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Moving the Frontiers in Artificial Lift Technology in Mature Field Operations

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The Value of Smart Artificial Lift Technology, Advanced Corrosion and Sand Control in Mature Field Operations

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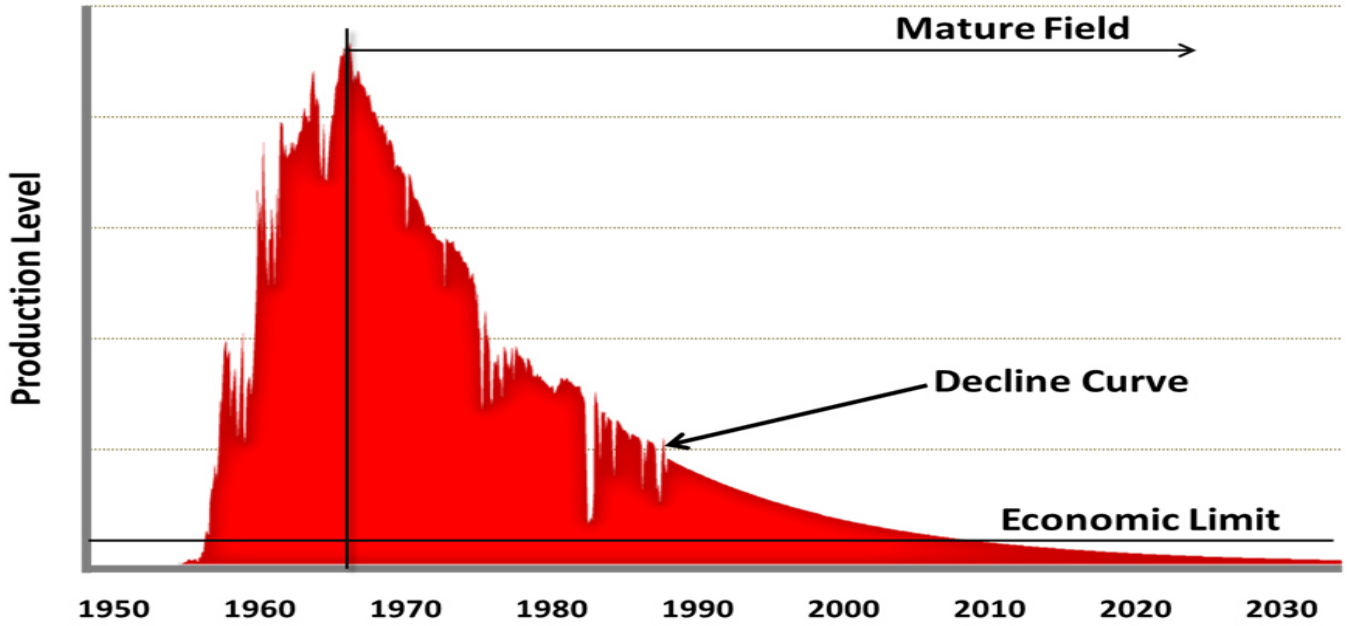
Agenda

- Introduction
- Advanced Draw-Down Control
- Corrosion Inhibition
- Sand Control
- Economic Evaluation
- Conclusions

INTRODUCTION

Defintion of Mature Fields*

A mature field is an oil or gas field, where production has reached its peak and has started to decline.
A mature field is not defined by age but rather by where the field is with respect to its peak production.



*Courtesy of Halliburton

Challenges in Mature Field Operations

- Old Oil and Gas Fields
- Production Decline = Economic Constraints
- High Water Cut = High Lifting & Water Treatment Costs
- Corrosion = Loss of Integrity = Short Meantime between failures
- Sand Produktion = Erosion = Short Meantime between failures
- Small Margins

Identified Areas for Improvement

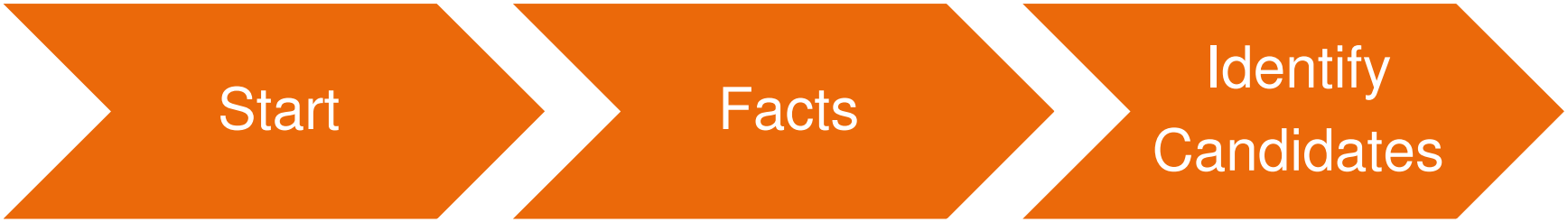
- Advanced draw-down control
- Effective sand control
- Oilfield Chemicals
  - Corrosion inhibitors
  - Paraffin inhibitors
- Modified design and operation parameters
  - Selected Materials
    - Rod Pumps
    - Rods with spray-metal couplings and protectors
    - Tubing Specs
    - Sucker Rod Specs

Examples of Smart Artificial Lift Technologies

- Continuous Level Control “MURAG”
- Ceramic Sand Screens
- Electronically Controlled Rod Rotator
- Spray Metal Rod Coupling
- Poly Lined Tubing
- Modified Electrical Submersible Pumps
- Modified Sucker Rod Pumps

