

Draft Energy Efficiency Forecasts

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AEMO Forecasting Reference Group



Brief



- Produce forecasts of energy efficiency attributable to specific policy measures to FY2041 and historical estimates from FY2001
 - Annually for each state and territory, electricity and gas; residential, commercial and industrial sectors (as defined); baseload (inc. hot water) and temperature-responsive portions of the load (heating, cooling); and each AEMO scenario
- Scope does not include documenting *total* energy efficiency change, but focuses on the impacts of significant policy measures
 - Estimates aim to represent the additional or incremental impacts of measures relative to a counter-factual 'without measures' scenario
 - which includes the changes to technology, markets that would have been expected to occur in any case
 - Includes consideration (and management) of double-counting risks between measures

Notes for interpretation of results



- Savings quantified are relative to the base year FY2001
- The historical impact of measures is, by definition, already present in consumption data (as avoided consumption)
- Projections based on linear regression analysis implicitly assume past efficiency impacts continue into the future
 - But these may over- or under-state *expected* future savings, when policy settings or impacts are changing
 - Our analysis can be used to adjust projections for the *differences* between linear projections and current expectations

Disclaimer



- First draft results and, in some cases (residential), not yet complete
 - There may well be revisions once the draft models are thoroughly reviewed
- Some research still to conduct – as noted below
- Not for citation or circulation except as specifically authorised by AEMO

Notes on methodology



- Three separate models this year
 - Industrial is new (defined as Div. B mining but excl. coal mining and coal seam gas; Div. C manufacturing but excl. aluminium; Div. D electricity, gas, water, waste)
 - Commercial defined as 'other business' (Div E. construction, commercial and services (F, G, H, J, K, L, M, N, O, P, Q, R, S), Div I transport, postal and warehousing; coal mining and coal seam gas)
 - Residential
- Bottom-up models of housing and non-residential stock turnover and energy use and policy impacts over time, reconciled with historical consumption (by fuel, state) and with Census/ABS dwelling counts for residential
 - Account for historical fuel switching
 - Allowances for autonomous/natural energy efficiency improvement
 - Discounts for non-additionality of certain policy impacts
- We model energy total energy consumption regardless of source, so must account for the share that is not revealed in metered consumption: behind the meter PV (and some cogen)

Measures modelled



- Residential:
 - Building code/BASIX
 - Greenhouse and Energy Minimum Standards (GEMS)
 - Energy Savings Scheme (ESS) (NSW)
 - Victorian Energy Efficiency Target/Energy Upgrades (VIC)
 - Retailer Energy Efficiency Scheme (SA)
- Commercial
 - As per residential, plus:
 - NABERS
 - Commercial Building Disclosure (CBD)
- Industrial
 - Energy Efficiency Obligations (EEO) program (closed in 2014)
 - GEMS
 - ESS

Innovations since 2018



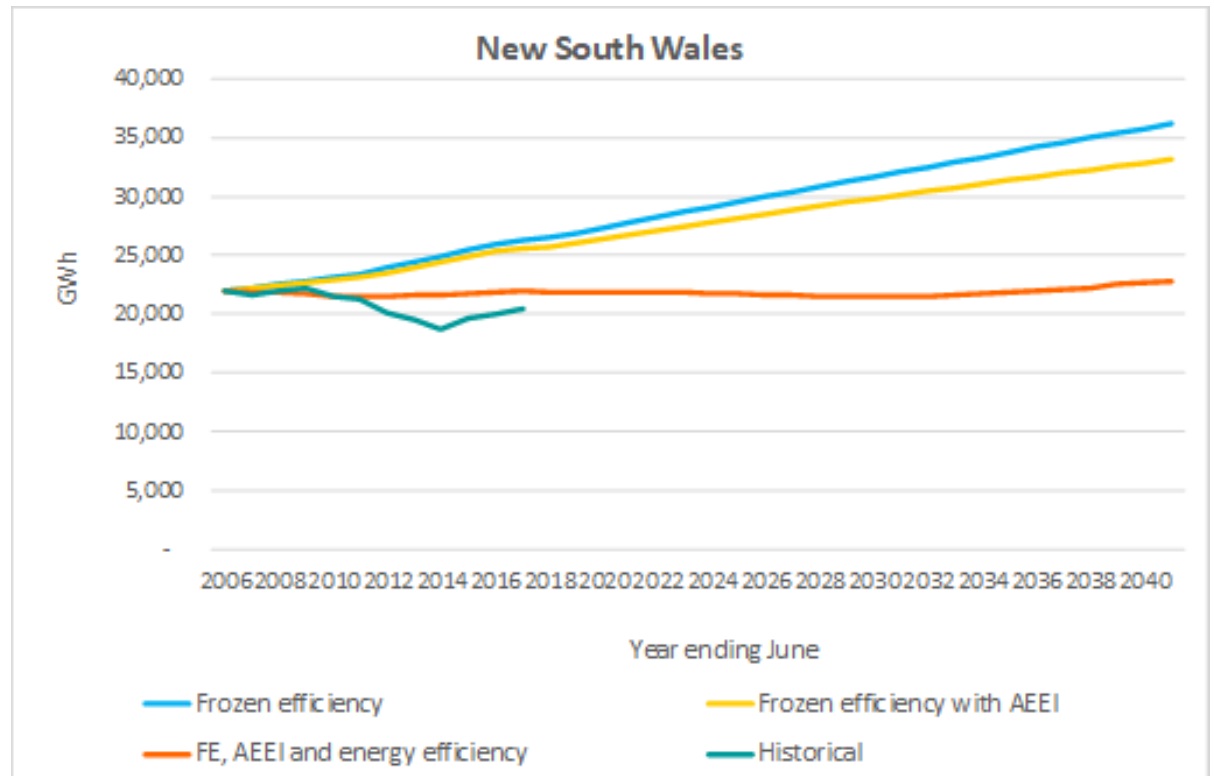
- Built a new housing stock model which:
 - Uses a new ABS series (*Household and family projections* Cat No. 3236.0 released 14/03 /2019) to project future mix of dwelling types (houses, townhouses, apartments) on future mix of household types;
 - Reconciles population underlying total household numbers in these ABS projections with AEMO population projections;
 - Uses Census data 2001 to 2016 for historic stock, including household type/dwelling type relationships
- Different approach to defining the temperature-responsive portions of the load – discussed later.

