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## **Driving towards a Carbon Neutral Future via Nature Based Solutions**

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Shell, New Energies Research & Technology

Carbon Management Workshop, Stanford University, November 8, 2019

# WARNING: Uncertainties ahead

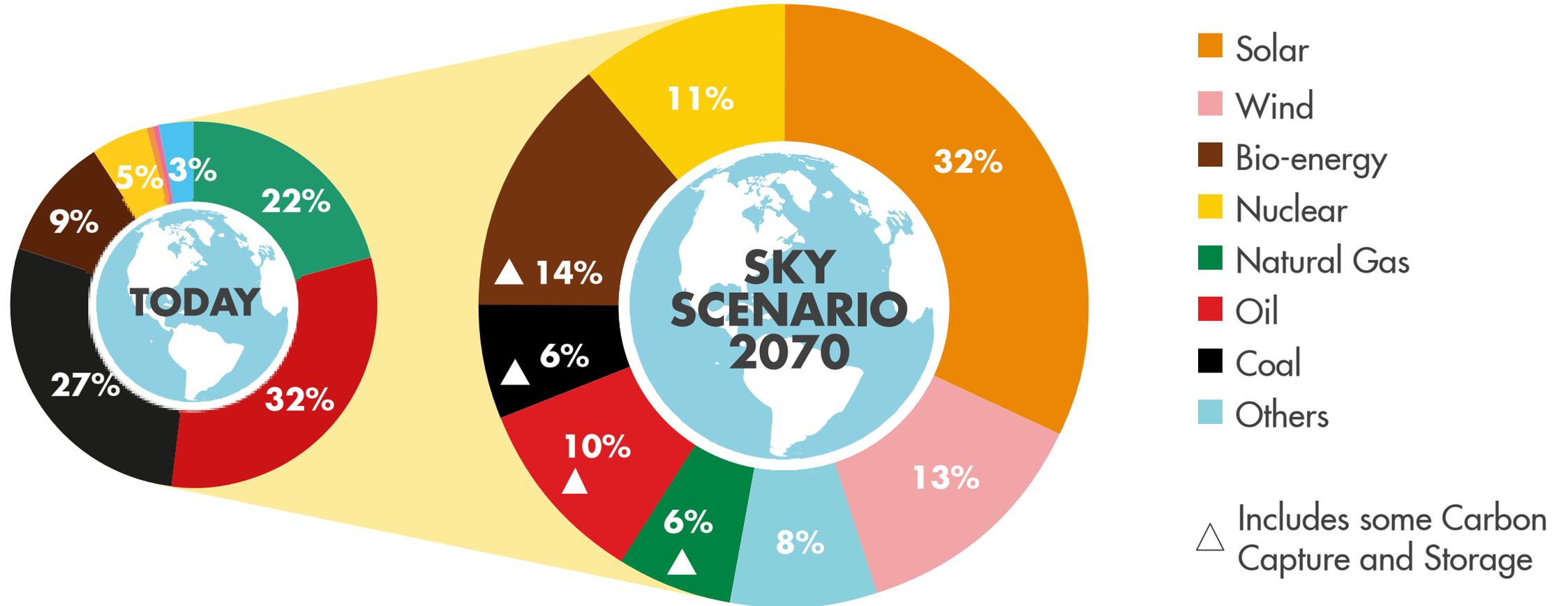
This presentation contains data from Shell's new Sky Scenario. Unlike Shell's previously published Mountains and Oceans exploratory scenarios, the Sky Scenario is targeted through the assumption that society reaches the Paris Agreement's goal of holding global average temperatures to well below 2°C. Unlike Shell's Mountains and Oceans scenarios which unfolded in an open-ended way based upon plausible assumptions and quantifications, the Sky Scenario was specifically designed to reach the Paris Agreement's goal in a technically possible manner. These scenarios are a part of an ongoing process used in Shell for over 40 years to challenge executives' perspectives on the future business environment. They are designed to stretch management to consider even events that may only be remotely possible. Scenarios, therefore, are not intended to be predictions of likely future events or outcomes and investors should not rely on them when making an investment decision with regard to Royal Dutch Shell plc securities.

Additionally, it is important to note that Shell's existing portfolio has been decades in development. While we believe our portfolio is resilient under a wide range of outlooks, including the IEA's 450 scenario (World Energy Outlook 2016), it includes assets across a spectrum of energy intensities including some with above-average intensity. While we seek to enhance our operations' average energy intensity through both the development of new projects and divestments, we have no immediate plans to move to a net-zero emissions portfolio over our investment horizon of 10-20 years. Although, we have no immediate plans to move to a net-zero emissions portfolio, in November of 2017, we announced our ambition to reduce our net carbon footprint in accordance with society's implementation of the Paris Agreement's goal of holding global average temperature to well below 2°C above pre-industrial levels. Accordingly, assuming society aligns itself with the Paris Agreement's goals, we aim to reduce our net carbon footprint, which includes not only our direct and indirect carbon emissions, associated with producing the energy products which we sell, but also our customers' emissions from their use of the energy products that we sell, by 20% in 2035 and by 50% in 2050.

