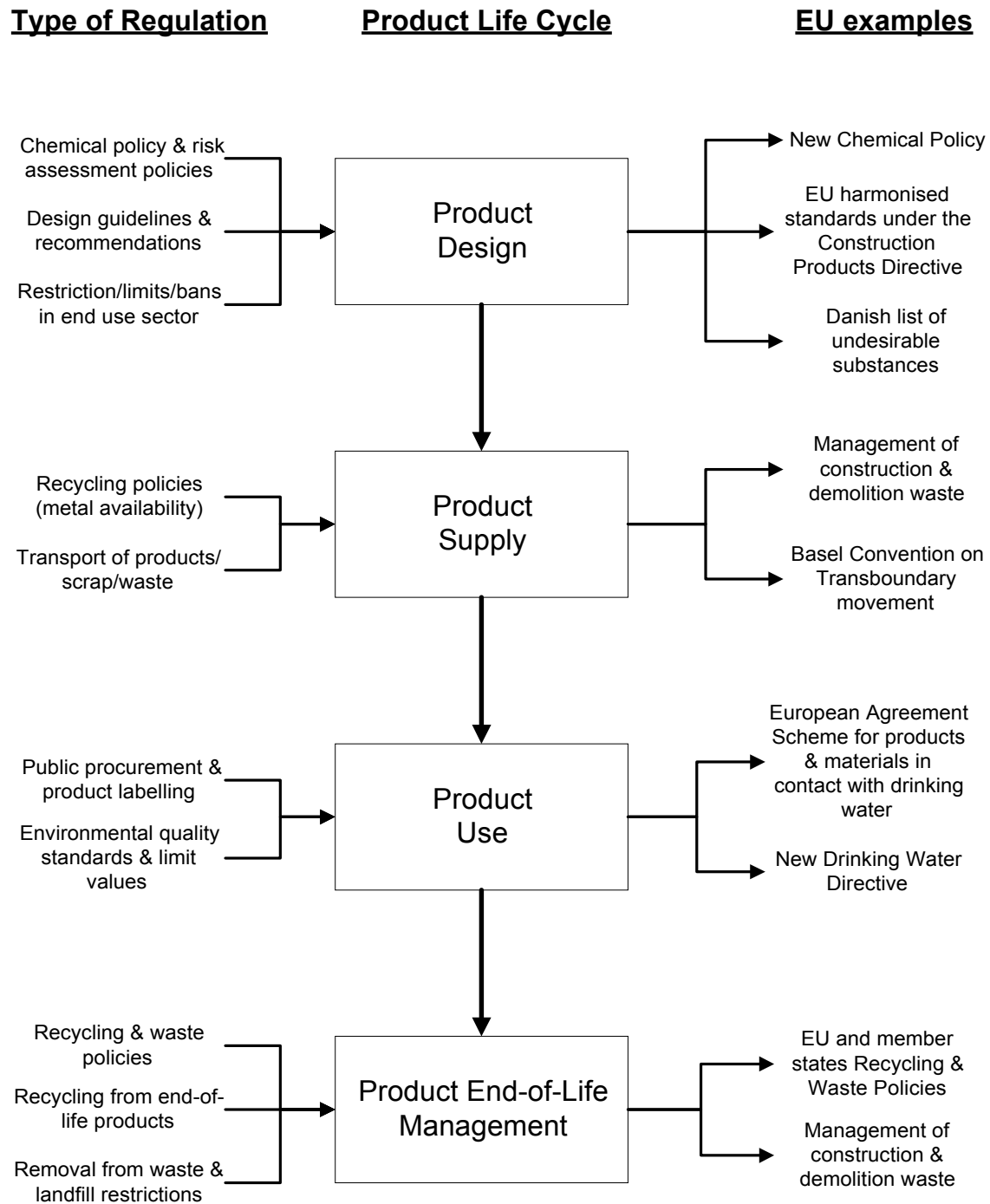


Figure 1: Potential points of impact of different types of regulations along the lifecycle of copper-bearing products illustrated for the EU building construction sector

2.4. Major Interest Groups Potentially Affected

Major interest groups involved in building construction from the copper perspective include interest groups over the entire lifecycle of copper-bearing products, such as:

Product design

- Architects
- Building-product designers

Production

- Ingot makers and foundries
- Brass mill operators
- Wire & cable producers
- Building-product manufacturers
- Building-product suppliers

Product use

- Construction companies
- Roof builders
- Plumbers
- House owners
- Public Procurement Agencies

End-of-life management

- Demolition companies
- Recycler/scrap dealers
- Waste disposal site operator

3. Copper Use in Building Construction

3.1. Major Commodities and Applications

In the following box a list of major copper-bearing products used in building construction is compiled.

Box 1: Copper-bearing products in a building

Air Conditioning & refrigeration systems (ACR tube)	Fire sprinklers
Architectural Features	Gas distribution systems
Architectural Hardware	Plumbing tube
Boilers	Radiators, heating & heat exchangers
Building wire	Roofing, Flashing, Gutters
- Electrical wire	Solar energy systems
- Ground wire	Solders, valves, fittings
- Communication wire	Water drainage system (drain, waste, ventilate tube – DWV tube)

3.1.1. Building Wire

Building wire usually comprises all electrical conductors within or on residential and non-residential buildings including electrical cable, communication wiring and grounding wire. Recognising the high electrical conductivity of copper, copper has been the material of choice for building wire in many countries. Therefore, building wire represents the most important copper market within the construction sector.

The main competitor of copper in this end use, aluminium, is mainly used in the service entrance cable, whereas copper wire is applied for distributing electricity within the building. In building construction, wire sizes generally range from 2 mm² (AWG 14) through cross sectional areas of 375 mm² (740 kcmil). In some publications, a distinction between building wire and power cable is carried out. Whereas core sizes < 35 mm² and < 1 kV are referred to as “building wire”, power cable core sizes are usually considered to be > 35 mm² and > 1 kV. In communication and signal transmission, wires are usually of AWG 22 size. In residential circuits common wire sizes vary between AWG 12 and AWG 14.

3.1.2. Potable Water Systems, Water drainage systems and Heating applications

For water distribution, circulation, heating and drainage, copper tubes and fittings are widely used for hot and cold domestic water and central heating systems and appliances (“plumbing tube”). Furthermore, copper tube is utilised for drain, waste and ventilate tubes (“DWV tubes”), which serve as soil stacks, vent stacks and branches. Cast brasses and bronzes are preferred for water circulation and distribution valves. Many other valves, faucets and some fittings are often made of brass.

3.1.3. Commercial/Industrial Tube for Air Conditioning and Refrigeration

Copper represents an important material for air conditioning condensers and evaporators. In this context, commercial copper tube (“ACR tube”) and other copper semis are used for heat transfer surfaces, tubing, motor windings, electrical controls, and valves and fittings. Furthermore, many gas distribution systems for natural and liquefied petroleum gas,

manufactured gas and medical gas rely on copper tubes. For fire sprinkler systems, copper and copper alloys are increasingly selected for tubes, joints and solders.

