Artificial Lift
R&D Council

Intelligent Rod Lift System Reduces over 430,000 lbs of CO_2 Emission Per Year,

A Permian Basin Case Study

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Permian Basin Case Study:
ESP/Beam Pump/Intelligent Long-Stroke Unit

Objective

- Measure Electricity Usage and calculate CO_2 emission in three Artificial Lift Methods with the purpose of determining an Energy Conscious approach when Producing High-Rate Oil Wells

Method

- Analyze Similar Permian Wells, utilizing three different forms of Artificial Lift
- Measure Electricity Usage per well*
- Calculate CO_2 emissions from measured electricity consumption using a publicly available CO_2 emissions factor provided by the *International Energy Regulator (IER)*

*All data was measured by the Producer using partially normalized data and verifiable calculations

Assumptions

- Within the United States, making one Kilowatt hour (KW*h) of electricity by using natural gas is equivalent to 0.92 lbs. of CO_2 emission **International Energy Regulator*.
- Specific Assumptions for each form of Artificial Lift to follow

Permian Basin Case Study:
ESP/Beam Pump/Intelligent Long-Stroke Unit

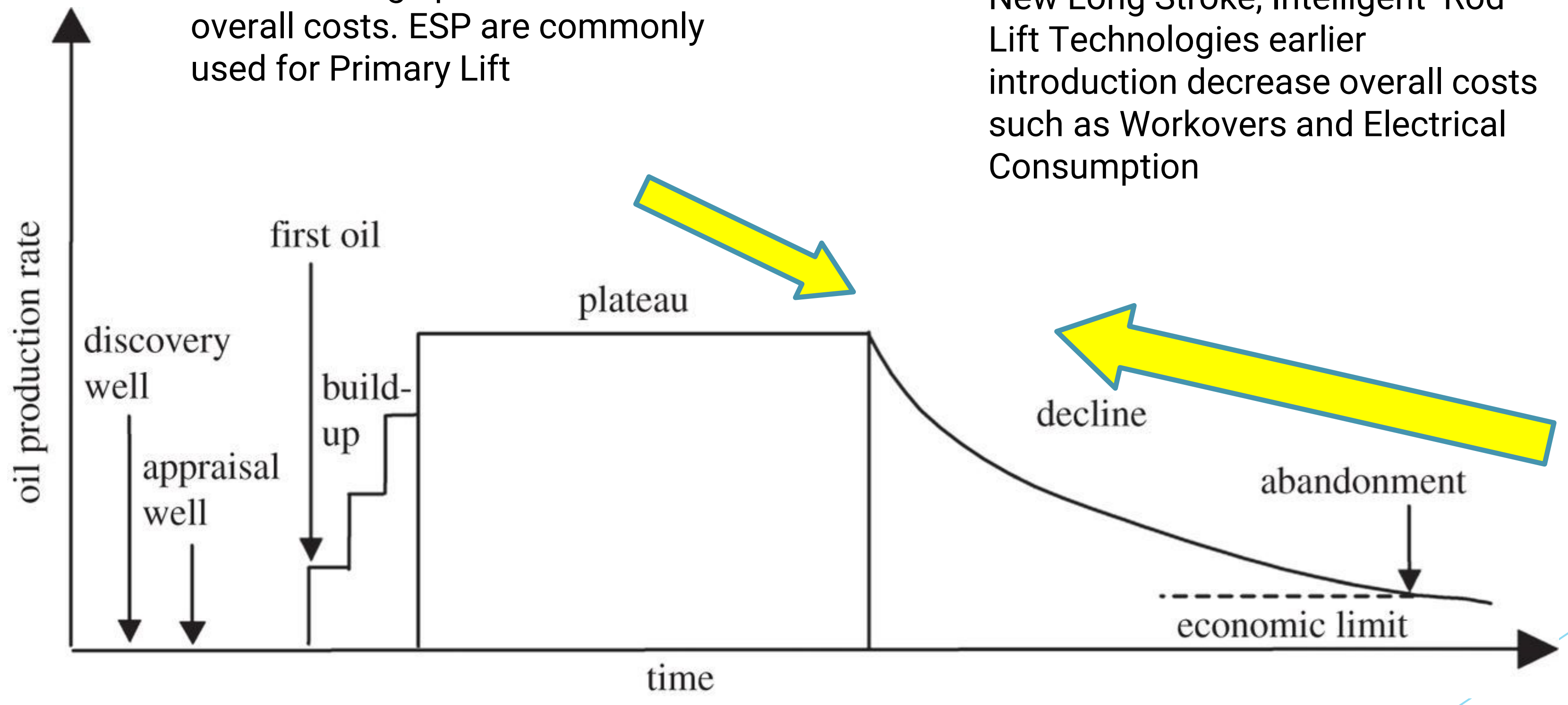
Findings

- Well 1 utilizing the Intelligent Long-Stroke Unit, saw 57% reduction in electricity usage as compared to well 3 in which ESP is running.
- Based on the reduction in electricity usage, 57% reduction in CO_2 emission can be inferred.
- A corresponding reduction of 430,663 lbs (195 tonnes) of CO_2 emission in one year due to less electricity usage is estimated when comparing BFPD produced and KW*H per Barrel.
- Utilizing Rod Lift Earlier in the Well's Life Cycle can Increase Production & Decrease Overall Costs

