Options Valuation in Unconventional Oil & Gas Wells

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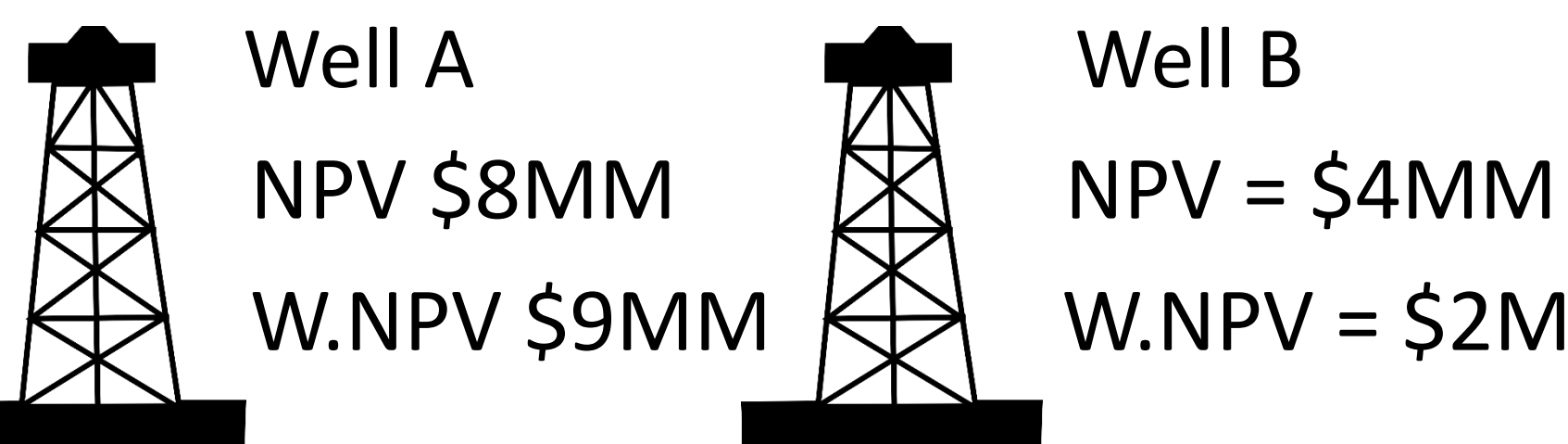
INTRODUCTION

- Unconventional oil and gas wells are valuable parts of a portfolio due to their flexibility.
- Unlike conventional assets, capital commitments can be scaled upwards or downwards according to the market or managerial preferences.
- The value of waiting to drill a well at the optimal time, also known as the option value, must be correctly captured by decision makers. Otherwise, the full value of flexibility in a portfolio will be lost.

2-WELL PLANNING EXAMPLE

- Consider these two wells. Which one should we drill this year?

Well A — NPV = $8MM
Well B — NPV = $4MM
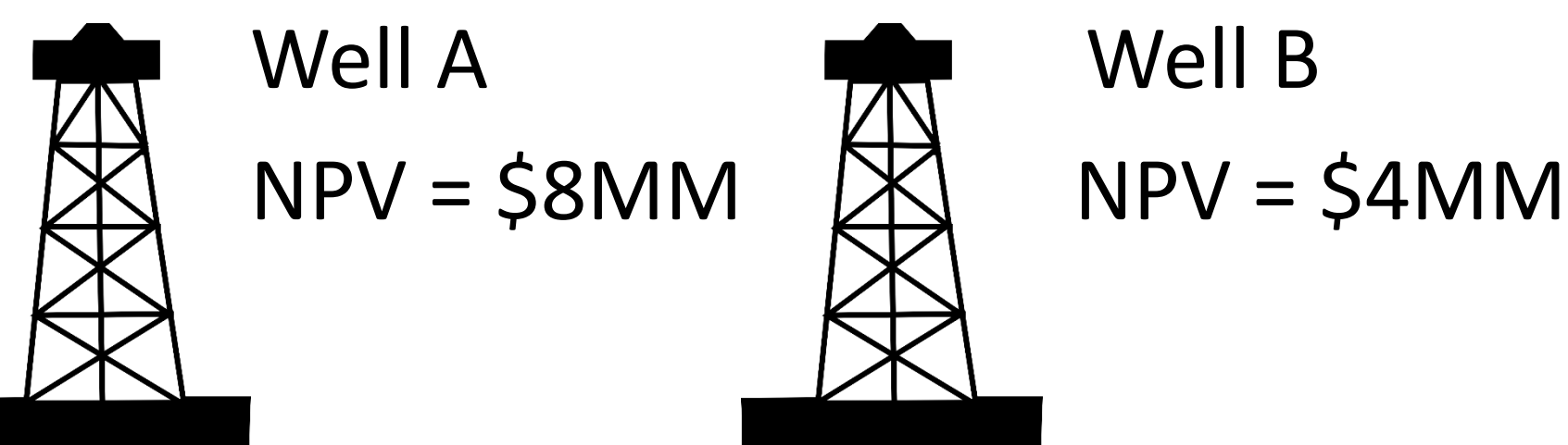
- We should clearly drill A this year and B next year for $11.6 MM.
- But what about option value?

