

Resource Efficiency: Potential and Economic Implications

The Report from the International Resource Panel to the G7

A presentation to the European Resources Forum 2016

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Rationale for increasing resource efficiency

- Assure the availability of resources for the future, in a context of growth of the human population and global economy
- Volatility of resource and commodity prices
- National resource security in the context of increasing competition for resources that may become geopolitically scarce
- Environmental impacts of resource extraction and use, including greenhouse gas emissions and other pollution, the depletion of renewable resource stocks, and land degradation and the loss of biodiversity.
- Considerable opportunities for resource efficiency to be increased with negative net costs, i.e. with overall economic benefits. (NB depends on the prices of the resources concerned and the ease with which resource efficiency can be increased by policy)



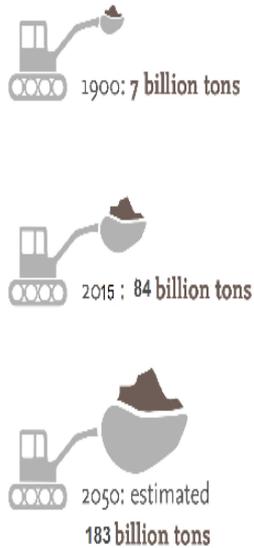
The imperative of increasing resource efficiency



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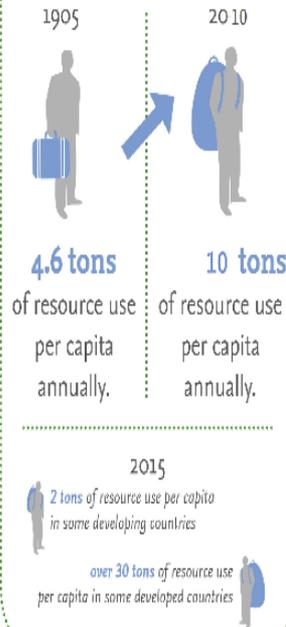
DEMAND FOR RESOURCES

Annual material* extraction rate



* Materials = fossil fuels, minerals, metals and biomass.

Increase in resource use per capita annually



Drivers for resource demand

- Growing population from 7 billion today to 9 billion by 2050
- Economic development and increasing global trade
- Increasing consumption of biomass
- Growing middle-class with changing consumption patterns

Results of resource demand

- Increasing resource extraction
- Greenhouse gas emissions
- Increasing resource scarcity
- Land degradation
- Price increases and volatility
- Water pollution
- Loss of biodiversity
- Air pollution

Impact on human health

The promise of double decoupling



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INNOVATIVE SOLUTION

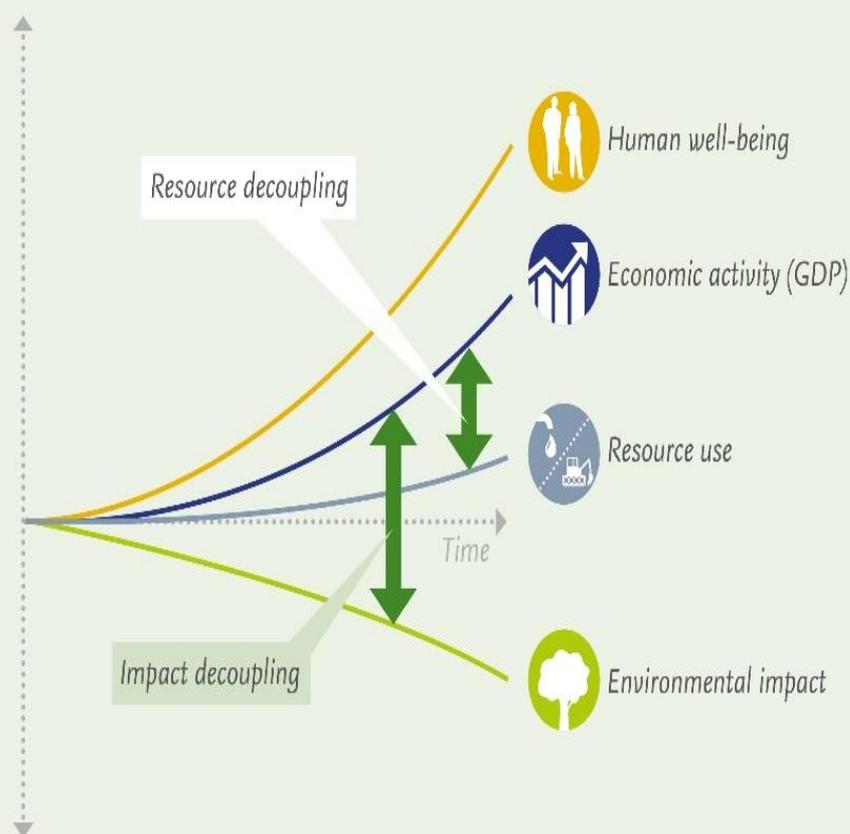
How can we protect the environment, reduce poverty and maintain economic growth?

