

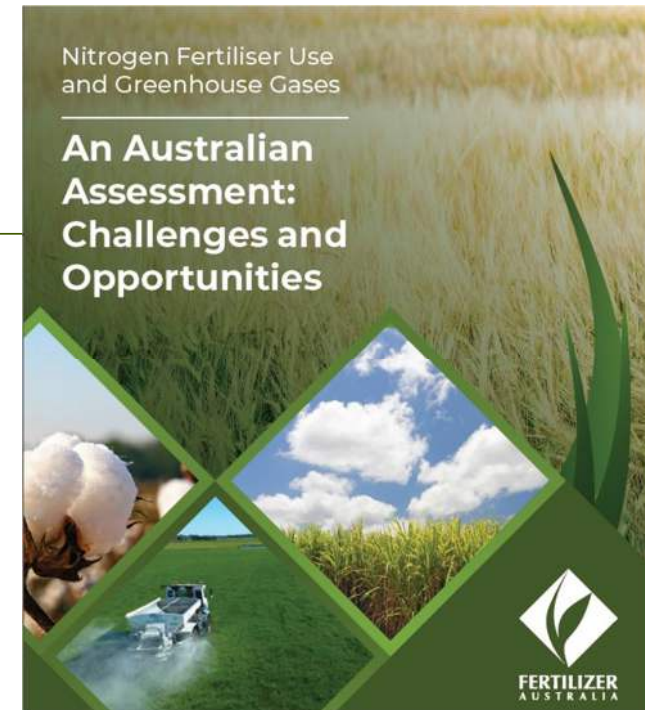
# An Australian assessment of nitrogen fertilizer inputs, efficiencies and gaseous losses.

Cameron Gourley and Jeff Kraak



# Presentation overview

- Australian farming landscape and role of nitrogen
- Nitrogen use efficiency
- International comparisons with cereal Prdn
- GHG emissions associated with nitrogen
- Policy options to improve NUE and reduce nitrogen losses

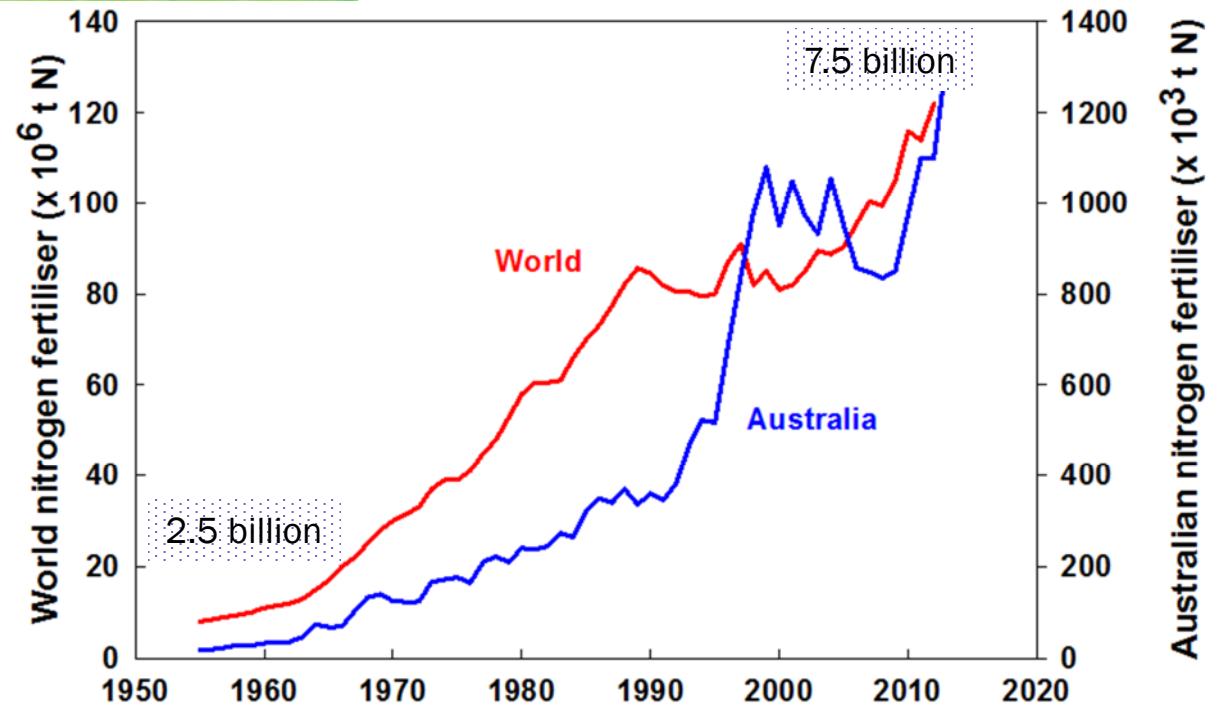
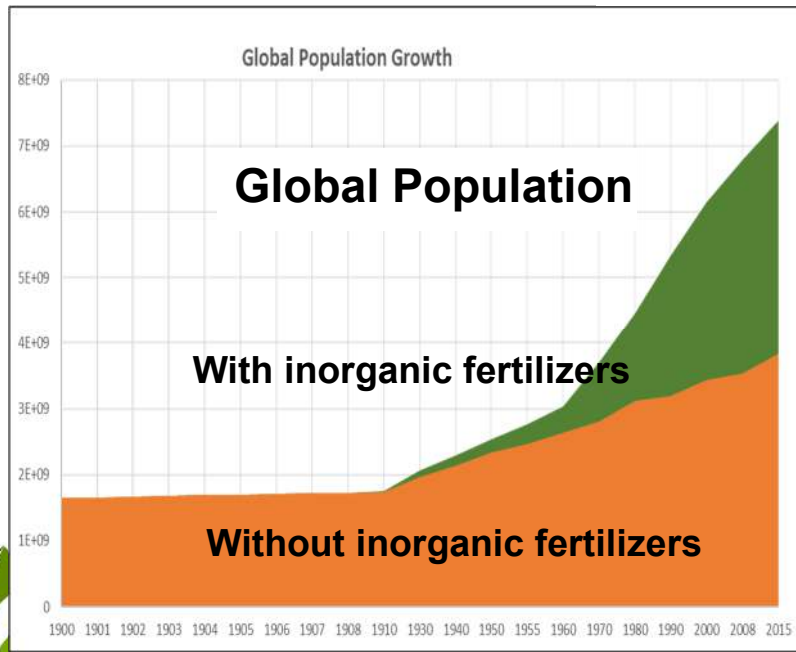