The companies in which Royal Dutch Shell plc directly and indirectly owns investments are separate legal entities. In this presentation "Shell", "Shell group" and "Royal Dutch Shell" are sometimes used for convenience where references are made to Royal Dutch Shell plc and its subsidiaries in general. Likewise, the words "we", "us" and "our" are also used to refer to subsidiaries in general or to those who work for them. These expressions are also used where no useful purpose is served by identifying the particular company or companies. "Subsidiaries", "Shell subsidiaries" and "Shell companies" as used in this presentation refer to companies over which Royal Dutch Shell plc either directly or indirectly has control. Entities and unincorporated arrangements over which Shell has joint control are generally referred to as "joint ventures" and "joint operations" respectively. Entities over which Shell has significant influence but neither control nor joint control are referred to as "associates". The term "Shell interest" is used for convenience to indicate the direct and/or indirect ownership interest held by Shell in a venture, partnership or company, after exclusion of all third-party interest.

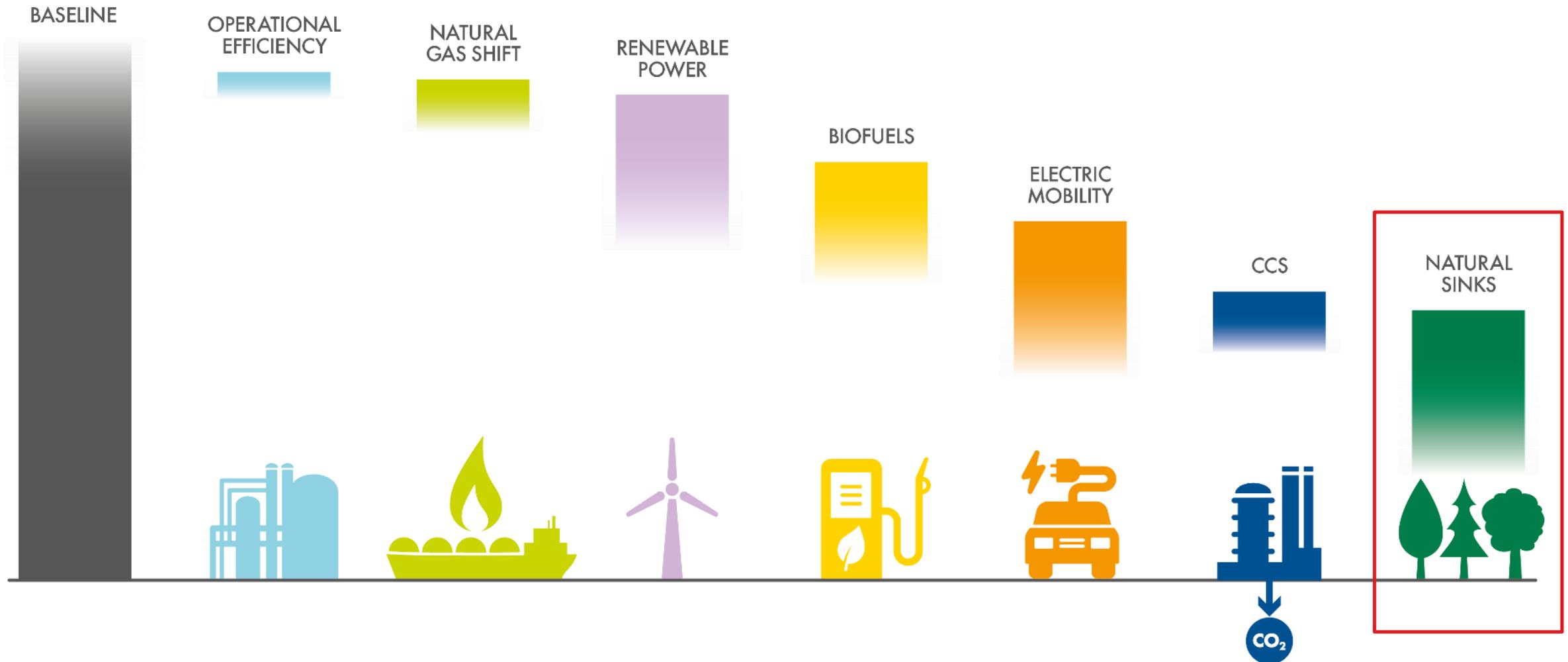
This presentation contains forward-looking statements concerning the financial condition, results of operations and businesses of Royal Dutch Shell. All statements other than statements of historical fact are, or may be deemed to be, forward-looking statements. Forward-looking statements are statements of future expectations that are based on management's current expectations and assumptions and involve known and unknown risks and uncertainties that could cause actual results, performance or events to differ materially from those expressed or implied in these statements. Forward-looking statements include, among other things, statements concerning the potential exposure of Royal Dutch Shell to market risks and statements expressing management's expectations, beliefs, estimates, forecasts, projections and assumptions. These forward-looking statements are identified by their use of terms and phrases such as "anticipate", "believe", "could", "estimate", "expect", "goals", "intend", "may", "objectives", "outlook", "plan", "probably", "project", "risks", "schedule", "seek", "should", "target", "will" and similar terms and phrases. There are a number of factors that could affect the future operations of Royal Dutch Shell and could cause those results to differ materially from those expressed in the forward-looking statements included in this web page, including (without limitation): (a) price fluctuations in crude oil and natural gas; (b) changes in demand for Shell's products; (c) currency fluctuations; (d) drilling and production results; (e) reserves estimates; (f) loss of market share and industry competition; (g) environmental and physical risks; (h) risks associated with the identification of suitable potential acquisition properties and targets, and successful negotiation and completion of such transactions; (i) the risk of doing business in developing countries and countries subject to international sanctions; (j) legislative, fiscal and regulatory developments including regulatory measures addressing climate change; (k) economic and financial market conditions in various countries and regions; (l) political risks, including the risks of expropriation and renegotiation of the terms of contracts with governmental entities, delays or advancements in the approval of projects and delays in the reimbursement for shared costs; and (m) changes in trading conditions. No assurance is provided that future dividend payments will match or exceed previous dividend payments. All forward-looking statements contained in this presentation are expressly qualified in their entirety by the cautionary statements contained or referred to in this section. Readers should not place undue reliance on forward-looking statements. Additional risk factors that may affect future results are contained in Royal Dutch Shell's Form 20-F for the year ended December 31, 2018 (available at [www.shell.com/investor](http://www.shell.com/investor) and [www.sec.gov](http://www.sec.gov)). These risk factors also expressly qualify all forward-looking statements contained in this presentation and should be considered by the reader. Each forward-looking statement speaks only as of the date of this presentation (**November 8, 2019**). Neither Royal Dutch Shell plc nor any of its subsidiaries undertake any obligation to publicly update or revise any forward-looking statement as a result of new information, future events or other information. In light of these risks, results could differ materially from those stated, implied or inferred from the forward-looking statements contained in this web page. We may have used certain terms, such as resources, in this presentation that United States Securities and Exchange Commission (SEC) strictly prohibits us from including in our filings with the SEC. U.S. investors are urged to consider closely the disclosure in our Form 20-F, File No 1-32575, available on the SEC website [www.sec.gov](http://www.sec.gov). You can also obtain this form from the SEC by calling 1-800-SEC-0330.

