Resources, a dynamic view
Executive Summary

This study is the third in the series for DG Environment in support of the thematic strategy on the sustainable use and management of resources, as defined in the 6EAP. It explores the decoupling of resource use from economic growth in two resource groups – the European aluminium and forest products sectors. Decoupling is considered to refer to the delinking of total resource use in each sector (including use of fossil fuels and ancillary materials) from the gross value added to the economy by the sector. The study does not address the decoupling of resource use in each sector from whole-economy economic growth (i.e. GDP), as the sectors have little influence over GDP, and it would mean that a sector in decline would always appear decoupled, while a growing sector would always be coupled.

The Main Conclusions from the Study
Policy, Economic and Environmental Impact Reviews

Environmental improvements can be encouraged most effectively through a combination of regulatory and incentive policies - the “stick and carrot” approach. There are already examples of both types of policy in the aluminium and forest products sectors in Europe, e.g. the IPPC regulations in the aluminium sector and the use of certification for forest products. The study rates semi-quantitatively a number of policies – mainly at EU level but some at national level – that are influencing environmental impacts at particular life cycle stages in the aluminium and forest products sector. The EU has a major world role in both the manufacture and consumption of aluminium and forest products. The EU15 produces about 10% of the world’s 23 million tonnes of primary aluminium, but consumes about 20% of the world’s production. The EU is more self-sufficient in the forest products sector with, for example, 90% of roundwood consumption met by domestic removals. Both products made from aluminium and those made from forest products are responsible for significant environmental impacts. The study reviews qualitatively the main sources of environmental impacts (e.g. global warming, acidification, stratospheric ozone depletion, etc.), across the five phases of the life cycle of products from the two sectors.

Life Cycle Assessment Review

Life cycle assessments are reviewed for six representative and common products: aluminium components in cars; aluminium cans; aluminium window frames; wooden window frames; newspaper; and carton board. The study includes all the main impacts in its review, but focuses on global warming potential (GWP). Much of the environmental impact associated with each of the products arises from energy use. The energy mix (i.e. the split between renewable and non-renewable energy) used in manufacturing a product has a major effect on the environmental impacts of the product during its manufacturing stage. The proportion of material in a product that is of recycled origin is another factor that can have a major effect on impacts at the manufacturing stage. For example, producing aluminium from scrap uses only about 5% of the energy needed to produce primary aluminium.

The material manufacturing impacts of products in the two sectors are a relatively small proportion of the total life cycle impacts. The total life cycle GWP impacts of aluminium are an order of magnitude more than those impacts from manufacturing the aluminium alone. This is largely because a high proportion of aluminium products have a long lifetime and many consume energy during use. The total life cycle GWP impacts of forest products are two orders of magnitude more than the impacts from material manufacturing alone, i.e. forestry.

Eco-efficiency and Material Flow Analysis

The decoupling of resource use from economic growth is best measured using resource productivity, which is gross value-added (GVA) divided by resources consumed (measured by DMC - direct material consumption). Relative decoupling is being achieved when resource productivity is increasing while resource use is also increasing. Absolute decoupling is being achieved when resource use is declining but
value added is growing. Absolute decoupling has no meaning when value added is decreasing – this is one of its weaknesses as an indicator. The actual measure of decoupling of resource use from economic growth is the growth rate in resource productivity (abbreviated to GRORP). A methodology has been developed for assessing the decoupling of resource use from economic growth in an industrial sector. It has been applied only up to the stage of material production but, in principle, it is equally valid in more complex analyses involving later stages in the supply chain. However, the data are not available to do this. The growth in resource productivity (GRORP) in the EU15 from 1995 to 2000 was calculated for the primary aluminium sector and for the forest products sector (the manufacture of wood, cork, pulp, paper and their products). The figures show a decline in resource productivity for the aluminium sector of 4.6%/year (GRORP = –4.6%/year) and for the forest products sector of 3.2%/year (GRORP = –3.2%/year). This appears to suggest that there has been no recent decoupling of resource use from economic growth in these sectors.