Known unknowns:



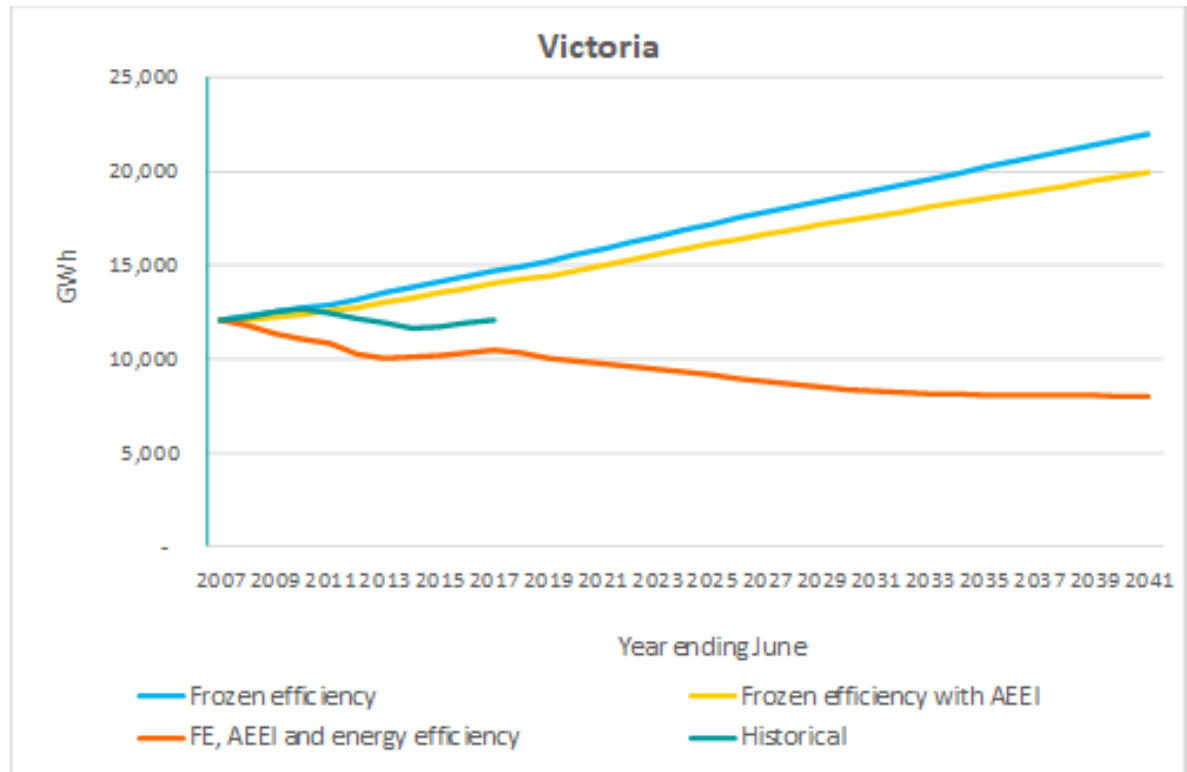
- For residential
 - Census data consistently, though erratically, under-estimate household and dwelling numbers
 - Demolition rates are not recorded/published – very important for the rate at which Code impacts take effect
 - Conversions from one Class to another poorly documented
 - Behind-the-meter PV consumption must be estimated
 - Key ABS collection on end-use and related behaviours ceased in 2014.
- For commercial, much greater uncertainty than residential
 - Energy consumption is published by ANZSIC code, which don't align with building classes and may include some process use of energy
 - A *significant* discontinuity in Australian Energy Statistics was discovered – 33 PJ (9,250 GWh) jump for electricity consumption between FY2002 – FY2003 (managed in consultation with the Office of the Chief Economist)
 - Stock size and turnover poorly documented – therefore it is modelled and outcomes (energy use) reconciled with historical estimates (but see above!)
 - Behind-the-meter PV consumption harder to estimate than for residential (shortcoming in AER RIN data)
- Industrial sector - AEMO surveys the main approach, but we quantify the (few) policy interventions
- Currently a lack of agreement between AES and AEMO consumption data for industrial and commercial – likely due to different categories

Draft Results – Residential NSW



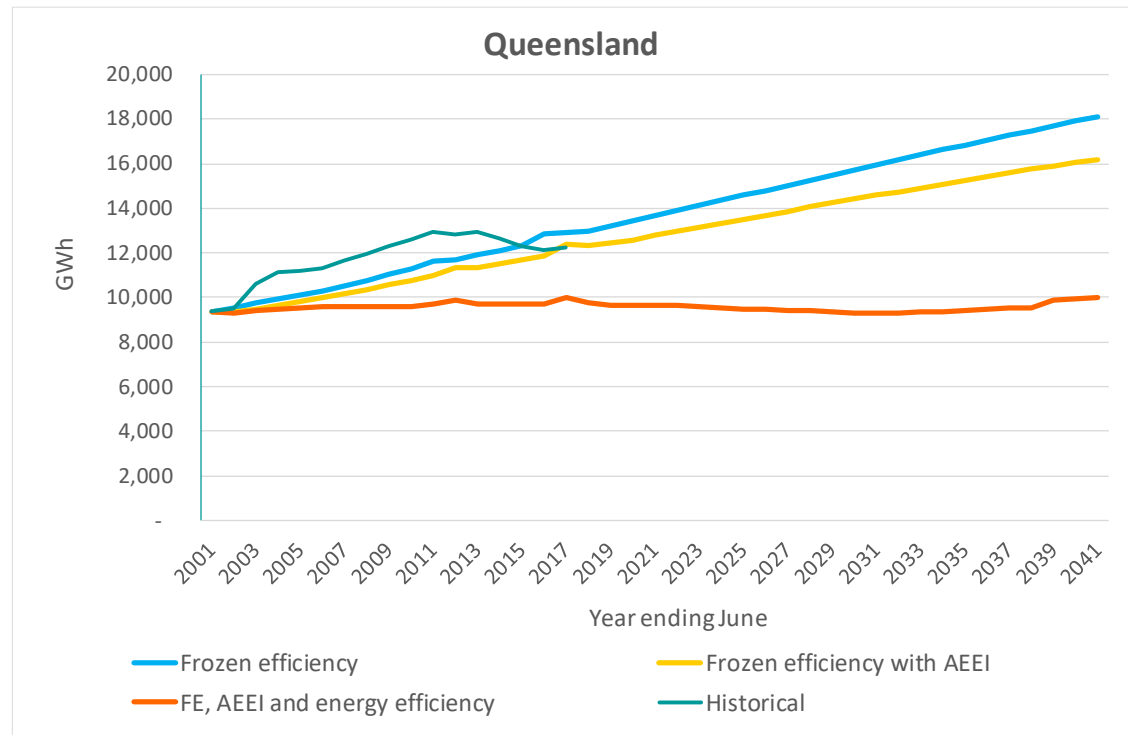
- Model slightly over-estimates actual consumption in 2008 – 2017 – likely the 'price shock' effect
 - NB: neutral scenario

