Estimating the Required Resource Volumes and Sources to Meet Strategic Targets*

Peter D. Carragher[1]

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[1]Rose & Associates, Houston, Texas, USA (petercarragher@roseassoc.com)

Abstract

This presentation describes an internally consistent method to link future strategic production targets to the various sources of future production that are available to a company; exploration, acquisition of conventional or unconventional assets, and improved recovery from existing fields. The methodology requires initial estimates of the company's exploration prospect inventory, proven reserves, and non-proved resource base. The model employs a variety of user-controlled parameters, such as the commonly used R/P ratio, and less common yet important ratios such as Reserve / Non-Proved Resources, Exploration Success Rate, and the efficiency of converting Exploration Discovered Volumes to Non-Proved Resources. These ratios can be set with knowledge of the company's competitor set. With the addition of estimated average costs to pull through all the resources to reserves, the company can develop an initial total plan and annual cost. Company leaders can use the insights gained from the initial passes to iterate the strategic goals, acceptable ratios and overall costs to reach an agreed set of achievable and financially prudent targets. The company can then allocate various parts of the targets and budgets to the operating divisions. This methodology is designed to produce accurate, but not precise views of the future. The company can, and should develop robust stochastic exploration portfolio predictions, production forecasts and portfolio models using more advanced tools.

Rose & Associates

Estimating the Required Resource Volumes and Sources to meet Strategic Targets

Peter D. Carragher
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AAPG ACE Calgary

June 21, 2016

Introduction

- There are significant long term, and often poorly understood implications in many strategic targets

- *Increase Production over the next 5 years*
- *Hold Production flat over the next 5 years*
- *Pause Exploration for a few years*
- *Pivot to long-lived unconventional resources*

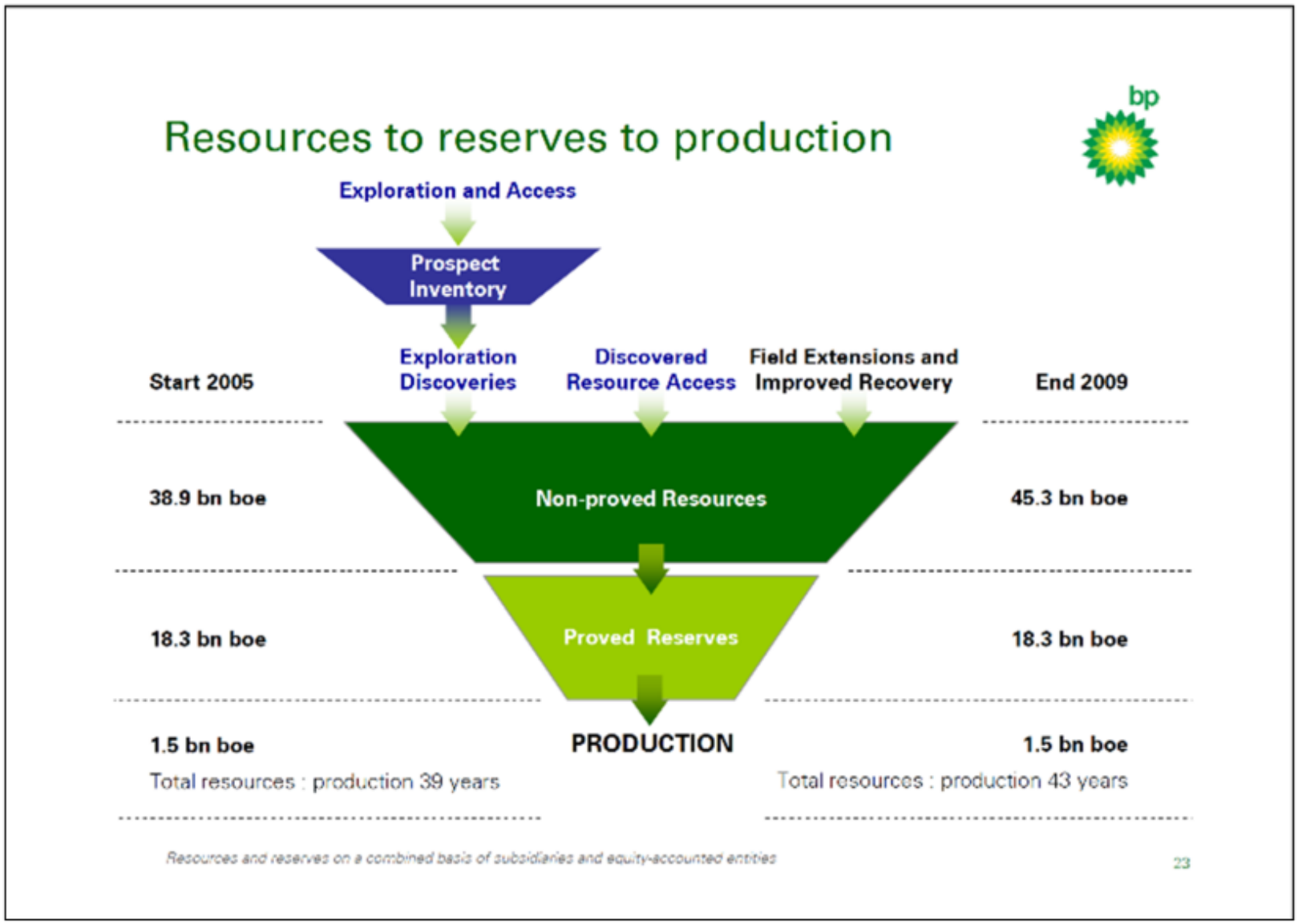
- Today's objective is to provide insights that link the sources of hydrocarbons to reserve and production goals

