



Smart Forestry Market Analysis

Analysis of current status and opportunities in forestry digitalization market

Summary presentation

DECEMBER 13, 2021

**BUSINESS
FINLAND**

FUTURE WATCH

Content

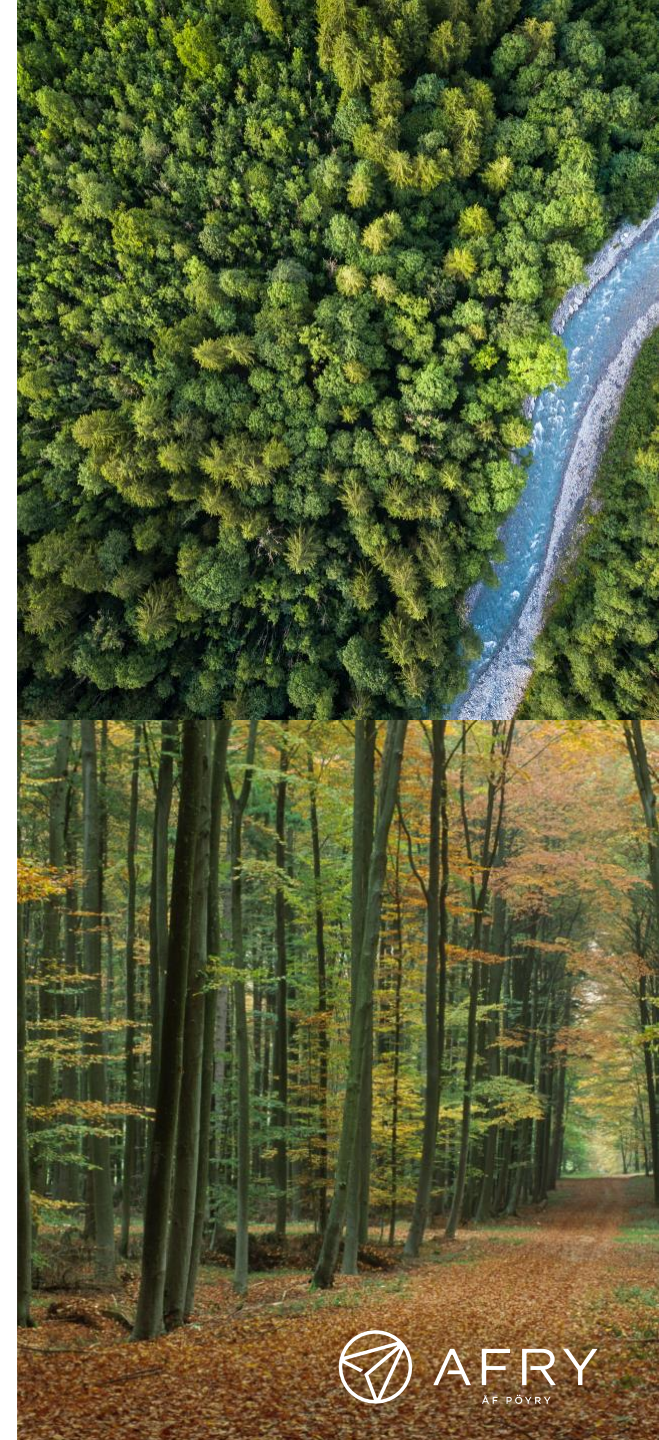
1. Introduction
2. Step a – High level market analysis
3. Step b – Opportunity analysis
4. Step c – Conclusions and recommendations

1. Introduction

INTRODUCTION

AFRY has supported Business Finland to analyse the Smart Forestry market and identify opportunities for Finnish companies in the sector

- Business Finland has launched a Smart Forestry programme, aiming at identifying new business opportunities in the global sustainable forestry and wood sourcing value chain, leveraging from Finnish know-how in forestry technology, data collection and analysis and optimisation within the value chain.
- In this context, Business Finland has decided to carry out a global landscape analysis the forestry digitalization industry in order to better understand the global market opportunities of Finnish forestry digitalization technology and know-how in a forward-looking manner.
- AFRY Management Consulting has been supporting Business Finland in the analysis during summer and autumn 2021.
- The analysis is based on publicly available data sources and databases, combined with knowledge of AFRY's global expert network and insight to global and local aspects of Smart Forestry. Also, based on AFRY's long experience in working in global forestry and bioindustry space, AFRY has a deep insight to the global forestry value chains, current practices and opportunities, including the regional specifics.

