Value added fossil fuels: Coal To Liquids with CCS

IEA Committee on Energy Research and Technology

Sydney – Feb 2012

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(Selected) Large scale CCS to date

Name	Type	CO2 capacity	Sink
Sleipner	Nat Gas	1 Mt/year	Saline formation
In Salah	Nat Gas	1 Mt/year	Gas reservoir
Weyburn/Midale	Substitute NG	2.5 Mt/year	EOR - pipeline
Snøhvit	Nat Gas	0.7 Mt/year	Saline formation
Gorgon	*Nat Gas*	*>3 Mt/year*	*Saline formation*
Mississippi Power	***IGCC***	*3 Mt/year*	*EOR – pipeline*
Medicine Bow Power and Fuels	*CTL*	*4 Mt/year*	*EOR - pipeline*

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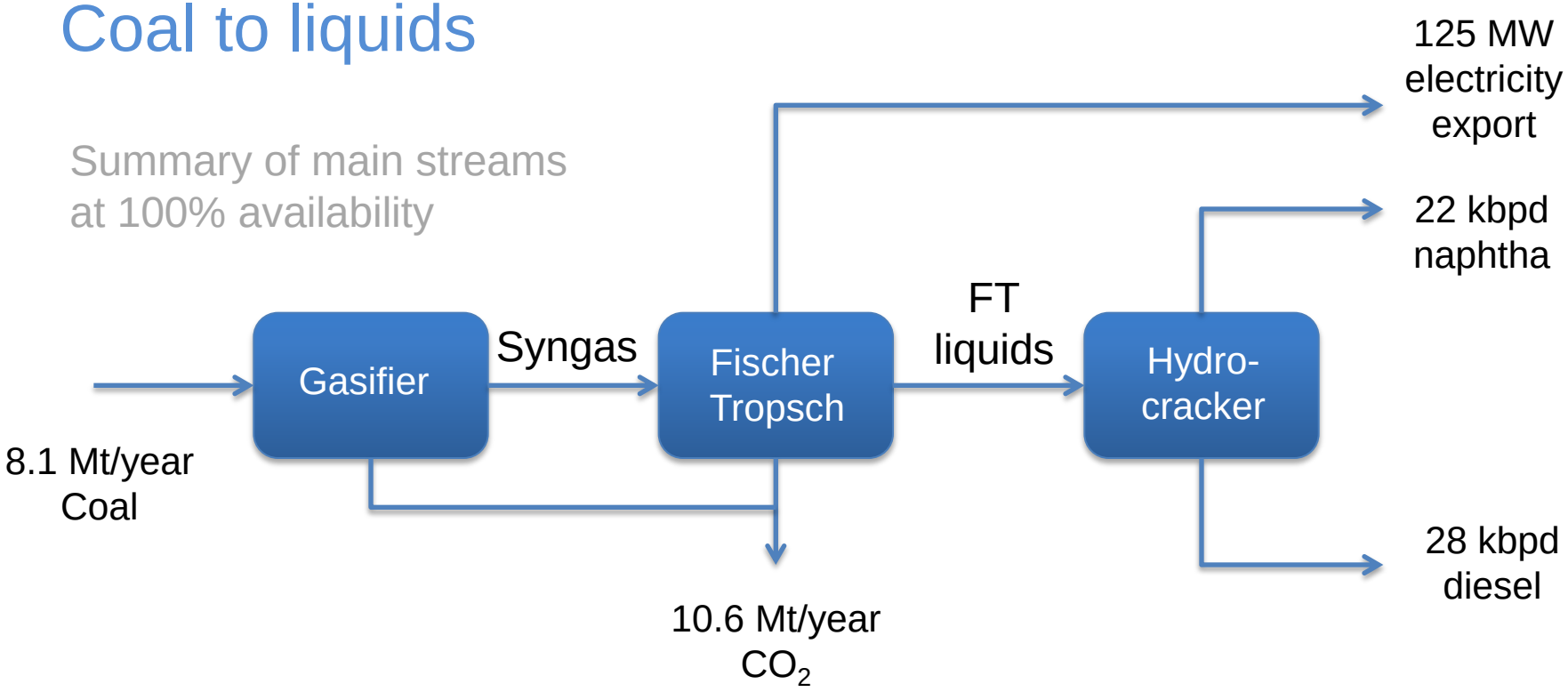
Italics – not yet in operation

Coal to liquids

Summary of main streams
at 100% availability



Source: Baseline technical and Economic Assessment of a Commercial Scale Fischer-Tropsch Liquids Facility DOE/NETL-2007/1260

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Coal to liquids

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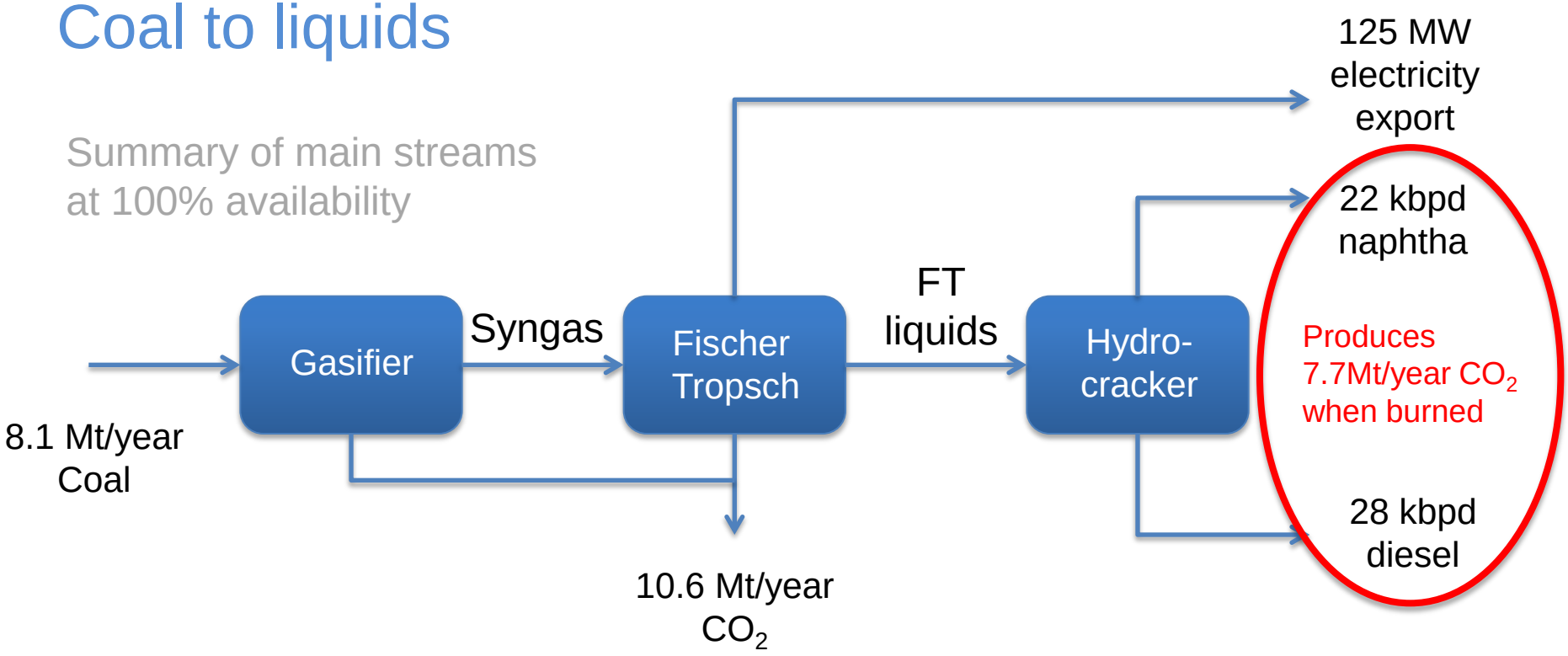

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Capital costs

- From NETL study
- Escalated using CE process plant index
- Included allowance for site specific capital and for CO2 transport and storage infrastructure
- Nominal $7,300M

Item	$k	%
EPC costs	2,807	100
Working capital	83	3
Process contingency	113	4
Project contingency	730	26
Startup	56	2
Owners costs	281	10
IDC	385	14
Financing fees	73	3
TOC for core plant ($k 2006)	4,528	
TOC for core plant ($k 2012)	5,737	
Site specific capital	500	
Transport and storage	500	
TOC for complete plant (2012)	**6,737**	

