# A Case for Nanomaterials in the Oil & Gas Exploration & Production Business

**Matt Bell – Shell Technology Ventures**

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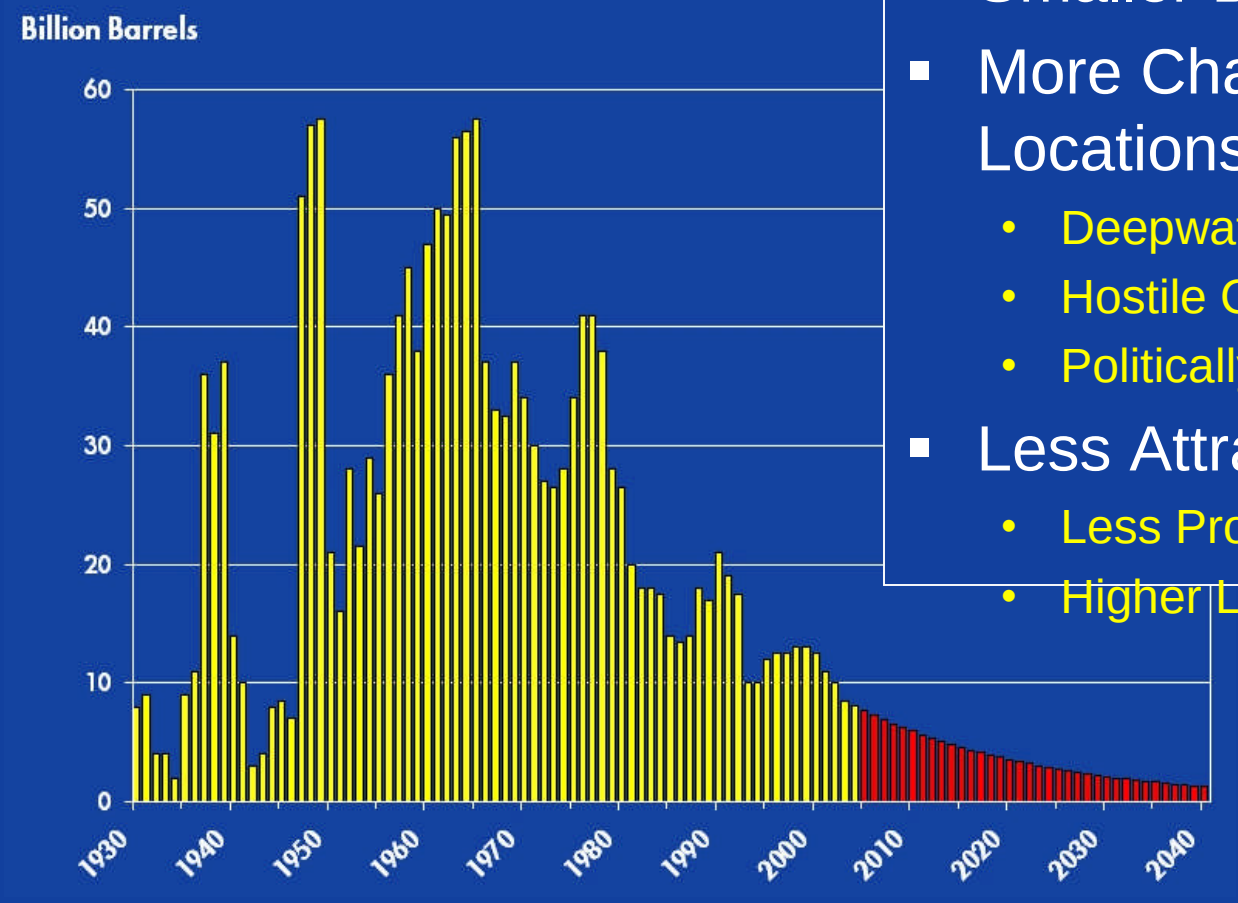
# Outline

- Challenges
- Why not Nano?
- Quick Wins
- Longer-Term Opportunities
- Size of the Prize
- Strategic Recommendations
- Conclusions

