IPCC Expert Meeting: Application of 2006 IPCC Guidelines to Other Areas
1-3 July 2014. Sofia, Bulgaria

Hosted by Executive Environment Agency of Bulgaria and the Task Force on National Greenhouse Gas Inventories (TFI)

Hilton Sofia, Sofia, Bulgaria

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## Topic (3): Calculation of mitigation potential / carbon footprint / Life Cycle Assessment (LCA), including application of 2006 IPCC Guidelines

**John Watterson**

**Christine St John Cox. With contributions from Judith Bates**



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# Today

**General context**

## Carbon footprinting

- Scope and boundaries
- Interpretation
- Calculations
- Emission factors
- Standards

## LCA

- Benefits of LCA
- Calculations
- Standards

## Mitigation potential

- Drivers
- How is it approached?

Key observations

Discussion points


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# Preamble

- Many thanks to the IPCC for the invitation to this meeting
- My background – technical advisor to the UK GHG inventory (former manager), and lead author of the stationary combustion chapter IPCC 2006 GLs
- Work in a company that provides the UK Inventory Agency role, and delivers carbon foot printing work and LCA analysis – so have insights into the delivery of all this type of work


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# General Context


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# Definitions

## Topic (3): Calculation of mitigation potential/carbon footprint / Life Cycle Assessment (LCA), including application of 2006 IPCC Guidelines

- **Mitigation potential** - Climate change mitigation are actions to limit the magnitude and/or rate of long-term climate change. The mitigation potential is an estimate of the possible reduction that can be achieved.

- **Carbon Footprint** - A carbon footprint is historically defined as the total sets of greenhouse gas emissions caused by an organisation, event, product or person.

- **LCA** – Life Cycle Assessment - Life-cycle assessment (LCA, also known as life-cycle analysis, ecobalance, and cradle-to-grave analysis) is a technique to assess environmental impacts associated with all the stages of a service, function or product's life from-cradle-to-grave.


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# More Definitions

- **Boundary** – a carbon footprint boundary is defined as the emissions that will be captured associated with the organisation, event, person or product.

- **Scope** – the scope of a carbon footprint is defined as the types of emissions sources that will be captured within a carbon footprint. This could be defined as all scope 1 or 2 emissions or simply based on emissions sources i.e. electricity, gas, shipping, but not waste, company travel or water.


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# What's the difference between a carbon footprint and an LCA?

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**Carbon footprint**

- **only** assesses the **global warming potential** of an organization, product, project or service

**Life cycle assessment (LCA)**

- **assesses multiple environmental impact categories**, includes
  - global warming,
  - but may also include
    - human health impacts,
    - ecosystem quality,
    - acidification,
    - land use, etc.

- There are different standards and organizations around each assessment.


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# Differences and similarities

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| Issue | IPCC guidelines | Carbon footprint | LCA |
|---|---|---|---|
| **Environmental impact / Emission sources** | $CO_2$, $CH_4$, $N_2O$<br>HFCs, PFCs, $SF_6$, $NF_3$ | $CO_2$, $CH_4$, $N_2O$<br>HFCs, PFCs, $SF_6$ | Includes wider range of impacts including, emissions to air, water and land, human health impacts, ecosystem quality, land use and resource use. These impacts are evaluated for their $CO_2e$ |
| **Enforcement** | Mandatory for those reporting under the UNFCCC | variable at a national or regional level – mainly voluntary, though increasing | Voluntary |
| **Boundary** | Political boundary geographical/ regional | Define boundary via equity share, operational or financial control | Product / service or system |
| **Principles** | Transparency<br>Completeness<br>Consistency<br>Comparability<br>Accuracy | Relevance<br>Completeness<br>Consistency<br>Transparency<br>Accuracy | Relevance<br>Completeness<br>Consistency<br>Transparency<br>Accuracy |
| **Reporting scopes** | From source (“production” based) | Scope 1, 2 and 3 | Whole life assessment |
| **Activity Data sources** | Activity data from wide range of sources – national energy balances, industrial production, animal numbers etc. | Activity data based on consumption across business and wider impacts | From cradle to grave assessment based on activity data |
| **QA / QC** | Expectations and methodologies set out in the GLs | Assurance and verification, materiality assessment. Accountancy/ISO standards | Sensitivity assessment |


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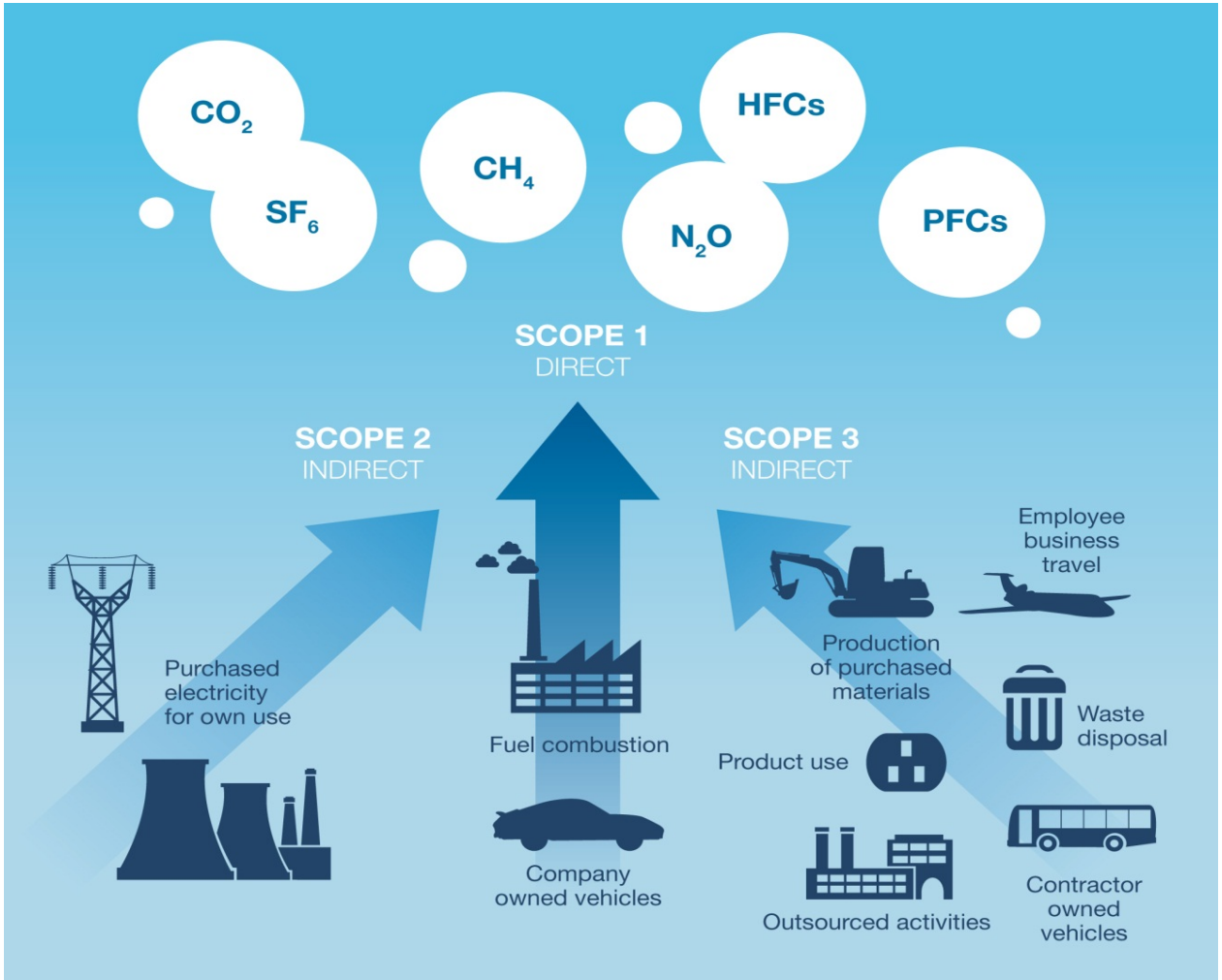
# Definition of carbon footprint

- **Carbon Footprint -** A carbon footprint is historically defined as the total sets of greenhouse gas emissions caused by an
  1. organisation,
  2. event,
  3. product or
  4. person.

