



Statoil

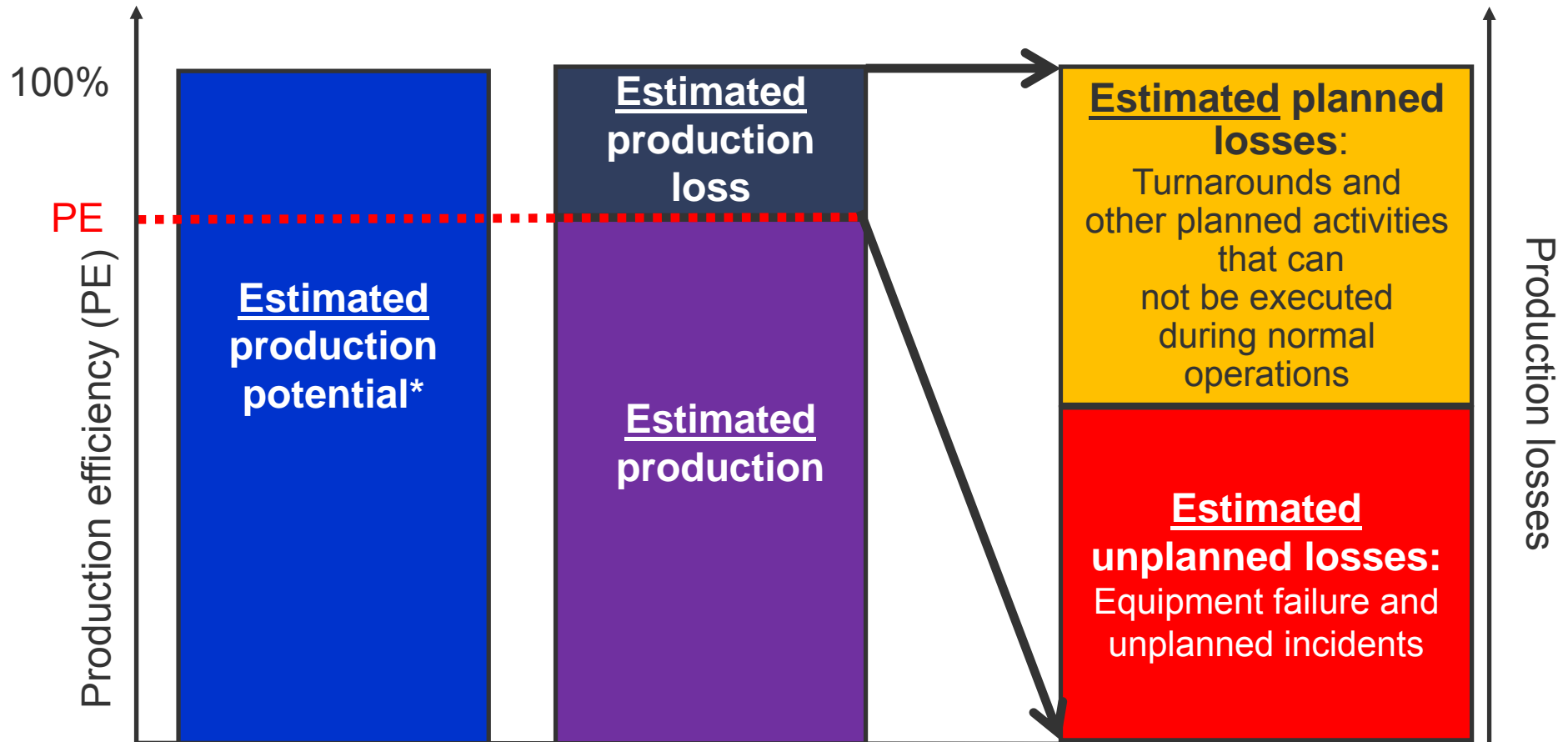
# Improving pre-operational production efficiency estimates

ESRA seminar – 28<sup>th</sup> January 2015

Classification: Internal

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# Production efficiency (PE)



*Statoil (pre – operational phases):*

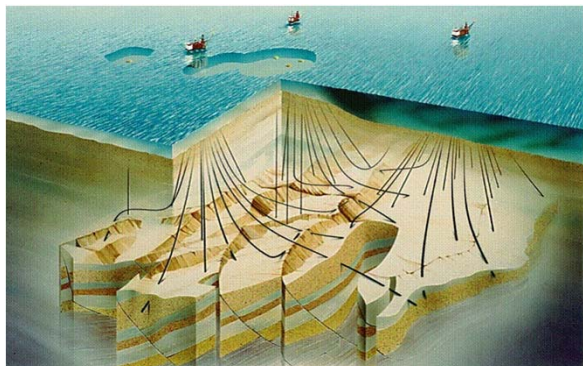
$$\text{Production efficiency} = \frac{\text{estimated production}}{\text{estimated production potential}}$$

