PATHWAYS TO DEEP DECARBONISATION IN 2050

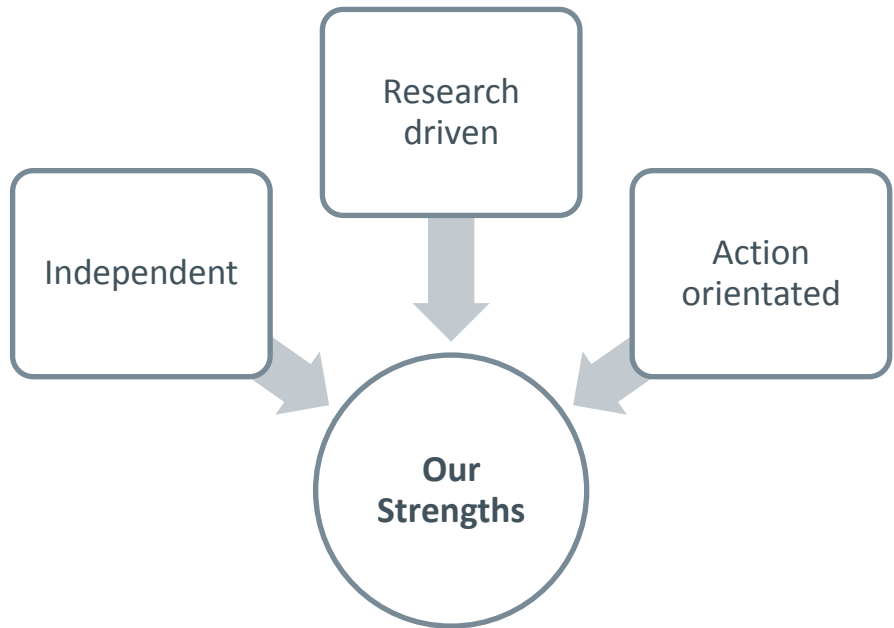## MODELLING LAND USE IN THE AUSTRALIAN 2050 CALCULATOR

International Conference on 2050 Calculator

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11 February 2015

ClimateWorks Australia is a non-profit partnership between Monash University and the Myer Foundation

Our Mission: Catalyse action to substantially reduce Australia's greenhouse gas emissions

THE MYER FOUNDATION

MONASH University

Australian museum
Eureka Prizes

10TH AUSTRALIAN SUSTAINABILITY AWARDS

Research driven

Independent

Action orientated

Our Strengths

Contents

1. Project context

2. Land use and Agriculture

3. Next steps

We are part of the global Deep Decarbonisation Pathways Project which includes 15 country teams

Joint Lead:

ClimateWorks AUSTRALIA | Australian National University

Modelling:

CSIRO | VICTORIA UNIVERSITY MELBOURNE AUSTRALIA

SUSTAINABLE DEVELOPMENT SOLUTIONS NETWORK
A GLOBAL INITIATIVE FOR THE UNITED NATIONS

IDDRI
SciencesPo.

Coordinated globally

- Consistent framework
- Global aggregation
- Knowledge sharing

Driven locally

- Country pathways
- Based on local potential
- Recognition of local context and constraints

The project is focused on technology solutions and identified "pillars" of transformation for deep decarbonisation

ENERGY PILLARS - COMMON TO TALL COUNTRIES

Ambitious Energy Efficiency
in all sectors leads to a halving of the energy intensity of the economy.

Low Carbon Electricity
Low carbon electricity is supplied by renewable energy or a mix of renewable energy and either CCS or nuclear power at similar costs.

Electrification and Fuel Switching
from fossil fuels to bioenergy, and from coal and oil to gas reduces emissions from transport, industry and buildings.

Non-Energy Emissions
are reduced through process improvements and CCS in industry, while a profitable shift from livestock grazing to carbon forestry offsets any remaining emissions.

CCS

Our analysis found that Australia can achieve zero net emissions with continued economic growth in line with recent years

Greenhouse gas emissions trajectory for illustrative pathway, MtCO2e, 1990-2050

Legend:
- Other
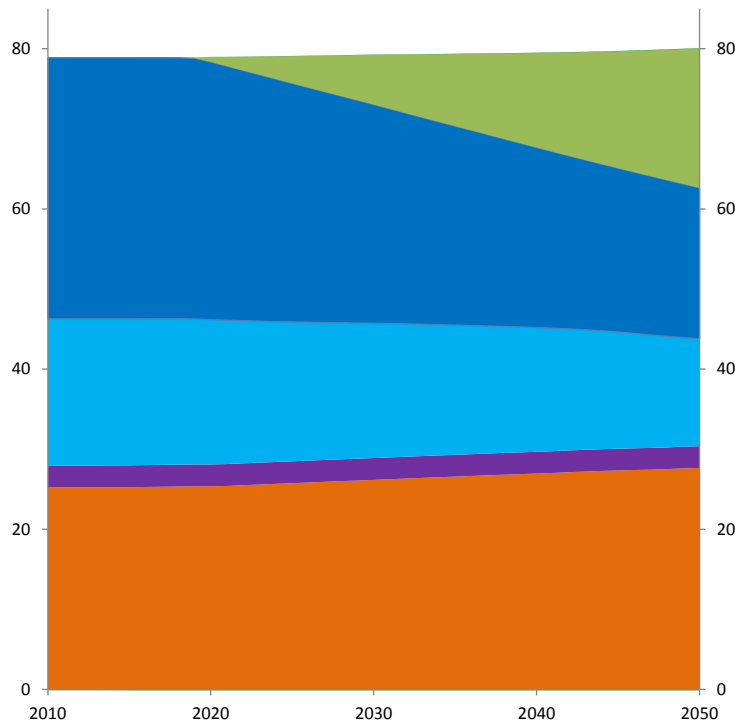- Fuel combustion
- Forestry
- Total
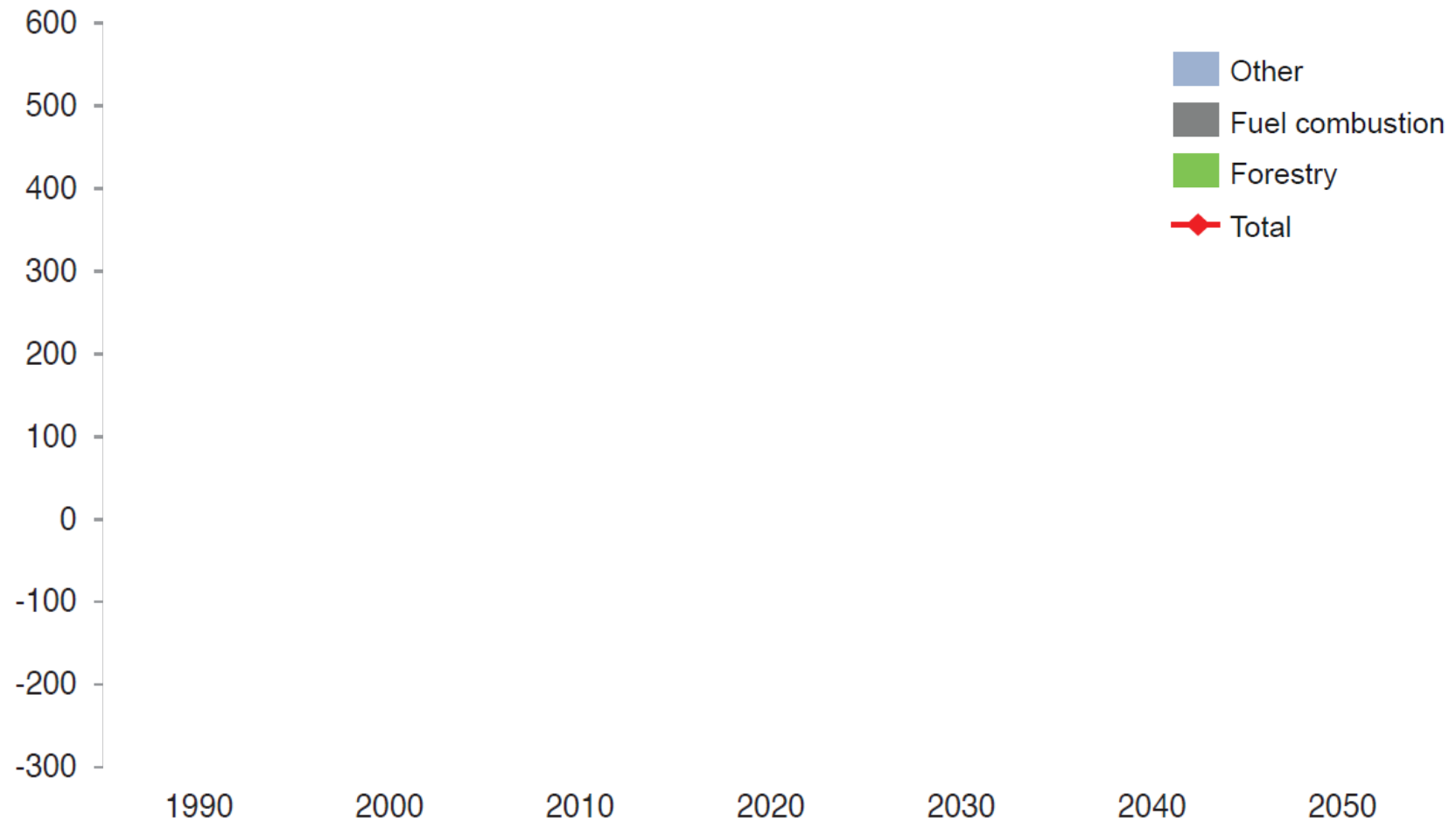
A large part of this is due to profitable shifts from cattle grazing to carbon forestry by 2050