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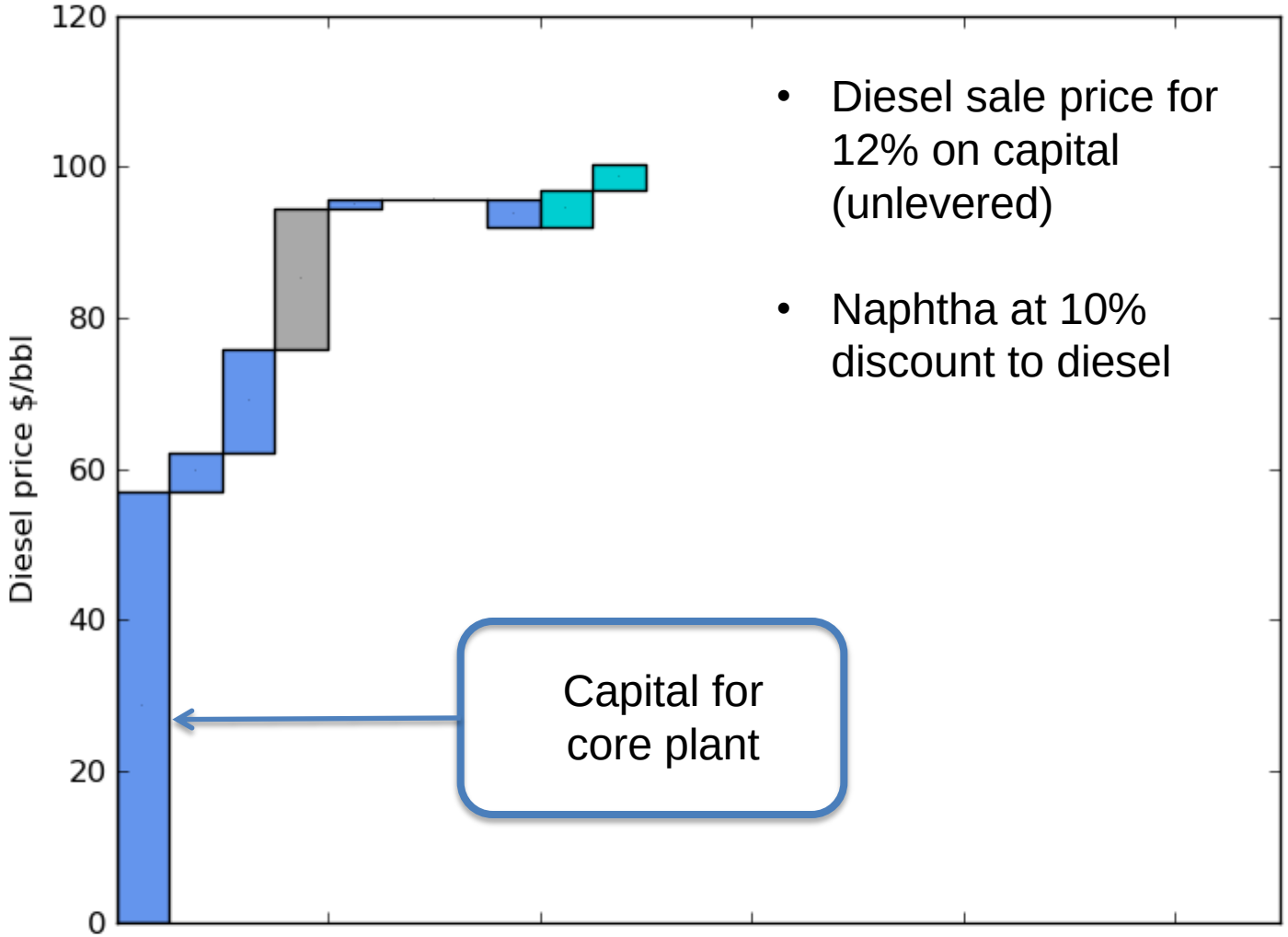
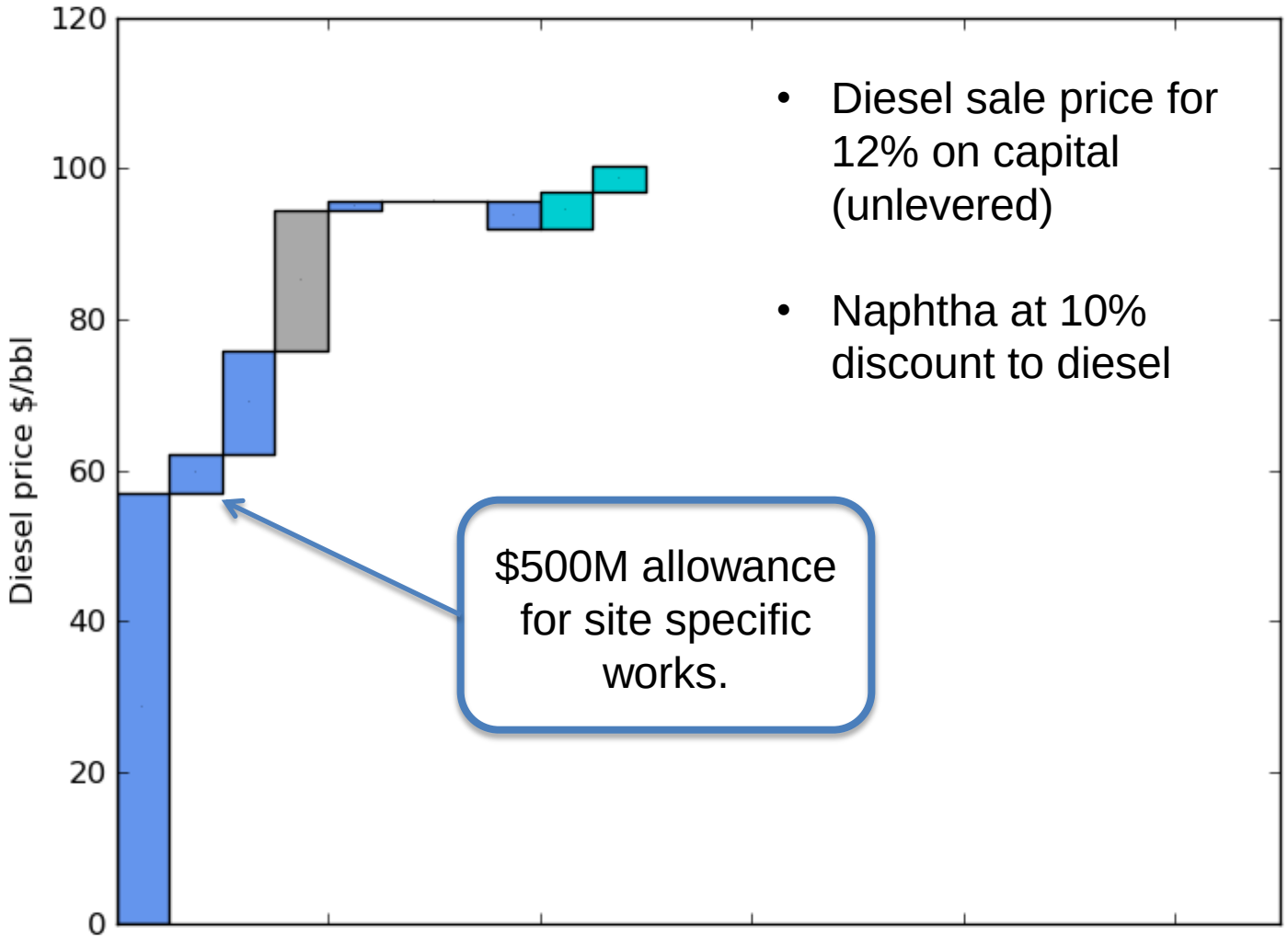


- Diesel sale price for 12% on capital (unlevered)
- Naphtha at 10% discount to diesel



