CHOOSING RESEARCH DIRECTIONS FOR CCS

MAX BALL, MANAGER, CCTF, SASKPOWER

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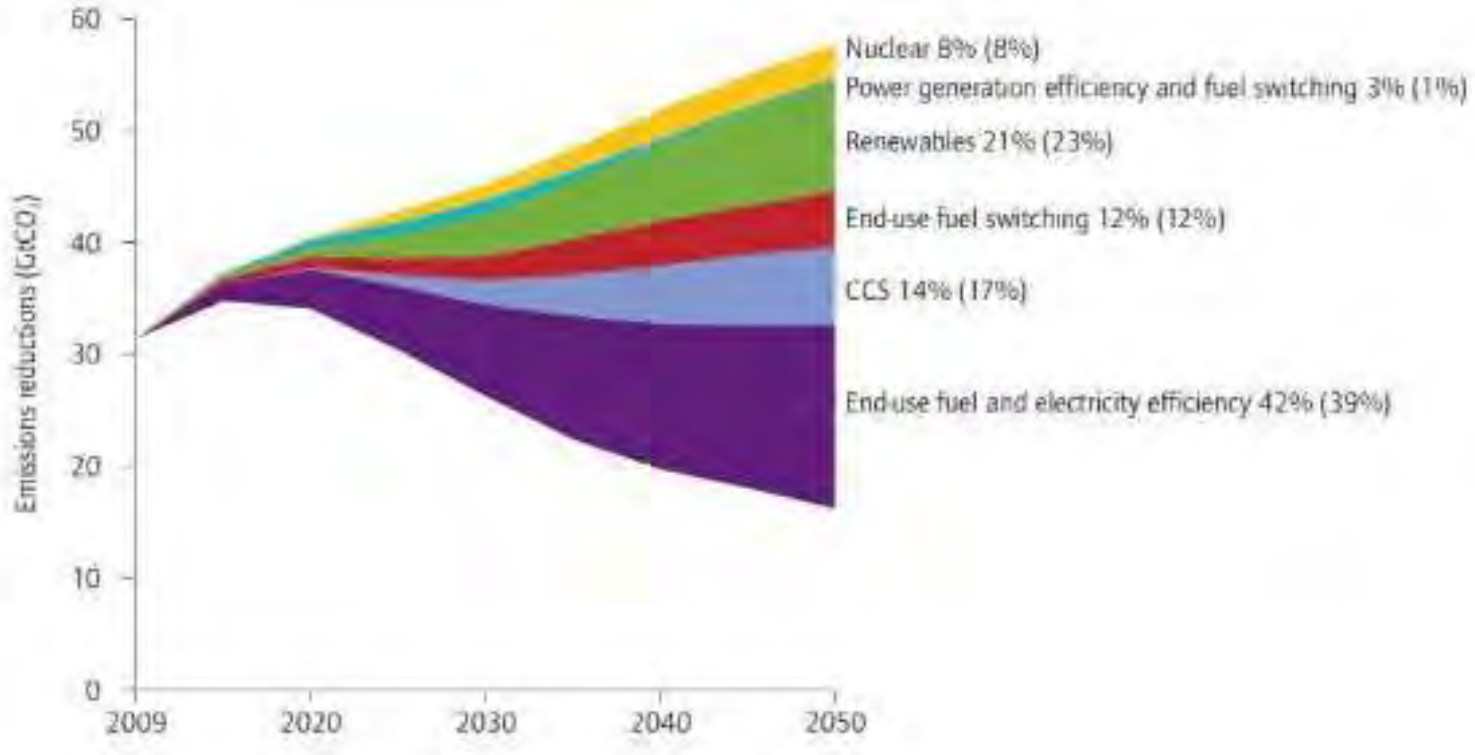
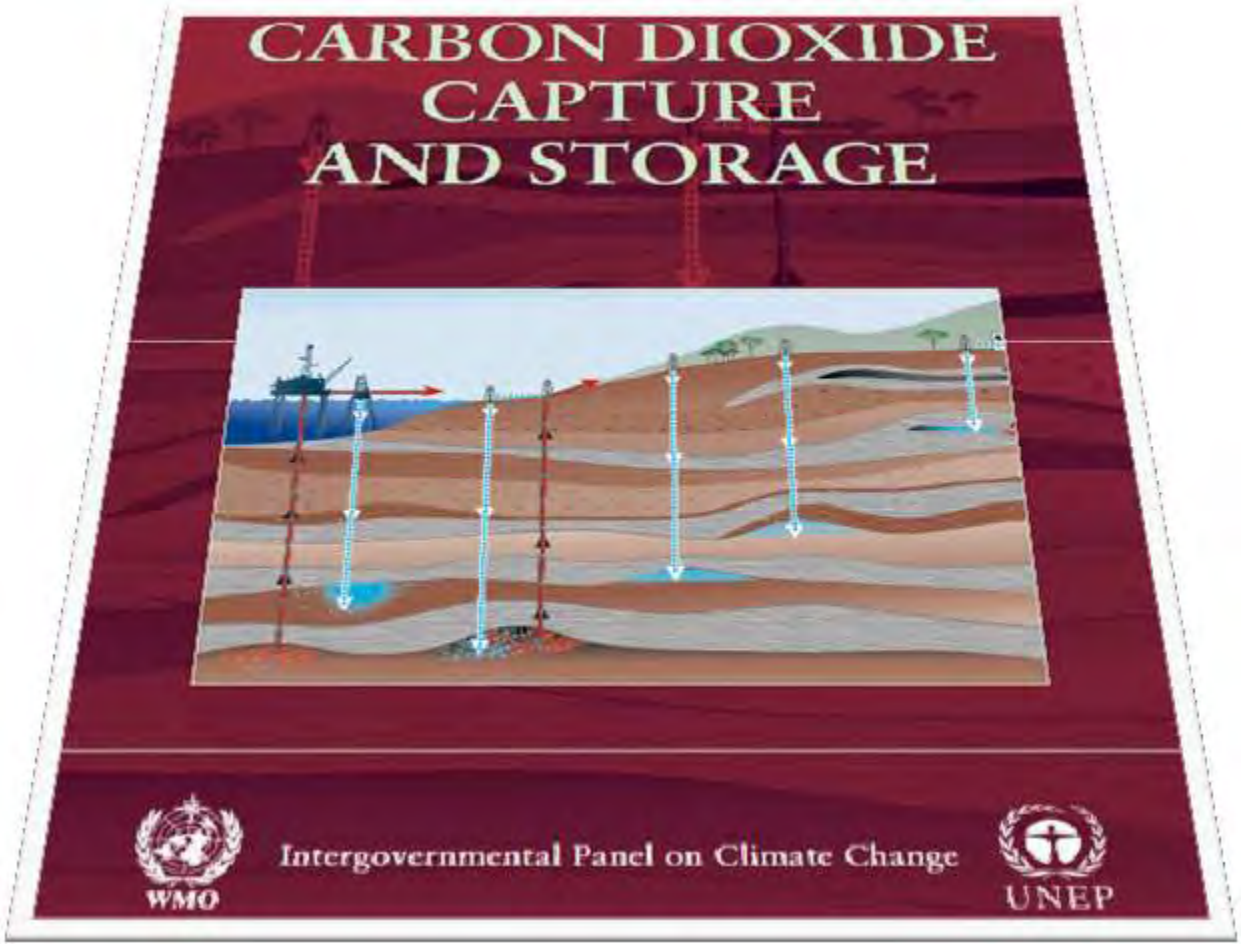
CLIMATE CHANGE MANAGEMENT REQUIRES TOOLS