- Robert Norton
- Cameron Gourley
- Peter Grace
- Jeff Kraak

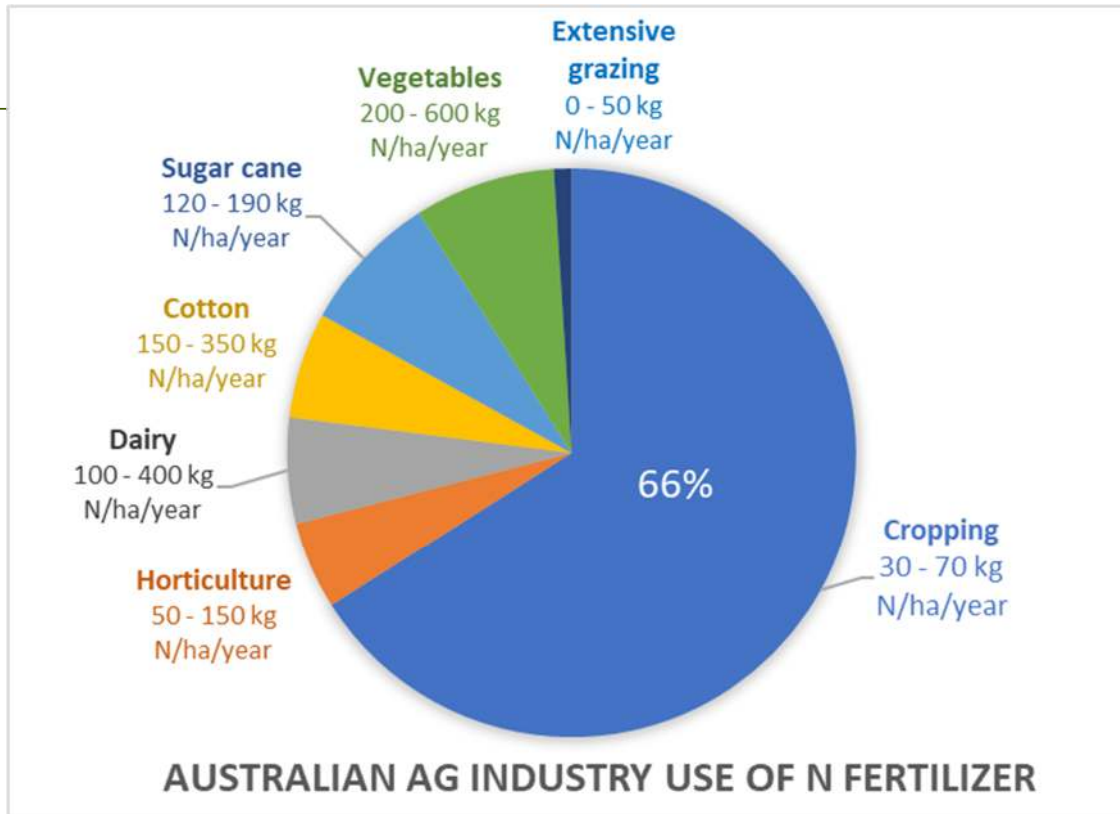


# “Fertiliser use is both essential and problematic”

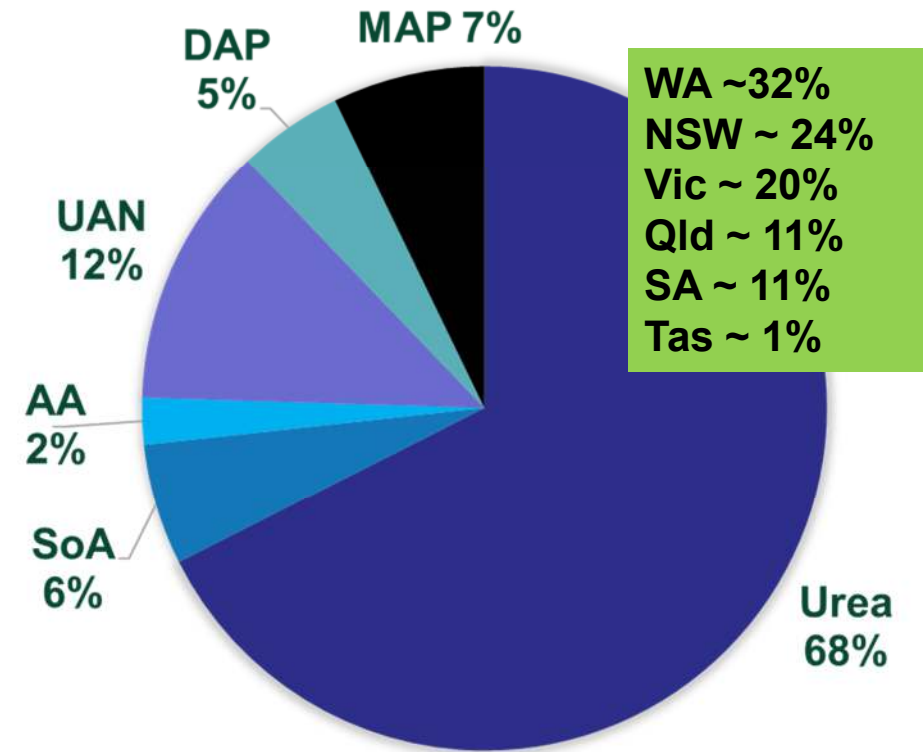
Davidson et al 2015



# Australian agricultural industries



1.6Mt N /year



### 1. Agronomic N efficiency (partial factor productivity)

➤ = kg grain / kg N applied

