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## Professor Lesley Sloss

Tuning compliance strategies to regional needs

[lsloss@EPRI.com](mailto:lsloss@EPRI.com)





Full report freely available from [www. sustainable-carbon.org](http://www.sustainable-carbon.org)

Thanks to the US Department of State, the International Centre for Sustainable Carbon, BCRC-Asia, and the Indonesian Government for supporting this work

## INTEGRITY

We interact and transact with honesty, transparency, fairness, and respect. Every action we take is conducted ethically and beyond reproach.



## SAFETY

Safety and security are the top priority and a commitment we make to each other.



## OBJECTIVITY

We conduct every aspect of our business free from favoritism, self-interest, and bias in judgement.



## COLLABORATION

We enable people to use their individual skills and talents, bring together global stakeholders, LISTEN to diverse views, and LEAD with expertise.



## PUBLIC BENEFIT

We demonstrate corporate responsibility through our actions and decisions to benefit society.



## INNOVATION

We relentlessly pursue creative thinking that advances valuable, science-based solutions.



## PEOPLE

We empower and foster a culture of diversity, inclusivity, and mentorship to motivate our colleagues.



## VALUE

We continuously strive for technical and operational excellence to provide lasting value to the energy industry and society.



# Values and Guiding Principles

## OUR VALUES

The core of our reputation, a non-negotiable reflection of our mission and commitment to do the right thing, based on trust that society extends to us

## OUR GUIDING PRINCIPLES

Behaviors and outcomes that we strive for, providing orientation in our day-to-day work and helping us when facing difficult decisions

# Knowledge (data) is power

Accurate data leads to a cost-effective emission reduction strategy for the coal sector

- Produce advanced and accurate emission estimates
- Create a ranking system to prioritize action
- Make informed technology decisions



# Obligations for the coal utility sector under the UN Minamata Convention on Mercury

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“EACH PARTY SHALL ESTABLISH, AS SOON AS PRACTICABLE AND NO LATER THAN FIVE YEARS AFTER THE DATE OF ENTRY INTO FORCE OF THE CONVENTION FOR IT, AND MAINTAIN THEREAFTER, AN INVENTORY OF EMISSIONS FROM RELEVANT SOURCES”

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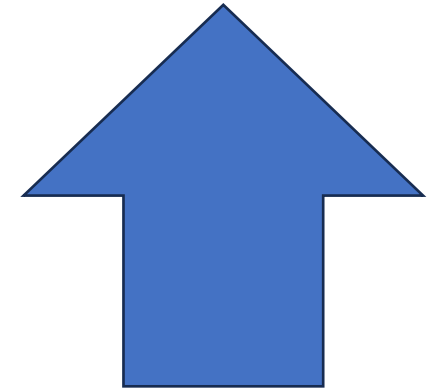
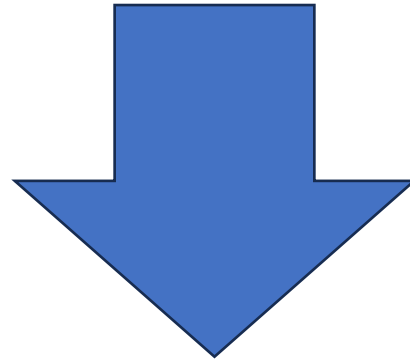
A PARTY WITH RELEVANT SOURCES SHALL TAKE MEASURES TO CONTROL EMISSIONS AND MAY PREPARE A NATIONAL PLAN SETTING OUT THE MEASURES TO BE TAKEN TO CONTROL EMISSIONS AND ITS EXPECTED TARGETS, GOALS AND OUTCOMES

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# Creating a detailed emission inventory

Most inventories are Level 1, produced using a “top-down” approach:

Total coal burned x emission factor







A more appropriate approach is, Level 2 “bottom-up”:

Data for each unit x specific emission factor

# Creating the dataset

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REAL DATA FROM PLANTS - MISSING DATA ESTIMATED THROUGH PROXY CALCULATIONS

 Unit/plant details	 Unit performance	 Emission controls	 Fuel quality
Unit and plant name	Operational load	Flue gas desulphurisation	Calorific value
Location	Utilisation/capacity factor	In boiler additives	Mercury content
Generating capacity	Specific energy consumption	NOx burners or SCR	Sulphur content
Certified operating and commissioning date	Annual coal consumption	PM controls	Chlorine content

# How to turn emission data into an emission reduction strategy



Create an accurate emission inventory for the fleet, with as much plant-specific data as possible

