Growing the Future

Exploring new values and new directions in the Forest, Paper & Packaging industry.

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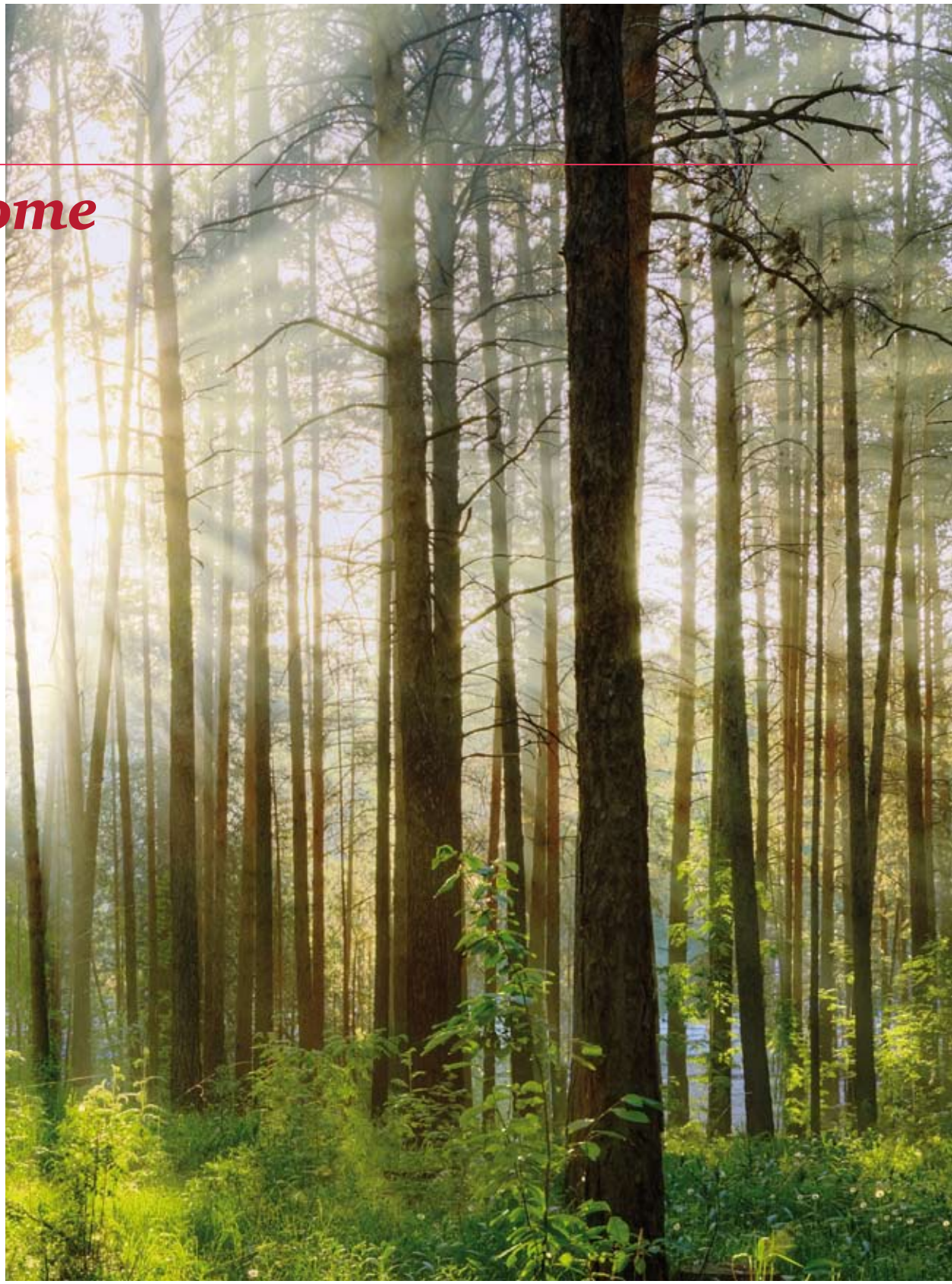
Welcome



We spend a lot of time talking to forest, paper and packaging (FPP) executives, and most of them believe their industry is changing dramatically. Some segments, like newsprint, are experiencing a truly structural decline; others are flat in some mature markets, but booming in emerging markets. And technology looks set to redefine what's possible across the value chain, from raw materials to consumer packaging.

In 2010 we published our third CEO Perspectives report, based on interviews with many of the industry's top executives. Thirty industry leaders told us how they believe the industry is changing, and some of the things they're doing in response. This paper continues the conversation by sharing some of our own thinking on major trends in the industry.

One of the most important themes that emerged from the last Perspectives was the idea of "deriving more value from each tree." An integrated process which includes pulp and paper-making together with energy generation, and potentially the production of chemicals or bio-fuels, uses all the various components of wood. That potentially means more economic value. New research in areas like nanotechnology may be able to use the natural properties of wood molecules more effectively – again, creating value. Innovation around products isn't just incremental – in some cases, it has the potential to create entirely new markets and re-shape the demand picture.

We see significant potential for forest product companies to benefit from extending the boundaries of what products (and by-products) the FPP industry produces, and how it does so. Executives will need to take a close look at their company's business model and consider where they can best compete in the value chain. Most companies won't be able to succeed on their own. They'll need to form alliances with other parties who may have better access to capital, experience in new markets like energy distribution, or research competence in areas like molecular chemistry. Finding good partners should help generate new, sustainable and profitable revenues – provided the right strategic choices are made in order to generate a respectable return on investment.

The world's forests aren't only a source for products – they also have enormous value as ecosystems which help regulate the world's climate and protect biodiversity. Many companies in the industry are already actively balancing conservation and production. But regulation might change the rules. Last year many CEOs told us they fear that regulation might create an uneven playing field for various companies using forest products. While the regulatory picture is still uncertain, one thing is for sure: competition for wood fibre – one of the world's most renewable resources, but not an infinite one – will be fierce.

In this short report, we take a look at how technology, competition for fibre and evolving value chains (including new collaborators and competitors) are redefining the possibilities for FPP companies, and briefly consider how business models may change in response. We believe that the FPP industry will need to both draw upon old strengths, like its considerable talents in forest and fibre management, and improve capabilities, for example around innovation and R&D, to make sure it gains full benefit from these developments.

Clive Suckling
Global Forest, Paper and Packaging Leader

Executive summary

FPP companies can and must change in fundamental ways over the next two decades in order to build a strong, profitable and sustainable industry for the future. In our view, several key factors will shape the sector's direction, including technology, fibre competition, changing industry structures (and new players/partners) and regulation. To adapt, FPP business models will need to change too.

Advances in technology

The internet, e-mail and electronic invoicing, e-book readers – these are all technologies that threaten demand for paper products over the long-term. At the same time, though, advances in technology will open up a whole range of new uses for paper, paper packaging, and fibre itself. Engineered wood is already transforming uses in residential construction and opening up possibilities for more use of wood in commercial construction. New possibilities like embedded sensors will open up more specialised uses for paper.

Improved bioproducts and biofuel production techniques will have a dramatic impact on how cost effective such fuel and chemical sources are – and if costs come down, demand for fibre for these uses will go up accordingly.

Technology also has the potential to increase both forest yields and production efficiency all across the value chain, but the gains are likely to be incremental rather than radical over the next twenty years. We believe that technology will impact demand trends dramatically and quickly – the supply side will change more slowly.

There is an urgent need for industry to take the lead, rather than wait for political agreement. The success of certification schemes shows that voluntary efforts can have a big impact.

Competition for limited fibre

The forest value chain is shifting. While demand for many types of paper will decline, particularly in mature markets, demand for a wide range of other uses for fibre will grow – and might possibly explode. Taken together, we believe that demand will outpace supply and we see increasing competition for fibre as a key shaping factor for future supply chains. There are two aspects to this. Firstly, pressures to shift to more sustainable products will make forest resources increasingly valuable. At the same time, finding the appropriate balance between production and conservation could become challenging as forests become increasingly valued for their vital role in the planet's ecology.

Trees are a great renewable resource, but they aren't an infinite one. There's only so much natural forest that can be sustainably managed, and finite amounts of land that are suitable for planting new forests. There will be competition from other land uses like agriculture as the world's population increases. Yields can be improved, but not indefinitely. The supply of

Companies from a diverse array of industries will compete with FPP players for control of fibre supplies and the best economic use of their resources. New methods of accessing fibre may emerge in response.

sustainably grown and harvested fibre will have natural limits, even if genetic modification techniques become widely used. We expect that companies from a diverse array of industries – energy, utilities, chemicals and potentially many more as biomaterials evolve – will compete with FPP companies for control of forests, or at least access to their fibre, and the best economic use of the resources they provide.

There will continue to be important regional differences. Asia's emerging markets are booming. In China and India, absolute demand for paper will still go up, although it won't increase as quickly as overall GDP growth. China in particular has a large fibre deficit, though, so pressure to secure access will grow.

New methods of accessing available fibre may emerge in response to the growing pressures. We see international fibre exchanges and the emergence of a new biomass aggregation industry as two possibilities, but there may be others as well.

Evolving industry structures and value chains

As uses for forest resources evolve, we will see new entrants into the value chain. Companies in industries like chemicals and energy will want to secure wood fibre for their own applications, changing the nature of competition, and indeed the structure of the industry. Working across industry boundaries will be increasingly important.

We believe there will be a wide range of potential collaborations for FPP companies looking to partner with these new market players. A cross-industry partner who already has a distribution network for suitable biofuels might make setting up a bio-refinery more cost effective, as just one example.

But it's not only in relatively new markets like energy and fuel that collaboration has potential. Traditional uses of timber in areas like residential construction can be expanded if wood is used together with other building materials. When packaging companies look to create more sustainable packaging solutions, the answer may lie in working together with plastics producers to create innovative, lightweight, durable new solutions. And paper manufacturers may need to work together with electronics companies and logistics operators to develop the next generation of high tech labels.

New entrants to the value chain will change the industry's structure. Working across industry boundaries will be increasingly important.

Changing regulation

Regulation has already had a major impact on the FPP industry, and we can expect more, not less, as the world's forests and the renewable resources they provide are too important to leave aside. Standing natural forests will become more valued for their carbon, climate regulation and broad ecosystem benefits, than for an alternative use of the land. In fact, all forests can be expected to be valued for a broader range of benefits than they are today. Direct public sector subsidies may be required, but regulation can provide support for the market mechanisms to make this happen too.

But regulation can cause distortions as well, for example by favouring one use of fibre at the expense of another often without regard to the full economic (and environmental) picture. A case today is energy wood in Europe. As a result the challenge for regulation is to ensure it facilitates the highest sustainable and value-added use of fibre and fibre resources and an all round appreciation of the valuable role played by forests both from conservation and production standpoints.

With a few exceptions, current policy is not sufficiently joined up from either a geographic or sector perspective. International efforts to agree on globally applicable regulation are notoriously difficult to achieve. Recent discussions in Copenhagen and Cancun make the challenges clear and suggest that there is an urgent need for industry to take the lead, rather than wait for political agreement.