Draft Results – Residential Victoria



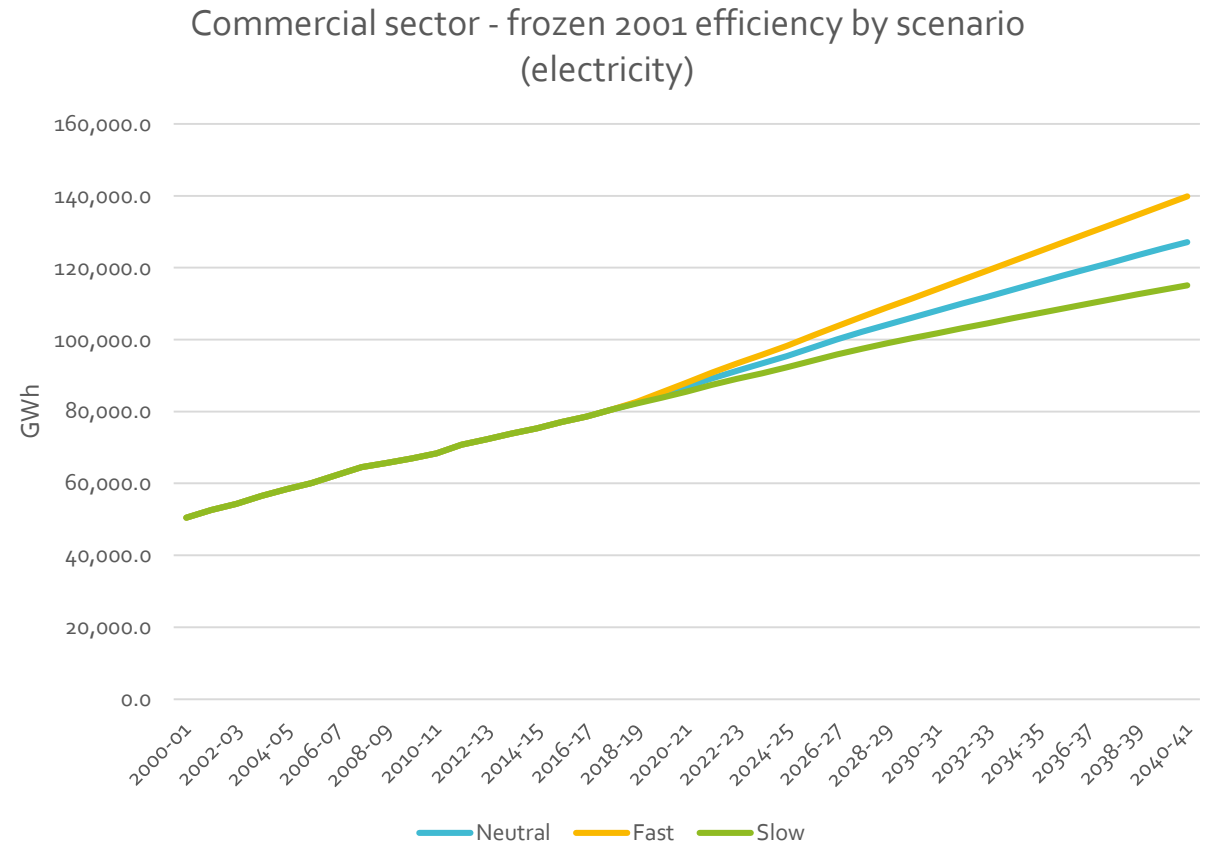
- Vic. Model is currently under-estimating actual demand – to be further investigated
 - Neutral scenario

Draft Results – Residential Queensland



- Qld model under-estimates historical consumption
- Generally, residential model is incomplete, with complete model expected next week