3.1.4. Roofing, Flushing, Gutters

Copper is used in roofs, built-in gutters and down-pipes and other decorative architectural features on both old and new buildings. In many applications copper is the material of choice due to its attractiveness and its resistance to extreme weather conditions such as heavy snowfall and wide temperature ranges. Major competing materials include the metals lead, zinc and steel as well as other materials such as shingles, slate, clay and tiles. The main copper semis used for roofing, flushing and gutters is copper sheet.

3.1.5. Other Applications

Copper and copper alloys are also used in the wide range of architectural features and hardware. Major interior design fixtures and decorative objects include, among others, handles, doorknobs, plates and lock cylinders. Furthermore, the use of copper in boiler systems and solar energy systems is worthwhile mentioning, highlighting copper's superior electrical and thermal conductivity.

Table 3 provides an overview of major applications, copper commodities used, benefits, challenges and competing materials in building construction.

Table 3: Benefits and challenges of copper in building construction products

Copper product	Main commodity	Major Benefits	Major Challenges	Competing materials
Roofing, flushing (leaders), gutters	Copper sheet	Appearance, Corrosion resistance, Stability (against snow fall) Temperature resistance (less expansion & contraction) Longevity Ease of installation & maintenance	Copper contained in water run-off	Roofing: Shingles, cedar shingles, slate, tile, clay Metals: galvanized steel, zinc, lead Flushing: Aluminium, Galvanized steel
Commercial tube (ACR, radiators & heating, gas distribution solders, fittings, valves, boilers)	Copper & alloy tube, Brass rod (valves, fittings)	Thermal conductivity, Corrosion resistance, Strength, Pressure tightness, Formability, Ease of installation & maintenance	ACR: Ammonia-based systems, Low income levels in many "warm-weather" countries	ACR: Plastic (CPVC tube, PEX tube, rubber hose tube) Radiators: Aluminium, steel
Plumbing tube (potable water systems)	Copper tube	Versatility, Durability,	Limit value of copper in potable water,	Plastic, galvanised steel

Copper product	Main commodity	Major Benefits	Major Challenges	Competing materials
		Strength, Biostatic effects, Biofouling resistance, Corrosion resistance (suitable waters), Temperature & pressure resistance, Longevity, Ease of installation & maintenance	Water hardness, Soft, acidic waters, Internal pitting, Scaling	
Fire sprinklers	Copper tube	Corrosion, pressure, heat & fire resistance, Ductility, Low maintenance		Steel, Plastic
Building wire	Copper wire & cable	Electrical conductivity, Strength, Ductility, Corrosion resistance, Thermal conductivity Longevity	Short-term Economic considerations	Electrical transmission: Aluminium Communication: Optical fibre, wireless communication

3.2. Selected Sectoral Data on Copper Use in Building Construction

Total semis production in Western Europe (including EU 15, Switzerland and Norway) amounted to close to 6 Million tonnes of copper, brass and alloy semis including wire & cable production in the year 2000. Main end-use sectors of copper in Europe are summarized in Figure 2. According to data from the IWCC, the sector of residential and non-residential building constructions including building wire represented with a share of 46 % by far the most important copper end-use sector in Europe in the year 2001.

Figure 3 illustrates that overall semis production in Western Europe is dominated by wire & cable followed by bars/rods/shapes and to less extent by plates/sheets/strips and tubes [ICSG 2002]. Whereas Western Europe can be regarded as self-sufficient in terms of tube and sheet production, around 10% of market share of wire & cable consumption have been imported from abroad in the year 1999.

According to Bloomsbury Mineral Economics (BME), copper use in building construction can be estimated to be around 2.1 Million tonnes of copper in 1998. The share of copper semis in building construction in Western Europe 1998 is illustrated in Figure 4. Energy cable and

copper tube account for the most important shares of overall semis use in building construction [BME 2000]¹.

According to the same source, copper use in building construction is expected to increase significantly from the 1990s level of around 1.8 Million tonnes reaching 2.6 Million tonnes in 2010. The increase in copper usage for wire & cable maybe attributed largely to an increasing demand of residential communications wiring and common building wire core sizes switching from AWG 14 to AWG 12 while meeting the need for increased loads in both new construction and remodelling of existing building structures. Further growth potential of copper in building construction may include, among others, increase in demand for copper sheet for solar energy systems, and for copper tube for fire sprinklers, air conditioning, heat exchangers and gas distribution pipes.

The European building wire and cable market is currently dominated by the companies Pirelli, Nexans, and Draka. The largest suppliers of the copper tube and copper sheet market include KME Group, Wieland, Outokumpu, Boliden Brass, Yorkshire Copper Tube and Prymetall (Norddeutsche Affinerie).

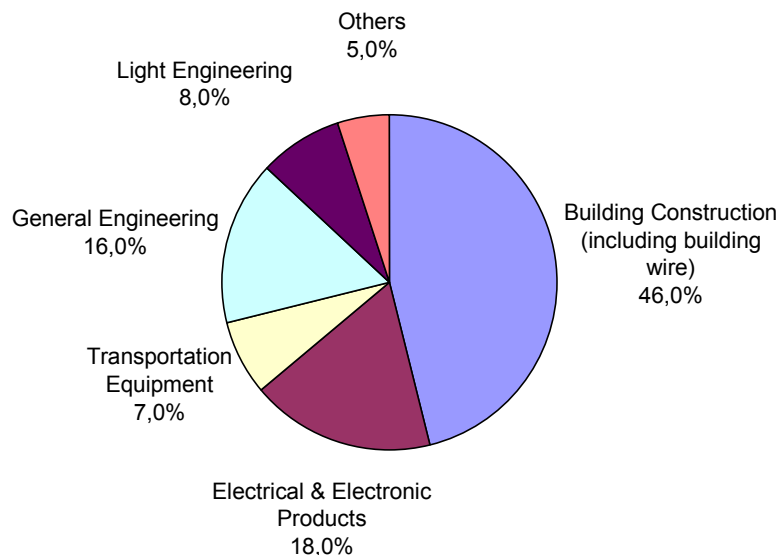


Figure 2: Copper usage by end-use sector in Europe in 2001 [IWCC 2001]²

¹ BME – Dewison, Paul (2000): Longterm Outlook for Copper. Volume 1: macroeconomic & Consumption Data. Bloomsbury Minerals Economic Ltd., UK, February 2000.

² IWCC – International Wrought Copper Council (2001): Major uses of Copper: Consumption by End-use Sector. Provisional Information from IWCC, UK 2001.