By **Decoupling**: breaking the link between resource use and economic growth



Using less land, water, energy and materials to maintain economic growth is: **Resource decoupling**

Using resources wisely over their lifetime to reduce environmental impact is: **Impact decoupling**



Key messages from the Summary for Policy Makers

<http://www.unep.org/resourcepanel/KnowledgeResources/AssessmentAreasReports/Cross-CuttingPublications/tabid/133337/Default.aspx>

Headline Message:

“With concerted action, there is significant potential for increasing resource efficiency, which will have numerous benefits for the economy and the environment”

By 2050 policies to improve resource efficiency and tackle climate change could

- **reduce global resource extraction** by up to **28%** globally.
- **cut global GHG emissions** by around **60%**,
- boost the value of **world economic activity** by **1%**



1. Key Message:

“Substantial increases in resource efficiency are essential to meet the Sustainable Development Goals – enabling development while protecting the environment”

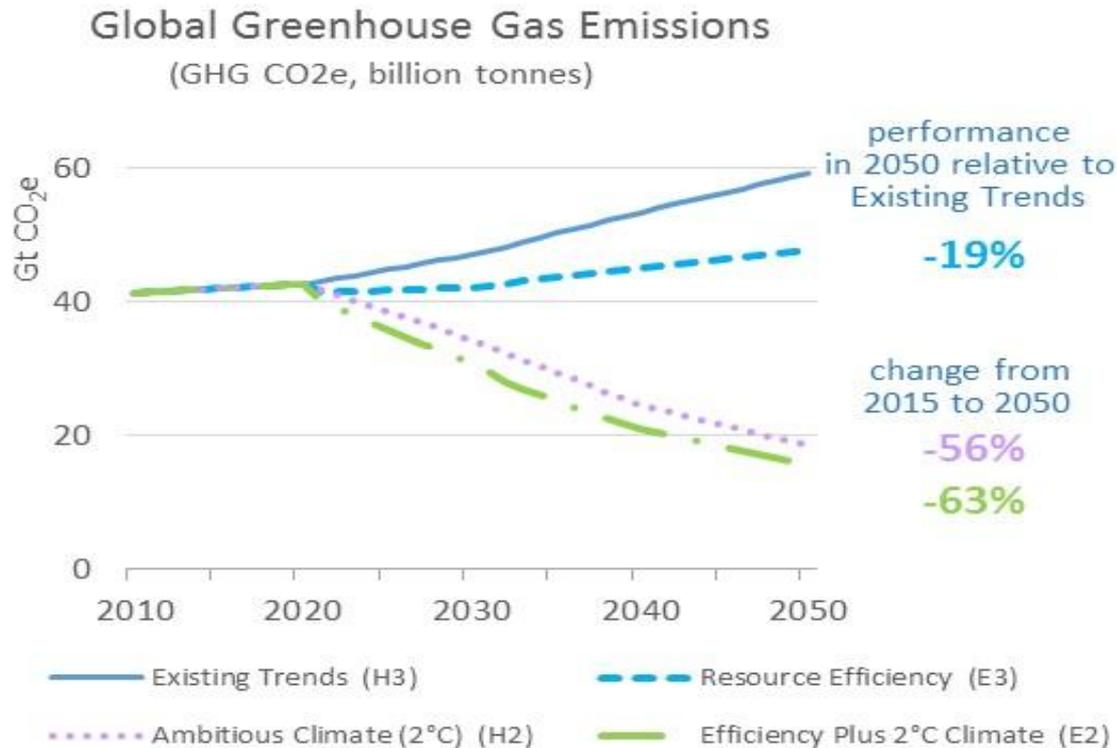
SDGs directly dependent on natural resources



2. Key Message:

“Improving resource efficiency is indispensable for meeting climate change targets cost effectively”

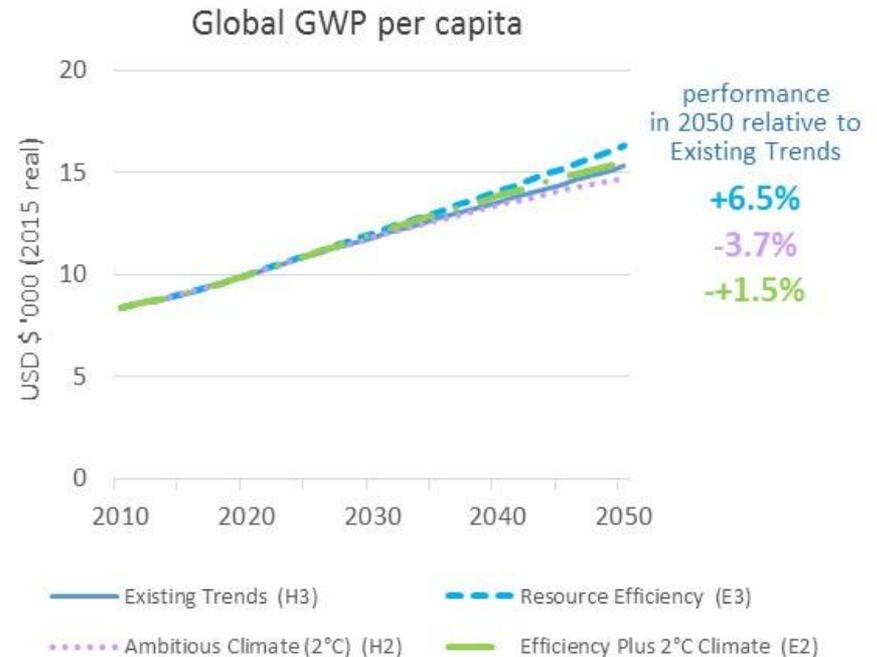
Modelling by Hatfield-Dodds, S., CSIRO, Australia



