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Deliverable. 5.1.1

**Roadmap for promoting biodiversity valuation in
Regional bioeconomy**

BIOPROSPECT: Conservation and sustainable capitalization of biodiversity in
forested areas

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Roadmap for promoting biodiversity valuation in Regional bioeconomy

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ABBREVIATIONS

| Term | Explanation |
|-------|--|
| CDGFC | Civil Dialogue Group on Forestry and Cork |
| CoR | European Committee of the Regions |
| EAFRD | European Agricultural Fund for Rural Development |
| EMFF | European Maritime and Fisheries Fund |
| ERDF | European Regional Development Fund |
| ESIF | European Structural and Investment Fund |
| ESF | European Social Fund |
| EU | European Union |
| MAP | Multi annual implementation plan of EU Forest Strategy |
| RIS3 | Research and Innovation Strategies for Smart Specialisation - RIS3 |
| R&D | Research and Development |
| R&I | Research and Innovation |
| SDGs | Sustainable Development Goals of United Nations. |
| SFM | Sustainable forest management |
| SME | Small Medium Enterprises |
| TRL | Technology Readiness Level |
| CDGFC | Civil Dialogue Group on Forestry and Cork |
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FOREWORD

The main aims of the project BIOPROSPECT are to explore and document the bioprospects of forested protected areas and the ways of sustainable capitalization as a mean for their wise management and conservation, to encourage cooperation partnerships and networking among economic development planners and PA managers, to develop a cross-border bioprospect assessment methodological framework and economic valuation model in order to achieve outcomes which benefit both economic development and conservation.

BIOPROSPECT Work Package 5 aims to mainstream biodiversity valuation into decision making and policy initiatives. Aims to integrate economic valuation in operational management of forested areas and policy initiatives of Balkan Mediterranean area.

This report, (deliverable D5.1.1 under Task 5.1 in Work Package 5) analyses the challenges and opportunities while providing guidelines to develop a forest based bioeconomy at Regional level.

EXECUTIVE SUMMARY

The public and private forests as well as the forest-based sector play a central role in the bioeconomy of European Regions. They provide material (wood and non-wood), bioenergy and a wealth of other regulating and cultural ecosystem services. These demands need to be properly balanced, and many targets have to be tackled simultaneously. Issues to be addressed with the forest bioeconomy include the conservation of biodiversity, the economically, environmentally and socially sustainable production processes, products and services, the ways that non-wood goods and ecosystem services managed and valued and finally how all these are integrated into dynamic land use of European Regions. Ensuring sustainable development is a necessary precondition for a successful forest-based bioeconomy.

Addressing the societal and environmental challenges of global change requires significant changes to the way our society produces and consumes goods and services. The Millennium Ecosystem Assessment puts ecosystem services at the centre of this effort and links human well-being to the impacts on ecosystems of changes in natural resources. The Economics of Ecosystems and Biodiversity initiative drew further attention to the economic benefits of conserving ecosystems and biodiversity, supporting the idea that economic instruments – if appropriately applied, developed and interpreted – can inform policy- and decision-making processes.

Each Region will need to find new ways to remain competitive and will need to develop a specific location-based approach to forest bioeconomy, adapted to existing biogeographical, economic and social specificities to maximise economic, social and environmental benefits. Success will depend on the ability to take advantage of the opportunities emerging from ongoing technological revolutions (e.g. bio- and nanotechnologies, digitalisation) to transform industry (new feedstocks, chemicals and materials, advanced manufacturing) into circular business models that leverage the potential of the sharing, platform and performance economies. But, it is not enough to develop a strong bio-based sector. It is necessary to create a biological framework for the economy, essentially to *greening* the economy, from construction, to transport and tourism. Ecotourism, wood construction, bio-based packaging and biofuels are all examples of how forest goods and services can transform major economic sectors.

Furthermore there is a need for a realistic understanding of the potential capacity of forest resources to contribute sustainably. In a situation with many possibilities,

synergies, trade-offs and uncertainties, indicators can help to avoid unwanted impacts, and support successful and sustainable bioeconomy development. They can be used to inform policy makers, synthesize complex matters and act as tools for decision support.

This report is the **Deliverable 5.1.1 “Roadmap for promoting biodiversity valuation in Regional bioeconomy”** developed within the framework of the project **“Conservation and sustainable capitalization of biodiversity in forested areas – BIOPROSPECT”** which is funded by «Interreg V-B “Balkan-Mediterranean 2014–2020”». The report analyses the challenges and opportunities while providing guidelines to develop a forest based bioeconomy at Regional level.

ΕΚΤΕΤΑΜΕΝΗ ΕΛΛΗΝΙΚΗ ΠΕΡΙΛΗΨΗ

Τα δημόσια και ιδιωτικά δάση καθώς και ο δασικός τομέας διαδραματίζουν κεντρικό ρόλο στη βιοϊονομία των ευρωπαϊκών περιφερειών. Παρέχουν υλικά-προϊόντα, βιοενέργεια και πληθώρα άλλων ρυθμιστικών και πολιτιστικών υπηρεσιών. Στο πλαίσιο αυτό η δασική βιοοικονομία αφορά τη διατήρηση της βιοποικιλότητας, τις οικονομικά, περιβαλλοντικά και κοινωνικά βιώσιμες παραγωγικές διαδικασίες, τα προϊόντα και τις οικοσυστημικές υπηρεσίες, τους τρόπους διαχείρισης και αποτίμησης των αγαθών από μη ξύλο και των οικοσυστημάτων και, τέλος, χρήση των ευρωπαϊκών περιφερειών. Η εξασφάλιση της βιώσιμης ανάπτυξης αποτελεί απαραίτητη προϋπόθεση για μια επιτυχημένη βιοοικονομία με βάση τα δάση.

Η αντιμετώπιση των κοινωνικών και περιβαλλοντικών προκλήσεων της παγκόσμιας αλλαγής απαιτεί σημαντικές αλλαγές στον τρόπο με τον οποίο η κοινωνία μας παράγει και καταναλώνει αγαθά και υπηρεσίες. Η αξιολόγηση των οικοσυστημάτων της χιλιετίας θέτει τις υπηρεσίες οικοσυστήματος στο επίκεντρο αυτής της προσπάθειας και συνδέει την ανθρώπινη ευημερία με τις επιπτώσεις των φυσικών πόρων στις οικοσυστήματα. Η πρωτοβουλία «Οικονομία των οικοσυστημάτων και της βιοποικιλότητας» επέστησε περαιτέρω προσοχή στα οικονομικά οφέλη της διατήρησης οικοσυστημάτων και βιοποικιλότητας, υποστηρίζοντας την ιδέα ότι τα οικονομικά μέσα - εφόσον εφαρμόζονται, αναπτύσσονται και ερμηνεύονται - μπορούν να ενημερώσουν τις διαδικασίες πολιτικής και λήψης αποφάσεων.

Κάθε Περιφέρεια θα πρέπει να βρει νέους τρόπους για να παραμείνει ανταγωνιστικός και θα χρειαστεί να αναπτύξει μια συγκεκριμένη προσέγγιση βάσει της τοποθεσίας για τη βιοϊονομία των δασών, προσαρμοσμένη στις υπάρχουσες βιογεωγραφικές, οικονομικές και κοινωνικές δυνατότητες, ώστε να μεγιστοποιηθούν τα οικονομικά, κοινωνικά και περιβαλλοντικά οφέλη. Η επιτυχία θα εξαρτηθεί από την ικανότητα αξιοποίησης των ευκαιριών που προκύπτουν από τις συνεχιζόμενες τεχνολογικές επαναστάσεις (π.χ. βιοτεχνολογίες και νανοτεχνολογίες, ψηφιοποίηση) για τη μετατροπή της βιομηχανίας (νέων πρώτων υλών, χημικών και υλικών, προηγμένης μεταποίησης) σε κυκλικά επιχειρηματικά μοντέλα που αξιοποιούν το δυναμικό της οικονομίας κοινής χρήσης, της πλατφόρμας και της απόδοσης. Όμως, δεν αρκεί να αναπτυχθεί ένας ισχυρός βιολογικός τομέας. Είναι απαραίτητο να δημιουργηθεί ένα βιολογικό πλαίσιο για την οικονομία, κυρίως για την εξομάλυνση της οικονομίας, από την κατασκευή, μέχρι τις μεταφορές και τον τουρισμό. Ο οικολογικός τουρισμός, η κατασκευή

ξύλου, οι βιολογικές συσκευασίες και τα βιοκαύσιμα είναι όλα παραδείγματα για το πώς τα αγροτικά προϊόντα και οι υπηρεσίες μπορούν να μεταμορφώσουν σημαντικούς οικονομικούς τομείς.

Επιπλέον, υπάρχει ανάγκη ρεαλιστικής κατανόησης της δυνητικής ικανότητας των δασικών πόρων να συμβάλουν στη Περιφερειακή Βιώσιμη Ανάπτυξη. Σε μια κατάσταση με πολλαπλές δυνατότητες, συνέργειες, συμβιβασμούς και αβεβαιότητες, η υιοθέτηση ενός αξιόπιστου συστήματος δεικτών, μπορεί να συμβάλει στην αποφυγή ανεπιθύμητων επιπτώσεων και να υποστηρίξουν την επιτυχή και βιώσιμη ανάπτυξη της βιοοικονομίας. Παράλληλα μπορούν να χρησιμοποιηθούν για να ενημερώσουν τους υπεύθυνους χάραξης πολιτικής, να συνθέσουν πολύπλοκα θέματα και να λειτουργήσουν ως εργαλεία υποστήριξης αποφάσεων.

Η έκθεση αυτή αποτελεί το Παραδοτέο 5.1.1 «Οδικός χάρτης για την προώθηση αποτίμησης της βιοποικιλότητας στην περιφερειακή βιοοικονομία» του έργου «Διατήρηση και βιώσιμη κεφαλαιοποίηση της βιοποικιλότητας στις δασικές περιοχές - BIOPROSPECT», το οποίο υλοποιείται στο πλαίσιο του Προγράμματος Ευρωπαϊκής Εδαφικής Συνεργασίας «Interreg V-B “Balkan-Mediterranean 2014–2020”».

Στρατηγικό Πλαίσιο

Τον Σεπτέμβριο του 2013 η ανακοίνωση της Επιτροπής με τίτλο «Μια νέα δασική στρατηγική της ΕΕ: για τα δάση και τον δασικό τομέα» (COM(2013)0659) καθόρισε τη νέα στρατηγική της ΕΕ και πρότεινε ένα ευρωπαϊκό πλαίσιο αναφοράς για τις τομεακές πολιτικές που έχουν αντίκτυπο στα δάση. Η στρατηγική αυτή έχει ως στόχους να διασφαλίσει ότι η διαχείριση των δασών της Ευρώπης γίνεται με βιώσιμο τρόπο και να ενισχύσει τη συμβολή της Ένωσης στην προώθηση της βιώσιμης διαχείρισης των δασών και στην αντιμετώπιση της αποψίλωσης των δασών σε παγκόσμιο επίπεδο.

Λαμβάνοντας υπόψη το γεγονός ότι τα δάση αποτελούν πολύ-λειτουργικά οικοσυστήματα έχει αναγνωριστεί η αξία και ενίσχυση της συμβολής των δασικών οικοσυστημάτων στη βιοοικονομία.

Η στρατηγική της ΕΕ για τη βιοοικονομία, που εγκρίθηκε στις 13 Φεβρουαρίου 2012, βασίζεται σε τρεις κύριους πυλώνες:

1) Επενδύσεις στην έρευνα, την καινοτομία και τις δεξιότητες για τη βιοοικονομία. Αυτό θα πρέπει να περιλαμβάνει ενωσιακή χρηματοδότηση, εθνική χρηματοδότηση, ιδιωτικές επενδύσεις και ενίσχυση των συνεργειών με άλλες πρωτοβουλίες πολιτικής.

2) Ανάπτυξη των αγορών και της ανταγωνιστικότητας σε κλάδους βιοοικονομίας μέσω βιώσιμης εντατικοποίησης της πρωτογενούς παραγωγής, μετατροπής αποβλήτων σε προϊόντα προστιθέμενης αξίας, καθώς και μέσω μηχανισμών αμοιβαίας μάθησης για τη βελτίωση της παραγωγής και της αποδοτικότητας των πόρων.

3) Ενίσχυση του συντονισμού των πολιτικών και της συμμετοχής των ενδιαφερομένων φορέων, μέσω της δημιουργίας μιας επιτροπής για τη βιοοικονομία, ενός παρατηρητηρίου βιοοικονομίας και τακτικών διασκέψεων των ενδιαφερόμενων μερών.

Η στρατηγική επιδιώκει συνέργειες και συμπληρωματικότητες με άλλους τομείς πολιτικής, μέσα και πηγές χρηματοδότησης με τους ίδιους στόχους, όπως το Ταμείο Συνοχής, η Κοινή Γεωργική Πολιτική και η Κοινή Αλιευτική Πολιτική (ΚΓΠ και ΚΑΛΠ), η Ολοκληρωμένη Θαλάσσια Πολιτική (ΟΘΠ), οι πολιτικές για το περιβάλλον, τη βιομηχανία, την απασχόληση, την ενέργεια και την υγεία.

Η στρατηγική είναι μία από τις επιχειρησιακές προτάσεις στο πλαίσιο των εμβληματικών πρωτοβουλιών Ένωσης της Καινοτομίας και Μια Ευρώπη που χρησιμοποιεί αποδοτικά τους πόρους της στρατηγικής «Ευρώπη 2020».

Ένα σχέδιο δράσης για την ανάπτυξη μιας βιώσιμης και κυκλικής βιοοικονομίας για την Ευρώπη, στην υπηρεσία της κοινωνίας και του περιβάλλοντος παρουσίασε το 2018 η Ευρωπαϊκή Επιτροπή. Στόχος της στρατηγικής αυτής είναι να βελτιώσει και να ενισχύσει τη χρήση των ανανεώσιμων πόρων για την αντιμετώπιση των παγκόσμιων και τοπικών προκλήσεων, όπως η κλιματική αλλαγή και η βιώσιμη ανάπτυξη. Η νέα στρατηγική για τη βιοοικονομία εντάσσεται στο πλαίσιο της προσπάθειας της Επιτροπής να προωθήσει την απασχόληση, την ανάπτυξη και τις επενδύσεις στην ΕΕ και αποτελεί επικαιροποίηση της στρατηγικής για τη βιοοικονομία που είχε ανακοινωθεί το 2012. Προς την κατεύθυνση αυτή έχει ξεκινήσει από αρκετές χώρες της Ε.Ε. (Γερμανία, Ισπανία, Ιταλία, Γαλλία, Βέλγιο κλπ) η εκπόνηση Εθνικών και Περιφερειακών στρατηγικών για την ανάπτυξη της Βιοοικονομίας.

Τομεακή ανάλυση

Η υιοθέτηση και εφαρμογή της βιο-οικονομίας σε διεργασίες που αφορούν στον δασικό πλούτο, μπορεί να οδηγήσει στην επίτευξη της βέλτιστης αξιοποίησης του πολυλειτουργικού ρόλου των δασών σε όλη την αλυσίδα αξίας αυτών, και να συμβάλλει

στην ενίσχυση της ανταγωνιστικότητας, της καινοτομίας αλλά και της γενικότερης ευημερίας των Ευρωπαϊκών Περιφερειών.

Τα δασικά οικοσυστήματα αποτελούν έναν από τους πυλώνες ανάπτυξης της χώρας, ο οποίος συμβάλει στην παροχή απασχόλησης και στη δημιουργία εισοδήματος. Λόγω του ιδιαίτερου χαρακτήρα της βιοοικονομίας των δασών, είναι σημαντικό να την αναλύσουμε στο πλαίσιο των αλυσίδων αξίας ή ακόμη και σε κύκλους τιμών. Εντούτοις, ο ολοκληρωμένος και κυκλικός χαρακτήρας κάνει τις βιοοικονομικές προσεγγίσεις να διαφέρουν από τις παραδοσιακές προσεγγίσεις στη χρήση φυσικών πόρων συνήθως μόνο για ένα σκοπό (π.χ. καλλιέργειες για τρόφιμα / ζωοτροφές ή ξύλο για ενέργεια). Επιπλέον, προκύπτουν νέοι και σύνθετοι κύκλοι αξιών λόγω νέων ερευνητικών ευρημάτων και τεχνολογικών ευκαιριών για εργασία με τα μοριακά δομικά στοιχεία των βιολογικών πόρων. Η ξυλεία παραμένει η κύρια πηγή εσόδων από τα δασικά οικοσυστήματα, καθώς είναι η πρώτη ύλη για μια μακρά αλυσίδα εμπορικών και μεταποιητικών επιχειρήσεων. Η χρήση της δασικής βιομάζας στην παραγωγή ενέργειας από ανανεώσιμες πηγές είναι μια εναλλακτική αξιοποίηση με πολλές προοπτικές, εφόσον παραχθεί με αειφορικό τρόπο και σεβασμό προς το φυσικό περιβάλλον και τις τοπικές κοινωνίες. Παράλληλα, τα δασικά οικοσυστήματα παράγουν και μια σειρά από μη ξυλώδη προϊόντα όπως είναι η ρητίνη, τα μανιτάρια, το μέλι, τα αρωματικά και φαρμακευτικά φυτά, κτλ. Παρέχουν επίσης ουσιαστικές οικοσυστημικές υπηρεσίες: προστατευτικές (βιοποικιλότητας, ανθρώπινων εγκαταστάσεων από φυσικούς κινδύνους, εδάφους από διάβρωση, υδάτινων πόρων), αναψυχής (φυσικές εμπειρίες, περιβαλλοντική εκπαίδευση, θήρα) και ρυθμιστικές (του κλίματος, του κύκλου του νερού, της ποιότητας της ατμόσφαιρας, του διοξειδίου του άνθρακα). Τα περισσότερα μη ξυλώδη προϊόντα παράγονται μέσω ξεπερασμένου θεσμικού πλαισίου που δεν προωθεί τη συστηματική εκμετάλλευση και την ένταξή τους σε σχετικές αγορές προϊόντων. Παρότι πολλές από τις οικοσυστημικές υπηρεσίες δεν αποτιμώνται έως σήμερα σε οικονομικούς όρους, αποτελούν ένα δυναμικό-βάση ανάπτυξης δραστηριοτήτων που συμβάλουν στην οικονομική ανάπτυξη. Η διασφάλιση της αειφόρου διαχείρισης των δασικών οικοσυστημάτων αποτελεί απαραίτητη προϋπόθεση προκειμένου να δημιουργηθεί το κατάλληλο πλαίσιο για την αξιοποίηση των υπηρεσιών του με ισόρροπο τρόπο, διατηρώντας και βελτιώνοντας τους δασικούς πόρους και ενθαρρύνοντας τη διαφοροποιημένη παραγωγή αγαθών και υπηρεσιών σε μακροχρόνια βάση, μέσω ενός επαρκούς και σταθερού θεσμικού πλαισίου.