- Applied mostly to footprints of organisations

- Product footprints being adopted slowly
  - More complex and
  - More expensive
  - Offers less benefits





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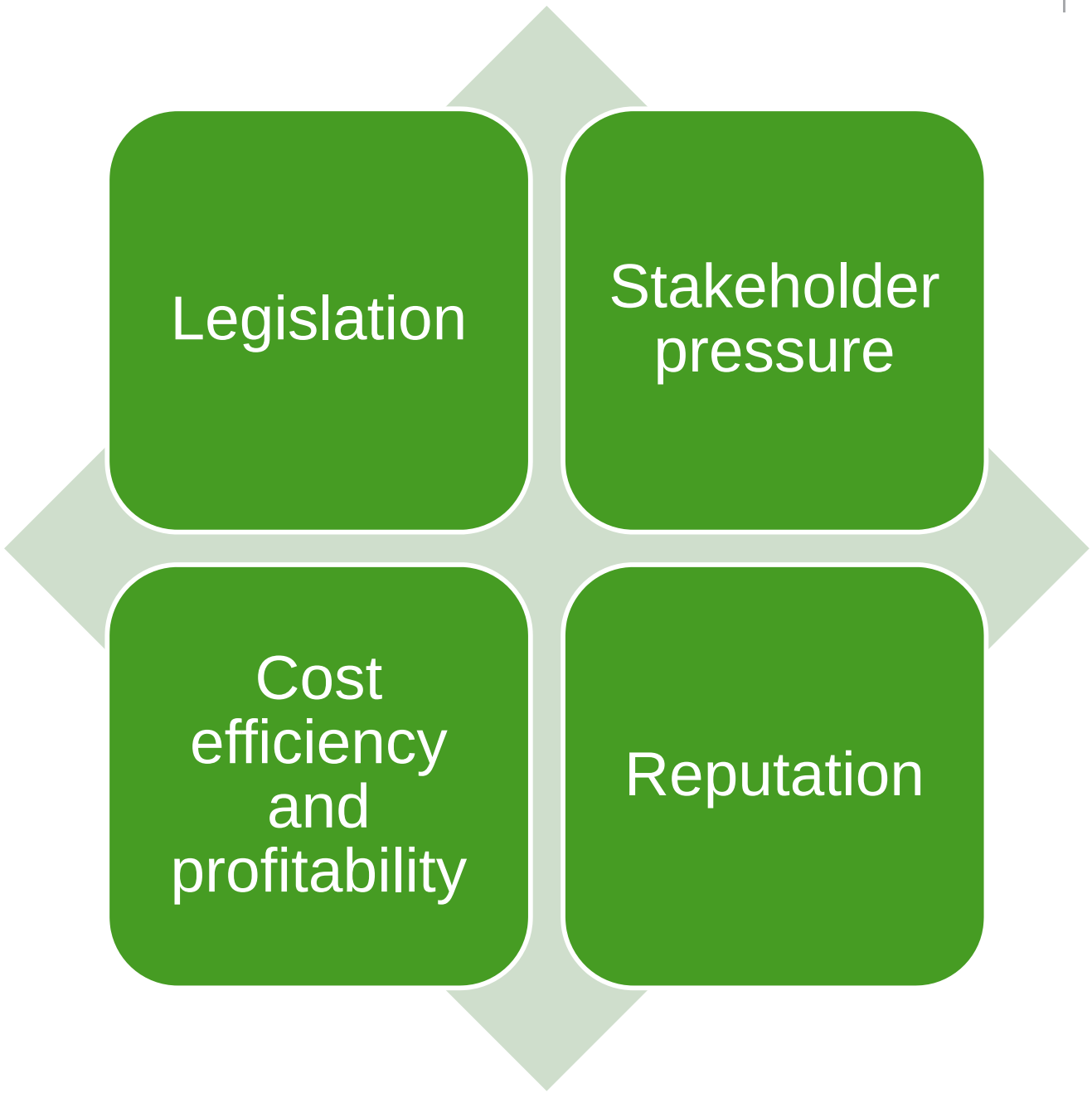
# Why are organisations reporting LCA or carbon footprints?





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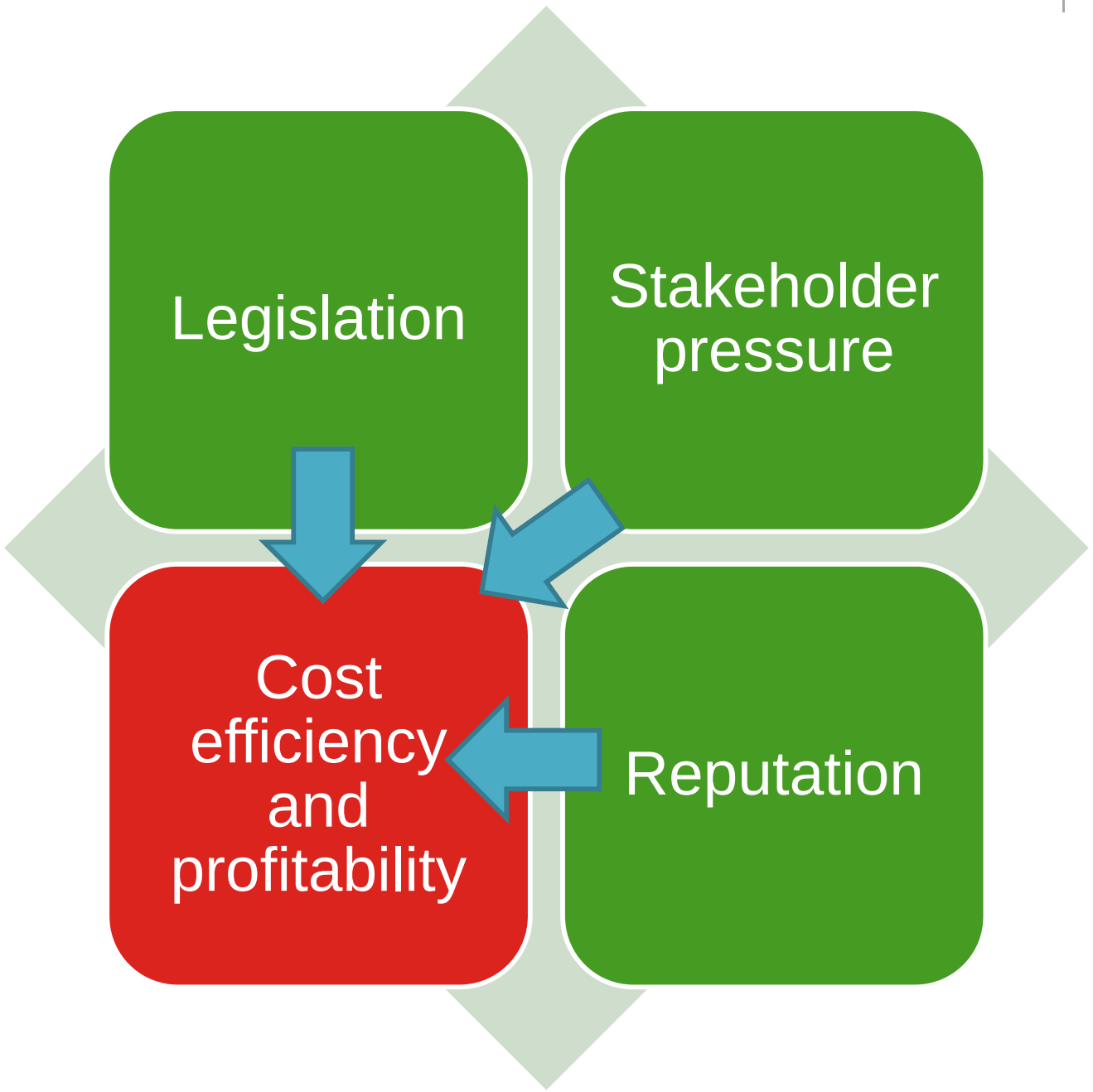
# Why are organisations reporting LCA or other footprints?





