



‘Burnout’ – the endgame for fossil fuels: Implications of rapid digitalisation, electrification and efficiency enhancement for global and UK gas markets

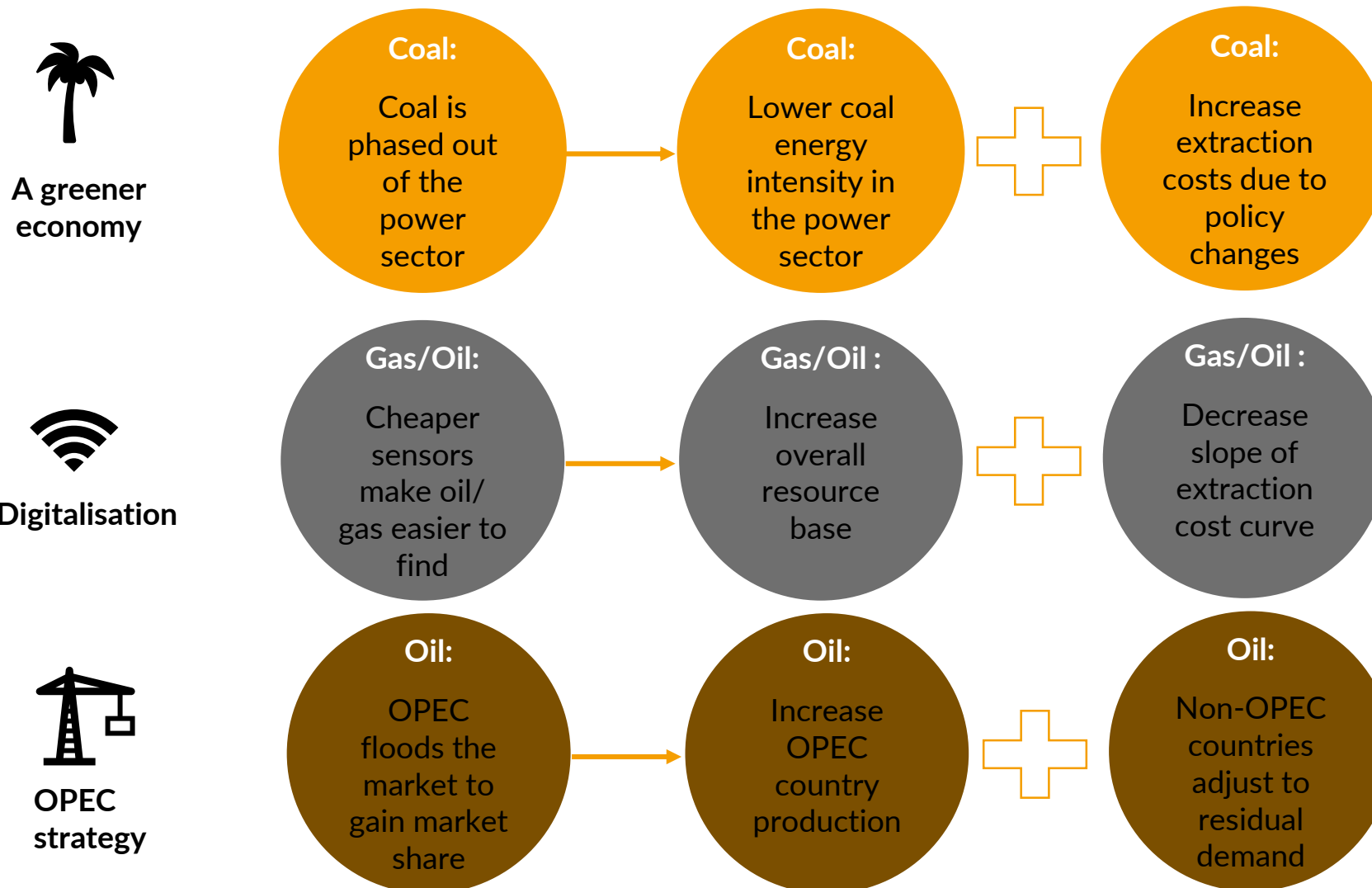
October 2018,

Richard Howard, Research Director – Aurora, richard.howard@auroraer.com

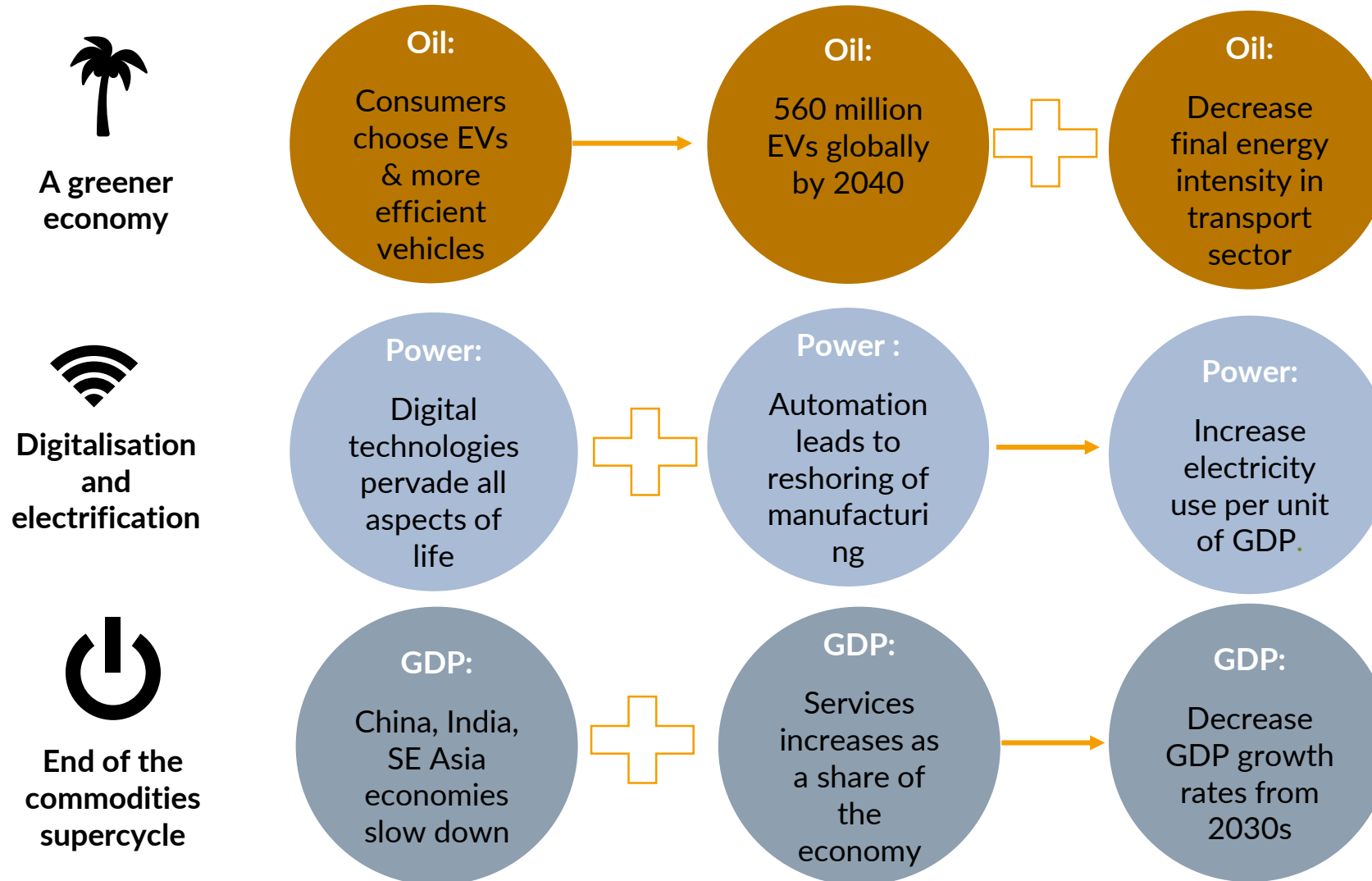
Agenda

1. Burnout envisages a world where technology drives the energy transition
2. Coal prices collapse as coal is phased out of power
3. OPEC seeks market share as fuel efficiency and EVs decrease oil demand
4. Fuel switching to gas ramps up in power and petrochemicals
5. Burnout does better than Paris NDCs in reducing global CO₂ emissions
6. Cumulative fossil fuel revenues decrease by over \$20 Trillion in Burnout

Digitalisation is the key driver of cheaper oil and gas supply; coal is phased out of power