### 2. Recovery N efficiency (Response to applied N)

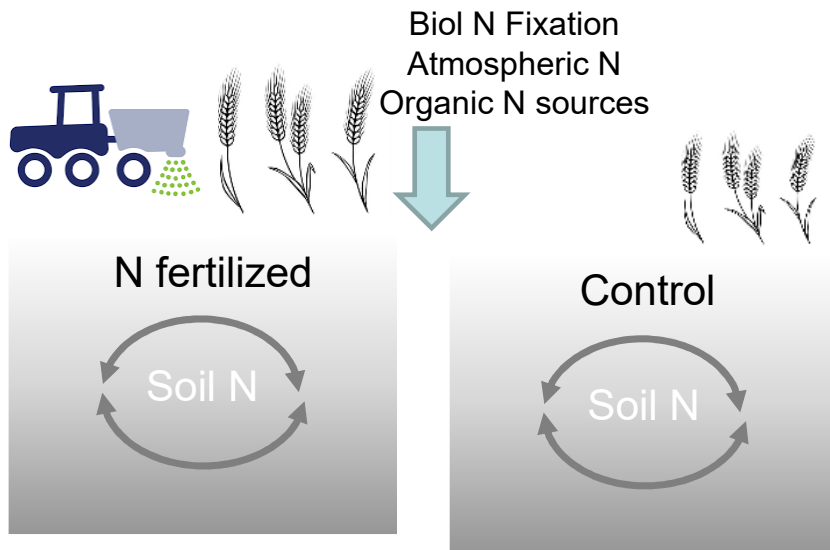
- Requires a control treatment
- = (kg N in grain<sub>Nfert</sub>) – (kg N in grain<sub>control</sub>) / kg N applied

### 3. Partial N balance (Removal to Use ratio)

- = kg N in grain / kg N applied
- Values around 1 (system sustainability)