CORROSION CONTROL

Corrosion Inhibitor Selection



- Identification of a certain corrosion problem

- Produced Media
- Material in use
- Conditions

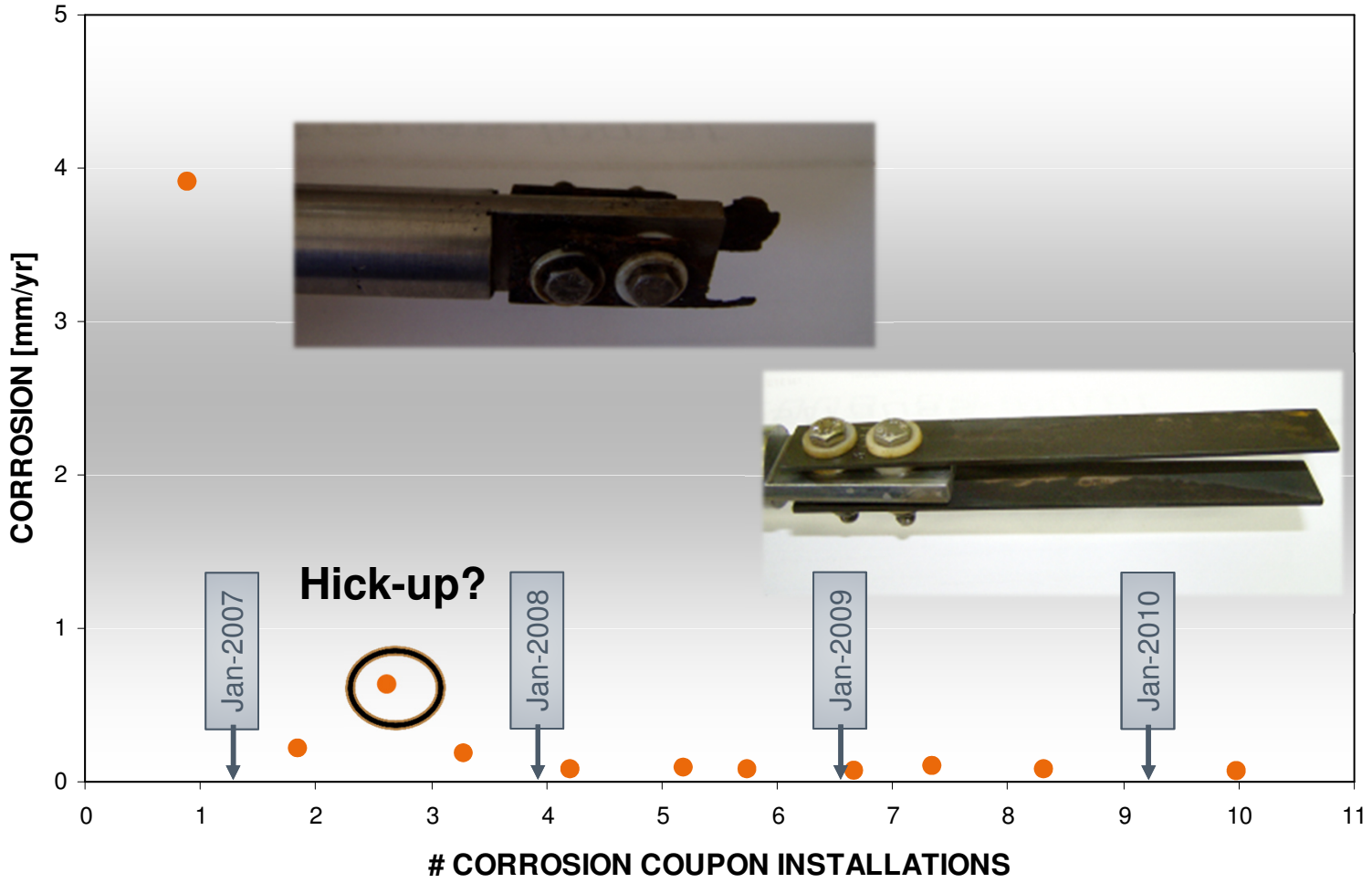
- Experience
- Know-How

- Verify performance

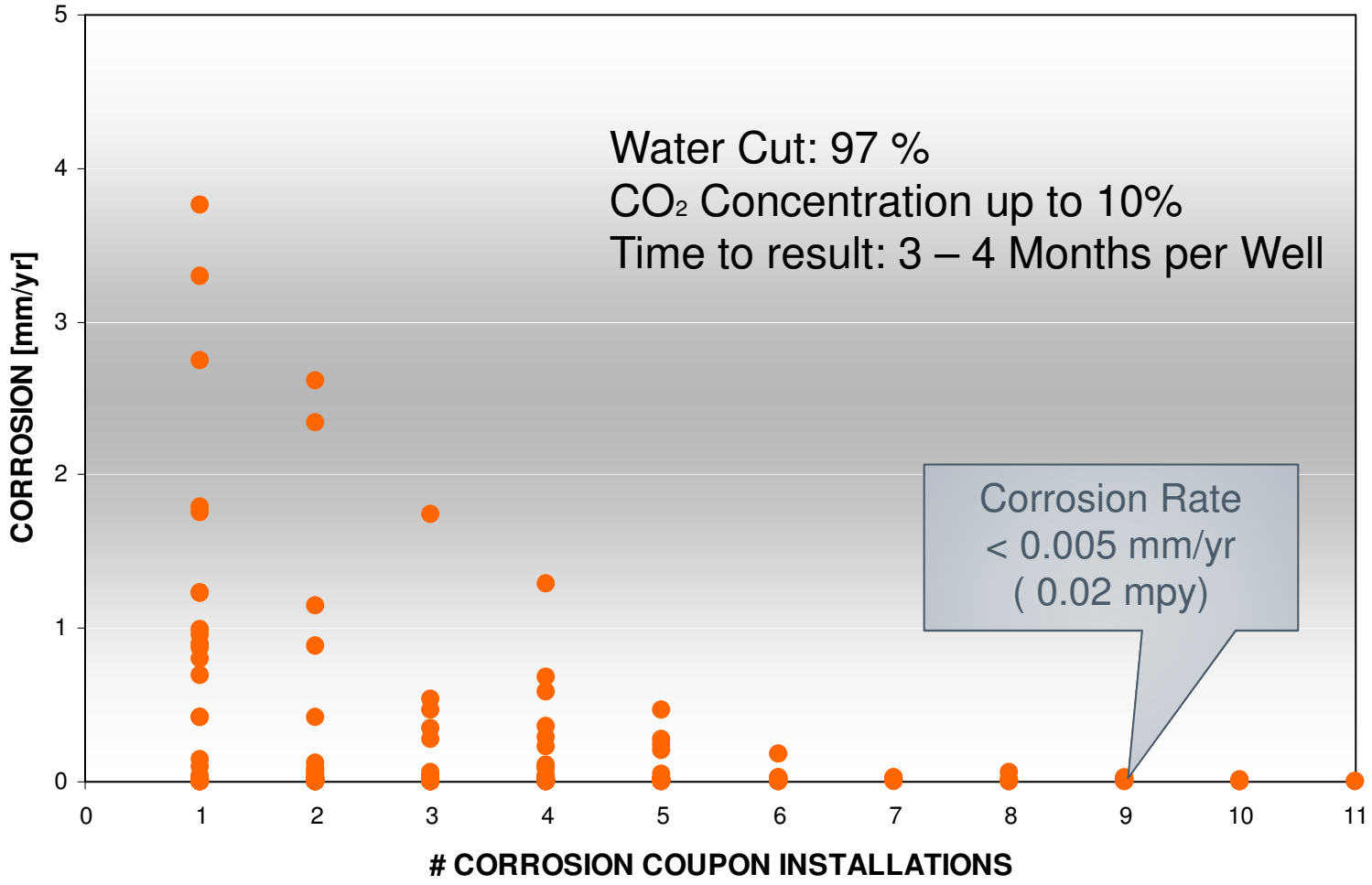
- Identification of best performing candidates

- Based on commercial and business issues

Corrosion Rates without & with Inhibition



Corrosion Inhibitor – Corr. Rate Survey Results

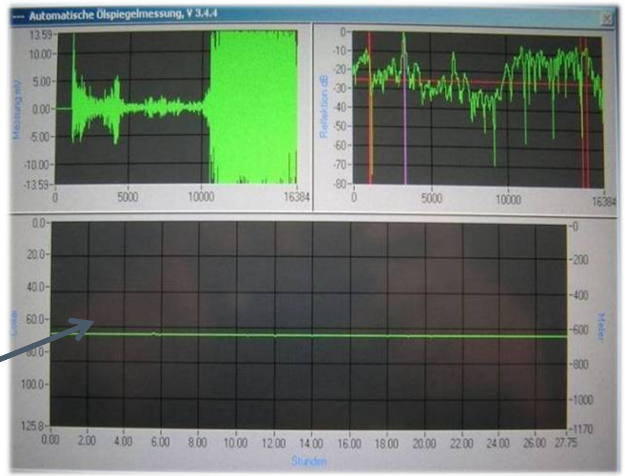


ACOUSTIC WELL MONITORING SYSTEM

Acoustic Well Monitoring System, Murag

- Easy to install at Wellhead without Workover
- Relative accuracy of measurement +/- 3 meter (10 ft) (at one minute intervals)
- Fluid level is identified automatically by analysis of the reflected signal pattern (including frequency analysis)
- Very effective in combination with Variable Speed Drives

