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POLICY OPTIONS FOR A RESOURCE EFFICIENT ECONOMY

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Modelling Resource Efficiency

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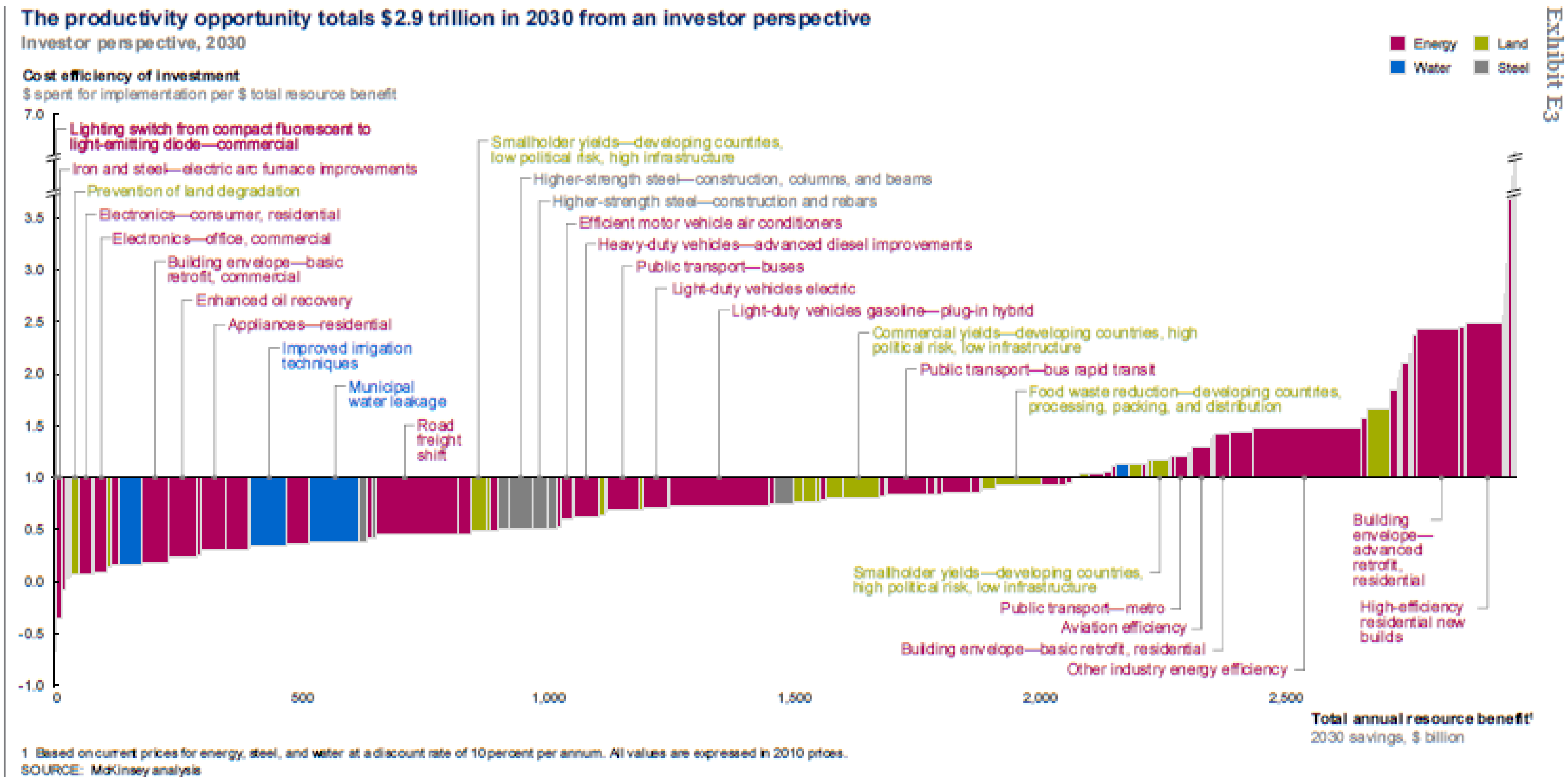
Microeconomic costs/benefits of resource efficiency