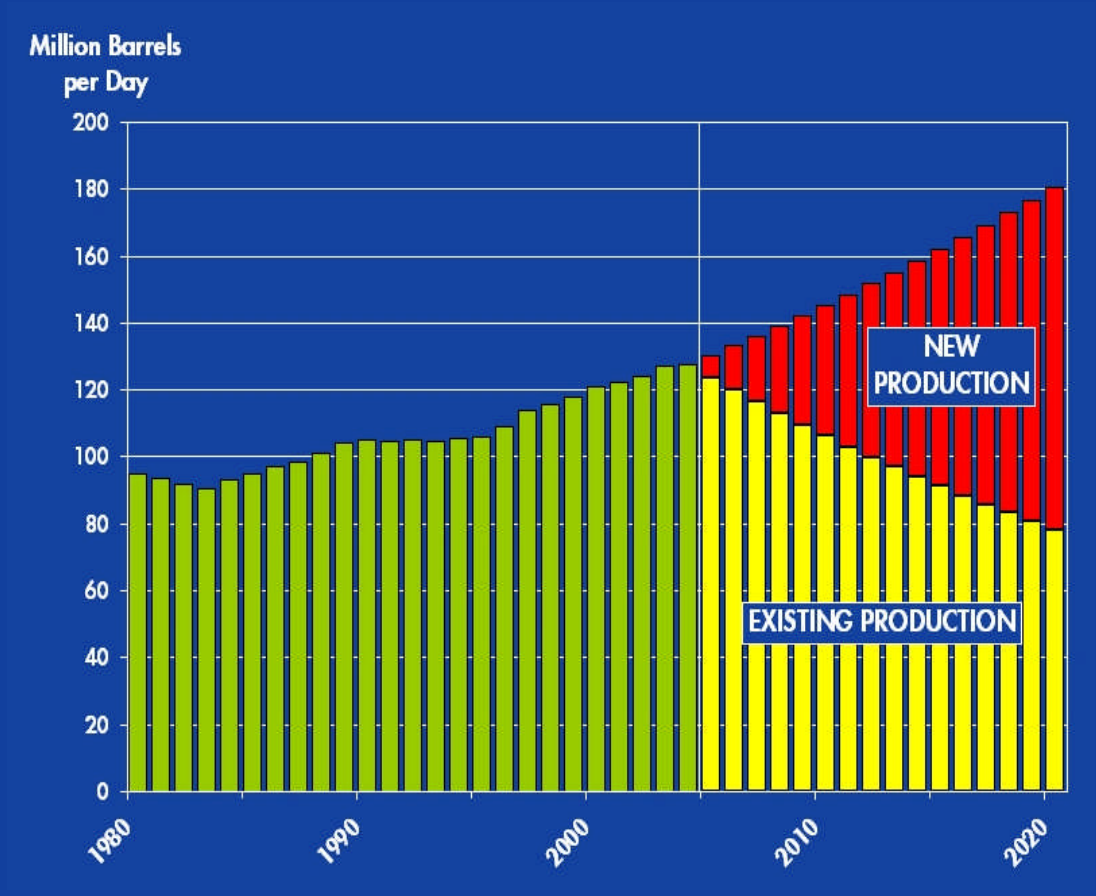
# E&P Challenges




**Total Discovered Volume, By Year**

- Smaller Discoveries
- More Challenging Locations
  - Deepwater
  - Hostile Climates
  - Politically Unstable Regions
- Less Attractive Resources
  - Less Prolific Reservoirs
  - Higher Levels of Contaminants

# E&P Challenges




**World Demand, Barrels of Oil Equivalent**

- Growing Demand
  - +2% per year
- Declining Fields
  - Many >40 years old
- How to Fill the Gap?
  - New developments
  - Increased recovery
  - Extended field life

# Material Challenges

- Surface Conditions
  - Hurricane force winds & associated waves
  - Water depths in excess of 10,000 ft
  - Arctic (-50°C) to desert (+50°C) climates
  - High throughput processing facilities
- Subsurface Conditions
  - Well depths reaching 30,000 ft
  - Exceeding 20,000 psi and 200 °C  (390 °F)
  - Weight of drilling assemblies >500 MT
  - Shock loads in excess of 100 G

