THE UNIVERSITY OF WESTERN AUSTRALIA

Achieve International Excellence

bushfire CRC

Economic analysis of prescribed burning for wildfire management in Western Australia

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The problem

Resource allocation

Pre-fire stage (i.e. prescribed burning)

The problem

Resource allocation

Pre-fire stage (i.e. prescribed burning)

During fire (suppression)

The problem

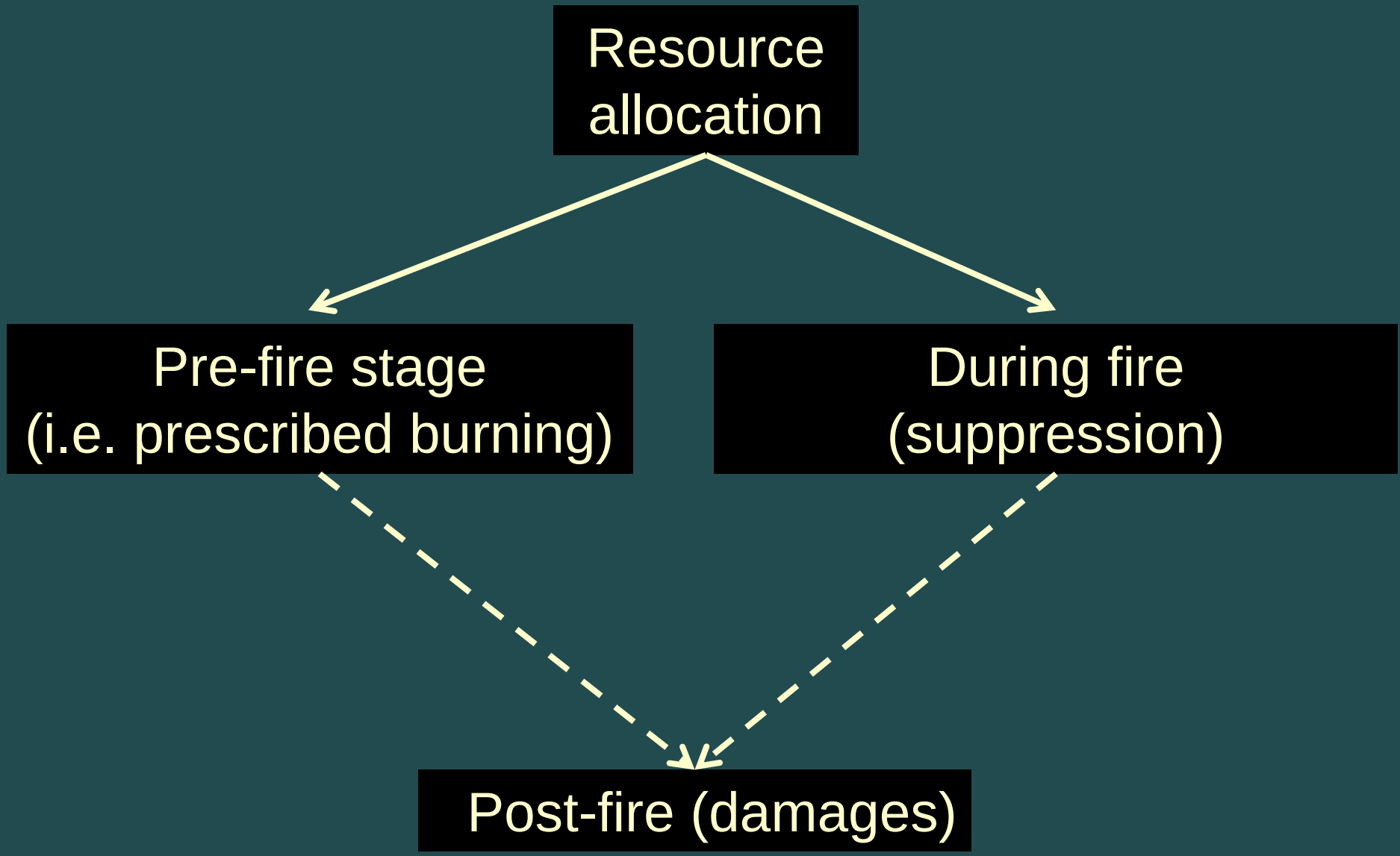
Resource allocation

Pre-fire stage (i.e. prescribed burning)

During fire (suppression)

Post-fire (damages)

The problem

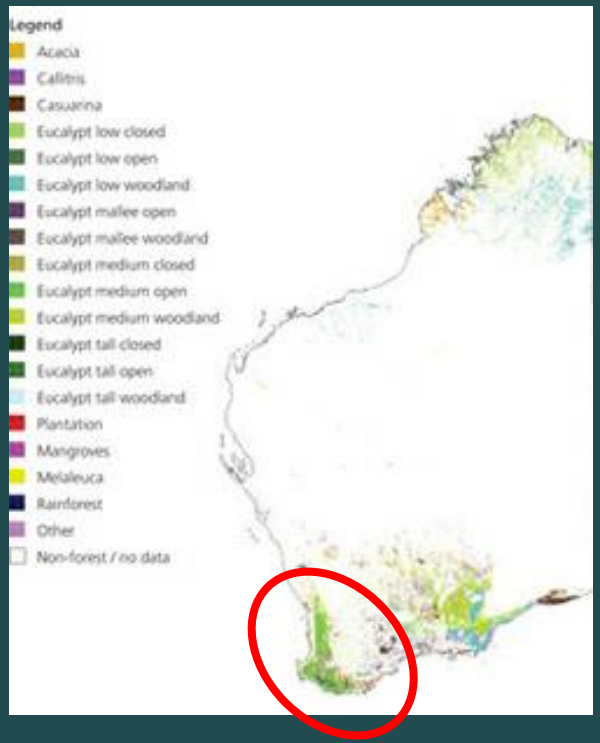

Resource allocation
Pre-fire stage (i.e. prescribed burning)
During fire (suppression)
Post-fire (damages)

Why economics?

- Implications of different uses of resources?
- How do we maximise benefits?
- Resource allocation between fire management activities?
- Trade-offs between different objectives?

South-west Western Australia

Forests



Flammable vegetation

People

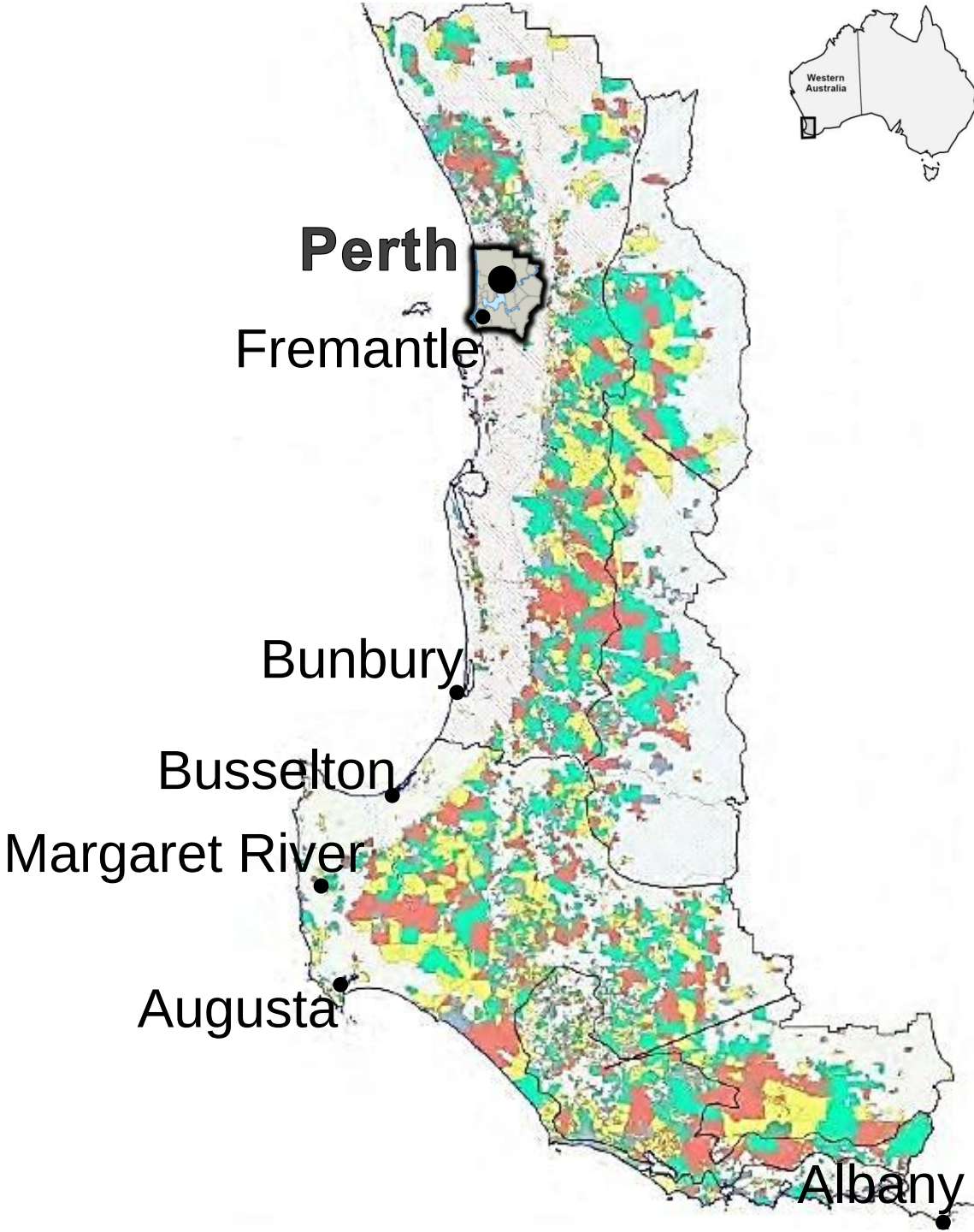
Wildland-urban interface scenario

Biodiversity

Unique flora and fauna

Fuel levels

~60% of south-west Australian forests fuels >7 years



- Regional centres
- 0-4 years
- 5-9 years
- 10-20 years
- 21+ years

Our research

Research goal:

What prescribed-burning strategy minimises the sum of costs and damages?