Well A — NPV $8MM — W.NPV $9MM
Well B — NPV = $4MM — W.NPV = $2M

- We should clearly drill B this year and A next year for $13MM.

METHODOLOGY (1/2)

MOTIVATING EXAMPLE

- Consider a well with known production of 4 bbls in year 1, 3 bbls in year 2, 2 bbls in year 3, and 1 bbl in year 4.
- Let this well cost $400 to drill, and have 4 years remaining on its lease.

MODELING PRICE UNCERTAINTY

- Let prices follow a binomial lattice, so at each point they can rise or fall:
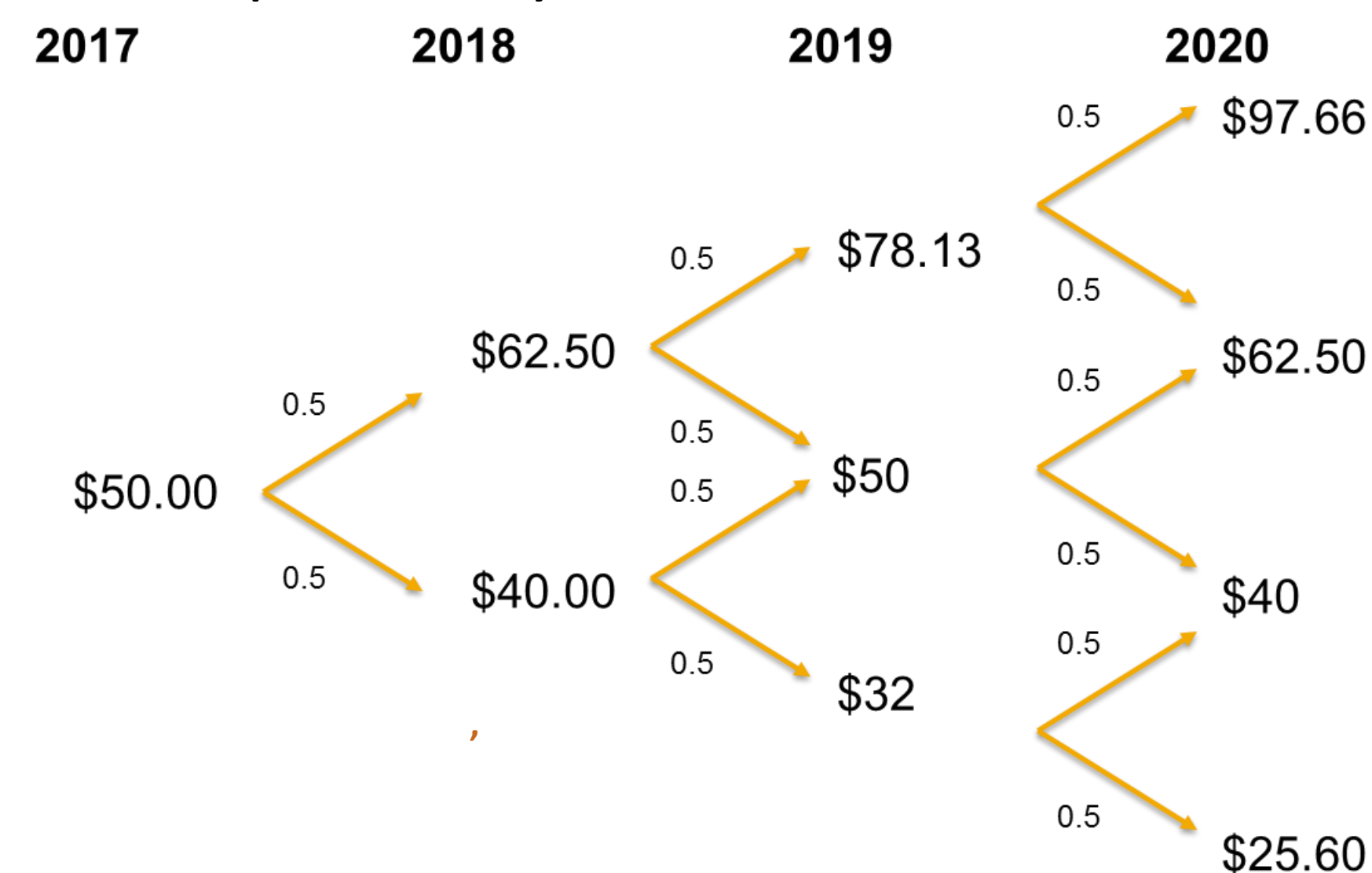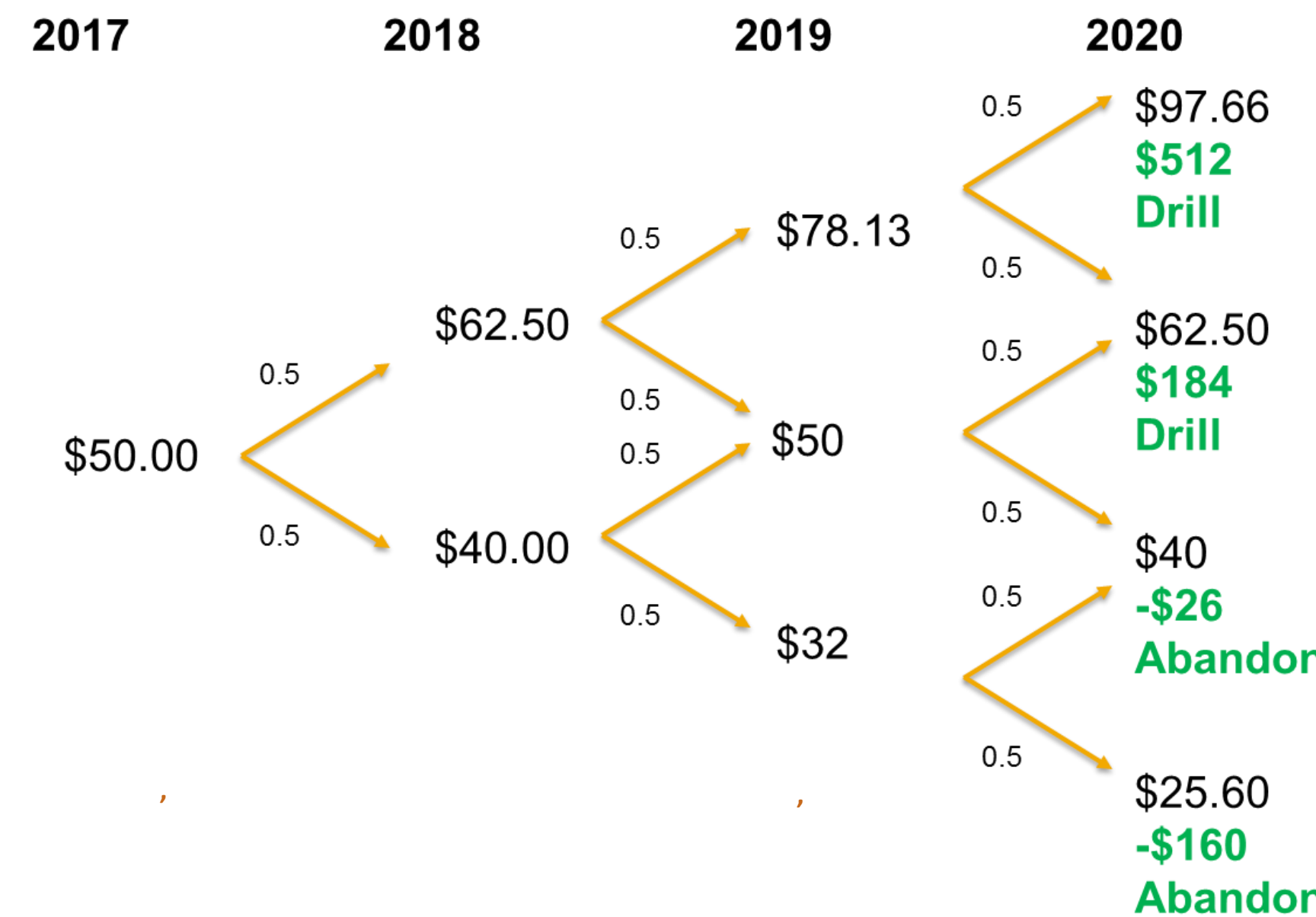

VALUE OF DRILLING NOW

- We can value the well by averaging the NPV over every possible price path.