IEA: All 2 Degrees Scenarios Without CCS are More Expensive – and Cost Matters



CITATION: ENERGY TECHNOLOGY PERSPECTIVES 2012, IEA

10 YEARS AGO


CARBON DIOXIDE
CAPTURE
AND STORAGE
WMO
Intergovernmental Panel on Climate Change
UNEP

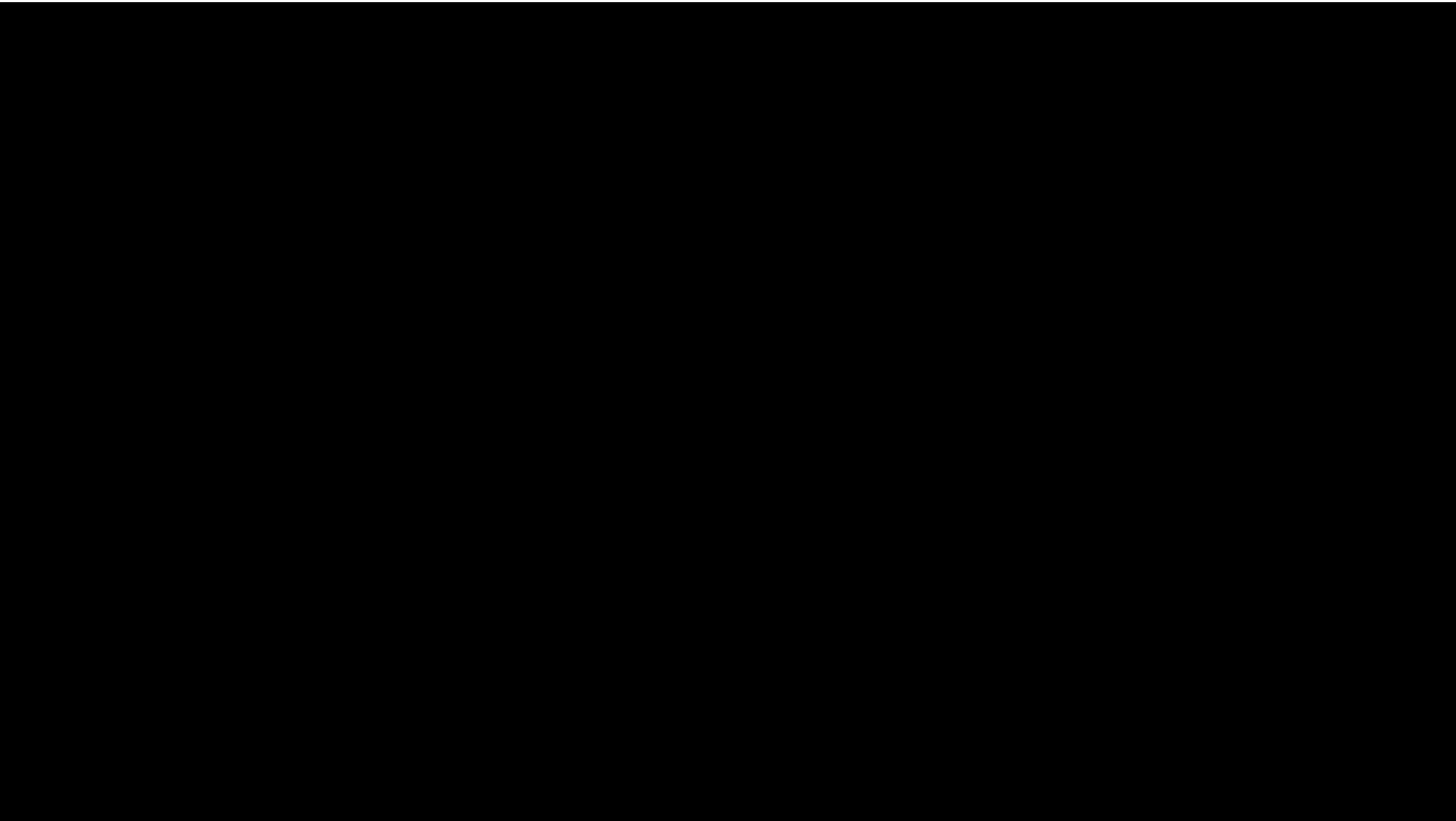
SASKPOWER CLEAN COAL TASK FORCE:

1. PEOPLE NEED TO SEE THAT IT WORKS

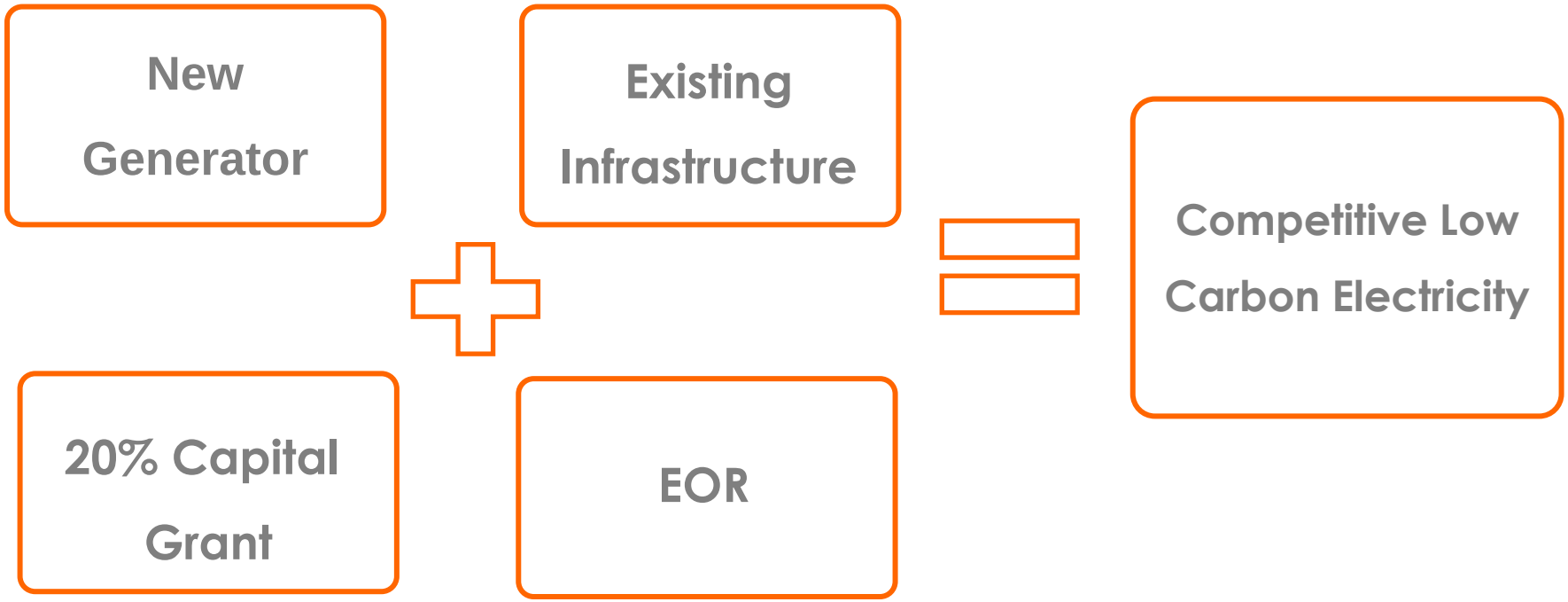
2. MUST HAVE SOCIAL ACCEPTANCE

3. MUST BE COST COMPETITVE WITH OTHER ACCEPTABLE ENERGY FORMS

PEOPLE NEED TO SEE THAT IT WORKS



SUCCESS FORMULA FOR BOUNDARY DAM ICCS DEMO



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BOUNDARY DAM CCS PROJECT IS NOW 6 MONTHS OLD!

5,000,000 mhr

Heavy Loads

$1.48M vs $1.24M

81 vs 72 months

120MW vs 110MW

200,000 Tonnes delivered for revenue

BOUNDARY DAM CCS PROJECT IS NOW 6 MONTHS OLD!

- some subsystems found to be conservative,
- some subsystems have deficiencies yet to solve: in reliability, capacity, automation or operability –
- No events contravening regulation
- On track for planned CO2 recovery rates
- Some equipment issues to be resolved

CCS DEMONSTRATION IN POWER GENERATION

NOW LIVE

COMING SOON

SASKPOWER CLEAN COAL TASK FORCE:

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3. MUST BE COST COMPETITVE WITH OTHER ACCEPTABLE ENERGY FORMS

PUBLIC ACCEPTANCE
IN SASKATCHEWAN

Saskatchewan 2008

- Linked to future of coal and oil industries
- Within the experience of regional population (pipelines, storage)
- Safe storage proven with Weyburn site since 2000
- Wide spread consultation

Saskatchewan 2015

- General acceptance
- Concern on cost – (20% over estimate)
- External Critics who are opposed to fossil use

Saskatchewan 2020

- Ideally:

a robust public understanding of lifecycle implications for CCS in overall socio/economic health and safety terms

PUBLIC ACCEPTANCE

GLOBALLY

2008

- 10 or 20 Pilot Plants Globally
- Large Financial Incentives for Development:
  - Canada
  - USA
  - EU
  - Australia
  - UK
  - Germany
  - Spain
  - Norway