Outline

- Resource Progression Model
- Developing a Consistent Forecast Model
  - From Exploration Access to Production
- Model Details
- Example Applications
  - Growing Production
  - Stable Production
- Summary & Conclusions

BP Resource Progression 2010

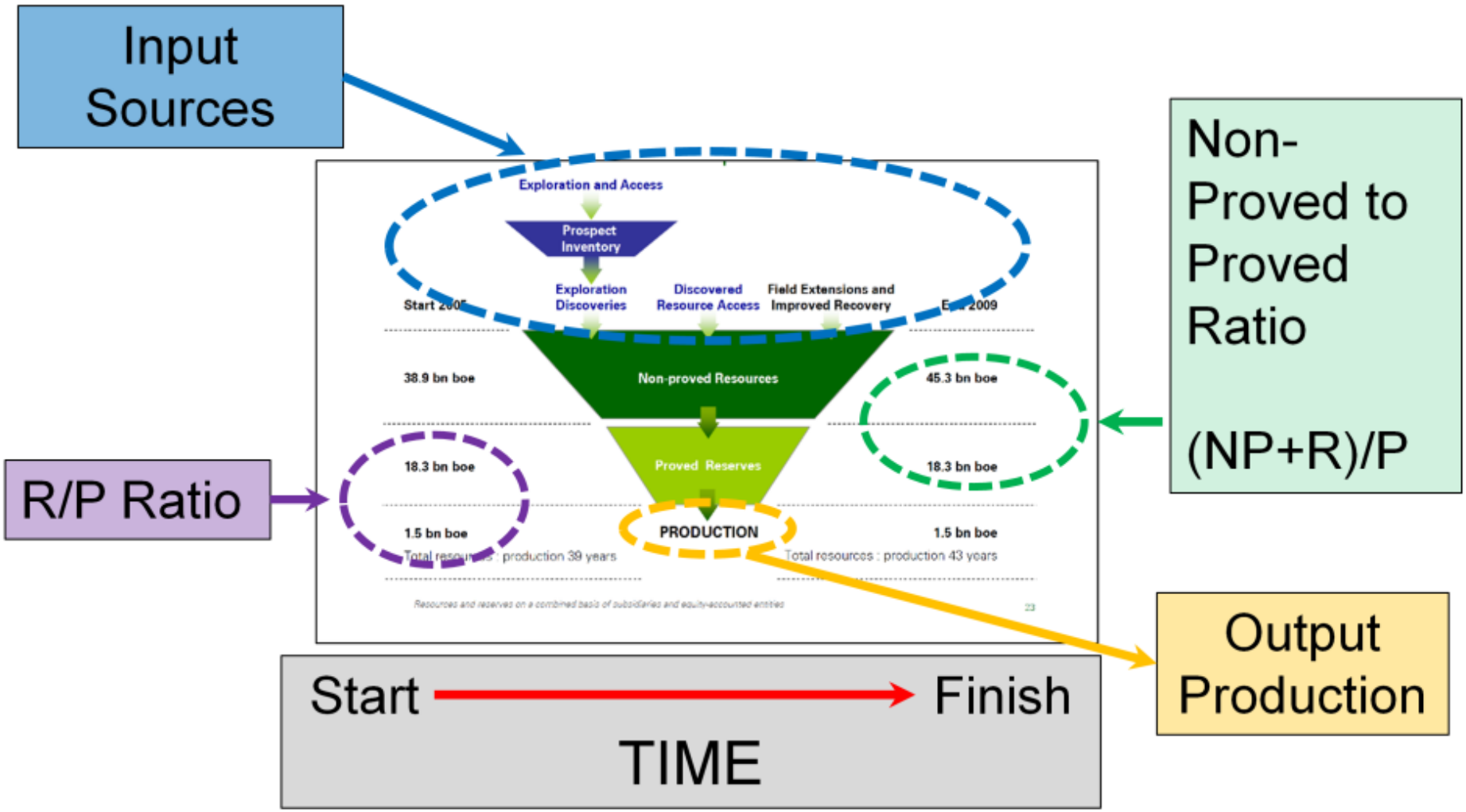
http://www.bp.com/content/dam/bp/pdf/investors/bp-ic-strategy-presentation-march-2010-slides.pdf



Presenter's notes: The Dynamic model I will introduce in this talk is derived from this static BP model. It is publicly available at the internet location shown. Key Features include volume estimates at the start and end of the period for both Proved Reserves and Non-Proved Resources. Production draws down the Reserves that are replenished by progressing resources from the non-proved category. In turn, the Non-Proved resources are replenished by Exploration, Discovered Resource access, M&A activity and Unconventionals, and by Field extensions and Improved recovery from the companies existing assets. Finally, Exploration Discoveries deplete the prospect inventory, which must be replenished by accessing new acreage.