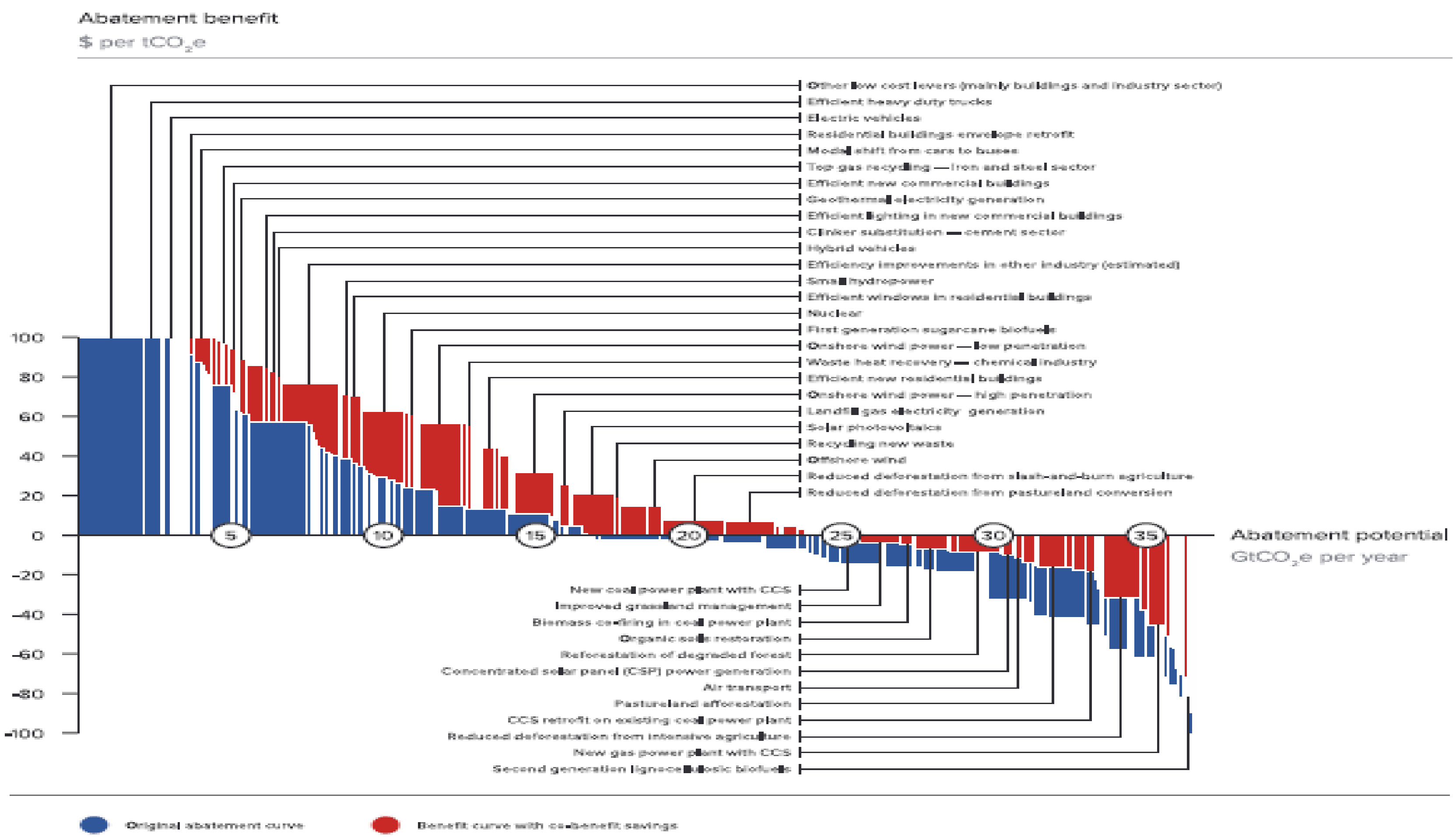
Source: Dobbs et al. 2011, Exhibit 3, p.13