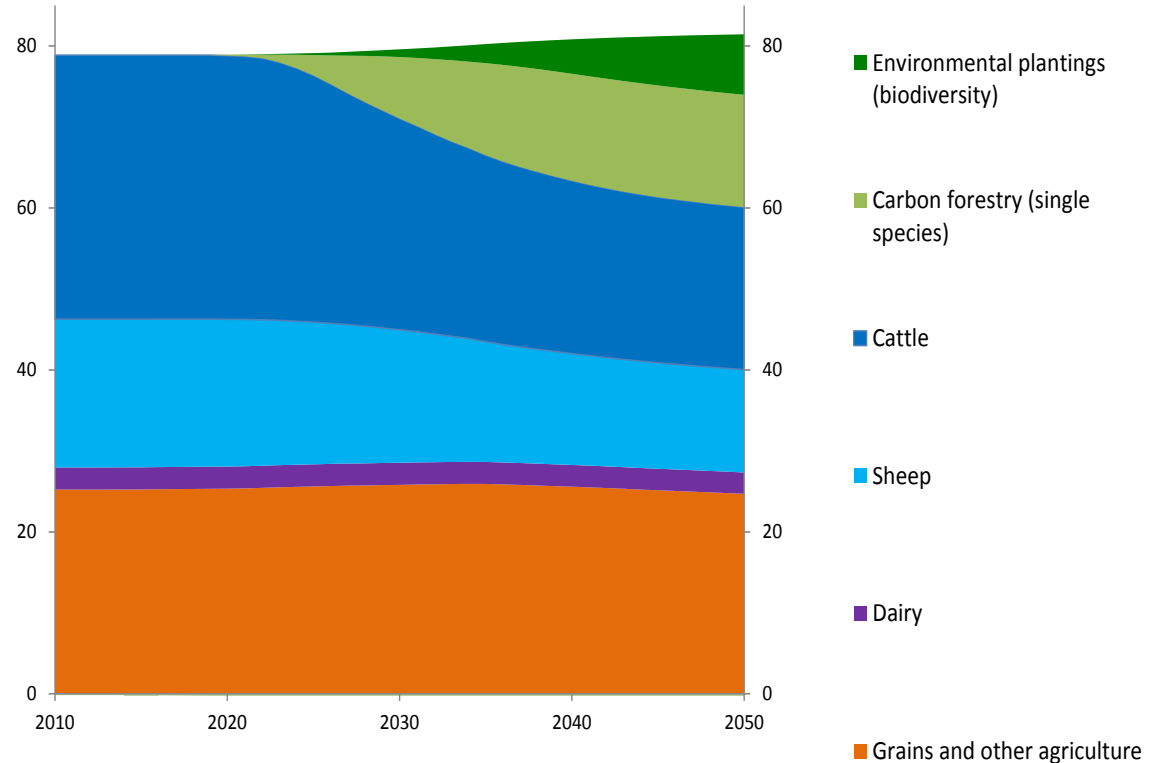**Land use change occurring under illustrative land use scenarios**

Complementary to *100% renewable grid* scenario
4.3 GtCO$_2$e abatement delivered, with single species plantings and constraint on annual rate of planting
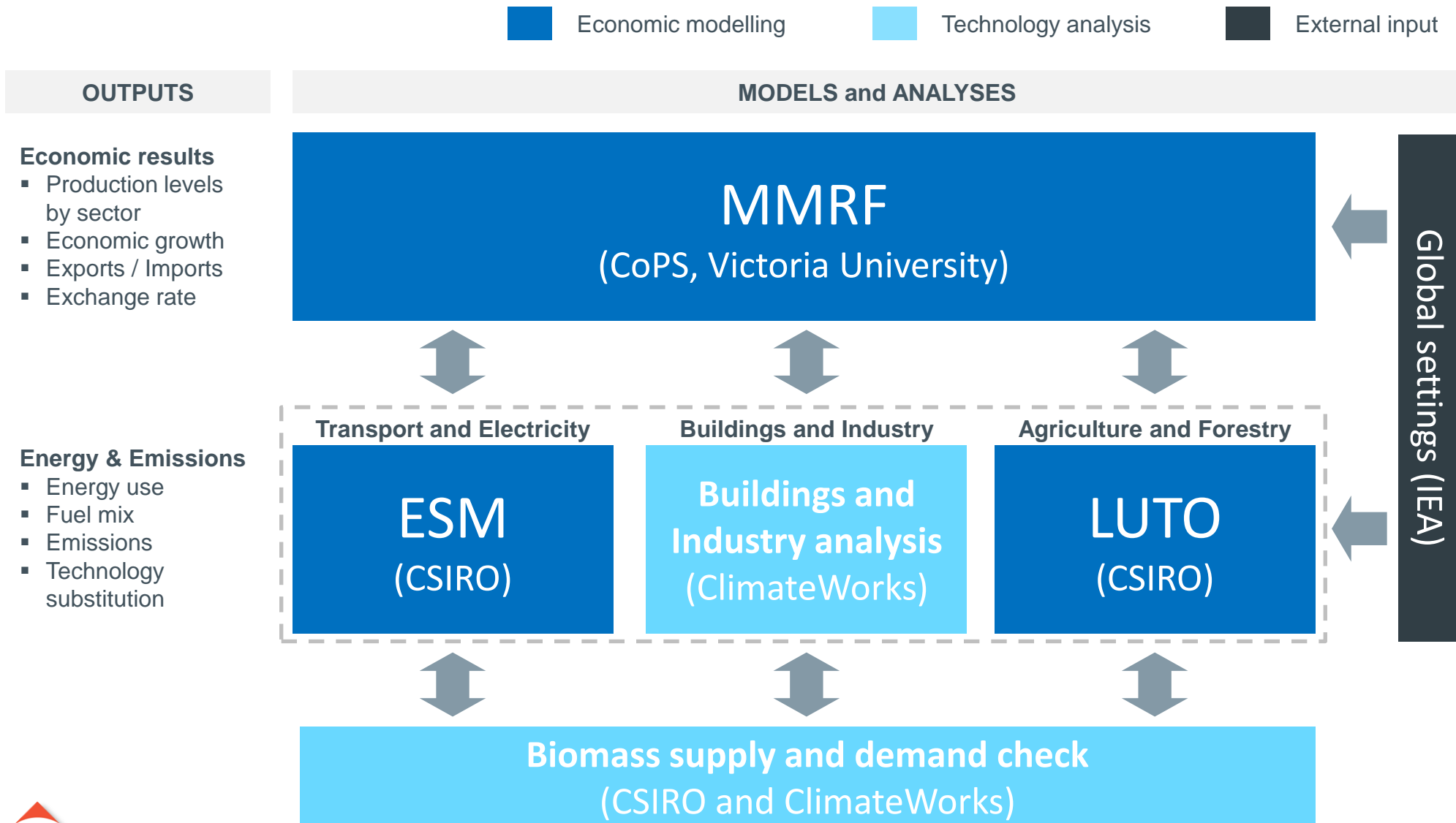
Complementary to *CCS* scenario
4.8 GtCO$_2$e abatement delivered, includes 35% of mixed native species and no constraint on annual rate of planting

Legend:
- Environmental plantings (biodiversity)
- Carbon forestry (single species)
- Cattle
- Sheep
- Dairy
- Grains and other agriculture

The full analysis uses a combination of top down and bottom up models

Economic modelling | **Technology analysis** | **External input**

OUTPUTS

Economic results
- Production levels by sector
- Economic growth
- Exports / Imports
- Exchange rate

Energy & Emissions
- Energy use
- Fuel mix
- Emissions
- Technology substitution

MODELS and ANALYSES

MMRF
(CoPS, Victoria University)

Global settings (IEA)

Transport and Electricity

ESM
(CSIRO)

Buildings and Industry

Buildings and Industry analysis
(ClimateWorks)

Agriculture and Forestry

LUTO
(CSIRO)

Biomass supply and demand check
(CSIRO and ClimateWorks)

We are trying to develop scenarios in line with our illustrative deep decarbonisation pathway (DDP)

- **Scenario 1**: business-as-usual / continuation of recent trends

- **Scenario 2**: moderate improvement / intermediary to DDP

- **Scenario 3**: DDP (broadly)

- **Scenario 4**: deeper reductions than DDP, in particular involving:
  - o behaviour change
  - o structural change (eg. from material efficiency)
  - o less advanced technologies (eg hydrogen)