3. Key Message:

“Resource efficiency can contribute to economic growth and job creation”

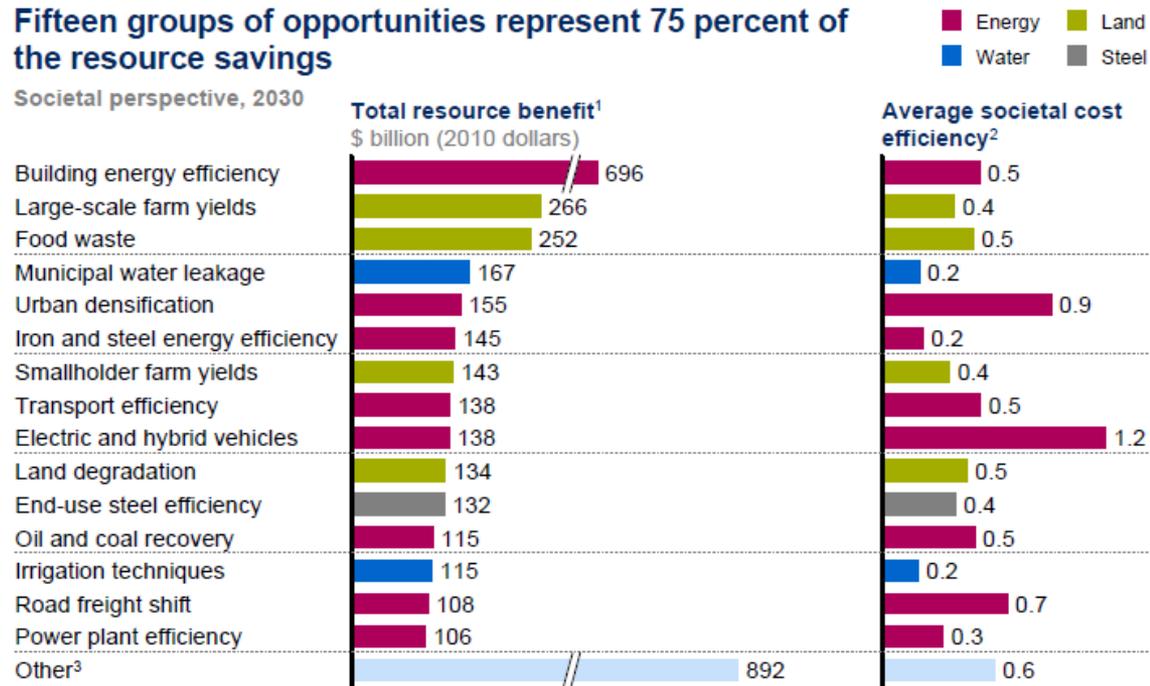
Modelling results differ in size, but all of them show that increasing resource efficiency can lead to **higher economic growth and employment**, often even when environmental benefits are not accounted for



4. Key Message:

“There are substantial areas of opportunity for greater resource efficiency”

The top 15 categories of resource efficiency potential



1 Based on current prices for energy, steel, and food plus unsubsidized water prices and a shadow cost for carbon.

2 Annualized cost of implementation divided by annual total resource benefit.

3 Includes other opportunities such as feed efficiency, industrial water efficiency, air transport, municipal water, steel recycling, wastewater reuse, and other industrial energy efficiency.

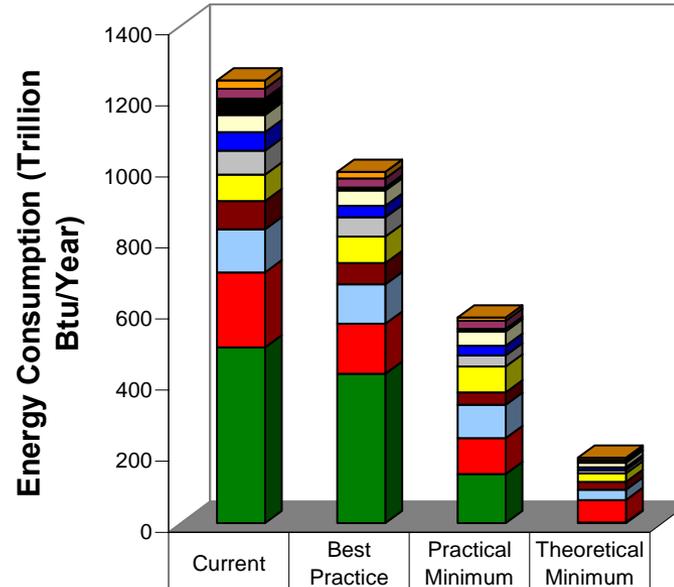
SOURCE: McKinsey analysis



5. Key Message:

“Increased resource efficiency is practically attainable”

