

# Future Development of the Norwegian Forest Industry, Based on Industry Expectations

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## Abstract

Forest industries worldwide are facing a range of challenges, such as declining demand for newsprint, fluctuating sawn-wood prices, and society's concern of forestry's negative environmental impacts. On the other hand, the growing interest in bioenergy and renewable products may represent opportunities for the forest sector. Few assessments of the industry's expectations regarding future development of the major external forces driving the forest sector seem to have been carried out. We undertook two participatory surveys of sawn-wood industry managers in Norway in 2010 and 2013, assessing their expectations of how key factors develop until 2020. The respondents expressed beliefs that the demand for sawn-wood and bioenergy will grow and that sawmilling productivity will increase together with international trade. Society's concern for the environment was expected to rise, leading to higher demand for wood products but also more expensive forestry operations. A bioenergy demand increase of 50 percent, very high energy prices, competitive second-generation biofuel, and the first second-generation biofuel plant being established in Norway were perceived to be notably less likely in 2013 than in 2010. The questions were associated with scenarios of the Norwegian forest sector used in quantitative scenario analyses. In the 2013 survey, less support was given to the scenario with high priority on environmental issues and rapid bioenergy deployment. Recent policy and market shifts that imply a lower emphasis on the environment and cheaper fossil fuels may help explain this change. The survey indicates that short-term shifts in policy and economic factors may considerably impact key agents' assumptions about the future.

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External policy and economic forces are impacting the forest industry through changes in production costs, raw material availability, competition, and demand for manufactured products. Technological development, changing demand patterns, and climate change mitigation policies are all external trends currently exerting influence on the forest sector (i.e., forest industries and forestry). In this study, we gauge how mid- to high-level managers in Norwegian sawn-wood industries consider opportunities and challenges by asking how likely they perceive various key development trends and events to materialize by 2020. The results will be used in quantitative scenario analyses of the Norwegian forest sector but may also be of interest for policymakers per se.

In the next section, current political and economic drivers impacting the forest industries are described. A brief review of studies carried out in the forest sector is subsequently presented, but all these are based on other methods or have slightly different scopes, as no studies were found using a survey to assess forest industry managers' expectations of future developments in the industry. The survey is described in detail in the "Methods" section together with how the survey is linked to a scenario analysis of the Norwegian forest sector, with the results displayed in the "Results." In

the "Discussion," the forest industry's perceived likelihood of the various events is compared with the scenarios before methods and results are reviewed and conclusions are drawn.

## Policy and economic drivers

While earlier environmental concerns over the forest industry were directed mostly at the local pollution to air and water from mills, later concerns include generation of

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solid waste and the industry's impacts of forest ecosystems (Bloemhof-Ruwaard et al. 1996) and, in the last years, harvest's impacts on carbon budgets (Manomet Center for Conservation Sciences 2010). In the 1990s, Greenpeace's campaigning and the German media's attention to the negative environmental effects of forestry in Nordic countries led the publisher Springer to call for documentation from the paper industry on ecologically sound forestry practices (Gulbrandsen 2002). The Norwegian industry replied by establishing the environmental standard "Living Forests" together with forest-owner organizations and environmental organizations, which later fulfilled the PEFC standard (Norwegian Forest Certification, n.d.).

The European Union has pledged to, by 2020, reduce its greenhouse gas emissions by 20 percent, increase the share of renewable energy by 20 percent, and improve its energy efficiency by 20 percent (European Commission 2009a, 2009b). This has caused the wood pellets markets to boom (Sikkema et al. 2011, Sjølie and Solberg 2011). However, these policies have been strongly criticized by environmental groups and have also raised concerns in the scientific community regarding negative impacts on biodiversity (Eggers et al. 2009, Verkerk et al. 2011) and forest carbon sequestration (e.g., Schlamadinger and Marland 1999, Böttcher et al. 2012).

The global paper market is currently going through substantial shifts, with quickly shrinking demand in Western Europe and the United States. European paper demand declined about 20 percent in the period 2007 to 2012, while changes in the US markets have been even more distorting with the demand for office paper declining 40 percent and newsprint 60 percent in the period 2001 to 2011 (Andersen 2012). The setbacks in the US newsprint market have led to more exports from North America (Mahlburg 2011), causing additional problems for European paper producers. Saw-wood demand is tightly linked to the construction of new houses and therefore vulnerable in periods with low economic growth. Finnish sawn-wood prices dipped in 2008 to 2009 as well as in 2011, and real prices have declined by almost 20 percent over the past 10 years (Hänninen and Sevola 2011). In the same period, the use of forest chips in Finland has grown seven times, while real chip prices have about doubled (Hänninen and Sevola 2011). Given that bioenergy producers are capable of paying as much for the chips as the pulp and paper producers, the growing demand for bioenergy may maintain the prices of sawmilling by-products.

Greenhouse gas emissions from wood material production are lower than from steel and concrete (Petersen and Solberg 2005); policies to reduce such emissions in the construction sector may thus impact positively on the sawmilling industry. Differently from the pulp and paper industry, for which the net capacity changes in Europe have been small in previous years (Andersen 2012), sawmilling capacity is growing in several Western European countries with an expected net growth of 2.4 million cubic meters (cbm) of sawn wood in Sweden from 2011 to 2012 (Hänninen and Sevola 2011). Without demand increasing at the same rate, the competition in the sawn-wood market is thus likely to tighten.

## Previous studies

Most published studies of interviews and surveys of market conditions carried out in the forest industries are

from Finland. Owari et al. (2006) interviewed directors and managers in Finnish forest industries to assess the perceived importance of forest certification in wood products marketing. The results indicated that certified companies are typically profiled as primary wood producers, focusing on export to markets with a strong demand for certified wood products. Certification was considered important for indicating a sense of responsibility, keeping market share, and selling products in existing markets. Although raising customer retention and satisfaction, the authors found no improvements in financial performance due to certification.