Artificial Lift Selection Theory

Traditionally, the Selection of the Artificial Method will have a direct bearing upon the well's overall costs. ESP are commonly used for Primary Lift

New Long Stroke, Intelligent Rod Lift Technologies earlier introduction decrease overall costs such as Workovers and Electrical Consumption



Assumptions

ESP

- Common and preferred form of primary Artificial Lift
- Can produce between 100 to 30,000 bbl/day
- High electrical consumption
- Expensive workovers
- Temp and gas can be an issue
- Can be deployed in horizontal section

Intelligent Long Stroke Unit

- Secondary form of Artificial Lift
- Midrange to high production depending on down hole pump and stroke length
- Low electrical consumption
- Moderate speeds to achieve high production
- Long stroke length capabilities
- Reduced workover events due to low speed

Beam Pump

- Commonly used secondary form of Artificial Lift
- Midrange production depending on down hole pump
- Moderate electrical consumption
- High speeds to achieve high production
- Moderate stroke length capabilities

Intelligent Features and Optimization

How Intelligent Features Optimize Operation:

Intelligent Long Stroke Unit had all the following intelligent features built in in its software. This means that a separate pump off controller or a well managing system was not required.

The following intelligent features were active for the study:

1. Upstroke rod sticking control to constantly monitor rod load and If a downhole issue causes a spike in the load anywhere during upstroke, the unit changes the direction of movement to downward and continues to pump with a shorter stroke.
2. Rod hang up and carrier bar separation control to slow the unit down if the load drops below a set point anywhere during downstroke. The unit speeds up again if carrier bar separation disappeared.
3. Casing/Fluid level control was set to slow down the unit in case of Fluid Over Pumping (FOP)
4. Auto Optimization to monitor the Dynacard and to try to make it rectangular as much as possible.

The following intelligent features were inactive for the study:

1. Chemical injection control to turn on and off the chemical injection skid based on the measured load to only inject chemicals when it is needed to save money and energy.
2. Rod Stretch control to pause the pumping unit at the bottom of every stroke and let the rod to relax before starting the next up stroke.