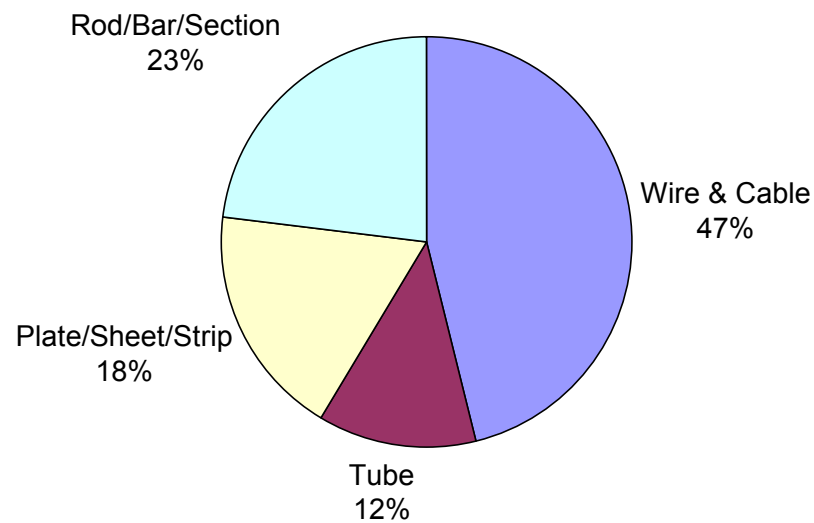


Figure 3: Share of Semis Production in Western Europe in 2000 [ICSG 2002]³

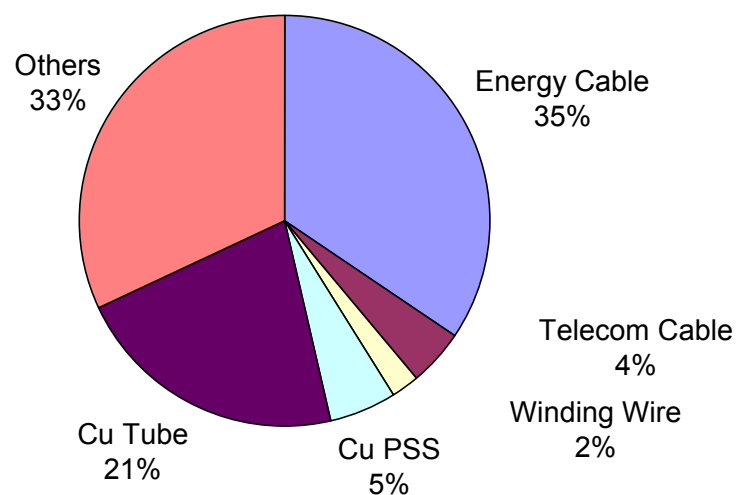


Figure 4: Estimated Share of copper semis in building construction in Western Europe 1998 [BME 2000]⁴

³ ICSG – International Copper Study Group (2002): Statistical data on semis fabrication in Western Europe for the year 2000. ICSG, Lisbon, Portugal, 2002.

⁴ BME – Dewison, Paul (2000): Longterm Outlook for Copper. Volume 1: macroeconomic & Consumption Data. Bloomsbury Minerals Economic Ltd., UK, February 2000.

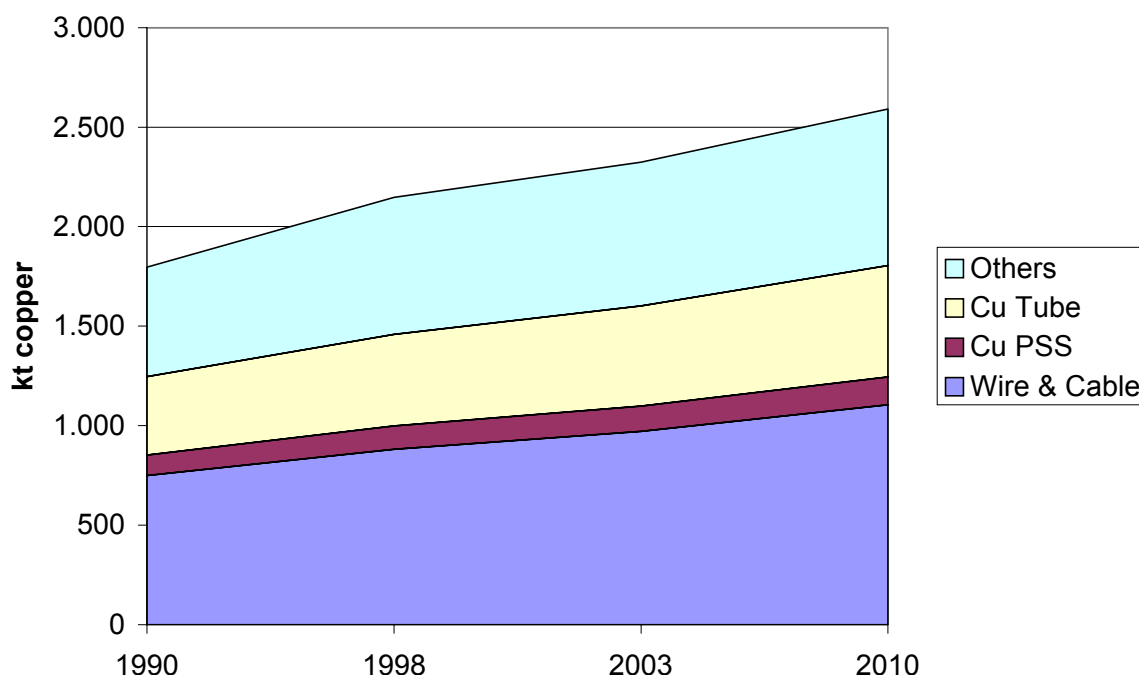


Figure 5: Market trend in copper consumption for building construction in Western Europe [BME 2000]⁴

3.3. Copper recycling from Construction and Demolition Waste

Regarding copper recycling from buildings no reported figures are available for Western Europe. According to the European Topic Centre on Waste and Material Flows, total Construction and Demolition Waste (C&D) amounted to 250 Million Tonnes in 1999 [ETCW 2002]⁵.

The ICSG Secretariat estimates the average copper content of C&D waste to be between 0.25 % to 0.30 % (including alloys). Total copper contained in C&D waste would then have been around 650,000 – 800,000 tonnes of copper & copper alloys in 1999.

The actual recycling rate of copper will depend on a variety of factors such as collection efficiency, dismantling, separation and recovery technology, as well as economic and environmental considerations.

According to information from the European Commission background documents on waste recycling in the building sector complemented by data from the Federal National Environmental Agencies and the European Topic Centre for Waste, the overall collection and recycling rate for construction and demolition waste materials may have been only around 50% as a Western European average. However, the material-specific rate for metals in general and copper-bearing products in particular can be expected to be significantly higher than that as many of the copper materials such as copper roofing and plumbing materials are usually selectively dismantled prior to the demolition of the buildings.

⁵ ETCW – European Topic Centre on Waste and Material Flows: Waste statistic [<http://waste.eionet.eu.int>], 2002.