In another survey of the Finnish forest industry, semi-structured interviews of 11 experts from forest industry and research were undertaken to assess the environmental impacts of the forest industry (Koskela 2011). Positive environmental impacts in the forest industry resulted from recycling, forest industry products, and use of energy. The experts mentioned a total of 18 different groups of environmental impacts. The five environmental impacts considered most important were energy, air emissions, water emissions, forest, and climate change. Most of the issues mentioned by the experts were by definition environmental aspects, not impacts. The most mentioned aspect was climate change.

Vihervaara and Kamppinen (2009) interviewed 12 key persons responsible for environmental and corporate affairs in the Finnish forest industries to obtain insight into sustainable forestry and their perceptions of the main future challenges and possibilities confronting the forest industries. The interviewees considered the challenges related to communication as the most important, including relations to nongovernmental organizations, ecological researchers, stakeholders, and markets. Challenges related to the supply of wood, including illegal logging, forest certification, and restrained roundwood supply caused by the question of old forests, were also considered of substantial importance. Use of wood for bioenergy purposes was considered a possible threat to the traditional forest industries but was also seen as an opportunity for the sector. Ecosystem services as climate change mitigation and emission trade were mentioned as future possibilities for the sector, along with improved efficiency in processing and new innovations.

Satu (2010) used the Delphi technique to obtain expert opinions of opportunities lying in the interface between traditional forest industries and the emerging bioenergy industry in Finland. The experts were also requested to identify the significance of various industry assets and activities and to indicate the importance of these assets and activities in 2015 compared with 2006. The identified key assets included production plants, raw material, technology, and business knowledge as well as skilled personnel, with all assets assumed being more important for the forest industry than for the bioenergy industry. The majority of the experts agreed that collaboration between these two industries is the only way to significantly increase biofuel production while recognizing that such collaboration would be very challenging. The management of customer relations was seen as the most important core activity in the forest industry, followed by research and development, which was thought to be greatly increasing in importance in the coming years.

Thirty-eight persons in the forest and bioenergy industries in 11 European countries participated in a survey among industrial operators and associations of the competitive

situation of biomass (Alakangas and Keränen 2011). The pulp and paper as well as board industries expressed concerns of possible tightening of the market due to the increased demand for wood energy and a lack of policies favoring the sector beyond the bioenergy industry.

Panwar et al. (2010) surveyed residents ( $n=282$ ) in four US states, where forestry historically and currently is socioeconomically important, on corporate social responsibility. The study found that women are more critical when evaluating an industry's social and environmental performance. In the area of environmental expectations, the women also exceeded the men. The authors speculate that women may place environmental issues higher than social issues, indicating that women perceive business activities to harm the environment more than inflicting problems on society. The results indicated some differences in perceived industry performance across education levels and urban/rural residency.

Thompson et al. (2010) examined social responsibility orientation (SRO) gaps between forest industry executives and people living in the US Pacific Northwest ( $n = 298$ ). The forest industry executives had a significantly lower SRO than other respondents, indicating a more individualistic social orientation. Analysis of demographic variables indicated individualistic beliefs to be more prominent among men and rural residents than among the general society respondents. Analysis of demographics and firm characteristics found no significant difference among forest industry executives. The authors argue that understanding gaps in SRO between business executives and the general population provides a basis for companies to understand any misalignments with societal values, which can be important when needing to balance different stakeholder demands.

## Scenario analyses

Scenario analysis is not a prediction of future development but rather an economically consistent assessment of the sector's behavior and responses to external factors for improving the understanding of complex dynamics and interactions (International Panel on Climate Change [IPCC] 2000). The advantage of quantitative model scenario analyses study lies in data-intensive, economically consistent assessments, but they seldom include the evaluation of the likelihood of the scenarios. Scenarios are typically created by researchers who do not necessarily have the insight of those working in the industry. The industry's expectations may be useful as input in quantitative scenario analyses for constructing or benchmarking scenarios. In a scenario analysis, each scenario consists of a set of events (Jarke et al. 1998), and in this study, we ask employees in the Norwegian forest industries how likely they consider that these events take place by 2020. In addition to the presumed direct policy interest, they will be used in quantitative scenario analyses of the Norwegian forest sector, which will supply industry and policymakers with information of how the sector may develop. Because the survey was undertaken twice, in December 2010 and December 2013, it also displays how market perceptions changed during this short period of time.

## Methods

### Survey

A questionnaire was distributed at two Norwegian sawmilling industry annual summits: the Christmas meeting

of the Technical Association of the Norwegian Sawmilling Industry in Hellerudsletta, Norway, on December 14, 2010, and on December 10, 2013. The participants were asked to answer the survey during the seminar, with the questionnaire subsequently being collected. Ninety-seven persons eligible for responding to the survey attended the meeting in 2010 and 94 in 2013, most of them being mid- to high-level managers in Norwegian sawmill companies.

The questionnaire consisted of totally 22 hypothetical forest sector development trends and events divided into four groups of questions: future domestic demand for wood-based products, international markets for wood-based products, costs and productivity, and environmental considerations (Table 1). The respondents were asked to indicate their beliefs of the various development trends and situations to take place in the Norwegian forest sector by 2020, using a 5-point Likert scale, where 1 indicated "very unlikely" and 5 "very likely."

### Linking the survey results to scenarios

Three alternative scenarios in addition to BAU of the Norwegian forest sector were developed with the objective of projecting the impacts on the Norwegian forest sector economy and greenhouse gas flows (Sjølie et al. 2010). The scenarios were built on the IPCC scenarios (IPCC 2000) with the basic drivers being economic growth, society's environmental concerns, and the degree of globalization. The spatial, partial equilibrium model of the Norwegian forest sector NorFor (Sjølie et al. 2011, 2013) is used for the scenario analyses. It projects forest management, harvest, production, and consumption of wood products and trade for each county in Norway and tracks the sector's main greenhouse gas fluxes. Producers (i.e., forest owners and industry owners) are assumed to maximize profit and consumer utility. The scenarios are the following:

0. BAU: Dominant recent trends will continue, and no drastic policies will be undertaken. Growth in gross domestic product is assumed moderate (1.5%/y), the energy price being 0.075 \$/kWh,<sup>1</sup> and the demand for forest products is assumed to follow actual trends.
1. High economic growth—high technology: The scenario is built on the IPCC A1 scenario, with high economic growth (2%/y) and a high degree of international trade leading to reduced world market roundwood prices. High-productivity growth in the sector, coupled with technological development, results in the establishment of biorefineries. The demand for bioenergy is reduced in this scenario due to low energy prices. While the demand for newsprint declines drastically, the demand for tissue and packaging increases.
2. Environment—greenhouse gas reduction: This scenario is constructed around the IPCC B2 scenario, where environmental issues and the reduction of greenhouse gas emissions have high priority in society. Economic growth and technological development are similar to BAU. The demand for bioenergy and solid wood products increases substantially owing to wood's "green image" and greenhouse gas-intensive products being

<sup>1</sup> A conversion factor of 8 from the Norwegian krone to the US dollar is used throughout this article.