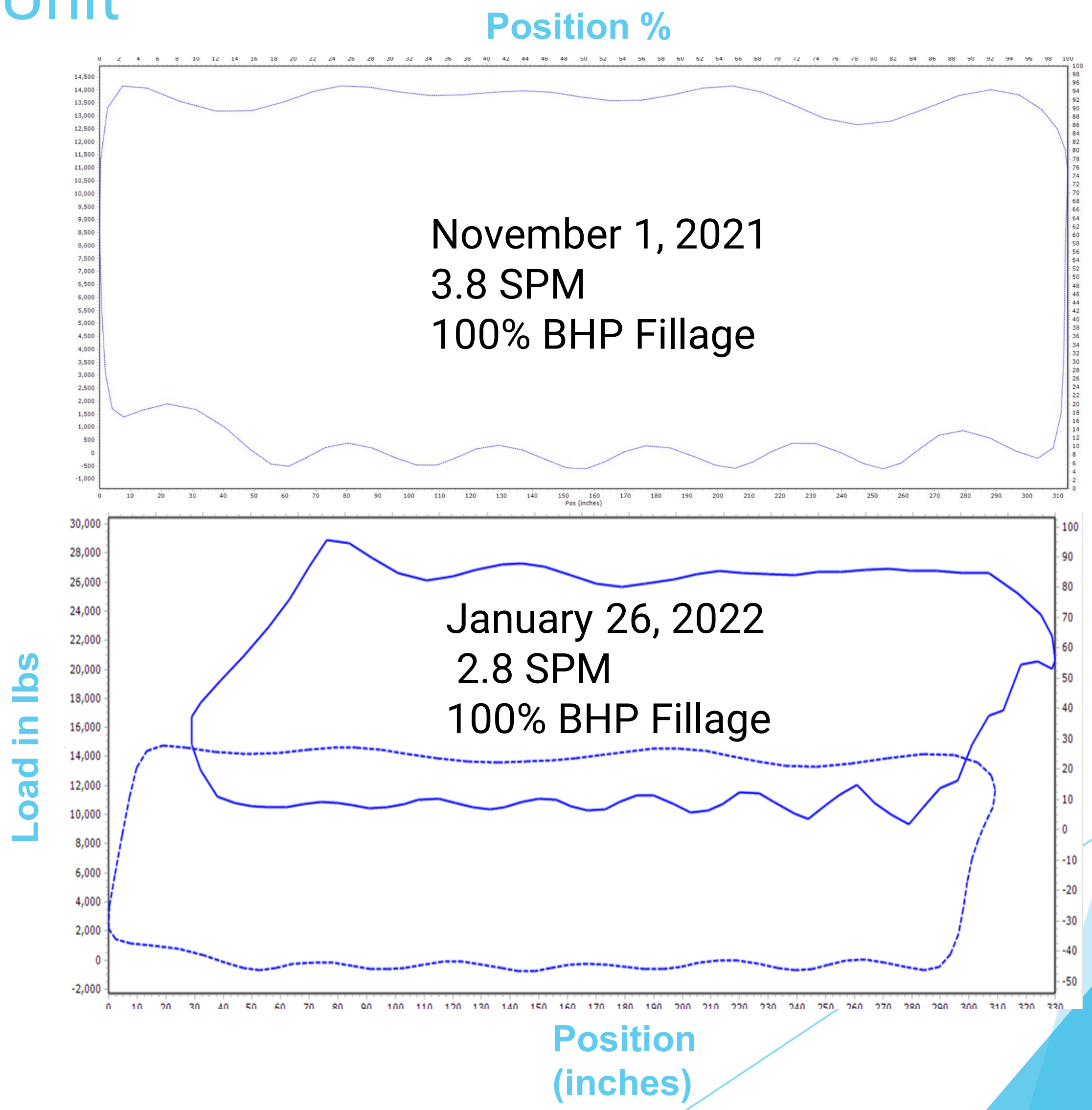
Comparative Well Data

Well Location	**Well 1** Intelligent Long-Stroke Unit	**Well 2** Traditional Pumpjack
Pumping Unit	SSi-400-200-336	C912-365-192
Well Depth (m)	4717	4686
Bore Size (in)	2.75	2.25
Stroke Length (in)	336	192
Surface Max Load (lbs)	30155	21944
Max Load (% of Rating)	75.39%	60.12%
Surface Min Load (lbs)	6985	6074
Average Pumping Speed (SPM)	3.8	4.8
No of daily cycles	5472	6912
Estimated # of Months to rod failure	121.8	96.5
In-balance Max Torque (m in-lbs)	N/A	799.0
In-balance Gearbox Load	N/A	87.61%
Production rate (BFPD)	750	400

Well 1– Dynacard

Intelligent Long Stroke Unit

- Total produced fluids with Rod Lift avg 750 BFPD
- Auto Optimization on every stroke
- Long Slow Strokes allows gravitational gas separation
- Faster Upstroke, slower downstroke provides full pump fillage
- Uptime in excess of 99.8%
- Increased longevity of downhole equipment due to longer stroke and slower speed



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Findings Summary

Well	Model	Average Production	PPRL (lbs)	Bore Size (in)	Electricity Consumption (KW*H/day)	Electricity Consumption (KW*H/bbl)	CO_2 Emission (lbs/bbl)
Well 1	**SSi 400LS**	750 BFPD	30155	2.75	975	1.30	1.196
Well 2	**C912**	400 BFPD	21944	2.25	462	1.16	1.058
Well 3	**ESP 1750**	800 BFPD	N.A	N.A	2410	3.01	2.769

*The electrical consumption was measured by the Producer at each well location.
*The overall efficiency of pump and motor excluding cable losses for ESP 1750 is 43% for 800 BFPD while the max. possible is 59%.
* Within the United States, making one Kilowatt hour (KW*h) of electricity by using natural gas is equivalent to 0.92 lbs. of CO_2 emission. **International Energy Regulator*

Findings

- Well 1 utilizing the Intelligent Long-Stroke Unit, saw 57% reduction in electricity usage compared to the ESP well on well 3. Therefore, 57% reduction in CO_2 emission can be inferred.
- A corresponding reduction of 430,663 lbs (195 tonnes) of CO_2 emission in one year due to less electricity usage is estimated when comparing BFPD produced and KW*H per Barrel.
- Utilizing Rod Lift earlier in the well's life cycle can increase production & decrease overall costs.
- Comparing Intelligent Long Stroke Unit with Beam Pump, equal energy consumption can be seen while PPRL is 40% more in Intelligent Long Stroke Unit, bore size is larger and production is almost doubled.

Thank You!

Questions?

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