Energy Efficiency Workshop

MARCH 2021

Strategy. Policy. Research.

Making the business case for sustainability

Definitions

- Energy efficiency is the amount of output or useful work done (*exergy*) per unit of energy consumption (eg, mpg)
  - Very often, we refer to energy *intensity*, which is the inverse of efficiency, or energy consumption per unit of output or useful work (eg, litres per 100kms)
- Note that historical energy efficiency (both market-led and policy-induced) is already included in historical consumption data
  - As a result, projections that draw on historical consumption data include energy efficiency effects – albeit often not transparently
  - In effect, we are seeking to identify how much larger annual consumption would have been/will be, due to energy efficiency change?
  - EE can also be thought of as *avoided consumption*

Approach

- Two key methological approaches:
  1. Factorisation analysis – this approach, pioneered by the International Energy Agency, disaggregates total change in (E)nergy or (E)missions over time into components including change in (S)tructure, (A)ctivity and (I)ntensity

$$E = A \sum_j S_j * I_j .$$

     - The intent is to determine the extent to which each effect (change in structure, activity, intensity (efficiency), and also fuel mix, contributes to the overall change in energy consumption
  2. Stock turnover modelling (by climate zone)
     - Considering the rate of new construction activity, retirements and demolitions, and the (average) energy intensity of the different stock elements as a function of their climate zone and vintage – mapped to jurisdictions

- We aim, first, to measure total annual EE change in the historical period, as this acts as a limit on the sum of market-led and policy-induced efficiency change
  - The market-led component is estimated with reference to literature or assumptions on 'autonomous' energy efficiency improvement
  - Policy measure impact is estimated bottom-up, drawing on key policy parameters and public reporting (supplemented in some cases by additional information from program managers)
    - Policy measures are discounted for non-additionalities to AEEI and/or other policy measures
    - Policy settings and demand drivers (GSP, population, etc) vary by scenario

Known Issues

1. Energy consumption data
   - Knowing how much energy is consumed in different market sectors and segments should be straightforward but…
     - AEMO's market segmentation differs from other sources (eg, Australian Energy Statistics, which is organised by ANZSIC classes)
     - The fraction of energy consumption by Large Industrial Loads (LILs) and SMEs by ANZIC class is difficult to estimate, primarily due to reporting and confidentiality constraints
     - AES and AEMO data show different trends over time, even adjusting for behind-the-meter renewables
       - This frustrates analysis of total EE change over time

2. Output data (also activity and structure)
   - Count/floor area of housing is relatively well known (Census), but BMM Commercial floor area is not known with confidence
     - New Commercial Building Baseline Study underway this year
   - Industrial output is not in the public domain
   - Overall, the key elements required to examine total EE change over time are *significantly uncertain*
     - Structural change at sub-sectoral level is likely to be impacting significantly on higher level observations of efficiency (intensity) change over time (eg, shifts from very-energy intensive to less-energy-intensive manufacturing)

Known Issues

3. Market-led efficiency change
   - The least well-understood component of total efficiency change
   - In principle, best measured as total EE change minus policy-induced change
     - Two key uncertainties are 1. total change in efficiency, as above, and 2. attribution – how much of the change would have occurred without policy? This can be analysed using *techno-economic analysis*, but this does not occur in Australia
     - There are some segments where outcomes 'additional to policy' are clear – eg, LED lighting and premium offices. However, even these two cases are also 'claimed' by numerous policy measures
       - Also, there are case studies in jurisdictions where policy has lagged, eg, commercial buildings in the NT
     - Generalising about market-led efficiency would require extensive analysis and significant data access at the end-use level – practically, neither of these are available in the short term

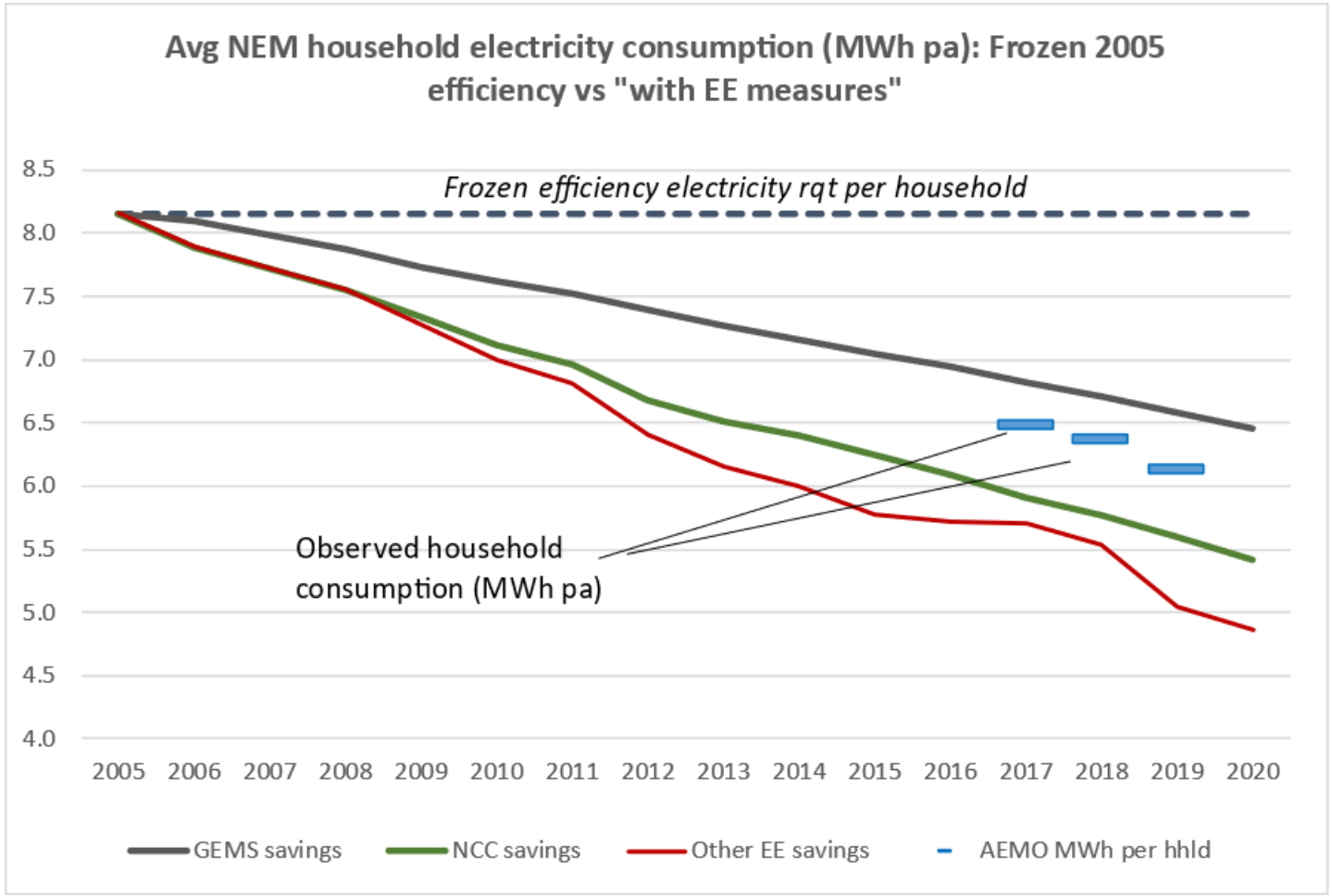
4. Policy-led efficiency change
   - Program/policy reporting can be misleading, as it often includes varying degrees of non-additionality to market-led change and/or to other measures
     - Independent evaluations, that specifically examine additionality, are the best source of data on real policy/program impacts, but these are rarely commissioned and even more rarely published
     - Some measures, like VEU and ERF, use carbon metrics, to it is not certain how these will to energy outcomes, particularly over time

Draft Results - Residential

- Residential EE savings reflect national and state EE drivers
  - National: GEMS, NCC
    - Taking into account state variations under NCC
  - State: NSW ESS, Vic VEU, SA REPS (formerly REES)
    - in additional to background levels of AEEI ≈ 0.5% pa
- For higher ambition scenarios, we add 'other states' schemes, modelled on NSW/VIC/SA approach

