

Management of US forests for timber and carbon monetised in the California carbon market

Box 1 Profile and Key Conclusions

- This case study is based on a \$23 million US investment in a forestry asset in California managed by a leading sustainable forestry manager. The 7,500-ha project is located on mature forest land in Northern California. The investor seeks to generate higher returns than a *timber only* scenario by optimising the management of the forest for both *timber production and carbon sequestration*.
- The asset is exposed to the California greenhouse gas (GHG) emissions trading system, where regulated emitters are able to purchase California Carbon Offsets (CCOs) to help meet their emission reduction obligations. Since inception of the California GHG emissions trading system in 2012, over 75% of CCOs generated have been from forestry projects in the US.
- Based upon Vivid Economics' analysis, the business case is compelling and robust for timber only as well as timber and carbon scenarios: the timber only investment is estimated to deliver an Internal Rate of Return (IRR) of 5% until 2050. The timber and carbon scenario will deliver IRR of 7%, and as much as 34% of revenue in the final decade is from sale of carbon credits. None of the two scenarios assumes land value appreciation.
- The project is expected to remove an average of 14,800 tonnes of CO₂e annually.
- The investable universe of in the US of forestry projects that could generate carbon revenues from reforestation is explored using an economic model which assumes that a federal carbon pricing initiative is established. The model explores the potential for marginal agricultural land or subutilised land in the US to be converted to forestry with the incentive of the carbon price. The results show that new forests established primarily for carbon sequestration purposes would increase by almost 90% between 2020 and 2050. This further indicates the growth-potential in the sector, with especially promising trends in the Appalachia region.
- A US federal carbon pricing initiative could incentivise "carbon farming" forestry projects with a total abatement potential of approximately 100 million tonnes of CO₂e annually.

1. Investment Thesis

Introduction^{1,2}

The California carbon market has created new value for US timberlands, creating an opportunity to monetize the value of carbon sequestration in forests across the United States. California's greenhouse gas emissions cap-and-trade system was established in 2013 as part of the Western Climate Initiative and is today one of the largest multi-sectoral emissions trading systems in the world.

¹ <https://www.c2es.org/content/california-cap-and-trade/>

² <https://ww2.arb.ca.gov/sites/default/files/classic/cc/capandtrade/offsets/overview.pdf>

It was implemented to help reach California's climate goals: GHG emissions at 1990 levels by 2020 (which was met in 2016), 40% below 1990 emissions levels by 2030, and 80% below 1990 emissions levels by 2050. In addition, the California governor signed an executive order that mandates economy-wide carbon neutrality by 2045, covering additional sectors outside the carbon market.

The demand for offsets, known as California Carbon Offsets (CCOs), is driven by law. In order to meet compliance obligations, regulated emitters are allowed to offset up to 4-8% of emissions through utilisation of CCOs.³ Forest projects located in the continental United States and Alaska, including avoided conversion, reforestation and improved forest management projects, may be eligible to be accredited to sell CCOs. Improved forest management projects under the California carbon offset project rules, described further below, have been commercially attractive to date.

An improved forest management project under the California rules can include increasing rotation ages, increasing productivity/forest health by thinning and planting more trees on understocked areas. CCOs are awarded for carbon in trees above a baseline.⁴ The first year of offset credits are awarded accordingly relative to the baseline, adjusting for leakage (for instance, if decline in wood production induces other plantations outside the project to harvest more). Subsequent credits are awarded based on growth over and above the baseline, minus harvests and leakage. In the longer term, reduced thinning intensity/frequency can result in greater total harvested wood products. The market creates option value for forest owners to monetize the growth of their forests as either timber harvest or carbon revenue depending on the relative, and typically uncorrelated, value of each commodity.

The archetype project considered in this case study is an improved forest management program focusing on Californian privately owned timberland. The project is located in North California and covers an area of 7,500 ha. The area has been forest land for the past 100 years and consists of a mix of native species, including Douglas-fir, Tanoak and other conifers. The age profile of trees is uneven.

Carbon Pricing Scenario Description

The future outlook of the project is analysed by comparing a timber-only management regime with a combined timber and carbon management regime.

The analysis uses carbon price forecast for the CCO until 2050⁵ as shown in Table 1.

Table 1 Carbon price forecast

Year	CCO price (USD)
2020	18
2030	55
2040	85
2050	130

³ 8% until 2020, 4% between 2021-2025 and 6% for 2026-2030.

⁴ The baseline is calculated as a conservative business-as-usual scenario which must be financially feasible and incorporate all legal constraints. The baseline is modelled over 100 years with growth and yield equations described in the official protocol.

