



Forests **and the climate**

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This is the Swedish Forest Industries Federation

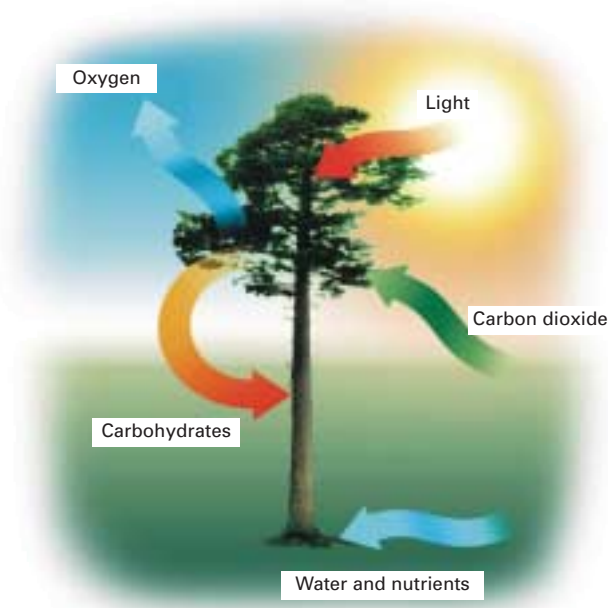
The role of the Swedish Forest Industries Federation is to watch over and promote the common interests of its affiliated companies within industrial policy and labour relations. Eighty pulp and paper companies and 260 sawmilling companies are members of the Federation. The Swedish Forest Industries Federation represents its members in contacts with politicians, government authorities and other decision-makers. The areas given priority within the Federation are forest policy, transport policy, recycling and recovery, and environmental and energy policy. A further role of the Federation is to promote the use of wood and paper as materials. Other areas of importance are research and the supply of competent personnel for the forest industry.

The key role of the forest

The forest is one of our most valuable natural resources – it is a source of raw materials for timber and paper products, and of energy; it has a biological diversity matched by few other biotopes; it provides an aesthetically pleasing environment for recreation and it binds more than 1,000 billion tonnes of carbon.

The fact that growing forests absorb carbon dioxide from the atmosphere and convert it into carbohydrates by means of the process known as photosynthesis is extremely important in our efforts to combat the greenhouse effect. Emissions of carbon dioxide from industry, society and transport have increased its concentration in the atmosphere. The world's forests have the unique ability to absorb carbon dioxide from the atmosphere and store it – both in the growing forest and in the timber and paper products that come from the forest. The more the forest grows and the more we use products from the forest, the better it is for the climate.

Forests and the forest industry will therefore be an important part of the solution to the climate change.



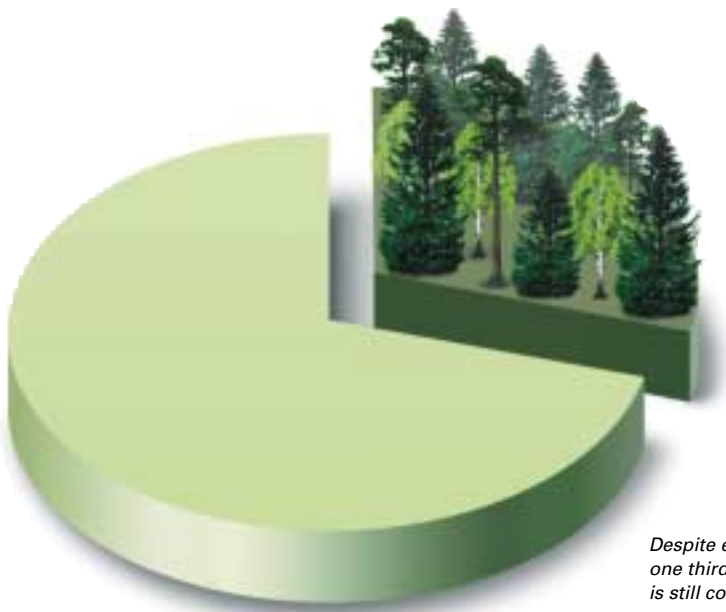
In photosynthesis, the tree absorbs carbon dioxide to form wood, which consists of fibre and stored solar energy.

” and it is one of the causes of the growing concentration of carbon dioxide in the atmosphere.

