COAL: TOWARDS ZERO CARBON EMISSIONS

DR ANDREW MINCHENER OBE
GENERAL MANAGER IEA CLEAN COAL CENTRE

PETROCOAL VIRTUAL CONFERENCE INDIA

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WHO WE ARE

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Technology Collaboration Programme
by IEA

- The IEA Clean Coal Centre is part of a network of autonomous collaborative partnerships focused on a wide range of energy technologies known as Technology Collaboration Programmes (TCPs)
- The TCPs are organised under the auspices of the International Energy Agency (IEA), but the TCPs are functionally and legally autonomous
- We are funded by national governments (contracting parties) and by corporate industrial organisations (sponsors)
- We are dedicated to providing independent information and analysis on how coal can become a cleaner source of energy, compatible with the UN Sustainable Development Goals

SCOPE OF PRESENTATION

- Coal use worldwide: challenges and opportunities
- Need to address efficiency and environmental issues
- Zero carbon emissions: CCS and CCUS
- IEACCC collaboration with Indian stakeholders

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COAL USE WORLDWIDE: CHALLENGES AND OPPORTUNITIES

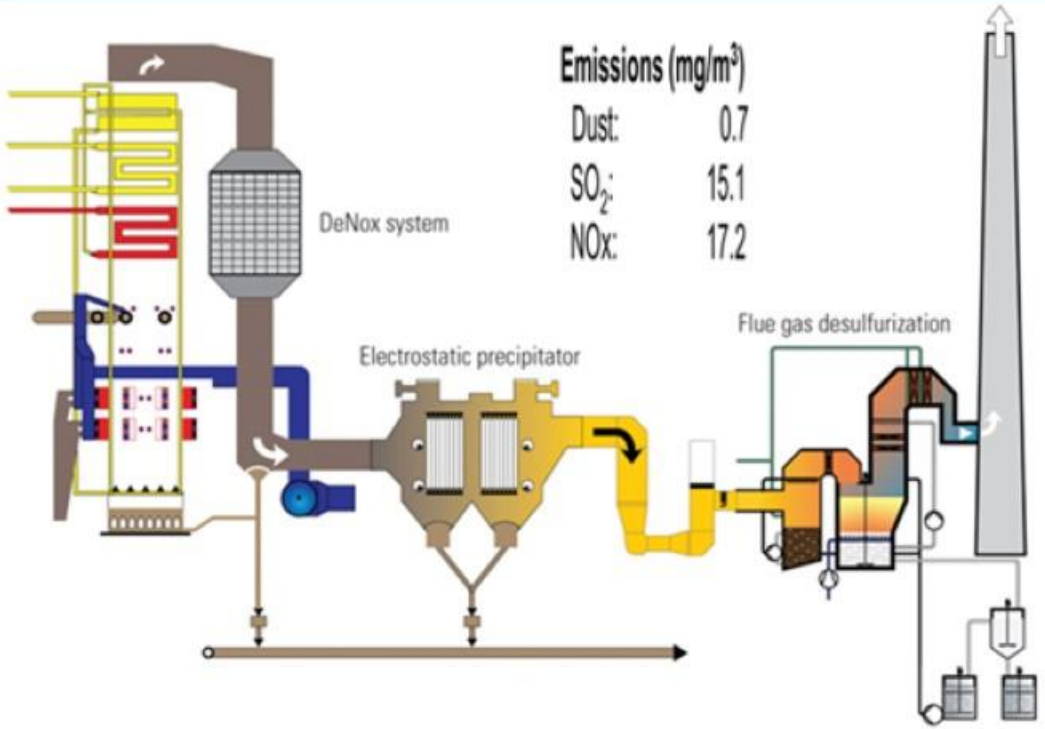
- Coal provides a means to lift populations out of poverty and to ensure robust reliable energy sources, for power, industry and chemicals production, which will take forward industrialisation in developing countries
- Coal has to be a part of the global energy mix, while the aim should be to limit conventional pollutant emissions with state of the art technology and minimise CO2 through improvements in efficiency and the subsequent introduction of CCS/CCUS
- Ongoing focus will be Asia