⁵ https://brattlefiles.blob.core.windows.net/files/11768_the_future_of_cap-and-trade_program_in_california_final_12.4.17.pdf

Note: The “Current Trends” scenario is used to forecast the price.
 Source: California Air and Resources Board (2020) Summary Results Report of Joint Auction #25. Brattle Group (2017)- Future of the Cap and Trade Program in California.

2. Investment Results and Future Outcomes

Profitability

The timber and carbon management regime drives the profitability upwards significantly (for the 2020-2050 period) compared to the timber only scenario, as shown in Table 1. In the carbon and timber scenario, the internal rate of return (IRR) is 6.5% until 2050, while the timber only scenario returns 5.2%. Table 1 – Internal rate of return

Table 1 – Internal rate of return

Year	Timber only	Timber and carbon
IRR (%)	5.2%	6.5%

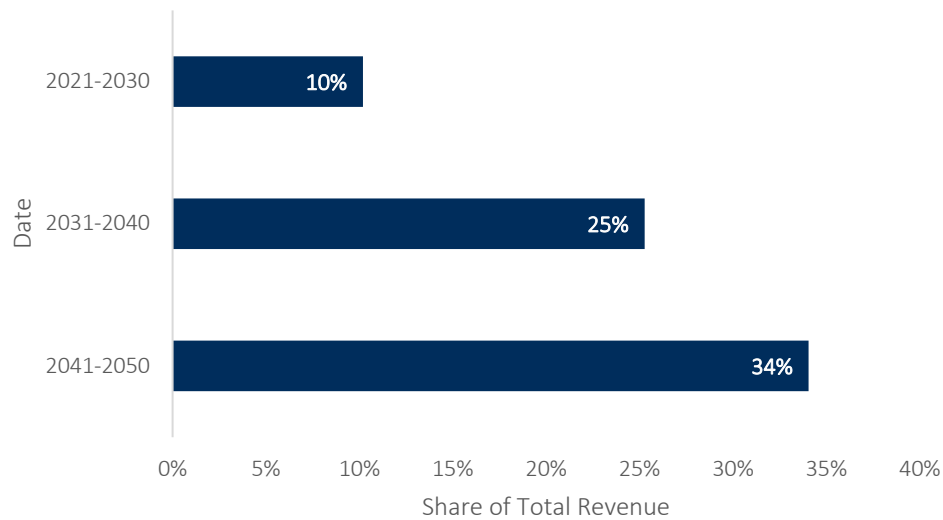
Note: Discount rate of 5%, real 2020 USD.
 Numbers are indicative because the timber to carbon exploitation ratio (timber harvested/carbon credited) is optimized using the 2020 carbon and timber prices, and remains constant through time. This means that future profitability levels are lower bound estimated because the management regime would be re-optimized to adjust for carbon and timber price variations.

Source: Vivid Economics Modelling

The project size is held constant and the harvest schedule is not reoptimized as the carbon price rises. In reality, the carbon price rise is expected to lead to project expansion and an increased focus on carbon credits, making the profits higher. Hence, the values below can be seen as a conservative lower bound.

The increase in carbon price leads to carbon revenue being increasingly more important in the project. In **Error! Reference source not found.** below we see carbon sales contributing 10% of total revenues in the 2020’s decade, 25% in the 2030’s and 34% in the 2040’s. The rest of the revenues come from timber sales.

Figure 1 Carbon revenues as a share of total revenue



Note: Non-discounted values

Source: Vivid Economics

Climate Impact

The 7,500-ha project is expected to produce 14,825 carbon credits annually, corresponding to the removal of 2 tonnes of CO₂e per hectare in recognition of improved management relative to common practice. This forms a lower bound on the actual biophysical sequestration, as accommodation is made for reserve requirements and leakage in the credits' calculation.

3. The Investible Universe and Opportunity to Scale

The California carbon market has created significant value for certain types of forests in the United States, particularly those that are managed natural forests and forests in an uneven aged management regime, because of the way the baseline is set and CCO are awarded under the California system. To consider how carbon pricing could more broadly create opportunities for forestry in the US, including reforestation, this analysis considers a different type of carbon crediting system. An economic model was used to study the opportunities that could arise for forestry with and without a US federal carbon market. The model explores the potential for marginal agricultural land or subutilised land to be converted to forestry with the incentive of the carbon price. A federal carbon market would reward carbon sequestration above a pre-specified business as usual scenario. For example, a hectare of land that is converted from agriculture into forests, will be credited for the additional carbon that is sequestered in the trees and soil. The economic model explores the land use dynamics that emerge from creating and increasing the carbon price — hence rewarding carbon farming — and maps where the opportunities will arise. The key assumptions behind each scenario are described in Table 2. The future costs and revenues of the project are then estimated using an economic model that optimises land use at the global scale (see technical annex for detailed information).

