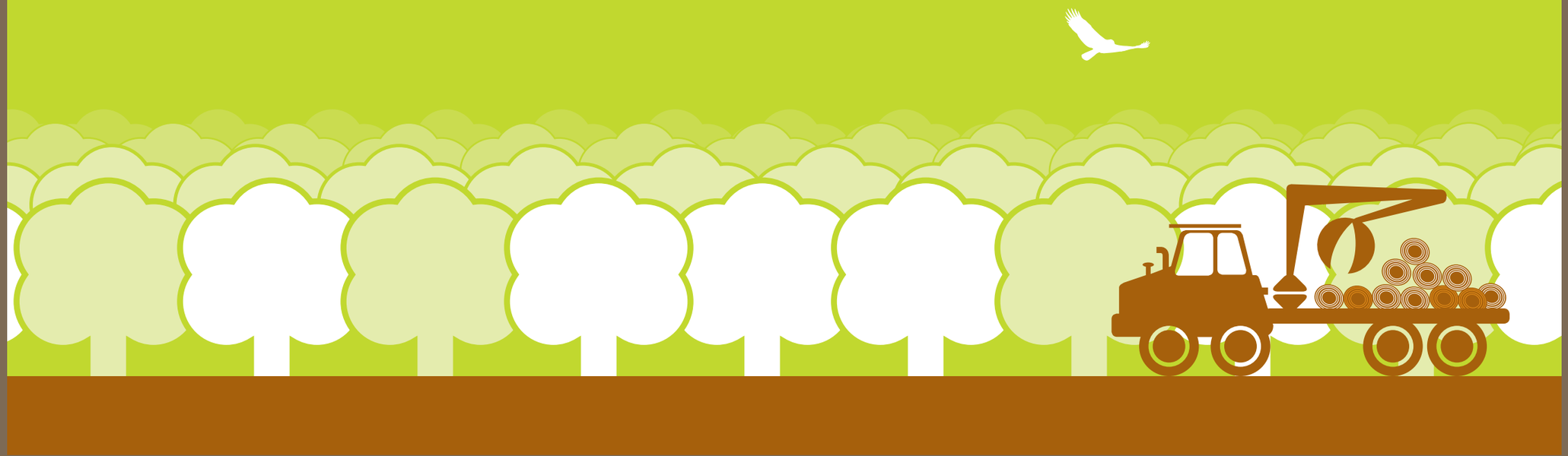
NEW GENERATION PLANTATIONS *project*

New Generation Plantations

Bioenergy and Carbon Report 2011



A new generation of plantations is vital to meet our timber, fibre, bioenergy and carbon storage needs

Foreword

During 2011, the International Year of Forests, WWF's *Living Forests Report* is examining drivers of deforestation and opportunities to shift to a new model of sustainable forestry, farming and consumption. The report aims to catalyze debate on the future role and value of forests in a world where humanity lives within the Earth's ecological limits and shares its resources equitably. Zero Net Deforestation and Forest Degradation (ZNDD) by 2020 is a critical milestone on the road toward this goal.

The first chapter (available at **www.wwf.panda.org/livingforests**) highlights the likely future pressures on forests due to increasing demand for food, materials and fuel. Towards 2050, the global population is projected to pass 9 billion and have a higher average income. Major systematic shifts will be needed for the Earth to sustain this many people. These include new consumption patterns that meet the needs of the poor while eliminating waste and over-consumption by the affluent.

Achieving and maintaining near-zero forest loss will also require forestry and farming practices that produce more with less land, water and pollution. This suggests an increasing reliance on high-yield plantations for timber, fibre, and biomass for energy. The *Living Forests Report* scenarios project that plantations will need to be expanded at a rate of 4–6 million hectares per year between now and 2050.

Establishing new plantations at this scale and pace presents many challenges: how to make enough land available without conversion of natural forests and other high conservation value ecosystems; how to intensify land-use without depleting water resources or increasing pollution from fertilizers or pesticides; how to safeguard the rights and needs of rural communities and forest-dependent peoples.

The New Generation Plantations (NGP) project embraces these challenges by identifying and promoting practices and policy frameworks that will enable a "new generation" of more sustainable plantations. The project offers a unique perspective by drawing on the combined experience of industry leaders, government forestry agencies and a large global conservation organization and finding common ground between them. It also provides a pragmatic perspective – relying on real-world efforts to find solutions, and learning from mistakes.

This report looks at how the NGP concept applies to two areas which will become increasingly important over the next few decades: bioenergy and carbon storage. It showcases bioenergy and carbon projects that NGP partners are already engaged in, and uses these to examine how New Generation Plantations can help to manage threats and realize opportunities.

Rodney Taylor
Director, Forests, WWF International

1.0 Executive summary

Recent years have seen a renewed focus on forests and a global interest in increased tree planting to mitigate climate change. Forest biomass provides a potentially vast source of renewable, low-carbon energy, offering an alternative to increasingly scarce fossil fuels. Standing forests absorb carbon dioxide from the atmosphere, and when wood is used in buildings or furniture, the carbon it contains may be stored for many years.

This report aims to show professional forest managers, forest product users and policy-makers how the NGP concept can support their work in the increasingly important bioenergy and carbon markets. It draws on the real-world experience of NGP project partners, incorporating case studies, observations made during study tours, and discussions amongst participants.

The increased focus on bioenergy and carbon brings social and environmental threats, as well as economic, social and environmental opportunities. Following NGP principles will help to minimize potential threats, including increased land competition and unsustainable intensification. It can also bring additional benefits, such as increasing local employment opportunities and providing wildlife habitats and ecosystem services.

From an analysis and discussion of bioenergy and carbon projects run by NGP participants, we conclude that:

- The NGP concept and principles work, whether the plantations are providing wood, fibre, bioenergy or carbon storage.
- Climate change and energy security mean carbon and bioenergy are significant and growing markets.
- NGPs can provide a renewable source of energy while maintaining and improving ecosystem services and people's livelihoods.
- Carbon markets are less developed than bioenergy markets. More clarity within the carbon market would help NGPs to realize their full potential.
- NGPs will increasingly need to demonstrate their carbon balance. Methodologies and standards exist but need to be further developed and harmonized.

About New Generation Plantations

WWF set up the NGP project, in partnership with private forestry companies and government agencies. New Generation Plantations are forest plantations that:

- maintain ecosystem integrity
- protect and enhance high conservation values
- are developed through effective stakeholder involvement processes
- contribute to economic growth and employment.

For more information, visit **www.newgenerationplantations.com**

Carbon and bioenergy projects can increase local employment opportunities and provide wildlife habitats.

2.0 About the New Generation Plantations project

The New Generation Plantations (NGP) project brings companies and governments from around the world together with WWF to examine the social, environmental, economic and cultural role of plantations. It addresses both the management of existing plantations and the development of new ones. We aim to improve plantations by learning from the real-world examples and experiences of participants, and sharing this information.

The NGP project started with the premise that well-managed plantations in the right places can help conserve biodiversity and meet human needs. In addition, we believe the plantation industry can contribute to sustainable economic growth and generate employment.

WWF's *Living Forests Report* model predicts that 4-6 million hectares of new plantations will be needed every year between now and 2050 to meet the growing demand for timber, fibre and biomass for energy[1]. However, we recognize that in some areas, without significant changes in policies and practices, expanding intensively managed plantations will cause controversy – for instance, by threatening the rights or livelihoods of forest-dependent peoples or valuable ecosystems and biodiversity.

The NGP project increases understanding of the contribution that plantations can play in landscapes and ecosystem functions. It collects examples of well-managed and appropriately located plantations, as key features of healthy, diverse and multi-functional forest landscapes, compatible with biodiversity conservation and human needs.

NGP project participants collectively developed three technical papers and a synthesis report over a two-year period, 2007–2009. These summarized shared insights of WWF and the companies and government departments involved on three main issues: ecosystem integrity, high conservation value forests, and stakeholder engagement. Our previous reports and case studies are available at **www.newgenerationplantations.com**

The NGP project is now ending its second phase, which began in July 2009 and spanned two years.

About this report

This report focuses on two climate-related issues: bioenergy and carbon. It aims to show professional forest managers, forest product users and policy-makers how the NGP concept can support their work in these increasingly important areas.

The report builds on the previously developed NGP concept and looks into the questions posed by these new areas. As before, we draw on our real-world experience, incorporating case studies, observations made during study tours, and discussions amongst participants.

The NGP framework was developed with a focus on the paper and timber sectors. However, we recognize that fast-growing plantations will have a significant role to play in the bioenergy sector, as well as the emerging biomaterials industry, and in global and local efforts to reduce atmospheric carbon; the NGP framework should be the basis for developing these new sectors. As a result, the ideas covered in this report are relevant to a wider audience than the traditional forestry sector, in particular to energy companies and policy-makers.

Fast-growing plantations will have a significant role to play in the bioenergy sector and efforts to reduce atmospheric carbon.

3.0 The NGP concept

The goal of the New Generation Plantations project is to identify, promote and communicate better practices for plantation design and management.

Putting principles into practice

Conditions and opportunities relating to and arising from plantations vary considerably. As a result, generalized frameworks for management are more useful than detailed prescriptive rules. However, these need to be based on principles aimed at positive environmental, social and economic outcomes.

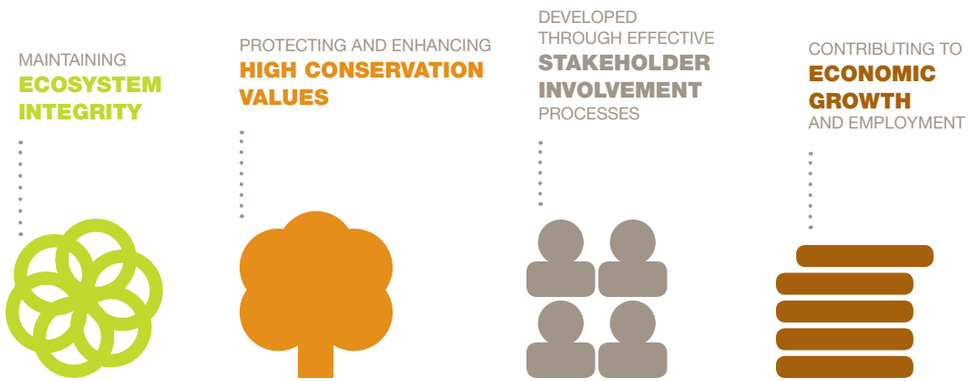
The NGP framework promotes tools that help achieve these results, as outlined on the following page. The tools identified are an evolving aspect of the framework, and are continually revised and added to.

Beyond the forest gate

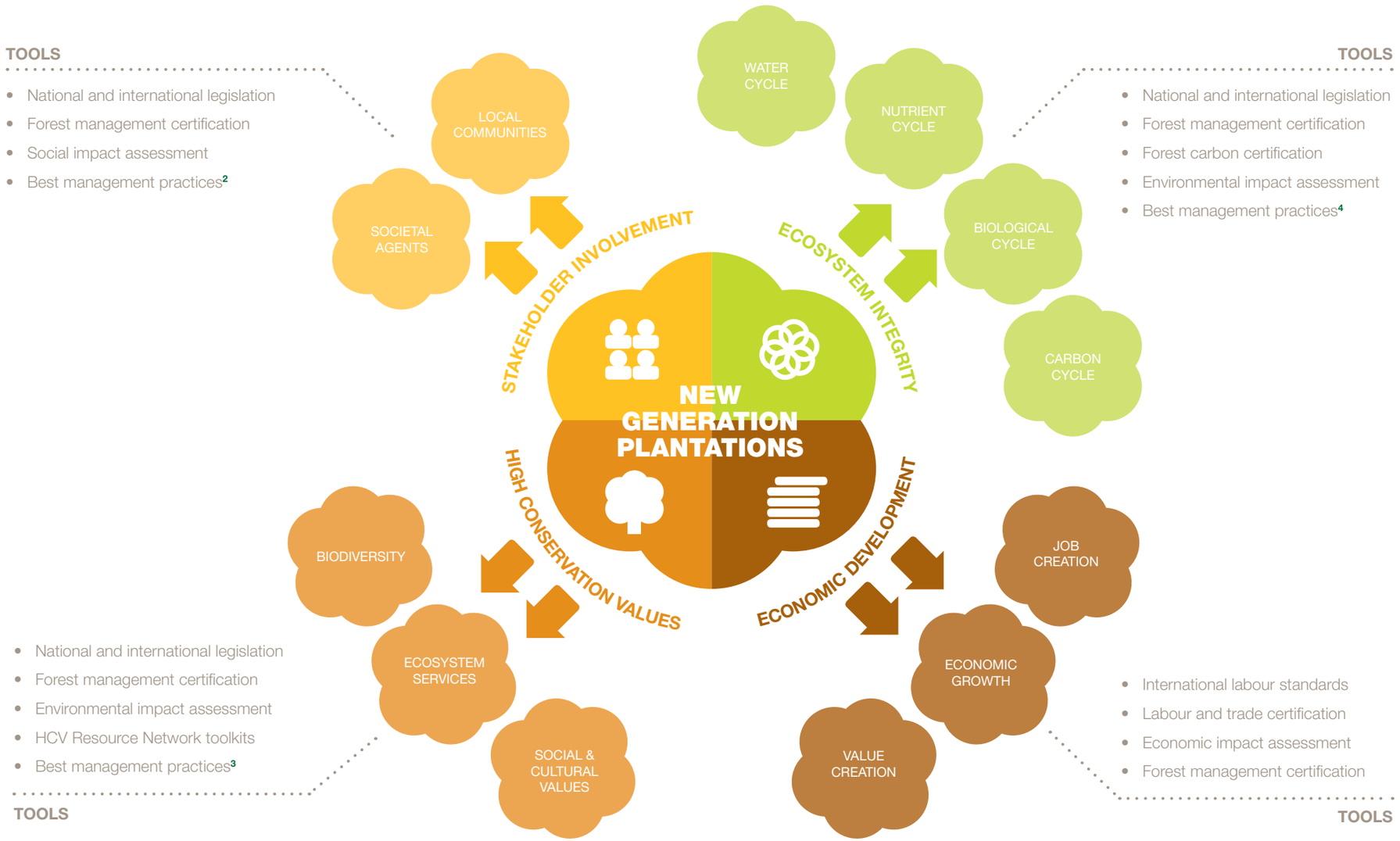
The NGP framework is concerned with forest management at the site and forest landscape level. Of course, the impact of plantations is much wider, encompassing everything from national land-use policies to the end use to which the wood is put. While we acknowledge these issues, what happens beyond the forest gate is beyond the remit of this report, and the NGP project.