Evaluate trade-offs between:

Prescribed-burning costs

Suppression costs

Wildfire damages

Our research

Application of an economic model to prescribed burning programs

Cost plus net value change
(Cost-benefit analysis)

AUSTRALIS Bushfire Simulator
(Joel Kelso, Drew Mellor and George Milne)

Our research

Prescribed burning strategy $

↓

Simulate fires (AUSTRALIS Bushfire Simulator)

↓ ↓

Suppression $

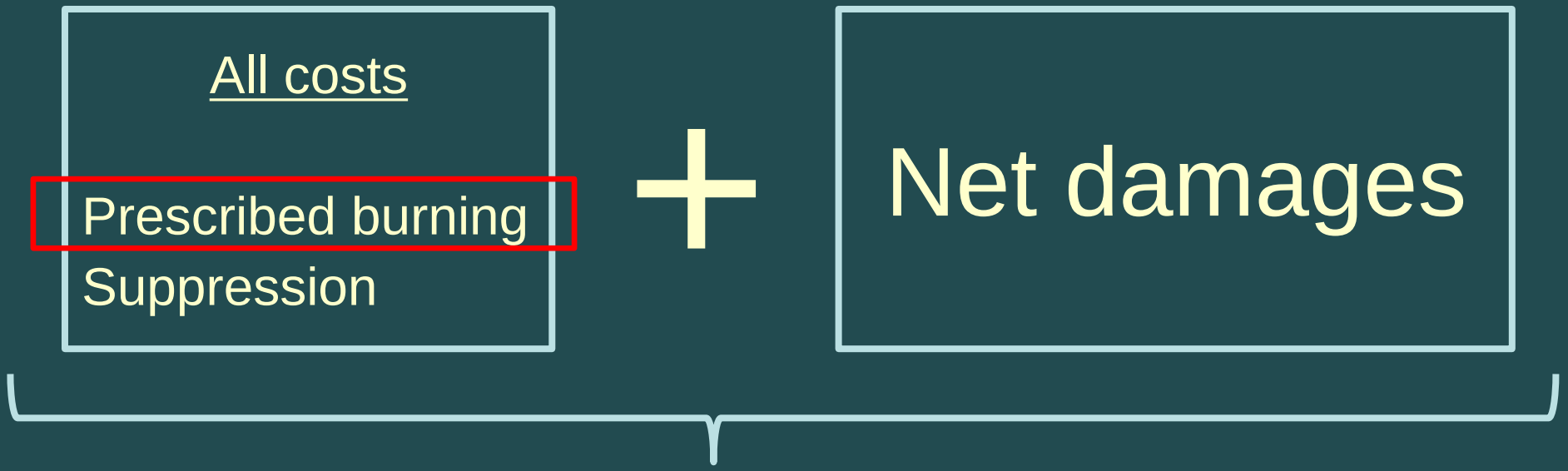
↓

Damages (human and environmental assets) $

Our research

All costs + Net damages

Our research



Our research

Starting with a synthetic landscape

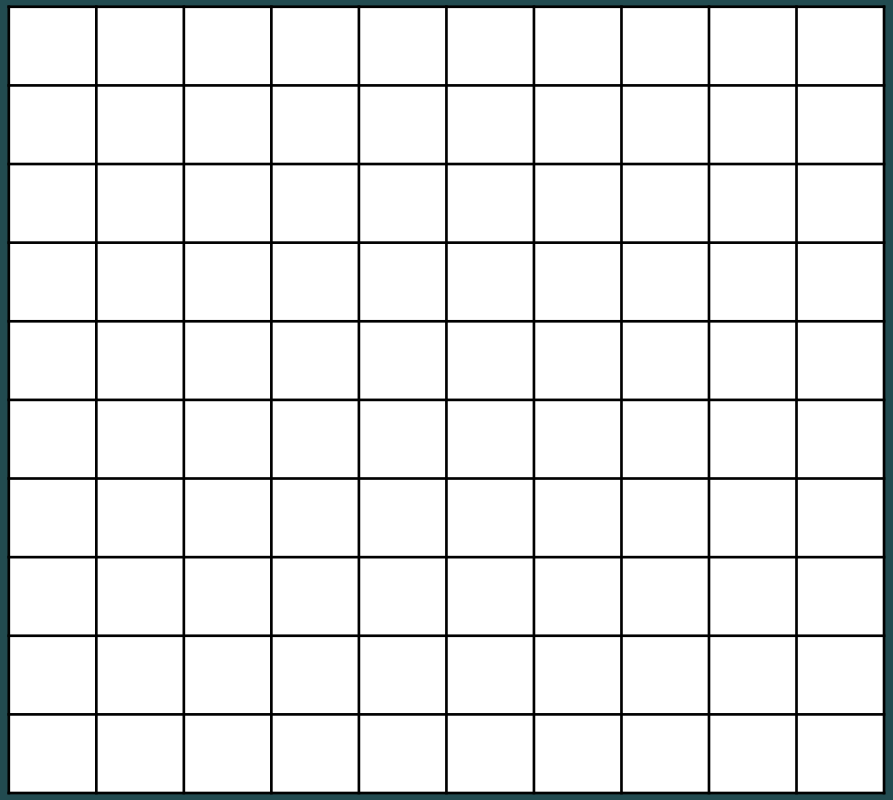
100,000 ha

Homogeneous jarrah forest

Application to a synthetic landscape

Prescribed burning:

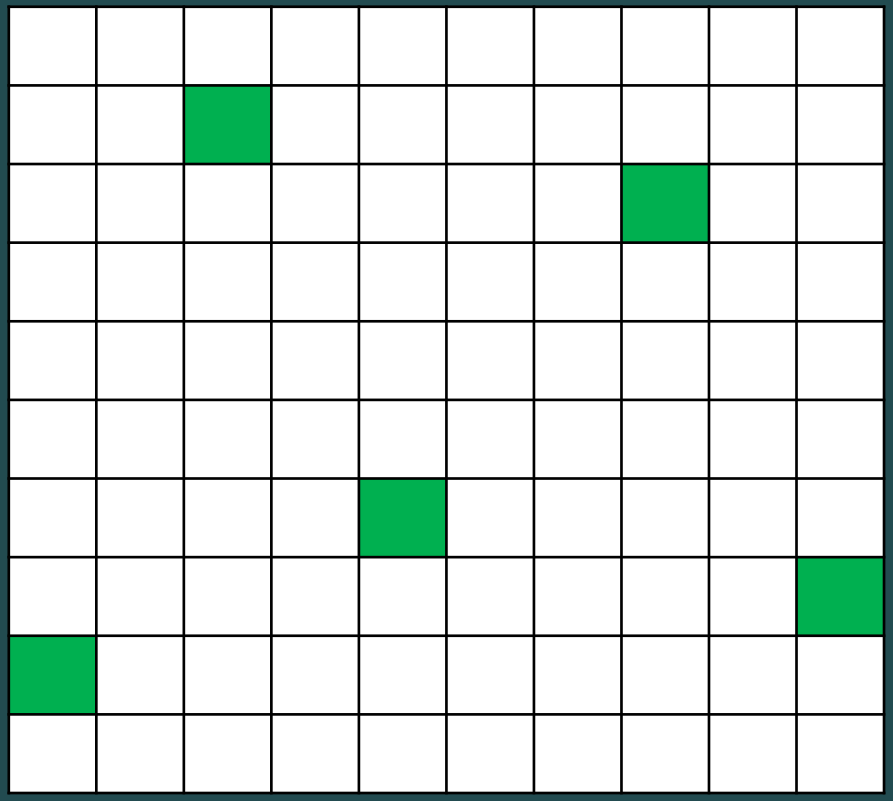
5% landscape/year



Application to a synthetic landscape

Prescribed burning:

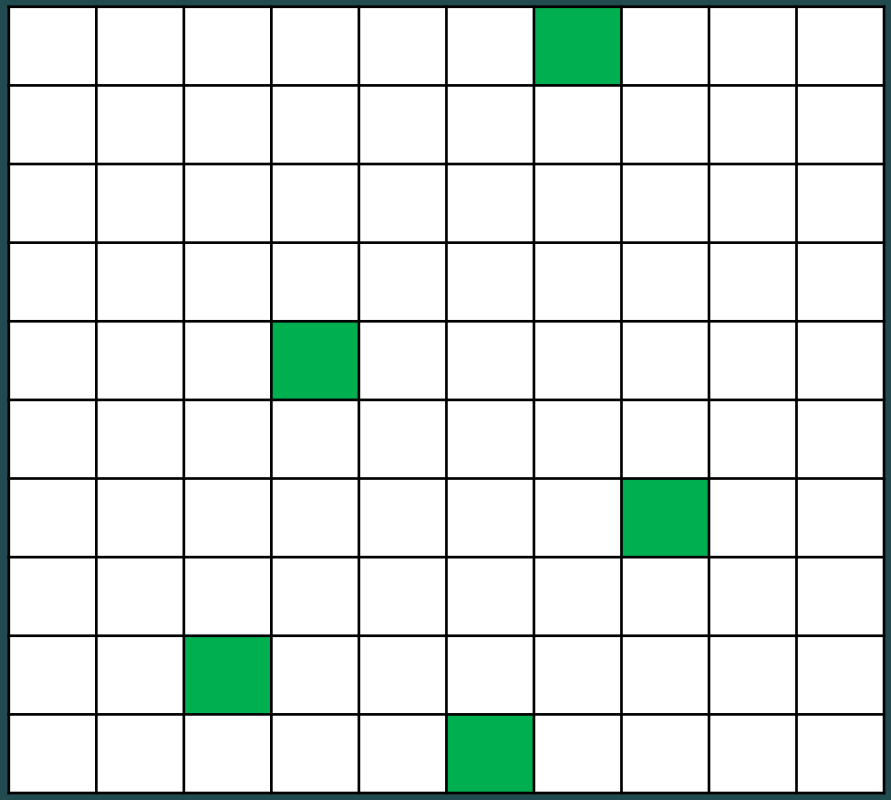
5% landscape/year



Application to a synthetic landscape

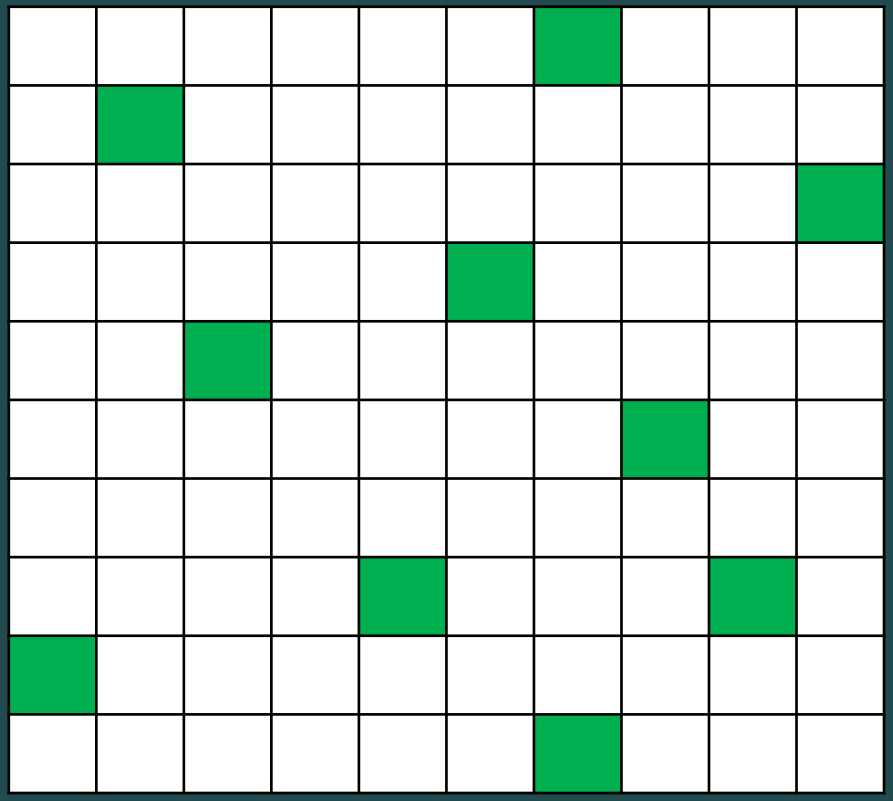
Prescribed burning:

5% landscape/year

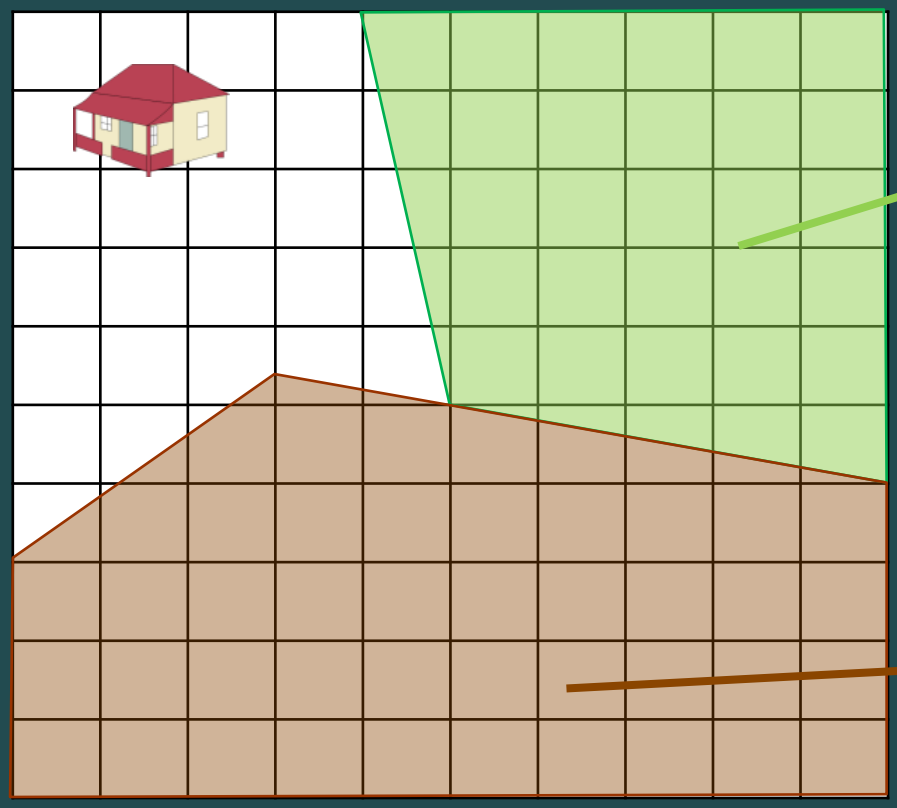


Application to a synthetic landscape

Prescribed burning:
10% landscape/year



Application to a synthetic landscape



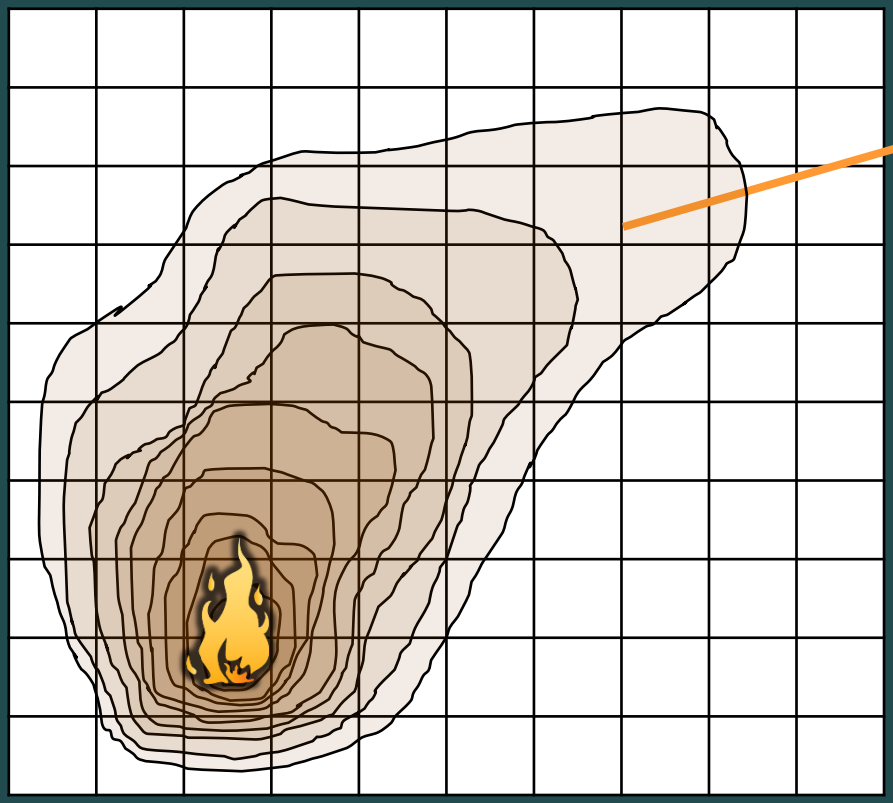
Conservation land

Timber production

Application to a synthetic landscape

- 3 prescribed burning strategies
  x 3 treatment sizes
  + no-strategy case for comparison = 10
- 4 varying weather conditions
  4 x 10 = 40 scenarios
- Random ignitions
  40 scenarios × 30 random ignitions
  = 1200 fires simulated

Application to a synthetic landscape



Area burned
Intensity

Application to a synthetic landscape

Damages:

- Timber
- Ecological values
- Recreational values
- Infrastructure

Area burned
Intensity

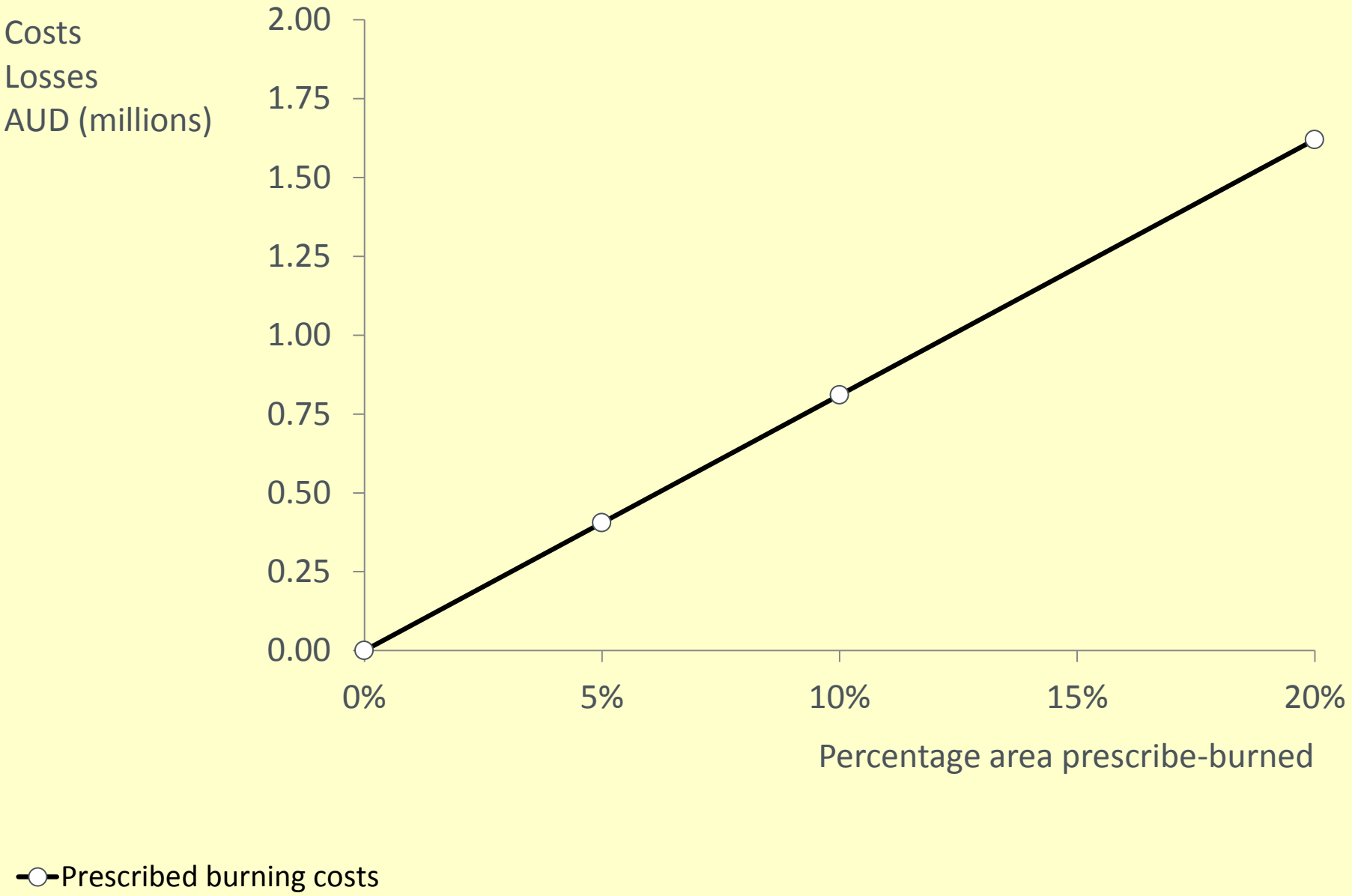
Probability weighted average of the simulated fires

