

EEE116

# Week 9 Introduction to sustainability

Dr. Yang Du

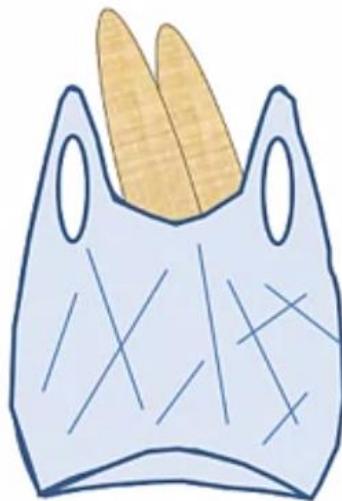


Xi'an Jiaotong-Liverpool University

西交利物浦大学

# Plastic VS Paper Bags

*Which do you think is the greener product option?*



*Plastic grocery bags?*

*OR*

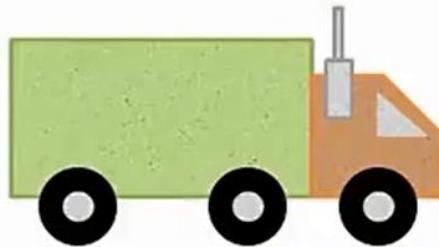


*Paper grocery bags?*

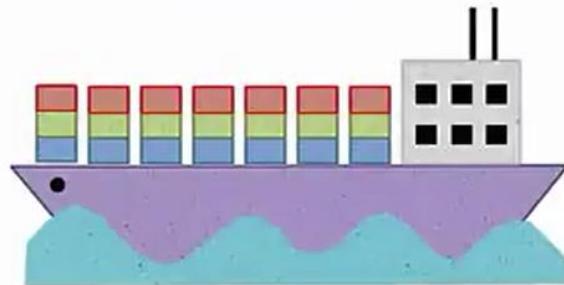


# Local VS Imported Food

*Which do you think is the greener product option?*



OR



*Food that is sourced locally?*

*Food that is imported?*



# Highlight from last week

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- ❑ Many sustainability issues are complex
  - need to consider the viewpoints of different parts of society
  
- ❑ Require an approach that considers issues in a systematic way
  - Step 1: “cradle-to-grave”
  - think about the whole life-cycle of a product

# Outline of the lecture

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A systematic approach to investigating sustainability:

1. Identify the stakeholders for the product (or process)
2. Consider cradle-to-grave or life-cycle for a product
3. Identify sustainability issues in each part of the cycle
4. Rate the importance of those issues
5. Suggest improvements and consider these in terms of
  - effect of the improvement
  - likelihood of it happening

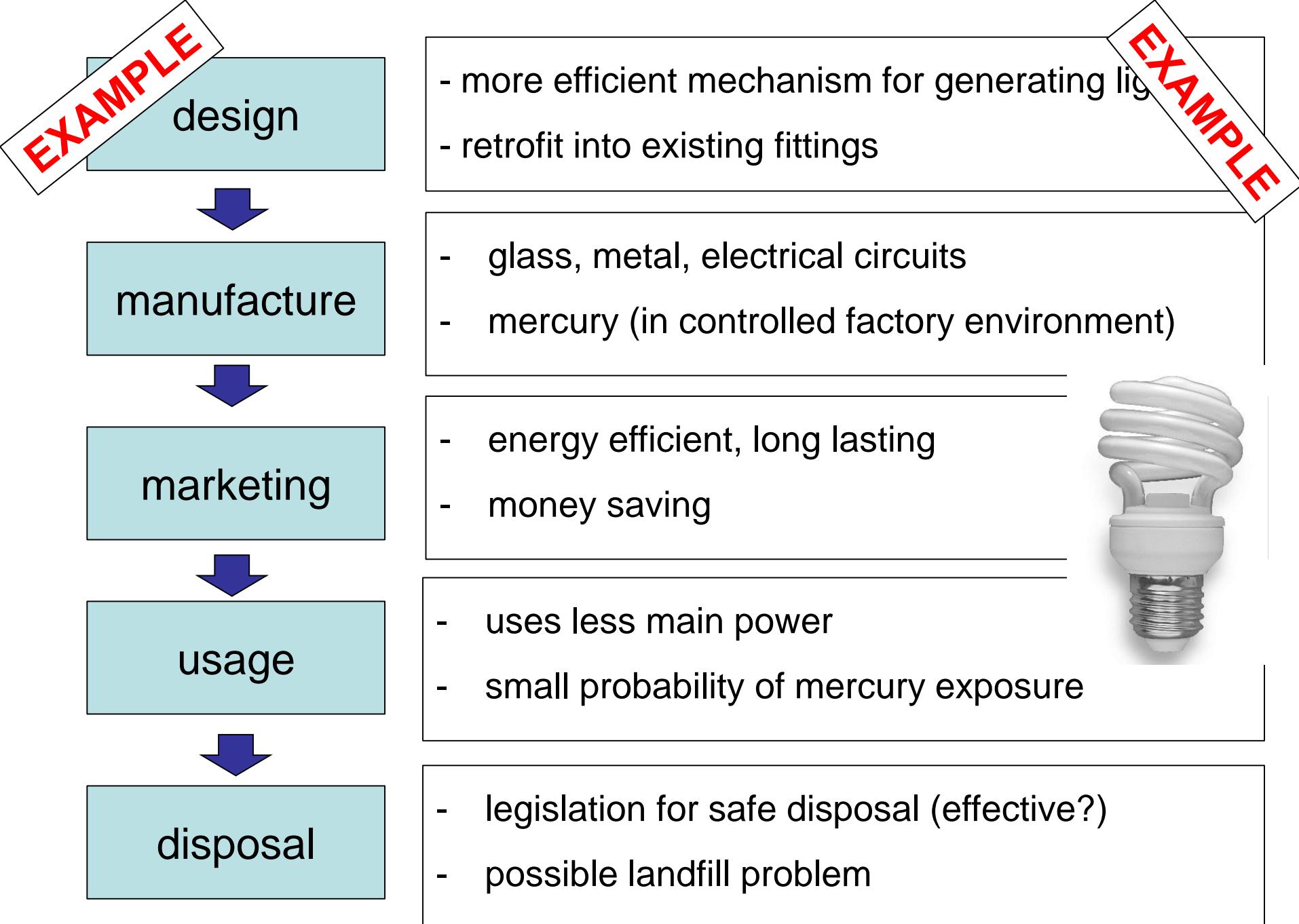
# **PART 1: IDENTIFYING SUSTAINABILITY ISSUES**

# **Cradle-to-grave** process

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This is one of the standard ways of considering sustainability issues

- What is the product design?
- How is it manufactured? (materials, processes)
- How is it packaged?
- How is it marketed?
- How is it used?
- What happens after use?



# Identifying the important factors

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- *Cradle to grave* approach provides a straightforward way to identify some sustainability issues
- However, we need to break down the sustainability issues into more detail
- One way of achieving this is construct a matrix of the important factors
  - (i) list the life-cycle stages of the product
  - (ii) identify the sustainability issue at each stage of the product life

# Identifying the important factors

- construct a matrix of sustainable development impacts

< product or process >      **Sustainable development factor**

<b>Life cycle stage ↓</b>	<b>Factor 1</b>	<b>Factor 2</b>	<b>Factor 3</b>	<b>Factor 4</b>	<b>Factor 5</b>
raw materials					
manufacture					
distribution					
use					

# Identifying the important factors for CFLs

**EXAMPLE**

Life cycle stage ↓	depletion of reserves	cost	energy usage	waste	carbon footprint
raw materials					
manufacture					
distribution					
use					
disposal					

# Identifying the important factors for CFLs

**EXAMPLE**



## SUSTAINABLE DEVELOPMENT FACTOR

Life cycle stage ↓	depletion of reserves	cost	energy usage	waste	carbon footprint
raw materials	Are any rare resources used ?	Is cost of raw materials a significant issue	Is a large amount of energy required to source the materials	Is there a waste issue for the <i>acquisition of raw materials</i>	Is there significant carbon emission <i>during the acquisition of resources</i>
manufacture	?	?	?	?	?

# Identifying the important factors for CFLs

**EXAMPLE**



Life cycle stage ↓	depletion of reserves	cost	energy usage	waste	carbon footprint
raw materials	glass, metal, mercury – minor issues		energy used to extract mercury	sand-mining (for glass)	
manufacture		significant due to complexity of lamp	mass-produced product, relatively efficient		some
distribution	petroleum for trucks, ships etc			exhausts etc	vehicle emissions
use			Uses electricity, even though efficiently	mercury – if lamp becomes broken	positive impact compared to alternatives
disposal		recovery of mercury expensive		potential for environment contamination	

# Example: Toothbrushes

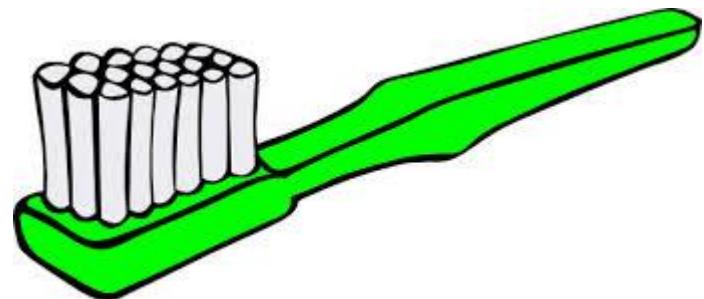
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- consumable item
- made from plastic with nylon bristles
- a few large manufacturers and a few small ones
- “sustainability” is probably not considered important



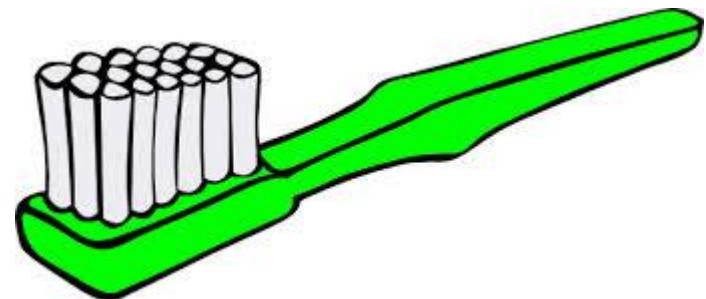
# Sustainability study for toothbrushes

1. Complete a cradle-to-grave study
2. Construct a matrix to break down the issues into more detail
3. Complete the matrix of sustainability issues



# Sustainability study for toothbrushes

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design



manufacture



marketing



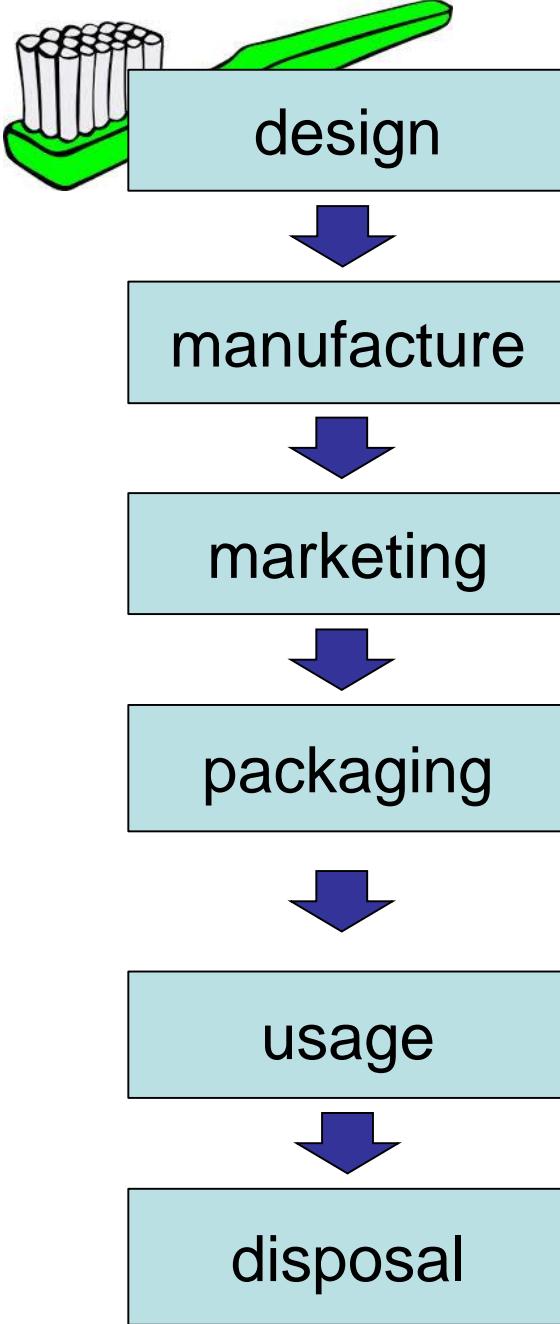
packaging



usage



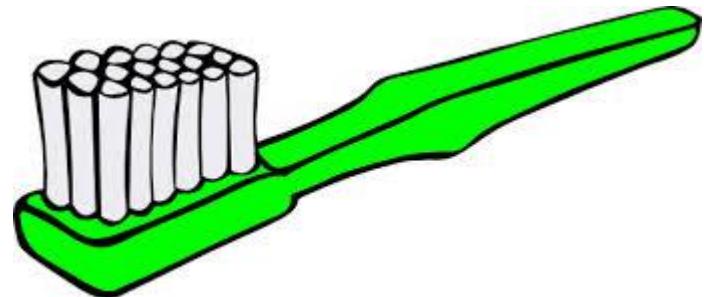
disposal



- two components: plastic handle and nylon bristles
  - designed for functionality and consumer appeal
- 
- plastic melted and molded into shape
  - nylon bristle cut to shape and fitted into the plastic
- 
- sold in supermarkets and pharmacies
  - range of prices and styles (sustainability is *non-issue*)
- 
- plastic “clam shell” + cardboard insert
  - transported from manufacturer (non-UK) to retailer
- 
- recommended to replace every 3 months
  - most consumers replace the item when bristles are worn
- 
- thrown away after use, deposited in landfill

# Sustainability study for toothbrushes

1. Complete a cradle-to-grave study
2. Construct a matrix to break down the issues into more detail
3. Complete the matrix of sustainability issues