In the absence of strong directional legislation, at the global level at least, we see a need for a broader consensus among different, competing industry groups as to how to divide up the world's fibre resources, perhaps via trade organisations working multinationally. FPP companies can also document and publicise the impact of projects like biodiversity efforts. And they can share their own life cycle analyses around the sustainability credentials of wood and fibre-based products in order to broaden awareness of their contributions to a more sustainable economy. The industry's voluntary efforts around forest certification already show that sector initiatives – basically self-regulation – can make a big impact.

Technology will impact FPP demand trends dramatically and quickly. The supply side will change too, but more slowly.

Future business models

Companies need to respond to these radical changes in the industry environment. Whilst strategies will need to adapt to take advantage of new opportunities, core businesses must be profitable. This may mean consolidating, divesting, closing down mills, rationalising product offerings, reducing costs and so forth, but with a rigour that's going to ensure the returns from existing core businesses are adequate and maintainable to regain the support of investors, who have been deterred by the poor returns in the industry.

In reality, companies already have to make these moves in tandem – strengthening core business performance and at the same time checking out new opportunities – as they seek to lay the foundations for new sources of growth. And the starting point is getting the most out of your assets. You'll also need to understand how the energy sector's growing interest in biomass is likely to change not only demand patterns, but also industry practices. And perhaps most importantly, make sure that you view innovation as one of the core skills your company's people need to master.

Make sure your core business is profitable, then look to adapt your strategy by taking a fresh look at your assets, understanding the impact of energy uses, and driving innovation.

Setting the scene

The world is changing. Populations are getting bigger, and resources are getting scarcer. Business is changing too, and more companies are acting on their corporate social responsibility. If we want to get to a future in 2050 where 9 billion people live well and within the earth's resources, we will need to work together to change how we live and work. Recently the World Business Council for Sustainable Development (WBCSD) invited 29 of its member companies, including PwC, to collaborate on its Vision 2050 project and help develop a pathway to a sustainable world.

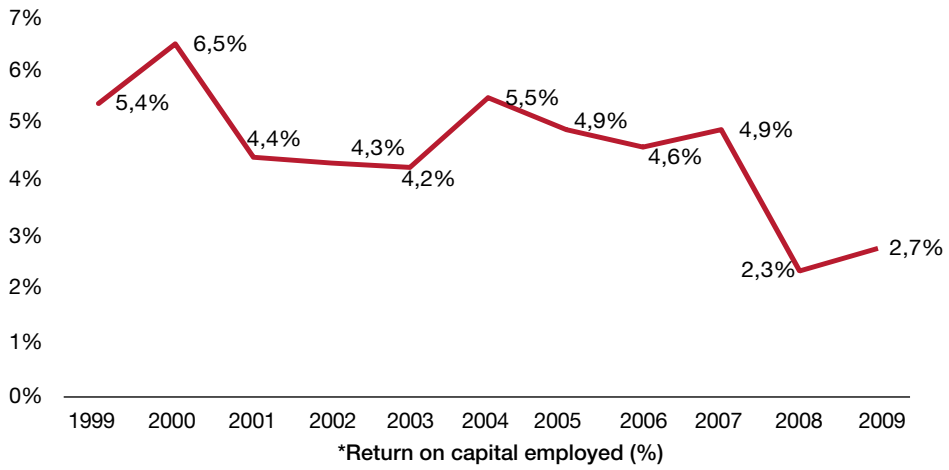
The project's report Vision 2050: The new agenda for business takes a positive look at the future and what could be – if businesses, government and people all work together[1]. This vision is supported by specific pathways in nine key areas of actions. The report's co-chairs say that the pathways are marked by massive opportunities – good news for business. At the same time, they also say "business-as-usual cannot get us to sustainability or secure economic and social prosperity; these can be achieved only through radical change, starting now. To play its role, business will still need to do what business does best: innovate, adapt, collaborate and execute."

The forest, paper and packaging industry will play a key role in a sustainable future

A closer look at the nine key areas identified within Vision 2050 shows the fundamental importance of the Forest, Paper and Packaging (FPP) industry to our planet's future. Forests themselves are one of the nine key areas, but forest products can also a play a key role in four other areas: energy and power (heat and power from woody biomass), building (wood as a green building material), mobility (biofuels from woody biomass), and materials (paper and fibre-based packaging as well as other uses for pulp and fibre, chemicals, etc).

We agree with the WBCSD that business can and must respond to the challenges posed by global climate change, and other global environmental issues like biodiversity. FPP companies in particular will find themselves at the forefront, because the pressures of climate change will drive new uses for fibre. While demand for today's core paper products, graphics papers especially, is likely to decline relative to general economic growth over the next twenty years, demand for other current uses like wood for construction, biomass, and biofuels will grow – and altogether new uses are likely to emerge. Taken together, we believe that demand side pressures will increase. The challenges posed by climate change also make protecting forests and their conservation role even more vital.

Figure 1: Industry Financial Performance: The Top 100 Forest, Paper & Packaging companies' ROCEs*



Source: PwC Global Forest, Paper & Packaging Industry Survey – 2010 Edition

Changing business models can only succeed if FPP companies improve their own profitability – 'getting the basics rights' still applies

Our conversations with CEOs often return to one theme – getting the basics right (see *CEO Perspectives, 2010 and 2008 editions*). That means making the right amount of the right product at the right price and providing top-quality customer service. Companies that succeed in these fundamentals should see a pay-off on their balance sheets. The industry's collective results suggest there's still a great deal of work to be done. In our *Global Forest, Paper & Packaging Industry Survey – 2010 Edition*, we found that levels of Return on Capital Employed (ROCE) were still very low, at an average of 2.7% for Figure 1: Industry Financial Performance: The Top 100 Forest, Paper & Packaging companies' ROCEs* our Top 100 companies (see Figure 1)[2]. Compare this to the 10-12% most analysts expect, and which many major Oil & Gas companies routinely achieve, or even exceed. Companies with weak profitability may have trouble convincing financial markets or shareholders to support the significant capital investments needed to pursue new business models. And existing cash-flows need to be solid before companies can take the risks inevitably associated around the development of major new revenue sources.

Changing technologies: more friend than foe

New technology will impact every aspect of the FPP industry. It will change how and which trees are planted and how forests are managed. It's improving the efficiency of the production process. It's reshaping demand for traditional products like wood products, paper and packaging. It's enabling a scaling up of commercial production of newer products like biomass for heat and power, biofuels, and organic chemicals. And if there are real breakthroughs in areas like nanotechnology, the rules of the game could change entirely.

FPP companies will need to stay ahead of the curve – and that will mean spending a lot more time and money on R&D.

New technologies for planted forests could increase yields, but some, like genetic modification, are controversial

The world's planted forests will need to yield more wood fibre. We believe there is already room for improvement using today's know-how. Better site selection and advanced forest management strategies can have a noticeable impact on overall yield. Remote sensing, a technique to monitor forest loss, health, structure and function by using satellite and geospatial techniques, should also help. Already effective, improvements in satellite and radar technology will likely make it even more useful.

Apart from harvesting and monitoring techniques, forestry generally has undergone limited technological change. Another route to improving forest yield is through improving genetic materials. This can be achieved through traditional cloning and grafting techniques. Researchers have already had great success using these methods for example, in Brazil to develop enhanced eucalyptus varieties, and such techniques could be applied on a broader scale.

Genetic engineering has the potential to speed up the improvements achieved by established breeding methods, or to develop plant traits that cannot be achieved conventionally. It also brings a number of risks such as the transfer of modified genes to wild trees, uncertain stability of the transferred tree, and the possibility of becoming an alien invasive species that might actually cause irreversible damage to ecosystems[3]. The UN Convention on Biological Diversity affirmed in 2006, 2008 and at Nagoya in 2010 that the "precautionary principle" should be used; this means that trees need to be proved safe before they are approved for commercial use.

The leading forest certification schemes currently won't certify plantations which use any types of genetically modified trees. Proponents agree that extensive research and safety controls are necessary, but argue that potentially enormous benefits suggest that such programmes may have a place in sustainable forest management. Until there is general agreement that genetic engineering is safe, it seems likely that commercial application will be limited.

Technology will re-shape wood's role in construction as green construction techniques go mainstream

The construction sector is a significant energy and materials consumer and source of Greenhouse Gas (GHG) emissions. Vision 2050 sets the ambitious goal of close to zero net emissions for buildings, with all new buildings constructed to zero net emissions standards, and significant retrofitting. Technology has already driven significant improvement – current 'green buildings' are designed to achieve a smaller environmental footprint than conventional buildings, including reduced energy, emission of GHG, water usage, air pollution, and maintenance impacts.

Efforts to improve the environmental profile of construction are very fragmented, though, with different standards popping up around the world, although some, like Leadership in Energy and Environmental Design (LEED), Green Globes, and Green Star are spreading beyond their home countries. The wood products industry itself is also very local, and in most countries extremely fragmented – so there's all the more need for the industry to work together around standards and promotion.

Wood products can help to minimise energy consumption during the construction phase, as they currently require less energy to extract, process, manufacture, transport, and construct across the life cycle versus other building materials such as steel and

concrete. Green buildings have higher construction costs, but once energy and other savings are factored in throughout the life of the building, they may actually save money. Wood is a great thermal insulator – 400x better than steel and 15x better than concrete according to one source[4]. Research also shows that it can help buildings meet targets to reduce energy for heating and cooling. And some studies suggest that the improved ventilation and lighting conditions common in buildings designed for sustainability actually makes people more productive and more likely to come in to work (and stay with the company)[5].

But many buildings are still using conventional methods – in 2005, only 10% of buildings constructed in North America met standards for sustainable building – in part because tenders have traditionally been focused on the lowest construction cost, rather than operating costs over the life of a building[6]. The tide may be beginning to turn, though. The number of LEED projects registered and certified by the US Green Building Council has soared since 2005. Many executives are now aware that they can recoup higher initial costs once the building is in operation[7]. As we discuss in more detail later in this paper, in some areas regulation is beginning to shift the bias, but this remains the exception rather than the rule. Builders also need to get up to speed on new techniques. Advancements in technologies for connecting wood to other materials are making it possible to increase the use of wood in larger buildings, but not all construction firms have the required skills to switch materials, or are convinced of the value of doing so.

The argument for wood is getting more compelling, though, as improved types of engineered wood are broadening the range of uses. There are other new technologies too, like new coatings and surface treatments based on nanotechnology, which will make the use of wood in construction increasingly practical and economic. These innovative new treatments would not only look great – similar to a high-grade finish – they could also prevent discoloration from sunlight. Advanced processes to combine wood fibre with plastics are also resulting in new materials with enhanced durability and strength, for example for decking and railings.

To stay competitive, wood products companies will need to watch their own bottom line. While wood currently has a significant sustainability advantage over steel and concrete, other building materials sectors are also researching ways to make their products more sustainable and improve their environmental profile. So the steel and concrete buildings of tomorrow may catch up on some of the key benchmarks.