### 4. System N balance (Output to input ratio)

- = (Σ (N outputs) / Σ (N inputs))



## Nitrogen use efficiency - *fit for purpose*



Scientifically supported



Farmer friendly & understandable



Provides clear guidance



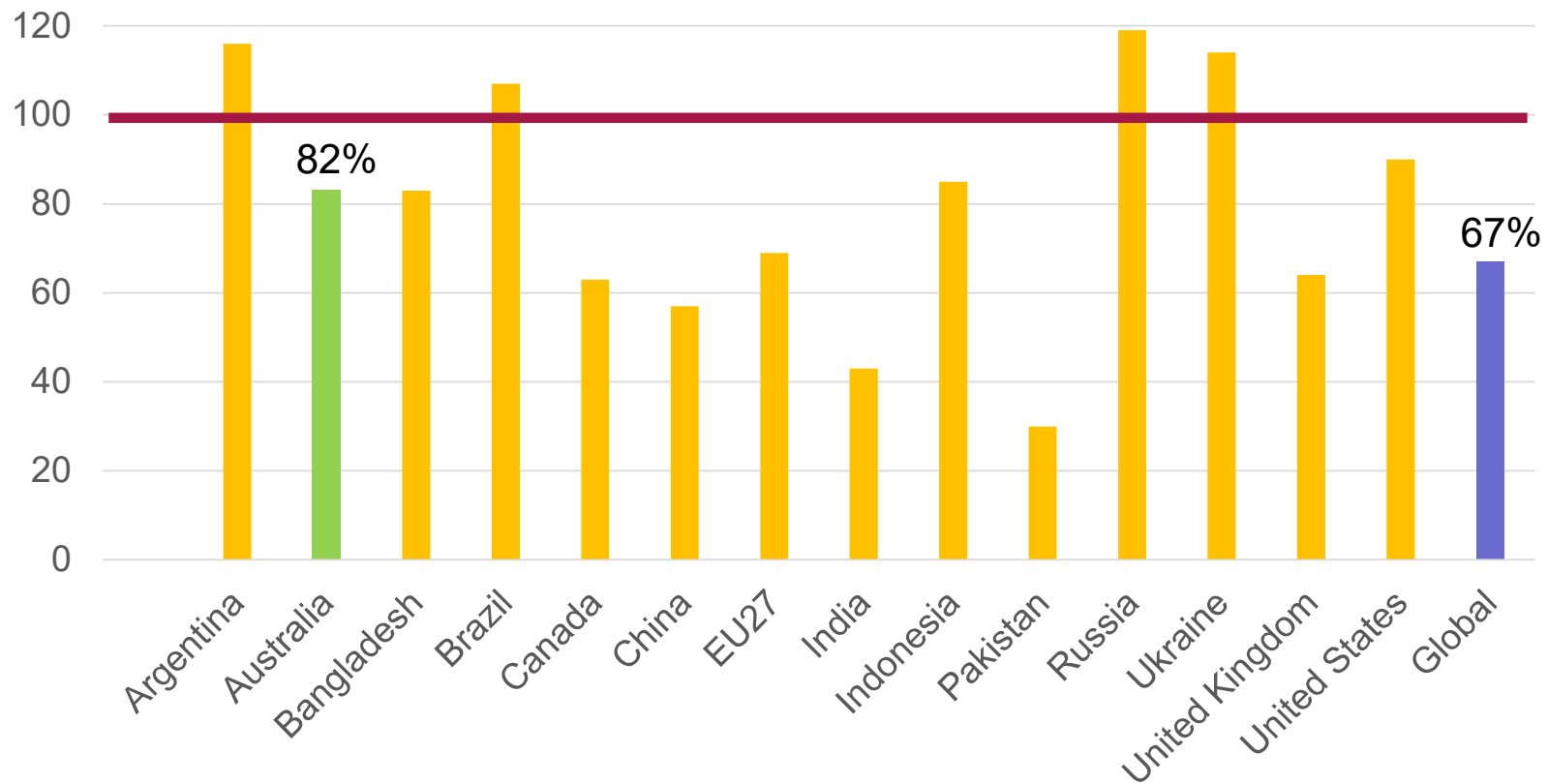
Benchmarks performance