2015

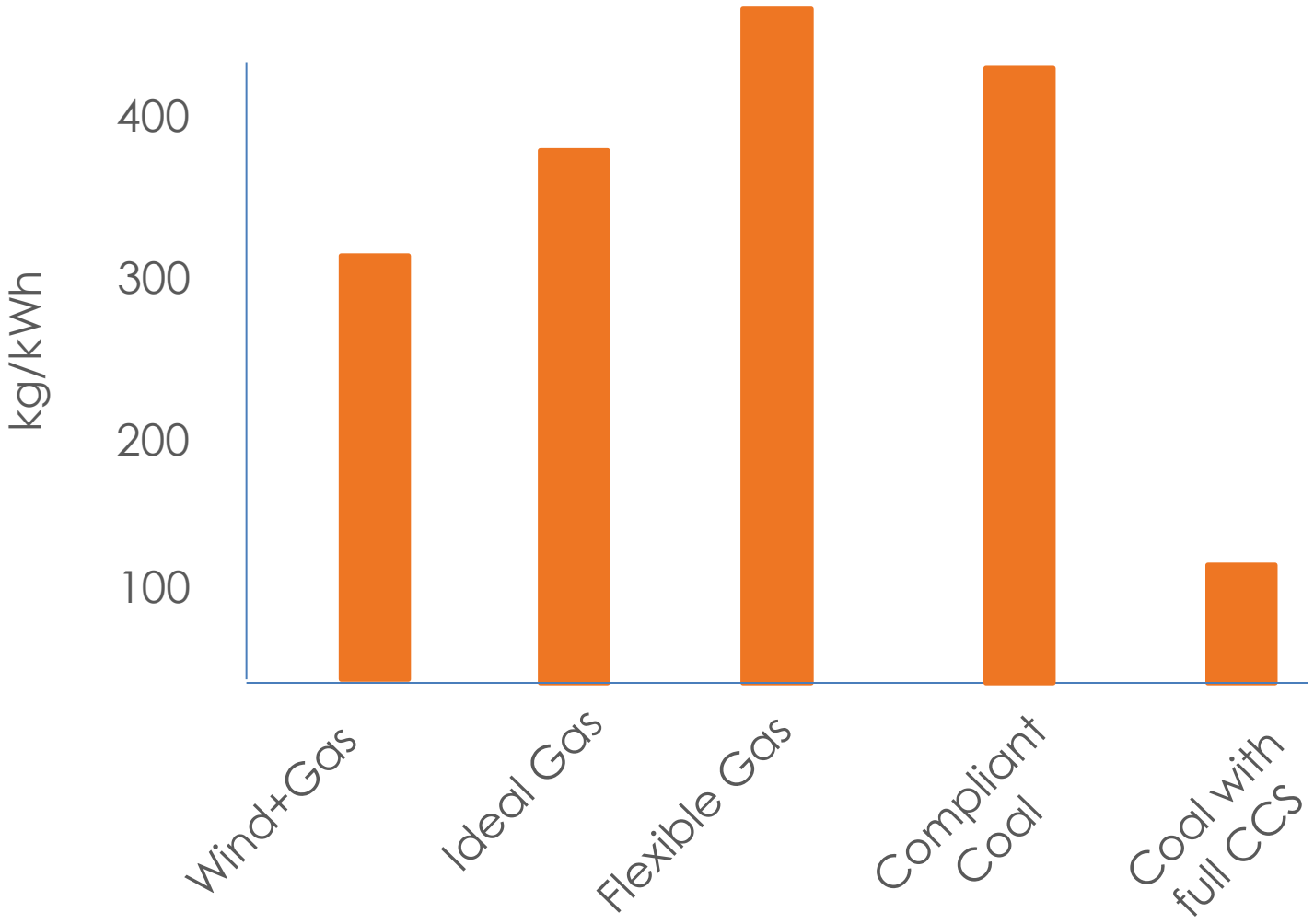
- Number of pilot plants roughly unchanged (+/- in various regions)
- Kemper County under construction
- Petra Nova Announced
- Capture from fertilizer and gas processing
- China/US accord
- Future Gen 2.0 and other flagship projects shut down
- Loss of public confidence in some regions

2020

- Ideally:

a robust public understanding of lifecycle implications for CCS in overall socio/economic health and safety terms

GHG INTENSITY
Selected Supply Options



SASKPOWER CLEAN COAL TASK FORCE:

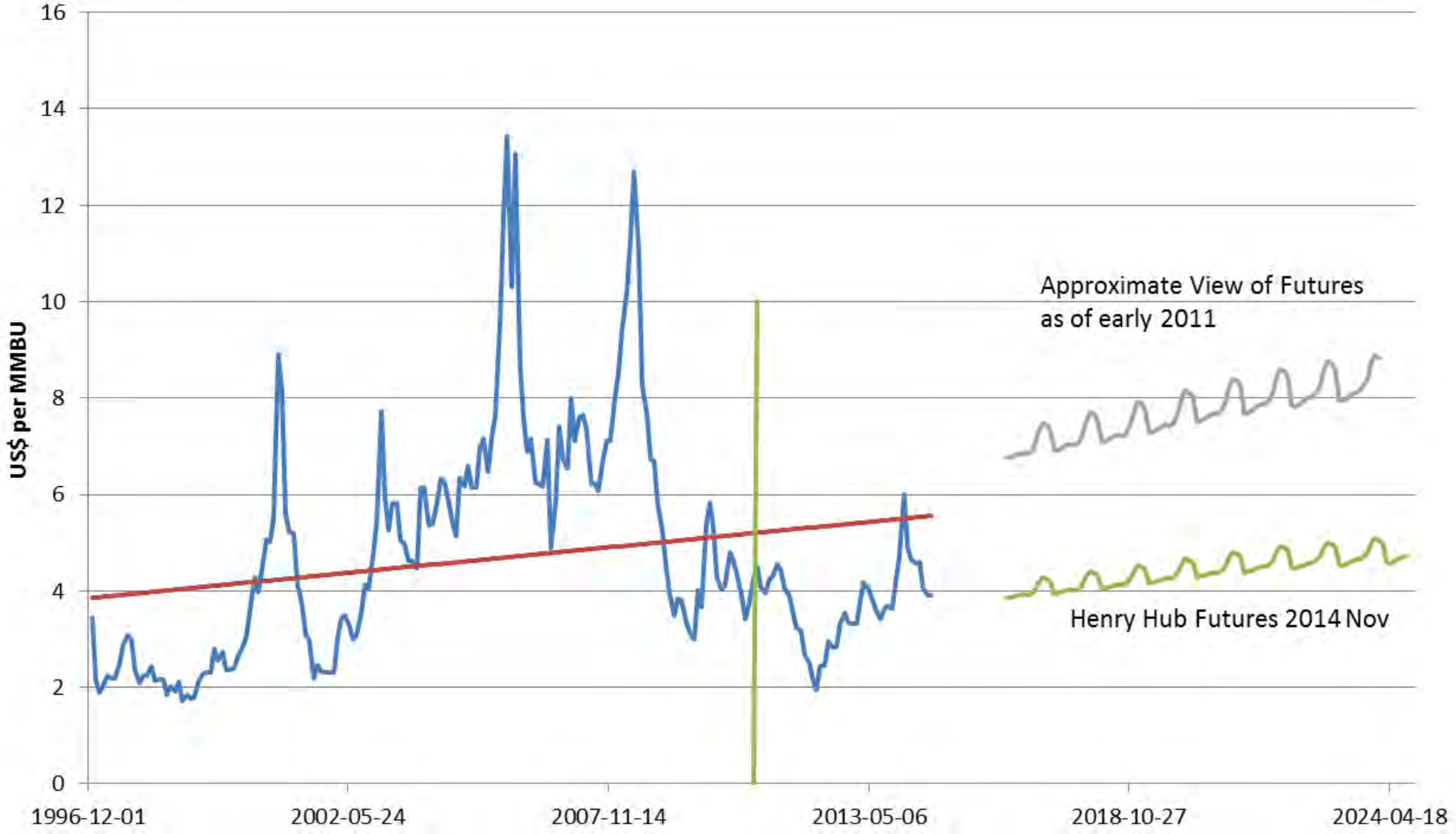
- ✓ 1. PEOPLE NEED TO SEE THAT IT WORKS
- ✓ 2. MUST HAVE SOCIAL ACCEPTANCE
- 3. MUST BE COST COMPETITVE WITH OTHER ACCEPTABLE ENERGY FORMS