The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 308371

Microeconomic costs/benefits of resource efficiency (inc. externalities)

Source: NCE 2014, Figure 6, p.43



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Barriers to resource efficiency

Source: Adapted from Sorrell et al. 2004, Table 2.5, p.55

Barrier	Claim
Risk	Resource efficiency investments may have higher technical or financial risks, or involve greater uncertainty over returns, justifying shorter payback periods, than other investments.
Imperfect information	Makers of inefficient products have incentives to conceal information about resource efficiency so that inefficient products may drive efficient products out of the market and cost-effective opportunities for resource efficiency may be missed.
Hidden costs	Resource efficiency technologies may not deliver the full range of performance utilities of other products. In addition, engineering-economic cost estimates may not account for all the costs associated with increasing resource efficiency, such as management and training costs, disruptions to production and the costs of gathering, analysing and applying information.
Access to capital	Access to capital for resource efficiency may be limited, and available capital may yield higher returns, or be perceived to do so because of internal accounting, appraisal and management procedures.
Split incentives	As with the common landlord-tenant relationship, the beneficiary of an investment in resource efficiency (often the tenant) may not be the economic actor who needs to make the investment (the landlord), and who will therefore not have the incentive to do so.
Bounded rationality	Individuals experience constraints on time, attention and the ability to process information, which may cause them to overlook resource efficiency opportunities, even given good information and appropriate incentives.

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Macroeconomic modelling of resource efficiency

- Different types of models
  - Computable general equilibrium (CGE) models
  - Macro-econometric models
  - System dynamic models
- Different theoretical foundations
- Different assumptions
- Different modelling methodologies

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CGE modelling of resource efficiency (1)

- Strong assumptions about clearing markets and rational, representative utility- or profit-maximising economic agents.
- Could start from a position of reflecting market inefficiencies and market distortions, and then ask how policy reforms could be undertaken to achieve a higher degree of resource efficiency - CGE models have been widely used in the assessment of the macroeconomic gains of tax policy reforms or trade policy reforms.
- Stern in NCE (2014, p.15): “These models often start from the assumption of an economy where resources are already efficiently allocated and there are no market failures.” Under these circumstances economic efficiency is already at a maximum, and increased technical efficiency in the use of material or energy resources can only be achieved at a net economic cost.
- Circular economy report from the Ellen MacArthur Foundation: “The circular economy scenario could increase the disposable income of an average European household through reduced cost of products and services and a conversion of unproductive to productive time (e.g. reduction in congestion cost). This could result in increased consumption and thereby higher GDP growth. Economic modelling across the three study sectors suggests that today’s disposable income of an average European household could increase as much as 18 percent by 2030 and 44 percent by 2050 in a circular scenario, compared with 7 and 24 percent in the current development scenario. European GDP could increase as much as 11 percent by 2030 and 27 percent by 2050 in a circular scenario, compared with 4 percent and 15 percent in the current development scenario, driven by increased consumption due largely to correcting market and regulatory lock-ins that prevent many inherently profitable circular opportunities from materialising. Thus, in a circular scenario, GDP could grow with 7 percentage points more by 2030 than the current development path and could increase the difference to 12 percentage points by 2050.” (EMF 2015, pp.32-33)

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CGE modelling of resource efficiency (2)

- Technical Report on the modelling: "[T]he bulk of multi-sector multi-region CGE models … adopts the drastic assumption of autonomous technical progress which comes along as 'manna from heaven'. … The unconditional technology forecasting does not quantify the economic cost (e.g. in R&D) to achieve specific technological change nor the opportunity cost of foregoing other directions of technological change. Scenario assumptions on drastically reduced capital and fuel cost for private transportation are not 'innocent' since the cost cuts come for free." (Böhringer and Rutherford 2015, pp.16-18, emphasis added)
- Modellers have assumed that, because of resource efficiency inducing technical change, a range of goods and services becomes considerably cheaper in 2030 than they were in 2015. The result is higher economic growth. This result takes no account of the costs of achieving this technical change, which may be real 'hidden costs', or be incurred in the overcoming of the barriers to increased efficiency.

