碳捕集利用与封存知识国际中心

INTERNATIONAL
CCS KNOWLEDGE
CENTRE

总裁 兼 首席执行官　　墨 镍
Mike Monea, President & CEO

加拿大碳捕集利用与封存工业化全链条实践回顾

Inter-Sector CCUS Knowledge Transfer
Canadian Boundary Dam Project

INTERNATIONAL CCS KNOWLEDGE CENTRE

ccsknowledge.com

碳捕集利用与封存知识国际中心

THE INTERNATIONAL CCS KNOWLEDGE CENTRE

Facilitates in an advisory role
Based on expertise and lessons learned

基于实际项目经验
与真知，承担顾问
角色辅助项目实施

- Mandate: Advance the understanding and use of CCS as a means of managing greenhouse gas emissions
- Sponsored jointly by global resource leader, BHP and CCS pioneer, SaskPower

Our Story for CCS

Large Scale Deployment (Boundary Dam 3)

↓

Operational & Policy Understandings

↓

Second Generation Application

↓

Trends & Gaps for Large-Scale Deployment

↓

Driving Future Opportunities

边界坝电站鸟瞰
BOUNDARY DAM

实践出真知：未来项目可降低造价30%以上

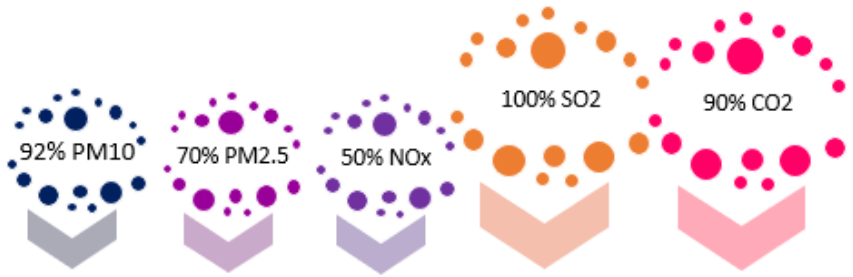
LEARNING STARTS HERE.

A NEXT PLANT CAN BE UP TO 30% CHEAPER.

Large Scale Deployment (Boundary Dam 3) 边界坝电站鸟瞰

- Post-combustion chosen from several studies
- CCS on coal-fired power operating since 2014
- Projected 90% capture rate & 30 yr life extension
- Initial investment = approximately CDN$1.5 billion
- CO2 is used for EOR or sequestered at Aquistore

CCS at Boundary Dam Power Station allowed for long-term production of over 110 MW of clean, base-load electricity in a fully integrated and full chain process



全烟气量碳捕集设施
- 具备年捕集1百万吨二氧化碳的能力
- 资源化利用增加石油采收率 （驱油）或永久封存

驱油---资源化利用
- 超临界态二氧化碳**经管道输往**周边油田
- 驱油生产过程温室气体排放降低30%

封存
- 超临界态二氧化碳封存于地下**3.4千米**深咸水层构造

性能：超标准 Performance: Exceeding Standards

1100 t/GWh = Lignite Coal Plant 1100吨/吉瓦时=褐煤排放

550-500 = Current Natural Gas Plant 现役燃气机组排放

420 = Canadian Regulations on Coal Plant 加拿大规定燃煤机组排放

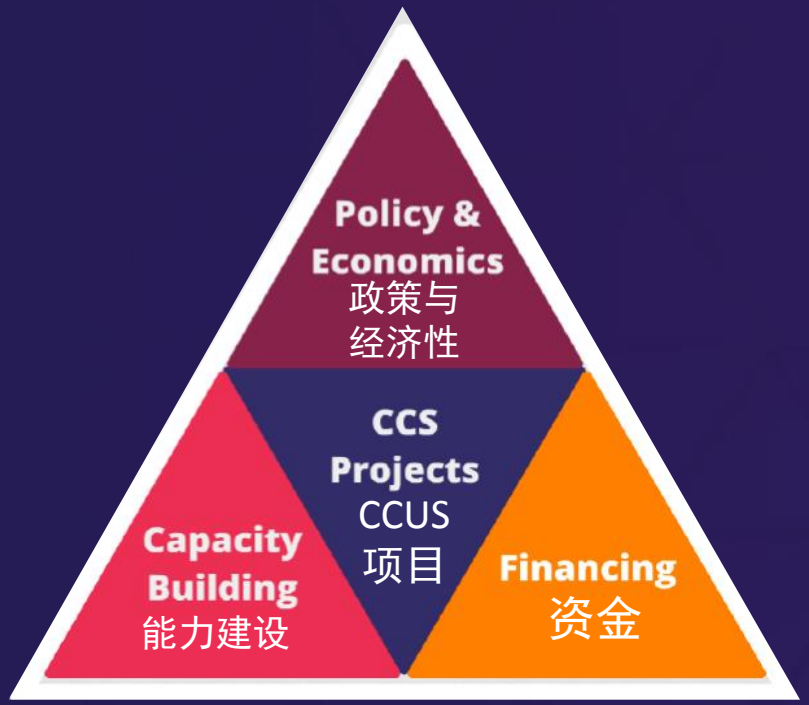
375-400 = New Natural Gas Plant 新建燃气机组规定排放