4. Identification of Impacts of Selected EU Regulations Affecting Copper Use in Building Construction

Three case studies are presented illustrating the methodical approach of the ICSG Secretariat for analysing the regulatory impact on copper-bearing products.

- Case Study 1 (Product design): EU Harmonised Product Standards for Environmental Product Declarations and Building Assessment
- Case Study 2 (Product use): German Action Plan for Sustainable Water Management
- Case Study 3 (Product End-of-life management): Working Document Management of Construction and Demolition Waste

For each regulatory case study the following information is provided:

- Text box summary
- Detailed description of regulation and impacts
- Mapping of impacts over the product life cycle
- Impact classification matrix

4.1. Case study 1 (Product Design): EU Harmonised Product Standards for Environmental Product Declarations and Building Assessment

Box 2: Harmonised Product Standards for Environmental Product Declarations (EPDs) and Building Assessment under the Construction Products Directive

Under consideration in the European Commission DG Enterprise – Construction Unit

Main objectives

- EPDs are used for communication purposes and product comparisons. Additionally, used as input for environmental building assessments enabling informed decision making on products and building components.
- A European harmonised EPD scheme under the Construction Products Directive would allow stakeholders to share environmental information on building materials, and ensure and facilitate the free transboundary circulation of building products.
- Harmonisation would also reduce administration and marketing costs of industry.

Copper-specific issues

- EPDs and building assessments are not intended to establish black or green lists of building construction products. Nevertheless, harmonised standards enable architects and constructors to assess environmental performance of different products and solutions. The selection of system boundaries and impact categories may impact the use of copper-bearing products.
- The inclusion of water quality criteria in product and building assessment tools such as heavy metal content may restrict the use of copper plumbing and roofing due to public procurement considerations and material choice of end users.
- To carry out LCAs of building products, generic data for building materials such as copper will need to be provided for metals and/or semi-fabricated products. Sources of

information would include industry associations or existing commercial available LCA databases.

- The proposed building assessments include provisions to include local conditions, health and safety considerations as well as criteria regarding the indoor environment.
- For copper, it has to be assured that any assessment considers the use phase appropriately as many of the environmental benefits and challenges are associated with the use of the product.

Major stakeholder groups affected

- Building material suppliers
- Building construction product manufacturers
- Building construction companies
- Architects

Implementation (next steps)

- Selection of a preferred scenario for harmonisation and
- Definition of objectives and scope of the mandate for CEN to develop the standards
- Two scenarios for harmonisation are currently considered:

⇒ EU harmonized EPD scenario: This mandatory approach on product-level would focus on transparent and comparable environmental communication to overcome market barriers. It would require a mandate of the European Commission to CEN to include EPD into the harmonised standards of Construction Products Directive (CPD) and would be widely based on ISO documents such as ISO TC 59.

⇒ Environmental Eurocodes scenario: This represents a semi-mandatory approach on building level to develop reliable overall environmental performance assessments of buildings and construction works. It needs a mandate of the European Commission to CEN to develop a Pre-Standard for an environmental building assessment including LCA impacts of construction materials and products.

The EU Construction Products Directive (CPD) sets a framework for the performance of constructions by defining essential requirements these products have to fulfil. The essential requirements n° 3 "Hygiene, health and the Environment" and n° 6 "Energy economy" may impact the use of copper-bearing products in building construction.

In recent years a number of Environmental Product Declaration (EPD) schemes to evaluate the environmental performance of building products using a life cycle approach have emerged in various member countries of the European Union.

Recognizing the potential market barrier of these differing schemes, the European Commission (DG Enterprise – Construction Unit) organised a workshop on LCA tools in building construction in September 13, 2002. Approximately 50 experts in the field of building construction, regulators and LCA practitioners from various European countries and with various backgrounds (construction industry, scientific institutes, standardisation organisations, governments) attended. The objective of this workshop was to obtain feedback on the draft outcomes of the PriceWaterhouseCoopers study "Comparative study of national schemes aiming to analyse the problems of LCA tools (connected with e.g. hazardous substances) and the environmental aspects in the harmonised standards. Draft outcomes of the study consist of a number of scenarios which may lead to harmonisation of LCI/LCA based schemes for construction products as well as the technical aspects of

harmonisation. The scenarios are elaborated in detail taking into account the goals, actors, input, drivers, bottlenecks, steps and time horizon as well as strengths and weaknesses of each approach.

In the construction sector, EPDs are used for communication purposes and product comparisons. Additionally, EPDs may be used as input for environmental building assessments enabling informed decision making on products and building components. Developed and proposed national EPD schemes and/or building assessments differ significantly. A European harmonised EPD scheme would allow stakeholders to share environmental information on building materials, and ensure and facilitate the free transboundary circulation of building products. Harmonisation would also reduce administration and marketing costs of industry.

In the study, two scenarios for harmonisation are elaborated:

- **EU Harmonized EPD Scenario:** This mandatory approach on product-level would focus on transparent and comparable environmental communication to overcome market barriers. It would require a mandate of the European Commission to CEN to include EPD into the harmonised standards of Construction Products Directive (CPD) and would be widely based on ISO documents such as ISO TC 59.
- **Environmental Eurocodes Scenario:** This scenario represents a semi-mandatory approach on building level to develop reliable overall environmental performance assessments of buildings and construction works. It needs a mandate of the European Commission to CEN to develop a Pre-Standard for an environmental building assessment including LCA impacts of construction materials and products.

From the copper point of view, the following issues may be of special importance inside and outside of Europe:

- EPDs and building assessments are not intended to establish black or green lists of building construction products. Nevertheless, harmonised standards enable architects and constructors to assess environmental performance of different products and solutions. The selection of system boundaries and impact categories may impact the use of copper-bearing products. In two existing national schemes issues regarding water quality are addressed. Whether or not water quality will be included as an impact category for the harmonised scheme remains open. In this context, concentration levels of copper in drinking and waste water may become an issue. The inclusion of water quality criteria such as heavy metal content may restrict the use of copper plumbing and roofing due to public procurement considerations and material choice of end users.
- To carry out LCAs of building products, generic data for building materials such as copper will need to be provided for metals and/or semi-fabricated products. Sources of information would include industry associations or existing commercial available LCA databases.
- In principle, the proposed recycling approach is beneficial for recycled materials such as metals. It foresees not to include an environmental burden for recycled materials deriving from their previous primary production.
- The proposed building assessments include provisions to include local conditions, health and safety considerations as well as criteria regarding the indoor environment.

- The energy efficiency consideration (essential requirement n° 6) may impact the use of copper in heating and air conditioning systems and benefit copper use in solar energy systems.
- To be consistent with the life-cycle approach, any assessment has to follow a “cradle-to-grave” approach and not a “cradle-to gate” approach. In practice, this means that the use, recycling and disposal phase has to be considered appropriately. This may become a crucial issue for copper as most of the competitive advantages as well as environmental benefits and challenges are associated with the product use.