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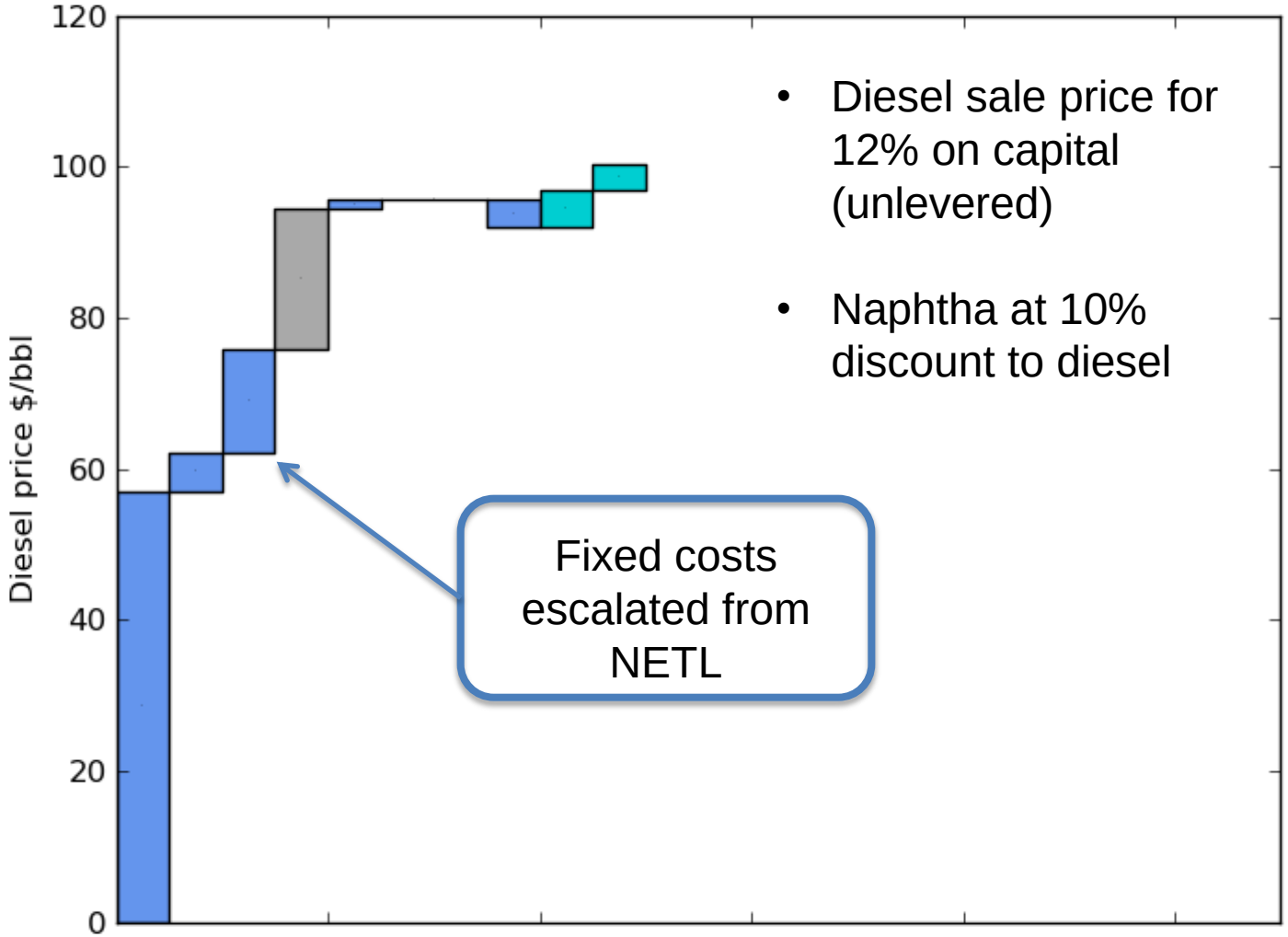

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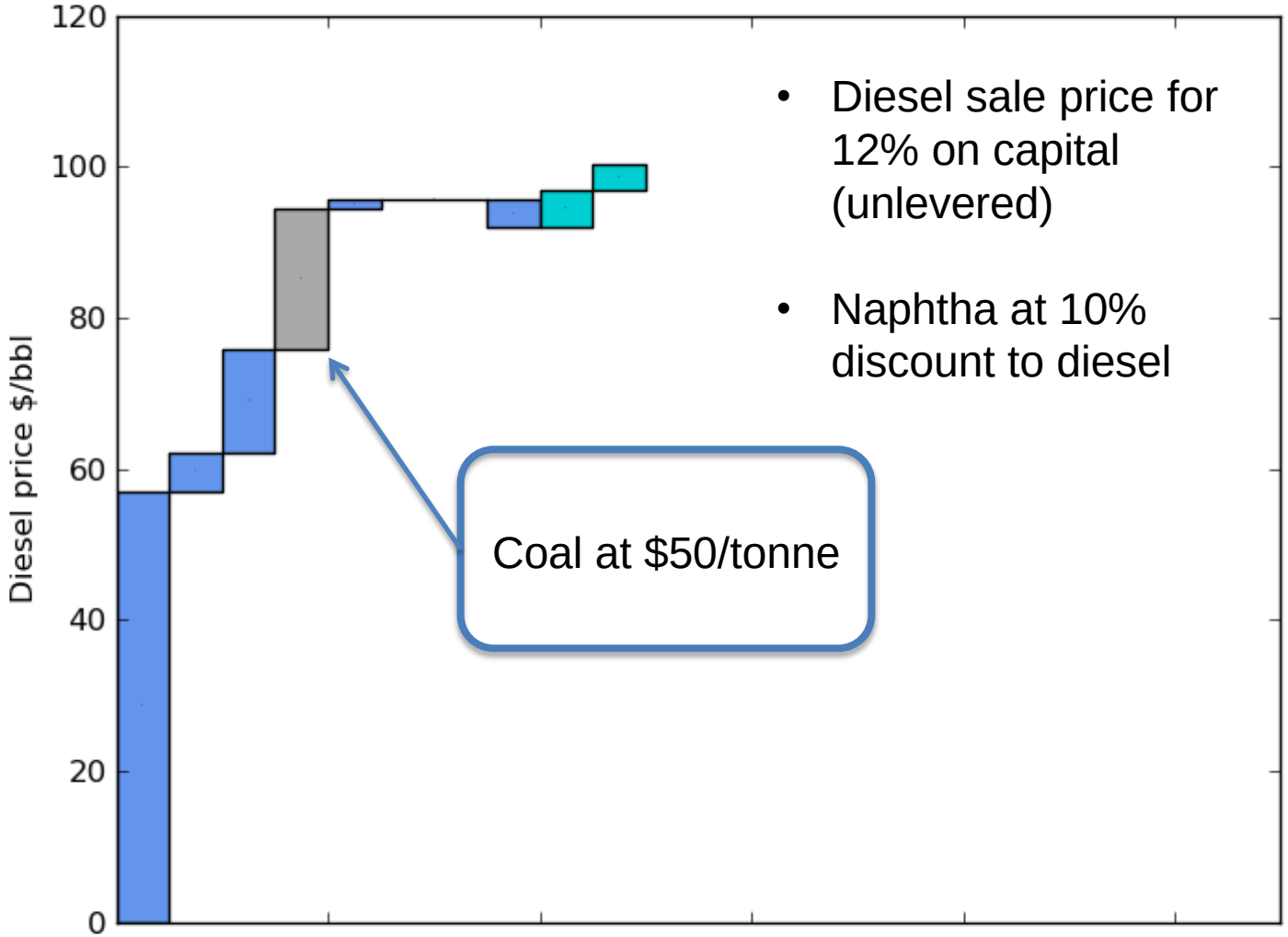