Digital media are having a major impact on demand for paper – and the news isn't all bad

Digital media are having a major impact on graphics paper demand, which is set to decline, possibly significantly in mature markets. And while demand continues to grow in emerging markets, it won't grow as fast as GDP. Market analysts indicate continued uncoupling of global growth in paper and paperboard from global GDP, concentrated on newsprint and printing and writing (P&W)grades, with annual average growth rates in P&W not exceeding 1.2% through to 2025 and newsprint negative[8]. This compares with trend global GDP growth averaging just above 4% over that period, and such growth as is available in these grades will be concentrated in emerging markets. The forces which are impacting mature markets will affect emerging markets as well. One example is digital substitution, particularly in areas like newspapers and magazines, where many consumers now prefer to read content online.

Consumers aren't the only ones driving the changes. Advertisers are shifting their dollars to digital media, and that means fewer pages. In 2009 global advertising spending in consumer magazines decreased 20% from 2008 levels, which were already down nearly 5% from 2007. While the economic downturn undoubtedly contributed to the decline, it continues a secular trend. By 2014, we anticipate that digital advertising will account for 10.4% of total advertising spending in consumer magazines, up from 4.7% in 2009[9]. And businesses are increasingly looking to implement paperless technologies for billing and other processes.

New devices like e-book readers, smart phones, and tablet PCs are only just beginning to make their impact felt. For example, the overall book market is growing, but this is primarily driven by increased sales of editions designed for new e-readers. These devices – and tablet PCs used as e-readers – could have particularly dire implications for the educational market, if textbook content switches to digital platforms.

In the emerging markets, demand for traditional paper products has been increasing as living standards and GDP rise, but many are concerned that some of the emerging markets may leapfrog to new technologies. For example, as the Indian middle-class grows, readers may choose to access written content on smart phones, IPads, Kindles or other e-readers, rather than buying magazines or newspapers. If this switch in consumer preferences happens, it will dim some of the only bright spots in the sector.

The possibilities for digital technology are far from exhausted, and it's difficult to predict what sorts of devices we'll be using in twenty years' time, and for what purposes. Take airline tickets. These have moved from paper tickets, to e-tickets, and boarding passes are increasingly printed out not at the airport, but on a home computer – or avoided altogether with a barcode boarding pass delivered to your smartphone.

In contrast, the possibilities for newsprint and graphic papers are fairly well-defined. The trick for the paper industry is learning to co-exist with digital technology. In some areas, the internet is creating completely new markets for paper products, like self-published books and photobooks produced on web-based platforms. Printing and writing paper consumption may be positively influenced by some new habits and lifestyles created by technology (printing out digital scrapbook pages is one example; home printing of materials like travel brochures that might previously have been commercially printed is another), although how long such trends will last remains to be seen.

-20%

Decline in advertising spend in consumer magazines in 2009

Digital printing is also changing the magazine market in fundamental ways. Technological advances have made much smaller print runs practical, and the result is actually an increase in magazine titles, as niche titles increase potential profitability.

The industry will need to focus on complementing other technologies, where paper adds value to the user experience. In our view, paper sales will become less driven by volume, and more driven by added value, such as incorporating sensors into paper to create new uses. Improvements in technology will help paper become lighter, stronger and more energy efficient to produce, without compromising quality. And as paper becomes less of an essential media, the industry will need to argue for how it contributes to value. Flexibility to respond to shifts in demand when fashions change will also be essential.

Lighter, stronger, smarter packaging

For paper packaging, improving strength and weight via better production technologies will be even more critical. As with paper, it's essential to look for new ways to add value, like developing smarter labels using sensors. Heat-sensitive packaging can let consumers know whether foods or beverages are at the right temperature. Integrating electronics may have other possibilities too. One company is developing pharmaceutical packaging which tracks when each pill is removed, helping caregivers track patient compliance more accurately. And new types of water repellent paper open up a variety of novel uses.

In the emerging markets, traditional types of paper and packaging can also help address health and hygiene issues. Well-designed packaging can help keep food from spoiling, for example.

Existing technologies to turn wood into energy and heat will improve and be scaled up, but woody biomass won't become a "mega" source of power

Burning wood to produce heat and power is one of the most traditional uses of the resource around. It's also a use that will increase exponentially over the next twenty years as existing technologies to convert woody biomass to heat and power are improved and emerging technologies are commercialised.

Chips are the current favourite wood feedstock for biomass power plants, with the technology well established. But wood chips still contain a lot of

water – around 50%. A denser form of biomass provides a better feedstock once energy wood needs to be moved longer distances, and a shift to drier pellets is developing fast. Torrefaction, a technique that uses an oxygen-free process to remove water and produces an energy-dense, easily storable fuel in pellet form, may be the next step, with the first pilot projects already underway.

In the future, it looks likely that a mix of technologies will be applied in different locales. When it comes to selecting the right feedstock, we recommend that companies keep their options open as much as possible. Any new boilers installed should ideally be capable of burning more than one possible form of biomass feedstock.

We also expect significant cost reduction as companies move up the learning curve. Many companies already generate heat and power for their own uses; increasing their output and selling some into the grid may only mean getting better and smarter at what they are already doing. Wood is a great source of combined heat and power and the most available source of biomass, but supply constraints mean it is unlikely to take off as the dominant replacement for fossil fuels. It will, however, have an important place in achieving a sustainable mix of renewable power sources.

Biofuels from woody biomass will become an important part of the overall fuel mix

Biofuels will become an important part of the overall fuel mix over the next ten to twenty years, particularly in sectors where other options such as electrically powered vehicles are not practical (i.e. aviation, shipping). One analyst predicts that total biofuels production will reach US$247bn by 2020[10]. There are a whole host of second-generation biofuel technologies, both tested and in research stages, which essentially turn cellulose from woody fibres (or other plant materials) into liquid fuels. Some technologies have actually been around for thirty years or more, including black liquor. That's one of the outputs produced when you take the energy rich part of wood fibre, the lignin, out of pulp during chemical processing and mix it with other chemicals.

Scaling second generation demonstration plants into large commercial sites is a challenge, though. There are technical and commercial challenges, for example efficient extraction of the complex sugars from cellulose and better microbes for breaking cellulose down in the biomass conversion process. Developing a usable commercial technology based on this type of R&D will mean partnering with players from outside the FPP sector.

The process for producing biofuels also makes possible the production of bio or green chemicals. Making chemicals from wood fibre extractives is not new – in fact some companies already had products in the marketplace 30 years ago, but found they were insufficiently profitable, while a few continue to produce chemicals today. Demand may soar, as plastics manufacturers look to tap into a growing market for organic plastics.

The World Economic Forum (WEF) defines bio-refineries as "facilities that convert biomass – biological materials from living or recently living organisms – into fuels, energy, chemicals and materials (and feed)"[11]. An integrated bio-refinery can extract the most value from the wood available. Such a plant would produce both high volume, low value outputs, like energy to fuel the facility and perhaps provide a surplus to sell into the grid and biofuels for transportation, as well as higher value, but lower volume outputs, like chemicals that replace those derived from hydrocarbons and high end products such as nutraceuticals, nutritional products with health benefits.

2010:

US$78bn

2020:

US$247bn

Estimated value of yearly biofuel production

(Source: Pike Research)

In some regions there may be opportunities for existing pulp mills to become re-purposed into bio-refineries with a wider range of products, including heat and power, biofuels, and biochemicals, as well as pulp. Converting an existing mill would still be a big investment, but could cost significantly less than building a new plant from scratch, and would also avoid the problem of finding a new site suitable for an industrial plant.

Of course wood is only one possible source of cellulose for second generation bio-refineries. Technologies are also under development using other plant cellulose materials such as elephant grass in Brazil, switch grass in the US and agricultural residues in China, to name but a few already being piloted. Micro algae can be used as a feedstock too; it is already being tested and has research support from some of the oil majors. In some cases, there will be synergies, as when FPP companies grow these crops together with trees on some of their forest lands. The first such cooperations are already in

place. Alternate biomass sources will provide competition too, for example around land use, if a viable parcel of land could be used for either a tree plantation or an annual energy crop.

Looking further out, regional biorefining clusters may develop around biomass, similar to the petrochemical-based clusters currently seen in places like Rotterdam. It is questionable though as to whether biomaterial clusters could ever reach the same scale as the petrochemical industry, though, because biomass supply is much more spread out than the world's oil deposits.

Pulp can be used for many other materials, if the economics are right

Biomass and biofuel technologies are already in or near commercial use, but there are also a whole range of products that are or could be made from cellulose using both current and emerging technologies.

Dissolving pulp has long been the basis for viscose (rayon) fibre, and for many other materials for which there are alternate choices, for example, acetate. If the price and performance of these materials is competitive with alternatives, demand is likely to increase. It's already happening in some areas. The Wall Street Journal reported in January of 2011 that dramatic increases in cotton prices (91% in 2010) have caused many designers to turn to rayon as a cheaper alternative. Some FPP companies are building mills to produce dissolving pulp, or converting existing facilities from paper pulp to dissolving pulp to respond to this increased demand. Formed or moulded pulp offers another wide range of potential applications, although fewer have achieved widespread commercial use.

More revolutionary uses may become economically viable as well. Nanotechnology holds significant promise to open up possibilities by manipulating cellulose on the molecular level. Breakthroughs in this area could have a profound impact. For example, recycled fibres might be designed which have the same print characteristics as virgin fibres, or cellulose could be used to create advanced composite materials. Such research is already underway in some areas, but is still very costly.

Improvements in waste processing are needed to develop true closed loops

Forest products are highly recyclable – if the right processes are in place. Better technology could improve the recycling rates which are already high in many Western countries. Improved sorting is one area. Recycling facilities need to sort different paper grades. Paper that gets used often picks up various contaminants; sorting and reducing these will also help to get more from the existing waste stream. Producers of waste recycling equipment are working to develop better processes for removing these.

Recycling mills currently produce a lot of additional waste, including some types of filler that could possibly be reused. Necessary technological advancements could come in the next seven to ten years, but there may not yet be sufficient economic incentive to drive such research[12]. Using the ash or separated sludge from these plants to produce energy or chemicals could increase the value gained during the recycling process – and reduce waste to landfills.

Wood often gets used together with other materials, or is stained or otherwise treated. Sometimes this means heavy metals getting thrown away along with the wood itself; detecting and eliminating these residues is important to re-using wood.

Ultimately the goal is to develop closed loop systems – that means to make sure that every part of a product can be reused at the end of its useful life, preferably via recycling but failing that via incineration. FPP companies will increasingly need to design paper, packaging and wood products with end of life in mind. As an example, this will mean changes to coatings – or working together with ink producers to make sure that the removal process is as efficient as possible.

Funding the necessary research

Industry and government research partnerships are already happening. The Agenda 2020 Technology Alliance is a Special Project of the American Forest & Paper Association (AF&PA) that brings together industry and academic researchers. It has joined together with a number of partners to produce the Forest Products Technology Roadmap, a comprehensive review of research needs and milestones intended to align industry, academia and government efforts. Similar efforts are happening elsewhere in the world. Such cooperations show that many companies are already committed to enhancing research. But the level of activity will need to step up – and given the sector's financial constraints, it will need to seek funding from outside sources.