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*ISO20815 Production assurance and reliability management:*

$$\text{Production availability} = \frac{\text{production}}{\text{planned production}}$$

# Production efficiency (PE) through the value chain

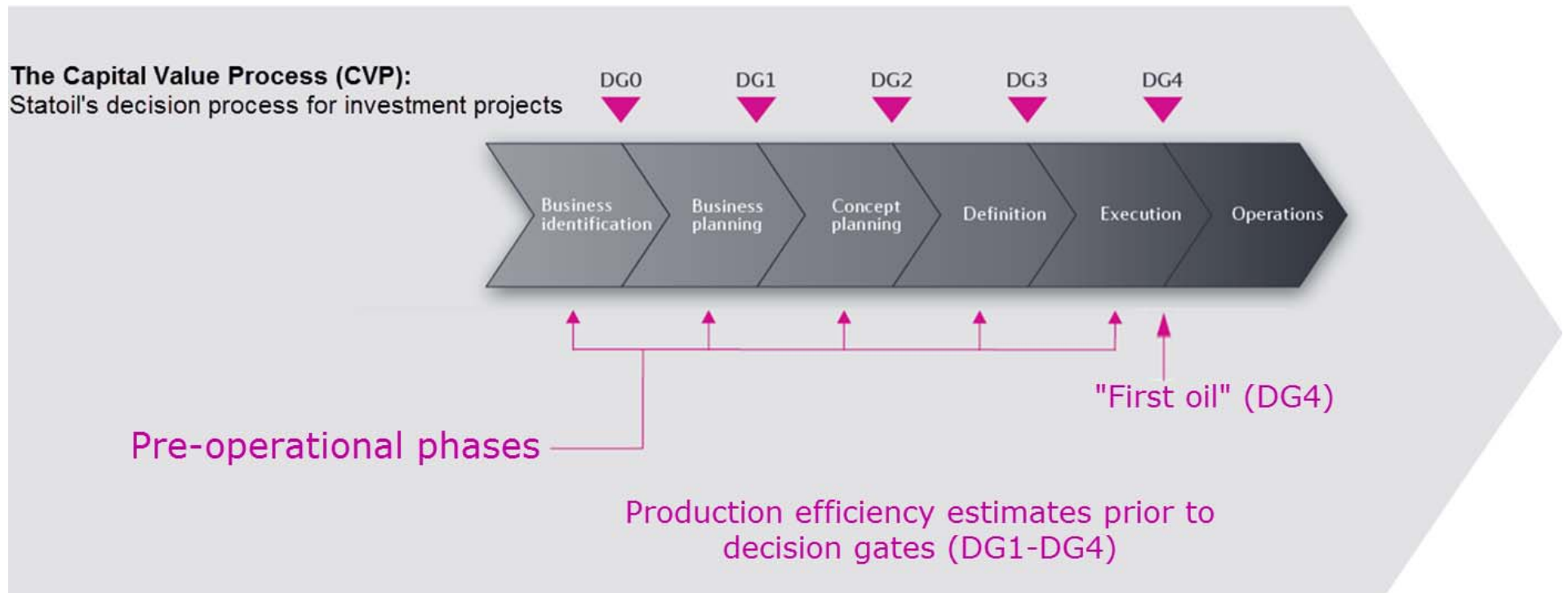


Reservoir/well-work	Plant	Export
Well-work, test of safety barriers, heavy-lift operations, sand and scale, well integrity issues	Mandatory inspections, modifications, tie-in of new fields, maintenance, projects, equipment failures, human error	Unavailable pipeline or installation/terminal downstream

Production loss group
1. Well equipment/activities
2. Subsea equipment/activities
3. Process plant equipment/activities
4. Turn around
5. Export
6. Others

- Each loss group has a breakdown of various loss categories.
- Production losses shall be registered and causes assigned in accordance to these categories.