Κατευθυντήριες γραμμές

Η περιφερειακή διάσταση της βιοοικονομίας αποκτά όλο και μεγαλύτερη σημασία τα τελευταία χρόνια. Οι αναδυόμενες πολιτικές δείχνουν όλο και περισσότερο κοινές πρωτοβουλίες για την προώθηση της ανάπτυξης της βιοοικονομίας μεταξύ των ευρωπαϊκών περιφερειών με παρόμοια χαρακτηριστικά.

Στο πλαίσιο αυτό κρίσιμο κοινό βήμα αποτελεί η αξιολόγηση των παρεχόμενων υπηρεσιών από τα δασικά οικοσυστήματα και η αποτίμηση τους. Η αποτίμηση είναι απαραίτητη καθώς συμβάλει σε:

1. Σύγκριση εναλλακτικών πολιτικών, προγραμμάτων και έργων.
2. Προσδιορισμό των ευκαιριών διαβίωσης, ανάπτυξης και επενδύσεων.
3. Σχεδιασμό μέσων περιβαλλοντικής πολιτικής, συμπεριλαμβανομένων κινήτρων, κανονισμών και παρακολούθησης. Πληροφορίες δηλαδή σχετικά με τις οικοσυστημικές υπηρεσίες που θα επιτρέψουν τον σχεδιασμό αποτελεσματικών, δίκαιων και βιώσιμων μέσων περιβαλλοντικής πολιτικής.
4. Διεξαγωγή ανάλυσης της υφιστάμενης κατάστασης. Ποια είναι δηλαδή η κατάσταση των οικοσυστημικών υπηρεσιών σε ένα δεδομένο πλαίσιο και ποιες αξίες και ενδιαφερόμενα μέρη συνδέονται με αυτές.

Η ενσωμάτωση της αποτίμησης στη διαδικασία λήψης αποφάσεων δύναται να πραγματοποιηθεί μέσα από τρία βήματα που περιλαμβάνουν: α)Αναγνώριση οικοσυστημικών υπηρεσιών των δασικών οικοσυστημάτων, β)αξιολόγηση-αποτίμηση και γ)παραγωγική αξιοποίηση.

Λαμβάνοντας υπόψη τα παραπάνω και στο πλαίσιο ενίσχυσης της Περιφερειακής δασικής βιοοικονομίας προτείνεται η ιοθέτηση μίας σειράς στρατηγικών βημάτων που περιλαμβάνουν κατά χρονολογική σειρά εφαρμογής τα ακόλουθα:

- ✓ Αύξηση της ευαισθητοποίησης του κοινού σχετικά με τη βιοοικονομία των δασών και προώθηση της κινητοποίησης και της εμπλοκής των πολιτών.
- ✓ Αξιολόγηση και αποτίμηση δασικής βιοποικιλότητας και υπηρεσιών οικοσυστήματος σε Περιφερειακό επίπεδο και δημιουργία κατάλληλου συστήματος παρακολούθησης.
- ✓ Ανάπτυξη Περιφερειακών στρατηγικών βιοοικονομίας με στόχο την αύξηση της αποτελεσματικότητας των δασικών πόρων, την προστασία της βιοποικιλότητας (συμμόρφωση με τις περιφερειακές στρατηγικές για τη βιοποικιλότητα),

ελαχιστοποίηση των επιβλαβών επιπτώσεων και μεγιστοποίηση των κοινών οφελών της βιοοικονομίας.

- ✓ Υποστήριξη της δασικής έρευνας, της πειραματική ανάπτυξης, των δράσεων επίδειξης και της κλαδικής καινοτομίας (τεχνολογικής και κοινωνικής) καθώς και της μεταφοράς γνώσης μεταξύ ερευνητικών ιδρυμάτων και ενδιαφερομένων φορέων (συμπεριλαμβανομένων των ιδιοκτητών δασών, υπευθύνων πολιτικής και λήψης αποφάσεων, επιχειρήσεων κ.λπ.)
- ✓ Ενίσχυση της υποστήριξης για την εκπαίδευση και την κατάρτιση ειδικευμένου εργατικού δυναμικού στον τομέα της βιοοικονομίας και των συναφών τομέων.
- ✓ Κινητοποίηση των επενδύσεων, μεταξύ άλλων μέσω της ανάπτυξης νέων χρηματοδοτικών μέσων για την ανάπτυξη των υφιστάμενων και νέων τεχνολογιών, καθώς και των βιομηχανικών διαδηλωτών.
- ✓ Υποστήριξη της δημιουργίας αγορών καινοτόμων, βιώσιμων και εν γένει προϊόντων παραγόμενων στο πλαίσιο κυκλικής οικονομίας και βιοοικονομίας, μέσω υφιστάμενων και αναδυόμενων ρυθμιστικών πλαισίων, συμπεριλαμβανομένων προτύπων και ετικετών, συστημάτων πιστοποίησης, εφαρμογής της νομοθεσίας για τα απόβλητα, τροφίμων και βιολογικών προϊόντων.

Απαραίτητη προϋπόθεση για την εφαρμογή των ανωτέρω αποτελεί η υιοθέτηση του κατάλληλου συστήματος δεικτών προκειμένου να καταστεί εφικτή η παρακολούθηση και αξιολόγηση των προτεινόμενων δράσεων. Οι προτεινόμενοι δείκτες περιφερειακής δασικής βιοοικονομίας αντικατοπτρίζουν τις προκλήσεις του ευρωπαϊκού δασικού τομέα σε περιφερειακό επίπεδο και τις επιπτώσεις που έχουν αυτές οι διαχειριστικές πρακτικές και πολιτικές σε δασικούς πόρους, δασικά προϊόντα, τοπική κοινωνία και οικονομία

1. INTRODUCTION

The public and private forests as well as the forest-based sector play a central role in the bioeconomy of European Regions. They provide material (wood and non-wood), bioenergy and a wealth of other regulating and cultural ecosystem services. These demands need to be properly balanced, and many targets have to be tackled simultaneously. Issues to be addressed with the forest bioeconomy include the conservation of biodiversity, the economically, environmentally and socially sustainable production processes, products and services, the ways that non-wood goods and ecosystem services managed and valued and finally how all these are integrated into dynamic land use of European Regions. Ensuring sustainable development is a necessary precondition for a successful forest-based bioeconomy.

Addressing the societal and environmental challenges of global change requires significant changes to the way our society produces and consumes goods and services. The Millennium Ecosystem Assessment puts ecosystem services at the centre of this effort and links human well-being to the impacts on ecosystems of changes in natural resources. The Economics of Ecosystems and Biodiversity initiative drew further attention to the economic benefits of conserving ecosystems and biodiversity, supporting the idea that economic instruments – if appropriately applied, developed and interpreted – can inform policy- and decision-making processes.

Each Region will need to find new ways to remain competitive and will need to develop a specific location-based approach to forest bioeconomy, adapted to existing biogeographical, economic and social specificities to maximise economic, social and environmental benefits. Success will depend on the ability to take advantage of the opportunities emerging from ongoing technological revolutions (e.g. bio- and nanotechnologies, digitalisation) to transform industry (new feedstocks, chemicals and materials, advanced manufacturing) into circular business models that leverage the potential of the sharing, platform and performance economies. But, it is not enough to develop a strong bio-based sector. It is necessary to create a biological framework for the economy, essentially to *greening* the economy, from construction, to transport and tourism. Ecotourism, wood construction, bio-based packaging and biofuels are all examples of how forest goods and services can transform major economic sectors.

Furthermore there is a need for a realistic understanding of the potential capacity of forest resources to contribute sustainably. In a situation with many possibilities,

synergies, trade-offs and uncertainties, indicators can help to avoid unwanted impacts, and support successful and sustainable bioeconomy development. They can be used to inform policy makers, synthesize complex matters and act as tools for decision support.

This report is the **Deliverable 5.1.1 “Roadmap for promoting biodiversity valuation in Regional bioeconomy”** developed within the framework of the project **“Conservation and sustainable capitalization of biodiversity in forested areas – BIOPROSPECT”** which is funded by «Interreg V-B “Balkan-Mediterranean 2014–2020”». The report analyses the challenges and opportunities while providing guidelines to develop a forest based bioeconomy at Regional level.

2. STRATEGIC FRAMEWORK: POLICIES AND BEST PRACTICES

2.1 EU forest strategy

In 2013, the European Commission adopted the New European Union (EU) Forest Strategy as a response to multiple emerging challenges forests and the forest-based sector were facing (European Commission, 2013a). Replacing the 1998 EU Forestry Strategy, it takes a holistic approach and develops an integrative framework in response to the increasing demands on forests. It addresses societal and policy priorities, covers the multiple benefits of forests and addresses the whole forest value-chain. The EU Forest Strategy is led by three guiding principles:

- Sustainable forest management and the multifunctional role of forests, delivering multiple goods and services in a balanced way and ensuring forest protection
- Resource efficiency, optimising the contribution of forests and the forest sector to rural development, growth and job creation
- Global forest responsibility, promoting sustainable production and consumption of forest products

EU Forest Strategy establishes the 2020 forest objectives in order to ensure and demonstrate that all forests in the EU are managed according to sustainable forest management principles and that the EU's contribution to promoting sustainable forest management and reducing deforestation at global level is strengthened, thus:

- contributing to balancing various forest functions, meeting demands, and delivering vital ecosystem services;
- providing a basis for forestry and the whole forest-based value chain to be competitive and viable contributors to the bio-based economy.

The EU Forest Strategy addresses the following set of eight interlinked Priority Areas, with a number of Strategic Orientations identified for each of them:

Contributing to major societal objectives

1. Supporting our rural and urban communities.
2. Fostering the competitiveness and sustainability of the EU's forest-based industries, bioenergy and the wider green economy.
3. Forests in a changing climate.
4. Protecting forests and enhancing ecosystem services.

Improving the knowledge base

5. What forests do we have and how are they changing?
6. New and innovative forestry and added-value products.

Coordination and communication

7. Working together to coherently manage and better understand our forests.
8. Forests from a global perspective.

The policy documents that are explicitly referenced by the Strategy are listed in the following Table (Aggestam, F. and Pölzl, H. 2018)

Table 1 Policy document(s) in EU forest strategy (Aggestam, F. and Pölzl, H. 2018)

| |
|---|
| <ul style="list-style-type: none">• 1998 Forest Strategy (COM (1998) 649, Council Resolution 1999/C 56/01).• Forest Action Plan 2007-2011 (COM (2006) 302)• Staff working document: A new EU Forest Strategy: for forests and the forest-based sector (SWD(2013) 343)• A blueprint for the EU forest-based industries (SWD(2013) 343)• EU Forest Communication Strategy• Land Use, Land-Use Change and Forestry (LULUCF) (Decision No 529/2013/E)• Green Paper on Forest Protection and Information (COM (2010) 66)• Plant Health (e.g., Directive 2000/29/EC)• REDD+ and FLEGT (Regulation 2173/2005)• EU Timber Regulation (Regulation (EU) No 995/2010) |
| <ul style="list-style-type: none">• Rural Development (e.g., Regulation 1303 /2013,1305/2013 and 1306/2013) |
| <ul style="list-style-type: none">• A Stronger European Industry for Growth and Economic Recovery (COM (2012) 582)• Integrated Industrial Policy for the Globalisation Era (COM (2010) 614)• Bioeconomy Strategy (COM (2012) 60)• Resource Efficiency Roadmap (COM (2011) 571) |
| <ul style="list-style-type: none">• EU Strategy on Adaptation to Climate Change (COM (2013)216)• EU Climate and Energy Package (e.g., COM (2010) 265)• Kyoto Protocol |
| <ul style="list-style-type: none">• 7th EU Environment Action Programme (Decision 1386/2013/EU)• Natura 2000 (e.g., Directive 2009/147/EC and Council Directive 92 /43/EEC)• LIFE+ (Regulation 1293/2013)• 2020 Biodiversity Strategy (COM (2011) 244)• Convention on Biological Diversity and the Aichi targets• United Nations Convention to Combat Desertification• Water Framework Directive (Directive 2000/60/EC) |
| <ul style="list-style-type: none">• 7th Research Framework Programme (Decision 1982/2006/EC)• Horizon 2020 (Regulation 1291/2013)• EUROPE 2020—A strategy for smart, sustainable and inclusive growth (COM (2010) 2020) |

- Forest Information System of Europe:
EU Forest Fire Information System

European Forest Data Centre

European Soil Data Centre

Integrated Environmental and Economic Accounting for Forests
 - Infrastructure for Spatial Information in the European Community (INSPIRE) (Directive 2007/2/EC)
 - Shared Environmental Information System (SEIS) (COM (2008) 46)
 - Copernicus (Regulation 377/2014)
-
- United Nations Framework Convention on Climate Change
 - Forest-based Sector Technology Platform
 - Standing Committee on Agricultural Research (SCAR)
 - European Innovation Partnership on Agricultural Productivity and Sustainability
 - Standing Forestry Committee (SFC) (Council Decision 89/367/EEC)
 - Advisory Group on Forestry and Cork (Commission Decision 2004/391/EC)
 - Habitat Committee
 - Expert Group on Natura 2000
 - Advisory Committee on Forest-based Industries (Commission Decision 97/837/EC)

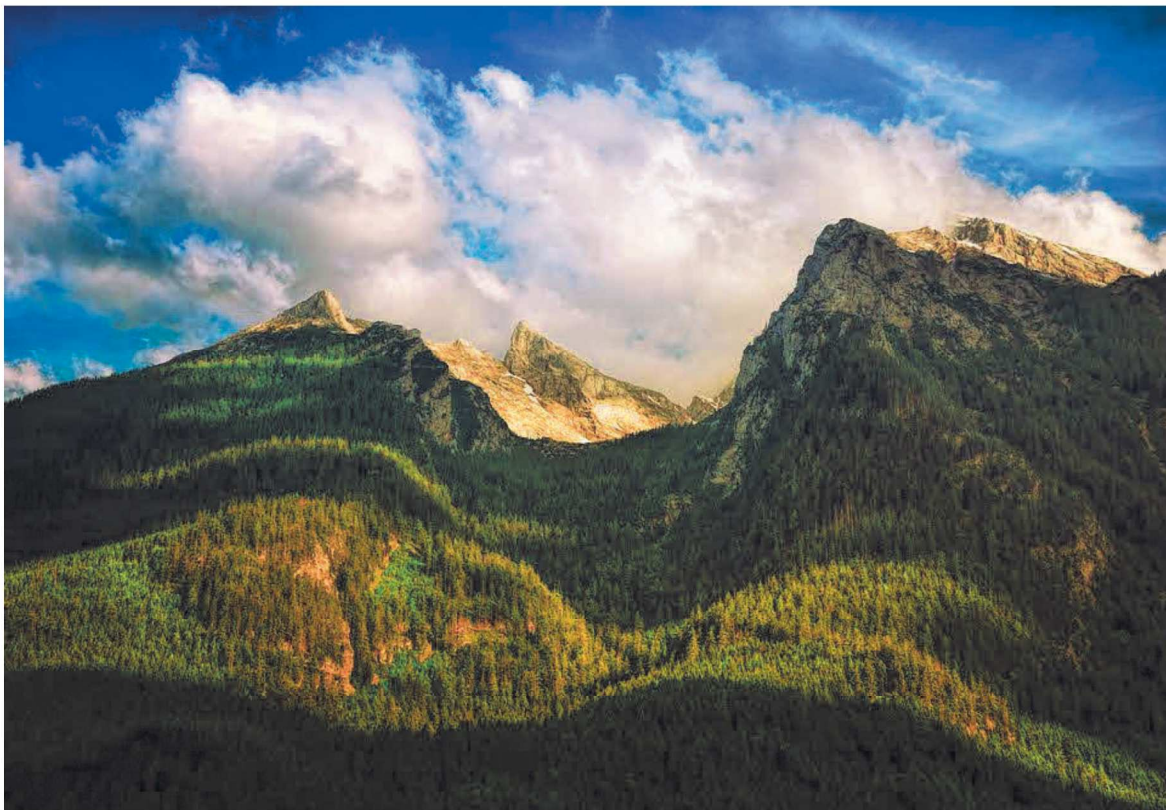
The 2014 Council conclusions welcomed the EU Forest Strategy and its holistic and balanced approach, addressing both forests as such and their value chains. They stressed that the Forest Strategy should enhance coordination and facilitate the coherence of forest-related policies by allowing for synergies with other sectors that influence forest management. Also the European Parliament adopted an own-initiative report in 2015 and, likewise, the Committee of the Regions and the European Economic and Social Committee also adopted opinions on the Strategy document in 2014.

In order to further operationalise the EU Forest Strategy, the Commission Services, in cooperation with the Standing Forestry Committee and the Civil Dialogue Group on Forestry & Cork, prepared a Multi-annual Implementation Plan (MAP) as a support tool for helping them implement the EU Forest Strategy (European Commission, 2015).

Since 2013, the policy context relevant to the EU Forest Strategy has evolved. Relevant events at the global and pan-European levels include the 7th Ministerial Conference on the Protection of Forests in Europe held in Madrid in 2015, the entry into force of the Paris Agreement on Climate Change in 2016) the COP 13 to the UN Convention on Biological Diversity in Cancun in 2016, the adoption of the UN 2030 Agenda for Sustainable Development and its Sustainable Development Goals in 2016, and the adoption of the UN Strategic Plan for Forests 2017-2030 in 2017.

At the EU level, the evolved context includes the setting of the Juncker Commission's ten priority areas for action, the EU 2030 Climate and Energy Framework including the proposals for a Regulation on Land Use, Land-Use Change and Forestry and the recast of

the Renewable Energy Directive, and the Commission's conclusions and action Plan following the fitness check of the Birds and Habitats Directives. In 2016, the evaluation of the implementation of the FLEGT Action Plan (2003-2014), as well as the review of the first two years of implementation of the EU Timber Regulation were completed. Ongoing policy work includes the review of the EU Timber Regulation, the review of the EU Bio economy Strategy, the agreement on and implementation of the Circular Economy Action Plan and the discussions on the future of the Common Agricultural Policy framed by multifunctional forestry (European Commission, 2019).



2.2 EU Policy framework for the conservation of Europe's biodiversity in forest protected areas

EU Biodiversity Strategy, adopted in May 2011, lays down the policy framework for achieving this overall objective. Several targets of the strategy have a direct relevance for forests, including Target 1 which call on Member States 'to fully implement the Birds and Habitats Directives and in particular to halt the deterioration in the status of all species

and habitats covered by EU nature legislation, and achieve a significant and measurable improvement in their status by 2020, compared to current assessments (EU, 2015).