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# Carbon footprint


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# Cradle to Grave diagram

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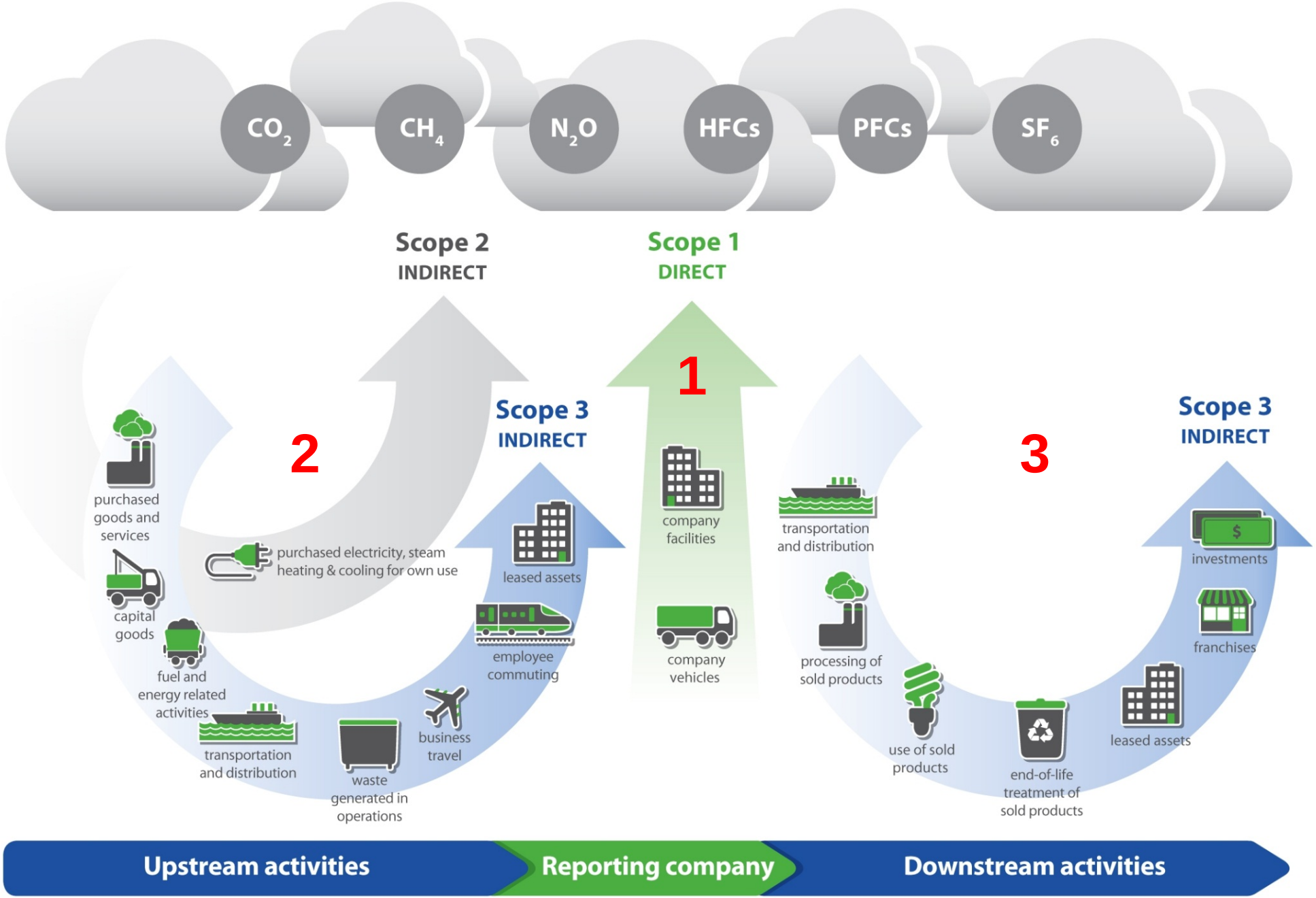



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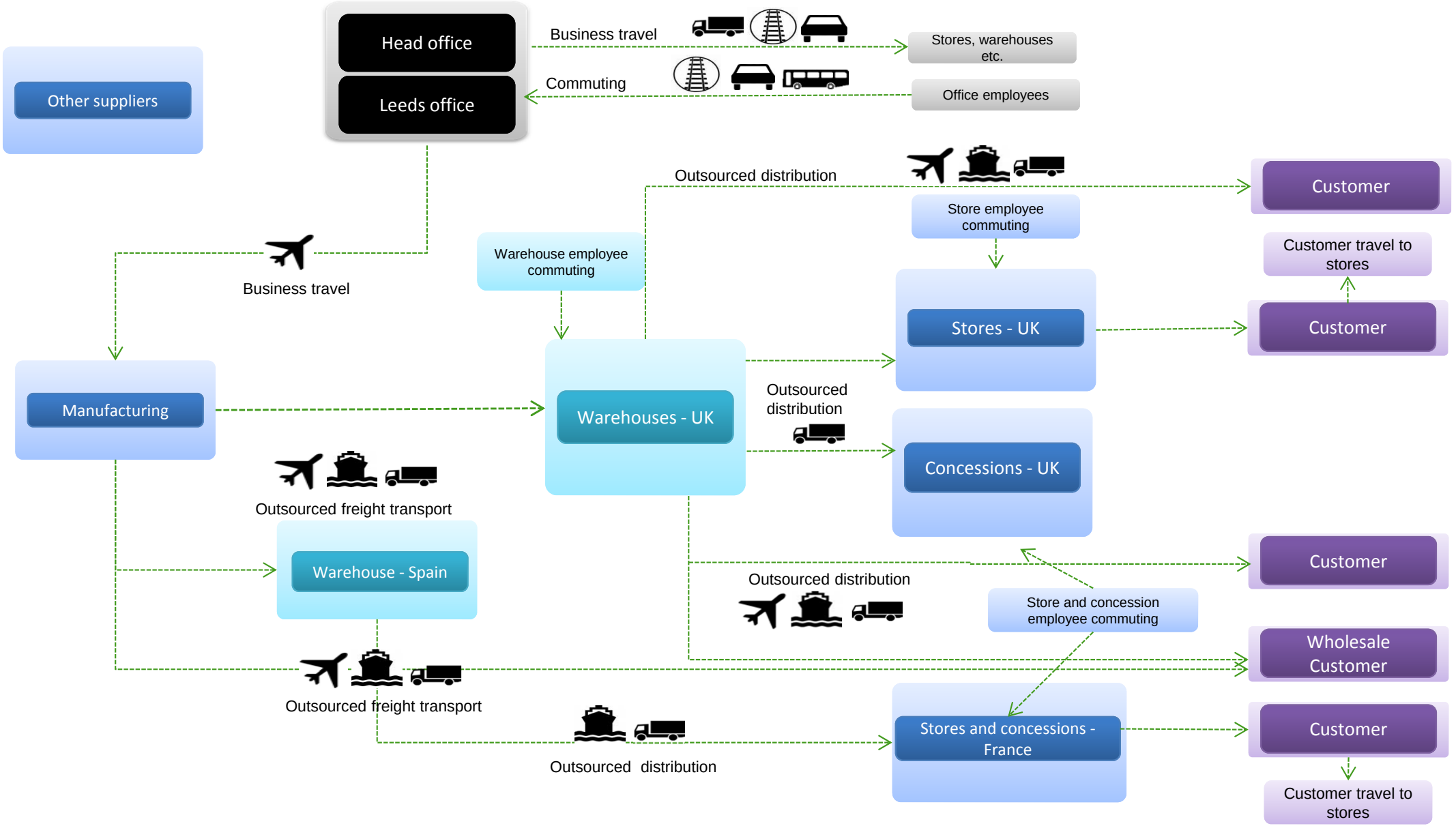
# Carbon Footprint – mapping emissions sources

The first step is mapping out emissions sources for product, event or organisation
Example A





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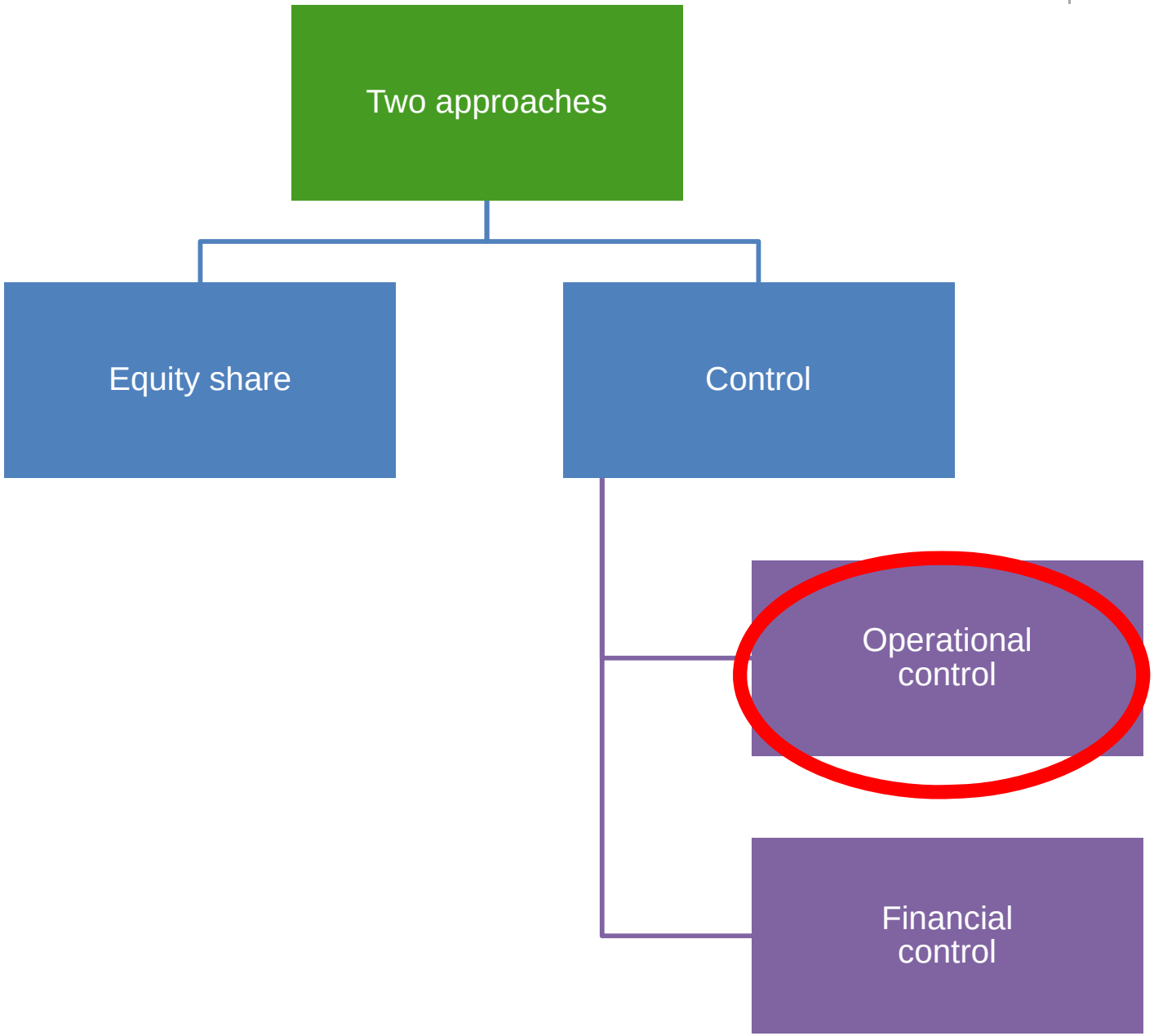
# Defining interpretation of boundaries for a carbon footprint