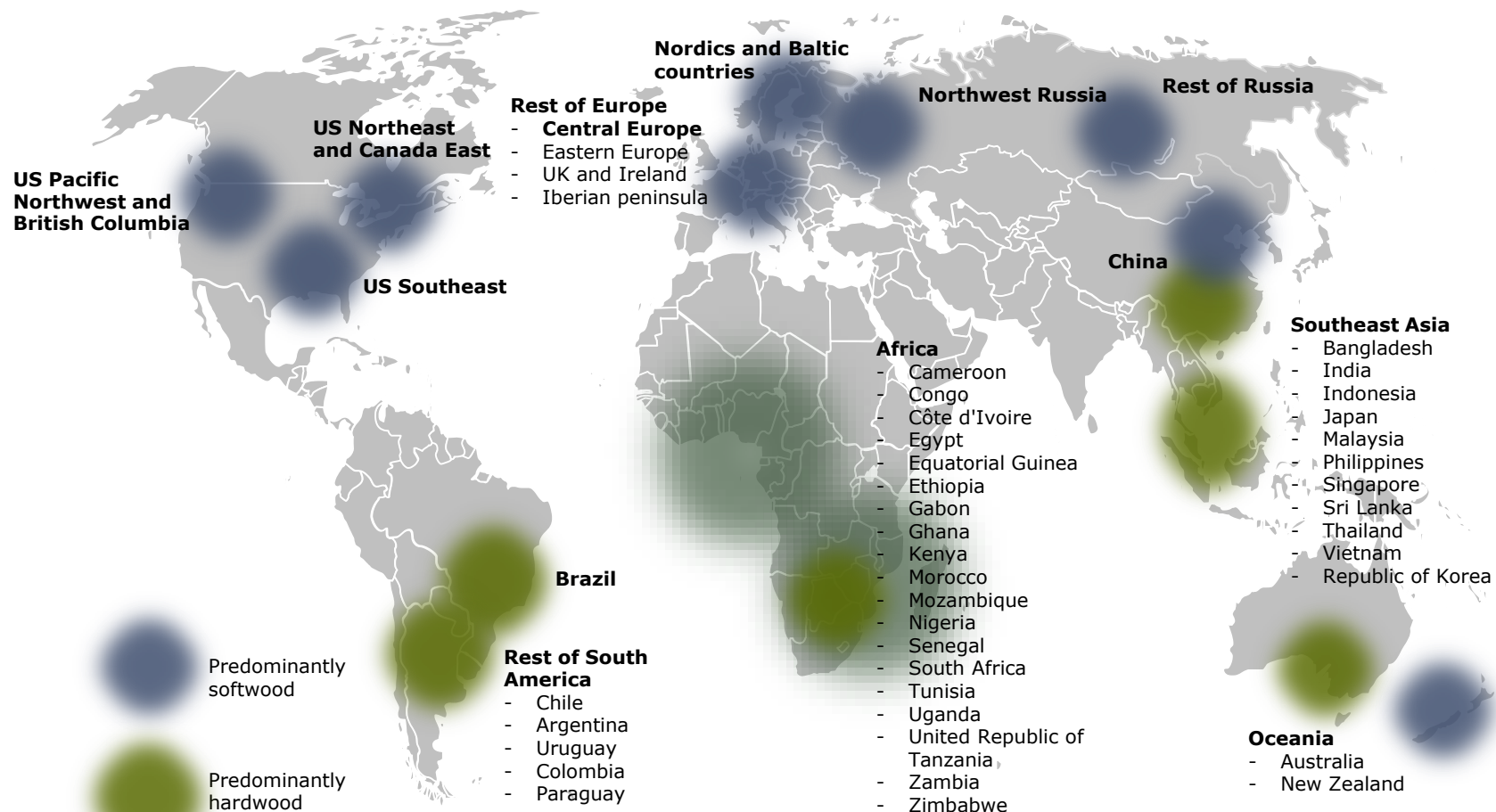


SCOPE AND APPROACH

The analysis consists of three steps: High level market analysis and opportunity analysis by macro region and operation area leads to conclusions and recommendations for focus areas



Geographic focus of the analysis covers the key existing and emerging forestry regions globally, at a regional level



The most relevant regions in terms of forest resources were selected for the analysis.

Industrial forest resources in Northern hemisphere are softwood dominated semi-natural forests:

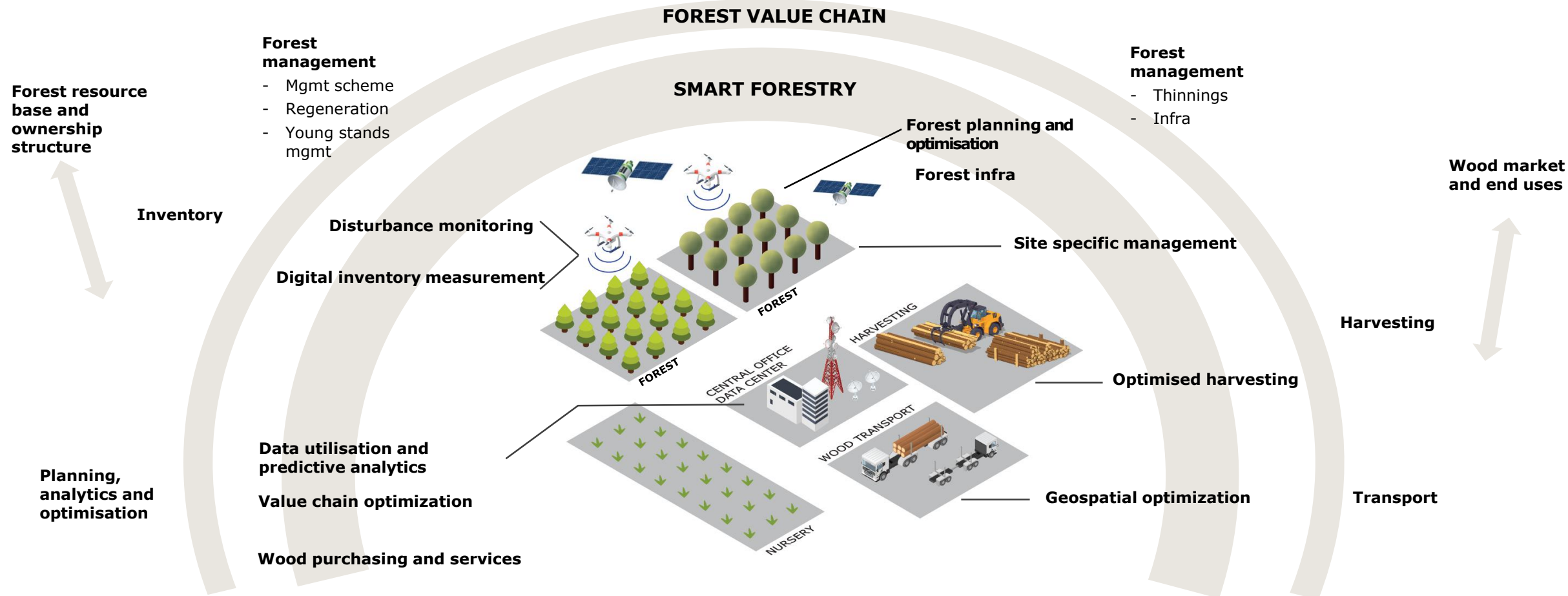
- Nordics and Baltic countries
- Rest of Europe (HW plantations in Iberian peninsula)
- Northwest Russia
- Rest of Russia
- US Southeast (mostly SW plantations)
- US Pacific Northwest and Canadian British Columbia
- US Northeast and East Canada