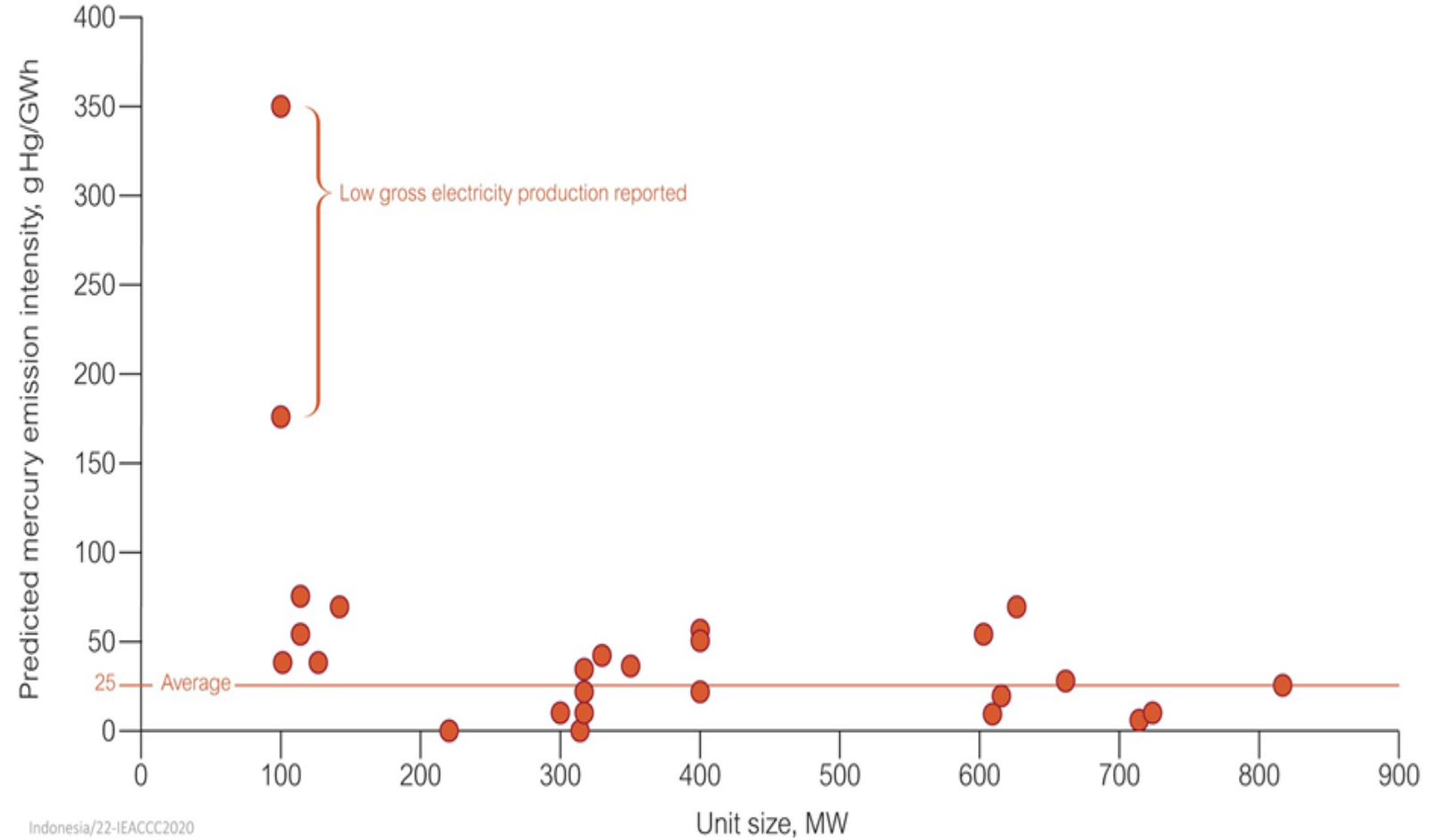


Rank the sources/units and focus on high-emitters and inefficient plants first



Create an emission reduction strategy which is appropriate – affordable and achievable, maximising “co-benefit” and multipollutant strategies

# Fleet emission intensity



Amount of Hg (g) emitted per GWh of electricity produced – an indication of “cleaner” burning plants.  
No indication of the size-related intensity of Hg emissions for units >100 MW

SOME UNITS EMIT  
AN ORDER OF  
MAGNITUDE MORE  
MERCURY PER GWh  
OF POWER  
PRODUCED THAN  
OTHERS

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# Factoring in plant lifetime