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# Carbon Footprint – defining approach

(linked to example in slide 14)

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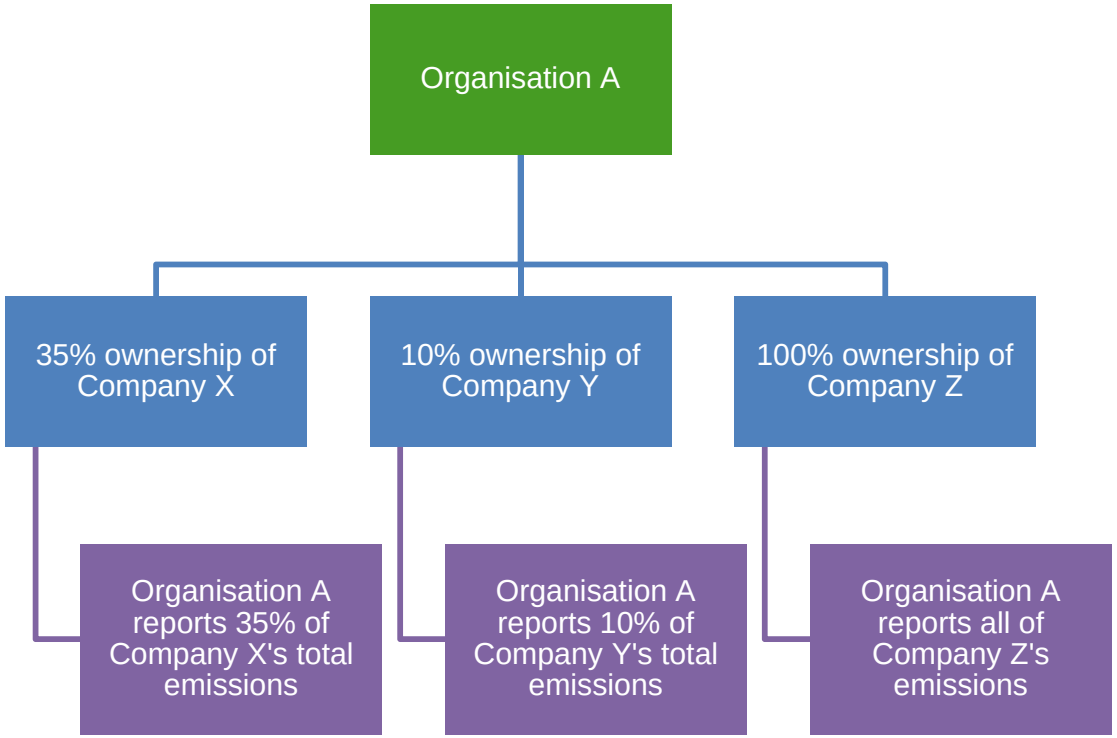
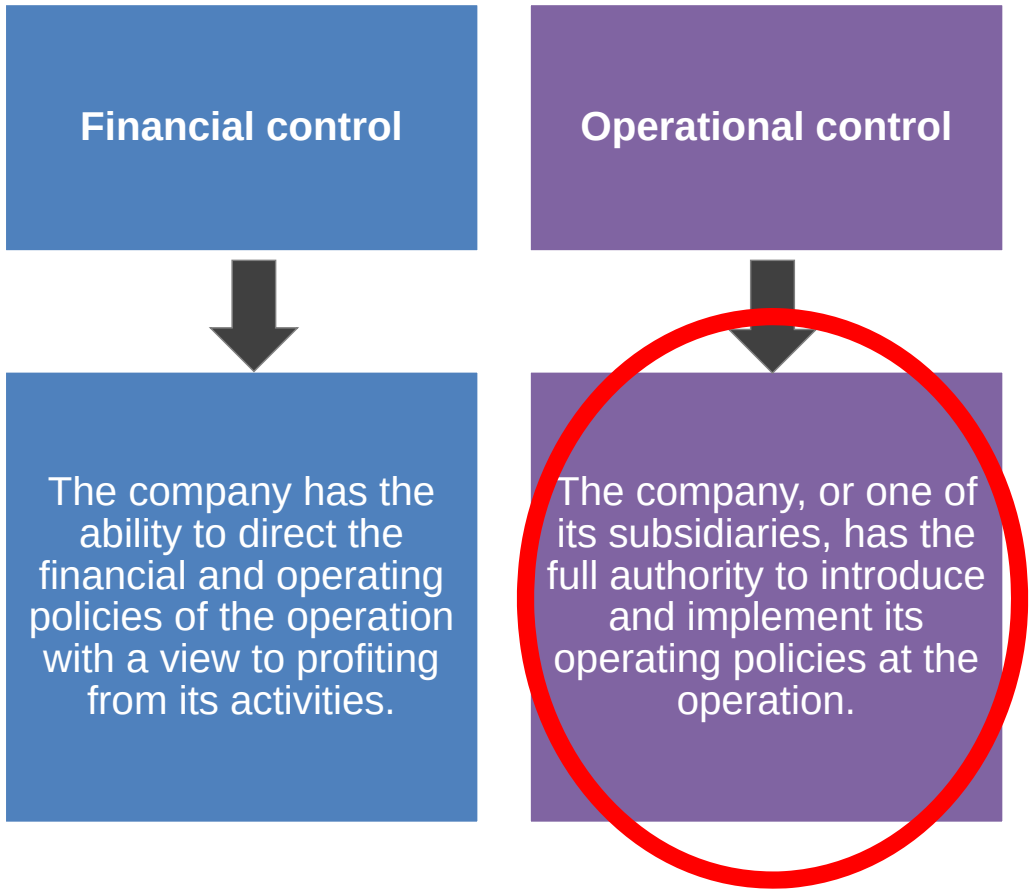
## Equity Share approach




## Control approach (must choose one approach)





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# What does that mean for a carbon footprint? Calculation

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- Data is collected in a different way, and calculated in a different form
- Calculation

Emission = Activity Data x Emission Factor

- **Example A** – Electricity calculation
- Activity data collected as consumed electricity NOT generated (takes into transmission loses)
- Might come from a number of countries so multiple factors required
- Emission Factor is “split” between Scope 2 and 3

- **Example B** – International shipping and/or distribution calculations
- Have to determine which scope emissions fall into Scope 1 or Scope 3
- Calculation or output might be amalgamated into one factor for $CO_2$ equivalent