Regularly reviewed and updated when necessary

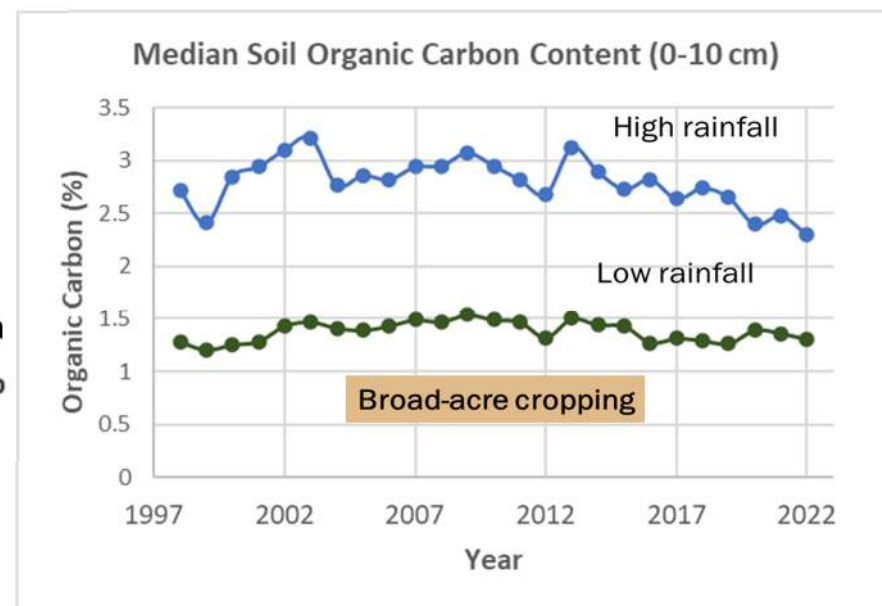
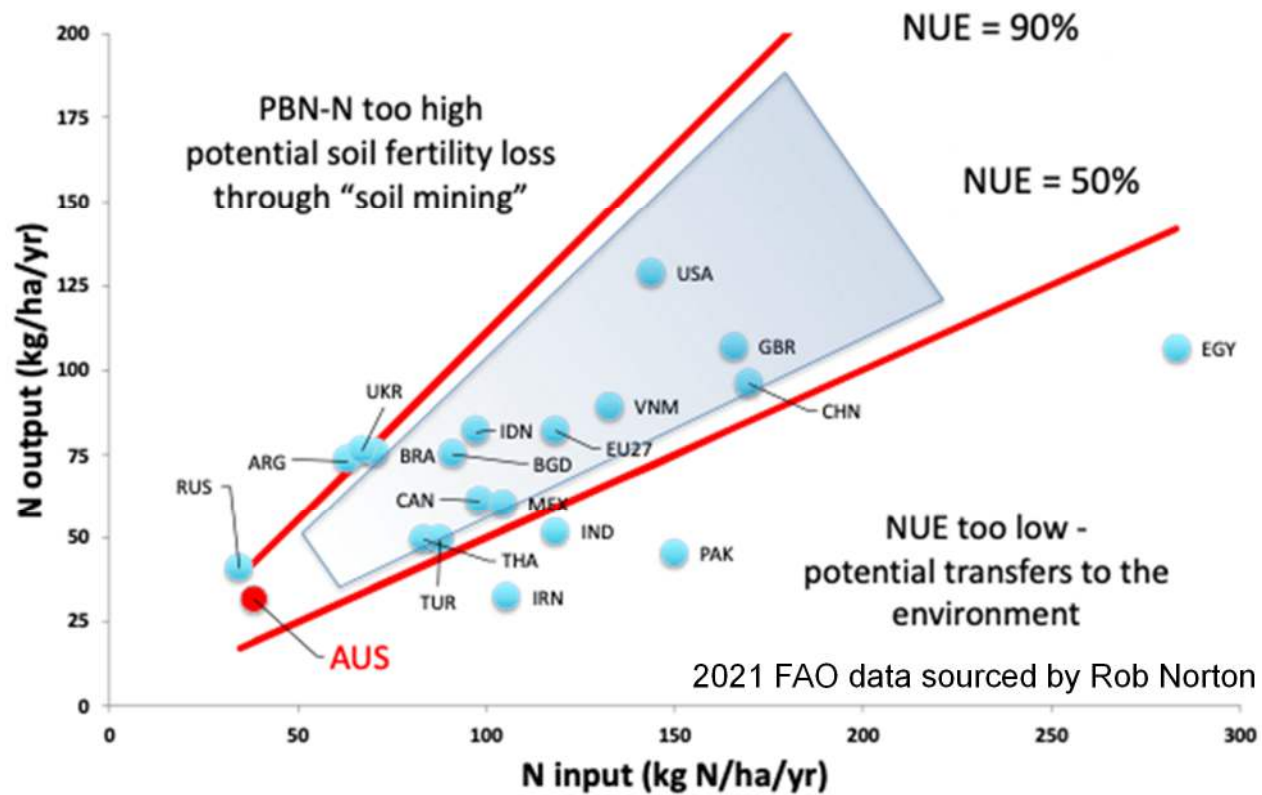


# Partial N Balance for major cereal producing countries (kg N grain /kg N fertiliser)



IFA Fertilizer Use By Crop Report, 2023, reporting for 2018.