## IMMEDIATELY PRIORITISES COST-EFFECTIVENESS



### Current method

Identifies plants which emitted the most mercury in the last operating year

**BUT**

assumes all plants are the same age



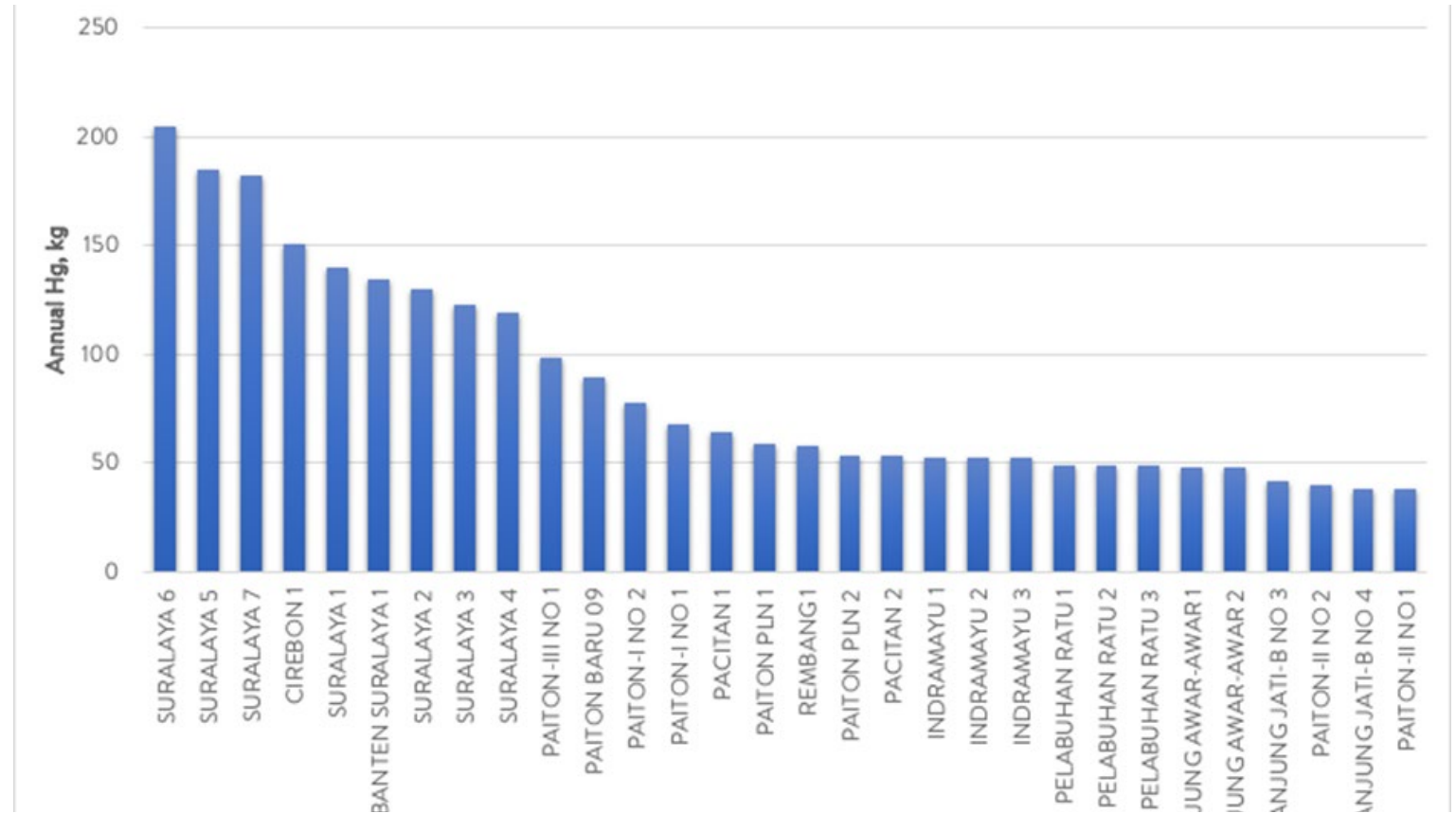
### Add in capacity factor/remaining lifetime

Removes older plants which will slow down or close soon

Allows focus for intervention on plants where control technologies may be effective in the long-term

ASSUMING PLANTS RUN UNTIL THEY ARE 40 YEARS OLD

Units which will emit >1t Hg over their remaining lifetime (Indonesia)



The top 10 units in Indonesia (out of 111 units) emit around 50% of the total emissions from the entire fleet

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# Strategies to reduce mercury from coal

# Techniques and technologies

- Coal cleaning
- Fuel switching and blending
- Boiler additives (oxidants)
- Pollution control systems for particulates, NO<sub>x</sub> and SO<sub>2</sub>
- Dedication mercury control systems (activated carbon etc)