Next steps of the European Commission include the selection of a preferred scenario for harmonisation and the definition of objectives and scope of the mandate for CEN.

The regulatory impact on copper usage will strongly depend on methodical decisions that have not been taken, yet, such as how to include toxicological aspects and how to consider appropriately the benefits and impacts from the use phase and the recycling step including considerations regarding longevity and recyclability of copper products.

For the purpose of this analysis, it is suggested that the final standards and assessment will eventually build on existing national approaches such as the fairly advanced “MRPI”⁶ and “MEPB”⁷-schemes in The Netherlands or the EPD schemes under development in the United Kingdom (“BRE”) and Finland.

In a recent report on the Dutch schemes, a number of metal-relevant shortcomings have been identified⁸. The most important ones (being also relevant for the other schemes under development) are that:

- The emissions of copper and zinc are evaluated using inappropriate characterization factors leading to a relatively large impact on the environmental profile, and
- The allocation method for benefits and impacts associated with the use of secondary materials has not been clearly defined, yet.

If these challenges are not appropriately addressed in the European Scheme, the introduction of EU Harmonized Environmental Product Declarations may discourage copper use in building construction in the future.

⁶ MRPI: Milieu Relevante Product Informatie – Environmentally Relevant Product Information

⁷ MEPB: Material Based Environmental Profile for Buildings

⁸ Ligthart, T.N. and Korenromp, R.H.: Evaluation of Environmental Declarations for Building Products. TNO-Report R 2002/683, December 2002.

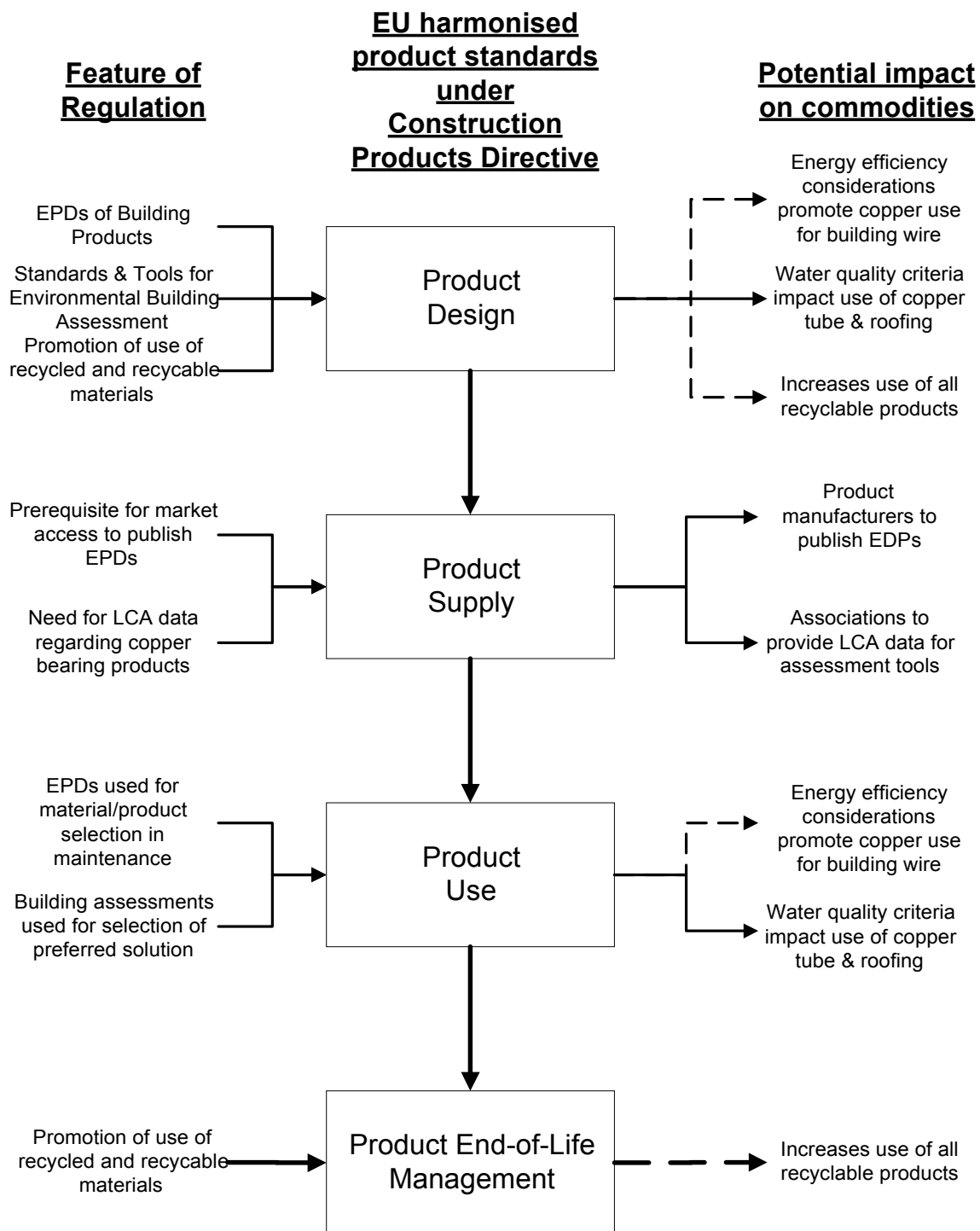


Figure 6: Overview of potential regulatory impacts of EU harmonised product standards under the EU Construction Product Directive

Table 4: Potential Regulatory Impacts of EU Harmonised Product Standards

Key Field	Life Cycle	Issue	Copper Usage					Remarks
			[--]	[-]	[0/?]	[+]	[++]	
Market structure	Design	Promotion of use						
	Supply	Commodity sales						Less use if copper characteristics not appropriately considered
	Use	Intensity of use						
	End-of-life	Recycled tonnage						
Competitiveness	Design	Reputation and image among product designers						See above
	Supply	Competitiveness of producers						
	Use	Competitiveness of products (vs. substitutes)						See above
	End-of-life	Competitiveness of recyclers						
International trade	Design	Product differentiation						
	Supply	Access to world market (export)						
	Use	Access to regulated area (import)						EPD as potential market barrier
	End-of-life	Transboundary scrap flows						
Social issues	Design	Acceptance and appearance to users						
	Supply	Employment level in production stage						
	Use	Ease of installation and maintenance						
	End-of-life	Health & safety in use & disposal						Biostatic benefits not considered
Environmental issues	Design	Recyclability						Pressure on designers and producers to develop more environmentally sound products
	Supply	Energy efficiency						
	Use	Prevention of dissipation						
	End-of-life	Recycling efficiency						

4.2. Case Study 2 (Product Use): German Action Plan for Sustainable Water Management

Box 2: German Action Plan for Sustainable Water Management

Action plan as proposed in a study commissioned by the Environmental Federal Agency (Umweltbundesamt) Germany in 1999