Table 1.—Development trends and situations included in the survey.

Question group	Development trend/situation	Scenario association <sup>a</sup>
Future domestic demand for wood-based products	Paper consumption in Norway and Europe will decline by up to 30% compared with today.	1. High economic growth—high technology
	The use of timber in construction and wooden houses will increase.	2. Environment—greenhouse gas reduction
	The demand for competitive materials such as steel and concrete will decline.	2. Environment—greenhouse gas reduction
	Sawn-wood demand increases to 1 cbm per person per year.	2. Environment—greenhouse gas reduction
	Total demand for bioenergy (heat, electricity, and fuel) increases by ~50% compared with today.	2. Environment—greenhouse gas reduction
International markets for wood-based products	The first second-generation biofuel plant is established in Norway.	2. Environment—greenhouse gas reduction
	European pulpwood prices decline by up to 30% compared with today.	1. High economic growth—high technology
	Increased risk of disease transmission reduces international timber trade	3. Sawn-wood market and bioenergy
Costs and productivity	Swedish sawn-wood prices decline by up to 10% compared with today.	3. Sawn-wood market and bioenergy
	More uniform European Union standards for sawn wood increases import opportunities.	3. Sawn-wood market and bioenergy
	Productivity in the sawn-wood industry increases by up to 15% compared with today.	1. High economic growth—high technology
	Productivity in the paper industry increases by up to 15% compared with today.	1. High economic growth—high technology
	Forestry costs are reduced by up to 15% compared with today.	1. High economic growth—high technology
Environmental considerations	Energy prices double the current level are not uncommon.	2. Environment—greenhouse gas reduction
	Second-generation biofuels are competitive with fossil fuels.	2. Environment—greenhouse gas reduction
	Issues such as biodiversity, conservation, and recreation are given more attention in the society.	2. Environment—greenhouse gas reduction
	~5% of all productive forest is conserved.	[2. Environment—greenhouse gas reduction]
	Changes in management and harvest operations increase forestry costs by up to 15% compared with today.	2. Environment—greenhouse gas reduction
	Forests older than 130 y shall not be harvested.	[2. Environment—greenhouse gas reduction]
	Wood is good: a trustworthy environmental profile increases the demand for wood products.	2. Environment—greenhouse gas reduction
Forest conservation is seen as better than the use of wood products, including for the purpose of carbon storage.	[2. Environment—greenhouse gas reduction]	
Because of the climate benefits, all harvested fields are regenerated denser than today.	[2. Environment—greenhouse gas reduction]	

<sup>a</sup> Brackets indicate loosely linked to Scenario 2.

heavily taxed. One second-generation biofuel plant is established in Norway.

3. Sawn-wood market and bioenergy: Based on the IPCC A2 scenario, with medium-level economic growth and technological development, environmental concerns are less emphasized in this scenario. More uniform standards within Europe (e.g., European conformity marking) increase regional trade of roundwood and sawn wood and lowers the European sawn-wood prices by 40\$/cbm compared with BAU. Subsidies to bioenergy grow due to the concerns of energy supply security, but second-generation biofuel is still too expensive to be produced in Norway.

Each question was associated with one scenario, as indicated in Table 1. The respondents' perceptions of the likelihood of elements constituting the scenarios could thus be assessed. However, some of the questions regarding specific environmental measures undertaken in forestry (“~5% of all productive forest is conserved,” “forests older than 130 y shall not be harvested,” “forest conservation is seen as better than the use of wood products, including for the purpose of carbon storage,” and “because of the climate benefits, all harvested fields are regenerated

denser than today”) do not follow directly from any scenario but are suggested to be linked to Scenario 2 (environment—greenhouse gas reduction), which is the closest scenario (labeled “[2. Environment—greenhouse gas reduction]” in Table 1). In the “Results” section, the forest industry’s assessment of the likelihood of different factors to take place in 2020 is compared with the factors constituting the scenarios.

## Results

Indication of belief in each development trend in 2010 and 2013 is contrasted in this section. However, as interesting trends across questions groups emerged, we chose to present the results with an emphasis on the various products (sawn wood, paper, and bioenergy) in addition to the two categories of forestry and environmental considerations. All questions had between 72 and 75 respondents in 2010 and between 69 and 72 in 2013.

### Sawn-wood products

The overall picture of expectations in the sawn-wood market is that there are few radical changes from 2010 to 2013 (Fig. 1). However, 15 fewer respondents (about 20%)