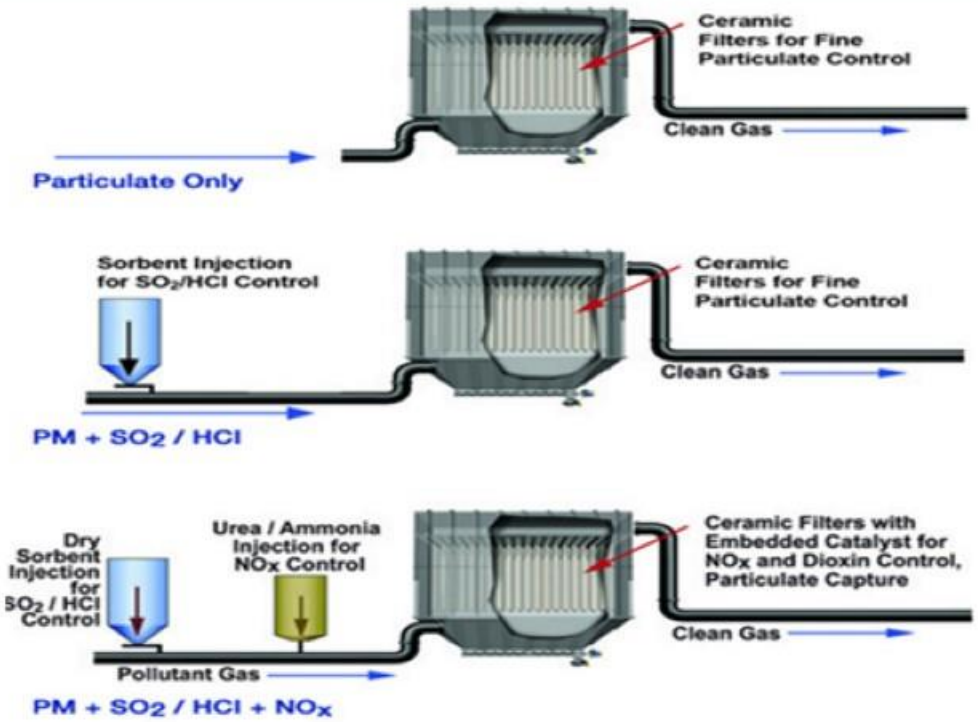
EXAMPLE OF TIGHTENING COAL POWER EMISSION STANDARDS IN CHINA

Pollutant (mg/m3)	Coal-fired power plant standard (from 2012)	Coal power plant ultralow standard	Gas-fired power plant standard
PM	20-30	10	5
SO2	50-200	35	30
NOx	100-200	50	50

- Coal power plants in Eastern China and Central China met the ultra-low emission standards by 2017 and 2018 respectively
- Coal power plants in Western China are encouraged to achieve emissions that meet or are close to ultra-low emission levels
- CFB and down-fired W flame boilers are exempted from meeting the ultra-low emissions but must meet the emission standards that came in force from 2012

AIR QUALITY AND EMISSIONS CONTROL





- HELE coal power plants have state of the art emissions control devices to remove particulates, NOx and SO_2
- Multipollutant technology offers the scope to combine all individual devices in to a single integrated system. This offers the significant potential of an efficient single solution that will reduce the land footprint and reduce the capital cost, thereby providing another step to zero pollutant emissions