Table 2 Scenario description

Scenario	Mitigation Policy	Carbon price	Annual Bioenergy Demand	Productivity increase by 2050 relative to 2020	Area protection	Ruminant meat demand
Business as usual (BAU)	Consistent with a 3-4C global temperature increase. Demand at the federal level is driven by the voluntary market.	\$14 USD in 2020, increasing to \$130 USD in 2050	20 EJ by 2050	37%	352 Mha (IUCN Category I,II)	No fadeout
Sustainable Scenario	Consistent with a below 2C global temperature increase. Federal-level compliance market with the same characteristics as the California ETS.	Starting at \$18 USD in 2020 and reaching \$30 USD by 2023, followed by a sharp increase after 2030 ending at \$140 USD by 2050	60 EJ by 2050	108%	352 Mha (IUCN Category I,II)	25% fadeout by 2050

Source: Vivid Economics using

Land Use Dynamics in the United States

Future economic dynamics in the SS are expected generate opportunities/incentives for forestland⁶ to expand onto agricultural land (cropland and pastureland). The economic land use model indicates that managed forests in the US as a whole are expected to rise from 27 million ha in 2020 to 51million ha in 2050. Other land available for revegetation (marginal agricultural land) also grows from 157 million ha to 191 million ha in the period.

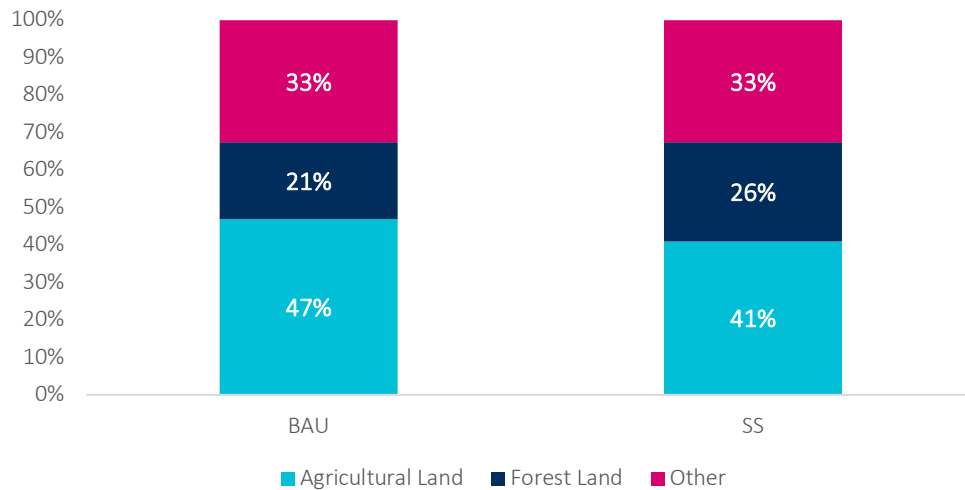
This expansion will be driven by three main factors:

1. A carbon price increase from \$16 USD in 2020 to \$130 USD in 2050. This tenfold increase will generate incentives to extend use of land due to new carbon revenues.
2. Increase in global demand for bioenergy will increase from 1 EJ in 2020 to 100 EJ in 2050, increasing the demand for biomass.

⁶ Forestland refers to managed plantations or unmanaged native vegetation growth.

3. An increase in agricultural productivity of 108% from 2020-2050, meaning that less land is required to fulfil food demand.

Figure 2 Land use dynamics in 2050 in the United States, comparison of BAU and SS