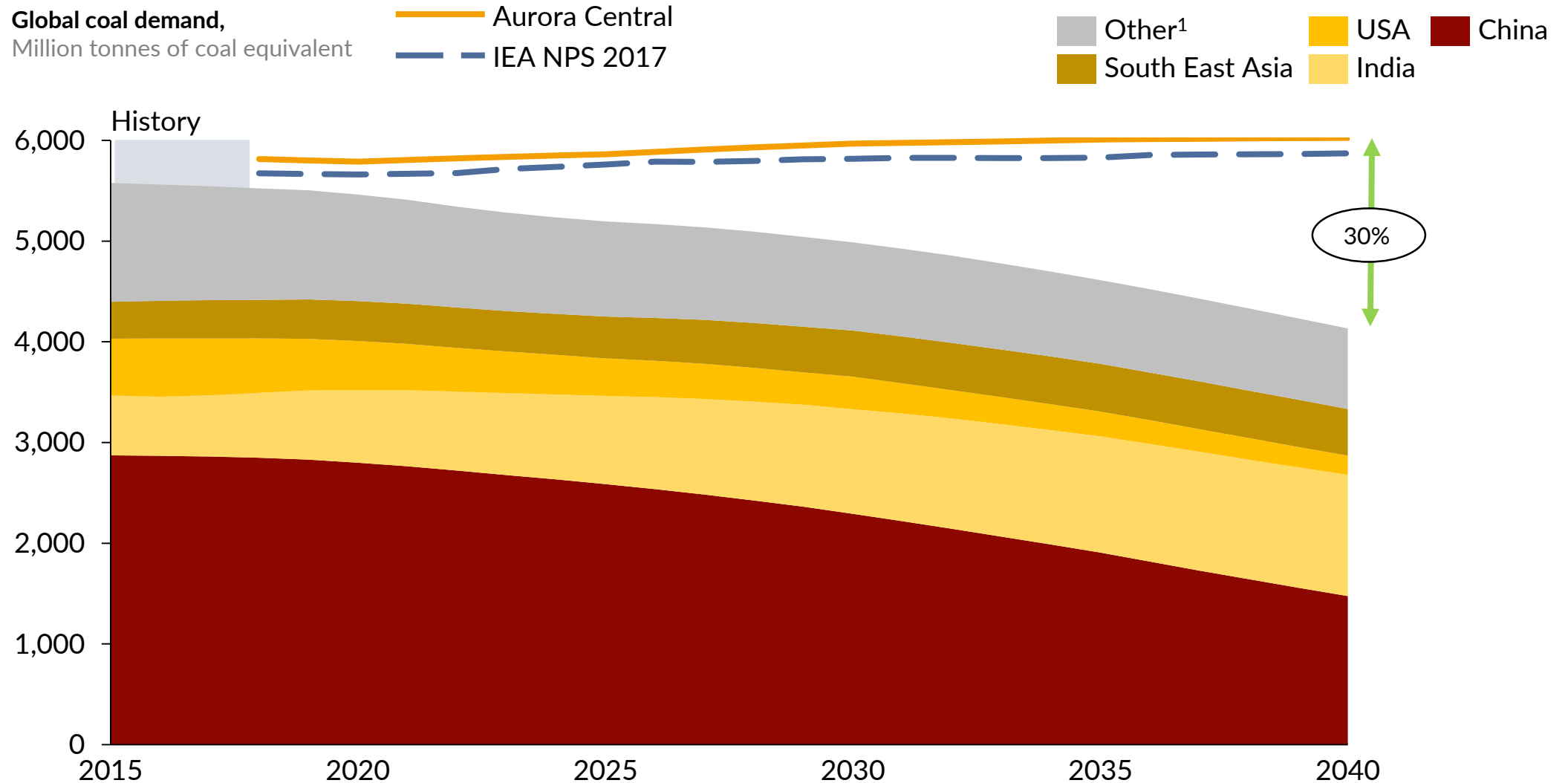
On the demand side, electrification and digitalisation decrease demand for oil and increase demand for power



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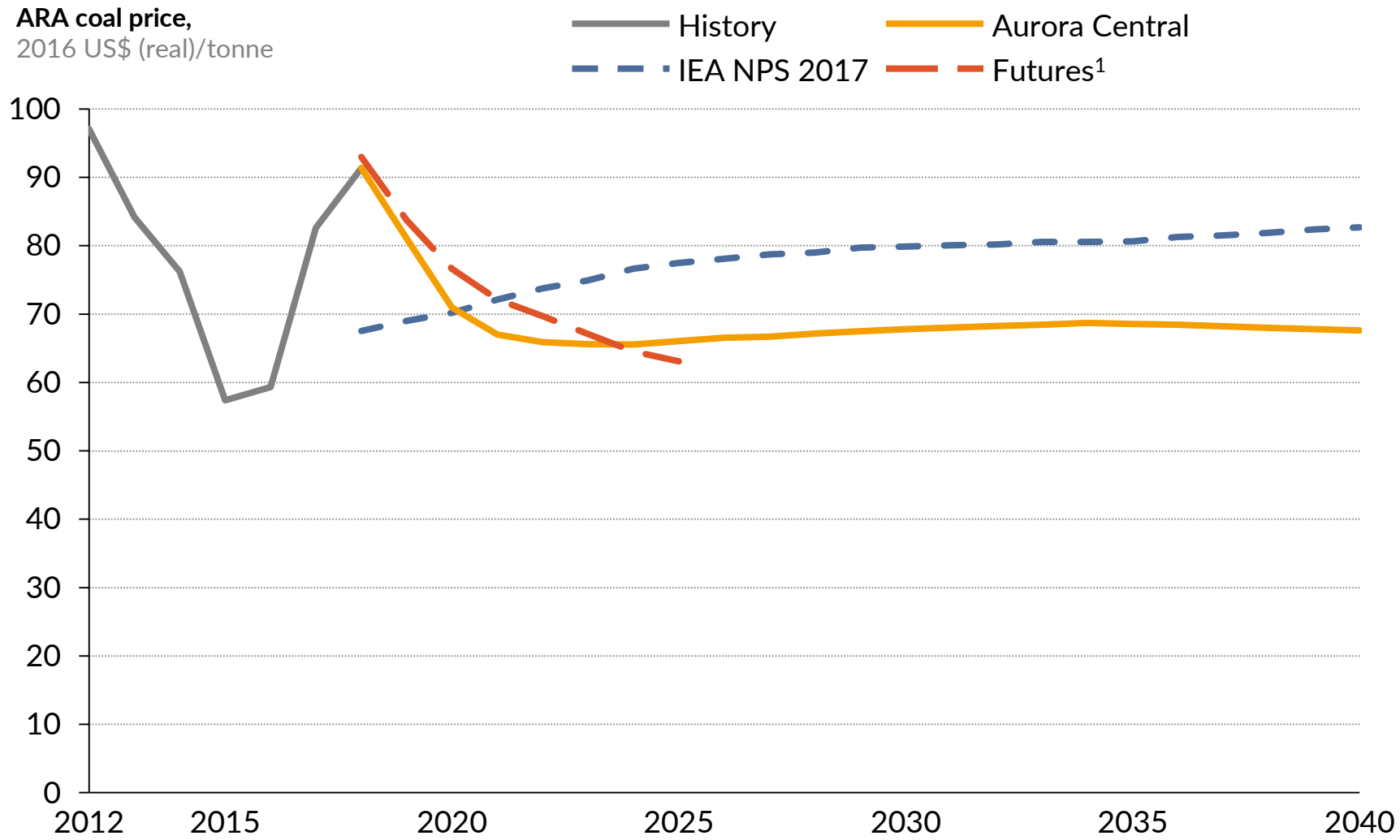
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A decrease in coal demand reduces new coal investment and causes existing coal production to shut down