However, there are several limitations associated with these results in terms of both reliability and representativeness. Issues of reliability include the relatively short timescale covered, the potential understatement of production due to non-disclosure of data, and the dependence of GVA on highly variable price data. Issues of representativeness include the fact that only the material commodity is accounted for as a resource (e.g. fuel consumption is not taken into account), that the data refer only to material manufacturing whereas most of the life-cycle impacts of products occur after this stage, and that no account is taken of resources used prior to import.

A valuable way of considering resource productivity is as specific GVA multiplied by resource efficiency (specific GVA is GVA per unit of production output, and resource efficiency is the production output per unit of DMC). Resource efficiency was calculated for primary aluminium manufacture from 1995 to 2001 and for the forest products sector from 1995 to 2000. Both increased at about 1%/year. For both sectors, the difference between the falling resource productivity and the slowly rising resource efficiency is explained by the fact that GVA per unit of production fell during the period, as a result of declining prices. Scarcity is not a significant issue for aluminium as life expectancy for bauxite is predicted to be about 300 years if world annual growth in production continues at 2.9%. New forest growth exceeds the annual cut by a large margin in the EU+AC and domestic supply exceeds demand; the sustainable yield is not therefore considered to be under threat.

Primary aluminium production in the EU is projected to double by 2030, i.e. to increase by 100%. Secondary production is expected to show a 170% increase. Projections for consumption of forest products (for the EU/EFTA) show increases by 2030 of 26% for sawn wood, 63% for wood-based panels, and 87% for paper and board.

**Technological and Managerial Options**

A review of the options with potential to improve resource productivity at different points in the life cycle of products highlighted the need to increase the level of recycling, to increase the lifetime of products, and to increase the proportion of energy consumed during product manufacture and use that comes from renewable sources.

**The Feasibility of Achieving Decoupling**

The study identified a number of limitations and weaknesses in the feasibility of measuring decoupling accurately in the aluminium and forest products sectors. These include a lack of reliable data, the unrepresentativeness of the results, only considering the sector’s commodity material (and not energy and other raw materials) and not covering the whole life cycle of the products in the sectors. A key question is whether decoupling of resource use from economic growth really addresses the environmental issues of concern in the EU. A number of limitations were identified in this approach, including: measuring decoupling on the basis of economic growth/value-added rather than a physical unit of actual service; concentrating on resource use measured in units of mass rather than measuring environmental impacts directly; the lack of targets as to the level of decoupling that is actually required; and not addressing the fundamental issues of eco-productivity and the absolute carrying capacity of the environment.
In principle, it is feasible under a business as usual (BAU) scenario for both the aluminium manufacturing sector and the forest products sector to achieve decoupling of resource use from economic growth. We tentatively project a small level of relative decoupling – about 2%/year for the aluminium sector and 1%/year for the forest products sector. However, there is a large amount of uncertainty in these figures and they are dependent on the ability of the sectors to turn their specific GVA figures from a decline during 1995–2000 into a rise. But even if this can be achieved, there is a strong chance that total resource consumption, as measured by DMC, will continue to rise in both sectors. Thus, achieving absolute decoupling of resource use from economic growth seems less likely for both sectors.

**International Equity**
The main issues relating to international equity have to be seen in the context of the impacts of primary aluminium production occurring largely outside the EU, whereas in the case of forest products, impacts are more evenly divided between the EU and elsewhere. Another relevant fact is that imports for use in the sectors have been steadily increasing in recent years.

**Feasibility of Defining Indicators and Targets**
A basket of indicators is necessary, as an aggregated indicator is only really suitable on the whole economy level. Eco-productivity indicators (e.g. GVA per unit of CO2 emissions) are valuable because economic performance is a universal standard of comparison. However, it is also useful to include in the indicator basket ones based on material output, e.g. aluminium produced per kg of fossil fuels used.