Main objectives

- Identify strategies and actions for sustainable water management
- Identify actions for reducing input of nutrients and hazardous substance including heavy metals in water bodies
- Identify specific potential measures for environmental problem areas considering existing environmental objectives

Copper-specific issues (proposed measures)

- Promote use of PE, PP and stainless steel plumbing tubes versus zinc-coated steel pipes and copper tube
- Discourage use of copper tubes for supply of drinking water from domestic fountains
- Discourage use of lead, zinc and copper as outdoor construction materials including roofing
- Inform architects, construction companies, plumbers and consumers on competitive and health advantages of alternative materials such as plastic, aluminium and stainless steel

Major stakeholder groups affected

- Brass mills
- Architects
- Plumbers
- Construction companies
- Public procurement offices

Implementation

Next steps include:

- Study under way to develop concept for target group oriented communication of benefits of sustainable water management
- Strategy paper on “Sustainable Water Supply Germany” recommends the reduction of inflows of nutritious and hazardous substances without presenting detailed measures on sectors or applications

According to the Federal Agency of the Environment, sustainable water management is defined as an integrated management of anthropogenic and natural water circuits considering three key objectives:

- Long-term protection of water bodies as important ecosystems
- Supply of water resources to present and future generations
- Development of options for a durable, environmentally sound, economic and social development

The Action Plan for Sustainable Water Management (1999) has been commissioned to identify problematic field of water management and to propose potential actions and measures for improving the current situation. Proposed measures are compiled in data sheet format including information such as summary of measure, identification of problem area, suitable instrument type, actors, environmental impacts addressed, timelines and cost-benefit considerations. Actions with special relevance for copper include:

- Discourage use of lead, zinc and copper as outdoor construction material to reduce diffuse contamination of water bodies and water treatment plants.
- Promote use of plastic and stainless steel pipes against zinc-coated steel pipes and copper tube in drinking and other sanitary water installations to reduce contamination of sewage sludge.

According to the action plan, both actions should be addressed through “informative instruments” following a voluntary approach aiming at both discouraging use of copper in product design and promoting competitive products at the use level.

Outline, objectives and cost-benefit considerations of these potential measures have been heavily criticized by industry. The new strategy paper on “Sustainable Water Supply in Germany” (2001) recommends the reduction of inflows of nutritious and hazardous substances to water bodies and water treatment plants without presenting detailed measures on sectors or applications, yet.

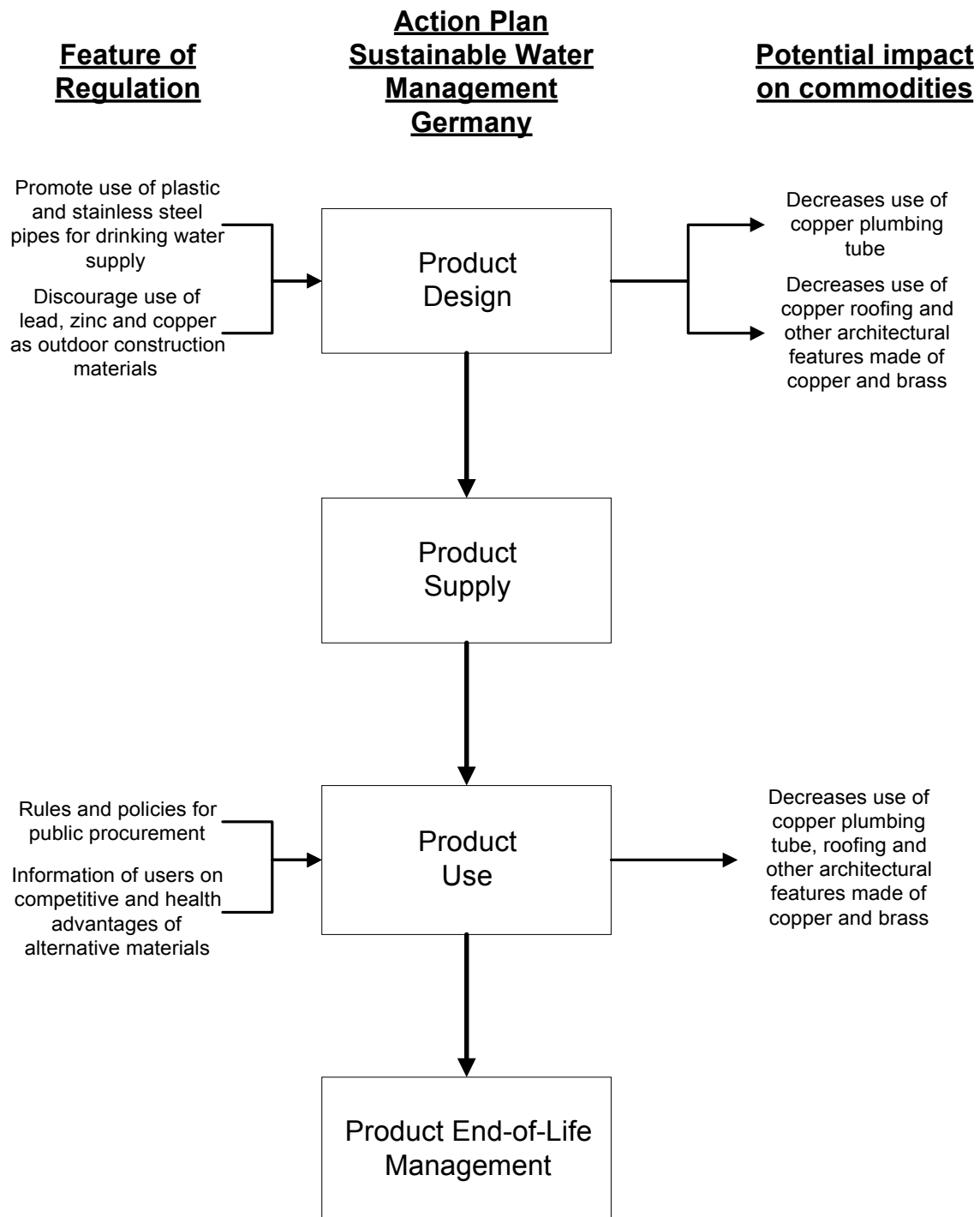


Figure 7: Overview of potential regulatory impacts of the German Action Plan for Sustainable Water Management

Table 5: Potential Regulatory Impacts of the German Action Plan Sustainable Water Management

