

PATHWAYS TO DEEP DECARBONISATION IN 2050

HOW AUSTRALIA CAN PROSPER
IN A LOW CARBON WORLD

Andy Jones – SEng briefing

30 September 2014

Pathways to Deep Decarbonisation in 2050: How Australia can prosper in a low carbon world.

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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.



Economic growth to 2050

Australia can decarbonise whilst maintaining economic prosperity. This study shows that real GDP grows at 2.4% per annum, a similar rate to the past 5 years



IDDRI
International Institute for
Democracy and
Development

The Deep Decarbonisation Pathways Project (DDPP) is a collaborative initiative to understand how 15 countries, representing 70% of global CO₂ emissions, can transition to a low carbon economy.



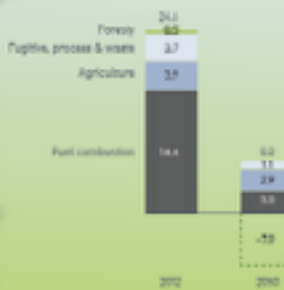
Electrification and Fuel Switching

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



Emissions in 2050

Australia can reach net zero emissions by 2050 and live within the global carbon budget



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.

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	NOW	2030	2050
MATURE TECHNOLOGIES	DEPLOY MORE		
DEMONSTRATED TECHNOLOGIES	R&D	DEPLOY	
EMERGING TECHNOLOGIES	R&D		DEPLOY

The development and ongoing review of deep decarbonisation pathways are fundamental to long-term planning for a low carbon future.

1. Background and context

2. Headline results

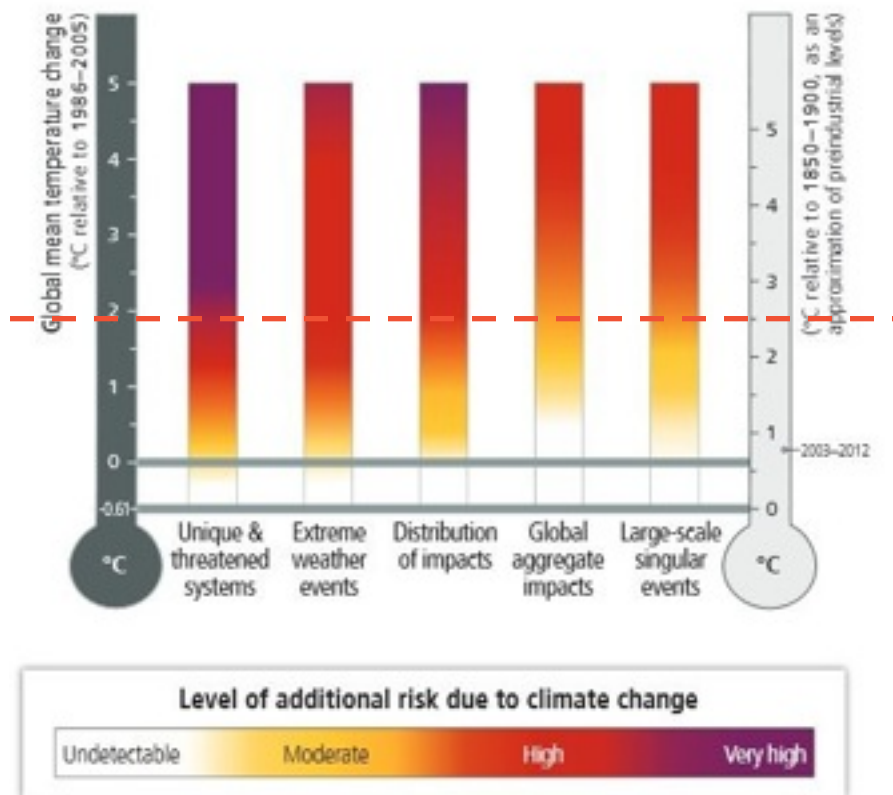
3. An illustrative pathway for Australia

4. Next steps



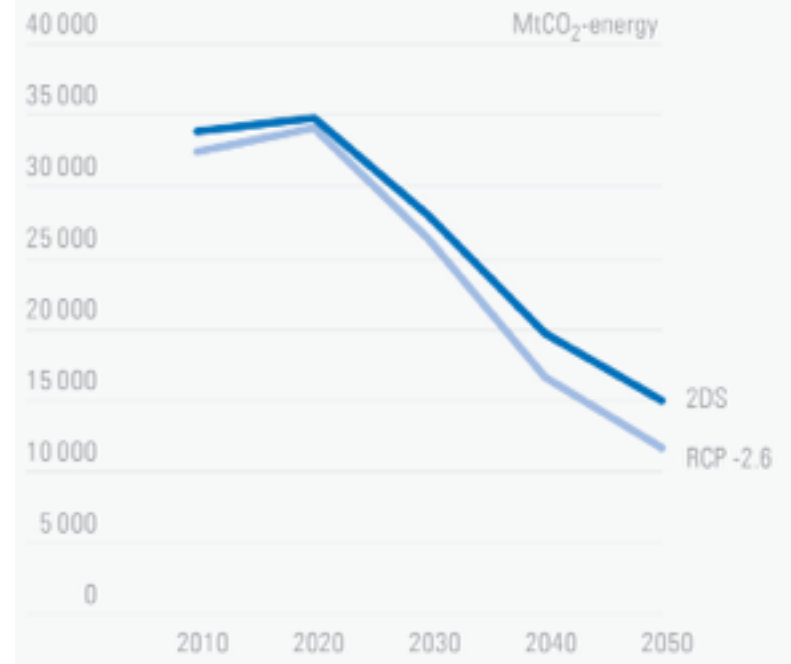
At COP 15 in Copenhagen, governments agreed that to reduce the risk of dangerous climate change, global warming must be limited to 2°C

Impacts of climate change – the 2 degrees threshold



Energy emissions reductions required to reach 2 degrees target

Figure 2.1. CO₂-energy emissions reduction trajectories for the IEA 2DS and RCP-2.6 scenarios, 2010 to 2050



Deep Decarbonisation: the transition to a very low carbon economy

DDPP Objectives:

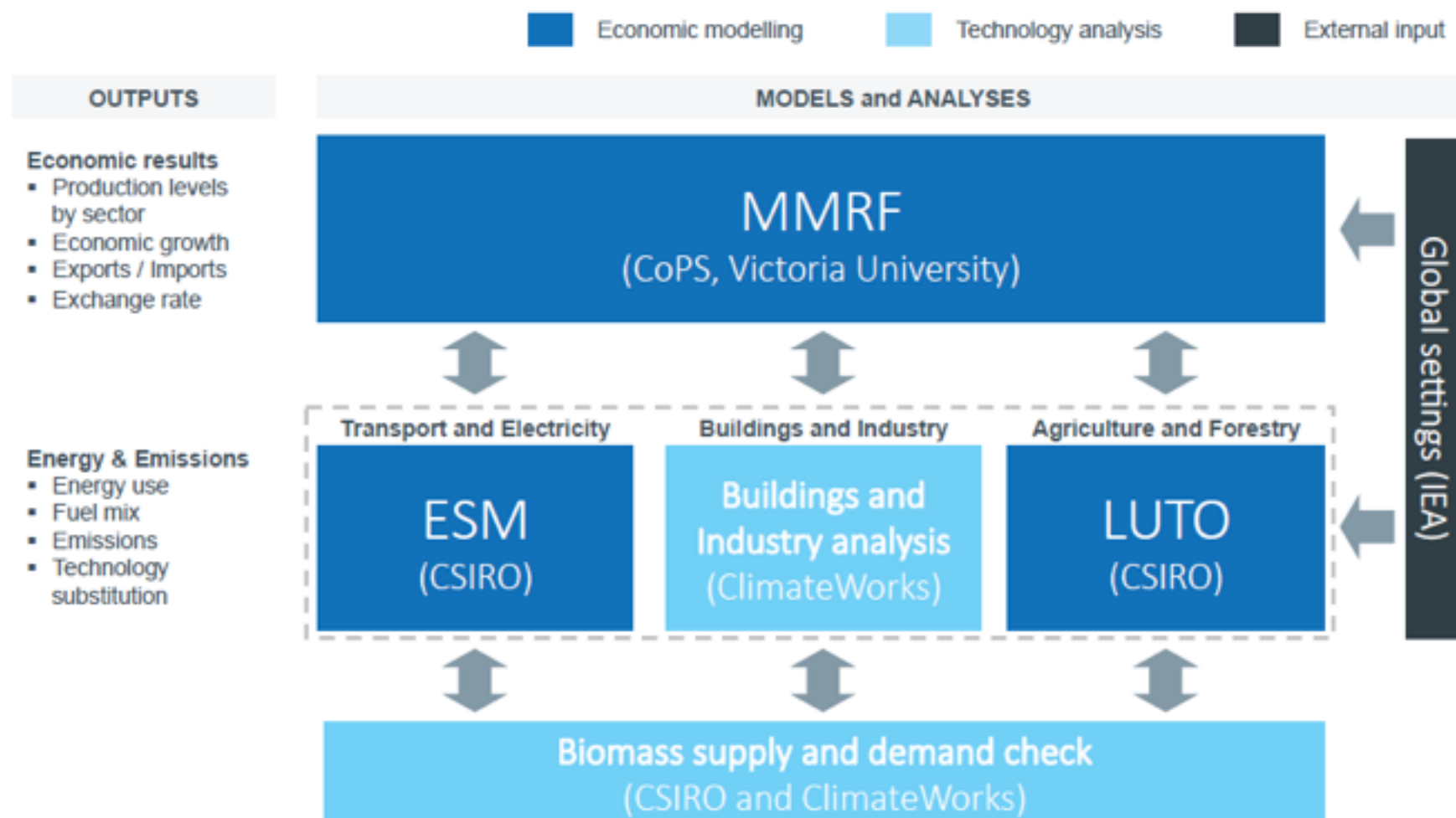
- Show how individual countries can transition to a very low carbon economy
- Support a positive outcome from COP21 by shifting the focus of negotiations from 'burden sharing' to 'problem solving'
- Highlight where collaboration amongst countries will be required



The DDPP is coordinated globally but driven locally by bottom up modeling



Economic modelling, supported by sectoral analysis of emissions reduction potential



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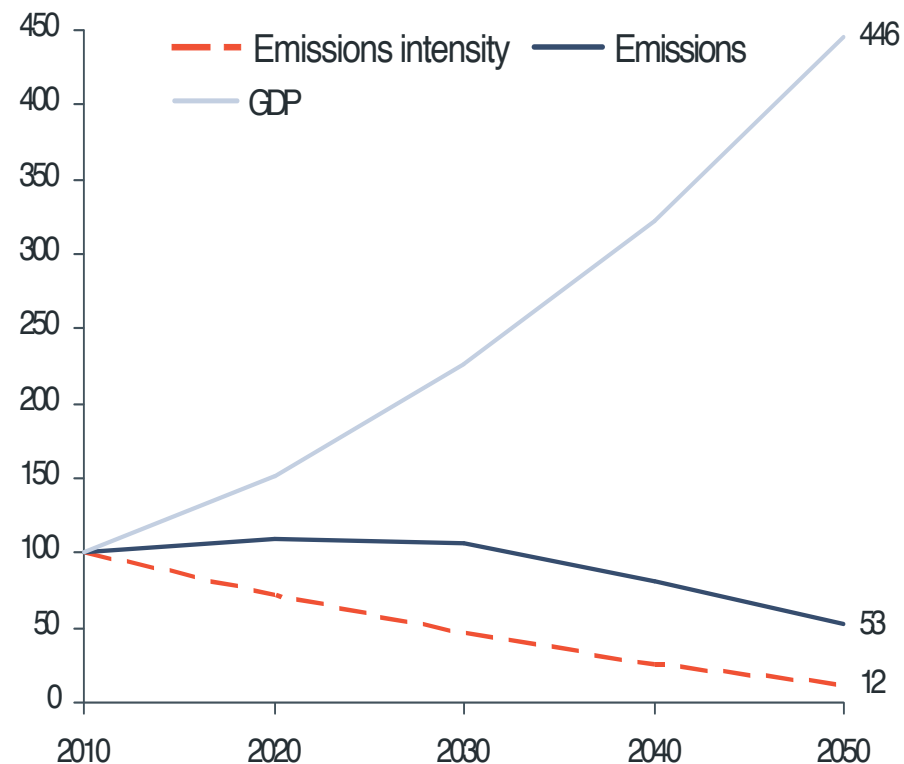


Participating countries can decarbonise whilst maintaining prosperity

Key findings:

- Decarbonisation of energy systems is possible for all economies studied
- Economic and population growth are compatible with decarbonisation
- Global collaboration will be required (R&D, trade, and financing mechanisms etc.)

Energy related CO₂ emissions reduction and GP growth, indices

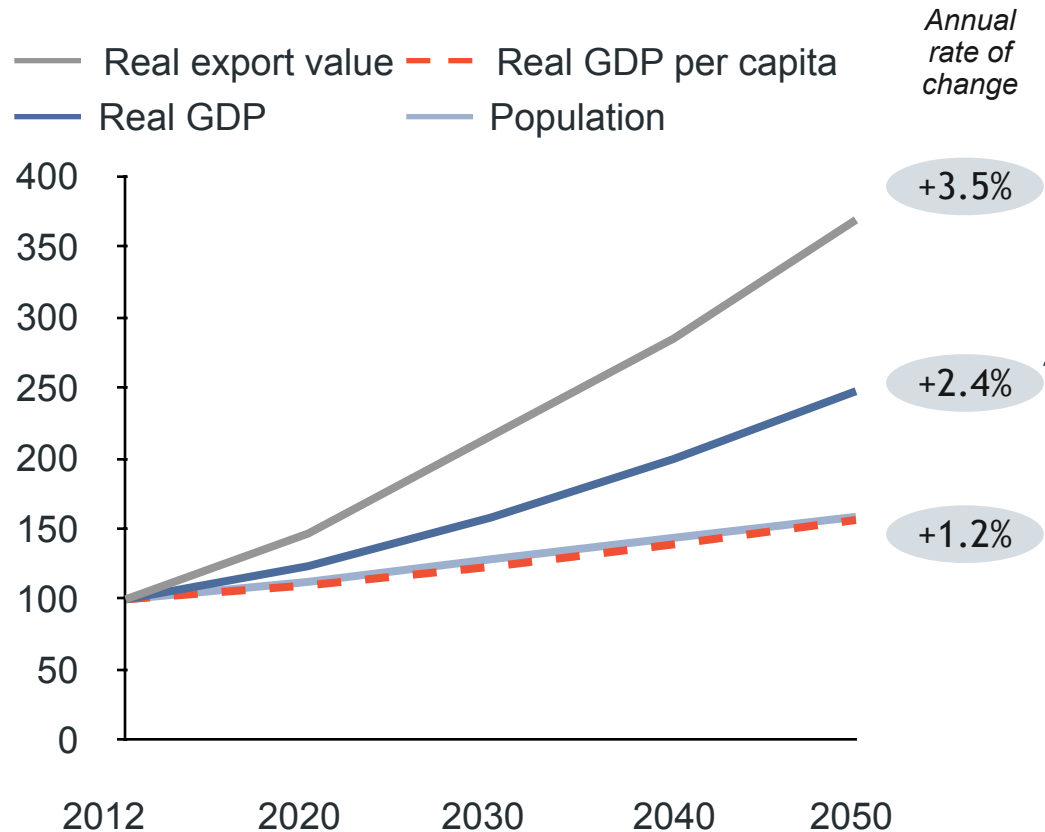


Note: the global parameters assumed for the modelling exercise were that all countries move to achieve the two degrees target, and each country investigates the maximum potential for domestic decarbonisation, without international trading