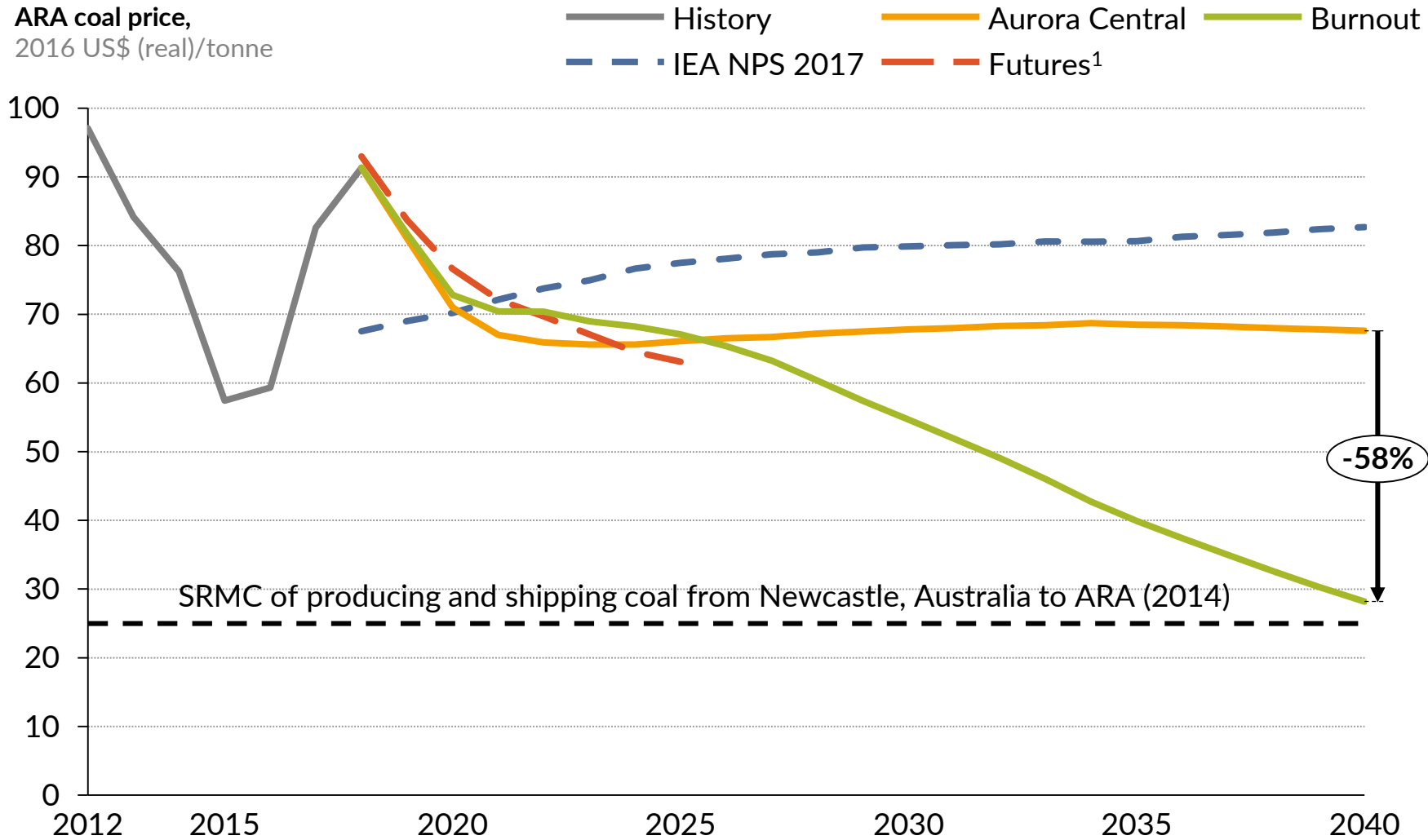
Notes: 1) Includes Africa, Japan, Russia, Eastern Europe, Australia, Former Soviet Union, Great Britain, Latin America, Canada, Brazil, France and Venezuela

As coal is phased out of power systems around the world, the coal price plummets



Notes: 1) As of 6/09/2018

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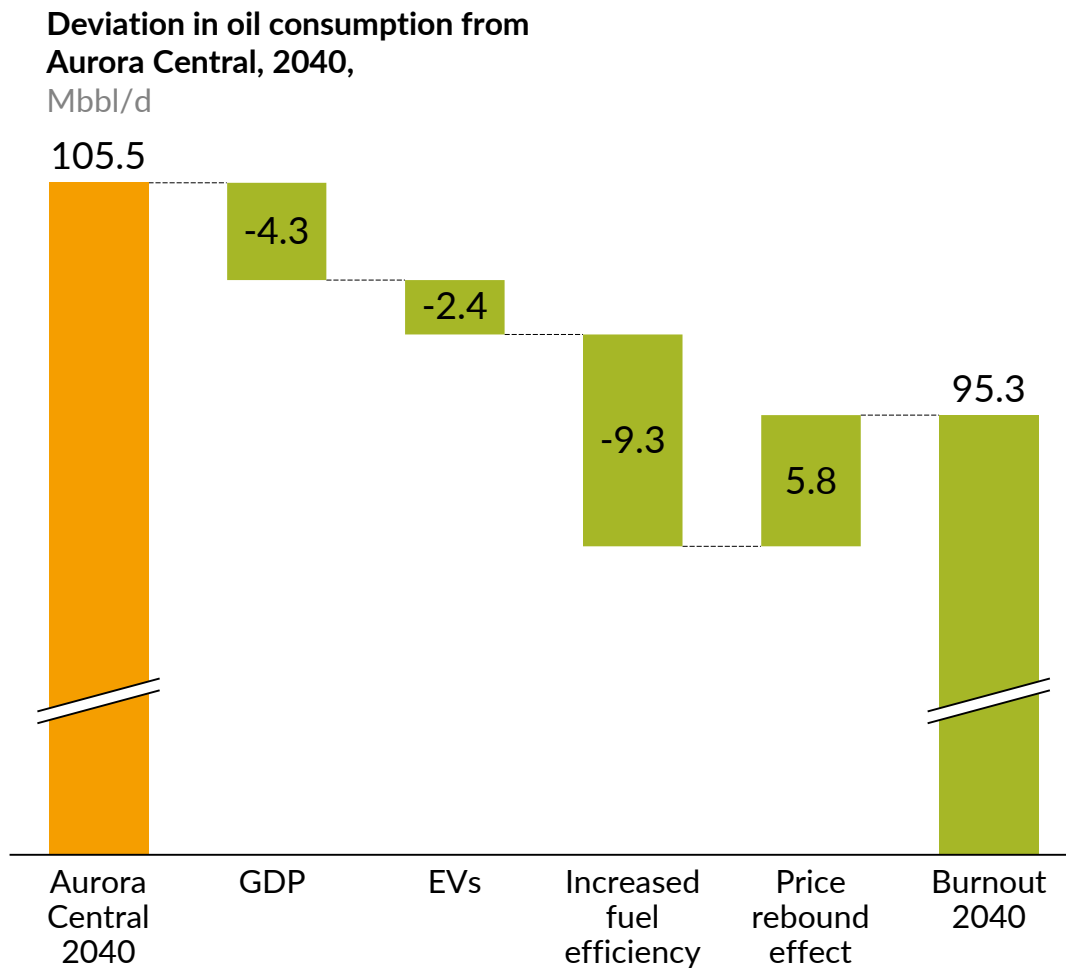