# Production efficiency estimates during the pre-operational phases



*PE estimates are especially important for concept selection (DG2) and investment decision (DG3)*

# Production attainment – importance of PE estimates

## Observation throughout the whole oil and gas industry (IPA):

Achieved production first period deviates substantially from the production forecast at the point of decision. This has a high negative impact on net present value of oil & gas projects ([Link to article from IPA](#)).

$$\text{Production Attainment} = \frac{\text{Actual Production}}{\text{Production Planned at Sanction}}$$

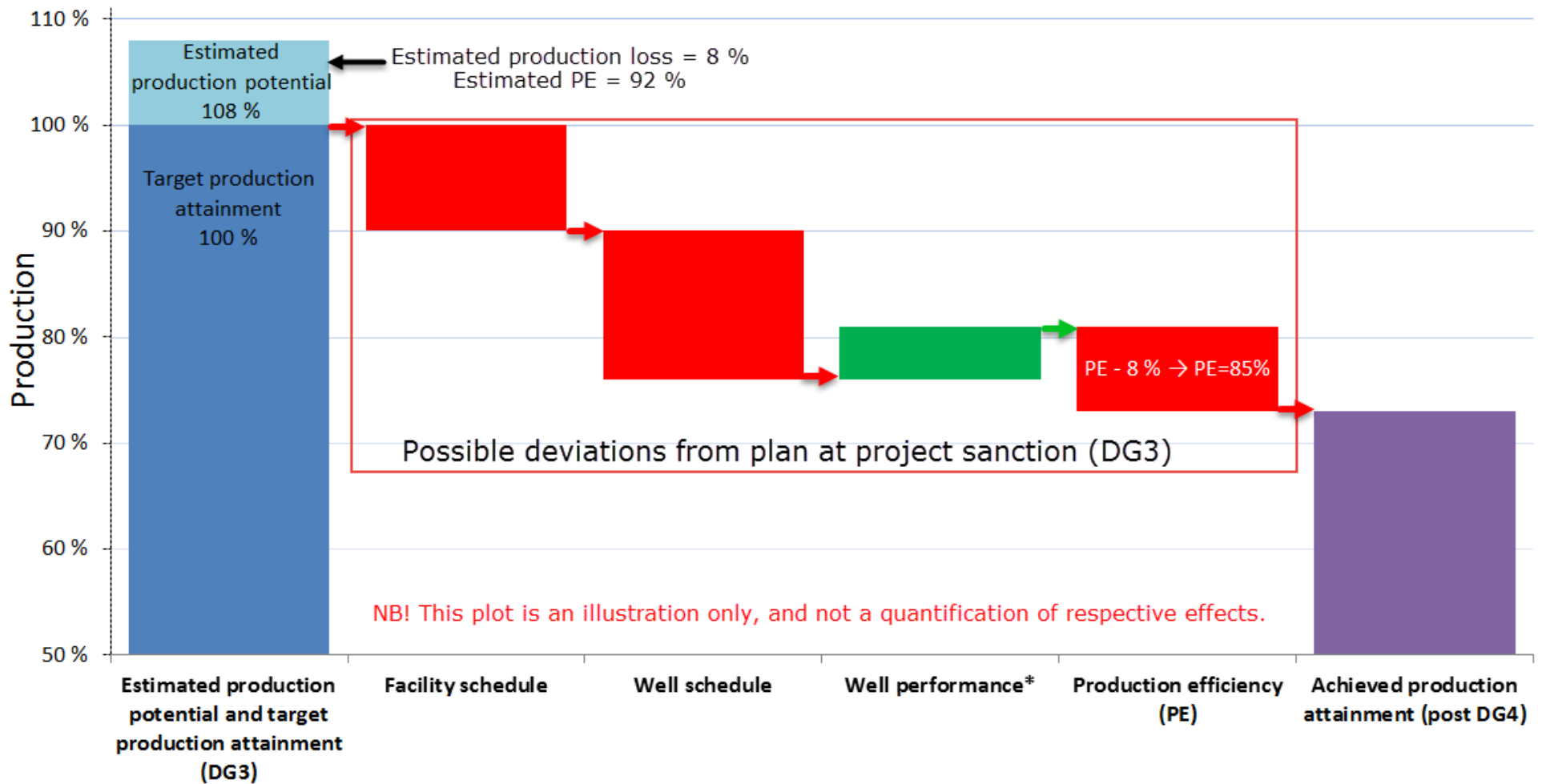
Source: IPA - Independent Project Analysis

Project sanction is at Statoil's decision gate 3 (DG3) when plan for development and production (PUD) is handed over to the Norwegian authorities.