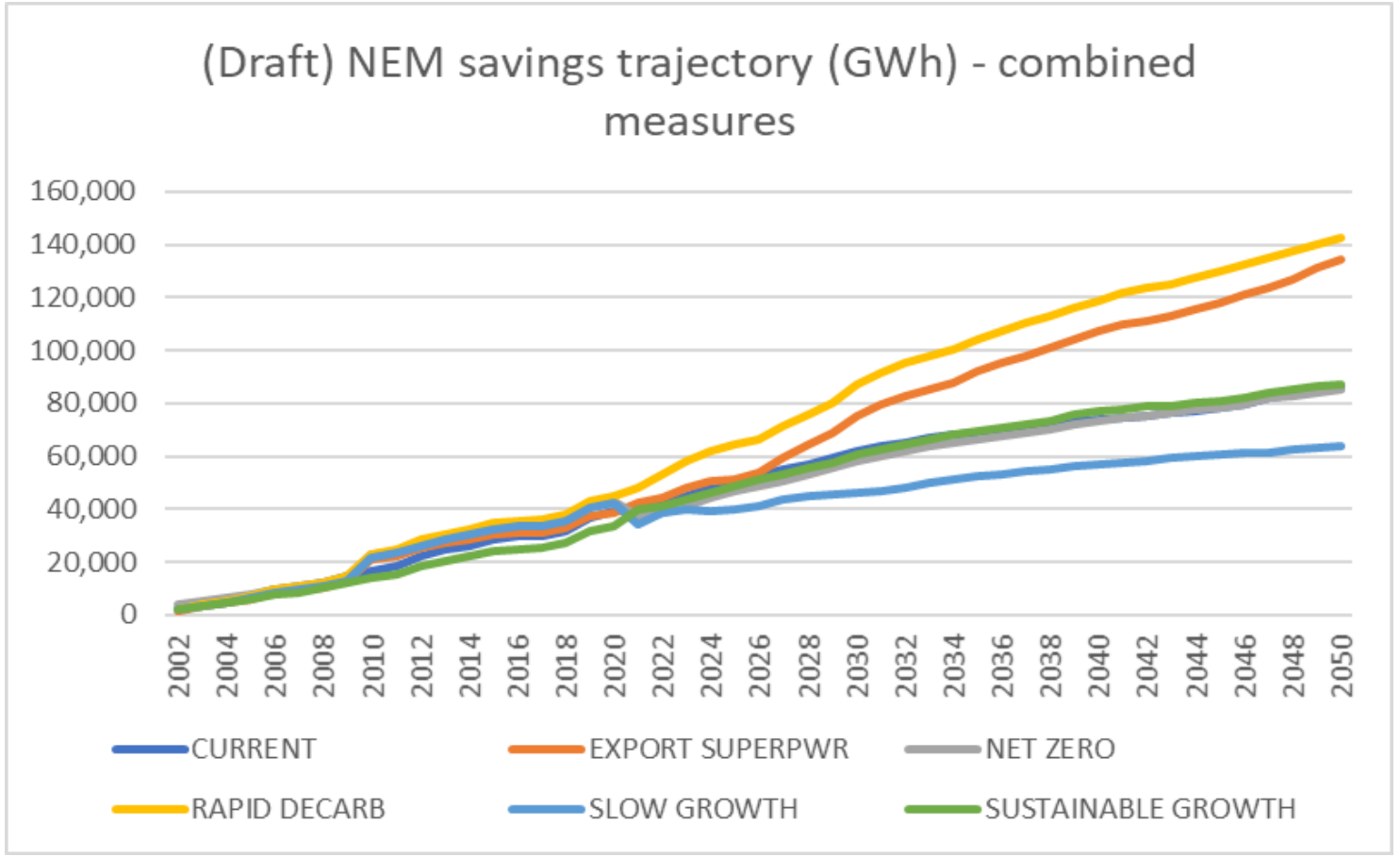
Draft Results - Residential

- Historical analysis: highlights the dampening effect of EE 'wedge' on underlying residential electricity consumption
  - … a saving of around 4.3 MWh pa per household, compared to 2005 average consumption levels, in the NEM



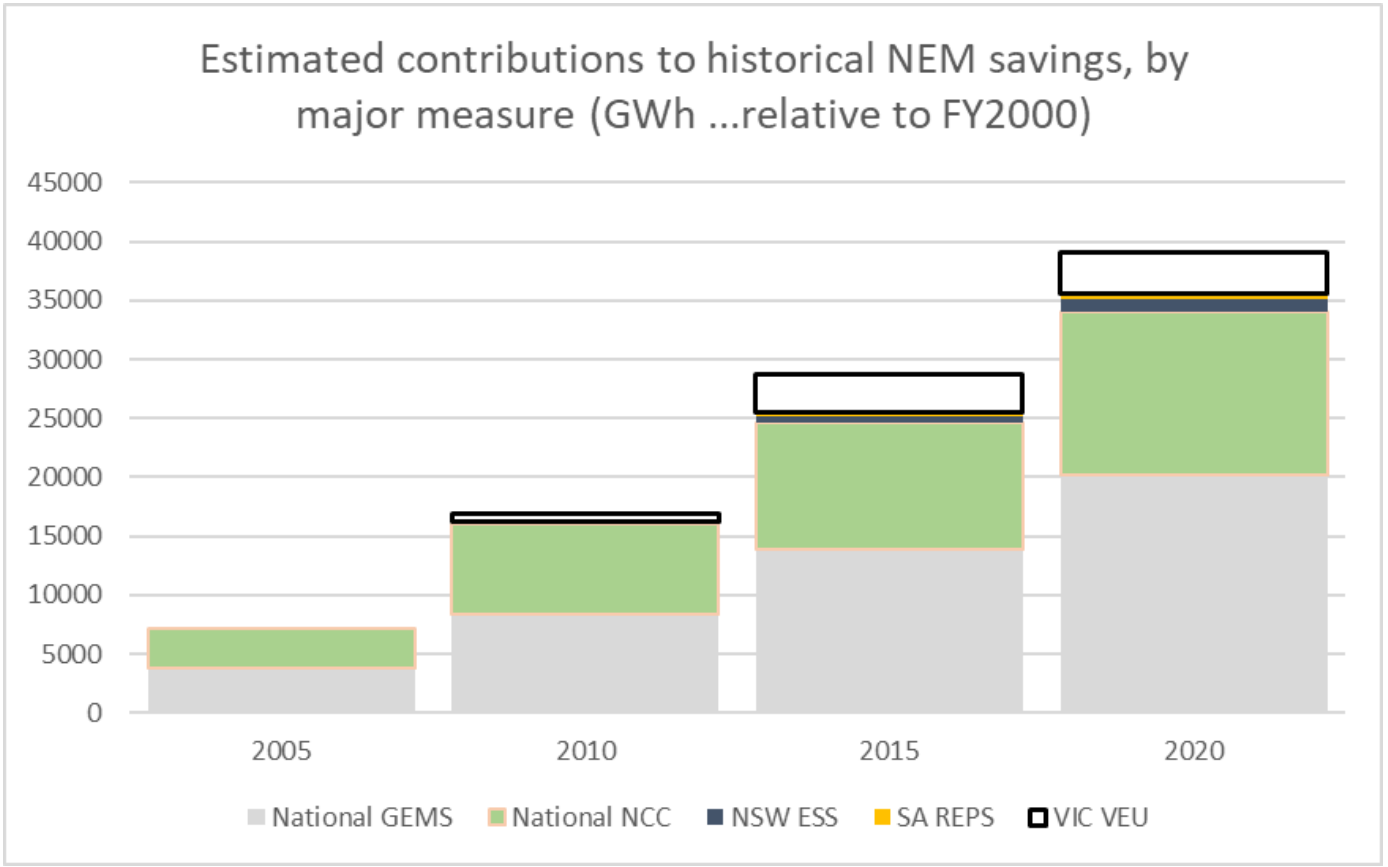
Draft Results - Residential

- EE measures are expected to continue to ameliorate residential energy demand
  - … and have differential impacts across the AEMO growth and policy response scenarios



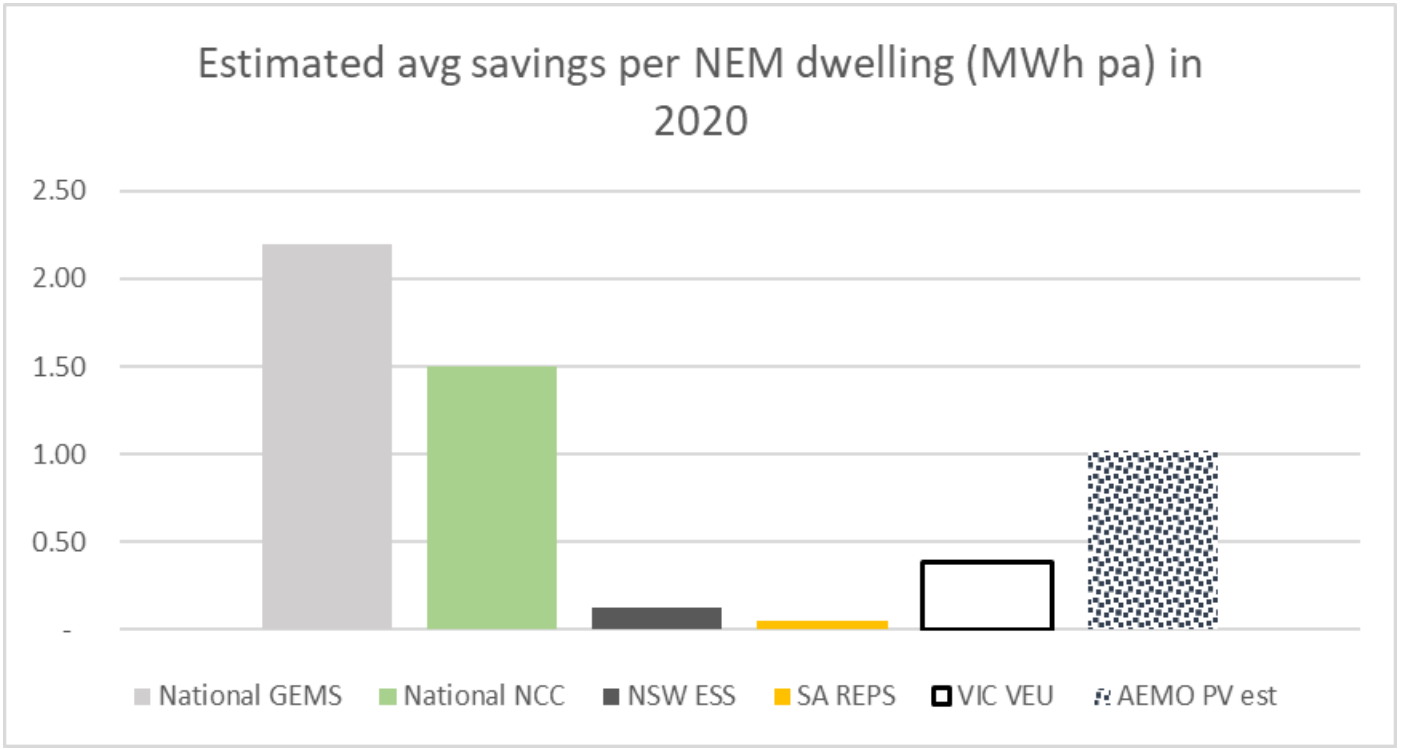
Draft Results - Residential

- State measures are making an increasing contribution to estimated EE savings over time
  - although still modest relative to national measures
  - GEMS and NCC relativities to be reviewed – GEMS may need further discounting