NGPs maintain ecosystem integrity, and protect and enhance high conservation values.

THE NGP PRINCIPLES



3.0 The NGP concept



4.0 Why are we focusing on bioenergy and carbon?

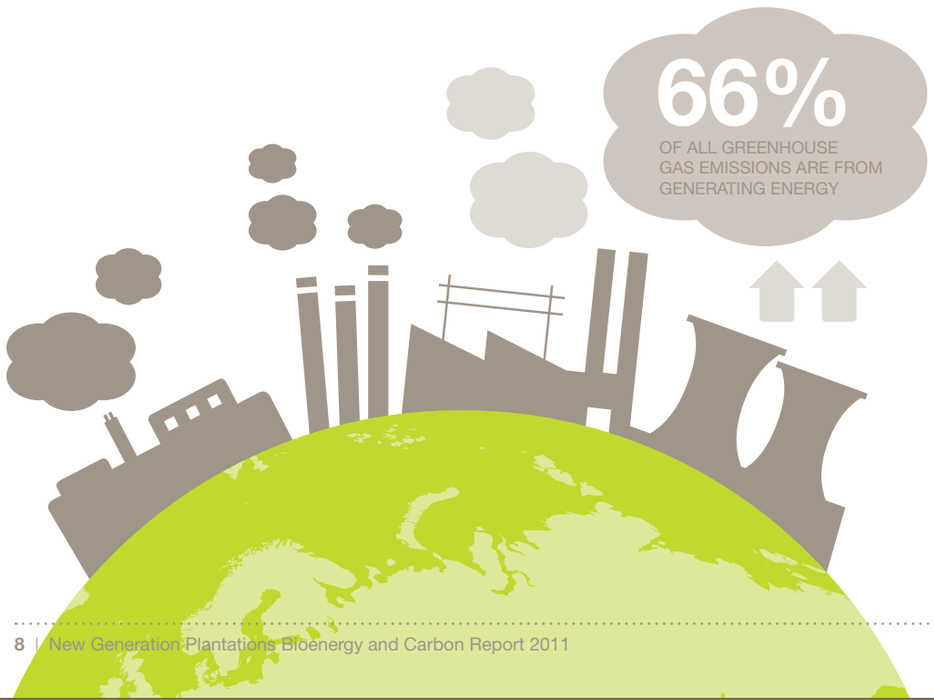
Recent years have seen a renewed focus on forests and a global interest in increased tree planting to mitigate climate change. Forest biomass provides a potentially vast source of renewable energy, with lower greenhouse gas emissions than increasingly scarce fossil fuels. Standing forests absorb carbon dioxide from the atmosphere, and when wood is used in buildings or furniture, the carbon it contains may be stored for many years.

Generating energy is responsible for around two-thirds of global greenhouse gas emissions. This makes finding alternative, low-carbon energy sources a priority for countries that are obliged to reduce their emissions under the Kyoto Protocol. The need to reduce emissions has also created a market for projects to offset carbon emissions and increase carbon stocks.

The UN climate change conference in Bali in 2007 introduced the concept of REDD – reducing emissions from deforestation and forest degradation in developing countries. Subsequent discussions have expanded the concept to include conservation, sustainable management and enhancement of forest carbon stocks – known as REDD+. Recent negotiations suggest that REDD+ will form part of a global climate deal to succeed the Kyoto Protocol at the end of 2012 – if a deal is agreed.

New Generation Plantations have the potential to be part of the solution in a number of related areas:

- **Climate change mitigation**
  Reducing carbon emissions from generating energy and from deforestation and forest degradation are fundamental to international efforts to tackle climate change. NGPs can offer both low-carbon bioenergy and carbon storage, while helping to conserve natural forests.
- **Energy security**
  The current global energy paradigm is unsustainable. Even without the climate crisis, there would be a need to find renewable alternatives to finite supplies of fossil fuels; energy security has become an issue of national concern in many countries. As a result, the bioenergy market is set to grow dramatically over the coming years.
- **Rural livelihoods**
  Alongside REDD+, plantations offer the potential to alleviate poverty in developing countries. The growing bioenergy and carbon markets offer opportunities for developing sustainable livelihoods, providing jobs for local people and income for smallholders.
- **Increased productivity without environmental degradation**
  A growing demand for bioenergy will increase pressure on forests even as schemes like REDD+ attempt to conserve them. On top of this, the UN Food and Agriculture Organization (FAO) has estimated that food production needs to increase by 70 per cent to feed the future global population by 2050[5]. They conclude that there is enough land available – but this analysis does not include areas of forest and cropland required for bioenergy and other renewable energy developments.
- **Integrated land-use planning**
  In reality there are likely to be many constraints to making more land available or to increasing yields, including land ownership questions and tenure rights for communities and indigenous peoples, lack of infrastructure and water availability. A further tension will be the strategic direction that governments take, especially concerning land-use planning. Land competition is likely to be a major challenge in the future, greater perhaps than conventional wisdom suggests. NGPs have an important role to play, as they can provide essential products (wood, paper, bioenergy) while also helping to conserve biodiversity and providing ecosystem services such as carbon storage, water regulation and erosion prevention.[6]



NGPs can provide essential products such as wood and bioenergy while helping to conserve habitats and providing ecosystem services like carbon storage

4.1 Bioenergy

More than half of the wood harvested globally is used to produce energy[7], making up around one-tenth of the global energy supply. Much of this is used for domestic cooking and heating in wood or charcoal stoves, particularly in the developing world. However, recent developments have given a completely new dimension to bioenergy production and use.

THE WORLD COULD NEED MORE THAN

3 BILLION

CUBIC METRES OF WOOD FOR RENEWABLE BIOENERGY BY 2050

Delivering (sustainable) bioenergy has become a priority in many developed and developing countries, though the drivers are different, ranging from climate change mitigation and energy security to protecting national industries. More than 50 countries have set legally binding targets on renewable energy, and others are bound by international agreements to reduce greenhouse gas emissions.

Bioenergy is needed to achieve these targets. It provides a reliable source of energy that can help to balance variable sources of renewable energy such as wind and solar power. It can also be used in applications where electricity isn't suitable, such as providing high temperature heat for industrial processes.

Bioenergy can be produced from a range of raw materials (feedstocks). As technology evolves, more materials will become suitable for bioenergy, but wood is likely to remain one of the most important feedstocks. In the EU, for example, more than half of renewable energy is biomass based with forests and dedicated plantations providing most of this.[8] In 2010, bioenergy provided 76.3 million tonnes of oil equivalent (Mtoe) in the EU; to meet renewable energy targets, this will need to increase to 124.5 Mtoe by 2020. While much of today's wood-based bioenergy is used for domestic heating, it is likely to play an increasingly important role in other areas, such as district heating and electricity generation.

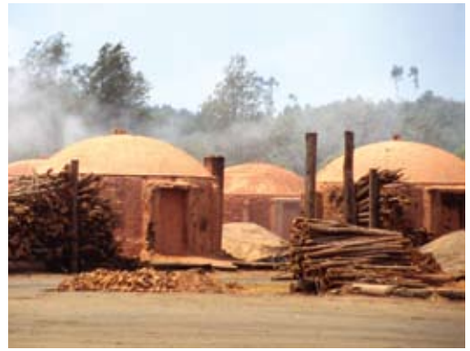
A recent WWF report estimated that, to move to a fully renewable energy supply, the world would need more than 3 billion cubic metres of wood for bioenergy purposes alone by 2050.[9] This is equivalent to the total harvest for all uses today.

Existing forests will continue to play an important role in delivering bioenergy feedstocks. However, as in the pulp and paper or timber sectors, the role of dedicated plantations is likely to increase. We can expect to see more plantations, and for them to be more intensively managed.

It's clear that bioenergy is becoming an increasingly valuable commercial market. Developments in the bioenergy arena are, however, largely policy driven. This makes it important for the forestry sector to engage with national and international policy in this area. Policy-makers need to be alert to the environmental, social and economic implications of a huge increase in bioenergy production, and develop safeguards and incentives to reduce potential negative impacts. A number of safeguards that NGP partners have deployed are outlined in the case studies in this report.

Why NGPs are involved

- Government targets on renewables and the rising price of fossil fuels have created a significant market for bioenergy, which is likely to grow rapidly over the next few decades.
- Growing demand for biomass for energy creates an opportunity for diversification in forest and plantation management. There is also a market for "low value" feedstocks such as by-products from timber and pulp processing. This can increase the value to plantation and forest owners and create economic opportunities, particularly in rural areas.
- NGP participants already have the expertise and ability to meet this market opportunity, and to do so in a socially and environmentally responsible way.



Wood makes up about one-tenth of the world's energy supply, much of it in the developing world.

4.2 Carbon

Ecosystems, and forests in particular, can slow climate change by absorbing and storing carbon. Everyone on Earth benefits from this ecosystem service, no matter where the carbon is stored. This has created markets for carbon storage services, putting a value on carbon as a global commodity[10] – although these remain far less developed than other commodity markets.

There are two main carbon markets:

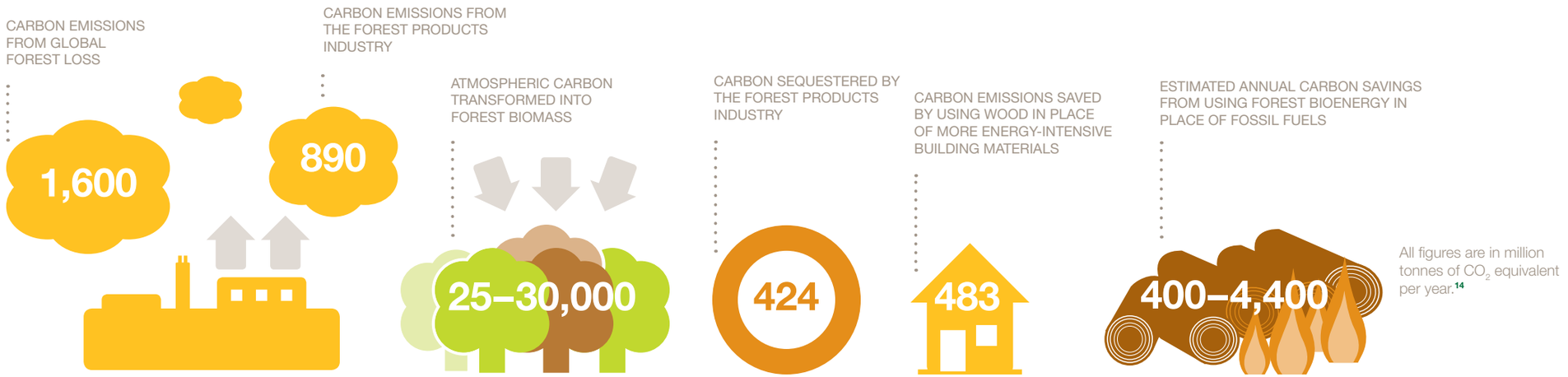
- Compliance market/trading schemes – companies and governments buy carbon credits to comply with legal caps on the amount of carbon they are allowed to emit. Schemes include the Clean Development Mechanism (CDM), which allows countries to meet part of their Kyoto Protocol commitments by investing in projects that reduce emissions in developing countries. The total value of transactions in the global compliance markets in 2009 was US$143,897 million.[11]
- Voluntary market/private deals – countries, companies, organizations and individuals voluntarily pay to offset their carbon footprint through projects that reduce emissions or absorb an equivalent amount of carbon. The voluntary market is smaller than the compliance market, but still significant, with transactions totalling US$387 million in 2009.[12] It is unregulated, but a number of mechanisms and standards exist for measuring emissions reductions (e.g. Voluntary Carbon Standard (VCS); Climate, Community and Biodiversity (CCB) Alliance; Gold Standard).

Carbon markets are not yet a major driver of plantation expansion; indeed, some compliance markets such as the European Union Emissions Trading Scheme exclude projects for planting trees to increase carbon sinks. To date, the impact on carbon levels has primarily been a side effect of forest and plantation management. However, a growing number of policies and market mechanisms are focusing attention on this area. National environmental policies, international schemes such as REDD+ for rewarding ecosystem services including carbon storage, and voluntary carbon offset schemes all offer opportunities for developing the NGP concept.