Draft Results - Commercial

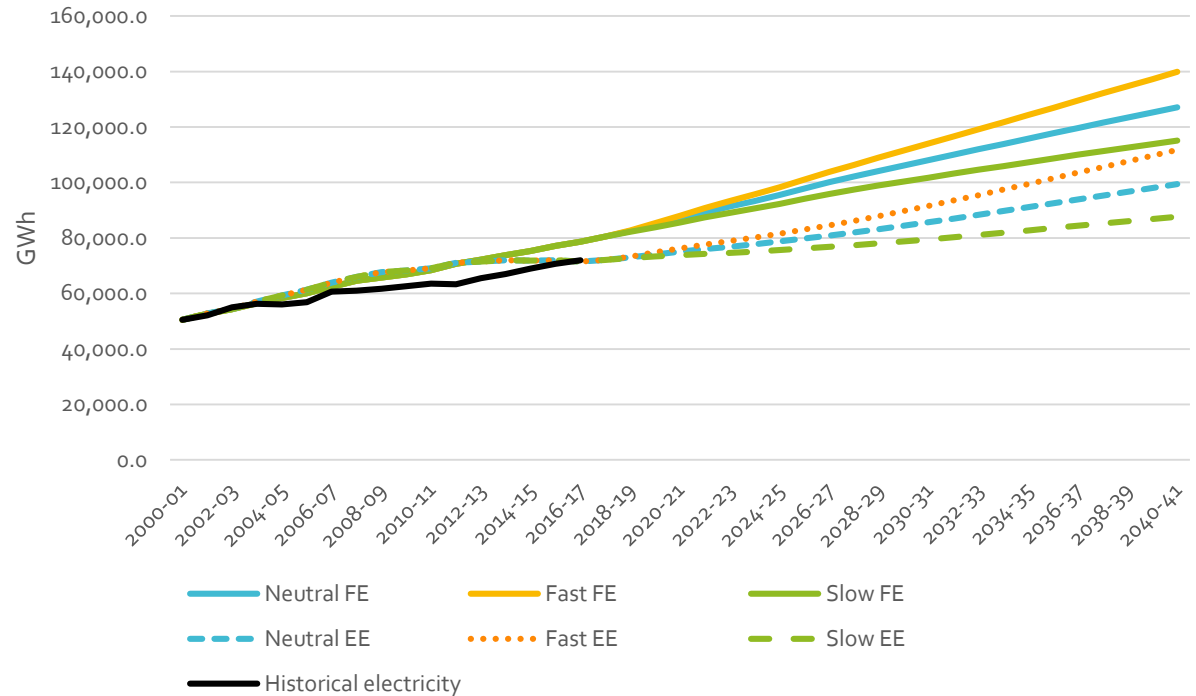


- Frozen efficiency by scenario projection indicates the sensitivity of consumption (before EE and other effects) to GDP growth
 - Net commercial stock growth (floor area) is modelled as responsive to GSP growth

Draft Results - Commercial



Commercial sector - frozen 2001 efficiency, and EE, by scenario
(adj. for AEEI and historical fuel switching - electricity)

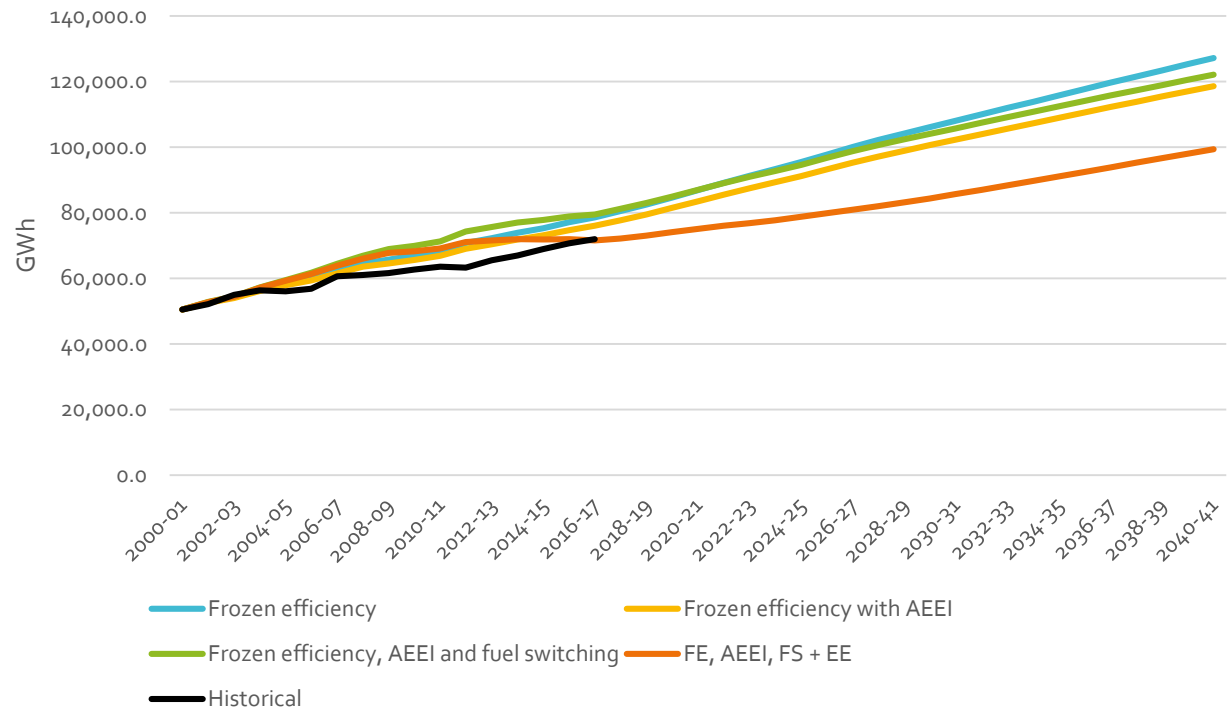


- Summary of the gap between frozen 2001 efficiency and consumption (electricity) reflecting policy measures, AEEI and historical fuel switching (by state)
- Model is currently over-estimating consumption in 2005 – 2016
 - Potential factors: stock growth may have slowed (rel. to GSP growth); behind the meter PV; behavioral responses to price shock; fuel switching behaviours

Draft Results - Commercial



Draft Results - Commercial Sector - Neutral Scenario - Australia
(electricity)