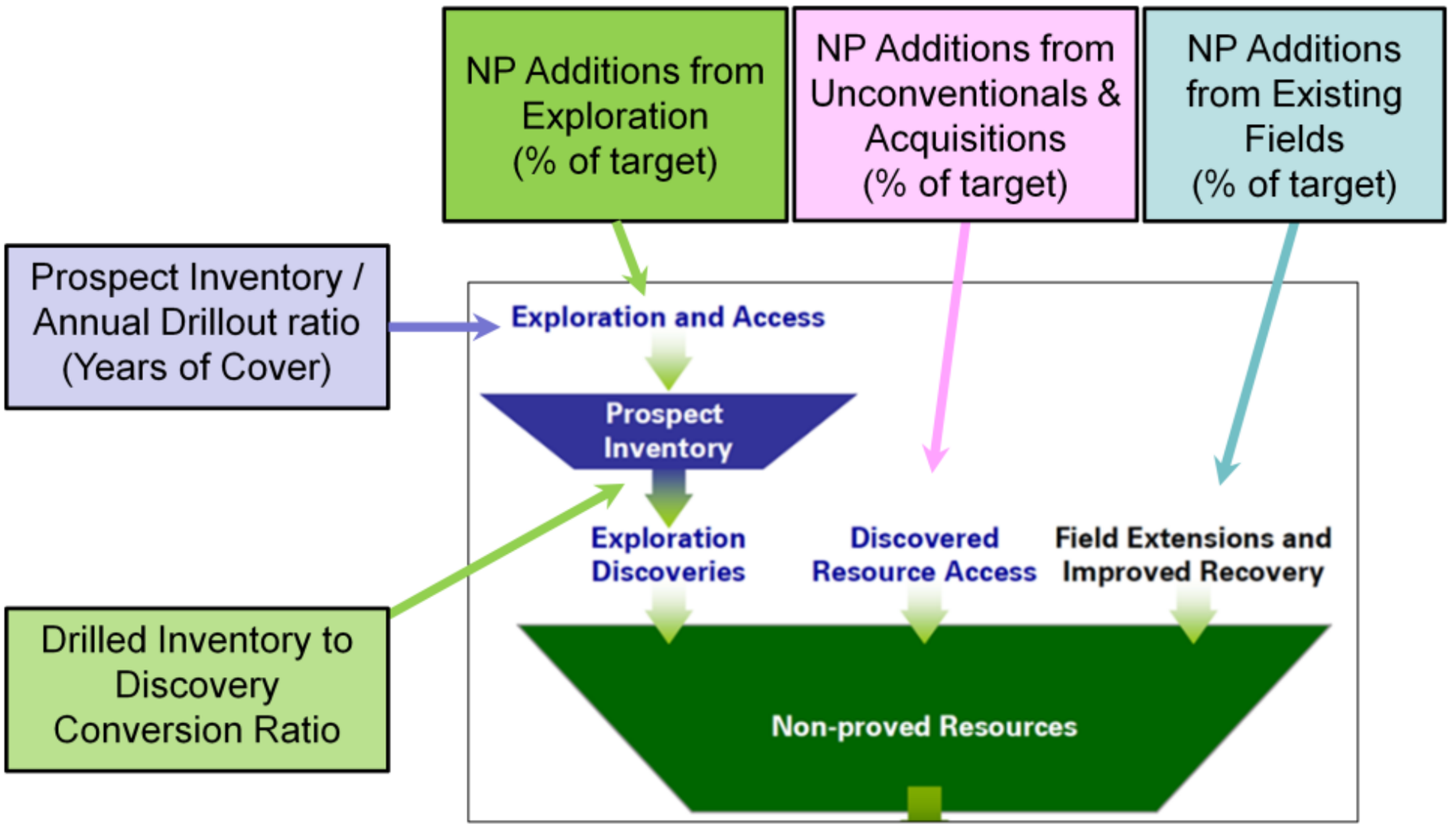
BP Resource Progression 2010

http://www.bp.com/content/dam/bp/pdf/investors/bp-ic-strategy-presentation-march-2010-slides.pdf



Presenter's notes: Several useful ratios can be extracted from this model at both the start and end of the period under consideration. These include not only the standard Reserves to Production R/P ratio, but also the ratio of Non-Proved Resources to Proved Reserves, and the total resource based to production ratio.