# SKY Scenario: A big shift in the primary energy mix by 2070



The size of the pie chart indicates growth of the energy system

# Ambition: Reduce the Net Carbon Footprint (NCF) of our Energy Products by ~20% by 2035 and by 50% by 2050, in step with society



# Why Shell has chosen NBS

Nature has the potential to provide more than a third of the climate solution by 2030.<sup>1</sup>

<sup>1</sup> The Nature Conservancy

Just two percent of the funding for climate action goes towards forest and land protection.<sup>2</sup>

<sup>2</sup> NY Declaration on Forests

A stretched 1.5°C increase of the global average temperature ambition can be achieved by net global reforestation to the size of Brazil in combination with other measures.<sup>3</sup>

<sup>3</sup> Massachusetts Institute of Technology, Shell Sky scenario data.



# Combating climate change with nature-based solutions

Nature-based solutions comprise all activities related to the protection, or re-development, of natural ecosystems – such as forests, grasslands and wetlands – to lower concentrations of greenhouse gases in the atmosphere. Such activities can typically lead to the marketing, trading and sale of carbon credits.



- Reforestation
- Avoided forest conversion
- Natural forest management
- Avoided wood fuel
- Fire management



- Biochar
- Trees in croplands
- Nutrient management
- Conservation agriculture
- Improved rice
- Grazing
- Avoided grassland conversion