# Sustainability study for toothbrushes

< product or process >		Sustainable development factor				
Life cycle stage ↓		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
raw materials						
manufacture						
distribution						
use						
disposal						

# Sustainability study for toothbrushes

## (1) Life-cycle

- 
- 
- 
- 
- 

## (2) Sustainability factors

- 
- 
- 
- 
-

# Sustainability study for toothbrushes

## (1) Life-cycle

- raw materials
- manufacture
- packaging (?)
- distribution (?)
- use
- disposal

## (2) Sustainability factors

- 
- 
- 
- 
-

# Sustainability study for toothbrushes

## (1) Life-cycle

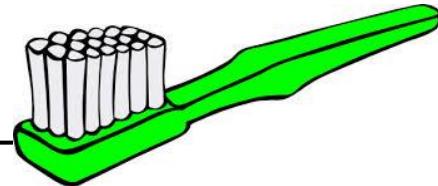
- raw materials
- manufacture
- packaging (?)
- distribution (?)
- use
- disposal

## (2) Sustainability factors

- depletion of resources
- cost
- energy usage
- waste
- carbon footprint

# TOOTHBRUSH

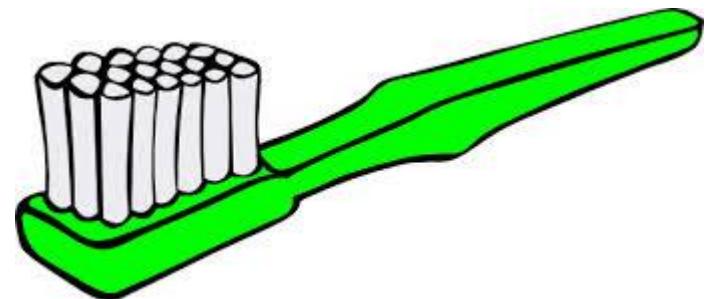
## Sustainable development factor



Life cycle stage ↓	depletion of reserves	cost	energy usage	waste	carbon footprint
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disposal					

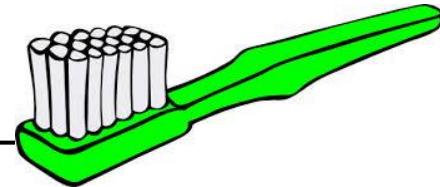
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# TOOTHBRUSH

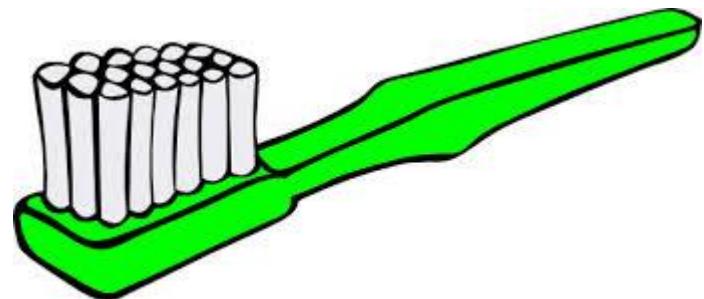
## Sustainable development factor



Life cycle stage ↓	depletion of reserves	cost	energy usage	waste	carbon footprint
raw materials	petroleum essential for plastic and nylon	crude oil	lots of energy used in manufacture of plastic and nylon	chemical wastes from factory	electricity used in oil refinery and plastics factory
manufacture	plastics, nylon, small amount of metal	plastic is cheaper than wood & metal	energy used in manufacture processing ( melting, molding etc)	chemical wastes from factory	electricity used in toothbrush factory
packaging	if in plastic, issues as above, paper boxes can be recycled			packaging usually thrown away	
distribution	petroleum used for transportation	depends on petrol cost	energy used in transportation		burning of fossil fuel
use	water used	consumer buys replacement when necessary			
disposal				most toothbrushes are thrown away - 100s of years lifetime in landfill	

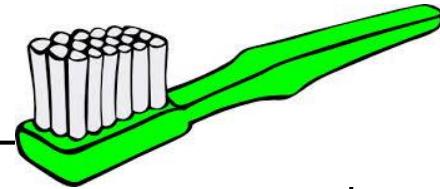
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3. Complete the matrix of sustainability issues
4. Rate the sustainability issues



# TOOTHBRUSH

## Sustainable development factor



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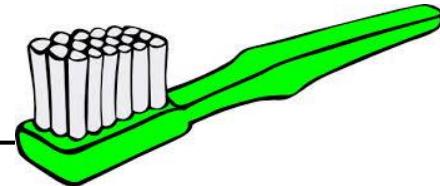
# Rating the sustainability issues

- construct a so-called “scoring matrix”, rating the different factors
  - 0 = no effect
  - 5 = major effect
  - negative number indicates an improvement

TOOTHBRUSH		Sustainable development factor			
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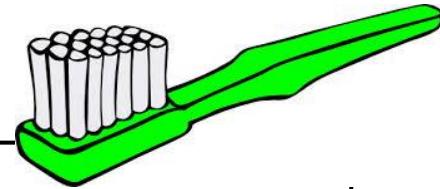
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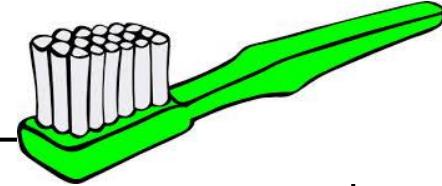
## Sustainable development factor



Life cycle stage ↓	depletion of reserves	cost	energy usage	waste	carbon footprint
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manufacture	plastics [1] n, small amount metal	plastic is cheaper than wood & metal	energy used in manufacture processing ( melting, molding etc)	chemical wastes from factory	electricity used in toothbrush factory
packaging	if in plastic [2] issues as above, or boxes can be recycled			packaging usually thrown away	
distribution	petroleu[1] sed for trans[ation]	depends on petrol cost	energy used in transportation		burning of fossil fuel
use	wa[3] sed	consumer buys replacement when necessary			
disposal				most toothbrushes are thrown away - 100s of years lifetime in landfill	

# TOOTHBRUSH

## Sustainable development factor



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packaging	if in plastic [2]ssues as above, [2]r boxes can be recycled			packaging [3]ually thrown away	
distribution	petroleum [1]sed for transportation	depends on [1]petrol	energy [2]ed in transportation		burning [2]ossil fuel
use	waste [3]sed	consumer buys replaces [2] when necessary			
disposal				most toothbrushes are thrown away - 100s of years lifetime in landfill [4]	

# Investigating product sustainability

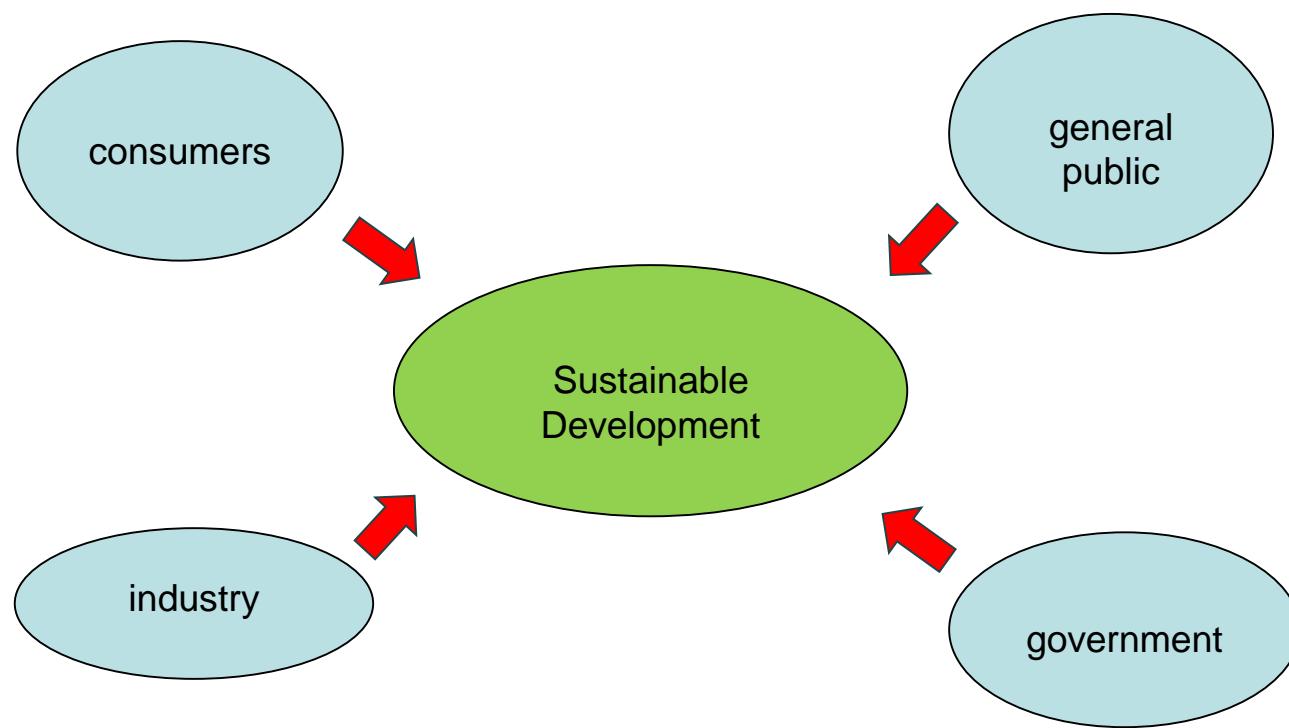
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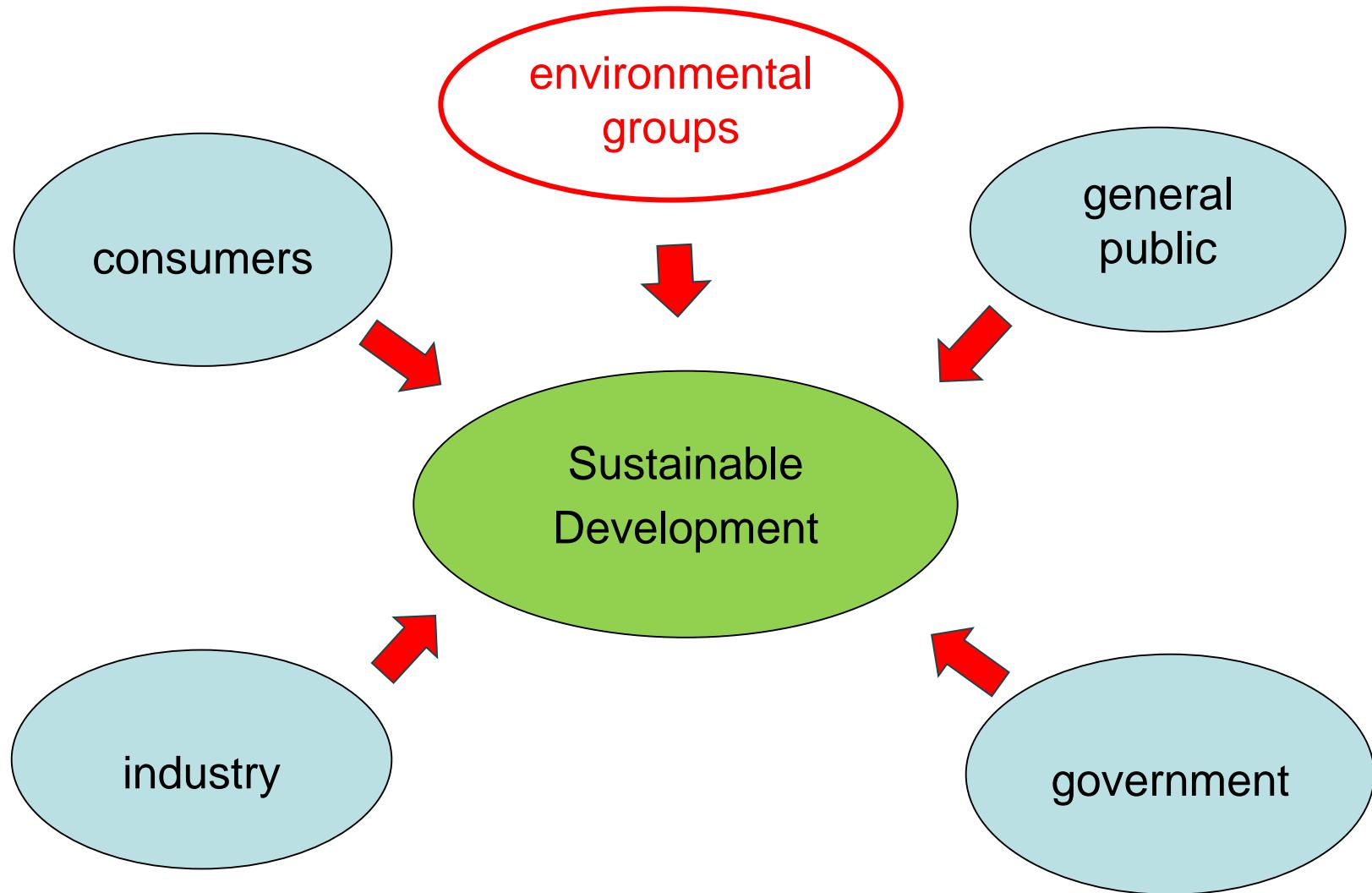
1. Complete a cradle-to-grave study
2. Construct a matrix to break down the issues into more detail
3. Complete the matrix of sustainability issues
4. Rate the sustainability issues
5. ??