MUST BE COST COMPETITIVE WITH ACCEPTABLE ALTERNATIVES

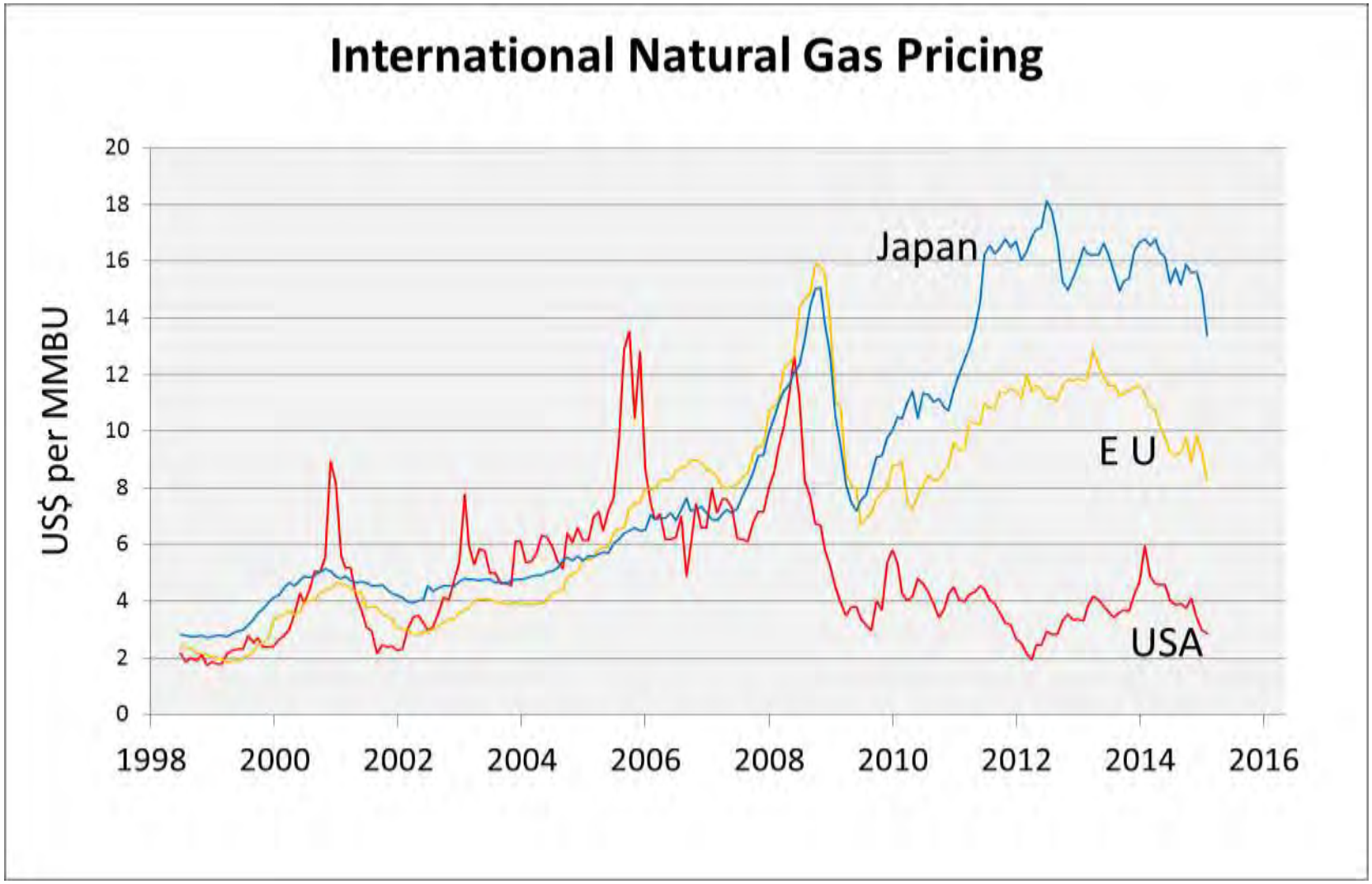
NATURAL GAS PRICING