The industrial forest resources in the tropics and Southern hemisphere concentrate on hardwood plantations:

- Brazil
- Rest of South America
- Africa (both SW and HW)
- China (both SW and HW)
- Southeast Asia
- Oceania (SW mostly in New Zealand, HW and SW in Australia)

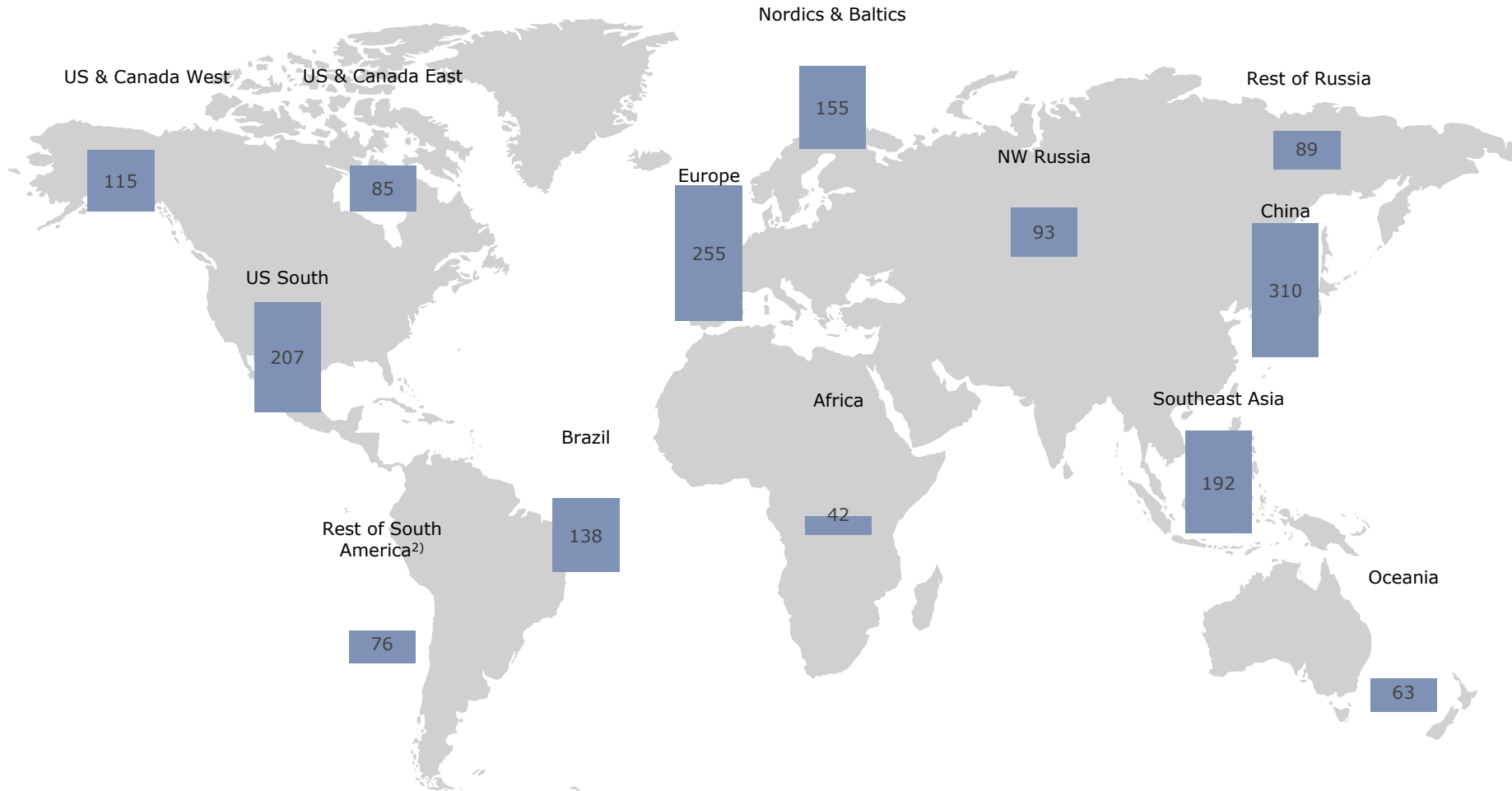
CONTEXT

Smart forestry focuses on digital solutions to improve accuracy and efficiency in the forestry value chain from forestry operations to harvesting and wood transport, including planning, analytics and optimisation