At this stage, we are focusing on energy and emissions

✓ Energy

✓ Emissions

✗ Costs

✗ Air quality

✗ Additional information

For many sectors, we are either increasing or decreasing the granularity of the UK my2050 template

Sector	Approach	Progress
Electricity	▪ Similar to UK ▪ Some simplifications	▪ Scoping in progress ▪ Completion by February
Industry	▪ More granular than UK 　o More sectors 　o More levers	▪ First draft of 3 scenarios completed (UK student) ▪ Review and refinement to be completed by February
Transport	▪ Similar to UK ▪ Some simplifications	▪ Mostly completed (4th scenario being refined)
Buildings	▪ Simplified approach to UK ▪ Focus on energy use per m^2 and % reduction rather than technology analysis	▪ Work in progress ▪ Completion by January
Agriculture & Forestry	▪ More granular than UK 　o Livestock 　o Carbon forestry 　o Interactions	▪ Scoping in progress 　o Data analysis 　o Structure ▪ Completion by February

Contents

1. Project context

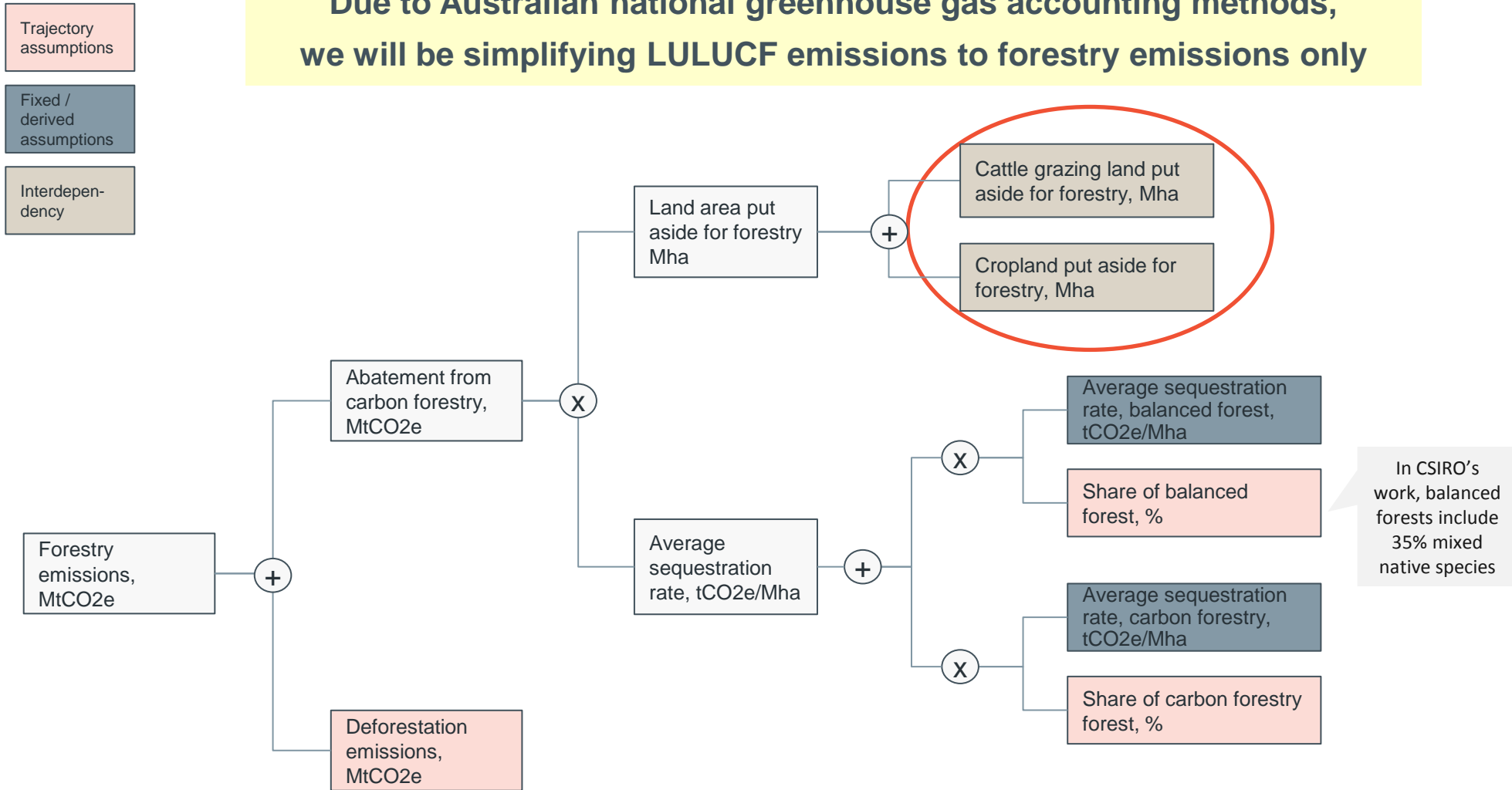2. Land use and Agriculture

3. Next steps

Key changes in the Australian calculator

- Addition of **Carbon forestry** calculations to account for the significant abatement potential in Australia

- Creating a dynamic link between **Carbon forestry** and **Agricultural emissions** (livestock)

- Creating a dynamic link between **Carbon forestry** and **Bioenergy supply** (Wood arising, new forest)
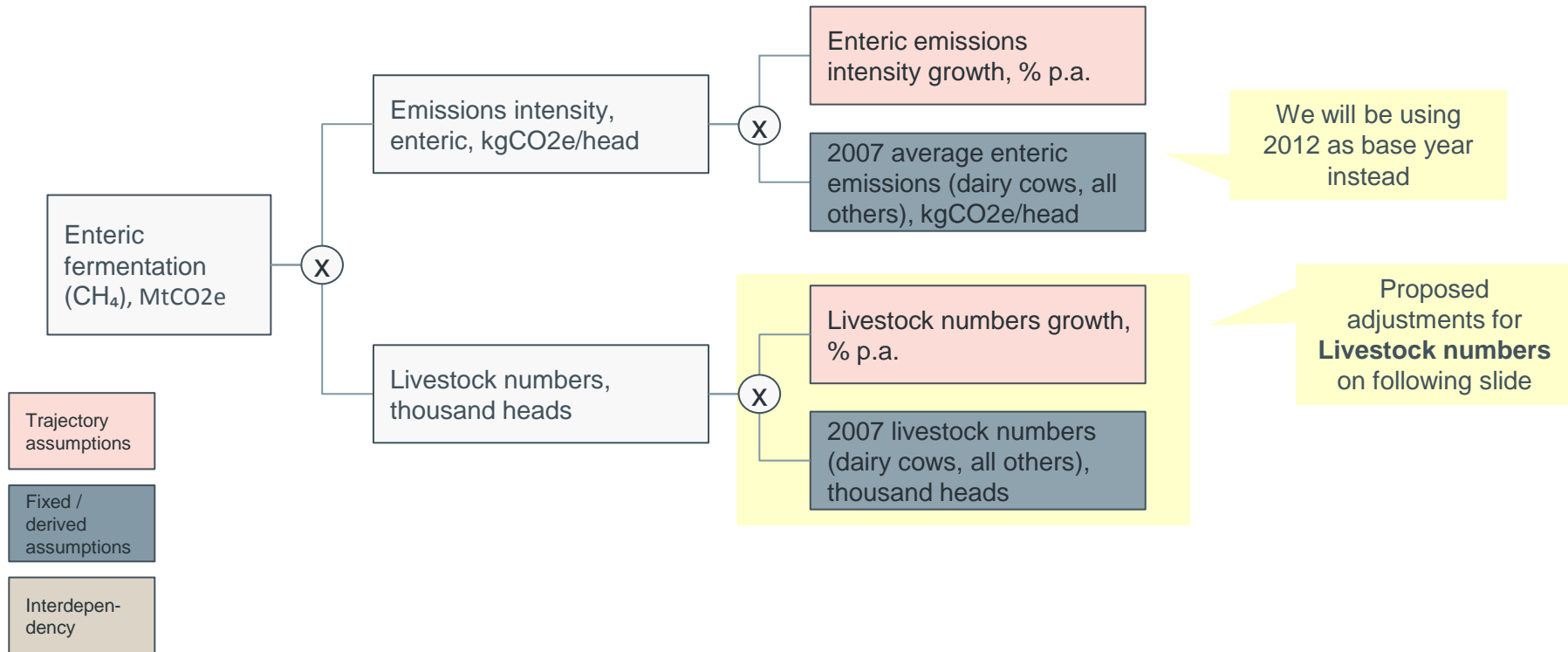
LULUCF emissions, Forestry emissions *(Addition for Australia)*

Due to Australian national greenhouse gas accounting methods, we will be simplifying LULUCF emissions to forestry emissions only
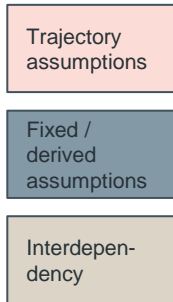
Trajectory assumptions