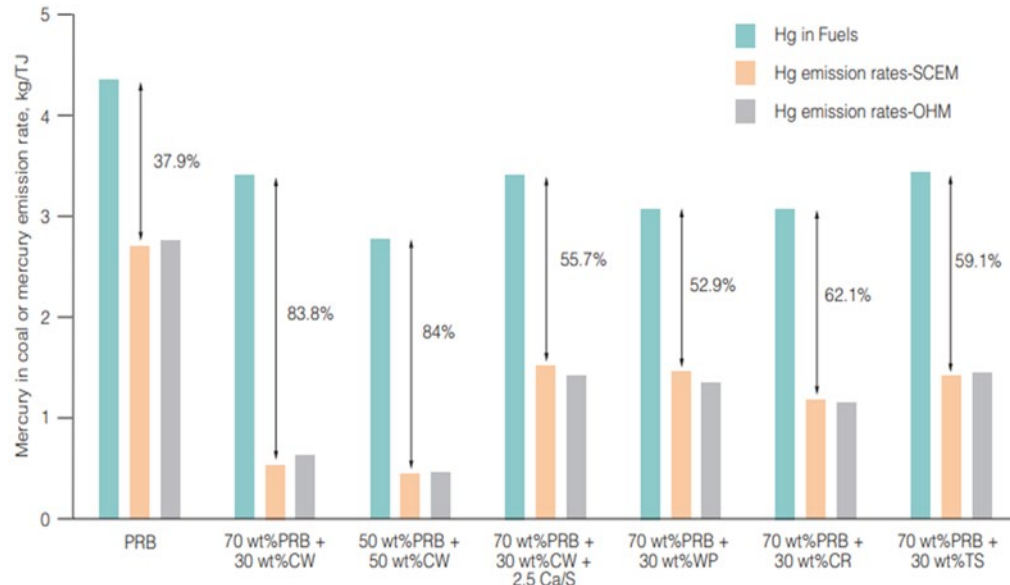
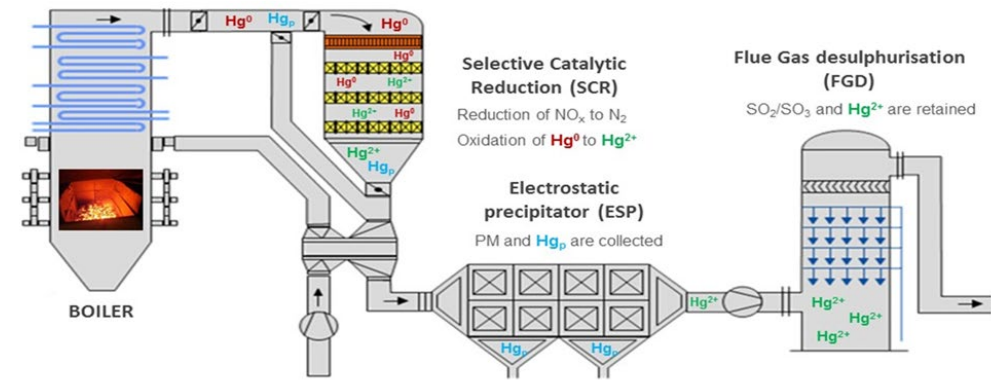


Figure 15 Variation of mercury emission during cofiring of subbituminous coal and biomass (Cao and others, 2008)



Best available techniques and technologies

# BAT/BEP

## Best available technology

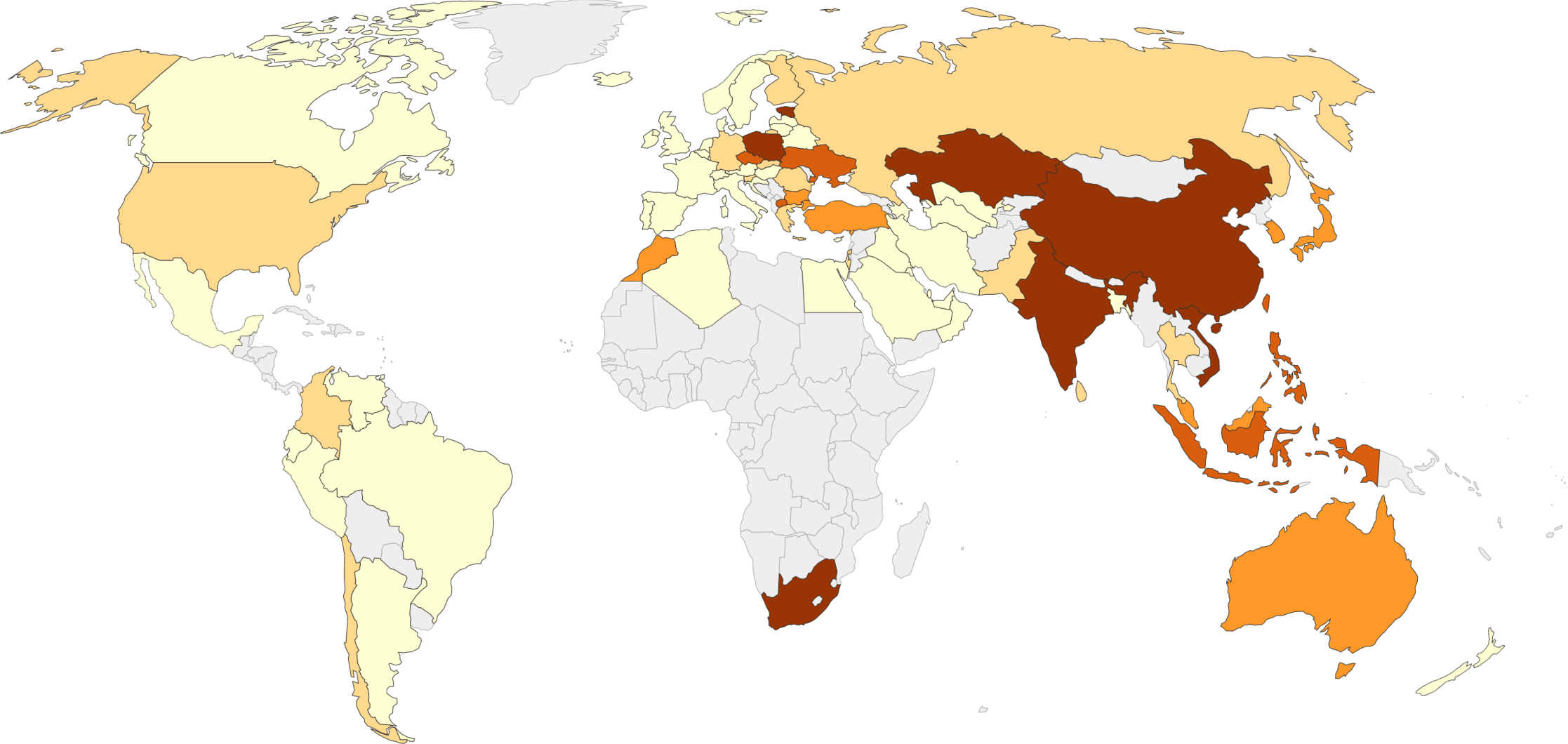
- “Best” is determined by factors such as mercury reduction efficiency but also by cost and appropriateness to achieve the goals of the national plan
- Many regions are still focusing on reducing emissions of particulates, SO<sub>2</sub> and NO<sub>x</sub> – mercury is not yet on the radar
- Maximize co-benefit effects (reduction of mercury with systems designed to control other pollutants)