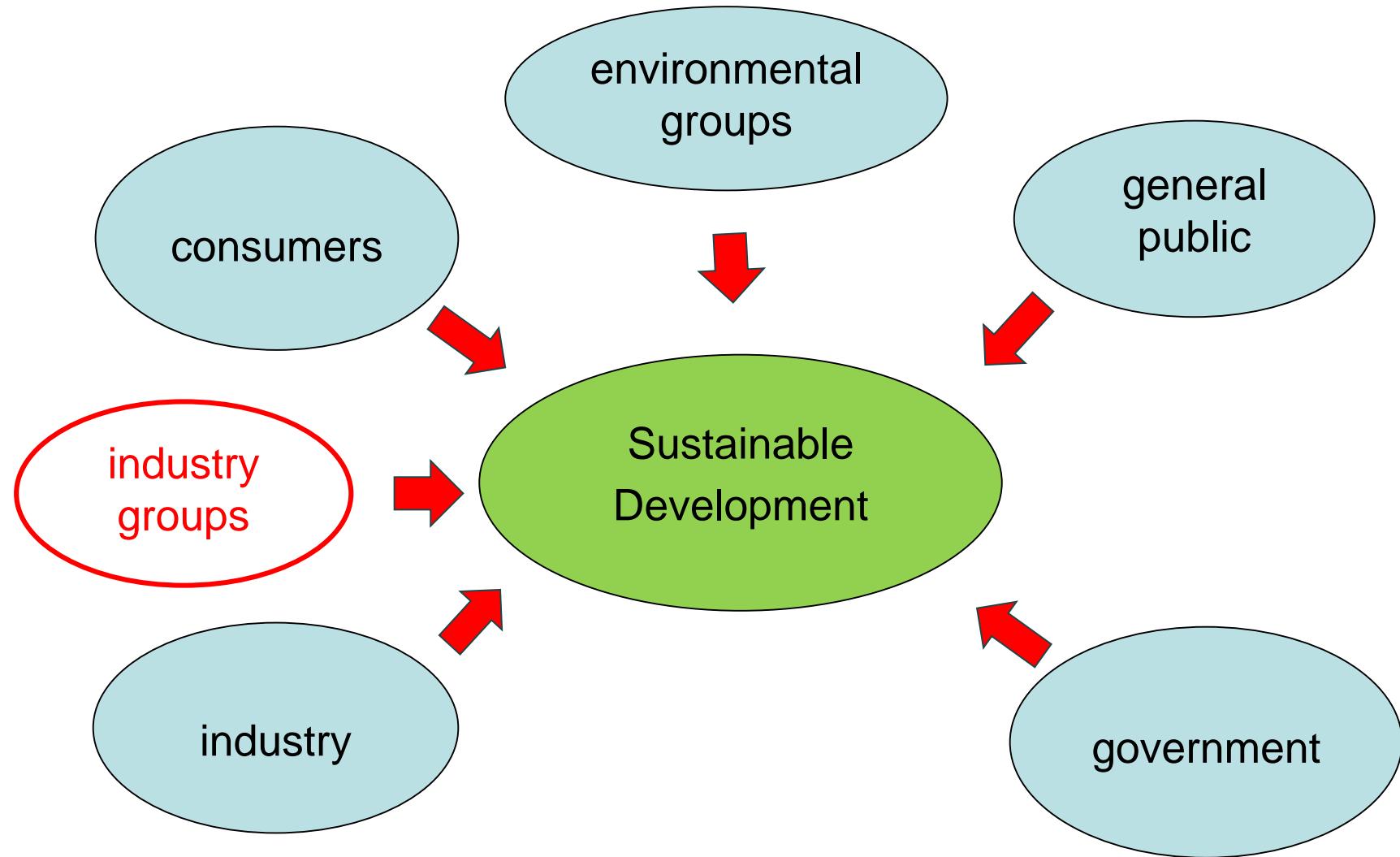
# **PART 2: STAKEHOLDERS AND THE ROLE OF REGULATION**

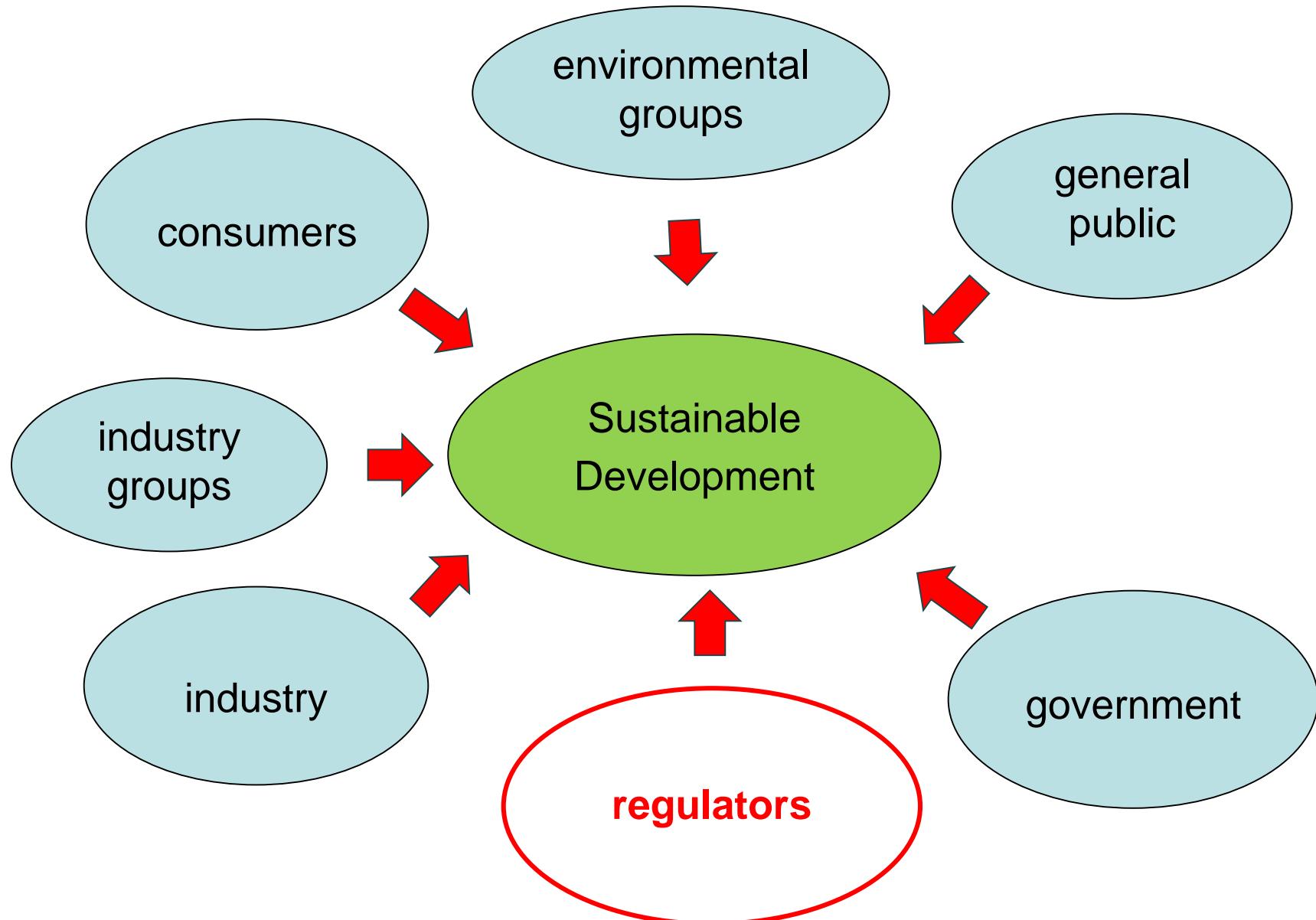
# Views on sustainability issues

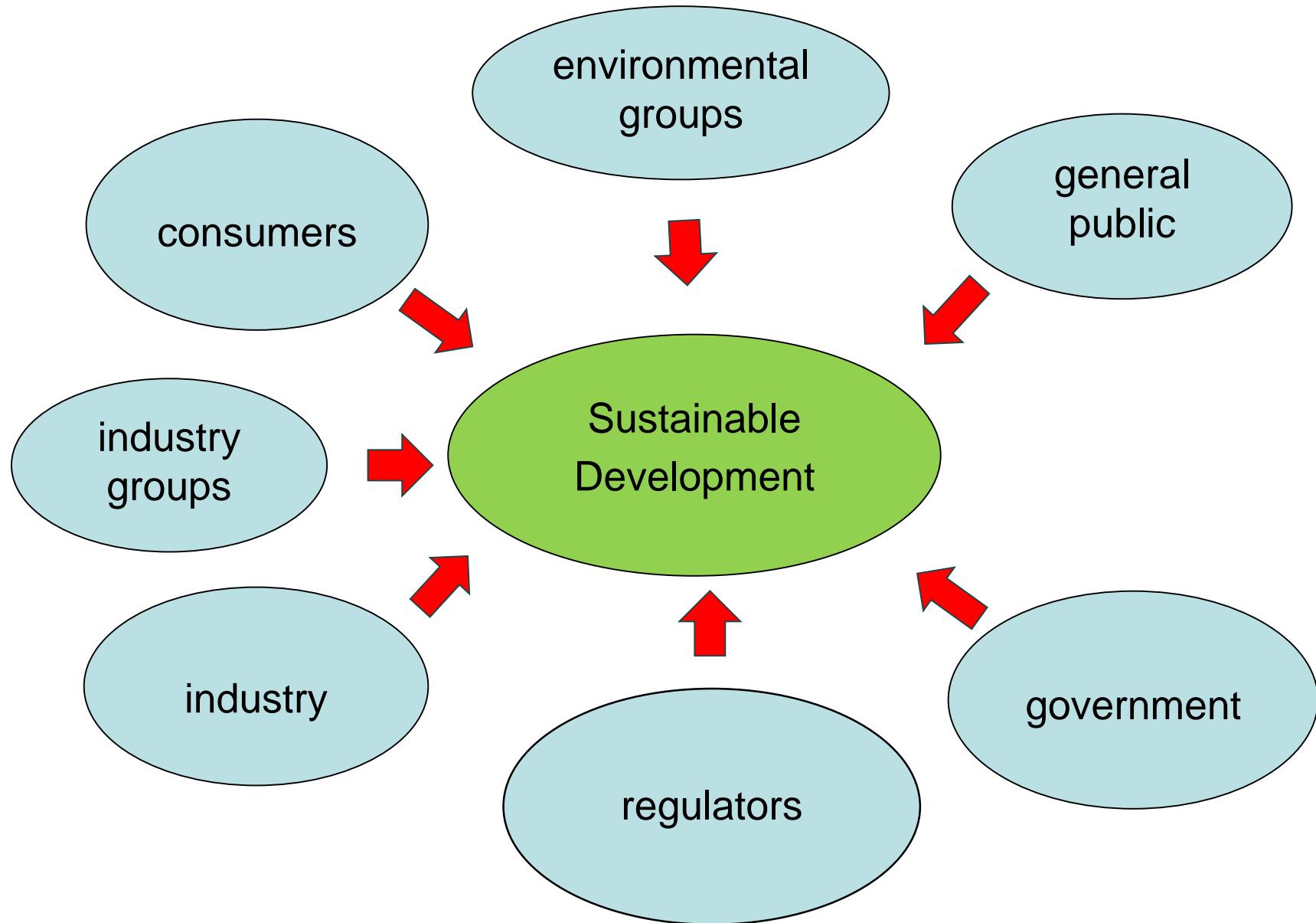
- Earlier, we said that sustainability has different aspects
  - economic + environmental + social











# The role of regulators

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- Regulations are an important factor in development of many types of products
  - tobacco & alcohol products, eggs
  - cars and consumer goods
- Some regulations affect sustainability issues
  - example: cars
  - example: appliances containing electronics

**EXAMPLE**

# The role of regulators: CFLs

- changeover from incandescent lamps to compact fluorescent lamps was driven by regulation, not direct consumer need
- Mercury usage remains an issue:
  - mercury use is strictly regulated
  - original plan was to phase out mercury usage over 10 years or so
  - industry claims mercury use in lamps is essential
  - environmental impact continues to increase



# Views on sustainability issues

- Earlier, we said that sustainability has different aspects
  - economic + environmental + social
- Any investigation of sustainability has to take into account the perspectives of different society groups

consumers

industry

pressure  
groups

general public

government

regulators

# Stakeholders: how to find info

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- search online!
  - government sites
  - industry sites
  - environment sites
  - news sites

**EXAMPLE**

**EXAMPLE**

# Example: stakeholders in CFLs

- Sustainability issue: regulation of mercury
- Stakeholders:
  - Consumers (domestic + industrial)
  - General public
  - National governments
  - Government groups
  - Industry
  - Pressure groups





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## Mercury

**Context** - Mercury is a heavy metal of which some forms are known to be highly toxic. Though mercury occurs naturally in the environment it is now mainly released by human activities.

Are these releases being controlled? Are humans and the environment at risk?

This Digest is a faithful summary of the leading scientific consensus report produced in 2002 by the United Nations Environment Programme (UNEP): "Executive Summary of the Global Mercury Assessment" [Learn more...](#)



1. What is mercury?
2. What are the impacts of mercury on human health?
3. What are the impacts of mercury on the environment?
4. Where is mercury found?
5. Where do the world's supplies of mercury come from?
6. What can be done to reduce mercury releases?





# ENVIRONMENT

European Commission > Environment > Chemicals > Mercury

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## Chemicals Home

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## Mercury

**NEW** [Public consultation on the ratification by the EU of the Minimata Convention on Mercury](#)

Mercury is an indestructible chemical element, the only metal that is liquid at ambient temperature. It is highly toxic to humans, animals and ecosystems, but it is found in all forms all across the world, in the air, water, sediments, soil and even inside living organisms.

In the presence of bacteria, mercury can change into methylmercury, its most toxic form. The main risk of exposure for human beings is food. Methylmercury accumulates in the food chain, and particularly in fish. Even relatively low doses can seriously affect the nervous system and could also harm the cardiovascular, immune and reproductive systems.

**EXAMPLE**

**EXAMPLE**

# Example: stakeholders in leather

- Sustainable development issue:
  - chemicals used for tanning the leather
- How to find information??



## [Chemicals Used in Leather Processing - International ...](https://sites.google.com/site/.../chemicals-used-in-leather-processing)

<https://sites.google.com/site/.../chemicals-used-in-leather-processing> ▾

International School of Tanning Technology. Search this site ... The following is a list of chemicals commonly used in leather making: Beamhouse and Tanyard

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## [Tanning - Wikipedia, the free encyclopedia](https://en.wikipedia.org/wiki/Tanning)

[en.wikipedia.org/wiki/Tanning](https://en.wikipedia.org/wiki/Tanning) ▾

Two men pressing the leather near the end of the tanning process in an American ...  
tanning used tannin, an acidic chemical compound from which the tanning ...  
[Sun tanning - Buckskin - Category:Tanning](#)

## [Toxic chemicals used for leather production poisoning ...](https://www.theecologist.org/.../toxic_chemicals_used_for_leather_production_...)

