WATER MANAGEMENT: THE NEXT MIDSTREAM REVOLUTION

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WATER MANAGEMENT FOR UNCONVENTIONAL RESERVOIRS

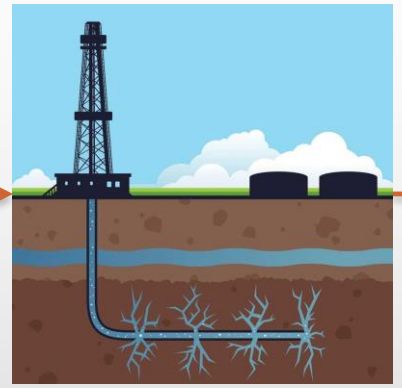
Source(s)

Transfer

Storage

Transfer

Use



Transfer

Transfer

Treatment for Reuse

Injection -Disposal

MARKET EVOLUTION

Natural Gas

Pipeline de-regulation & new end use markets led to Midstream Gas Business

Power

Utility de-regulation & gas fired combined cycle technology led to Independent Power Producers

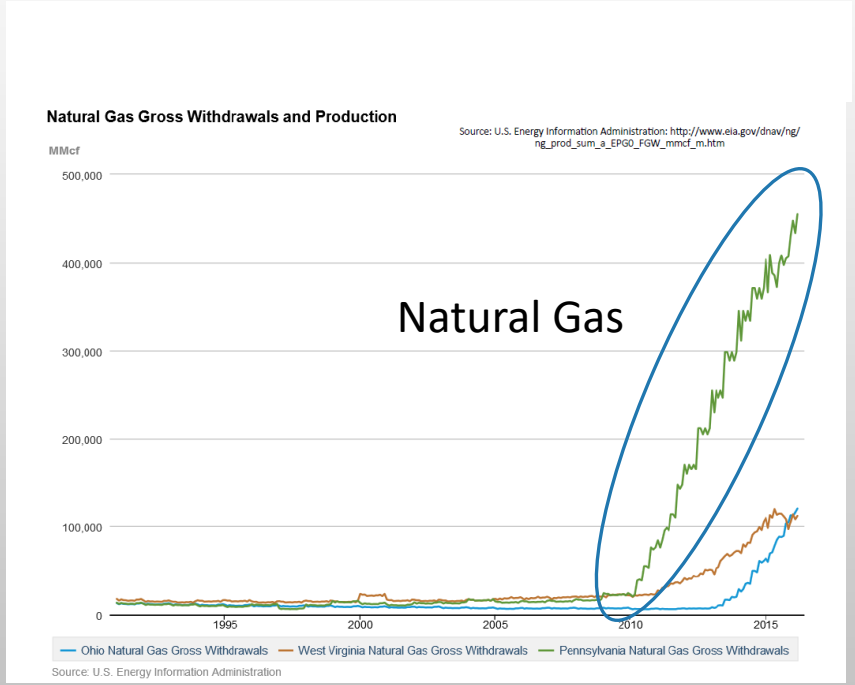
Renewables

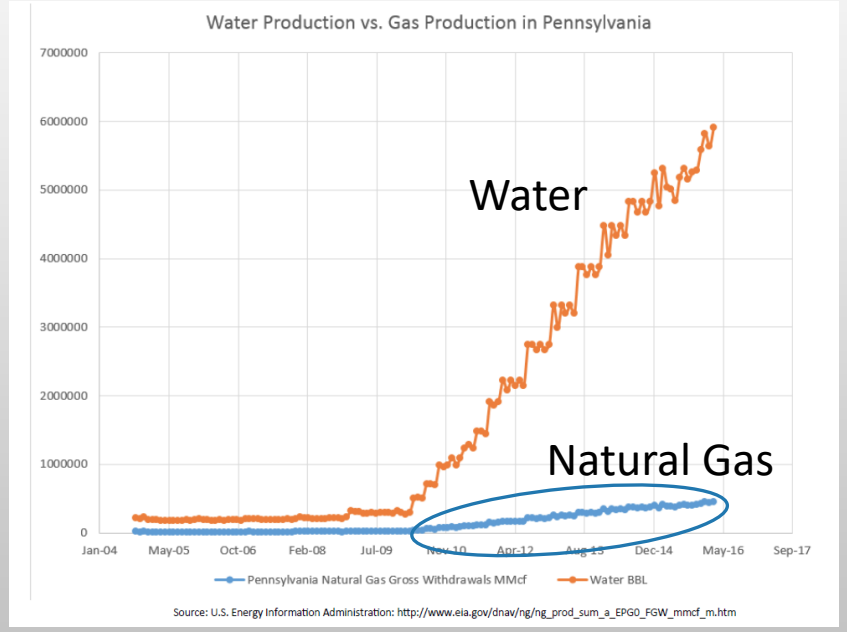
Government incentives & mass scale production led to wind and solar development