Establishing plantations on non-forested land, via afforestation, increases land-based carbon stocks (except on some deep organic soils). By contrast, establishing plantations by converting forested land that has not previously been managed for wood production often results in increased carbon emissions.[13] Plantations are likely to have a positive effect on the climate, provided they are managed sustainably and don't replace natural or semi-natural forests.

Planting trees on non-forested land has a positive impact on the climate by reducing levels of carbon in the atmosphere.

CARBON IMPACT OF THE FOREST PRODUCTS INDUSTRY



All figures are in million tonnes of CO_2 equivalent per year.[14]

4.2 Carbon

Many plantation owners and forest product companies attempt to reduce the loss of carbon from forest ecosystems; several NGP partners are involved in projects to measure and improve their carbon impact. Since carbon is a key component of woody biomass, increasing biomass growth will absorb more CO_2 from the atmosphere. Conversely, more intensive harvesting is likely to increase the amount of carbon released.

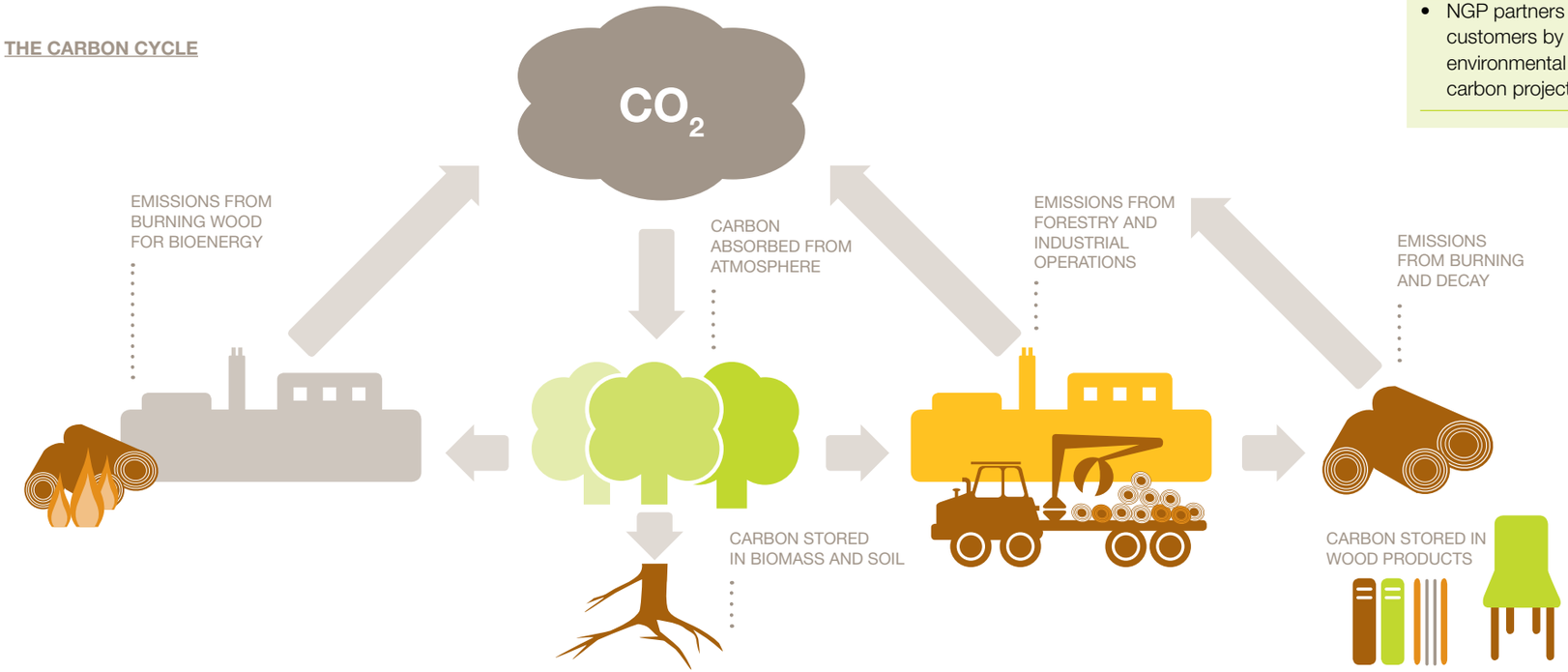
However, the full carbon story is complex, and woody biomass is only one component. Soil (a huge but sometimes overlooked store of carbon), operational practices, and the way timber is processed and used beyond the forest gate all have a major impact on a plantation's carbon balance.

Forests eventually reach saturation point, after which they can absorb no more carbon; in this situation, selective harvesting for wood and bioenergy is the only long-term technique for improving net carbon abatement.

Why NGPs are involved

- Government targets on emission reductions have focused attention on the role of afforestation in establishing a larger domestic carbon sink.
- Increasing carbon stocks aligns with companies' corporate social responsibility aims, such as providing employment, biodiversity conservation and restoring native woodland.
- Carbon trading and the voluntary carbon offset market provide a business opportunity, although there remains a high degree of uncertainty in these areas. Some governments have policies to promote investment by private companies, such as the **China Green Carbon Foundation.** However, carbon trading on its own does not yet provide an economic incentive for planting forests.
- NGP partners aim to attract and educate customers by demonstrating the positive environmental impact of their carbon projects.

THE CARBON CYCLE



5.0 Bioenergy and carbon: opportunities and threats

The increased focus on bioenergy and carbon brings social and environmental threats, as well as economic, social and environmental opportunities.

Land competition

As discussed above, feeding a growing global population will require large increases in food production. The growth in population and growth in consumption will also require more land and natural resources, including pulp and timber. If bioenergy production also increases as predicted, this will put pressure on the available land, with a number of possible negative consequences. Without effective safeguards, we will see more forest conversion, threatening biodiversity, the rights and livelihoods of people who depend on forests, and the ecosystem services forests provide. Producing bioenergy feedstocks on highly productive agricultural land could result in food shortages and price hikes or simply displace food production, leading indirectly to more forest clearance. However, at a global level, there are many opportunities to develop plantations on marginal agricultural land and degraded landscapes.

Intensification

The increased demand for biomass for energy will put pressure on forest managers to harvest more intensively. Intensively managed plantations already supply around 40 per cent of industrial roundwood, even though their area is relatively small compared to the area of managed forests. Although woody biomass has the potential to be a cleaner source of energy than fossil fuels over the long term, this is only the case if the principles of sustainable management are applied. NGP partners have already begun to investigate the implications of using stumps and brash for bioenergy. The use of such residues presents opportunities and challenges. Harvesting brash and stumps, for example, can reduce levels of carbon and nutrients in the soil; these issues are not always well understood, and need further exploration.

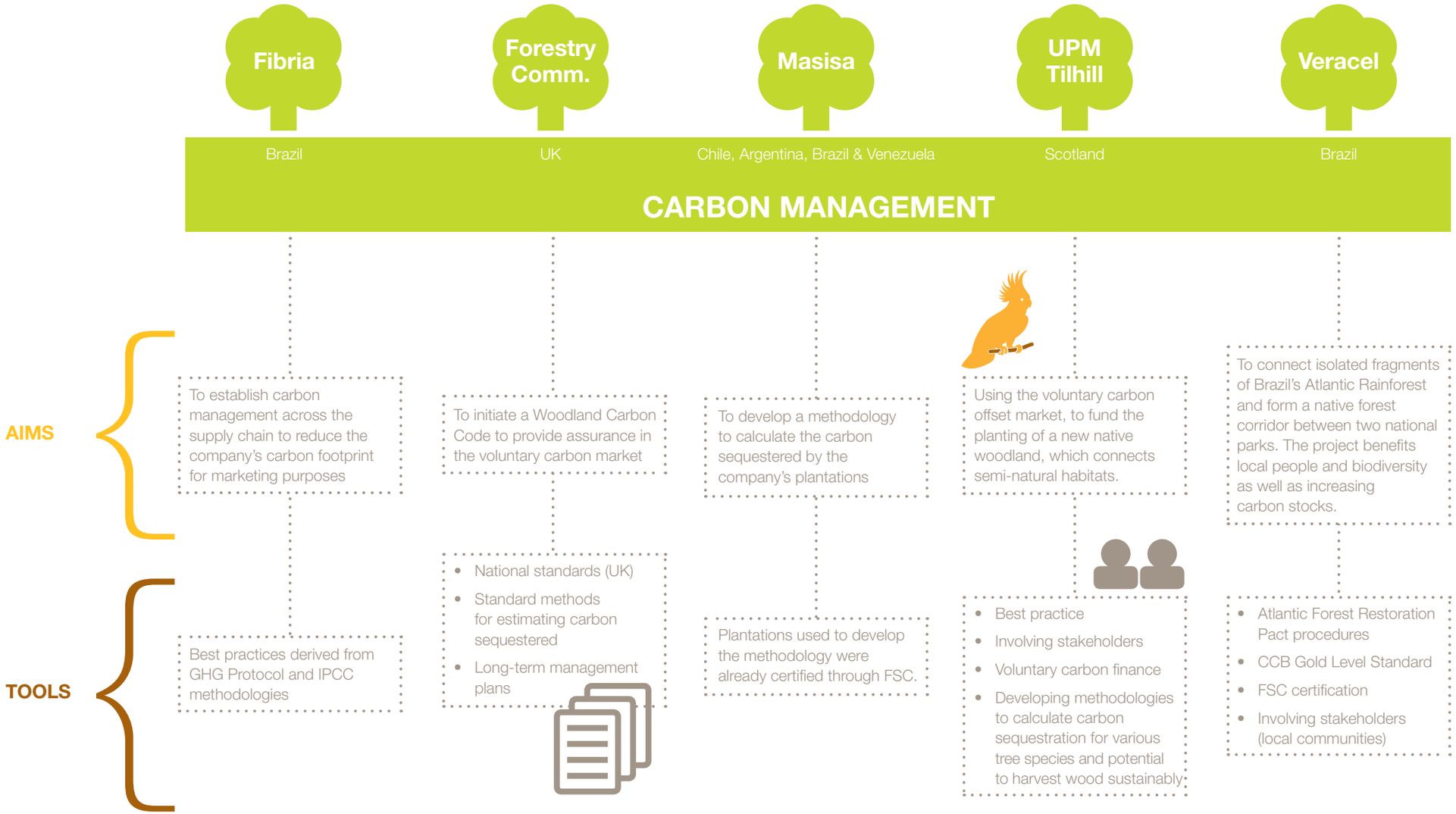
Co-benefits

Bioenergy and carbon management could provide an additional source of income for forest and plantation owners and local communities. Well-managed and appropriately located plantations, both for bioenergy and carbon sequestration, can bring further benefits, including wildlife habitats and services such as flood prevention.

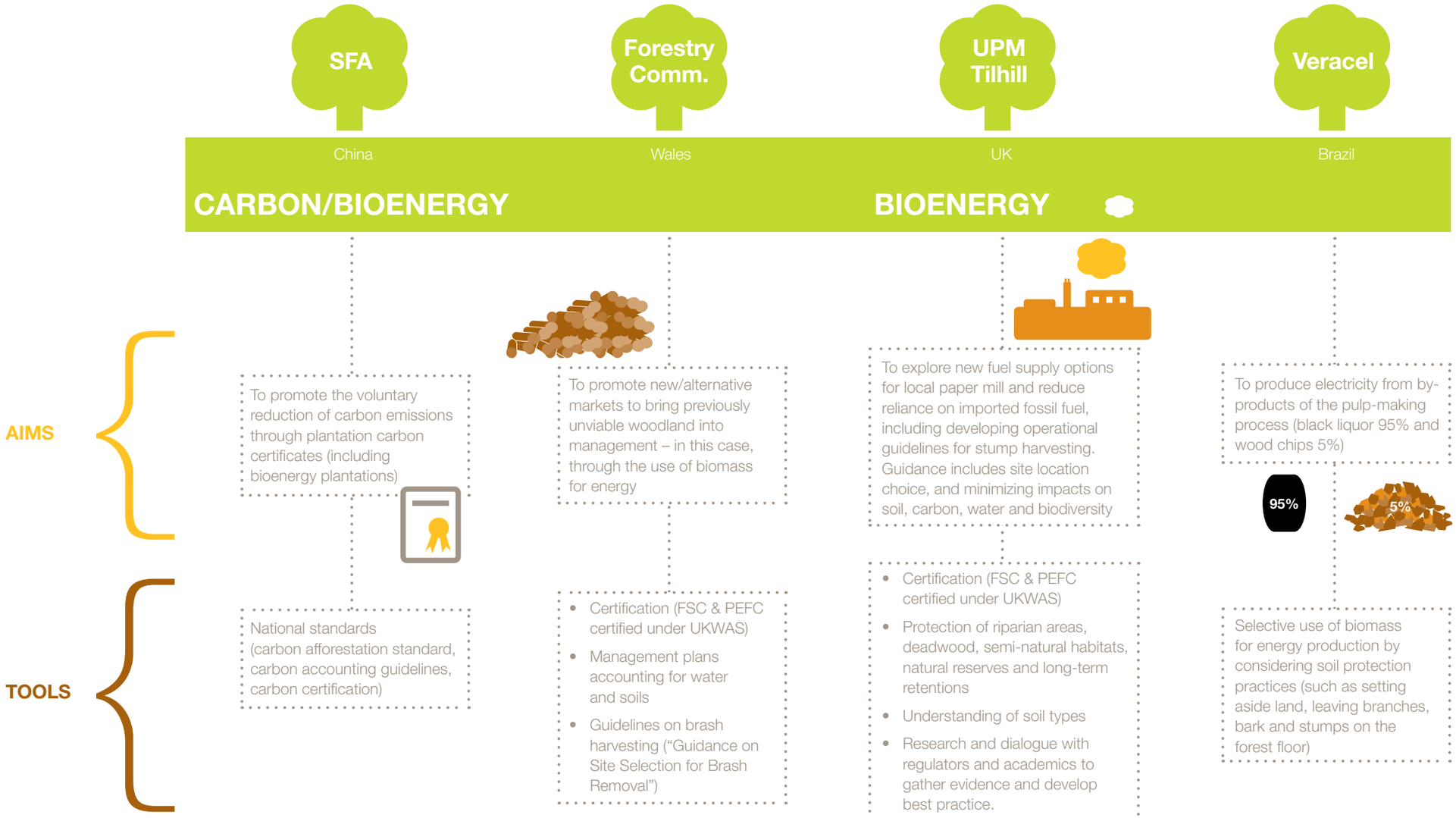
Brash and tree stumps are a possible source of bioenergy, but this can affect soil carbon and nutrient levels.