Fixed / derived assumptions

Interdependency

Cattle grazing land put aside for forestry, Mha

Cropland put aside for forestry, Mha

Land area put aside for forestry Mha

Abatement from carbon forestry, MtCO2e

Forestry emissions, MtCO2e

Deforestation emissions, MtCO2e

Average sequestration rate, tCO2e/Mha

Average sequestration rate, balanced forest, tCO2e/Mha

Share of balanced forest, %

Average sequestration rate, carbon forestry, tCO2e/Mha

Share of carbon forestry forest, %

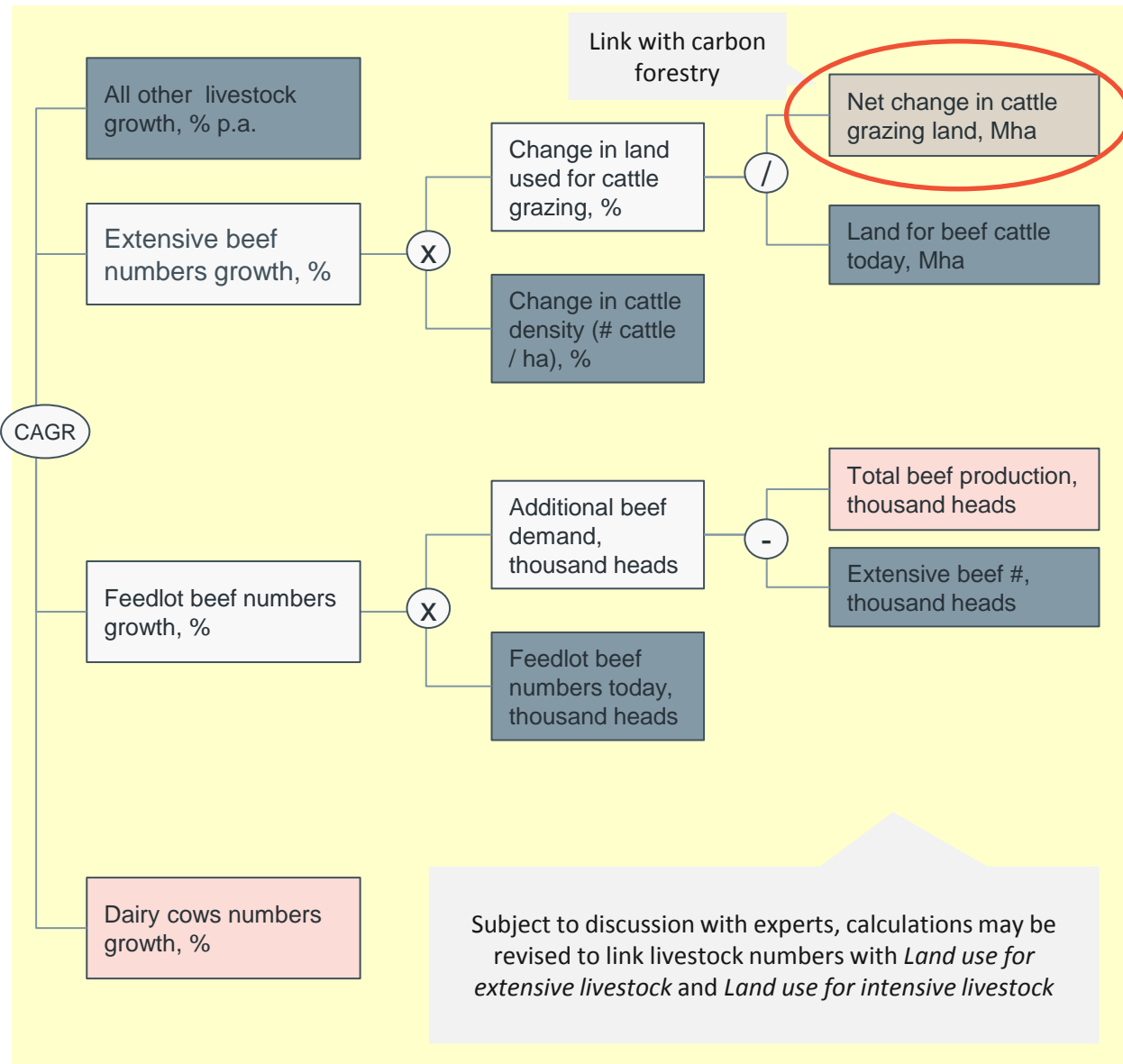In CSIRO's work, balanced forests include 35% mixed native species

Looking at extensive vs intensive beef production due to different emissions intensities and projected growth rates

Enteric emissions intensity growth, % p.a.

2007 average enteric emissions (dairy cows, all others), kgCO2e/head

We will be using 2012 as base year instead

Emissions intensity, enteric, kgCO2e/head

Enteric fermentation (CH₄), MtCO2e

Livestock numbers growth, % p.a.

2007 livestock numbers (dairy cows, all others), thousand heads

Proposed adjustments for **Livestock numbers** on following slide

Livestock numbers, thousand heads

Trajectory assumptions

Fixed / derived assumptions

Interdependency

Agricultural emissions, Enteric fermentation emissions (con't)

Bioenergy, wood arising, new forest

Trajectory assumptions

Fixed / derived assumptions

Interdependency

Link with carbon forestry

(see LULUCF section)

Cattle grazing land put aside for forestry, Mha

Cropland put aside for forestry, Mha

New forest area, Mha

Yields base year, wood from managed forests, odt/ha

Forestry arisings, new forests (million odt)

X

Yield Intensity, wood from managed forests, odt/ha

X

Yield Growth, wood from managed forests, % p.a.

Energy from wood arising, new forest (TWh)

X

Fraction collected, forestry arisings collection, new forests %

Proposed addition for Australia (structure TBD)