Water

The next major market ~~evolution~~ revolution

THE SHALE WATER REVOLUTION





The steep slope of the gas boom in PA, starting in 2009…

… dwarfed by the "water boom"

THE OIL & GAS WATER MARKET

New math for the hydraulic fracturing of shale

WATER IN:

Conventional:	30,000 bbls/well * 1 well = 30,000 bbls
Shale:	500,000 bbls/well * 12 wells = 6,000,000 bbls (*200X increase*)

WATER OUT:

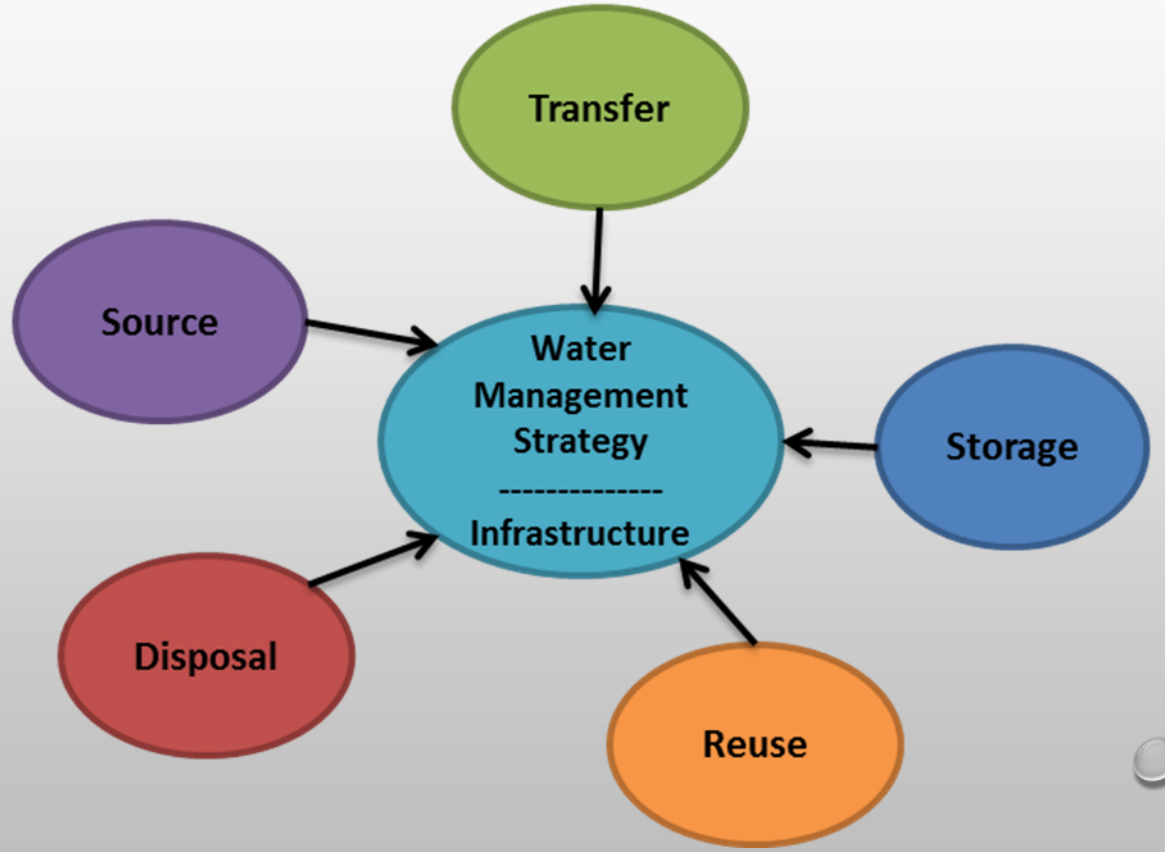
Conventional:	500 bpd/well – 250 bpd/well (waterflood)= 250 bpd
Shale:	4,000 bpd/well * 12 wells = 48,000 bpd (*200X increase*)