The Birds and Habitats Directives are the cornerstones of the EU's biodiversity policy. They enable all 28 EU Member States to work together, within a common legislative framework, to preserve Europe's most endangered and valuable species and habitats across their entire natural range within the EU. The Birds Directive covers all bird species occurring in the wild state in the EU (ca 500 species) whereas the Habitats Directive targets a sub-set of around 2000 species, which are in need of protection to prevent their disappearance or because they are representative of important habitats in the European Union. Some 230 habitat types are also protected in their own right under the Habitats Directive. These are often referred to as species or habitats of Community interest (EU, 2015),

The overall objective of the two directives is to ensure that the species and habitat types they aim to protect are maintained at, or restored to a favourable conservation status throughout their natural range within the EU. Member States are required to take the appropriate measures to attain this objective whilst taking account of economic, social and cultural requirements and regional and local characteristics. This target is defined in positive terms, oriented towards a favourable situation, which needs to be reached and maintained. It is therefore more than just avoiding their deterioration. More specifically, the EU Nature directives require Member States to (EU, 2015):

- Designate, preserve, and where necessary restore, core sites for the protection of species and habitat types listed in Annex I and II of the Habitats Directive and Annex I of the Birds Directive, as well as for migratory birds. Collectively these sites form part of the EU-wide Natura 2000 Network.
- Establish a species protection regime for all wild European bird species and other endangered species listed in Annex IV and V of the Habitats Directive. This protection regime applies across the species' entire natural range in the EU, i.e. both inside and outside Natura 2000 sites.

Member States report back to the Commission every 6 years on the conservation status of those habitat types and species of EU importance present in their territory, not only on their Natura 2000 sites. This is done using a standard methodology²⁶ that enables the Commission to aggregate the data at both a biogeographical and an EU level. It is not

surprising that half of the Natura 2000 Network is made up of forests albeit with significant differences between countries and biogeographical regions (EU, 2015)

2.3 EU strategy for Bioeconomy

The EU's 2012 Bioeconomy Strategy defines the bioeconomy as "the production of renewable biological resources and the conversion of these resources and waste streams into value added products, such as food, feed, bio-based products as well as bioenergy". The aim of the Strategy is to pave the way to a more innovative, resource efficient and competitive society that reconciles food security with the sustainable use of renewable resources for industrial purposes, while ensuring environmental protection. To this end the strategy identifies five key objectives of the bioeconomy:

- (i) Ensuring food security;
- (ii) Managing natural resources sustainably;
- (iii) Reducing dependence on non-renewable sources;
- (iv) Mitigating and adapting to climate change;
- (v) Creating jobs and maintaining EU competitiveness.

It is important to note the multiple aims of the strategy and the wider bioeconomy agenda. The goal is not simply to increase agricultural or biomass output, but also to deliver more sustainable resource use, mitigate and adapt to climate change and promote sustainable growth. Hence the bioeconomy is closely linked to the circular economy agenda, i.e. one of resource efficiency, the circular use and reuse of resources, reduction in consumption and more sustainable consumption and production patterns.

Arguably, the (sustainable) bioeconomy agenda fundamentally depends on achieving a circular, more efficient economy. This is because of the potential scale consequences of, for example, attempting to replace the existing consumption of non-renewable sources with bioresources on a one to one basis. Excessive emphasis on alternative uses of biomass, in the absence of a wider shift in consumption and efficiency of resource use, could shift the focus away from models of agriculture and food production based on high quality products and services, conservation and management of cultural landscapes, preservation of multifunctional ecosystems, support to local economies based on synergy with tourism (Schmid, et al. 2012). These aspects are seen as key to the competitive advantage of many rural areas and give a strong identity to European agriculture. As highlighted in the EEA's 2018 report on the circular and bioeconomy:

“exploiting biomass is not necessarily circular and sustainable. Processed biomaterials are not always biodegradable, and mixing them with technical materials can hamper recycling. In addition, exploitation of biomaterials may increase pressure on natural resources and dependence on use of non-biological materials with considerable environmental impact, including agrichemicals” (EEA 2018) . Clear principles are needed in order to fulfil the potential of the bioeconomy towards sustainability and green growth.

Under the EU’s Strategy a Bioeconomy Panel made up of key stakeholders (European Commission 2013b) was set up. In 2017 they published a ‘Manifesto’ setting out principles on which they considered a European bioeconomy should be based. It noted that “the development of the bioeconomy needs to be driven by the desire to meet several of the big societal challenges of our time. The EU bioeconomy should be sustainable in terms of people (jobs, inclusiveness), planet (limits to resources, biodiversity, ecological balance and climate) and profit (resource efficiency, competitiveness)” (Bioeconomy stakeholder manifesto 2017).

Within the conception of the bioeconomy all three elements of sustainable development feature strongly. Economic, social and environmental change have to be driven by a more innovative, efficient and multi-faceted approach to the use of biomass. The bioeconomy is often cited as a mechanism by which the aims set out in the UN 2030 Agenda for Sustainable Development (United Nations Resolution 2015) could be realised, potentially contributing to the achievement of several Sustainable Development Goals (SDGs). The SDGs commonly cited as relevant to the bioeconomy are (Global Bioeconomy Summit 2015):

- ☐ Economic growth and eradication of poverty (SDG 1);
- ☐ Food security and nutrition (SDG 2);
- ☐ Healthy lives (SDG 3);
- ☐ Water and sanitation (SDG 6);
- ☐ Affordable and clean energy (SDG 7);
- ☐ Sustainable consumption and production (SDG 12);
- ☐ Climate change (SDG 13);
- ☐ Oceans, seas and marine resources (SDG 14); and
- ☐ Terrestrial ecosystems, forests, desertification, land degradation and biodiversity (SDG 15).

As much as the bioeconomy can contribute to the sustainable development goals, it may also challenge their achievement. This will depend on the approach to implementation and the scale of use and sustainable production (Dietz et al. 2018). At the recent Global Bioeconomy Summit, stakeholders from across the globe recognised the need for the bioeconomy to fulfil and address sustainability issues in order to provide a contribution to the SDGs.

Regarding the concept of a forest-based bioeconomy is currently understood and used in different ways, indicating distinct strategic meanings and importance. The European forest-based bioeconomy is affected by a huge number of policy instruments. Different policies affect distinct stages of the forest-based value chain (and its respective sub-sectors) in different ways. Diversification processes, as part of a cross-sectoral bioeconomy, increase this complexity. Several policies address trade-offs between economic profitability/competitiveness and social and environmental sustainability. The latter is of particular importance as the forest-based bioeconomy is dependent on forest ecosystem goods and services produced on one third of the territory of the EU where many of these areas are subject to contradicting societal demands. This raises the general question in how far policies can transform trade-offs into synergies (Winkel 2017).

2.4 Bioeconomy at National and Regional level

Bioeconomy related research and innovation (R&I) is a priority for most of European countries and regions in the time period 2014-2020. According to European Commission (2017), 207 out of 210 analysed territorial units (EU regions and countries), almost 98.6%, include bioeconomy related aspects in their 2014- 2020 R&I priorities and plans. However, denominations of bioeconomy aspects in the different territorial unit scan vary enormously (from low-carbon, green growth, sustainable agriculture, innovative food production, green chemistry, eco-innovation and circular economy to blue growth).

Some countries and regions follow a strategic approach to support the bioeconomy. The analysis shows that 19 Member States already have a bioeconomy strategy (or a similar strategic document) in place or are in the process of developing a strategy. Moreover, 49 of the analysed regions have developed a regional bioeconomy strategy or a similar comprehensive document. In the regions and countries without an explicit bioeconomy strategy, the bioeconomy support is often embedded in one or several other strategic documents or funding programmes. These are mainly specific national or regional R&I strategies and plans, sectoral innovation strategies and plans (e.g. innovation in agriculture, fisheries, waste management) or strategic frameworks partially covering bioeconomy (e.g. circular economy, blue economy).

Regional bioeconomy ecosystems in Europe are, first and foremost, built around the usual stakeholders of regional innovation systems: Regional governments and public administration, businesses and representatives of sectoral associations and business intermediaries, as well as academic, scientific and technological institutions. Clusters are an important tool to gather stakeholders around specific bioeconomy sectors/products, especially in strongly industrialised regions, but also increasingly in rural regions. In comparison to traditional industrial clusters, bioeconomy related clusters often need to integrate also producers of biological resources, i.e. farmers and fishermen, as well as their associations, e.g. cooperatives. In particular, at the level of government, coordination among different policy areas (e.g. research and innovation, agriculture, environment) is needed to promote the bioeconomy.

The vast majority of European RIS3 strategies foresees support for bioeconomy R&I in 2014- 2020. Most of them within the field of agro-food or energy R&I. For this purpose, a wide range of instruments and modalities to support the bioeconomy is envisaged by

the Regions for the 2014-2020 funding period. The different instruments range between support to R&I projects, promotion of networks and clusters, physical infrastructure to the promotion of technology transfer and technology services, training and capacity-building. Moreover, financial instruments and venture capital measures are foreseen to bundle resources and to raise more investments. With regard to targeted recipients for bioeconomy support measures, most of the analysed regions/strategies focus on SMEs and companies. Many regions anticipate to focus on various target groups at the same time, instead of considering one specific group. Another relevant target group are projects that involve both business and research partners. The information gathered in RIS3 documents for EU28 shows that 67% of the regions intend to use European Structural and Investment Funds (ESIF) as funding source to support their bioeconomy activities. Given that information on ESIF co-funding of R&I activities, apart from EAFRD, is usually not split per sector and that some bioeconomy relevant activities are included in different thematic objectives (low carbon, SME, environment), the real number of regions planning to use ESIF cofunding might be even higher. In particular, ERDF, EAFRD and EMFF are used by the regions and countries, but also to less extent ESF. Moreover, the data gathered show that 77% of the regions foresee H2020 co-funding for bioeconomy related activities. H2020 is mentioned as funding source in almost all RIS3 strategies. However, due to competitive character of the calls, it is difficult to state a definite figure for the period 2014-2020. Many regions highlight, in particular, different ERA-Net networks/projects and the JPIs (Joint Programming Initiatives) as relevant for their bioeconomy deployment. The analysis shows that European countries and regions also use a variety of other EU programmes for the purpose of bioeconomy promotion, e.g. Interreg, LIFE+, CIP/COSME, ERASMUS+, Intelligent Energy Europe.

An overview of Bioeconomy and related strategies around Europe is provided in Table 2.1.

In Greece, the main governmental body implementing Bio-economy policies is the Ministry of Environment and Energy (YPEN) which launched the 1st National Strategy for the Circular Economy in the 25th of May 2018 for public consultation. In addition, the “Strategic plan for the development of research, technology and innovation under the National Strategic Reference Framework (NSRF) 2007-13” (19) aims to restructure the Greek economy, gearing it towards high value added products and services, and achieve the transition to a knowledge based economy and society. Relevant policy documents and activities in that respect include: (a) The Green Growth

Strategic Action Programme (2010-2015) instruments which provide opportunities for industrial biotechnology centers to set up green public procurement and grant green businesses easier access to capital. Solutions for waste management, including waste re-use, are particularly fostered (20); (b) the National renewable energy action plan (2010) – in accordance with the EU's 20% renewable energy target by 2020 (16) and (c) Law 4414/2016 that drafts the national strategy for protection against the effects of climate change and provides a new Support Scheme for power plants from renewable energy sources and cogeneration of high performance electricity and heat. At Regional Level most efforts for Bio-economy development are related with the Regional Research and Innovation Strategies for Smart Specialization (RIS3), while at local level several municipalities have developed initiatives to recycle and exploit biomass (Papadopoulou et al. 2018).



Table 2. Overview of Bioeconomy related strategies across Europe (ENRD 2018)

| Country | Strategy | Timeframe | Type | Goal | Priority areas |
|----------------|---|-----------|-------------------------------|---|---|
| European Union | Innovating for Sustainable Growth: A Bioeconomy for Europe (2012) | 2020 | EU Bioeconomy Strategy | It aims to reconcile food security with sustainable use of renewable resources, while ensuring environmental protection. | Agriculture Forestry Fisheries Aquaculture Processing industries |
| | Review of the 2012 European Bioeconomy Strategy (2017) | 2020 | EU Bioeconomy Strategy review | To assess progress against the objectives and priorities set in EU Bioeconomy Strategy | Agriculture Forestry Fisheries Aquaculture Processing industries |
| Austria | Research, Technology and Innovation Strategy for Bio-based Industries in Austria (2014) | 2030 | Research and Innovation | Further develop the bio-based industry by promoting research, technology and innovation projects. The following product groups are prioritised: insulation and building products; biogenic composite materials, biopolymers; biofuels, biogenic fertilisers, and enzymes and pharmaceutical products. | Food industry Chemicals industry Pharmaceutical industry Timber industry |
| | Policy Paper on the Bioeconomy (2013) | | | | |
| Belgium | Bioeconomy in Flanders (2014) and Action Plan | 2030 | Regional Bioeconomy Strategy | Green growth; job creation, and development of a circular economy | Agriculture Forestry Fishing Food industry Wood-processing sector Pulp and paper industry Environmental technology sector |

| Country | Strategy | Timeframe | Type | Goal | Priority areas |
|---------|---|-----------|------------------------------|--|---|
| Denmark | Growth Plan for Water, Bio and Environmental Solutions (2013) | n/a | Green Economy | Both plans aim to foster economic growth, employment and exports | Construction and infrastructure sector |
| | | | | | Energy sector |
| | | | | | Industrial sectors (textile, chemical, biotechnology) |
| Denmark | Growth Plan for Food (2013) | n/a | Green Economy | | Water resources |
| | | | | | Bio-based products |
| | | | | | Air |
| Finland | The Finnish Bioeconomy Strategy (2014) | 2025 | National Bioeconomy Strategy | Growth and competitiveness | Resource efficiency and waste |
| | | | | | Horizontal (research; knowledge transfer; market promotion; marketing; expert; investments) |
| | | | | | Resource efficient food production |
| Finland | The Finnish Bioeconomy Strategy (2014) | 2025 | National Bioeconomy Strategy | Growth and competitiveness | Forestry (timber market or diversification of wood products, including for energy) |
| | | | | | Biotechnologies (health and pharmaceutical research) |
| | | | | | Water (efficiency and recycling) |
| Finland | The Finnish Bioeconomy Strategy (2014) | 2025 | National Bioeconomy Strategy | Growth and competitiveness | Agriculture |
| | | | | | Services (tourism) |
| | | | | | |

| Country | Strategy | Timeframe | Type | Goal | Priority areas |
|---------|--|-----------|------------------------------|--|---|
| France | A Bioeconomy Strategy for France (2017) and the related action plan 2018-2020 (2018) | 2030 | National Bioeconomy Strategy | Sustainable economic growth; Increased employment and improved trade balance and international competitiveness; Self-sufficiency. The Strategy is intended to contribute to the sustainable and efficient production and use of bioresources. | Supply chains in relation to: <ul style="list-style-type: none"> • Biomass for food production; • Materials; • Bio-based molecules; • Bioenergy; • Ecosystem services. |
| | National Strategy for the Ecological Transition towards Sustainable Development 2015-2020 (2015) | 2020 | High Tech | Development of key sectors for the bioeconomy, i.e. industrial biotechnology and renewable energy | Energy production from renewable sources Chemical and plastics more ecological |
| Germany | National Policy Strategy on Bioeconomy (2013) | n/a | National Bioeconomy Strategy | Set priorities for a knowledge-based bioeconomy | All bioeconomy value chains. Cross-sector areas: <u>Coherent policy framework</u> Information and dialogue with society |

| Country | Strategy | Timeframe | Type | Goal | Priority areas |
|---------|----------|-----------|------|------|---|
| | | | | | Training |
| | | | | | Thematic areas: |
| | | | | | Sustainable production and provision of resources |
| | | | | | Growth, innovation and technologies |
| | | | | | Value adding networks |
| | | | | | Competition among uses of land |
| | | | | | International context |
| | | | | | Funding programmes include: |
| | | | | | Renewable resources |
| | | | | | Global food security |
| | | | | | Sustainable agricultural production |
| | | | | | Plant breeding and animal health |
| | | | | | Biomass-based energy carriers |
| | | | | | Biotechnology |
| | | | | | Biogas |
| | | | | | Lignocellulose materials |
| | | | | | Algae |
| | | | | | Sustainable use of food and biomass |
| | | | | | Development of bio-based products |
| | | | | | |
| | | | | | Farming and the agri-food business |
| | | | | | Marine and maritime industries |
| | | | | | Forestry |
| | | | | | |
| | | | | | |

| Country | Strategy | Timeframe | Type | Goal | Priority areas |
|---------|---|-----------|-------------------------|---|--|
| | Plan for Rural Development (2017) | | | Maintaining natural capital; Technologies to produce value added bio-based products; Biotechnologies | Novel protein production Water and water management Energy Biopharmaceutical products |
| | Harnessing Our Ocean Wealth (2012) | n/a | Blue Economy | Strengthen sustainable growth; Optimise economic benefits from marine resources | Marine resources for renewable energy and health applications |
| | Delivering our Green Potential (2012) | n/a | Green Economy | Identify business opportunities for companies resulting from the green economy. The bioeconomy is mentioned as a research area, which could be expanded by investing in research institutions. | Wide range of sectors, including agriculture, marine and forestry; renewable energy and efficiency; waste and water management; transport. |
| | Towards 2030: Teagasc's Role in Transforming Ireland's Agri-Food Sector and the Wider Bioeconomy (2008) | 2030 | Research and Innovation | Contribute to coping with challenges such as food and energy security; Help achieving social goals, including public health, improved food products and enhanced rural development | Food production and processing Value-added food processing Agri-environmental products and services Energy and bio-processing |

| Country | Strategy | Timeframe | Type | Goal | Priority areas |
|-----------|--|-----------|------------------------------|---|-------------------------------------|
| Italy | Bioeconomy in Italy: A unique opportunity to reconnect economy, society and environment (2017) and Action Plan | 2030 | National Bioeconomy Strategy | Increased competitiveness and promotion of green growth. Reduce fossil fuel dependence and promote rural and coastal development. | Agriculture |
| | | | | | Forestry |
| | | | | | Marine |
| | | | | | Agri-food sector |
| | | | | | Bio-based industry |
| Latvia | Latvian Bioeconomy Strategy 2030 (2017) | 2030 | National Bioeconomy Strategy | Support the UN 2030 agenda (SDGs 2, 7, 8, 12, 13 and 14) | Agriculture |
| | | | | | Forestry |
| | | | | Promotion of rural development and increased per capita income. Development of high value-added bio-based products and services | Fisheries |
| | | | | | Food and feed industry |
| | | | | | Wood industry |
| | | | | | Chemical and pharma industry |
| Lithuania | National Industrial Biotechnology Development Programme (2011-2013) | 2013 | High Tech | Industrial biotechnology research development programme accounting €0.7 million. The main aims were: • Technology development; • Pilot and demonstration projects; • infrastructure investment and commercial use of by products and waste. | Bioplastics |
| | | | | | Second-generation biofuels |
| | | | | | Biopharmaceuticals and animal drugs |
| | | | | | Bio-based materials |
| | Smart specialisation (2014) | 2020 | Research and Innovation | | Energy and sustainable development |