2. Step a – High level market analysis

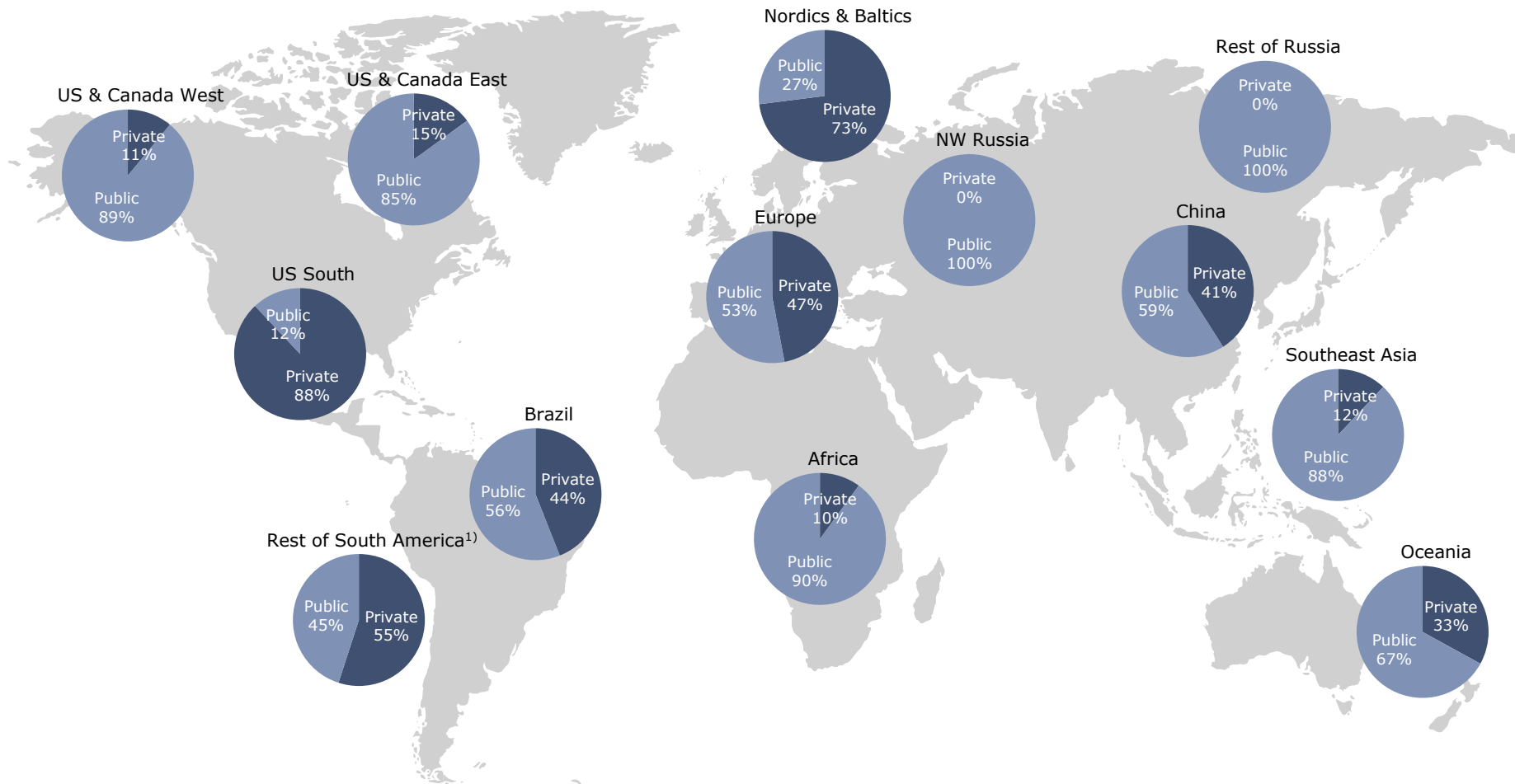
Industrial roundwood harvest volume (total ~2 000 M m³/a) concentrates to a few key areas globally



Harvesting volume in million m³/a (2019); 1) Excludes fuelwood 2) Includes: Argentina, Chile, Colombia, Paraguay and Uruguay
Regions included in the analysis cover > 90 % of the global total industrial roundwood harvest

STEP A SUMMARY – FOREST OWNERSHIP

Public forest ownership is globally common, but forest plantations are mostly privately owned. Private forest ownership prevails in Nordics and US South



1) Includes: Argentina, Chile, Colombia, Paraguay and Uruguay

STEP A SUMMARY – MARKET SIZE AND MARKET STRUCTURE TO SUPPORT SMART FORESTRY DEVELOPMENT

Based on the high level forest sector overview, Nordics & Baltics, Europe, US South, Brazil and Oceania appear the most potential regions to benefit from smart forestry. However, opportunities exist in other regions also.

Region	Commercial forest area	Industrial roundwood harvest	Market size	Forestry practices	Harvest and transport systems	Forest cluster structure	Market structure
Nordics and Baltics	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●
Rest of Europe	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●
NW Russia	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●
Rest of Russia	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●
US South	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●
US and Canada East	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●
US and Canada West	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●
Brazil	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●
Rest of S. America	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ● *
China	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●
Southeast Asia	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ● *
Oceania	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●
Africa	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ● *

* Large variation between countries in Southeast Asia and South America. South Africa has clearly more advanced forest sector compared to the rest of Africa.