## Best environmental practice

- Consider full balance of plant issues
- Consider chain of custody when mercury moves from the flue gas to solid by-products or liquid effluents

*... Consider the broader energy strategy of the region*

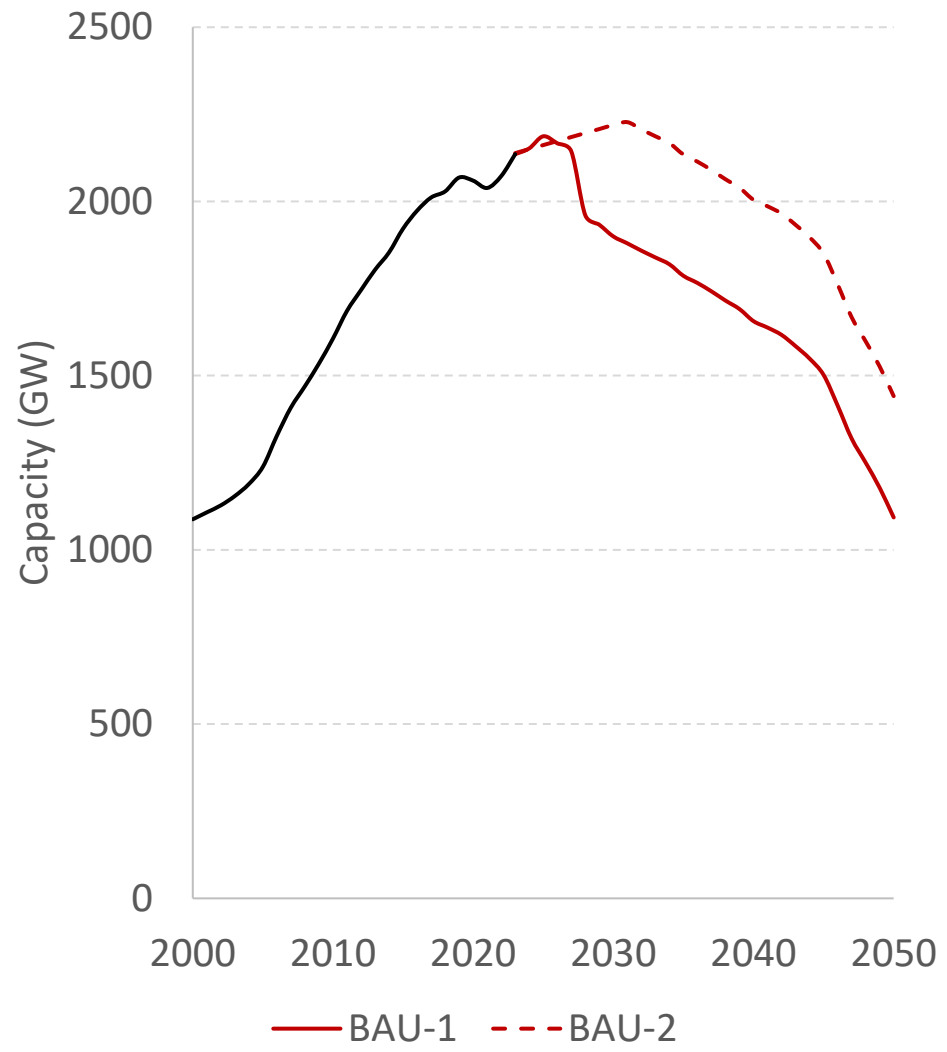
# Share of primary energy from coal



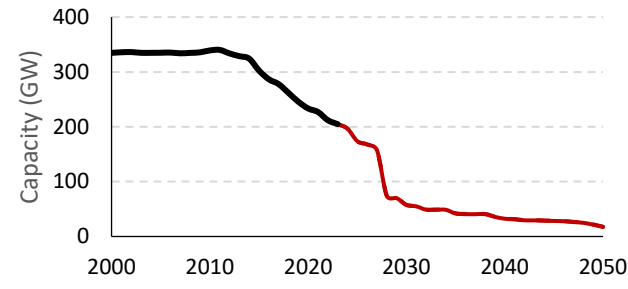
# Coal-Fired Power Plants (CFPP) – Capacity