Production efficiency estimates are one of several input parameters for the production profiles (i.e. production planned at sanction).

\* Start- and end-date should be explicitly stated

# Factors affecting production attainment

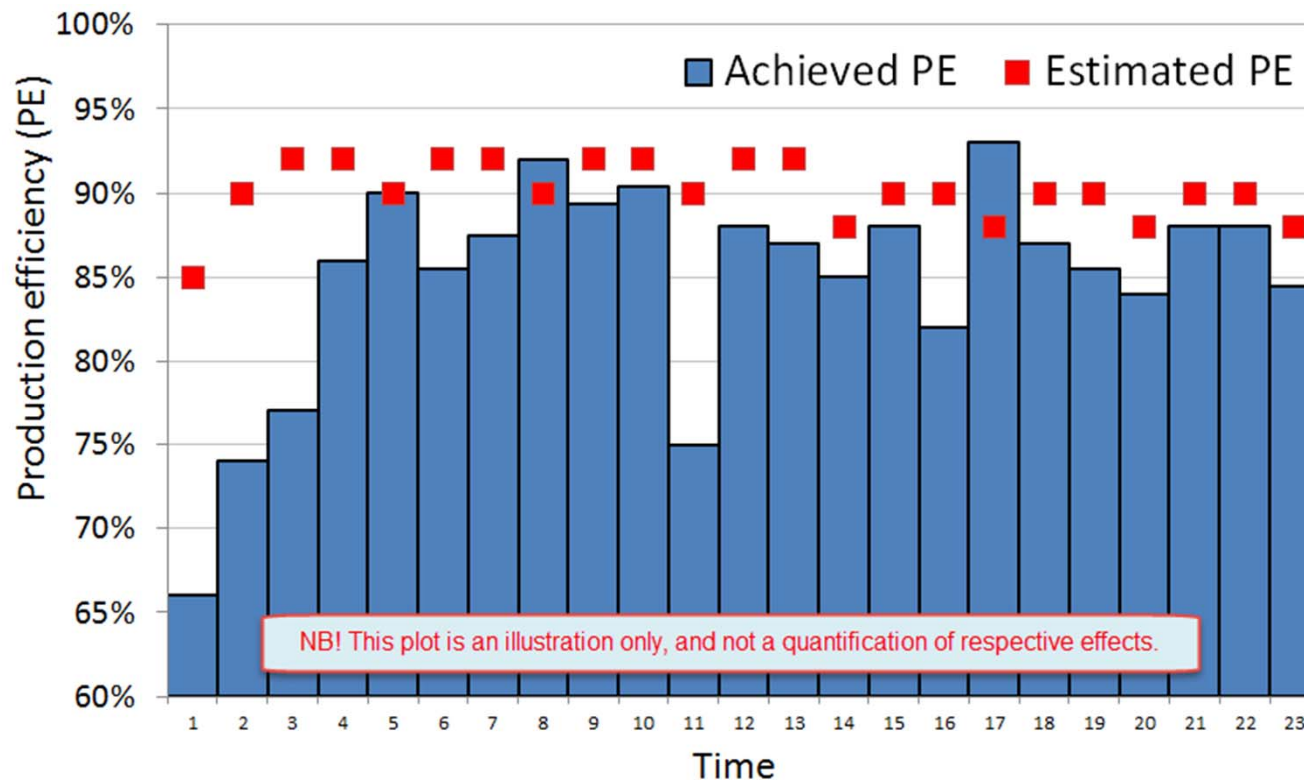


\*Well performance is a function of reservoir performance, well- design and completion

# Shortcomings of pre-operational PE estimates

1. Deviation between estimated PE and achieved PE
2. Impact of start-up issues
3. Use of time varying PE estimates
4. Uncertainty range for PE estimates