| Country | Strategy | Timeframe | Type | Goal | Priority areas |
|-------------|---|-----------|------------------|---|--|
| | | | | <p>Foster growth and competitiveness through identifying R&D and innovation solutions.</p> <p>20 priority areas are identified, alongside procedures for monitoring and an overarching action plan for the development of the Strategy.</p> | <p>Inclusive and creative society</p> <p>Agro-innovation and food technologies</p> <p>New production processes, materials and technologies</p> <p>Health technologies and biotechnologies</p> <p>Transport, logistics and information and communication technologies</p> |
| Netherlands | Green Growth: for a strong sustainable economy (2013) | n/a | Green Economy | <p>Strengthen green growth and international competitiveness</p> <p>The bio-based economy is considered a priority of future economic activities, especially through promoting R&D and demonstration projects</p> | Cascading use of biomass |
| | Green Growth – From Biomass to Business (2012) | n/a | Biobased Economy | Strengthen competitiveness and create new business | <p>Bio-based materials</p> <p>Bioenergy and bio-chemicals</p> <p>Integrated biorefineries</p> <p>Optimised cultivation and biomass production</p> <p>Recovery and recycling of water, nutrients and soil</p> <p>Economy, policy and sustainability</p> |
| | Framework memorandum on the Bio-based Economy (2012) | n/a | Green Economy | <p>Coping with societal challenges, including climate change, energy security and resource scarcity.</p> <p>This is promoted via enhanced knowledge infrastructure; regional private-public clusters; and policy.</p> | Efficient use of biomass for food, industrial products and energy |

| Country | Strategy | Timeframe | Type | Goal | Priority areas |
|----------|--|-----------|------------------------------|---|---|
| Portugal | National Strategy for Oceans (2013-2020) | 2020 | Blue Economy | Valorise the ocean and its coastal areas by setting up sectoral and cross-sectoral projects; Support economic growth and generate employment | Aquaculture |
| | | | | | Blue biotechnology |
| | | | | | Blue energy |
| Spain | The Spanish Bioeconomy Strategy Horizon 2030 (2016) | 2030 | National Bioeconomy Strategy | Global perspective: <ul style="list-style-type: none"> • Climate change; • Food security. National/regional level: <ul style="list-style-type: none"> • Increase competitiveness and economic growth; • Diversified and more environmental sustainable economy. | Agri-food |
| | | | | | Forestry |
| | | | | | Bio-based industry (i.e. biorefineries, bioenergy, production of biomass from non conventional sources) |
| | Extremadura 2030 (2017): Strategy for Green and Circular Economy | 2030 | Regional Bioeconomy Strategy | Improved resource management; Development of agro-ecological practices; Development of new 4.0 business models | Agri-food Forestry and wood processing Clean energy Green tourism Health sector |
| | The Andalucía Bioeconomy Strategy (under development) | 2030 | Regional Bioeconomy Strategy | Support the creation of bio-products value chains in relation to: <ul style="list-style-type: none"> • Production of biological raw materials or biomass; • Technological processing; | Agriculture Forestry Fisheries Food and pulp and paper production |

| Country | Strategy | Timeframe | Type | Goal | Priority areas |
|----------------|--|-----------|------------------------------|--|---|
| | | | | <ul style="list-style-type: none"> Consumption patterns. | Chemical, biotechnological and energy industries |
| Sweden | Swedish Research and Innovation Strategy for a Bio-based Economy (2012) | n/a | Research and Innovation | Identify research gaps and develop a strategy for investments that are needed in research, development and innovation for the bio-based economy | Increased biomass production |
| | | | | | Creation of smarter products by refining biomass (waste and residues) |
| | | | | | Consumption patterns |
| | | | | | Policy instruments guiding and impacts of biomass production |
| United Kingdom | UK Synthetic Biology Strategy Plan 'Biodesign for the Bioeconomy' (2016) | n/a | High Tech | Stimulate sustainable economic growth; create jobs and strengthen productivity and competitiveness; Capacity building and multi-stakeholder partnerships (All) | Sustainable materials |
| | Building a high value bioeconomy, opportunities from waste (2015) | n/a | Circular Economy | Encourage R&D into technologies (Strategy Plan) | Chemicals |
| | | | | | Energy |
| | Biorefinery Roadmap Scotland (2015) | n/a | Bioenergy | Reduce environmental pollution and GHG emissions; R&D support in the field of biotechnologies and biorefineries (Waste strategy) | Residues and wastes |
| | | | | Encourage sustainable manufacturing and innovative products through R&D support for biorefinery development and consortia formation (Roadmap) | Co-products and residues of timber |
| | | | | | Household waste; commercial and industrial waste |
| | A Bioeconomy for the Baltic Sea Region (2014) | n/a | Regional Bioeconomy Strategy | Portraying efforts on the bioeconomy across the Baltic Sea region and scoping interest among stakeholders to develop a regional bioeconomy strategy | Macroalgae |
| | | | | | Food and feed |
| | | | | | Bio-based non-food, including bio-materials, bio-chemicals, enzymes |

| Country | Strategy | Timeframe | Type | Goal | Priority areas |
|--|---|-----------|------------------------------|---|---|
| Baltic Sea Region ¹⁶ | | | | | Bio-based energy |
| Danube Region ¹⁷ | Bioeconomy for the Danube region (2017) | n/a | Regional Bioeconomy Strategy | Mapping bioeconomy related initiatives in the Danube Region and supporting the initiation of bioeconomy strategy for the region | In order to development a bioeconomy, governance needs include: Political support Involvement of regions and local actors Multi-stakeholder dialogue and knowledge exchange Awareness raising and education |
| West Nordic Countries ¹⁸ | Future Opportunities for Bioeconomy in the West Nordic Countries (2014) | n/a | Regional Bioeconomy Strategy | Boost green growth and create added value through the use of natural resources | Fisheries Agriculture, by means of expanded research on soil conservation, grazing pressure and new crop variants. |

3. SECTORIAL ANALYSIS OF FOREST BIOECONOMY IN RELATION TO BIODIVERSITY AND OPEN/SOCIAL INNOVATION

In a bioeconomy context, an important challenge for the forest-based sector is to overcome the narrow definition of forest resources and wood-based products, including primary production. There is a need to move towards a horizontally and vertically integrated sector which covers the whole value chain of forest products and services, taking sustainable development as its core principle. Moreover, in a world in which narratives are ever more important, fact- and science-based narratives can be important to inform policy makers and the public at large. It is important for the forest-based sector to demonstrate its contribution to a bioeconomy in a sustainable and inclusive way (Wolfslehner et al. 2016).

The forest-based sector includes all stakeholders with a major interest in forestry, forest-based materials and products. Wood is the key component of the pulp and paper industry, it can be used for energy production, it is an important construction material and for the furniture industry. Forest-based biomass is also used for many different bio-based products, such as insulation material, barrier materials for damp protection, biopolymers, bio-based plastics and composites, carbon fibre, chemicals and cellulose-based textiles, smart packaging materials (Swedish Forest Industries Federation 2013).

In addition to raw materials, forests also provide a wide range of vital ecosystem services. The forest plays an essential role in climate change mitigation, safeguarding biodiversity, providing fresh-water, non-wood forest products and recreational environments. The forest-based sector depends on a broad range of scientific disciplines and technologies. Recent advances in for example physics, cell biology and genomics have enabled new tree-breeding technologies for enhancing wood qualities and pest resilience as well as enzymes for use in papermaking (Forest-based Sector Technology Platform 2013).

3.1 Bioeconomy sectors

Within the context of the challenges of our time, such as climate change through GHG emissions, biodiversity preservation, food safety and availability of materials and energy, the bioeconomy represents an important shift towards a new economic and industrial revolution. This is because bioeconomy is part of three major evolutions:

- ❑ First, bioeconomy is key in the transition from fossil/petroleum- based resources towards bioresources in industrial production. Bioeconomy refers to an economy that relies on

renewable natural resources rather than on fossil resources and petroleum based materials to produce energy, products and services. In this sense, bioeconomy proposes a new industrial revolution/wave.

- ❑ Second, bioeconomy is a crucial element of the circular economy based on the 'cascading use', reuse and recycling of resources (including waste) and the contemplation of complete lifecycles of resources and materials. A 'cascading use' describes the multiple utilisation of a resource (in different forms) during a specific time interval. Bioeconomy is about adopting an integrated and systemic view on food, energy and industrial production. In a circular economy, materials that can be reused and recycled are injected back into consumption cycle as new (raw) materials. This converts what is waste for some economic actors into "secondary raw materials" for others. Understanding the systemic nature of problems such as scarcity of resources, pollution and reduction of waste, the European Commission adopted in December 2015 a circular economy package to foster sustainable economic growth, while using resources in a more sustainable way (European Commission 2015a). The circular economy initiative is closely linked to bioeconomy, industrial growth, energy and climate policies. A circular or life cycle approach to agriculture and manufacturing requires new and integrative perspectives of value chains and production processes, bringing together formerly separated sectors, e.g. agriculture, energy production, textiles and chemicals.
- ❑ Third, bioeconomy offers a potential to modernise traditional economic sectors and to generate new sustainable economic growth through enabling new technologies such as biotechnology and nanotechnology.

Given that the definition and inclusion of sectors vary from one study to the other, these studies are not fully comparable. In general, there are certain core bioeconomic activities that can be related to primary production and the direct use of primary resources: agriculture, fishing and forestry, food industry and bioenergy. Other sectors are increasingly forming part of the bio-based economy, as they use biological resources as input for their production processes. The need to adapt technologies and engineering to the bio-based production has an indirect impact also on sectors such as machine-tool manufacturing, services as well as water supply and retail trade (Figure 3.1).

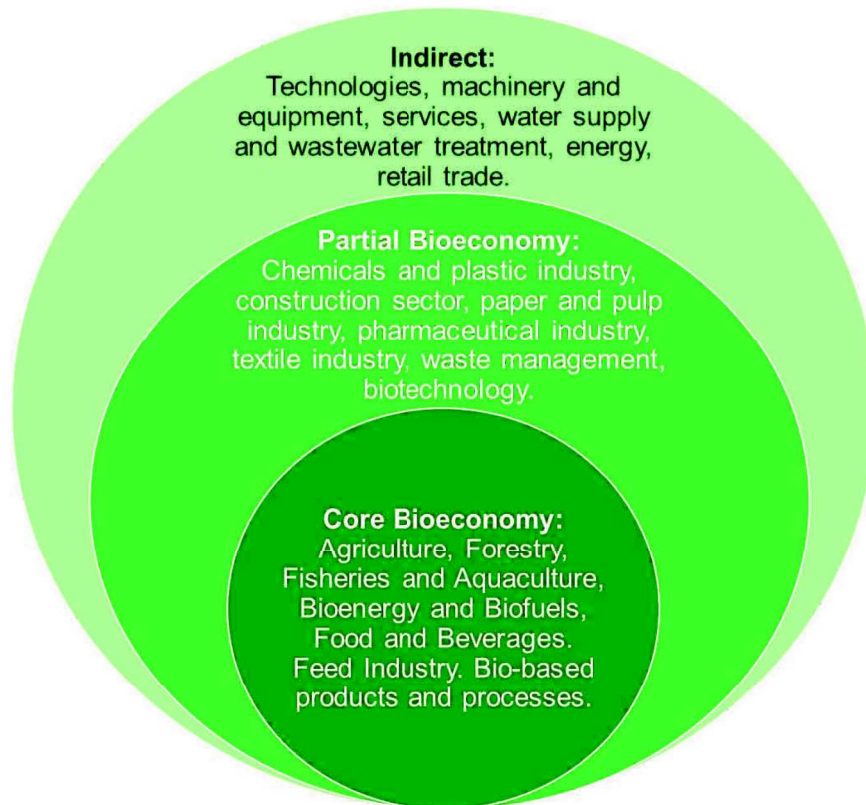


Figure 1 Economic sectors in bioeconomy

Bioeconomy is increasingly important in a number of economic sectors. One of the particularities of the bioeconomy is that it is not sectoral in nature, nor does it have a focus on specific territories, technologies or science fields. Rather it brings together traditional sectors such as agriculture, forestry and fisheries with innovative research fields such as nanotechnology and synthetic biology as well as highly advanced manufacturing systems and technologies. For European countries and regions, this is an opportunity to promote growth and jobs, in particular, in rural or peripheral regions, in case the wealth in natural assets in these regions can be connected to the knowledge and technological capacities available in other regions of Europe.

Converging trends lead to market pull and technology push effects that encourage innovative approaches in many economic sectors, including agro-food, forestry and lumber, aquaculture, heat and electricity production, paper and pulp, construction, sustainable chemistry, industrial manufacturing, industrial and environmental biotechnology etc. The shift from fossil resources to biological resources affects also wider part of the manufacturing industry, such as the packaging industry, the chemical industry, the cosmetics industry as well as the production of energy and fuels (Figure 3.2).

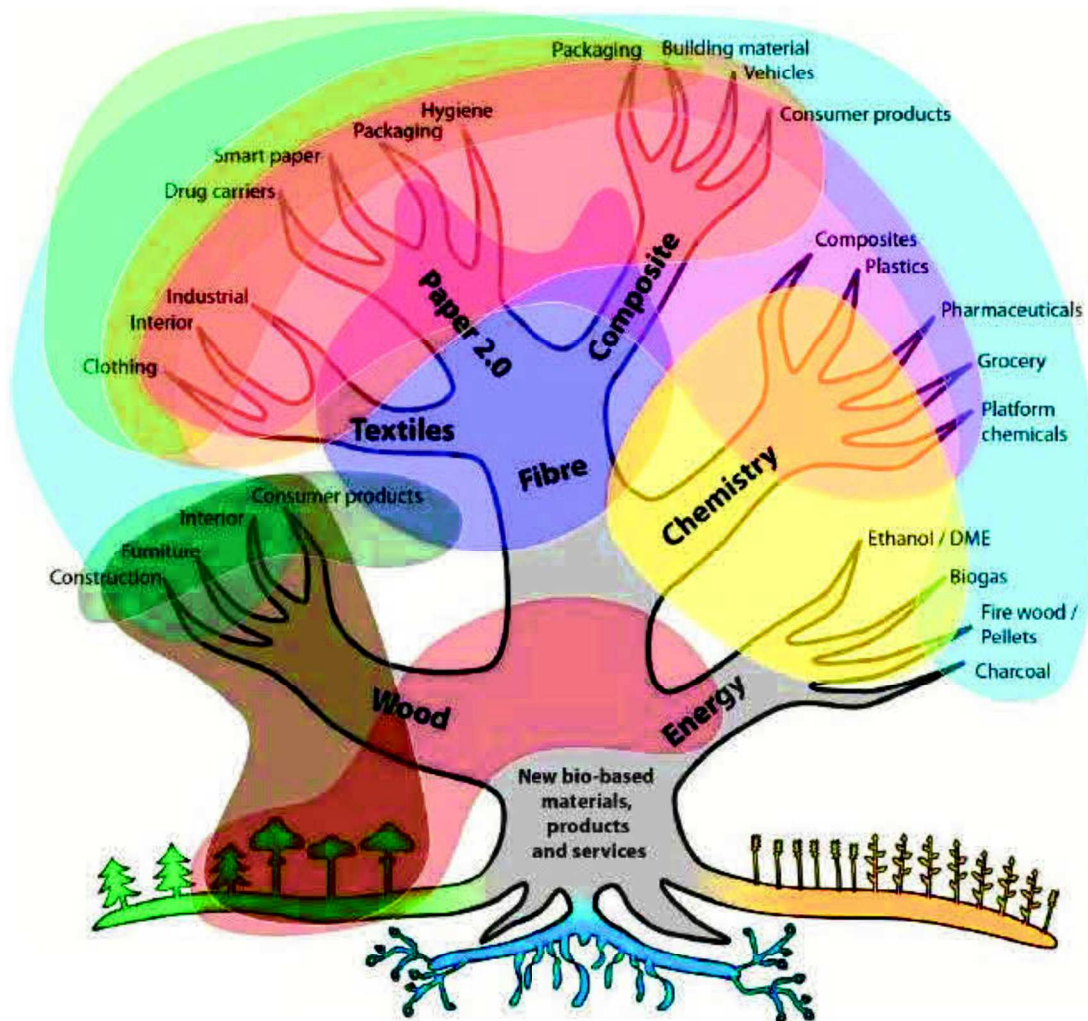


Figure 2 Sectors and products connected to forestry-based biomass (Source: Swedish Forest Industries Federation 2013)

3.2 Value chains

Because of the particular character of forest bioeconomy it is important to analyze it in the context of value chains or even in value cycles. However, the integrated and circular character makes bioeconomic approaches differ from traditional approaches to use natural resources usually for one purpose only (e.g. crops for food/feed or wood for energy). Furthermore, new and complex value cycles emerge due to new research findings and technological opportunities to work with the molecular building blocks of biological resources.