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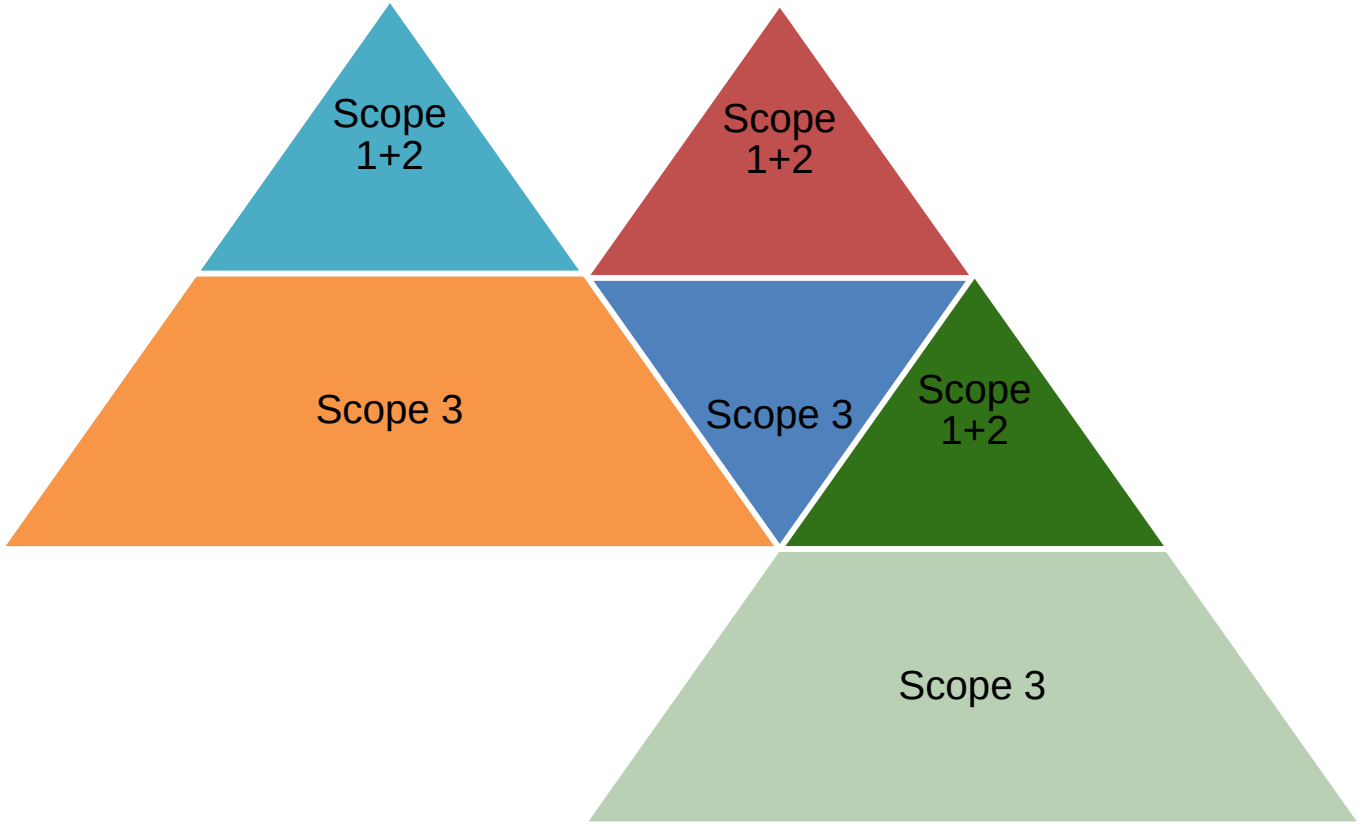
# Carbon footprint reporting format

- Emissions reported in:
  - Scope 1
  - Scope 2
  - Scope 1+2
- And
  - Scope 3 -
- Scope 3 kept separate to avoid double counting.

Overlap and therefore possible double counting





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# Data gathering for a carbon footprint

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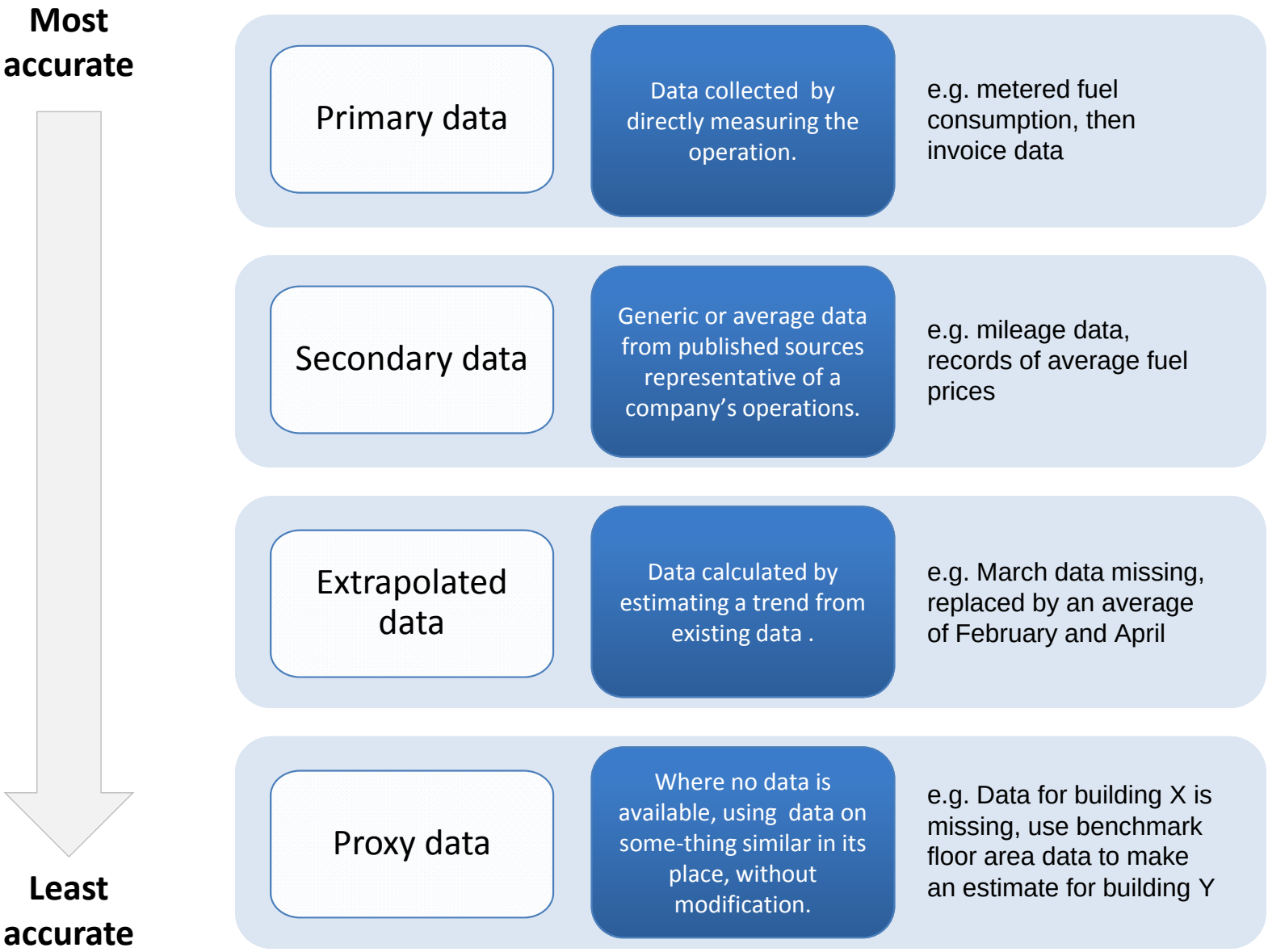



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# Sources of Emission Factors

Where are factors sourced from:

- Some international factors provided by sources such as IPCC guidelines, GHG Protocol
- National factors
- Some nations provide factors for other countries or regions too
- Research bodies such as Eco-invent, Leeds supply chain data, SimaPro

- Factors cover may sources

- Factors provided for materials

- Varying quality


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# A selection of the organisational standards – a lot!

- ABI Energia Linee Guida
- Act on the Rational Use of Energy
- American Petroleum Institute Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Natural Gas Industry, 2009
- Australia - National Greenhouse and Energy Reporting Act
- Bilan Carbone
- Brazil GHG Protocol Programme
- Canadian Association of Petroleum Producers, Calculating Greenhouse Gas Emissions, 2003
- China Corporate Energy Conservation and GHG Management Programme
- Defra Voluntary Reporting Guidelines
- ENCORD: Construction CO2e Measurement Protocol
- Energy Information Administration 1605B
- Environment Canada, Sulphur hexafluoride (SF6) Emission Estimation and Reporting Protocol for Electric Utilities
- Environment Canada, Aluminum Production, Guidance Manual for Estimating Greenhouse Gas Emissions
- Environment Canada, Base Metals Smelting/Refining, Guidance Manual for Estimating Greenhouse Gas Emissions
- Environment Canada, Cement Production, Guidance Manual for Estimating Greenhouse Gas Emissions
- Environment Canada, Primary Iron and Steel Production, Guidance Manual for Estimating Greenhouse Gas Emissions
- Environment Canada, Lime Production, Guidance Manual for Estimating Greenhouse Gas Emissions
- Primary Magnesium Production and Casting, Guidance Manual for Estimating Greenhouse Gas Emissions
- Environment Canada, Metal Mining, Guidance Manual for Estimating Greenhouse Gas Emissions
- EPRA (European Public Real Estate Association) guidelines, 2011
- European Union Emission Trading System (EU ETS): The Monitoring and Reporting Regulation (MMR) – General guidance for installations
- European Union Emission Trading System (EU ETS): The Monitoring and Reporting Regulation (MMR) – General guidance for aircraft operators
- Hong Kong Environmental Protection Department, Guidelines to Account for and Report on Greenhouse Gas Emissions and Removals for Buildings, 2010
- ICLEI Local Government GHG Protocol
- India GHG Inventory Programme
- International Wine Industry Greenhouse Gas Protocol and Accounting Tool
- IPCC Guidelines for National Greenhouse Gas Inventories, 2006
- IPIECA's Petroleum Industry Guidelines for reporting GHG emissions, 2003
- IPIECA's Petroleum Industry Guidelines for reporting GHG emissions, 2nd edition, 2011 ISO 14064-1
- Japan Ministry of the Environment, Law Concerning the Promotion of the Measures to Cope with Global Warming, Superceded by Revision of the Act on Promotion of Global Warming Countermeasures (2005 Amendment)
- Korea GHG and Energy Target Management System Operating Guidelines
- New Zealand - Guidance for Voluntary, Corporate Greenhouse Gas Reporting
- Philippine Greenhouse Gas Accounting and Reporting Programme (PhilGARP)
- Programa GEI Mexico
- Regional Greenhouse Gas Initiative (RGGI) Model Rule
- Taiwan - GHG Reduction Act
- The Climate Registry: Electric Power Sector (EPS) Protocol
- The Climate Registry: General Reporting Protocol
- The Climate Registry: Local Government Operations (LGO) Protocol
- The Climate Registry: Oil & Gas Protocol
- The Cool Farm Tool
- The GHG Indicator: UNEP Guidelines for Calculating Greenhouse Gas Emissions for Businesses and Non-Commercial Organisations
- The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (Revised Edition)
- The Greenhouse Gas Protocol Agricultural Guidance: Interpreting the Corporate Accounting and Reporting Standard for the Agricultural Sector
- The Greenhouse Gas Protocol: Public Sector Standard
- The Tokyo Cap-and Trade Program
- US EPA Climate Leaders: Direct Emissions from Iron and Steel Production1
- US EPA Climate Leaders: Direct Emissions from Municipal Solid Waste Landfilling1
- US EPA Climate Leaders: Direct HFC and PFC Emissions from Manufacturing Refrigeration and Air Conditioning Equipment1
- US EPA Climate Leaders: Direct HFC and PFC Emissions from Use of Refrigeration and Air Conditioning Equipment1
- US EPA Climate Leaders: Indirect Emissions from Purchases/ Sales of Electricity and Steam1
- US EPA Climate Leaders: Direct Emissions from Stationary Combustion1
- US EPA Climate Leaders: Direct Emissions from Mobile Combustion Sources1
- US EPA Mandatory Greenhouse Gas Reporting Rule
- WBCSD: The Cement CO2 and Energy Protocol
- World Steel Association CO2 emissions data collection guidelines