Energy content / calorific value, wood (TWh/ Million odt) – base year
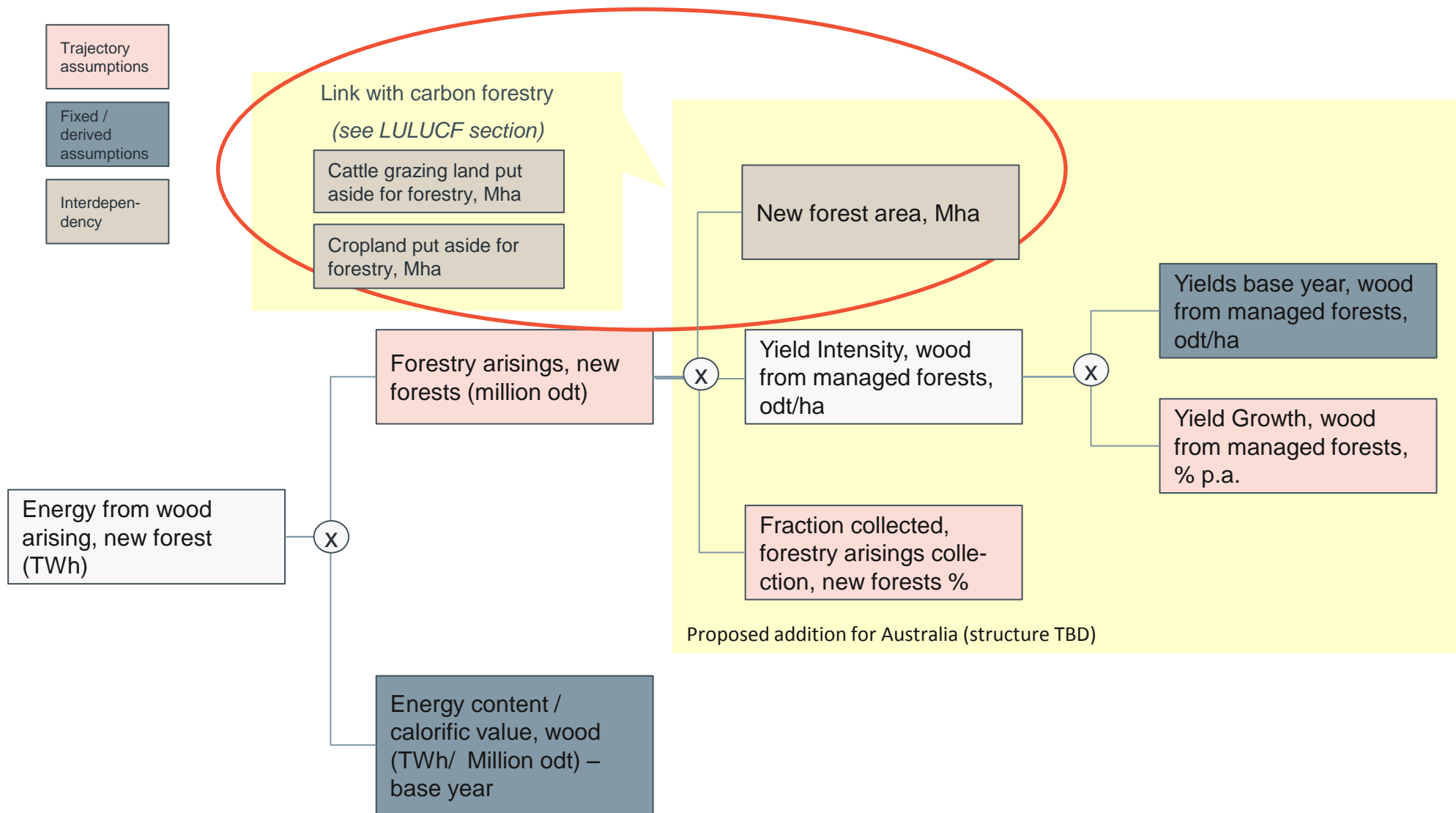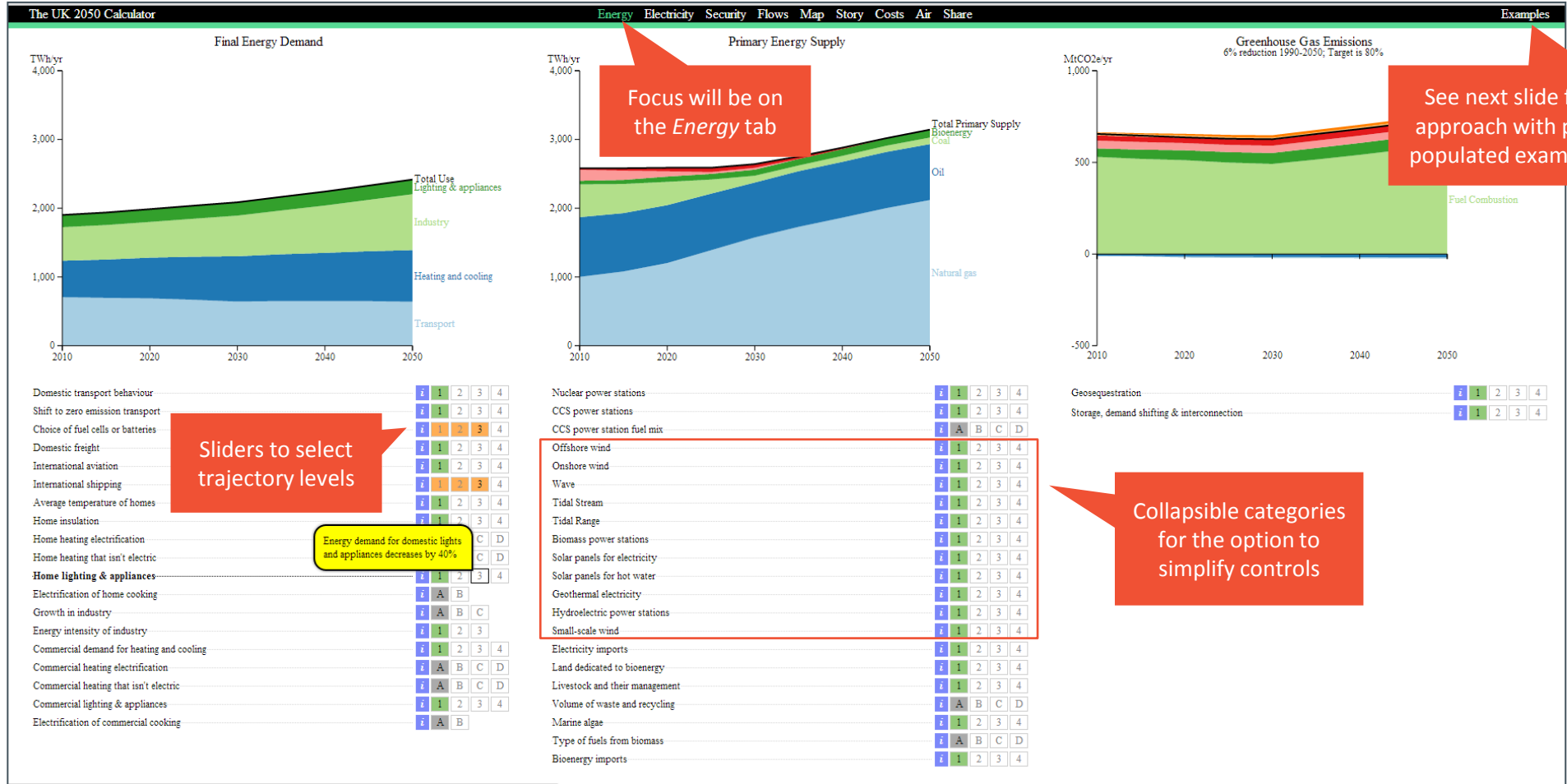
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1. Project context