Other Ratios & Inputs



Presenter's notes: There are other factors needed to convert this static model into a dynamic one. The Top row sets out a decision on the relative percentages of non-proved replenishment from each of the three sources, Exploration, Discovered Resource Access and Field Extensions and Improved Recovery. In the column on the left are two other required ratios. The first ratio is an estimate of how much of the pre-drill chance weighted EUR is converted into Non-proved resources. This is a common feature of the hand over from exploration to appraisal and development. The point here is not to discuss the merits of this issue, but simply to recognize that it exists and factor it into this scaling exercise. This is an estimate of how large the Prospect inventory, measured in chance weighted BOEs and needs to be relative to the annual Drillout volumes. It is expressed in "Years of Cover". For example if the Non-Proved replenishment plan requires 200 mmboe annually form exploration, and the company typically converts 80 percent of the annual Drillout to NP, the annual Drillout is 250mmboe. If the leadership team's judgment is that a 5-year cover is prudent, then the PI target will be 1,250 mmboe.

To Develop a Dynamic, Time Bound View

All components are linked by equations driven by user-controlled ratios and percentages

- Production draws down Reserves
- Reserves have to be replaced
  - Generally from the Non-Proved Resource Stock
- Non-Proved Resources have to be replaced
  - Generally from
    - Exploration
    - Discovered Resource Access – Unconventionals and Acquisitions
    - Improved Recovery and Extensions of Existing Fields
- Exploration Inventory is drilled out to add resources to NP and needs to be replaced
  - By New Acreage Acquisition

Inputs, Controls & Linkages

Resources and PI at Start

MY-E&P-CO RESOURCE PROGRESSION		
EVALUATION DATE:	12/31/2015	
Ratio Model for Company Data		
ADD	1,292	MMBOE to Prospect Inventory
ISCOVER	1,280	MMBOE by Exploration Drilling
ADD	1,280	MMBOE by Field Extension / Improved Recovery
DD	1,319	MMBOE by Direct Resource Access
PROGRE	1,844	MMBOE to Proved Reserves
PRODUCE	1,826	MMBOE in the Period

Dates	PROSPECT INVENTORY Risk Weighted MMBOE	
12/31/2015	PROSPECT INVENTORY	2,000
5	Revisions	100
Year(s)	Additions	1,192
	Drillout (-ve)	(1,829)
12/31/2020	PROSPECT INVENTORY	1,463
5	Year Exploration Discoveries	1,280
	memo: Average Discovered Volume per year	256
	memo: PI Drillout per Year	25%

	12/31/2015	Exploration Discoveries	Field Extension & Improved Recovery	Direct Resource Access	Non -Proved to Proved Reserve Progression	Total Production In Period (-ve)	12/31/2020	Period Change
Risked Prospect Inventory	2,100						1,463	(637)
Non Proved Resources	6,000	1,280	1,280	1,319	(1,844)		8,036	2,036
Proved Reserves	4,000				1,844	(1,826)	4,018	18
Total Resource base	12,100						13,516	1,416
ANNUAL PRODUCTION	365				Direct Entry Period Production forecast MMBOE (-ve)	0	365	0
memo: Daily Production	1,000,000						1,000,000	0

KEY RATIOS - in Years or Percent		START OF PERIOD	END OF PERIOD	CHANGE	*Competitor Target Ratios*	*Company vs Comparator*
Reserves / Production	R / P	11.0	11.0	0.0	*12*	*-1.0*
Non-Proved + Proved Reserves / Production	(NPR + R) / P	27.4	33.0	5.6	*40*	*-7.0*
Prospect Inventory + Non Proved + Proved Reserves / Production	(PI+NPR+R) / P	33.1	37.0	3.9	*48*	*-11.0*
Non-Proved / Proved Ratio	NP / P	1.5	2.0	0.5	*2.2*	*-0.2*
Exploration Discoveries Percent of Non-Proved Additions	ExD / NP Adds	*n/a*	33%	*n/a*	*30%*	*3%*
Field Extension + Improved Recovery Percent of Non-Proved Additions	FE-IR / NP Adds	*n/a*	33%	*n/a*	*20%*	*13%*
Direct Resource Access Percent of Non-Proved Additions	DRA / NP Adds	*n/a*	34%	*n/a*	*50%*	*-16%*
Exploration Discoveries Percent of Drillout Volumes	ExD / DO	*n/a*	70%	*n/a*	*60%*	*10%*
Prospect Inventory/Drillout Ratio (Years of Cover)	PI / Drillout Volume	5.5	4.0	-1.5	*6.0*	*-2.0*

Presenter's notes: The following few slides are not meant to be read, but rather are illustrations of the key inputs and outputs that I will zoom into later.