The increased demand for biomass for energy will put pressure on forest managers to harvest more intensively

6.0 Case studies analysis: Carbon management



6.1 Case studies analysis: Bioenergy



6.1 Case studies analysis: How the NGP concept applies

The NGP concept can and should be applied to all plantations, irrespective of whether they are intended for fibre, timber, bioenergy or carbon storage.

Bioenergy and carbon management are new markets, and most of the case studies concern NGP partners' first steps in these sectors; a few build on their existing practices (**Veracel's bioenergy case study**; **UPM Tilhill's carbon management case study**). There were several common factors behind both the carbon management and the bioenergy case studies:

- Government targets on renewable energy and carbon emissions, resulting from concerns on climate change and energy security.
- Business opportunity – diversifying outputs and exploring the emerging, growing markets of bioenergy and carbon, and adding value to current products.
- Capacity – NGP partners' existing expertise and resources mean they are well placed to develop in these emerging markets.
- Values – developing these markets fits with NGP partners' social, environmental and economic principles, including promoting biodiversity and local economies.

In most of the case studies, bioenergy production or carbon management was the main goal. In some, however, they were secondary or indirect aims. Carbon management, in particular, can complement biodiversity and ecosystem conservation projects. The main aim of **Veracel's Mata Atlântica project**, for example, is to restore native rainforest; carbon sequestration is an additional benefit, and commercial carbon credit contracts help to fund the project. **China Green Carbon Foundation (CGCF)** presented an interesting case: funding from the voluntary carbon offset market was used to create jatropha plantations. As well as sequestering carbon, the trees produce oily seeds that can be used for bioenergy.

The NGP concept employs a number of tool and principles, identified on p.7. Several of these are in evidence in the case studies:

Carbon certification

- **Masisa** developed a methodology for valuing carbon sequestered in its plantations for participating in the CDM and Chicago Climate Exchange (CCX).
- **Fibria** began measuring carbon sequestration in its conservation areas after joining the Carbon Disclosure Project and CCX.
- **Veracel** is following the CCB Gold Level Standard in its Atlantic Rainforest restoration project

Forest management certification

- To measure their carbon sequestration, **Veracel** and **Masisa** drew on information already collected and verified as part of their FSC certification
- **Forestry Commission Wales** is able to fulfil a long-term bioenergy contract sustainably by using only wood certified under the UK Woodland Assurance Standard (UKWAS)

National standards and guidelines

- Forestry Commission has developed the **Woodland Carbon Code**, a national standard for verifying carbon savings from tree-planting projects. **UPM's Loch Ken plantation** was one of the trial sites for developing the code.
- **China Green Carbon Foundation** exceeded the State Forestry Administration's best practice guidelines in its bioenergy and carbon plantations.

Stakeholder involvement

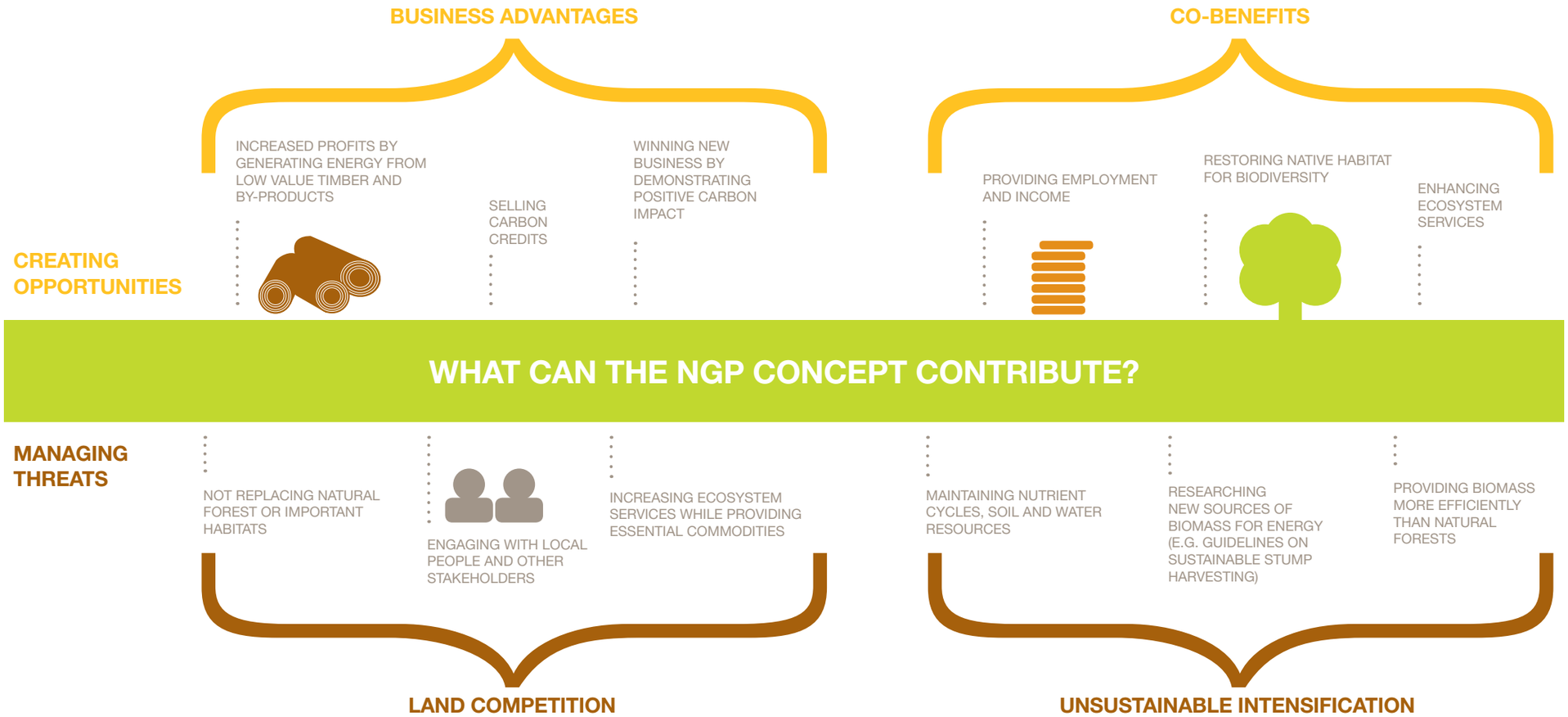
- To develop **guidelines for stump extraction**, UPM consulted external regulators, environmental agencies, competitors and academic researchers.
- **Veracel's Atlantic Rainforest restoration project** has included work with local farmers and NGOs, and support for the local cooperative that carries out the replanting.

This demonstrates that the existing tools of the NGP framework are relevant and useful when it comes to bioenergy and carbon.

7.0 What can the NGP concept contribute?

Bioenergy and carbon are increasingly important markets. They provide economic opportunities and employment, particularly in rural areas. They will also play a significant role in global efforts to combat climate change.

The NGP concept aims to make the most of these opportunities while maintaining high environmental and social values. As the case studies show, it provides tools to help managers avoid threats associated with bioenergy, while offering other co-benefits. For customers, NGP principles are a guarantee that bioenergy feedstocks and carbon credits are – like timber and fibre – genuinely sustainable. The NGP concept should also inform the wider debate on bioenergy and forest carbon.



7.1 Managing threats

Land competition

The NGP concept seeks to minimize any negative impact of land-use change. Plantations following the NGP concept maintain ecosystem integrity and conservation values – they do not replace functioning natural forest ecosystems or high conservation value habitats. Engaging with local people and other stakeholders is another key pillar of the NGP framework; when necessary, NGPs will carry out a social impact assessment, as well as an environmental impact assessment, before establishing a plantation.

While biofuel crops may be grown on prime agricultural land, this is unlikely to be the case for bioenergy tree plantations – quite apart from NGPs' social and environmental commitments, it would rarely make economic sense to replace productive cropland with a plantation that will not bring in an income for several years. With the debate over biofuel and food becoming more urgent, NGPs' potential to provide sustainable biofuels needs to be recognized. Indeed, NGPs can reduce land competition pressures. Planting trees on degraded land can increase ecosystem services (carbon sequestration, water retention etc.) while also providing commodities (bioenergy feedstocks, timber, fibre) more efficiently than natural forests.

Getting more from the land

China is planting large areas of forest to help absorb its CO_2 emissions – but it is finding other uses for these plantations too. China Green Carbon Foundation (CGCF) funds tree plantations by selling voluntary carbon offsets to businesses and individuals. In Yunnan province, it has funded a 22,083 hectare jatropha plantation. The trees not only sequester carbon as they grow, but also produce oily seeds which can be used as a biofuel. This can provide an extra income for farmers, although more investment is needed to build a local factory to process the oil.

Read the full case study.

Intensification

Harvesting more biomass from plantations for bioenergy purposes could have negative impacts on biodiversity and ecosystem integrity. The NGP framework already focuses on ensuring nutrient cycles – including the carbon cycle – and soil and water resources are cared for. This reduces the potential risks from intensification. As the case studies show, NGP partners are already addressing this issue – both by researching the possibilities of sustainable intensification (UPM Tilhill developing guidelines for stump extraction – see box) and rejecting unsustainable practices (Veracel's decision not to use branches, bark and stumps for bioenergy, to protect soil nutrient levels).

Harvesting more wood, more sustainably

New sources of biomass are needed to meet the increasing demand for bioenergy. Tree stumps are one possibility – but harvesting them can be damaging on certain sites and soil types. UPM Tilhill has developed operational guidelines for sustainable stump harvesting in the UK, where this is a relatively new operation. These include evidence-based guidance on identifying suitable sites and minimizing adverse impacts on soil, carbon, water and biodiversity. UPM's evidence suggests that stumps can provide a sustainable source of energy, but only in the right conditions. The guidelines advise against harvesting from very organic soils, because of the loss of soil carbon. They also suggest that stumps and brash shouldn't be harvested from the same site, as brash helps prevent soil damage from machinery.

Read the full case study.

The NGP concept seeks to minimize any negative impacts of land-use change or intensification.

7.2 Creating opportunities

Business advantages

Bioenergy and carbon markets offer new opportunities for NGP partners to expand, and to add value to their business. Veracel, for example, saves money by generating electricity from by-products in its pulp mill. Bioenergy is an important new market for Forestry Commission Wales, which had seen a fall in demand for timber because of an increase in recycled fibre. By calculating the carbon sequestered in its plantations, Masisa is able to demonstrate carbon savings that can be traded commercially.

Improving and demonstrating the positive carbon impact of plantations offers further business benefits. It can help companies to become more transparent, and to differentiate themselves from their competitors. This can help to attract customers who are seeking to reduce their own environmental impact. This is one of the key aims of Fibria's efforts to record and communicate its carbon footprint.

Co-benefits

As the case studies in this report show, carbon management and bioenergy in NGPs can bring further social, economic and environmental benefits.

When NGP principles are followed, bioenergy and carbon plantations can make a significant contribution to poverty alleviation. Veracel's Atlantic Rainforest restoration project has directly created 45 jobs with a local co-operative in Brazil. As well as sequestering carbon, CGCF's jatropha plantations provide a source of income for farmers who harvest the seeds for biofuel

While carbon sequestration is an environmental benefit in itself, funding from carbon markets can support other conservation work. Both Veracel and UPM Tilhill have used voluntary carbon market finance to restore/create native forest and woodland. As part of its carbon footprint, Fibria measures the value of carbon sequestered in its conservation areas, giving the company a further incentive to preserve endangered habitats. On a study tour to Yunnan province, China, NGP participants visited a jatropha plantation which was originally established to prevent erosion on a steep, arid hillside; using oil from the jatropha seeds for bioenergy was a later development.

There are other potential synergies that could be explored further – such as using carbon sequestration projects to create wildlife corridors, agroforestry projects (combining forestry with crops or livestock), or using bioenergy plantations for flood risk management and water purification.