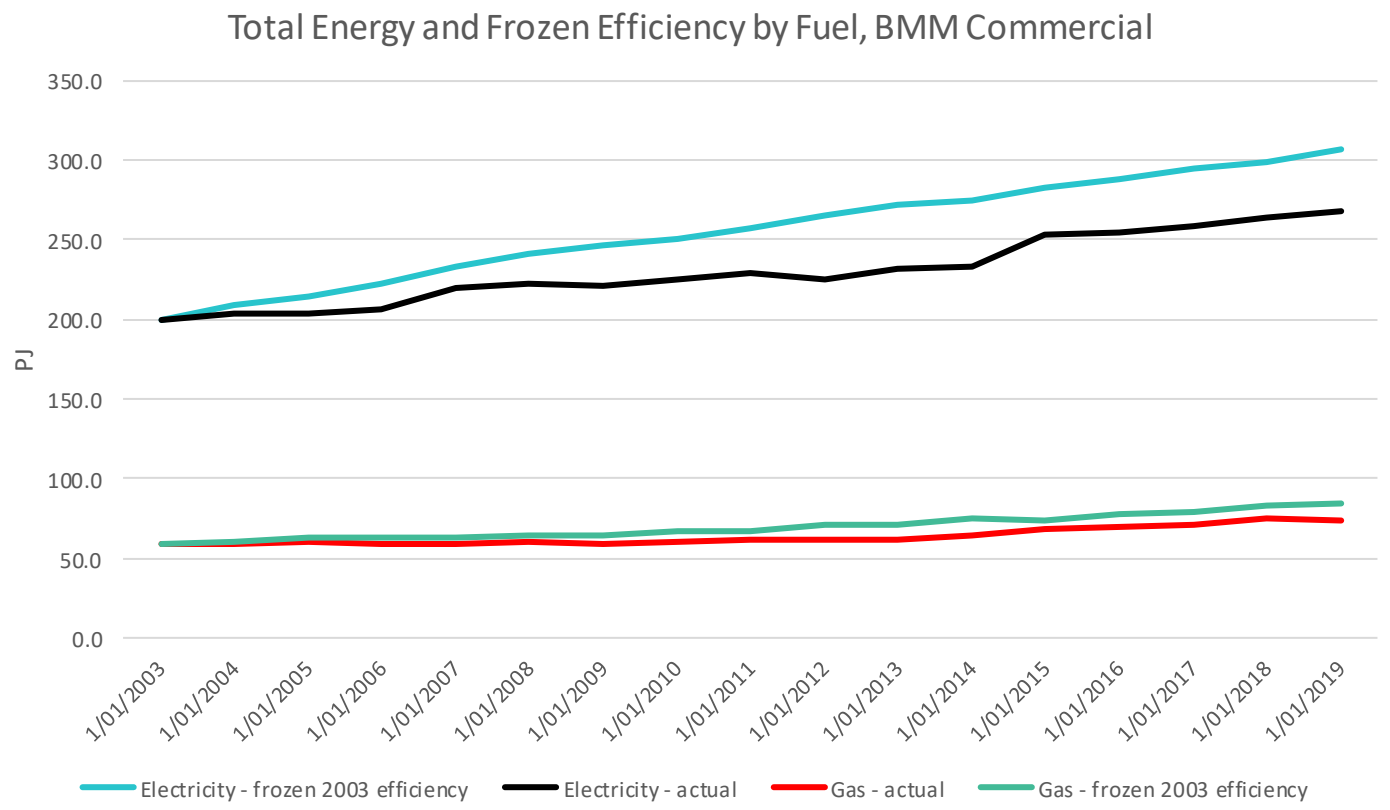
Draft Results - Residential

- Uptake of rooftop solar is an increasing factor in metered energy demand
  - increasing penetration of PV in household sector
  - is already comparable to NCC in its impact on grid sourced electricity in the NEM
  - PV trajectory vitally important in supply & infrastructure planning



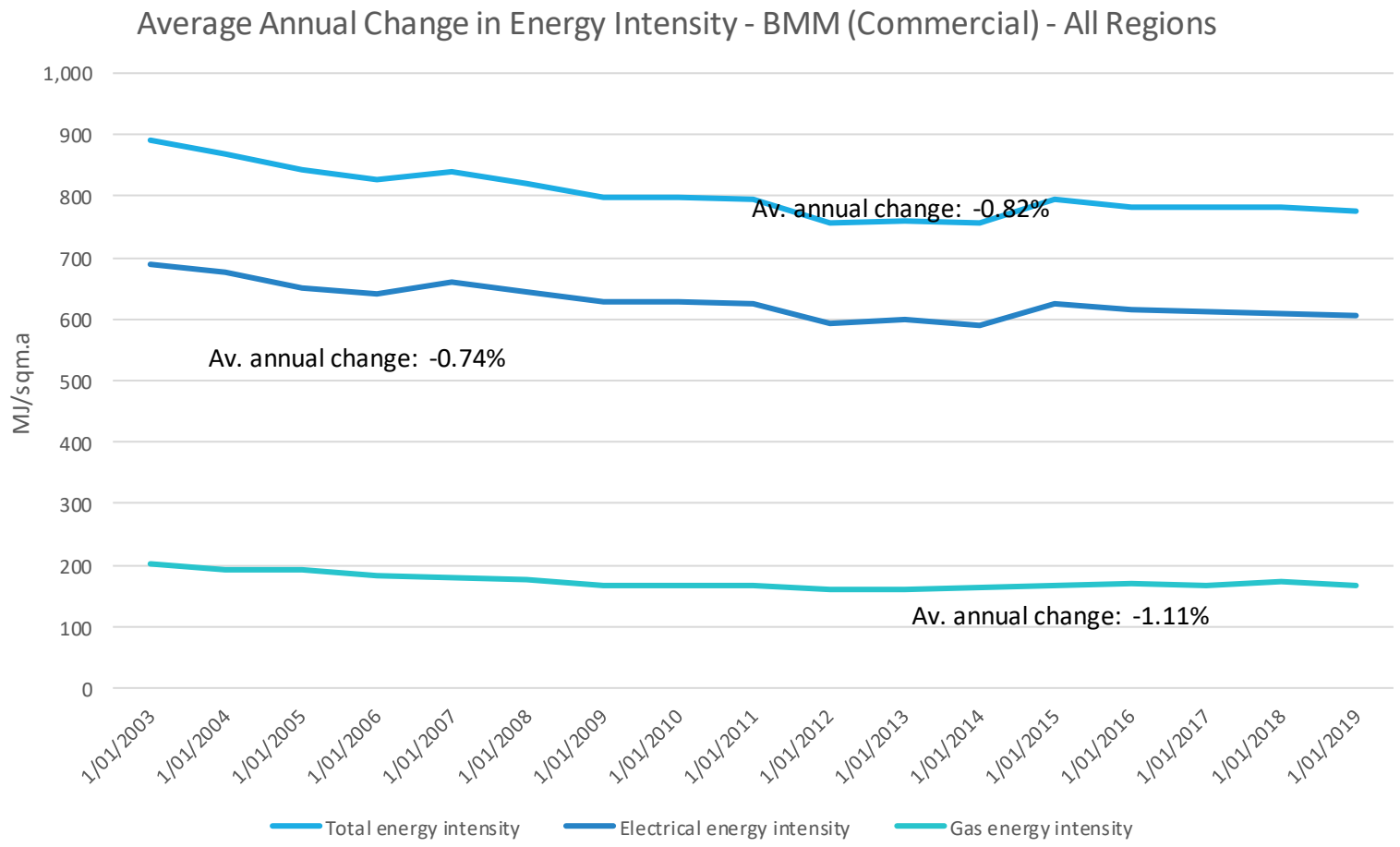
Draft Results – Business Mass Market (Commercial)

- In the BMM Commercial sector, there has also been overall efficiency improvement since 2003
  - electricity consumption in 2019 was 39.2 PJ less than it would have been if there had been no efficiency improvement
  - gas consumption was 10.1 PJ lower