[www.theecologist.org/.../toxic\\_chemicals\\_used\\_for\\_leather\\_production\\_...](https://www.theecologist.org/.../toxic_chemicals_used_for_leather_production_...) ▾

26 Oct 2012 - India's tanning industry has started tackling environmental issues but its progress on worker safety is woeful. As Peter Bengtsen found out, ...

## [\[PDF\] Leather Tanning - Environmental Protection Agency](https://www.epa.gov/ttnchie1/ap42/ch09/final/c9s15.pdf)

[www.epa.gov/ttnchie1/ap42/ch09/final/c9s15.pdf](https://www.epa.gov/ttnchie1/ap42/ch09/final/c9s15.pdf) ▾

Tanning is essentially the reaction of collagen fibers in the hide with tannins, chromium, alum, or other chemical agents. The most common tanning agents used in the U. S. are trivalent chromium and vegetable tannins extracted from specific tree barks.

## [Leather Manufacturing Process](https://www.leathersellers.co.uk/content.php?pid=96)

[www.leathersellers.co.uk/content.php?pid=96](https://www.leathersellers.co.uk/content.php?pid=96) ▾

The use of hides and skins, tanned or untanned, as useful articles has been with us ...  
tanning and retanning chemicals used in the production of leather, and the ...

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Information sites

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26 Oct 2012 - India's tanning industry has started tackling en

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Environmental group

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Government/ regulator

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Industry

# Other useful sources

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- Technical journals
  - online in general, available in university library
- Environment agency (UK)
- Direct.gov.uk – environment and greener living (UK)
- Department of Energy and Climate Change (UK)
- European Commission sites
- Industry sites (example:  
[http://www.lighting.philips.co.uk/pwc\\_li/gb\\_en/subsites/oem/download/eup\\_legislation\\_philips\\_oem.pdf](http://www.lighting.philips.co.uk/pwc_li/gb_en/subsites/oem/download/eup_legislation_philips_oem.pdf)

# Investigating product sustainability

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1. Identify the stakeholders!!
2. Complete a cradle-to-grave study
3. Construct a matrix to break down the issues into more detail
4. Complete the matrix of sustainability issues
5. Rate the sustainability issues
6. ???

# **PART 3: ASSESSING IMPROVEMENT TO PRODUCT DESIGN**

# Improving sustainability

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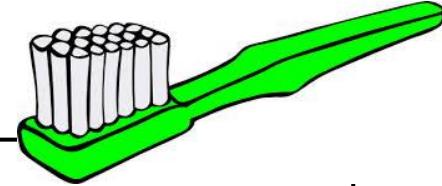
- We have just discussed the process of identifying sustainability issues

Q: For any product, how can we determine the best way to improve sustainability??

A: Look at the matrix for sustainability issues

# TOOTHBRUSH

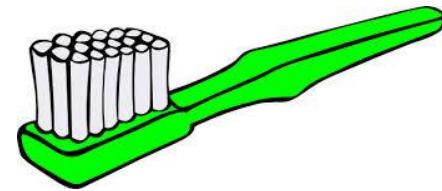
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disposal				most toothbrushes are thrown away - 100s of years lifetime in landfill [4]	

# Possible improvements

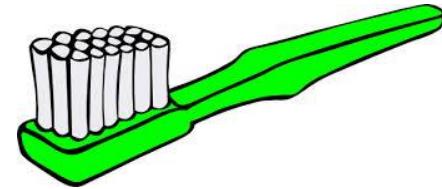
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1. Use detachable heads
  - allows you to continue to use the plastic handle
  - allows you to change the head easily for different types of bristles
  - reduces use of resources

# Possible improvements

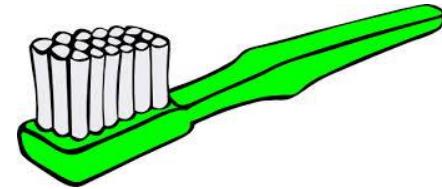
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1. Use detachable heads (to reuse the plastic handle)
  
2. Use recycled plastic
  - reduces consumption of resources
  - would require manufacturers to change production process

# Possible improvements

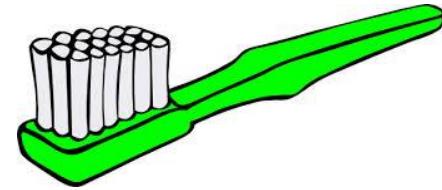
---



1. Use detachable heads (to reuse the plastic handle)
2. Use recycled plastic
3. Replace plastic with environmentally friendly materials
  - removes plastic from the product
  - changes resource use
  - changes after-use problem of landfill

# Possible improvements

---



1. Use detachable heads (to reuse the plastic handle)
2. Use recycled plastic
3. Replace plastic with environmentally friendly materials



# preserve

Nothing wasted. Everything gained.®

## recycle

GIMME 5

## explore

LEARN

## shop

PRODUCTS

# shop

Home > Shop > Bath > Oral Care > Toothbrush in Travel Case | Single



## Toothbrush in Travel Case | Single

\$3.30

### BRISTLE TYPE

-- Choose Option --



### COLORS



### SUBSCRIPTION

None



### SUBSCRIPTION

Subscribing to a product will guarantee that it is regularly delivered to you when you need it. It can also save you money!

### QUANTITY

1

ADD TO CART



Such a simple change for you.  
Such a big change for earth.

The hundreds of choices we make each day impact the environment.  
Sometimes it's a big decision... sometimes it's as small as changing your toothbrush.

In Australia, over 30 million toothbrushes are used and disposed of by Australians each year, amounting to approximately 1000 tonnes of landfill each year. The plastic they're made of won't break down in our lifetime. Nor within the lifetime of our children. Imagine that on a global scale.

Invented by a Brisbane dentist, The Environmental Toothbrush is a simple solution. Made from bamboo, a natural cellulose fibre, they are biodegradable, environmentally sustainable, and do not pollute the environment. The amazing growth and self-renewing ability of bamboo means that deforestation is not necessary either. Even our packaging is bio-degradable.

(Our toothbrush is **BPA FREE** and **FAIR TRADED** and **VEGAN FRIENDLY**)

You will be helping the earth and your wallet. The Environmental Toothbrush is available in a pack of 12 for only \$36

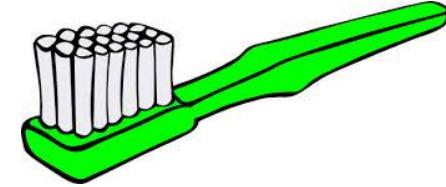
(Freight free in Australia and New Zealand, \$12 Freight per box for International sales).

**NOTE: New Zealand customers click on the Australia Only button.**

Make the change to the Environmental Toothbrush today. It's only natural.



# Improving sustainability



TOOTHBRUSH		Sustainable development factor				
Life cycle stage ↓	depletion of reserves	cost	energy usage	waste	carbon footprint	
raw materials	petroleum <span style="border: 1px solid red; padding: 2px;">4</span> essential for plastic and nylon	crude oil <span style="border: 1px solid red; padding: 2px;">1</span>	lots of energy used in manufacture of plastic and nylon <span style="border: 1px solid red; padding: 2px;">3</span>	chemical wastes from factory <span style="border: 1px solid red; padding: 2px;">3</span>	electricity used in oil refinery and plastics factory <span style="border: 1px solid red; padding: 2px;">3</span>	
manufacture	plastics, nylon, small amounts of metal <span style="border: 1px solid red; padding: 2px;">1</span>	plastic is cheaper than wood & metal <span style="border: 1px solid red; padding: 2px;">2</span>	energy used in manufacture processing (melting, molding etc) <span style="border: 1px solid red; padding: 2px;">3</span>	chemical wastes from factory <span style="border: 1px solid red; padding: 2px;">3</span>	electricity used in toothbrush factory <span style="border: 1px solid red; padding: 2px;">3</span>	
packaging	if in plastic issues as above, paper boxes can be recycled <span style="border: 1px solid red; padding: 2px;">2</span>			packaging <span style="border: 1px solid red; padding: 2px;">3</span> usually thrown away		
distribution	petroleum <span style="border: 1px solid red; padding: 2px;">1</span> used for transportation	depends <span style="border: 1px solid red; padding: 2px;">1</span> on petrol cost	energy <span style="border: 1px solid red; padding: 2px;">2</span> used in transportation		burning <span style="border: 1px solid red; padding: 2px;">2</span> of fossil fuel	
use	water <span style="border: 1px solid red; padding: 2px;">2</span> used	consumer buys replacement when necessary <span style="border: 1px solid red; padding: 2px;">2</span>				
disposal				most toothbrushes are thrown away - <span style="border: 1px solid red; padding: 2px;">3</span> 100s of years lifetime in landfill		

- ❑ Conclude that some improvements can be made in the sustainable development of toothbrushes

# Improving sustainability

---

Q: For any product, how can we determine the best way to improve sustainability??

A: Look at the matrix for sustainability issues

Then ...

- Identify several areas where improvements are possible
- Assess the benefits and problems associated with these improvements

# **PART 4: DIFFERENT TYPES OF IMPROVEMENTS**

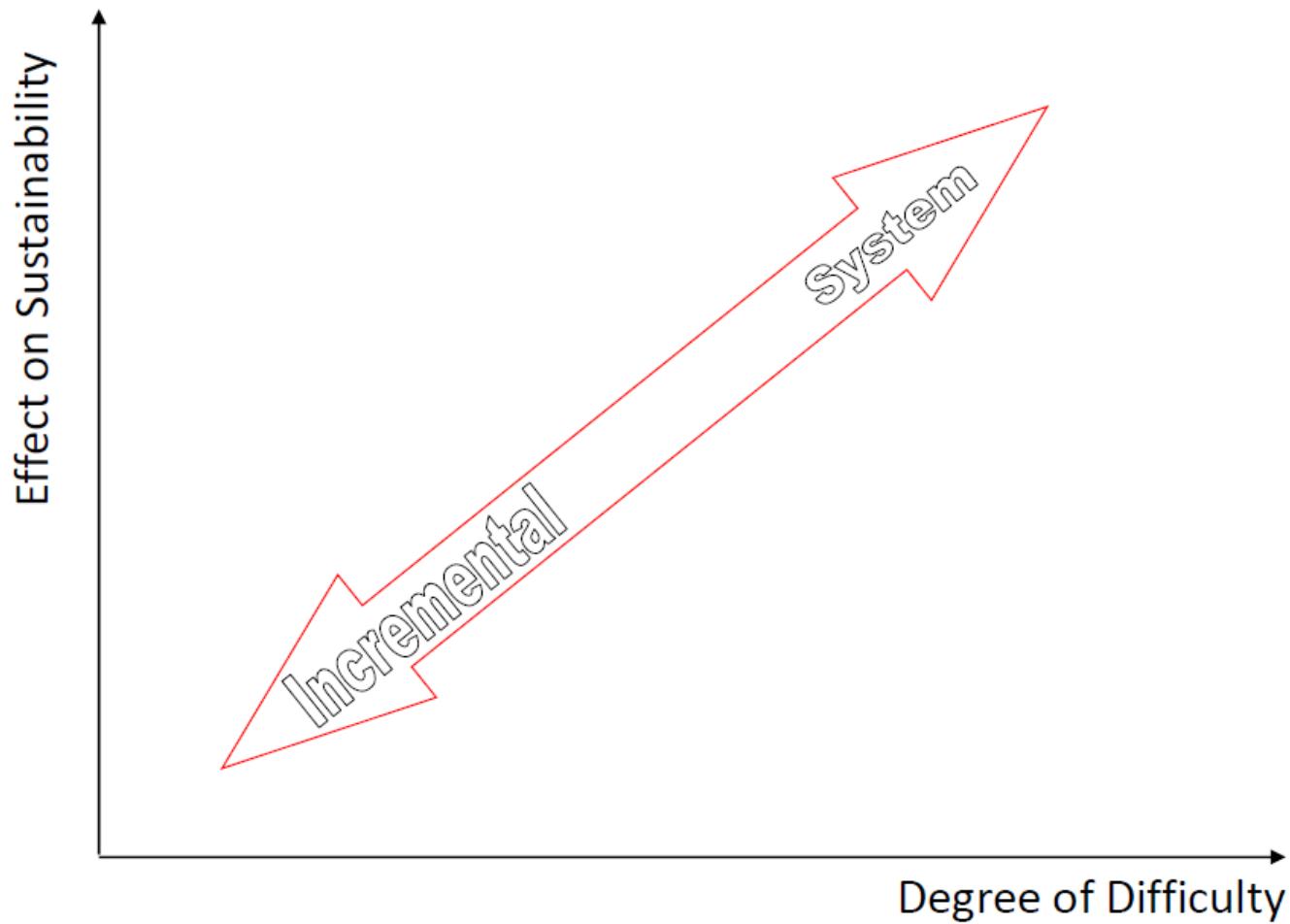
# Types of improvements

---

- Not all improvements are the same
- Some improvements
  - easy to implement but small effect
  - difficult to implement but large effect
- Ideal improvement is easy to implement and has a large effect
  - (these are very hard to find)