Application to a synthetic landscape

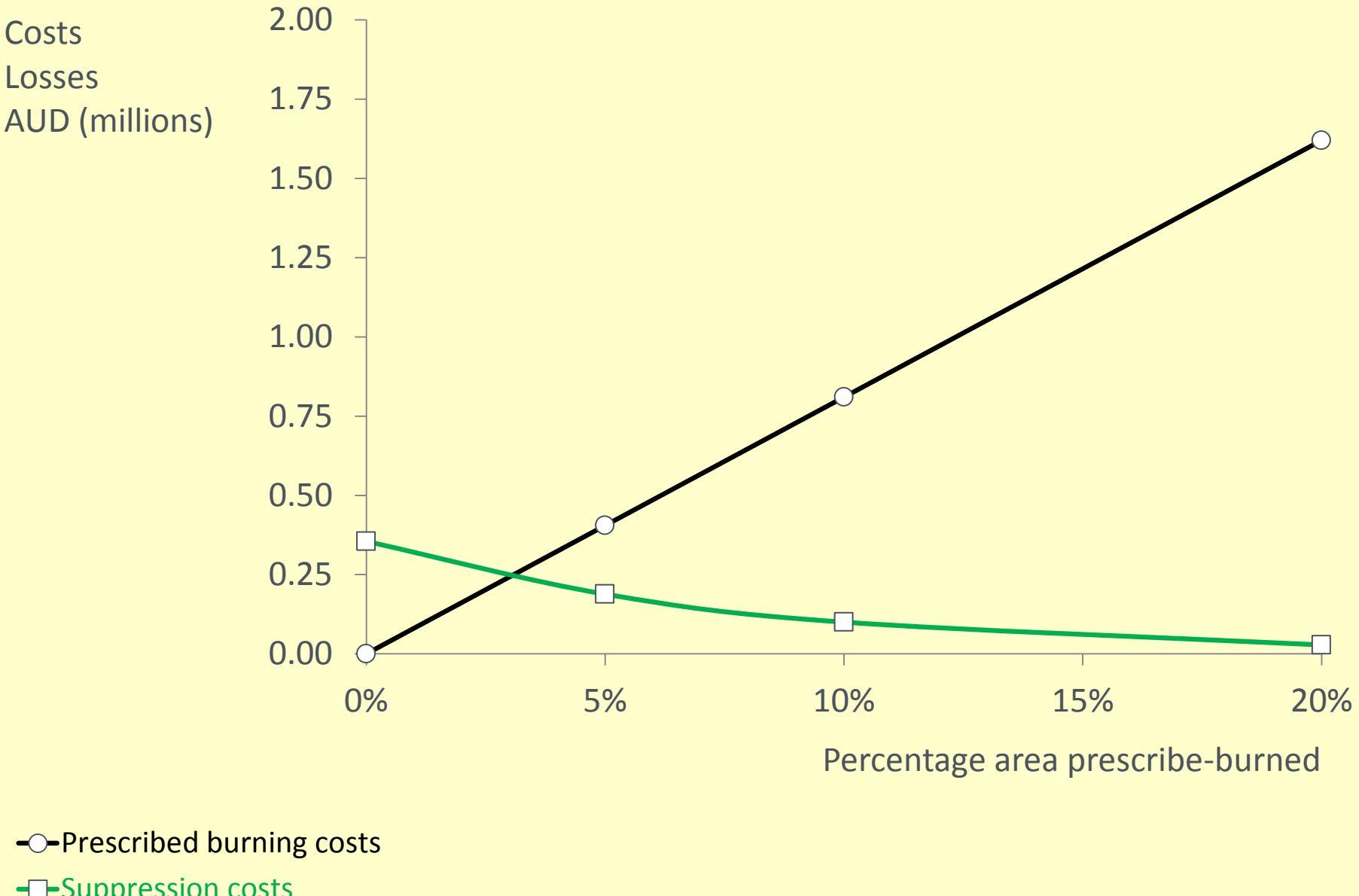
Suppression ← Prescribed burning strategy

Results

Results Cost plus Net Value Change



Results Cost plus Net Value Change



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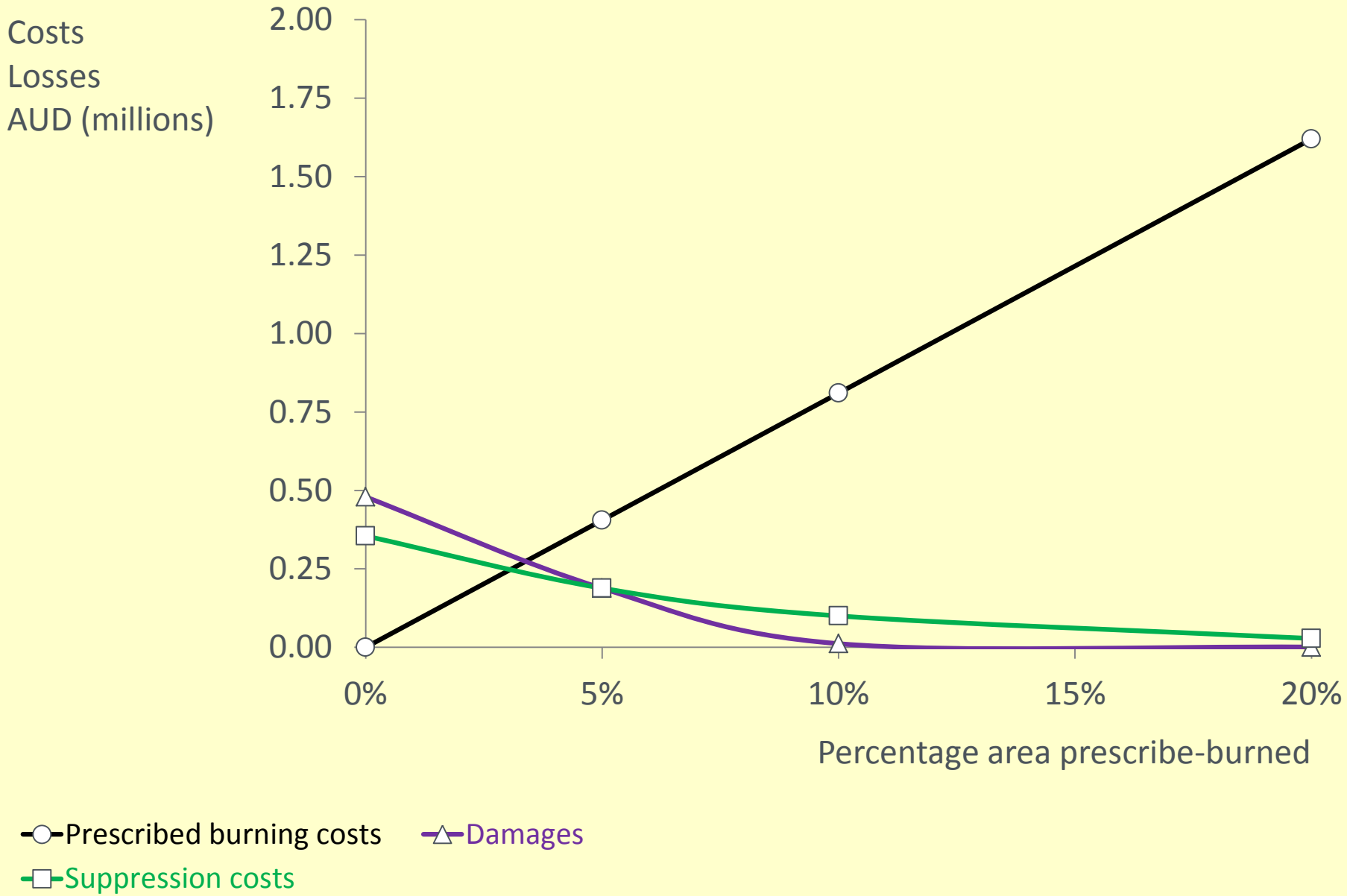