300 - 325 = Wind (with peakers) 风电排放（调峰机组）

120 - 140 = CCS on Boundary Dam 3 边界坝电站3号CCS机组排放

Operational Understandings: Sharing Lessons Learned

"Real world" considerations for using CCS are important.
加速全球CCUS技术工业化应用

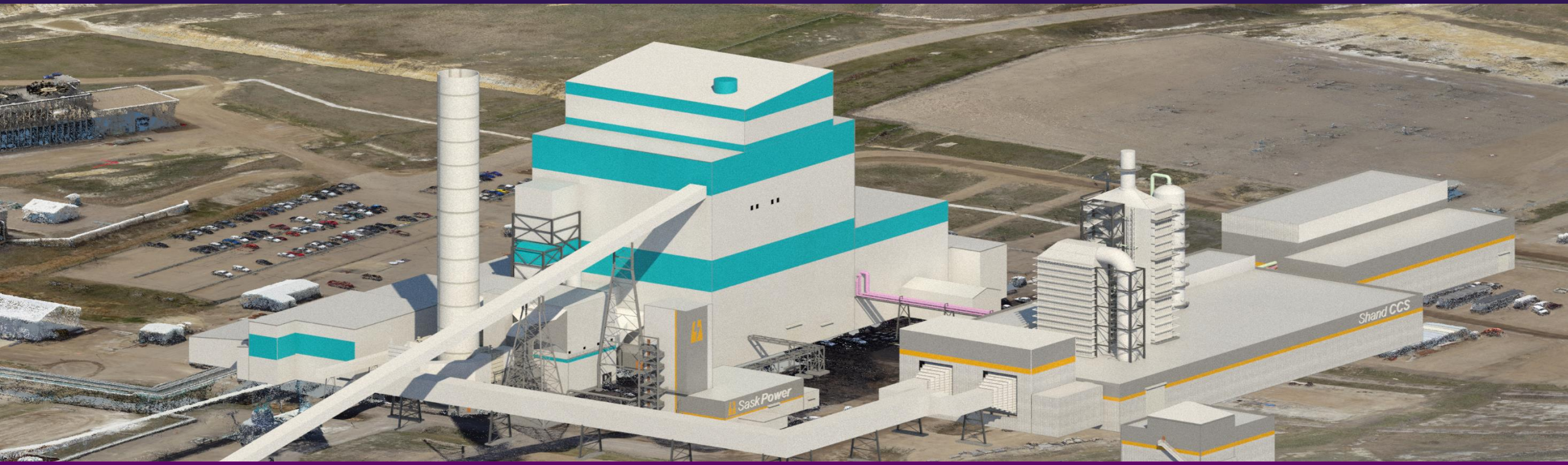


We must COLLABORATE - Not just talk about collaborating.

- Stimulate development
- Bring down costs
- Promote greater knowledge exchange

SECOND GENERATION DESIGN

SASKPOWER SHAND POWER STATION



HIGHLIGHTS OF FEASIBILITY STUDY:

- Designed to capture 2Mt
- 67% cost reduction (per tonne CO_2)
- Can capture up to 97% and integrates well with renewables

About the Shand Feasibility Study

Feasibility Study evaluates the economics of a CCS retrofit & life extension on 300MW coal fired power plant in Saskatchewan

- Projected capture capacity of **2Mt/yr**
- Capital cost to be **67% less** per tonne of CO_2 captured
- Cost of capture at **$45US/t CO_2**
- Capture rate can reach **up to 97%** with reduced load (i.e. renewables on grid)
- Fly ash sales can further reduce CO_2 (potential 125,000t CO_2/yr reduced)

Carbon neutral?