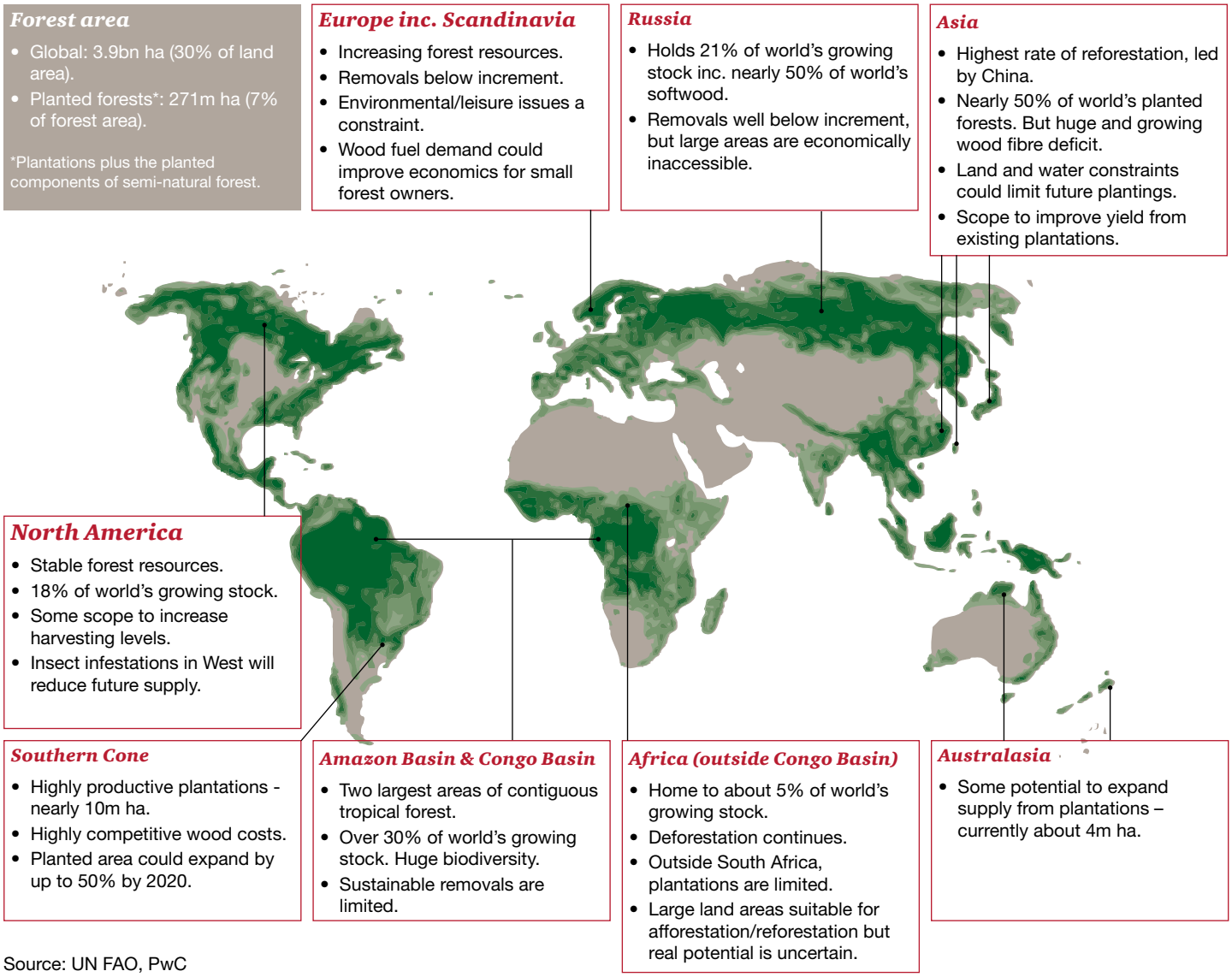
In their *Energy Technology Perspectives 2010 (ETP 2010)* report, the International Energy Agency (IEA) estimates that to achieve a 50% CO2 emissions reduction from business-as-usual levels by 2050 (compared to a 2005 baseline; their "BLUE Map" scenario), government funding for R&D in low-carbon technologies will need to be two to five times higher than current levels. The IEA also reports that this message is being taken seriously by many countries, and that governments of both the Major Economies Forum and the IEA have agreed to dramatically increase and co-ordinate public-sector investments in low-carbon R&D, with a view to doubling such investments by 2015. There will be competition for the available monies, though, so the FPP industry will need to make a strong case to receive its share of such funding.

Cutting the cake: the challenge of dividing the world's limited fibre resources

We believe there will be increased competition for wood fibre as demand for new and emerging uses increases and the global population grows. Geographically, there is also a mismatch between the location of harvested wood fibre resources and the fastest growing sources of demand. Further, there will be increased tensions between using forests for conservation (or other non-timber purposes) or for productive purposes.

Meeting these challenges may mean rethinking the use of current assets. Planting new forests will be inevitable – but will need to be done with great care. Collecting and using waste fibre more effectively will also be critical. And altogether new ways of accessing fibre may be needed to manage increasingly complex and crowded value chains.

Figure 2: Wood Fibre Resources: Global Overview



Source: UN FAO, PwC

Balancing production and conservation

Forests are vital resources, both for their productive value and their conservation value; any discussion of the future of forestry has to look at the balance between these two roles. Sustainably-managed native forests have long performed multiple roles providing both commercial wood supply and environmental benefits. While there is scope to increase harvest levels in such forests, it is unlikely they will make a significant contribution to meeting the growing demand for fibre. In fact altogether, most of the 30% or so of the world's land surface that is forested can be expected to make a reducing relative contribution to meeting wood fibre needs. Many of these forests are economically inaccessible or are sensitive to disturbance. Whilst there is scope to increase harvest levels, the potential for productivity improvement is limited. Additionally we can expect many of these forests to be increasingly valued for their conservation and amenity benefits which will often impose restrictions on industrial wood output. These restrictions will be greatest in the tropics. While all forests naturally play a role in regulating the earth's climate, the impact of tropical forests is most intense. They are also home to the highest numbers of plant and animal species, so they're arguably the most important for biodiversity conservation.

Increasingly therefore, wood fibre needs will need to be met from planted forests (see figure 2). These currently cover around 272 million hectares or around 7% of the total forest area. Already these forests provide about two-thirds of global industrial roundwood output (i.e. the volume of harvested wood which is not used as wood fuel and which approximates half of the total global wood harvest)[13]. The WBCSD estimates that the yield and harvest from planted forests, will need to increase threefold by 2050, with land-area increasing 60%.

So just plant more trees?

In many countries, businesses and governments are doing just that. Planted forests of all kinds are growing rapidly, with both existing players and new entrants expanding acreage. In 2005, there were already nearly 141 million ha of plantation forest globally, an increase of over 12.8 million ha compared to 2000[14]. These trees absorb a lot of carbon and provide a renewable resource for use in paper, packaging and other products.

Plantations have already faced a lot of criticism, though, for everything from tearing down natural forests to make way for plantations, to displacement of local peoples, to accusations that they have damaged local water tables. Certainly mistakes have been made, but we believe that plantations still represent the single best opportunity to meet increased demand for forest products without damaging ecosystems, provided planting is done responsibly. Many companies are already incorporating lessons learned from early projects into their current activities.

Planting 200 million trees = $3bn investment

Using a mosaic approach helps balance production and conservation goals; Brazil leading the way

How do the rules work in practice? Planting forests responsibly begins with finding the right site and ensuring that planting there won't disturb local water tables, displace wildlife or local populations, damage plant diversity or prevent agricultural land from being used to grow food. Some companies are now taking a mosaic approach, where natural forests, wetlands, plantations, agricultural lands, and other land-uses are planned so that they form a sensible pattern, or mosaic. This helps planted forests to sustain biodiversity, for example by providing 'biodiversity corridors' for wildlife to get from one natural habitat to another.

Fibria in Brazil is one example of a company already developing mosaic landscapes on its own land. In a separate development, in 2006 they launched a partnership with Santander and local NGO's to create the Ecological Corridor Project, which aims to reforest a total area of 150,000 ha once covered by Atlantic rainforest, starting in the Vale do Paraiba in the state of Sao Paulo[15]. Fibria estimates the project will require the planting of 200 million trees and an investment of around US$3bn, much of which will be raised from donors[16]. The 150,000 ha, which is under multiple ownership, will include a planned 28,000 ha of productive forest (mainly eucalyptus) and 122,000 ha of conservation area (primarily native species).

Indeed, Brazil as a whole stands out as the world leader in forest plantation agriculture. While total plantation acreage is much less than in some other emerging markets like China, Brazil's nearly 6 million ha of plantations produce significant amounts of fibre for the global market. Tree plantations use only about 1% of Brazil's total land area, but they are one of the most important agricultural products.

There is a lot more potential, and Brazil's government is looking at regulation designed to stimulate reforestation projects and the production of certified wood and its derivatives.

20 million hectares

China's 2020 goal for additional woodland planting to fuel bioenergy projects.

China's emphasis shifting from reforestation for environmental reasons to productive forests to fuel bioenergy goals

Brazil's largest trading partner is now China, and large shipments of pulp are one reason why. China's growing demand can't be supplied by local forests, despite aggressive efforts to expand plantations over the past two decades. Strong demand for forest products led to significant deforestation in China after World War II, but the Chinese government has since initiated significant efforts to reverse the trend. China now has over 40 million ha of plantations serving either conservation or production needs. However, the domestic timber harvest fall well short of China's demand for fibre. In 2009, China imported over 100 million metres^3 on a roundwood equivalent basis – roughly as much as Canada's entire timber harvest in that year[17]. One issue is that the yield from these plantations is often low due to mistakes in planting or poor silviculture. China has accordingly undertaken initiatives to improve the quality of its plantations.

Further, China has dramatic ambitions to increase domestic fibre resources. In August 2010 the country's State Forestry Administration released a draft National Plan for the Protection and Use of Forestland, a ten-year programme with the goal of increasing bioenergy development in the forestry sector. The plan calls for the planting of an additional 20 million ha of wooded land that is stated to be used to provide feedstock for bioenergy projects – a major expansion of plantation forestry in China and one which firmly bets on bioenergy as an effective use of woody fibre.

Plantations are still only happening on a small scale in Africa, but there have been some successful examples of government and industry cooperation

Parts of Africa have both the land and the right growing conditions. In Sub-Saharan Africa only South Africa and Swaziland have exploited the potential for plantations, yet there are already some good examples of how government and business can cooperate to achieve both conservation and production goals. In the near term, there is potential to expand the acreage of plantations, with East Africa currently attracting the greatest attention.

As demand for paper products drops in mature markets and decouples from GDP growth in emerging ones, new uses will make up a larger share of fibre usage

While demand for some types of paper is likely to decrease, the many other uses for wood fibre are likely to mean dramatic increases in demand overall. In the EU alone, 340-420 million metres³ (under bark) of woody biomass per year is forecast to be needed solely for energy purposes by 2020, if current government policies continue[18]. Most of that is incremental, leading to a forest fibre deficit of 200-260 million metres³ under those assumptions by 2020[19].