The world's disappearing forests

A very long time ago, two-thirds of the earth's land mass was covered by forest. Today, only half remains. Humans have step by step pushed back the frontiers of the forests, which have disappeared as fast as the world's population has grown. Humans have burnt down forests in order to obtain land for cultivation and chopped down trees for fuel. This is still going on today, and it is one of the causes of the growing concentration of carbon dioxide in the atmosphere.

The debate on the destruction of forests has mainly focused on the world's rain forests. This is perhaps natural as the rain forest is a fascinating and invaluable ecosystem. More than half of the world's 30 million species of plant and animal life are to be found in the rain forest. If this is destroyed, many of these species and unique natural environments will become extinct.



Despite extensive deforestation, one third of the earth's land mass is still covered by forest.

In the timber-rich rain forests, there is also a significant reserve of bound carbon. This is released when the forest is burnt or when fallen trees decay. However, a virgin rain forest exists in balance with the atmosphere and is a net producer of neither carbon dioxide nor oxygen.

The burning and clearing of forests to provide food and shelter for humans is the main reason why the forests' frontiers are being pushed back and their area diminishing. Of the reduction in forested areas, only ten per cent or so is caused by forestry activities as a means of obtaining timber.

The wood taken from forests is predominantly used as fuel. No less than 80 per cent of the wood harvested in developing countries is used for heating, cooking and such purposes.

But industrially processed wood is also largely used to produce energy. No less than 40 per cent of the wood consumed for pulp and paper production is used, in one way or another, to produce energy: the bark and the black liquor – which contains the wood's lignin – are incinerated, and some of the recovered paper is used in thermal power stations. Provided the wood used for industrial purposes comes from sustainable forests, this type of incineration does not contribute to the greenhouse effect.

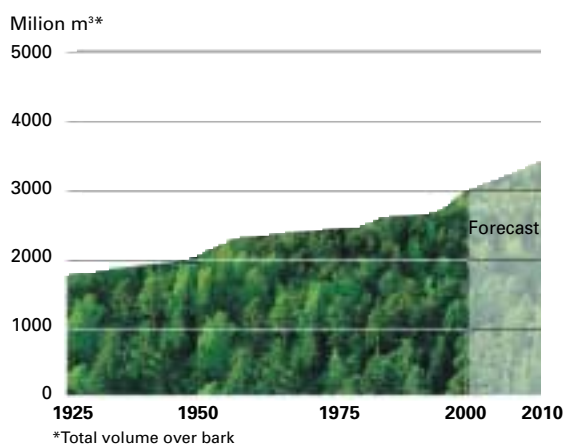


” the largest investment in new production capacity ever made by Swedish industry.

Sweden’s growing forests

Sweden is currently one of the few countries in the world with ample forests in relation to its population. The area under forest has been expanded and, over the past couple of centuries, wood stocks have doubled. The drive in the 1900s to create new, flourishing forests is probably the largest investment in new production capacity ever made by Swedish industry. Sweden’s forests, which had previously been in very poor condition, are once again filled with trees, and almost all of the country’s forests are now actively cultivated. The Swedish forest has thus been influenced by man for many years, and natural, untouched virgin forest is a rare sight indeed.

The years between 1860 and 1880 saw the construction of the first mills for the production of pulp. As far as forest management was concerned, this opened new opportunities. Previously, harvesting was mainly a matter of felling selected trees, and only the largest ones were used by the sawmills. Thanks to the emergence of the pulp industry, smaller trees also acquired an economic value, and modern forestry, including cultivation, thinning and harvesting, became possible.

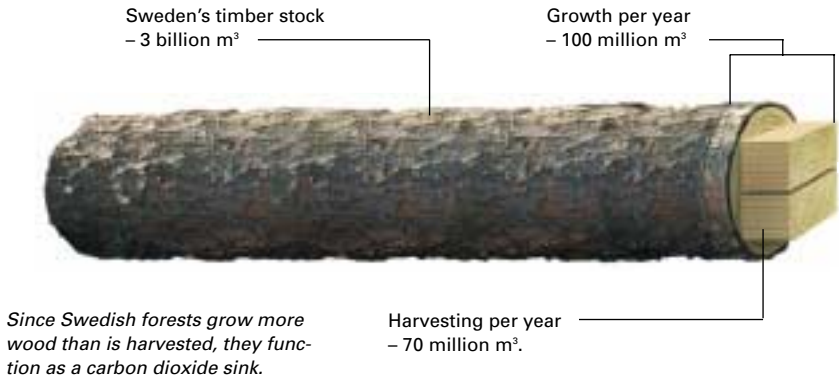


Swedish wood stocks increased during the 1900s and will continue to do so in the 2000s.