P	1	2	3	4	NPV
$1/8$	50	62.5	78.13	97.66	173
$1/8$	50	62.5	78.13	62.5	147
$1/8$	50	62.5	50	62.5	100
$1/8$	50	62.5	50	40	83
$1/8$	50	40	50	62.5	39
$1/8$	50	40	50	40	22
$1/8$	50	40	32	40	-8
$1/8$	50	40	32	25.6	-19

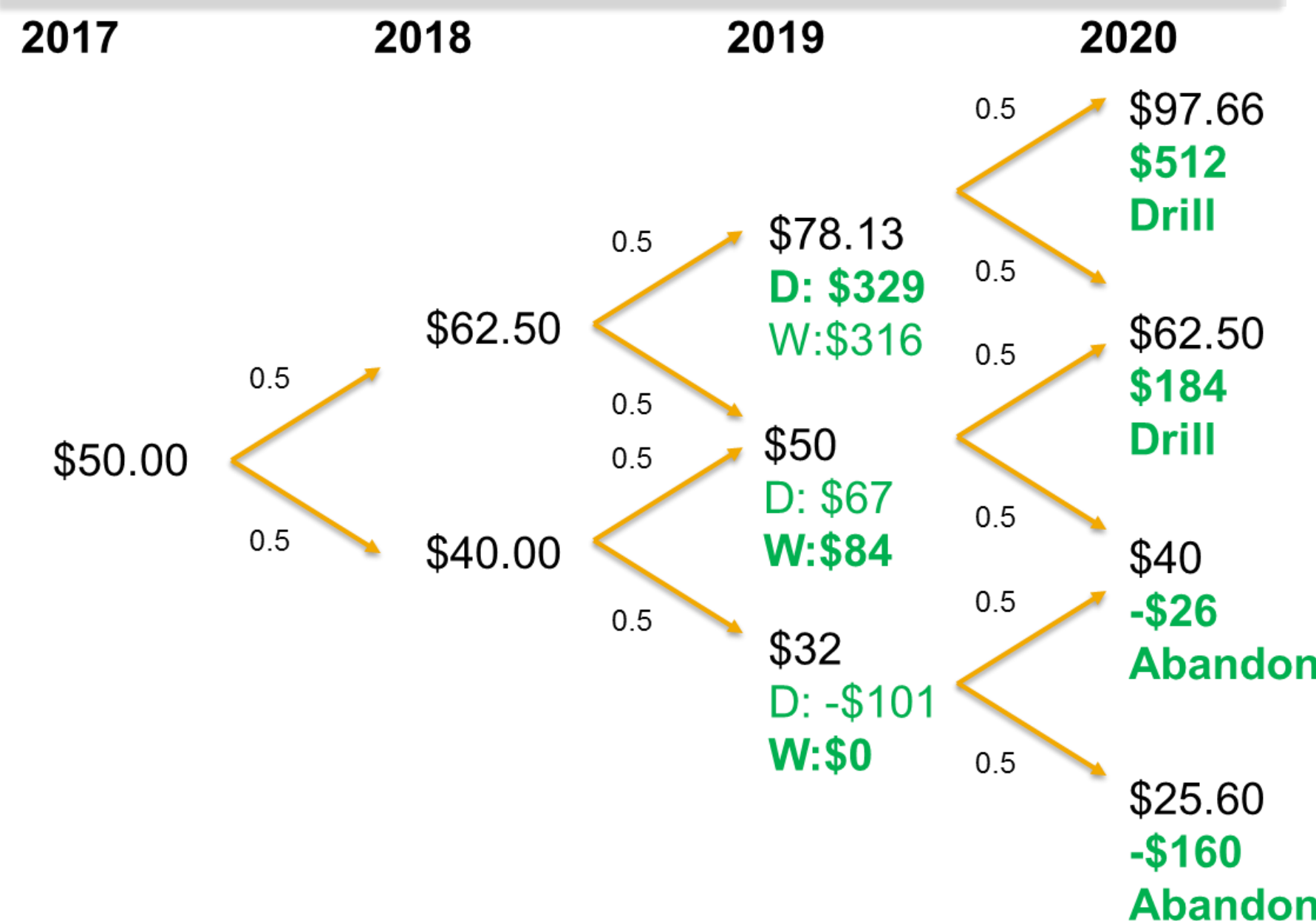*Exp. NPV* $67

METHODOLOGY (2/2)