(Data from Macquarie University GEF project)

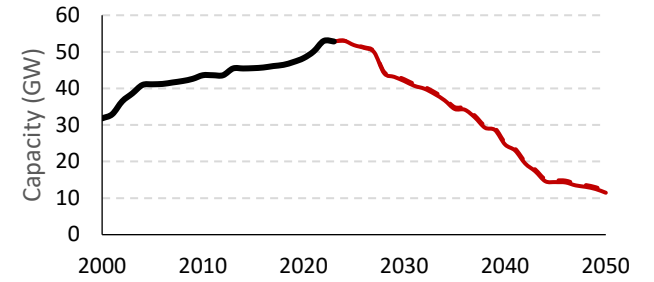
### CFPP capacity - Global



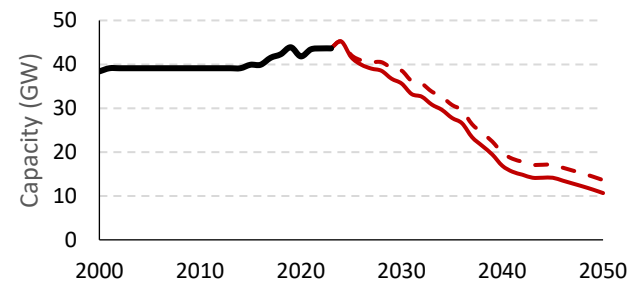
### United States



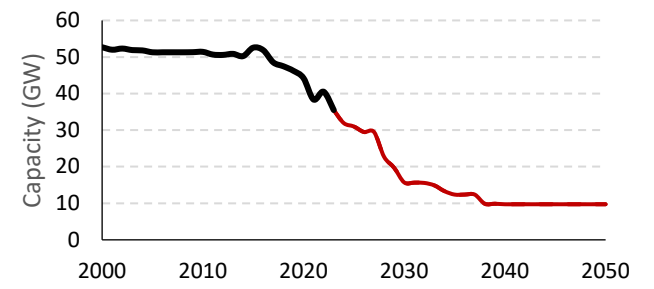
### Japan



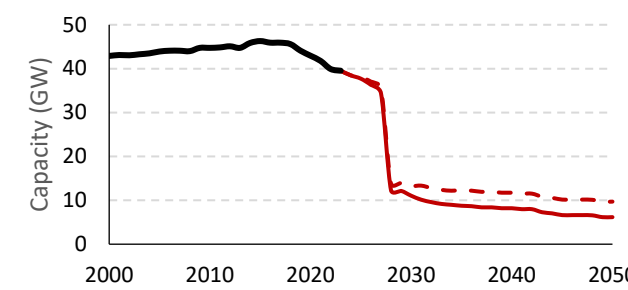