Energy consumption and saving potential by equipment type in US mining industry



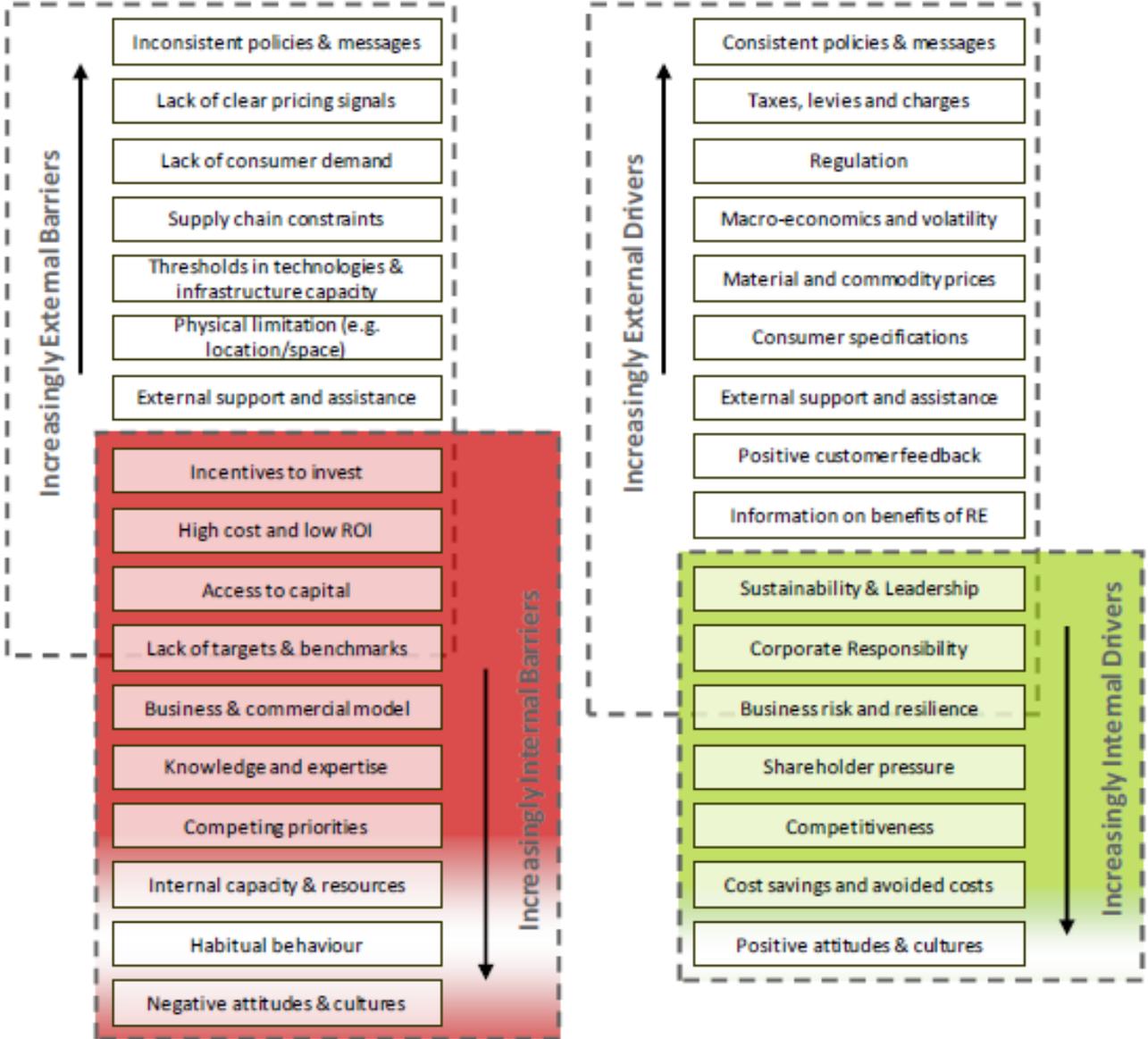
| | Current | Best Practice | Practical Minimum | Theoretical Minimum |
|-----------------------------|---------|---------------|-------------------|---------------------|
| ■ Blasting | 24 | 18 | 10 | 5 |
| ■ Dewatering | 28 | 25 | 23 | 7 |
| ■ Separations | 46 | 8 | 7 | 2 |
| ■ Electric Equipment | 48 | 43 | 40 | 13 |
| ■ Crushing | 52 | 32 | 27 | 8 |
| ■ Drilling | 67 | 54 | 32 | 9 |
| ■ Ancillary Operations | 75 | 75 | 72 | 24 |
| ■ Digging | 79 | 60 | 35 | 22 |
| ■ Ventilation | 122 | 111 | 94 | 29 |
| ■ Materials Handling-Diesel | 211 | 141 | 101 | 63 |
| ■ Grinding | 494 | 420 | 138 | 2 |

Conclusions from the report: Realising the potential

- Markets will not achieve higher rates of resource efficiency by themselves
- There are significant barriers to the increases in resource efficiency which are required, but they can be removed
- Public policy and political will be needed and countries required to take concerted action
- EU's Circular Economy Package (CEP), and G7 Alliance on Resource Efficiency, are steps in the right direction, but
 - Should be scaled up and intensified
 - CEP Plan of Action needs to be made more specific, with targets and timescales