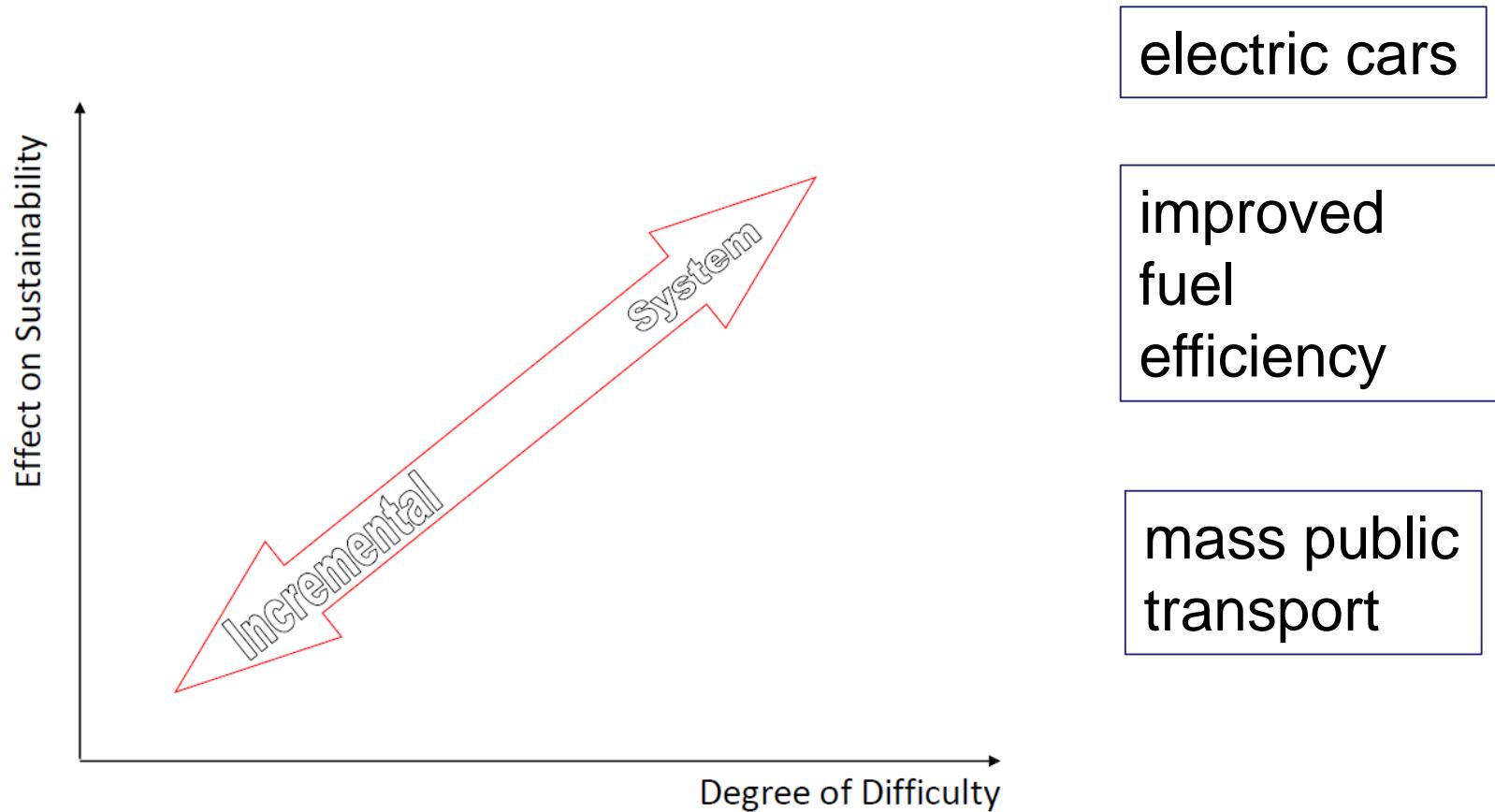
# The design challenge

---



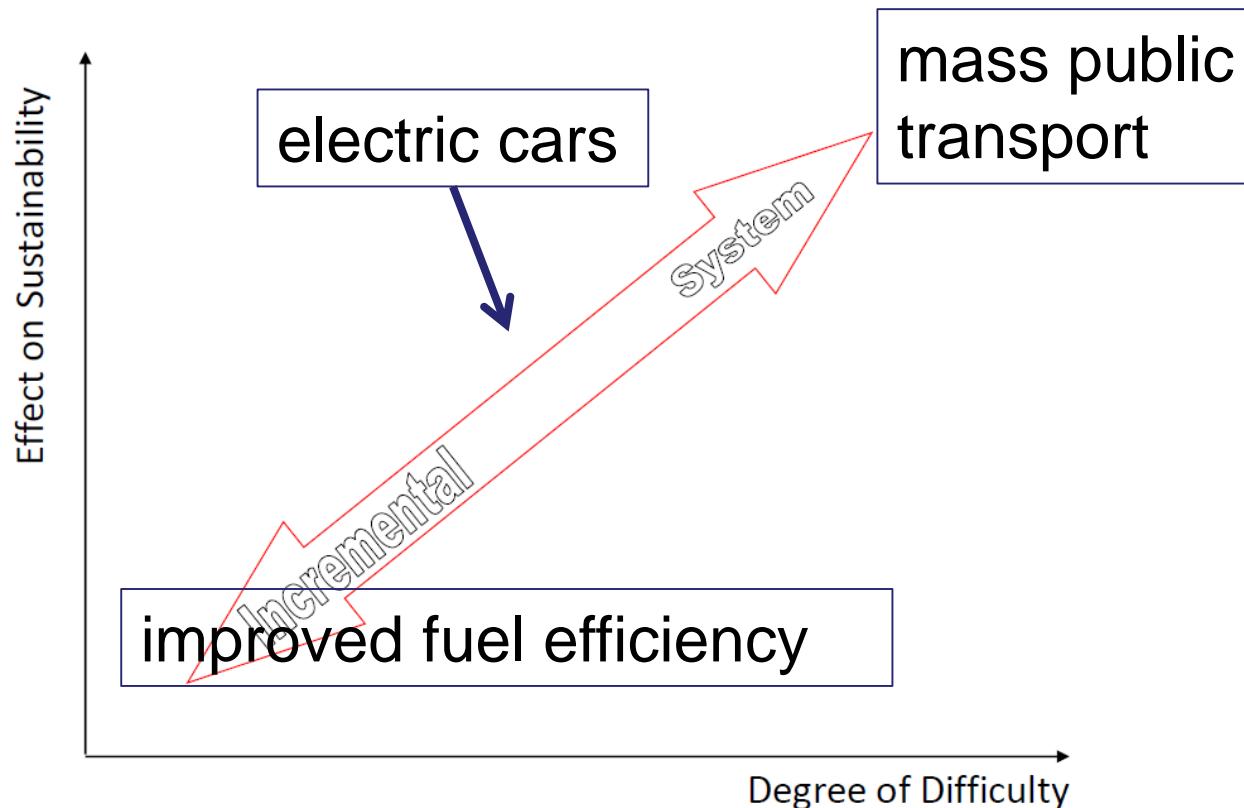
# Example 1: the design challenge

- Where do improvements to transport sustainability appear on the diagram?



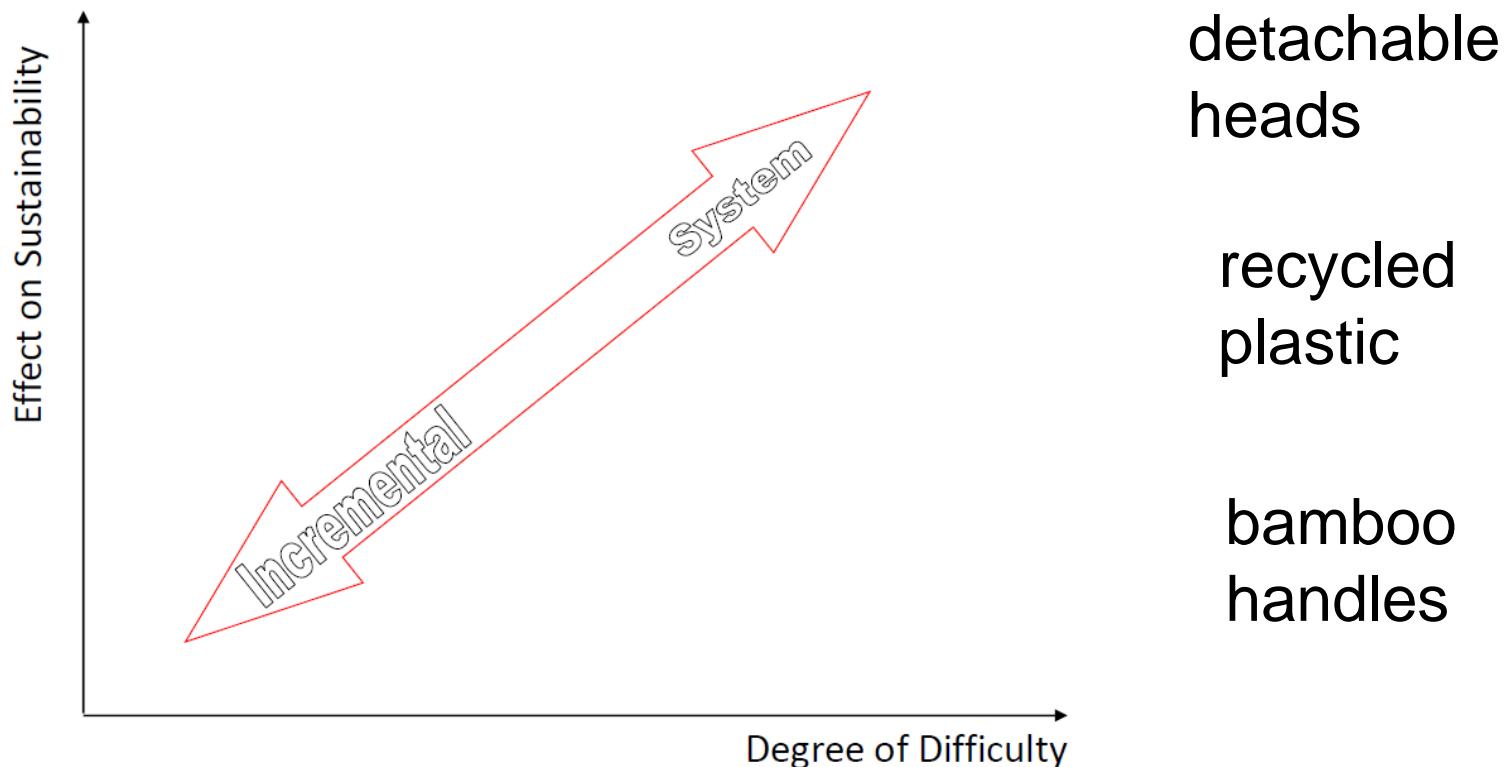
# Example 1: the design challenge

- Where do improvements to transport sustainability appear on the diagram?



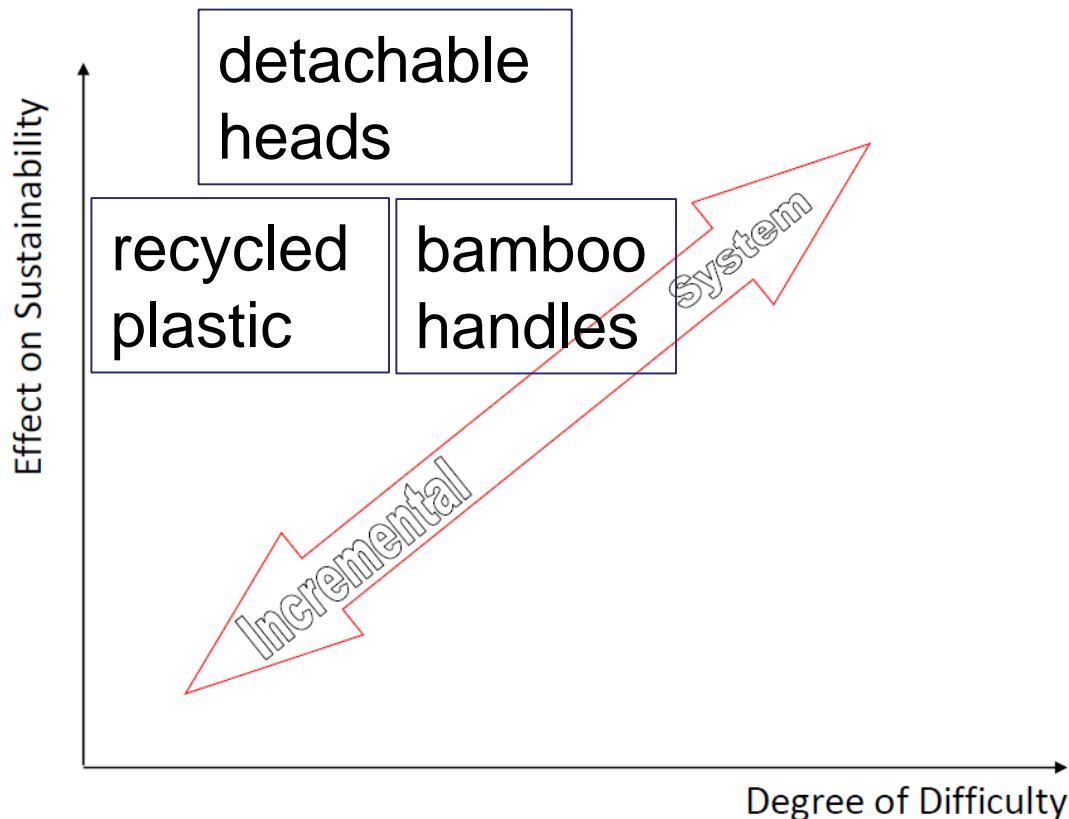
# Example 2: the design challenge

- ❑ Where do our toothbrush improvements appear on the diagram?