- Onshore oil and gas activity in the United States *produces* over **20 Billion barrels** of "produced" water annually (*6X greater than crude oil*)
- Drilling and completions activity *consumes* an additional **2 billion barrels** of "source" water each year
- Nationwide, less than 2% of all produced water is re-used

Estimates: $80 - $100 Billion of investments in the Permian alone

WATER MANAGEMENT STRATEGY = INFRASTRUCTURE

- ALL DECISIONS AROUND WATER MANAGEMENT REVOLVE AROUND INFRASTRUCTURE
- HEAVY INVESTMENT NEEDED TO FIT DEMAND, BUT UTILIZATION IS OFTEN CYCLIC
- SIGNIFICANT OPPORTUNITY FOR MIDSTREAM SOLUTIONS



KEY CONCERNS: REGIONAL CONSTRAINTS, IMPACTS

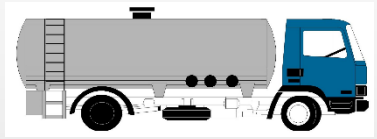
- MARCELLUS
  - SOURCING NOT AS CONSTRAINED, BUT COULD HAVE LOCAL COMPETITION FOR RESOURCE
  - REUSE DRIVEN BY DISPOSAL COSTS AND CONSTRAINTS (REGULATORY)
- BAKKEN
  - SOURCE NOT AS CONSTRAINED, BUT INFRASTRUCTURE LIMITED (CLIMATE)
  - DISPOSAL BECOMING A LOCAL CONCERN IN SOME AREAS, IMPACTING DRILLING COSTS
- EAGLE FORD
  - SOURCING CONSTRAINED BY GROUNDWATER CONSERVATION DISTRICTS
  - DISPOSAL CONCERNS WHERE COMMUNICATION FROM INJECTION ZONE TO PRODUCING ZONE COULD OCCUR
- OKLAHOMA
  - INDUCED SEISMICITY

PERMIAN BASIN

- THE PERMIAN BASIN (DELAWARE, MIDLAND, CENTRAL BASIN PLATFORM) CONSISTS OF STACKED PLAYS WITH MULTIPLE PRODUCTIVE INTERVALS
- WATER SUPPLY, TRANSFER, AND DISPOSAL CAN REPRESENT AN AVERAGE OF OVER 20% OF WELL COMPLETION COSTS
- WATER TO OIL RATIOS ARE TYPICALLY ABOVE 1:1 FOR ALL FORMATIONS ACCESSED FOR PRODUCTION, SO PRODUCED WATER DISPOSAL COST CAN REPRESENT OVER 25% OF LIFTING COSTS
- DURING EXPLORATION AND EARLY DEVELOPMENT, MINIMAL INFRASTRUCTURE IS IN PLACE TO SUPPORT WATER DEMAND FOR COMPLETIONS AND PRODUCED WATER DISPOSAL
- PRODUCED WATER REUSE IN COMPLETIONS COULD MITIGATE BOTH WATER SUPPLY AND PRODUCED WATER DISPOSAL LIMITATIONS

SHALE WATER 1.0: TRUCKING & DISPOSAL

Producer
Well Pad



Producer or 3rd Party
Owned Disposal Well

- Disposal done by producers or outsourced to service companies and local providers
- Pipeline connects and long term commitments were rare as producers were "experimenting" with shale development
- All-in costs $2 - $10+/bbl

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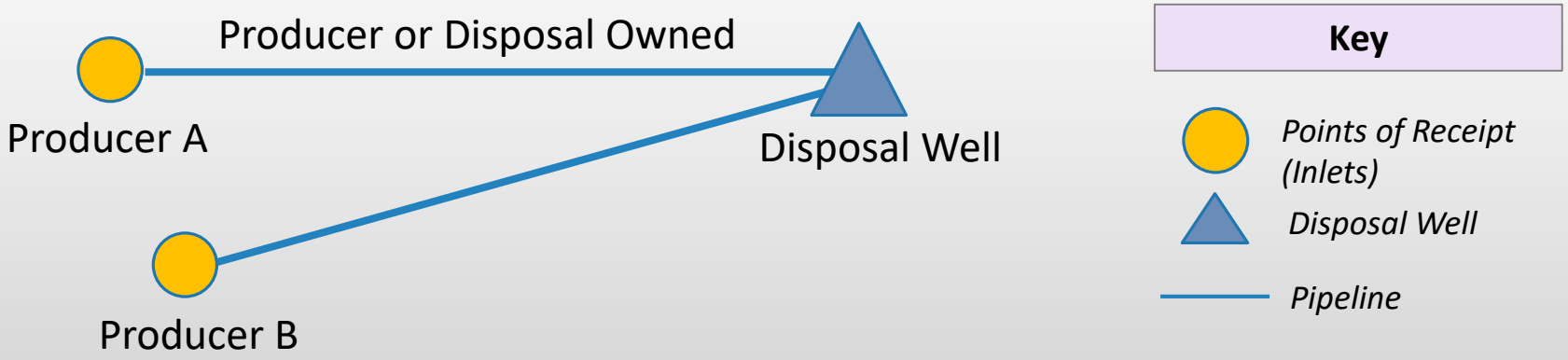
SHALE WATER 2.0: PIPE & DISPOSAL