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# Organisational GHG Reporting Standards - rationalised

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- **IPCC Guidelines for National Greenhouse Gas Inventories, 2006**
- **Non-for-profit**
  - The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (Revised Edition)
  - The Climate Registry: General Reporting Protocol
  - ISO 140064 Parts 1, 2 and 3 (3 for assurance)
- **Regulation for nations or regions**
  - European Union Emission Trading System (EU ETS): The Monitoring and Reporting Regulation (MMR) – General guidance for installations
  - Australia - National Greenhouse and Energy Reporting Act
  - Taiwan - GHG Reduction Act
- **National reporting methodologies for corporates**
  - UK - Defra Voluntary Reporting Guidelines
  - Bilan Carbone - France
  - Brazil GHG Protocol Programme
  - China Corporate Energy Conservation and GHG Management Programme
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# Widely used standards

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- **The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (Revised Edition)**
- **ISO 140064 Parts 1, 2 and 3 (3 for assurance)**
  - Small differences but very much the same approach
  - BUT National standards where reporting required do vary
  - Challenge is that many organisations will be required to report repeatedly under numerous formats
- **For example in UK:**

| Reporting mechanism | ETS | UK Carbon Reduction Commitment (CRC) | UK Mandatory GHG reporting (companies on LSE ~1,000) |
|---|---|---|---|
| Types of emissions required to report | Thermal heat generated | Electricity and gas usage | Scope 1 and Scope 2 – so much wider than CRC |
| Emissions factors | Default to installation specific (Tiers) | Differs until Phase 2 to GHG reporting | DECC factors published annually |
| Boundaries | EU | UK | International |
| Annual Cycle | yes | April to March annually | Company's financial year |
| Reporting body | Environment Agency | Environment Agency | Companies House in annual report |


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# The Godfather - GHG Protocol

- **The Greenhouse Gas Protocol (GHG Protocol)**
- International accounting tool for government and business
- Understand, quantify and manage GHG emissions
- Most widely used
- Developed in partnership with:
  - WRI (World Resources Institute) and
  - WBCSD (World Business Council for Sustainable Development)


- Corporate Accounting and Reporting Standard
- First generated in 2001 and updated in 2013.

- Tools are consistent with IPCC 1996 including:
  - hierarchy of calculation approaches and techniques ranging from the application of generic emission factors to direct monitoring
- http://www.ghgprotocol.org/

- GHG Protocol calculation tools uses IPCC default EFs – which can be overidden with company specific values


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# GHG Protocol

- Other relevant standards GHG protocol have developed:
  - Value Chain and Scope 3 Accounting
  - Product Life Cycle Standard
  - Avoided Emissions
  - Mitigation Accounting
  - City Accounting

Was there any IPCC involvement?
(we do not think there was!)

- Approach to reviewing standards and new standards
  - Highly collaborative – involving organisations, governments, NGOs and consultants

- For example for the Product Life Cycle Standard and Value Chain and Scope 3 Accounting saw:
- 3 year development period
  - 2,300 participants from 55 countries;
  - 112 members formed technical working groups to draft the standards, and;
  - 38 companies from various industries road tested the standards in 2010.


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# Life Cycle Assessment


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# Definitions

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- **LCA – Life Cycle Assessment - Life-cycle assessment (LCA, also known as life-cycle analysis, ecobalance, and cradle-to-grave analysis) is a technique to assess environmental impacts associated with all the stages of a product's life from-cradle-to-grave.**


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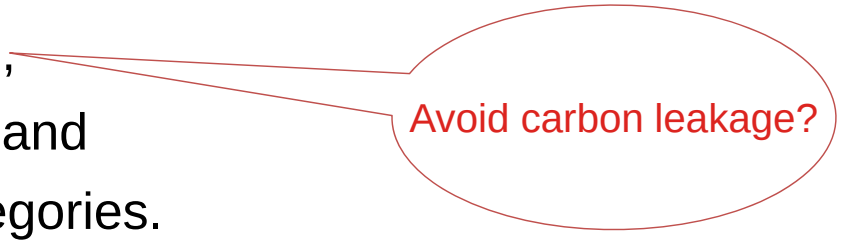
# Benefits of LCA against carbon footprint of a product

- Benefits
  - allows you to avoid burden shifting,
  - encompassing the entire life cycle and
  - multiple environmental impact categories.

  You don't want to reduce the impacts in one impact category or life cycle phase, but increase them in another.
- Modelling your project, product, service or organization in LCA software, might allow you to both conduct a carbon footprint using IPCC 2006 methodologies, or Greenhouse Gas Protocol as well as assessing other environmental impacts using one of several internationally accepted impact assessment methods, (e.g. ReCiPe, TRACI, IMPACT 2002+, Ecological footprint, Eco-indicator 99)




J1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スライド 29

J1 Judith What about these standards? do you get asked about these as well as the ISO standards?

Chris – the ISO standard tells you how to carry out the LCA and the recommended approach to several methdlogoial issues in defining, boundary, scope, allocations etc), the impact assessment methdologies have all been developed by differnt organisations, and use different ways to group and convert different emissions into common environmental impacts. Once you have your lifecycle inventory results you can apply whichever Impact Assesment methdology you want (or indeed more than one). Which one you choose may depend on what impacts you are most concerned about as some cover some aspects better than others. Have changed text slightly to take out direct refercne to SimaPro as it isi only one of several tools – if you want to put back in suggest use (e.g. SimaPro,Gabi, Umberto)

Judith, 2014/06/26

# LCA calculations

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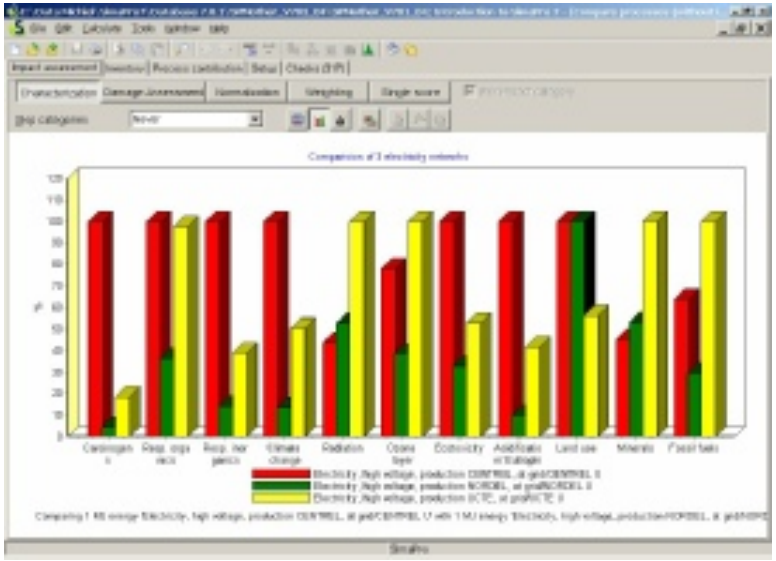
- Calculations typically through proprietary lifecycle software
  - Gabi,
  - SimaPro
  - Umberto
  - Or sector specific tools such as those for waste management (e.g. WRATE)



- Ecoinvent factors
  - 10,000 LCI datasets
  - Cover a range of sectors
  - energy supply, agriculture, transport, biofuels and biomaterials, bulk and specialty chemicals, construction materials, packaging materials, basic and precious metals, metals processing, ICT and electronics, dairy, wood, and waste treatment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# LCA standards

