The costs and benefits of restoring a continent's terrestrial ecosystems

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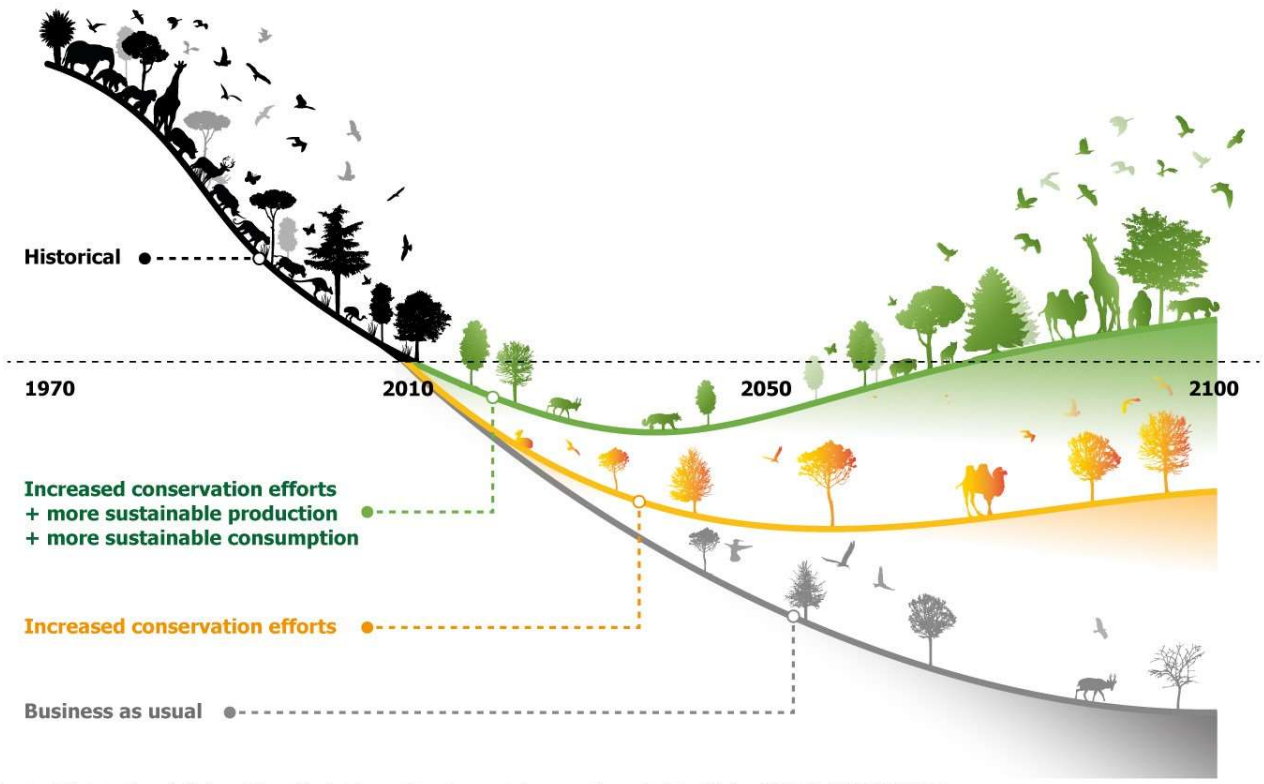


This artwork illustrates the main findings of the article, but does not intend to accurately represent its results (https://doi.org/10.1038/s41586-020-2705-y)

- Global biodiversity is in rapid decline
- Ecological restoration is vital to improve conservation outcomes

UNITED NATIONS DECADE ON
ECOSYSTEM
RESTORATION
2021-2030

RESTORE
OUR FUTURE
BONN CHALLENGE

Multiple international landscape-scale ecosystem restoration commitments have been made by most nations such as:

- The Convention of Biological Diversity Aichi Target 15
- Sustainable Development Goal 15.3
- The Bonn Challenge, and
- The United Nations Decade on Ecosystem Restoration.