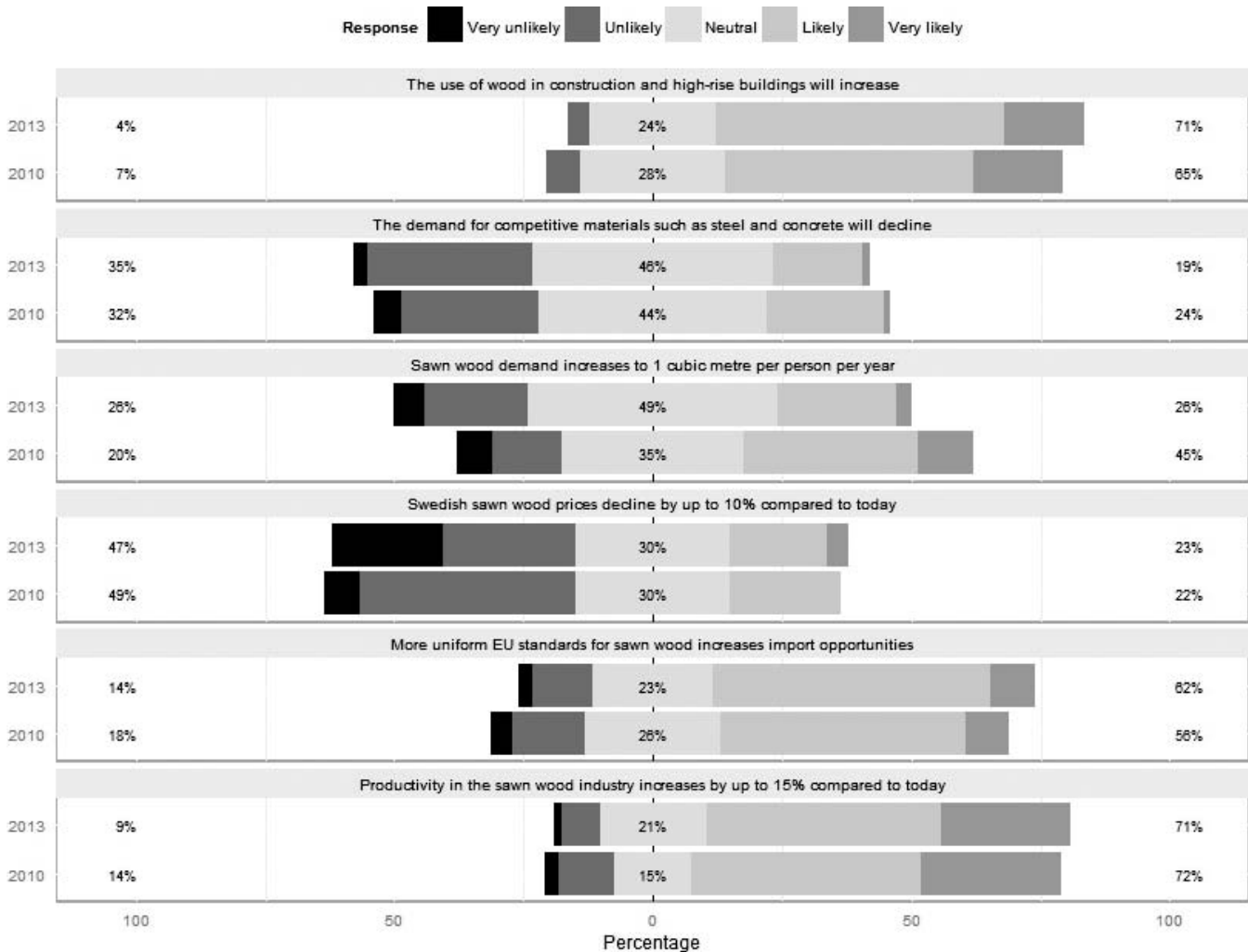


Figure 1.—Responses for development trends and events in the sawn-wood sector in 2013 and 2010. The percentage numbers to the left in the figure refer to the sum of the shares of “very unlikely” and “unlikely” responses (i.e., 1 and 2 on the Likert scale), the percentage numbers in the middle refer to the shares of “neutral” response (i.e., 3 on the Likert scale), and the percentage numbers to the right refer to the sum of the shares of “likely” and “very likely” responses (i.e., 4 and 5 on the Likert scale) in each of the years 2010 and 2013. A skew to the right from 2010 to 2013 thus indicates higher belief.

believed in the “1 cbm per capita and year consumption” goal in 2013 than in 2010. The respondents reported continued belief in increased use of wood in construction and high-rise buildings. They were also positive about productivity growth in the sawn-wood industry. Both years, most respondents did not foresee the 10 percent decline in Swedish sawn-wood prices but believed in more sawn-wood import opportunities.

### Paper products

Almost half of the respondents found a 30 percent decline in paper consumption in Norway and Europe to be likely, a number that barely changed between the 2 years (Fig. 2). This belief was not followed by the view of a 30 percent decline in pulpwood prices. Also, the respondents did not, in general, foresee a reduction in international trade due to the risk of phytosanitary diseases.

### Bioenergy

The largest changes in the survey from 2010 to 2013 were seen in the bioenergy sector. Compared with 2010,

considerably fewer respondents in 2013 believed in energy prices twice the current level, high-demand growth for bioenergy, second-generation biofuel being competitive with fossil fuels, and the first second-generation biofuel plant being established in Norway in 2020 (Fig. 3). The largest change among all questions seen in the survey was on the question “energy prices double the current level is not uncommon.” Thirty-four fewer respondents checked 4 or 5 (likely and very likely) on this question in 2013 than in 2010, a reduction from 74 to 41 percent of the respondents. In 2010, 41 percent believed in second-generation biofuels being competitive with fossil fuels, but only 19 percent expressed the same opinion in 2013.

### Forestry

The respondents were asked to indicate their belief in two development trends regarding forestry costs. Both in 2010 and 2013, about one-third answered likely or very likely, one-third neutral, and one-third unlikely or very unlikely to the question that forestry costs are reduced by up to 15 percent by 2020. About half of the respondents