At the same time, as we've already noted, demand for newsprint and other printing and writing (P&W) papers will decline. In Europe, there's a lot of existing capacity that simply won't be needed for newsprint or P&W paper. Many of these mills are located near sustainably managed forest resources. Repurposing some of them as bio-refineries to produce energy and other bioproducts – with or without paper pulp in the mix – may be one good option. That could also mean protecting some jobs that would otherwise be lost if the whole facility closed. Pilot projects are already underway.

In the case of much of Scandinavia, existing pulp and paper mills that may be repurposed normally have a stable supply of fibre from managed forests. But what about other parts of the world where pulp and paper production may not be as closely linked to local forest resources? Unless the mills meet specific local market demand or have access to competitive sources of fibre, their future is bleak under any scenario.

Increasing populations and increasing wealth mean more fibre is needed and sustainable development policies will likely accentuate this trend, regardless of the expected declines in traditional paper usage in the northern hemisphere. As the emphasis shifts between various alternative uses, the focus will also shift from accessing fibre to using fibre more efficiently. In some applications, there will be viable alternatives to woody biomass, although land availability may be a limiting factor. Technologies can help, but those businesses that control, or have secure access to competitive sources of fibre will be well-positioned.

Waste and recycled fibre streams

In some parts of the world, a lot of paper is already recycled. In the US, the AF&PA estimates that nearly two-thirds (63.4%) of paper used was recovered for recycling in 2009, exceeding the industry's voluntary target. For old newsprint/uncoated mechanical papers, the percentage was even higher, at 70%. Rates were even higher in Europe, with the European Recovered Paper Council reporting a record 72.2% of paper recycled in 2009. There's huge room for improvement in other parts of the world like China though, where recycling is still more often a cottage industry rather than a fully functioning system.

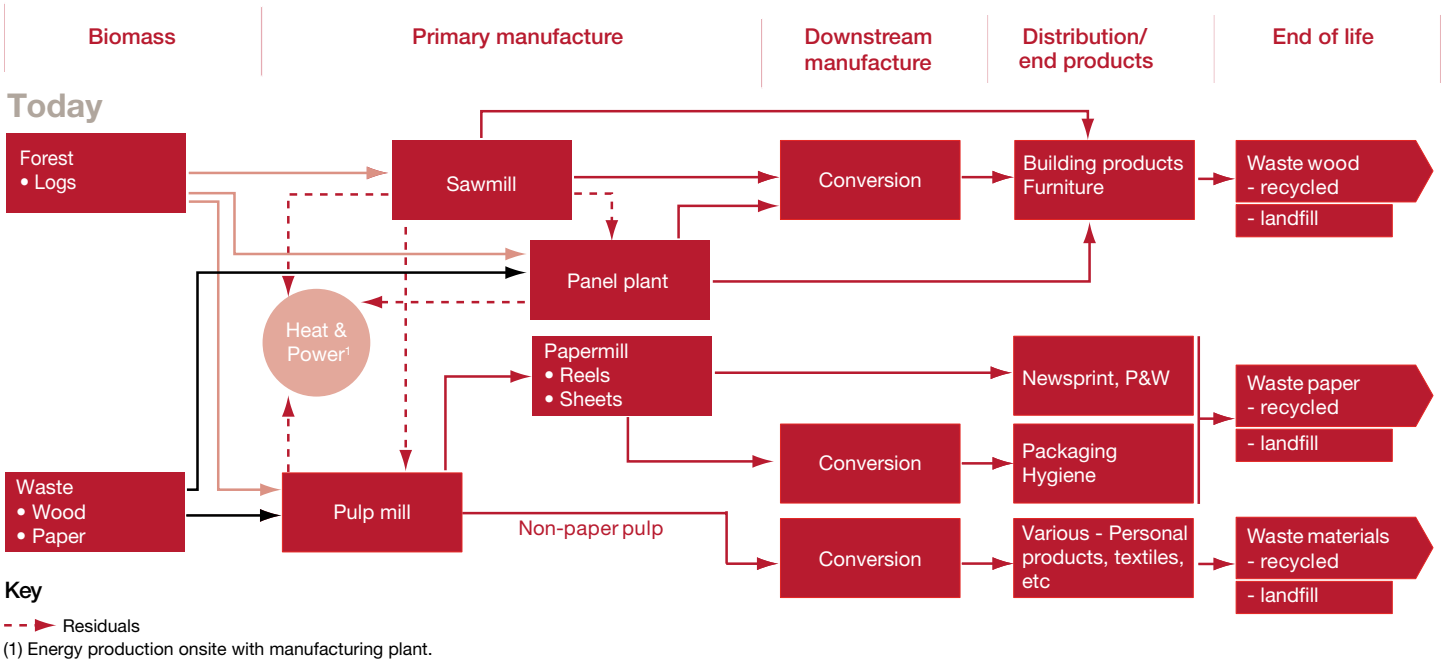
Much of the paper collected in the US and Europe is currently sent to China, which has compensated for its virgin fibre deficit in part by making greater use of waste paper. But when the global economic downturn hit in 2008/2009, Chinese exports dropped – and so did demand for paper and packaging made from recycled fibre. Fluctuations in prices meant that in some cases, recovered paper actually ended up in landfills. And while technologies for sorting waste and using recycled fibre are improving, the future stability of the recycled fibre stream may depend on both changes in the level of demand for recycled paper and packaging, and the ability of the industry to react to them.

Reshaping the value chain: fresh competition and cross-sector partnerships

We see the forest and forest products value chain shifting, fragmenting and altogether becoming more complex. Technological improvements will have an impact on what type of wood is suitable for various uses. The possibilities for conversion of wood fibre will expand dramatically, with heat and power, biofuels, and chemicals vying for use of wood fibre. Control or access to fibre resources will become more contested. Closing loops will become a more earnest endeavour, as the pressures mount to use resources more efficiently and to eliminate waste; this will drive new value chain partnerships. And new types of wood supply contracts, and risk management and trading mechanisms for fibre supply seem likely to emerge, driven by the needs of the energy sector.

The forest, paper and packaging value chain begins with the fibre resource, be it primary or secondary fibre. Primary manufacture, downstream manufacturing and distribution/end user products are the next steps, before the value chain ends – or in some cases starts over (see figure 3).

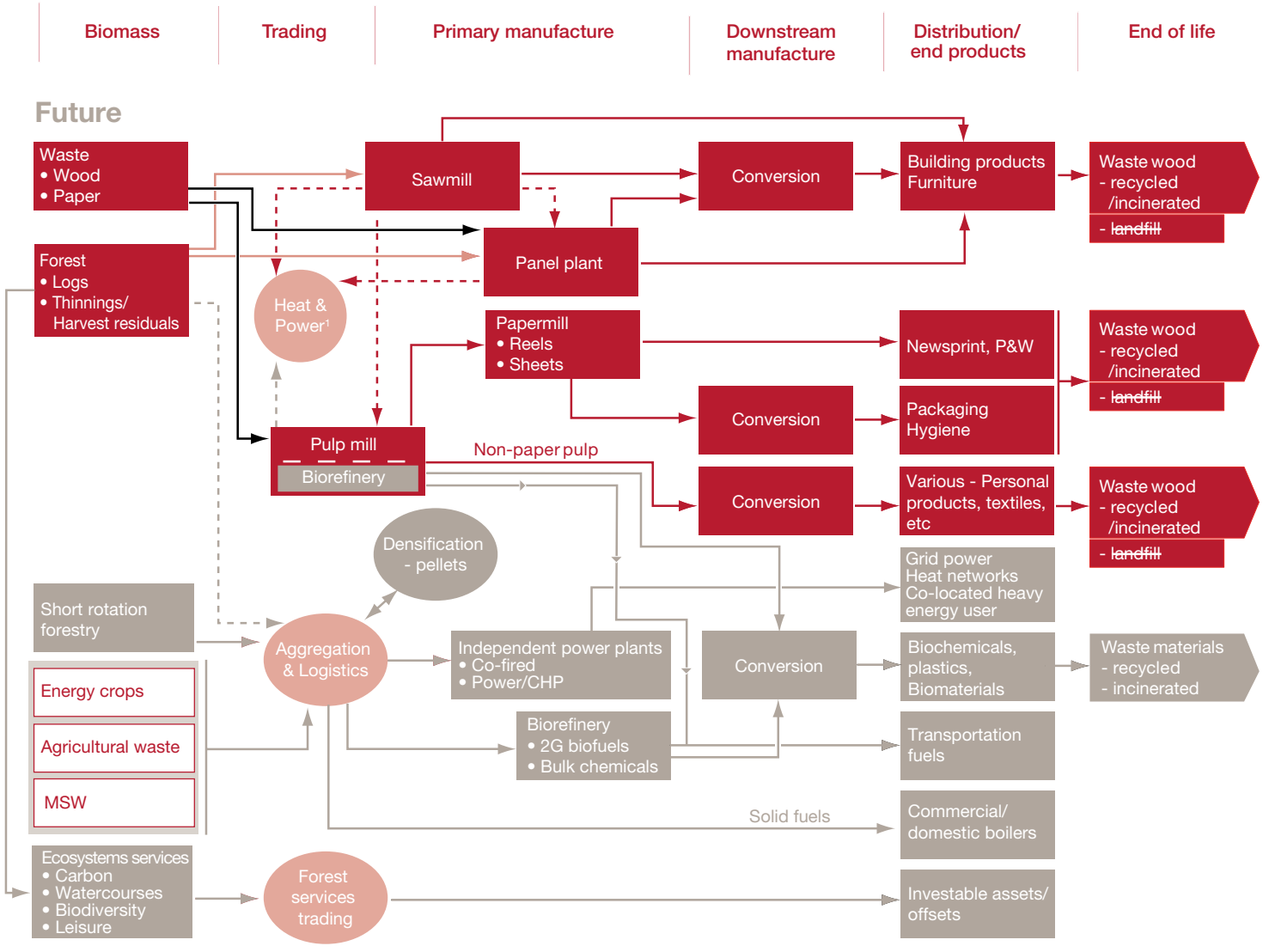
Figure 3: The Past Value Chain (simplified)



(1) Energy production onsite with manufacturing plant.

Over the next two decades, every stage in the value chain will become considerably more complicated as the diagram below show (see figure 4). Where non-traditional uses are emerging, there's likely to be a lot of fragmentation, with many new entrants. And in traditional areas, the industry will need to consolidate especially where market demand is contracting, and at the same time secure the finance for mill conversions or other needed capital investments required to shift to energy production or broaden the product palette. Flexibility will be paramount, as demand patterns for new product categories may be volatile.

Figure 4: The Future Value Chain (simplified)



(1) Onsite energy production potentailly also for third parties (e.g. via grid, heat networks, co-located heavy energy user) – flow line is not shown.