Source: Swedish University of Agricultural Sciences.

As interest in this type of forestry started to emerge, so too did our understanding of how forests should be cultivated. By the turn of the century, the seeds of the "green revolution" that was to come had already been planted. The Swedish Forestry Act in 1903 triggered off a restoration programme on a massive scale. Widespread forest cultivation turned old, bare forest lands and dilapidated, creamed forest into flourishing young forests. Little by little, forests became denser and more extensive, filled with new trees that were better able to absorb the solar energy pouring onto them. The flora and fauna returned to these new forests, and what had previously been impoverished land acquired a new lease of life – albeit different to that of the old, virgin forests.

The results of this can be seen in the first appraisals that were made, as long ago as in the 19th century, of the condition of Sweden's forests. The 1920s saw the introduction of more sophisticated surveys, in the form of the National Forest Survey programme, that provide valuable information on the development of the country's forests. The statistics indicate that forests in Sweden showed impressive growth during the 1900s: while the world's forests became depleted, the volume of wood in Sweden's forests was increasing throughout the whole of the 20th century. According to a recent study, SKA 99 (Forest Impact Analysis) present-



A sink – a place where, or a process by which, some specific component leaves a system.
(Oxford English Dictionary)

” It is also the reason why our forest lands are a carbon dioxide sink.

ted in the spring of 2000, this growth will continue throughout the coming century. From growth of around 100 million m³sk per year in the later decades of the 1900s, the rate will annually rise to 110 million m³sk during the early years of the 2000s and eventually, by the end of this century, it will reach 115 million m³sk.

The reason for the healthy state of the country’s forests is simple: the volume harvested has always fallen short of annual growth. Year by year, this non-harvested growth has added to the growing stock of timber. This is the foundation of the Swedish forestry concept; it is what distinguishes our forestry from that in many other countries. It is also the reason why our forest lands are a carbon dioxide sink.

Thus, Swedish forestry lives solely on the interest. The capital – the stock of wood – should remain in the forest and grow. Throughout the 20th century, the goal was to build up this productive capital so that harvesting could then increase in line with the rising ”interest payments” generated by the accelerating growth. As long as this policy is applied, the forests will never disappear. Instead, they will be a perpetual natural source of raw materials.

The many different roles of the forest

Paragraph 1 in the Swedish Forestry Act of 1994 states that: "The forest is a natural resource that shall be managed in such a manner that it generates a sustainable healthy yield while its biological diversity is maintained. Forest management shall also take other public interests into account."

Today, it is taken self-evident that wood production must be combined with the preservation and restoration of biological diversity and other natural features. That this is achievable has been shown by the modern forestry methods that have been developed in Sweden over the past 20 years. Forestry certification is the definite confirmation of this.

The "other public interests" mentioned in the Act refer to the role the forest has as a place for recreation, relaxation and inspiration.

The forest is also crucial to the carbon dioxide balance – a role that had not attracted much attention in 1994, when the Act was written. Immense quantities of carbon are locked up in the world's forests: 350 billion tonnes above ground and 800 billion below, in the roots and humus layers of the forest – all in all, 1,150 billion tonnes of carbon. This means that there is far more fixed carbon in the world's forests than there is locked up in the form of carbon dioxide in the atmosphere (760 billion tonnes). In Europe, forests account for 20 billion tonnes of fixed carbon, of which 8 billion tonnes are above ground.

A growing forest thus binds carbon dioxide. This is an effect of the process of photosynthesis: under the catalytic influence of sunlight, carbon dioxide and water form carbohydrates and oxygen. Some of these carbohydrates are consumed – the tree breathes and carbon dioxide is re-formed – while the remainder builds the tree: it grows. Each cubic metre of wood contains more than 200 kg of carbon. The manner in which the forests are cultivated in Sweden – the harvesting of mature forest followed by the planting of young trees – is beneficial to the carbon dioxide balance. Virgin forest, on the other hand, in which growth and decay offset each other, makes no positive contribution to the carbon dioxide balance.