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Macro-econometric modelling of resource efficiency (1)

- Post-Keynesian assumptions about non-clearing markets, possible market inefficiencies
- Policy and other interventions can improve economic efficiency and lead to increases in output and employment.
- This mechanism is in addition to the possible increases in output from technological change leading to reduced costs (perhaps through increased resource efficiency)

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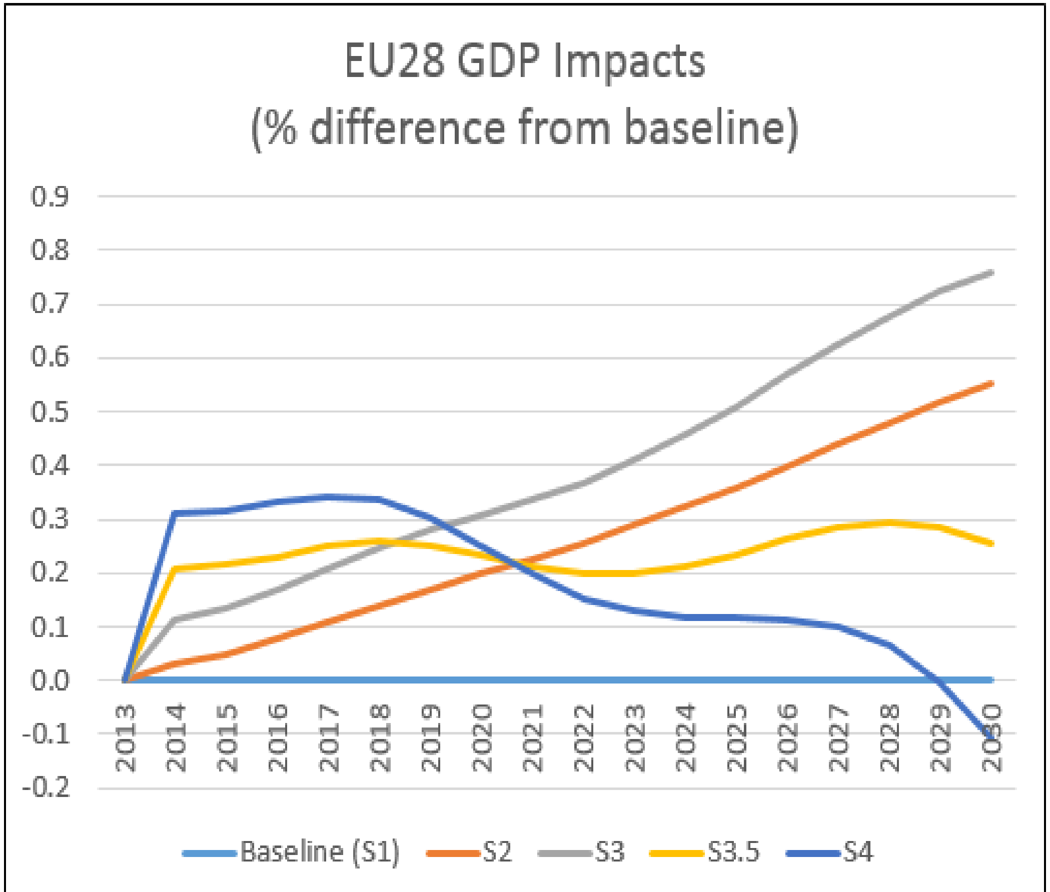
Macro-econometric modelling of resource efficiency (2)

Source: CE and BioIS 2014



Overall resource productivity improvement between 2014 and 2030

Scenario	Description	Approximate Improvement (2014-30)
S1	Baseline	14 %
S2	Modest and flexible improvement	15%
S3	Enhanced and flexible improvement	30%
S3.5	Further enhanced and flexible improvement	40%
S4	Ambitious and flexible improvement	50%