And while there will be a lot of new competitors, there's opportunity to work together too. New types of business collaborations will be essential, both to drive research agendas and to explore new business areas. New industrial partnerships will have to emerge with partners across the supply chain. These new players may also influence how the industry does business in fundamental ways. For example, as energy uses become more important, energy prices, be they gas, oil, diesel or so on, will likely set floor prices for wood fibre; further, energy producers will want long-term supply contracts with volume commitments and price mechanisms linked to available indices. These are the types of fuel supply model to which the Energy and Utilities sectors are accustomed. This could lead to the creation of new risk management and trading mechanisms for wood fibre that could reach across the whole market.

Wood products companies will need to cooperate to make the case for wood and improve productivity and distribution processes to control costs

Some wood products companies see other wood products companies as their main competition, rather than alternative non-wood materials and products. But cooperation across the sector will be absolutely critical in order to promote wood as a great building material. Some campaigns started by the forest industry, governments and sometimes forest owners' promotion agencies target decision makers to influence attitudes – technical and cultural – in favour of wood.

Many construction firms are not yet experienced in using wood in some types of structures and applications, so wood products producers will need to cooperate with builders to increase their knowledge. Wood is most often used together with other building materials, so working together with makers of other types of building materials (e.g. steel), will be important. Other industries such as chemicals may also help, for example in developing coatings which help windows retain heat better, or in developing engineered wood products that combine wood with plastic to make durable building materials. Working with distributors will also be important; particularly as they help customers make choices about which construction techniques to use.

Collaboration with other sectors could result in new, more sustainable packaging solutions

For FPP companies, working together with companies from other sectors may be critical, whether it's to develop new coatings to enhance water resistance, or pairing paper labels with plastic containers or aluminium cans. The industry will also need to continue innovating, for example to improve the performance/weight ratio of paper, and to develop biocoating solutions for current products that combine paper and plastics.

Cross-sector partnerships bring together different types of know-how and help access capital for R&D and investment in new technologies

Who will run these new enterprises? FPP companies already know how to manage forests, so shifting their strategies to change the amounts and type of wood produced won't require learning a whole new business. Many don't know very much about marketing biochemicals or biofuels, though. Many don't have cash to spare either, meaning that financing may be hard to come by.

Partnerships across industry lines will make sense and the first such cooperations are already producing results; for example, the BioDME consortium includes paper, energy and automotive companies, among others, working with new player Chemrec. The first Volvo trucks are already running on a BioDME fuel produced on the site of a Smurfit Kappa mill in Pitea, Sweden. Chemrec estimates that Sweden's pulp mills alone could produce enough BioDME to fuel one half of heavy road transportation in that country, with a net GHG emissions reduction of 95% over petroleum-based diesel oil.

Connecting the dots: the case for co-ordinated regulation and industry leadership

In the past, we haven't put a value on many of the services that nature provides, like clean air, sufficient water, pollinating insects, etc. Payment for Ecosystem Services (PES) schemes seek to correct this oversight. Efforts to mitigate climate change are already targeting the preservation and enhancement of forests as one of the most cost-effective ways to combat the impact of GHG emissions. Many governments are making policies to encourage the use of renewable energy and renewable fuels. Policies around other uses for wood and wood products like green building and sustainable packaging are also springing up around the world. The impact of all these types of regulation on FPP companies will be significant.

One of the primary goals of regulation should be to support making the best use of available resources. Unfortunately current efforts fall well short of that aim. And given the difficulties inherent in reaching broad agreement on international policy, we think it's vital that companies help take the lead in developing policies and approaches that help maximise the use of resources and minimise damage to the environment. The FPP industry is already a leader in developing industry-led efforts for voluntary self-regulation, with forest certification and chain-of-custody schemes providing a good example. Such programmes involve meeting strict standards for sustainable forest management, and have helped the industry respond to stakeholder concerns around issues like deforestation. In some cases, they have helped companies receive recognition for good practices already in place; in others they have provided an incentive to companies to improve their processes; for example, to meet forest certification standards. The WBCSD reports that global demand for certified wood could grow tenfold by 2050, from US$5bn per year (based on FSC-certified fibre only) currently to US$50bn per year (for fibre certified by one of several leading standards)[20].

Sustainable packaging is another area where many companies are currently developing voluntary standards, with an eye to helping customers improve their own carbon footprints. In our recent examination of sustainable packaging in the UK and Europe, we found that local market conditions and recycling practices have a profound impact on which packaging solution is the most sustainable for particular uses[21]. Rather than attacking the credentials of other materials in packaging, we concluded that the industry needs to focus on promoting greater understanding of the merits of its products and the true impact of how it manufactures them. Life Cycle Assessment (LCA) is one of the specific analysis tools that can help promote that understanding and it is increasingly being used to assess the full economic, environmental and social consequences of products and processes in many industry sectors[22].

Even if consumers want to make sustainable choices and governments or companies are looking to implement sustainable procurement policies, they can't do so without adequate information. Access to comprehensive, clear information will be very important not only to those making consumption choices; it will also have a major impact on the policy agenda. As the FPP value chain becomes more complex, it will also be more difficult to evaluate the relative impact of different activities. Lobbyists from varied industry perspectives may come to very different assessments of how their sectors should be treated – and regulators' decisions could affect the playing field significantly. Working together across sectors to shape the agenda makes clear sense, particularly as more cross-industry partnerships emerge. A healthy forest industry will be important not only to traditional FPP companies, but also to other sectors like energy and chemicals. And if regulation supports making the best economic use of forests, it will also drive creation of more jobs and more wealth, so it helps policy-makers too.

Government regulation will have a profound impact but will it be possible to develop coordinated policy?

Regulation must consider the multiple productive and conservation uses of forests. It needs to reward sustainable forest management, or at least avoid penalising it. Policy-makers need to understand that wood is a renewable resource, but not an infinite one. When they develop regulations that have the effect of promoting the use of energy from biomass, for example, they need to take into account how redirecting wood from other uses may impact timber and pulp markets. Regulation also needs to be co-ordinated across regions, to avoid the risk that stricter forest conservation in one country leads to increased illegal logging in a neighbour, as just one example amongst many. It will be extremely challenging to reach consensus across geographies around appropriate regulation of all types, from forestry, to green building, to sustainable packaging.

Preventing deforestation is key to reducing GHG emissions; REDD+ is a first step but implementation will be tough

Probably the best known global framework measure currently under discussion is REDD+, an abbreviation which stands for Reducing Emissions from Deforestation and Forest Degradation (REDD). The term describes a whole range of policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries[23]. The Copenhagen talks in December 2009 failed to reach a global consensus on carbon reductions, but they did show that much of the world agrees that REDD+ is the right idea. US$4.5bn in REDD+ 'Fast-Start' funding has already been pledged to give the programme a fast start.

A lot more capital will be needed to save the world's forests. Regulation will also be important; significant private investment will be essential to achieve policy objectives via the REDD scheme and this will not happen until companies understand what the longer-term policy frameworks will be. And while REDD+ is needed to head off deforestation, implementation will not be easy or straight-forward. We discuss the issue in more detail in our recent publication, *Report for the Conservation Finance Alliance – National REDD+ funding frameworks and achieving REDD+ readiness – findings from consultation*[24].

If you are an FPP company operating in developing tropical countries and practicing sustainable harvesting you may face some new risks, like increased competition for natural forest land from carbon developers seeking to establish REDD+ projects. There may also be important opportunities, like gaining REDD+ payments for afforestation or reforestation of land.

In addition to REDD+, other types of payment for ecosystem services (PES) programmes are likely to be important. Right now, your company – and your competitors – generally doesn't pay for much of its impact on ecosystems and biodiversity, even though in the long run it costs a lot more to repair damaged ecosystems than it does to protect intact ones. Certain types of pollution are the exception, with penalties assessed by organisations like the US Environmental Protection Agency (EPA). That may change, though. In 2010, the *TEEB – The Economics of Ecosystems and Biodiversity Report for Business report*[25] documented that ecosystems actually add a lot of economic value that's not historically been accounted for, and made suggestions for how businesses can both protect the environment and realise business opportunities from sustainable management.

The size of the biodiversity offsetting market currently accounts for US$2-4bn per year, spread across the world. The US has become an important hot spot, as wetland banking has gained recognition as a valuable way to improve habitat conservation. Countries within the EU are also looking at biodiversity and other PES systems.

Voluntary certification programmes and government policies will drive growth in the use of wood in construction

Wood is already used extensively in some types of construction, in some parts of the world. Future demand trends will be impacted by both voluntary standards and government regulation.

Governments' support of sustainable construction standards influences demand for a variety of green building materials, including wood. The options range from progressive procurement policies to tax breaks, through to stricter building standards. Some areas like New York City already offer a tax incentive for green buildings. In the US, cities like Chicago are requiring that all public buildings meet LEED certification standards, making this voluntary standard mandatory. Other cities like Washington DC are going one step further and requiring that both public and private buildings meet such standards. Many European countries have also introduced more stringent requirements on environmental factors like energy usage. These programmes are critical to achieving widespread implementation of green building practices.

The private sector can also help. Some companies are already choosing to follow green construction standards as part of their own efforts to reduce their carbon footprint. Many such standards rate the use of wood (particularly certified wood) highly, so increased pick-up is likely to impact demand.

Regulation is driving a shift to biomass for heat and power

In some countries, particularly in Europe, regulation requiring a shift to renewable energy sources is driving huge investment in biomass facilities. In the UK, approximately 5.4 GW of new capacity (equivalent to about 5 nuclear power stations) had been announced as of November 2010, including 30 projects with capacity of 50MW or more[26]. (Note: these totals only include plants with capacity of 50MW or more. Additionally, there are many smaller biomass plants either in operation or planned). Generating this much power will take a lot of biomass – the planned plants will need over 40 million green tonnes of biomass feedstock per year, mostly imported woody biomass in chip or pellet form. Although the UK has the most ambitious plans, it's by no means alone in switching to biomass.

The European Union's ambitious target of 20% renewable energy by 2020 is prompting countries all around Europe to pass more regulations promoting renewable energy. Biomass will be the single most important component. Current sources of supply won't be enough if the EU is going to meet its 20/20/20 targets. The EU's official calculations assume that total heat and power production from biomass will more than double from the 2007 level, but at current annual growth levels only about one-third of the additional biomass-based energy requirement will be met[27]. So investment needs to ramp up.

For companies to make money producing energy, governments around the world will need to continue to promote biomass as a source of renewable energy. Subsidies are both good and bad for the FPP industry. While they make energy production more profitable, they also interfere with competition for smaller diameter roundwood which is normally put to other uses. So making paper or other products might get more expensive as pressure on the raw material increases.

Regulation will impact the future of biofuels

Biofuels are another area where government subsidies or incentives are having a major impact on markets. When governments mandate or encourage a shift to renewable fuels with grants, subsidies or other local regulations including taxes, it changes the profitability of potential investments. In Brazil, 17.6% of the fuel used by the transport sector in 2008 came from ethanol (mostly first generation from sugarcane) – a direct result of government policy promoting its use. In Europe, the EU's 20/20/20 targets include a 10% target for biofuels in transportation, and country level policies have had a significant impact on demand[28].