Barriers

Drivers



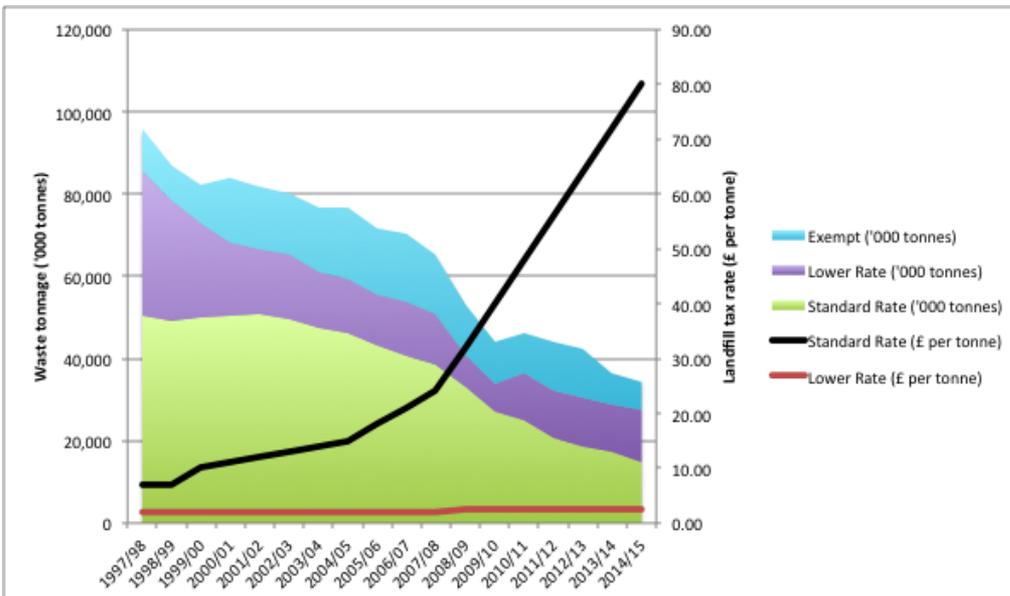
Source: AMEC, & BioIS. (2013). The opportunities to business of improving resource efficiency. Final Report to the European Commission. : AMEC Environment & Infrastructure and Bio Intelligence Service



The disconnect between resource efficiency and economic efficiency: the resource-efficient option may be more expensive

Rebalance the cost of labour, and the costs of resources and pollution by:

- pricing externalities and using taxation to stimulate investment in resource-efficient alternatives
- using dynamic taxes to buffer price fluctuations, thereby reducing volatility and future uncertainty
- creating other incentives for actors to favour paying for labour to save materials, rather than for materials to save labour, such as reducing taxes on labour



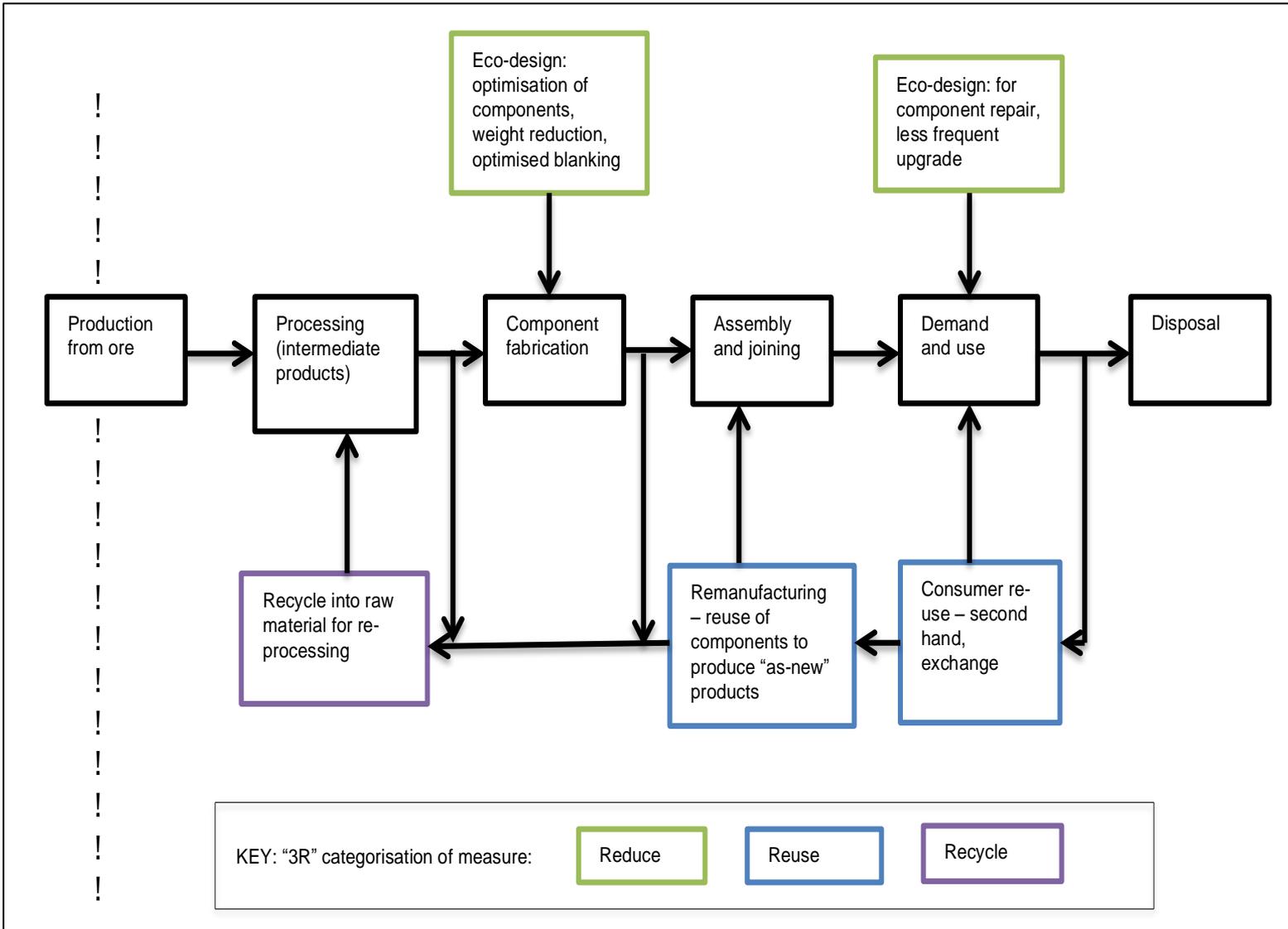
UK: Waste tonnage sent to landfill, and landfill tax rates