Australia can decarbonise while GDP grows at an average annual rate of 2.4%, a similar rate to the past 5 years

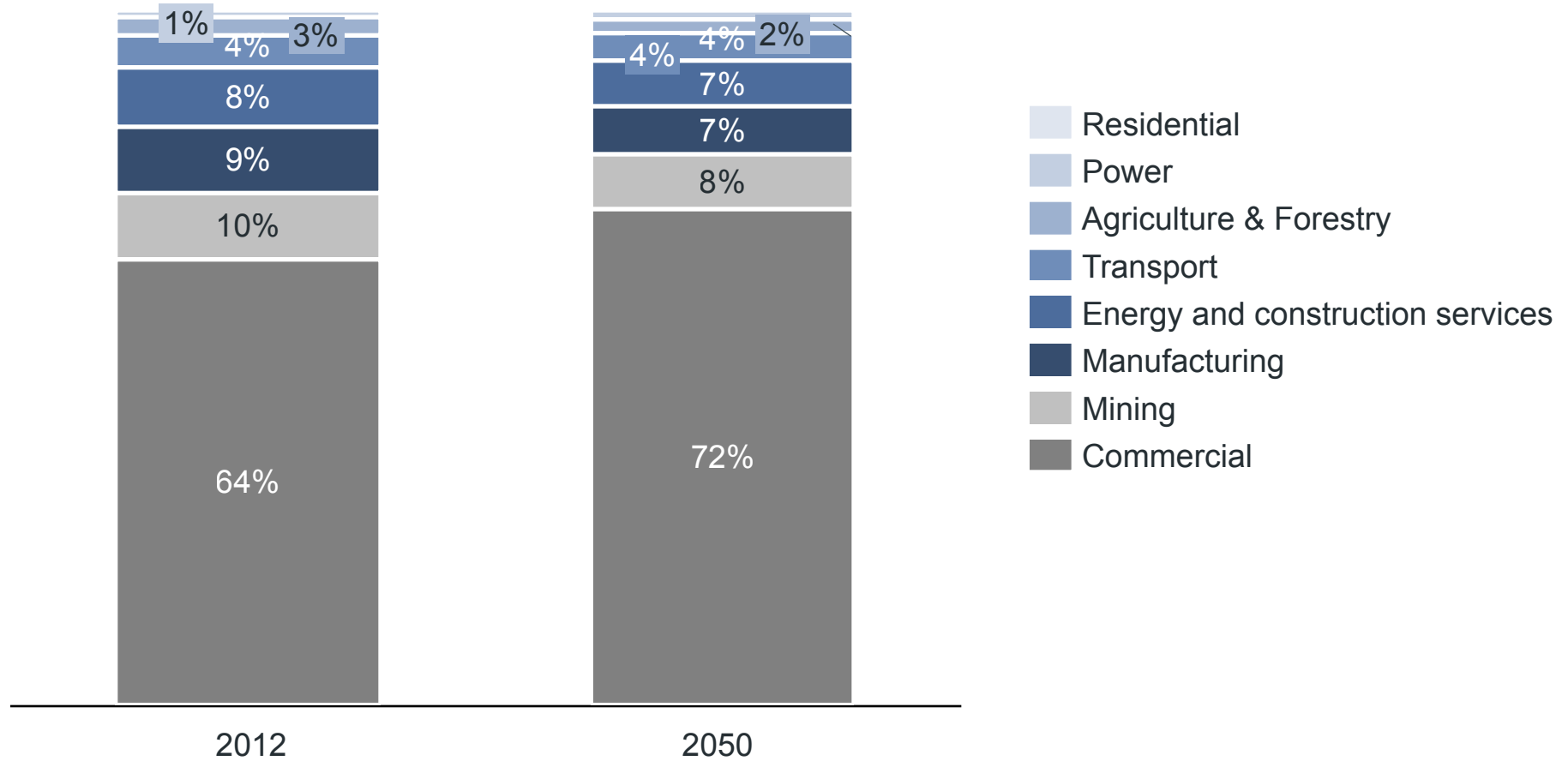
Key economic indicators, indices



* The modelling comprises a reference case as a technical assumption, which overstates the economic cost incurred. Under this scenario, the annual growth in GDP would be 2.6% by 2050 cf 2.4%. This reference case assumes no climate change mitigation in Australia, while the rest of the world undertakes mitigation. The reference case thus overstates the degree of action required and economic cost incurred. Any actions to reduce emissions, such as those that have already been taken in Australia, reduce the cost compared to the estimates provided here.

The structure of Australia's economy would not need to change significantly, with continued mining and manufacturing while services continue to grow

Distribution of sectoral value added, %



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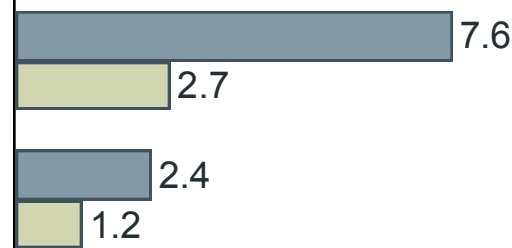
Deep decarbonisation relies on three energy transformations