As mentioned above, annual growth exceeds harvesting in Sweden. This means that wood stocks are increasing year by year, and with them, the volume of fixed carbon: the Swedish forest is therefore a carbon sink. And the carbon sink is huge: the annual uptake of carbon is equivalent to the emissions from all types of transportation in the country, as well as from the fuel consumption of all of Swedish basic industries.

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The Climate and the Kyoto Protocol

Levels of carbon dioxide in the atmosphere have risen markedly over the past century, parallel to an increase in average global temperatures. Scientists consider that there is a connection between the two, and argue that the carbon dioxide in the atmosphere acts like the glass roof and windows of a greenhouse, preventing heat from being radiated off the earth's surface.

There are several reasons for the rise in carbon dioxide levels, but the most important is the burning of fossil fuels. During the past two centuries, man has been burning the reserves of fossil coal and oil that have accumulated over many millions of years in the earth's crust. Emissions of carbon dioxide are far too high to be absorbed by the growing biomass. Between 1850 and 1998, some 270 billion tonnes of carbon were released into the atmosphere in the form of carbon dioxide, mainly through the combustion of fossil fuels. Roughly half this amount was released during the same period from the burning of forests. The effect of all this is that there has been a 30 per cent increase of carbon dioxide in the atmosphere. This means that 43 per cent of the emissions have remained in the atmosphere, while the remaining 57 per cent, or 230 billion tonnes of carbon, have been absorbed in equal amounts by the sea and the growing biomass, mainly forests.

The annual global carbon dioxide balance is as follows:

Emissions

Combustion of fossil fuels	6.3	<i>Billion tonnes of carbon</i>
Deforestation in the tropics	1.6	
<hr/> Total	<hr/> 7.9	

Absorption

Seas and lakes	2.3
Increased biomass	2.3
Into the atmosphere	3.3
<hr/> Total	<hr/> 7.9

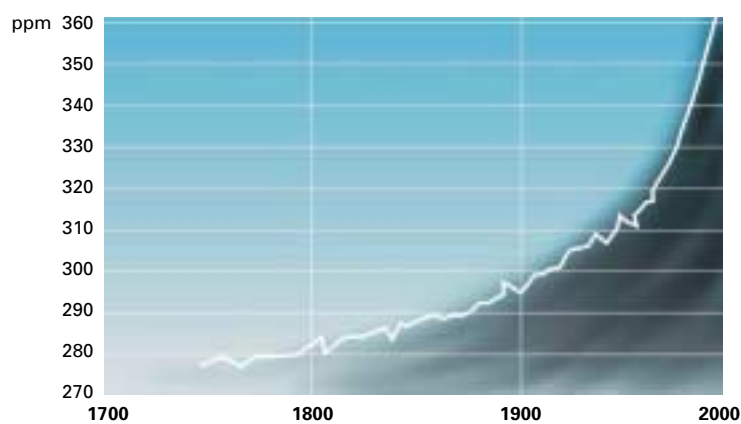
(Figures in this section are taken from a report published by the IPCC (a UN body) in May 2000)

In other words, it is the net accumulation of 3.3 billion tonnes of carbon in the atmosphere that is the problem. In view of this, it is hardly surprising that the principal objective of the UN general convention on climate change drawn up in Rio in 1992 is that the concentration of greenhouse gases should be stabilised at a level that does not represent a hazard to the environment. Following this, the Swedish Parliament decided that emissions of carbon dioxide in 2000 were to be stabilised at the 1990 level and then reduced.

In 1997, the Kyoto Protocol set quantitative targets for how far emissions should be reduced, calling upon the industrialised countries to bring average emissions between the years 2008 and 2012 down by 5.2 per cent from the level of 1990. On the part of the EU countries, this meant a reduction of eight per cent. Sweden, on the other hand, managed to negotiate within the EU for an increase in emissions of four per cent. The primary reason for this is that Sweden has already reduced its emissions by 45 per cent during the two decades between 1970 and 1990.