The forest-based sector in Europe provides society with a wide variety of products and services, ranging from paper, packaging, tissue paper and furniture, to carpentry and construction materials, wood-based panels, textile fibres, biofuels, bio-energy, chemicals and still much more. According to Forest-based Sector Technology Platform (FTP) (2018), the sector is a well-integrated value-chain with three main subsectors: forestry, the woodworking industries and the pulp and paper industries. It provides around 8 per cent of the EU's total manufacturing added value and creates close to 4 million jobs. Forest available for wood supply cover one-third of the EU's landmass and provide income for

Project co-funded by the European Union and national funds of the participating countries BMP1/Z1/2336/2017

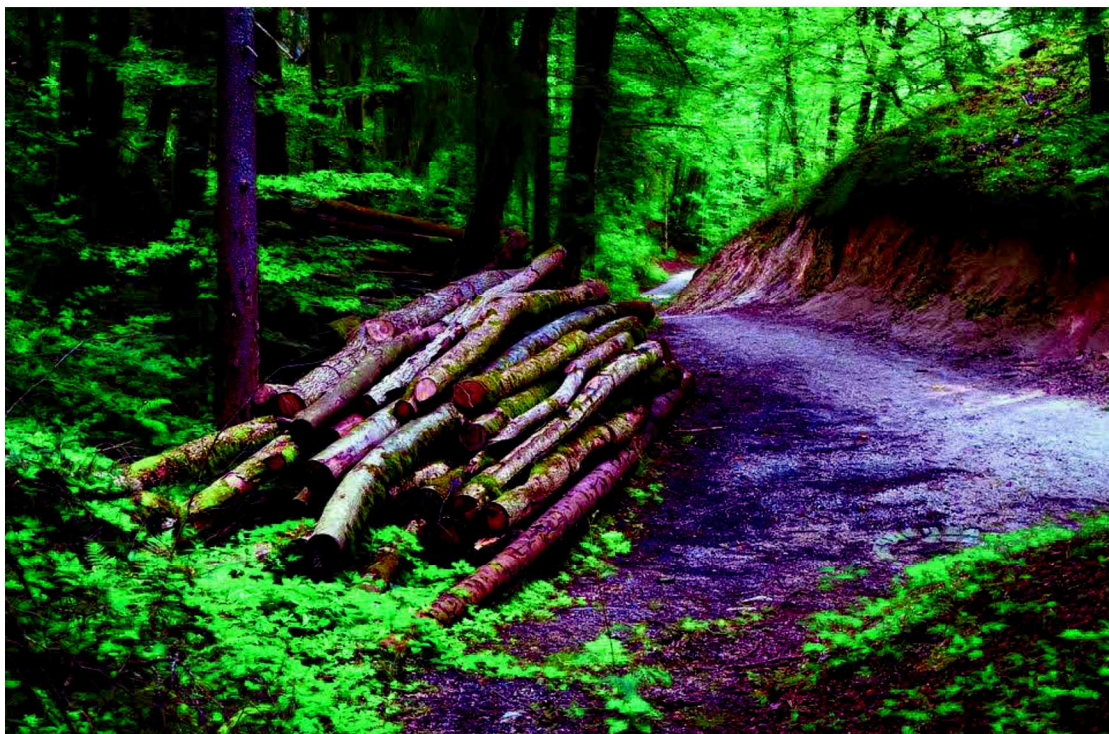
approximately 16 million forest owners, and thousands of employers in public forest management organizations.

Forestry

Sustainably managed, healthy and resilient forest ecosystems are a prerequisite for providing society with wood as well as other goods and services (including carbon sequestration, groundwater, erosion protection, biodiversity, and recreational opportunities). European forest holders have long, practical experience of sustainable forest management, which continues to evolve thanks to innovation, improved expertise and emerging societal demands. The implementation of existing European and national policies, regulations and voluntary tools, ensures the sustainable sourcing of forest biomass, irrespective of its end use.

Woodworking industries

The woodworking industries include sawmilling, planing and wood impregnation (12 per cent), other woodworking industries (47 per cent), and furniture (41 per cent). In 2015, turnover in the EU woodworking industries amounted to € 129 billion and incorporated an estimated 170 000 companies, employing substantially more than 1 million workers. In addition, 120 000 companies were active in the furniture sector. These figures, however, remain an underestimation, since SMEs are not necessarily included in Member States' reporting.



The pulp and paper industries

The pulp and paper industries, also referred to as the forest-fibre and paper industries, had a total turnover of € 81 billion in 2016 and employed about 175 000 people. As well as using virgin forest fibres, the European pulp and paper industries are one of the major recyclers in Europe. They reached a world record paper recycling rate of 72.3 per cent in 2017 (which is close to the theoretical maximum), while 90 per cent of newspapers and corrugated boxes are made from recycled fibres.

Managed with care and expertise through different types of ownership, from large and medium-scale managers of public forests to small-scale family forest owners and cooperatives, the forests of Europe offer an unsurpassable renewable raw material. The European forest area increases by an amazing equivalent of 1 500 football pitches per day. As only about two-thirds of the wood growth is harvested, a significant net increase of standing woody biomass is left unused each year. This builds up a resource base for future needs. From forest-fibre technologies to advanced paper and board design, as well as a range of different biobased materials, the paper industries currently invest around € 5 billion annually to offer a broader spectrum of resource-efficient products. In the areas of biorefinery and nanotechnology, the industry has already made substantial progress and is now rapidly ramping up production of green textile fibres and nanocellulose. Lignin and bark show potential in various applications; however, additional investment in development is required to reach full business potential.

New products outlook

The global and European drivers related to the need to move to low carbon and sustainable bioeconomy and the policies supporting this objective, for example, are opening many interesting opportunities for the industry to move in new directions. In fact, it appears that that this mature sector is currently experiencing changes and transformations that are larger than it has faced over the last century. The industry is diversifying its business strategies and product portfolios towards a variety of complete new products. These portfolios seem to be based increasingly on high value-added products and services rather than large-scale bulk production. Diversification and new product portfolios (Figure 3.3) also mean that the industry is entering into totally new markets with the creation of new networks and customer bases (Hetemäki 2014).

Biorefinery is a platform for transition.

There has been plenty of interest towards forest biorefineries (FB), particularly in countries with high-quality R&D, a mature state in the forest-based industries and abundant lignocellulosic biomass resources. A forest biorefinery can be defined as a multi-product factory that integrates biomass conversion processes and equipment in order to produce bioenergy (e.g. biodiesel, bio-oil, bioethanol, green electricity, heat and pellets) and bioproducts (e.g. bio-composites, bio-plastics) from wood-based biomass. The FB can use multiple feedstocks, including pulpwood, harvesting residues, extracts from effluents, fractions of pulping liquors, as well as recycled paper and industrial wastes. It can be a large-scale industrial facility, integrated into a pulp and paper mill, or a medium- or small-scale facility integrated into a sawmill or plywood mill (most of the discussions have focused on the former). An important goal of a forest biorefinery is to more efficiently utilize the entire potential of raw materials and by-streams of the forest-based sector for a broad range of products.

Wood products: the potential for a breakthrough

The wood products industry is much older than the paper industry, and in this sense even more mature. However, in the last decades, there has been a number of technological, process and business developments in wood construction in Europe as discussed below. Likewise, advances in wood modification technologies are improving the durability and creating opportunities for the use of temperate hardwood in a wider range of exterior applications. There are also great potential for structural uses of hardwood in interior construction and furniture design. There are also high hopes that political targets for moving to low carbon bioeconomy will support wood raw material-based construction, in particular. Wood building materials are likely to have greenhouse gas mitigation benefits unlike other building materials such as concrete and steel. The sector itself has high hopes that this will also materialize in future as a major driver for the increasing demand for wood products.

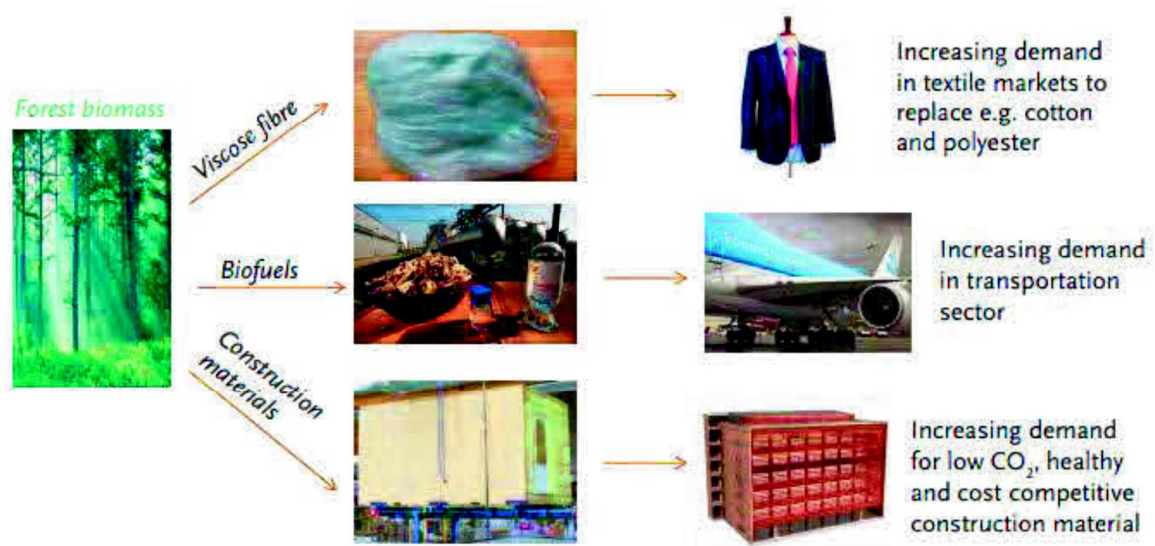


Figure 3.3. Illustration of some forest product developments and their end uses

Several policies and policy instruments are important towards similar prioritisation from both a policy making and industry perspective. This includes policy domains such as climate and energy, environment and forest focused policies and instruments (Figure 3.4). However while the EU Forest Strategy largely focuses on forests and forest focused policy, forest based industries were concerned with policies and policy instruments relevant to the entire forest value chain (excluding primary processing) and that have a direct or indirect impact on the industry. Some policy domains, such as environment, climate and energy, are therefore considered forest relevant in the CCA as well as the Strategy, simply due to their overall significance. It can also be noted that the EU Forest Strategy focuses, to a large extent, on voluntary instruments (e.g., strategies and roadmaps) and only resorts to legislation if it relates directly to forests (e.g., Natura 2000, Life+ and Timber Regulation) while forest based industries prioritised instruments that have an impact on how they are allowed to operate (Aggestam and Pölzl 2018).

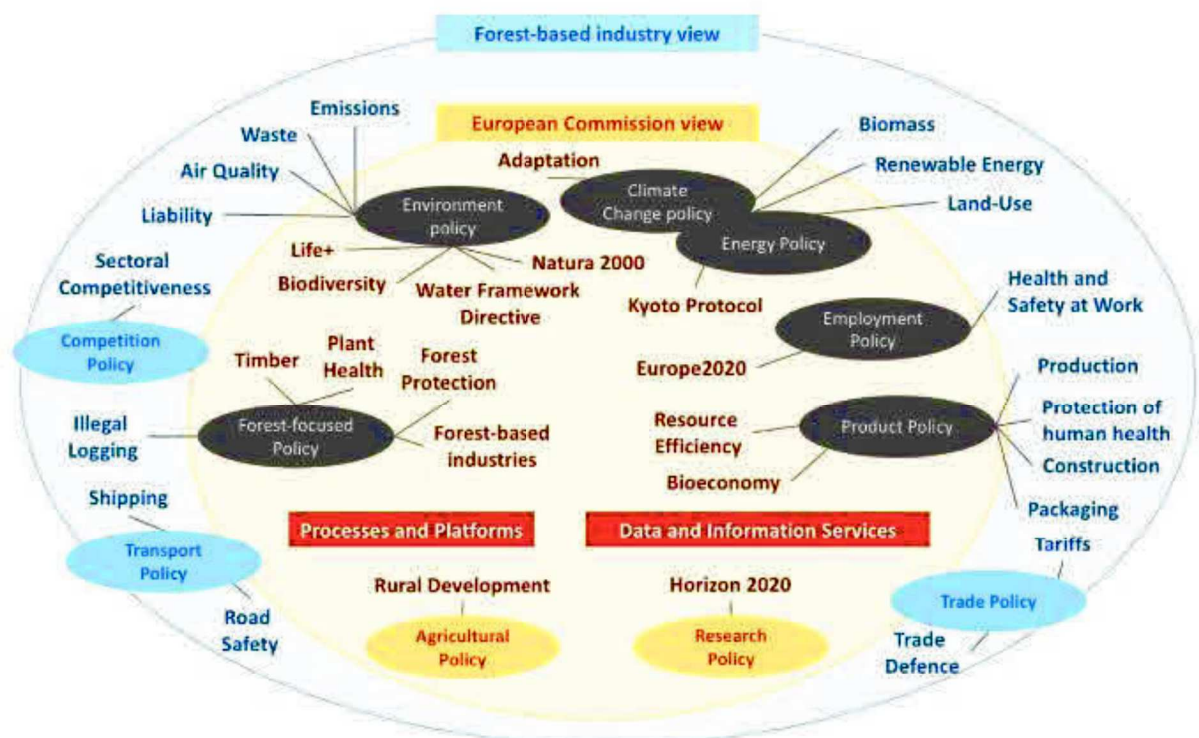


Figure 3 EC and industry policy priorities associated with the forest based sector value chain.

3.3 Biodiversity and forest bioeconomy

A sustainable bioeconomy must value natural resources and diminish environmental pressures and increase the use of sustainable renewable products, restore and enhance ecosystems' functions and biodiversity. Thus, for the bioeconomy to deliver on sustainability, we must be able to better understand and measure its effects and impacts on the ecological boundaries of our planet. This is necessary to develop the bioeconomy in a way that attenuates pressures on the environment, values and protects biodiversity and enhances the full range of ecosystem services. These actions aim at increasing the overall knowledge and monitoring of the bioeconomy. All of them respond to the need to have an in depth knowledge of the sustainable biomass supply limits at the local, regional and global level. This knowledge will feed into the other operational actions of this strategy. These actions will provide the foundation to reinforce the resilience of land and marine ecosystems, enhance their biodiversity and ensure their contribution to climate mitigation while transforming our fossil-based economy into a bio-based economy.

In forestry the green economy benefit starts when and occurs through management tools and investments that could limit trade-off effects of traditional multi-functionality and expand the ES availability for the society with a scope of fairness within and among generations. In order to promote the effectiveness of green economy in managed forests, the UNECE Committee on Forests and the Forest Industry (COFFI) and the FAO European Forestry Commission (EFC) decided to take action and prepared the Rovaniemi Action Plan for the Forest Sector in a Green Economy (ECE/TIM/SP/35). The Action Plan consists of 5 pillars with their respective goals, which are:

- (i) sustainable production and consumption of forest products (patterns of production, consumption and trade of forest products are truly sustainable);
- (ii) a low carbon forest sector (the forest sector makes the best possible contribution to mitigation of, and adaptation to, climate change);
- (iii) decent green jobs in the forest sector (the workforce is able to implement sustainable forest management, and the forest sector contributes to achieving the social goals of the green economy by providing decent jobs);
- (iv) long-term provision of forest ES (forest functions are identified and valued and payments for ES – PES (Payment for Ecosystem Services)– are established, thus encouraging sustainable production and consumption patterns);

- (v) policy development and monitoring of the forest sector in relation to a green economy (policy-makers and institutions in the forest sector promote sustainable forest management, in a way that is adequate to mainstream the green economy in forest sector policies).

In this perspective, only an ecosystem-based management of natural resources can halt the loss of biodiversity and the degrade of resources quality. This is exactly one of the purposes of the Bioeconomy Strategy, properly aimed at improving the knowledge base and fostering innovation to increase productivity, while ensuring sustainable resource use and alleviating stress on the environment.

According to European Commission (2018), enhancing the knowledge base and understanding of specific bioeconomy areas will be based on acquiring more data, generating better information and systemic analysis of data and information including:

- The status and resilience of forest ecosystems and their biodiversity. This includes their related socio-economic costs and benefits, and their capacities to serve as a sustainable domestic biomass source, to sequester carbon and to increase climate resilience.

- The sustainable biomass availability as well as public and private bioeconomy investments.

Enhancing the knowledge base will include forward looking, cross-sectoral assessments, modelling and scenarios. Progress in the bioeconomy will be systematically monitored for a responsible and inclusive governance and coherent policy-making. The status of biodiversity, ecosystem, degraded land areas and land at risk of climate change impacts, such as desertification will also be monitored, to restore land based and marine ecosystems. The Commission will implement an EU-wide, internationally coherent monitoring system to track the progress towards a sustainable, circular bioeconomy in Europe and to underpin related policy areas. Knowledge gained will be used to provide voluntary guidance for operating the bioeconomy within safe ecological limits. The benefits from biodiversity-rich ecosystems will be better integrated in primary production through a specific support to agro-ecology, the development of microbiome-based solutions, new tools to integrate pollinators in value chains and specific support for agro-ecology.

knowledge-based improvement of the concept and its operationalization are in line with the EU nature and biodiversity strategies, directives and overall policies, which are expected to enhance and promote biodiversity conservation, the sustainable use of natural resources, while improving communication, mainstreaming and policy consideration in a wide societal and political context (Marchetti et al. 2014).

3.4 Social and open innovation

Human well-being depends on ecosystem services (ES) (Costanza et al., 2014; Knight and Rosa, 2011). Social systems are affected by changes in the functioning ecosystems and by the resultant flow of their services (Nijnik and Miller, 2013); Open and social innovation encompasses new forms of interaction between environmental, economic, and social realms in order to solve shared problems and achieve common goals through strengthened collaboration and bottom-up initiatives. This approach has significant potential if forest bioeconomy and the sustainable management of forest ecosystems.

Following Murray et al., (2010) social innovation processes can be considered in several sequential steps.

At first, opportunities and challenges, and external institutional and broader material contexts, can lead actors to initiate innovation processes to generate and develop new ideas, and ways of working. New ideas emerge from groups or individuals, and, if developed up to collective actions, they can move on to a second stage where ideas are tested in practice. This second stage can be done through simply testing things, or through more formal pilots, prototypes or even (in theory at least) randomised controlled trials. The process of refining and testing ideas is particularly important because it is through iteration, trial and error, that cooperation and partnerships can be created and conflicts can be resolved. It is also through these processes that measures of success come to be agreed upon

When the idea expands to collective action, prototypes such as new institutions can consolidate to ensure more robust and stable practices, which potentially can then scale-up and create systemic change either at local level or in a large institutional setting. Systemic change, such as replacement of institutions by newly established or reconfigured institution is the ultimate goal of SI. Different paths leading to SI usually involve the interaction of many elements: social movements, institutional change business models, laws and regulations, data and infrastructures, and entirely new ways of thinking and doing, usually over long periods of time.

Much regional development work can be seen as built around sector-specific development, where particular industries benefit from agglomeration economies and operate as sectoral clusters. Within the European Union in particular, the recognition of diversity within regions has underpinned a model of territorial development where geographical specificities may provide a potential for smart specialisation in economic activities. The above is reflected in social innovation initiatives in forested areas of European Union. However, social innovation is not specifically mentioned in literature on regional development, but in the more nuanced models it is trust, informal ties and untraded

interdependencies between actors which are seen as key factors determining positive differentials in economic performance.