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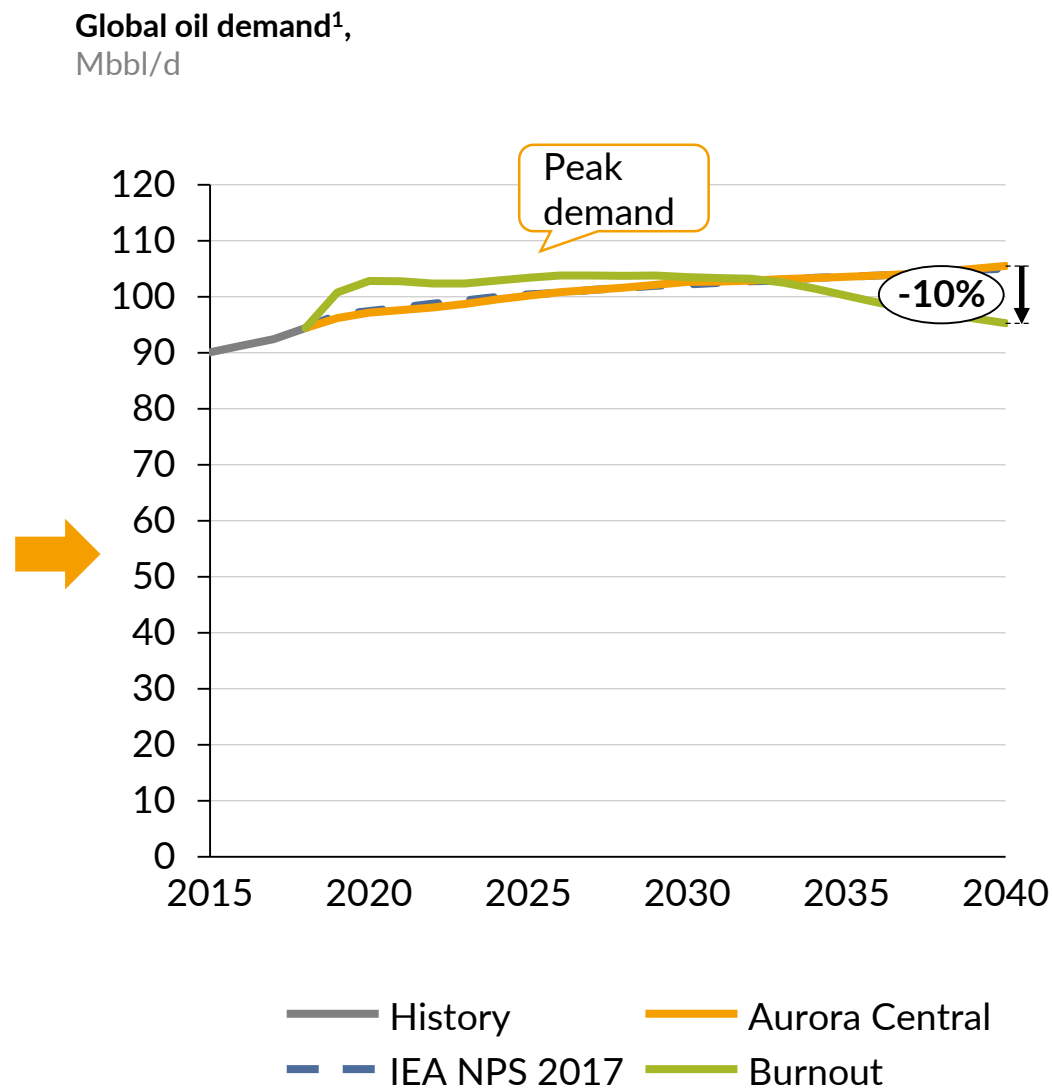
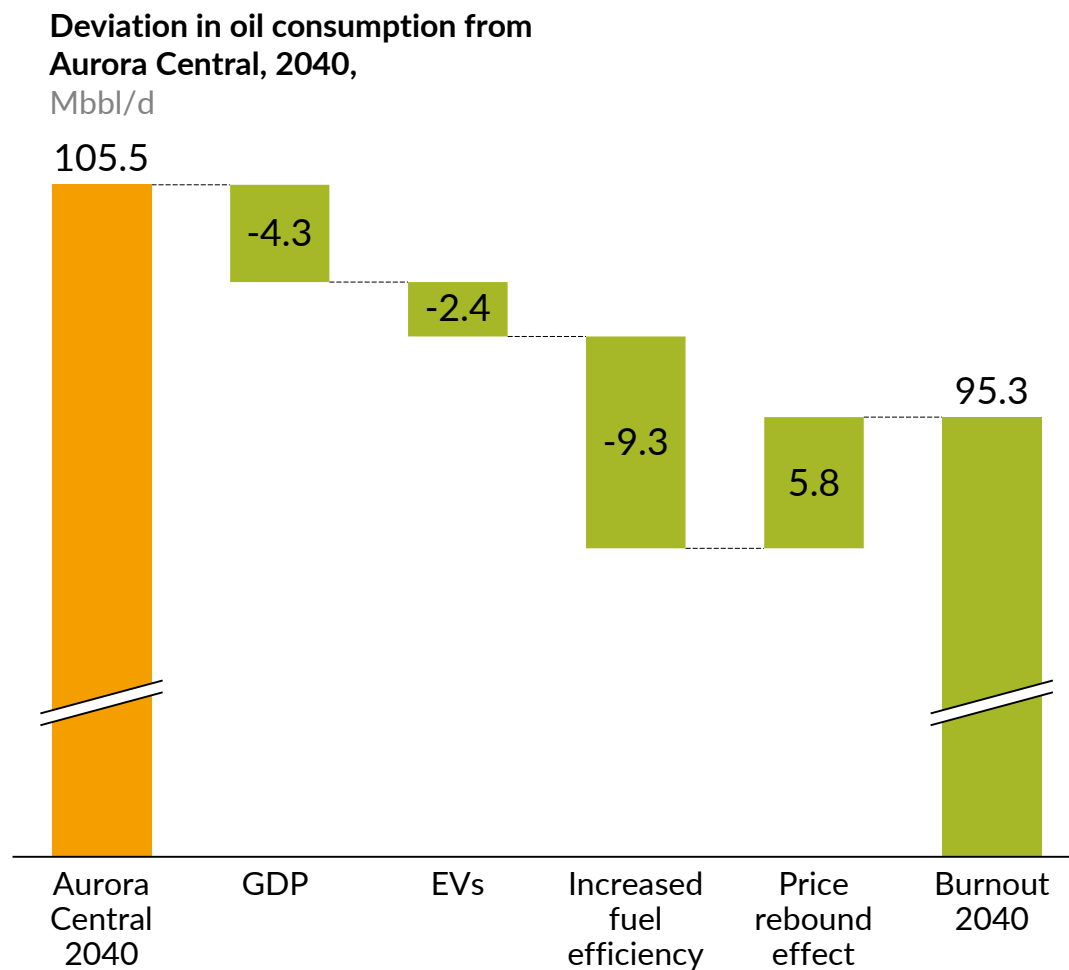
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Improved fuel efficiency and a switch to EVs cause oil demand to decline from the 2030s, ending 10% lower than IEA's forecast



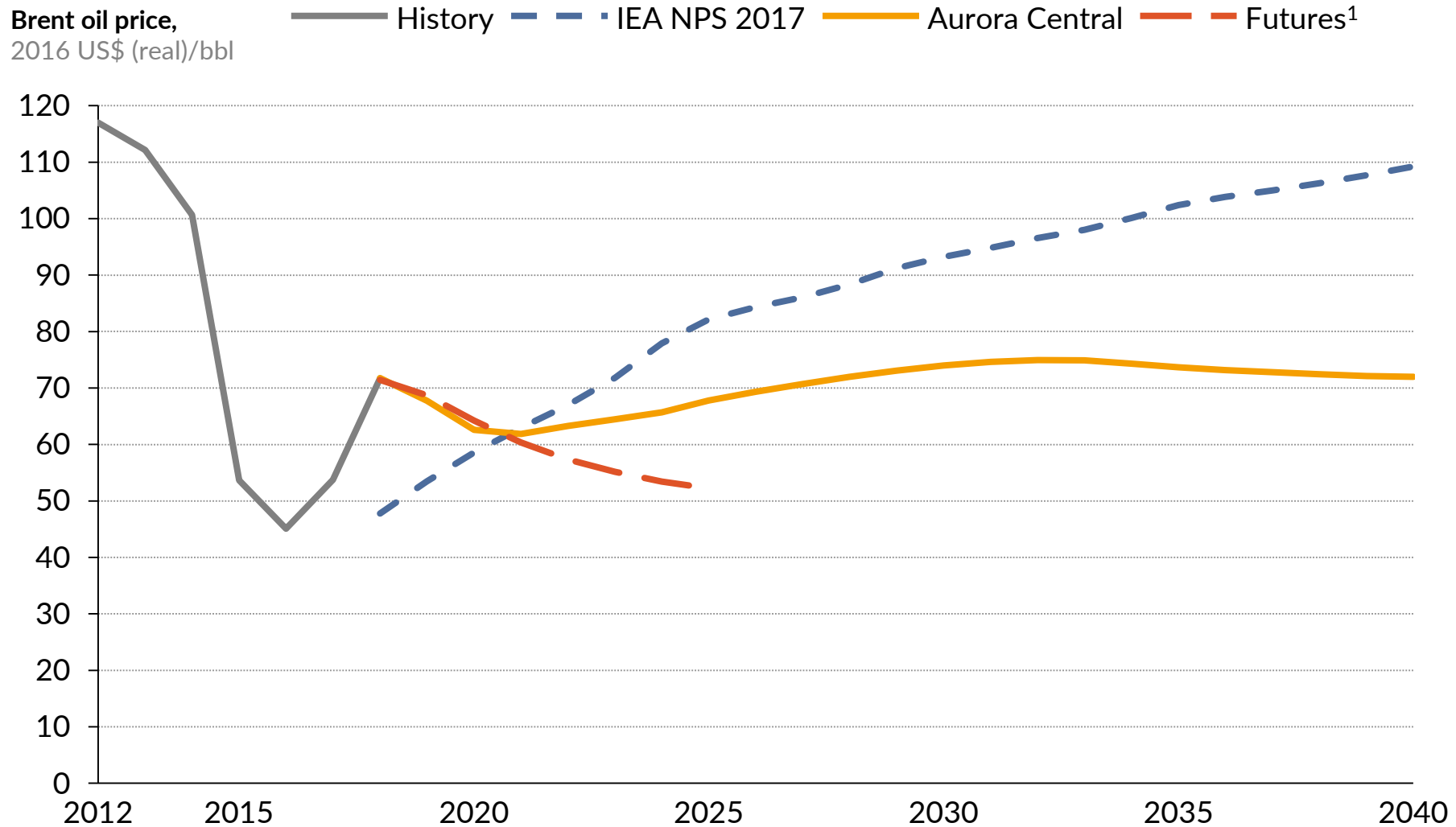
Notes: 1) Includes changes in stock inventories