Key Field	Life Cycle	Issue	Copper Usage					Remarks
			[--]	[-]	[0/?]	[+]	[++]	
Market structure	Design	Promotion of use						Promotion of competitive products and discouragement of copper plumbing and roofing
	Supply	Commodity sales						
	Use	Intensity of use						
	End-of-life	Recycled tonnage						
Competitiveness	Design	Reputation and image among product designers						Promotion of competitive products and discouragement of copper use
	Supply	Competitiveness of producers						
	Use	Competitiveness of products (vs. substitutes)						
	End-of-life	Competitiveness of recyclers						
International trade	Design	Product differentiation						
	Supply	Access to world market (export)						
	Use	Access to regulated area (import)						See above
	End-of-life	Transboundary scrap flows						
Social issues	Design	Acceptance and appearance to users						See above
	Supply	Employment level in production stage						
	Use	Ease of installation and maintenance						Longevity of copper products
	End-of-life	Health & safety in use & disposal						Less biostatic benefit in use
Environmental issues	Design	Recyclability						
	Supply	Energy efficiency						
	Use	Prevention of dissipation						
	End-of-life	Recycling efficiency						

4.3. Case Study 3 (Product End-of-Life Management): Working Document Management of Construction and Demolition Waste

Box: Management of Construction and Demolition Waste – Working Document

Nº1, European Commission DG Environment E3, 4 April 2000

Working document under consideration addressing construction and demolition waste as priority waste stream (construction, demolition rehabilitation activities)

Main objectives:

- Address largest waste stream in quantitative terms
- Increase recycling (currently ca. 25% recycled) and reduce waste disposed in landfills (currently ca. 75% disposed in landfills)
- Reduce presence of hazardous waste in waste stream
- Prevent contamination of landfills or recycled inert wastes through separation of dangerous wastes

Copper-specific issues:

- Limit use of dangerous substances (e.g. heavy metals lead, cadmium, mercury)
- Promote re-use of heating, ventilation and air-conditioning equipment
- Restrict or ban the landfill of construction and demolition waste
- Separation at source of hazardous waste (e.g. lead piping or roofing material)
- Selective dismantling in the light of the techniques available and of the local recovery system
- Waste sorting for recycling purposes (e.g. metals), preferably at actual point of waste generation
- Application of selective demolition techniques (waste separation at source)
- Target recovery figures
- Development of local recycling systems
- Development of the recycled product markets (e.g. for non-ferrous metals)
- Public procurement policy for promoting use of recycled materials and products
- Implementation of demolition permits including inventory of waste to be managed or precise building audit/diagnosis before demolition
- Implementation of new building-product standards based on technical performance and not on composition or origin
- Amendment of existing building-product standards which raise barriers to recycling

Major stakeholder groups affected

- Direct: brass mills, wire & cable producers, architects, building-product designers, manufacturers, construction companies, demolition companies, plumbers, roof builders
- Indirect: house owners, scrap recyclers, waste disposal site operators

Implementation: Potential instruments available for implementation

- Proposal for a directive
- Environmental agreement
- Proposal for a recommendation of Commission/Council/Parliament

The Working Document on Management of Construction and Demolition Waste (C&D) has been published by the Waste Management Unit of DG Environment in April 2000. It outlines the situation in the Member States concerning the management of this waste stream and instruments for improvement on the basis of an extensive report. It also suggests possible alternatives for Community action.

According to DG Environment, C&D waste represents the largest waste stream in quantitative terms (180 Million tonnes per year). To date, 75 % of C&D waste is landfilled and only 25 % recycled in the European Union. Dangerous waste (such as asbestos and heavy metals) is not always separated from waste.

The environmental objectives of the proposed strategy include to:

- Develop prevention policies for reducing waste stream and making waste less hazardous,
- Establish incentives for recycling,
- Improve management of construction and demolition waste.

The increased collection, sorting, recycling and reuse of construction and demolition waste may increase copper scrap availability and quality for recycling and, therefore, increase the overall recycling efficiency. Also, in the product design stage, the recognition of recyclability of copper products and the restriction of lead use may benefit copper usage.

On the other hand, more energy will have to be applied for collection, treatment and transport of waste and recycled fractions. Also, the ease of installation of building products may be potentially affected to guarantee effective dismantling and recycling after use. The overall impact of introducing the proposed measures on the competitiveness of products and recyclers have not been analysed in detail, yet.

Since the presentation of the Working document, no follow-up action has been announced by the European Commission, yet.