Good practices and examples of social innovation initiatives related to Mediterranean and Balkan forests may include among others, the following:

- ☐ Development of the social cooperatives in Bulgaria, including forest consumer cooperatives, as a social - innovative approach in the field of bio - economy and to show the positive effect of their use and development.
- ☐ Prevention of forest fires in Spain, from forestry defense groups (ADFs) – associations of forest landowners, local volunteers and representatives of municipal councils.
- ☐ The Mediterranean Model Forest Network. A regional network of local networks including 13 regions and countries: Castilla y León (S), Murcia (S), Corsica (F), Provence-Alps-Costa de Azul (F), Sardinia (IT), Tuscany (IT), Istria (HR), Magnesia (GR), Western Macedonia (GR); Turkey, Tunisia, Morocco
- ☐ The Produtos silvestres do Alentejo (Portugal). The Collective Efficiency Strategy (EEC) “Valorization of the Mediterranean Wild Resources – A Strategy for Low Density Areas in Southern Portugal” is inserted in the PROVERE program and its aim is to create an entrepreneurial dynamic in the low density territories in Southern Portugal, focusing on the wild resources of the region. To do so, they have taken an approach that crosses innovation in production and transformation of resources with production and implementation of a marketing strategy that relates the intervention territory with the cluster at cause.
- ☐ Borgotaro mushroom (Italy) with the cooperation of 15 Agro-tourisms/ Farm businesses 12 Hotels/Guest quarters 8 B&B/Inns/Hostels 9 Cheese, sausage and wine growing and producing factories 2 Didactic farms 3 Museums/Private collections 30 Restaurants/Porterhouses 26 Typical products sellers

Social innovation can be key for supporting the Mediterranean forest landscape and these important examples from the region highlight this potential. Nonetheless, flexible frameworks are needed to provide evidence of what works and what does not work, to support practitioners and policy makers in assisting social innovation initiatives. As these cases make clear, local actors should be supported in sharing information and best practices, and to achieve funding lines in order to strengthen existing embryos of social innovation into long-term, successful initiatives.



4. INTERVENTION LEVELS AND REGIONAL ECOSYSTEMS OF BIOECONOMY

There is evidence that there are significant opportunities in Greece for the development of a wealthy and lucrative economy, based on renewable resources. However, effective growth of Bio-economy in Greece depends on successful cooperation of all stakeholders (state, business, citizens). Regional bioeconomy ecosystems in Europe are, first and foremost, built around the usual stakeholders of regional innovation systems: Government and public administration, businesses and representatives of sectoral associations and business intermediaries, as well as academic, scientific and technological institutions.

In particular, at the level of government, coordination among different policy areas (e.g. research and innovation, agriculture, environment) is needed to promote the bioeconomy as for example in the Region of Crete where a special working group has been formed for the implementation of the RIS3, comprised of different directorates of the Region of Crete, among others the Regional Directorate of Regional Planning, the Directorate of Environment and Spatial Planning, the Directorate

Project co-funded by the European Union and national funds of the participating countries BMP1/Z1/2336/2017 of Agricultural Economy. The Coordinator of the working group comes from the Regional Directorate of Regional Planning and is responsible for the general support and implementation of the RIS3.

Especially in strongly industrialised regions, but also increasingly in rural regions, clusters are an important tool to gather stakeholders around specific bioeconomy sectors/products. Clusters help e.g. “overcoming the region’s lack of critical mass and integrating Lapland’s industries into global value chains”

In comparison to traditional industrial clusters, bioeconomy related clusters often need to integrate also producers of biological resources, i.e. farmers and fishermen, as well as cooperatives, agricultural and export associations.

Moreover, many regions count on science and technology intermediary and transfer organisations to bridge the gap between research and the development of new products and diffusion of innovation among companies, in particular SMEs. The intermediary organisations or ‘bridges’ are particularly important in the emergent field of bioeconomy, where cooperation among different sectors is required and many technologies are still rather immature.

In addition to the usual stakeholders, the analysed bioeconomy related innovation systems present additional emergent players that seem to play a vital role in the promotion of the bioeconomy, these are presented in Table 4.1.

Table 3 Emergent players in regional bioeconomy systems (source: *Spatial Foresight, SWEKO, ÖIR, t33, Nordregio, Berman Group, Infyde 2017*)

| Type | Example |
|---|---|
| Bioeconomy Strategy Councils | The Strategy Council Bioeconomy Weser-Ems (‘Strategierat Bioökonomie Weser-Ems’) connects as intermediary public and private interests and stakeholders. It consists of 25 stakeholders coming from enterprises, research institutions and public institutions. The council has aligned the support of the Bioeconomy, which has resulted in the Master Plan Bioeconomy. The objective of the Council of Bioeconomy is to define areas of cooperation and to discuss further potential and bottlenecks. (Weser-Ems) |
| Bridges and links (thematic platforms, networks, projects) | National networks for fisheries and aquaculture in collaboration with the Central Denmark Region. Based on dialogues between the triple helix actors during 2014-2015, lists of more than 100 project initiatives and action plans have been developed for the fisheries and aquaculture industries (North Denmark) Czech Biogas Association, a national technology platform with more than 40 biogas industry members and leading R&D institutions from the whole Czech Republic and from abroad. (South Bohemia) |

| | |
|--|---|
| | <p>The new Lappish Innovation platform - Centre of Arctic Smartness Excellence will be created to support cluster's needs and also feed innovations and ideas and work as a booster for innovations using the TRL (technological readiness level) classification implementation, in particular in development, testing and service design laboratories and facilities. (Lapland)</p> |
| Specialised Technology, Research and Innovation Centres | <p>The Centre of Food and Fermentation Technologies (CFFT) is a R&D company that focuses on improving quality, functionality and stability of food, as well as developing and introducing new innovative food and fermentation technologies. CFFT has an extensive cooperation with research institutions and more than 40 industrial enterprises from different countries. (Estonia)</p> <p>The South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocenoses (CENAKVA) is a new infrastructure and research project which has been built in Vodňany town upon experience and knowledge base of the Fisheries and Hydrobiology Research Institute of the Faculty of Fisheries and Water Protection. The infrastructure project started in 2010 and was finished in 2013. (South Bohemia)</p> |
| Operational coordination bodies at Regional/local level | <p>North Sea Science Park, Nordsøen forskerpark, actively participates in a variety of projects, all of which are intended to promote development and growth in the fisheries and aquaculture industries. An important task will involve fundraising for project proposals that have been developed by stakeholders in the network development process. [...] Nordsøen forskerpark will be instrumental in supporting the development and implementation of some of the proposed initiatives. (North Denmark)</p> <p>Tehimpuls Association and the Agro Food Banat Crisana Cluster act as facilitators and multipliers of knowledge well connected with the researchers from the region's universities: Banat's University of Agricultural Sciences and Veterinary Medicine, Politehnica University, West University and Medicine and Pharmacy University.</p> <p>(West Region, Romania)</p> |
| Cross-border and interregional cooperation | <p>Region Skåne is one of six partners in a project funded by the Baltic Sea Interreg programme; Smart Blue Regions, which seeks to enhance blue growth opportunities, i.e. bioeconomy related to the maritime resources, based on increased capacity of the regions to implement research and innovation strategies for smart specialisation (RIS3). BUCEFALOS was a EU LIFE+ project in which the City of Malmö, Region Skåne and Trelleborg Municipality were investing about 3 million EUR to enable the region of Skåne to work towards the resource-efficient use of the excess aquatic biomass which is mainly treated as waste. (Skåne)</p> <p>The Cross-Border Smart Specialisation Strategy of Galicia - Northern Portugal (RIS3T) establishes strategic collaboration in bioeconomy related areas such as Biomass and marine energies and resources and agri-food and agri-environmental systems. (Galicia and Norte)</p> <p>The European Commission's 'Action plan for the EU Strategy for the Baltic Sea Region' mentions bioeconomy as one of the main priorities, where marine energy, blue biotechnology and sustainable use of biomass are pivotal topics. (Lithuania)</p> |

5. THE ROLE OF STAKEHOLDERS

The involvement and participation by stakeholders, private or public, is essential for a balanced development of forest-related policy and bioeconomy, as well as relevant programmes and regulatory frameworks affecting forests (Sotirov et al., 2015, Kleinschmit et al., 2018). Participation can, amongst other things, help to open new opportunities that improve relations with the public, enhance investment in Sustainable Forest Management, and facilitate new perspective and demands for forest products and services towards forest bioeconomy straightening.

Generally, a fundamental and early-stage involvement of appropriate policy makers and stakeholders is reflected in the fact that three bodies have been involved in developing the list of actions in the Forest MAP, which also names appropriate actors and stakeholders for subsequent implementation. These three bodies are the Standing Forestry Committee (SFC), the Civil Dialogue Group on Forestry and Cork (CDGFC), and the Expert Group on Forest-based Industries and Sectorally Related Issues, representing a wide range of societal perspectives and interests at the EU level. The Expert Group on Forest-based Industries and Sectorally Related Issues involves a wide range of stakeholder representatives (e.g., from trade, business associations and NGOs) as well as Member States and Commission representatives as appropriate actors. Likewise, the SFC in accordance with the Council conclusions provides member State representatives an important role as appropriate actors in forest policy, and facilitates cooperation and coordination with the appropriate Commission services on forest-related policy issues at EU level. Lastly, the CDGFC provides for an institutionalised mechanism through which various stakeholder contributions can be voiced and appropriately considered under the EU Forest Strategy. Hence, the EU Forest Strategy and its implementation generally is designed making a fundamental and positive contribution towards addressing and involving appropriate policy makers and stakeholders.

The EU Forest Strategy as well as the Forest MAP foresee:

- a) specific roles for policy makers, and at times for stakeholders, for each of the actions and
- b) different specific forms and aspects of participation and involvement between policy makers and stakeholders might have occurred under each of the Priority Areas and the various actions.

Hence, this section analyses both aspects, before the following section presents more broad and qualitative insights into participation and involvement under the EU Forest Strategy from the survey, thus arriving at a comprehensive picture on the issue.

Involvement and participation issues under Priority Area 1, 'Supporting our rural and urban communities', have been mainly and extensively covered in the "Evaluation study of the forestry

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measures under Rural Development” (Alliance Environment et al. 2017). A main element positively contributing to the involvement of appropriate policy makers and stakeholders are the institutionalised programming procedures of RDPs, involving all relevant policy actors especially at national and sub-national levels, as well as the formal stakeholder participation procedures in place in rural development programmes. This corresponds with the actors’ and stakeholders’ roles foreseen in the Forest MAP.

When it comes to Priority Area 2, ‘Fostering the competitiveness and sustainability of the EU’s forest-based industries’, appropriate policy makes from EU and MS levels as well as stakeholders have been involved in the actions as foreseen. In particular, forest-based sector stakeholders’ involvement has been implemented as foreseen through the activities of the Forest-Based Sector Technology Platform (FTP), the European Innovation Partnerships (EIP) dealing with forest-related topics (e.g., EIP for Agricultural productivity and Sustainability and EIP Raw Materials). The European Regions for Innovation in Agriculture, Food and Forestry (ERIAFF), which has conducted 3 workshops in cooperation with European Forest Institute (EFI), the European State Forest Association (EUSTAFOR), the European Regions Research and Innovation Network (ERRIN), COPA-COGECA, European Association of Mountain Areas (EUROMONTANA) and the Confederation of European Forest Owners (CEPF) on how to inform-prioritize-collaborate in networking EU Regions on innovation in forest management, use of wood and forest-related Services.

On the topic of Priority Area 3, ‘Forests in a changing climate’, the appropriate stakeholders and policy makers from MS and EU have been involved as planned. In particular, stakeholders have been involved in the development of the regulation on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry (LULUCF) into the 2030 climate and energy framework . Also, as part of the ongoing evaluation of the EU Adaptation Strategy, public consultation workshops were organized in April 2017 and January 2018, with participation from the forestry sector. In relation to fire risk management, the science-policy interface is furthermore seen as essential for gathering experts and relevant stakeholders from across Europe to identify knowledge and innovation gaps to formulate robust recommendations to improve risk management.

Under Priority Area 4, ‘Protecting forests and enhancing ecosystem services’ the relevant policy makers have been involved as intended. One of the main topics of concerns the implementation of Natura 2000 in forests, which requires a high degree of exchange between stakeholders, collaborative processes and management. It is worth mentioning that a Natura 2000 and Forest Guidance document has been produced in direct response to concerns raised by forest owners and managers as well as nature conservationists, over the management of forests on Natura 2000 sites (European Commission, 2015). However, although significant progress has been made, recent findings also demonstrate that

many challenges remain (Sotirov et al., 2017). Stakeholders have also been involved in the revised Plant Health Regulation.

Genetic research is covered by both the Priority Area 4 and 5, 'What forests do we have and how are they changing?'. Work on forest genetic resources found broad involvement of the European Commission, EU stakeholder groups, and support from Member States through the European Forest Genetic Resources Programme (EUFORGEN). Under Priority Area 5 policy makers from EU and MS levels have been involved appropriately, also including the DIABOLO project with innovative aspects of participation.

Under Priority Area 6, 'New and innovative forestry and added-value products' the relevant policy makers have been involved as planned. In particular, a study found 387 project connected to issues of involvement (Lovric et. al. 2017). The Forest-based Sector Technology Platform (FTP) and the European Innovation Partnerships work as catalysts for transnational research, coordination of research and innovation between the European Commission, Member States and stakeholders.

Working together to coherently manage and better understand our forests (Priority Area 7) has drawn on the appropriate policy makers from EU and MS levels. In particular, it incited productive collaborations with aspects of participation. Positive examples of stakeholder driven networking initiative can also be found, such as Innovawood, a European network with more than 50 members from 27 different countries that aims to support the forest-based sector, wood-based products and the furniture sector. The Innovawood network has funded 18 projects in total, while only 5 after 2013. Yet another long-running initiative to improve transnational cooperation between scientists and professionals as well as technology transfer in the forestry sector is the European Cooperation in Science and Technology (COST) program. Networking of research institutions and transfer of innovation to new generations of highly educated forest professionals has also been promoted by the European Commission through its Erasmus+ program in the field of higher education. The Erasmus+ Knowledge Alliance program has been active in promoting the links between higher education institutions and the industrial sector in the construction and furniture sector (Katch-e project) and in new entrepreneurial capacity in the forest-based activities (ECOSTAR project). The involvement of the forest-based sector, e.g. under UNECE/FAO forest communicators network as well as in holding campaigns and events can be further strengthened for increasing the societal outreach.

Under a global perspective (Priority Area 8) the appropriate policy makers from MS, Commission and the Council Working Party on Forestry had been involved, The degree to which this involvement is appropriate or sufficient could not be assessed. Particularly, involvement played prominent e.g. in the public consultations on the EU approach against Wildlife Trafficking and the review of the EU Timber

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Regulation, which was based on both, national reporting received by Member States and inputs received through a public consultation process.

In terms of bioeconomy, it is underlined that systematic stakeholder participation from the beginning can play an important role in addressing persistent societal problems in a credible, transparent, and multi-perspective way, as well as enable innovations. Public decision making on sustainability is characterized by uncertainty, different values and interests, communities in dispute, as well as urgency, so that holistic approaches have included multiple fields of knowledge and perspectives of different stakeholders. Most of the policy strategy developments in bioeconomy have already adopted a more or less participatory approach by stakeholder conferences, workshops and surveys, and private–public partnerships to encourage successful market integration (Zeug et al. 2019).

In this direction the EU Bioeconomy Stakeholders Panel launched in 2017 the European Bioeconomy Manifesto, calling for an ambitious revision of the European Bioeconomy Strategy. Such a revision would help tackle climate change and meet the needs of a growing population whilst boosting Europe’s resource efficiency, competitiveness and long-term economic growth. The Manifesto highlights that regions are key actors in developing a European bioeconomy and bioeconomy can make regions more attractive. Regions are important to keep vital rural economies and realising regional cycles. Mutual learning within and between regions and more resources for peer-to-peer exchanges at the EU level are essential, and mentions guiding principles to effectively implement the bioeconomy on the ground, i.e. in existing agriculture, forestry, marine and industrial contexts (BEU 2016). In this perspective, within regional systems, emphasis has not only to be put on public administration and government, research and innovation centres, and on businesses and clusters but also on other relevant stakeholders that can integrate different biomass and production loops and, ideally, start to close the loops as in the circular economy approach.

6. GUIDELINES FOR PROMOTING BIODIVERSITY VALUATION AND SUPPORT OF BIOECONOMY AT REGIONAL LEVEL

6.1 The Regional Dimension of Bioeconomy

The regional dimension of bioeconomy has gained greater importance in recent years. The emerging policy initiatives shows that countries with similarities in their resource endowment and economic conditions increasingly pursue joint initiatives to foster bioeconomy development. This results in efforts to develop macro-regional policy strategies and initiatives in Central and Eastern Europe, the Nordic countries, Eastern Africa and countries in Latin America and the Caribbean. There has also been a substantial increase in sub-regional bioeconomy initiatives initiated by federal states, regional authorities and municipalities. Regions may find it easier to specialize and focus on their comparative advantages in order to create higher value from local resources. The bioeconomy is seen as a means of promoting rural development, creating employment opportunities and improving the regional innovation system.

6.2 Why valuing biodiversity and ecosystem services at regional level

Although all people depend on nature for their well-being, the benefits of nature are often neglected in policies; moreover, losses in natural capital have direct economic consequences that are often underestimated. The benefits deriving from ESs and the costs of the degradation and loss of ecosystems and biodiversity are incurred on the ground but may be largely unnoticed at a larger scale (TEEB, 2009).

Valuation can be defined as the process of attributing a certain economic or noneconomic value to something. This manual focuses on the economic valuation of ESs – that is, valuation that measures, in monetary terms, people's preferences for the benefits they get from ESs. A lack of, or inadequate, ES valuation can lead to the overexploitation of the resource stocks generating those services, such as the overharvesting of timber and the consequent degradation or loss of the forests supplying the timber. A lack of, or inadequate, ES valuation can also result in poorly informed decisions in the design of projects or investments or in choosing among land-use options. For example, a simplistic evaluation of the costs and benefits of converting a forest to, say, intensive agriculture that ignores the loss of ESs provided by the forest could result in net negative economic outcomes in the long term. For each option (e.g. maintaining a forest or converting to another land use), the impacts on ecosystems should be evaluated, including the associated impacts in the provision of ESs (e.g. reduced woodfuel and timber production; increased production of agricultural crops; reduced carbon sequestration and air

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quality; reduced water quality; changes in microclimatic conditions, such as increased temperatures; and reduced forest recreation and landscape amenity). Such changes may affect human welfare – such as by increasing the need to buy or collect woodfuel elsewhere; increasing the number of job and income opportunities through agriculture; reducing human health due to worsening air quality and the costs associated with medical care; reducing water quality; and increasing the travel costs associated with forest recreation. It is possible to estimate the economic value associated with changes in ESs. Such valuations can be used in assessing the impacts of land-use changes, implementing ecosystem management options (e.g. forest conservation through set-asides versus active forest management), and comparing options for providing services and the investments involved (e.g. coastal protection through mangrove forest conservation, compared with the building of new grey infrastructure like seawalls). Valuations can help in revealing the relative importance of different ESs, establishing priorities, informing decision makers, guiding budgeting and resource allocation (e.g. financing, subsidies and investments), and managing potential trade-offs and consequent conflicts among ES beneficiaries.

Decision makers need to understand the ESs generated by natural capital in zones under their responsibility; the extent to which ESs are (at risk of) being lost; which ESs might be enhanced; the economic costs of losing ESs; and who incurs these costs and where and when. Valuations can help in developing the necessary evidence base and should address spatial relationships among the sources and beneficiaries of ESs (TEEB, 2009).