Urbanisation must become more resource-efficient, especially in respect of transport

- Five “Ds” are important in shaping energy use and transportation:
 - Density: Population density (people per square km) as well as activity density (people plus jobs per square km)
 - Diversity of uses, e.g. mixed residential – commercial
 - Distance to public transit (the closer the better)
 - Design to support multiple modes of travel, including pedestrian, bicycle, automobile and public transit
 - Access to Destinations, with focus on job locations
- Vauban, eco-city development in Germany:
 - All of the housing is designed to a high efficiency standard, with 100 buildings reaching Passivhaus standard, and many with solar cells installed, including 59 that are net exporters of electricity.
 - The area is designed to enable sustainable transport, with a tram line connecting to the centre of Freiburg, and all homes within easy walking distance of a tram stop.
 - The layout of the district has been designed to actively encourage walking and cycling and discourage car use, by reducing the number of streets through which cars can pass continuously through the neighbourhood, but a network of pedestrian and cycle paths permeates the neighbourhood with continuity



Co-ordination of logistics and supply chains: the 3Rs



The growing practice of industrial symbiosis

Eco-Town programme in Japan

- 61 recycling facilities established across the 26 Eco-Towns.
- Nearly 2 million tonnes of waste recycled per year, in various industrial processes.
- Stimulated private sector activity – for every government subsidised plant, 1.5 built by private sector without subsidy, due to connections made by the programme.
- Carbon emissions also saved – for example reduced by 14% in Kawasaki Eco-Town.

Eco-Industrial Park programme in Korea

- Reduced material waste: 477,633 tonnes.
- Cost reductions: USD 97 million.
- Revenue generation: USD 92 million.

National Industrial Symbiosis Programme (NISP) in UK

- Received £28 million in public funding over 2005-10
- Diverted 7 mt materials from landfill, reduced CO₂ emissions by 6 mt, saved 9.7 mt virgin materials and 9.6 mt water, and reduced hazardous waste by 0.36 mt.
- Increased business sales by £176 million, reduced business costs by £156 million, leveraged £131 million in private investment, and saved or created a total of 8,700 jobs.
- This extra economic activity meant that the Treasury received in taxes more than three times its original £28 million investment