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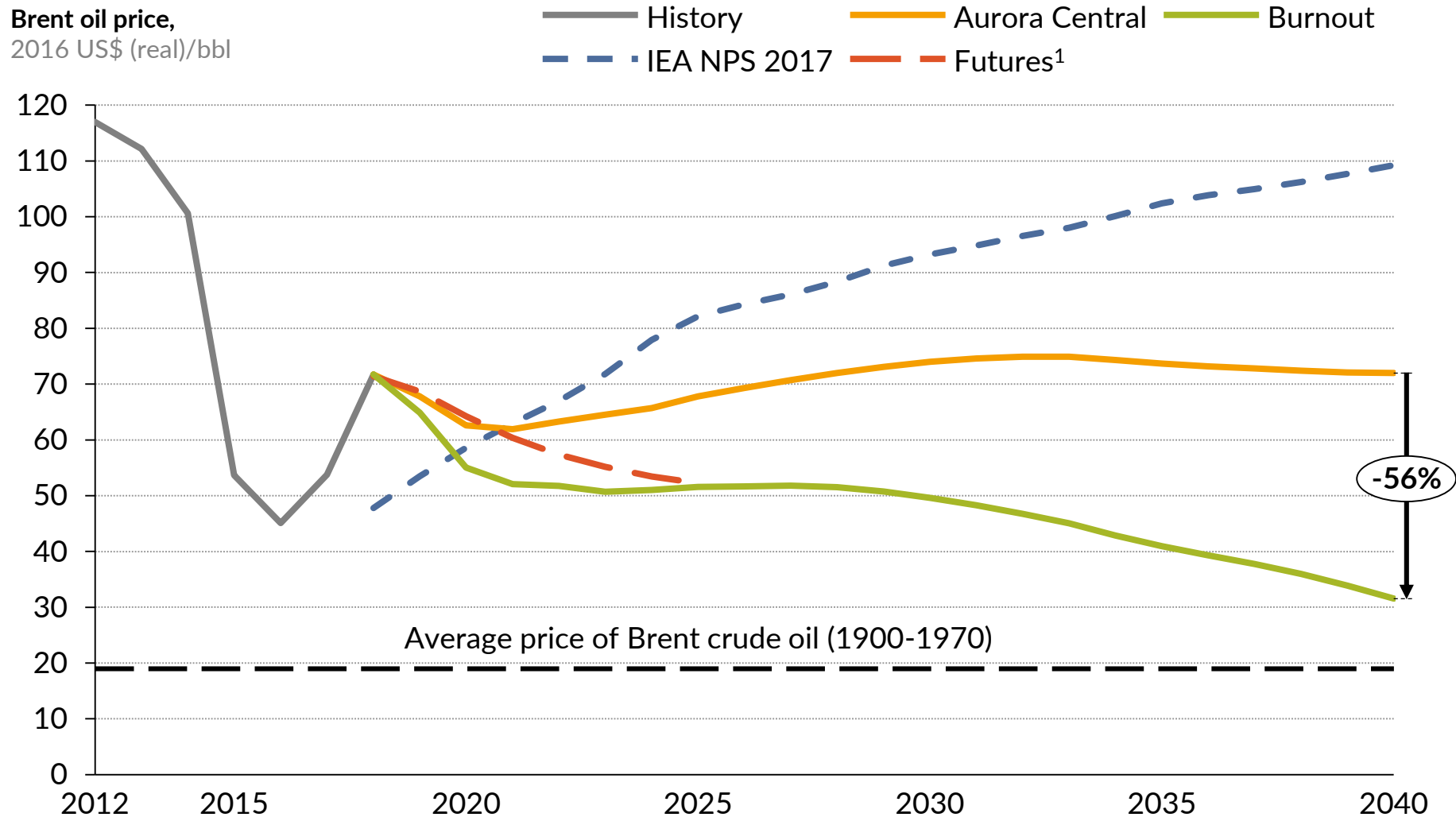
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This demand destruction causes the oil price to drop to \$32/bbl by 2040, near the long run historic price



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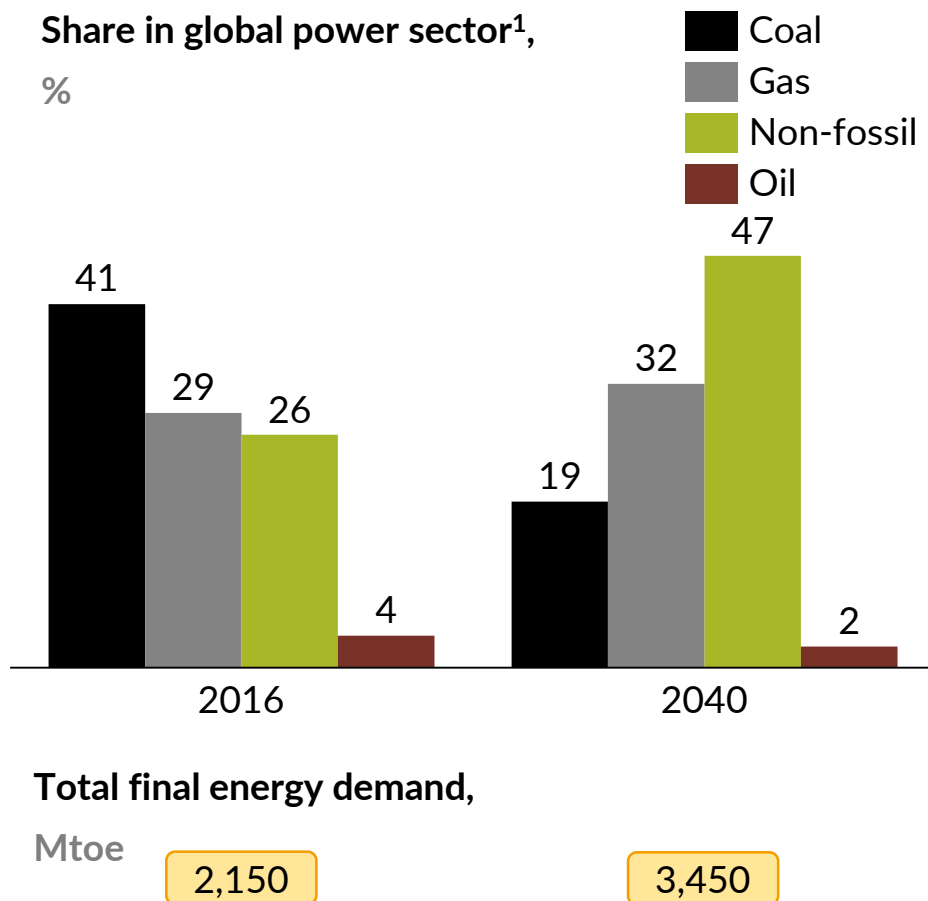
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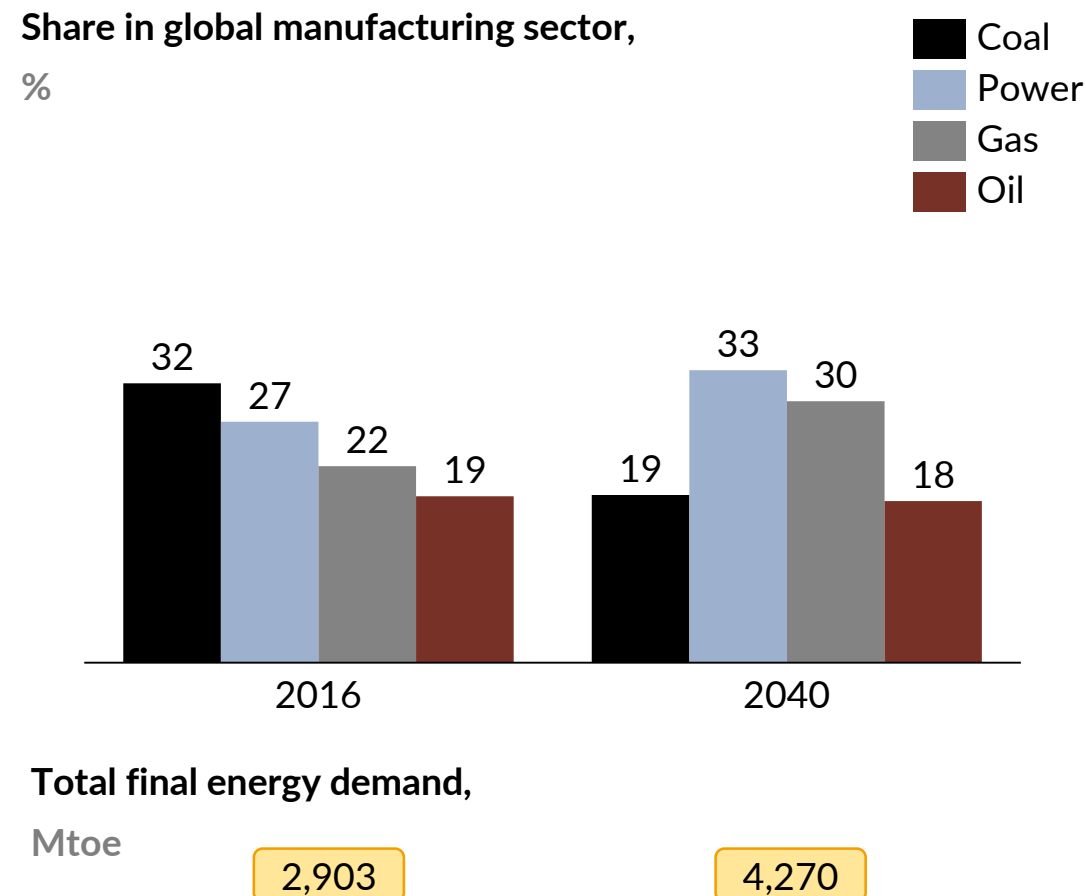
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Fuel switching towards gas occurs in both the power and manufacturing sectors

The power sector sees a switch from coal towards gas and non-fossil sources..