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Macro-econometric modelling of resource efficiency (3)

- “We have introduced a tax on the consumption of raw materials. Tax revenues are collected by national governments and recycled back at Member State level through lower income taxes and employers’ social security contributions (i.e. labour taxes) in order to achieve revenue neutrality. … The scenario results suggest that reductions in resource consumption can be achieved with a positive impact on European GDP. This is mainly driven by our assumption for revenue recycling that the revenues generated get used to reduce income tax rates and employers’ social security payments.” (CE and BioIS 2014, p.46) In a case where “there is no recycling of the revenues from [taxes], the net positive GDP impacts are much smaller and become negative over time.”
- GDP increases in such models can also be driven by increased investment employing previously unemployed resources, or by technical change leading to reduced resource prices and increased consumption
- Along with GDP increases may go increases in employment (because of previous unemployment)

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System dynamic modelling of resource efficiency (1)

- System dynamics models model the relationships between different system components on the basis of causal loops which may have positive or negative effects. Threshold 21 (T21-World) model used in the UNEP Green Economy Report.
- Natural capital enters into the production functions of some of the economic sectors in the model.
- In addition, the model represents directly several environmental dimensions (including land, water energy, waste and emissions): "In the GER BAU scenario the feedback effects from natural resource depletion are sufficiently important that the annual rate of world GDP growth gradually falls from about 2.7 per cent per year in the period 2010-2020 to 2.2 per cent in 2020-2030 and further to 1.6 per cent in 2030-2050. … BAU scenarios push consumption, stimulating economic growth in the short and medium term, thus exacerbating known historical trends of depletion of natural resources. As a consequence, in the longer term, the decline of natural resources (e.g. fish stocks, forestland and fossil fuels) has a negative impact on GDP (i.e. through reduced production capacity, higher energy prices and growing emissions) and results in a lower level of employment. Additional consequences may include large-scale migration driven by resource shortages (e.g. water), faster global warming and considerable biodiversity losses.
- "The green scenarios, by promoting investment in key ecosystem services and low carbon development, show slightly slower economic growth in the short to medium term, but faster and more sustainable growth in the longer term. In this respect, the green scenarios show more resilience, by lowering emissions, reducing dependence on volatile fuels and using natural resources more efficiently and sustainably." (UNEP 2011, pp.518, 519)