How sinks will be treated in the Kyoto Protocol has not yet been decided in detail. Both the Rio Convention and the Kyoto Protocol adopt a holistic approach, promoting a combination of lower emissions and increased absorption in sinks, but however this happens, the forests and the way they are managed will have a major role to play for the climate and climate policy.

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The concentration of carbon dioxide in the atmosphere has risen by 30 per cent since the beginning of the 1900s. (ppm = parts per million)

Forests are part of the solution to the climate change

What role do forests have to play in climate policy? From an international viewpoint the most important measure is to reduce deforestation in the tropics. Seen from a Swedish or European perspective, the following areas are of greatest importance:

- developing the forest sink
- promoting the use of wood and paper products
- replacing fossil-based products by wood based
- replacing fossil fuel with biofuels

Developing the forest sink

According to reports from the Swedish Environmental Protection Agency – which apply the Climate Convention’s methodology – the forest sink in Sweden amounted to 28 million tonnes of carbon dioxide in 1998. This figure is based on forest growth and harvesting and does not include forest land as such. In 1997 the figure was 32 million tonnes and the variations from year to year are mainly due to variations in harvesting volumes. Thirty million tonnes of carbon dioxide is equivalent to 8 million tonnes of carbon. The Swedish Environmental Protection Agency estimates that 18 million tonnes of carbon dioxide, or 5 million tonnes of carbon, are absorbed by forest lands. All in all, this corresponds to almost all fossil emissions in Sweden (57 million tonnes of carbon dioxide in 1998, according to the Swedish Environmental Protection Agency).

In the National Board of Forestry’s newly completed project SKA 99 it is pointed out that previous analyses of growth in the volume of wood in forests may have been overestimated as a result of incorrect assumptions regarding the biomass in branches and roots. Instead of 7-10 million tonnes of carbon annually stored in the forests during the 1980s and 1990s, the correct figure is closer to 5-7 million tonnes.

Based on direct measurements of the carbon dioxide flows in forests, calculations have been made showing that the forest sink, including land, was 30-32 million tonnes of carbon per year during the 1990s, which is almost twice the volume of emissions from fossil fuels.

Whether the forest sink is twice, or half, the volume of fossil emissions

in Sweden, it must be incorporated into Swedish climate policy. We need to learn more about how the sink is affected by forestry methods in order to develop it further, and research is being carried out in this area. In addition, the principle must receive political acceptance and the international regulatory framework must be drawn up in a way that promotes the build up of carbon deposits in forests.

The forest sink is defined in §§ 3.3 and 3.4 in the Kyoto Protocol, but the original definition covers a very small proportion of the true forest sink. It is principally tropical plantation forests that are regarded as sinks, but IPCC's comprehensive research report presents alternative viewpoints and methods of calculation. It is a matter of urgency, that sinks as a result of sustainable forestry – of the type carried out in Sweden – are also included in the calculations. Naturally, one requirement must be that the measurement and calculation of forest growth is performed in an uncontroversial manner.

A number of different measures can also be taken on individual stand level to stimulate both increased growth and carbon bonding as well as lower emissions of carbon dioxide. Choice of tree species and scarification are important aspects. Today, all of this must be seen as part of the concept of sustainable forestry, and be promoted by the development of national and international regulatory frameworks and conventions.

Promoting the use of wood and paper products

Large quantities of carbon are bound in wooden houses and wooden structures, and significant amounts are also found in the increasing quantity of paper circulating in the society. The view that bound carbon will disappear once the forest has been harvested is, therefore, erroneous – many forest products remain in circulation for a long time.

The forest is a sink for carbon dioxide since growth is greater than harvesting. Strictly speaking this is correct but it is a somewhat narrow outlook. In calculations of the sink, it is assumed that the harvested timber is immediately converted into carbon dioxide, but in reality this is not the case. Wooden houses and wooden bridges store carbon for decades, it may

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” **The entire system is a sink.**

be stored in books for 10 years, while in toilet paper it is rapidly returned to nature. In newsprint and corrugated fibreboard the carbon circulates several times via the recovery of paper and is therefore stored longer than would otherwise be the case. In this way, the recycling of carbon dioxide into the atmosphere is delayed.

The conclusion that can be drawn from the figure on the opposite page is that the more we get forests to grow and the more we use forest products, the more carbon dioxide "the system" can absorb from the atmosphere and store. Both now and in the foreseeable future the system will absorb more carbon dioxide than it releases into the atmosphere. The entire system is a sink.