Rating:

- ● ● Clearly supporting smart forestry development
- ● ● Neutral for smart forestry development
- ● ● Less favourable for smart forestry development

3. Step b – Opportunity analysis

Future forest industry trends likely remain positive around most of the world, driven by mega trends that support use of wood based products



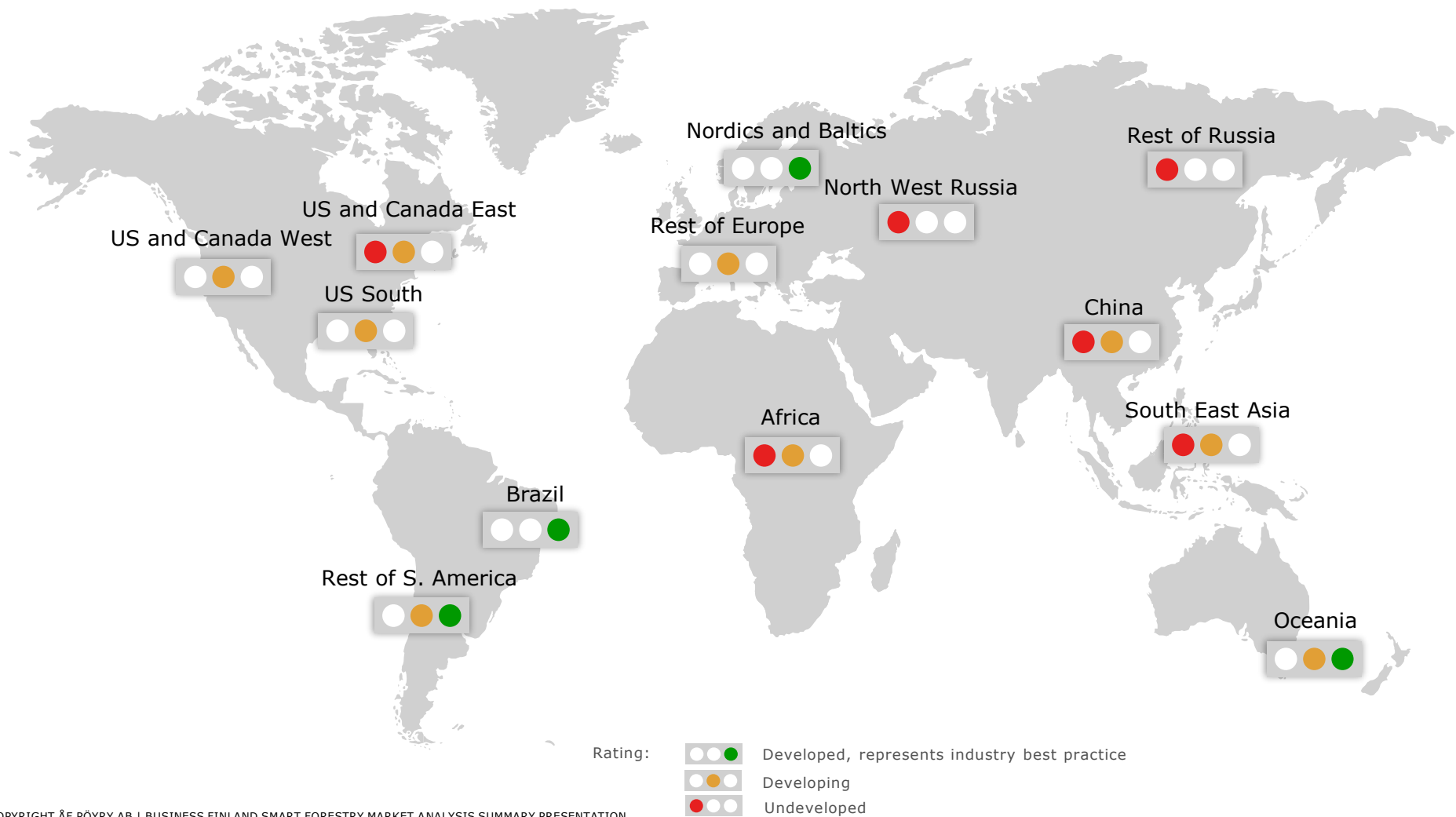
STEP B SUMMARY – OVERALL FUTURE FOREST SECTOR TRENDS

Regional and sectoral differences exist between regions. For example USA and Canada West suffer from forest damages that decrease wood availability