Today** 2050

Ambitious energy efficiency

Energy intensity of GDP, MJ/\$

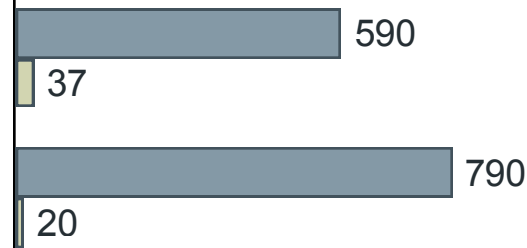
12 DDP*
Australia



Low-carbon electricity

Carbon intensity of electricity, gCO2e/kWh

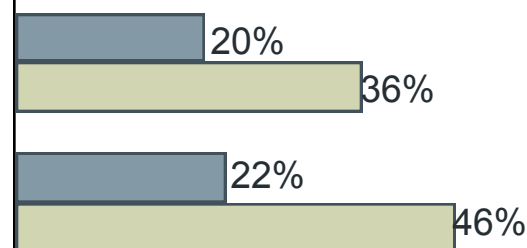
15 DDP
Australia



Electrification and fuel switching

Share of electricity in final energy, %

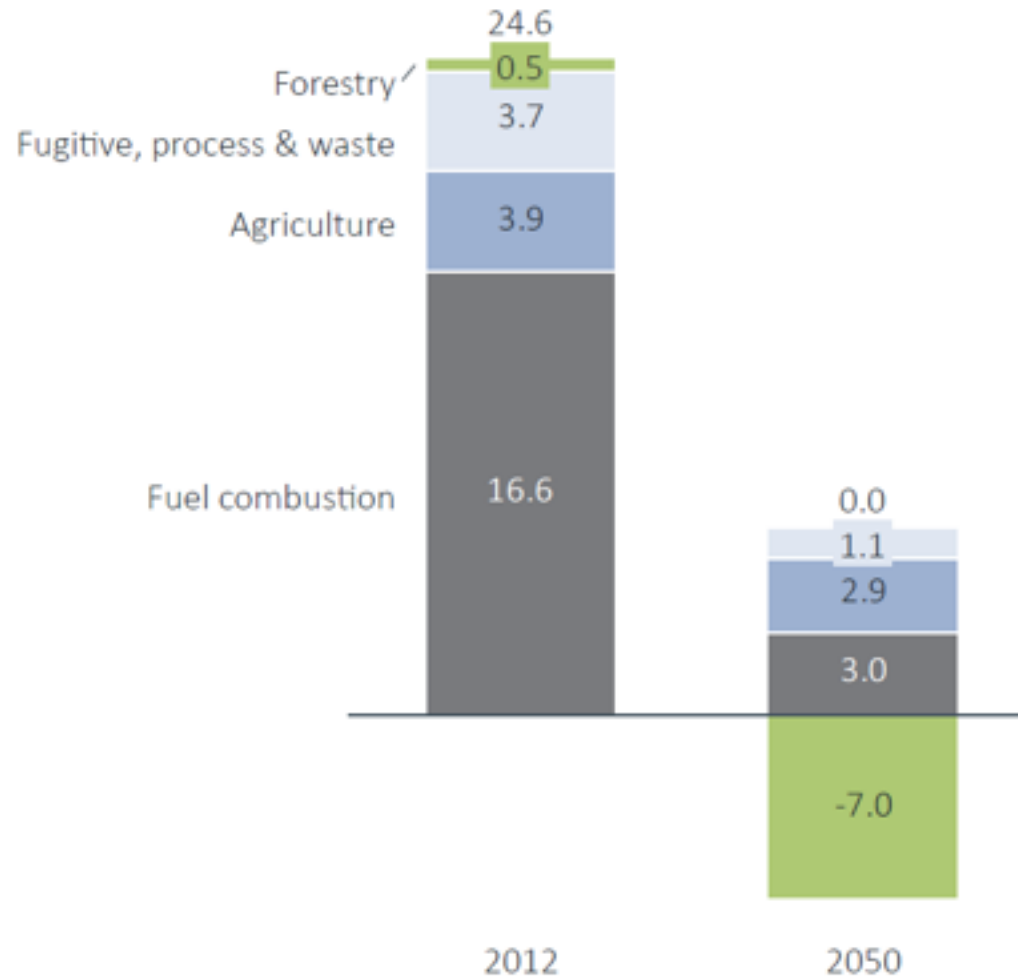
15 DDP
Australia



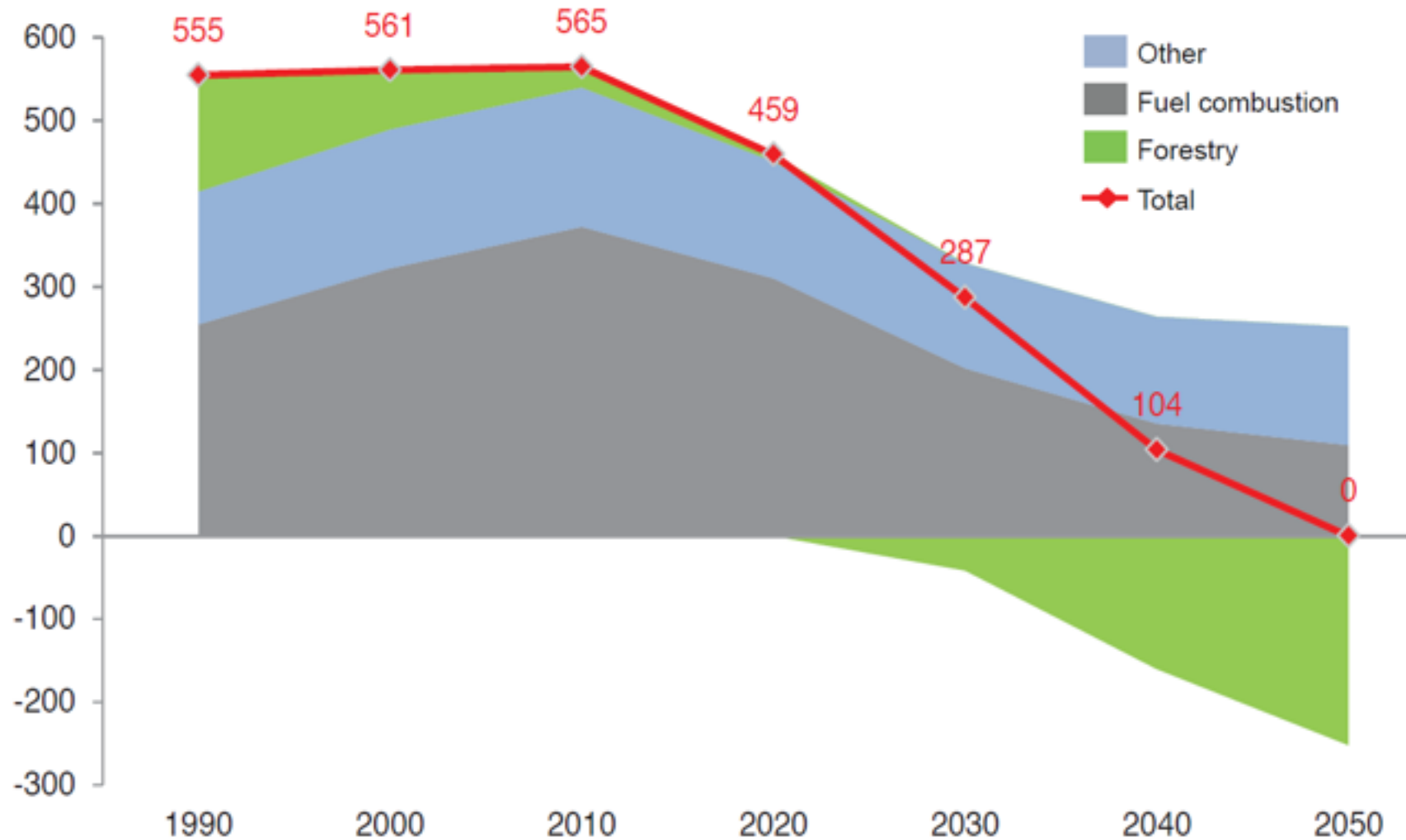
* Based on complete country chapters, excluding India, Brazil and Germany; ** 2012 for Australia, 2010 for DDP countries