Using timber products in place of energy-intensive materials such as steel and cement, or biomaterials instead of oil-based plastics, can also improve energy efficiency and significantly increase carbon storage times.

Carbon credits – not just good for the climate

Veracel has helped fund the planting and restoration of 318 hectares of rainforest in Brazil by selling carbon credits on the voluntary market. The project's goal is to connect isolated fragments of the Atlantic Rainforest and form a native forest corridor between two national parks, Monte Pascoal and Pau Brazil. With only 7 per cent of the original forest remaining, projects like this are critical to conserving the region's extraordinary biodiversity. Veracel works closely with local landowners and communities. The project is helping to improve rural livelihoods, and has directly generated 45 jobs with a local cooperative.

Read the full case study.

Bioenergy and carbon plantations can provide rural jobs and support economic development

8.0 Developing the NGP concept

The NGP framework already addresses the carbon cycle in principle, and includes tools to help managers to improve their plantations' carbon balance. Similarly, a variety of standards exists to verify projects' carbon savings. However, there is a need for more consistency between these standards and more detailed guidance on best practice in measuring and improving carbon impact.

Standard methods for assessing the net carbon abatement of plantation management would allow NGPs to play a more prominent role in the carbon market. At the moment, some compliance markets and voluntary schemes exclude tree planting projects because of the difficulty of assessing their long-term carbon impact – including emissions associated with plantation management alongside carbon sequestration by trees. The NGP concept could help to harmonize existing standards.

A further challenge for policy makers and forest managers is to consider how timber and biomaterials can reduce reliance on fossil fuels and store carbon in the longer term – and how this can be measured. However, these issues go beyond the current scope of the NGP project.

Measuring the long-term carbon savings from plantations and wood products is an ongoing challenge.

9.0 Conclusions

The NGP concept and principles work, whether the plantations are providing wood, fibre, bioenergy or carbon storage.
While bioenergy and carbon projects may bring new challenges, such as increased land competition and more intensive management, NGPs already have the tools to deal with these. The NGP concept ensures plantations are being managed to high environmental and social standards, and it is important to communicate this to bioenergy and carbon customers. The experience of NGP partners is also valuable for policy-makers concerned with bioenergy and carbon.

Climate change and energy security mean carbon and bioenergy are significant and growing markets.
There will inevitably be an expansion of plantations to meet the demand for sustainable energy. Companies applying NGP principles can benefit from this opportunity. Equally, people and the planet will benefit if these plantations are managed according to NGP principles.

NGPs can provide a renewable source of energy while maintaining and improving ecosystem services and people's livelihoods.
Applying NGP principles reduces the risk of negative social and environmental impacts posed by some forms of bioenergy – unlike agricultural biofuels, for example, NGPs are unlikely to have a major impact on food production. NGP tools can also help to minimize greenhouse gas emissions from bioenergy.

Carbon markets are less developed than bioenergy markets. More clarity would help NGPs to realize their full potential.
A strong, legally binding global climate deal would help to bring compliance and voluntary carbon markets into focus. Despite the uncertainties of measuring carbon sequestration and storage over the long term, NGPs undoubtedly have a positive contribution to make; funding from carbon markets would allow more such projects to happen.

NGPs will increasingly need to demonstrate their carbon balance. Methodologies and standards exist but need to be further developed and harmonized.
This lies beyond the scope of the NGP project, but partners have the experience and expertise to contribute. Recognized standards will help forest managers to improve their practices, and give confidence to customers and investors. Demonstrating their carbon impact can also be a useful marketing tool for NGP partners.

10.0 Glossary of terms

Bioenergy
Energy derived from biomass. This energy can be used to generate electricity, supply heat and produce liquid biofuels.

Biomass
Living or recently living organic material both above and below ground, e.g. trees, crops, grasses, tree litter, roots, animal wastes.

Brash
Branches, tree tops and other tree material not suitable for conventional timber processing. Brash is usually left on site, where it provides important ground cover and nutrients.

Carbon sequestration/capture
Removal of carbon dioxide from the atmosphere into other forms such as biomass.

Carbon storage
Storage of carbon in forms other than the atmosphere, such as growing trees, harvested wood products and soil.

Ecosystem integrity
Ecosystems have integrity when their landscape features, species and natural processes are unbroken and in good health.

Ecosystem services
The benefits people obtain from nature. These include provisioning services such as food and water; regulating services such as regulation of floods, drought, land degradation, and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious and other non-material benefits.

High conservation value
Areas of outstanding or critical environmental, social or cultural importance. Protecting High Conservation Value Forests is a principle of Forest Stewardship Council (FSC) certification.

Net carbon abatement
The net sum of CO_2 removed from the atmosphere by plantations, carbon stored in wood harvested from the plantation and emissions avoided by using wood in place of other materials, minus the carbon emissions from plantation operations, including timber harvesting.

Riparian
Riparian areas are those alongside streams, rivers and lakes. Riparian forests and woodlands are particularly important for biodiversity and ecosystem services.

Stakeholder engagement
Process by which all people involved in or affected by a project are involved in decision-making.

11.0 Endnotes

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All websites accessed June 2011.

12.0 Credits

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This report summarizes shared insights of WWF, forest plantation companies and government departments and was developed collectively over a two-year period, during and between three study tours in Malaysia, Chile and China, and one technical meeting in London.

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Case Study

NEW GENERATION PLANTATIONS project

A | Fibria, Forest Division

Fibria´s carbon management programmes

Drivers and background

Fibria has always been at the forefront of corporate efforts to tackle climate change. Its founding companies began participating in the Chicago Climate Exchange (CCX) and the Investor Carbon Disclosure Project (CDP) programme in 2006. Fibria has inventoried its greenhouse gases (GHGs) since 2005. In 2010, it became the first forestry company in the world to integrate carbon management across its supply chain through the CDP Supply Chain programme and participate on the Carbon Efficient Index (ICO2) from the Brazilian stock exchange, BMF&BOVESPA.

The carbon footprint concept has broadened in recent years, with increased efforts to measure and understand the hidden impacts of products (e.g. GHG Protocol, PAS2050). An increased interest in carbon footprint among countries, businesses and individuals has triggered a new demand for less carbon-intensive products. In response to these developments and opportunities, Fibria has pushed its greenhouse gases inventory to a new level.

Summary

Fibria´s work on carbon footprint disclosure has not only provided quantitative results. It has also helped to develop best practices derived from GHG Protocol and Intergovernmental Panel on Climate Change (IPCC) methodologies.

In its first assessment in 2008, Fibria used the widest boundaries it could identify, from the nurseries where seedlings are produced to the main international ports where Fibria's pulp is delivered. The company followed a wide understanding regarding what should be considered direct and indirect emissions.

Emissions from activities directly related to the pulp production process, regardless of whether these were carried out by Fibria or outsourced, are included as direct emissions. Employee commuting and business travel are also counted as direct emissions within Fibria's carbon footprint.

Indirect emissions cover logistical operations regarding final product transportation. In 2010, Fibria joined the CDP Supply Chain programme in an effort to engage its suppliers and, in the near future, to have a better measure of its real carbon footprint. Fibria is also concerned with how information is disclosed. This is important, as the subject is a complex one. Fibria presents flowcharts showing what is included, making it easier to understand and more transparent.

Carbon sequestration is also included in the carbon footprint assessment. The calculation is made considering the gain in mass of trees in Fibria's plantations, and the amount of carbon within this, converted to CO_2. Fibria´s carbon footprint for 2010 also included an estimate of carbon sequestration for conservation areas on its land, employing IPCC's standard sequestration factors. This effort is just beginning, and better results are expected in future.

Fibria has designated 38 per cent of its land area for preserving endangered habitats; estimating carbon dioxide sequestration for these areas will help to maintain this practice. Besides natural regeneration, Fibria is helping to restore hotspots identified by Conservation International.

In 2010, restoration of 2,800 hectares began, with investments of around R$6 million (US$3.8m). For 2011, Fibria's target is to recover 3,500 hectares.

These numbers shows the importance of developing methodologies to measure carbon sequestration within protected and restored areas to spread and increase conservation initiatives.

DIRECT EMISSIONS
FORESTRY OPERATIONS
PULP PRODUCTION
EMPLOYEE COMMUTING
BUSINESS TRAVEL

INDIRECT EMISSIONS
DELIVERING FINAL PRODUCT
ELECTRICITY FROM GRID

CARBON SEQUESTRATION
PLANTATIONS
CONSERVATION AREAS

FIBRIA'S CARBON FOOTPRINT

Case Study A

Fibria Forest Division

Fibria's carbon management programme

Challenges and difficulties

Today, Fibria´s challenges consist of:

- reducing the time required to produce the GHG emissions inventory
- reducing uncertainties within the annual data
- extending and measuring Scope 3 emissions (indirect emissions), up to the customer level
- setting feasible reduction targets.

Solving these issues will improve management capabilities and increase opportunities for further reducing GHG emissions.

An action plan is in place to solve these issues, including initiatives like the CDP Supply Chain programme mentioned above. It consists of a questionnaire for suppliers, covering a wide range of areas: governance, risks and opportunities, strategy, quantity and breakdown of emissions, and communication.

First year results showed varying levels of engagement by suppliers. Of 76 suppliers invited, 55 per cent answered the questionnaire. This is reasonable for the first year, but Fibria is committed to promoting carbon management throughout the supply chain. For 2011, 91 suppliers were invited.

Because of Brazil's political situation and uncertainties surrounding long-lasting and efficient initiatives to fight climate change, Fibria has postponed setting medium- and long-term targets for reducing emissions. It has, however, begun actions such as energy-efficiency programmes that have an immediate impact.

Outputs, results and lessons learned

In deciding to directly manage carbon emissions, Fibria wanted to raise the bar not only within its own operations but across the sector. Transparency when disclosing emissions, boundaries and calculations was a primary concern.

The company's eco-efficiency strategy has increased the focus on carbon. Although Fibria has not yet set formal reduction targets, departments are already working to tackle areas that have the largest impact on carbon footprint.

The carbon inventory has became a powerful management tool, and has improved dialogue with stakeholders, suppliers and customers. Results so far have motivated the company to develop its influence in the supply chain, expanding carbon management and climate change awareness in small, medium and large companies.

Fibria's carbon footprint calculations include its whole supply chain, right through to the customer.

Case Study

NEW GENERATION PLANTATIONS project

B | Forestry Commission Great Britain

Developing the Woodland Carbon Code

Background and drivers

The potential for woodlands to absorb CO_2 from the atmosphere while providing a host of other benefits for society and biodiversity is increasingly recognized in the UK. Many individuals and businesses wish to contribute to tree planting to help society soak up the carbon it emits. However, before investing in such projects, people want to be sure schemes will actually deliver the carbon savings that they claim.

The UK government is also interested in this issue, for two main reasons. Firstly, it wishes to ensure that the positive benefits of woodland creation don't become diminished by false claims about carbon savings. Secondly, it hopes to mobilize more private finance by increasing investor confidence. This will help to achieve the ambitious woodland creation targets that all four countries of the UK have set.

Through the Forestry Commission, the government has developed a Woodland Carbon Code to provide assurance in the voluntary carbon market.

Summary of the main code requirements

An accredited certification body, appointed by the independent UK Accreditation Service, will assess projects. Those that meet the code's requirements will be able to use the Woodland Carbon Code logo.

To do so, projects must:

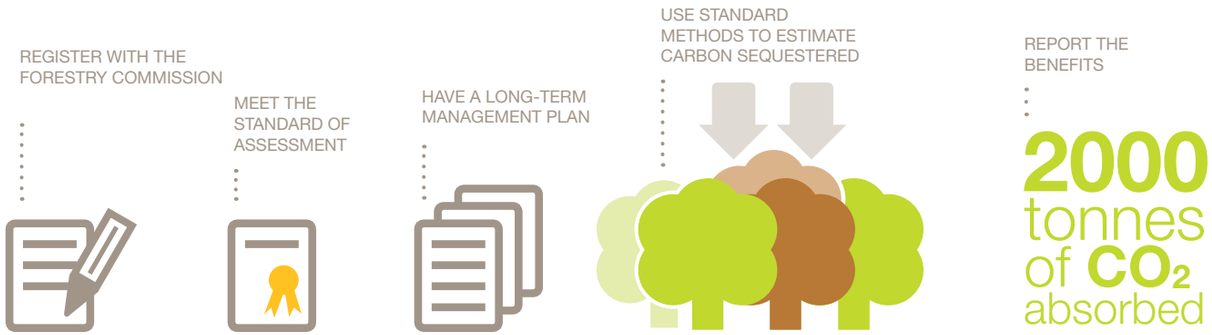
- be registered with the Forestry Commission, stating the exact location of the new woodland and their long-term objectives
- meet national forestry standards as set out in the UK Forestry Standard to ensure they are sustainably and responsibly managed
- have a long-term management plan
- use standard methods for estimating the carbon that will be sequestered
- demonstrate additionality – that they will deliver carbon benefits that wouldn't have happened otherwise.

Methodology

Projects must register with the Forestry Commission, then organize assessment by one of the accredited certification bodies. Projects will only be able to claim carbon benefits once these have been realized, although finance may be provided up front to help initiate a project. Other protocols such as long-term carbon sequestration averages have been built into the code, so timber can still be harvested without undermining the carbon claims.

The code also requires a rigorous assessment of additionality at project level. Finally, the code includes an agreed method for applicants to report the benefits they are providing to society, to help deal with any potential false claims.