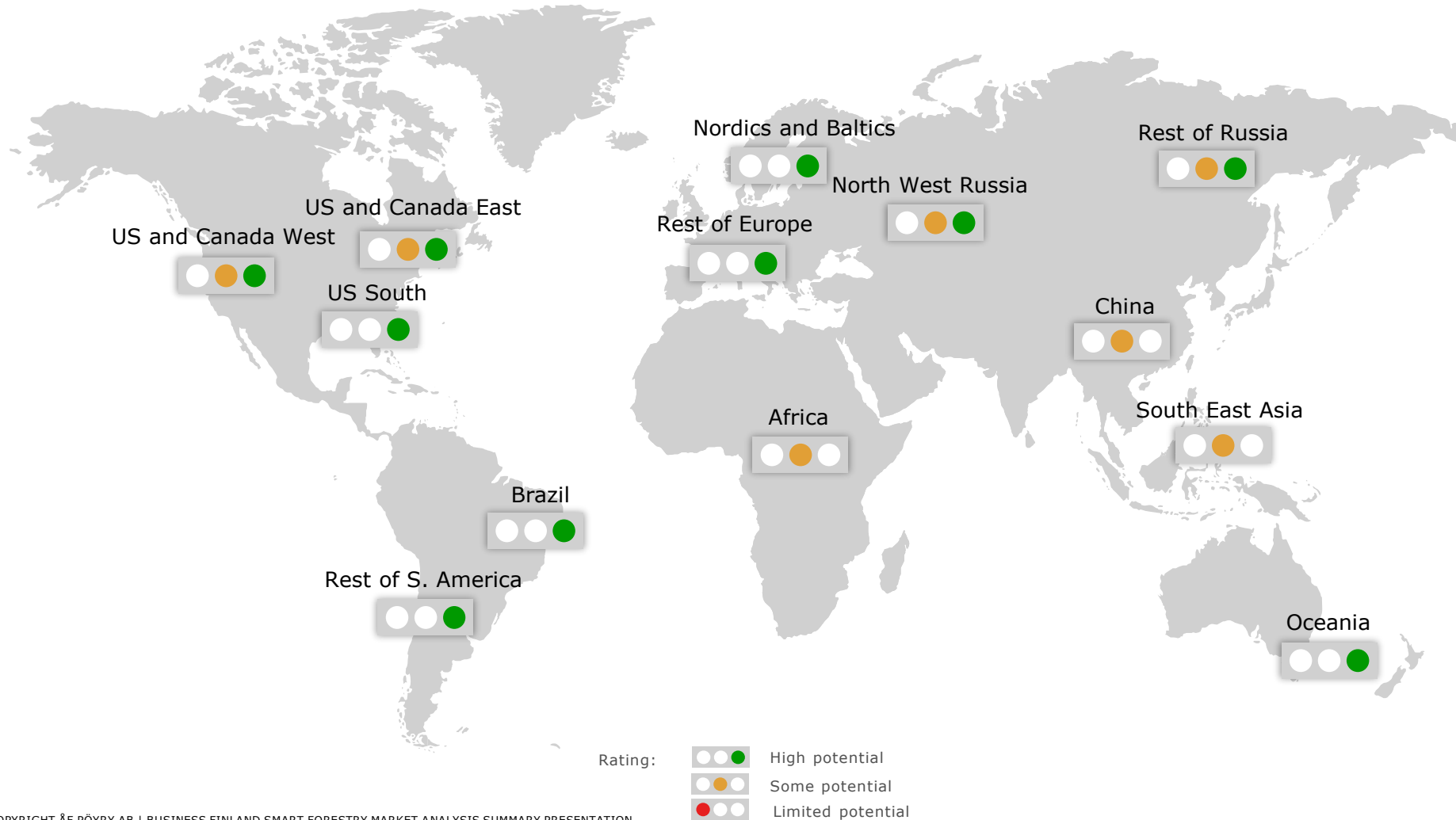
Region	Forest plantation area	Industrial roundwood harvest	Sawnwood & plywood production	Pulp production	Reconstituted panels production	Overall forest sector trend
Nordics and Baltics	-	↗	↗	↗	↗	↗
Rest of Europe ¹⁾	↔	↗	↗	↗	↗	↗
NW Russia	-	↗	↗	↗	↗	↗
Rest of Russia	-	↔	↗	↔	↗	↗
US South	↔	↗	↗	↔	↗	↗
US and Canada East	-	↘	↔	↘	↗	↔
US and Canada West	-	↘	↘	↔	↔	↔
Brazil	↗	↗	↗	↗	↗	↗
Rest of S. America	↗	↗	↗	↗	↗	↗
China	↗	↗	↗	↗	↗	↗
Southeast Asia	↗	↗	↗	↗	↗	↗
Oceania	↔	↔	↔	↔	↔	↔
Africa	↗	↗	↗	↔	↗	↗

1) Plantation area in Rest of Europe consists of Iberian peninsula, UK & Ireland

Current smart forestry best practices exist in the Nordics and the Baltics, South America and Oceania



All of the regions are promising for development of smart forestry practices, but Europe, North America, Oceania and Latin America in particular



STEP B SUMMARY – FUTURE POTENTIAL OF SMART FORESTRY PRACTICES

Most forestry regions globally have high potential for Smart forestry expansion, but weighting between the topic areas varies between regions

Region	Planning & optimisation	Digital inventory & disturbance monitoring	Mechanised & site specific management	Optimised harvesting & logistics	Data utilisation & predictive analytics	Digital wood purchasing & services	Overall Smart Forestry market potential
Nordics and Baltics	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>
Rest of Europe	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>
NW Russia	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>
Rest of Russia	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>
US South	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>
US and Canada East	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>
US and Canada West	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>
Brazil	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>
Rest of S. America	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>
China	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>
Southeast Asia	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>
Oceania	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>
Africa	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>

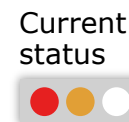
Note: Market potential rating considers also market size and characteristics. Individual companies may differ from the average market potential within the region

Rating:

-
- High potential

Region	Smart Forestry current status	Smart Forestry market potential
Nordics and Baltics	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>
Rest of Europe	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>
NW Russia	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>
Rest of Russia	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>
US South	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>
US and Canada East	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>
US and Canada West	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>
Brazil	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>
Rest of S. America	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>
China	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>
Southeast Asia	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>
Oceania	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>
Africa	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>