Inputs, Controls & Linkages

User Controlled Ratios and Percentages

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Inputs, Controls & Linkages

Production Goal

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Presenter's notes: The overall goal is set in terms of a target BOE production rate at the end of the period.

Inputs, Controls & Linkages

Contribution to NP Resources

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Presenter's notes: The model then provides an estimate of the relative contribution to NP resources from the three sources.

Inputs, Controls & Linkages

Summary

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Presenter's notes: And produces an integrated summary of requirements

Example – Growing Production

- Grow from 100,000 BOEPD to 120,000 BOEPD in 5 years
- Focus on Conventional Exploration
  - 60% of NP additions from Exploration
  - 30% from Existing Fields & 10% from Acquisitions
- Hold R/P at 11 and NP/P at 2
- Drillout conversion to NP – 70%
- Prospect Inventory has 4 years of cover

START Reserves / Production Ratio	11.0
TARGET Reserves / Production Ratio	11.0
START Non-Proved / Proved Ratio	2.0
TARGET Non-Proved / Proved Ratio	2.0
Exploration Discoveries Percent of Non-Proved Additions	60%
Field Extension + Improved Recovery Percent of Non-Proved Additions	30%
Direct Resource Access Percent of Non-Proved Additions	10%
Exploration Discoveries Percent of Drillout Volumes	70%
Prospect Inventory/Drillout Ratio (Years of Cover)	4