For Australia, there is a fourth pillar: non-energy emissions reductions






Greenhouse gas emissions per capita by source, tCO₂e per capita, 2012 and 2050



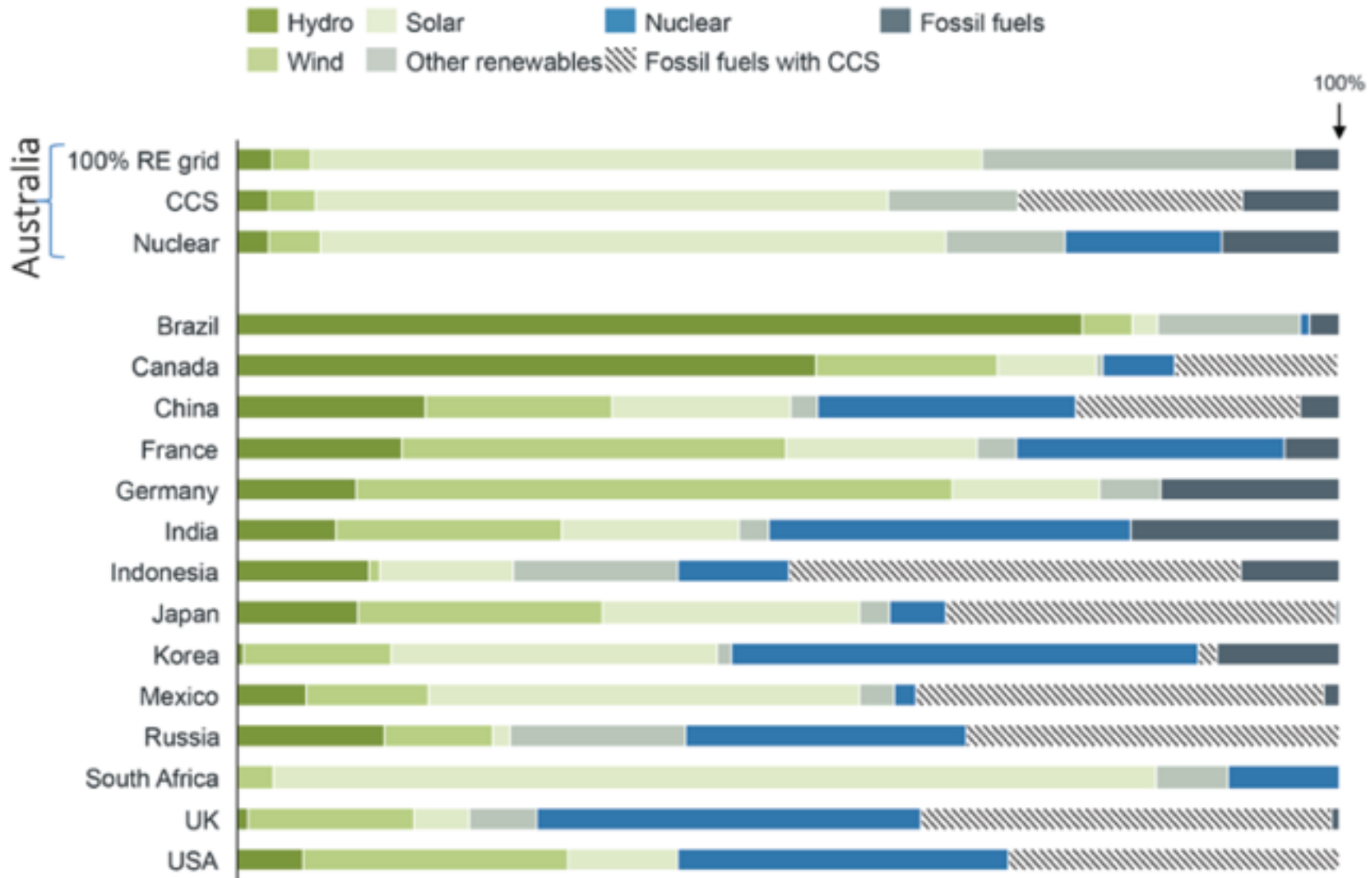
The trajectory of Australia's illustrative deep decarbonisation pathway



Decarbonisation occurs across all sectors of the Australian economy

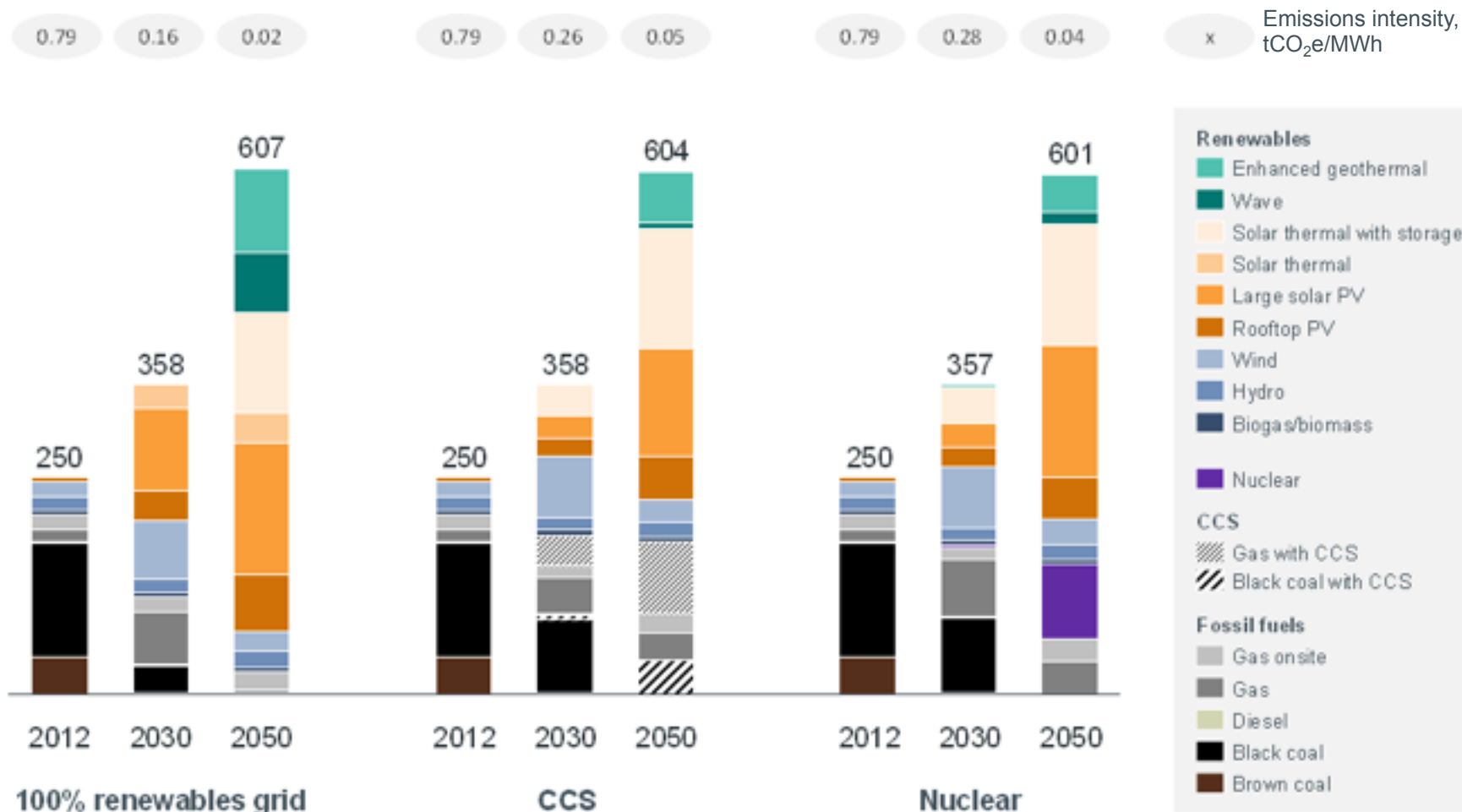
Sector	Ambitious energy efficiency	Low carbon electricity	Electrification and fuel switching	Non-energy emissions
 Electricity	<ul style="list-style-type: none"> Improved efficiency of on-site and remote gas generation through use of solar panels and cogeneration 	<ul style="list-style-type: none"> Renewables or a mix of renewables and either CCS or nuclear provide near zero emissions electricity Variable supply is supported by battery and thermal storage 		
 Industry	<ul style="list-style-type: none"> Continuation of current trends deliver 30 to 40% improvement in energy efficiency Offset in mining by structural energy intensity increases 		<ul style="list-style-type: none"> Electrification of heating and mining processes leads to tripling of electricity use Decrease in coal use Bioenergy increase 9-fold in particular through 50% shift oil to biofuels in mining 	<ul style="list-style-type: none"> Process improvements, materials substitution, increased combustion/ catalysis of gases with high global warming potential Implementation of CCS (up to 50%) for CO₂
 Transport	<ul style="list-style-type: none"> Strong energy efficiency in all modes Trend to smaller cars Small shift from air to rail & teleconferencing 	<ul style="list-style-type: none"> Uptake of batteries supports management of variable electricity supply 	<ul style="list-style-type: none"> Cars and LCVs shift to electric vehicles, hybrids and fuel cells by 2050 Road freight shifts to gas 50% biofuels in aviation 	
 Buildings	<ul style="list-style-type: none"> Halving of energy use per households and energy use per m² in commercial buildings 	<ul style="list-style-type: none"> Rooftop PV generation multiplies 10 to 15-fold across 3 scenarios 	<ul style="list-style-type: none"> Near full electrification of buildings energy use 	
 Agriculture & Forestry				<ul style="list-style-type: none"> Best practice farming reduces emissions Shift to profitable carbon forestry offsets all residual emissions