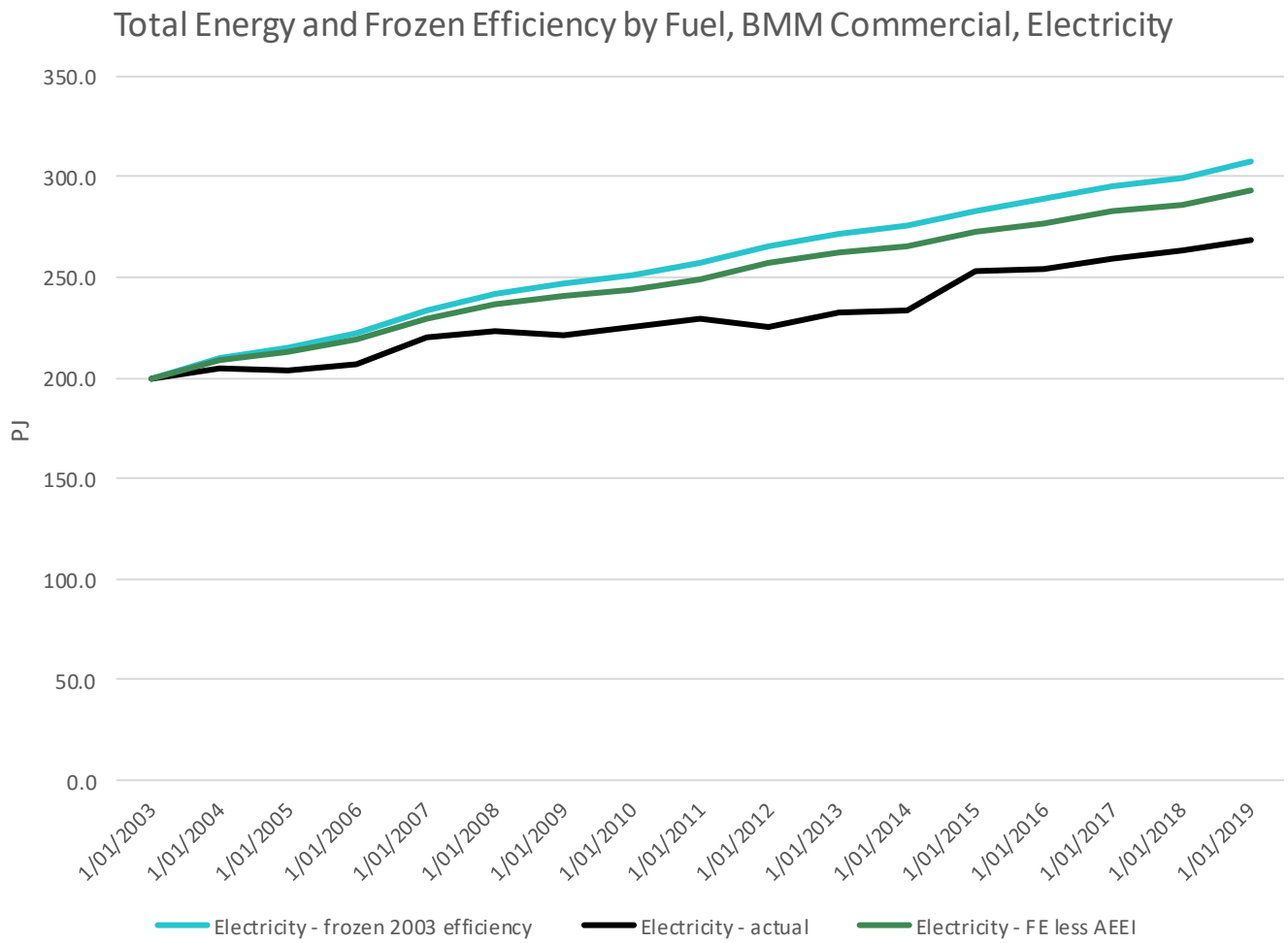
Draft Results – Business Mass Market (Commercial)

- The total improvement in EE in BMM Commercial was ~0.8% per year since 2003
  - Faster reduction in gas intensity mostly likely represents electrification



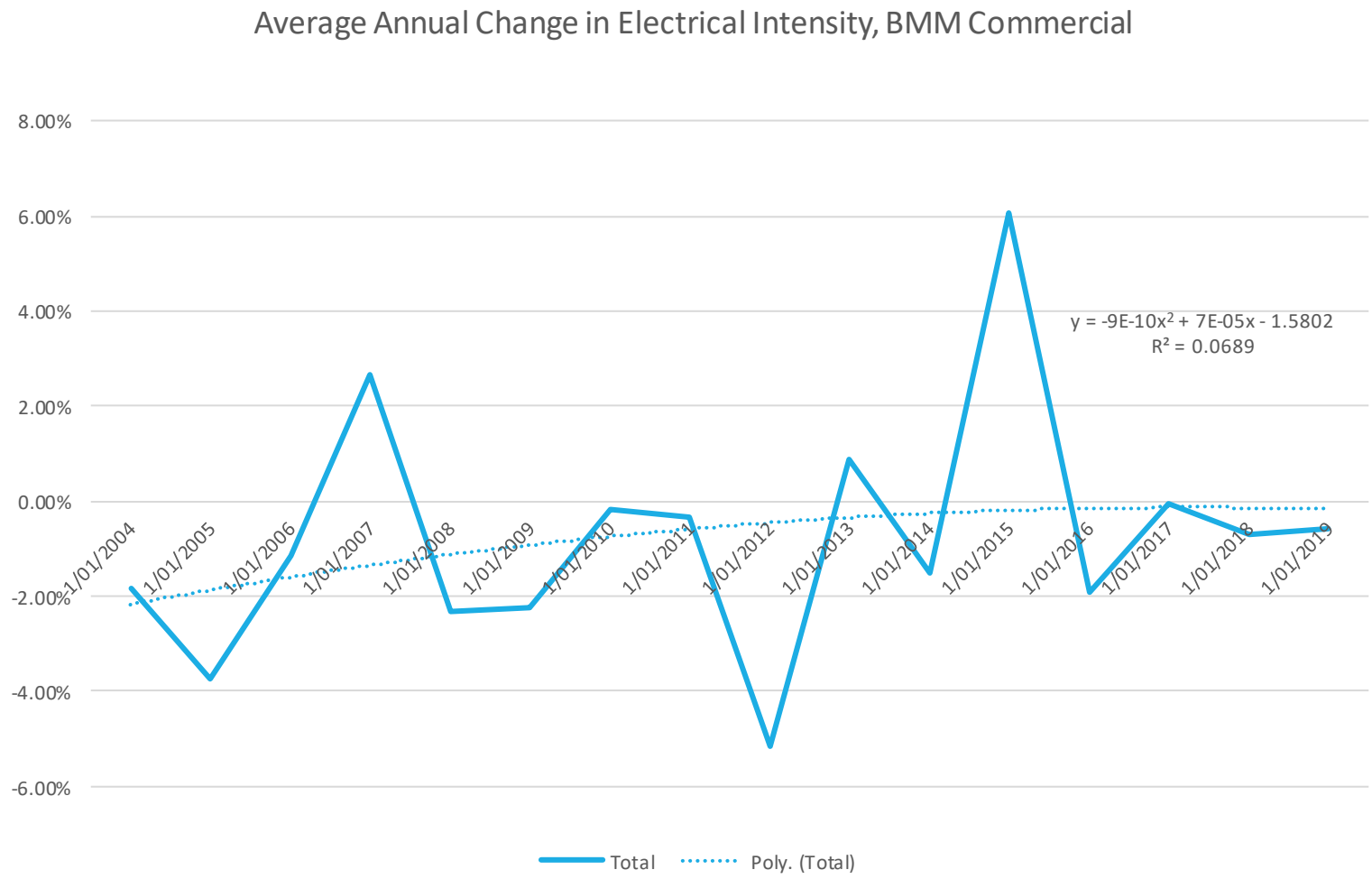
Draft Results – Business Mass Market (Commercial)

- We estimate autonomous or market-led EE improvement represented around 1/3 of total improvement to 2019 for electricity (very little for gas – not shown)