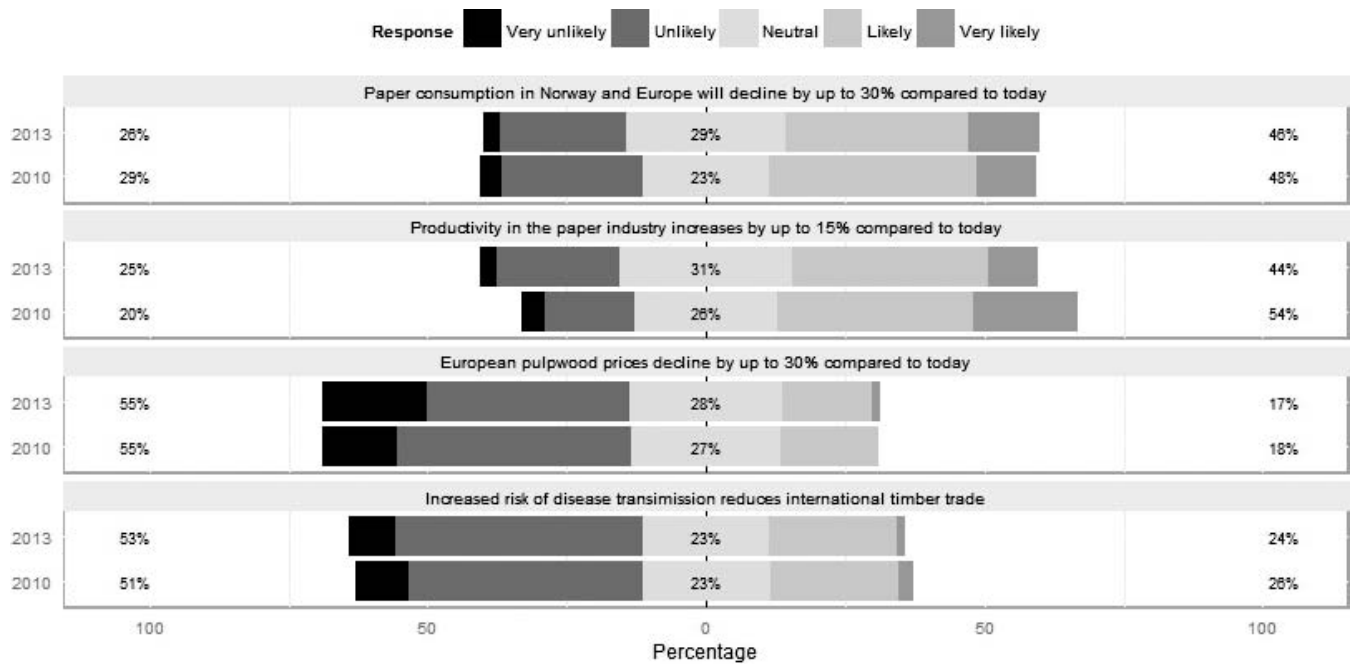


Figure 2.—Responses for development trends and events in the paper sector in 2013 and 2010. For an explanation of the graphs, see Figure 1.

found forestry costs increase by up to 15 percent owing to changes in management and harvest operations to be unlikely (Fig. 4).

### Environmental issues

In 2010, 80 percent of the sample believed in “more attention being paid to environmental issues in the society” and “wood is good: a trustworthy environmental profile increases the demand for wood products.” These numbers

declined to 63 and 68 percent in 2013, respectively (Fig. 5). The 2010 to 2013 changes in responses on the more specific questions regarding environmental considerations in forestry were small, while the overall trend was slightly less belief in these measures being undertaken by 2020. Two-thirds answered positively to the question of 5 percent of all productive forest to be preserved in 2010, contrasted to 50 percent in 2013.

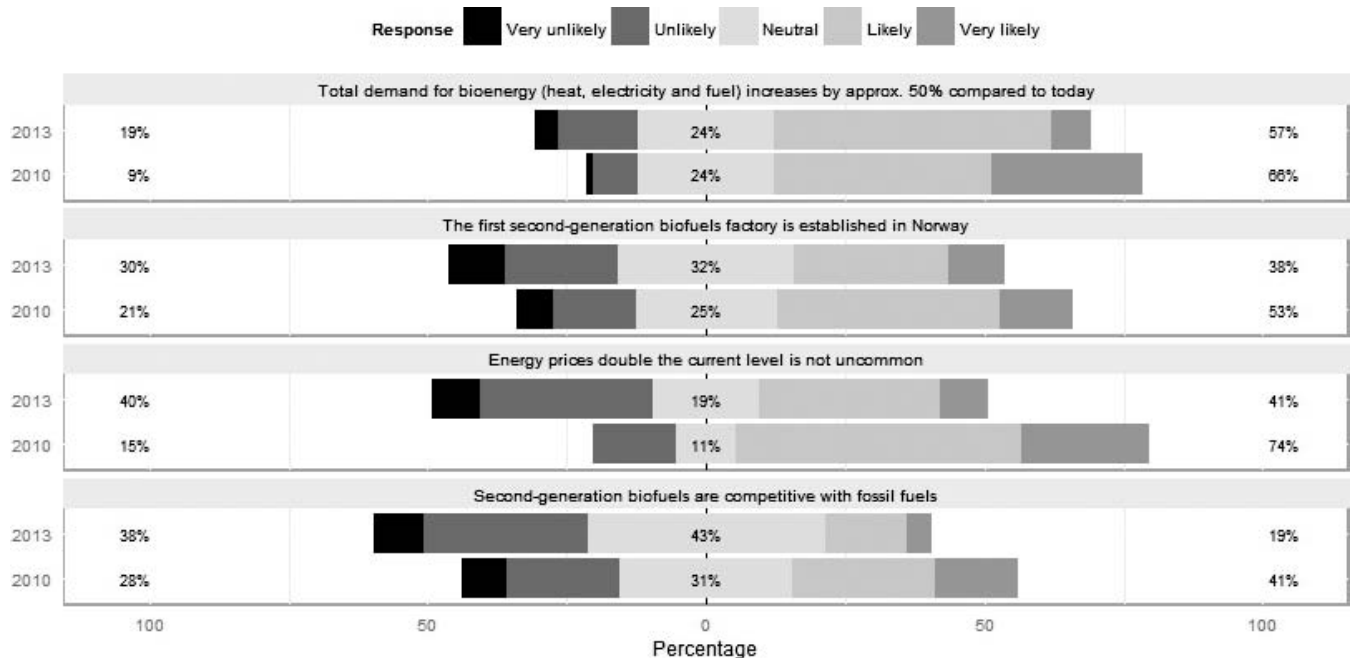


Figure 3.—Responses for development trends and events in the bioenergy sector in 2013 and 2010. For an explanation of the graphs, see Figure 1.