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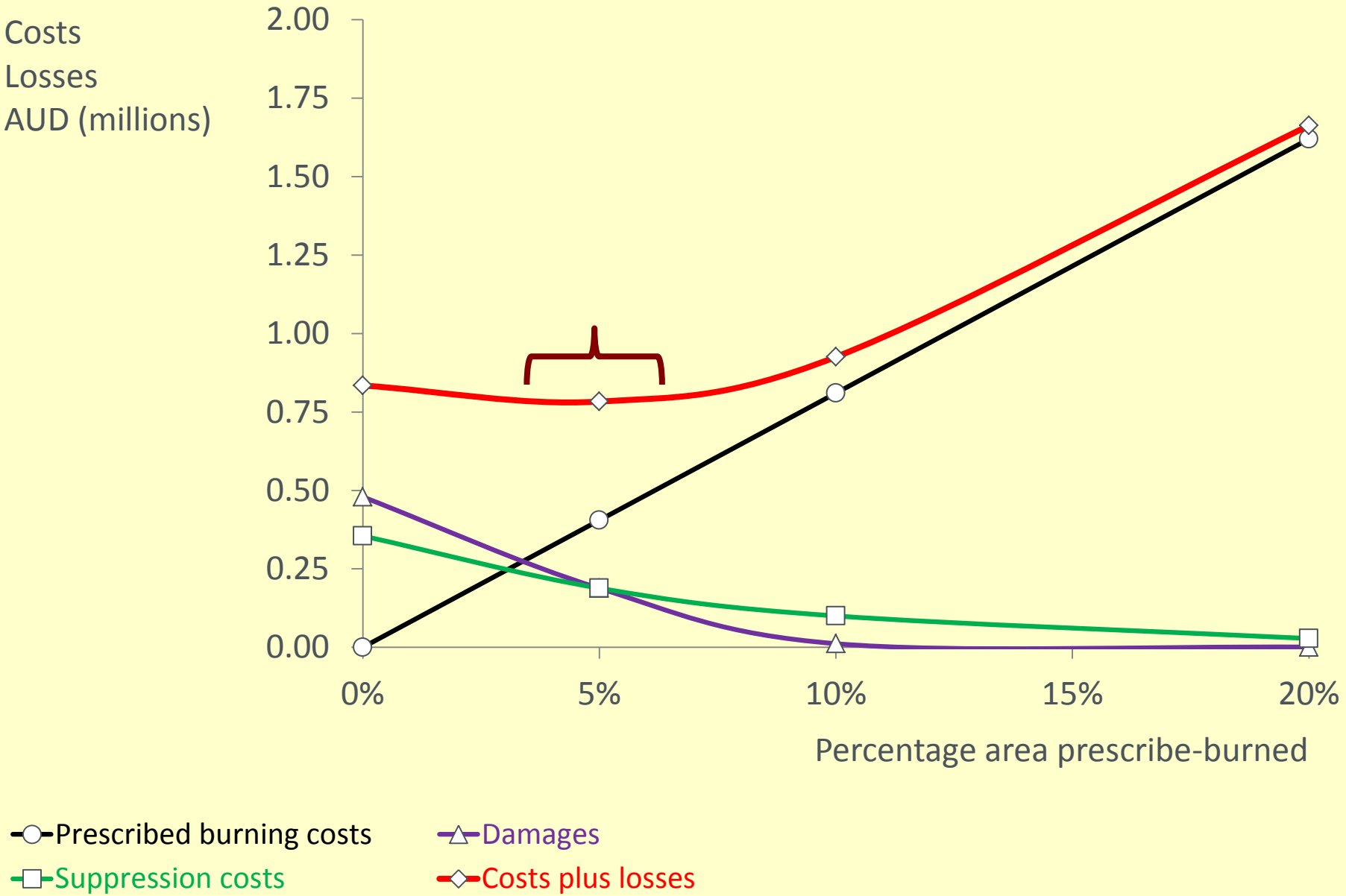
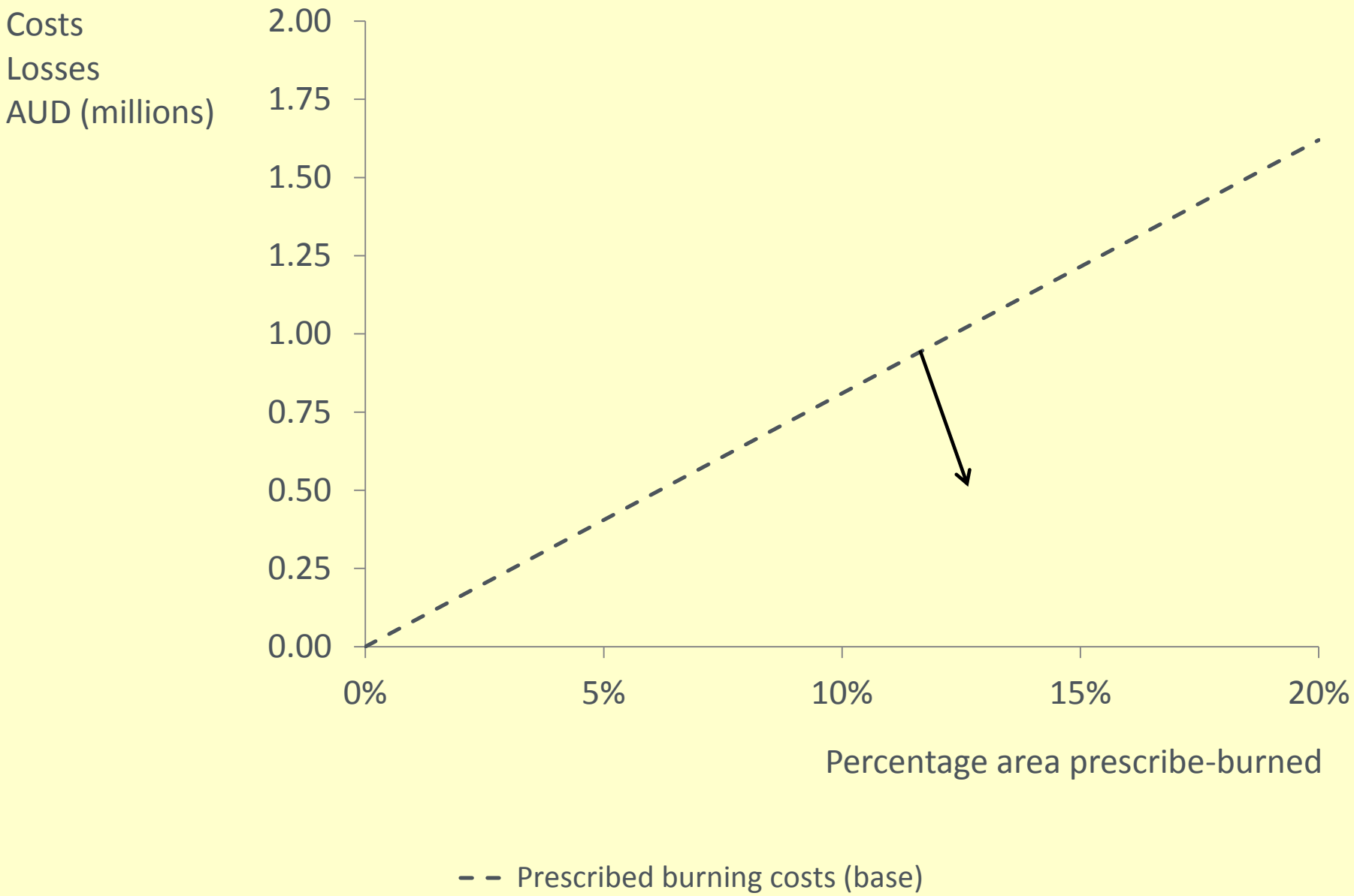


Sensitivity analysis

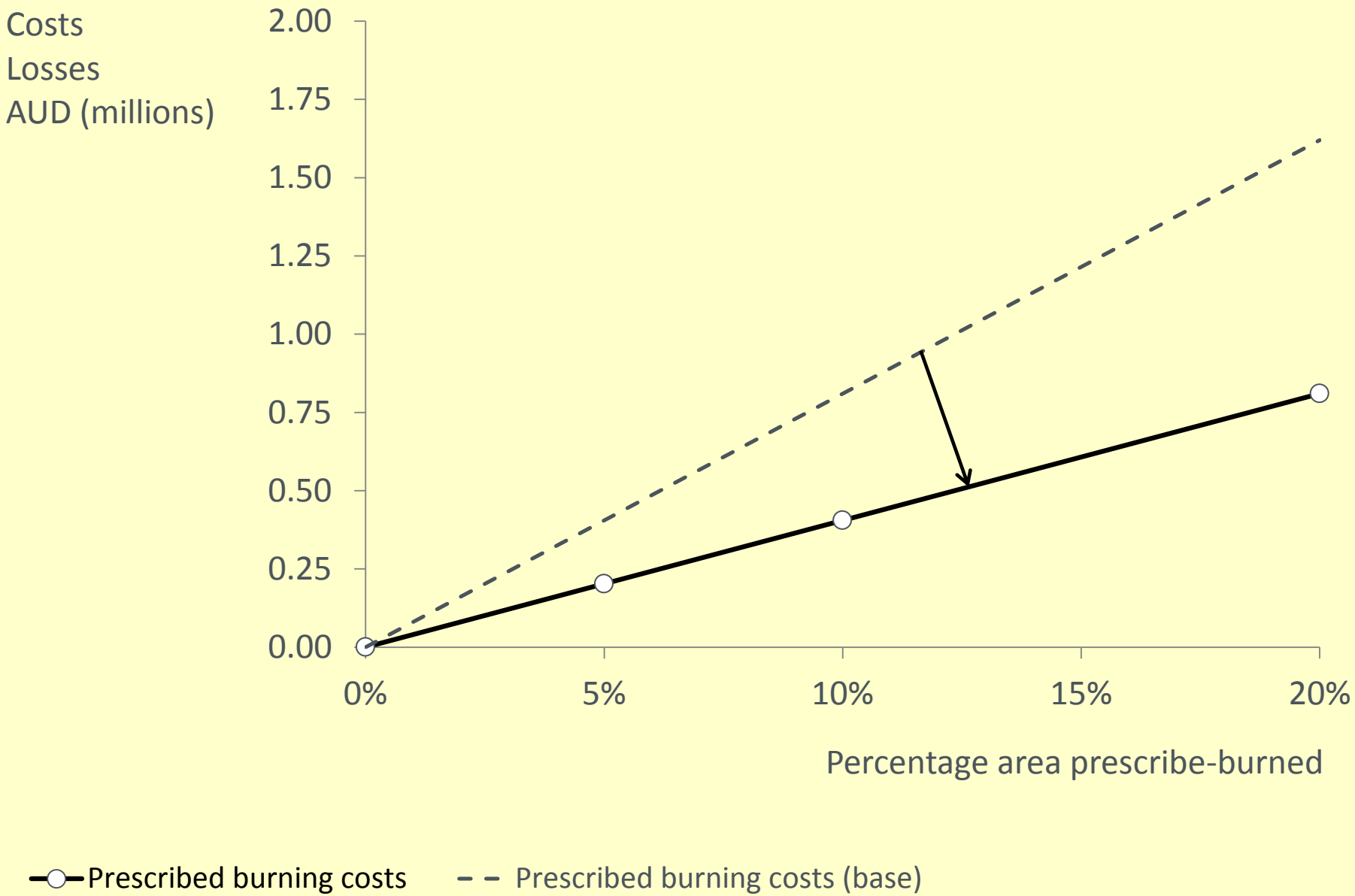
Optimal prescribed burning strategy sensitive to changes (+-50%) in:

- prescribed burning costs
- probabilities of fire occurrence
- urban area (damage) values
- suppression costs