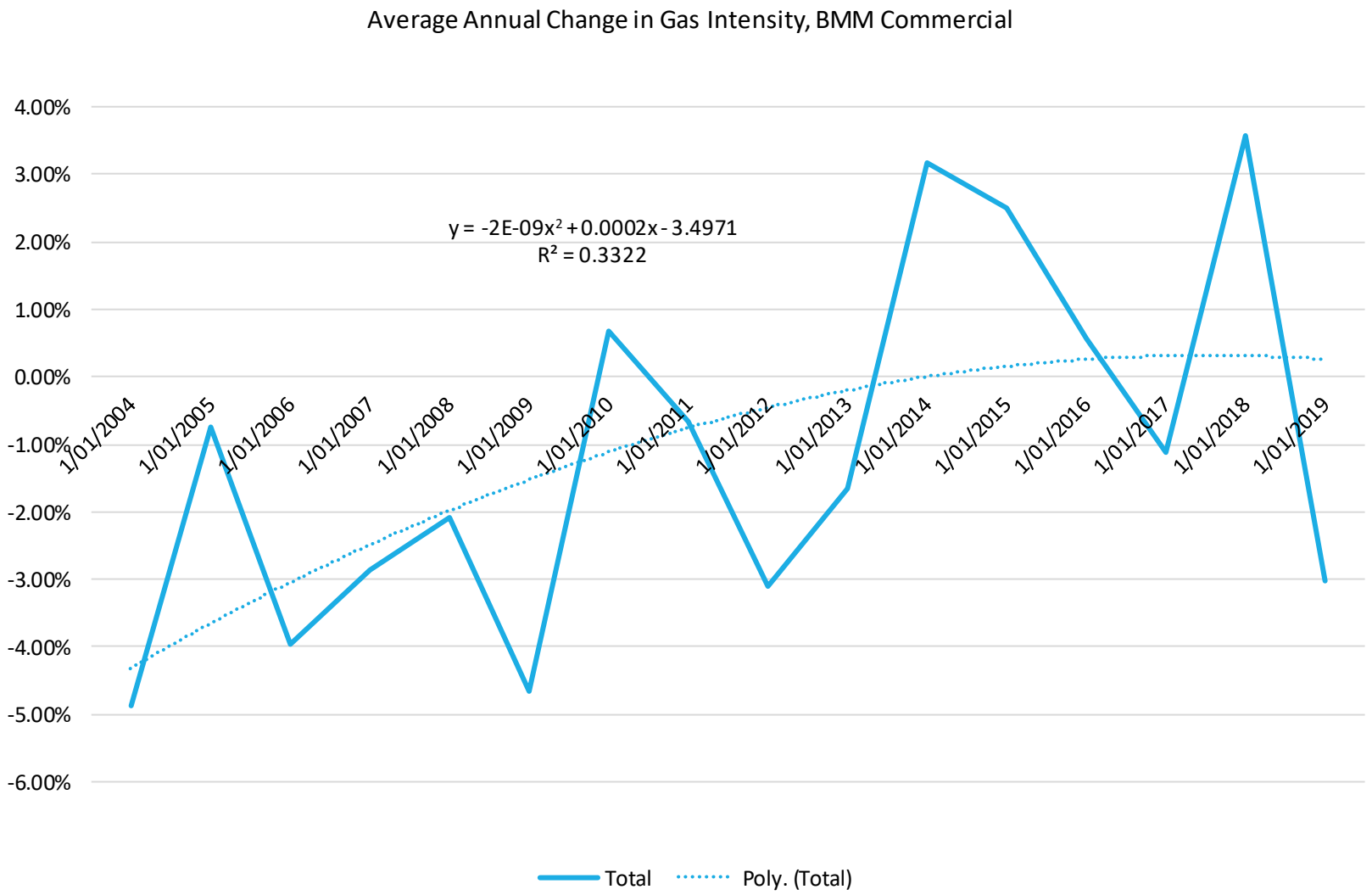
Draft Results – Business Mass Market (Commercial)

- However, the *rate* of total EE improvement appears to have been slowing over time, to ~0% in recent years for both electricity…



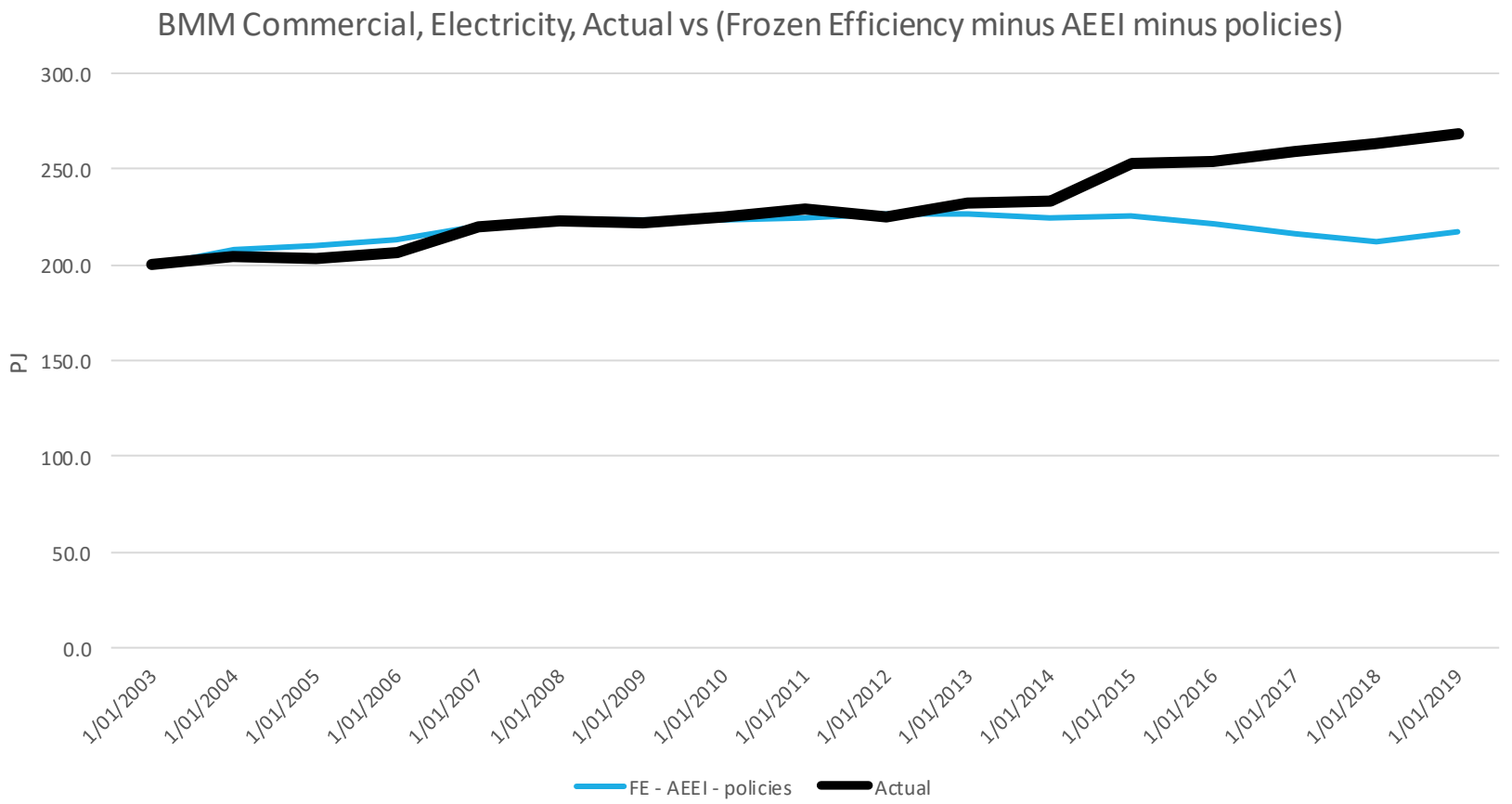
Draft Results – Business Mass Market (Commercial)

- …and gas



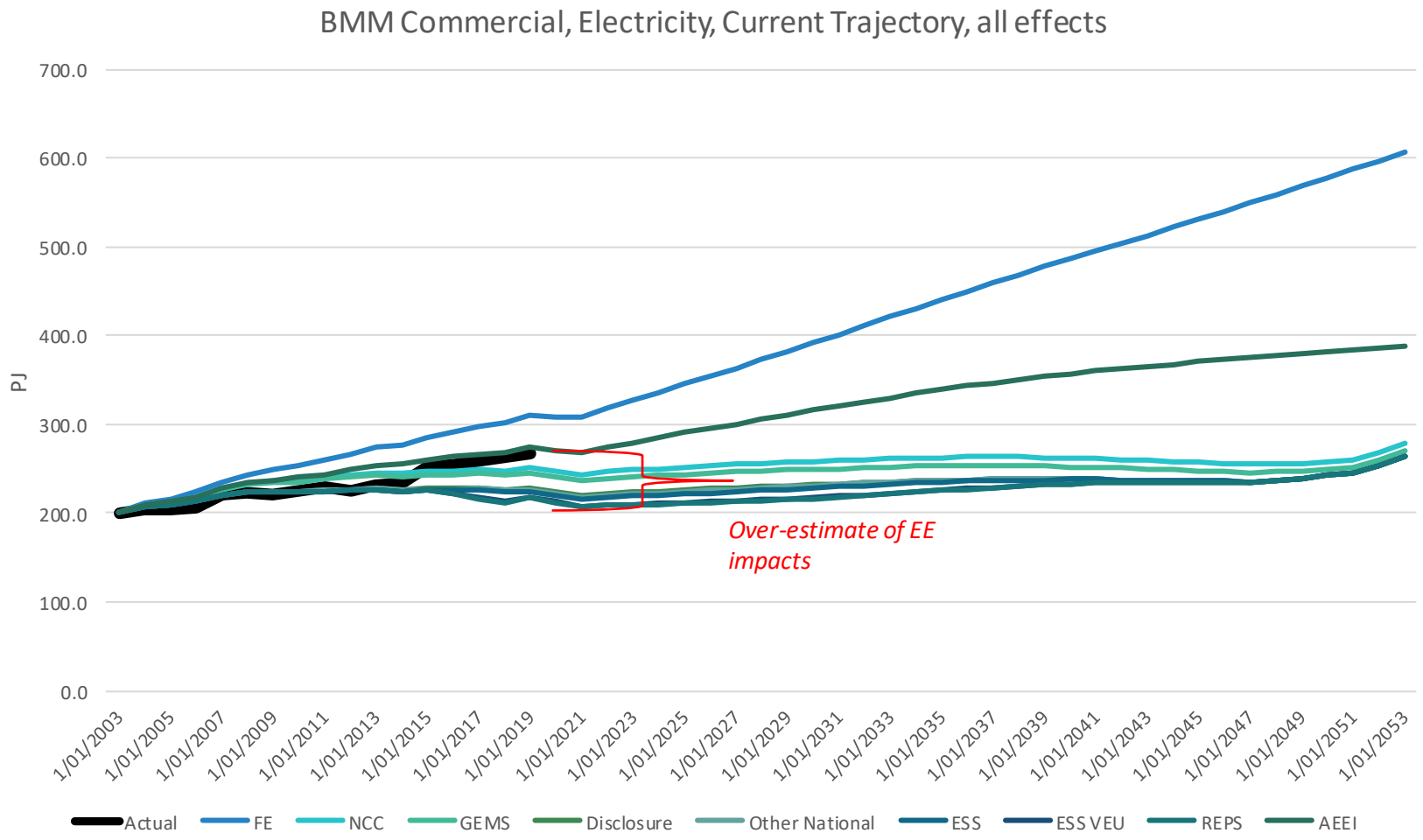
Draft Results – Business Mass Market (Commercial)