- Coastal restoration and protection
- Peat restoration and protection

# Nature Conservancy-led science has helped build the case for NCS/NBS



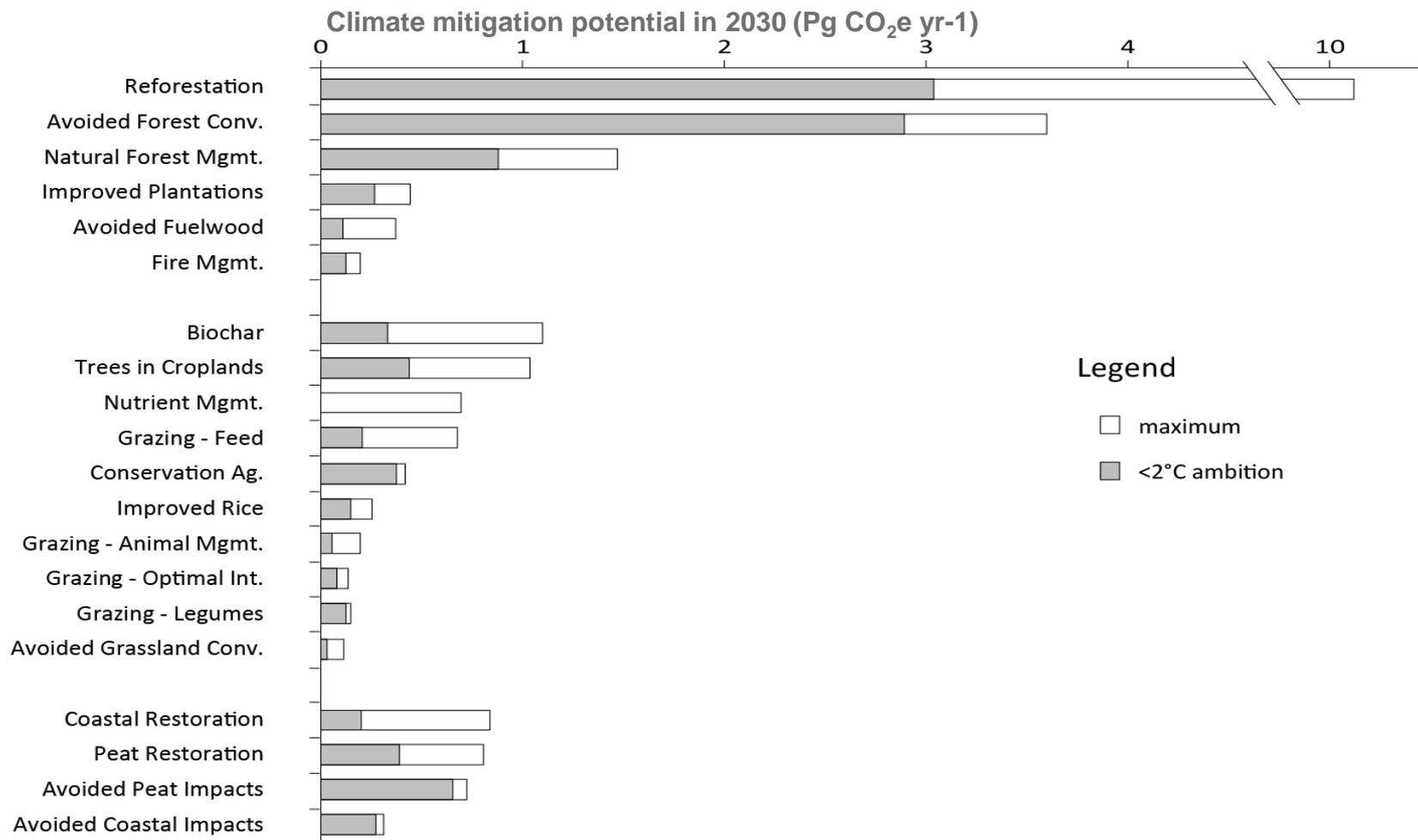
FORESTS



AGRICULTURAL LANDS & GRASSLANDS

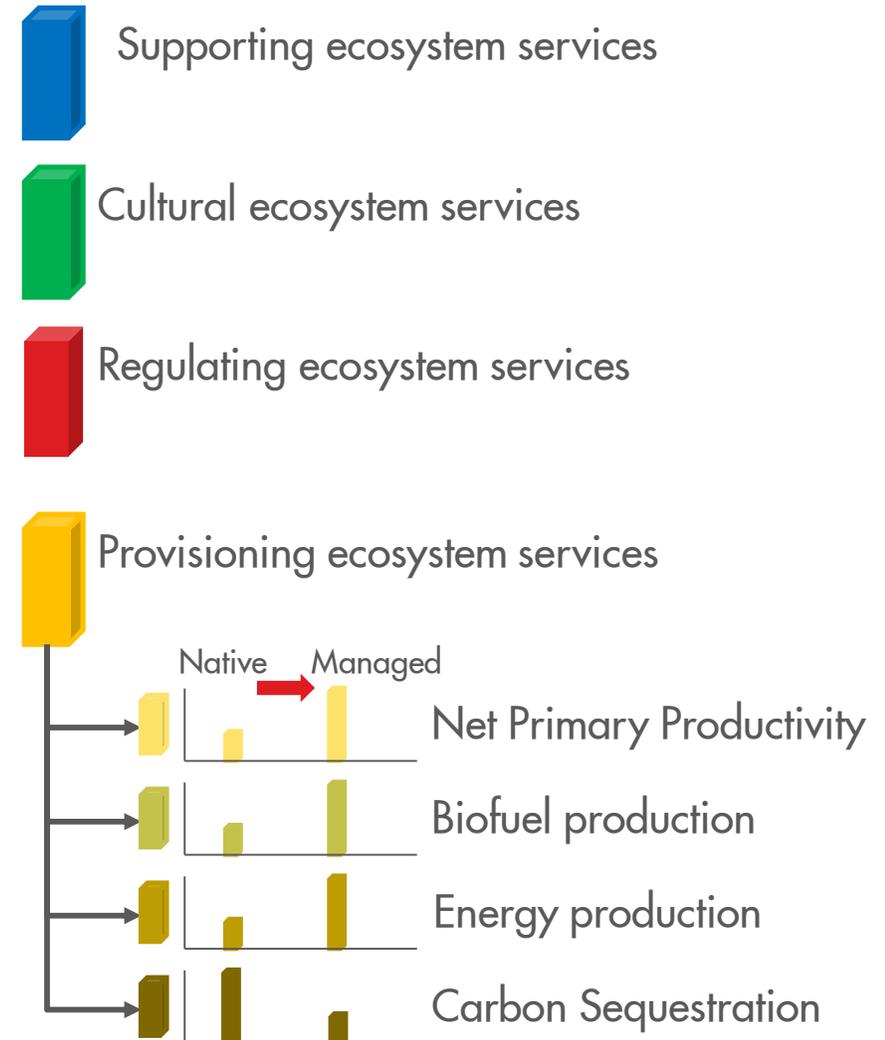