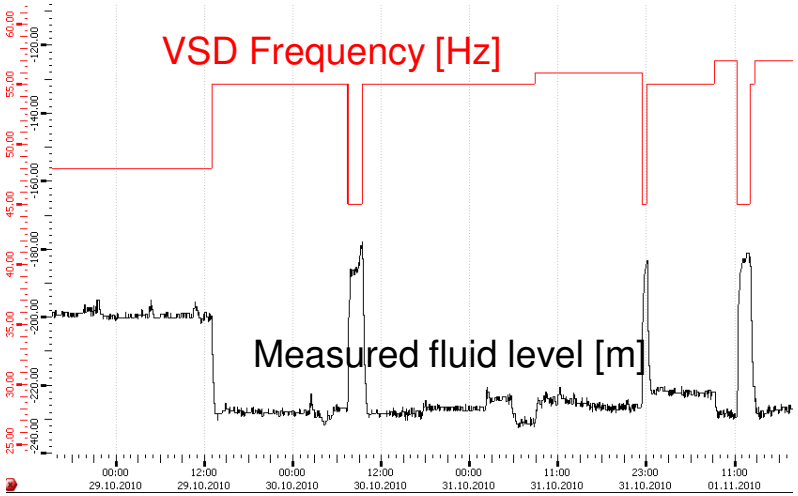
Measured fluid level



Fluid Level Measurement, Production Optimisation

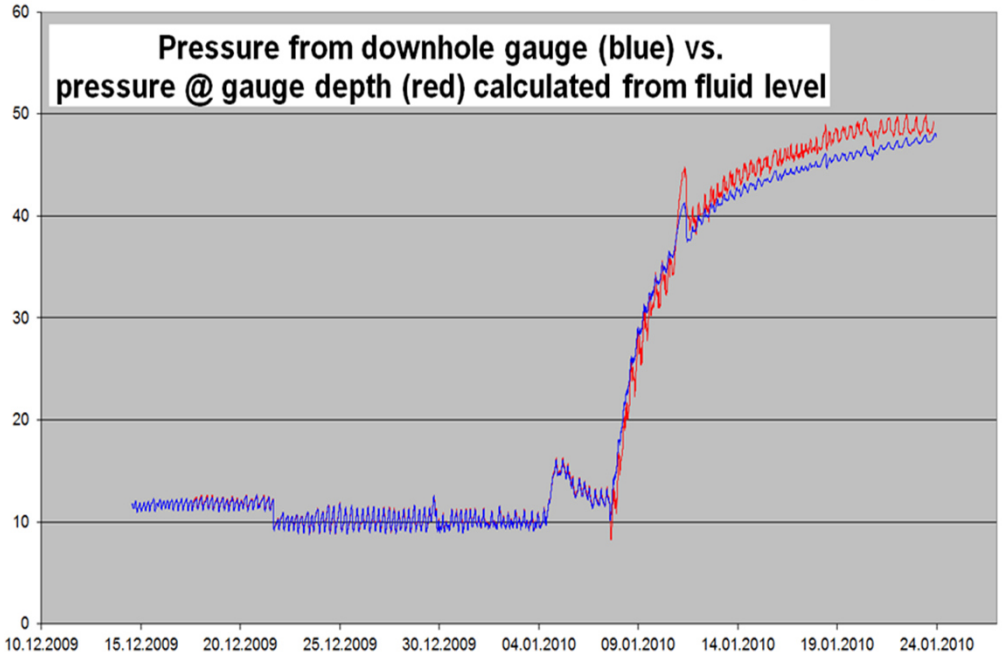
- Prevents pumps from running dry –> increases run life
- Pumps operated safely with maximum possible draw-down
- Accelerated production
- Increased ultimate recovery

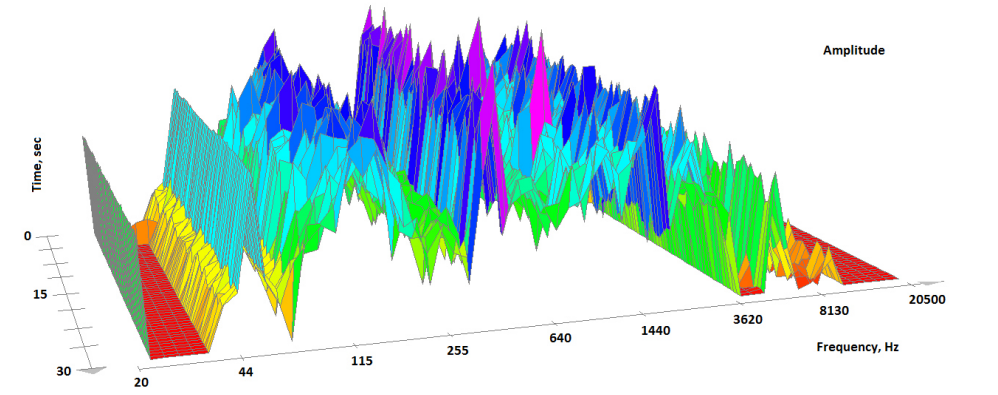
Response on change of ESP speed



Further Applications

- Reservoir Engineering
  - Pressure build-up survey
- Production Operations
  - Condition monitoring of downhole equipment using noise pattern
  - Detection of abnormal conditions (valve malfunction, tubing leak, rod buckling, etc.)





Electronically Controlled Rod Rotator

- Measures load and assures rod rotation when side wall force due to buckling is minimum
- Rotates only when necessary, thus minimizing number of rotations
- Thus reduces wear on tubing and rods