Naturally, the use of paper and wood also provides the economic conditions needed for active forestry – perhaps above all this is why it benefits the climate to use more newspapers, books and corrugated board boxes, even though these products do not store carbon for a particularly long period of time.

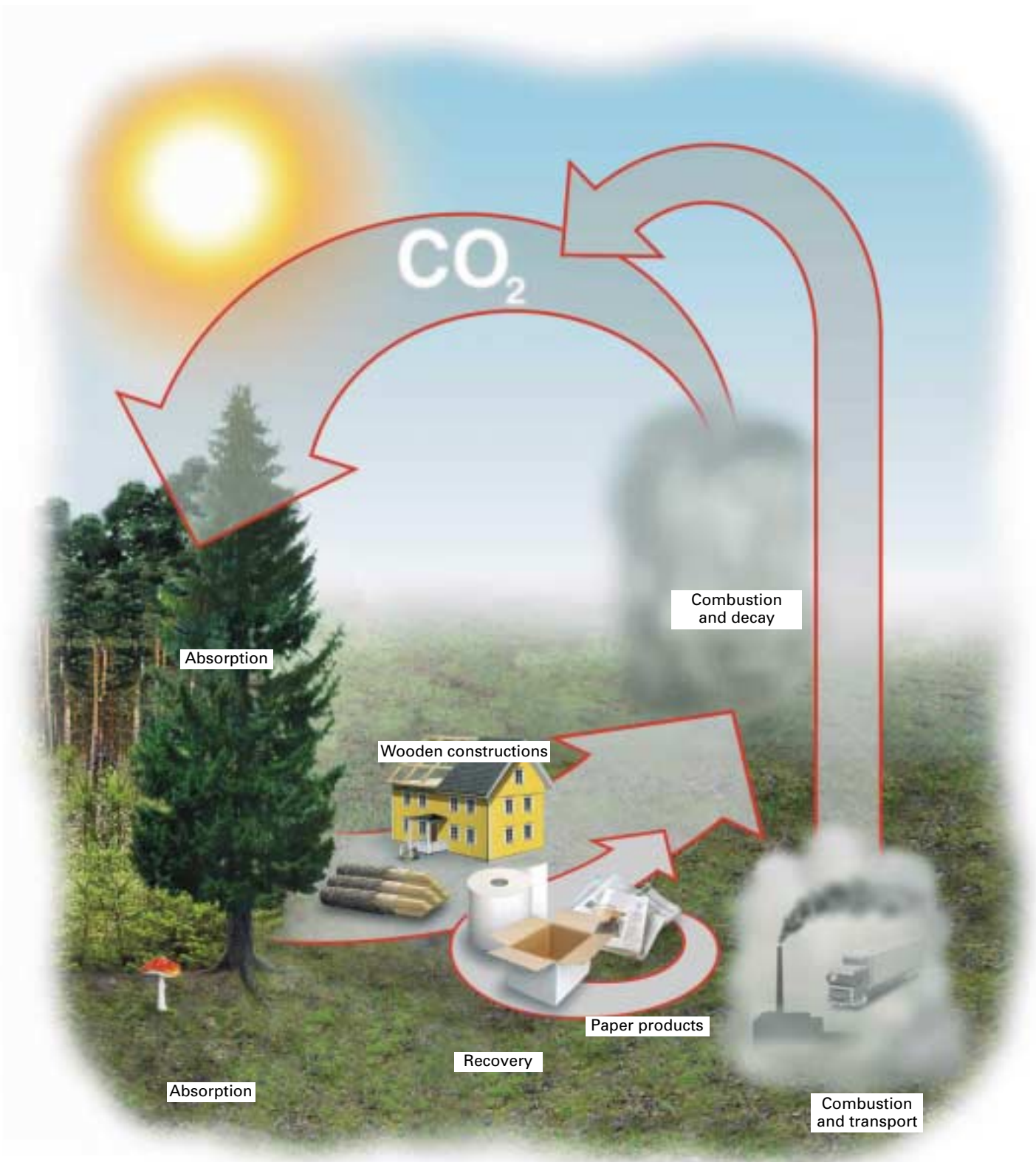
Replace fossil-based products

In this context, fossil-based products mean products that are manufactured from fossil-based raw materials – such as plastics – and products that are the result of an energy-intensive manufacturing process – such as aluminium, steel or concrete.