How to effectively implement and budget landscape-scale restoration to achieve a conservation goal

- Governments and environmental organisations need systematic methods to plan and budget their restoration commitments
- Where should restoration be located?
- How much does it cost?
- How much carbon abatement in return?

- This research outlines a systematic approach to determine where cost-effective restoration actions should be located to achieve 30% ecosystem coverage across Australia while maintaining agricultural production.
- We estimate the costs to achieve this over 30 years, paying farmers to forego marginal land for conservation and management
- Additionally, we present the expected carbon abatement from the restoration

Restoration planning for a conservation goal

Define a clear goal with any constraints

e.g. Restore native vegetation to have 30% coverage in good ecological condition for each terrestrial ecosystem without compromising food production

Requires:

- Definition and map of spatial categories e.g. ecosystems
- Definition and map of features e.g. vegetation and condition
- Definition and map of areas to avoid e.g. urban and intensive agriculture

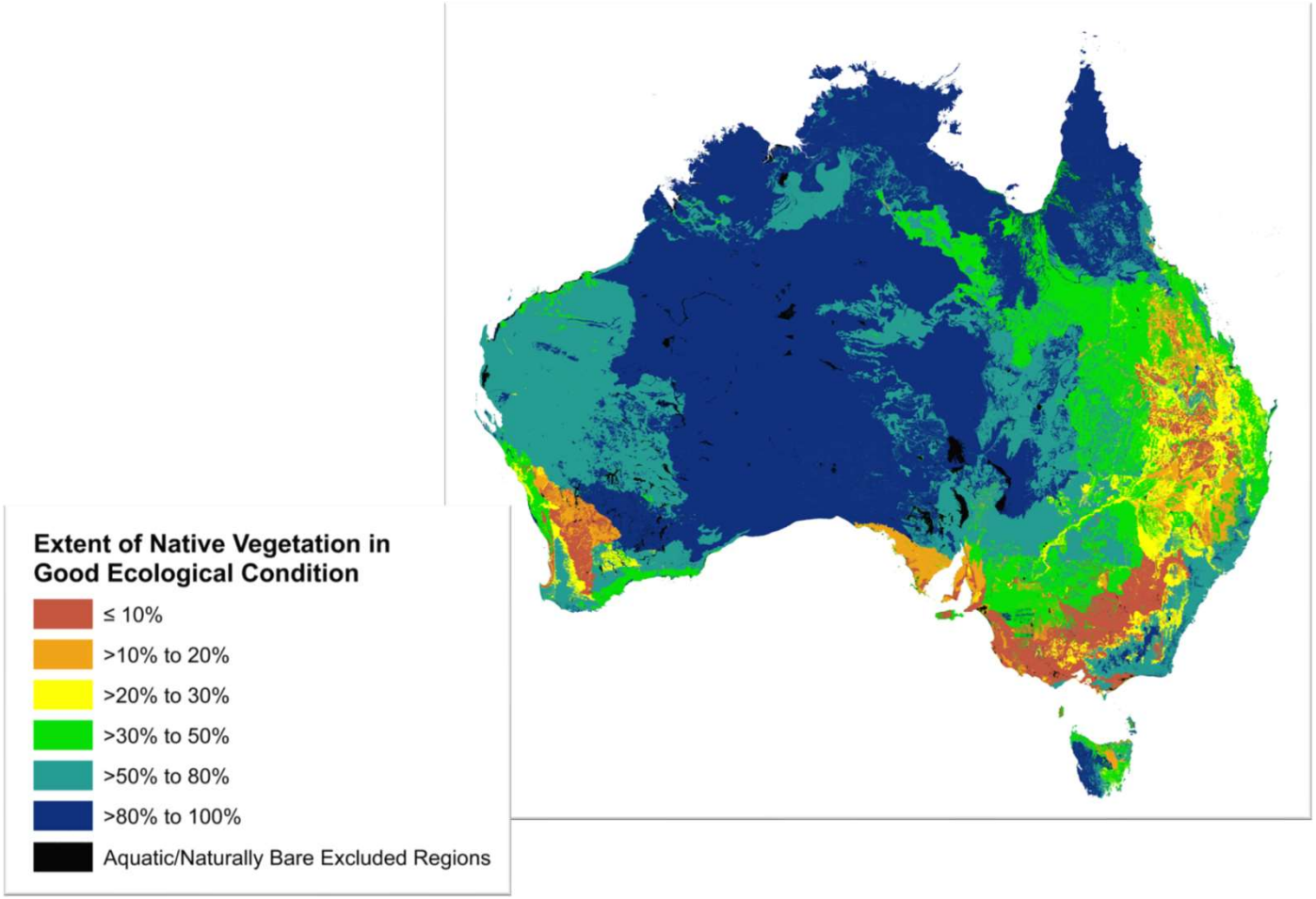
How to achieve goal effectively and how much would this cost?