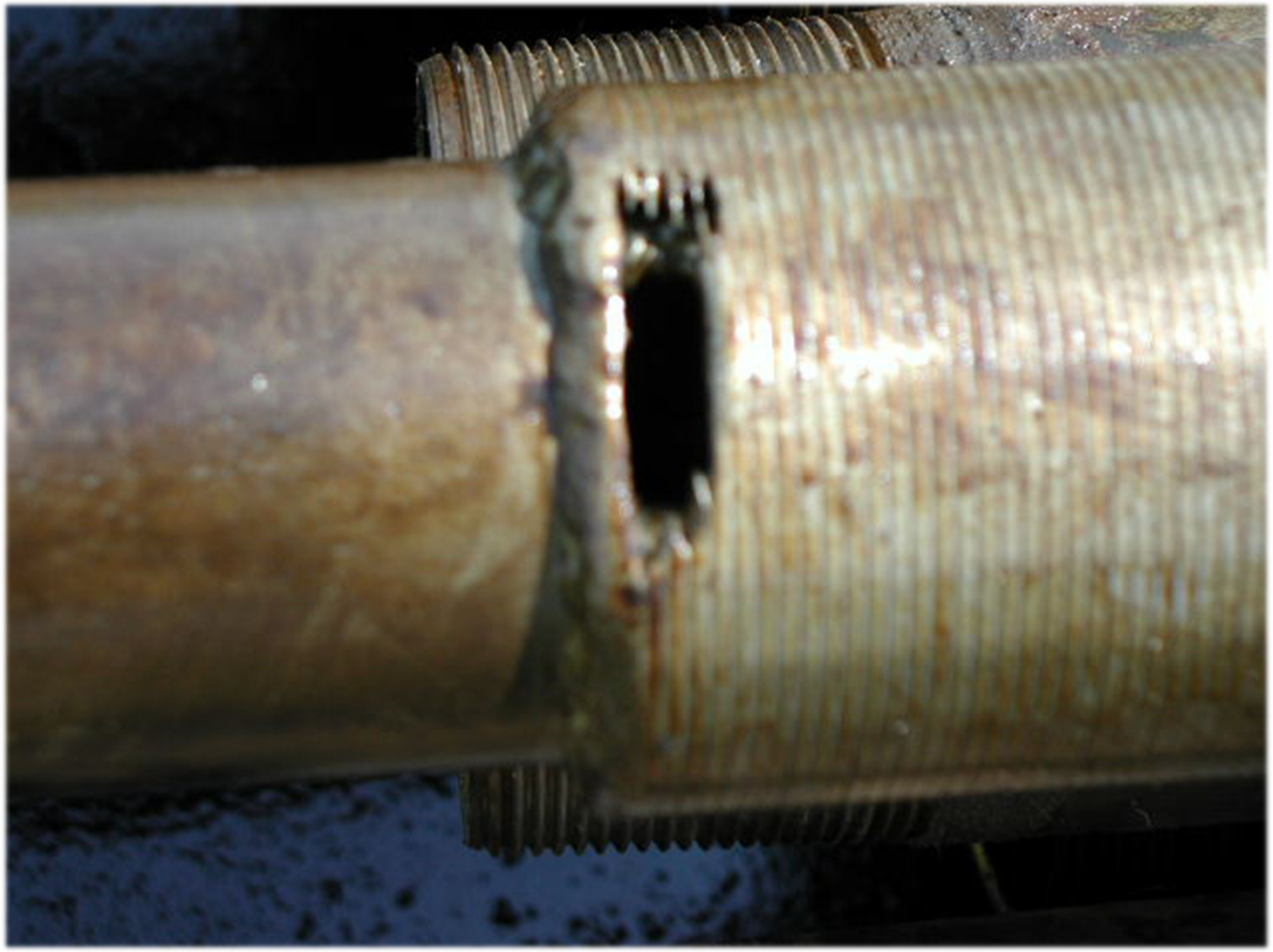
Electronically Controlled Rod Rotator

SAND CONTROL

Conventional Sand Control

- Wire-wrapped screens, stainless steel in combination with gravel packs
- System works satisfactorily, however, a production loss due to additional pressure drop across the assembly is observed
- Some screens collapsed after acid stimulations
- Scaling plugs the screen creating hot spots, which give rise to erosion