NATURAL GAS PRICING

HENRY HUB – NOV 2014

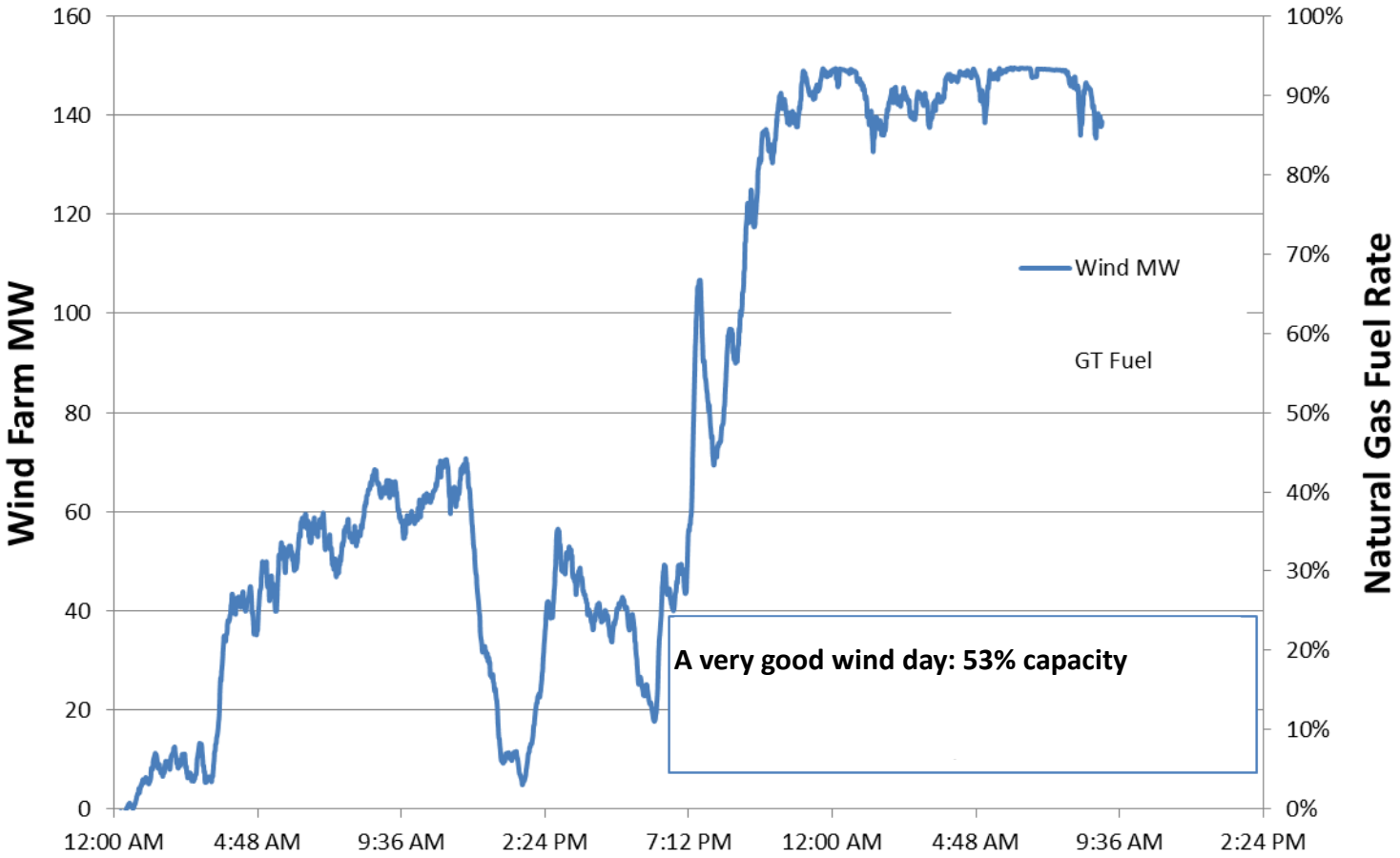


GLOBAL NATURAL GAS PRICING