Sensitivity analysis: -50% prescribed burning costs



Sensitivity analysis: -50% prescribed burning costs



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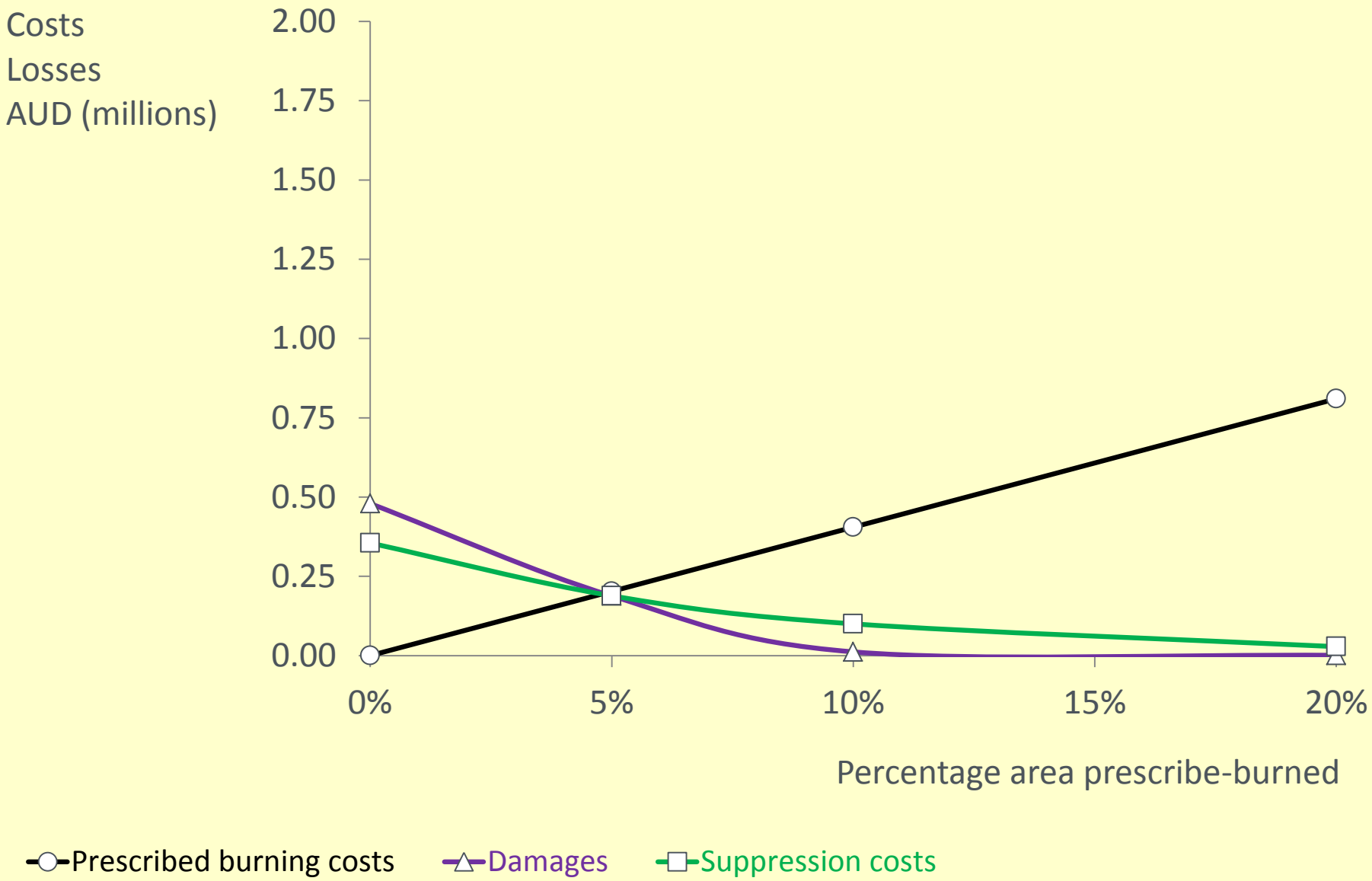

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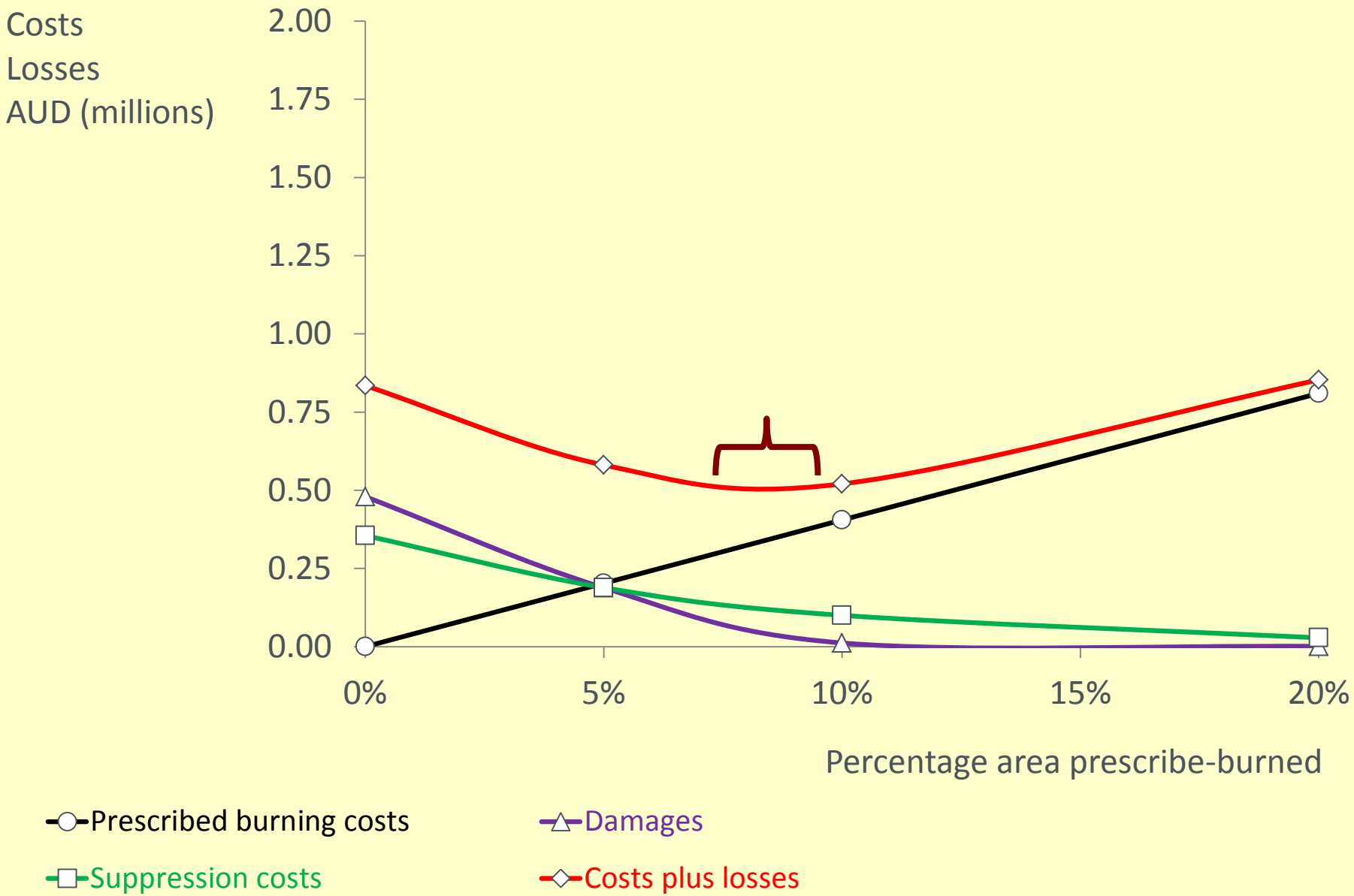
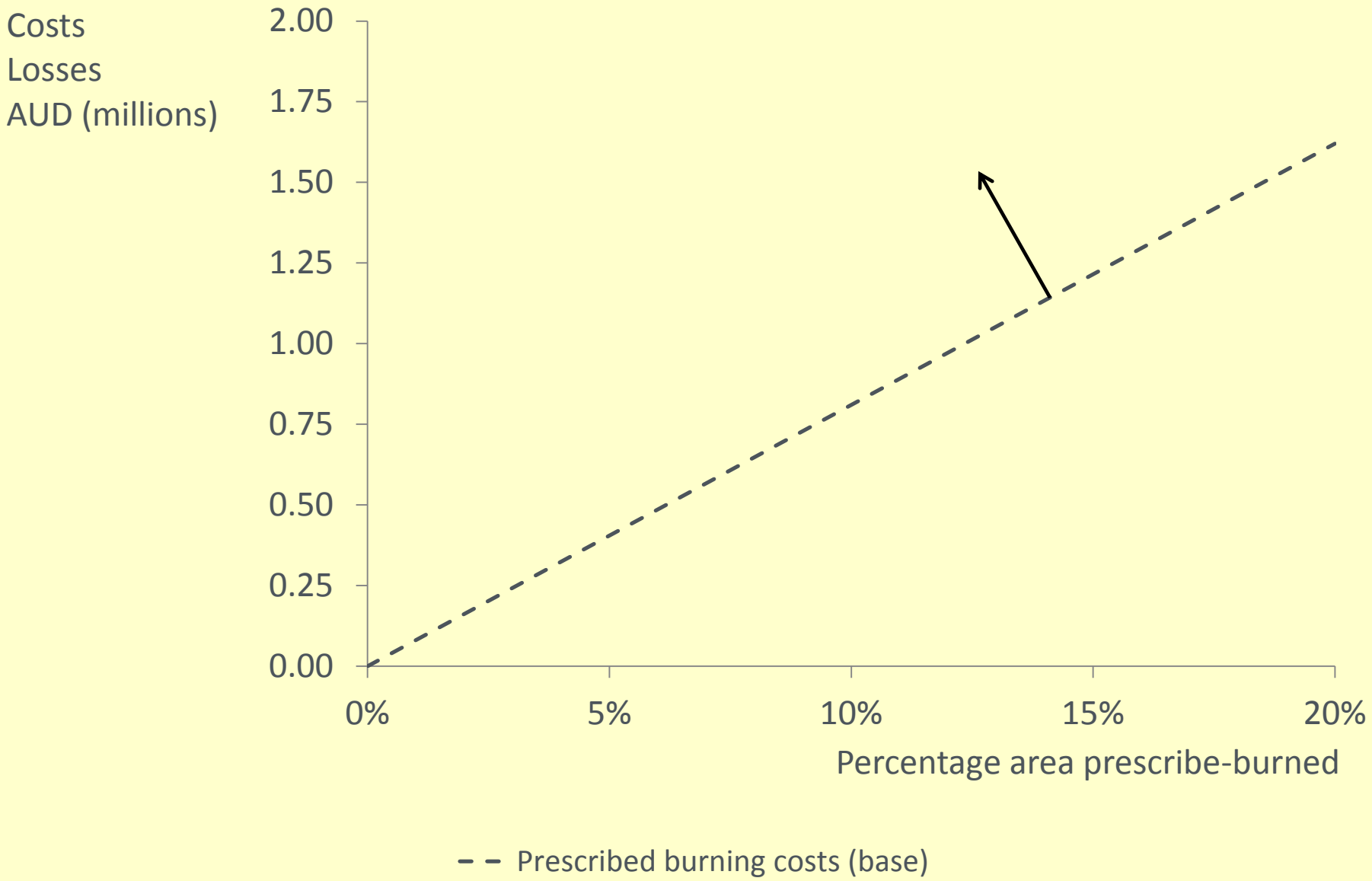