**Defining Policy Options**
Potential policy options for improving resource productivity in the two sectors were considered under categories such as regulation, tradable permits, voluntary agreements and public information. Several options are worthy of further investigation. But before developing specific policy options, further quantitative assessment of the need for new policies and the potential role of any BAU policies in working against decoupling is necessary.

**The Main Recommendations from the Study**

**Understanding Decoupling in the Whole EU Economy**
More research is needed to understand why the resource productivity of the whole economy of the EU15 has been rising (e.g. by 1.8%/year between 1995 and 2000).

**The Need for Decoupling**
Further research is also needed to establish how much and what kind of decoupling is required across the whole EU economy. This depends upon how much environmental impacts need to be reduced and what level of economic growth is required.

**The Need for Policy**
This study suggests that a low rate of relative, but not absolute, decoupling will occur under BAU in the aluminium and forest products sectors if certain conditions are met. Having determined the level of decoupling required, a more detailed assessment of the need for further policy to meet the EU-wide demand for decoupling will be necessary.

**Development of Indicators**
A range of eco-efficiency indicators meeting different criteria should be developed, not just one aggregated indicator. Indicators should include hidden and foreign flows, as well as all materials associated with the main commodity material (notably fossil fuels). This will require the use of TMC (total material consumption) rather than DMC (direct material consumption). Generic and simplified LCA data should be developed and made available publicly. Resource use data obtained through material flow analysis (MFA) will be essential for deducing environmental impacts using these generic LCAs. Aggregation of resource use data should still be used for limited purposes such as macro or whole-
economy MFA. Productivity-based indicators (i.e. those based on gross value added) should be further developed. However, indicators based on physical outputs such as production or service units (e.g. vehicle miles travelled) should also be developed as they avoid price fluctuations.

Data Collection and Provision
Improvements are needed in the reliability of material flow data. There is a need to address the limitations posed by non-disclosure rules and legislation could be introduced or amended to require certain manufacturing companies in the product supply chain to submit annual material flow accounts. Recycling accounts should be made within MFAs, which should include data on post-consumer-recycle (PCR) amounts. This may require addressing the codes currently existing in the NACE/Prodcom classification, which do not adequately identify scrap or waste.

Technological and Managerial Options
Our technological and managerial recommendations are made subject to further assessment through costbenefit analysis. Both sectors should continue to increase the proportion of renewable energy used, both for the manufacture of the products, and by the products in use. In the aluminium sector, recycling rates should be increased (particularly for disposable packaging and construction products). The substitution of aluminium for other materials should be considered in the many applications where it can reduce a product’s environmental impacts in use (e.g. in transport). All primary aluminium processes should aim to use the best available technologies to increase energy efficiency and optimise processes to reduce emissions. In the forest products sector, over-packaging of products should be addressed and there is scope for improving the collection and recycling of paper waste. All biomass waste from pulp and paper making processes should be subject to recycling or energy recovery, and the wood fabrication sector should phase out its use of volatile organic compounds. Clean technologies and closed loop water recycling should also be implemented.

Policy Options
The potential for an increased role for the use of voluntary agreements in increasing the application of best practice to improve resource efficiency should be explored with industry. Detailed consideration should also be given to the secondary impacts of future policies, e.g., the potential shift in consumer demand between products of different resource groups. Legislation should be considered to set national recycling and/or recovery rate targets for key end-of-life aluminium and forest products, and to set minimum time limits for product durability. Consideration should be given to minimising the municipal incineration of aluminium, and to setting overall energy efficiency targets for aluminium and paper production. Legislation should also be considered to ensure uptake of best practice techniques associated with decoupling, e.g. timber certification. Best practice should be disseminated to producers on how to improve resource efficiency through reduced material use, extending product life, using energy efficiently and designing for recycling. Public information campaigns should be used to encourage consumer choice towards the purchase of more resource efficient material/product types.