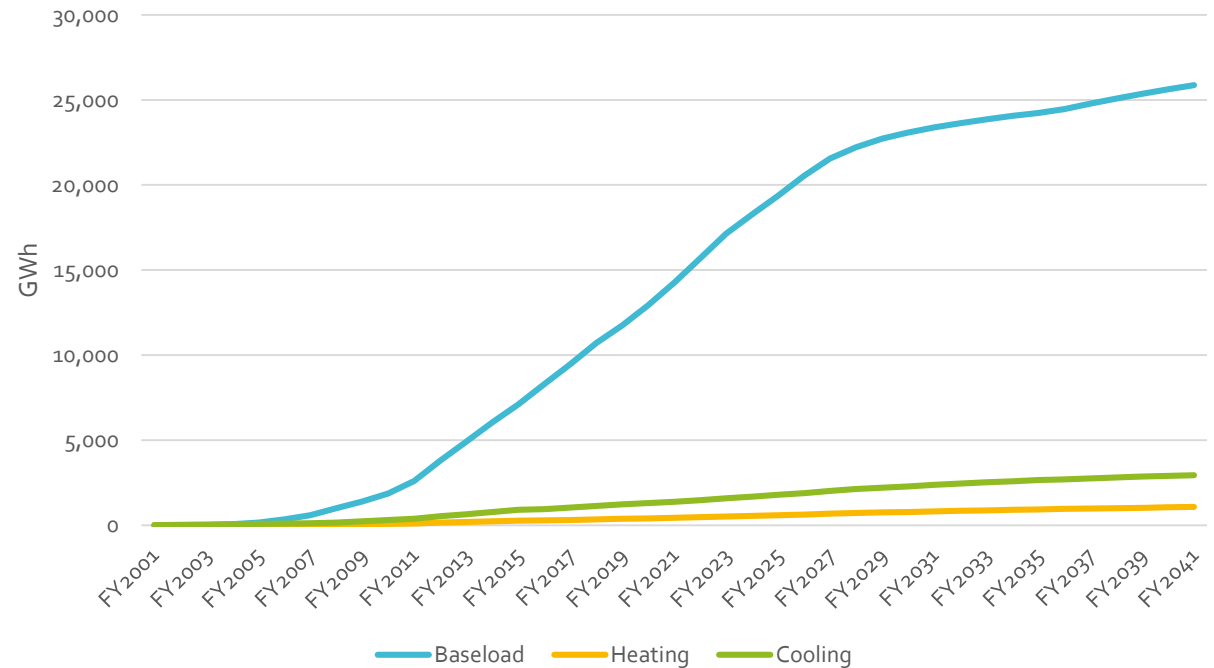


- Illustrates *components* of the change from frozen efficiency to expected consumption – neutral scenario
 - AEEI reduces consumption; fuel switching increases electricity consumption (most but not all states); efficiency reduces consumption

Draft Results - Commercial



Commercial Sector - Avoided Electricity Consumption by Load Segment - Neutral Scenario - Australia

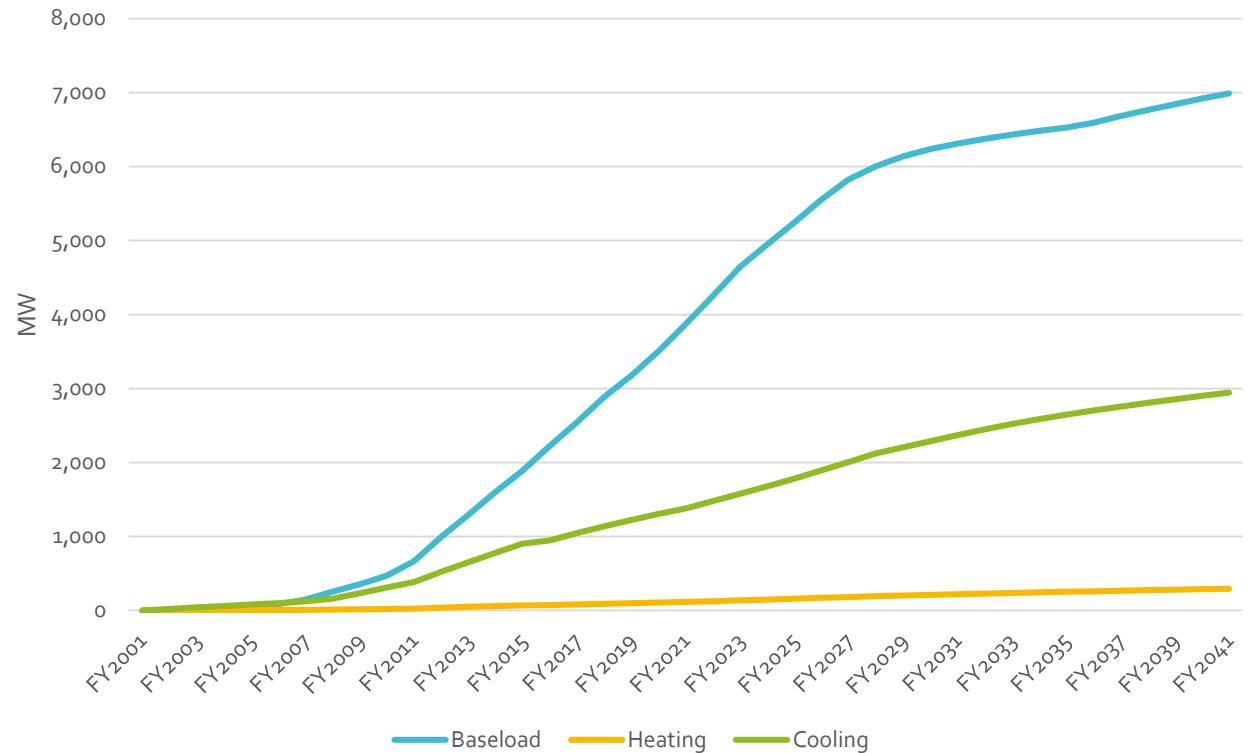


- Avoided consumption is primarily being generated by avoided baseload consumption
- Reflects a change in definition of 'heating' and 'cooling' to 'temperature responsive' portions of the load – smaller shares of the total than last year
 - Eg, HVAC systems consume significant energy even at moderate temperatures

Draft Results - Commercial



Avoided maximum demand (relative to FY2001) - commercial sector - neutral scenario - Australia



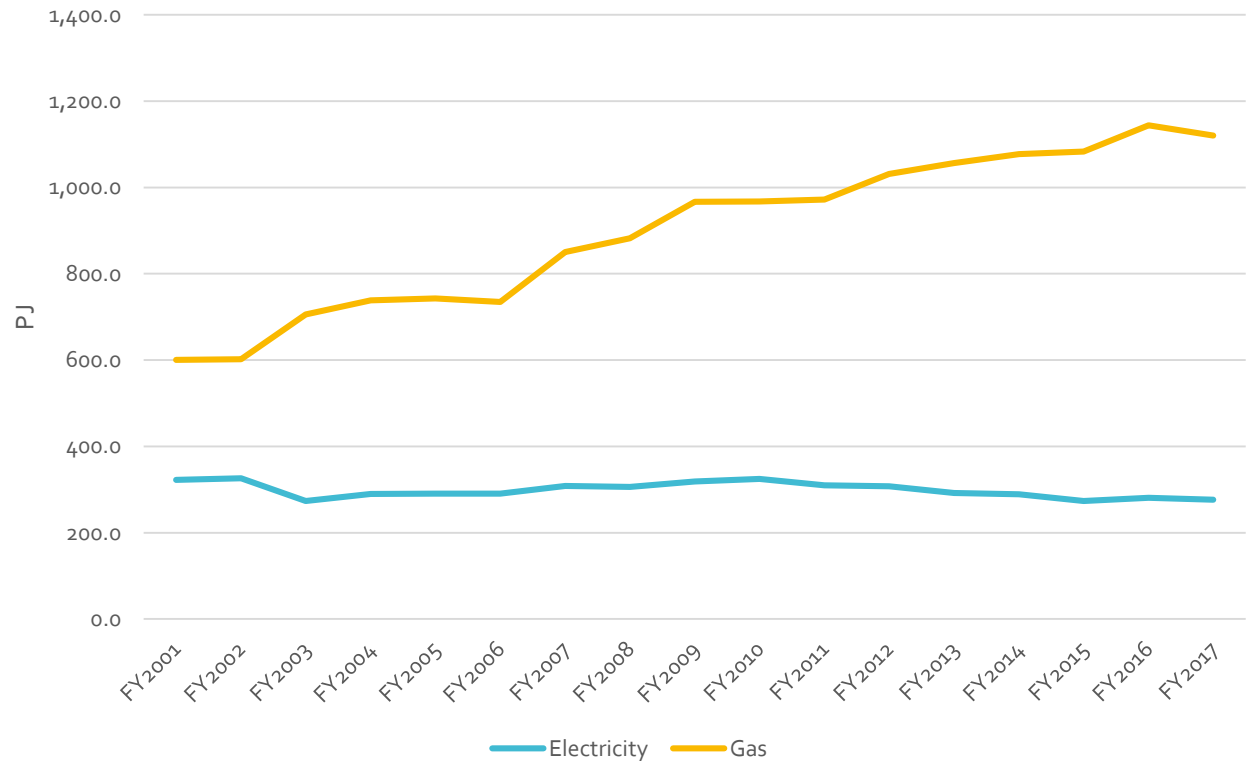
- As a result, avoided maximum demand is primarily being generated by avoided baseload consumption
 - At the moment, NABERS, CBD, state schemes assumed to generate mainly baseload savings (lighting the single largest contributor) – may be able to refine this in consultation with states/program managers
 - Conservation load factor 0.4 as per 2018