Sensitivity analysis: +50% prescribed burning costs



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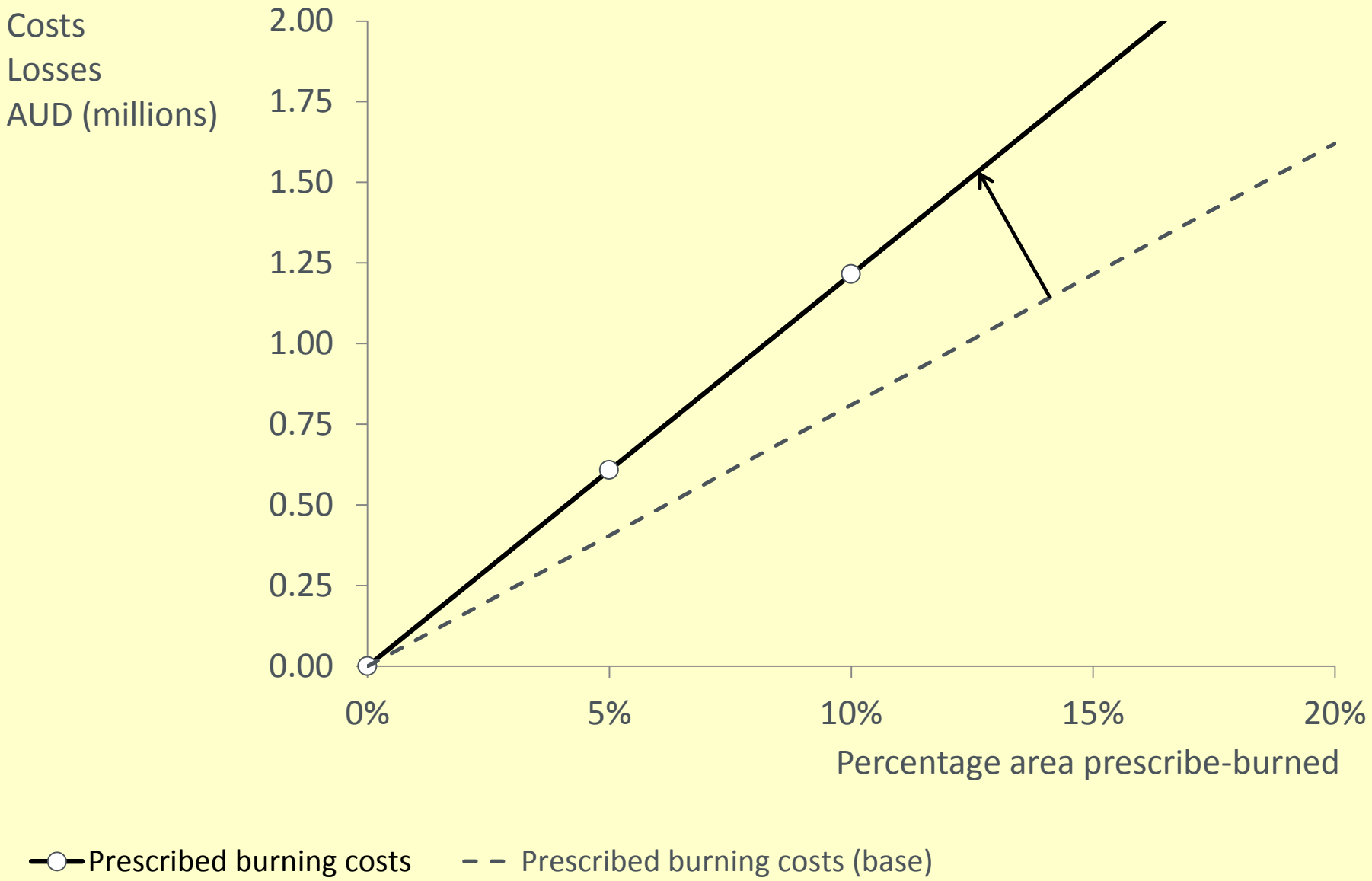

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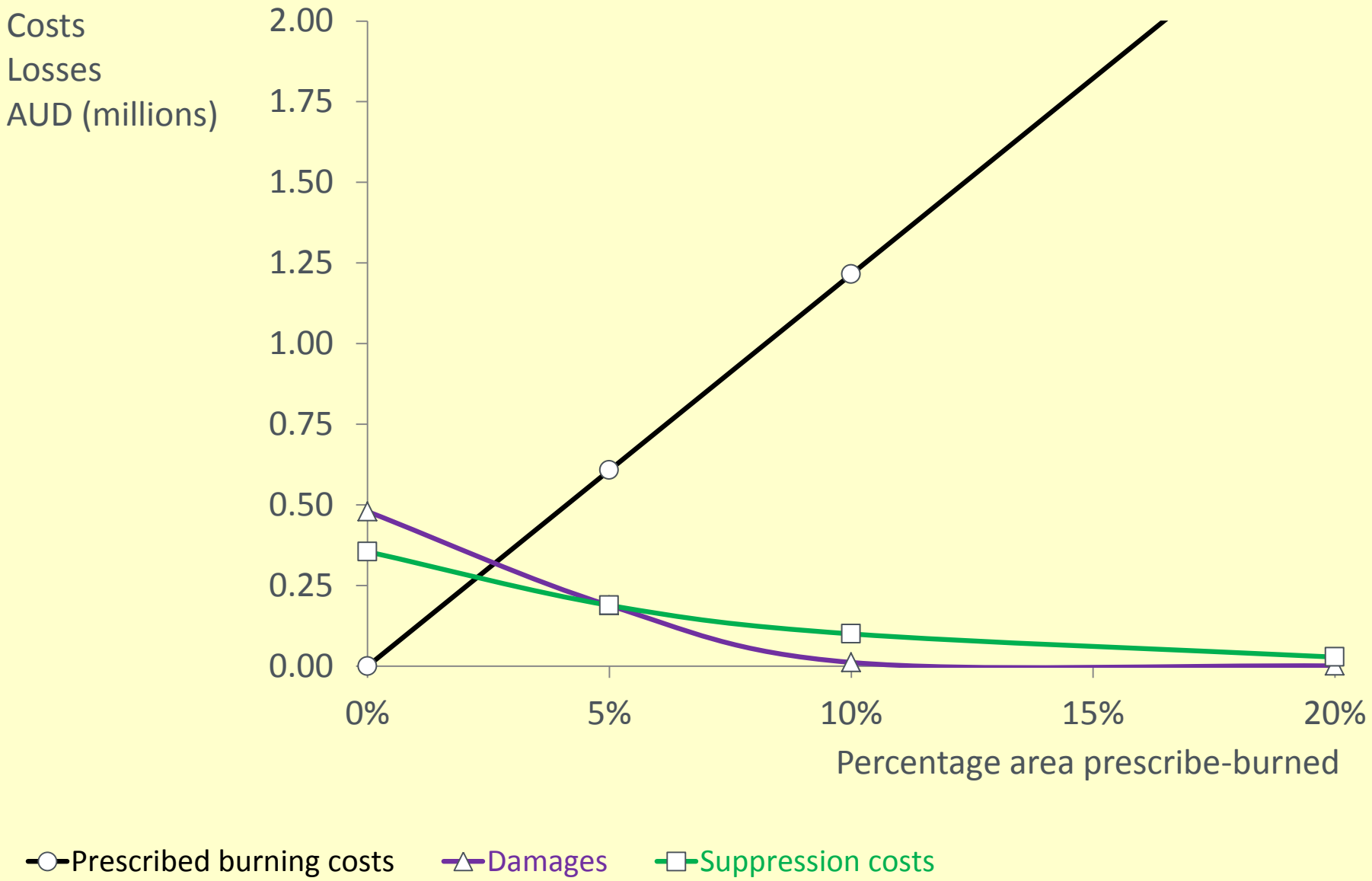

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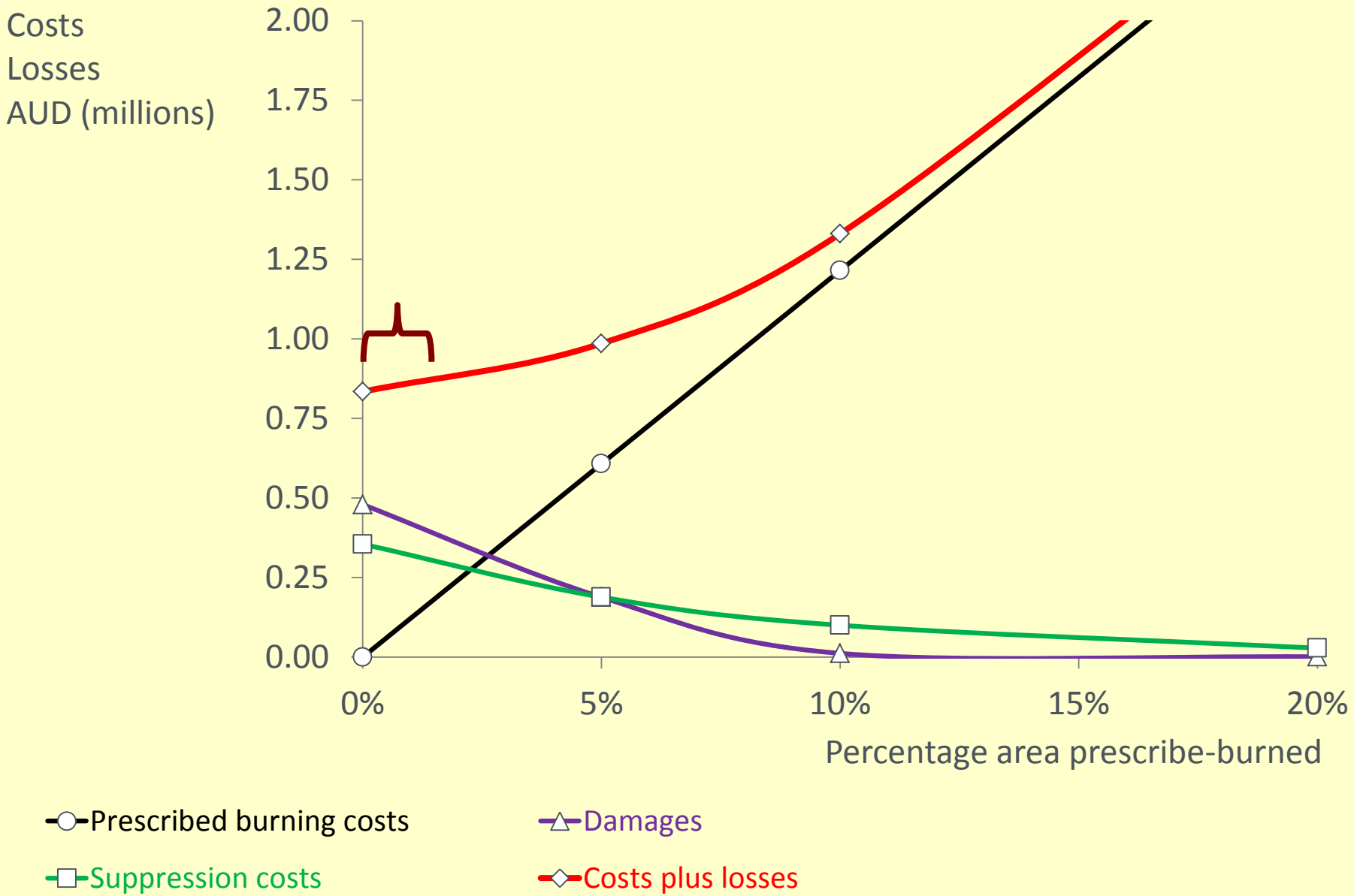