Multiple gathering lines connected to a single 3rd party disposal well is the forerunner to a traditional midstream water model.



- As water volumes grew and oil prices fell, focus turned from flexibility to cost efficiency
- Strong economics underpin the decision to replace trucks with pipe (costs < $1.00/bbl)
- Some disposal operators are now installing pipe as part of their business models, most pipe is still producer owned

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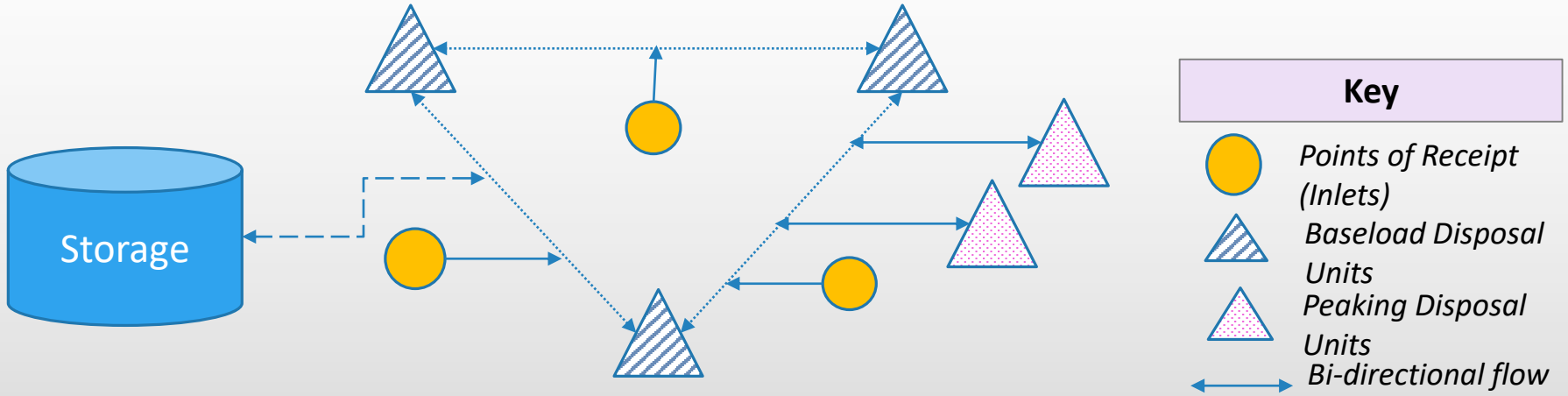
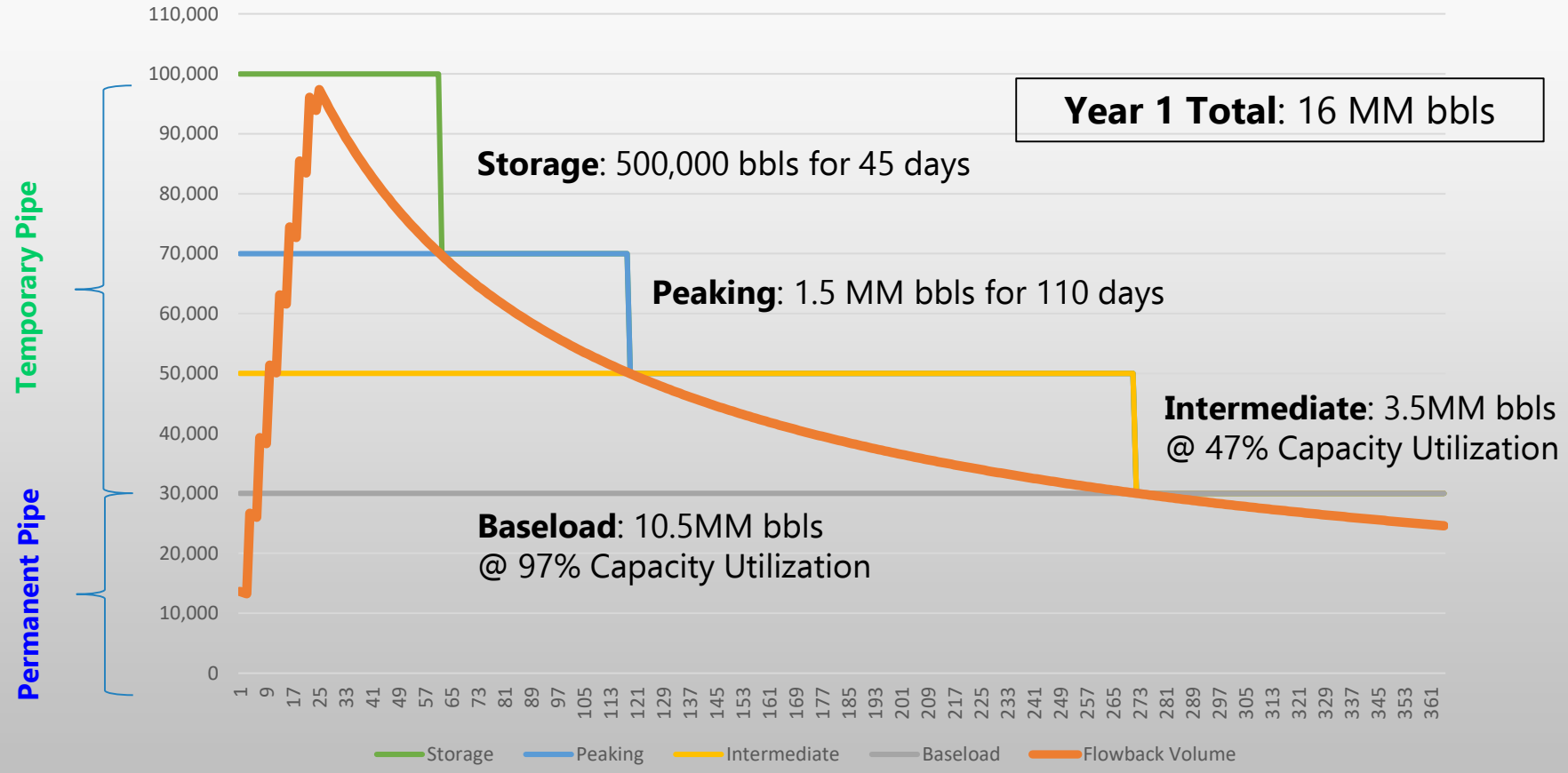
SHALE WATER 3.0: WATER MIDSTREAM