Valuing ESs is a step in the political decision-making process towards ensuring human wellbeing (Daily et al., 2009). Valuation and economic analysis provide decision makers with information on how society might balance the trade-offs inherent in resource-allocation decisions (TEEB, 2010a; Markandya et al., 2007). Moreover, valuation is a prerequisite for creating market-based mechanisms, such as payments for ecosystem services (PES), to encourage the provision of ESs. Reasons for valuing ESs include the identification of missing markets; the internalization of externalities in planning and project formulation; the correction of market failures; the assessment of synergies and trade-offs among different land uses; the setting of marketbased instruments for ESs and development of market opportunities; the management of uncertain future supply-and-demand scenarios for natural resources; the design of ecosystem conservation initiatives and programmes by both private and public actors; and natural resource accounting (Costanza et al., 1997; Pascual and Muradian, 2010; Panayoutou, 1993).

Valuation is the process of attributing a value (either economic or non-economic) to something. The aim of economic valuation is to measure, in monetary terms, people's preferences for the benefits they obtain from, for example, ecosystem processes (TEEB, 2010a). Non-economic valuation often

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examines how the opinions of people are shaped or their preferences articulated, mostly beyond monetary terms. Even though noneconomic valuation could be helpful in informing policy choices, this manual is confined to economic valuation. The fact that ecosystems are valuable should encourage decision makers – ranging from individuals to governments – to take them into account in their decisions. Recognition that ecosystems and ESs are valuable is only an initial step; quantifying the value is likely to be more persuasive in decision making. ESs may be measured and assessed in various ways and according to various metrics, which are broadly either qualitative, quantitative or monetary (Figure 6.1).

Qualitative analysis generally focuses on non-numerical information, quantitative analysis involves numerical data, and monetary analysis translates quantitative data into currency values (TEEB, 2009). The type of metric used depends largely on the benefit being measured, the time and resources available and the significance of the decisions to be made. Valuing all ESs in monetary terms might be difficult. For example, only a small subset of ecosystem processes and components are priced and incorporated in transactions as commodities or services (Pascual and Muradian, 2010). Difficulties exist in quantifying most ESs in terms that are comparable with the services obtained from human-made assets (Costanza et al., 1997). Economics is about choice, and every decision is preceded by the weighing of values among alternatives (Bingham et al., 1995). Measurement in monetary terms provides estimates of values in comparable units to enable the assessment of trade-offs and to demonstrate the importance of certain ESs (DEFRA, 2007). The logic behind ecosystem valuation, therefore, is to unravel the complexities of socio-ecological relationships, make explicit how human decisions would affect ES values, and express such changes in value in units (e.g. monetary) that allow their incorporation in public decision-making processes (Mooney, Cooper and Reid, 2005). Natural resource management decisions based on comparisons of benefits and costs are likely to be biased, however, when only a few ESs have clearly defined monetary value (Krieger, 2001).

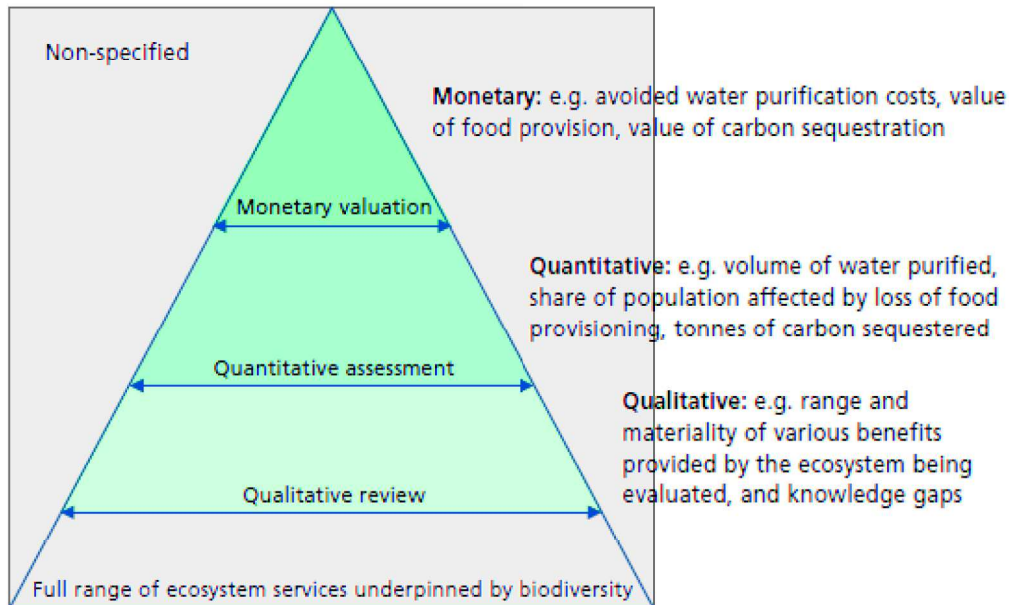


Figure 4 The benefits pyramid for ecosystem services

At regional level the seven basic purposes for the assessment and valuation of forest biodiversity and ESs (Berghöfer *et al.* 2015) are the following:

1. **Comparing alternative policies, programmes and projects.** How do alternatives differ in terms of ES gains and losses?
2. **Identifying livelihood, development and investment opportunities.** What new or improved economic opportunities can be developed based on the conservation and sustainable use of ESs?
3. **Designing environmental policy instruments, including incentives, regulations and monitoring.** What information on ESs will enable the design of effective, equitable and sustainable environmental policy instruments?
4. **Undertaking scoping and situation analysis.** What is the state of ESs in a given context, and what values and stakeholders are associated with them?
5. **Enhancing environmental awareness or advocating for a policy option.** How can information on the provision and impacts of ESs be used to “make the case” for a given policy option?
6. **Tackling environmental conflicts.** How can a focus on ESs provide credible information on environmental change to help resolve conflicts?
7. **Appraising and assessing impacts of policy changes.** How can ES valuation inform choices on, for example, competing uses (e.g. land uses) and funding priorities?

6.3 Introducing valuation in regional decision making

Including ES valuation in decision making is a three-step process: 1) recognizing biodiversity and ESs; 2) demonstrating ESs; and 3) capturing ESs (Daily *et al.*, 2009; TEEB, 2010b).

Recognizing forest biodiversity and ecosystem services

Recognizing forest ESs involves first assessing the links between policy changes and changes in ecosystem functions and between those and ESs. Classical ecology and conservation biology can help in analysing the impacts of land-use change on biodiversity or ecosystem resilience. Forest biodiversity can be used to assess the condition and status of forest ecosystems (e.g. under different management regimes) and thereby the supply of ESs. It is also important to identify the stakeholders influencing or benefiting from ESs and how they might be affected by policy changes. In broader terms, this means also considering who has an interest in or will be affected by policy changes, who might be able to inform the valuation process, and who comprise the target audience for the valuation results (Waite, Burke and Gray, 2014).

Studies have shown that, in some countries, ESs and other non-marketed goods account for 47–89 percent of the “GDP of the poor”. On the other hand, agriculture, forestry and fisheries account for just 6–17 percent of national GDP (TEEB, 2010b). This means that the value of forests and other ecosystems to poor rural households differs significantly from the value captured by classical economic tools and indicators such as GDP. Assessing the GDP of the poor, therefore, is important for informing policymakers about the potential of conservation efforts to reduce poverty.

Demonstrating forest ecosystem services

Demonstrating ESs requires selecting and implementing the appropriate economic valuation methods such as the one proposed by the BIOPROSPECT project. Such selection depends on several factors, including the ESs being assessed; the type of value (e.g. use or passive-use); the aim of the valuation; the availability of, and access to, data; data quality; and budgetary, technical and time constraints. Valuation is best used for assessing the consequences of changes in the provision of ESs arising from different management options, rather than attempting to estimate the total value of ecosystems (TEEB, 2010b).

A useful approach is to identify and analyse scenarios defined with the support of experts and based on the inputs of stakeholders. Scenarios should be consistent and plausible visions of the future, taking into account existing information and projections. This enables the:

1. quantification of the **likely changes in ESs** under each scenario;

2. tracking of **changes in social and environmental metrics** (e.g. forest area, growing stock, carbon stock and number of species); and
3. translation of changes into **monetary values** using appropriate economic valuation methods (Waite, Burke and Gray, 2014).

Valuing certain ESs using existing methods might be difficult or even impossible; nonetheless, it is important to identify all significant changes in ESs that may occur in the various scenarios, including those that cannot be monetized. Scenario building and analysis can be done using various approaches, such as the following:

- ☐ **Modelling.** This might involve the use of dedicated ES-modelling tools such as InVEST73 – Integrated Valuation of Ecosystem Services and Tradeoffs – and ARIES74 – Artificial Intelligence for Ecosystem Services. Christin, Bagstad and Verdone (2016) reviewed ES modelling tools using a study by Bagstad *et al.* (2013). Annex 5 contains a list of such tools, and additional information is available in Pandeya *et al.* (2016).
- ☐ **Experts.** Professionals with expertise in the economic effects of ESs provide inputs and outline the expected impacts of policy changes (e.g. via focus groups or using the Delphi method).
- ☐ **Analysis of similar cases.** The impacts and effects observed in similar cases are identified and transferred or adapted to the current situation.
- ☐ **Mixed approaches.** A combination of two or more of the above is used (e.g. modelling and experts, or experts and the analysis of similar cases).

Assessments of changes in ESs and their value under different scenarios should aim to inform decision makers about distributional effects – that is, the distribution of impacts among stakeholders arising from changes in ESs (Who is affected?), as well as the spatial/geographical (Where will the impacts occur?) and temporal (When will the impacts occur?) distributions. It is underlined that Geographical Information Systems and Remote Sensing techniques provide accurate and reliable data and is a necessary tool for the assessment and valuation of forest biodiversity and ESs.

Demonstrating the economic value of ESs and the impacts of changes in their delivery is important, even when it is not possible to capture value. The demonstration of economic value can support decision makers in addressing trade-offs among management choices and land uses by helping identify the most efficient use of natural resources and means of delivering ESs (TEEB, 2010b).

Capturing the value of ecosystem services

The economic trade-offs involved in delivering ESs is a key challenge for decision makers. Even when it has been estimated, the value of many ESs remains external to markets and a gap exists, therefore, between the recognition of the economic value of forest biodiversity and ESs to society and the financial benefits available to landowners, managers and other stakeholders. Capturing the value of ESs is about seeking ways to fill this gap and therefore overcoming the undervaluation of ESs. A wide range of economically informed policy instruments is available, in four main categories (IPBES, 2016):

- 1) legal and regulatory instruments;
- 2) rights-based instruments and customary norms;
- 3) economic and financial instruments (or market-based instruments); and
- 4) social and cultural instruments.

Such categories have largely been considered independently in the past, with a strong focus on market-based instruments (Pirard and Lapeyre, 2014), particularly PES, but there is growing attention on policy-mix approaches (Ring and Schröter-Schlaack, 2011).

6.4 Proposed Practical & Policy Measures

In addition to European and national programmes and strategies to stimulate the bioeconomy, considerable bioeconomy deployment takes place at sub-national level through bioeconomy projects and initiatives promoted by regional and local public authorities, by clusters and private companies, or by universities, research centres or technology and innovation service providers. Some of them use European and/or national co-funding, but also local and regional resources are put into value. Regional bioeconomy ecosystems in Europe are built around governments and public administration, businesses and representatives of sectoral associations and business intermediaries, as well as academic, scientific and technological institutions. Especially in strongly industrialised regions, but also increasingly in rural regions, clusters are an important tool to gather stakeholders around specific bioeconomy sectors/products. In comparison to traditional industrial clusters, bioeconomy related clusters often need to integrate also producers of biological resources, i.e. farmers and fishermen, as well as their associations, i.e. cooperatives. In particular, at governmental level, coordination among different policy areas (e.g. research and innovation, economic/industry development, agriculture, environment) is needed to promote the bioeconomy. In addition, new bioeconomy related organisations, such as bioeconomy strategy councils, thematic platforms and networks, operational coordination bodies, specific technology centres etc. might be useful to link different players in bioeconomy ecosystems and to develop bridges between different communities and sectors.

In general, the policy strategies are not limited to defining broad goals and visions for the bioeconomy. Some of them, such as Italy, Latvia, and the UK, also provide concrete quantitative targets for bioeconomy development. These targets range from increasing the bioindustry share of GDP or annual sales of biotech products, to raising the general bioeconomy turnover and creating more bioeconomy-related jobs. Generally speaking, most of the countries still prefer to define qualitative targets. In EU only Spain provide concrete budget targets within their bioeconomy policy strategy by listing funding opportunities and dividing them into concrete funding phases.

Interestingly, many of the recent strategy papers so far lack a corresponding action plan or roadmap. Only France and Spain provide a dedicated action plan to support the strategy's implementation. Others at least lay the foundation for action plans (e.g. Italy Latvia and Norway) or for a set of concrete policy measures to be implemented by the government. Generally, the proposed measures focus on both the demand and supply side. Public investment in bioeconomy development typically includes science, technology and innovation funding; infrastructure development; capacity building and education; commercialization support; demand-side instruments; regulatory activities;

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measures for good governance and support for international collaboration in the bioeconomy. In the following section, the report summarizes trends, differences and specific features of policy measures defined in recent policy strategies.

In this perspective a further development of bioeconomy related R&I activities of EU regions and would require (Spatial Foresight, SWECO, ÖIR, t33, Nordregio, Berman Group, Infyde, 2017):

- ☐ common definition/classification of the bioeconomy, for bioeconomy related economic and research activities and for bioeconomy maturity in EU regions that allows for monitoring and benchmarking bioeconomy deployment and support knowledge transfer.
- ☐ Valuation of biodiversity and ecosystem services in support of public consultation, regional strategies development and decision making process.
- ☐ coordinated support from the EU level to cities and regions in strategic planning and communication within a streamlined and integrated EU strategy and policy framework for the bioeconomy. Also the knowledge exchange between Member States and among regions should be supported.
- ☐ strategic planning and leadership to coordinate, align and combine efforts on R&I (engaging industrial/SME, research, agriculture/fishery and environmental stakeholders), according to the different bioeconomy profiles and maturity levels.
- ☐ more specialized support on the development of value chains according to the different bioeconomy profiles and maturity levels. Cross-border and interregional cooperation (twinning, networks) with regions of a similar profiles are already a valued tool.
- ☐ support in engaging also the traditional sectors and SMEs in conversion processes (technology, business) towards the bioeconomy.
- ☐ support on developing transdisciplinary and specific bioeconomy competences and skills, both for research and academia and in businesses.
- ☐ better access to finance for small scale demo activities and pilot plants until new value chains and new technologies reach a sufficient TRL level to be market-ready.

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- ☐ more synergies and better coordination in funding and investments, in particular between ESIF and H2020.
- ☐ activities to raise public awareness and acceptance in regional bioeconomy ecosystems and overall society about the potential benefits and perceived threats of the bioeconomy for cities and regions. Participatory approaches should be used to develop solutions for potential conflicts at local and regional level regarding land use, management of natural resources, and biotechnological research.

The above can be classified in two main categories of practical and policy measures as described in the following paragraphs.



A. Proposed practical measures

A.1 Promoting Innovation

Public R&D funding is widely considered a key measure for enhancing the innovation ecosystem for the bioeconomy. In this respect, recent policy strategies specifically highlight the importance of promoting links between fundamental and applied research and supporting multidisciplinary research alliances. The governments of France, Italy, Latvia, Spain, and the UK, for example, use the instruments

Project co-funded by the European Union and national funds of the participating countries BMP1/Z1/2336/2017 of R&D grants, competitions and public funds. Support for public R&D should be further facilitated by leveraging public funding at regional, national and supra-national level.

The promotion of public-private partnerships also appears highly relevant to ensure jointly-funded innovation projects. Interestingly. In general, there is need for increased private R&D, e.g. in the form of industry-led consortia that should facilitate investment in pre-competitive research. The establishment of research networks and centers of excellence, which aim to ensure continuous stakeholder cooperation and dialogue, are among the priorities. Furthermore, the fostering innovations based on traditional knowledge and low-tech and social innovations which include open innovation platforms and citizen science approaches, is encouraged.

A.2 Supporting Infrastructure

With respect to the promotion of infrastructure development, the priority is relatively straightforward. In addition to fostering multi-user pilot and demonstration facilities, establishing biorefinery demo plants is rated most relevant. The development of digital infrastructure, bioeconomy hubs, networks and clusters is also considered important for bringing together stakeholders, ensuring learning from best practices and encouraging regional innovation ecosystems. In the Asian countries in particular, the concept of a so-called “Biopolis” is gaining increasing importance. Its aim is to bring together major research institutes to create a center of excellence in bioeconomy experimentation.

A.3 Supporting Capacity Building

Countries around the world are facing the challenge of developing a skilled workforce for the bioeconomy of the future. Several countries have already established bioeconomy-related education and capacity building programs. As a pioneer, the University of Hohenheim in Germany established the first interdisciplinary master’s program in bioeconomy in 2015.

The University of Munich recently announced the establishment of an integrative research center in Straubing where research and teaching will concentrate on biobased resources, sustainability and bioeconomy. In connection with this, ten new degree programs will be set up and six new professorships on bioeconomy will be appointed.

In Greece, the University of Piraeus and the National and Kapodistrian University of Athens have developed a master's program on "Bioeconomics". In the Czech Republic, the University of South Bohemia has established an interdisciplinary bioeconomy course for postgraduates. In addition to getting a theoretical and basic background in bioeconomy, students are encouraged to work on an actual case study with industry partners.

In France, the European Center for Biotechnology and Bioeconomy has been established in 2015. By this, the support for four bioeconomic-relevant chairs and academic programs (e.g. in the area of biotechnology, biomaterials and green chemistry) has been increased. In Italy, the first European master's program in "Bioeconomy in the Circular Economy" was launched in 2017. It is a public-private partnership between four Italian universities, three industrial partners, and an Italian banking group. The Lodz Declaration on a European Bioeconomy Education Platform was announced within the Poland Congress on Bioeconomy in November 2017. The platform is intended to foster exchange between multi-disciplinary bioeconomy education programs to build a skilled working force for the new generation.

The support for education and capacity building measures is also deeply rooted in the bioeconomy (-related) strategies. Measures for promoting capacity development include publicly-funded training courses for professionals in entrepreneurship, innovation management, technology transfer and IP rights; new training programs that relate to the needs of the private sector; and promoting the career path of graduates by connecting them with industry and business. Tools and materials for self-training are also needed as being highly important.

With respect to bioeconomy-related education, the regional strategies mainly prioritize the establishment of inter-disciplinary academic bioeconomy courses (including master's and doctoral programs). Further measures include bioeconomy programs for schools, postgraduate education to improve both technical and soft skills, life-long learning opportunities and education programs for policy-makers at all levels of government.