- Africa
- Russia
- Oceania
- China
- Others



STEP B SUMMARY – REGIONAL RANKING

Based on scoring, the most promising regions are Nordics & Baltics, Brazil, Rest of Europe, US South and Rest of South America

Region	Market size	Market structure	Estimated future forest sector trend	Future smart forestry potential	Total score
Nordics and Baltics	3	3	3	3	12
Rest of Europe	2.5	3	3	3	11.5
NW Russia	2.5	2	3	2.5	10
Rest of Russia	2	2	3	2.5	9.5
US South	3	3	2.5	3	11.5
US and Canada East	2.5	2	2	2.5	9
US and Canada West	2.5	2	2	2.5	9
Brazil	3	3	3	3	12
Rest of S. America	2	2.5	3	3	10.5
China	2.5	2	3	2	9.5
Southeast Asia	2.5	1.5	3	2	9
Oceania	2	3	2	3	10
Africa	1	2	3	2	8

4. Step c – Conclusions and recommendations

Climate change, carbon markets and new biomass-based products together with policy changes can transform the smart forestry markets

- The global megatrends are expected to continue in the future. Those will drive the forest sector growth in the future, but they are not seen as disruptive changes.
- The forest sector production level depends on general economic trends and policies. Global recession would reduce forest sector production as construction activity and household spending decrease. However, the economic cycles would change the market size for smart forestry solutions but not the underlying structure of smart forestry needs. Policies meanwhile can change smart forestry markets, but they are often regional and their impacts are difficult to predict in advance.

Climate change impacts

Climate change can have two type of direct disruptive changes to the forestry sector around the globe. The impacts vary by region and depend on magnitude of climate change.

- 1) Climate change increases forest damage risks from abiotic and biotic factors (e.g. in Russia and North America), which could increase demand for forest disturbance monitoring and precision silvicultural, harvesting and logistics solutions.
- 2) The growth conditions change due to changes in precipitation and temperature, requiring modified species, planting, silvicultural and rotation regimes. This leads to requirements for new site specific management, planning and optimisation.

Developing carbon markets

Compliance carbon markets are currently on national or regional levels and only voluntary carbon markets exist on global level. Forest carbon is included in most global voluntary carbon schemes, but not in all compliance markets.

If the carbon markets, either for forest carbon emissions allowances or forest carbon offsets, become more effective and functional, it would create additional or alternative revenue streams to wood production. This would create new needs for forest inventory, monitoring, planning and optimisation, as carbon could be integrated to all major forest owner processes.

New biomass-based products

New biomass-based products would change existing wood flows and increase competition for wood with current wood consuming industries.

New companies and new geographical regions could emerge as producers of new innovative products, which could change the consumer base for smart forestry solutions.

Precise data collection and utilisation for planning, optimisation, forecasting and analytics forms the backbone of Smart Forestry opportunities

Region	Nordics and Baltics	Rest of Europe	Russia	North America	South America
Planning & optimisation	<ul style="list-style-type: none"> - Integration between systems - Comprehensive optimisation and scenario analysis - Carbon and NTFP integration 	<ul style="list-style-type: none"> - Planning in plantation operations - Comprehensive optimisation and scenario analysis capabilities 		<ul style="list-style-type: none"> - Development of new areas, such as forest carbon creates new need for simulation and optimization 	<ul style="list-style-type: none"> - Planning and optimization even at tree level - Optimisation around multiple planning levels and product areas
Digital inventory & disturbance monitoring	<ul style="list-style-type: none"> - Remote sensing at single tree level - Near real time inventory and disturbance monitoring 	<ul style="list-style-type: none"> - Up-to-date remote sensing solutions - Near real time disturbance monitoring 	<ul style="list-style-type: none"> - Up-to-date remote sensing solutions to species and forest quality recognition - Disturbance monitoring 	<ul style="list-style-type: none"> - Remote sensing solutions for large challenging to measure/varying forest areas - Near real time disturbance monitoring 	<ul style="list-style-type: none"> - Single tree level forest inventory at frequent time resolution - Early and predictive disturbance monitoring
Mechanised & site specific management				<ul style="list-style-type: none"> - Mechanisation of silviculture - Needs-basis silvicultural applications 	<ul style="list-style-type: none"> - Site specific and needs based silvicultural applications
Optimised harvesting & logistics			<ul style="list-style-type: none"> - Optimised CTL harvesting - Service and maintenance - Operator training - Monitoring and optimization of harvesting and logistics 		<ul style="list-style-type: none"> - Wider use of telemetry for data collection, safety and optimisation - Improving network access to submit data at field
Data utilisation & predictive analytics	<ul style="list-style-type: none"> - Multi source data analytics and planning - Analytics from historical toward predictive 	<ul style="list-style-type: none"> - Predictive analytics around forest calamities 		<ul style="list-style-type: none"> - Integration and wider utilisation of multi source data for planning, decision making and forecasts 	<ul style="list-style-type: none"> - Integration and wider utilisation of multi source data for planning, decision making and forecasts
Digital wood purchasing & services	<ul style="list-style-type: none"> - Easy to use / mobile based wood sales and silvicultural services platforms 	<ul style="list-style-type: none"> - Digital wood sales platforms 			
Customer segments	<ul style="list-style-type: none"> - State Forest companies - Forest industry (pulp & paper, sawnwood/plywood) - Forest Centres, state actors, forest owner associations - Large-scale private forest owners - Forest investment managers 	<ul style="list-style-type: none"> - State Forest companies - Forest owners associations, national forest centres and institutes - Plantation forest owners - Forest industry (pulp, sawnwood, panels) - Forest investment managers 	<ul style="list-style-type: none"> - Large forest industry companies (pulp, plywood and sawnwood) - Regional forestry authorities 	<ul style="list-style-type: none"> - Large scale institutional forest owners - Forest industry (pulp, sawmill, plywood, reconstitute panels, pellets) 	<ul style="list-style-type: none"> - Large pulp and paper integrates - Institutional forest owners - New greenfield plantation players