Divide into planning units with associated information of the action and associated costs. Optimal solution calculated with Marxan or other conservation planning software

Requires:

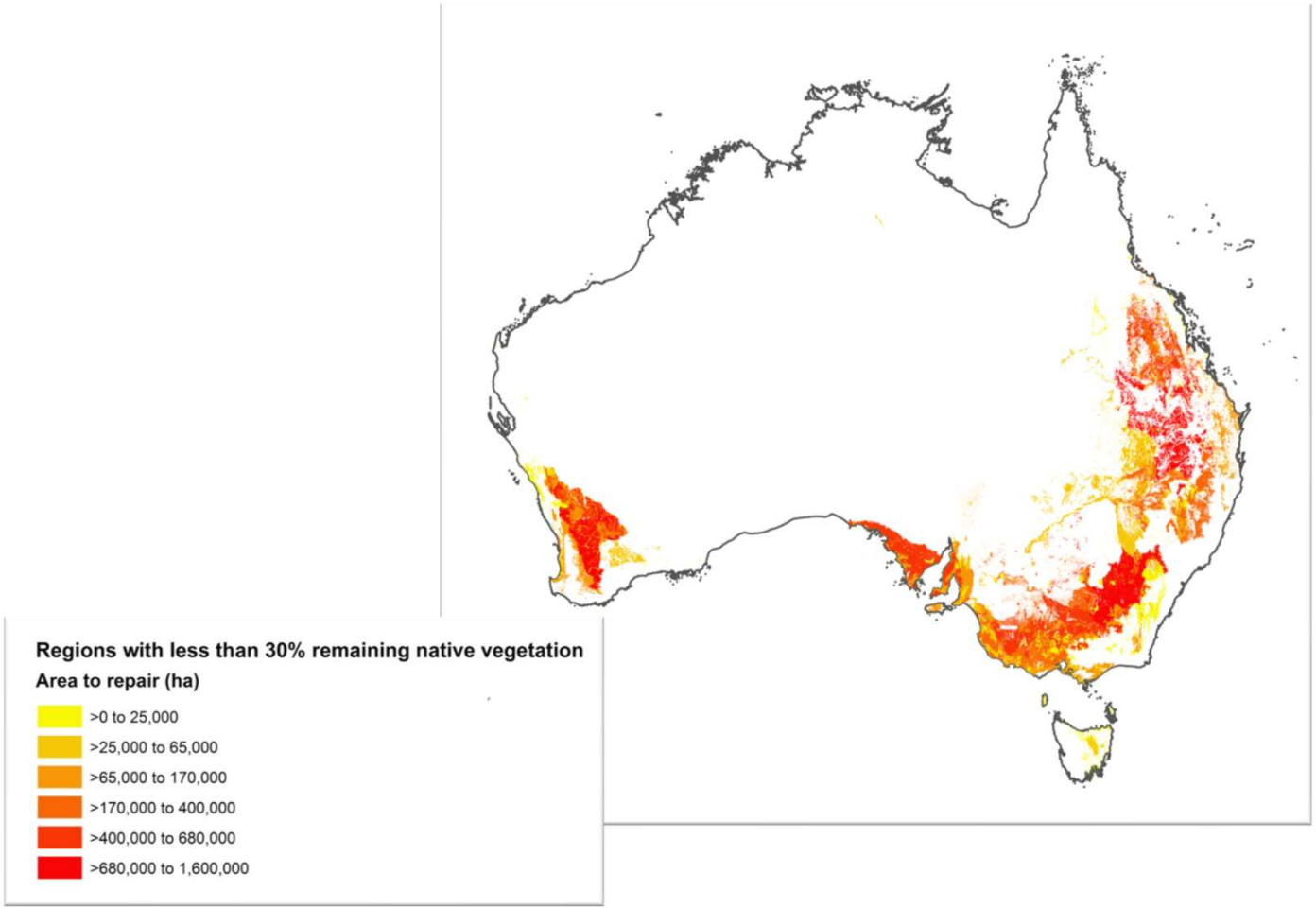
- Feasibility information e.g. constrain to areas where restoration possible or associated probabilities
- Action costs based underlying features e.g. restoration costs based on vegetation condition
- Definition and map for other associated costs e.g. stewardship payments and management costs