HOW DID COSTS COME DOWN?

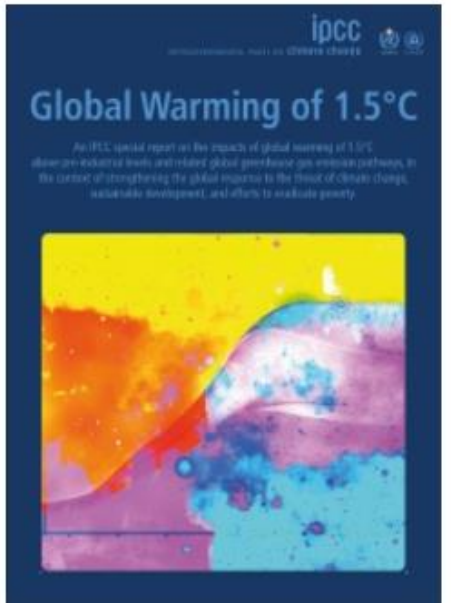
- Lessons learned from building and operating BD3
- Construction at a larger scale using extensive modularization
- Integration of the bigger unit's steam cycle

Second Generation Application to Coal and Other Sources

- IPCC's 5th Assessment Report: median increase in mitigation cost is 138% without CCS
- Almost all IPCC 1.5°C pathway scenarios include CCS

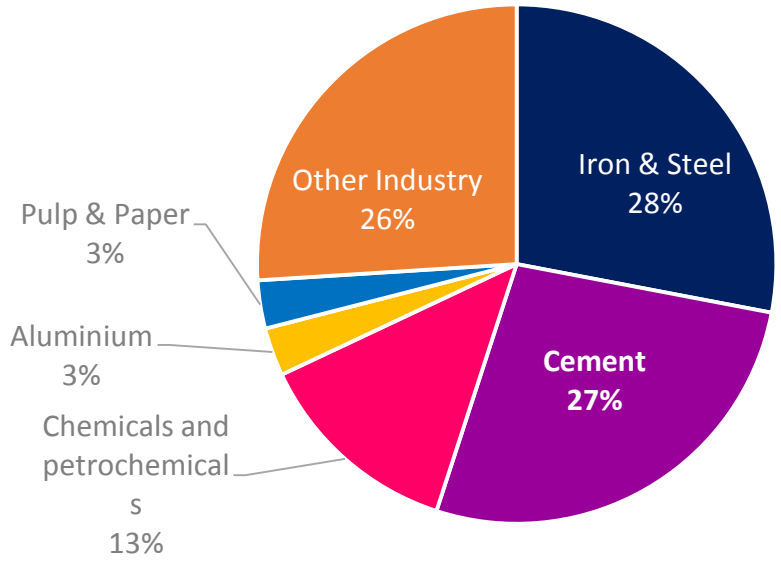
CCS technology is proven;
so de-risked deployment can occur

- *Reliable* and *affordable* energy with reduced emissions are imperative for energy security.
- Implementation of CCS can:
  - allow existing generating assets to operate cleanly and
  - aid to decarbonize industrial emissions.



Second Generation Application to Industrial Emissions

Direct industrial CO2 emissions (2014)



- Industrial CO2 emissions represent 24% of global CO2 emissions at 8.3 Gt CO_2 (2014).
- Industrial separation may be possible for high CO2 content flue gases
- Post combustion capture is downstream from an emissions source so BD3 learnings can be applied

Information on this slide is sourced from International Energy Agency, Energy Technology Perspectives 2017

Second Generation Application to Industrial Emissions

Lessons learns from operational experience at Boundary Dam CCS Facility and findings from the Shand CCS Feasibility Study can be applied to other industrial sources of emissions

- Size and layout considerations / integration are key considerations
- Costs can be saved with CO2 infrastructure hubs, cost recovery with EOR, modularization and byproduct sales decisions
- Optimization is still required for particular flue gas characteristics to save operating costs

INTERNATIONAL
CCS KNOWLEDGE
CENTRE

碳捕集与封存知识国际中心

鸣　谢
Thank You

For more information please visit our website at:
欲了解更多信息，请登陆：
ccsknowledge.com

Contact us by email :
或通过电子邮件联系:
info@ccsknowledge.com

Don’t forget to follow us on Twitter:
请跟踪我们的“推特” (类似微信)
@ccsknowledge