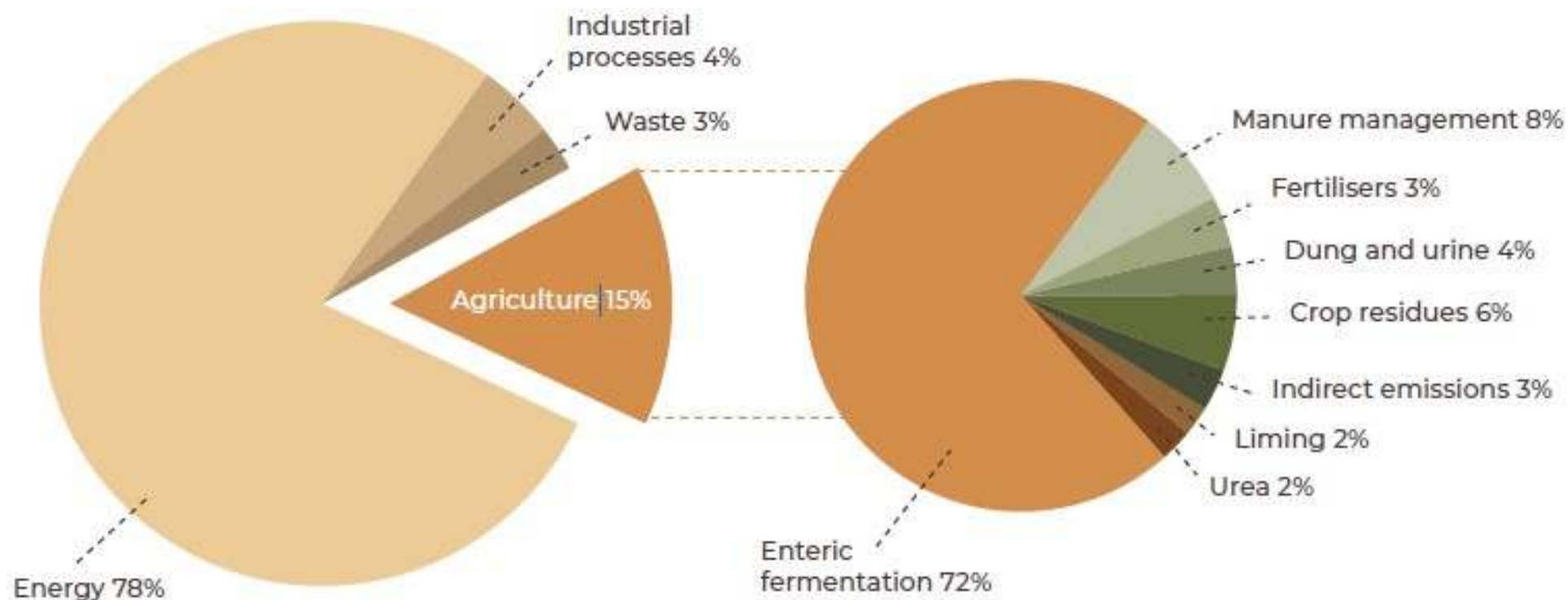




Long-term soil monitoring data SE WA, provided by A Neuhaus

# Current Australian GHG situation

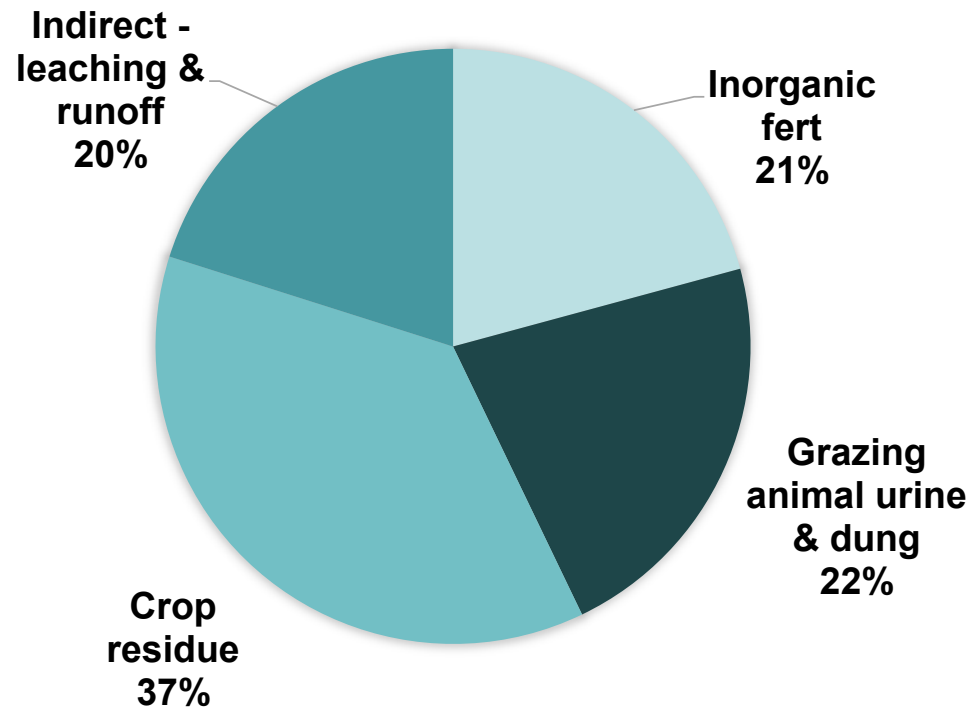
➤ Net GHG emission 464.8 Mt of CO<sub>2</sub>e - Ag sector: 74.6 Mt