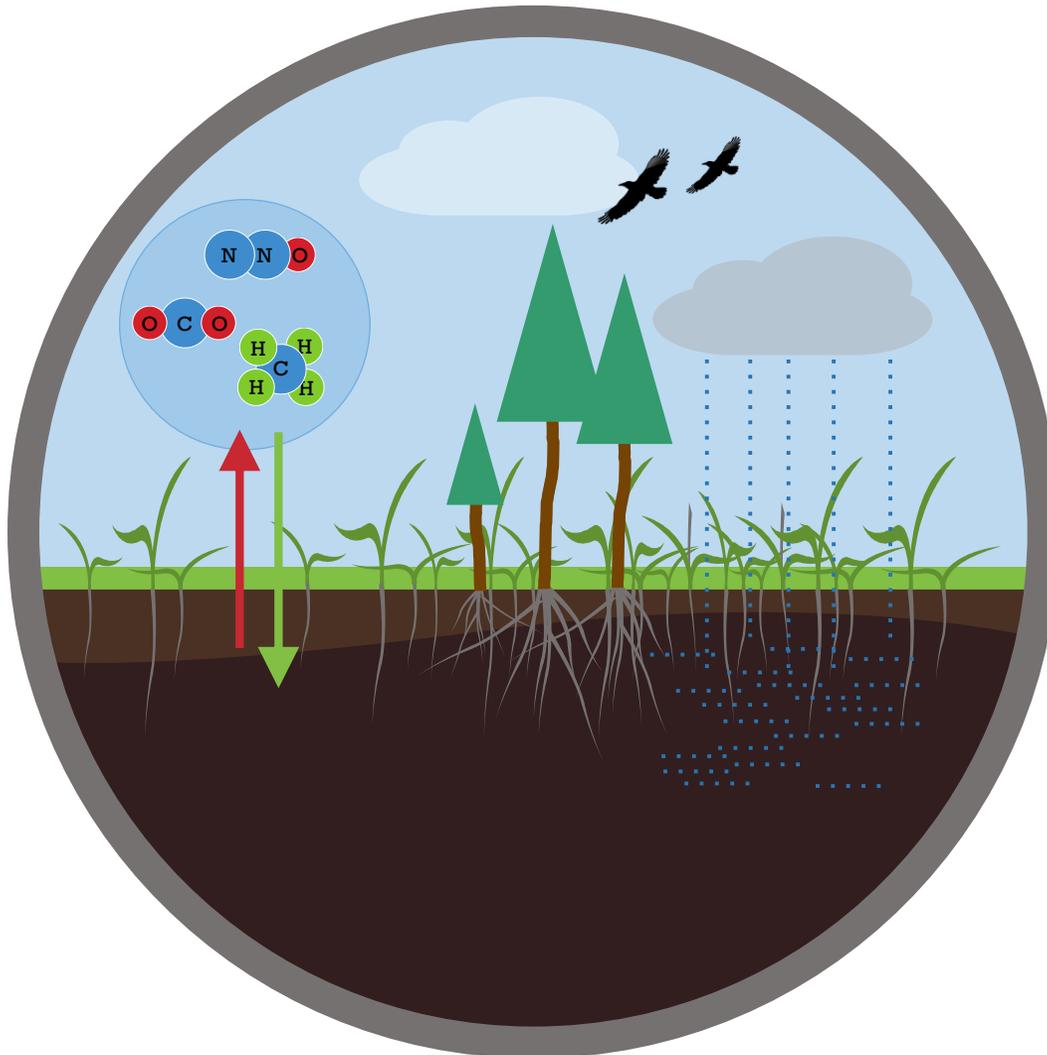


WETLANDS



Source: Griscom et al. (PNAS 2017)

# NBS is more than planting trees: Ecosystem Services



# R&D to improve NBS Methods

Evaluation of peatland and forest restoration methods  
Screening of NBS for commercial pilot R&D testing