Typical Hot Spot

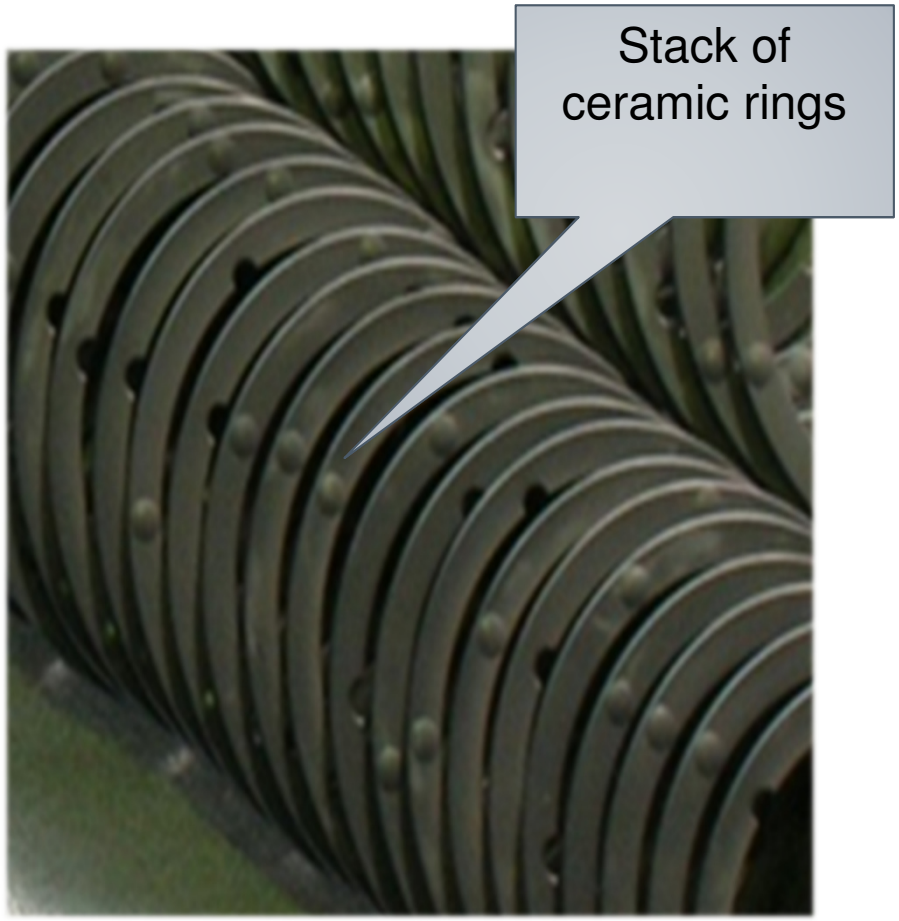


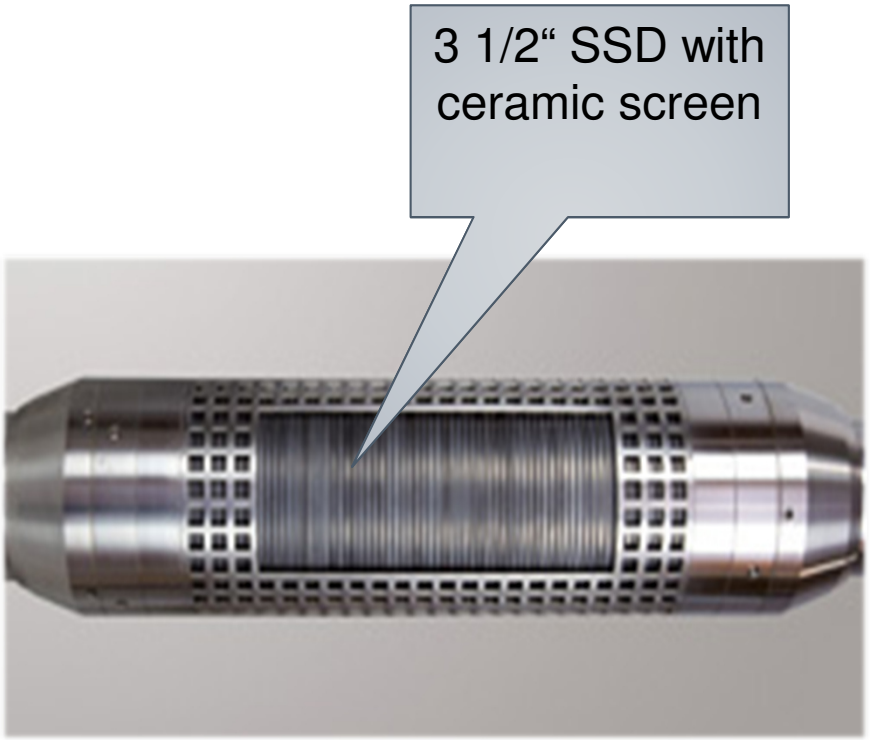
After Acid Treatment

Sand Control with Ceramic Screens

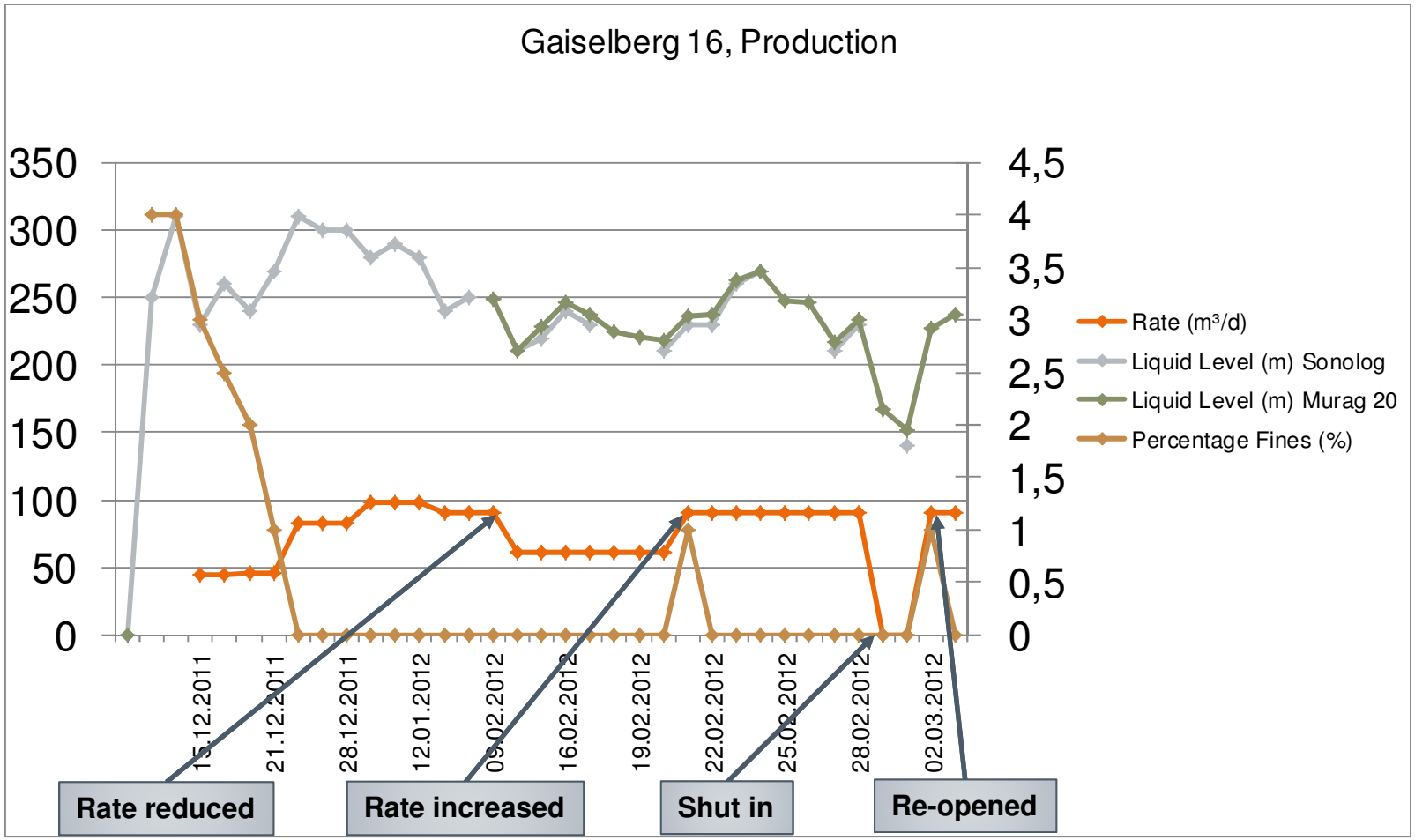
- Unique material properties of SiC
  - Utmost resistant against erosion
  - Highly corrosion resistant
  - Lower density compared with steel (less weight)
  - Heat resistant up to 1800°C
  - High hardness
  - High stiffness

Features of Ceramic Screens





Gaiselberg 16, Production



WEAR AND TEAR CONTROL

Reduction of Wear with Coated Sinker Bars

- Sinker Bars weigh the lower part of the rod string directly above the pump (more tension during „down stroke“) . Buckling and Friction is thus minimised.
- Specially designed „super fine surface finish“ metal film on flexible centralisers, which further smoothens surface and reduces the loss of material
- The metal film is also used for couplings of the rod string.

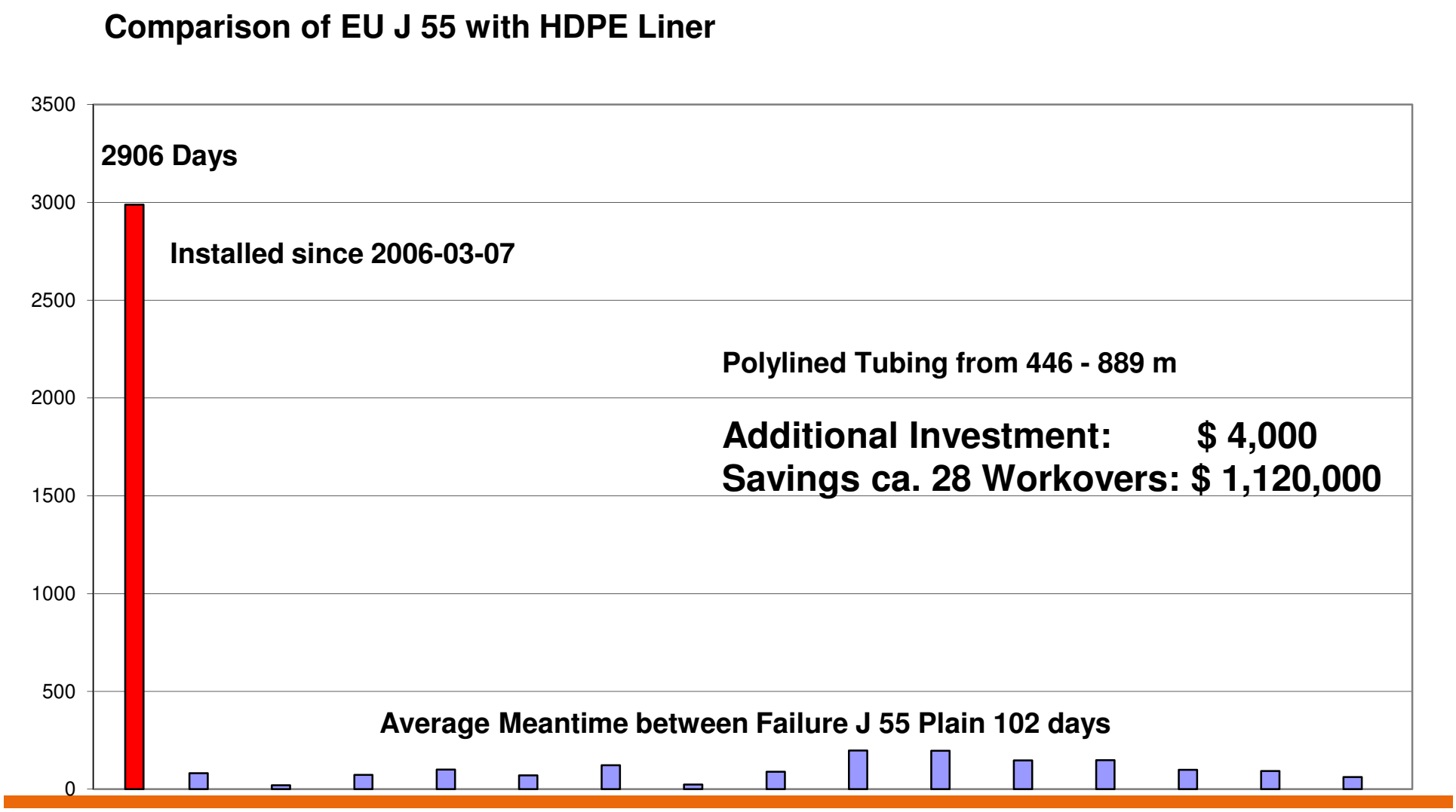
Sinker Bars with Super Fine Finish Coating

Reduction of Wear with Specially Developed Polylined Tubing

Modified HDPE – Temperature up to 95° C

- Advantages:
  - Less paraffin precipitation due to better heat insulation
  - Less tendency for depositions due to smooth surface
  - Less abrasion due to less friction
  - Energy savings due to less friction (10 to 15%)
  - Re-use of used tubing