In the US, subsidies for biofuel have stimulated production. To date it has focused primarily on first-generation corn ethanol, which has a significantly larger carbon footprint than ethanol from sugarcane or second-generation cellulosic fuel sources. Current regulation doesn't specifically target woody biomass as a feedstock for biofuels, so projects aimed at producing biofuels from such sources will be in direct competition with first-generation technologies and competing sources of ligno-cellulose.

Emissions regulation

Most of the regulation we've already discussed is happening as part of efforts to reduce energy consumption and GHG emissions. We believe that the drive to improve on both fronts will continue, regardless of whether or not a binding global agreement is reached. Regional or national policies will be one driver; increasing pressure from customers, and ultimately consumers, will be important too. And reducing energy consumption always makes economic sense. That said, demand for some of the alternate uses for forest products will be impacted by carbon prices, whether these are achieved by direct taxation or market mechanisms (e.g. cap and trade), because they will have an impact on the overall cost of some of these options versus alternate materials. For many new product opportunities, the issue is not so much performance (with suitable processing fibre can meet most performance requirements), but rather relative price.

40 million tonnes per year

Estimated amount of green biomass needed to fire new biomass power plants planned in the UK.

Building your future: new directions in business models

The industry will look different in twenty years time. There will be less production of newsprint. Other grades may suffer more or less, depending on how consumer attitudes develop. Office business application (OBA) products are likely to have a brighter future than higher grades generally used in magazines, for example, as people move from purchasing already printed materials to printing at home on demand. Packaging and hygiene applications will continue to be bright spots, with the growth opportunities in emerging markets especially being attractive. China, India and Brazil and other highly populated developing countries are likely to become increasingly important markets.

Technology's impact will be huge. Some traditional uses will evolve from commodities into more value-added products, for example new paper features will allow for printed electronics on paper. Sustainability will enhance demand for some traditional uses, like wood in construction and home decor. Biomass for heat and power, biofuels, and organic chemicals are all likely to grow, but may compete with each other for resources.

Evolving value chains will mean greater fragmentation in some segments and consolidation in others. New competitors and new partnerships will emerge. Flexibility will be critical. Every FPP company will need to have a clear strategy, and one that's flexible enough to adapt to changes in raw material, transport and energy costs, carbon prices, and shifting demand levels.

Start with the basics, then look to your strategy

With so many changes happening in the industry, it's easy to lose focus on the fundamentals. But before you consider how your company will react to – and maybe shape – new market opportunities, you need to focus attention on your core business. All FPP companies must ensure that their core business is profitable. Otherwise investors won't back their new ventures and the opportunities will go to other players.

In Europe, particularly, we believe that consolidation of paper producers remains vital. We argued this need in our CEO Perspectives publications in both 2006 and 2008, and the rapid growth of potential new entrants and competitors is making it even more important for traditional producers to improve their operating margins.

Once core profitability is in place, it's time to think more strategically. Nearly every FPP company will need to adapt its business models to cope with the far-reaching levels of change in the industry. The process will be a gradual one, given long investment cycles in this industry. You'll need to consider various types of collaboration. R&D will become far more important. There won't be only one path to success; but you will need to make choices in the next five to ten years which will shape your company's future for the next twenty or thirty years and beyond

Get the most out of your asset base

What's your company's best asset? If the answer is that you own or have access to large amounts of biomass, you may have good opportunities to provide bio-energy with low-value wood, including using harvesting waste. A lot of skill and research will be needed to find out how much wood can be taken away during harvesting. A big demand for energy wood means a big change in forest management – it means more frequent thinnings as well as more energy forests, as meeting energy demand cannot be contingent upon residues from other fibre processes (roundwood harvesting, sawmilling, etc). Many forest companies have the necessary experience and know-how to make such changes in-house already, unlike competitors from other industries.

If you've got strong networks in place with small producers, you may be able to serve as a 'bio-mass aggregator" to deliver large amounts of fibre to new production facilities that need to be able to rely on a steady stream of fibre. Similar systems already exist in some markets, where fibre is aggregated for sale to pulp makers, for example in Japan.

If your answer is producing certain grades of paper or speciality packaging most cost effectively, then achieving excellence in traditional core products may be a viable business model. If you are positioned as a low-cost producer of commodity products, innovating around process will be important. Where your product palettes are in decline, it will be important to manage supply. That means you need to be big enough to manage the supply base as demand shrinks, by defending and increasing your market share. There may also be opportunities to grow in emerging markets. If you're in a value-added niche, innovating around products and quickly responding to market trends will help ensure continued profitability. That may mean installing new or adapting existing paper machines which are able to switch grades more flexibly.

Improve efficiency to help cope with changes to demand

If you are a leading wood products company, identifying your best asset may be more difficult, as demand patterns are radically shifting. We've already discussed the probability of increased demand for wood in construction as green building goes mainstream. Demand isn't likely to go up uniformly, though. Sales of engineered wood products will increase more. And while in the past natural long lengths and wide widths of solid sawn timber were needed for many uses that required high levels of stability, new engineering technology and modern manufacturing techniques now make it possible to use smaller diameter timber resources.

Over the longer-term, this may mean a major shift in what type of wood gets grown and where. So your company may need to review its product-mix and add more value through services (e.g. design, engineering, logistics management) and through further processing.

Other types of changes to improve efficiency will also be important. Wood products companies will need to improve productivity, probably by focusing on standardised products manufactured under continuous-flow processing methods. They'll need to produce a large volume, but at low unit costs. They'll also need a good distribution structure that will let them ship large volumes to market.

These types of improvements are a good idea for paper and packaging companies too.

Return to the sector's roots: energy

Burning wood for heat is the oldest and most common usage of wood. New biomass energy plants and biofuel refineries are actually returning to this most fundamental use of wood fibre. We believe that energy will return to being the baseline use for wood fibre – and FPP companies will need to take many further steps to respond to resulting changes in the market.

If you own pulp mills, do they have potential to generate more heat and power, or be converted to multi-purpose bio-refineries? Are they located in areas which might make sense as a regional biomaterials hub?

Existing pulp plants may be able to be repurposed to produce energy – we've already discussed some projects currently underway. And some companies may even want to build their own power plants; for example, in Scandinavia, some companies are already going down this road.

It's happening in other parts of the world too. Weyerhaeuser in the US is actively exploring options for increasing its production of bioenergy through its joint venture Catchlight with Chevron, an energy company. As part of the company's focus on forestry, it's also making a concerted effort to get credit for, and earn profits from, the ecosystem services produced on the land it manages, another example of a good way to maximise value from existing assets.

Understand how the energy sector will drive changes to FPP industry practices

Energy producers are looking to biomass suppliers to provide wood fuel on long term contracts – 5, 10 yrs or even longer. Just like coal and gas. They are looking for guaranteed supply – this risk is borne by the supplier not the customer. They are looking for determinable prices – ideally linked to energy prices or to energy wood futures. Such market mechanisms don't exist yet, but we believe they may emerge over the coming years. All of these buyer requirements are accentuated where the market (e.g. via project finance) is funding the energy plant; and given the huge investment requirement in renewables, a great many will depend on market finance.

Given the volumes of wood required for energy production, all of this is highly significant as it means the base level demand for fibre will be set by the energy market (and biomass itself provides baseload power) requiring a level of contractual commitment and forward risk management to which the fibre supply industry is unaccustomed.

Under this evolving scenario, it seems possible that more extensive change could be driven across the whole FPP sector to current fibre trading practices, resulting in more long-term contracting and perhaps the development of international fibre exchanges for different grades of primary and secondary fibre. This would be following the path of other internationally traded commodities.

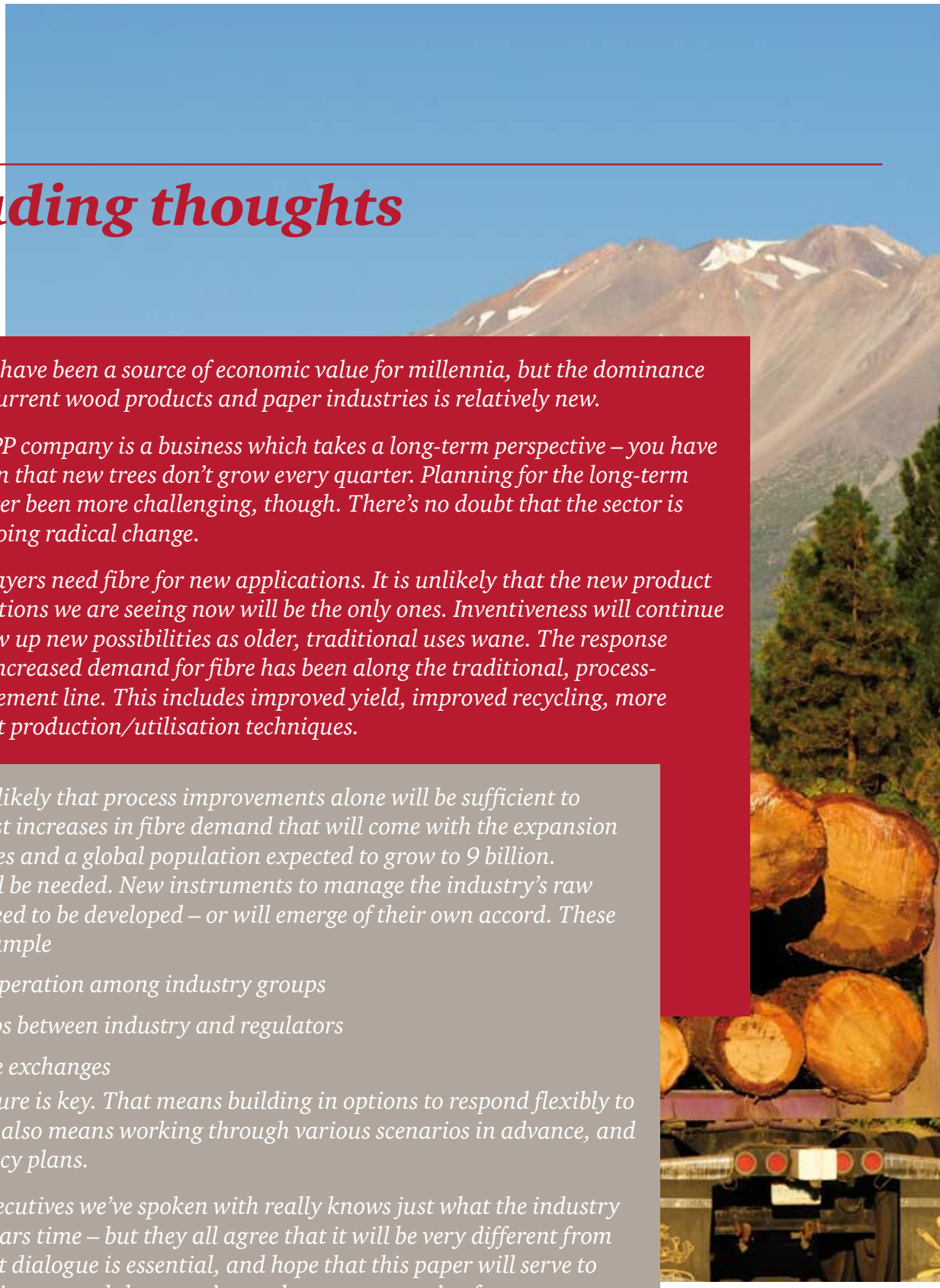
Turn your company into an innovation-driven business

No matter what direction you set for your companies, it's certain you'll need strong capabilities around innovation, be it in products, processes, end-uses or markets. Some of the sectors which may provide new competition for FPP have a stronger tradition of innovation. Take the chemicals industry. It's been called the first "science-based industry", and R&D has had a massive impact on the sector's profitability. Many new applications for wood fibre will be based on a solid understanding of the chemical components of cellulose and how they can be manipulated – and chemists are used to looking for new materials.