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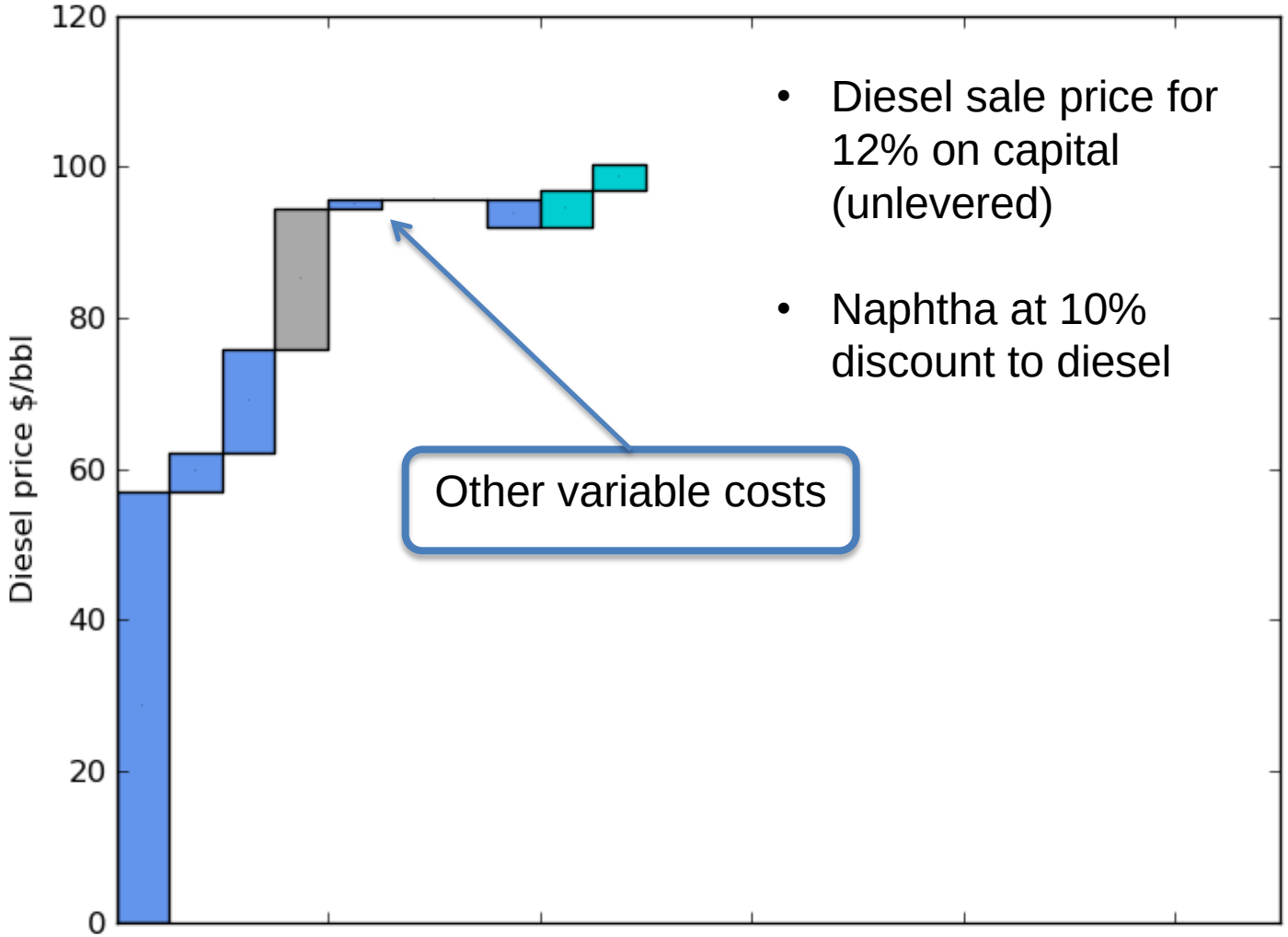