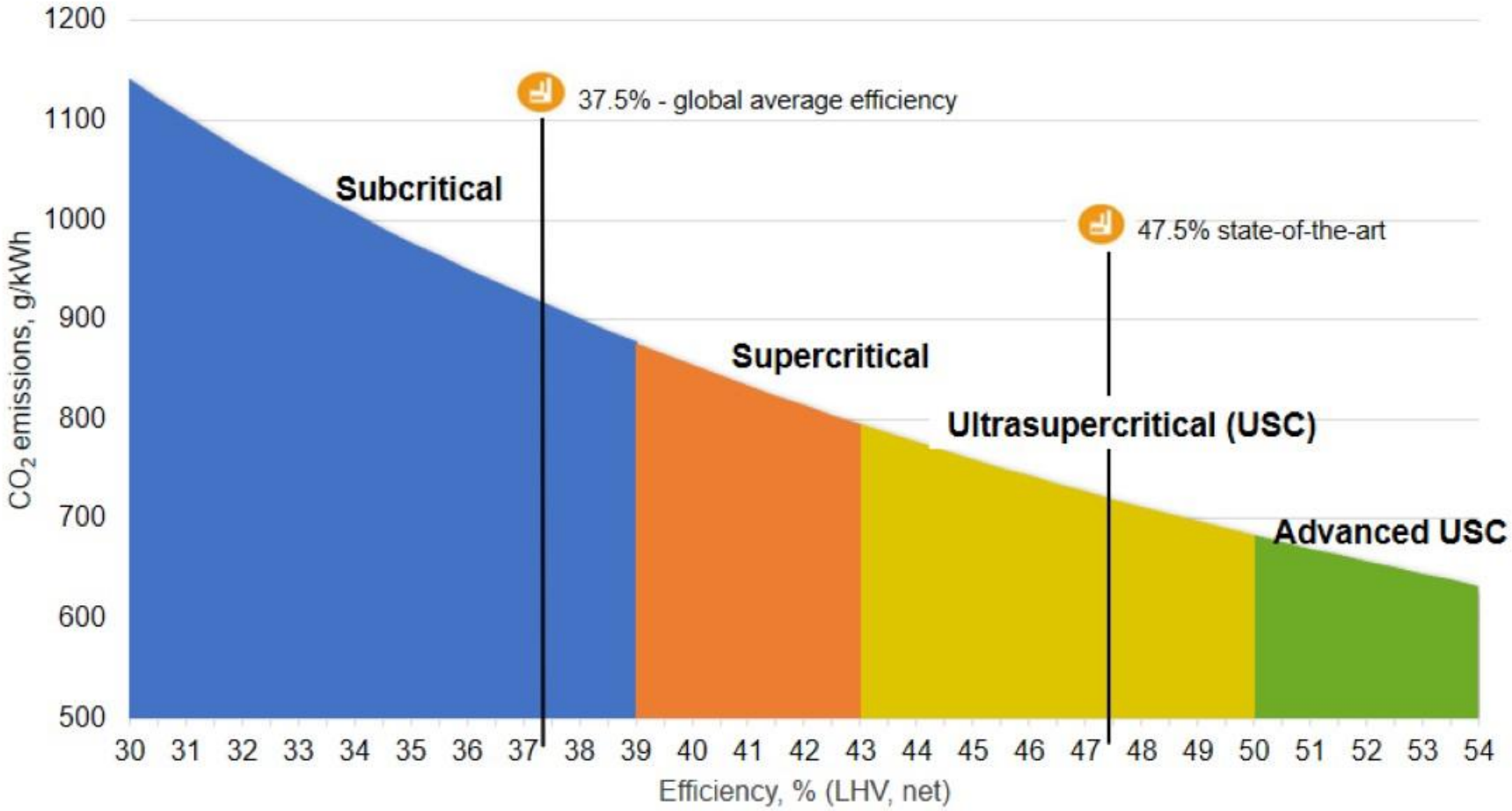
CHINA COAL POWER EFFICIENCY STANDARDS

Plant size (MWe)	New plants (g/kWh)		Existing plants by 2020 (g/kWh)
	Wet cooling	Dry cooling	
PC units			
600	≤285	≤302	≤300
1000	≤282	≤299	
All plants	≤300		≤310
CFB units			
300	≤310	≤327	n/a
600	≤303	≤320	n/a

IMPROVING COAL PLANT EFFICIENCY

Potential for ~2 Gt of CO_2 savings if global average brought to state of the art

USC not strictly defined – broadly refers to use of material advances since the 1990s (P91/92)