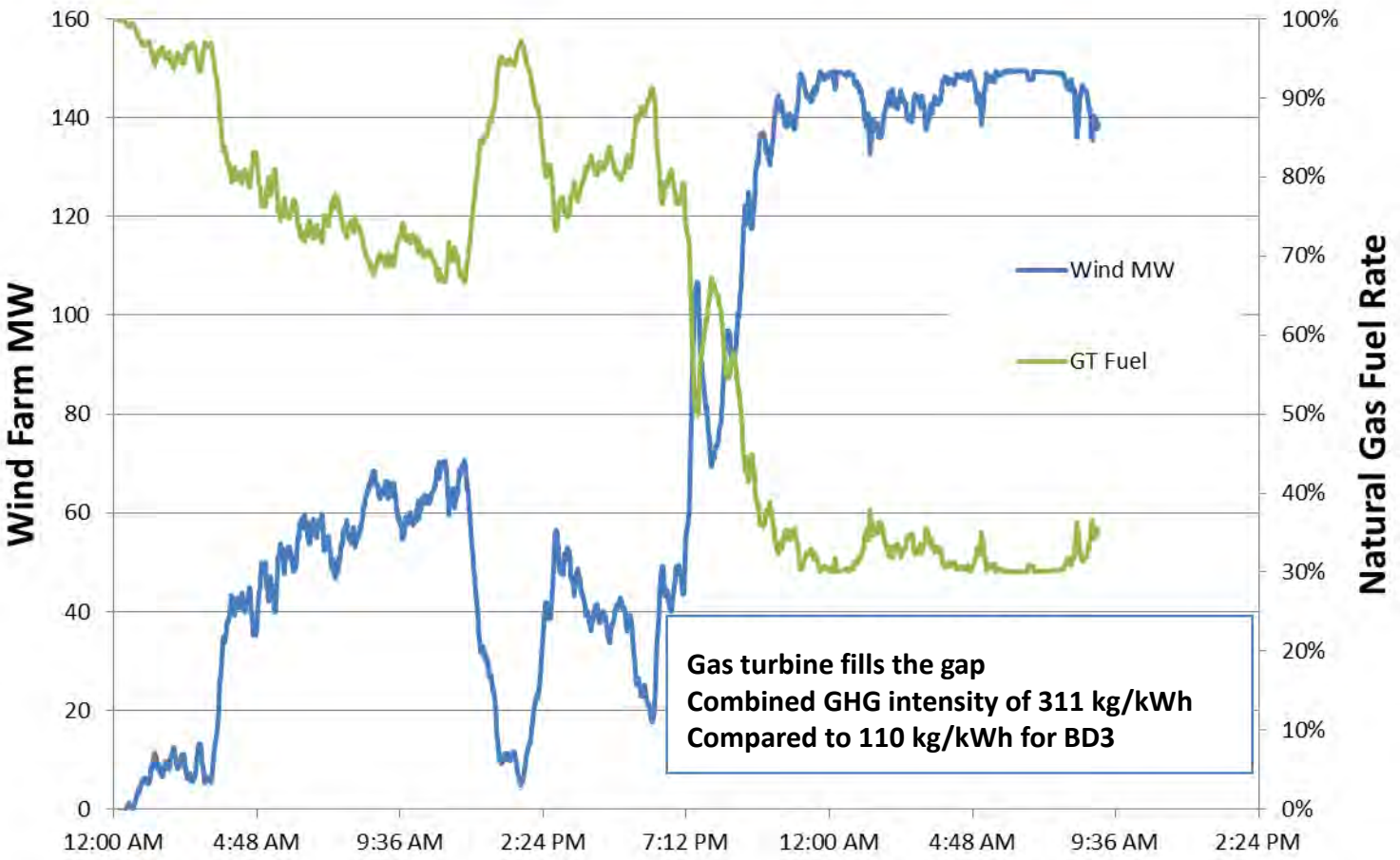


WIND

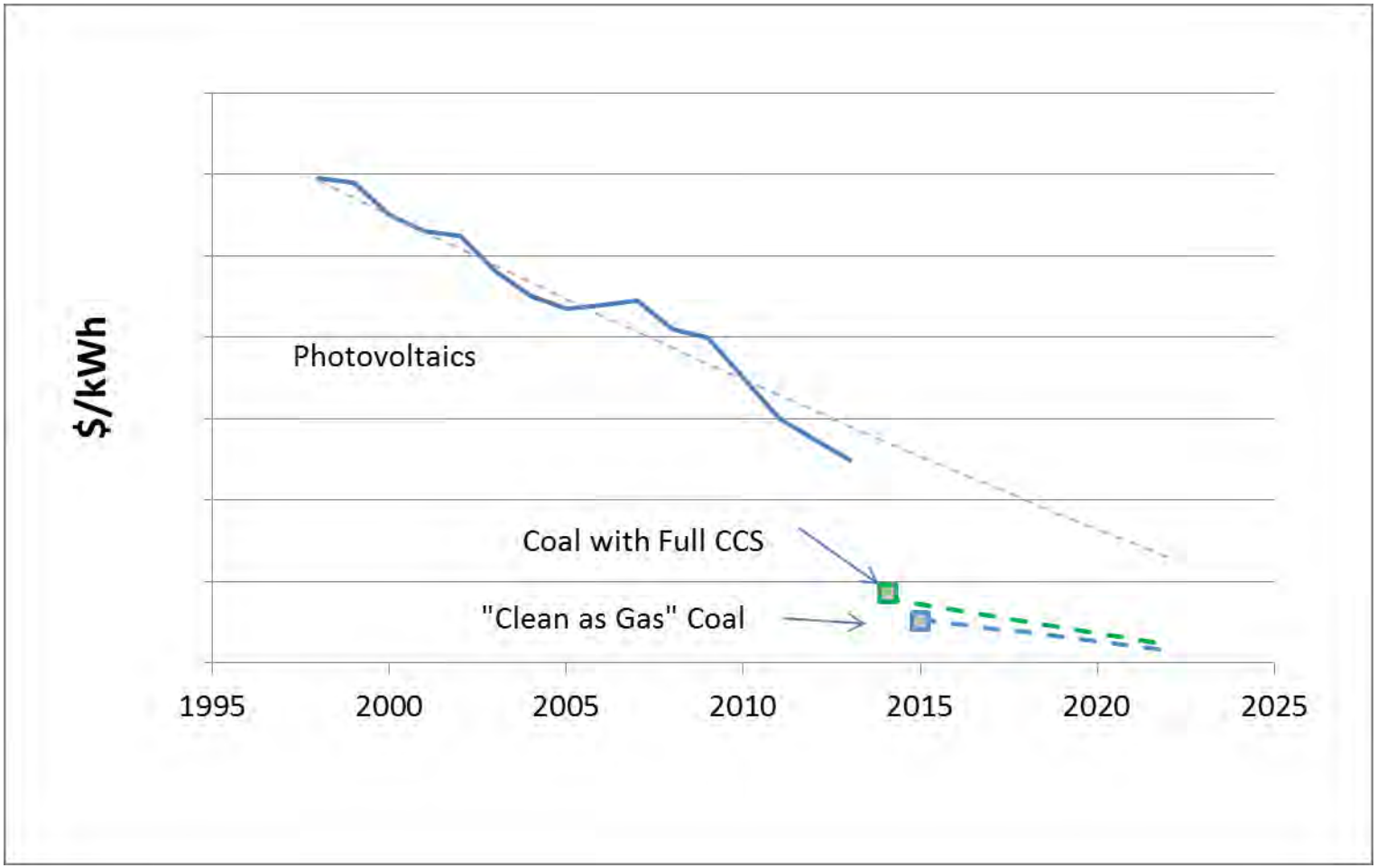
WIND FARM NEEDS TO WORK WITH SOMETHING ELSE