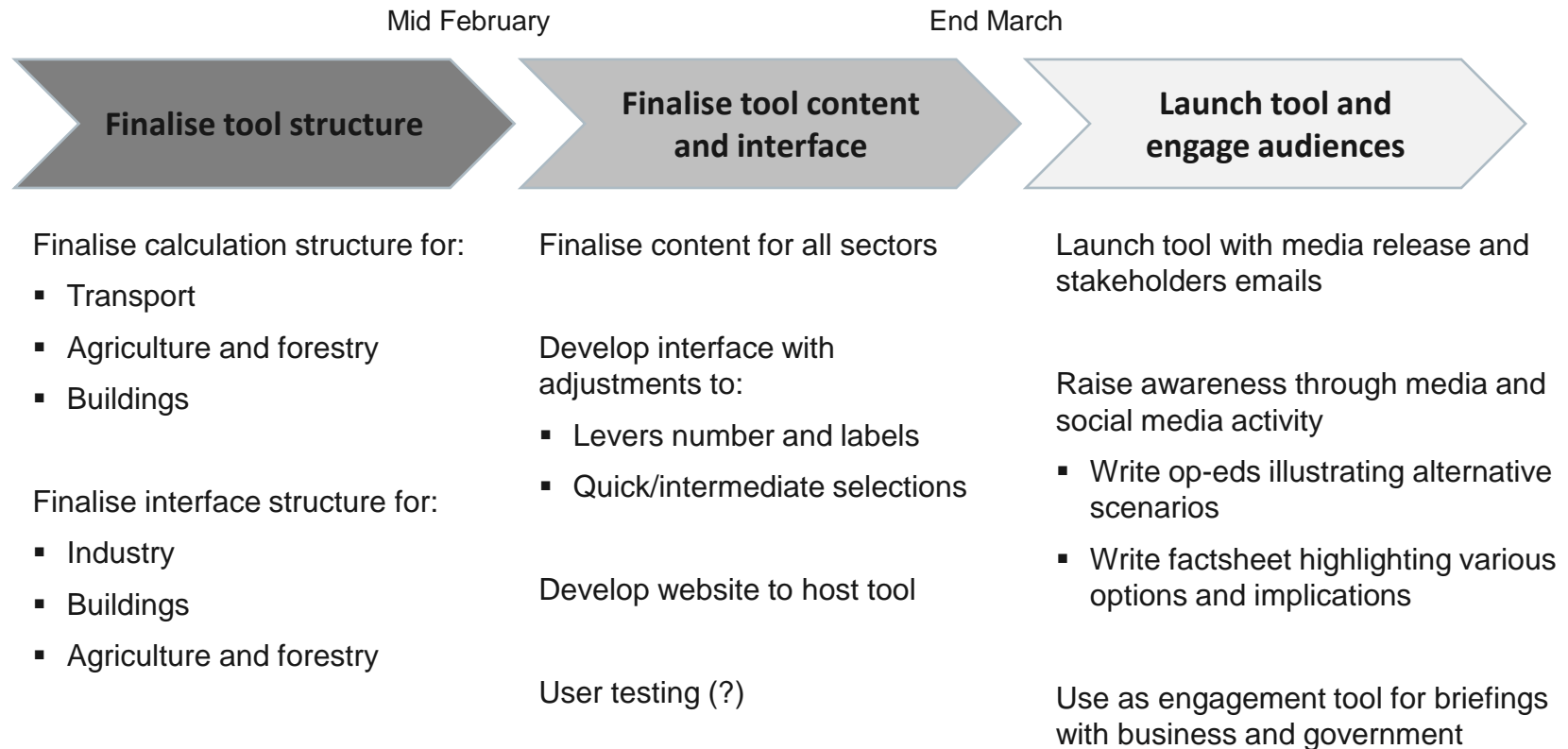2. Land use and Agriculture

3. Next steps

We are planning to make minor adjustments to the interface to improve the user experience
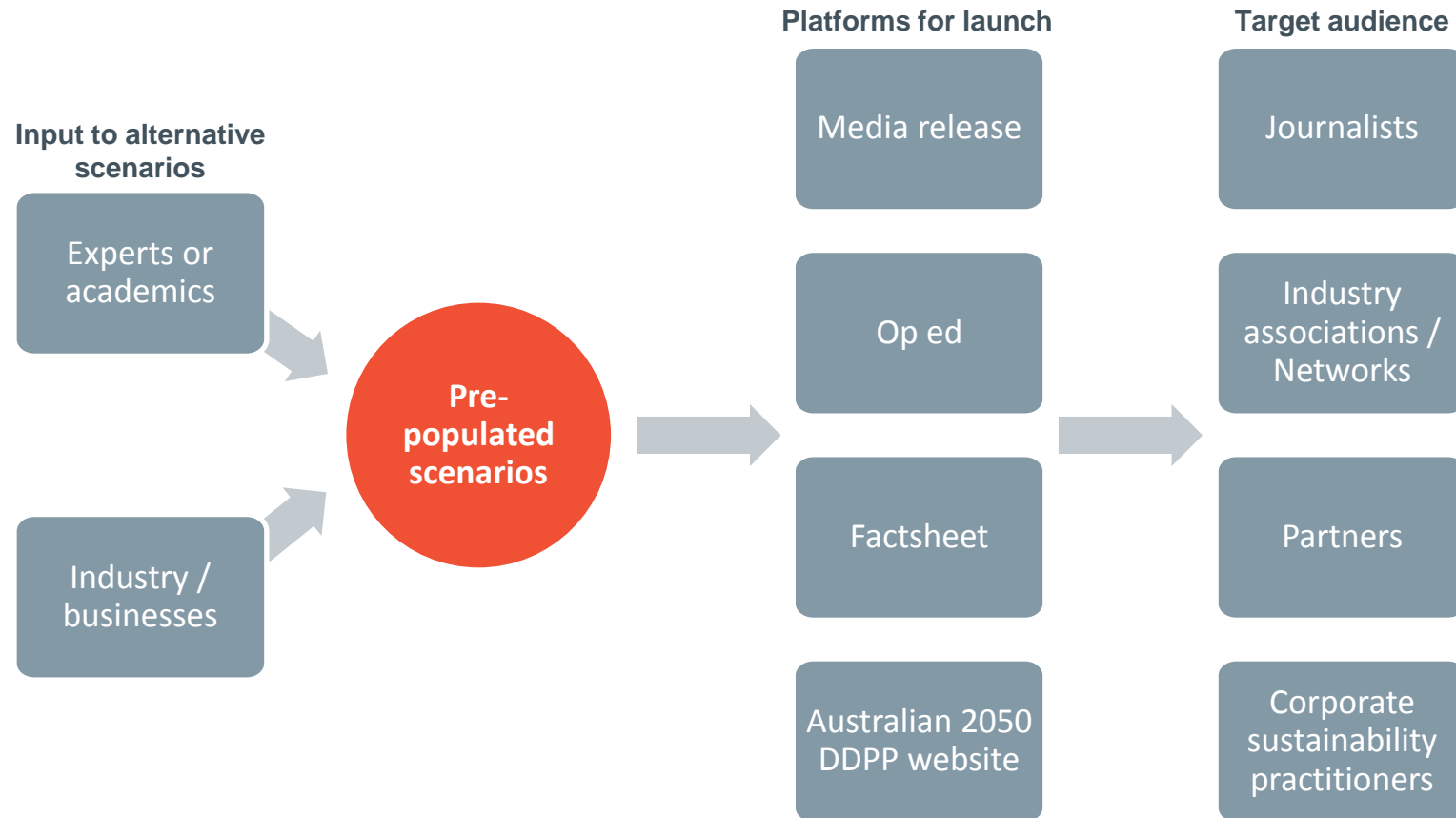
Introduce structure (e.g. left to right, top to bottom) to help users navigate the page

Focus will be on the *Energy* tab

See next slide for approach with pre-populated examples

Sliders to select trajectory levels

Collapsible categories for the option to simplify controls

We are currently aiming to deliver a first version of the tool at the end of March, and start engaging soon afterwards

Mid February   End March

Finalise tool structure	Finalise tool content and interface	Launch tool and engage audiences

Finalise calculation structure for:

- Transport
- Agriculture and forestry
- Buildings

Finalise interface structure for:

- Industry
- Buildings
- Agriculture and forestry

Finalise content for all sectors

Develop interface with adjustments to:

- Levers number and labels
- Quick/intermediate selections

Develop website to host tool

User testing (?)

Launch tool with media release and stakeholders emails

Raise awareness through media and social media activity

- Write op-eds illustrating alternative scenarios
- Write factsheet highlighting various options and implications

Use as engagement tool for briefings with business and government

Our proposed launch strategy for the 2050 Calculator will build on a few pre-populated alternative scenarios

Input to alternative scenarios
- Experts or academics
- Industry / businesses

Pre-populated scenarios

Platforms for launch
- Media release
- Op ed
- Factsheet
- Australian 2050 DDPP website

Target audience
- Journalists
- Industry associations / Networks
- Partners
- Corporate sustainability practitioners

FOR FURTHER INFORMATION:

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APPENDIX

1. Bioenergy supply

2. Combustion emissions

3. Agricultural emissions

4. LULUCF emissions

Bioenergy supply

- Factoring in profitable land shift to **carbon forestry** in determining amount of new forestry arising for **Wood arising, new forest**

- Linking **Energy from manure** with **Emissions from manure management**

- Simplified calculations for:

    - Biocrops (first and second gen)
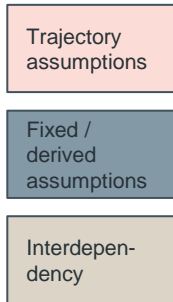
    - Straw waste

    - Wood arising, old forest
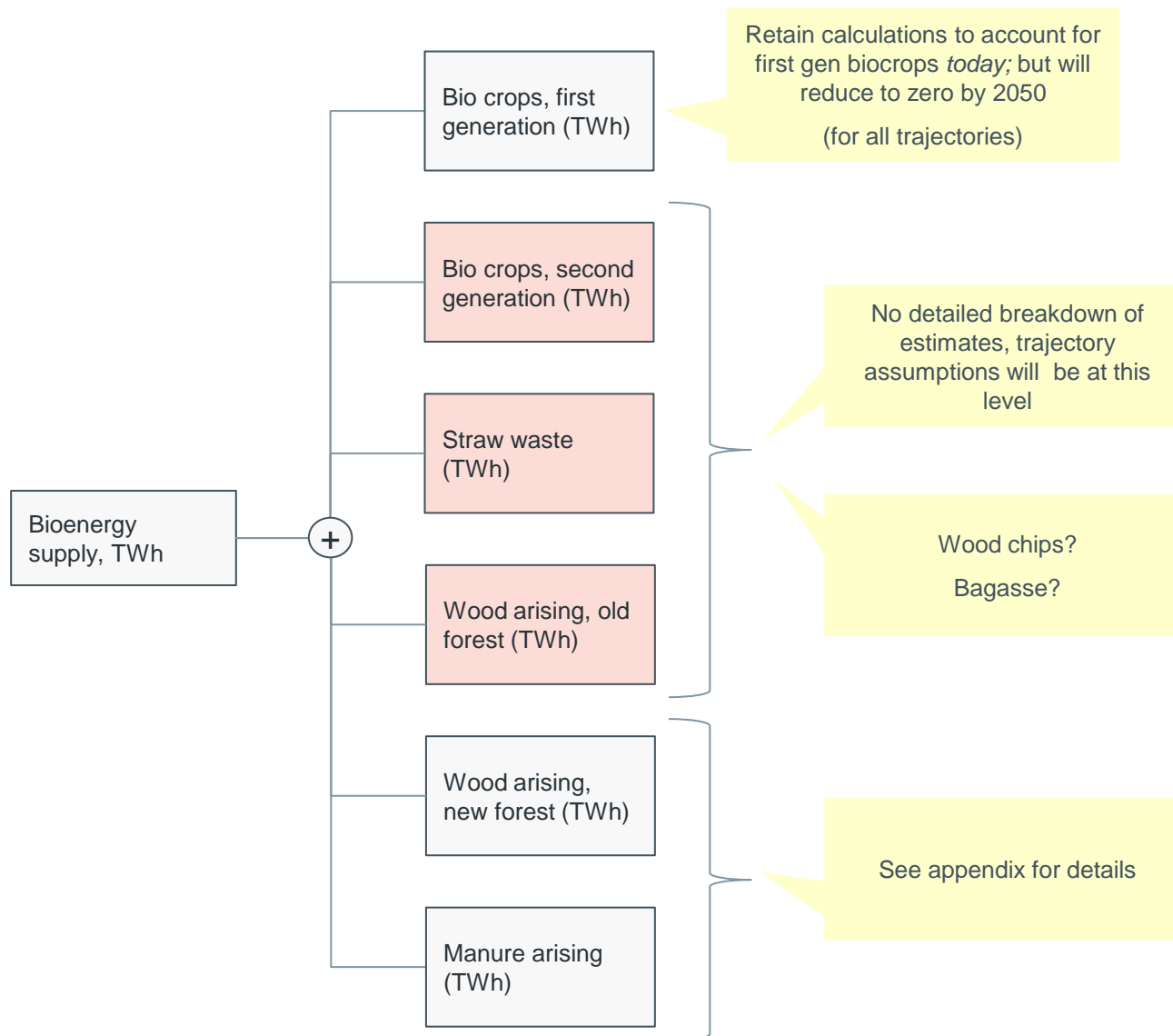
Combustion emissions