DIFFERENT REGIONS HAVE DIFFERENT ENERGY OPTIONS AND ARE AT VARIOUS STAGES OF INDUSTRIAL DEVELOPMENT

THEY HAVE DIFFERENT PRIORITIES FOR ENSURING A SUSTAINABLE FUTURE

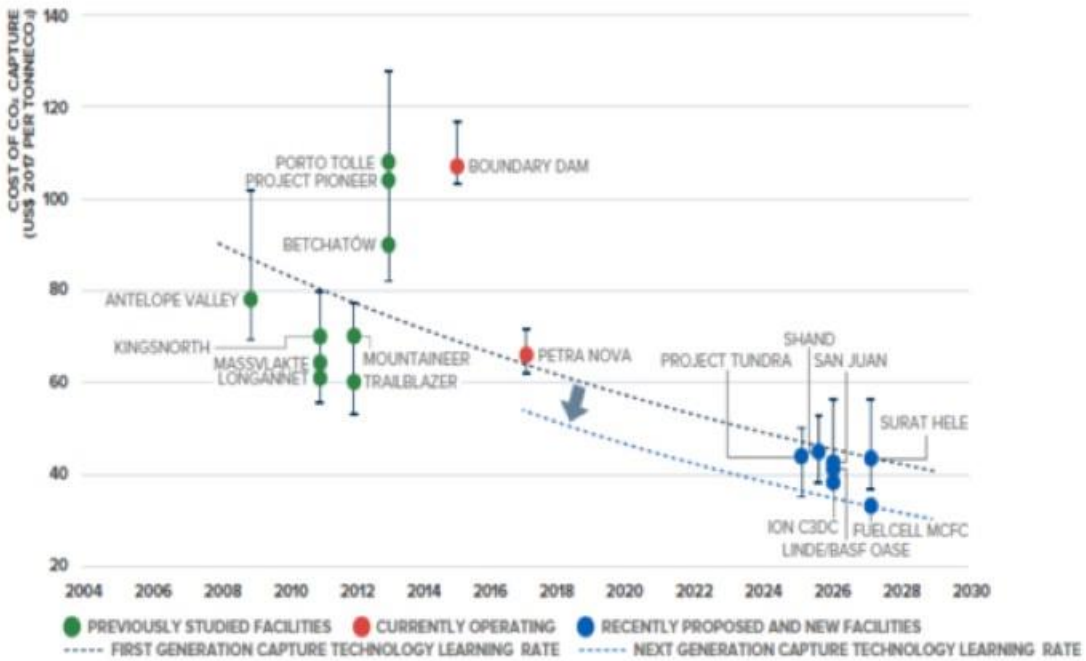
ZERO CARBON EMISSIONS: CCS AND CCUS

- 19 operational CCUS facilities able to store 37-38 $MtCO_2/y$
- 4 in construction due to complete by 2020-21
- 10 in advanced design using FEED approach
- 18 in early stages of development
- Key regions are North America, Europe, Middle East and Asia Pacific

Global CCUS installations (GCCSI, 2019)

COSTS REDUCTION: LEARNING BY DOING

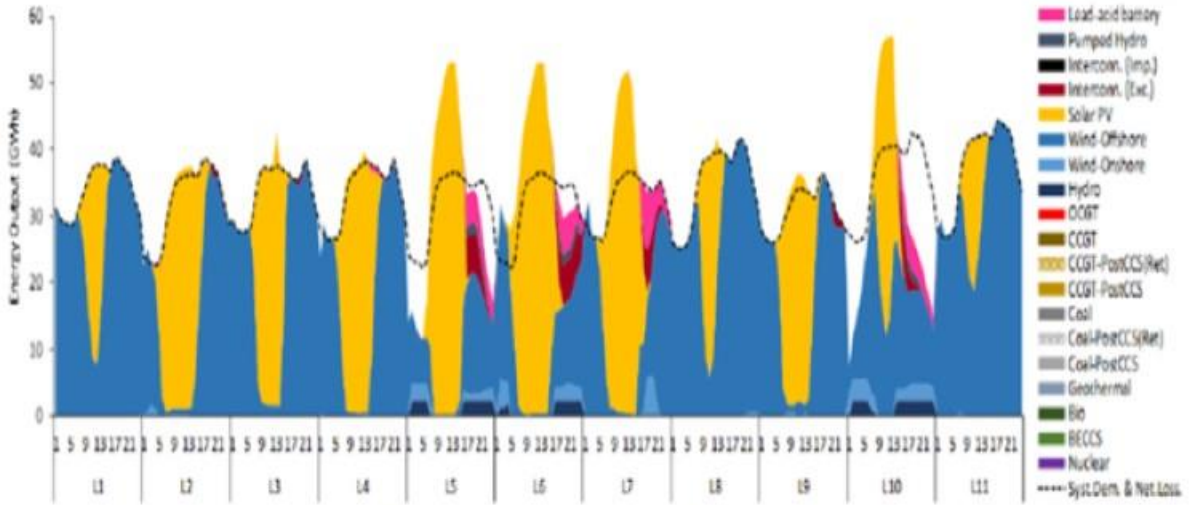
- Scale-up
- Site layout and modularisation
- Increased primary power plant efficiency
- Optimising CCUS operating envelope
- Development of CCUS supply chain
- Operating cost reduction
- Amine degradation
- Component redundancy for reduced maintenance costs
- CCUS facility bypass
- System integration