Changes over time in

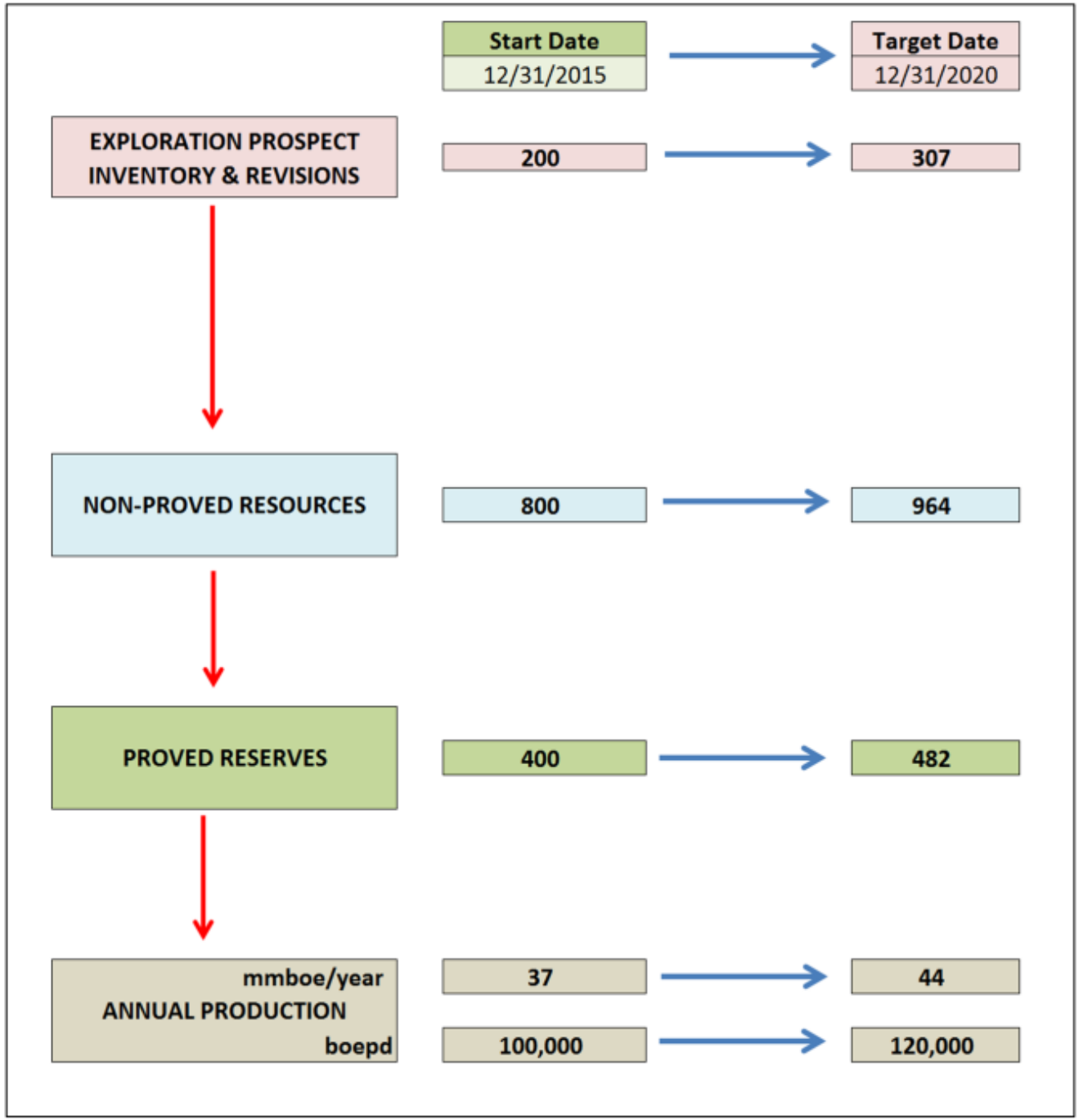
Prospect Inventory

Non-Proved Resources &

Proved Reserves

All Tied to

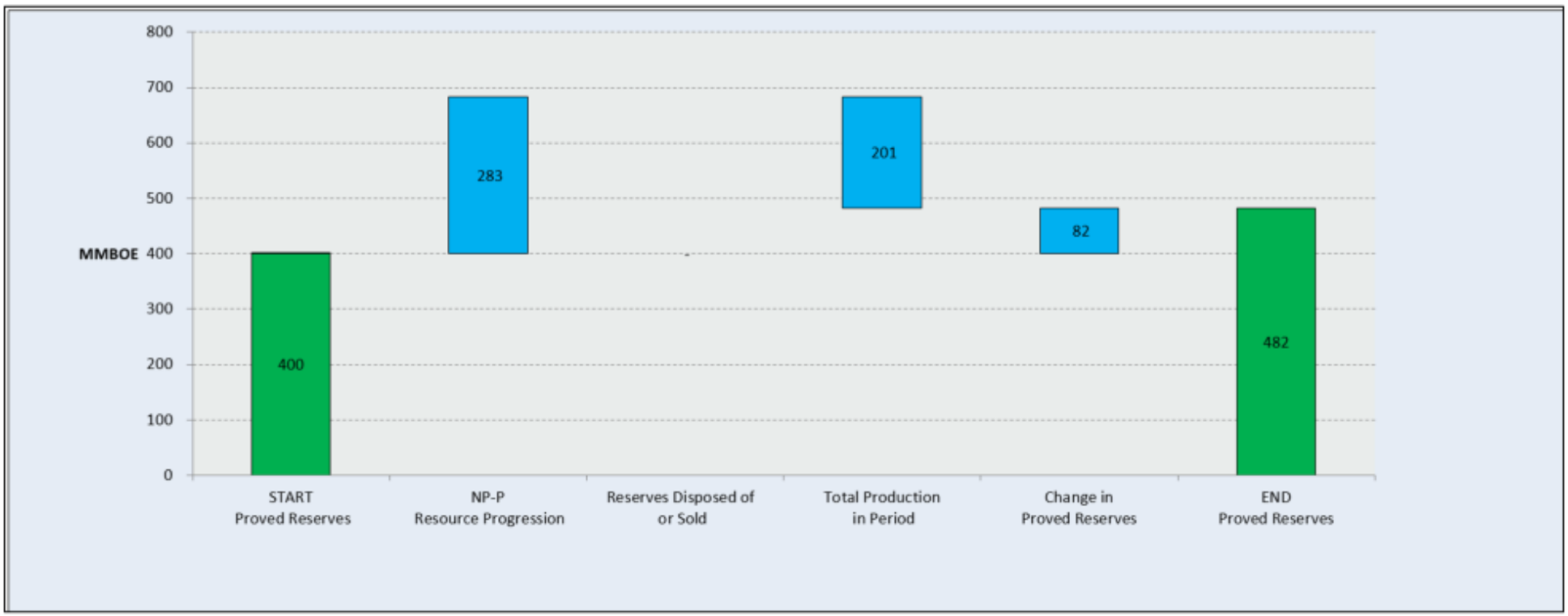
Increasing Production



Presenter's notes: To sustain the increased production of 120,000 BOEPD proved reserves increase to 482mmboe, NP increases to 964mmboe and the PI increase to 307mmboe.