Australian ecosystems' extent of native vegetation



Thirty percent is the level of native vegetation coverage required before ecosystem services and biodiversity sharply declines

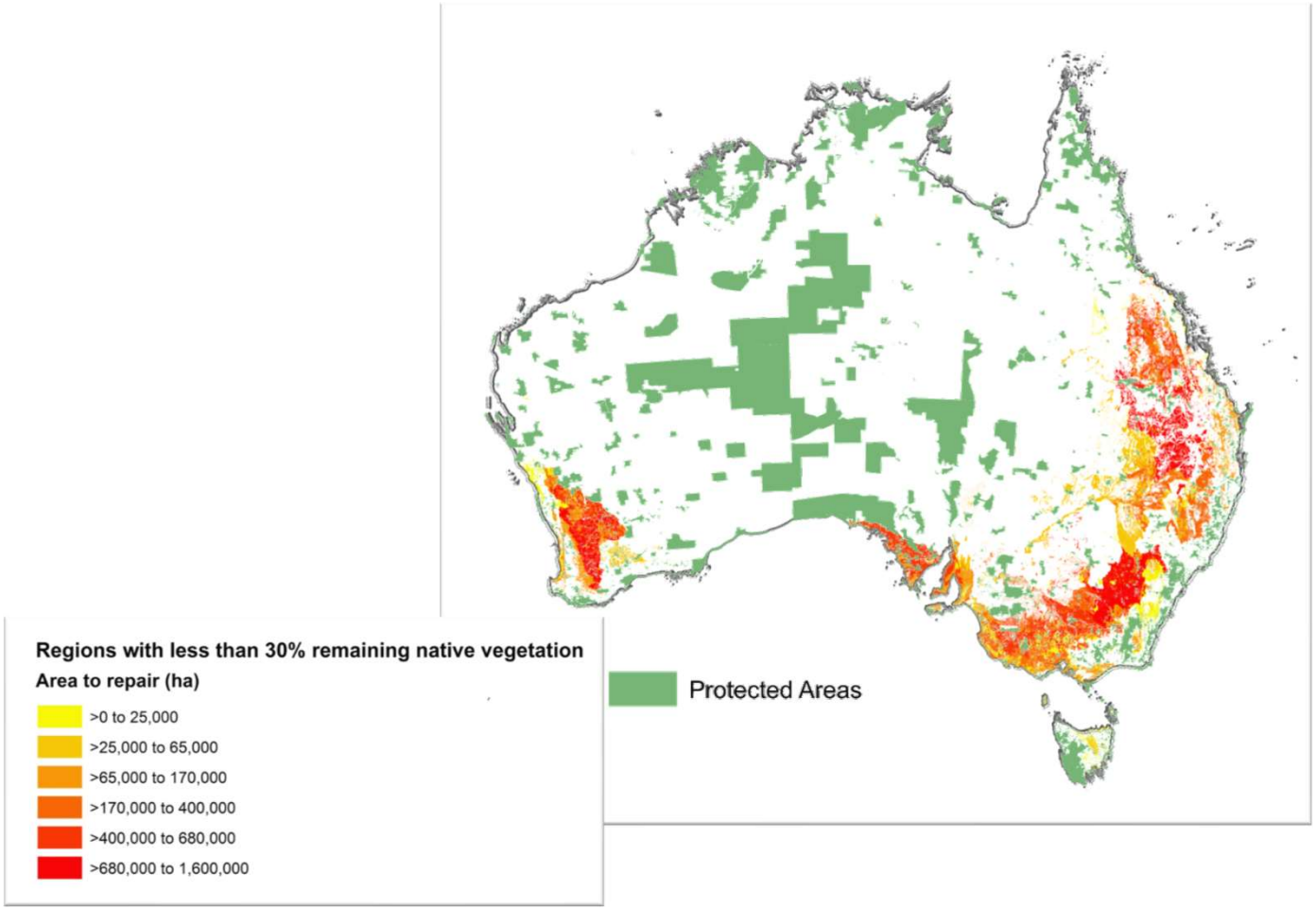
Australian ecosystems to restore



250 (19.5%) terrestrial ecosystems in Australia had less than 30% coverage of native vegetation in good ecological condition.

For all ecosystems to reach the 30% threshold of native vegetation in good condition, at least 12.9 million ha needs to be restored (1.7% of the terrestrial area of Australia)