# Shortcoming 1: Deviation between estimated PE and achieved PE

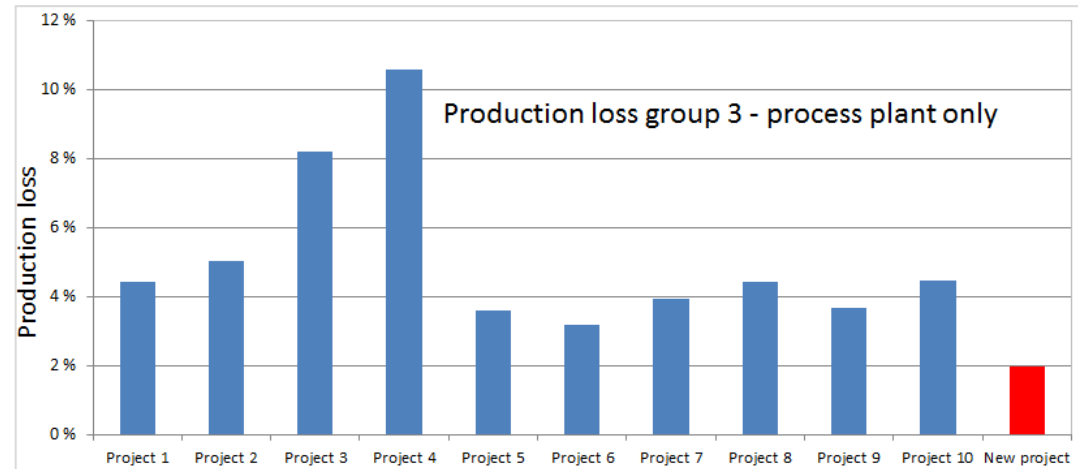


*Achieved PE during operations are generally lower than the PE estimates predicted at project sanction*



# Improvement measure(s) 1

Loss group	Loss category
1. Well equipment/activities	1.1 Planned activities on well equipment
	1.2 Well tests
	1.3 Operational problems for well equipment
	1.4 Equipment failure and unplanned activities for well equipment
	1.5 Lack of competence/handling failures for well equipment
	1.6 Well operations to maintain/increase production
2. Equipment/activities between well and process plant (e.g. subsea installation)	2.1 Planned activities for equipment between well and process plant
	2.2 Operational problems caused by modification projects between well and process plant
	2.3 Operational problems for equipment between well and process plant
	2.4 Equipment failure and unplanned activities for equipment between well and process plant
	2.5 Lack of competence / errors for equipment between well and process plant
	2.6 Modification projects for equipment between well and process plant
3. Process plant equipment/activities	3.1 Planned activities for process plant
	3.2 Operational problems caused by the modification of projects
	3.3 Process / operational problems
	3.4 Equipment failures and unplanned activities
	3.5 Lack of expertise/ errors committed
	3.6 Modification projects
4. Turnarounds	4.1 Planned turnaround
	4.2 Extended turnaround
5. Export	5.1 Equipment failure and unplanned activities at other plants
	5.2 Planned activities at the export terminal
	5.3 Equipment failure and unplanned activities at export terminal
	5.4 Unavailability of tanker and loading operations
	5.5 Unavailable export pipeline
	5.6 Reduced gas demand
6. Others	5.7 Planned activities on other plants
	6.1 Authority-imposed reductions
	6.2 Strike/lock-out
	6.3 Weather problems
	6.4 Safety/ emergency preparedness requirement
	6.5 Others
6.6 External power supply	