Draft Results - Industrial



Historical consumption 'other industrial' (as defined)

Source: Australian Energy Statistics

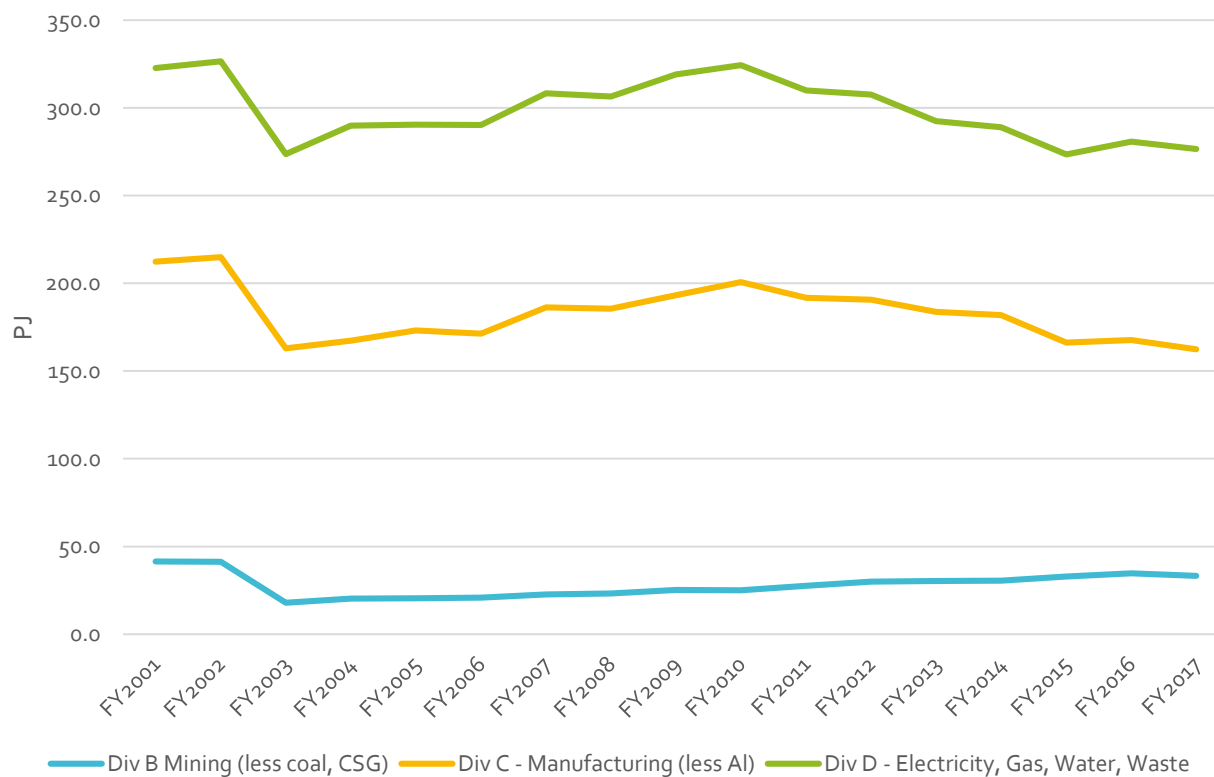


- Significant growth in gas use, and some reduction in electricity use, over time

Draft Results - Industrial



Historical electricity consumption 'other industrial' (by ANZSIC Division) Source: Australian Energy Statistics