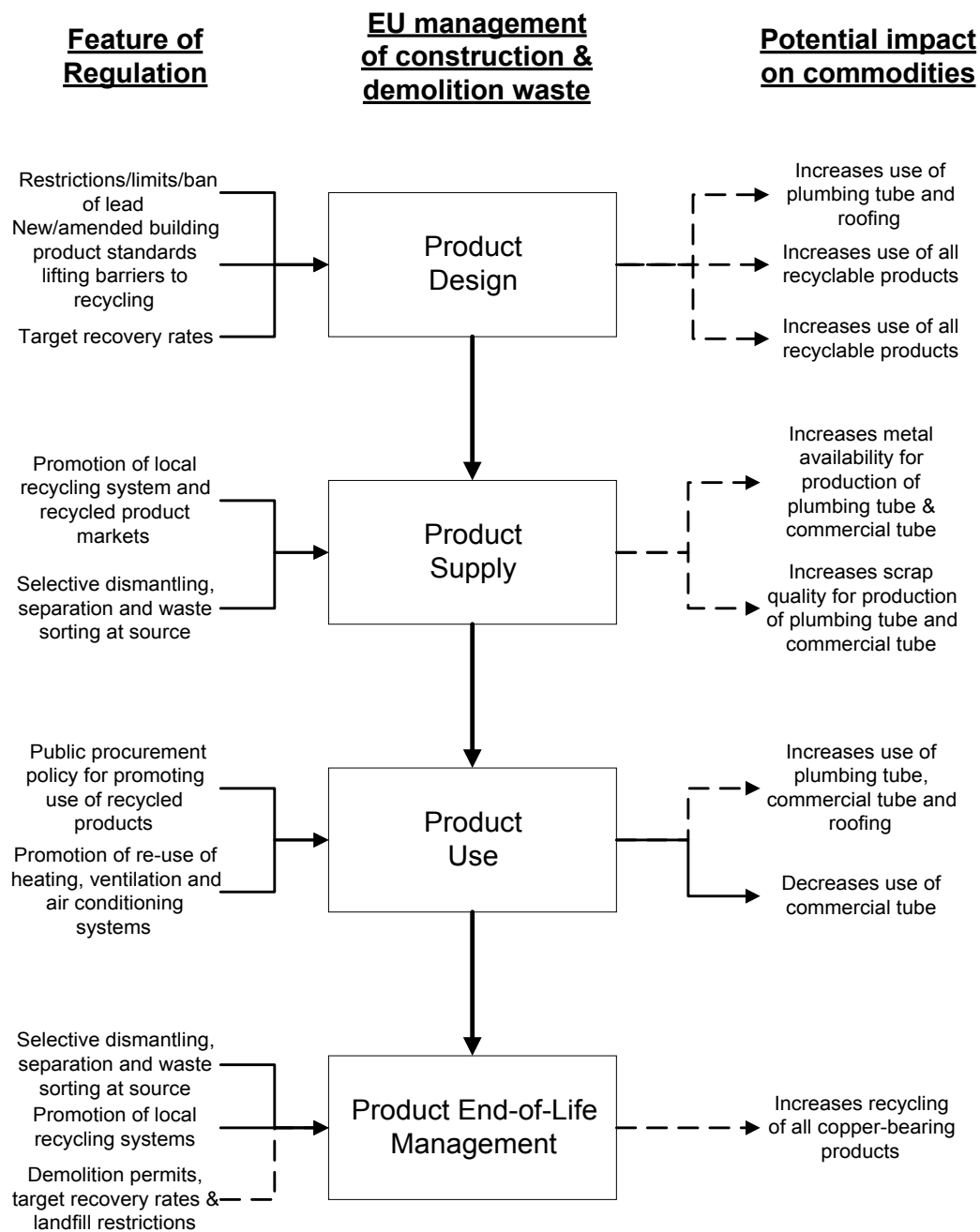


Figure 8: Overview of potential regulatory impacts of the EU Working Document on Management of Construction and Demolition Waste

Table 6: Potential Regulatory Impacts of the draft Working new EU Policy for Management of Construction and Demolition Waste

Key Field	Life Cycle	Issue	Copper Usage					Remarks
			[--]	[-]	[0/?]	[+]	[++]	
Market structure	Design	Promotion of use						
	Supply	Commodity sales						
	Use	Intensity of use						
	End-of-life	Recycled tonnage						Increased availability of scrap
Competitiveness	Design	Reputation and image among product designers						Recognition of re-cyclability of Cu
	Supply	Competitiveness of producers						
	Use	Competitiveness of products (vs. substitutes)						Restriction of lead use for plumbing
	End-of-life	Competitiveness of recyclers						Pressure of target recovery rates
International trade	Design	Product differentiation						
	Supply	Access to world market (export)						
	Use	Access to regulated area (import)						
	End-of-life	Transboundary scrap flows						More scrap becomes available
Social issues	Design	Acceptance and appearance to users						
	Supply	Employment level in production stage						
	Use	Ease of installation and maintenance						Need for building assessments
	End-of-life	Health & safety in use & disposal						Increased recycling
Environmental issues	Design	Recyclability						
	Supply	Energy efficiency						Increased energy use for recycling
	Use	Prevention of dissipation						
	End-of-life	Recycling efficiency						Increased recycling

5. Quantification of Regulatory Impacts

5.1. Methodical Challenges and Data Needs

Besides identifying potential impacts of a regulation being introduced, in many cases it is also important to quantify the associated economic, environmental and social effects including both benefits and challenges.

The main objectives of the quantification would include to:

- Identify and weight relationships and cross-impacts,
- Carry out a preliminary evaluation (“screening”) of impacts,
- Support any ongoing or upcoming discussion process on regulations as such and/or regulatory features and
- Set priorities for further in-depth analysis.

For this purpose, it is necessary to develop a set of transparent, acceptable and meaningful indicators. The arising set of indicators can then be used to assess the status-quo and then to build an impact scenario and a reference scenario without regulation being introduced. Recognising the complexity of regulatory impacts, both qualitative and quantitative indicators are needed. Whereas some impacts such as those associated with the design phase, installation and maintenance issues and health and safety considerations are often difficult to quantify, others are more easily to assess in theory. However, the selection of indicators has to take into account the availability of data and any issues related to necessary commercial confidentiality and competitiveness.

Using the previously introduced regulatory impact matrix as a starting point, the following draft set of indicators for measuring potential regulatory impacts on copper usage arising from a regulation being introduced can be applied. Aiming at facilitating the first assessment, appropriate allocation methods should be selected to enable the use of existing or shortly available data.

The most important key indicator in any case would be the total tonnage of copper products affected.

However, the proposed set of indicators can only lead to a preliminary assessment and identification of issues. Therefore, it should always be complemented with a more practice-oriented in-depth analysis of impacts including the consideration of regional, product and sector specific issues.

5.2. Potential Sources of Data

Existing sources of data for quantifying regulatory impacts include the following sources:

- ICSG statistics on production and trade of copper product and scrap
- ICSG economic data on employment, sales and competitiveness of the copper sector by production stage
- ICSG recycling data (scrap survey, case studies on commodities and recycling efficiencies, etc.)
- IWCC end use statistics: The confidentiality of detailed sectoral and/or country-specific end use data has to be recognised.

- CDA/ICA market studies

Major data gaps include:

- Recycling Efficiency Ratio (RER): The Copper Recycling Working Group of the ICSG is working on developing methodology and data for assessing the Recycling Efficiency Ratio. In this context, a pilot study for Western Europe is conducted.
- Socio-economic data on product level: The ICSG is collecting economic data for the copper sector by production stages and regions/countries. The allocation of (direct) economic data to affected products such as employment level and commodity sales that have been derived for the overall copper sector can eventually be carried out using end use data and mass and/or value criteria for allocation. Recognising the important indirect
- Environmental data on energy efficiency and dissipation in use: These might be available through the ongoing Life Cycle Assessment (LCA) work of the European Copper Institute (ECI) and the International Copper Association (ICA) as well as within the context of the ongoing voluntary risk assessment work of the European copper industry.

Table 7: Draft indicator set for measuring potential regulatory impacts on copper use

Key Field	Life Cycle	Issue	Indicator	Unit
Market structure	Design	Promotion of use	Qualitative	
	Supply	Commodity sales	Market size of copper-bearing product	[t Product affected]
	Use	Intensity of use	Use intensity of copper-bearing product	[t Product/unit]
	End-of-life	Recycled tonnage	Recycling Input Ratio (RIR)	[%]
Competitiveness	Design	Reputation and image among product designers	Qualitative	
	Supply	Competitiveness of producers	Value added of producers	[€/t Cu]
	Use	Competitiveness of products (vs. substitutes)	Product price	[€/t Cu product]
	End-of-life	Competitiveness of recyclers	Scrap price	[€/t Cu scrap]
International trade	Design	Product differentiation	Qualitative	
	Supply	Access to world market (export)	Export of copper-bearing product	[t Product]
	Use	Access to regulated area (import)	Import of copper-bearing product	[t Product]
	End-of-life	Transboundary scrap flows	Scrap import-export balance	[t Cu scrap]
Social issues	Design	Acceptance and appearance to users	Qualitative	
	Supply	Employment level in production stage	Number of Employees for production/manufacture	[n°]
	Use	Ease of installation and maintenance	Qualitative	
	End-of-life	Health & safety in use & disposal	Qualitative	
Environmental issues	Design	Recyclability	Theoretical Recycling Availability	[%]
	Supply	Energy efficiency	Energy use (LCA approach)	[kWh/unit]
	Use	Prevention of dissipation	Copper emission	[kg Cu/unit]
	End-of-life	Recycling efficiency	Recycling Efficiency Ratio (RER)	[%]