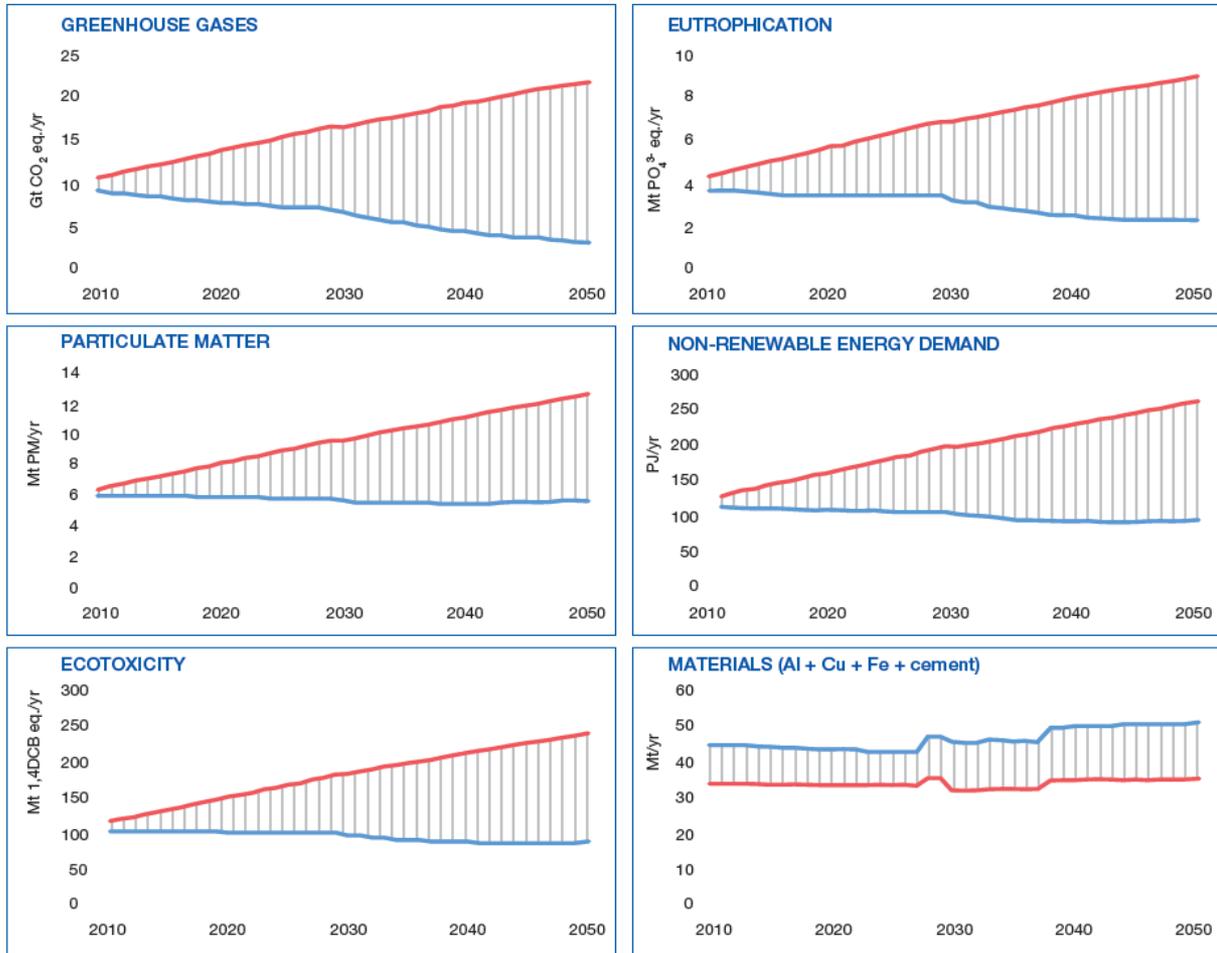


Regulations that militate against resource efficiency should be changed

- Rules set up to manage a linear material management chain may prevent material classified as waste from re-entering the supply chain.
- Regulations that govern materials, water and energy flows, while continuing to safeguard human health and the environment, should be revised to enable more circular resource flows.
- Definitions and provisions for waste management, recycling and removing counter-productive subsidies should be revisited.
- The Action Plan of the European Commission's Circular Economy Strategy seeks to:
 - Distinguish secondary raw materials from wastes;
 - Set quality standards for such materials; and
 - Clarify extended producer responsibility (EPR) schemes for their management.
- EPR schemes, when effectively defined and implemented, can greatly increase the quantity of materials recovered for recycling: schemes in Sofia in Bulgaria increased the recycling or WEEE by over 150 percent over 4 years, while buy back campaigns in Romania have led to 80-90 percent recycling of WEEE, equivalent to 30 percent of waste sales in Romania



Increased resource efficiency will make a low-carbon electricity system preferable across the board



■ BLUE Map ■ Baseline

UNEP. (2015). Green Energy Choices: The benefits, risks, and trade-offs of low-carbon technologies for electricity production. E.G.Hertwich, T. Gibon, S. Suh, J. Aloisi de Larderel, A. Arvesen, P. Bayer, J. Bergesen, E. Bouman, G. Heath, C. Peña, P. Purohit, A. Ramirez. . Paris: International Resource Panel, United Nations Environment Programme



The transition to resource efficiency needs to be carefully managed in respect of ‘losers’

- In some industries reduced material extraction will translate into reduced revenues and job losses. In this context it is important that transitional issues are properly addressed and appropriate compensation for “losers” considered.
- Resource efficiency has the potential to create jobs in other areas, so that rather than resist resource efficiency or support resource-inefficient activities, it may be preferable to set up programmes to transfer redundant workers to, and re-train them for, resource-efficient sectors and activities.
- Numerous established sectors have very significant resource efficiency opportunities, including: energy efficiency in buildings and iron and steel production; large-scale and small-holder farm yields; food waste; municipal water leakage; urban densification; power plant and transport efficiency; electric and hybrid vehicles; land degradation; oil and coal recovery; irrigation efficiency; road freight shift
- Important success factors in realising these opportunities include: developing and training a skilled workforce; using skill bases for declining industries to seed newly emerging industries; the role of government in assisting industries and supply chains by supporting co-location and manufacturing regions; ‘patient capital’, favouring longer-term returns on investment; research and development in new technologies; well-designed regulation to incentivise product and process efficiency; support for new business models based on reuse, remanufacturing, and ‘servitisation’ models.

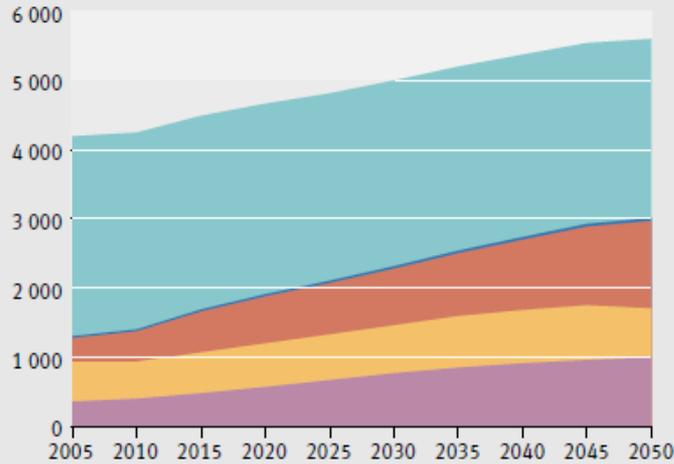


National and international targets for resource efficiency should be adopted and progress towards them monitored