IN 2020 THE DECISION IS CLEAR

IN 2019 WE COMPARE DRILLING VS. WAITING

WE WORK BACKWARDS TO YEAR 1

Drilling the well now yields an expected NPV of $67, but waiting has an expected NPV of $103!
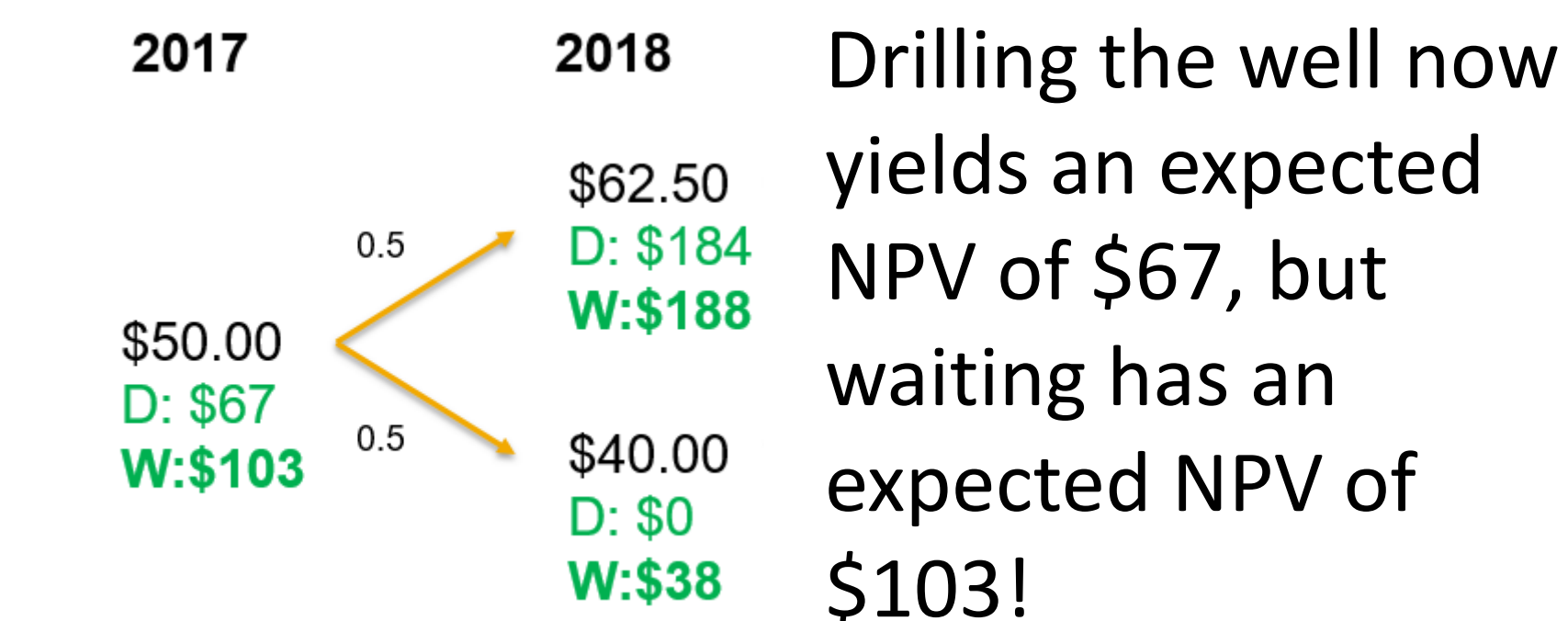
RESULTS

OPTIONS GENERATE SIGNIFICANT VALUE

- In our sample problem, having a 4 year option on a lease increases the project value by 53%
- If exercised optimally, options protect against downside risk and allow managers to fully take advantage of upside risk.
- Uncertainties are a source of value. The better we can understand uncertainties affecting a decision, the more value we can create through optimal decision making.
- Executives across multiple sectors lose billions of dollars in revenue by not fully modeling option values on projects.

ONGOING WORK

1. Optimal Well Scheduling Using Option Valuation:

   In joint work with Statoil, we are looking at optimizing well scheduling in shale oil fields by capturing option values of wells through approximate dynamic programming techniques.

2. Utility Functions in Applied Decision Analysis Projects:

   We are studying when it is appropriate for decision analysts to use different utility functions, with applications from oil and gas.