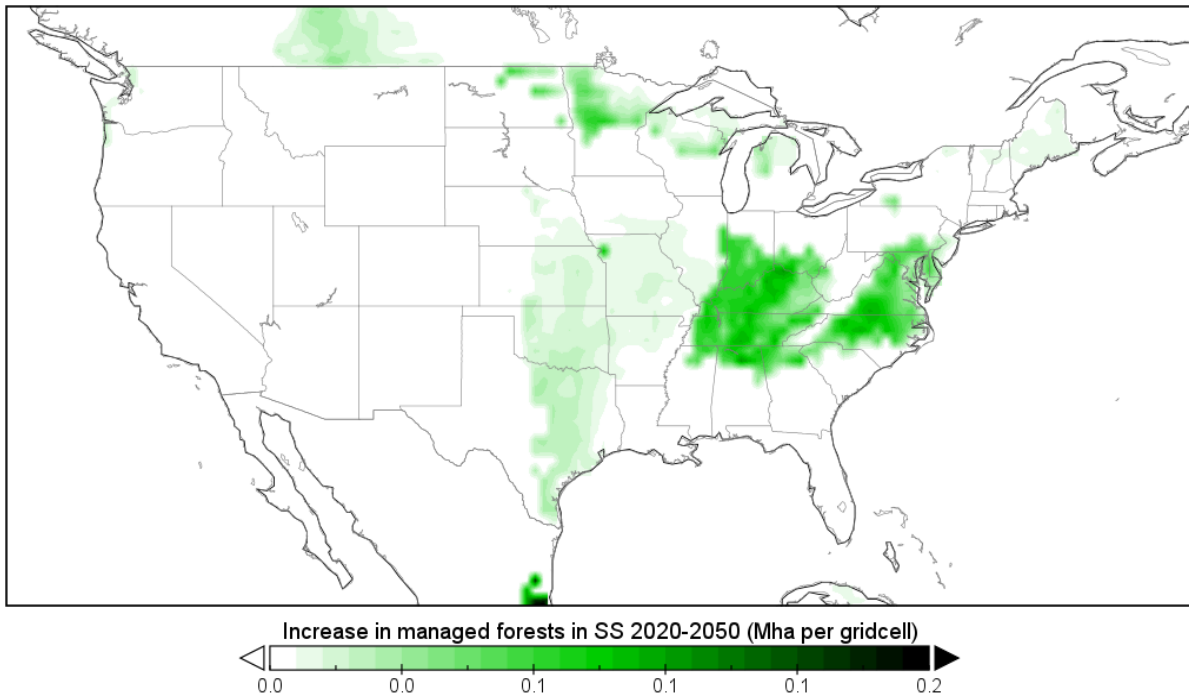


Note: Other includes primary and secondary vegetation as well as urban areas (remain constant). Agricultural land is a combination of cropland and pastureland. Forestland includes both managed forest and other land.

Source: Vivid Economics

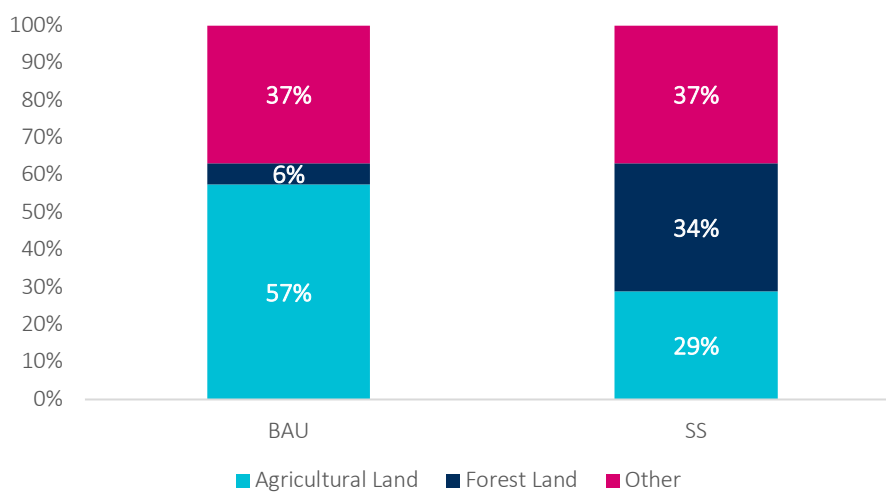
Nevertheless, the regional dynamics within the US are widely heterogenous depending on land productivity, local price dynamics etc. As seen in Figure 3, managed forestry for instance has substantial growth potential in the east of the US. This growth happens predominantly at the expense of agricultural land. Kentucky and Tennessee have the largest potential.

Figure 3 Managed Forestry Increase between 2020 and 2050 in SS in the USA



Note: [Click here to enter note](#)
 Source: Vivid Economics and MAgPIE

Figure 4 Land use dynamics in 2050 in Tennessee, comparison of BAU and SS



Note: [Click here to enter note](#)
 Source: Vivid Economics and MAgPIE

Climate Impact

In the US as a whole, there are just over 27 million hectares of managed forest today. If all of this area were to be converted to improved management practices similar to the archetype project above (i.e. increased rotation ages, increased productivity/forest health by thinning and planting more trees on understocked areas), it would have a carbon sequestration potential of 54 million tonnes of CO₂e annually. In the SS scenario, managed forests are expected to expand to 51 million hectares, that is an expansion of 89%. This would raise the sequestration potential to over 100 million tonnes of CO₂e/year – equivalent to taking almost 1.5 million cars off the road.