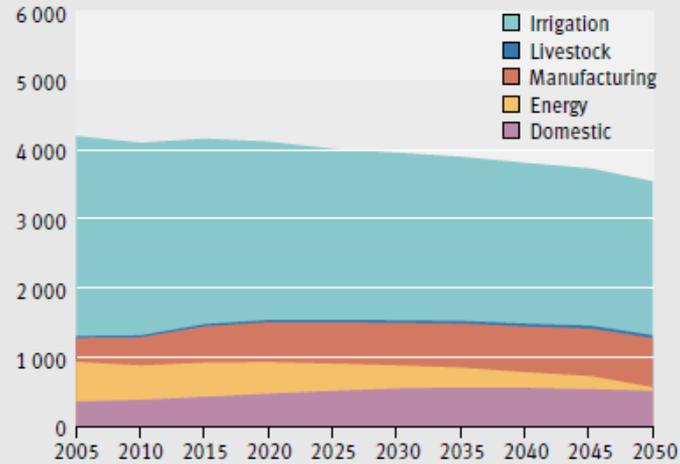
- The SDGs
- Material flow indicators in the context of Japan's "Fundamental Plan for Establishing a Sound Material-Cycle Society"

| Fiscal year | | 2020 (Target year) | 2000 | 2013 | 2013 vs.2000 |
|-----------------------|---------------------------------|-----------------------|------|------|--------------|
| Resource productivity | 10,000 yen/ton | 46 | 25 | 38 | + 53% |
| Cyclical use rate | % | 17 | 10 | 16 | + 6 |
| Final disposal amount | Total (million tons) | 17 | 56 | 16 | - 71% |
| | Municipal waste (million tons) | - | 12 | 5 | - 62% |
| | Industrial waste (Million tons) | - | 44 | 12 | - 73% |

Conventional world withdrawals, km³



Sustainable world withdrawals, km³

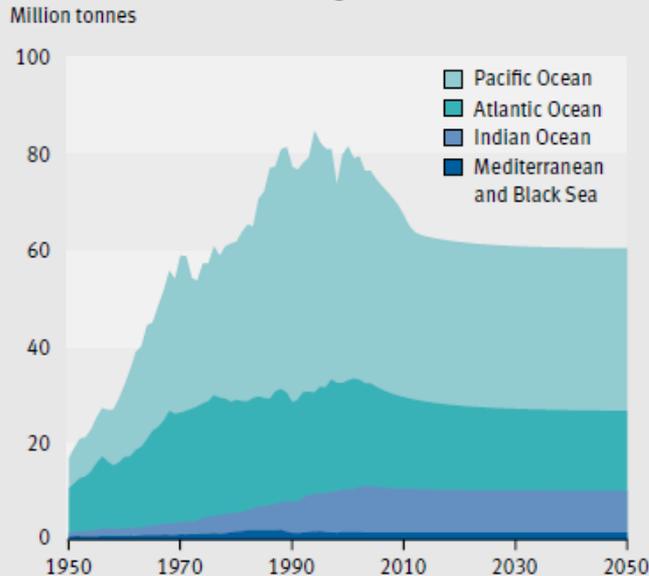


Source: New calculations for GEO-5; WaterGap model from Alcamo et al. 2003 and Flörke and Alcamo 2004

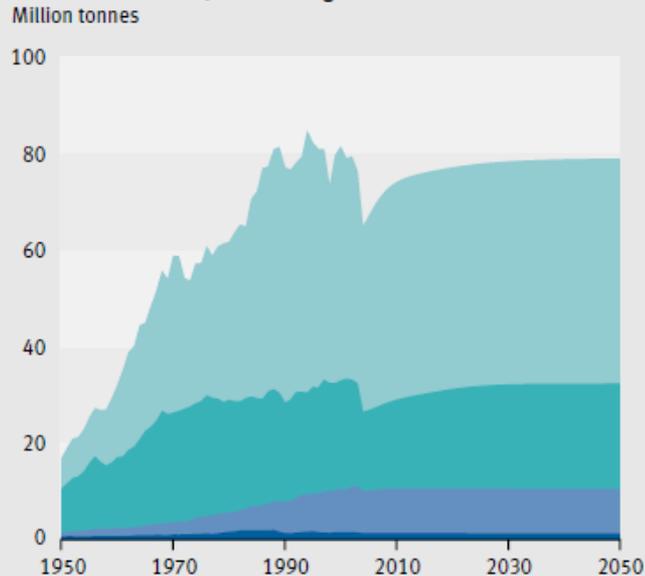
A sustainable world? Yes, we can.

Projections of water withdrawals by sector under different scenarios
Source: UNEP, GEO-5

Conventional worlds, with fishing effort maintained



Sustainable worlds, with fishing effort reduced



Source: Ten Brink et al. 2010

Marine catches with and without a reduction in fishing effort
Source: UNEP, GEO-5





Thank you

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www.bartlett.ucl.ac.uk/sustainable