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- **PAS 2050: - but limited to carbon**
  - Publicly Available Specification (PAS)
  - Issued by British Standards Institute (BSI)
  - published first in 2008, revised in 2011 (when GHG Product Life Cycle Standard was launched)
- **GHG Protocol Product Life Cycle Standard – limited to carbon**
  - Publically available specification launched 2011
  - Globally used
  - Development of standard consulted on widely
- **ISO standards - able to cover wider environmental impacts**
  - International (global) Standard
  - Set of standards on LCA and review of LCA published (2006-2012)
  - Specific standard on carbon footprint of products published 2013
  - Also deals with how carbon footprint should be communicated


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J2 Chris See my prvious not
ReCiPe, Traci etc are not standards as such they are just different impact assessment methodologies so not sure they belong on this slide.
Judith, 2014/06/26

# ISO Standards on LCA

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- ISO 14040:2006
  Environmental management -- Life cycle assessment -- Principles and framework
- ISO 14044:2006
  Environmental management -- Life cycle assessment -- Requirements and guidelines
- ISO 14045:2012
  Environmental management -- Eco-efficiency assessment of product systems -- Principles, requirements and guidelines
- ISO/DIS 14046.2
  Environmental management -- Water footprint -- Principles, requirements and guidelines
- ISO/TR 14047:2012
  Environmental management -- Life cycle assessment -- Illustrative examples on how to apply ISO 14044 to impact assessment situations
- ISO/TS 14048:2002
  Environmental management -- Life cycle assessment -- Data documentation format
- ISO/TR 14049:2012
  Environmental management -- Life cycle assessment -- Illustrative examples on how to apply ISO 14044 to goal and scope definition and inventory analysis
- ISO/TS 14071:2014
  Environmental management -- Life cycle assessment -- Critical review processes and reviewer competencies: Additional requirements and guidelines to ISO 14044:2006
- ISO/DTS 14072
  Environmental management -- Life cycle assessment -- Requirements and guidelines for organizational life cycle assessment
- ISO/AWI TR 14073
  Environmental management -- Water footprint -- Illustrative examples on how to apply ISO 14046


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# Which standard?

- All provide requirements and guidelines
- Decisions involve LCA issues, like goal and scope definition, data collection strategies, and reporting.
- Specific issues relevant for carbon footprints, including land-use change, carbon uptake, biogenic carbon emissions, soil carbon change, and green electricity.
- All standards build on existing life cycle assessment methods established through ISO 14040 and ISO 14044.
- But small differences exist among the standards. BSI, WRI/WBCSD and ISO cooperated to increase alignment of the standards.
  - ISO 14067 is general standard, although some requirements are quite specific, e.g. requirements on the use of green electricity.
  - PAS 2050 and GHG Protocol provide more detailed requirements and guidance with less space for interpretation.


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# Reporting requirements

Not currently a requirement to report using LCA with a few exceptions such as shown below:

- Under EU renewable energy directive biofuels have to deliver a minimum saving in GHG emissions calculated on a LCA basis
- The EU's Integrated Product Policy incorporates life cycle thinking, and the Ecolabelling scheme for products, uses LCA when looking at criteria for the label
- Under France's Grenelle 2, high volume consumer products need to have environmental product declarations which are produced on an LCA basis


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# Mitigation Potential


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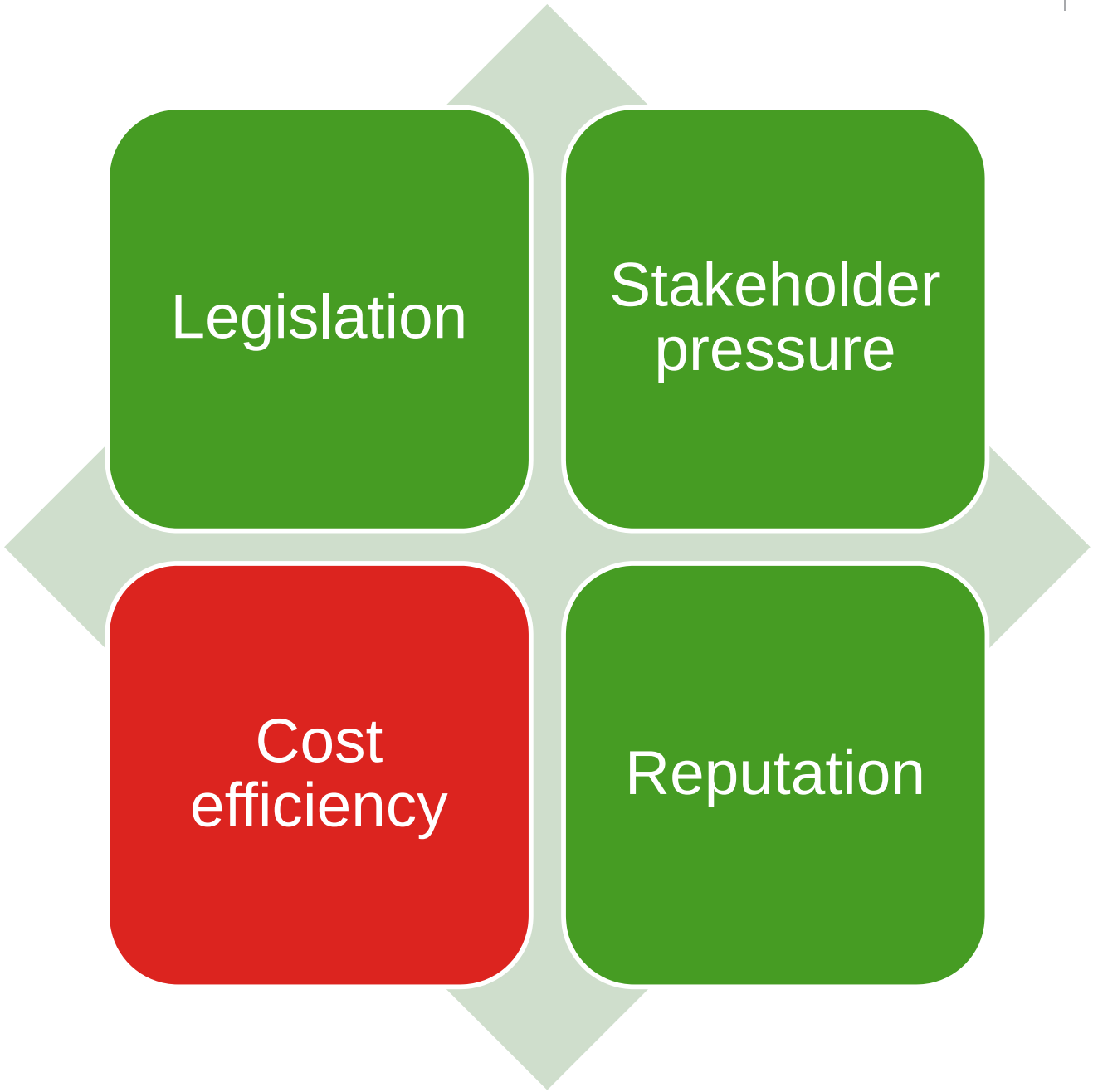
# Why are organisations reporting LCA or other footprints?





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# How is mitigation approached?

- Cost efficiency
- Best practice /opportunity appraisal
- Assessed by prioritisation through MACC or Internal rate of return (IRR) and return on investment (ROI) or payback

- What are businesses doing with the information that they have - are they using scope 1, 2 and 3?

- Timeline – typically short timelines 2-5 years average, some 10 years, few beyond – business planning on short cycles – not like a nation

- Science based target setting not yet present – GHG protocol involved in developing a science based target setting standard to encourage organisations to start setting targets based on the need rather than the measures


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# Key Observations and Thoughts for Discussion


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# Key observations – Carbon footprinting

- Approach and principles same as IPCC Guidance
- Boundaries are organisational or activity not geographical or political
- Differences in scopes and therefore reporting
- Generally not mandatory more voluntary- though changing
- Many standards available and applicable for different purposes
- Some gaps and complexity appearing
  - little consistency in standards, emission factors, and reporting requirements on a geographical basis.
  - At national or international level care has to be taken with double counting
  - Factors of higher quality for certain emissions than others


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# Key observations – LCA

- LCA covers wider environmental aspects than carbon footprinting
- Value chain approach taken for activity
- Less standards and less widely used
- Expensive and complex process
- Software generally used
- Broad range of emissions factors available from limited number of sources
- QA/QC seems less developed in comparison to IPCC GLs


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# Key observations – Mitigation

- Evaluation of mitigation done on a measure by measure basis
- Estimates often made based on best practice and benchmarks
- Evaluated on financial returns available
- Target setting
  - linked to measures expected to be implemented
  - tend to be short to medium term and low percentage target (not typically ambitious)
- Science based target setting not widely adopted
- GHG protocol pushing for adoption of science based


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# Questions for discussion

- Should there be more discussion on how methodologies are being applied?
- Can non-IPCC guidance make use of IPCC QA/QC and uncertainty methodologies – these are well developed, and often less developed in other guidance
- What might the IPCC be able to learn from other guidance? EF applicability?
- Should the IPCC support the development develop of alternative approaches ("other areas" i.e. not national GHG inventory guidance)?
- Where can IPCC support the development of alternative approaches?