Estimates have been made in Norway of the effect of using different construction materials on carbon dioxide concentrations. The figures relate to emissions of carbon dioxide from the manufacture of each material.

Glulam	1.5	<i>kg of carbon dioxide per square metre building area</i>
Timber	1.4	
Steel (scrap-based)	5.2	
Steel (ore-based)	19.3	
Concrete	11.1	

(Source: The Norwegian Institute of Wood Technology and the Norwegian Institute of Building Research)



The forest is crucial for the carbon dioxide balance. Trees absorb vast amounts of carbon dioxide from the atmosphere. Together with the solar energy and the process known as photosynthesis, carbon dioxide is converted into oxygen and carbohydrates. The carbohydrates are the building blocks for the growth of the tree and because of this, carbon is stored in the growing forest.

Harvested wood is processed into timber and paper products in which the stored carbon remains. Wooden houses in particular are important because they bind carbon dioxide for long periods of time. When forestry products are finally burnt or decay, the carbon dioxide absorbed by the trees is released and returned to the cycle.

In Sweden, the forests are growing faster than they are being harvested and therefore the quantity of bound carbon is increasing year by year. This means that the forest absorbs more carbon dioxide than is included in the biological cycle. This annual increase is larger than the emissions from all the transport activities in Sweden and from the combustion of fossil fuels in the basic industries in Sweden.

This survey also projected the effect of putting one cubic metre of wood to use in different ways. The results show how much the reduction in carbon dioxide emissions would be if one cubic metre of wood were used instead of the alternatives.

As a source of energy instead of coal	700	<i>kg of carbondioxide</i>
As a source of energy instead of oil	600	
Instead of lightweight clinkers in buildings	800	
Instead of steel in a building's supporting structure	500	
In windows instead of aluminium	1,200	

These figures suggest that considerable reductions in emissions can be achieved in this way. In addition, as an extra bonus, the timber structure acts as bonded carbon throughout its lifetime, and once it has served its purpose becomes a biofuel (such as demolition wood), thus potentially reducing emissions even more. The potential offered by wood substitution has not been investigated, and there is an acute need to do this. The choice of material should become a new and natural feature in tomorrow's climate policies.

Substitution with biofuel-based materials is, in effect, equivalent to substitution with biofuels, and produces the same rapid effect.

Replacing fossil fuels

When biofuels from the forest are burnt, the stored solar energy is released and the carbon dioxide that was fixed by photosynthesis returns to the atmosphere. There is thus no net increase in carbon dioxide and no contribution to the greenhouse effect. Biofuels from the forest consist not only of wood but also of spent liquors, residues and waste products from the forest, the mills and waste management.

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Sweden already uses considerable quantities of biofuel, which account for over 90 TWh, or just over 30 per cent, of the nation's entire fuel requirements of almost 300 TWh.