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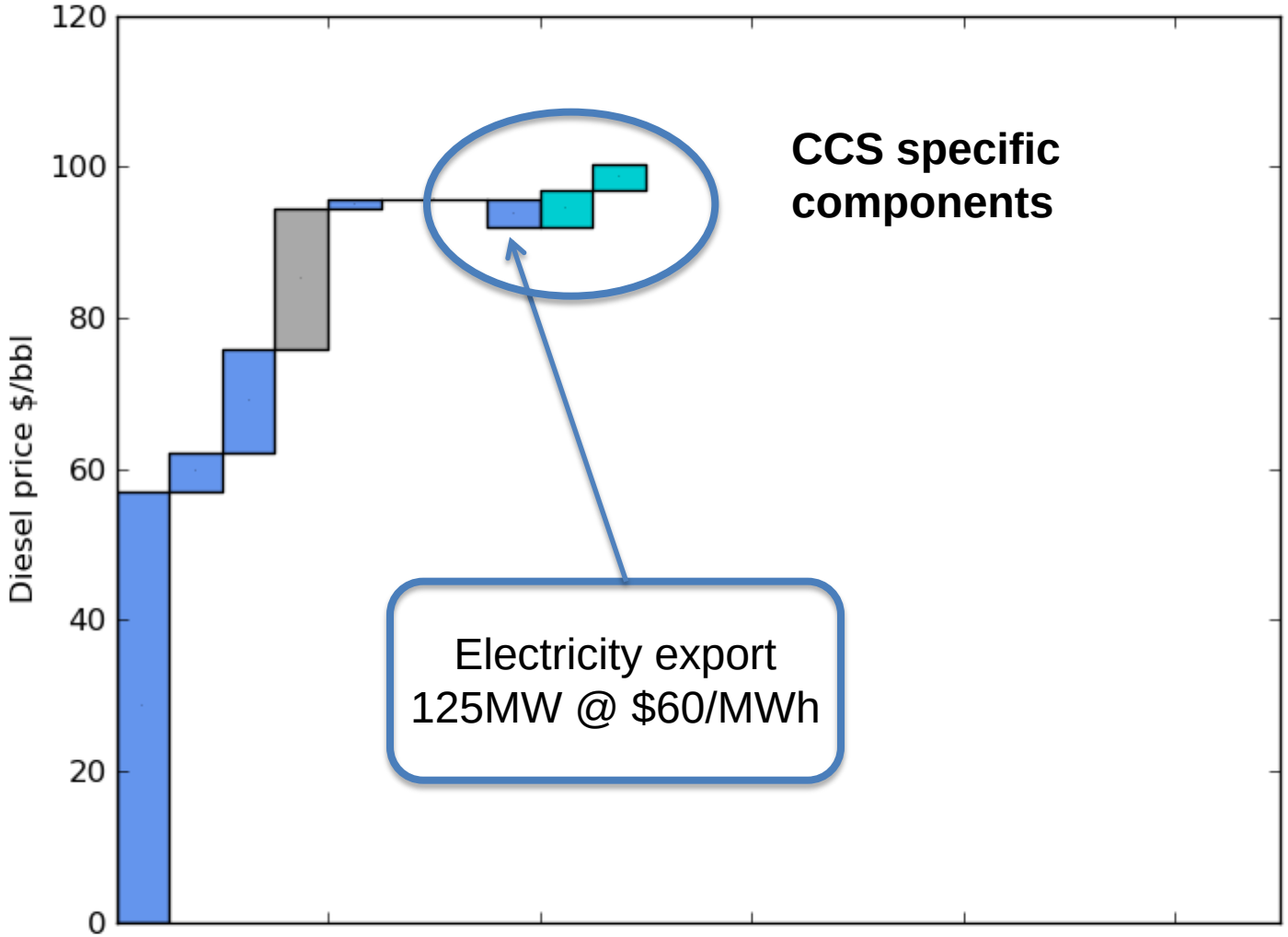
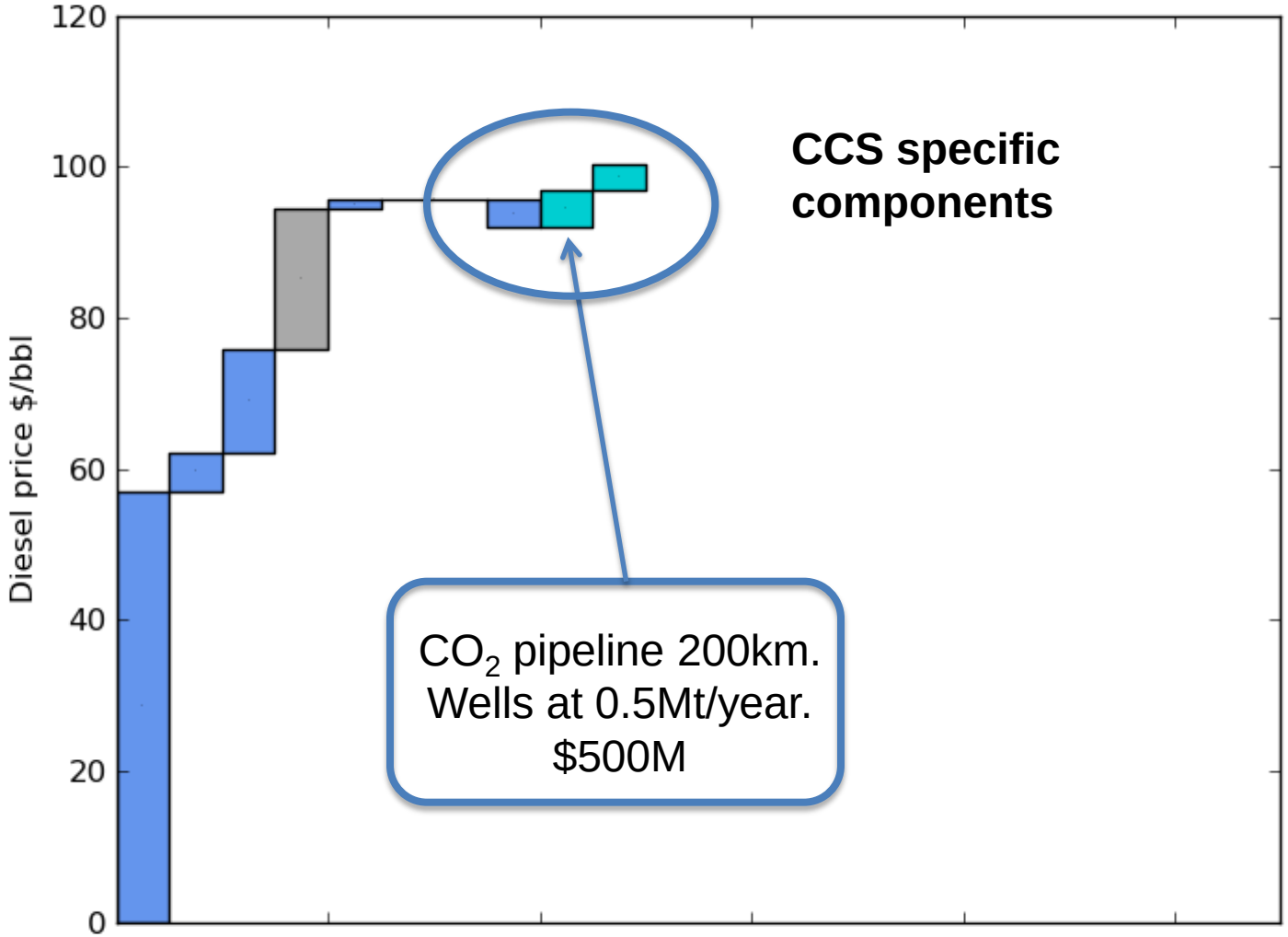
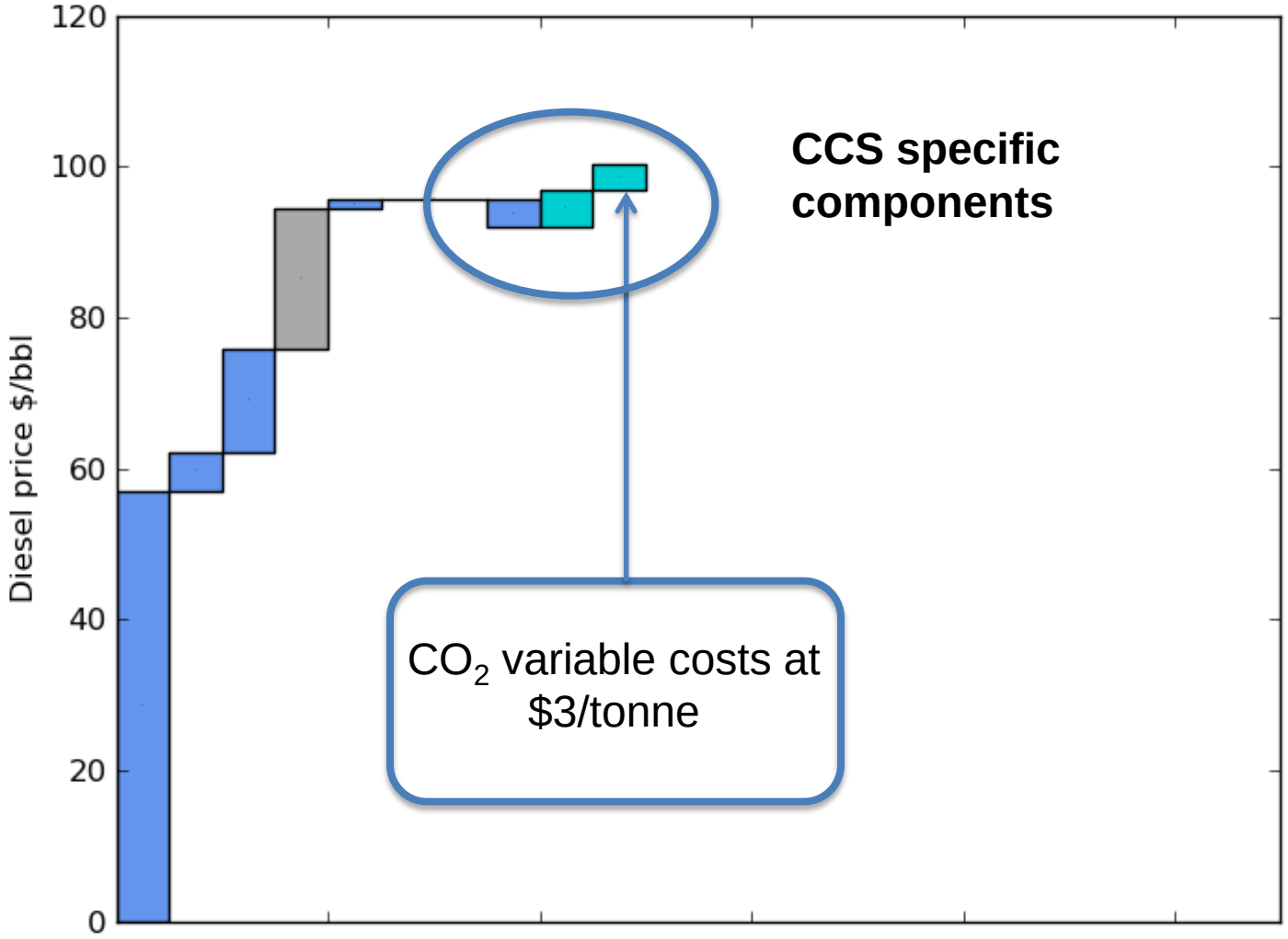
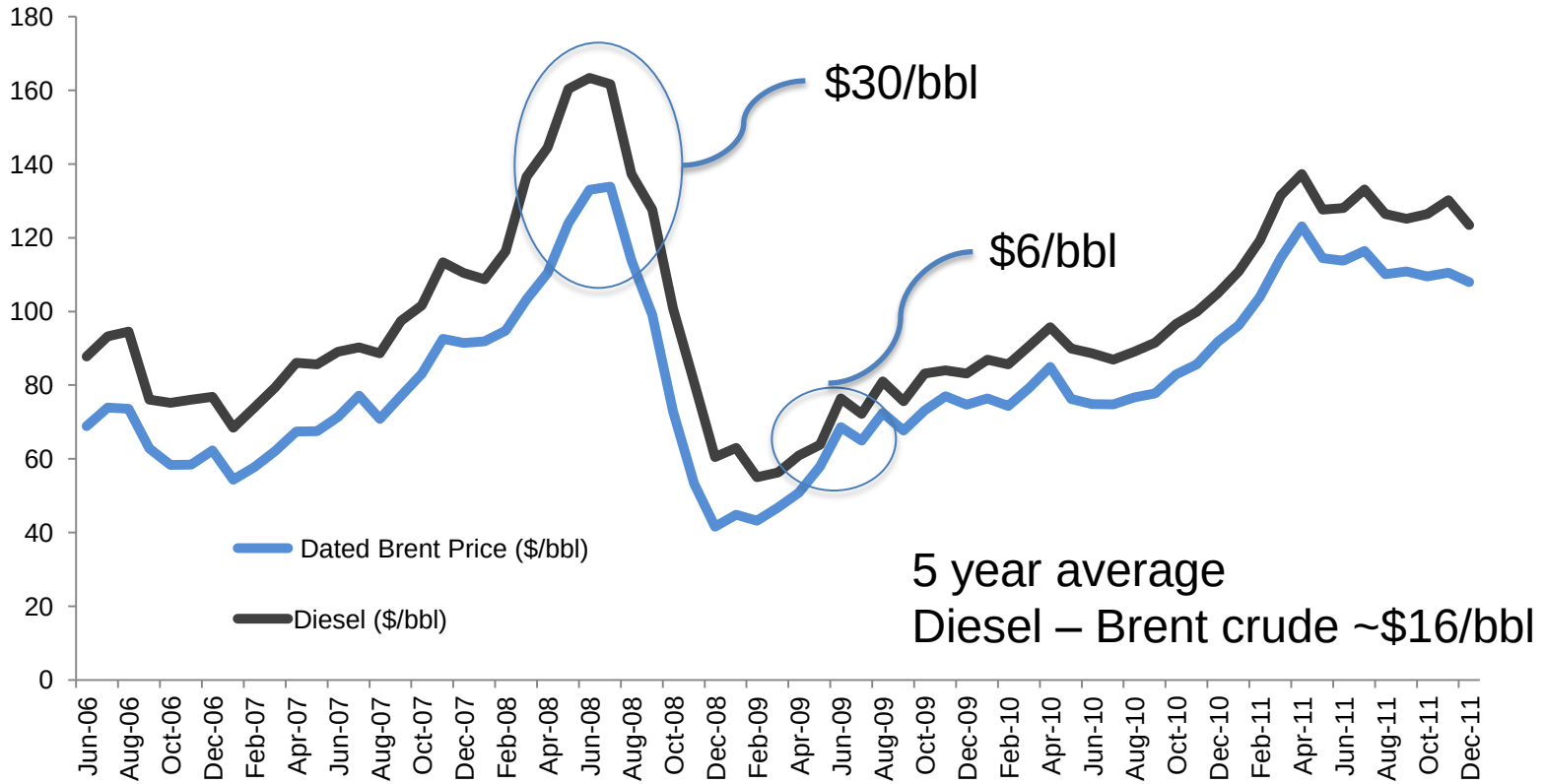

120
100
80
60
40
20
0
Diesel price $/bbl
CCS specific components
Electricity export
125MW @ $60/MWh

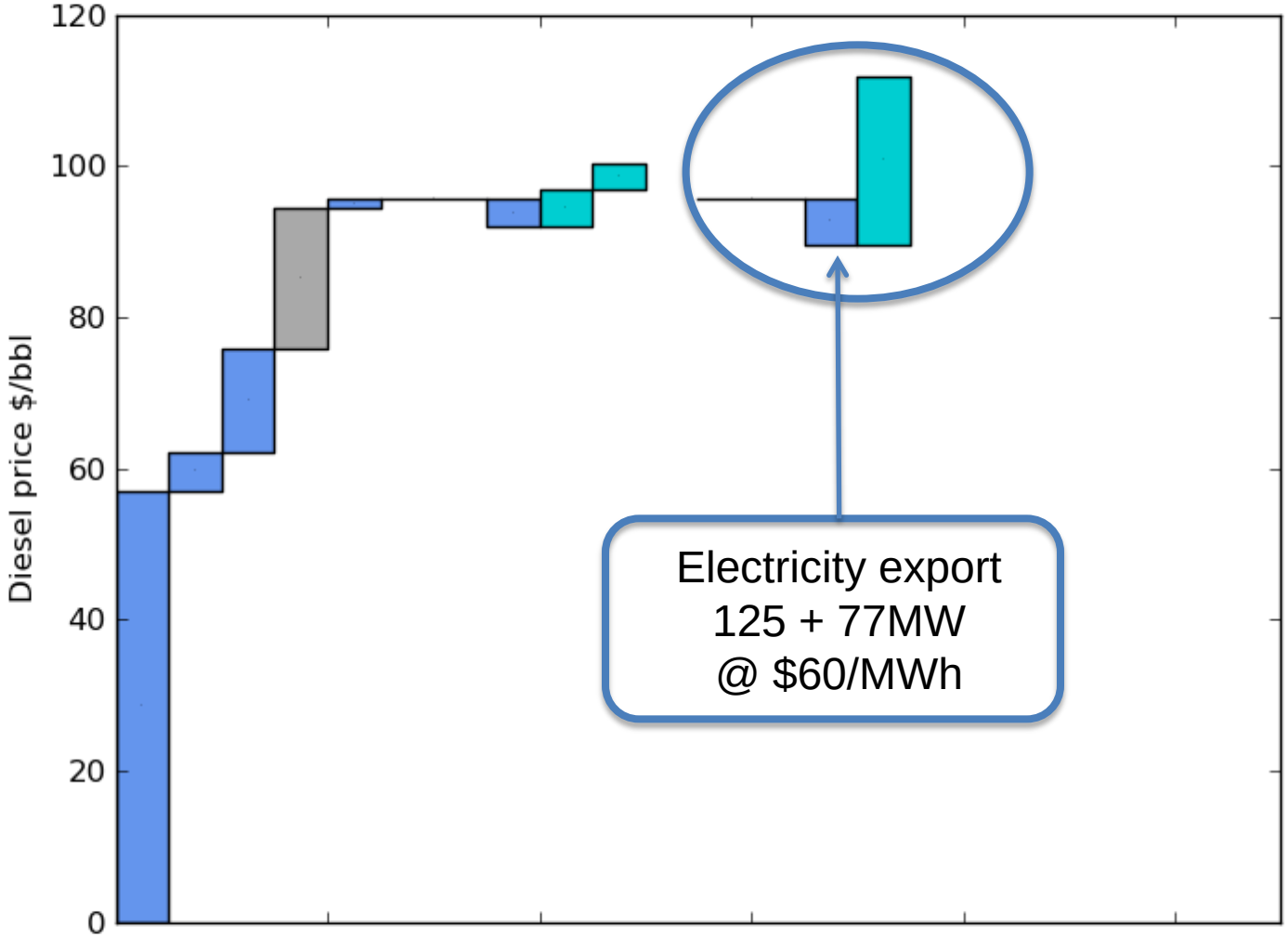

120
100
80
60
40
20
0
Diesel price $/bbl
CCS specific components
CO_2 pipeline 200km.
Wells at 0.5Mt/year.
$500M


120
100
80
60
40
20
0
Diesel price $/bbl
CCS specific components
CO_2 variable costs at $3/tonne

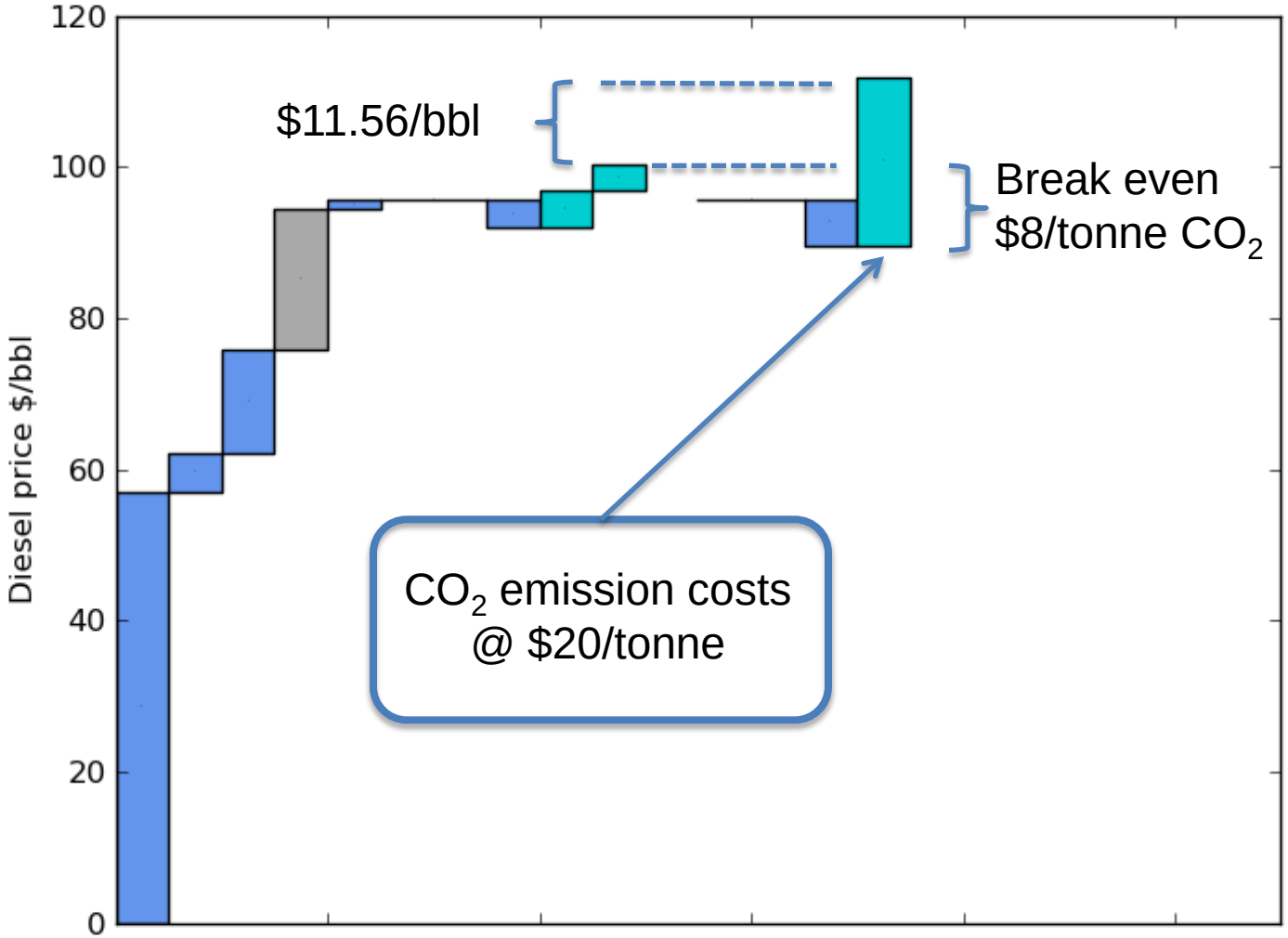
Historical crude/diesel price



Source: http://www.indexmundi.com/commodities/



Without CCS.
CO_2 vented



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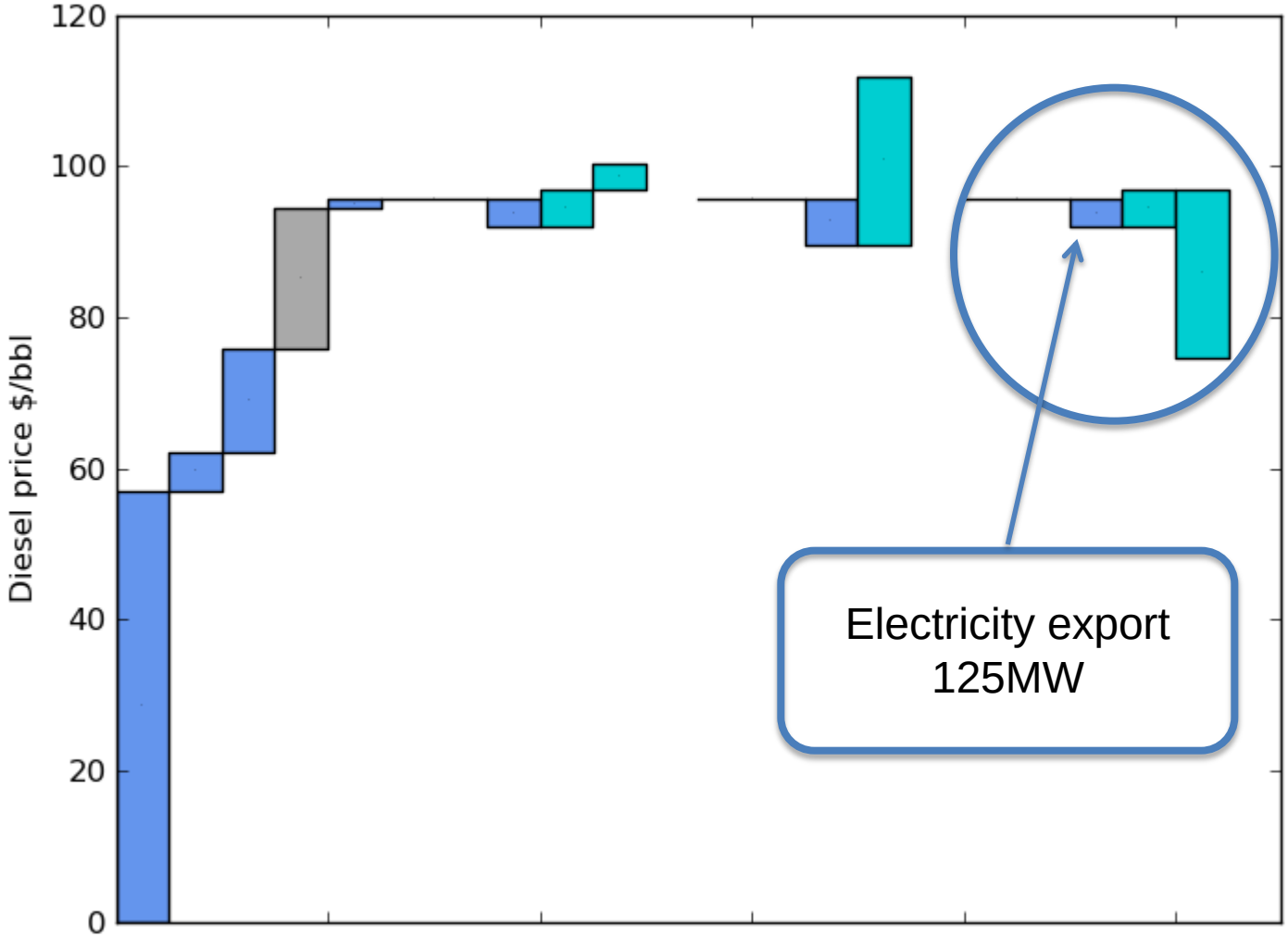
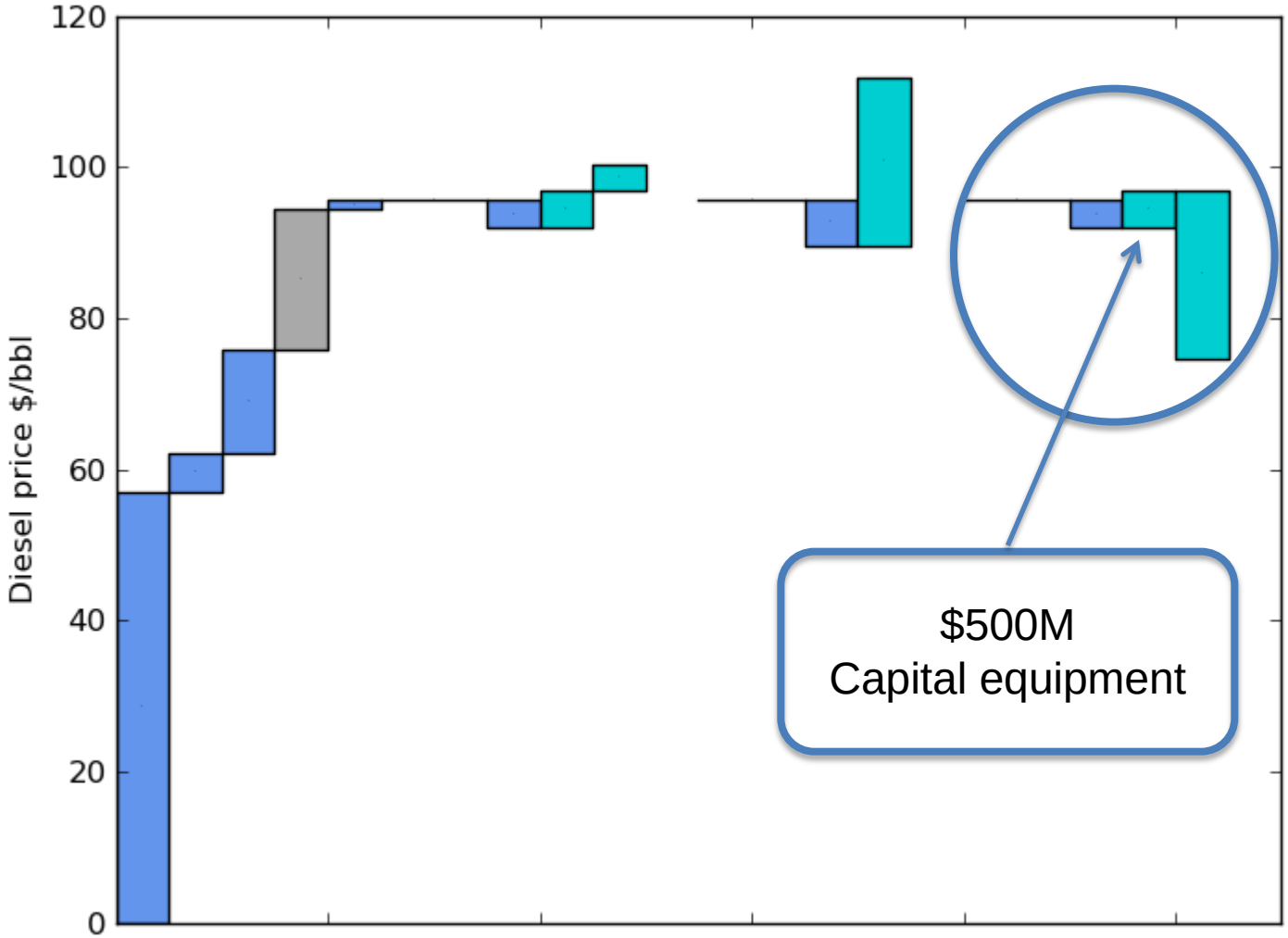
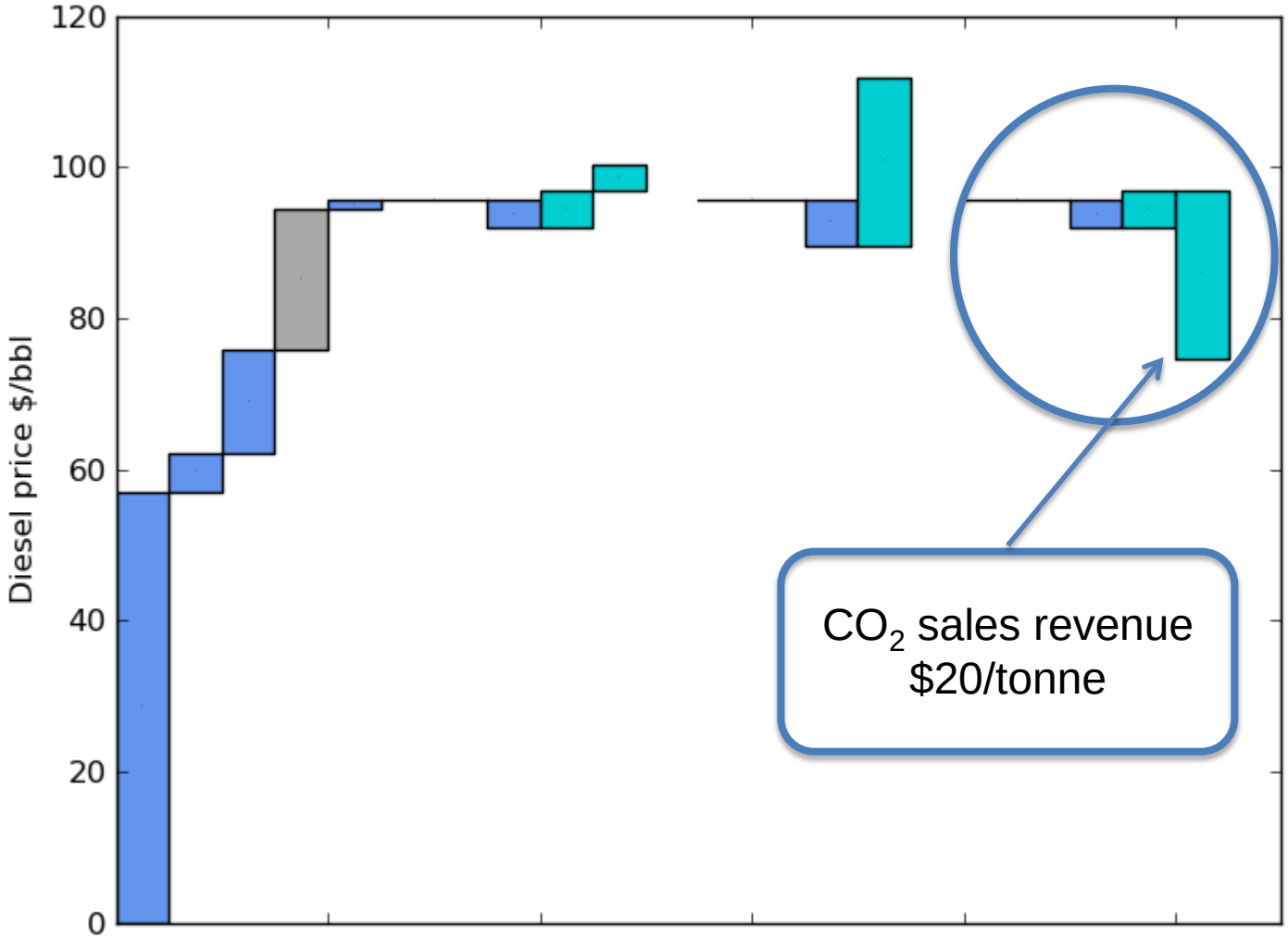

120
100
80
60
40
20
0
Diesel price $/bbl
Electricity export
125MW

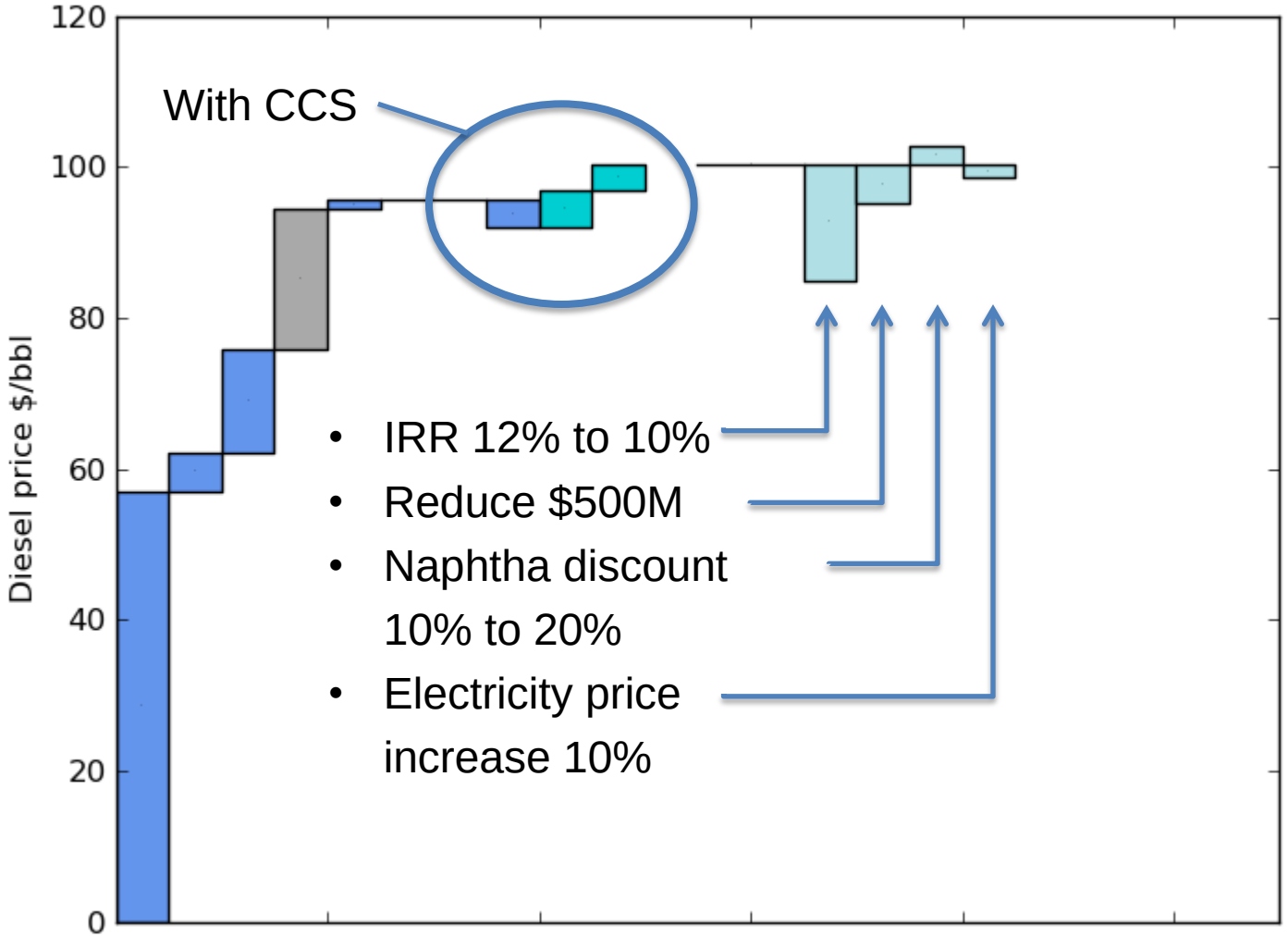
CO_2 to EOR



CO_2 to EOR


120
100
80
60
40
20
0
Diesel price $/bbl
CO_2 sales revenue
$20/tonne

CO_2 to EOR



Sensitivities

Observations

- CTL investments appear plausible at current oil prices.
- Investment decision is driven by confidence that oil price will remain high enough to cover enormous capital outlays
- Only a small CO_2 price ($8/tonne) is required to make CCS break even compared to venting
  - Any policy to support CTL would need to address capital service in low oil price
  - Supporting CO_2 infrastructure would not materially influence investment economics but may change perception of risk.
- Advantaged locations:
  - Low construction cost
  - Access to “stranded” coal
  - Sales path for naphtha
  - EOR

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Policy issues

- Security of supply and economics are the drivers. Not CO_2 reduction compared to mineral oil.
- Premise is that supporting CTL may stimulate CO_2 infrastructure and CCS development.
- Value of CO_2 infrastructure (in this case) is $500M. How does this compare to covering downside crude price risk on $7B?
  - Liquid fuel supply security may influence this balance
- CTL may happen spontaneously (or with small incentives) in advantaged locations.
  - Where are these advantaged locations and do they fit with CCS for power?
  - Can we engage the Oil and Gas industry in this effort?

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