# Australian nitrous oxide sources

Ag contributes 79% of total N<sub>2</sub>O emissions

## NITROUS OXIDE - AG



# Australian N fertilizer emission factors

Production system	Current EF (%)
Low rainfall (< 600mm)	0.29
High rainfall (> 600mm)	0.80
Irrigated cropping	0.62
Irrigated pasture	0.59
Non-irrigated pasture	0.17
Cotton	0.53
Sugarcane	1.77
Horticulture	0.63



# Current Aust N<sub>2</sub>O regulations

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- N<sub>2</sub>O regulated under National Greenhouse and Energy Report (NGER)
- NGER has a strong focus on businesses with large emissions
- Emission Reduction Fund (ERF) – N<sub>2</sub>O reduction irrigated cotton



# Levers to pull to enhance nutrient performance

- use of organic sources (composts, manures, residues)
- maximise biological N fixation (rotation/inoculation)
- use Enhanced Efficiency Fertilisers to manage loss processes.



- rate matched to demand of the crop
- dynamic simulation modelling of crop demand
- slightly lowering rates has a small effect on yield, but large effect on loss processes eg GHG, Leaching, acidification.
- include other sources – mineralisation/immobilisation.

- match timing of N by split applications –
  - soil or foliar applied
  - avoid times when losses are likely to be high.

- place where roots are active
- use paddock zones rather than blanket rates – soil or plant assessed.
- application to meet the target rate.

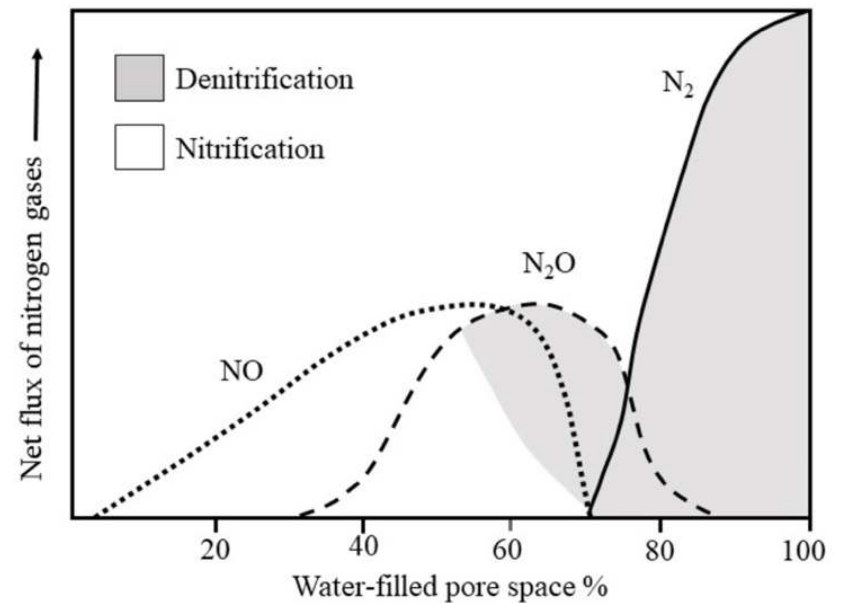


## Managing denitrification risks by addressing the three main drivers:

1. the amount of labile carbon in the soil
2. the soil moisture content
3. the amount of nitrate in the soil