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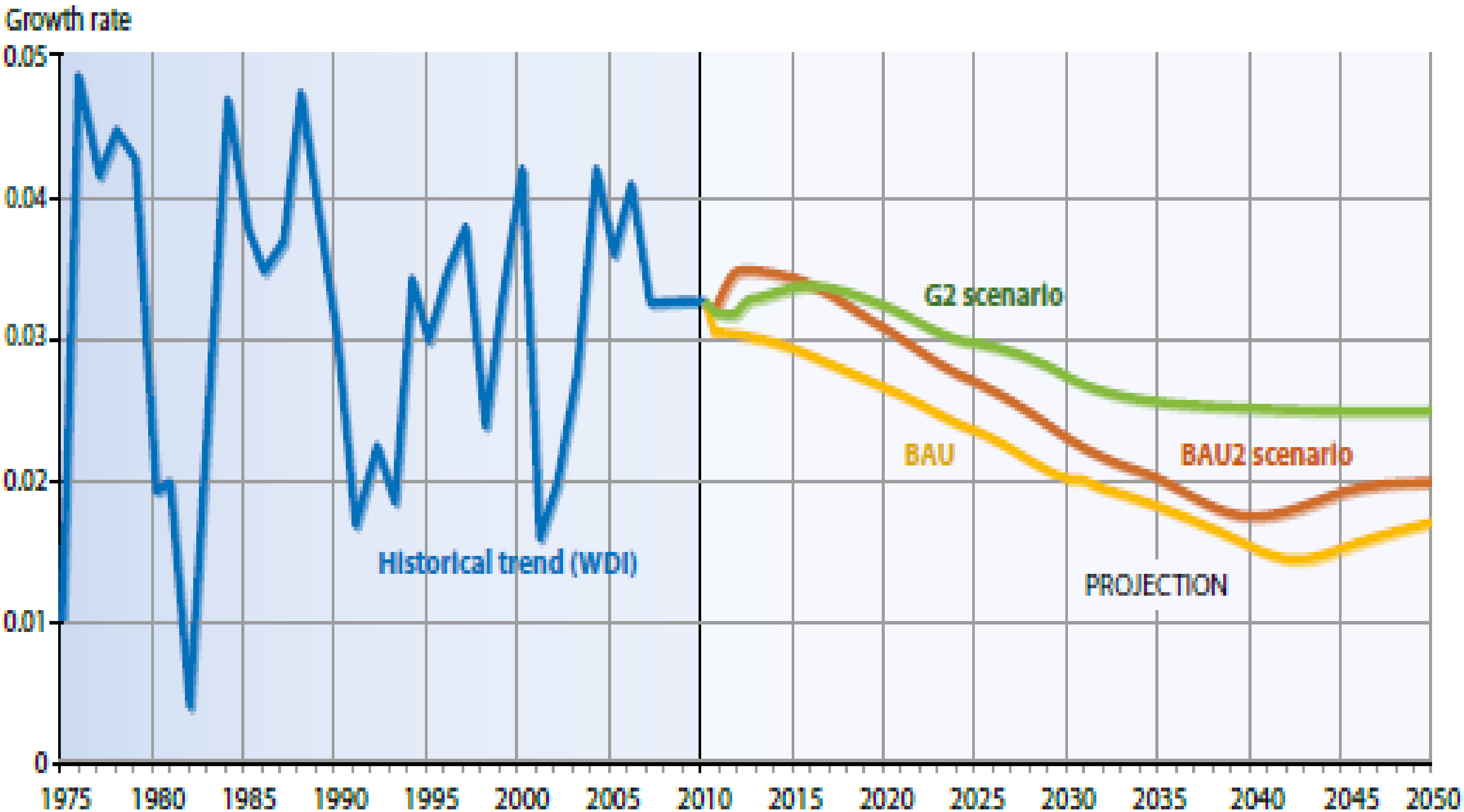
System dynamic modelling of resource efficiency (2)

Source: UNEP 2011, Figure 13, p.523



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Conclusions

- Increasing resource efficiency can substantially reduce resource-related costs and associated environmental impacts.
- Where these resource efficiency increases come about through pure market processes, economic growth will be the result. Indeed, increased economic efficiency is one of the principal drivers of economic growth.
- The increased economic growth will reduce the resource and environmental benefits of increased resource efficiency through the rebound effect, unless this is counteracted through policy.
- Where resource efficiency does not come about through pure market processes, then the economic implications of increasing it, perhaps through public policy, are less clear. It means that there are market failures or other barriers to resource efficiency.
- If there are externalities, and these are appropriately internalised through public policy, then economic efficiency and human well-being will increase, but whether monetary economic output (GDP) does so will depend on the externality and the policy measure used to internalise it.
- Removing barriers to resource efficiency may involve costs, and these costs may be high enough to offset the cost benefits of increased resource efficiency. In these cases, increasing resource efficiency will not result in increased economic efficiency and net economic benefits.
- Whether increased resource efficiency will lead to increased output and employment depends on the nature of the macroeconomic modelling being employed, with assumptions about unemployed resources, and the way the labour market is modelled, being especially important.
- Most attempts to model the economic implications of increased resource efficiency, where this is not driven by markets, are not able to take account of the costs of removing the barriers to resource efficiency to a very limited extent or not at all.
- Modelling results in these cases effectively show the macroeconomic benefits of increasing resource efficiency if the barriers to such an increase could be removed costlessly.
- These considerations argue for caution in interpreting the results of studies of the macroeconomic outcomes, whether for output or employment, of scenarios that increase resource efficiency.

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