Growth Case

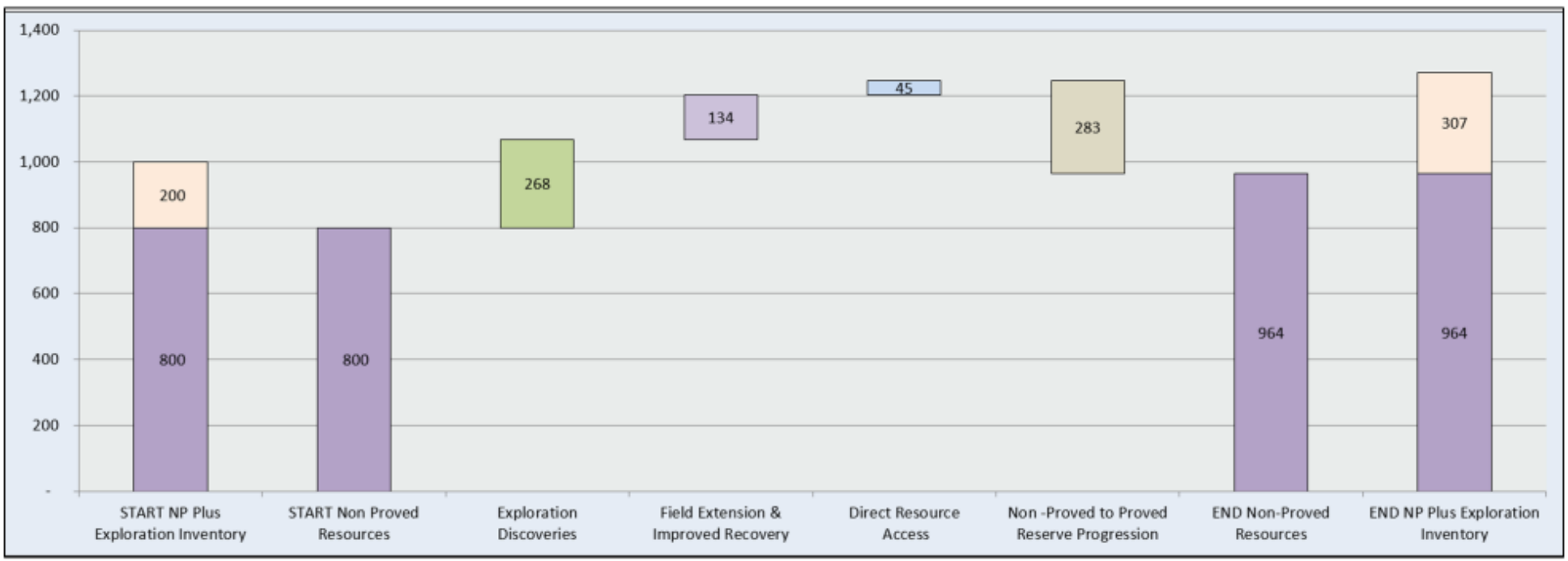
Reserves increase to support increased production



Presenter's notes: Data can be shown as a waterfall diagram for proved reserves.

Growth Case

Non-Proved Resources and Exploration PI increase to support increased Reserves



Presenter's notes: And for the changes in Non-Proved resources and the Prospect Inventory

Explicit Tasks to Support Production Growth
over 5 Years

MY E&P CO		
EVALUATION DATE:	12/16/2015	
Ratio Model for Company Data		
ADD	490	MMBOE to Prospect Inventory
DISCOVER	268	MMBOE by Exploration Drilling
ADD	134	MMBOE by Field Extension / Improved Recovery
ADD	45	MMBOE by Direct Resource Access
PROGRESS	283	MMBOE to Proved Reserves
PRODUCE	201	MMBOE in the Period

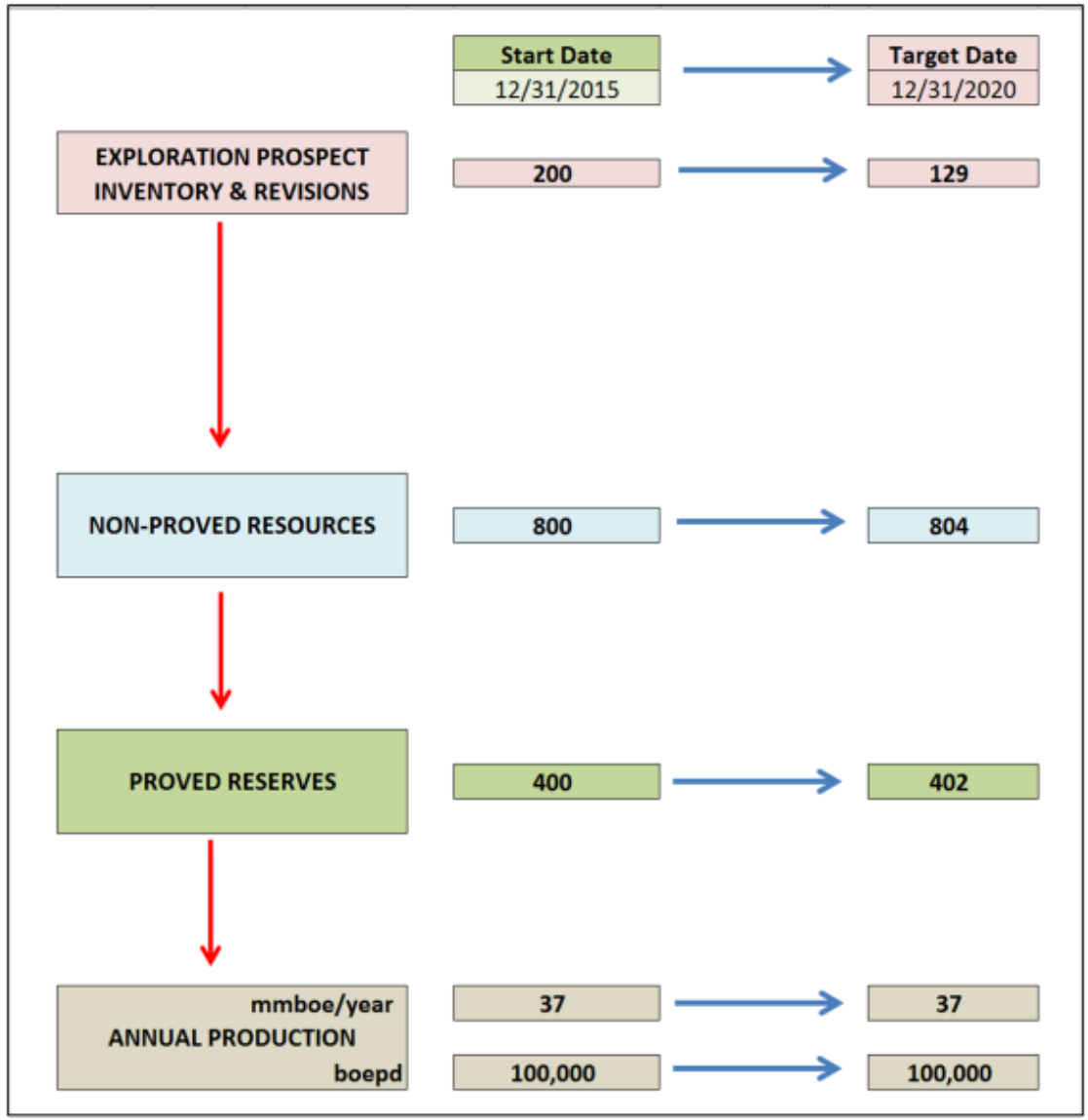
Presenter's notes: Here are the targets that need to be met for this company to grow.