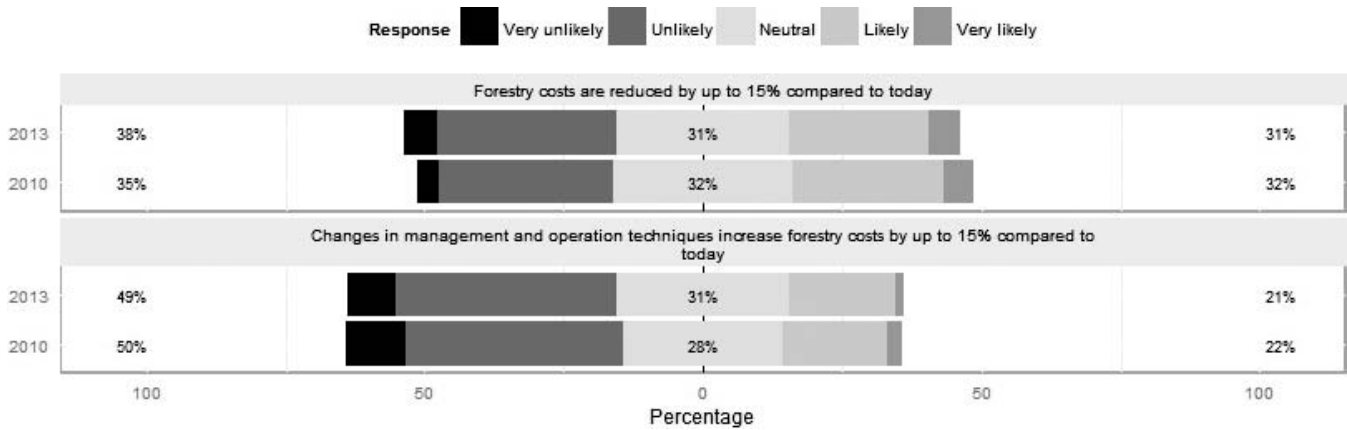


Figure 4.—Responses for development trends regarding forestry costs in 2013 and 2010. For an explanation of the graphs, see Figure 1.

Eleven questions had a median of 4 in the 2010 survey, while six questions had a median of 4 in 2013 (Table 2). Thus, there was a considerable reduction in support for certain statements between the two surveys. A Mann-Whitney *U* test (Mann and Whitney 1947) indicated that the

responses for the 2 years were significantly different at a 5 percent level for the following questions: sawn-wood demand increases to 1 cbm per person per year; energy prices double the current level is not uncommon; total demand for bioenergy (heat, electricity, and fuel) increases

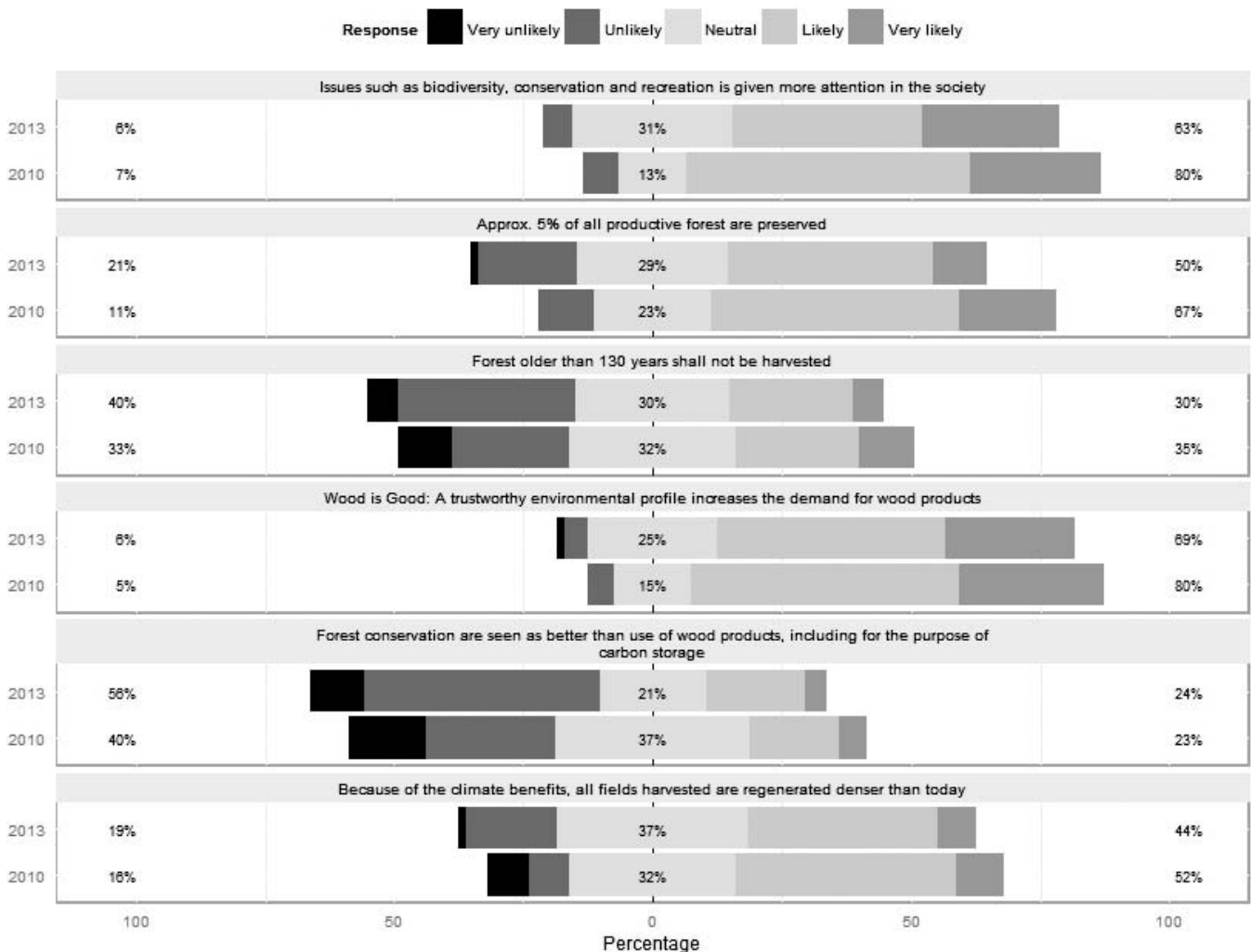


Figure 5.—Responses for development trends regarding environmental issues in 2013 and 2010. For an explanation of the graphs, see Figure 1.