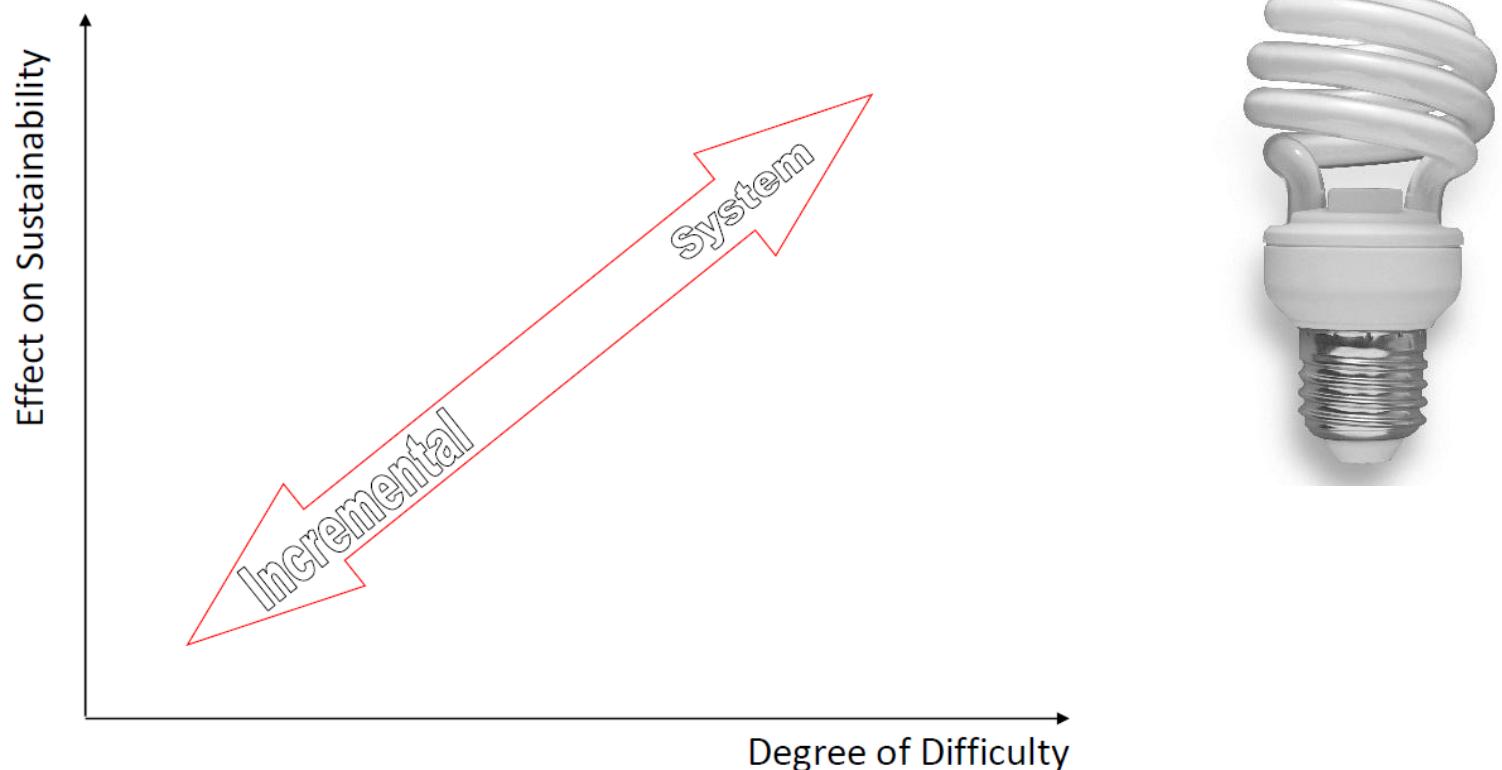
# Example 2: the design challenge

- ❑ Where do our toothbrush improvements appear on the diagram?



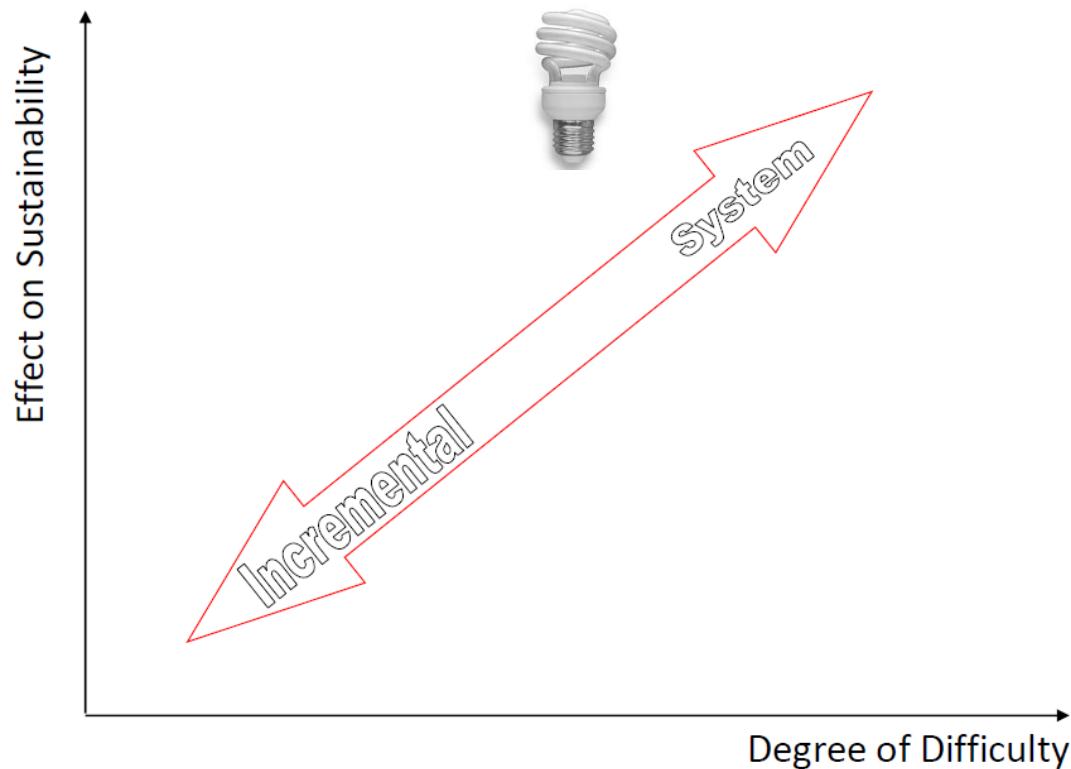
# Example 3: the design challenge

- ❑ Where does the change in light bulbs appear on the diagram?



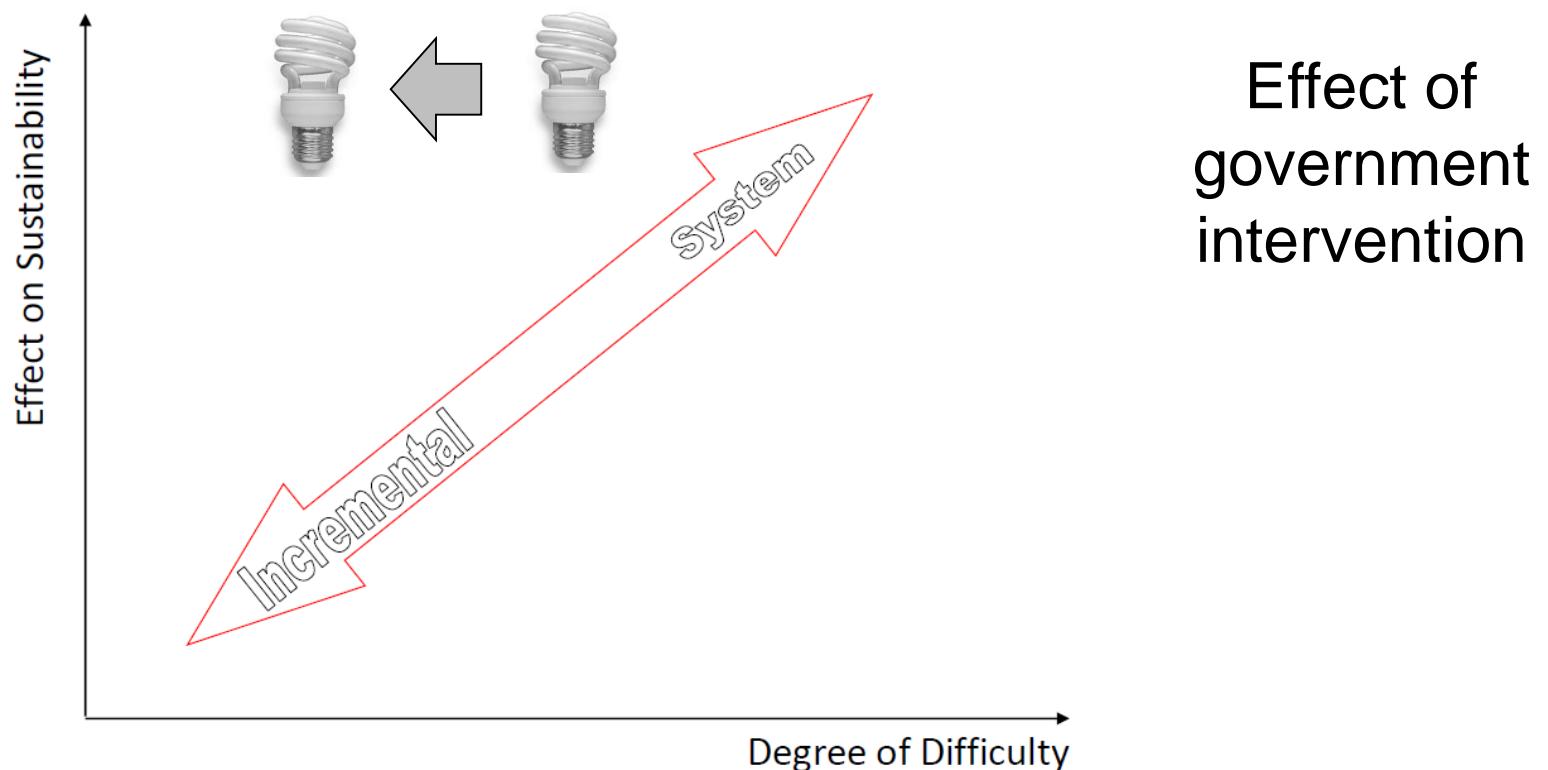
# Example 3: the design challenge

- ❑ Where does the change in light bulbs appear on the diagram?



# Example 3: the design challenge

- Where does the change in light bulbs appear on the diagram?





# Hello we are the Voice of the lighting industry in Europe



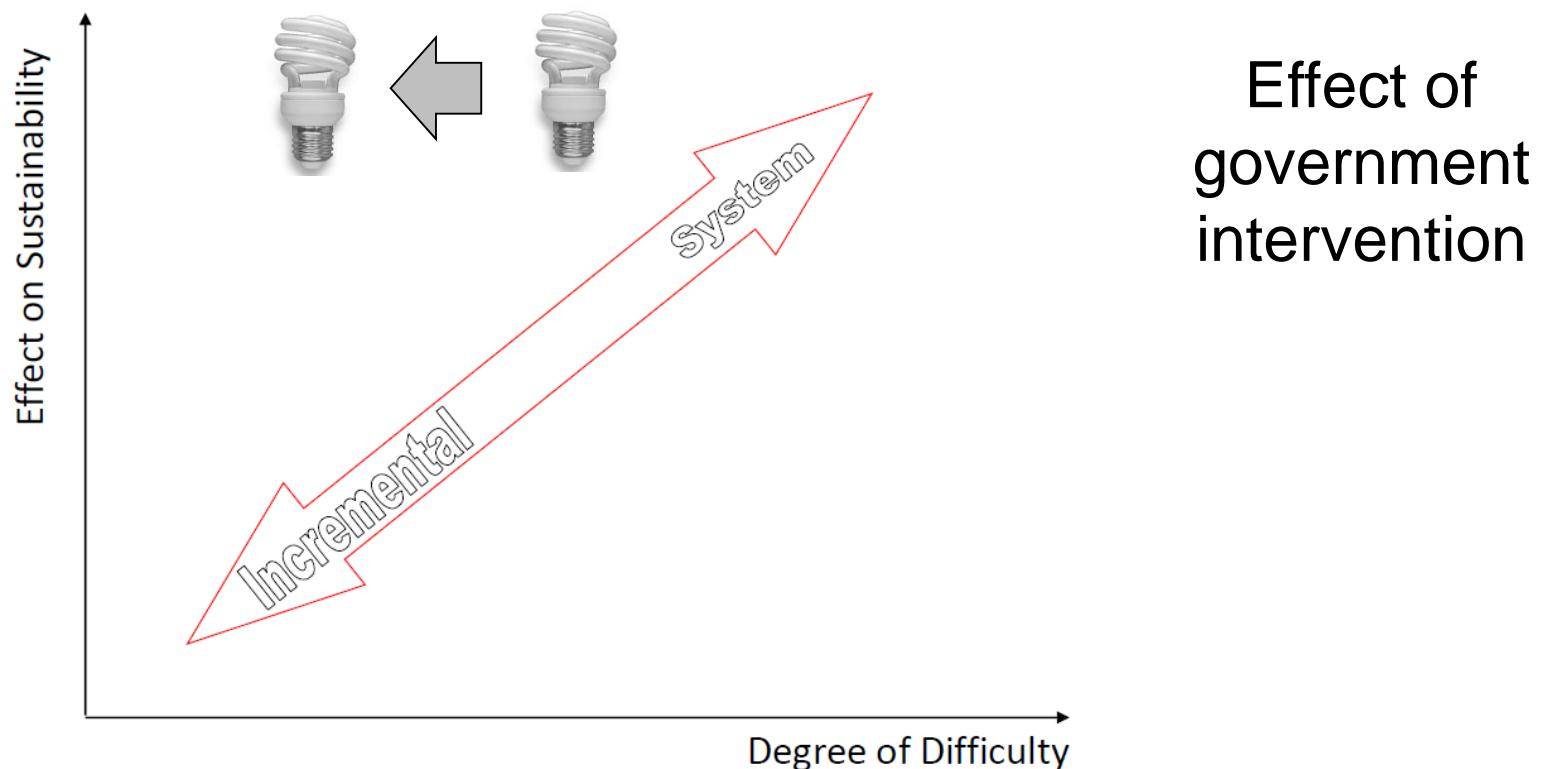
LightingEurope is an industry association representing leading European lighting manufacturers, national lighting associations, and companies producing materials. We are committed to innovation, sustainability, quality and leadership. We contribute to shape policy and establish industry standards and guidelines. We are dedicated to promoting efficient lighting practices for the benefit of the global environment, human comfort, and the health and safety of consumers.

## Let's talk

*a series of videos featuring voices  
from the lighting industry*

# Example 3: the design challenge

- Where does the change in light bulbs appear on the diagram?