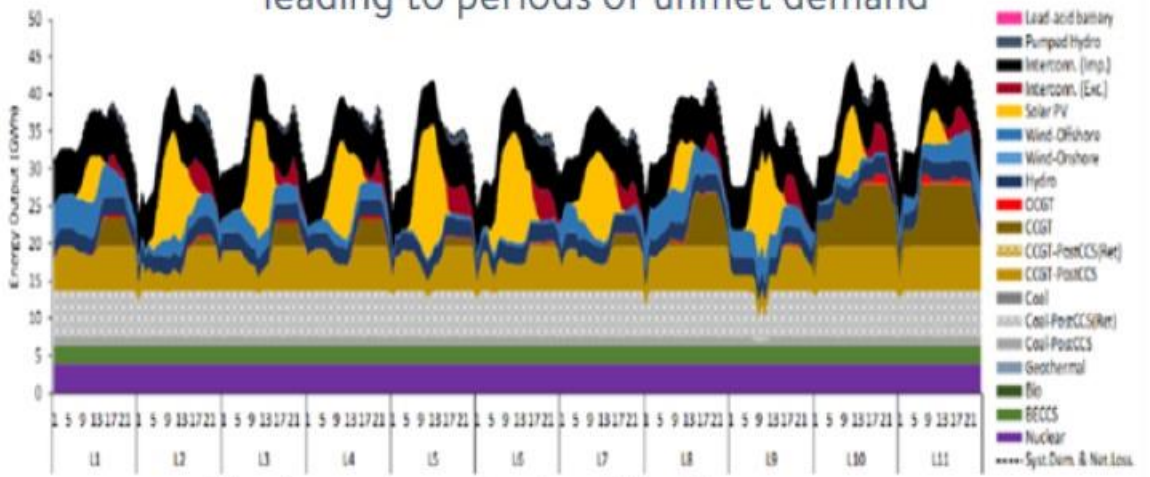
TECHNOLOGY INTERPLAY FOR RELIABLE COST-EFFECTIVE LOW CARBON POWER GENERATION

HOW TO STABILISE THE GRID (PRATAMA AND MAC DOWELL, 2019)

- Include dispatchable generation, to use on demand at request of power grid operators, according to operational needs
- Coal or gas are proven options as can be biomass and hydro. Dispatchable generators can be turned on or off and can adjust their power output according to requirements
- When the grid system is integrated to ensure an interplay, say, of coal (or gas) and VRE sources, the dispatchable power source can be readily adjusted to balance the grid. This interplay of dispatchable power with VRE provides the necessary inertia to avoid outages. Equally important, such systems can always meet demand



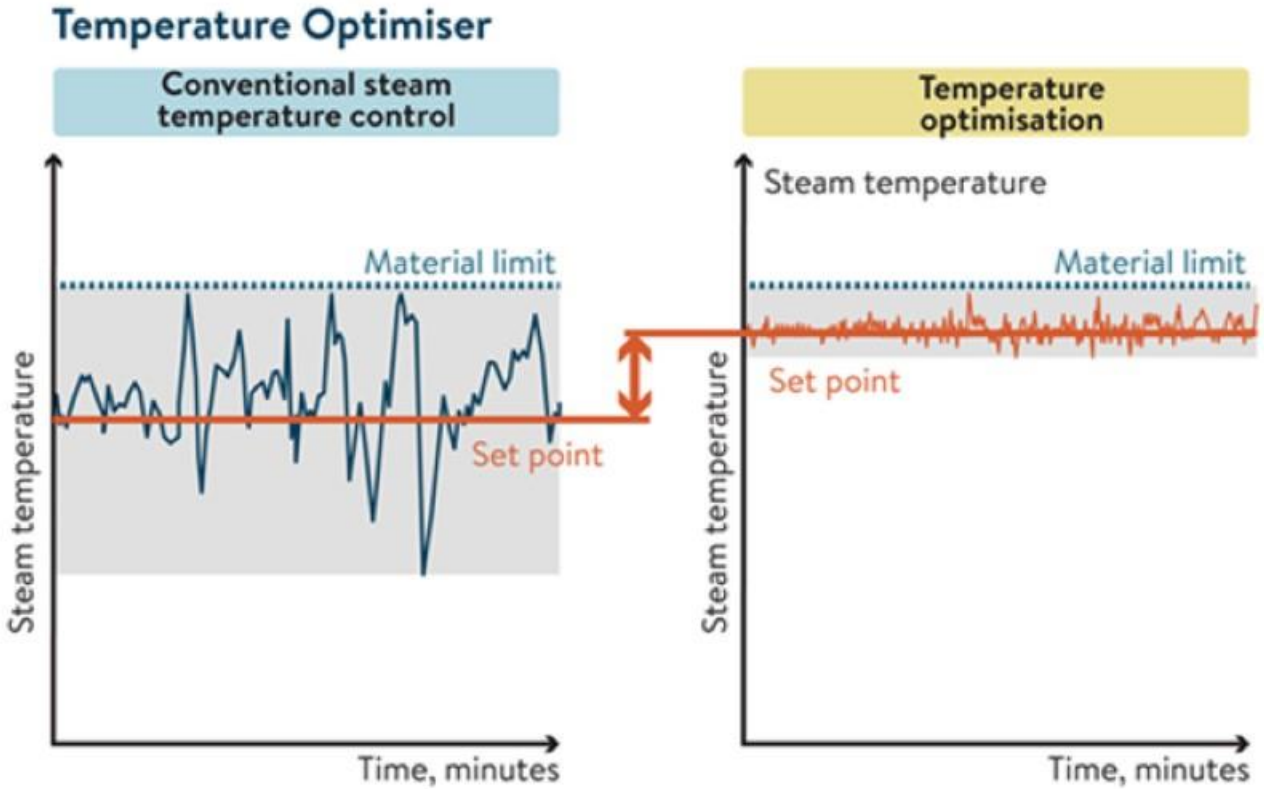
use of renewables and storage only, leading to periods of unmet demand