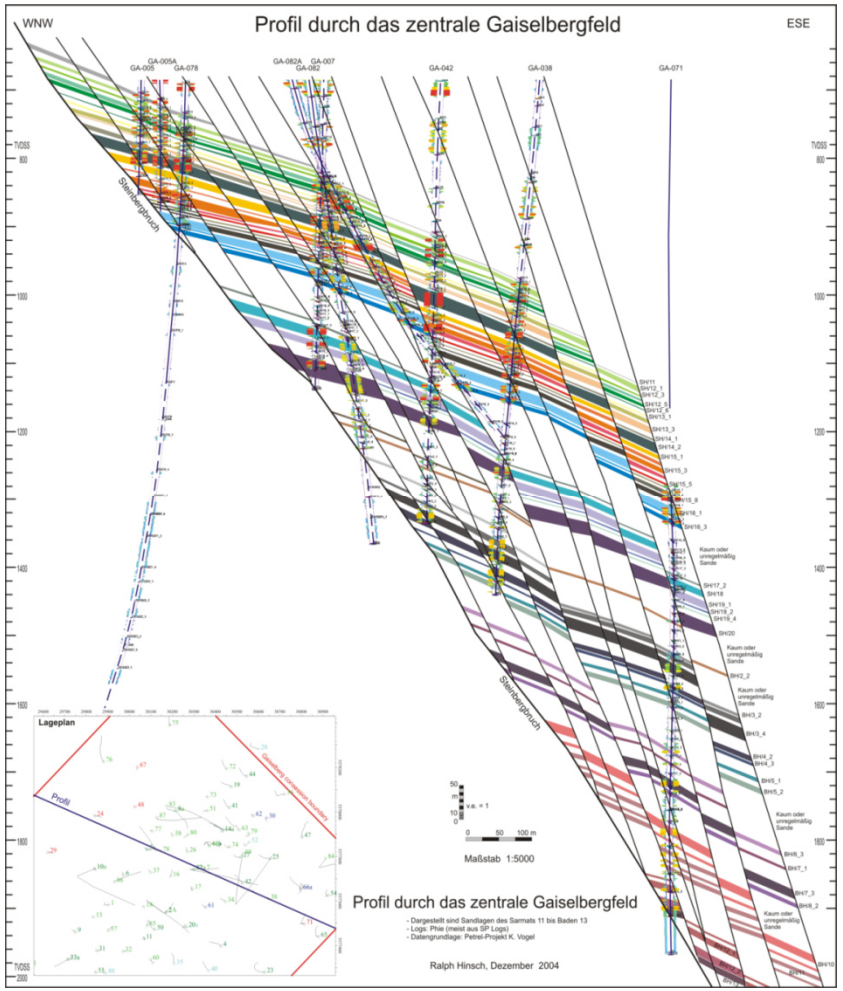
Poly-Lined Tubing



ECONOMIC EVALUATION

Case Study: Operation Centre Zistersdorf

- Two fields in Operation since 1937
- Complex Geology along the major „Steinberg“ Fault
  - Numerous small fractures
  - Many unconsolidated formations
- Hydrocarbon bearing more than 1000m in „Neogen“
- 62 wells (of which 30 in production)
- Up to 10% CO2 in associated gas
- High Water Cut (ca. 95%)