HOW TO OBTAIN THE WOODLAND CARBON CODE



Woodland Carbon CO_2de

Case Study B

Forestry Commission Great Britain

Developing the Woodland Carbon Code

Governance

The code has been developed using a multi-stakeholder process with full public consultation. The Forestry Commission has provided the capacity to develop the technical requirements, and consulted on all main proposals before finalizing the code. Forest Research, the Forestry Commission's research arm, has been crucial in providing models and protocols to ensure carbon estimates are accurate and include a full account of emissions from tree establishment and other forest operations.

Challenges

Developing a voluntary code for the UK has been challenging for two main reasons. Firstly, there is the interface with the compliance market, where it's not possible to trade carbon credits generated in the UK. The code has had to be clear and firm about what claims are legitimate via a voluntary route. Secondly, the development has been very technical – both in the science of overall carbon savings and in finding robust ways to demonstrate additionality and permanence.

Results

The code was piloted through 15 woodland creation projects across the UK. This pilot exercise will enable certification bodies to be appointed, and firm up the requirements of the code. It was launched UK-wide in summer 2011.

Only after the code is up and running will it be possible to judge its success. The code is about regularizing an emerging market; ultimately, its success will be dictated by market uptake.

More private carbon finance will help to achieve the UK's ambitious woodland creation targets.

Case Study

NEW GENERATION PLANTATIONS project

C | Masisa, Forest Division

Methodology for carbon capture quantification in forest plantations

Background and drivers

Grupo Nueva, the company which controls Masisa, acknowledges the critical importance of climate change. Masisa helps reduce greenhouse gases by using energy from burning biomass, continuously reducing the use of fossil fuels and improving the energy efficiency of its processes. It also promotes carbon sequestration by the forest plantations and native forests it owns.

In 2006, Masisa made a commitment to:

- continue improving the energy efficiency of its generation processes and product transportation, in both industrial and forest areas
- initiate cogeneration projects, improve its energy efficiency, and sequester more carbon in its plantations and forests, through the Clean Development Mechanism (CDM) and voluntary markets such as the Chicago Climate Exchange (CCX)
- communicate the benefits of these actions to Masisa clients and a wider audience.

In December 2006, Masisa entered the CCX voluntary carbon market. The company considers the carbon market mechanism can help it achieve its commitments for reducing greenhouse gas emissions, be a leader in the forest sector and improve its triple bottom line (economic, environmental and social).

Project summary

Masisa developed a methodology for valuing the carbon sequestered by its forest plantations in Chile, Argentina, Brazil and Venezuela. The model is largely based on information and tools the company uses already. This information is verified annually for the plantations' FSC certification, so this was a great support for developing the methodology, and for subsequent verification or external auditing for the CCX.

The model uses the company's internal information, which has been prepared to a high standard of accuracy. This information starts with mapping the company's plantations, to calculate the size of each management unit or stand. This is linked with other plantation attributes at a stand level (e.g. forest species, year of plantation, soil productivity, site index), forest management, and stock and growth projections based on each unit. At this stage, it is especially useful to have IT tools such as geographical information systems (GIS), growth simulators and database management systems.

Every 31 December, using the information and tools already mentioned, Masisa estimates the stem biomass of its stock at stand level for all plantations to be included in its carbon calculations. The year 2002 is used as a baseline to determine the growth in stock. Using other studies to determine the average dry density of each species and their wood carbon content, it is possible to convert the estimated biomass stock into estimated carbon stock. This can then be used to calculate the CO_2 absorbed.

The difference between this value each year gives the total amount of CO_2 sequestered annually, once harvests, fires, losses due to disease, stumpage sales and other factors have been taken into account.

FSC certification helps Masisa verify the carbon absorbed by its plantations.

Case Study C

Masisa Forest Division
Methodology for carbon capture quantification in forest plantations

Challenges and difficulties

One of Masisa's short-term challenges in estimating the CO_2 captured by its plantations more accurately is to include biomass from branches, leaves and roots. This is expected to substantially increase the estimated amount of carbon sequestered.

A long-term challenge is to find a way to measure and incorporate the way wood is used after harvest. Current methodology suggests that captured CO_2 immediately returns to the atmosphere once the wood is harvested. In fact, wood products may store carbon for many decades. Equally, they can reduce greenhouse gas emissions when they are used in place of less energy efficient materials such as cement, steel and plastic. Quantifying these benefits, however, remains a major challenge.

In the forestry field, there are further important challenges. High density plantations have a high volume of biomass and therefore carbon capture; however, this affects water levels (through rain interception and water consumption) so this trade-off needs to be managed carefully in areas where water supplies are limited. Masisa favours planting trees at a lower density, using waste and commercial thinning.

Outputs, results and lessons learned

The results from 2003 to 2010 showed that Masisa's forest plantations are a highly efficient way to capture carbon. Combined with the efforts to reduce energy consumption and industrial CO_2 emissions, they are an important tool for neutralizing the industry's carbon impact.

As well as neutralizing the company's carbon emissions, Masisa's plantations generate a significant volume of additional CO_2 reductions. These can be traded on the voluntary carbon market.

Unfortunately, the CCX closed in 2010, before Masisa could trade its carbon credits. This was largely due to the lack of commitment from the US to tackling climate change, meaning a mandatory carbon trade market failed to develop. The financial crisis of 2008 also led to a dramatic drop in carbon prices.

However, the measurement process helped Masisa achieve important goals. It has reduced the company's energy use, given it knowledge of the total carbon footprint of all its processes (industrial and forest) and helped it achieve a leading position among other forest companies in this area.

Measuring carbon stored in wood products is a long-term challenge.

Case Study

NEW GENERATION PLANTATIONS project

D | UPM Tilhill

Using the voluntary carbon offset market to fund native woodland creation

Background and drivers

UPM Tilhill is a private forest industry company which creates new woodland throughout the UK. The company identified an opportunity to plant a new native woodland which would provide a link between semi-natural habitats around Loch Ken and substantial forestry plantations, offering environmental benefits.

Although financial support was available from the Forestry Commission, the state forest organization, the level of funding was not sufficient to enable such a project to proceed. So UPM Tilhill approached Forest Carbon, a broker in the voluntary carbon offset (VCO) market, to investigate the potential for top-up funding.

Forest Carbon confirmed that the proposed project met their criteria. They offered funding from one of their clients, a car insurance company that offers to offset its customers' vehicle emissions.

Summary

UPM Tilhill planted a new 57-hectare native woodland at Ken View, beginning in April 2010, following current best practice. Early growth and survival has been excellent.

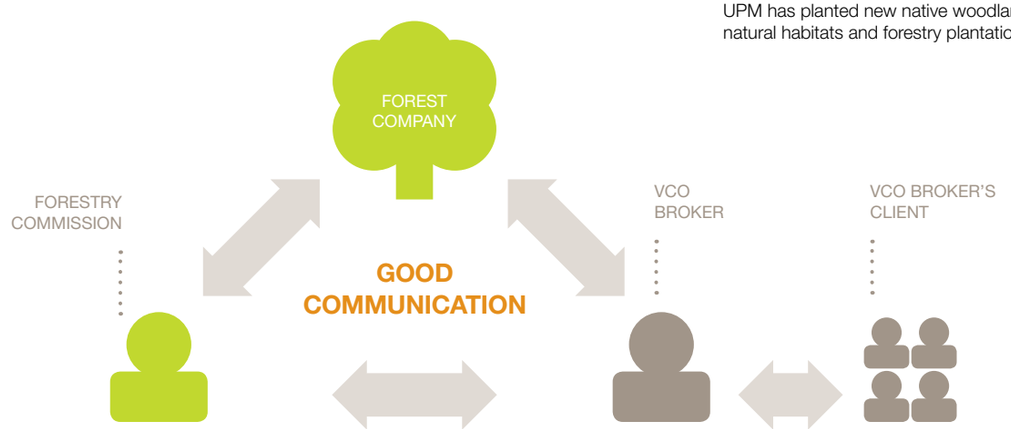
The funding package included Forestry Commission capital grants, payable through the Scottish Rural Development Programme (SRDP), with top-up funding from VCOs.

Best management practices

UPM Tilhill has significant experience in creating new native woodland, so this in itself was not a challenge. The key to delivering the project was building a viable funding package and identifying an investor prepared to implement it.

Such projects include significant risks. When the land is purchased, there is no guarantee that expected funding contracts will be issued. A key success factor is the ability to keep all parties fully informed and involved in the project and to meet the objectives of each party.

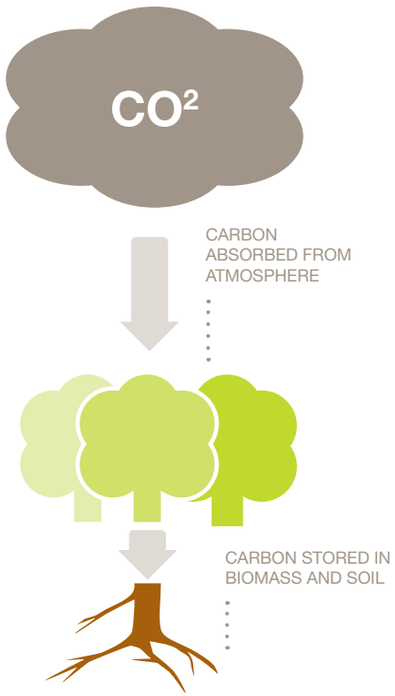
UPM has planted new native woodland linking semi-natural habitats and forestry plantations.



Case Study D

UPM Tilhill

Using the voluntary carbon offset market to fund native woodland creation



Challenges and difficulties

The key challenge on this project is the level of uncertainty and bureaucracy surrounding the funding. The difficulties associated with obtaining funding through SRDP are widely appreciated within the UK forest industry. However, carbon funding also brings significant challenges:

- **Measuring carbon sequestration**
  In initial discussions, one of the main concerns was how to calculate the levels of carbon sequestered in the future. This is not surprising, as the techniques were not well developed at the time. UPM had to develop a procedure for calculating carbon sequestration from scratch; this has since formed the basis for the standard methodology in the Forestry Commission's **Woodland Carbon Code**. Although there is scope for refining these calculations, the method adopted is logical, repeatable and readily audited.
- **Dealing with "additionality"**
  The VCO market is based around the concept that any planting which it supports must be "additional" – that is, it would not have happened otherwise. Carbon brokers want this to be demonstrated beyond any reasonable doubt for each project. Project managers understand this sentiment and are happy to demonstrate it in their applications. However, as the market develops, further tests continue to be added. Because of the small size of most carbon projects, such tests have a significant financial impact.
- **Dealing with timber production**
  Most VCO contracts don't appear to allow timber production during the contract period and seem to be designed to discourage any timber production from the site beyond the contract period. No carbon funding is available for productive conifers.

  As the market for VCOs increases, demand is growing for larger sites. On such sites, timber production has an important role to play in managing habitats, providing rural employment and providing a sustainable supply of raw materials. However, VCO purchasers appear to believe that timber production is "a bad thing" and that it makes carbon sequestration harder to prove or calculate. This ignores the role timber production plays in sustainable woodland management. It also ignores the potential of timber itself in reducing carbon emissions by substituting for non-renewable building materials or fuels. In a world of finite resources, will our great-grandchildren thank us for the 100-year VCO contracts we sign today?
- **The Carbon Code**
  Ken View is one of the trial sites for the Woodland Carbon Code which the Forestry Commission is developing. The code is thorough and rigorous, and has the potential to transform the voluntary carbon market in the UK by making projects "mainstream".

  There is a risk that the code could add to the administrative burden of VCO projects. However, it already overlaps significantly with other requirements, and it should be possible to ensure that where this occurs (e.g. with SRDP contracts) the administration is not replicated.

Outputs, results and lessons learned

Ken View is an example of a successful VCO project and shows the potential of funding from the voluntary carbon market.

However, UPM's experience of the process has shown that issues remain in developing the VCO market to fund woodland creation.

The money raised by VCOs should be used to deliver good quality projects on the ground. Unfortunately, there is a real risk that money will be spent on auditing and application processes.

The challenge for the VCO market is to spend money on trees, not paperwork.

Case Study

NEW GENERATION PLANTATIONS *project*

E | Veracel Celulose

Forest restoration, carbon storage and income generation: Monte Pascoal – Pau Brasil Ecological Corridor

Background and drivers

Alongside its own rainforest restoration programme, financed and conducted by the company, Veracel facilitates and supports a rainforest restoration project financed by the carbon market. The project involves several NGOs in southern Bahia state in Brazil, where Veracel's pulp mill and its fast-growing eucalyptus plantations are also located.

Project summary

The project, The Monte Pascoal–Pau Brasil Ecological Corridor, aims to restore Atlantic rainforest on suitable areas belonging to local land owners, especially cattle ranchers. The project goal is to connect isolated fragments of the Atlantic Rainforest and form a native forest corridor between two national parks, Monte Pascoal and Pau Brasil.

The project supports social development in the region by providing concrete jobs and income opportunities for the local community. A local cooperative, Cooplantar (Cooperative of Reforestation Workers of Far Southern Bahia), carries out the practical planting and restoration work.

There are several ongoing ecological corridor projects in Brazil. Success depends strongly on how they are financed. All ecological corridor projects are carried out within the broader governmental effort to find resources to connect rainforest fragments in coastal Brazil.