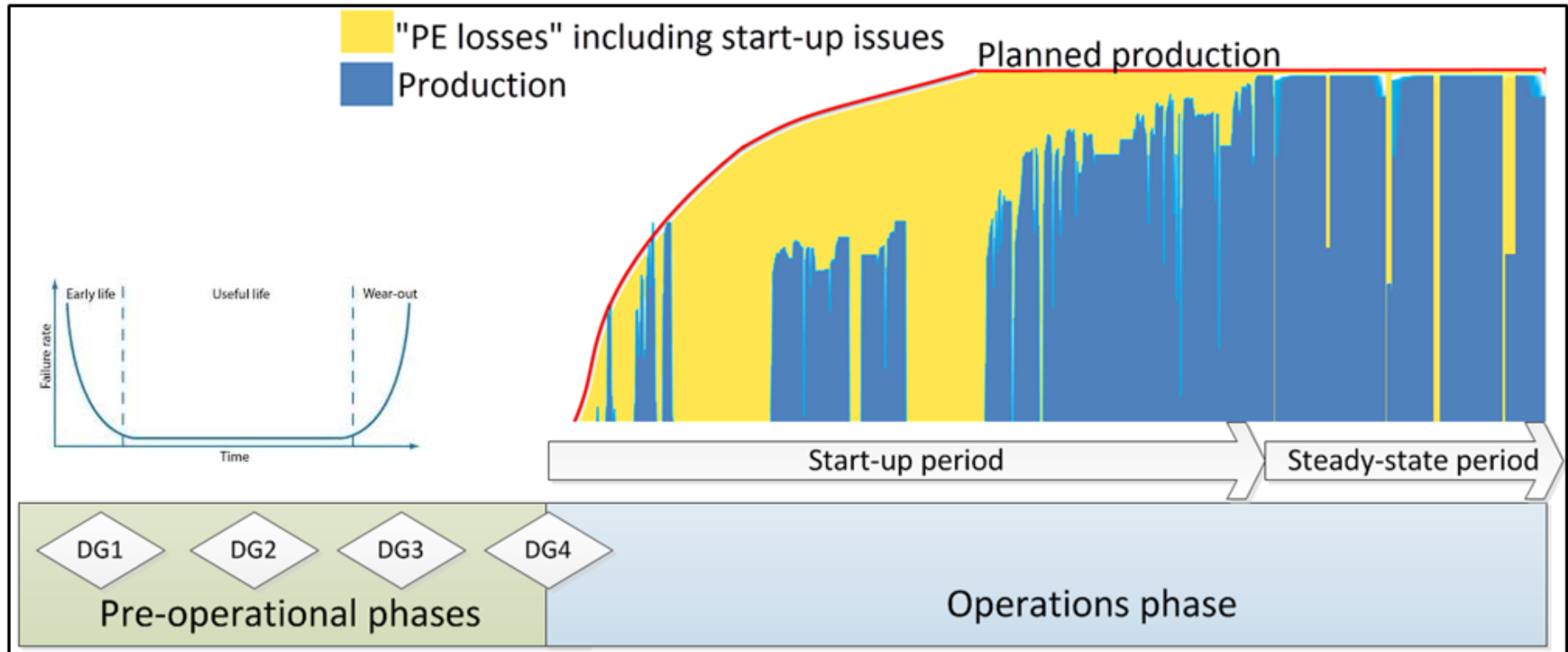


Check and adjust PE estimates by utilising benchmark from operating fields

Evaluate all relevant production loss groups and belonging loss categories

*A «standard» approach “RAM” simulation model is often limited to include common equipment failures and some planned activities*

# Shortcoming 2: Impact of start-up issues



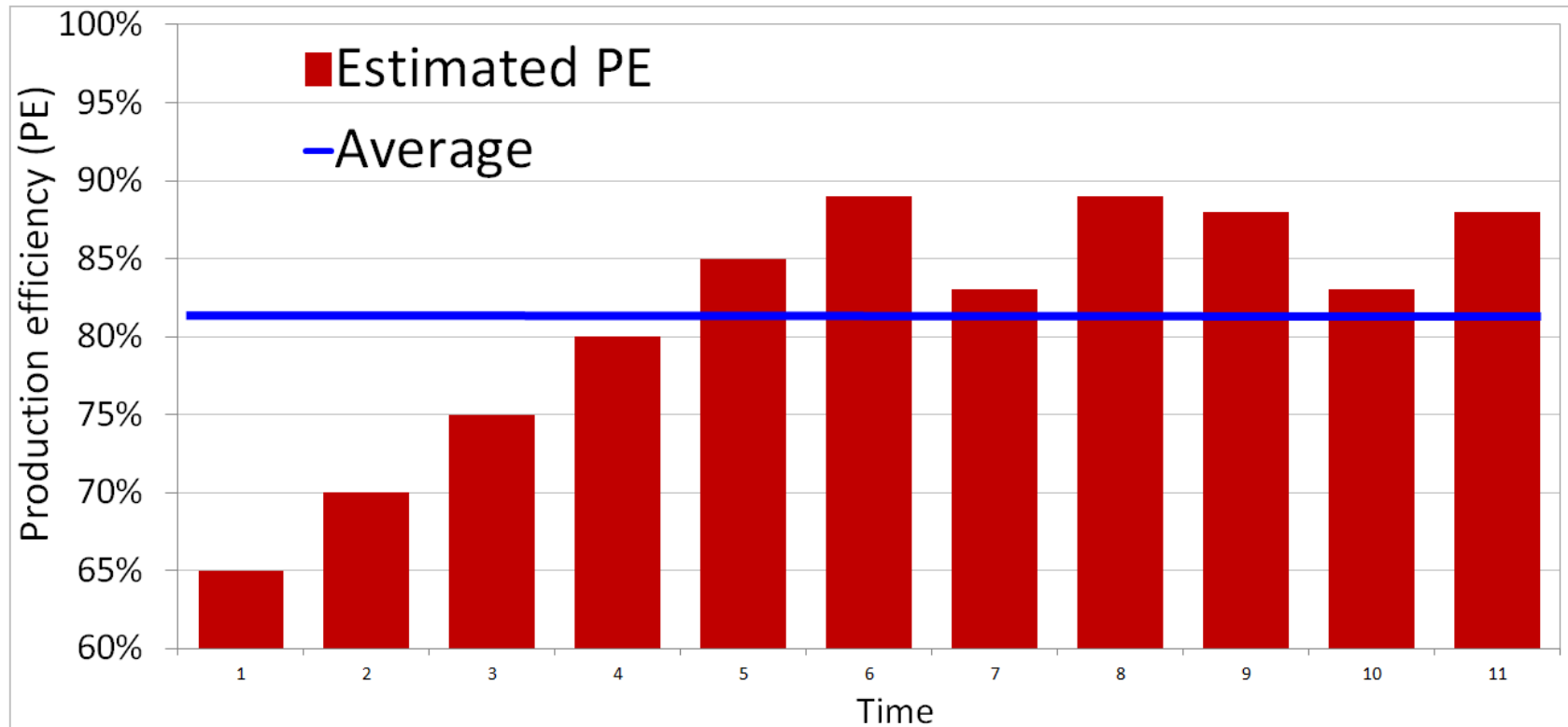
## Improvement measure 2: Include impact of start-up issues