Low carbon electricity is supplied from a combination of renewables, nuclear and CCS



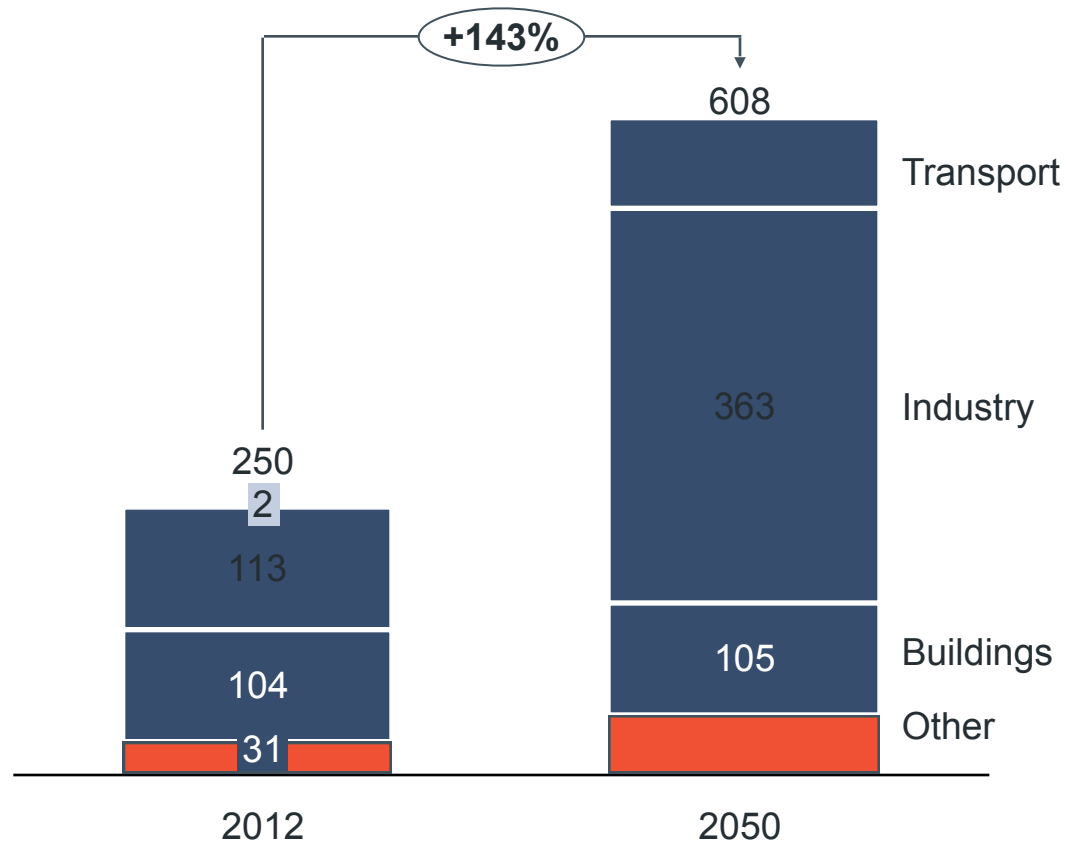
Australia's electricity grid can be almost completely decarbonised, using renewables or a mix of renewables and either CCS or nuclear, at similar costs

Generation mix, TWh



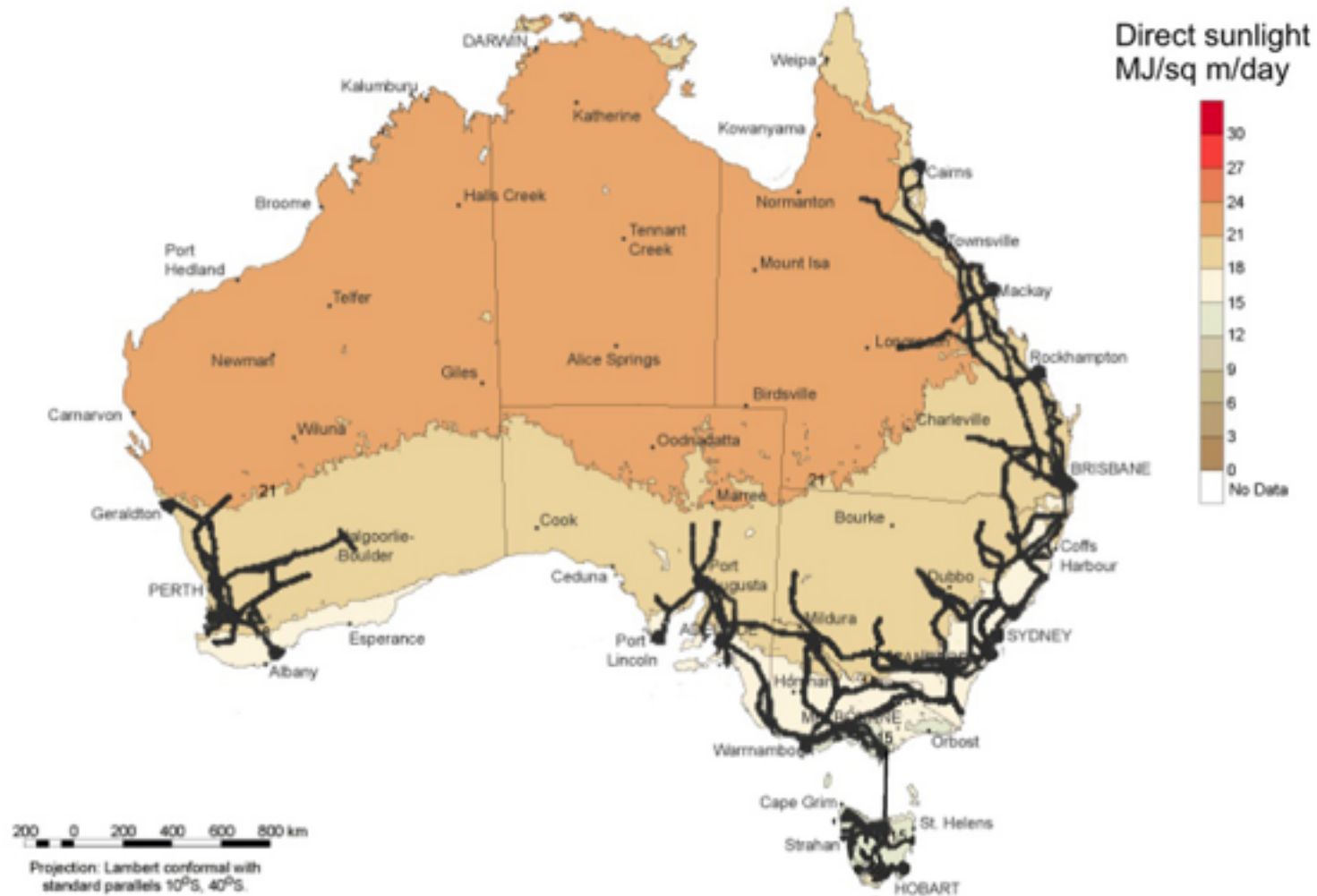
Even with deep energy efficiency, electricity demand would increase about 2.5 times, driven primarily by the electrification of industry and transport