Best management practices

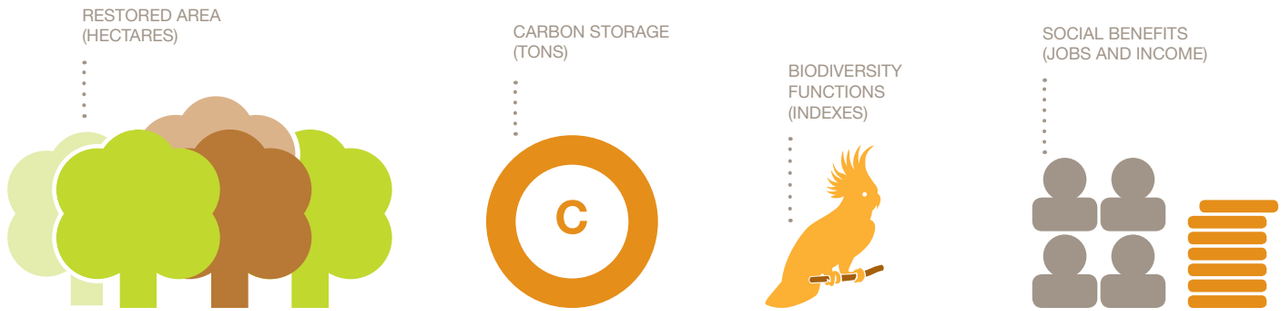
The Monte Pascoal–Pau Brasil Ecological Corridor project follows state-of-the-art procedures, according to the methodology of the Atlantic Forest Restoration Pact. These procedures cover seed collection techniques, seedling production guidelines, soil preparation, planting and all maintenance activities.

The project complies with the Gold Level Standard of the Climate, Community and Biodiversity Alliance (CCB), a partnership of international NGOs and research institutes. The certification gives assurance that international standards are applied and monitored.

Selecting the best locations for restoration involves a number of criteria also adopted by the CCB Gold Level. The performance is measured through restored area (in hectares), carbon storage (in tons), biodiversity functions (indexes) and social benefits (jobs and incomes).

From the social perspective, local communities are encouraged to form cooperatives, associations or small companies, and provided with technical and managerial training. These organizations comply with Forest Stewardship Certification (FSC) standards, which means they can provide services for FSC-certified companies such as Veracel. This has also increased skills and management capacity in the region. Veracel's role has included facilitating contacts between tree farmers and NGOs and providing financial support to Cooplantar´s training programme.

HOW THE PERFORMANCE OF RESTORATION PROJECTS IS MEASURED



Case Study E

Veracel Celulose

Forest restoration, carbon storage and income generation: Monte Pascoal–Pau Brasil Ecological Corridor

Challenges and difficulties

During the two years of the project, major development steps have been required from all the project partners.

The first challenge was to comply with the CCB Gold Level Standard. The biggest subsequent challenge has centred on rainforest restoration agreements with local land owners. These agreements must be long term (30 years). Ongoing political debate surrounding the National Forest Law, which may result in changes to conservation area laws in Brazil, affected the negotiations. The possible revision of the law created uncertainty among land owners regarding areas that are suitable for rainforest restoration.

A third challenge has been the price of carbon offsets in the voluntary market. The carbon price has not covered the rainforest restoration costs. The project participants have added to the financing with other fundraising strategies, including donations and complementary projects.

Outputs, results and lessons learned

So far the Monte Pascoal–Pau Brasil Ecological Corridor project has given rise to four commercial carbon credit contracts. The sold carbon credits are leading to the replanting and restoration of 318 hectares of rainforest.

The project has directly generated 45 local jobs at the Cooplantar cooperative.

The rainforest restoration includes native seed collection in the region's preserved rainforests, seedling production at the nursery, soil preparations, planting of native seedlings and manual weed control (without use of herbicides) on the restoration areas.

The planting and restoration work creates jobs for local people.

Case Study

NEW GENERATION PLANTATIONS *project*

F | China Green Carbon Foundation

Using voluntary carbon offset funding to develop forests for bioenergy

Background and drivers

China is gradually moving from an energy-intensive economic development model to a low-carbon economy. The Chinese government promotes afforestation as a key strategy for climate change mitigation, and is increasing efforts to speed up the pace of plantations nationwide. The funding for afforestation is mostly from government budgets. Over the past few years, and in response to government calls to increase forest carbon, the industrial sector in China has been looking for innovations in corporate social responsibility and new investment opportunities.

In July 2007, as a bridge between the Chinese government and the private sector, China Green Carbon Foundation (CGCF – previously known as China Green Carbon Fund), was initiated. The co-sponsors include China National Petroleum Corporation (CNPC), State Forestry Administration (SFA) and Sino-Forest Corporation Canada.

CGCF has raised US$60 million for developing forests for bioenergy and carbon, and other related projects. Carbon sequestration in plantations is recorded in the corporate social responsibility accounts of donors on CGCF's website. CNPC, the biggest donor up to now, has donated US$40 million, which will be mainly used for developing bioenergy plantations.

The jatropha bioenergy forest plantation in Yunnan is one of the demonstration projects funded by CGCF. The growing trees sequester carbon, while also producing oily seeds which can be used as an alternative biofuel.

With the successful implementation of these projects, more and more individuals and enterprises are donating to CGCF to offset their own carbon emissions, whether from day-to-day activities or agricultural and industrial processes.

Summary

The Yunnan bioenergy plantation was established in 2007 and 2008, with funding of US$1.2 million coming solely from CGCF. A forest area of 22,083 hectares of *jatropha curcas L*. was planted in nine counties around the cities of Yuxi, Chuxiong, Lijiang and Xishuangbanna, in Yunnan province. Local governmental forestry agencies have contracts with CGCF to manage the plantations.

Case Study F

China Green Carbon Foundation

Using voluntary carbon offset funding to develop forests for bioenergy

Best management practices

Professional afforestation companies planted the woodland, strictly following the best practice standards of the National Technical Regulations on Afforestation (GB/T15776-2006) issued by the SFA. Independent field inspections authorized by CGCF in 2009 showed seedlings to have a 73 per cent survival rate, which is better than the regulations require.

In order to reduce greenhouse gas (GHG) emissions and maximize carbon sequestration, the disturbance rate to the woodland was kept below 10 per cent during site preparation. All GHG emissions from establishing the plantation were recorded and deducted from the carbon sequestration account.

Estimating carbon sequestration

CGCF assigned the carbon accounting and monitoring of Yunnan's bioenergy forest project to Kunming Survey and Design Institute of SFA (Kunming Institute) in 2007; the crediting period of the project is 20 years. The Kunming Institute's methodology is based on CGCF's guidelines on carbon accounting and monitoring of afforestation projects. It involved collecting all project design documents, a field investigation of the plantation sites, and analyzing the baseline of the project in 2007 and 2008. It established a growth model for *jatropha curcas L*. to estimate the potential carbon to be sequestrated. This worked out at approximately 1.41 million tons of CO_2 equivalent over the next 20 years.

Challenges

Jatropha seeds provide a source of renewable biofuel. However, there is a lack of manufacturers to process this oil. Further investment is needed for a local processing plant.

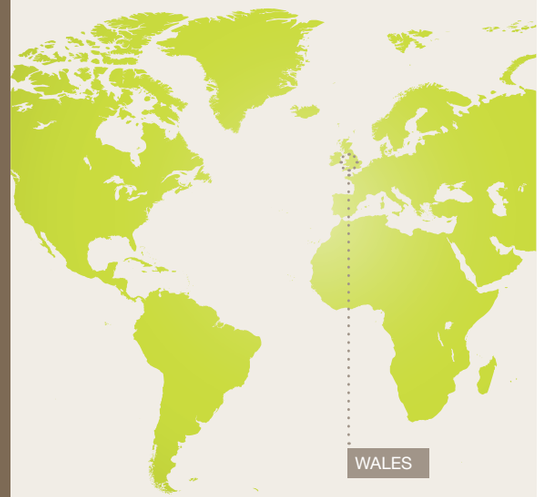
Increased demand for jatropha oil would provide a sustainable income for farmers, and increase their motivation to manage the plantations.

Jatropha plantations in China provide carbon storage, bioenergy and local jobs.

Case Study

NEW GENERATION PLANTATIONS project

G | Forestry Commission Wales
Supply of biomass to Western Bio Energy



Background and drivers

Forestry Commission Wales is the Welsh Government's Department of Forestry. Its role is to promote sustainable management of woodlands to increase their value to society and the environment. It also manages 125,000 hectares of woodland on behalf of the Welsh Government.

In 2002, a number of traditional virgin wood fibre markets in Wales and just across the border in England increased their use of recycled wood fibre as their primary raw material. This led to a fall in both the value of and the demand for smaller diameter round timber, especially in South Wales.

Forestry Commission Wales invited business proposals in an effort to promote new or alternative markets. One proposal came from Western Bio Energy Ltd, which operates a 10MW biomass power plant near Port Talbot, South Wales. This led to a 12-year supply contract between Forestry Commission Wales and Western Bio Energy for up to 66,000 tonnes of wood fibre per year. From the start, there was a fundamental commitment to making sure that the supply of biomass was sustainable, following the UK Forestry Standard and Forestry Commission Wales's forest certification.

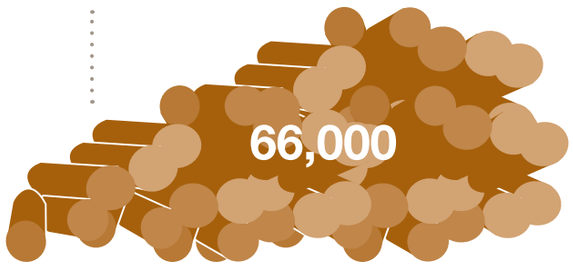
Supply of certified biomass

All of the wood fibre supplied by Forestry Commission Wales under its contract with Western Bio Energy is certified by the Forest Stewardship Council (FSC) and PEFC. Forestry Commission Wales uses its operational and programme planning system to identify what fibre to use, and to ensure that:

- timing and scale of forest operations minimize environmental disturbance
- appropriate harvesting methods minimize damage to soils and water
- operating methods reflect site sensitivities, retaining living and dead trees, clumps, patches, buffers and corridors
- brash harvesting is managed according to the Forestry Commission's "Guidance on Site Selection for Brash Removal". This informs site selection, and timing and quantity of brash and stumps to be recovered.

Bioenergy has provided a new market for smaller diameter timber in South Wales.

TONNES OF WOOD FIBRE SUPPLIED PER YEAR



Case Study G

Forestry Commission Wales
Supply of biomass to Western Bio Energy

Management practices

The "Guidance on Site Selection for Brash Removal" has been developed to ensure that brash recovery – seen as a new forest operation – meets the requirements of sustainable forest management. It has established best practice protocols for both site assessment and operational practice. Brash is only recovered from sites where the risks are considered manageable. The following factors are taken into consideration:

- machine traffic causing physical damage to soil such as compaction, rutting and erosion, leading to increased turbidity and siltation of local watercourses
- removal of essential nutrients (nitrogen, phosphorus and potassium) and carbon in brash residues, leading to lower soil fertility, potential loss of tree growth in subsequent rotations, and reduced soil carbon storage
- removal of base cations (calcium, magnesium, sodium and potassium) reducing soil buffering capacity and leading to increased acidification of soil and stream water.

The risk of damage depends on site sensitivity; on many sites it can be effectively controlled by good planning and forest management. The Forestry Commission has produced a number of guides on good practice:

- Whole-Tree Harvesting: A Guide to Good Practice (1997)
- Forests and Soil Conservation Guidelines (1998)
- Forests and Water Guidelines (2003)
- Protecting the Environment during Mechanised Harvesting Operations (2005)
- Managing Brash on Conifer Clearfell Sites (2006).

The guidance adopts a relatively broad-brush, precautionary approach. It recommends avoiding the removal of brash residues in potential acid-sensitive areas and on all nutrient-poor soils (where poor fertility may limit tree growth).

The guidance enables managers to allocate sites to a risk category based on physical characteristics, then follow the appropriate best practice.

Risk category with recommended good practice measures to control risk

Low
Normal good practice

Medium
Brash baling and brash removal should be limited to largely needle-free brash (<20% needles remaining), except on groundwater gley soils, where fresh brash can be removed. Brash removal should be restricted to dry periods unless it involves secondary extraction, which can be done in wet periods. Enough brash needs to be retained on site and extraction routes to protect soils from machine traffic.

High
Removal of brash is unlikely to be sustainable and should generally be avoided. Could be considered if nutrients and/or base cations are replaced via remedial treatments such as applying limestone or wood ash (none needed on Juncus bogs), subject to an assessment of suitability, cost-effectiveness and sustainability. Enough brash of adequate strength must be retained to protect soils from machine traffic.

Case Study G

Forestry Commission Wales
Supply of biomass to Western Bio Energy

The critical role of sustainable forest management

The UK Forestry Standard (UKFS), first published in 1998, provides a comprehensive statement of the UK government's approach to sustainable forestry. It explains how the UKFS will be delivered in practice, and defines the criteria and indicators of sustainable management for all forests in the UK. These are linked to the developing international protocols for sustainable forestry.