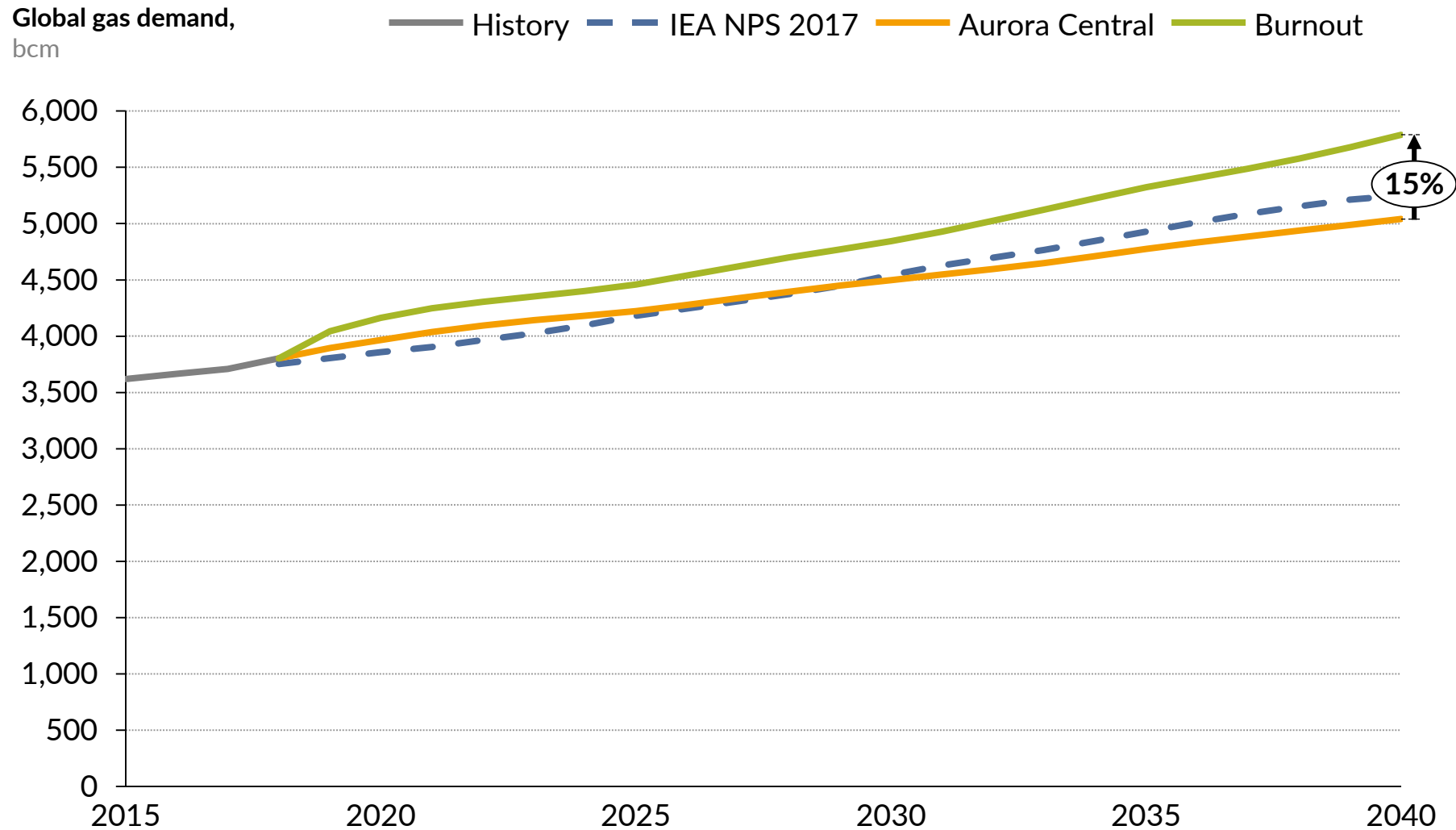


...whilst manufacturing sees a shift towards gas and power



Notes: 1) On final consumption basis: Mtoes of fuel multiplied by average fleet efficiency (37% LHV for coal, 49% LHV for gas, 32% LHV for oil); 2) Includes hydro, renewables, biomass and nuclear

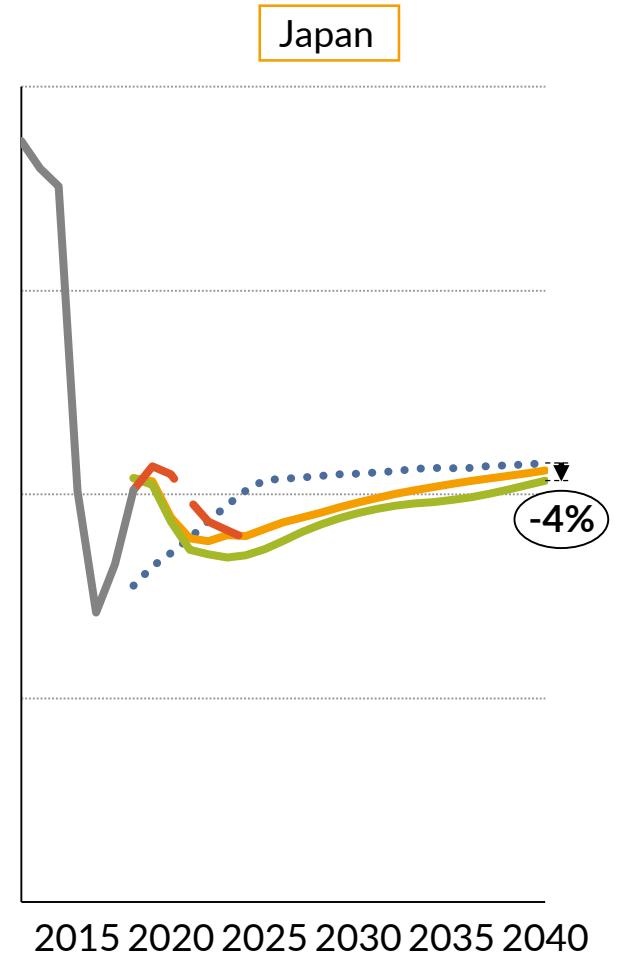
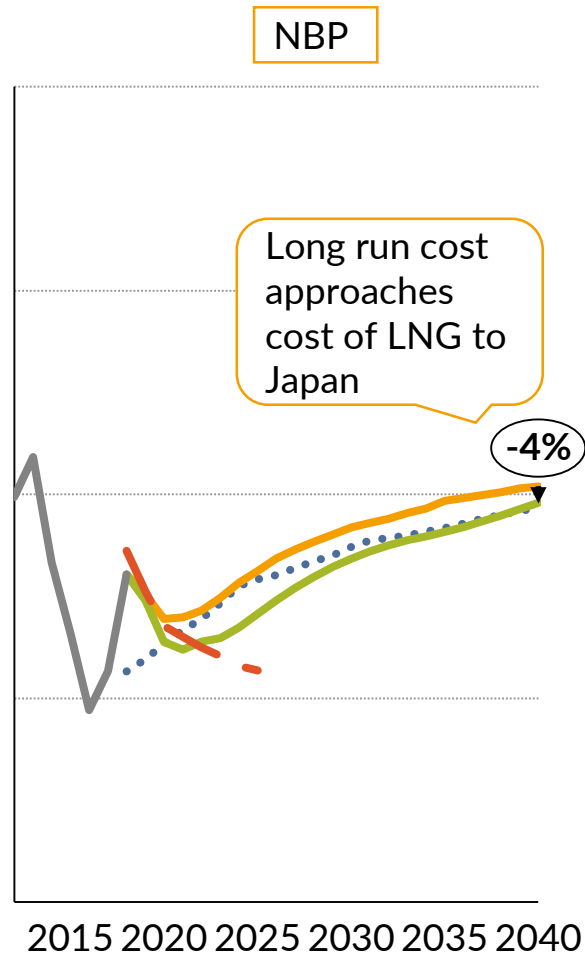
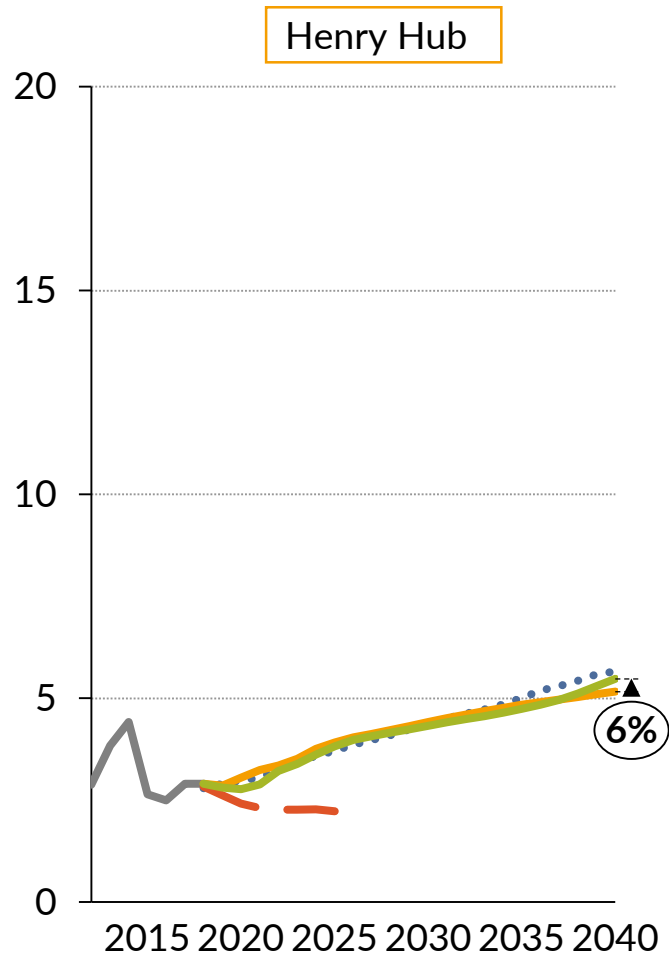
This fuel switching causes global gas supply and demand to maintain an upwards trajectory across the forecast