A.4 Supporting Commercialization

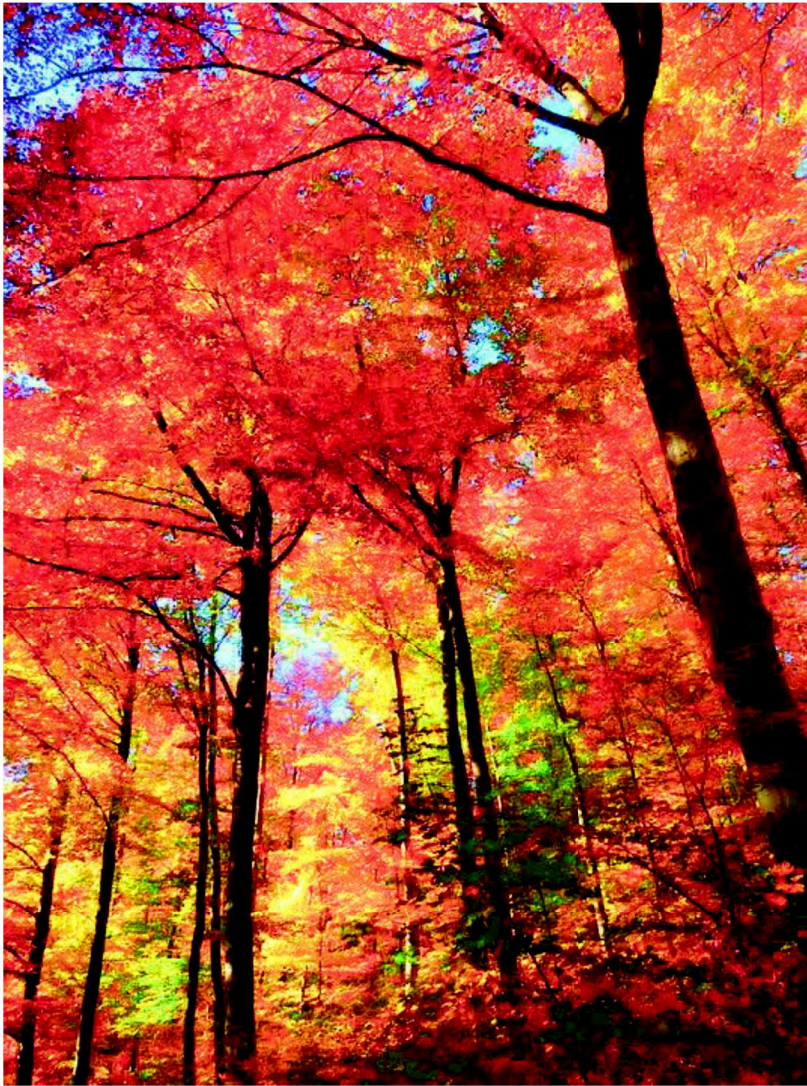
The most relevant approach to supporting commercialization efforts is seen as guaranteeing access to capital for biobased companies. Promoting debt and equity financing, early-stage funding, incentives for angel and venture investors as well as the general modernizing of funding mechanisms are all considered highly relevant. However, the development of green bond markets and green guarantee mechanisms, green industry funds and green stock indices is also rated promising.

The European Commission, at the end of 2017, announced the establishment of a Bioeconomy Investment Platform with up to EUR 100 million (around USD 123 million) backing to improve access to finance for bioeconomy companies in Europe. The platform's financial support is based on the EU budget. It further strives to mobilize additional public and private investment for bioeconomy development. Information on existing funding opportunities is often still lacking. As a pioneer, the European Investment Bank and the Biobased Industry Consortium published first overviews of European financial instruments in 2017. The reports show to what extent different financial instruments can be used to promote bioeconomy-related projects and corporate financing. Additional measures, may include knowledge and technology transfer, increased marketing efforts, access to scale-up facilities and policies facilitating increased export and internationalization, in order to promote commercialization.

At national level consider tax incentives for biobased companies are important to enable them to enter the market. These include accelerated capital cost allowances, deduction of R&D costs, exemption from VAT, reduced corporate tax rates and special tax rates for technology transfer.

A.5 Supporting the Demand-Side

To stimulate demand for biobased products and services, the introduction of public procurement policies are highly promising. Proposed measures range from introducing standards for biobased public procurement to reviewing the present regulatory framework on public procurement. In addition, the promotion of certification schemes (e.g. for sustainably-produced biomass) and standards and labels indicating a product's life cycle impact should aim to attract greater attention to biobased products and services. This includes updating building codes and standards to increase the share of wood or hemp in construction.



B. Proposed policy measures

B.1 Improvement of bioeconomy strategic planning and governance

The regions with a middle and low level of maturity, in particular in Central and Eastern and in South Europe, need to develop their bioeconomy ecosystems, in particular bridging elements and platforms between traditional (agro-food, fisheries) sectors, industry, science and research, technology as well as public administration.

As a first and more important step this requires analysis of the existing potential through regional assessment and valuation of forest biodiversity and ecosystem services as well as the current and prospective value chain approach.

According to the key strategic orientations for the support to research and innovation of the Strategic Plan for Horizon Europe – the European Union Framework Programme for Research and Innovation 2021 – 2027 (European Commission 2019b), assessing and valuing biodiversity, ecosystem services and nature-based solutions, and supporting the development and adoption of natural capital accounting frameworks and metrics will support their mainstreaming in public and private decision-making. A necessary pre-condition for efficient biodiversity action is investment into long-term integrated monitoring frameworks and associated tools, including new technologies and approaches, to monitor trends and dynamics of drivers of change and of biodiversity and ecosystem services.

Assessing how extraction, production, consumption, trade, and behaviour patterns, especially primary production and food systems, affect biodiversity loss and ecosystem services, and how ecological transitions can be socially fair is a priority. Better understanding on how measuring and valuing natural capital changes the public and private decision making at all levels is needed, including for business and investors, and for exploring solutions to improve the biodiversity impact of retailers in global value chains. Impacts of digital transformation, new emerging technologies and social innovation on biodiversity need to be addressed. This includes maintaining materials in the economy for as long as possible and comprehensive assessment methodologies for nature-based solutions in business and for social justice (performance indicators, standards, reference models, risk analysis, life cycle assessment).

Integrative regional bioeconomy ecosystems have to be developed. Specific 'bridging links' (e.g. thematic platforms, regional networks, flagship projects, specialised innovation centres, science parks) have to support the interaction of stakeholders and ensure knowledge transfer, knowledge management and communication. Rural innovation partnerships, linking existing local action groups, operational groups and regional innovation systems, can help to promote innovation in most prominent subsectors (agriculture, fisheries, forestry, food).

Regional strategic planning and governance is crucial to deploy the bioeconomy. The development of a common regional vision for the bioeconomy, priority-setting, and coordination among research, industrial and agricultural policies is key to develop regional bioeconomy support frameworks that can be co-funded by national and EU funds.

Twinning, partnerships and interregional cooperation between regions with the same bioeconomy profile/approach can facilitate learning and knowledge transfer. Cooperation projects and partnerships with a bioeconomy focus shall be promoted within existing cooperation programmes and in macro-regional and sea-basin strategies.

B.2 Support to value chain/cycle development and engaging SMEs

New bioeconomy technologies and business processes require still important investments to lower operational costs and generate benefits. Technological readiness is still low. Support schemes are needed not only for high-end solutions but also to increase the technology readiness level (TRL) of small-scale technologies that can be useful also in regions with a low bioeconomy maturity.

Pilot facilities/plants and development/demonstration plants to support upscaling activities are needed for new/niche value chains. Support for new infrastructure and equipment is needed, in particular in low-maturity regions. In addition, knowledge exchange and analysis of existing pilot and demonstration plants and infrastructure facilities is needed in order to better exploit existing ones and enable decision-making on building new ones.

In order to optimise/convert existing value chains and to integrate different chains into regional value cycles, local/regional stakeholders – SMEs, in particular – must be actively engaged and supported, e.g. through voucher programmes for the use of pilot facilities and demo plants or open access demo infrastructure. Not only the primary producers have to be involved, but also stakeholders upstream and downstream of the core bioeconomy business.

B.3 Develop R&I on technologies, knowledge transfer and new bioeconomy skills

It is important to shorten the learning curve for new value chains through knowledge diffusion in thematic networks, platforms, cooperation projects, transfer of results etc. These platforms, e.g. S3 platforms, should involve all relevant stakeholders. In particular, low and middle maturity regions should be encouraged and supported in developing necessary capacities to join these platforms. Existing partnerships (e.g. EIP AGRI, BBI-JU) networks, initiatives and platforms (e.g. ERA-NETs, ERRIN, ERRIAFF, Vanguard, CPMR, S3 platforms, macro-regional initiatives) regarding bioeconomy should be better promoted in order to further stimulate learning and knowledge transfer to regions with a lower bioeconomy maturity.

There is a need for capacity-building and support schemes (administration) for participation in existing networks and platforms for smaller countries and regions with a low bioeconomy maturity. Knowledge transfer and mutual learning between regions could be enhanced through more specific thematic platforms. Thematic networks and working groups for bioeconomy related R&I within the agro-food sector, as the most important bioeconomy sub-sector in EU regions, should be promoted to streamline common interests and prepare joint programming and R&I activities (e.g. on crops, horticulture, seeds, animal husbandry, dairy, bread and pastries, NFF, beverages, starch biomass, sugar biomass, water management, packaging). Networks and working groups could embrace a range of

sub-sectors and value chain elements in order to optimise and modify into value cycles and create closed loops.

Bioeconomy support to R&I has to focus on multi- and transdisciplinary (not only biotech) projects to promote the generation of value cycles and closed loops. This requires integrated research but also transdisciplinary education (both university as well as vocational and continuous training) and skills for the bioeconomy.

B.4 Coordinate funding and synergies between instruments

There is a need to generate synergies and improve coordination in funding and investments, in particular between ESIF and H2020 and the instruments of ERA-Nets and Era-Net Co-funds, JPI, EIP, KIC, S3 platforms, BBI-JU. These funding sources and activities that are already taking place, including the Seal of Excellence scheme, have to be disseminated and communicated to all relevant national and regional stakeholders in regional bioeconomy ecosystems, as they offer valuable funding opportunities and help to establish thematic platforms and networks within bioeconomy domains. Initiatives to coordinate and bring together funds and stakeholders, such as ERA-PLATFORM, have to be strengthened and further developed in order to enhance visibility and facilitate participation of regions and smaller countries.

Local and regional policymakers have to be aware of the potential benefits and approaches to the bioeconomy in their region, and should increase their knowledge on how existing funds (ESIF, H2020, ERA-Nets, COSME, LIFE+ etc.) can be used and synergies generated to stimulate the bioeconomy at regional level. A better communication of good practices and project results might be necessary.

B.5 Raise public awareness and acceptance

Regions need guidance and support in order to engage civil society and consumers. Activities are needed to raise awareness on potential benefits of new/modified value chains in forestry sector, as well as on the benefits of a circular economy and on the cascading use of biological resources and residues/by-products. Negative perceptions and fears should be better analysed and addressed. Bioeconomy standards and labels should be developed to give an overview on positive and negative features of bio-based and recycled products. Protection of consumer rights has to be considered as an important aspect to enhance acceptance of bio-based and recycled products. Overall, advancing

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towards citizen-friendly forest value chains and cycles should be one objective of bioeconomy deployment.

Promoting forest bioeconomy step by step

Summarizing the above in a step wise approach from short term to long term measures, the regional policy initiatives and actions are presented in BOX 1.

BOX 1.

Step wise approach for promoting forest bioeconomy at Regional level

- ✓ Increase public awareness regarding forest bioeconomy and promote citizens mobilization and engagement.
- ✓ Assessment and valuation of regional forest biodiversity and ecosystem services and establishment of appropriate monitoring scheme
- ✓ Development of regional strategies with a view to increasing forest resource efficiency, protecting biodiversity (compliance with regional biodiversity strategies) minimising harmful impacts and maximising co-benefits of the bioeconomy.
- ✓ Support strategic research, pilot demonstration project and innovation action (both technological and social) as well as knowledge transfer between research institutions and stakeholders (including forest owners, managers SMEs etc)
- ✓ Strengthen support for the education and training of a skilled workforce in the bioeconomy and related fields.
- ✓ Mobilise investments, including through the deployment of new financial Instruments to scale up and roll out existing and new technologies, as well as industrial demonstrators.
- ✓ Support the creation of markets for novel, innovative and more sustainable and circular bioeconomy products and processes through existing and emerging regulatory frameworks, including standards and labels, certification schemes, implementation of waste legislation, food and bio-based products.

6.5 Forest bioeconomy indicators

The bioeconomy is expected to be the guiding paradigm within the forest-based sector in the years to come. It has been defined in various ways, and in a forest-based context can be understood to mean the utilisation of forests to create products and services that help economies to replace fossil-based raw materials, products and services. The forest-based bioeconomy links the whole forest value chain from the management and use of natural resources to the delivery of products and services. The cross-cutting, intersectoral and circular character of the bioeconomy demands a systemic perspective of the regional deployment of the bioeconomy. Today, there are some European regions that strongly focus on the bioeconomy as one of their economic and innovation priorities and can be considered as bioeconomy leaders. Others are starting to develop bioeconomy strategies, updating and modernising either their agricultural profile or their industrial profile towards more integrated, sustainable, circular and resource efficient approaches (Spatial Foresight, SWECO, ÖIR, t33, Nordregio, Berman Group, Infyde 2017).

Bioeconomy indicators need to reflect the increasingly changing and diversifying European forest-based sector, and the impacts that these changes have on forest resources and forest-based products. A good lesson to remember is the impacts of the first generation biofuels boom in the beginning of this century, which caused problems e.g., in energy efficiency, CO₂ impacts, land use and food prices. Indicators and assessment should help to avoid such unwanted impacts, and support successful and sustainable bioeconomy development. Indicators need to better capture the possible synergies and trade-offs between the different societal demands for forest resources, and between the forest sector and other sectors. Because of the diversification of the forest-based sector there is also a need to develop the collection and recording of the statistics that form the basis of the indicators, to more accurately reflect changes. Forest monitoring would benefit from being harmonised and its instruments made comparable with other sectoral instruments. The experience and lessons learned from forest indicator development and processes (e.g., FOREST EUROPE) should be made use of, and these indicators further updated and developed to fit the whole forest-based bioeconomy (Wolfslehner 2016).

It is underlined however that Indicator development is often more a political than a technical task. Frequently, the strongest effort is put into technical design and data collection, while the negotiation of principles and goals is neglected. A cross-sectoral political forum could debate the priorities, metrics of assessment, choice of targets and the acceptance of trade-offs. Forest bioeconomy Indicators is important to consider national strategies and approaches, and their role in the EU bioeconomy as a whole. In addition of being policy relevant, indicators should be used to communicate and provide information to the wider public, as well as supporting new forms of

information-sharing and citizen science. New approaches such as key and headline indicators and indices should be tested to satisfy these needs. In any case indicators form the structural and methodological backbone of integrated bioeconomy monitoring. A common platform for the EU data providers and national data gatherers requires consensus and agreement on procedures, goals and targets.

Considering the above and in line with the recommendations of the European Forest Institute (Wolfslehner 2016) a potential set of forest-based indicators for regional bioeconomy are presented in Table 6.1. Furthermore these recommendations align with Smart Specialisation Strategy (S3) EU policies in the sense that they are rooted in a regional assessment, in the targeting of regional sectoral advantages and in regional networks of industries and stakeholders.

Table 4. Proposed forest-based bioeconomy indicators.

| Bioeconomy aspects | Forest-related topics | Proposed Regional Indicators |
|--|---|---|
| 1) Ensuring food security | Role of forests in watershed management and water provision to secure sustainable food production | Blue water footprint |
| | | Water use in total Forestry Wood Chain and by sub-sectors |
| | Edible non-wood forest products | Value and quantity of marketed non-wood goods from forest and other wooded land |
| 2) Sustainable management of natural resources | Present SFM criteria and indicators for SFM | Natural resource index |
| | | Red List Index |
| | | Forest area |
| | | Forests under management plan |
| | | Protected forests |
| | | Forest fragmentation |
| | | Illegal logging |
| | Forest ecosystem services | Ecosystem services performance assessment |
| | | Value of forest ecosystems services |
| | Social aspects and life quality | Recreation in forests |
| | | Urban forestry and human health |
| | | Public awareness level and initiatives |
| 3) Reducing dependence on | Carbon footprint and renewable goods: bio-based products, | Carbon footprint |
| | | Resource productivity |

| | | |
|--|---|---|
| non-renewable resources | bioenergy, carbon in wood products | Recycling rate for paper and wood products |
| | | Resource use of the bioeconomy |
| | Energy security, independence from non-renewables | Share of renewable energy in gross final energy consumption |
| | | Wood energy |
| 4) Mitigating and adapting to climate change | Compliance with climate protocol | Greenhouse gas balance |
| | | Resource and materials efficiency |
| | | Forest-related carbon stocks |
| | Resilience and risk | Deposition and concentration of air pollutants on forest and other wooded land |
| | | Forest soil quality |
| | | Genetic resources |
| | | Introduced tree species |
| 5) Increasing competitiveness and creating jobs | Economy and employment | Contribution of forest sector to GDP |
| | | Forest related holdings and enterprises |
| | | Forest sector workforce |
| | | Employment in the total bioeconomy and its sectors, and the contribution of the bioeconomy to total regional employment |
| | | Renewable energy jobs |
| | Innovation and start-ups | Eco-innovation index |
| | | Innovation – new products in total Forestry Wood Chain and by sub-sector |
| | | Growth of specific bio-based technologies, processes or products |
| | | Use and development of biotechnology in the bioeconomy |
| | | Research into technical and organizational aspects of forest bioeconomy |
| | | Patents on resource efficiency technologies |
| | | Cooperation initiatives and/or projects between SMSs and research organizations |
| | | Participation in networks/clusters/platforms and other initiatives towards bioeconomy or sustainable forest management |
| | | Share of biofuel industry that is part of the |

| | | |
|--|--|--|
| | Emerging societal trends and new markets | bioeconomy in terms of GDP, employment, turnover |
| | | Share of chemical industry that is part of the bioeconomy in terms of GDP, employment, turnover |
| | | Share of biotechnology industry that is part of the bioeconomy in terms of GDP, employment, turnover |

The forest-based value chain is directly linked to a bioeconomy. It does not only concern the primary production of forest resources, but also the use of wood and non-wood material, the provision of forest ecosystem services, as well as energy production and material use during recycling processes. Therefore, a broadening of current forest indicator understanding is required. The proposed forest bioeconomy indicators reflect the increasingly changing and diversifying European forest-based sector at regional level, and the impacts that these changes have on forest resources, forest-based products local economy and society.

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