- Wider adoption of consistent reporting methods? Is this necessary, or a good idea?
- Closer support of GHG protocol guidance development?
- "Science based" target setting?
- Style and form of guidance – this could affect levels of interest and uptake
- Spatial resolution issues – if, and how can these be treated?

- Do "people" use the IPCC guidelines to calculate the emissions reductions that can be achieved – mitigation?


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# Inside SimaPro

- Inside SimaPro
- Several databases
- Different cover ages – some is highly processed
- Main one is Ecoinvent
- EFs per fuel and emissions by unit product – this means less transparency. Also by e.g. of coal burnt to give 1MJ
- Can enter EFs your self

- European Reference Lifecycle Database http://eplca.jrc.ec.europa.eu/
- http://eplca.jrc.ec.europa.eu/ELCD3/
- http://eplca.jrc.ec.europa.eu/ELCD3/processSearch.xhtml


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# European Reference Lifecycle Database - example

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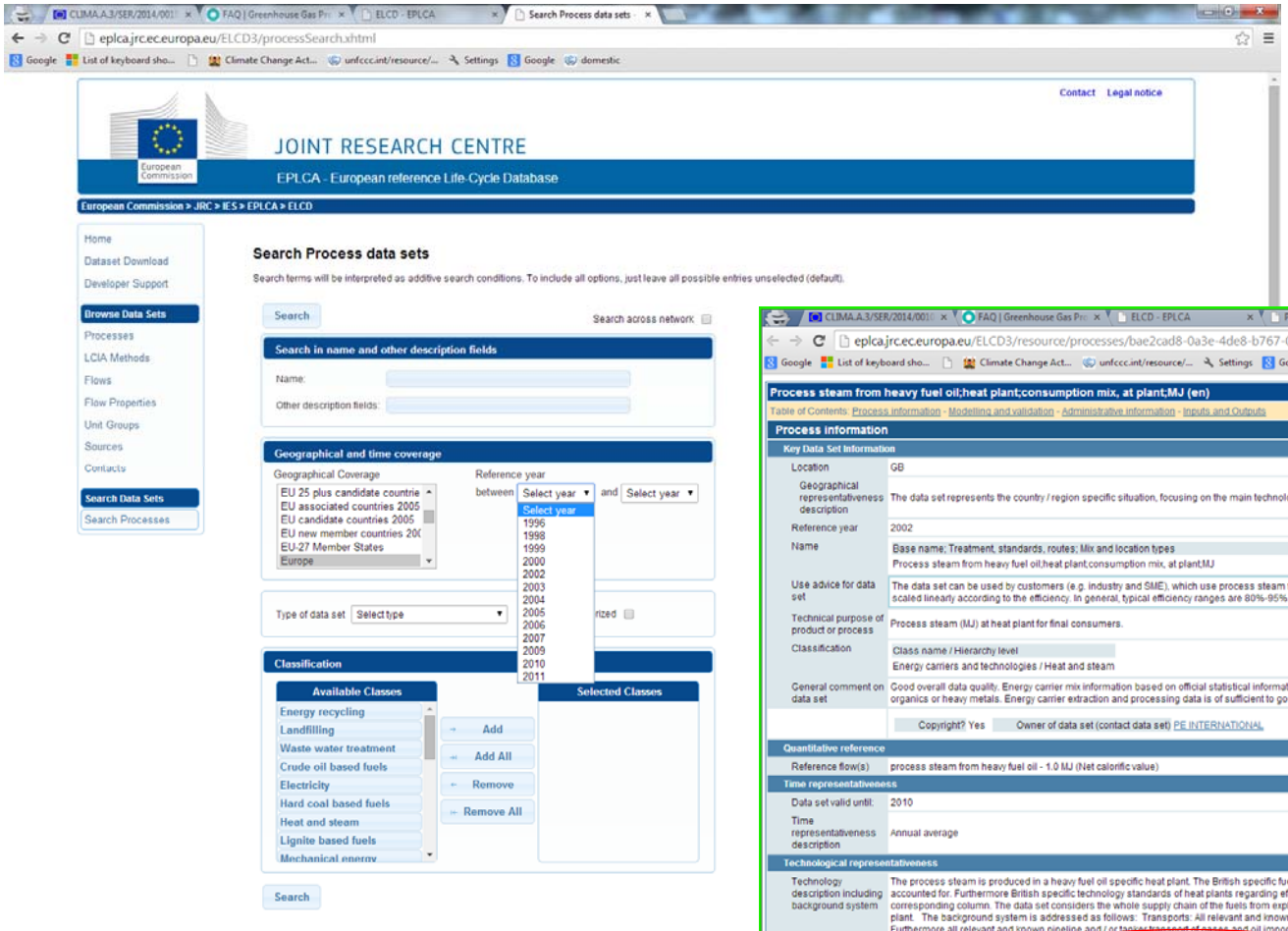


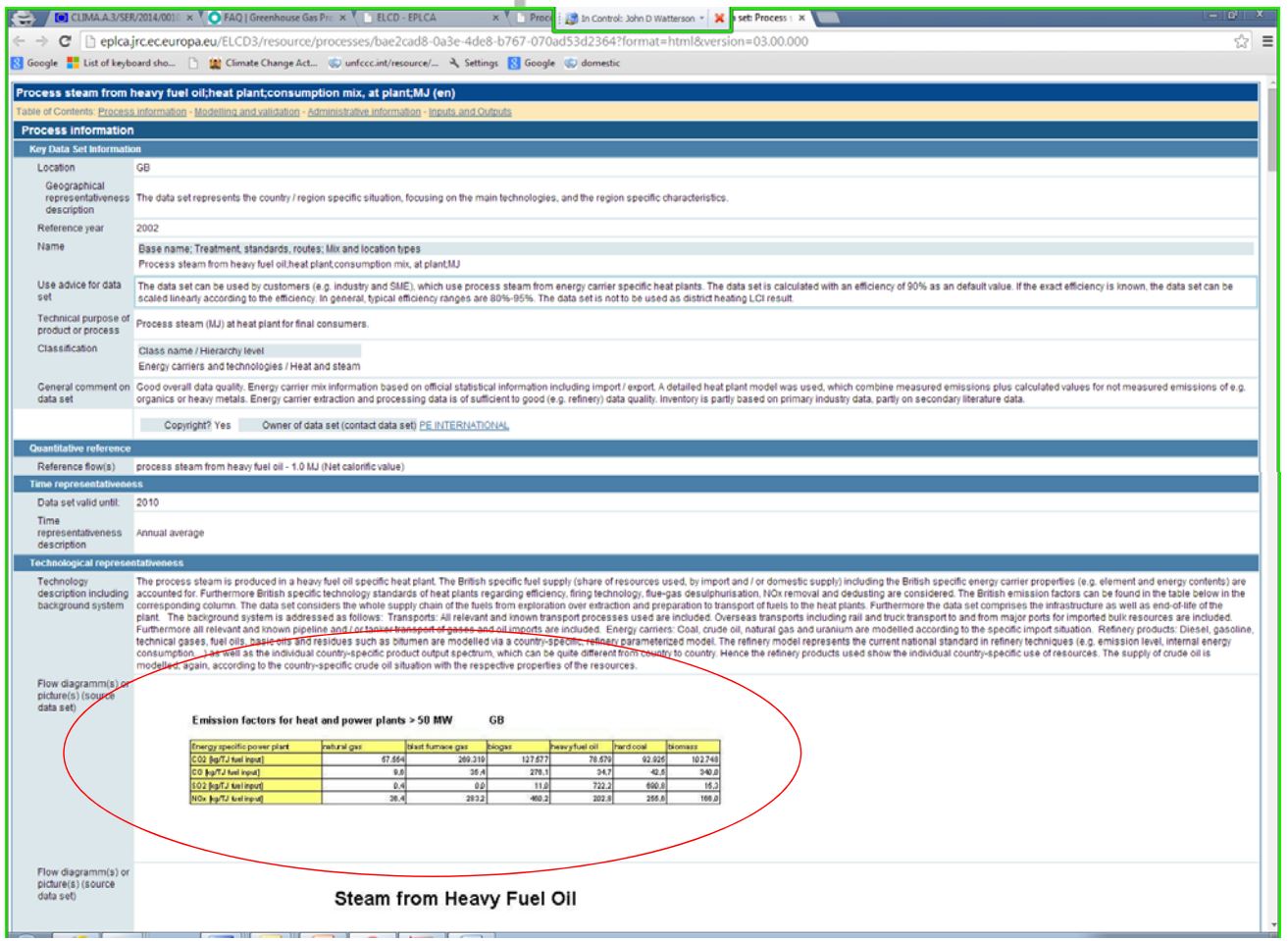



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