- **Parameters to be defined base on a review of project specific characteristics and benchmarking from comparable fields:**
  - Duration of the start-up period
  - Magnitude of start-up issues on production efficiency

Time period from production start-up	Additional production loss due to start-up issues (reduced PE)		
	Low	Expected	High
0 – 6 months	5 %	15 %	35 %
7 – 12 months	2 %	10 %	30 %
13 – 24 months	1 %	5 %	20 %
> 24 months	0 %		

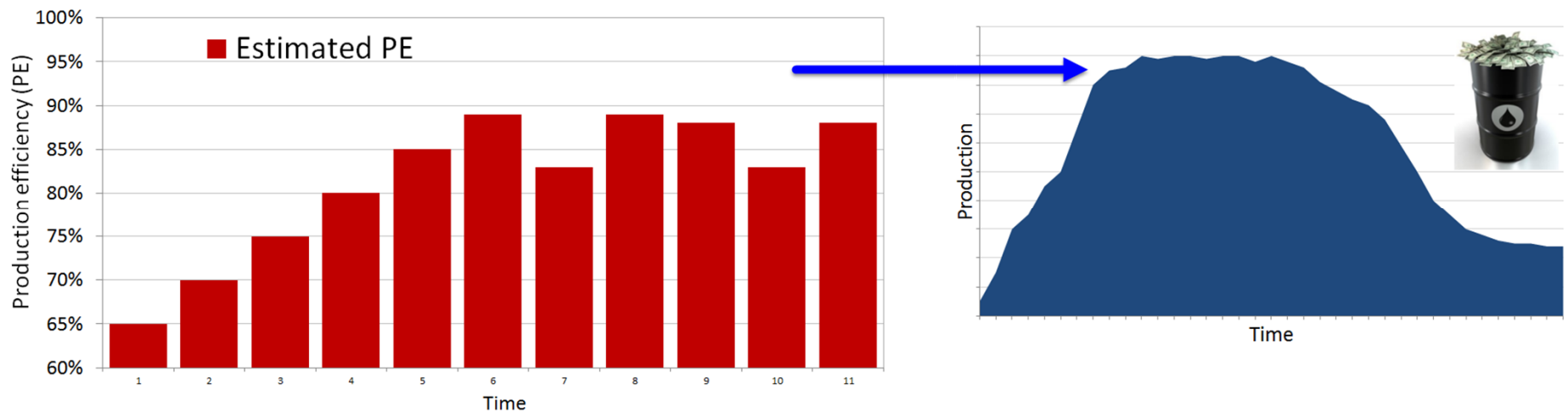
Mitigating actions for reducing the duration- and magnitude of start-up issues must be identified

## Shortcoming 3: Use of time varying PE estimates



PE estimates vary over time due to start-up issues, changing redundancy levels, turnarounds etc.

# Improvement measure 3: Ensure use of time varying PE estimates



Strengthen collaboration in Statoil to ensure that the petroleum technology function applies the time varying PE estimates for the production profiles.