Peatland restoration



Mangrove restoration

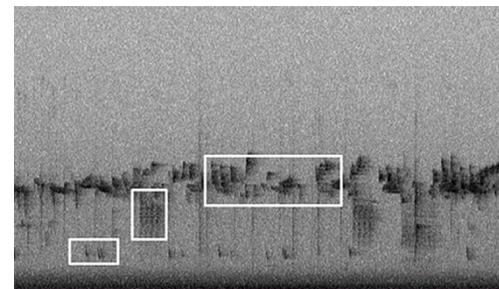


Rice management

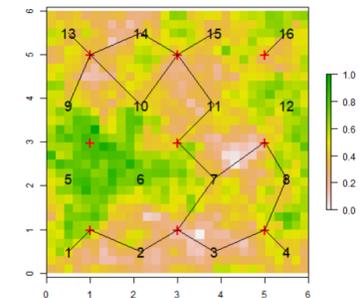


Grassland management

**Drop the microphone – biodiversity monitoring**  
Track and analyse a variety of insects/birds/animals continuously and remotely



Acoustic fingerprints



Spatially mapping diversity

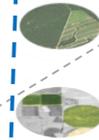
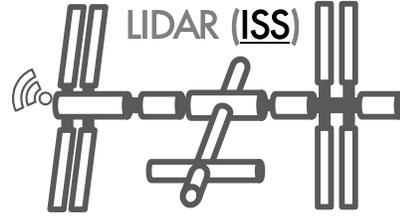
# Integration across NBS measurement platforms



Radar  
(NASA/ESA)

Multi spectral  
(RGB, hyperspectral)  
(Airbus/planet.com)

LIDAR (ISS)



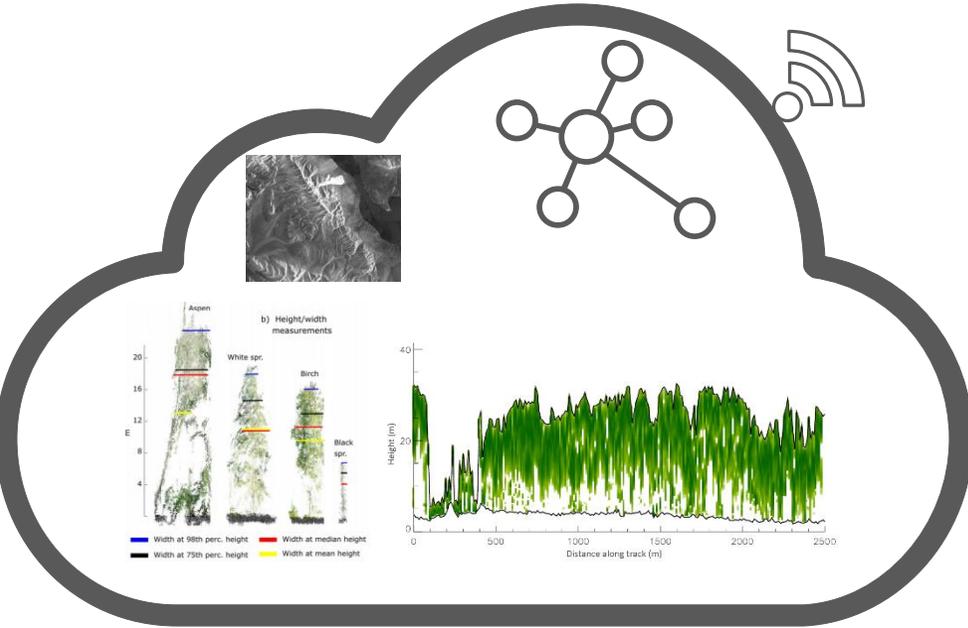
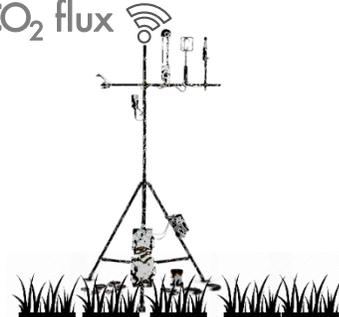
Drones