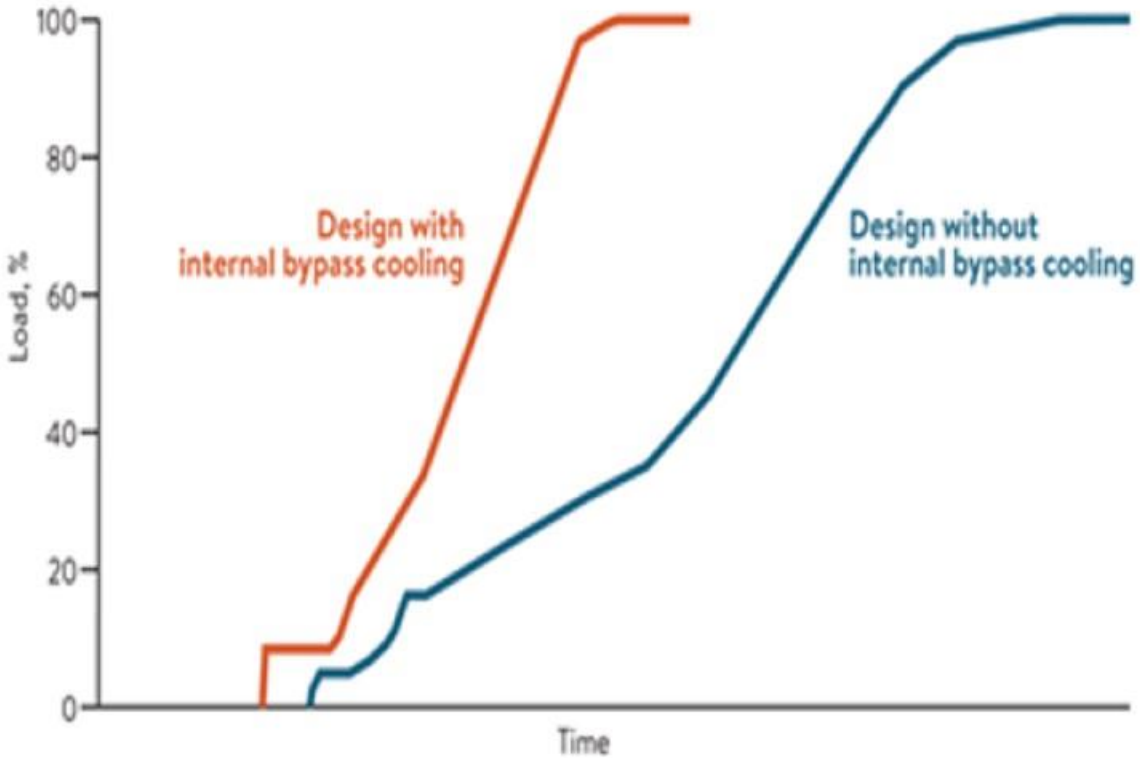
The lowest-cost mix with all technologies available

...AND BE FLEXIBLE (CHITTORA 2018)

- Such coal power plants can ensure dispatchable power with very flexible operation that provides the inertia for stable operation with VRE



The Temperature Optimiser solution increases the efficiency through higher steam temperatures and the use of appropriate control elements for reheater temperature



Effect of design improvements on plant ramp rate

IEACCC ONGOING COLLABORATION WITH INDIA

USDOS CAPACITY BUILDING IN INDONESIA AND INDIA

- Capacity building with the Indonesian coal power sector to identify sustainable strategies for mercury monitoring, evaluation and reduction

- Capacity building with the Indian coal power sector covering all conventional emissions control requirements, plus efficient flexible operation, recognising that such reduction strategies can provide the associated means to limit mercury emissions

- Approach will **provide long term and sustainable benefits for the coal power sector** in both Indonesia and India, with scope to be used by other emerging economies in due course