Total Australian electricity demand, TWh

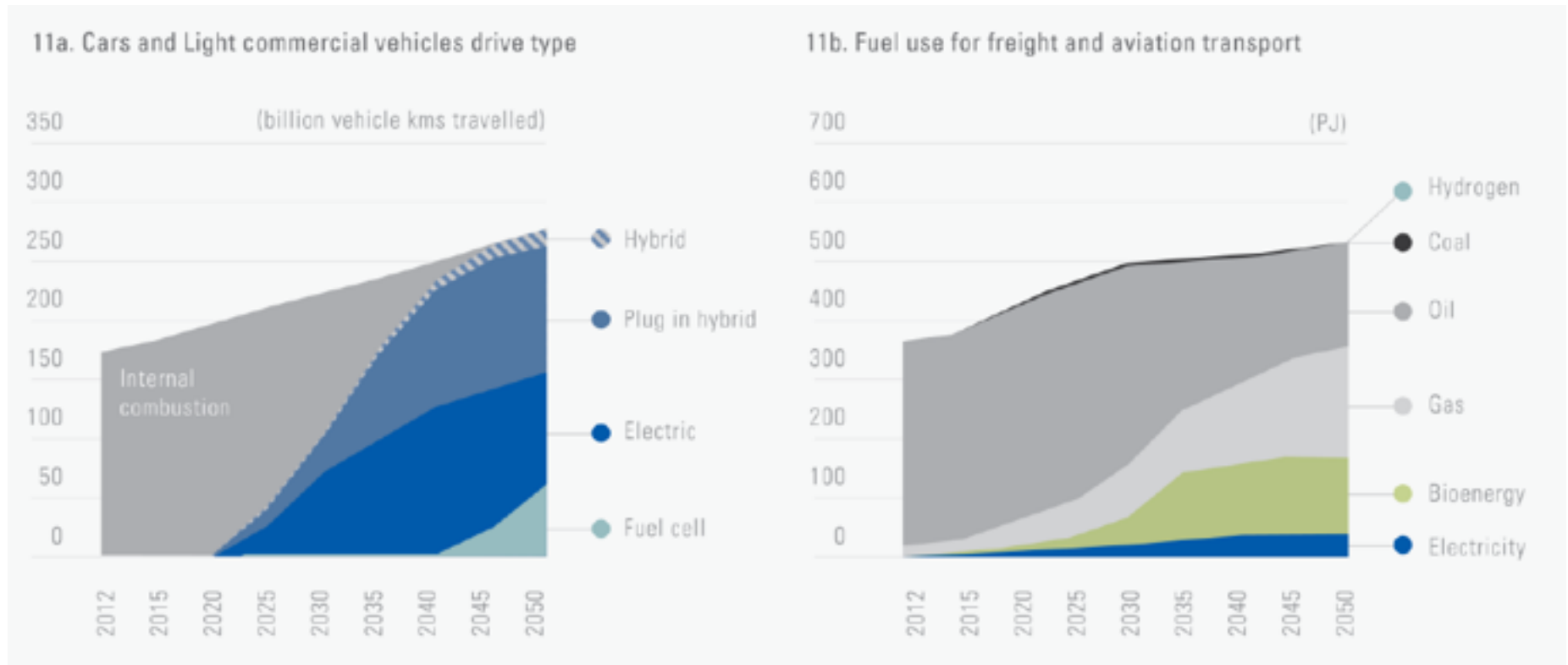


Australia's current transmission network might need to be extended to capture realise Australia's renewable energy potential

Today's grids compared with solar radiation



Decarbonisation of transport in Australia could be achieved through switching to electric, hybrid, and fuel cell cars, and to gas for trucks and bioenergy for planes



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In order to meet the carbon budget, decisions must be made in a long-term context, and action needs to start now

Key success factors to enable deep decarbonisation

Implication for government

Accelerate action now to reduce emissions

- Implement **profitable opportunities** e.g. energy efficiency
- Will **reduce the cost of action** and provide flexibility in future

Incentives for early action

Increased 2020 target

Avoid lock in of emissions intensive technologies

- Provide **clear long-term signals** to inform investment decisions
- Ensure **new assets** are compatible with the long-term pathway

Standards on vehicles, buildings, new developments

2050 emissions reductions target

Prepare for the future

- **Invest in R&D** to fill technology gaps and reduce costs
- Build the **supply chains, skills and capabilities**
- Develop country, region and sector **pathways** to help transition