- Multiple producers and disposal wells on an interconnected system can improve capital efficiency and optionality
- Storage enhances system reliability and balances peaks/valley
- An integrated water network allows disposal capacity to be "dispatched" similar to power grid

MANAGING A 25 WELL PAD

(assume 3 wells online every 3 days)



Year 1 Total: 16 MM bbls

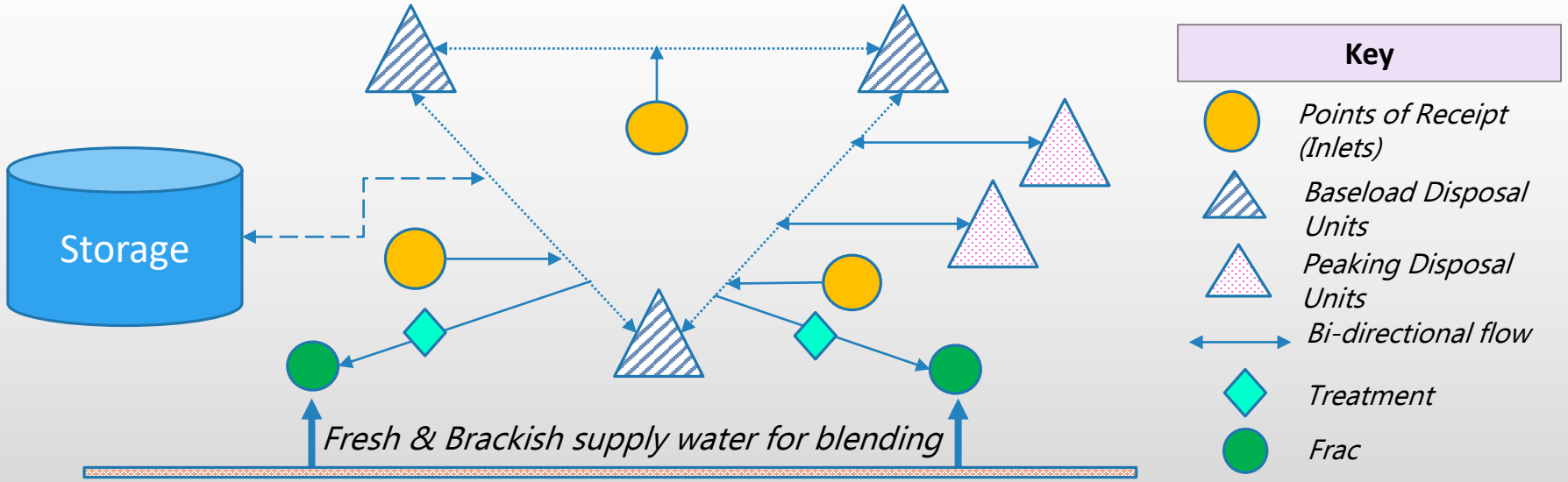
Storage: 500,000 bbls for 45 days

Peaking: 1.5 MM bbls for 110 days

Intermediate: 3.5MM bbls
@ 47% Capacity Utilization

Baseload: 10.5MM bbls
@ 97% Capacity Utilization

SHALE WATER 4.0: INCORPORATING REUSE



- Existing infrastructure can be utilized as a water distribution system (similar to a gas LDC)
- Significant savings can be achieved through reuse, storage, transportation, treatment, and blending services

SAVINGS POTENTIAL FROM RE-USE

Traditional Fresh Water Sourcing

	$/BBL	BBLs	Total Cost
Fresh	$0.55	600,000	$330,000

50/50 Produced Water Blend

	$/BBL	# BBLs	Total Cost
Re-Use Water			
Producer Re-delivery	($0.05)	200,000	($10,000)
Producer Banked	$0.15	50,000	$7,500
3rd Party Make-up	$0.25	50,000	$12,500
Fresh Water	$0.55	300,000	$165,000
Total	**$0.29**	**600,000**	**$175,000**

- Outsourced scenario offers significant savings thru re-use
- Re-use strategy leverages installed produced water infrastructure for transportation, storage, and re-delivery
- In this example, a 50-50 blend of produced and fresh water results in a 45% savings in sourcing costs for each well completed

CRITICAL PRODUCER DECISIONS

1. WATER INFRASTRUCTURE OR TRUCKING & DISPOSAL? ➔ ALL PRODUCERS SHOULD HAVE A WATER MANAGEMENT STRATEGY THAT UTILIZES INFRASTRUCTURE VS. TRUCKING

2. SELF BUILD OR PARTNER? ➔ DEPENDS ON ACREAGE POSITION, SURFACE OWNERSHIP, LEASE AGREEMENTS, EXISTING INFRASTRUCTURE, CAPACITY AND SOURCING LIMITATIONS, DRILLING SCHEDULE, DEVELOPMENT PLAN, ETC.

3. WHICH PARTNER? ➔ WHAT ARE THE PRODUCER'S TOP PRIORITIES? SCHEDULE? PRODUCTION? COST? FLEXIBILITY? WHAT IS THE PRODUCER'S RISK TOLERANCE?

FINAL THOUGHTS

- WATER MUST BE EFFICIENTLY, ECONOMICALLY, AND RESPONSIBLY MANAGED FOR SUSTAINED OIL AND GAS PRODUCTION IN THE PERMIAN BASIN
- INFRASTRUCTURE IS THE KEY TO LEVERAGING OPTIMIZED SOLUTIONS FOR THE FULL LIFE CYCLE OF WATER
- GROWING CONCERN FOR CUMULATIVE IMPACTS OF BOTH SOURCING AND DISPOSAL CAN BE BETTER MANAGED WITH SHARED APPROACHES AND SHARED SYSTEMS
- WATER MANAGEMENT MIDSTREAM IS A GROWING INDUSTRY, WITH INFRASTRUCTURE INVESTMENT EXPECTED TO EXCEED $100 BILLION IN THE PERMIAN ALONE