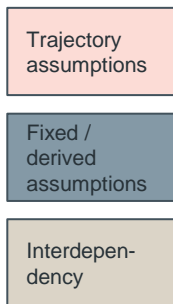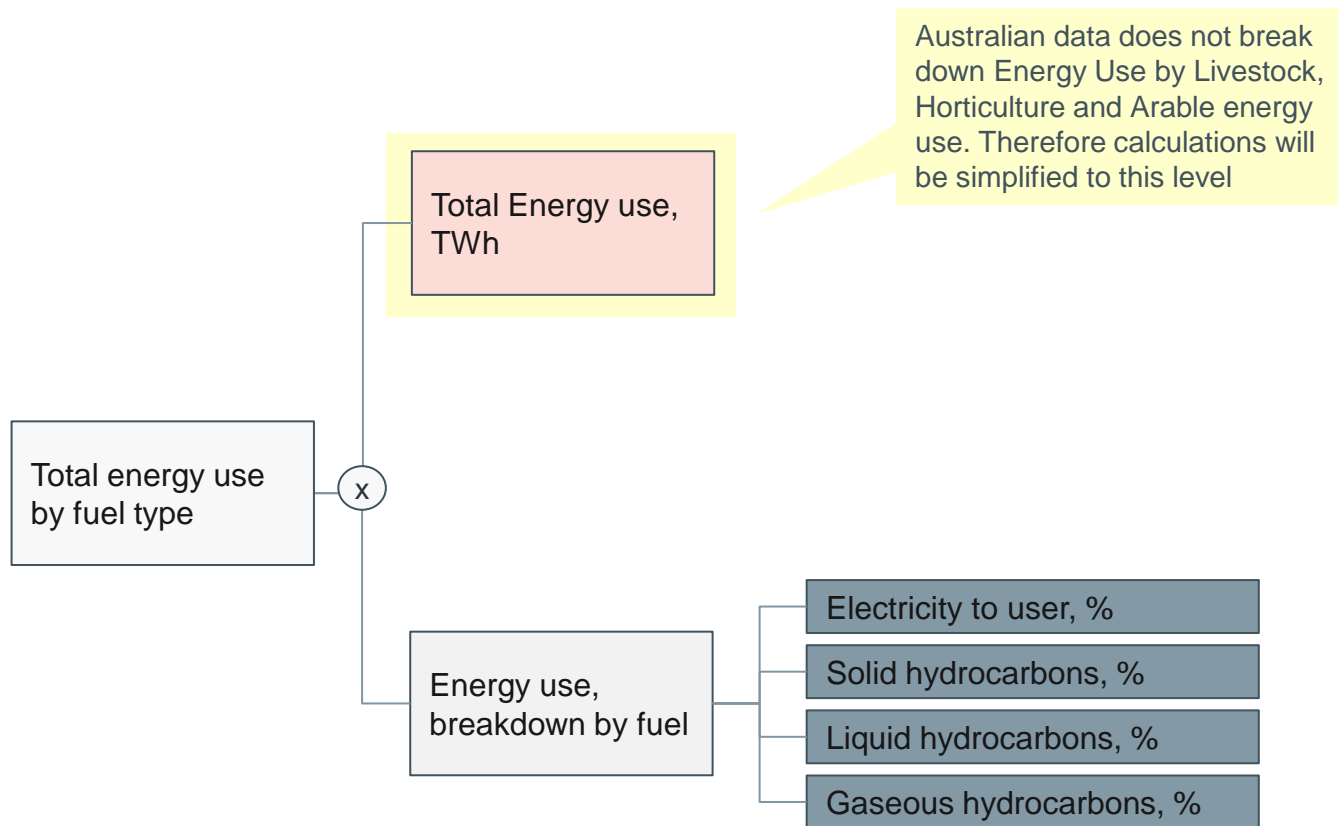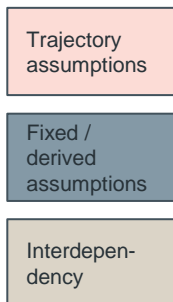# Bioenergy, wood arising, new forest
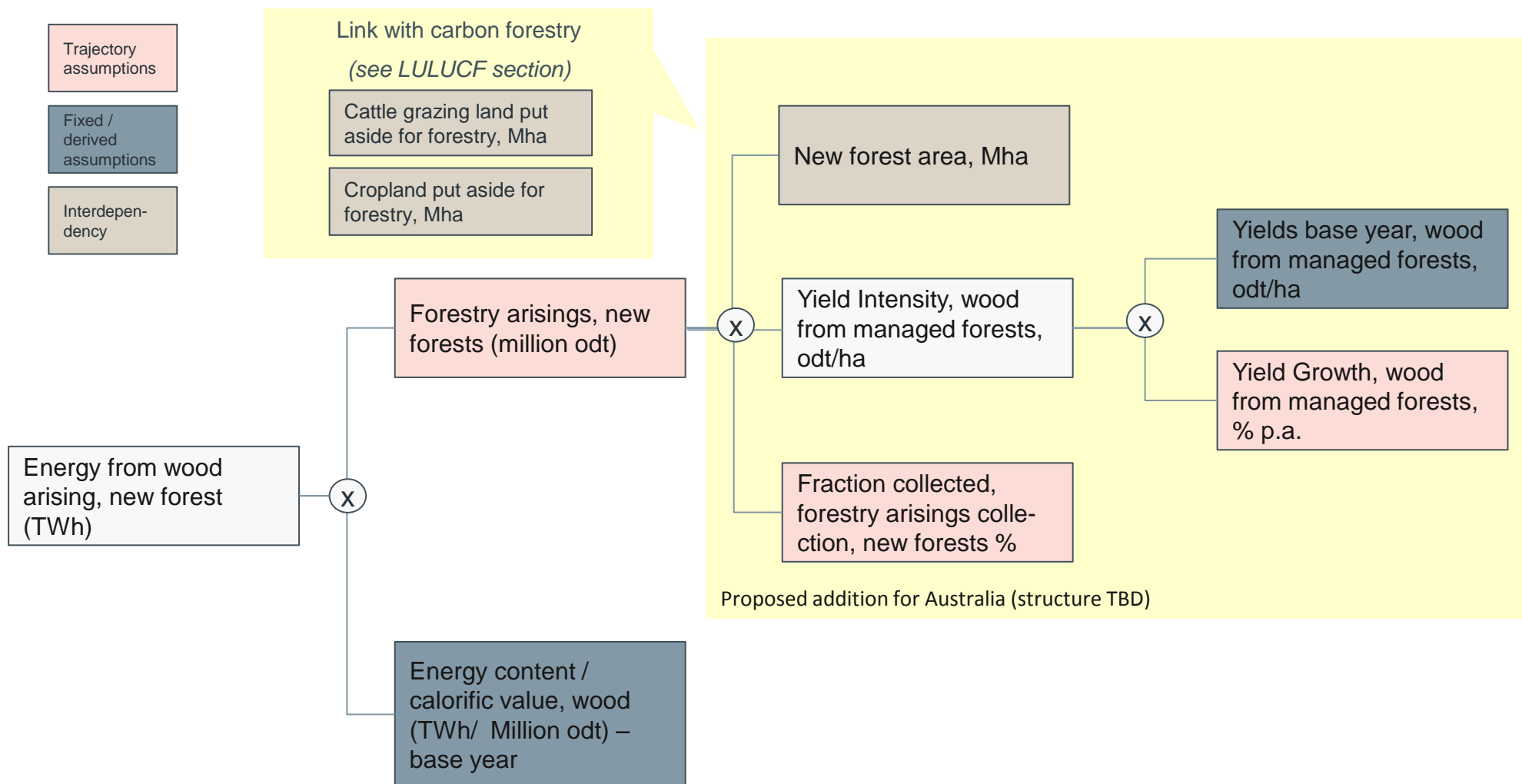
Bioenergy, manure arising
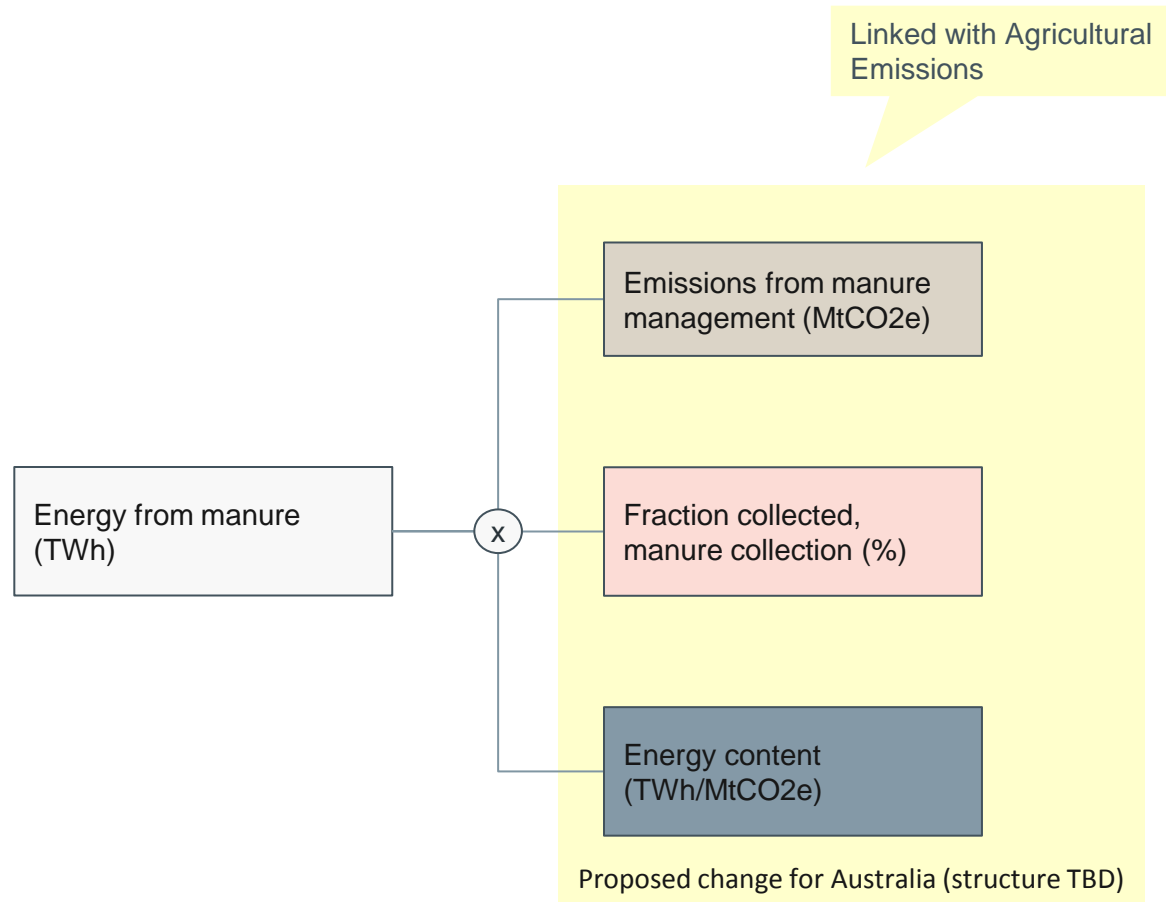
Trajectory assumptions