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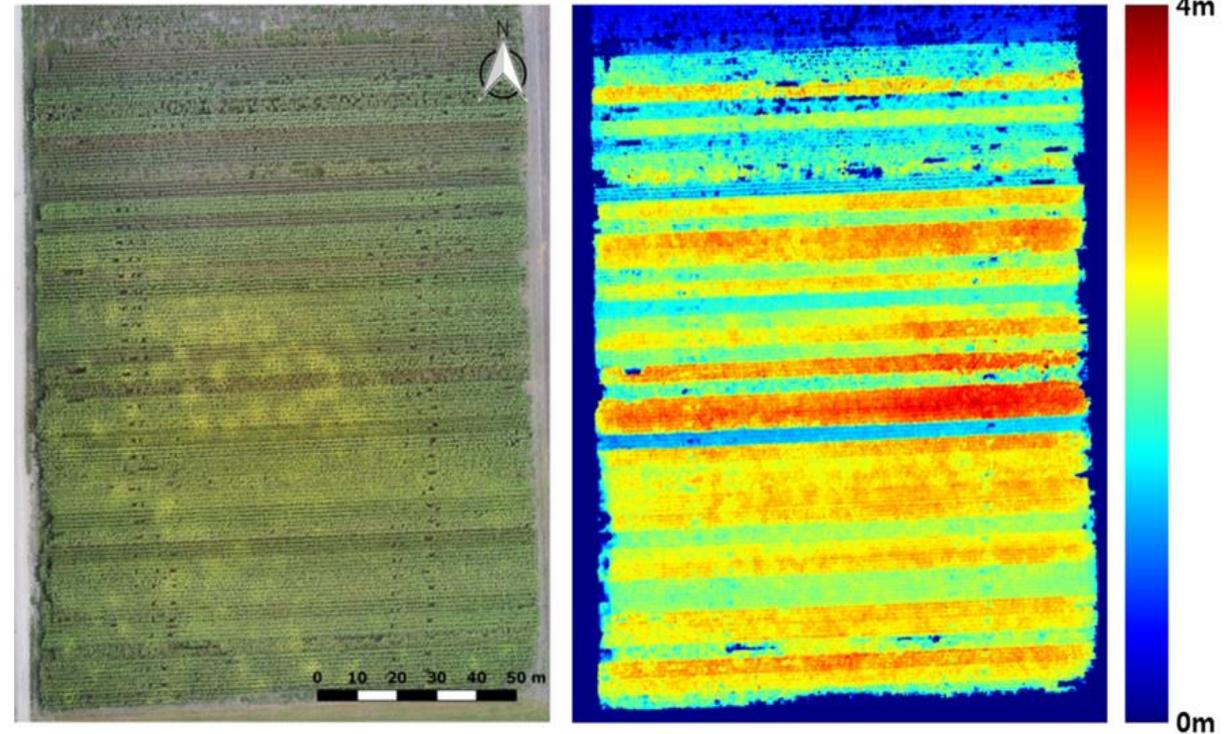
Biomass  
Carbon

NEE  
CO<sub>2</sub> flux



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# UAV Biomass Estimation for NBS



Reproduced from A. Chang et al. 2017. Crop height monitoring with digital imagery from Unmanned Aerial System (UAS). *Comput. Electron. Ag.* 141, 232-237