### South Africa



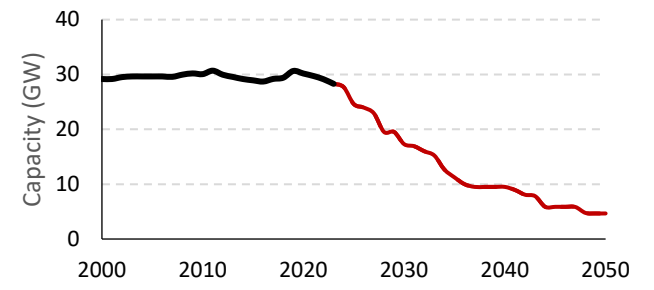
### Germany



### Russia



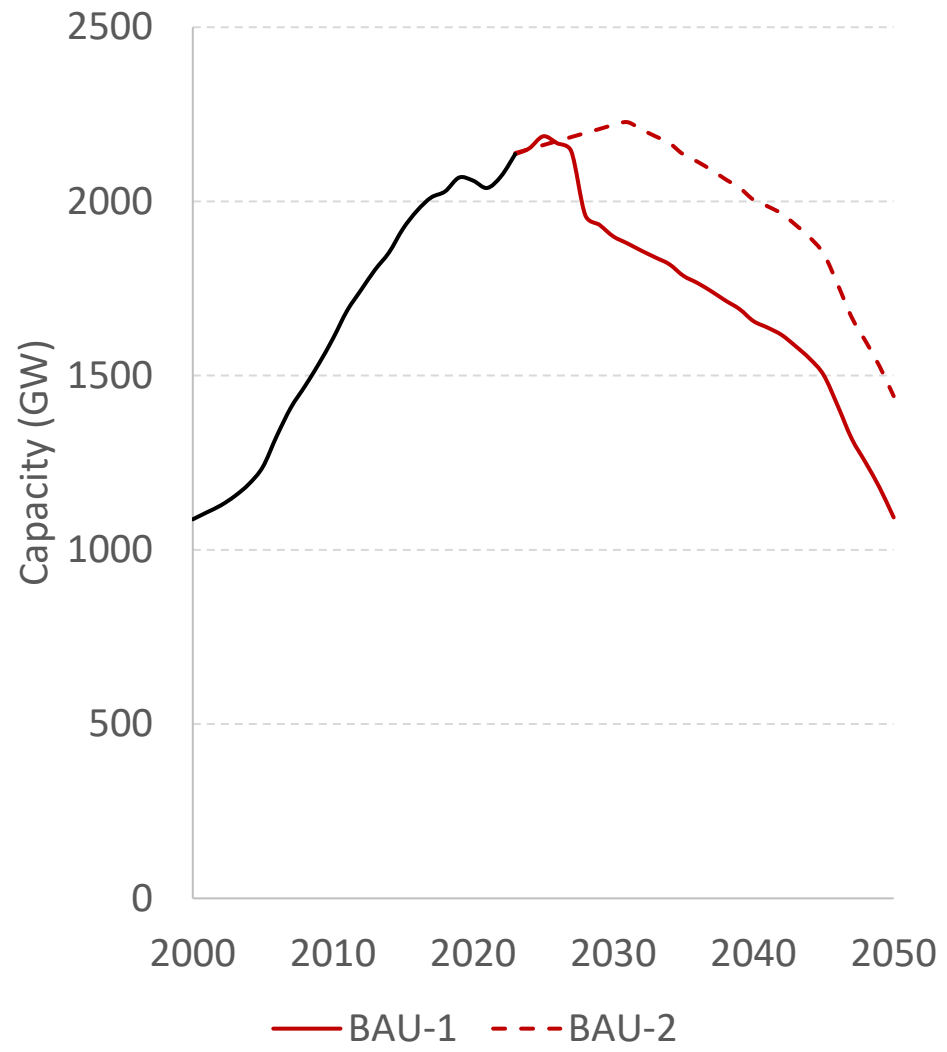
### Poland



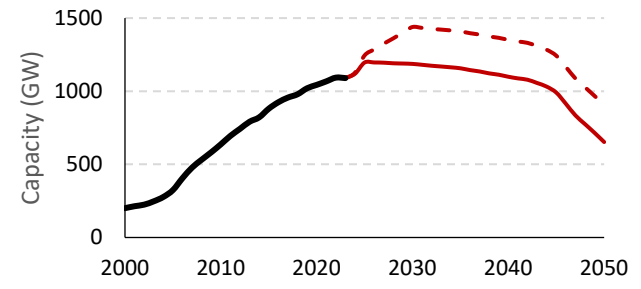
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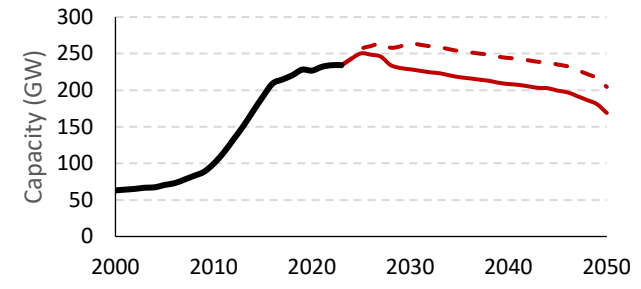
CFPP capacity - Global