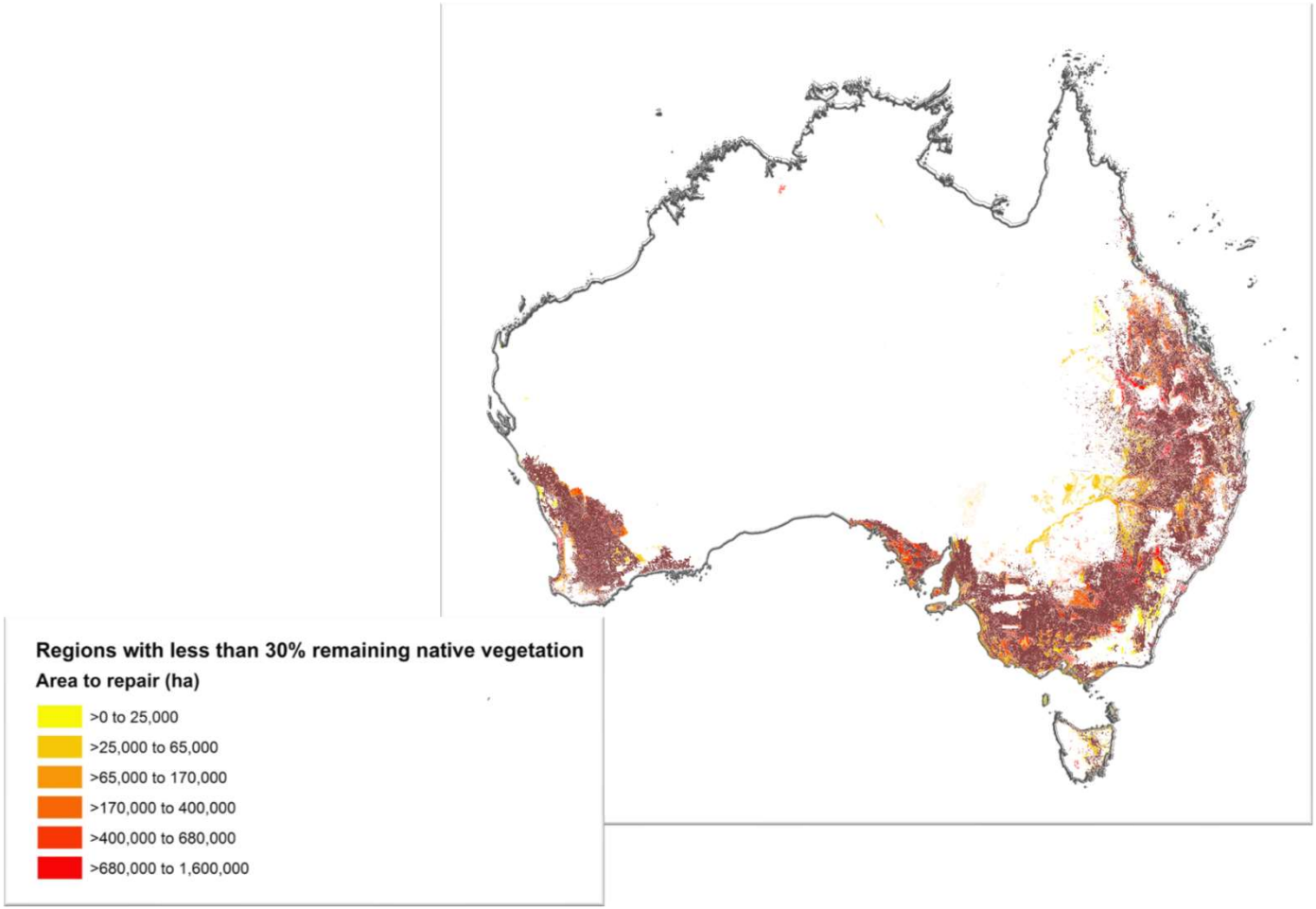
Overlap with the protected area estate



10% of the area needing restoration (1.3 million ha, of the 12.9 million ha) can be restored on land that is within the protected area estate.

No acquisition costs

Excluding the Intensive Agriculture Area and Urban/Infrastructure Dominated Areas



To increase the likelihood of uptake and to be able to maintain our agricultural production, we looked for solutions for the remaining area to restore, outside urban, industrial, and intensive agricultural areas.

Almost all (99.8%) ecosystems can achieve 30% coverage outside the bounds of intensive agriculture and urban areas

Cost Assumptions

Direct Restoration Costs		
Vegetation category	Cost to passively restore transformed land	Cost to actively restore cleared land
Rainforest	2,824	11,297
Forests and woodlands	1,412	5,648
Shrublands	847	3,389
Grasslands	565	2,259
Chenopods, samphire shrubs and forblands	847	3,389