- Comparing modelled savings (market-led and policy-induced) with actual consumption shows that efficiency has not kept pace with actual consumption since ~2014
  - ie, model is currently over-estimating efficiency impacts in the period since 2014
    - This will require correction in final projections



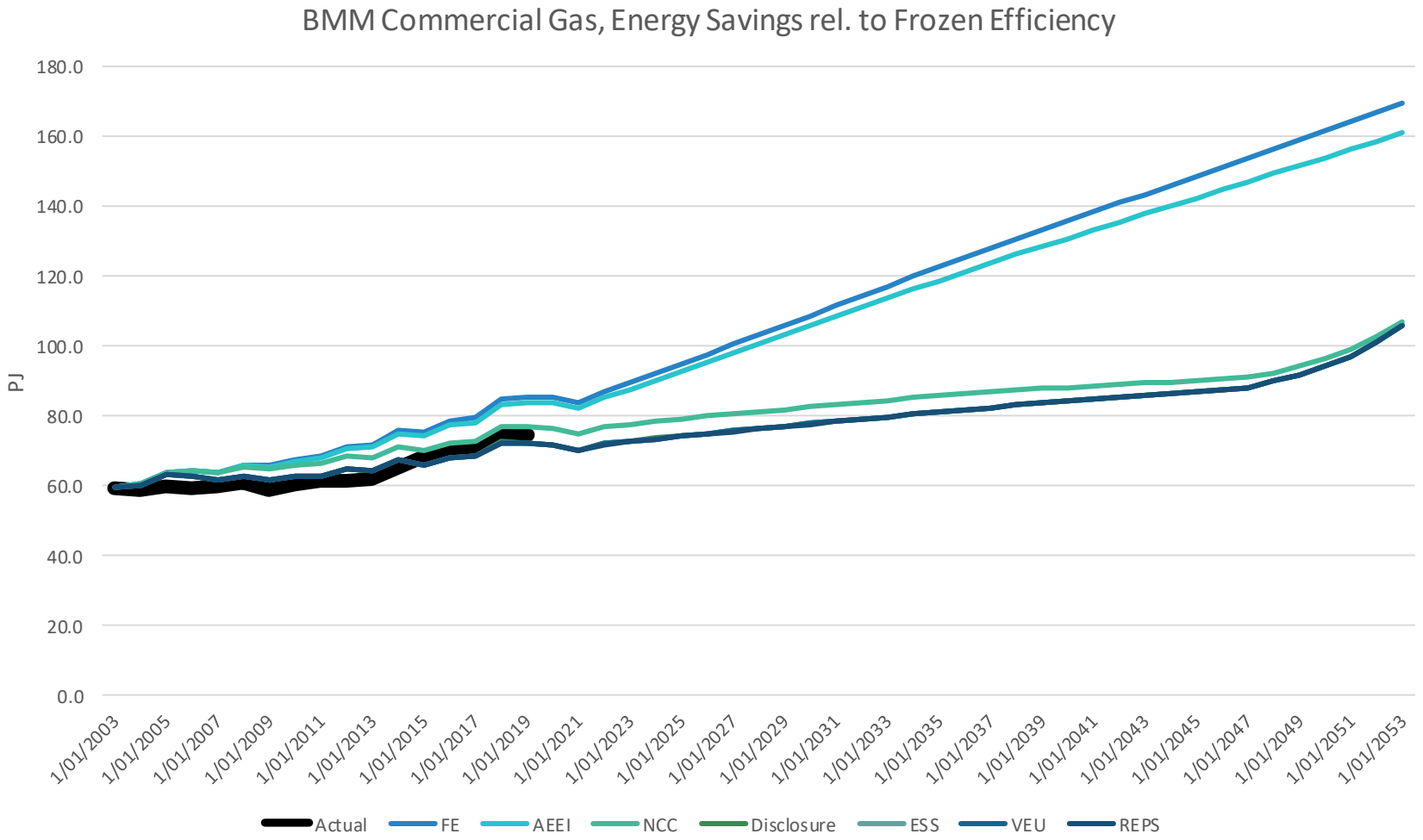
Draft Results – Business Mass Market (Commercial)

- Current Trajectory for electricity for BMM Commercial is showing significant efficiency improvements but, relative to actual history, these are over-estimated after 2014
  - probably both market-led and policy-induced EE



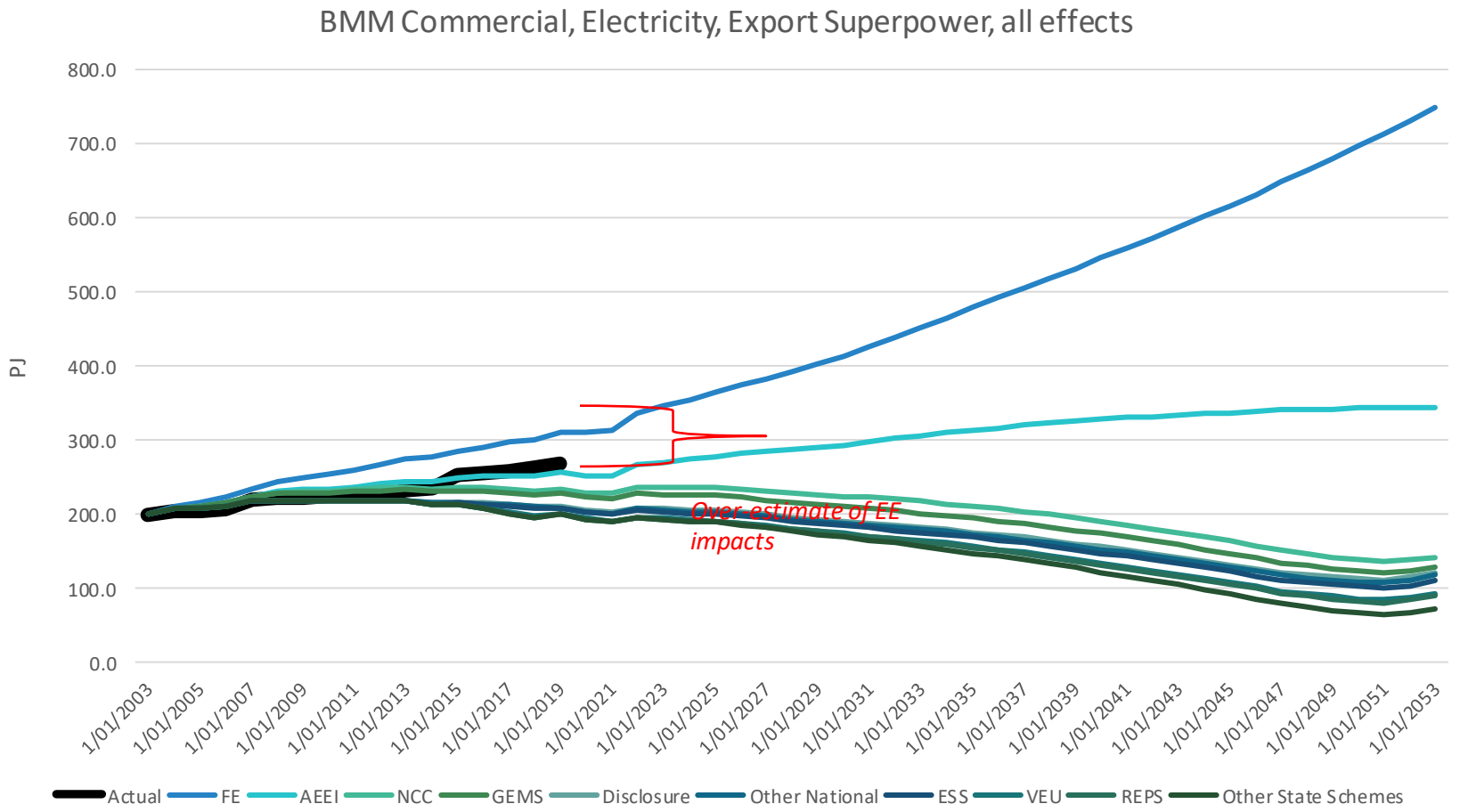
Draft Results – Business Mass Market (Commercial)