# Different types of improvements

---

- When assessing the possibility of improving sustainability of a product, you need to consider
  - the amount of improvement
  - the likelihood of the improvement actually happening
  - the role of regulation

# **PART 5: RESEARCHING A SUSTAINABILITY REPORT**

# Purpose of writing a report

---

- You accumulate information on many aspects of the report topic
- Type of information depends on the type of report
  - Experimental data? Measurement methods?  
Background information?
- You decide the information that is most correct, or most relevant, or both
- You summarise the most important and relevant information (so that the reader doesn't have to read everything you did)

# Researching a sustainability report

---

Step 1: Write down all the information that you know

Step 2: From this, search for information to confirm or extend your knowledge

Step 3: Revise “the information that you know”

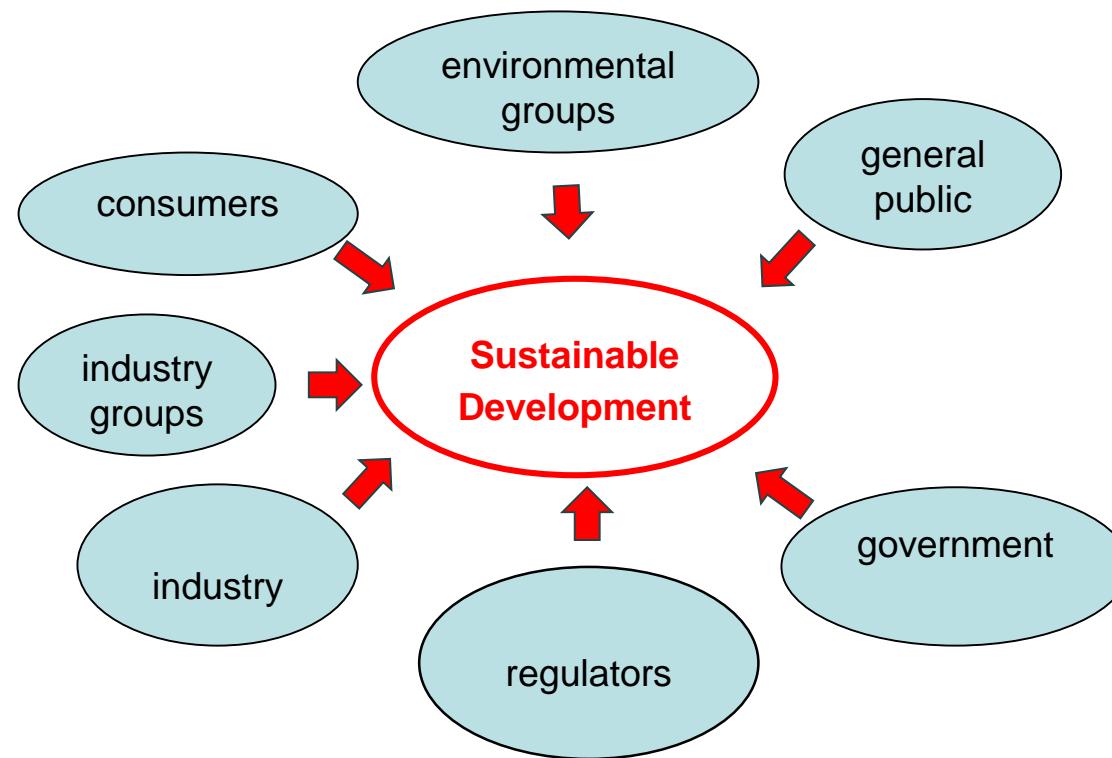
Step 4: Identify topics that you still don’t know

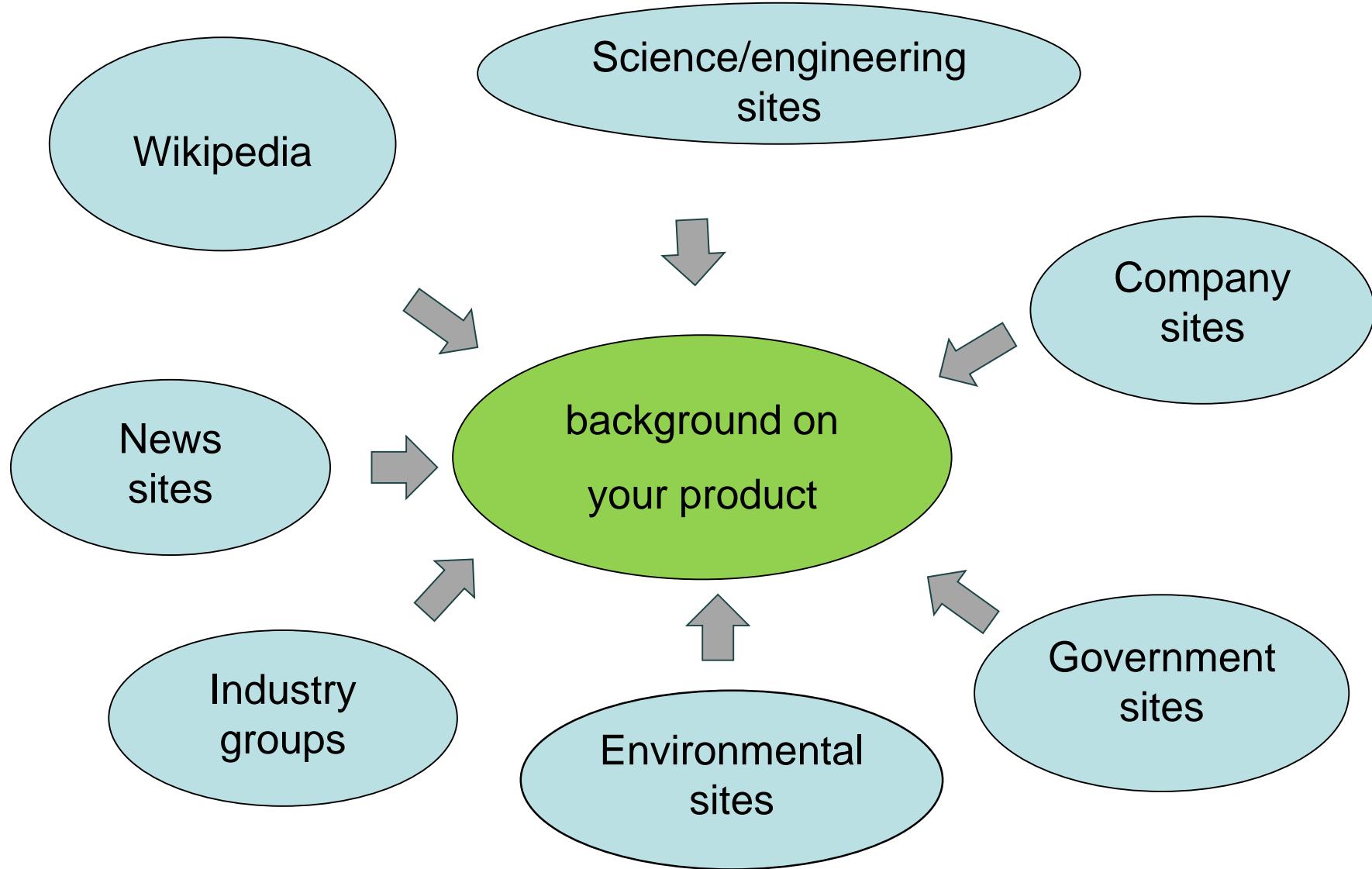
Step 5: Search again

Step 6: repeat steps 3, 4 and 5

# Which sources can you trust?

- Remember that you are looking for a range of information





# Which sources can you trust?

---

- The answer depends on your question!
- What information are you looking for?
- You should search a range of sites, and use the information appropriately

# Example: Researching CFLs

---



- What sites could you find?
- What sites should you trust?

# Identifying the important factors for CFLs



	Life on of reserves	cost	energy usage	waste	carbon footprint
materials	glass, metal, mercury – minor issues		energy used to extract mercury	sand-mining (for glass)	
manufacture		significant due to complexity of lamp	mass-produced product, relatively efficient		some
distribution	petroleum for trucks, ships etc			exhausts etc	vehicle emissions
use			Uses electricity, even though efficiently	mercury – if lamp becomes broken	positive impact compared to alternatives
disposal		recovery of mercury expensive		potential for environment contamination	

**EXAMPLE**

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## Compact fluorescent lamp - Wikipedia

[https://en.wikipedia.org/wiki/Compact\\_fluorescent\\_lamp](https://en.wikipedia.org/wiki/Compact_fluorescent_lamp) ▾

A compact fluorescent lamp (CFL), also called compact fluorescent light, energy-saving light, and compact fluorescent tube, is a fluorescent lamp designed to ...

[History](#) · [Design](#) · [Characteristics](#) · [Health and environmental impact](#)

## Energy-Saving Light Bulbs, CFLs, Compact Fluorescent Bulbs | The ...

[www.thelightbulb.co.uk/light-bulbs/energy-saving-fluorescent](http://www.thelightbulb.co.uk/light-bulbs/energy-saving-fluorescent) ▾

Lowest price guaranteed on energy-saving compact fluorescent (CFL) bulbs. We're the UK's largest light bulb store and have been trusted for over 40 years.

[Energy Saving Fluorescent](#) · [Plumen & Squirrel Cage](#) · [Micro Lynx](#) · [PLF Compact](#)

## Compact fluorescent bulbs. Discover the full range | Philips

[www.philips.co.uk/c-m-li/compact-fluorescent-bulbs](http://www.philips.co.uk/c-m-li/compact-fluorescent-bulbs) ▾

Find the perfect Philips Compact fluorescent bulbs; Discover the entire Philips range, read reviews, order online today or find your local store.

## Compact fluorescent light - CFL integrated | GE Lighting Europe

[www.gelighting.com/LightingWeb/emea/products/lamps/cfl-integrated/overview/](http://www.gelighting.com/LightingWeb/emea/products/lamps/cfl-integrated/overview/) ▾

Compact Fluorescent Lamps. GE's extensive compact fluorescent lamps give you the energy saving benefits you want and the high quality lighting you expect.



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## High Bay Compact Fluorescent Lights | Warehouse-Lighting.com

[www.warehouse-lighting.com](http://www.warehouse-lighting.com) › ... › High Bay Light Fixtures ▾

Did you know that compact fluorescent lights (CFLs) can help decrease your commercial and industrial utility bills? According to the U.S. Environmental ...

## BBC News - Why eco-light bulbs aren't what they seem

[news.bbc.co.uk/2/hi/uk\\_news/magazine/8406923.stm](http://news.bbc.co.uk/2/hi/uk_news/magazine/8406923.stm) ▾

11 Dec 2009 - A guide to the amount of light given by a CFL bulb is given on its box ... The Lighting Industry Federation says the claims on the packaging are ...

## Compact Fluorescent Lights (CFLs): Enlightening Facts

[www.thehcf.org/cflprimer.html](http://www.thehcf.org/cflprimer.html) ▾

duced the compact fluorescent light bulb (CFL) with electronic ballast and, in the ... 19 by the lighting industry) and a reflective recessed flood light (the R30, ...

## Frequently Asked Questions About Compact Fluorescent Lamps - NEMA

<https://www.nema.org/.../Lamps/.../Frequently-Asked-Questions-About-Compact-Fluo...> ▾

Compact fluorescent lamps, also known as CFLs, are a type of fluorescent lighting; ... Industrial use of mercury has declined drastically in all sectors, including ...

Indoor - CFL High Bay - Cooper Industries



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## High Bay Compact Fluorescent Lights | Warehouse-Lighting.com

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Did you know that compact fluorescent lights (CFLs) can help decrease your commercial and industrial utility bills? According to the U.S. Environmental ...

## BBC News - Why eco-light bulbs aren't what they seem

[news.bbc.co.uk/2/hi/uk\\_news/magazine/8406923.stm](http://news.bbc.co.uk/2/hi/uk_news/magazine/8406923.stm) ▾

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<https://www.nema.org/.../Lamps/.../Frequently-Asked-Questions-About-Compact-Fluo...> ▾

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## Indoor - CFL High Bay - Cooper Industries

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### [Compact fluorescent light bulbs contaminate the environment with ...](#)

[www.naturalnews.com/021907\\_compact\\_fluorescent\\_lights\\_lamps.html](http://www.naturalnews.com/021907_compact_fluorescent_lights_lamps.html) ▾

20 Jun 2007 - A **compact fluorescent light** is a type of energy-saving bulb that fits into a standard light bulb socket or plugs into a small lighting fixture, and ...

### [Benefits of CFL Bulbs - How CFL Bulbs Work | HowStuffWorks](#)

[science.howstuffworks.com/environmental/green-tech/sustainable/cfl-bulb1.htm](http://science.howstuffworks.com/environmental/green-tech/sustainable/cfl-bulb1.htm) ▾

... of **CFL** bulbs are numerous. Visit HowStuffWorks to learn the benefits of **CFL** bulbs. ... The environment comes out ahead, too. A good deal of electricity ...

### [LCA of a compact fluorescent lamp | OSRAM](#)

<https://www.osram.com/.../environmental/.../lca...compact-fluorescent-lamp/index.jsp> ▾

The following table depicts the environmental impact of the **compact fluorescent lamp** during production, including the Cumulated Energy Demand (CED) of this ...

### [Compact Fluorescent Bulbs and Mercury: Reality Check](#)

[www.popularmechanics.com/home/reviews/a1733/4217864/](http://www.popularmechanics.com/home/reviews/a1733/4217864/) ▾

10 Jun 2007 - Following our lab test of energy-saving **light bulbs**, we received reader questions about the environmental impact of the mercury contained in ...



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### IS IT GREEN?: The Compact Fluorescent Light | Inhabitat - Green ...

[inhabitat.com/is-it-green-the-compact-fluorescent-lamp/](http://inhabitat.com/is-it-green-the-compact-fluorescent-lamp/) ▾

29 Jul 2009 - First, the case for CFLs: Compact fluorescent light bulbs use around 75% less energy and last 10 times as long as incandescent bulbs. The fact ...