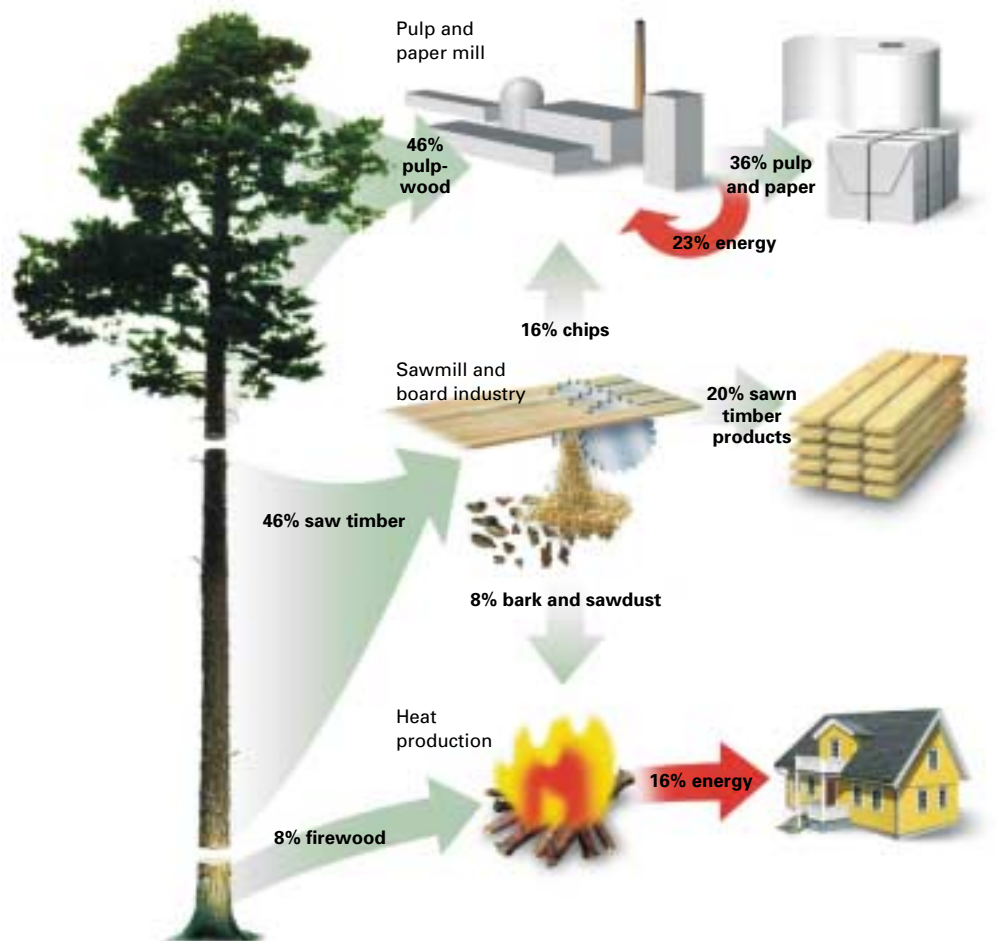
	<i>TWh</i>
Oil	168
Gas	9
Coal	25
Biofuel	92
Total	294

The use of biofuel can be broken down into the following:

	<i>TWh</i>
Waste liquors	34
Wood fuel	33
Pellets etc	4
Waste	5
Peat	3
Pitch fuel	2
Fire wood	11
Total	92

The forest industry is by far the largest player in the biofuel system. Volumes and development potential are directly related to the level of harvesting and the development of the industry itself. Spent liquors and pitch fuel are produced by the pulp production process and are reused in the process itself; wood fuel includes the tree branches and tops removed on harvesting and the bark, chips and sawdust generated as by-products in the production of pulp and sawn timber. The waste is mainly household waste, which naturally also consists of paper; and fire wood is the wood that forest owners and others collect themselves in the forests.

As can be seen, a very high proportion of these forest raw materials is used as fuel. Almost 40 per cent of the harvested round timber destined for pulp and sawmills is used as fuel in one way or another (see illustration on next page), and this is in addition to the wood fuel from branches



” There is a considerable potential to make greater use of bio-fuels.

and tops that are collected in a separate operation when harvested.

There is a considerable potential to make greater use of biofuels. This would mainly involve making use of more of the branches and tops during harvesting, although this would probably require the return of the ash to the soil to prevent it becoming depleted of certain minerals. This could then mean that the extraction of wood fuel could be doubled, although this is probably the limit of what is biologically reasonable and economically feasible to take from the forest.

Why forests are important for climate policy

Deforestation in different parts of the world is one factor behind the increased levels of carbon dioxide in the atmosphere. Despite this, immense quantities of carbon are stored in the world's forests – a reserve that can further increase as a result of sustainable forestry. In order to make best use of this opportunity, national and international regulatory frameworks must be drawn up in a way that promotes developments in this direction. Stimulating the build up of sinks would be a powerful and cost effective climate policy measure. Naturally, it would not replace measures to reduce the use of fossil fuels, but would complement them. All means must be applied to achieve the long-term goal of stabilising the level of carbon dioxide in the atmosphere.

This overall view, in which the reduction of emissions and absorption in forest sinks are equally important, also includes forest products. The use of wood and paper products should be promoted, since the manufacture of such products gives rise to lower emissions than most other products, and furthermore they store carbon dioxide.

The conclusion is clear: forests and the forest industry are part of the solution to the climate change. The more forests grow and the more of their products we use, the better for the climate.

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