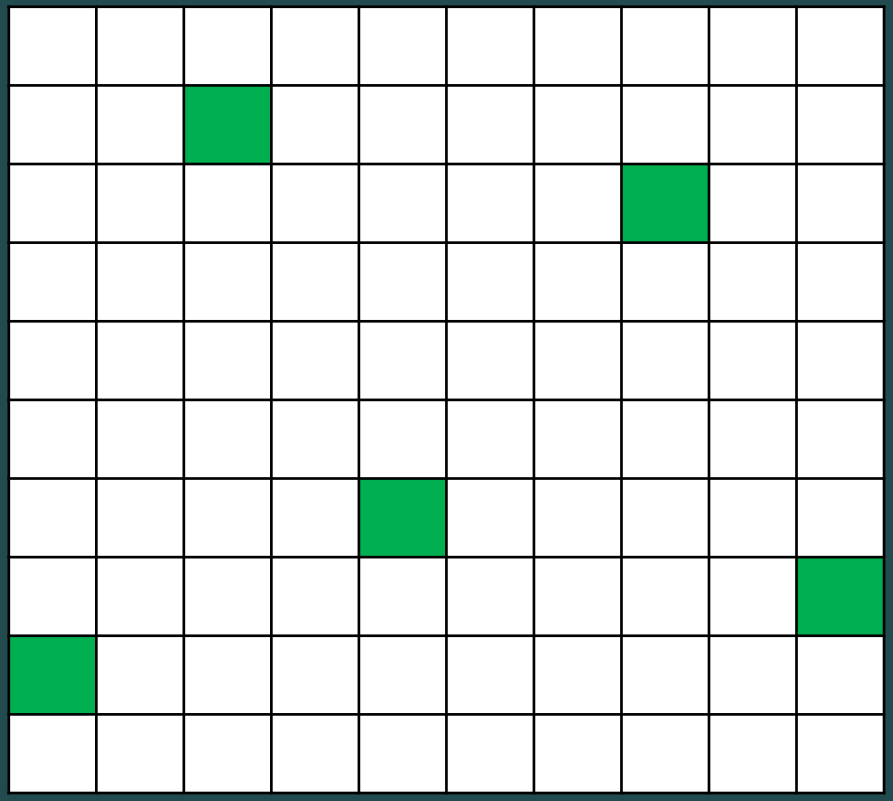
Next step

Apply economic analysis to a real landscape

Next step

Real landscape:

Constraint on prescribed burning



Synthetic landscape:

Prescribed burning applied everywhere

Next step

Real landscape:

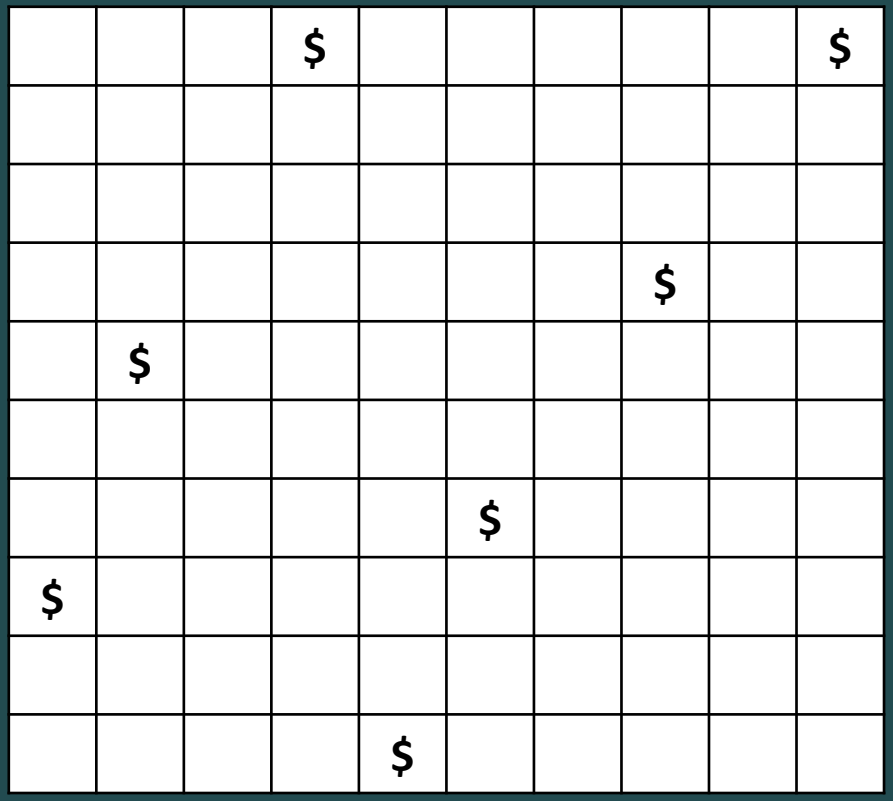
Constraint on prescribed burning

X	X	X	X	X	✓	✓	✓	✓	✓
X	X	X	X	✓	✓	✓	✓	✓	✓
X	X	X	X	✓	✓	✓	✓	✓	✓
X	X	X	X	✓	✓	✓	✓	✓	✓
X	X	X	X	✓	✓	✓	✓	✓	✓
X	X	X	✓	✓	✓	✓	✓	✓	✓
X	X	X	✓	✓	✓	✓	✓	✓	✓
X	✓	✓	✓	✓	✓	✓	✓	✓	✓
X	X	✓	✓	✓	✓	✓	✓	✓	✓
X	X	X	X	X	X	X	✓	✓	✓

Next step

Real landscape:

Varying prescribed burning costs



Synthetic landscape:

Uniform prescribed burning costs

Next step

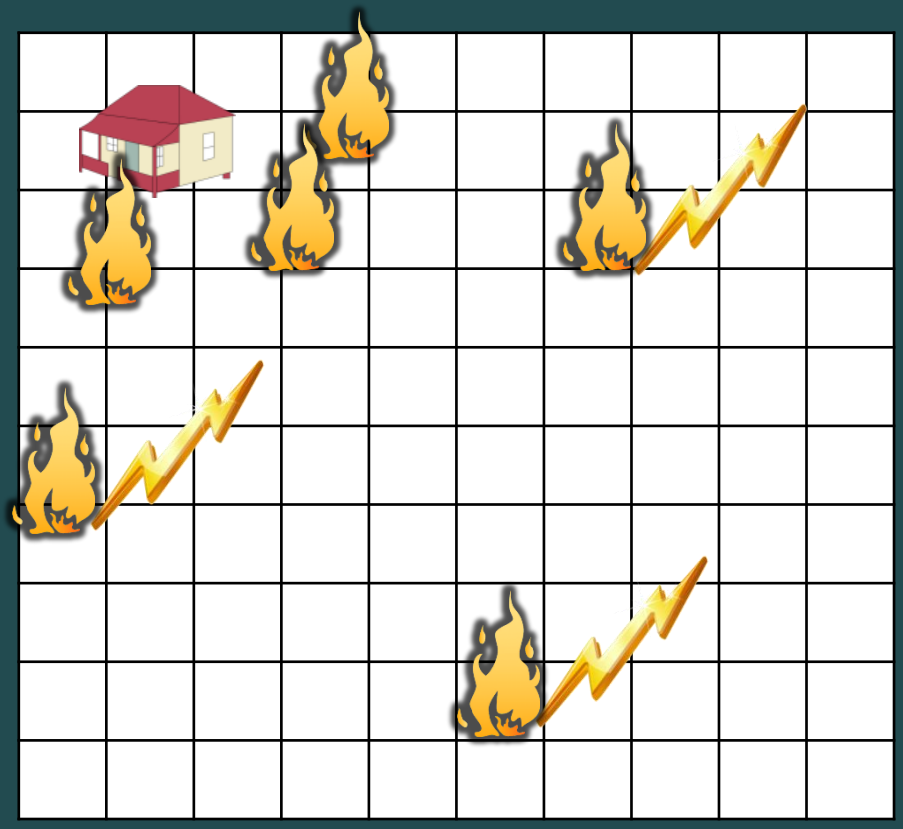
Real landscape:

Varying prescribed burning costs

									$
				$$$	$$$			$	$
				$$$	$$$			$	$
				$$$					
					$$	$$			
					$$	$$	$$		
					$$	$$			

Next step

Real landscape:
Ignition probability model



Synthetic landscape:
Random fire ignitions

Next step

- Constraint on prescribed burning
- Varying prescribed burning costs
- Ignition probability model
- Prescribed burning prioritization rule
- Real land use data
- All weather conditions (real historical data)
- Suppression as a function of fire conditions

And after this…

Dynamic optimization…

How do the results change in the long run?

What are the implications for bushfire management policies?

Conclusion

Apply economic analysis to fire management in the south-west of Western Australia

Help to make decisions for optimal levels of different strategies

Evaluate implications of changing a prescribed-burning strategy