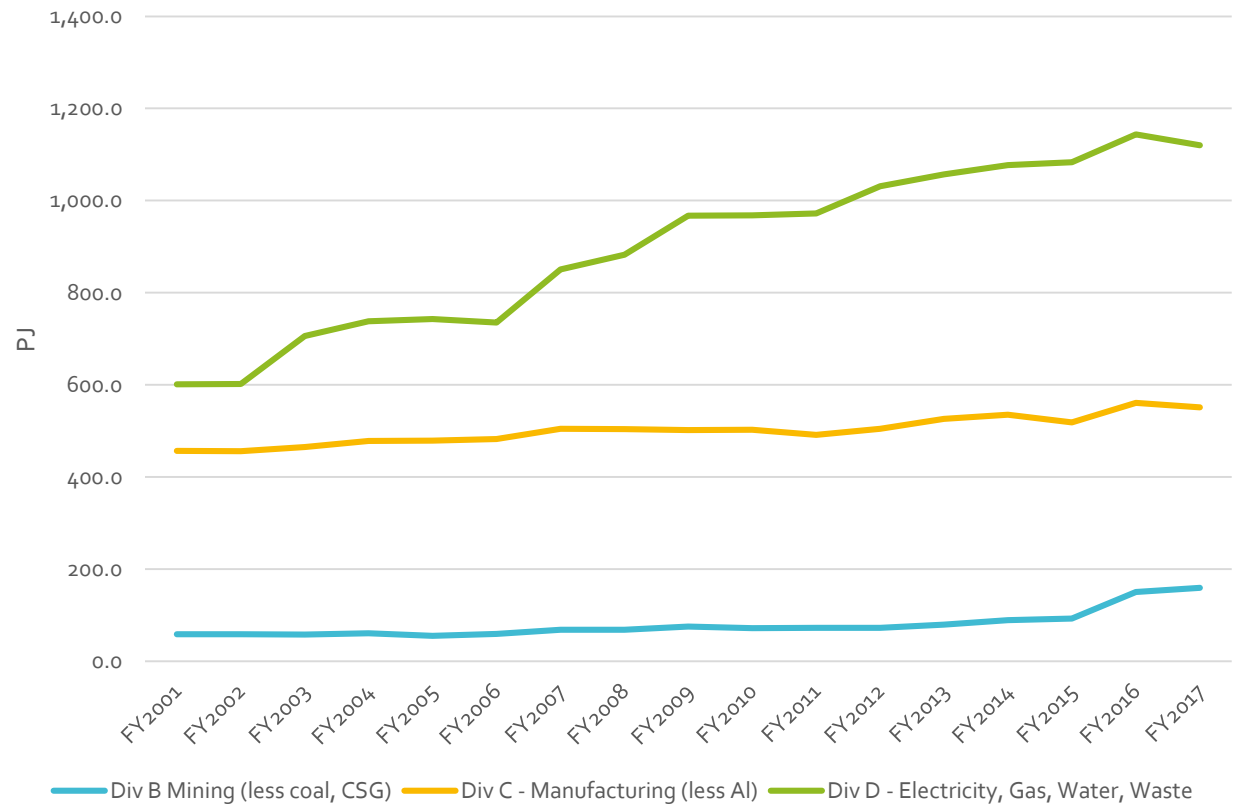


- Electricity consumption in Div D is gross consumption (excluding electricity generation)
- Could be another AES discontinuity at work between FY2002 - FY2003

Draft Results - Industrial



Historical gas consumption 'other industrial' (by ANZSIC Division)
Source: Australian Energy Statistics

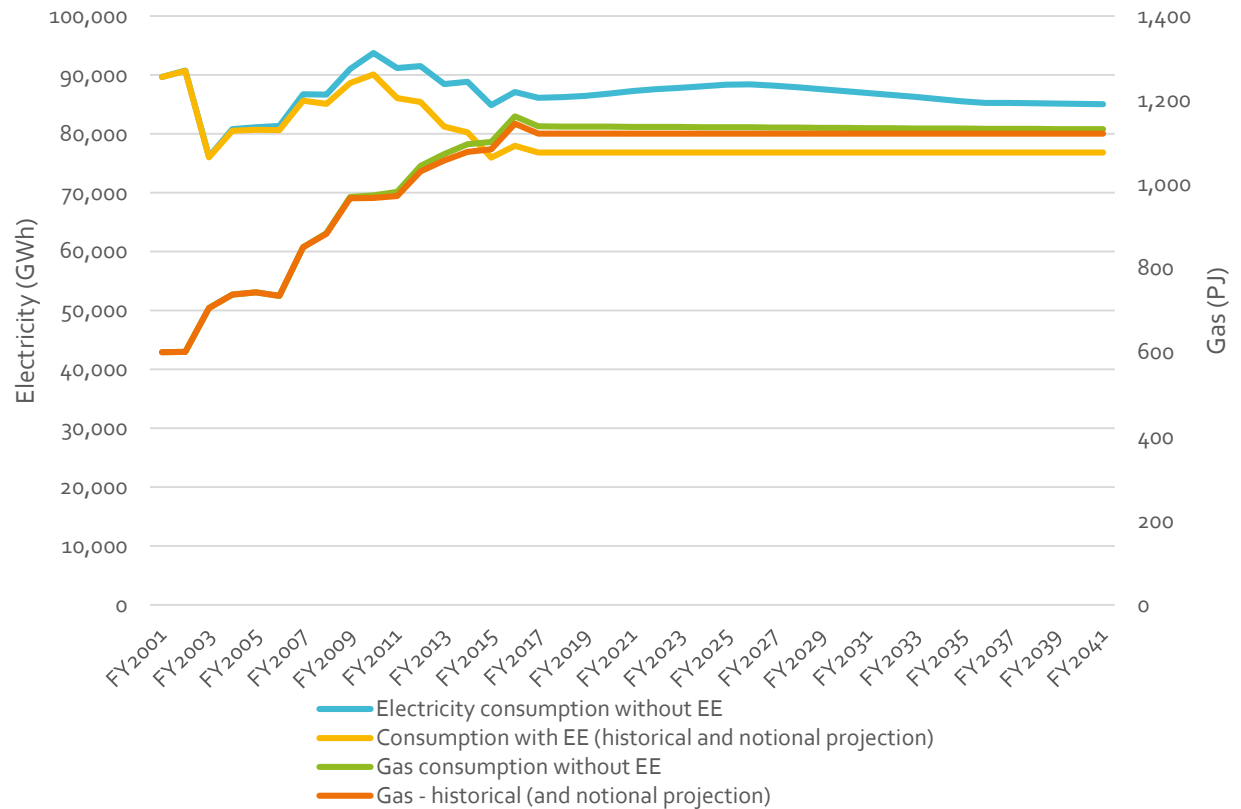


- Gas consumption does not appear to be affected by discontinuities
- Main growth (but slowing) in Division D