Significant Increase of Equipment Lifetime with a Reduction of Repair Workovers

- 2005

  190 failures

  per 100 active wells

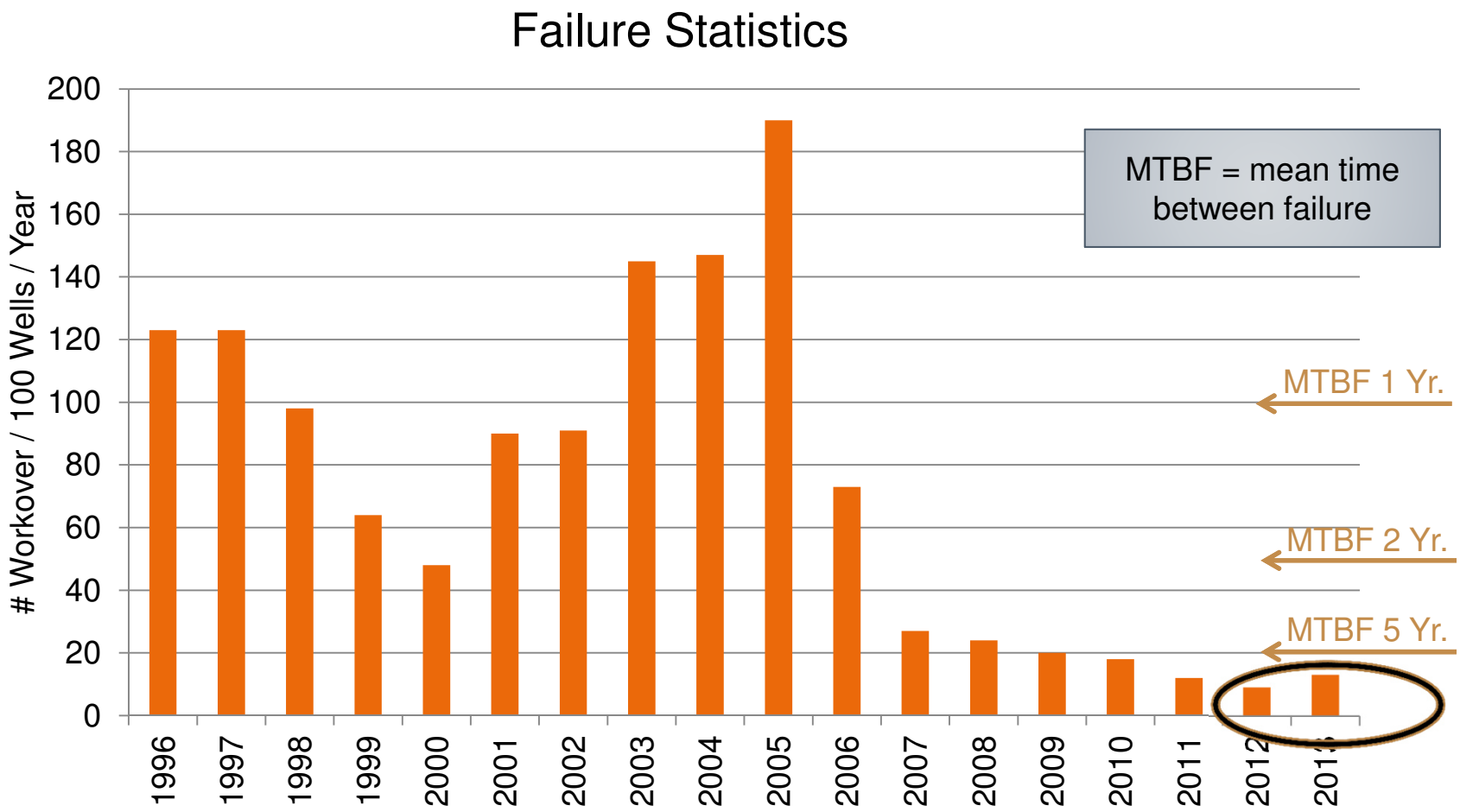
- 2012

  9 failures

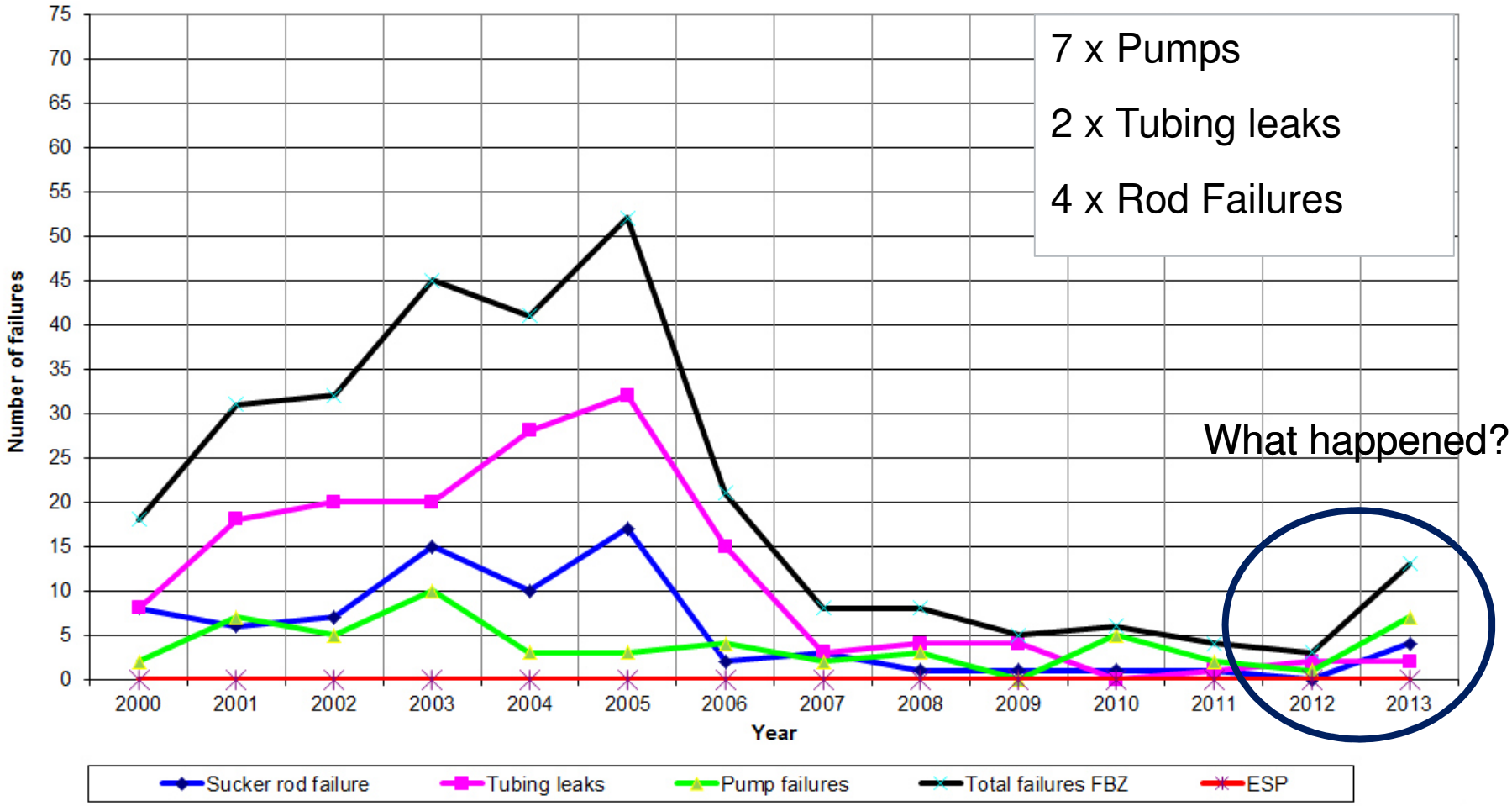
  per 100 active wells

Theoretical time between failures 11.1 years

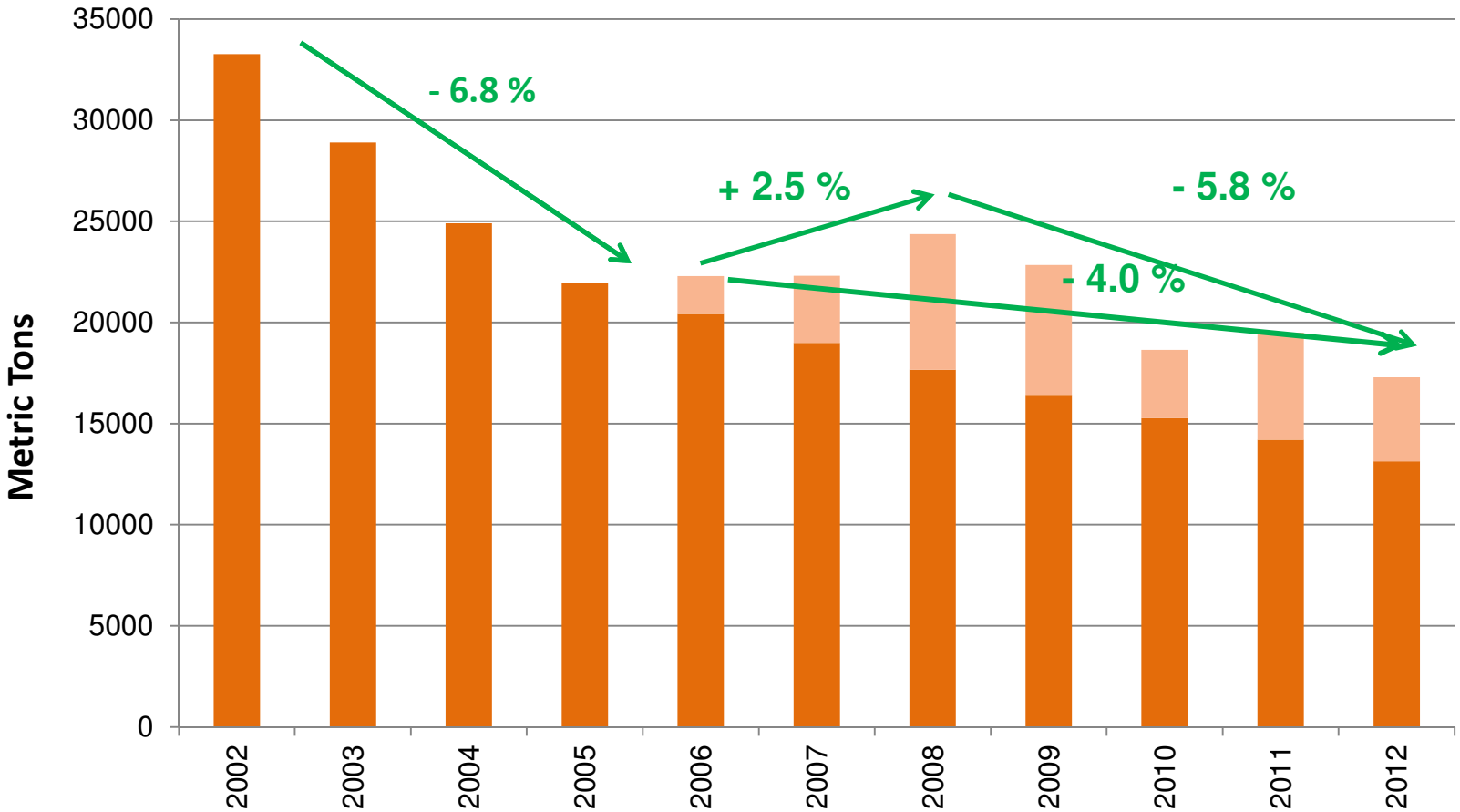
Significant Increase of Equipment Lifetime with a Reduction of Repair Workovers