- Current Trajectory for gas for BMM Commercial is showing a relatively good fit with historical consumption
  - Only significant savings are from NCC, and include fuel switching assumptions



Draft Results – Business Mass Market (Commercial)

- Export Superpower for electricity for BMM Commercial illustrates the *relative* impact of more ambitious policy settings and stronger demand
  - As with Current Trajectory, however, savings are currently significantly over-estimated, at least since 2015



Draft Results – Business Mass Market (Commercial)

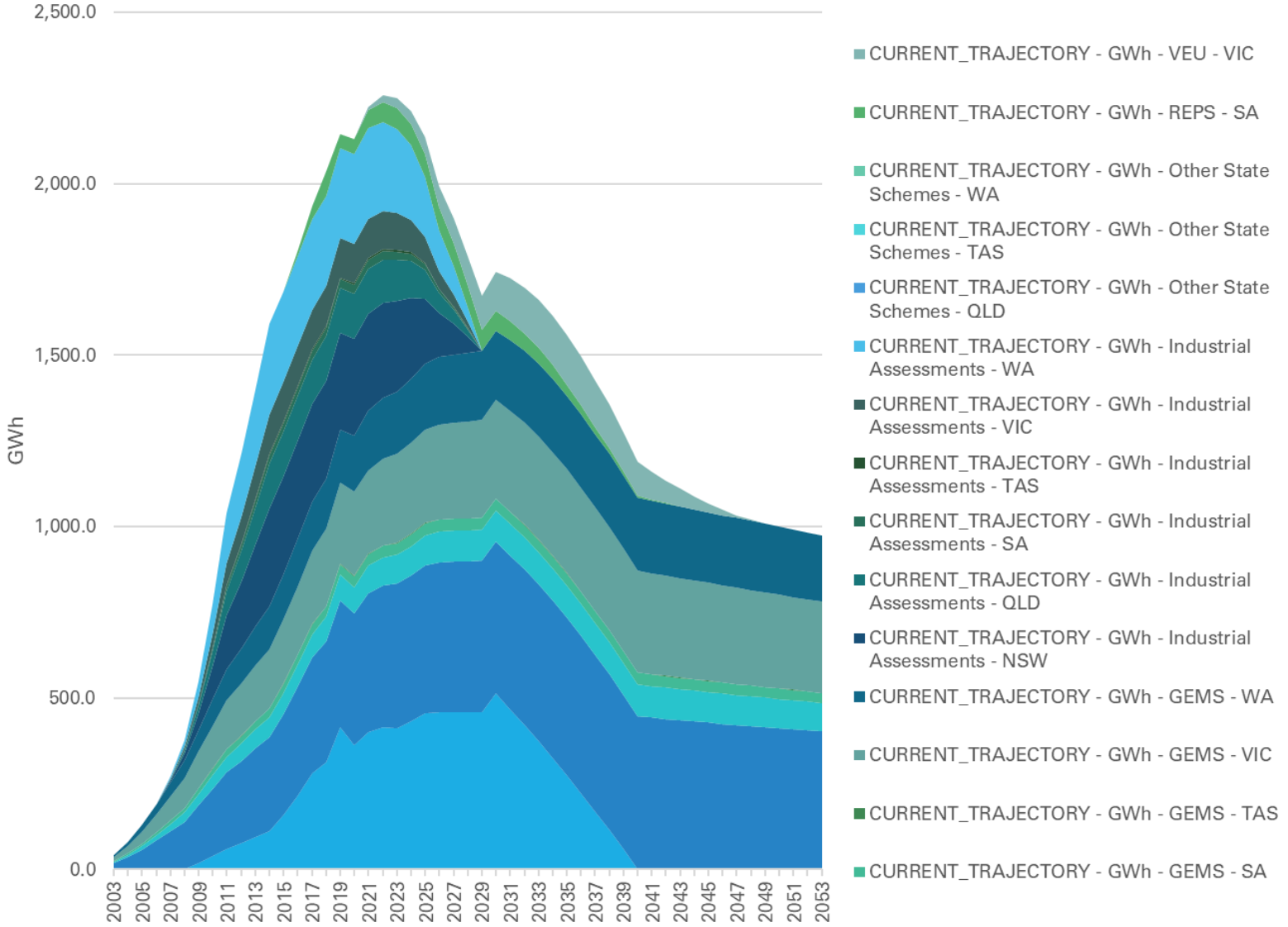
- These results suggest that:
  - Market-led EE improvement appears over-estimated, despite modest assumptions of ~0.4% per year
  - Policy-induced EE also appears over-estimated, at least since 2015, despite significant discounting of headline savings
    - AEEI and NCC are the two largest effects by far, so investigations will start with these
- These results *could* suggest that market factors (longer operating hours, greater occupant density, more air conditioning, bigger cool chain, rising cooling demands) have been tending to drive *up* energy intensity, at least reducing (if not offsetting) the impact of technological improvements
  - In the 2000s, efficiency measures more than offset these trends, leading to a net reduction in energy intensity
  - But with little advancement in key national efficiency policies (NCC, GEMS in particular), and some policy reversals (carbon pricing and efficiency measures funding by it), efficiency was less able to offset market trends in the 2010s, leading to no net efficiency change in recent years.
    - However, ideally we would achieve greater confidence in both energy consumption and activity/structural trends, and preferably sectoral and end-use analysis

Draft Results – Business Mass Market (Industrial)

- Analysis of *total* and market-led EE for BMM Industrial is not feasible due
  - to limited time series for actual energy consumption
  - no clear output metric for industrial SMEs
    - Industry value-added a theoretical option, but would need to resolve industrial SMEs within ANZSIC sectors/sub-sectors
- BMM Industrial savings therefore estimated bottom up by program and discounted for non-additionality to AEEI
- For current trajectory, we count GEMS, the historical impact of EEO, state schemes (ESS, etc)
  - For higher ambition scenarios we add a hypothetical 'industrial assessments' program from FY2022
    - Design bears a passing resemblance to EEO, and uptake/impact assumptions come from EEO, expressed per unit of industrial value-added

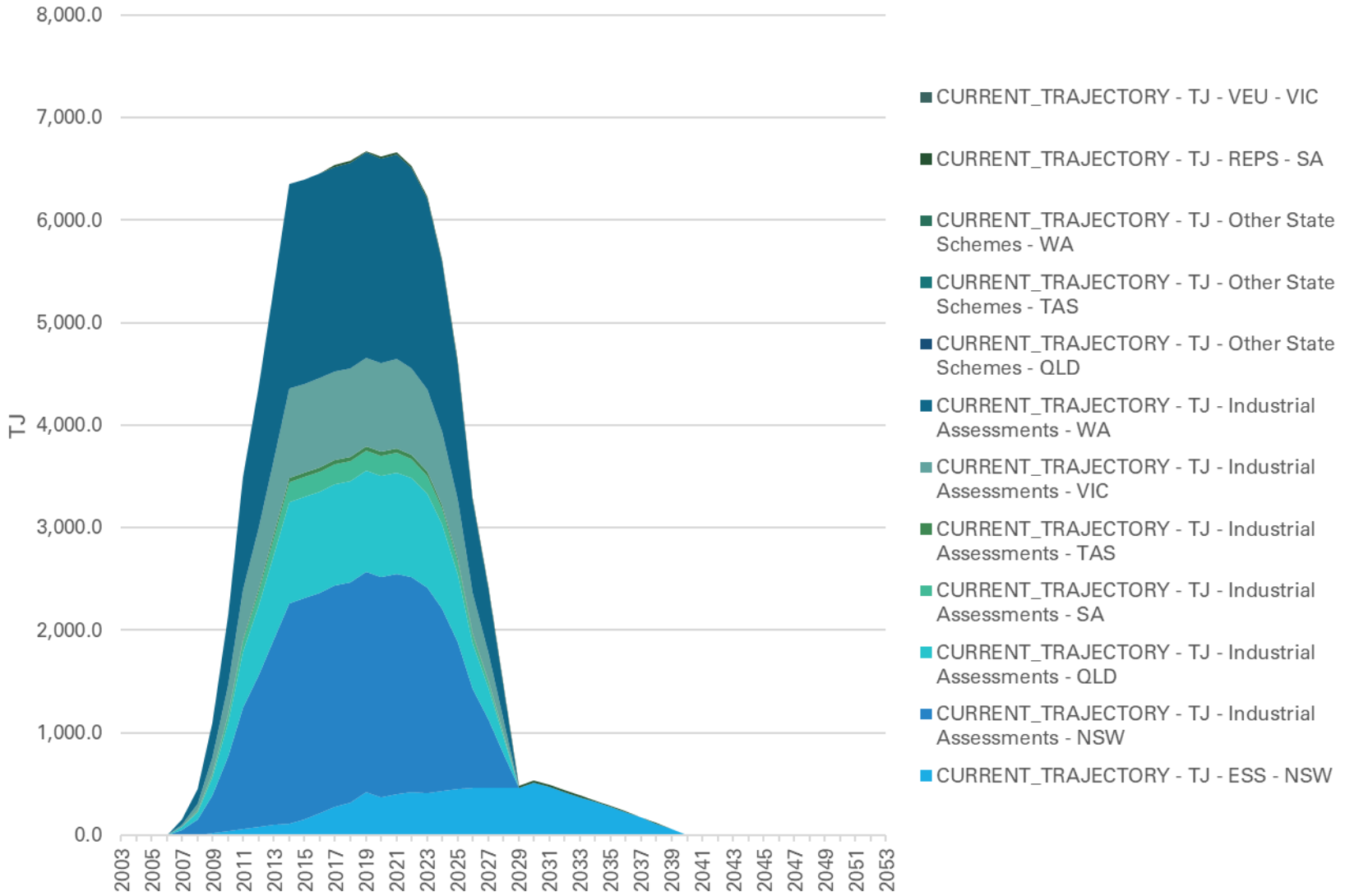
Draft Results – Business Mass Market (Industrial)