Direct restoration costs: As per table, increasing 2% per annum

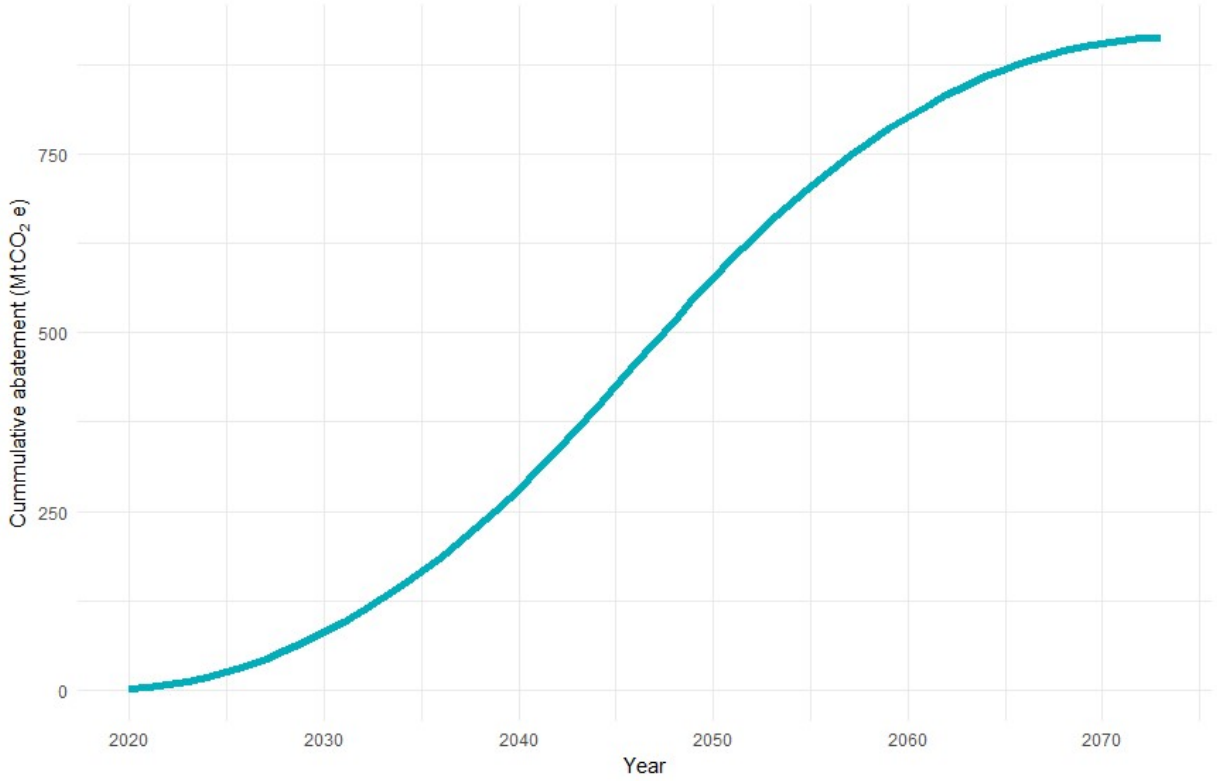
Management costs: $6.25/ha inflated at 2% per annum

Stewardship costs: 12-year average annual farm-cash income to capture the fluctuations in returns, increasing at 2% per annum, and capitalised in perpetuity by dividing by 5%

We identified the sites across Australia where revegetation would be most cost-effective, using *Marxan*, *a* conservation planning tool. These are the places where land requires the least revegetation work and returns the lowest profit to farmers, thus minimising the direct restoration and stewardship costs.

- Pictured are the cost-effective restoration sites in heavily degraded ecosystems across Australia, with examples of possible restoration sites or landscapes
- The first year's cost would be $2.1 billion
- The NPV of the total investment required is $41.5 billion

Action	2020 Expenditure	NPV of total expenditure from 2020 to 2050
Restore 1.3 million hectares of degraded native vegetation to a healthy ecological condition within the Protected Area estate	$135 million	$2,614 million
Restore 11.6 million hectares of degraded native vegetation to a healthy ecological condition of non-prime agricultural land	$1,161 million	$22,477 million
Incentivise the sustainable management of 11.6 million hectares of non-prime agricultural land	$810 million	$15,684 million
Monitoring and management of restored area (fire, weeds, feral animals)	$3 million	$696 million
Total	$2,109 million	$41,471 million



- Restoring Australia's ecosystems could achieve a cumulative abatement of 913 $MtCO_2e$
- By the year 2030, the annual abatement is 13 $MtCO_2e$ which grows to an annual abatement of 26 $MtCO_2e$ by 2050.

Conclusions

- We created a nationwide plan to reduce the rate of species loss and sequester carbon through habitat restoration on marginal farming land
- It would cost only 0.1% of GDP each year to do this while restoring every habitat type to 30% cover
- De-bugs myth we can’t have a healthy environment and a strong economy

Thank you