Route Causes of Failures



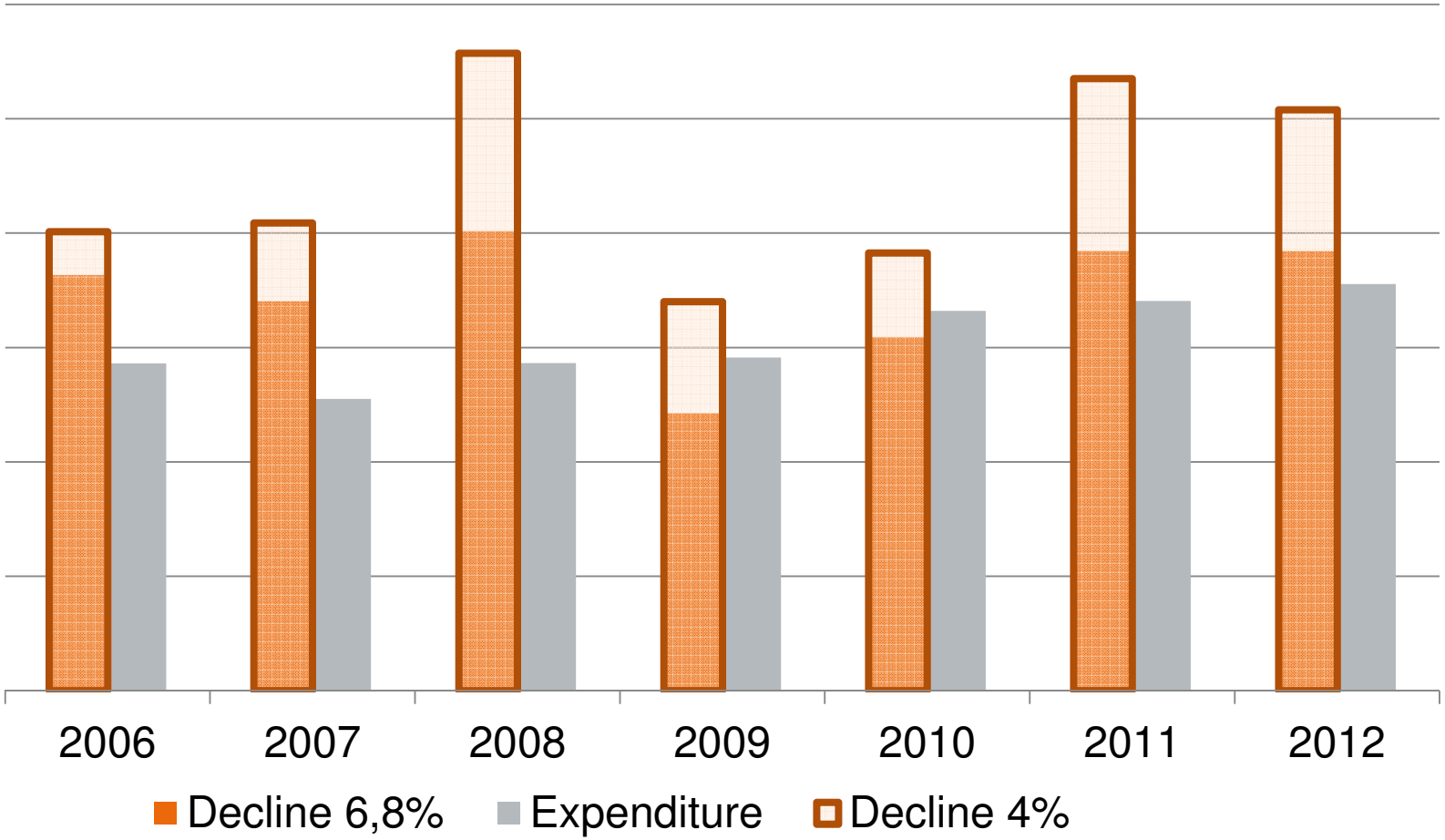
Production Results until 2012



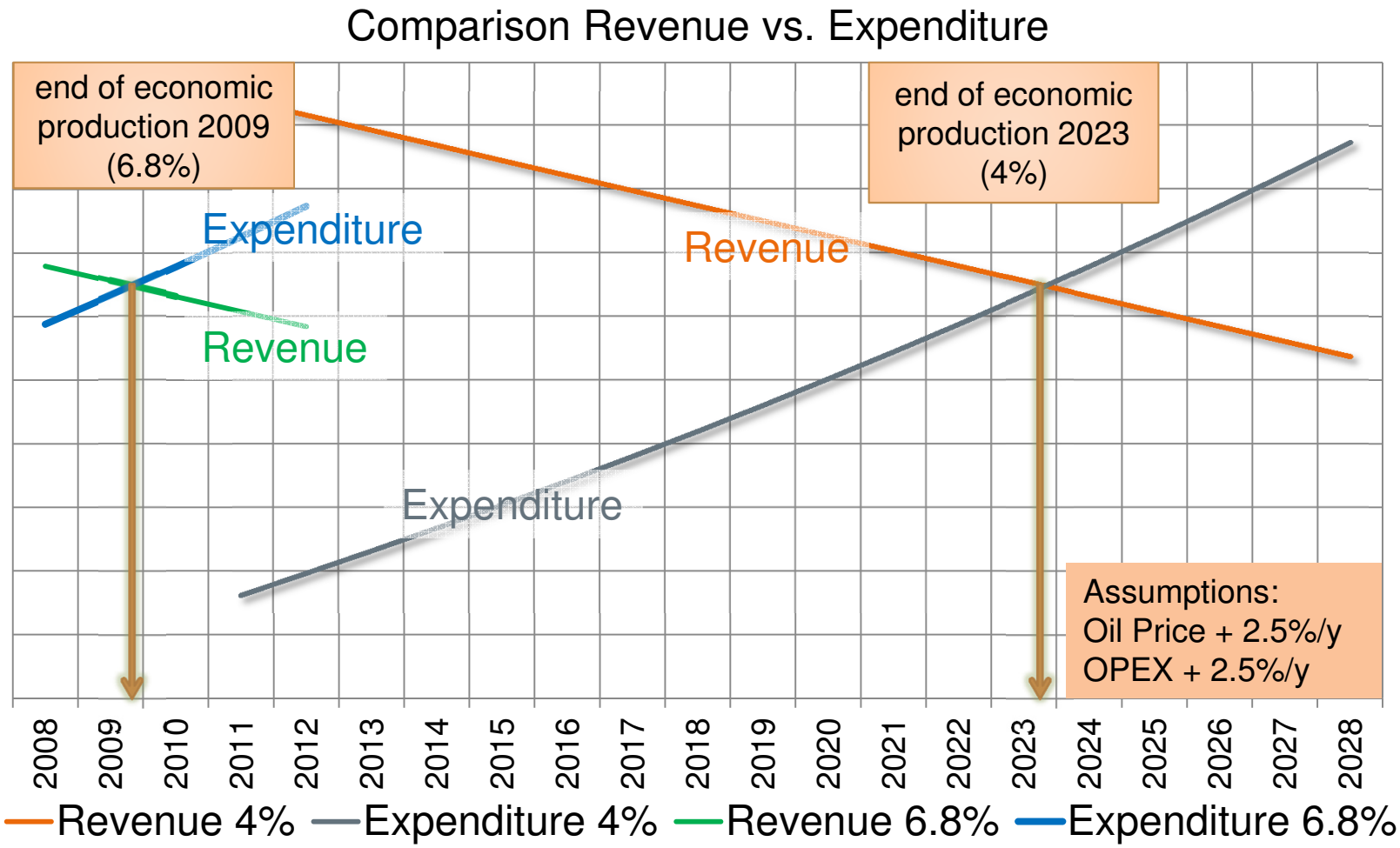
Production Forecast

- Case 1: Business as usual = Production decline 6,8%
- Case 2: Technology Implementation = Production decline 4%

Revenue vs. Expenditure 6.8% (base) vs 4%



Marginal Cost Analysis 6.8% versus 4% Decline



Conclusion: The Way to Success

- Challenge: Limited expectation of field lifetime
- Approach: Building a ‘Mature Field’ Competence Team to develop new solutions
- Process:
  - 1. Analysis of available technologies along the production chain
  - 2. Identification of advanced materials with exceptional lifetime in tough production environments
  - 3. Development of a stringent selection process for corrosion inhibition
- Results: Development of new technologies ‘fit for purpose’ , modifications of existing technologies, use of new materials.

The value of an idea lies in the using of it.

Thomas A. Edison

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