Estimated Costs to Grow Production
over 5 Years

MY E&P CO				
EVALUATION DATE:	12/16/2015			
Ratio Model for Company Data				$MM
ADD	490	MMBOE to Prospect Inventory	for costs of	($735)
DISCOVER	268	MMBOE by Exploration Drilling	for costs of	($805)
ADD	134	MMBOE by Field Extension / Improved Recovery	for costs of	($403)
ADD	45	MMBOE by Direct Resource Access	for costs of	($179)
PROGRESS	283	MMBOE to Proved Reserves	for costs of	($3,396)
PRODUCE	201	MMBOE in the Period	**TOTAL Costs**	**($5,518)**
			memo:- Per Year	**($1,104)**

Presenter's notes: And by plugging in average costs per BOE for each category an estimate of the investment needed can be quickly developed.

What will it take to hold Production Level?



Presenter's notes: An alternative case, holding production level can be easily reviewed. In this case, the Prospect inventory is depleted on a net basis. Other options, such as adjusting the R/P and Non-Proved to Proved ratios, the mix of sources, and the amount of PI cover can be rapidly investigated.

Level Production Case

Significantly Lower Resource Goals & Activity

MY E&P CO		
EVALUATION DATE:	12/16/2015	
Ratio Model for Company Data		
ADD	90	MMBOE to Prospect Inventory
DISCOVER	113	MMBOE by Exploration Drilling
ADD	56	MMBOE by Field Extension / Improved Recovery
ADD	19	MMBOE by Direct Resource Access
PROGRESS	184	MMBOE to Proved Reserves
PRODUCE	183	MMBOE in the Period

Level Production Case

Significantly Lower Costs

MY E&P CO				
EVALUATION DATE:	12/16/2015			
Ratio Model for Company Data				$MM
ADD	90	MMBOE to Prospect Inventory	for costs of	($135)
DISCOVER	113	MMBOE by Exploration Drilling	for costs of	($338)
ADD	56	MMBOE by Field Extension / Improved Recovery	for costs of	($169)
ADD	19	MMBOE by Direct Resource Access	for costs of	($75)
PROGRESS	184	MMBOE to Proved Reserves	for costs of	($2,213)
PRODUCE	183	MMBOE in the Period	**TOTAL Costs**	**($2,930)**
			memo:- Per Year	**($586)**

Summary & Conclusions

- Strategic Goals and strategy shifts affect all aspects of an E&P Company's Plan
- In our business of producing oil and gas, simply holding production level requires considerable effort
- Growing Production and Maintaining Key R/P and NP/P ratios requires significant additional investment above the level production case
- Joined-up planning and alignment between Exploration, Production and M&A departments is essential for successful delivery

Back-Up 1
Exploration Pause Case

- Lower Exploration Activity from Level Case 5YCosts of $523mm ($135mm + $388mm) to ~ $210mm
- Lower Annual Costs by about $92mm per year from $586mm to $494mm
- Hold R/P Constant

Reduced Exploration and Lower Budget Case

Lower Budgets and Constant R/P results in

Depleted Prospect Inventory &

Lower Production at the end of the period