Development of Smart Forestry in the mid term relies largely on improved utilisation of multiple data sources, increase of data resolution and wider optimisation capability

Disturbance monitoring

- Utilisation of multiple data sources
- Automation of data processing and interpretation
- Predictive analytical capability to identify high risk areas

Digital inventory measurement

- Gradual shift towards larger utilisation of tree level data
- Utilisation of multiple data sources in multiple resolutions

Data utilisation and predictive analytics

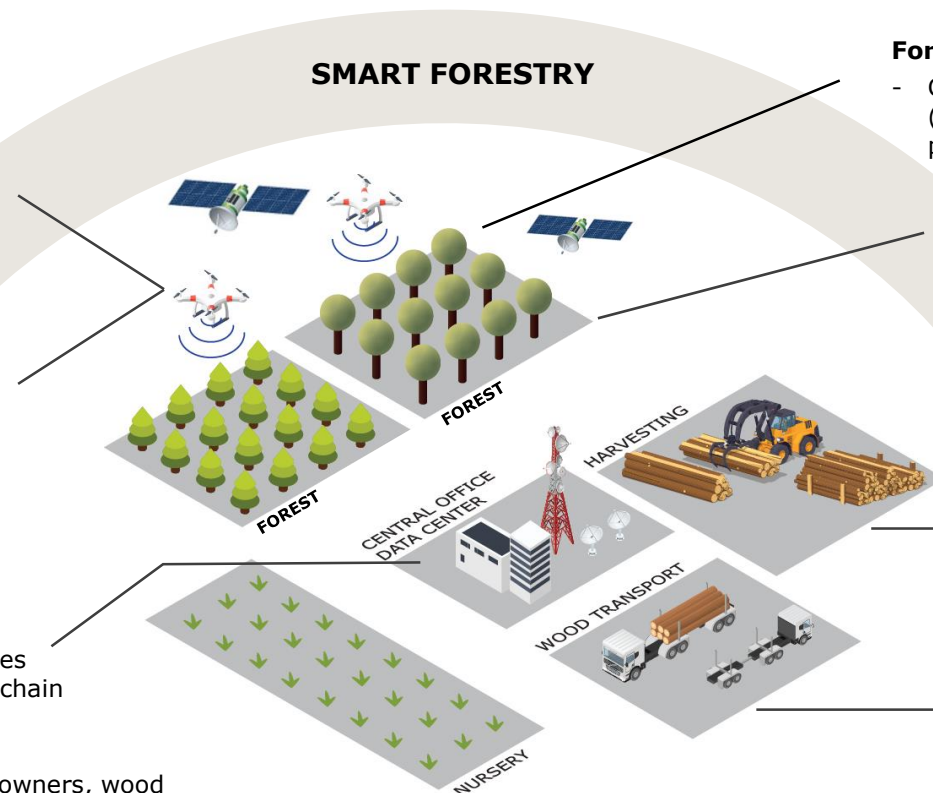
- Predictive analytics combining multiple data sources for more precise forest management decisions and early identification of anomalies

Value chain optimization

- Predictive analytics combining multiple data sources for more value optimisation throughout the value chain

Wood purchasing

- Digital wood trading platforms connecting forest owners, wood consumers and service providers



Forest planning and optimisation

- Capability to utilisation of higher resolution (e.g. sub-cumprament level) data in planning

Forest infra

- Forest infra (roads, interim storages, etc.) integration to planning

Site specific management

- Utilisation of high-resolution input data to allocate right management action at the right time at the right location

Optimised harvesting

- Utilisation of high resolution inventory and planning data for more precise planning and optimisation of harvesting operations. Long term trend towards increasing automation and autonomous operation of harvesting machinery

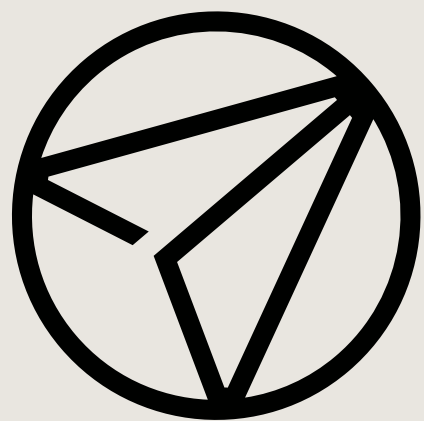
Geospatial optimization

- Optimisation of transport capacity allocation based on near real time information of harvesting operation and market
- Long term trend in logistics towards automatisisation of transportation.

CONTACT INFORMATION

Smart Forestry Market Analysis

AFRY Management Consulting Oy
Jaakonkatu 3, 01621 Vantaa | Finland
Info.fi@afry.com
+358 10 3310



AFRY

ÅF PÖYRY

BUSINESS FINLAND

FUTURE **WATCH**

WWW.BUSINESSFINLAND.FI
www.marketopportunities.fi