Gas prices are similar to the Central scenario, despite higher demand and lower production costs

Gas price at stated delivery point, 2016 US\$ (real)/MMBtu

— History — Aurora Central — Burnout
⋯ IEA NPS 2017 - - Futures¹



Notes: 1) As of 6/09/18

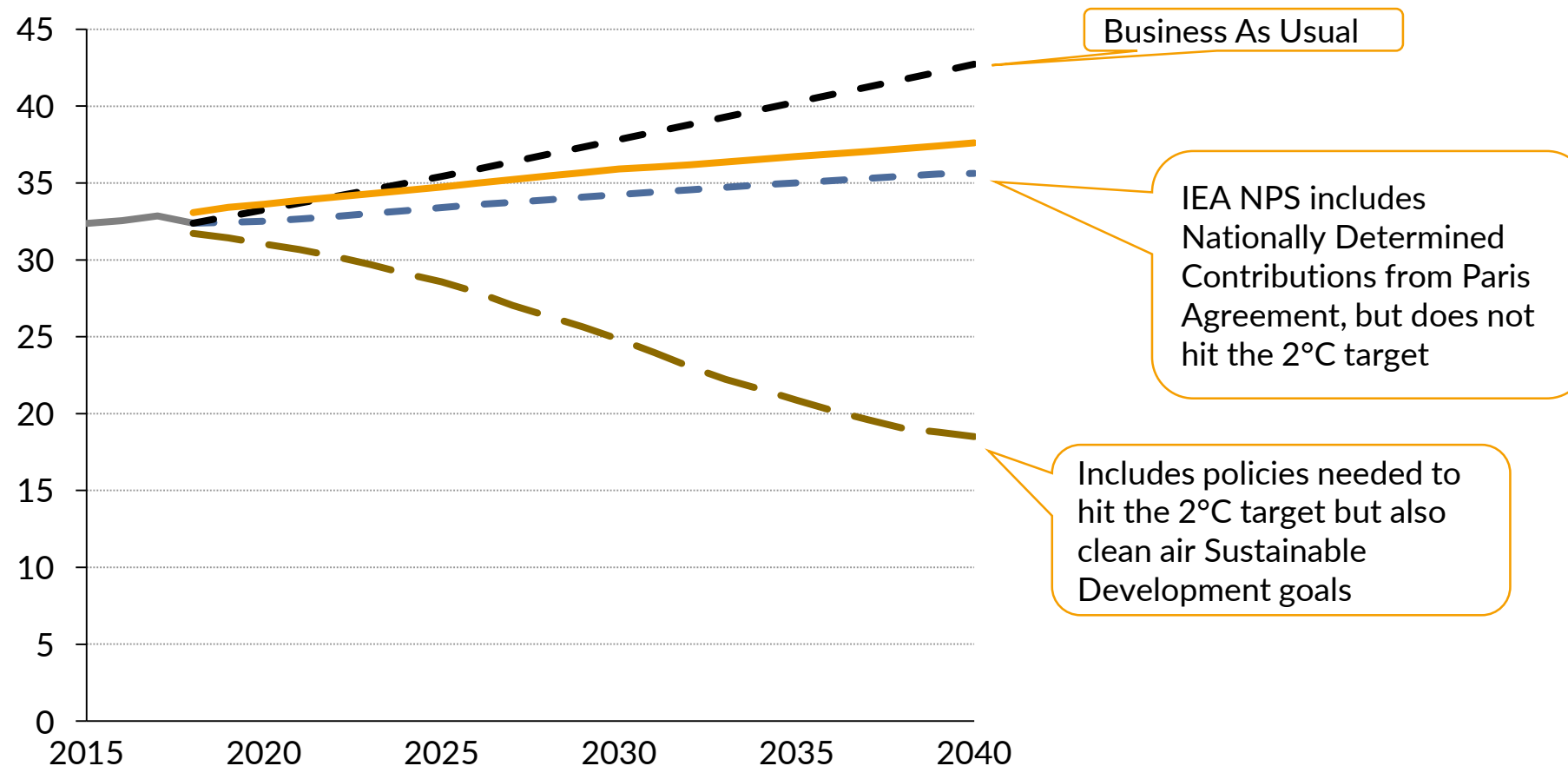
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Burnout scenario achieves lower global CO₂ emissions than NDCs alone, but does not hit the 2°C target

Global CO₂ emissions from fuel use, Gigatonnes CO₂

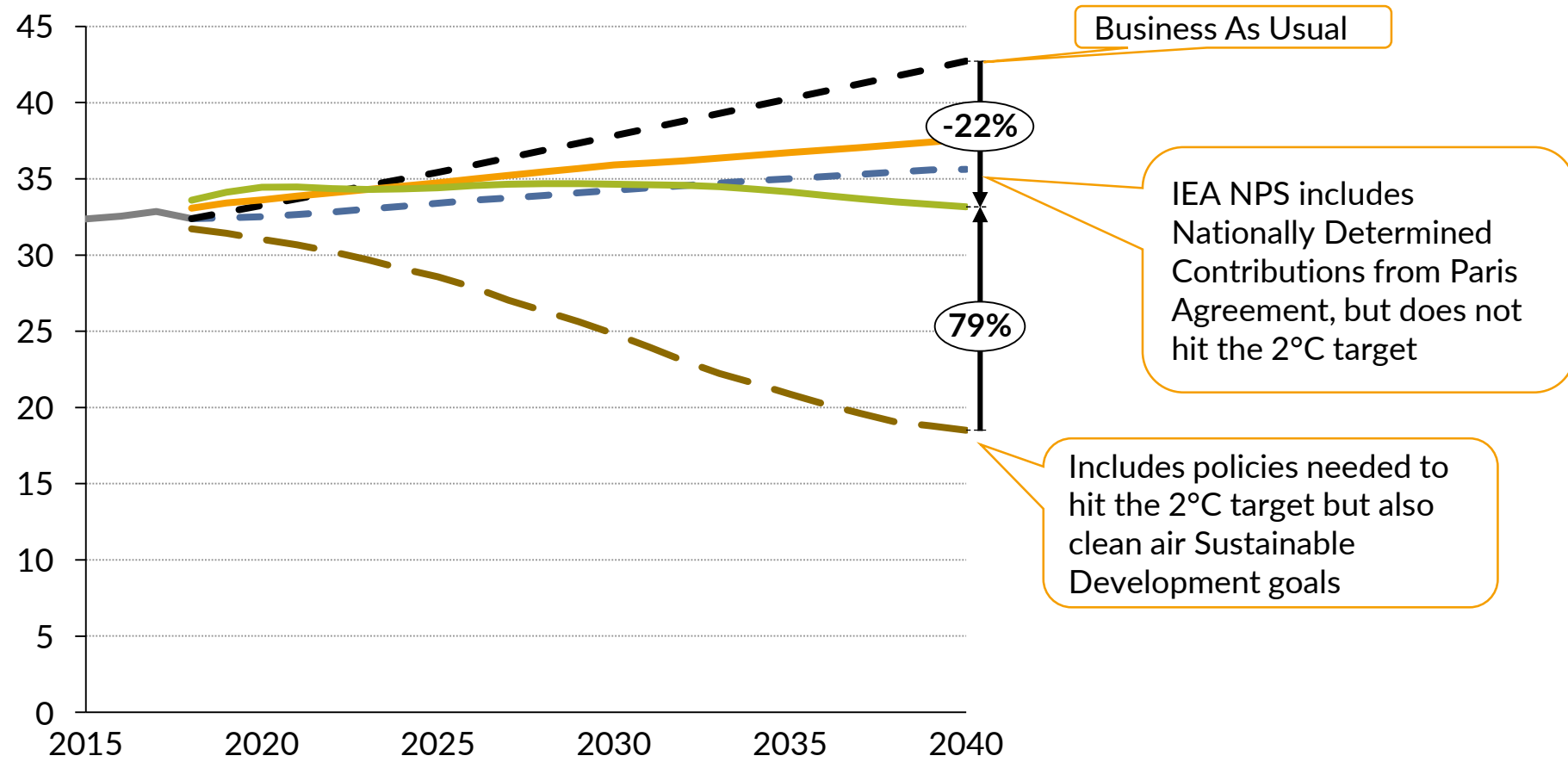
History IEA SDS 2017 Aurora Central
IEA NPS 2017 IEA CPS 2017