### Benefits of CFL Bulbs - How CFL Bulbs Work | HowStuffWorks

[science.howstuffworks.com/environmental/green-tech/sustainable/cfl-bulb1.htm](http://science.howstuffworks.com/environmental/green-tech/sustainable/cfl-bulb1.htm) ▾

Visit HowStuffWorks to learn the benefits of CFL bulbs. ... Even with the higher price tag of CFLs -- you'll pay \$2 to \$4 for a CFL versus 30 to 40 cents for a typical incandescent bulb -- they still save you money. ... Top 5 Green Mobile Phones.



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## Consumer Energy Center - Incandescent, LED, Fluorescent, Compact ...

[www.consumerenergycenter.org/lighting/bulbs.html](http://www.consumerenergycenter.org/lighting/bulbs.html) ▾

When choosing many appliances, consumers can compare EnergyGuide labels, ... The distinction is important, because a new 13-watt compact fluorescent light ...

## Whatever happened to CFL bulbs - Consumer Reports

[www.consumerreports.org/cro/news/2015/02/whatever-happened-to-cfl.../index.htm](http://www.consumerreports.org/cro/news/2015/02/whatever-happened-to-cfl.../index.htm) ▾

12 Feb 2015 - Here are some top picks from Consumer Reports' lightbulb tests. ... And while CFL stands for Compact Fluorescent Light or Lamp, you couldn't ...

## Compact Fluorescent Light Bulbs (CFLs) | US EPA

<https://www.epa.gov/cfl> ▾

10 Aug 2016 - CFLs can help you save money, use less energy, reduce light bulb changes, and lower greenhouse gas emissions, which lead to climate ...

## Compact Fluorescent Lighting Consumer Reports Jan99 - Mindfully.org

[www.mindfully.org/Energy/Compact-Fluorescent-Lighting.htm](http://www.mindfully.org/Energy/Compact-Fluorescent-Lighting.htm) ▾

But They Can Last For Years And Make For An Economical Alternative To Regular Bulbs. Consumer Reports Jan99. Compact fluorescent light bulbs, introduced ...

## Ethical shopping guide to energy saving light ... - Ethical Consumer

[www.ethicalconsumer.org/humanrights/energy/lighting/lightbulbs.aspx](http://www.ethicalconsumer.org/humanrights/energy/lighting/lightbulbs.aspx) ▾

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## Compact Fluorescent Lighting Consumer Reports Jan99 - Mindfully.org

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## Compact Fluorescent Lighting Consumer Reports Jan99 - Mindfully.org

[www.mindfully.org/Energy/Compact-Fluorescent-Lighting.htm](http://www.mindfully.org/Energy/Compact-Fluorescent-Lighting.htm) ▾

But They Can Last For Years And Make For An Economical Alternative To Regular Bulbs. **Consumer Reports** Jan99. **Compact fluorescent light** bulbs, introduced ...

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### [The True Cost Of Light Bulbs: LED vs CFL vs Incandescent - Green ...](#)

[greenlivingideas.com/2015/02/19/the-true-cost-of-light-bulbs-led-cfl-incandescent/](http://greenlivingideas.com/2015/02/19/the-true-cost-of-light-bulbs-led-cfl-incandescent/) ▾

19 Feb 2015 - Tags: annual cost of appliances, **cfl vs. led**, cost of use, energy savings, equation, how to calculate, lightbulbs, real cost of lightbulbs ...

### [LED versus CFL? - TheGreenAge](#)

[www.thegreenage.co.uk/led-versus-cfl-energy-saving-lighting/](http://www.thegreenage.co.uk/led-versus-cfl-energy-saving-lighting/) ▾

7 May 2014 - **LED or CFL?** One has been around a long time and is certainly efficient. The other is the new kid on the block, with lots to offer.

### [T8 Fluorescent Lamps vs T8 LED Tubes | Premier Lighting](#)

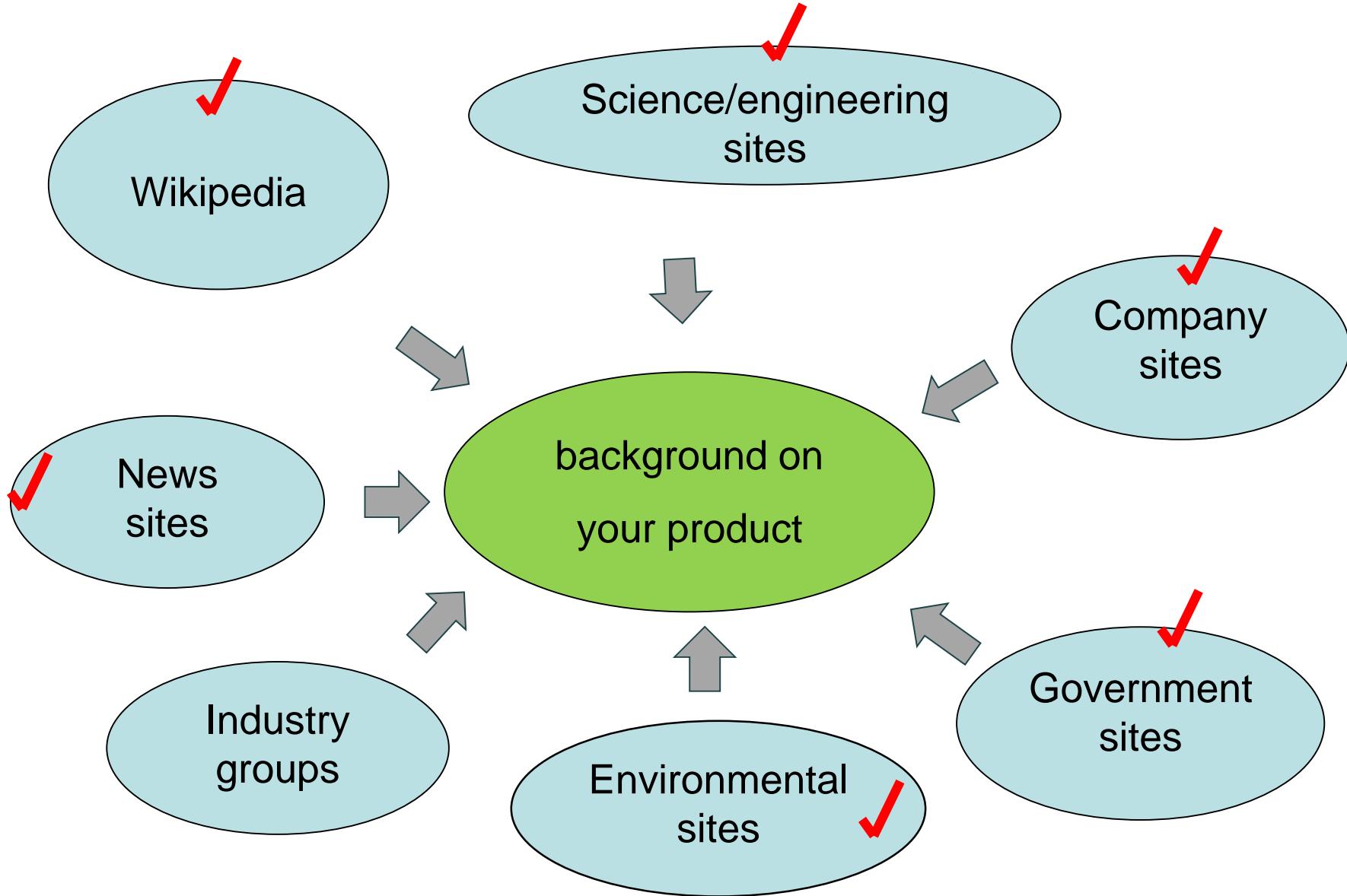
[www.premierltg.com/should-you-replace-your-t8-fluorescent-lamps-with-t8-led-tubes...](http://www.premierltg.com/should-you-replace-your-t8-fluorescent-lamps-with-t8-led-tubes...) ▾

3 Jul 2015 - Should You Replace Your T8 Fluorescent Lamps with T8 LED ..... The tube led T8 save electricity twice as much as the **compact fluorescent**.

### [LED vs Fluorescent: 10 Problems To Consider With Fluorescent Lighting](#)

[www.hoveyelectric.com/.../LED-vs-Fluorescent-10-Problems-To-Consider-With-Fluo...](http://www.hoveyelectric.com/.../LED-vs-Fluorescent-10-Problems-To-Consider-With-Fluo...) ▾

9 Sep 2013 - When considering fluorescent bulbs **vs LED** bulbs, you must ... The **compact fluorescent lamp (CFL)** replaces regular incandescent bulbs.



# Researching CFLs

---



- Search for a range of sources
- Read a few representative websites
  - Wikipedia
  - News sites
  - Environment and consumer sites
  - Industry sites
  - + others
- Accumulate information

# Example: Researching golf balls

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- What sites could you find?
- What sites should you trust?





what is a golf ball made out of



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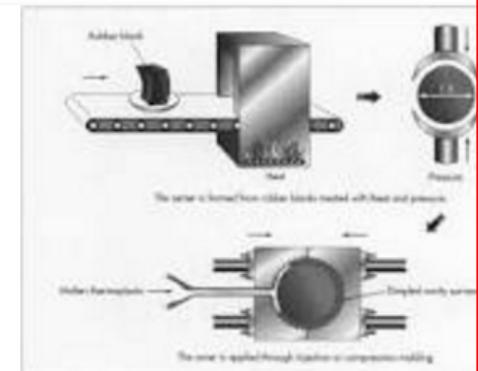
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A **golf ball** is **made** up of mostly plastic and rubber materials. A two-piece **ball** consists of a solid rubber core with a durable thermoplastic (ionomer resin) cover. The rubber starts **out** as a hard block, which must be heated and pressed to form a sphere.



[How golf ball is made - material, manufacture, history, used, parts ...](#)  
[www.madehow.com/Volume-3/Golf-Ball.html](http://www.madehow.com/Volume-3/Golf-Ball.html)

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[Golf ball - Wikipedia](#)

[https://en.wikipedia.org/wiki/Golf\\_ball](https://en.wikipedia.org/wiki/Golf_ball) ▾

The new design became known as the rubber Haskell **golf ball**. For decades, the wound rubber ball consisted of a liquid-filled or solid round core that was wound with a layer of rubber thread into a larger round inner core and then covered with a thin outer shell **made** of balata sap.

[History](#) · [Regulations](#) · [Aerodynamics](#) · [Design](#)

[What Golf Balls Are Made Of | Golfsmith](#)

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### [Golf balls: 'Humanity's signature litter' - CNN.com](#)

[www.cnn.com/2009/SPORT/11/04/littering.golf.balls/](http://www.cnn.com/2009/SPORT/11/04/littering.golf.balls/) ▾

10 Nov 2009 - It seems the simple plastic **golf ball** is increasingly becoming a major ... a number of tests to determine the **environmental impact** of **golf balls** on ...

### [Golf balls: An environmental hazard? - Golf Digest](#)

[www.golfdigest.com/story/golf-balls-an-environmental-hazard](http://www.golfdigest.com/story/golf-balls-an-environmental-hazard) ▾

10 Nov 2009 - CNN is reporting that the Danish Golf Union is looking into the **impact** lost or discarded **golf balls** have on the **environment** and it isn't ...

### [Golf Balls Take 1000 Years to Decompose - Green Living Ideas](#)

[greenlivingideas.com/2009/11/13/golf-balls-1000-years-decompose/](http://greenlivingideas.com/2009/11/13/golf-balls-1000-years-decompose/) ▾

13 Nov 2009 - **Golf ball** litter is becoming an environmental concern on this planet. ... been very little research on the **environmental impact** of **golf balls**, but it's ...

### [Golf balls take 1,000 years to decompose - Telegraph](#)

[www.telegraph.co.uk › News › Earth › Earth News](http://www.telegraph.co.uk › News › Earth › Earth News) ▾

11 Nov 2009 - **Golf balls** are becoming a "major litter problem", according to scientists ... has conducted research into the **environmental impact** of the litter.



thermoplastic environmental impact



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**what environmental effect does thermoplastic resin product have ...**

<https://answers.yahoo.com/question/?qid=20070510132910AAp57kc> ▾

10 May 2007 - cPath=21\_42&product\_id=1404# there's a link for the product i'm analysing. what would the impact on the environment be? can it be recycled?

**BBC - GCSE Bitesize: Environmental issues**

[www.bbc.co.uk](http://www.bbc.co.uk) › Home › Design & Technology › Resistant materials

Environmental issues. Making a product uses resources, such as raw materials and energy. This has an impact on the environment. There are a number of ...

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# Researching golf balls

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- Search for a range of sources
- Read a few representative websites
  - Wikipedia
  - News sites
  - Environment and consumer sites
  - Industry sites
  - + others
- Accumulate information

# Researching a sustainability report

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Step 1: Write down all the information that you know

Step 2: From this, search for information to confirm or extend your knowledge

Step 3: Revise “the information that you know”

Step 4: Identify topics that you still don’t know

Step 5: Search again

Step 6: repeat steps 3, 4 and 5

# **PART 6: SUSTAINABILITY: IT IS WORTH IT?**

# Why are you studying thi

# LECTURE 1

- Engineering is responsible for development and implementation of nearly all aspects of modern life
- It is the responsibility of engineers to understand the problems and to develop solutions
- Understanding sustainable development is part of your training as a professional engineer

# “The business of sustainability”

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McKinsey Global Survey (2011)

“Many companies are actively integrating sustainability principles into their businesses ...”

- Reputational benefits
- Operational and growth-oriented benefits
- Particularly common in energy, mining and transport sectors and

[http://www.mckinsey.com/insights/energy\\_resources\\_materials/the\\_business\\_of\\_sustainability\\_mckinsey\\_global\\_survey\\_result](http://www.mckinsey.com/insights/energy_resources_materials/the_business_of_sustainability_mckinsey_global_survey_result)

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# LECTURE 1

- Engineering is responsible for development and implementation of nearly all aspects of modern life
- It is the responsibility of engineers to understand the problems and to develop solutions

- Understanding sustainable development is part of your training as a professional engineer

# SUMMARY:

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A systematic approach to investigating sustainability:

1. Identify the stakeholders for the product (or process)
2. Consider cradle-to-grave or life-cycle for a product
3. Identify sustainability issues in each part of the cycle
4. Rate the importance of those issues
5. Suggest improvements and consider these in terms of
  - effect of the improvement
  - likelihood of it happening