Table 2.—Survey statistics: quartiles (first [Q1], second [median], and third [Q3]) for 2010 and 2012 and P value of Mann-Whitney U test (only those with P value < 0.05 are reported).

Category	Question	Associated scenario <sup>a</sup>	2010			2013			Mann-Whitney U test: P value
			Q1	Median	Q3	Q1	Median	Q3	
Sawn-wood sector	The use of wood in construction and high-rise buildings will increase.	2	3	4	4	3	4	4	
	The demand for competitive materials as steel and concrete will decline.	2	2	3	3	2	3	3	
	Sawn-wood demand increases to 1 cbm per person per year.	2	3	3	4	2	3	3.25	0.038
	Swedish sawn-wood prices decline by up to 10% compared with today.	3	2	3	3	2	3	3	
	More uniform European Union standards for sawn wood increases import opportunities.	3	3	4	4	3	4	4	
	Productivity in the sawn-wood industry increases by up to 15% compared with today.	1	3	4	5	3	4	4	
Paper sector	Paper consumption in Norway and Europe will decline by up to 30% compared with today.	1	2	3	4	2.75	3	4	
	Productivity in the paper industry increases by up to 15% compared with today.	1	3	4	4	2.25	3	4	
	European pulpwood prices decline by up to 30% compared with today.	1	2	2	3	2	2	3	
	Increased risk of disease transmission reduces international timber trade.	3	2	2	3.75	2	2	3	
Bioenergy sector	Total demand for bioenergy (heat, electricity, and fuel) increases by ~50% compared with today.	2	3	4	5	3	4	4	0.015
	The first second-generation biofuel plant is established in Norway.	2	3	4	4	2	3	4	
	Energy prices double the current level are not uncommon.	2	3.25	4	4	2	3	4	2.80E-05
	Second-generation biofuels are competitive with fossil fuels.	2	2	3	4	2	3	3	0.028
Forestry costs	Forestry costs are reduced by up to 15% compared with today.	1	2	3	4	2	3	4	
	Changes in management and harvest operations increase forestry costs by up to 15% compared with today.	2	4	4	5	3	4	4	
Environmental issues	Issues such as biodiversity, conservation, and recreation are given more attention in the society	2	3	4	4	3	3	4	
	~5% of all productive forest is conserved.	[2]	3	4	4	3	3	4	0.023
	Forests older than 130 y shall not be harvested.	[2]	2	3	3	2	2	3	
	Wood is good: a trustworthy environmental profile increases the demand for wood products.	2	4	4	4.5	3	4	4.75	
	Forest conservation is seen as better than the use of wood products, including for the purpose of carbon storage.	[2]	2	2.5	3	2	2.5	3	
	Because of the climate benefits, all harvested fields are regenerated denser than today.	[2]	2	3	4	2	3	4	

<sup>a</sup> Brackets indicate loosely linked to Scenario 2.

by approximately 50 percent compared with today; second-generation biofuels are competitive with fossil fuels; and approximately 5 percent of all productive forest is conserved (Table 2). In all these cases, the responses shifted toward less belief in that situation occurring in 2020 between the two surveys.

## Scenarios

Table 3 displays the number of questions perceived as likely linked to the scenarios. A question was categorized as likely if the median of the answers exceeded 3. Of the five questions associated with Scenario 1 (high economic growth—high technology), two were considered likely in 2010 (15% productivity growth in the sawn-wood industry and in the paper industry), while in 2013, this belief was expected only for the sawn-wood industry.

Ten questions were associated with Scenario 2 (environment—greenhouse gas reduction), where a shift in the perceptions was observed between the two surveys. The only two trends not perceived likely in 2010 were reduced demand for steel and concrete and second-generation biofuel being competitive with fossil fuel. Still not considered probable 3 years later, these two questions were in 2013 joined by sawn-wood demand growing to 1 cbm per person, doubled energy prices, second-generation biofuel being established in Norway, and biodiversity issues given higher priority in the unlikely group.

Of the more specific environmental measures given in the survey that were loosely linked to Scenario 2, labeled “[2. Environment—greenhouse gas reduction],” in 2010 the respondents expected only one situation to materialize: an increase to 5 percent of all productive forestland being conserved by 2020. However, none of the development



**Table 3.**—Number of questions associated with each scenario and the number of questions perceived as likely, i.e., with median > 3, in 2010 and 2013.

Scenario	No. of questions	2010		2013	
		2010	2013	2010	2013
1. High economic growth—high technology	5	2	1	2	1
2. Environment—greenhouse gas reduction	10	7	4	7	4
[2. Environment—greenhouse gas reduction]	4	1	0	1	0
3. Sawn-wood market and bioenergy	5	1	1	1	1

trends in this category of environmental measures were expected by the respondents in 2013. There were no changes in the number of questions perceived probable in Scenario 3 (sawn-wood market and bioenergy) in 2010 and 2013.

Of the 19 questions directly associated with the scenarios, 10 were perceived likely in 2010 and 6 in 2013 (Table 3). The respondents expressed in general a strong belief in productivity growth in the sector, compatible with Scenario 1 (high economic growth—high technology). In both 2010 and 2013, they answered positively to the question of a 30 percent decline in paper consumption but not on the question of a similar decline in pulpwood prices. The shrinkage in demand for paper may thus be believed to be mitigated partly by growing bioenergy markets. However, the confidence in bioenergy expansion has clearly deteriorated between the two surveys. Thus, while the support for the main trends and situations specified in Scenario 2 (environment—greenhouse gas reduction) was rather strong in 2010, with 7 of 10 questions perceived as likely, only 4 of the questions were considered probable in 2013. In Scenario 3 (sawn-wood market and bioenergy), there were no radical changes between the two surveys.