Fixed / derived assumptions

Interdependency

Linked with Agricultural Emissions

Energy from manure (TWh)

x

Emissions from manure management (MtCO2e)

Fraction collected, manure collection (%)

Energy content (TWh/MtCO2e)

Proposed change for Australia (structure TBD)

Combustion emissions

APPENDIX

1. Bioenergy supply

2. Combustion emissions

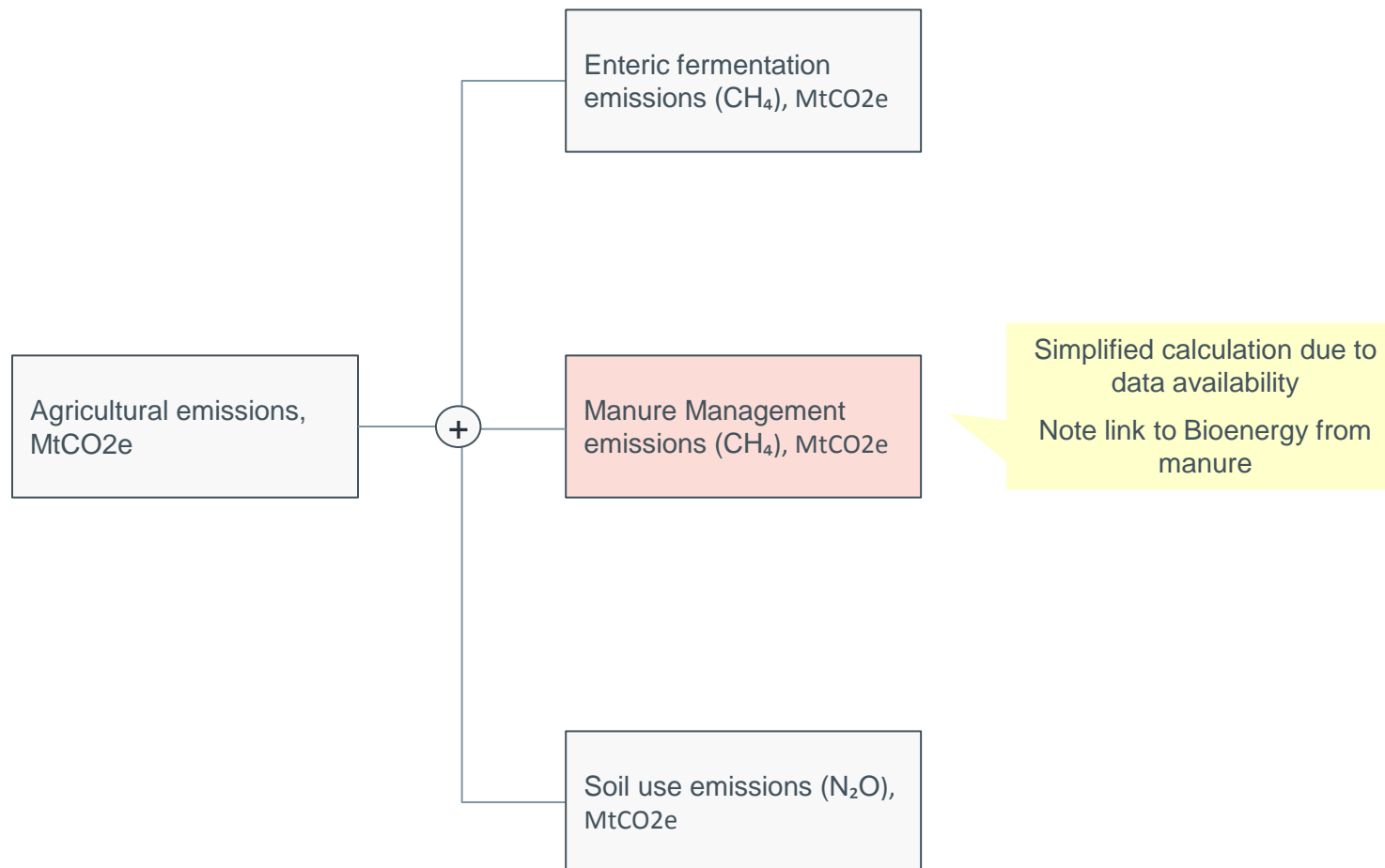3. Agricultural emissions

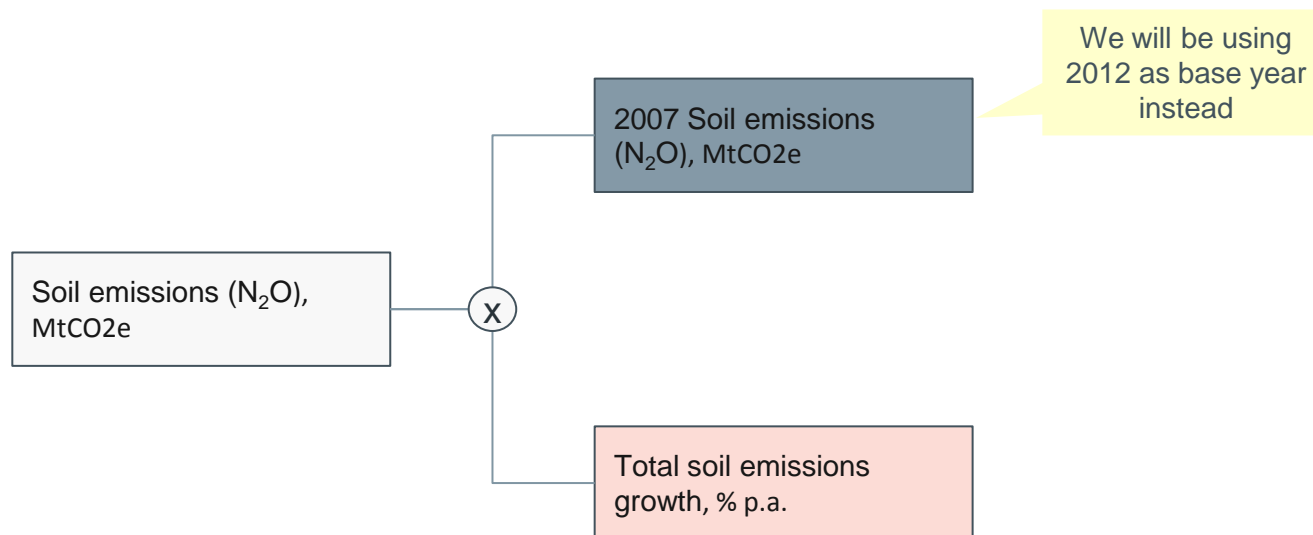4. LULUCF emissions

Agricultural emissions

- More granular estimates of livestock numbers to estimate **Enteric fermentation emissions**

    - Extensive livestock vs Intensive livestock due to different emissions intensities and growth rates

    - Change in cattle grazing land linked with carbon forestry

- Consider the impact of use of nitrogen fertiliser on **Soil emissions**

Agricultural emissions

APPENDIX

1. Bioenergy supply

2. Combustion emissions

3. Agricultural emissions

4. LULUCF emissions

Land use emissions

- Addition of **Carbon forestry** calculations to account for the significant abatement potential in Australia

- Explicit interdependencies between Carbon forestry and Agricultural emissions

- Removed calculations for other types of land uses due to different carbon accounting methods in Australia