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Global CO₂ emissions from fuel use, Gigatonnes CO₂

— History
 — IEA SDS 2017
 — Aurora Central
- - IEA NPS 2017
 - - IEA CPS 2017
 — Burnout



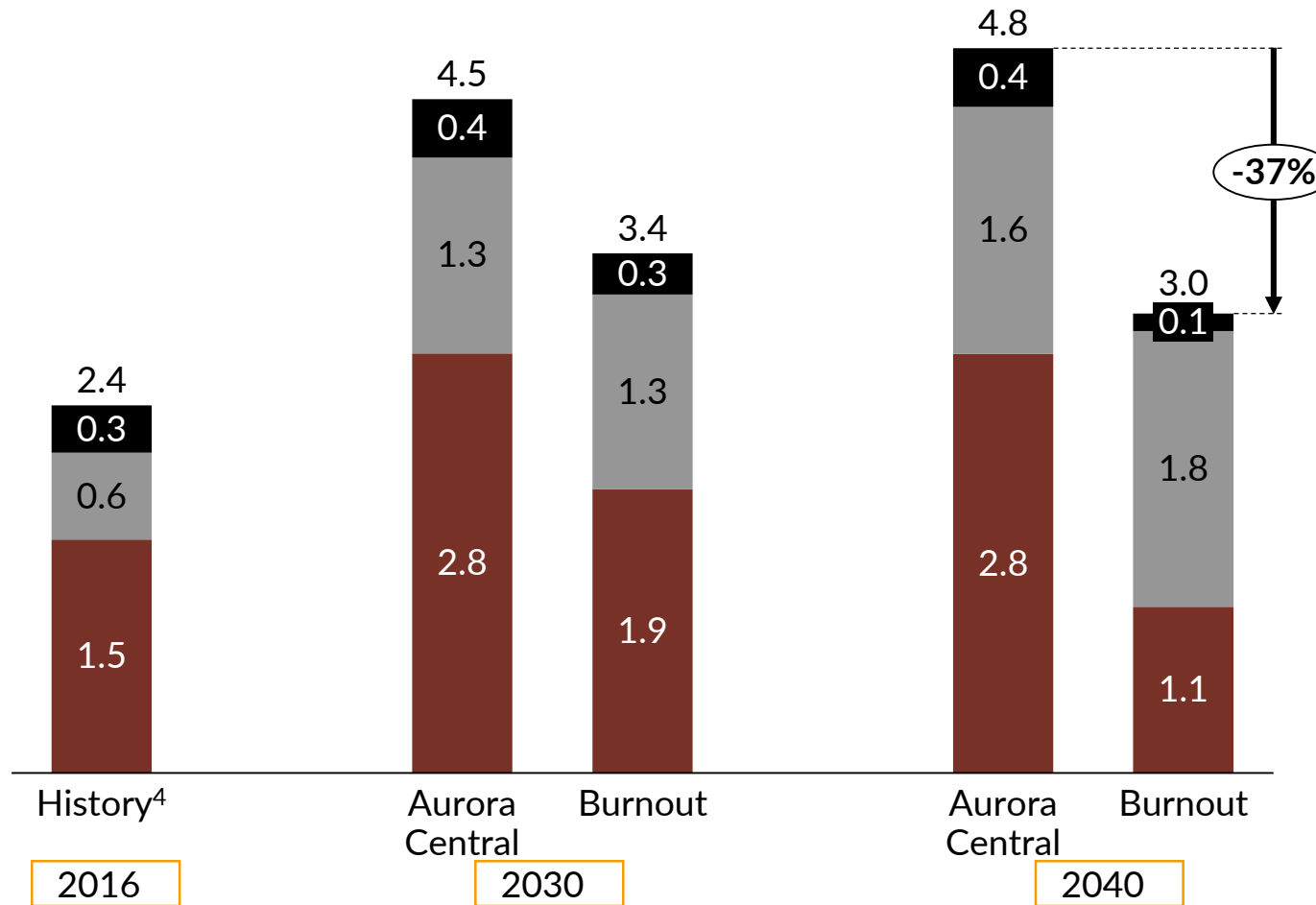
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Compared to BAU scenario, Burnout sees \$21 Trillion loss in oil and coal revenues to 2040; whilst gas market expands significantly

Revenue¹,
2016 US\$ Trillion (real)

Coal² Gas³ Oil



- Cumulative change in revenues (2018-2040) between Aurora Central and Burnout is substantial:
 - A decrease of **\$19 Trillion** for oil
 - A decrease of **\$2.4 Trillion** for coal
 - An increase of **\$0.33 Trillion** for gas
- Gas consumption growth prevents total revenues under Burnout being as low as during the energy commodity price slump in 2016

Notes: 1) Volume X price; 2) At the ARA price; 3) Sum of (hub price X volume consumed by regions buying from that hub); 4) Using 2016 data from BP Statistical Review 2017

Key takeaways

- Technology and consumer preferences drive the energy transition in Burnout and achieve greater emissions savings than Paris NDCs alone
- **Governments should create an environment where innovative business models and technologies are stimulated and able to be financed competitively**

- Oil demand peaks in the mid 2020s as a result of the growth in EVs and improvements in fuel efficiency, causing oil prices to drop substantially thereafter
- **This results in almost \$20 Trillion in lost revenue for oil companies between 2018 and 2040**

- Gas and power become increasingly important energy vectors, together comprising 52% of final energy consumption in 2040 (up from 39% today)
- **Between 2018 and 2040, gas market revenues more than double to \$1.8 Trillion/year**

European Gas Market Service

Market analysis and forecasts for all participants in the European gas market

1 European Gas Market Forecasts



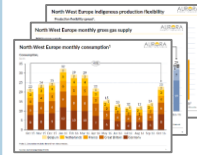
- European gas market development until 2040 including hub prices, seasonal and regional spreads, demand evolution, supply development within Europe and in key supplying regions, LNG and pipeline import flows
- Key modelling assumptions result from in-depth market research drawing on our unparalleled expertise across the energy, policy, environmental and financial sectors, and are further refined through a detailed consultation process across private and public sector players
- Forecasts are produced with our in-house European gas flow dispatch model that includes 430+ pipelines, all storages and LNG import facilities as well as detailed modelling of demand zones
- Comprehensive annual report (~120 pages) with full review and outlook of the market; quarterly updates (~20 pages) focusing on changes in forward prices, geopolitical and technology developments
- Additionally, a presentation with all exhibits plus underlying data in xls is provided

2 Global Energy Market Forecasts



- Aurora's long-term forecasts for oil, gas and coal markets presents a fully consistent view on fuel prices, production, and consumption by major countries and regions
- Identifies key areas of long-term uncertainty in global energy markets
- Provides central, high, low, and P10/P90 price sensitivity analyses, based on historical variation in key sources of uncertainty
- Produced with our in-house global energy market model, which provides full substitution among the commodities and regions (e.g. impact on European gas price if China's growth slumps or India builds more coal power stations)
- Our global energy market model is used to underpin BP's Energy Outlook and the scenarios they present
- The annual main report (~160 pages) provides a full outlook on the expected supply and demand balance going forward, published once a year with quarterly updates

3 Monthly market summaries



- Monthly summary on key performance parameters of the European gas market that set the market results into perspective for management to stay on top of the developments
- North West European Gas System Performance Summary: monthly snapshot of key operating characteristics of the gas market. Key statistics include hub prices, volumes, trade, suppliers market share, indigenous production flexibility and storage provision for security of supply

4 Analytics and data platform EOS



- Access to detailed historical and real-time European gas market data
- Data with daily granularity includes
 - Demand, supply and production
 - Pipeline flows and imports/exports
 - Storage utilisation and LNG sent-outs
 - Regional gas prices and commodity price data
- Data can be viewed, charted and downloaded

5 Bilateral meetings & analyst support



- Bilateral workshops with senior members and subject experts of Aurora's team to discuss Aurora's analyses and views on the market
- Short-notice support by our analysts on questions arising from our research

6 Invitation to Aurora's annual Spring Forum



- In our by-invitation-only annual Spring Forum industry leaders discuss the challenges of the energy industry of tomorrow
- Being held at distinguished venues at the University of Oxford
- Key note speakers of our 2018 Forum included Clair Perry MP (Minister State, BEIS), Magnus Hall (CEO, Vattenfall), Spencer Dale (Chief Economist, BP) and Steven Fries (Chief Economist, Shell)

For more information and pricing, contact
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