## Discussion

Market agents' expectations of how the forest sector will look in the future are impacted by big, long-term trends in society as well as short-term market and policy shifts. While the responses on most questions were not markedly different between the two surveys, clear shifts in perceived future market conditions for bioenergy were detected. We interpret the significant lower expectations of energy prices double the current level, the breakthrough for second-generation biofuel, and the 50 percent increase in bioenergy demand as responses to previous years' energy policy and market changes. With growing North American terrestrial oil and gas production, oil prices are believed to decline (World Bank 2013), reducing the probability of competitive second-generation biofuel. A green electricity certificates system that will expand Norwegian renewable electricity production up to 2020 by more than 10 percent was voted in 2011 (Norwegian Water Resources and Energy Directorate, n.d.). Bioenergy producers are not believed to benefit from the system (Blokhus 2011), and electricity prices may be reduced (Bye and Hoel 2009).

Alongside reduced expectations of a boost in the bioenergy sector, there was a significant decline between the two surveys in the belief of conserving 5 percent of all productive forestland, which would signify a doubling of the current protected area (Søgaard et al. 2012). The participants' belief in society's growing environmental concerns and the wood-is-good concept to trigger demand growth for wood products was simultaneously dampened. These shifts

might be linked to the voters' reduced interest in environmental issues, such as climate policy in the period 2009 to 2013 (Livgard 2014). A possible underlying reason is the increased focus on economic growth, job creation, and international competitiveness due to the continuing economic crisis in Europe.

However, despite the decrease between the two surveys, the respondents assigned high trust in the perceived environmental beneficial aspects of wood helping to boost demand. Thus, compared with their colleagues in Finland who saw communication and public attitudes as the largest risk facing the industry (Vihervaara and Kamppinen 2009), the Norwegian industry seemed more optimistic with regard to society's environmental concerns, believing that these considerations would be an opportunity for the sector.

Sawn-wood prices had reached historically high levels when the survey was carried out in 2010. With the price decline of 16 percent between the two surveys, the belief in domestic wood consumption reaching the often-mentioned consumption goal of 1 cbm sawn wood per capita and per year declined. So far, sawn wood in Norwegian markets has consisted mainly of domestic products. More imports from Sweden following the previous years' capacity expansions have been considered plausible but do not seem to be supported by this sample. Sawn-wood consumption growing from the current per-capita level of about 0.57 cbm (Food and Agriculture Organization 2014, Statistics Norway 2014 [numbers reported represent the estimated apparent consumption of coniferous and nonconiferous sawn wood: domestic production + imports – exports]) is a policy goal. Use of wood in urban construction has been highlighted with the extensive use of wood in several modern wood construction projects over the past few years in Norway (Norwegian Ministry of Culture 2009) that may have triggered the respondents' belief in such utilization.

Roundwood is today traded relatively freely within Europe, while special treatment is partly required for coniferous imported from elsewhere (Dwinell 1997). There is a fear that a warmer climate may lead to the escalation of the spread of infectious diseases in plants (Anderson et al. 2004), triggering such measures as tighter trade regulations, but this worry was not shared by the sample.

The insight offered by this sample is valuable for those working with the construction of scenarios related to the forest and bioenergy sectors because industry managers' understanding of markets often complement researchers' expertise. In parallel, with their day-to-day scrutinizing of markets, managers may inform policymakers of upcoming issues important for policies. Conversely, policymakers need to know about the industry's expectations of the future, as these will influence how they react to policies. For investors and those related to the sector economically, complementing information reduces risk and may help in investment decisions.

On a more general level, this survey shows that short-term shifts in policy and economic factors may considerably impact agents' assumptions about the future. Responses on trends closely linked to the current policy and market climate seem considerably more volatile than those on more technological character (i.e., productivity growth), which maintain a higher degree of stability. The development of most such scenarios is at least to some extent based on market and policy conditions that may change considerably within a short time. If conditions change radically and care

is not taken, scenarios could quickly lose relevance. Ideally, scenarios should be formulated to be robust to sudden shifts and, even better (and more difficult), include the at-that-point unknown factors that later will be brought into play.

## Conclusions and Limitations

Carrying out surveys during seminars is an effective way to lower administrative costs and enable high response rates. As with all surveys, there are some potential pitfalls. Acquiescence bias (i.e., that respondents tend to agree with the statement and give a positive answer; Watson 1992), may have occurred, illustrated by the two partly contradictory questions on forestry costs (Fig. 4) where the responses are not mutually consistent. Given that this bias is of the same magnitude in both survey years, the trend in responses is not biased. The end-aversion (or central-tendency) bias (i.e., that people tend to avoid the maximum and minimum categories) is also well known in the literature of surveys (Kaplan 2001). Categories 1 and 5 have received a very small share of the total responses. Of course, that may simply reflect the fact that people did not have strong opinions regarding many of the questions. However, the trend that fewer questions received high ratings in the second survey suggest that market and policy shifts that impact people's expectations were seized in the study.

Taken together, the sawn-wood industry expressed a high degree of certainty in increased 2020 bioenergy production in 2010 but considerably less so in 2013. In both years, they supported the view of high-productivity growth in the sector, albeit with higher costs of forestry due to changes in management and harvest operations. The respondents believed in a continued decline in European paper consumption but not in pulpwood price reduction of a similar magnitude. The answers also revealed strong beliefs in a more environmentally concerned society that puts constraints on forestry in order to preserve the forests' biodiversity and carbon benefits. More regulations might be an opportunity if they could lead to an improved image of wood, and the respondents seemed rather certain that such an image will impact positively on the demand for wood products. Associating the questions to forest sector scenarios displayed that the previous years' changes in the energy market and policy probably has led to reduced support for the environmental and climate change mitigation scenario compared with the 2010 survey. Even within a relatively short time frame, informed agents' perceptions regarding important future events have changed considerably.

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