The UKFS also forms the basis for the UK Woodland Assurance Standard (UKWAS). This provides a voluntary national standard of responsible forest management, supported by forestry, environmental and social organizations and by the government. UKWAS requires forest managers to comply with the law and certification standards on:

- management planning
- woodland design: creation, felling and replanting
- operations
- protection and maintenance
- conservation and enhancement of biodiversity
- the community
- forestry workforce.

In 1999, the woodland Forestry Commission Wales manages on behalf of the Welsh Government was certified as meeting the highest international environmental, economic and social standards, as set by the FSC/PEFC. Certified status is maintained with an annual independent audit.

Outputs, results and lessons learned

Forestry Commission Wales can meet its long-term contractual commitment to supply biomass for bioenergy sustainably. The material it supplies carries the FSC/PEFC label, demonstrating that it's a product of woodland managed to the highest standard.

Long-term management plans, which allow Forestry Commission Wales to estimate its future production levels, are essential for entering into such a long-term supply contract.

The Forestry Commission has produced guidance on sustainable brash removal.

Case Study

NEW GENERATION PLANTATIONS *project*

H | UPM Tilhill

Developing sustainable stump harvesting guidelines for the UK

Background and drivers

UPM recognizes climate change and its potential impacts as serious threats. It aims to develop its business to mitigate those impacts and contribute to government targets for renewable, low-carbon energy sources. Woody biomass can be a sustainable source of energy and a valuable renewable alternative to fossil fuels.

As UPM's paper mills use large amounts of electricity, the company has invested heavily in developing sustainable energy to minimize its dependence on fossil fuels. Its energy portfolio is dominated by CO_2-neutral energy sources, and UPM aims to become a major player in the production of second generation advanced biofuels. To date UPM has built 13 modern biomass-based combined heat and power plants, greatly reducing its fossil fuel consumption. UPM Tilhill manages the supply of energy wood for the UK plants.

BIOMASS COMBINED HEAT AND POWER PLANTS BUILT BY UPM TO REDUCE FOSSIL FUEL DEPENDENCE.

Summary

New biomass sources are needed to meet increasing demands for woodfuel in the UK. Scandinavian experience shows that harvesting the stumps can generate additional biomass when trees are felled. This is, however, a new operation for UK forestry.

The key aim of the project was to develop operational guidelines for stump harvesting. Three trial sites were established in Scotland during 2008. The project was guided by a multidisciplinary team within UPM and through engagement with external regulators (including the Forestry Commission – an NGP partner), Scottish Environment Protection Agency, UK Woodland Assurance Standard (UKWAS) auditors, and competitors. Running parallel was a UPM-funded literature review at Bangor University, *Stump Harvesting for Bioenergy – A Review of the Environmental Impacts.*

The trial sites covered a range of soil and slope conditions as well as historic crop management. They are described as first or second rotation commercial Sitka spruce plantations established on unimproved hill ground. All sites were clearfelled at around 40 years old and are FSC- and PEFC-certified under the UKWAS standard.

UPM engaged stump harvesting operators on the trial sites, who worked to a pre-determined environmental matrix. This involved establishing buffer zones around riparian areas, standing deadwood, semi-natural habitats, natural reserves and long-term retentions. The creation of these buffer zones meant that stumps could be harvested from no more than 60–70 per cent of any one felling site.

Stump harvesting guidelines seek to minimize adverse impacts on soil, carbon, water and biodiversity.

Case Study H

UPM Tilhill

Developing sustainable stump harvesting guidelines for the UK

Best management practices

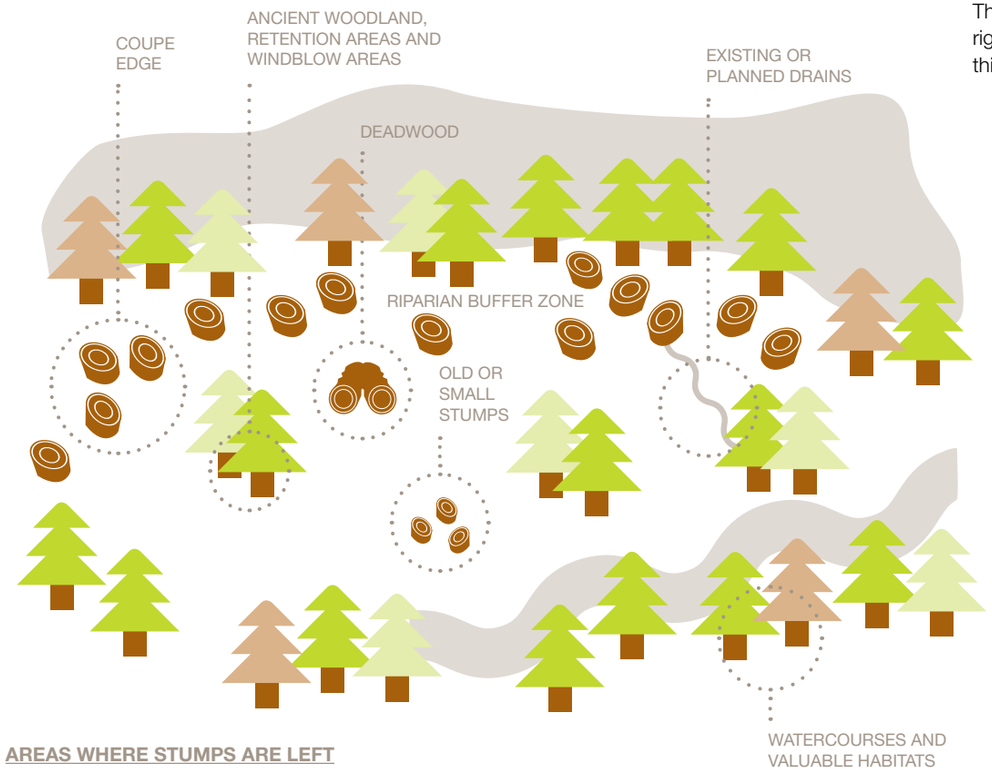
The stump harvesting trial sites informed the development of best practice guidance. This guidance ensures that stump harvesting is planned and carried out in a manner that is compatible with sustainable forestry practice. This includes identifying suitable sites and minimizing adverse impacts on soil, carbon, water and biodiversity. Crucially, the guidance also identifies opportunities related to renewable energy, forest health, site preparation and habitat restoration, and is acceptable under UKWAS.

Challenges and difficulties

There were three main challenges. Firstly, there were widely held negative perceptions among key stakeholders about the impact of stump harvesting on the environment. Involving these key stakeholders in the project meant it was planned and implemented in a methodical way, adhering to existing regulations, and allowed for common learning and development.

Secondly, as this was a new operation in the UK, there were challenges with the economics of integrating stump harvesting into conventional felling, ground preparation and logistics operations. The trial sites were instrumental in getting the costs right and building up a competent resource to carry this work out.

Finally, involving competitors had much risk attached, especially in a situation where new businesses are rapidly being developed. However, this was crucial to achieving a UK-wide protocol acceptable to the authorities and the whole private sector.



AREAS WHERE STUMPS ARE LEFT

Case Study H

UPM Tilhill

Developing sustainable stump harvesting guidelines for the UK

Outputs, results and lessons learned

The main output was a set of operational guidelines which promote sustainable harvesting of biomass for energy under UK conditions. These encourage a risk-adjusted and evidence-based approach. The UK forestry regulator considered it to be "a good example of self-regulation" and used the lessons learned in drafting its own advice on stump harvesting. The guidelines were also adopted by two of UPM's competitors.

UPM has produced training and briefing materials for site managers/operators as a result of the trials. These are essential to ensure that the requirements are fully understood and disseminated.

There are several important lessons. The need for a fully functioning cross-disciplinary team within UPM allowed for the sharing of experience and expertise. Involving key external stakeholders ensured the trials remained fully compliant with UK forestry and environmental legislation.

A key operational lesson (in the UK context) is that few sites can accommodate both brash and stump harvesting. This is because brash is required to prevent soil damage during clearfelling and stump harvesting operations. Indeed, the time between clearfell and stump harvesting should be kept to a minimum to ensure fresh brash.

More lessons are likely to be learned as UPM continues to monitor the impact of stump harvesting at the trial sites. Issues include the incidence of Hylobius attack on new crops and whether the increased soil disturbance will lead to problems with weeds or, conversely, improved woodland establishment rates. UPM and the Forestry Commission are co-funding a PhD student to investigate the impact of stump harvesting on soil structure.

Forest Research (the research arm of the Forestry Commission) is also looking at the issue of soil carbon loss as a result of stump harvesting, and the main reason that the guidance recommends avoiding harvesting stumps from very organic soils. Current research will continue to determine the long-term viability of stump harvesting as a source of bioenergy.

New biomass sources are needed to meet increasing demands for woodfuel in the UK.

Case Study

NEW GENERATION PLANTATIONS *project*

I | Veracel Celulose
Bioenergy generation

Background and drivers

Like any other modern chemical pulp mill, Veracel's pulp mill generates a surplus of electricity from wooden biomass. Veracel, a joint venture of Stora Enso and Fibria in southern Bahia, receives renewable raw material from its fast-growing eucalyptus plantations close to the mill.

More precisely, the main energy source for the pulp mill's bioelectricity comes from organic matter called black liquor, a by-product of the pulp-making process. Black liquor consists of water, pulp-cooking chemicals and organic matter derived from wood. The pulp-cooking chemicals are separated and reused, while the organic matter is burned in the mill's boilers to run the turbines and generate electricity.

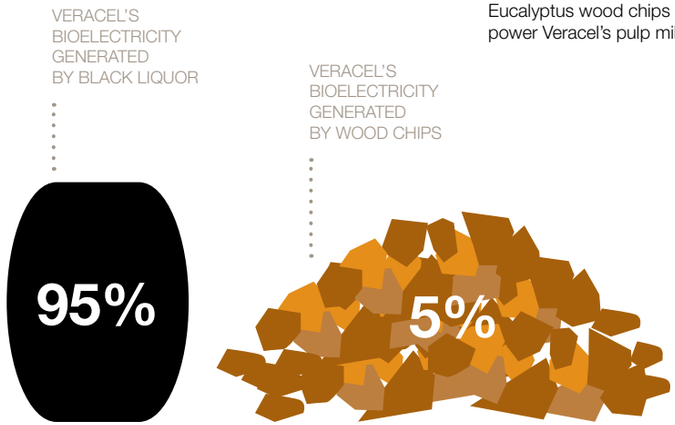
Project summary

Veracel has supplied electricity to the national grid in Brazil since 2006. The decision on whether to buy, produce or sell electricity is based on comparing the spot energy price to the biomass cost.

In the Brazilian electricity market, hydropower plays a main role. Seasonal variation in rainfall means that, during some months of the year, the supply of hydropower declines, and the demand on alternative electricity sources goes up. Veracel's electricity supply helps to balance the energy mix. The pulp mill curbs CO_2 emissions by reducing the use of fossil fuels, as most of the complementary electricity supply in Brazil comes from oil and gas plants.

Veracel also uses wood chips to generate electricity. Black liquor fuels around 95 per cent of Veracel's bioelectricity and wood chips around 5 per cent.

Eucalyptus wood chips and other by-products help to power Veracel's pulp mill.



Case Study I

Veracel Celulose
Bioenergy generation

Best management practices

Veracel's renewable raw material comes from fast-growing eucalyptus plantations – using native tropical forest is not any kind of option. Instead, the company actively preserves and restores native tropical forests in the areas it operates.

Today, Veracel owns around 210,000 hectares of land in the south of Bahia. It has planted close to 91,000 hectares with eucalyptus and more than 105,000 hectares are set aside for preservation.

The remaining area either consists of infrastructure (for example, roads and the nursery) or is available for planting eucalyptus.

Harvesting operations on tree plantations produce biomass residues that could be used for bioenergy generation. However, Veracel leaves bark, branches, stumps and leaves on the field to protect the soil's physical properties and to reduce nutrient losses. Only debarked logs are transported to the mill. The decomposable organic material left within the plantation is important in the humid tropics, where soil nutrient pools are often poor due to high temperatures and precipitation.

Challenges and difficulties

Apart from the biomass that preserves the soil surface on plantations, other by-products could be used for energy purposes. These are mainly wasted fibres from the mill's dry machine screening system and bark that remains on the logs after mechanical debarking during harvesting. After natural water removal, they could work as an additional bioenergy feedstock in the mill. However, instead of electricity generation, they are currently processed into bio-fertilizers and reused in Veracel's plantations during the planting of new trees.

Outputs, results and lessons learned

Veracel wants to constantly monitor and revise its processes in order to identify both bottlenecks and opportunities in bioenergy generation.

Bioelectricity is important for Veracel and helps the company reduce its energy costs. It also brings additional revenues when sold to the national grid. On top of this, substituting electricity generated by fossil fuels with bioelectricity prevents CO_2 emissions.

Despite Veracel's own electricity surplus, the mill still needs some fossil fuels in its processes, mainly related to preparing the "white liquor" used in the pulp-cooking process. The most viable solution to reduce Veracel's CO_2 emissions originating from fossil fuels is to substitute the use of heavy/residual oil in the lime kiln by less polluting natural gas. This will happen when Veracel is connected to the national gas pipeline by July 2011.

Wood gasification technology is a future opportunity in the forest industry. When wood gasification becomes feasible, operational and safe on large-scale operations, Veracel may be able to produce even more renewable bioenergy from eucalyptus within its processes.

Veracel uses fast-growing plantations for its raw materials while conserving native tropical forest.