FERTILIZER AUSTRALIA



# Fert Aust Policy recommendations

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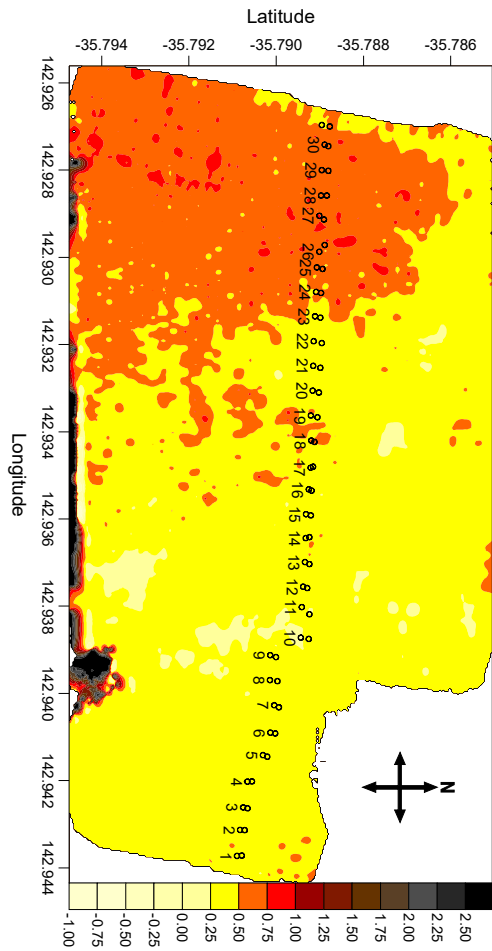
- encourage greater use of soil and plant testing
- encourage greater adoption of precision agriculture tools
- encourage use of N inhibitors
- formally assess the effectiveness and risks associated with inhibitors



# Increased use of soil and plant testing



# Encourage precision agriculture



# Encourage N inhibitor use

- nitrification inhibitors can reduce  $N_2O$  by up to 79%
- estimated 1.13 Mt  $CO_2e$  if all urea was treated
- cost of treatment is often greater than the benefit for many growers
- Gov pays for  $N_2O$  reduction to business that treats the N fert
- value passed onto grower in reduced cost of treated N fert



# Grower benefits

- Easy
- Immediate
- Low risk
- Able to claim N<sub>2</sub>O abatement in emissions footprint of their production.



# Benefits for Australia

- gets the job done
- simplified administration
- easy to verify treatment via audit.



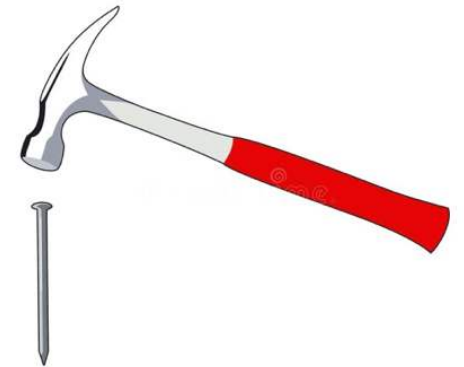
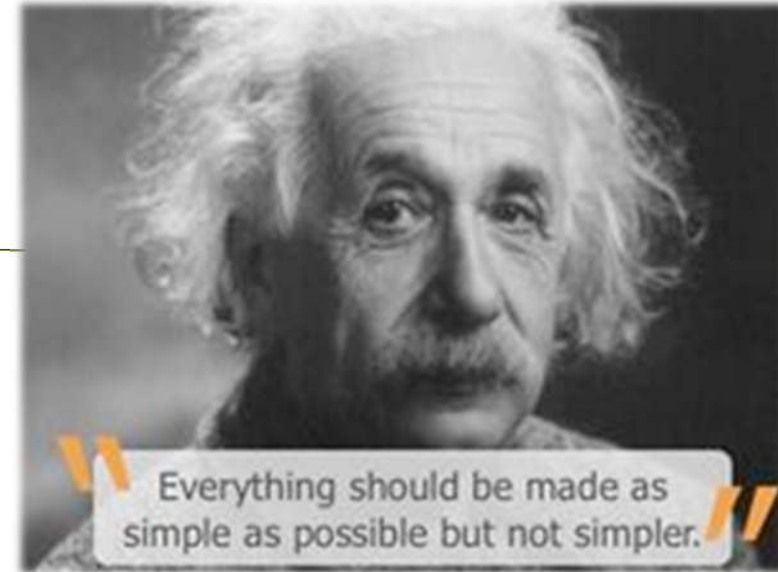
# Assess the effectiveness and risks associated with inhibitors

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- effectiveness to reduce N<sub>2</sub>O
- operator health & safety
- plant safety
- consumer safety and international trade implications
- long-term soil microbial health
- risks to the wider environment e.g. the water quality.

# What are the lessons?

- there are no silver bullets
- integrated nutrient management plans deploy a range of strategies
- strategies need to be collaborative, transparent, economic and practical
- educate and incentivize rather than regulate.



For more details:

