Going from Optimization to Innovation in Unconventional Oil and Gas

PROPEL Energy Tech Forum
March 2016

About ADI Analytics

- Going from Optimization to Innovation in Unconventional Oil and Gas

ADI Analytics is a boutique consulting firm serving energy and chemical companies with passion, rigor, and expertise

	Markets	Technology	Operations	Functions
Oil & Gas	 Exploration	 Production	 Refining	 Distribution
Power & Mining	 Coal	 Generation	 Transmission	 Carbon
Renewables & Cleantech	 Biomass	 Solar	 Wind	 Geothermal
Chemical & Industrial	 Plastics	 Materials	 Auto	 Manufacturing

Fortune 500 and mid-sized companies, start-ups, investors, and governments have hired us to shape decisions globally

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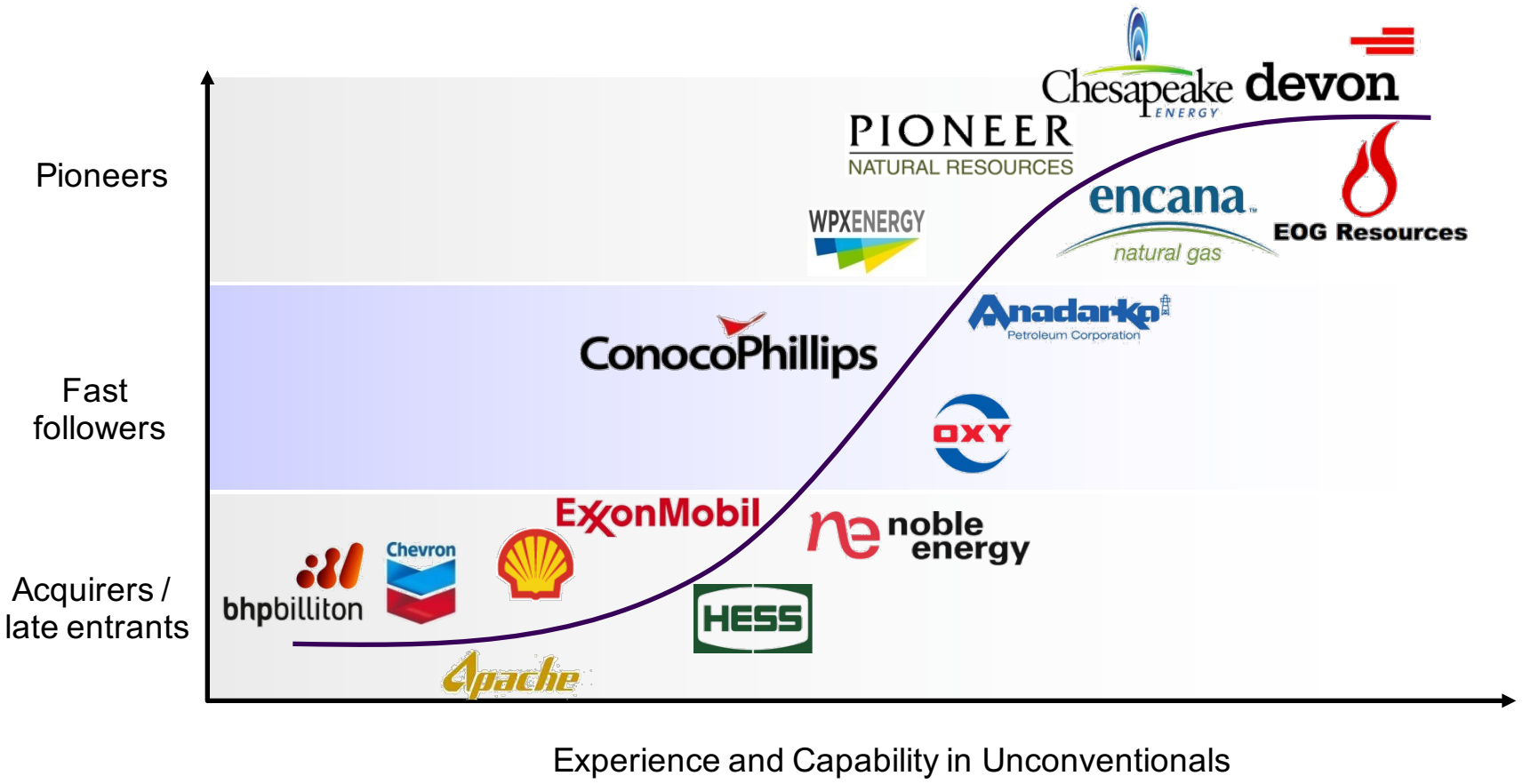
- **Going from Optimization to Innovation in Unconventional Oil and Gas**

Key messages

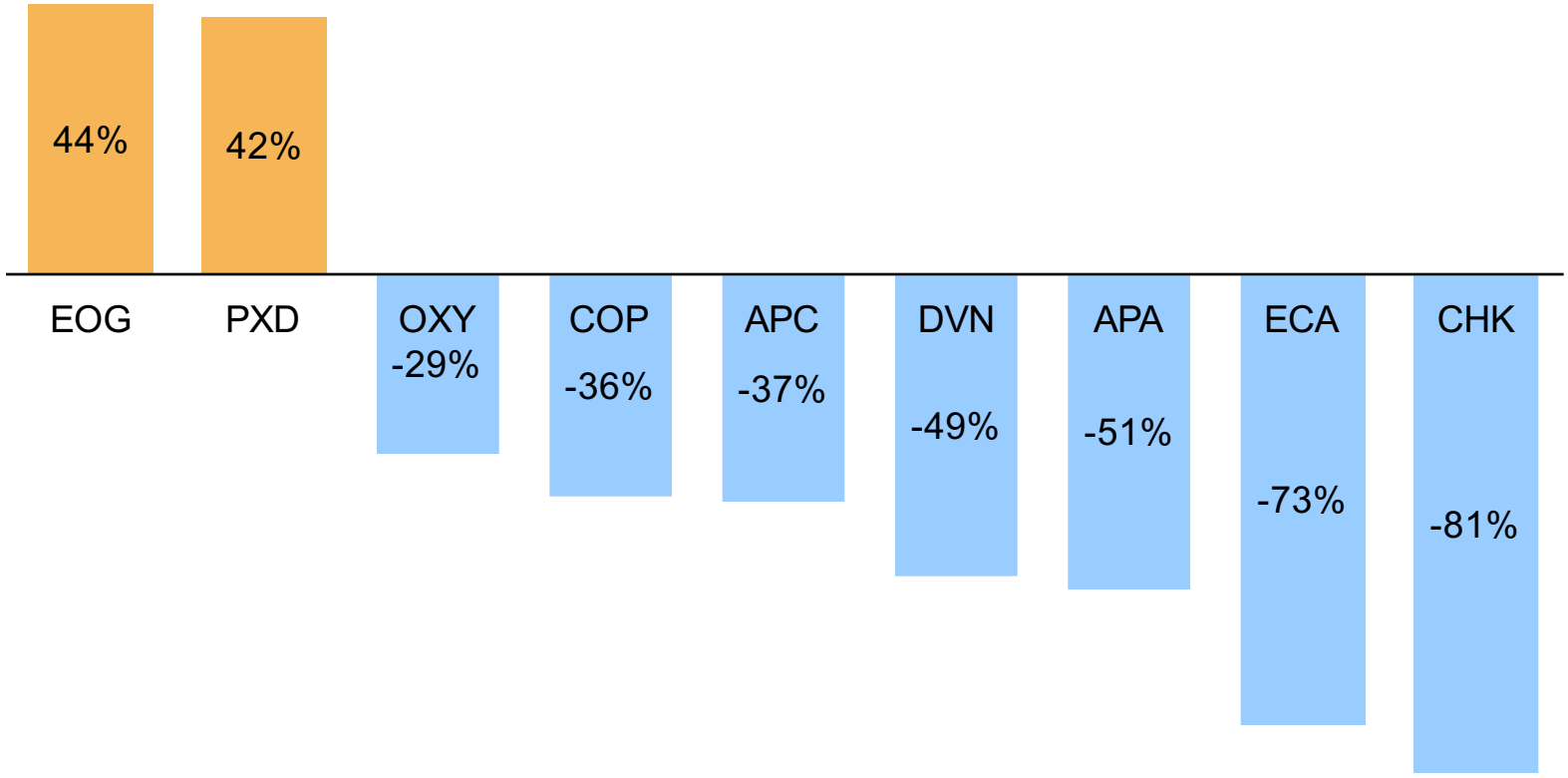
1	Rocks matter more than you think – First movers among North American unconventional players are benefiting more from operational best practices.

North American unconventionals was a "small business" revolution and not led by Big Oil



First movers who pivoted quickly away from gas to oil and liquids acreage – EOG and Pioneer – have done really well

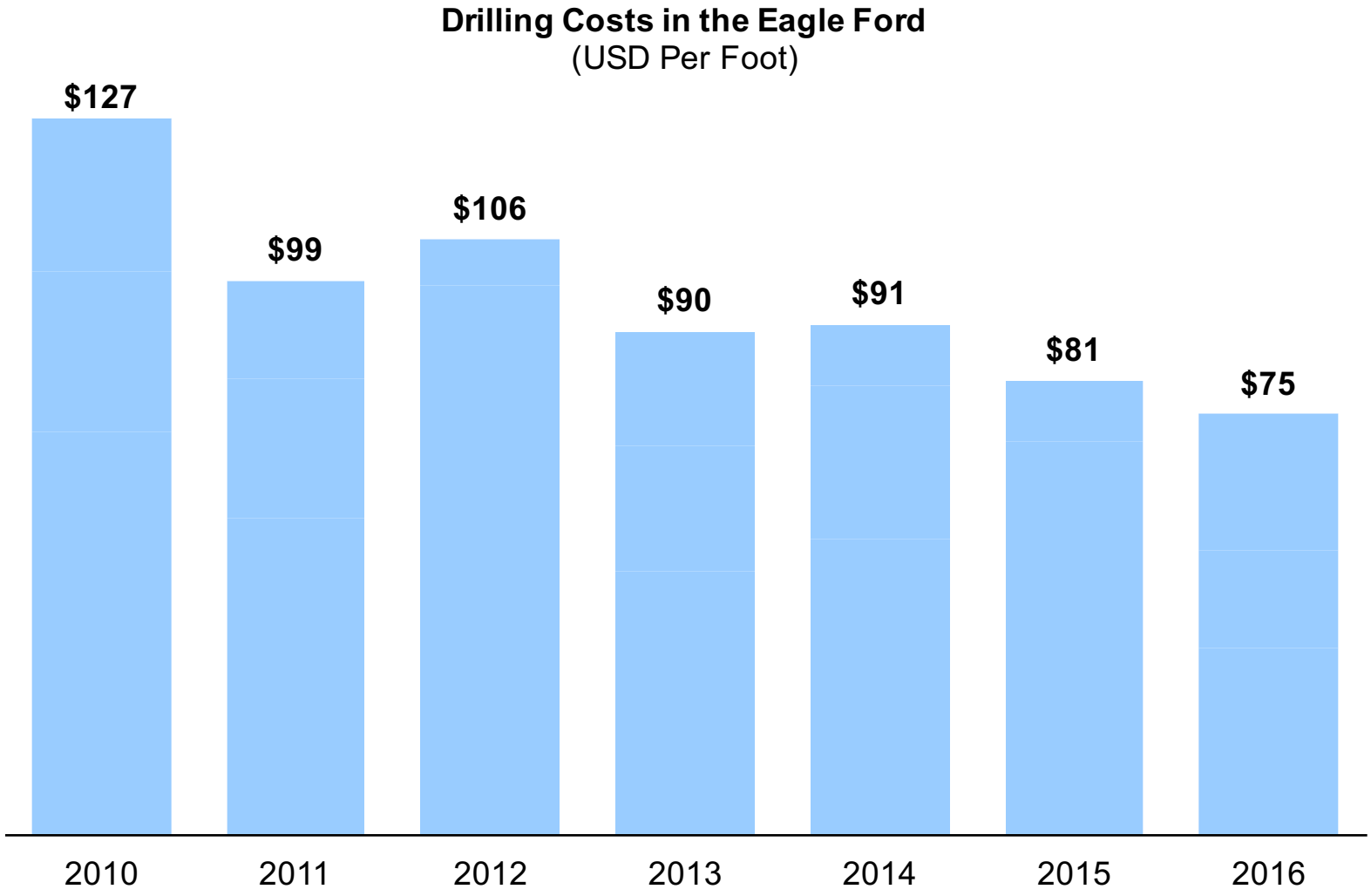
Investment Performance for Top Operators
(Total Shareholder Return, 2012-15)



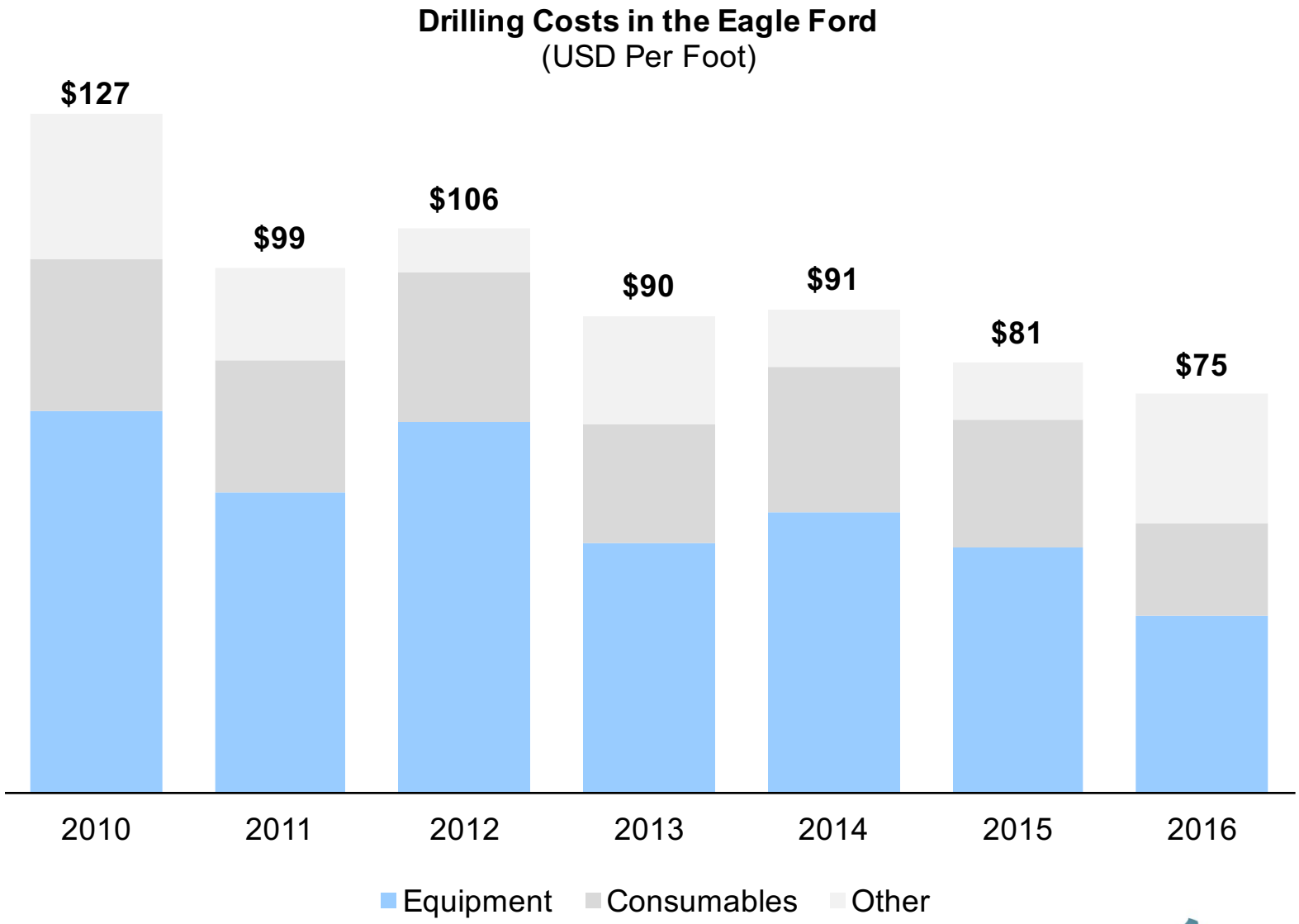
Key messages

2	Drilling rig productivity and multi-well pads have provided most of the cost reductions in North American unconventionals.

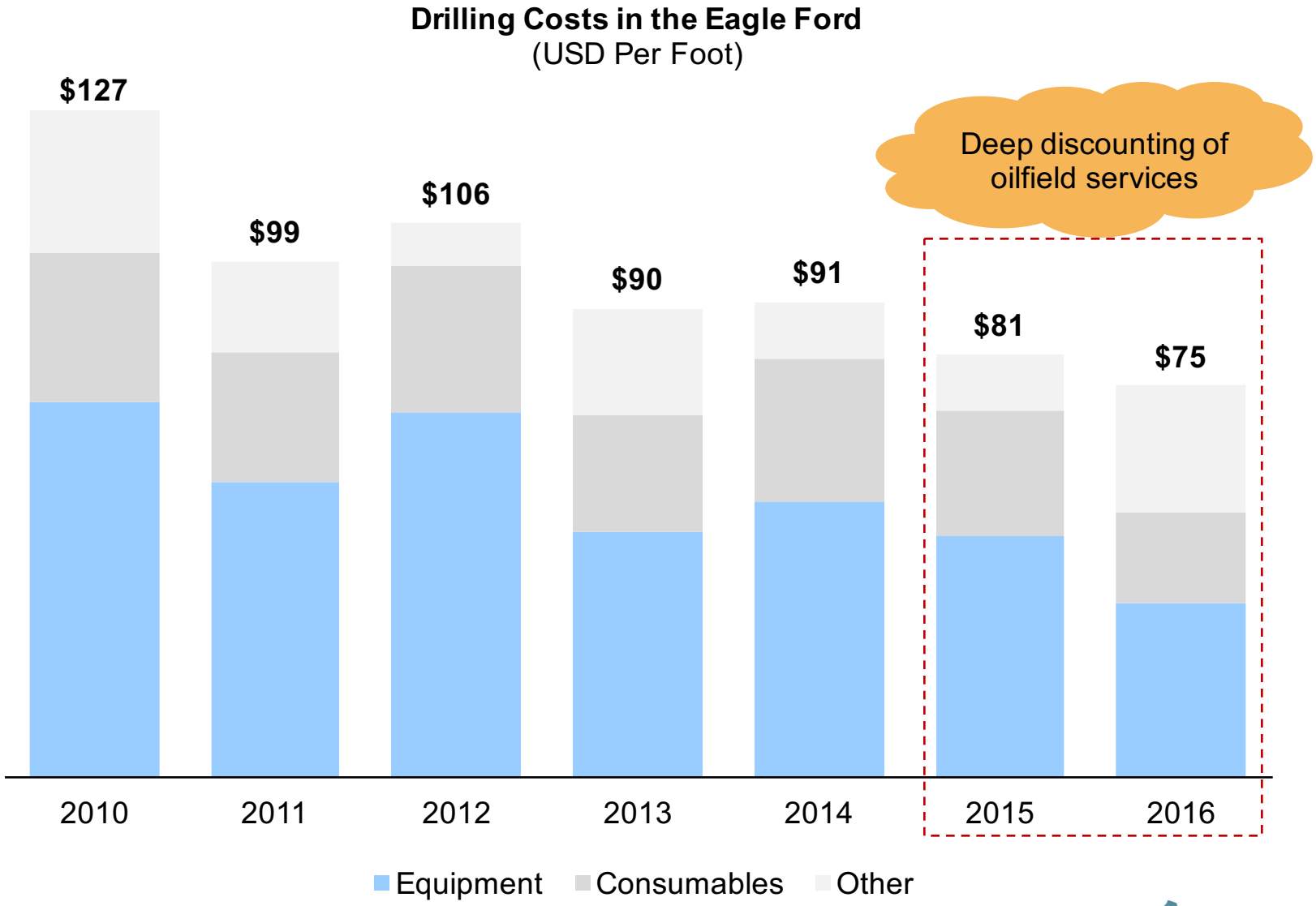
Drilling costs for unconventional oil and gas wells have come down significantly …



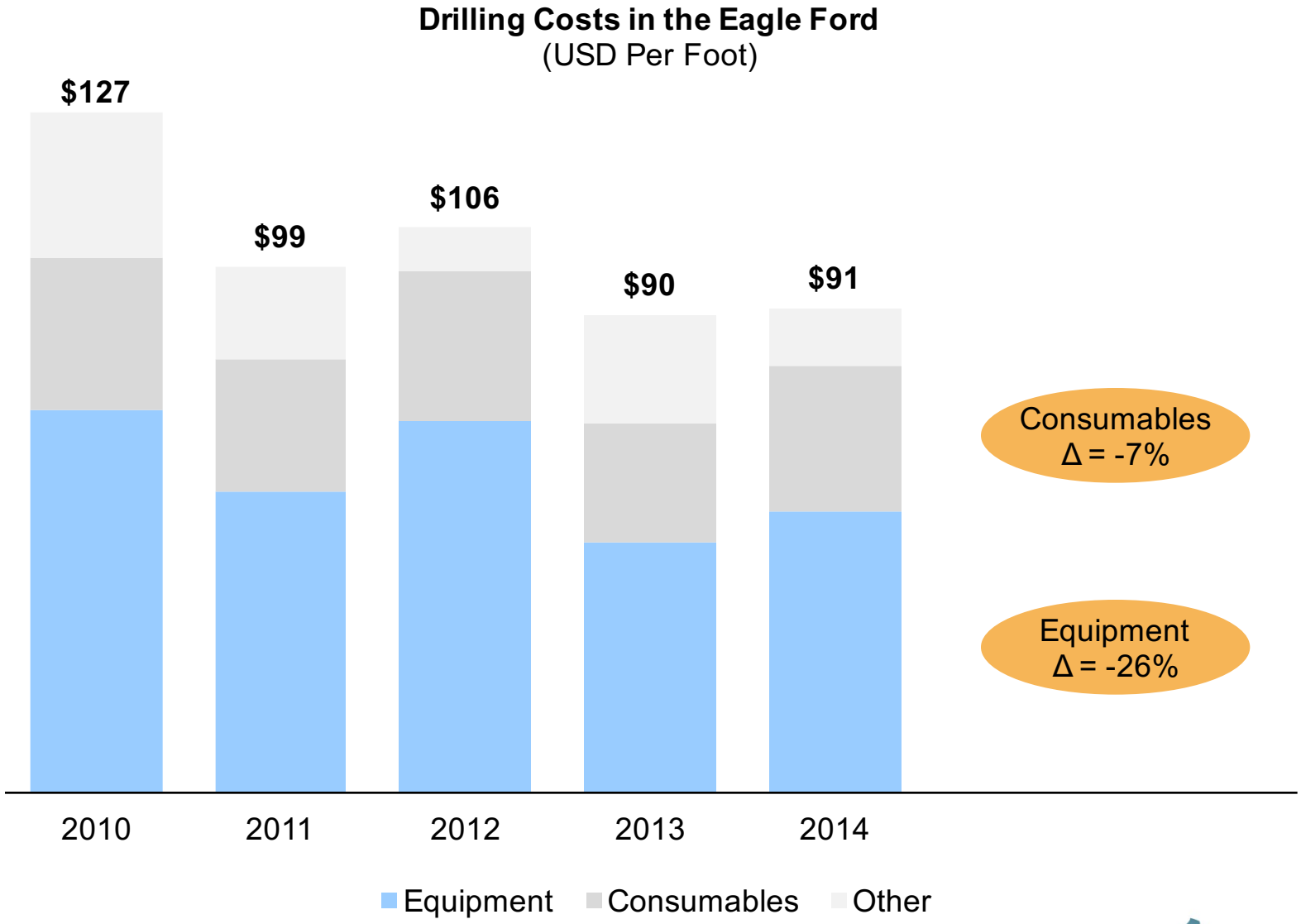
… With varying levels of reduction across key categories



Cost reductions in the past 18 months, however, have come mainly from deep price discounts for oilfield services



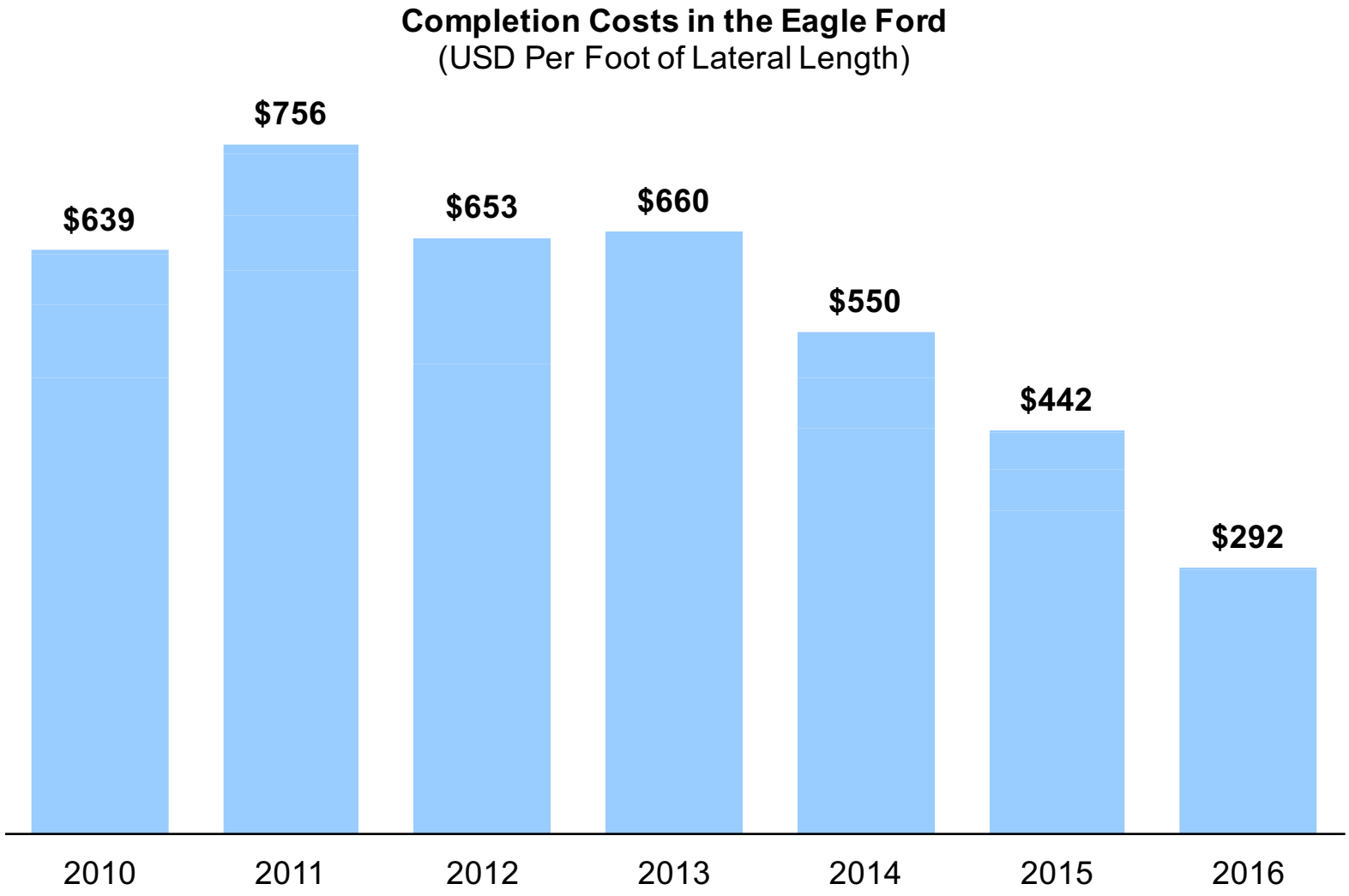
Through 2014, rig productivity and multi-well pads cut drilling costs but drill bits and drilling chemicals have changed little



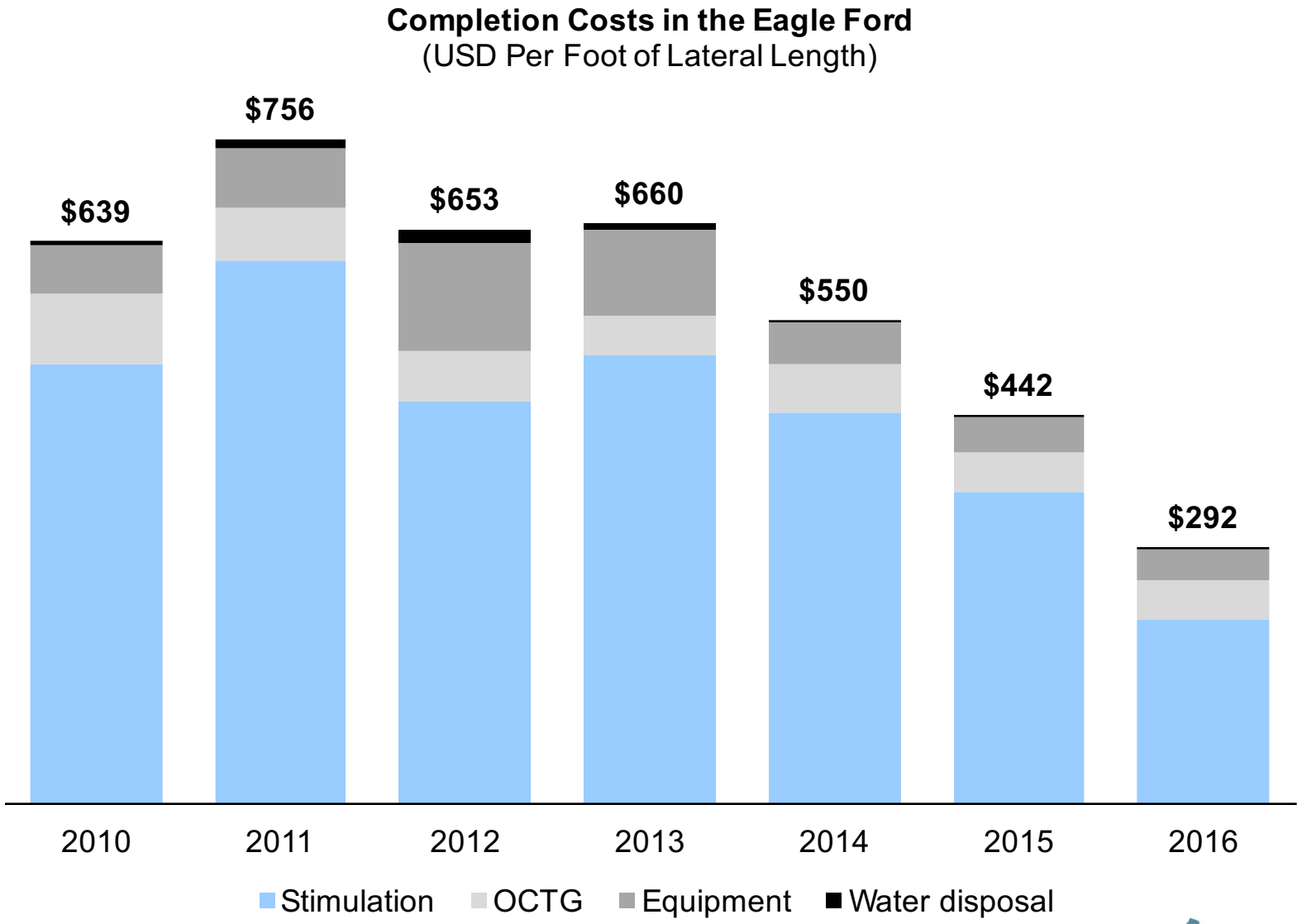
Key messages

3	Completion costs have not really fallen and could be fertile ground for new technologies and innovation.

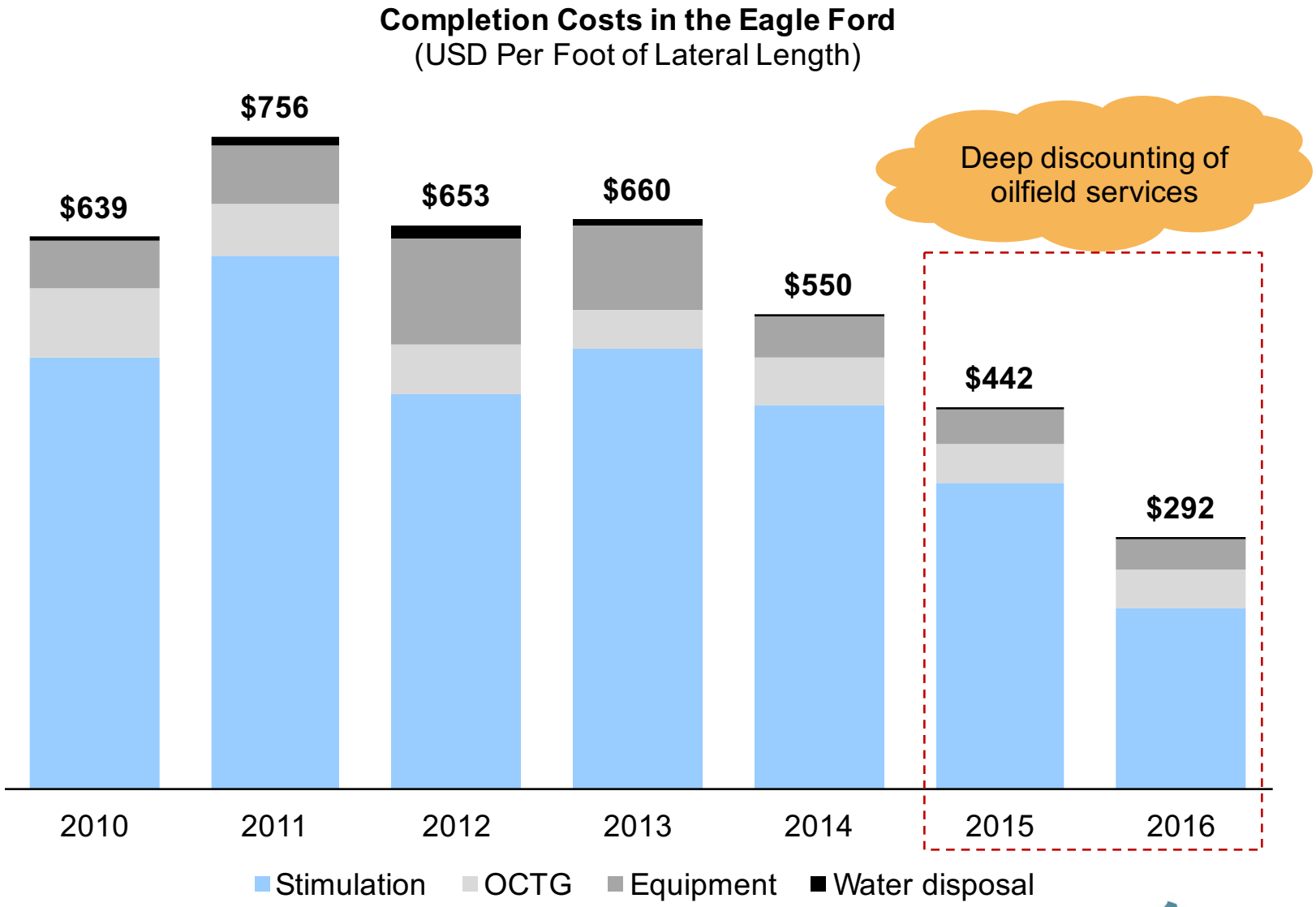
Completion costs have also fallen but more slowly in comparion to drilling costs



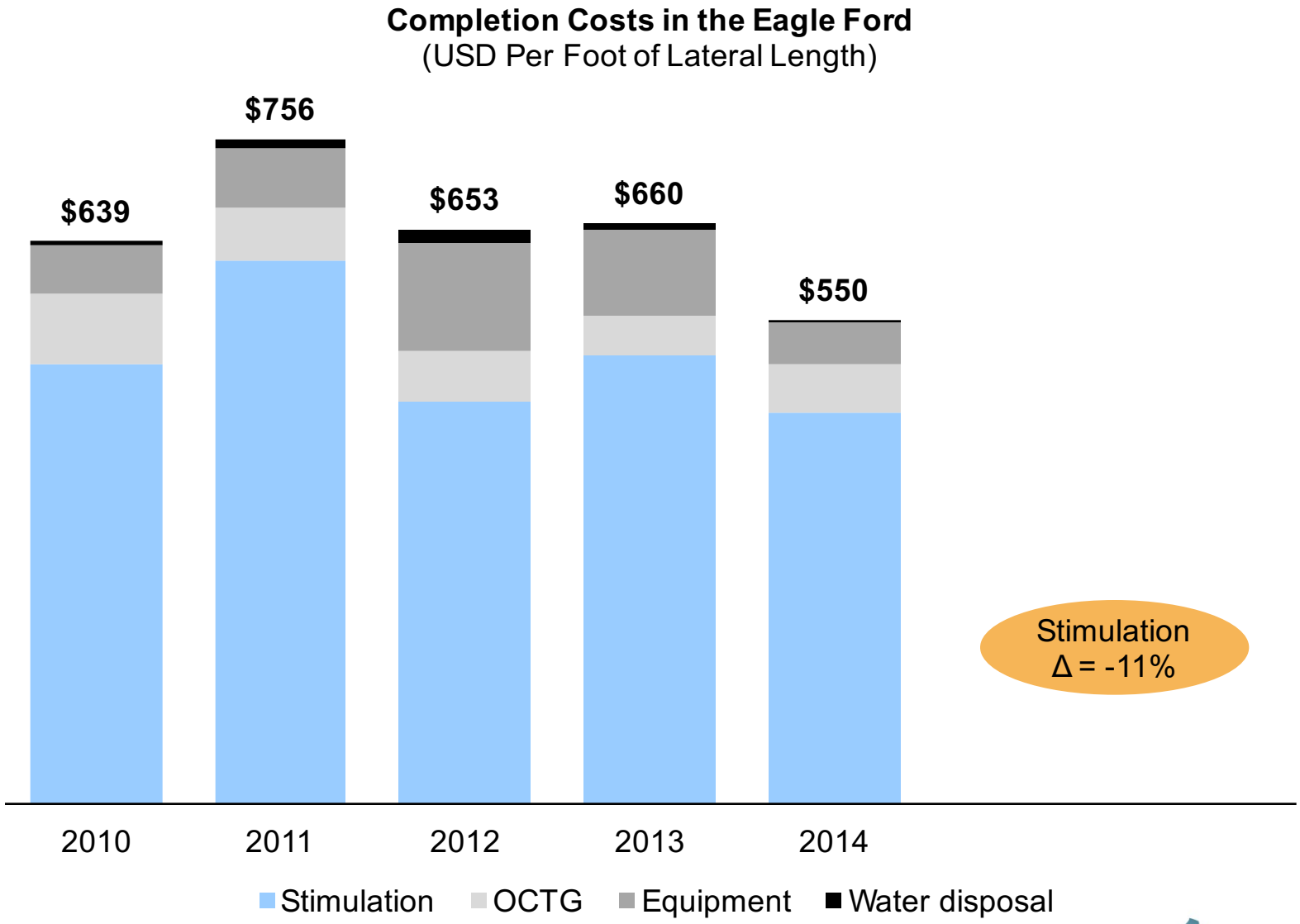
Perforation and frac stimulation is the largest cost item; the share of other cost categories very significantly by play



Aggressive cost reductions seen recently are mainly due to oilfield service discounts versus efficiency or innovation



Through 2014, completion capabilities have improved but costs have not fallen as much as those for drilling



Key messages

4	Unconventional cost reductions have come mainly from operational optimization than the development and adoption of new technologies.

Unconventional players have adopted numerous initiatives to reduce costs across the value chain …

1 Exploration	2 Drilling	3 Completions	4 Production
2D Seismic	Multi-well pads	Sequential / parallel fracs	Production facility optim.
Advanced core analysis	Walking rigs	Zipper fracs	Water management
3D Seismic	Own rig transportation	Own sand mines/frac flts.	Flare gas management
Reservoir modeling	Fit-for-purpose rigs	Own water systems	Emission reduction
Microseismic	Geosteering	Longer laterals	Refracturing
	Well spacing	More stages	
	Well orientation	Proppant use optimization	
	Bi-fuel rigs	Bi-fuel frac fleets	
	Customized well designs	Microseismic	
	SIMOPS	Green completions	
	Well placement	Flowback analysis	
	Batch drilling	Engineered completions	
		Energized fracs	

… But most of the widely-practiced are primarily efforts to optimize operations and not really new technologies

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Going beyond optimization, unconventional oil and gas operators have several pain points and innovation needs

Major Innovation Challenges

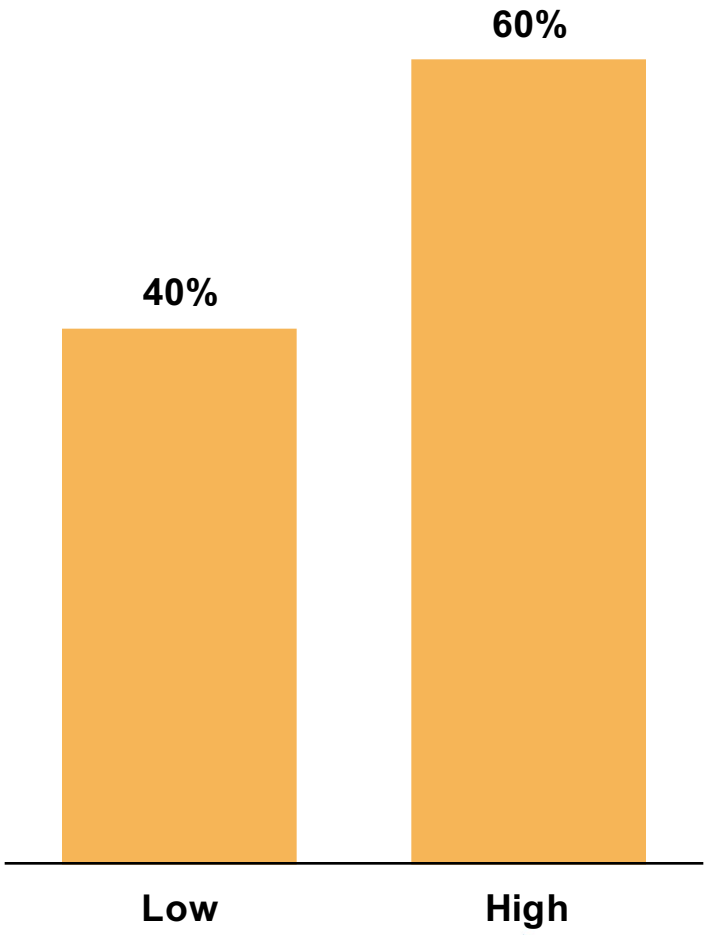
Exploration	1	Ability to “explore” for sweet spots
	2	Improve predictive modeling capabilities
	3	Develop tools for hydrocarbon characterization
Drilling & Completions	4	Develop faster, cheaper, precise, and cleaner D&C technologies
	5	Improve completions with better fractures and equipment
	6	Increase hydrocarbon recovery or reduce shale gas well decline rates
Production	7	Optimize water and emission footprint through new practices and technologies
	8	Reduce decline rates through EOR, in-fill drilling, refracs, and other tools
	9	Develop technologies that allow for better integration with midstream assets

How do we put the wells in the right place, with the right orientation, and choose where to complete based on data?

Current unconventional best practices …

- Limited exploration, if any
- Find sweet spots by trial and error
- Perforate the reservoir every 50 or 100 feet
- Stimulate stages with identical fluid and proppant volumes

… Produce far too many under-performing fractures



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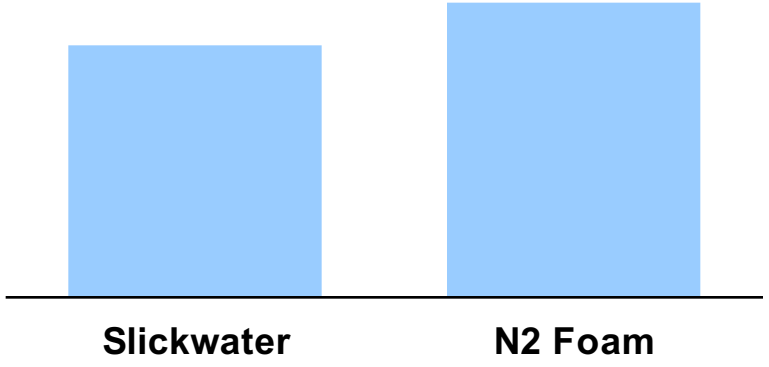
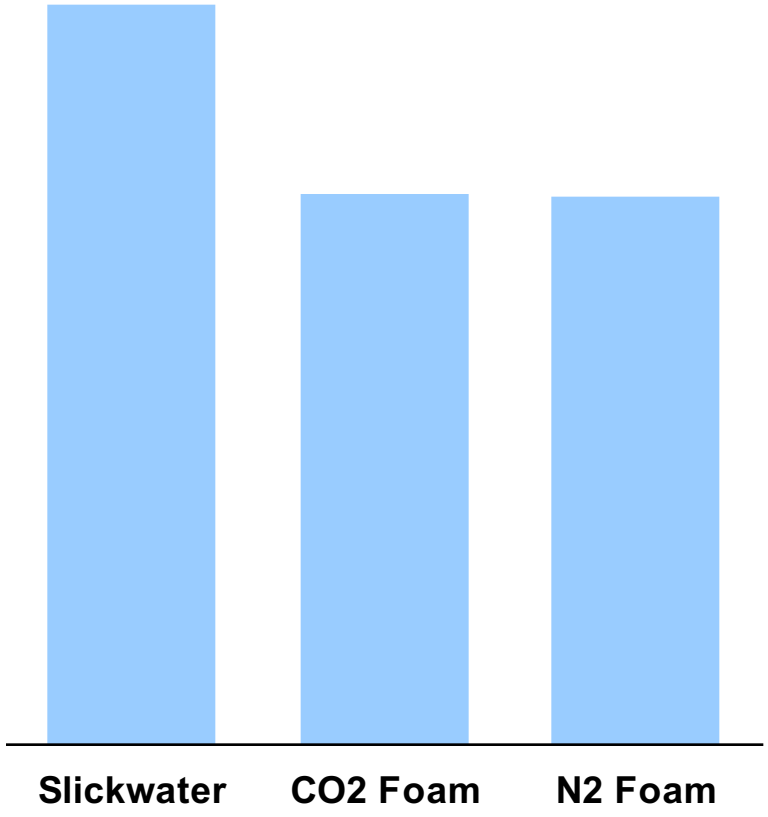
Energized fracs can compete with water only if the latter's lifecycle costs are fully included in completion costs

Fracture Treatment in Montney …
(U.S. $ Million)

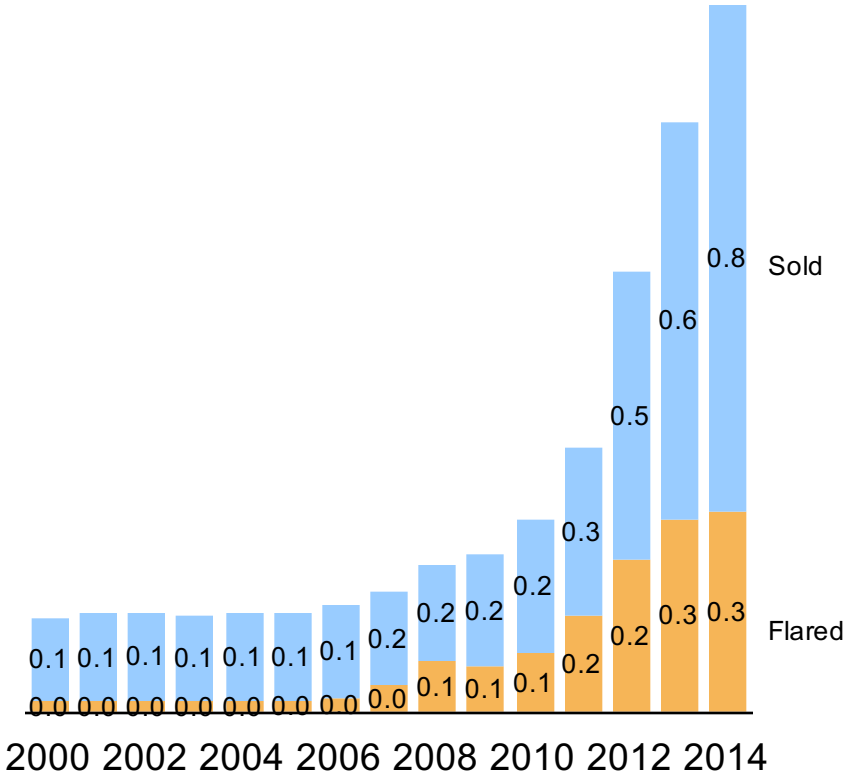


… With Lifecycle Water Costs
(U.S. $ Million)

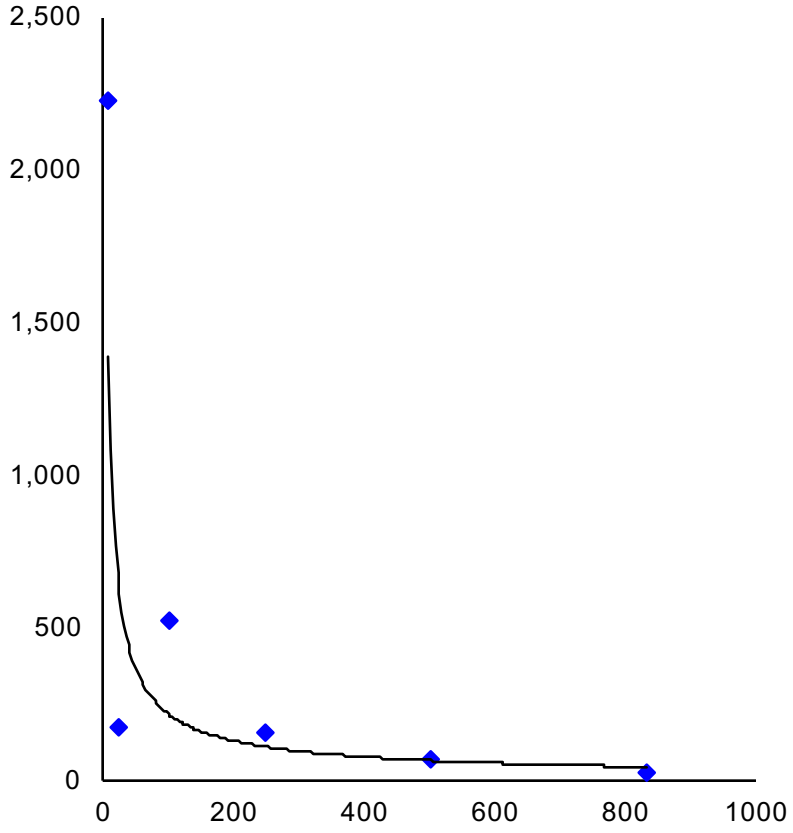


Natural gas flaring is emerging as a key issue addressing which will require new technologies at a smaller scale

Gas Production and Flaring
(Billion Cubic Feet Per Day)



Bakken Flaring Rates by Well
(Thousand Cubic Feet Per Day)



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