WIND FARM NEEDS TO WORK WITH SOMETHING ELSE



TECHNOLOGY COST REDUCING WITH EXPERIENCE

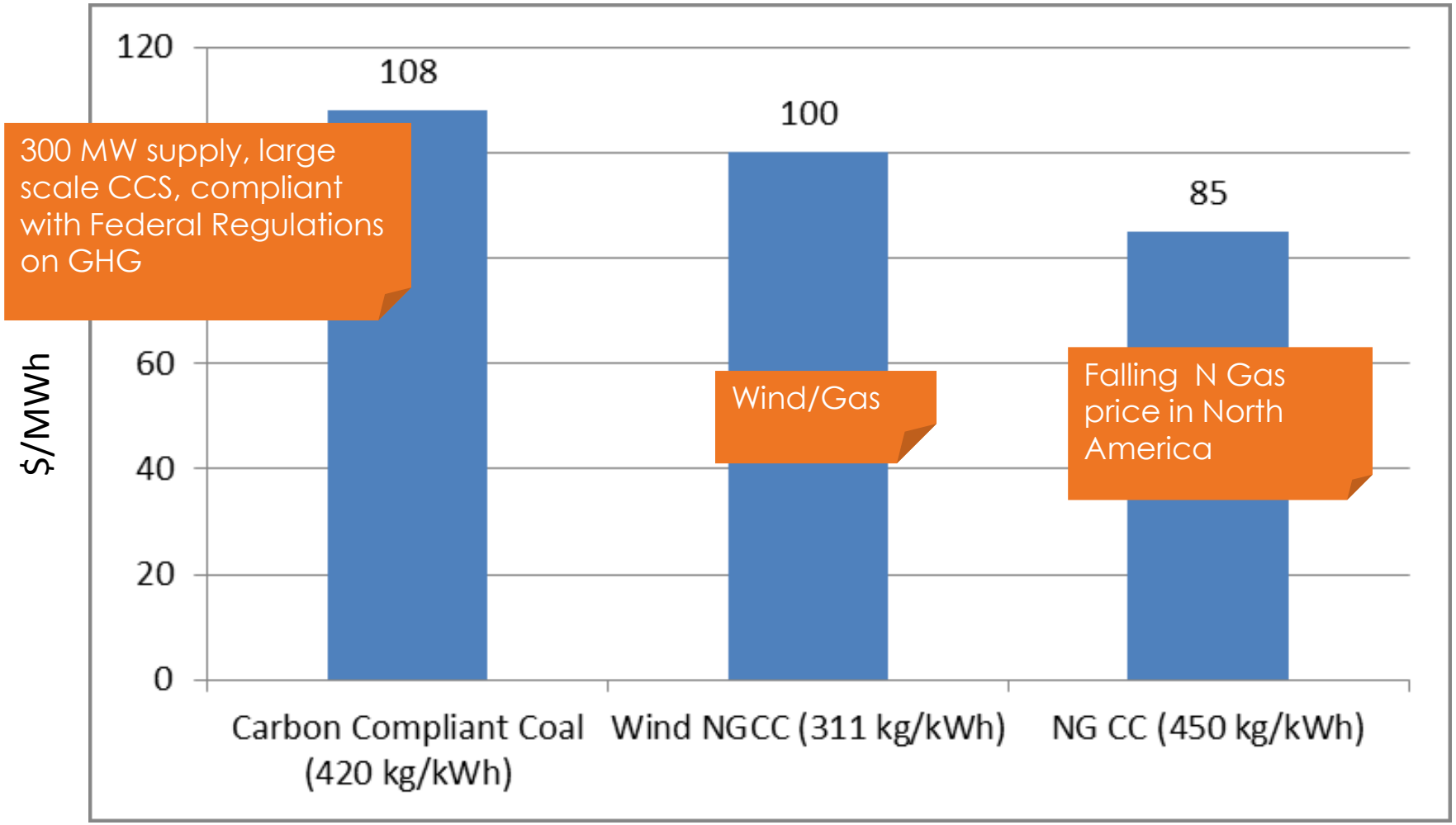


LEVELIZED COST

- Concept of **levelized cost** goes back to the early 20th Century when analysts understood that initial cost was not a deciding factor in selecting generation supplies, but detailed economic modeling of every combination was not viable
- Used here as a proxy for lifecycle costs
- OK for very similar models
- Lifecycle costs are the real test

SELECTED SUPPLY OPTIONS FOR SASK

STARTING POINT FOR COMPETITION



CAN WE CLOSE THE GAP?

- **Technical Improvements**
- **Business Case Improvements**
  - Economies of scale and replication
  - Better certainty in Design and Performance
  - Reduced Financial, Business and execution risk
  - Equivalent Tax Treatment

WILL THE GAP CLOSE ITSELF?

- **Gas Price Increase**
- **Emissions Regulations for Gas**

THE FUTURE OF CCS AT SASKPOWER

Unit	Initial Investment	Final Investment	In Service
BD 4/5	2016	**2019***	**2025***
BD 6	2022	2024	**2028***
PR 1	2024	2026	**2030***
PR 2	2024	2026	**2030***
Shand 1	2037	2039	**2043***
New Build	New costs more than rebuild today		

*** Fixed by Regulation**

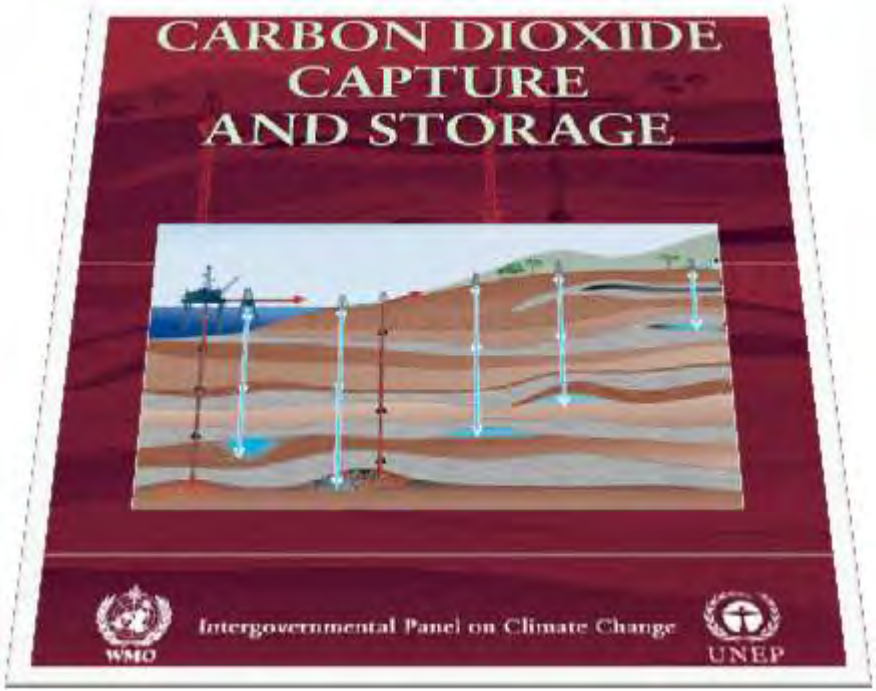
POSSIBLE FUTURE OF CCS AT SASKPOWER

BOUNDARY DAM UNITS #4 & 5

SASKPOWER CARBON CAPTURE TEST FACILITY (CCTF)

THE PERFECT COST MODEL

10 YEARS FROM NOW:



1. People will have seen that CCS works

2. Most people will accept that CCS is a safe and viable GHG management option

3. CCS will have been economically competitive some of the time

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