Coal power plant Batang, Indonesia, Shutterstock, cpaulfell


Image: Bigstock

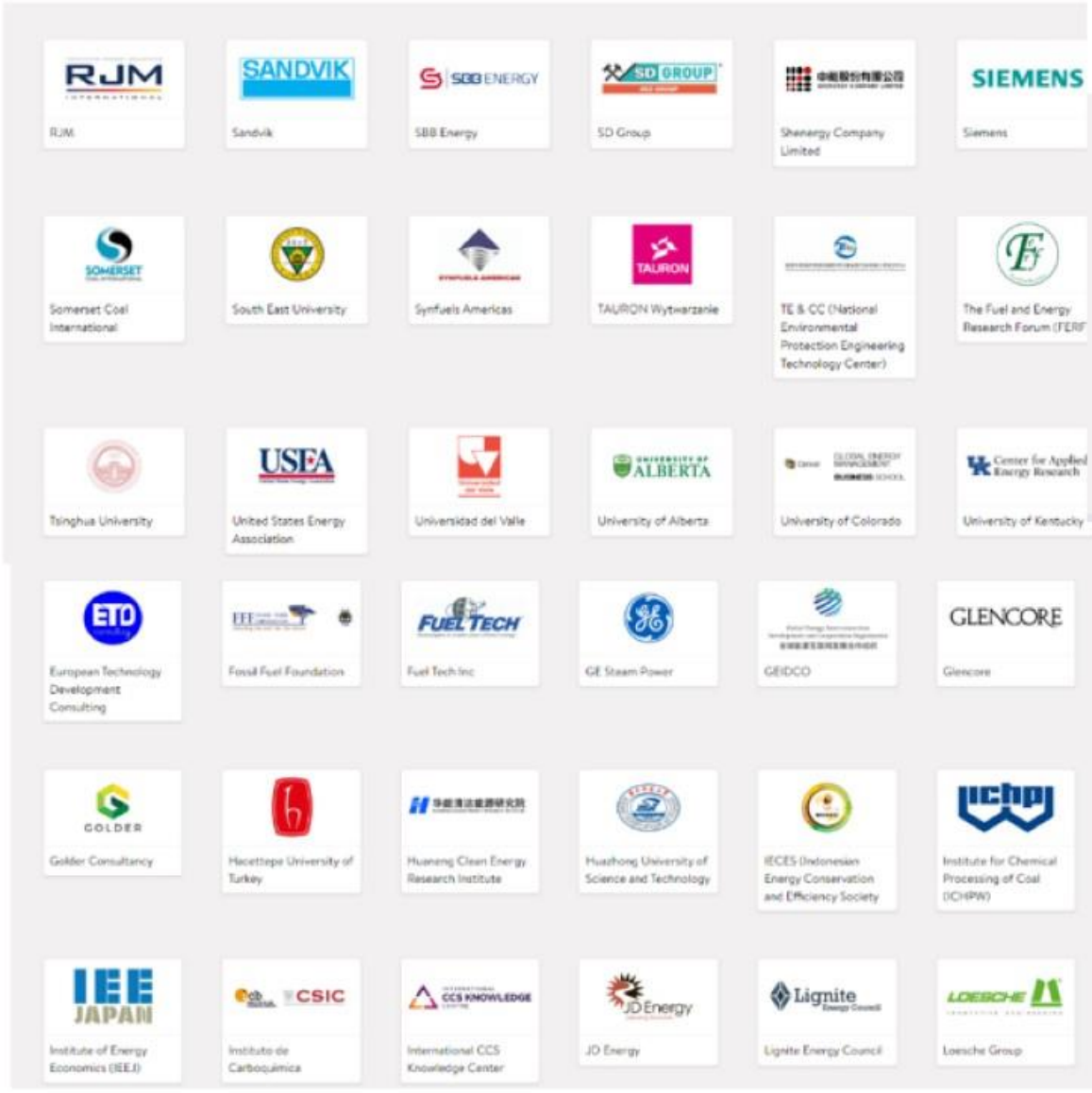
PATHWAY STUDY FOR INDIA

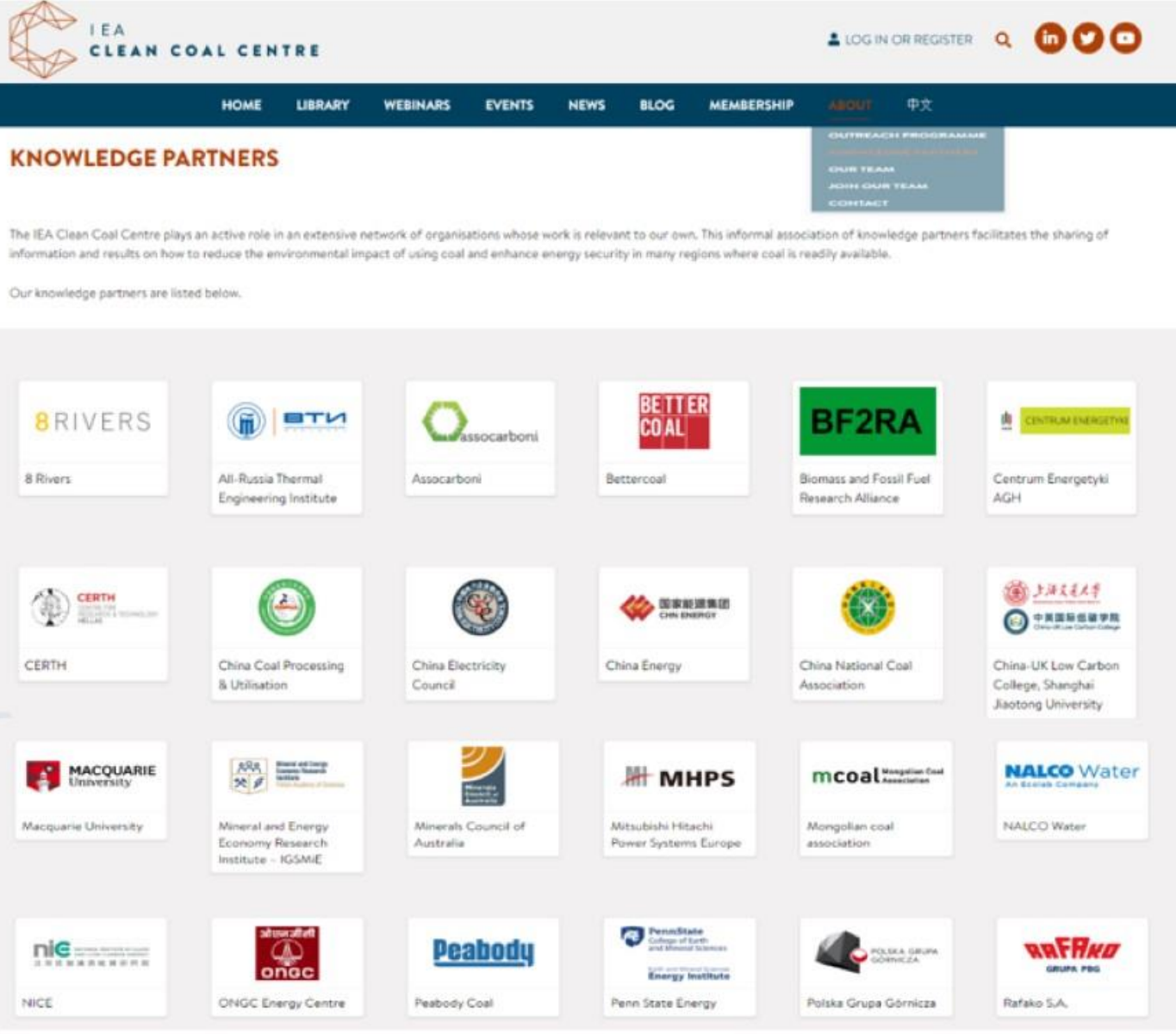
Determine a pathway for reducing CO_2 and other emissions such as SOx, NOx and particulates from the coal power sector in India out to 2040, covering:

- Establishing and implementing policies for change
- Increasing efficiency and flexibility of the coal power fleet
- Improving air quality with robust standards and control technologies
- CCS/CCUS capacity building, leading towards technology introduction, both for coal power and large industrial processes
- Simulation of coal power deployment through to 2040
- Development of an overall pathway for accelerating the uptake of high-efficiency, low-emissions (HELE) coal power plant, compliant with stricter environmental norms and identification of a policy driven route for CCS/CCUS introduction

CIAB

JOIN OUR KNOWLEDGE PARTNERS





Find more information about the network at:
https://www.iea-coal.org/knowledge-partners/

ONGOING STAKEHOLDER ENGAGEMENT

USDOS CAPACITY BUILDING

- NTPC
- CenPEEP

PATHWAY STUDY

- Indian Institute of technology
- Technical University of Madhya Predesh
- JNCASR
- Coal Preparation Society of India
- Siemens India
- BHEL

KNOWLEDGE PARTNERS NETWORK

- Energy & Environment Foundation, India
- Esvin Advanced Technologies Ltd, India
- ONGC Energy Centre
- Coal Preparation Society of India
- Centre for Science and the Environment
- Siemens India
- Dastur Energy

COUNTRIES WITH IEACCC KNOWLEDGE PARTNERS REPRESENTATIVES

AUSTRALIA (3)	BELGIUM (1)	BRAZIL (1)	CANADA (3)	CHINA (15)
COLOMBIA (1)	CZECH REPUBLIC (3)	FRANCE (1)	GERMANY (6)	GREECE (1)
HUNGARY (1)	INDIA (7)	INDONESIA (2)	ITALY (2)	JAPAN (4)
LATVIA (1)	MONGOLIA (1)	POLAND (7)	RUSSIA (1)	SLOVENIA (2)
SOUTH AFRICA (2)	SPAIN (2)	SWEDEN (1)	SWITZERLAND (3)	TURKEY (2)
UK (12)	USA (18)			
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THANK YOU FOR LISTENING

ANY QUESTIONS?

Dr Andrew Minchener OBE
andrew.minchener@iea-coal.org