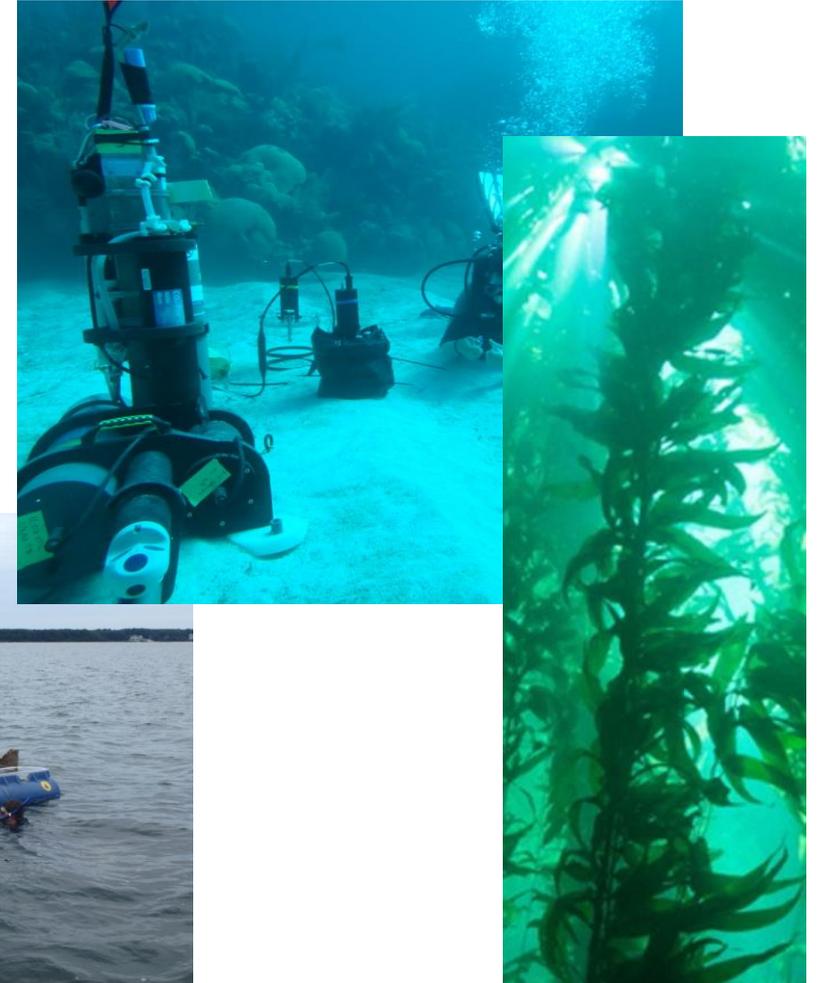
# R&D Needs for Aquatic Carbon

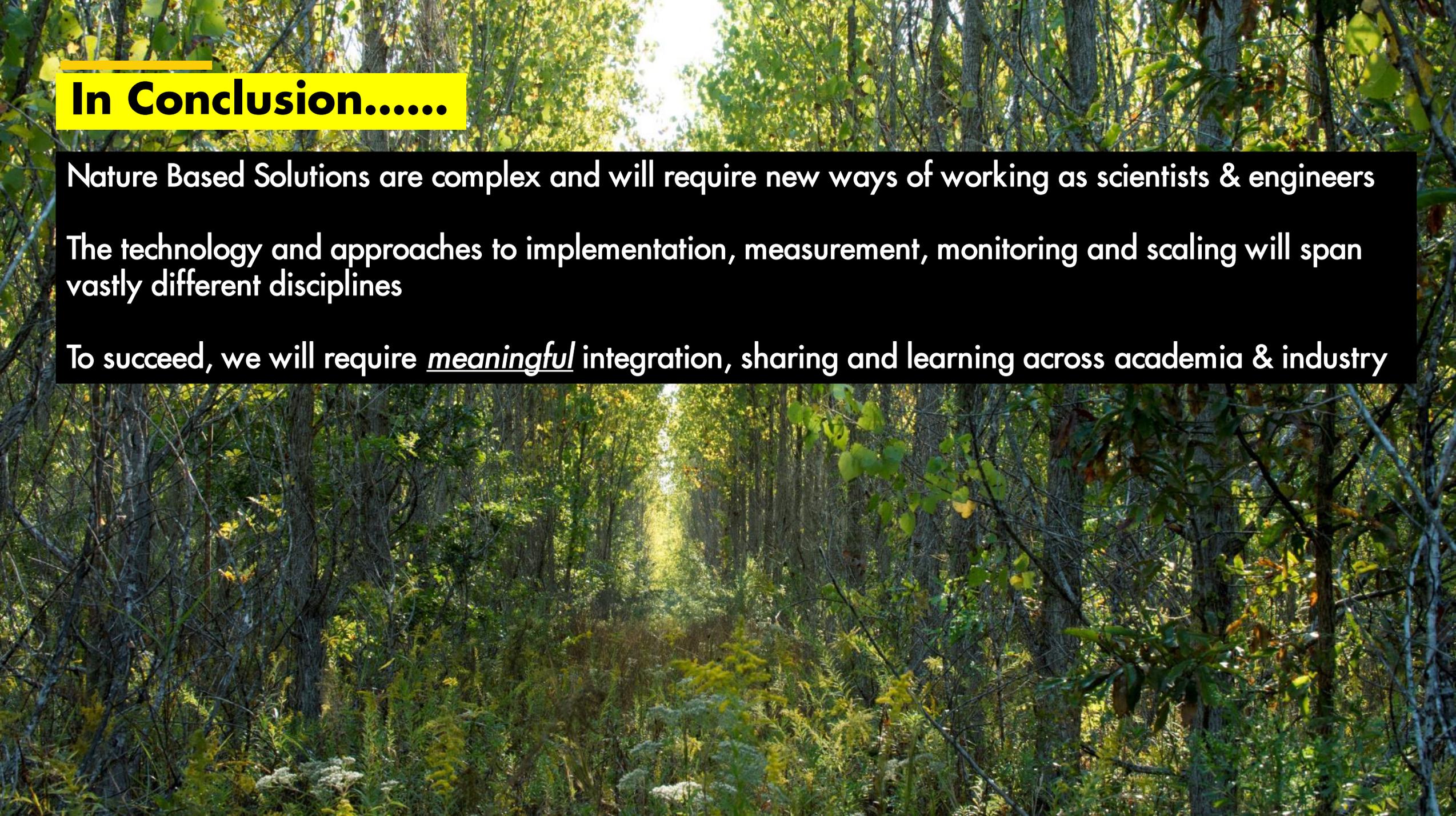
## Carbon Flux

- Aquatic carbon stock measurements are less developed than terrestrial systems, and complicated by the marine environment
- Sensor lifetimes will need to increase to provide more rigorous estimates of carbon uptake in marine ecosystems such as seagrasses and mangroves

## Carbon Accumulation and Biomonitoring

- Tracking historical carbon accumulation and sources in marine ecosystems requires novel tool development
- Biomarker tracking techniques will need to be developed for macroalgae, which may also serve as a future biomass feedstock





## In Conclusion.....

Nature Based Solutions are complex and will require new ways of working as scientists & engineers

The technology and approaches to implementation, measurement, monitoring and scaling will span vastly different disciplines

To succeed, we will require *meaningful* integration, sharing and learning across academia & industry