*“Low hanging fruit” for strengthening production attainment (?)*

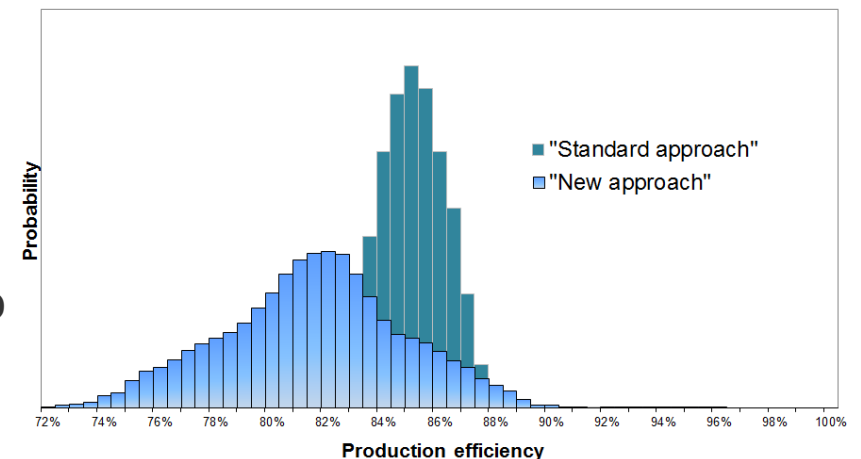
# Shortcoming 4: Uncertainty range for PE estimates

## Low- and high production profiles:

- PE uncertainty is not fully incorporated in petroleum technology's uncertainty analysis

## Results from a “standard approach”:

- Narrow PE uncertainty range
- Several aspects are not covered – limited to input to simulation model

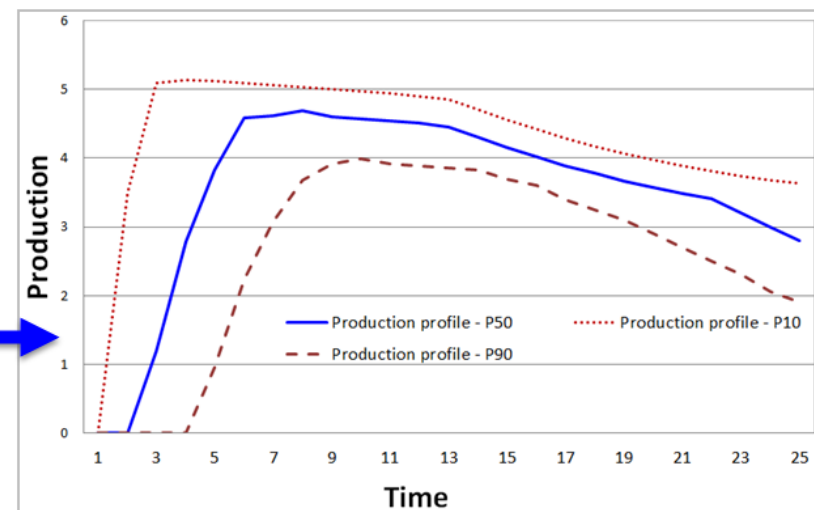
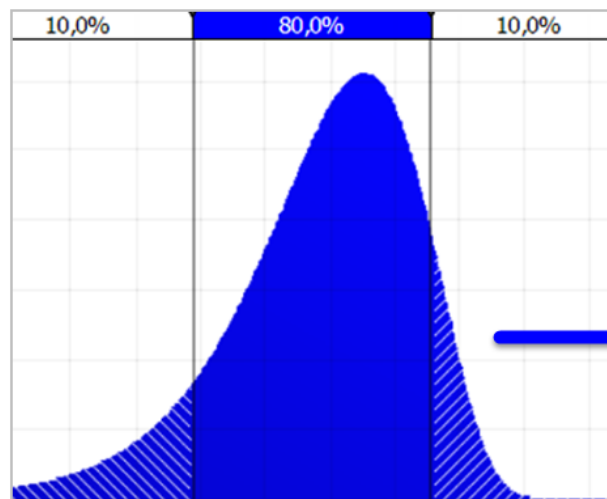


## Operational experience shows:

- Large annual variation
- Large variation between fields

## Improvement measure 4: Establish uncertainty range for PE estimates

- Establish low- and high estimates for PE:
  - Establish low- and high estimates for each loss group (based on project characteristics and quantitative assessment of operational experience from similar oil- and gas fields)
  - Monte Carlo simulation to establish uncertainty range for total production loss
- PE uncertainty range is one of several input parameters to petroleum technology's uncertainty analysis when low- and high production profiles are established



# Questions?



There's never been a better  
time for **good ideas**

Presentation title

Presenters name

Presenters title

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