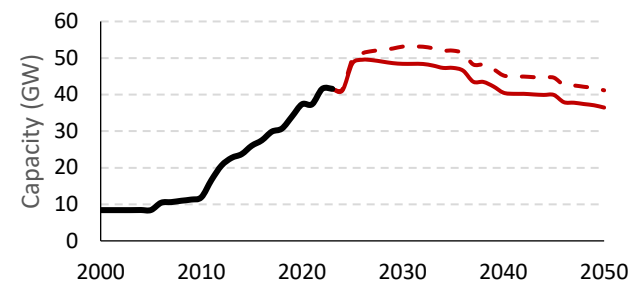
China



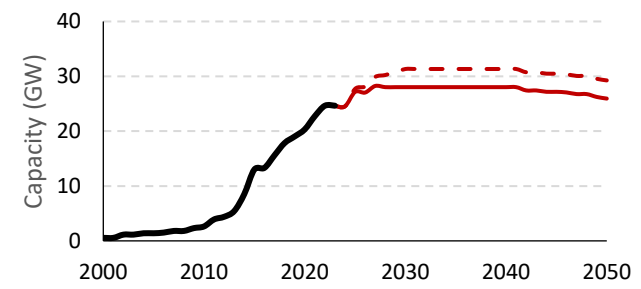
India



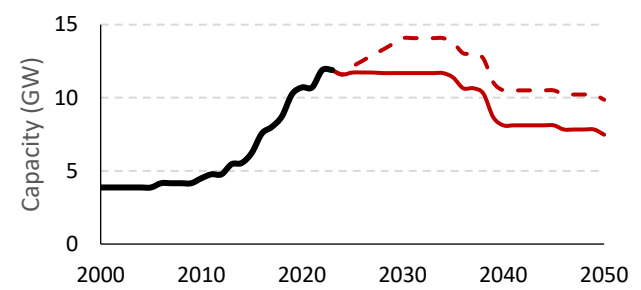
Indonesia



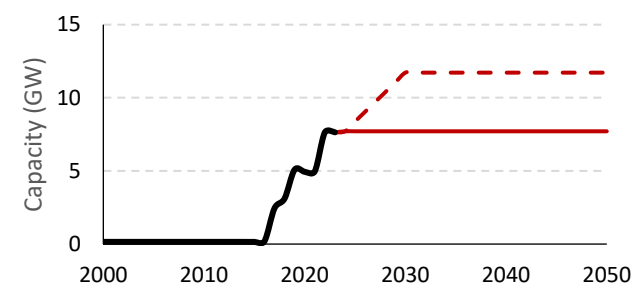
Vietnam



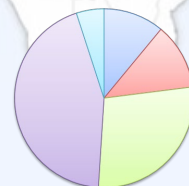
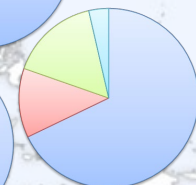
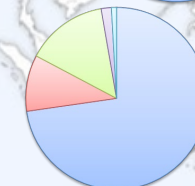
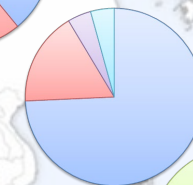
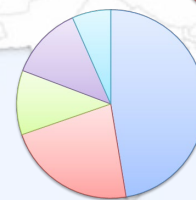
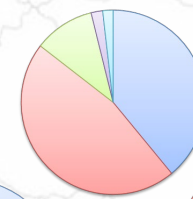
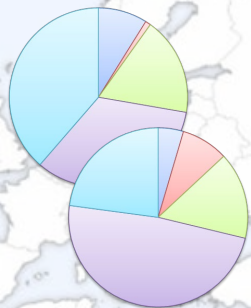
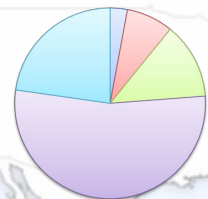
Philippines (the)



Pakistan



# Remaining Lifetime (2020-)



- > 30yrs
- 20-30yrs
- 10-20yrs
- 5-10yrs
- < 5yrs



**The majority of mercury emissions from coal are from emerging regions and this will be the case for decades**

# Cost-effective strategies for emerging regions

## Fuel changes:

Poor quality coal decreases plant efficiency and increases emissions of all pollutants (washing and blending options)

Biomass cofiring is being tested in India and Indonesia

## Co-benefit effects:

Any time a retrofit or upgrade happens, all pollutants should be considered in the technology choice

## Plant optimization/ repurposing:

Coal is needed to provide stable power until cleaner options are affordable (which could be decades in some regions)

Plants that continue to operate must do so as cleanly and efficiently as possible

# Coal fleets in emerging economies

- *Coal plants in emerging regions could remain major sources of mercury emissions for decades*
- *These regions are unlikely to suddenly focus on mercury when other pollutants are still a priority - it is therefore critical that reduction strategies for mercury are integrated into strategic fleet management*

*EPRI is working with the coal sector in emerging economies in a holistic manner to ensure that, until coal is ultimately retired from the energy mix, the remaining plants provide as clean and efficient a bridge to carbon-free power as possible*

[l.sloss@epri.com](mailto:l.sloss@epri.com)

# Conclusions

The Minamata convention only requires a total sectoral inventory. Enhanced inventories inform a significantly more cost-effective reduction strategy

A ranking approach, considering plant-specific factors including remaining operating lifetime, determines where action will achieve the greatest results

It is possible and even likely that acting on a few plants could achieve faster and more cost-effective emission reduction than a blanket requirement for action across all plants

Emerging economies will continue to rely on their aging coal fleets for many years – it is imperative that these fleets run as efficiently as possibly until their ultimate closure

**Continuing coal operation requires strategic management**

# EPRI Research & Development

## TECHNOLOGY INNOVATION

Driving thought leadership, advanced R&D, and technology scouting and incubation to sustain a full pipeline of solutions



Nuclear Power



Energy Supply and Low-Carbon Resources



Electrification and Sustainable Energy Strategy



Transmission and Distribution Infrastructure



Integrated Grid and Energy Services

## STRATEGIC RESEARCH



Low-Carbon Resources



End-Use/Economy-Wide Carbon Reduction



Electric System Reliability/Resilience



Electric System Flexibility



Market Transformation/Policy/Regulatory Education



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