- BMM Industrial results for Current Trajectory (electricity)
  - Estimated bottom up by program and discounted for non-additionality to AEEI



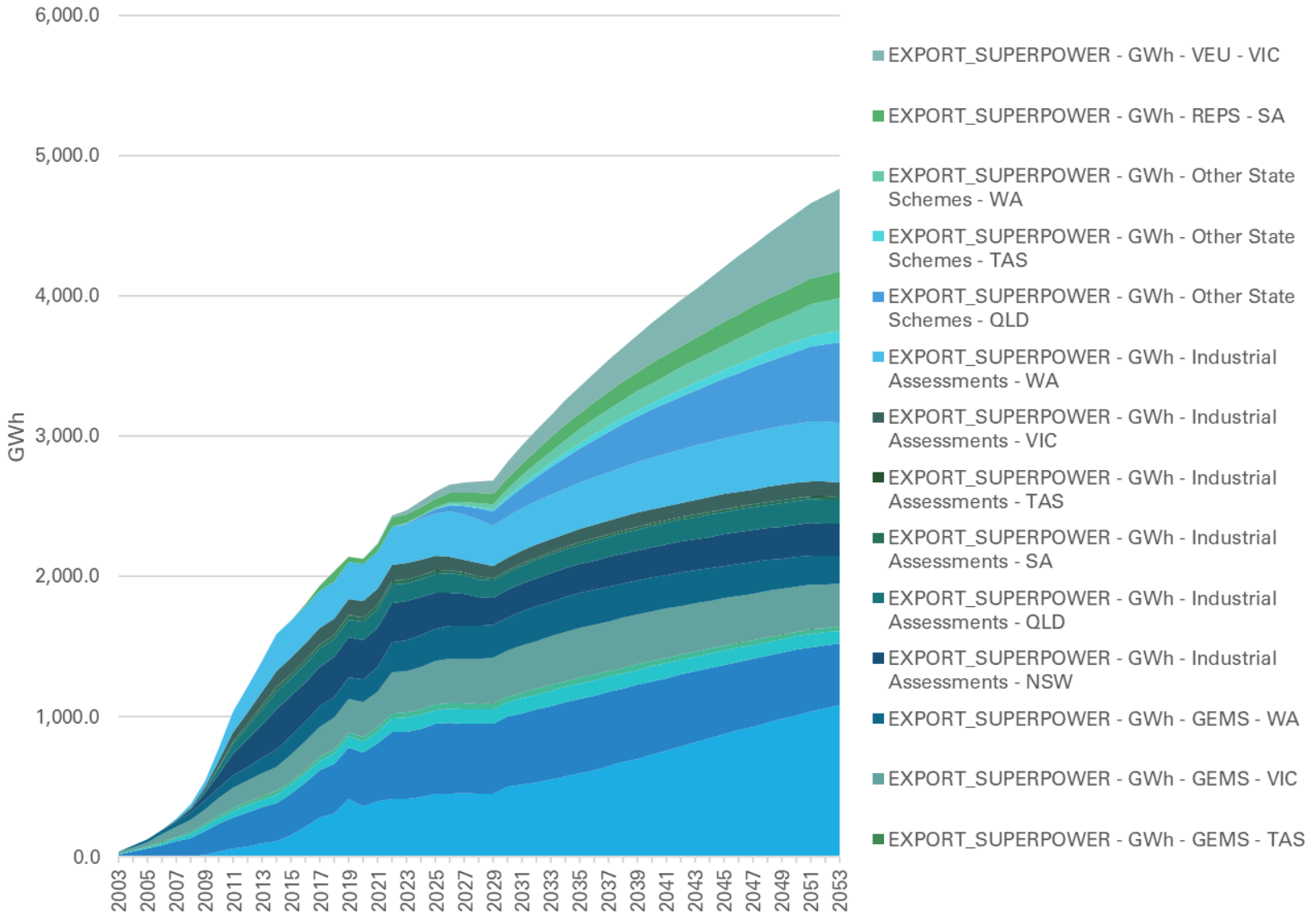
Draft Results – Business Mass Market (Industrial)

- BMM Industrial results for Current Trajectory (gas):



Draft Results – Business Mass Market (Industrial)

- BMM Industrial results for Export Superpower (electricity):



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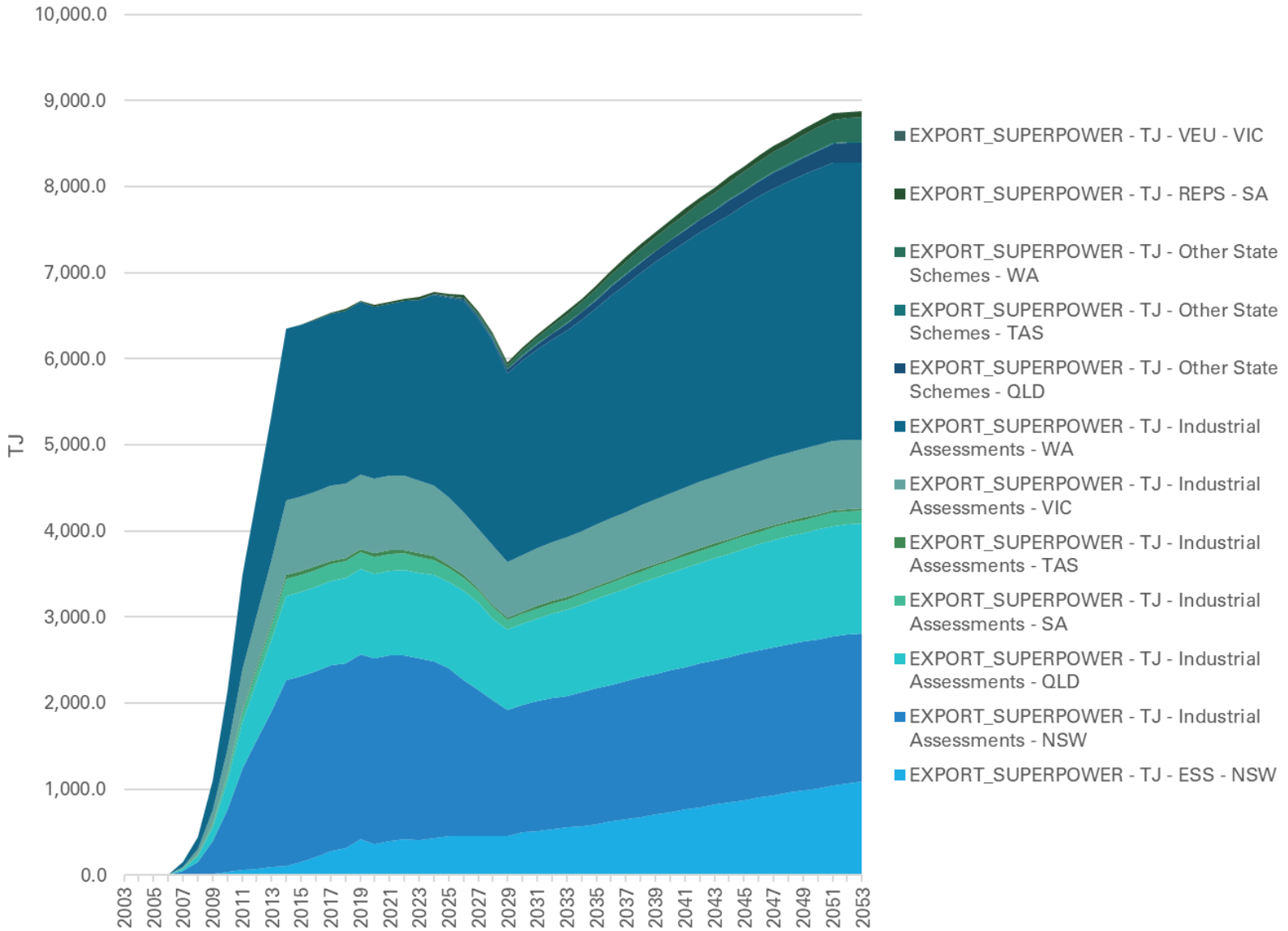
- BMM Industrial results for Export Superpower (gas):



Draft Energy Efficiency Forecasts 2021

- Q & A