Draft Results - Industrial



Industrial EE cf historical (and notional projection), Australia

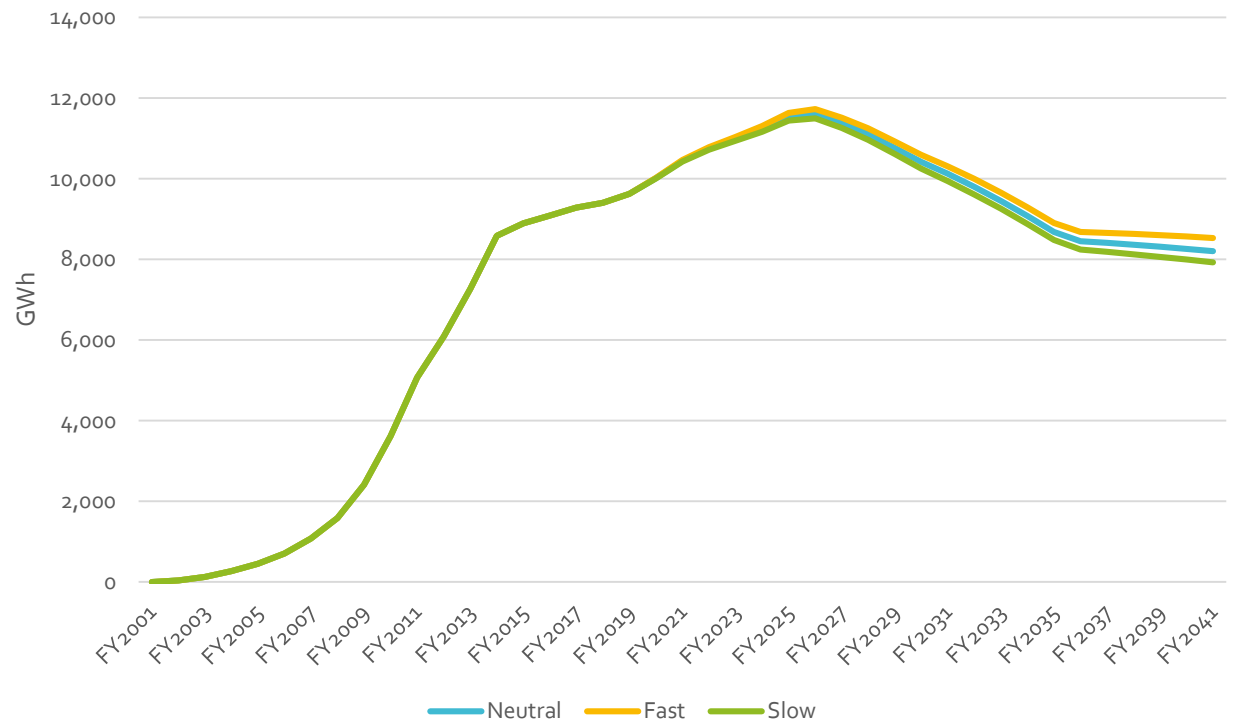


- Overall savings are small relative to consumption
- Electricity savings more significant than for gas
 - GEMS covers electricity, not gas
 - ESS (understood to be) weighted towards electricity
 - EEO savings weighted towards gas

Draft Results - Industrial



Industrial Sector - Avoided Electricity Demand by Scenario - Australia

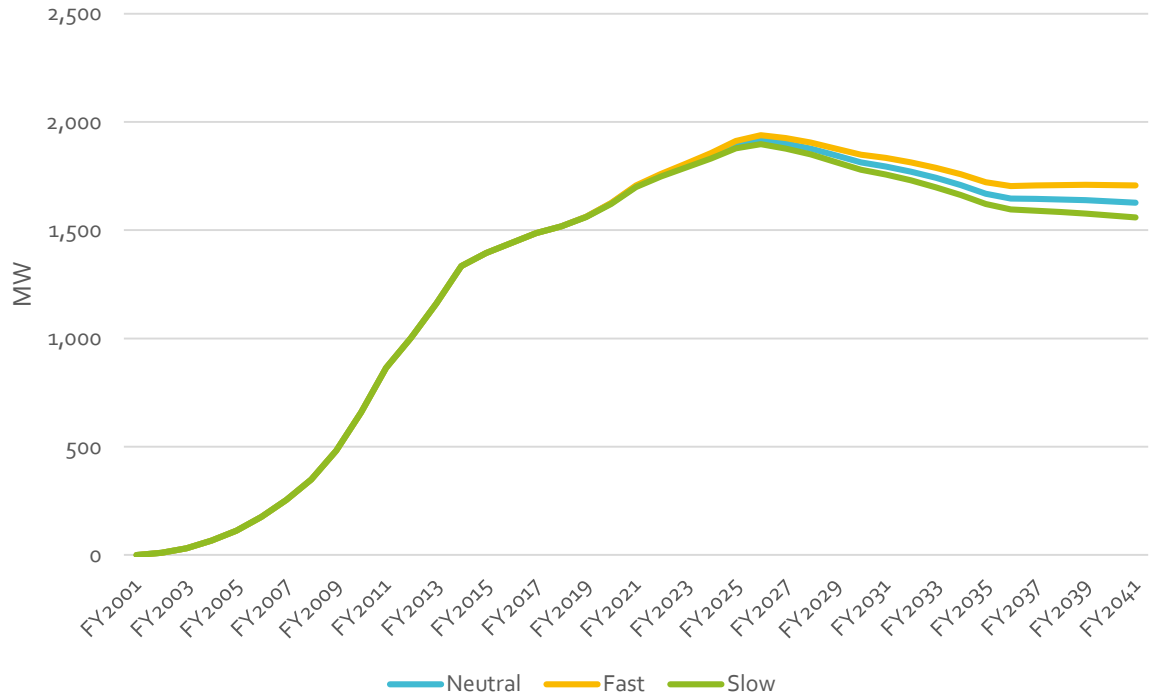


- Savings only weakly differentiated by scenario
 - EEO (closed in 2014) assumed to have legacy impacts, but not differentiated by scenario
 - GEMS, ESS are differentiated by scenario, but industrial sector savings are not large

Draft Results - Industrial



Avoided maximum demand - industrial sector - electricity - by scenario



- Similar pattern for avoided maximum demand
 - Savings assumed to be all baseload
 - CLFs differentiated by end-use for GEMS; assumed to be 1 for ESS, EEO.

Further work



- Complete all residential states
- General review and QA
- Estimate behind-the-meter PV, residential and commercial
- Examine/improve historical model fit
- Temperature-responsive savings from NABERS, CBD, state schemes?
- Further consideration of double-counting risks
 - Also, additionality to BAU – with LED lighting a particularly difficult case
- Industrial CLFs; temperature-responsive component? (eg, cool rooms, refrigeration)
- Further discussions with Office Chief Economist re AEMO/AES data fit and discontinuities
- Fuel switching behaviours?
 - Can we examine by end use and fuel?

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