Partnering with innovation-rich companies will be one option, but you'll need to consider ways to drive innovation too. How do your current research directions map to major trends? Do you already have promising new products in the pipeline? How will you fund research? Are you taking advantage of government programmes, for example to increase the production of renewable energy? Will you need to attract new investors like pension funds?

Don't forget your people. Do they have the skills to manage change and innovation? Do you have sufficient engineering talent? Even if you do, looking at internal structures, like appropriate HR policies to train and reward innovation can be productive. Are there any gaps in your operations in emerging markets where you expect higher rates of growth?

Concluding thoughts



Forests have been a source of economic value for millennia, but the dominance of the current wood products and paper industries is relatively new.

Your FPP company is a business which takes a long-term perspective – you have to, given that new trees don't grow every quarter. Planning for the long-term has never been more challenging, though. There's no doubt that the sector is undergoing radical change.

New players need fibre for new applications. It is unlikely that the new product applications we are seeing now will be the only ones. Inventiveness will continue to throw up new possibilities as older, traditional uses wane. The response to the increased demand for fibre has been along the traditional, process-improvement line. This includes improved yield, improved recycling, more efficient production/utilisation techniques.

However, it seems unlikely that process improvements alone will be sufficient to accommodate the vast increases in fibre demand that will come with the expansion of emerging economies and a global population expected to grow to 9 billion. More plantations will be needed. New instruments to manage the industry's raw materials will also need to be developed – or will emerge of their own accord. These could include, for example

- *Transnational cooperation among industry groups*
- *Closer partnerships between industry and regulators*
- *International fibre exchanges*

Flexibility for the future is key. That means building in options to respond flexibly to changing demand. It also means working through various scenarios in advance, and developing contingency plans.

None of the senior executives we've spoken with really knows just what the industry will look like in 20 years time – but they all agree that it will be very different from today. We believe that dialogue is essential, and hope that this paper will serve to further the conversation around the sector's – and your company's – future.

Mark your calendar

PwC's 24th Annual Global Forest & Paper Industry Conference

Changing directions

Opportunities and outlook for people, products and markets

11 May, 2011

Although the global forest, paper and packaging sector has recently been faced with several challenging shifts in the marketplace, it is now time to change directions and revolutionise strategy.

Join us at the 24th annual PwC global forest & paper industry conference 11 May 2011. CEOs, senior executives, customers, suppliers, government policy makers and PwC leaders will explore how the forest products sector is changing directions and how this can translate into fresh opportunities and new sources of value for your company.

To register, or for more information, go to:

www.pwc.com/forestconf11

Further reading

CEO Perspectives: Viewpoints of CEOs in the forest, paper & packaging industry worldwide (2010 edition)

Our third edition of CEO Perspectives summarises the thoughts of 33 CEOs, or equivalent, from leading forest, paper & non-paper packaging sectors on the state of the industry, the key issues it faces and its future direction. This latest edition grappled with major changes in the world in which the FPP industry operates. It has also highlighted the split between mature and emerging markets. So how will the industry reshape itself to meet future challenges? Our study takes a look at the types of transformation needed in the industry, and elaborates on four key trends — getting the business basics right, improving cost structures, deriving the most value from every tree and shaping the industry's future.

Forest, Paper and Packaging Deals — Global deals activity in the forest, paper & packaging industry (2009)

2010 edition due March 2011

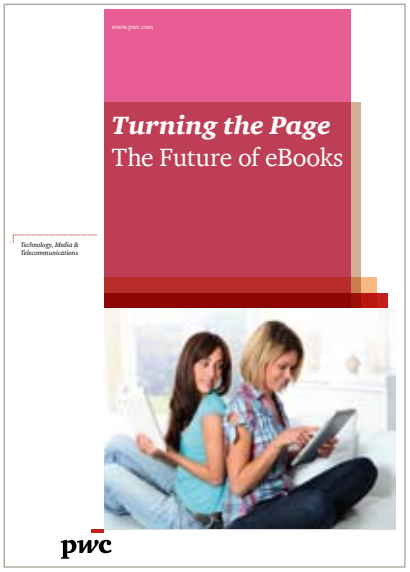
Forest, Paper and Packaging Deals reviews the deal activity in the FPP industries. We examine the rationale behind deal trends and key individual deals. This year we include discussion of restructuring activity in North America in order to address the impact of financial distress on that region's deal market, and look at the reasons behind the high level of deals which took place in Latin America. We highlight some critical issues for companies engaging in deal activity within the sector, including timberland investments, biopathways, and sustainable packaging issues.

Global Annual Forest, Paper & Packaging Industry survey - 2010 edition

The Global Forest, Paper & Packaging Industry Survey, now in its 13th year, provides insight into the major companies and an overview of the issues and events shaping the industry. This year's Survey summarises the 2009 publicly available year-over-year financial information of the PwC Top 100, the 100 largest forest, paper and packaging companies in the world, ranked by sales revenue.

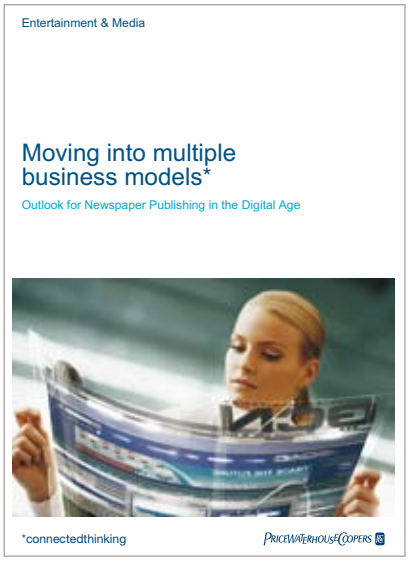
Turning the Page: The Future of eBooks (2010)

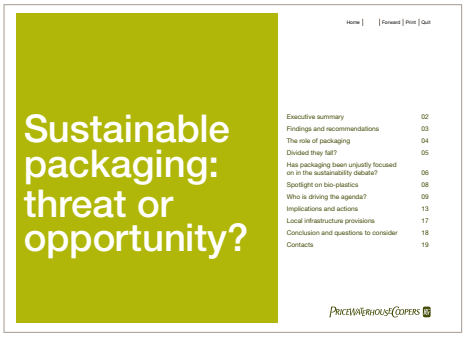
Created by a cross-border team within PwC, this new study examines trends and developments in the eBooks and eReaders market in the United States, United Kingdom, the Netherlands, and Germany, and discusses major challenges and key questions for the publishing industry that will resonate worldwide. Given that publishers, Internet bookstores, and companies that manufacture eReaders have high expectations for the digital future of the book industry, the study asks if a new generation of eReaders may, at last, achieve the long-awaited breakthrough that lures consumers away from paper and ink.



Outlook for Newspaper Publishing in the Digital Age (2009)

This study examines the outlook for newspaper publishers as they deal with long-term structural challenges related to declining circulation and ad sales, adapt to the digital revolution, and cope with the continuing fallout of the global economic slowdown. Research by PwC's Entertainment & Media Industry practice, carried out in cooperation with the World Association of Newspapers (WAN), focuses on two key issues: the change of consumer behaviour with respect to their consumption of news content, and the response of newspaper publishers, advertisers, advertising agencies and media buyers to these changes.



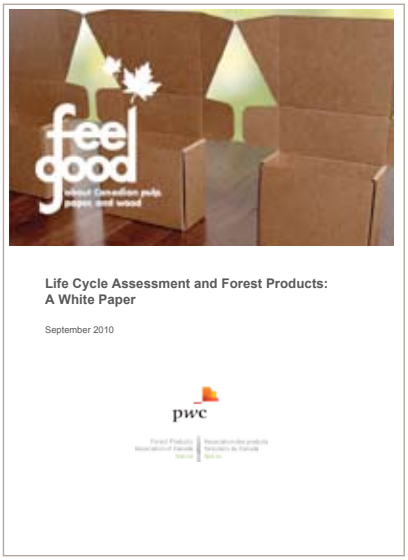


Sustainable packaging: threat or opportunity? (2010)

Under constant pressure from government, the media, customers and consumers, the packaging industry is increasingly being forced to consider how its products can be made more sustainable. Faced with pressing issues of over capacity, low prices and high raw material costs, should 'sustainable packaging' be a top concern for packaging senior executives? Based on in-depth interviews with senior executives from leading packaging companies in Europe, we outline in this report the key challenges and opportunities the issue of 'sustainable packaging' raises for leaders in the industry.

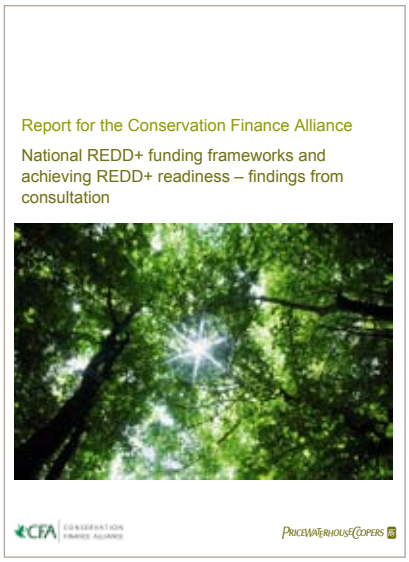
Life Cycle Assessment and Forest Products: A White Paper (2010)

An amplified focus on the environmental, social and economic sustainability credentials of companies and products has led to an increase in the application of life cycle thinking, which includes economic, environmental and social consequences of a product or process over its entire life cycle. LCA is increasingly being used as an important and effective tool to support multiple types of sustainability goals. The Forest Products Association of Canada (FPAC) and PwC developed this white paper to provide information about LCA and as a reference for those interested in learning how LCA can be applied in the forest products industry. This white paper is intended for those new to LCA, as well as those who are already familiar with the concept.



National REDD+ funding frameworks and achieving REDD+ readiness - findings from consultation (2010)

This new study, commissioned by the Conservation Finance Alliance (CFA) and PwC is the first detailed analysis of how REDD+ funding is currently, or could in the future be managed and disbursed within the intended recipient nations. The study highlights the practical capacity and governance issues facing donor and recipient countries, in the roll out of Copenhagen's 'fast start' funding and prospects for long term engagement with donors and private sector investors. It makes a series of recommendations for the steps needed to encourage REDD+ funding at scale to recipient countries.



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