R&D and pilot programs

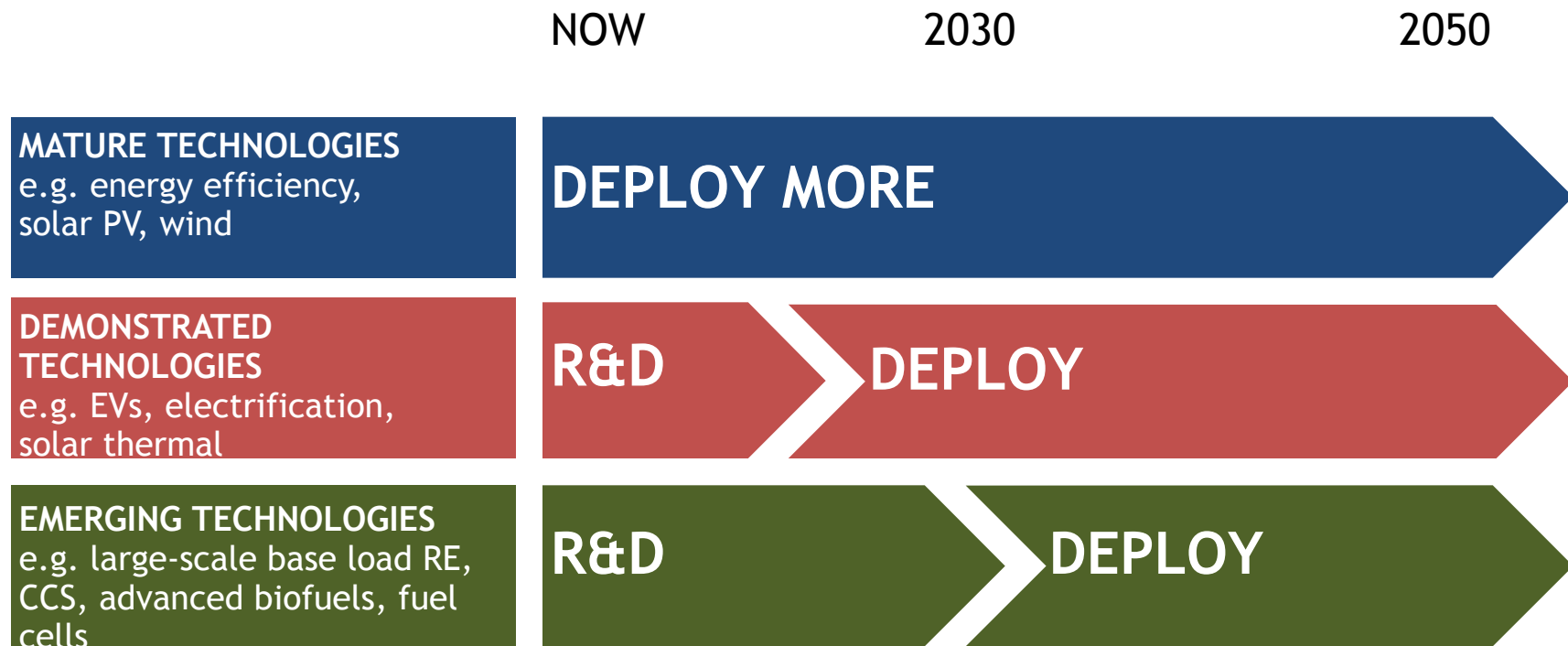
Support pathways development

Implications for investors:

assess asset readiness for a decarbonised world; identify growth sectors



R&D is required to prepare for large-scale deployment of base load low carbon electricity from around 2030 and other technologies






Today it might be hard to imagine how we might achieve this, but a lot can happen in 36 years...

- In 1933 the world was still emerging from the great depression but by 1969...
- Today, solar panels cost 90% less than in 1980 and 50% less than in 1998
- 20 years ago very few people had an email address
- 7 years ago very few people had a smartphone



Some decarbonisation is already underway

	Target	Activity	Domestic goals
<div>CHINA</div> 	<p>-40 to -45% emissions intensity from 2005 to 2020</p> <p>15% renewable energy by 2020</p>	<ul style="list-style-type: none"> Peak coal consumption by 2020 Coal power banned from major cities by 2020 7 pilot emissions trading schemes 	<ul style="list-style-type: none"> Reduce air pollution Become global leader in green technologies and renewable energy Energy security
<div>USA</div> 	<p>-17% emissions from 2005 to 2020</p> <p>-83% emissions from 2005 to 2050</p>	<ul style="list-style-type: none"> 35 states with renewable targets 23 states with energy efficiency targets Clean Power Plan could cut carbon by 30% vs 2005 	<ul style="list-style-type: none"> Reduce dependence on foreign oil Reduce energy costs Drive innovation in energy technology
<div>EU</div> 	<p>-20 to -30% emissions from 1990 to 2020</p> <p>20% renewable energy by 2020</p>	<ul style="list-style-type: none"> EU Emissions Trading Scheme that operates in 28 countries Effort Sharing Decision that sets national targets for non-ETS emissions 	<ul style="list-style-type: none"> Improve productivity and competitiveness Energy security Jobs creation



Next steps

UN PROCESS



2014

Sep 2014
Climate Summit in
New York

2015

Dec 2015
COP21 in Paris

GLOBAL DDPP



July 2014
DDPP Interim Report

2015
Further analysis and
DDPP Phase 2 report

AUSTRALIAN DDPP



Sep 2014
Initial Australian
report

Oct 2014 – July 2015
Domestic engagement
& further analysis

Mid 2015
Follow up
Australian report



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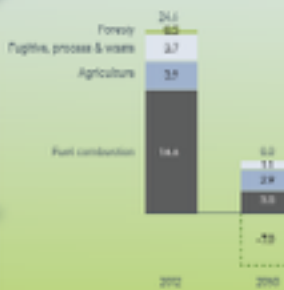
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FOR FURTHER INFORMATION:

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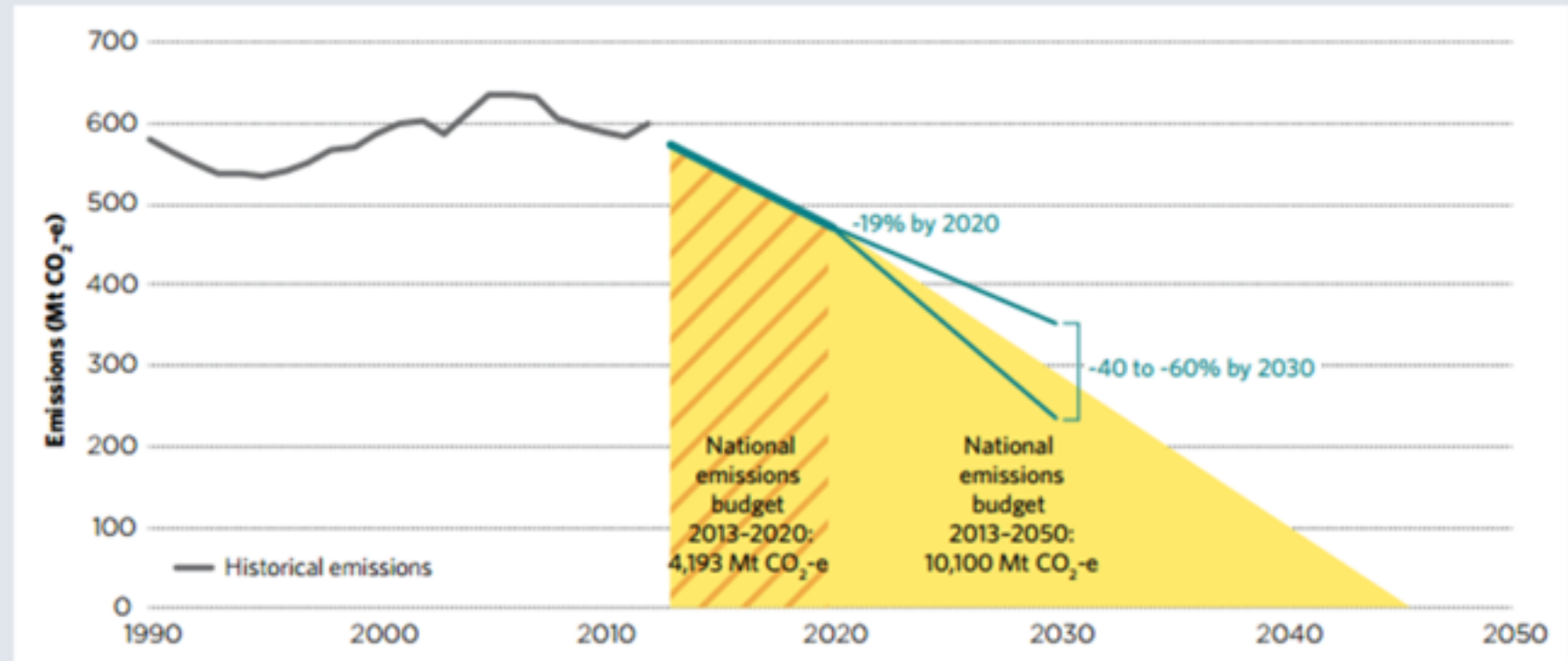
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Head of Research

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Cumulative carbon budgets

FIGURE 1: RECOMMENDED EMISSIONS REDUCTION GOALS



Recommended equitable trajectory for Australia (CCA 2014)