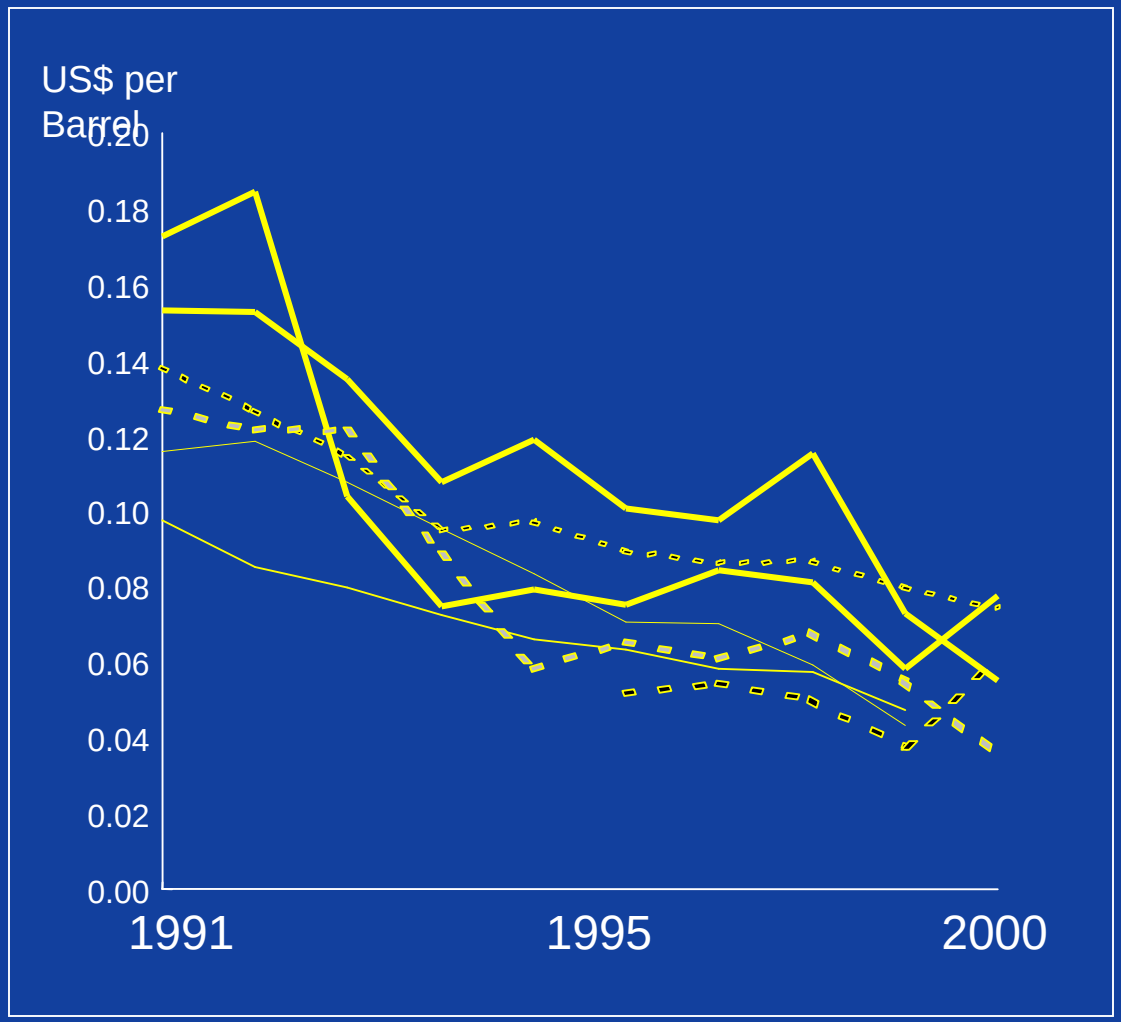
# Material Challenges

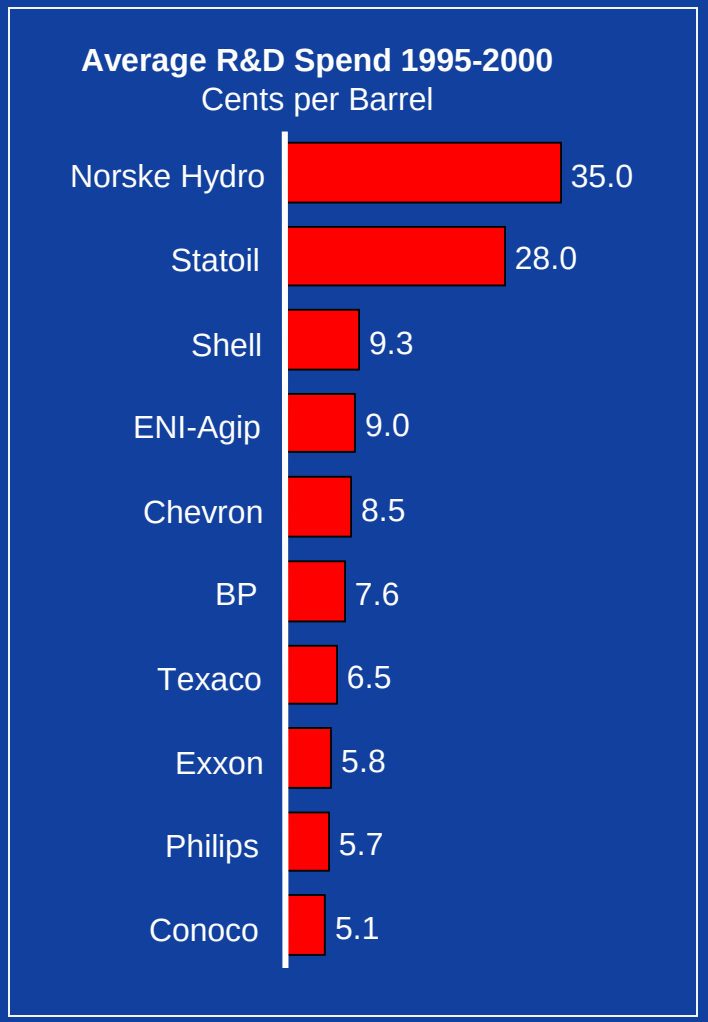
- Strength vs. Weight
- Corrosion Resistance
- Abrasion & Wear Resistance
- Thermal Conductivity
- Pressure Rating vs. Wall Thickness
- Specialty Chemicals
- Sensors & Telemetry

# Why So Little Nano?

- Lack of Innovation
- Barriers to Entry & Adoption
- Perceived Cost & Risk
- Lack of Awareness (EP ⇐⇒ Nanomaterials)

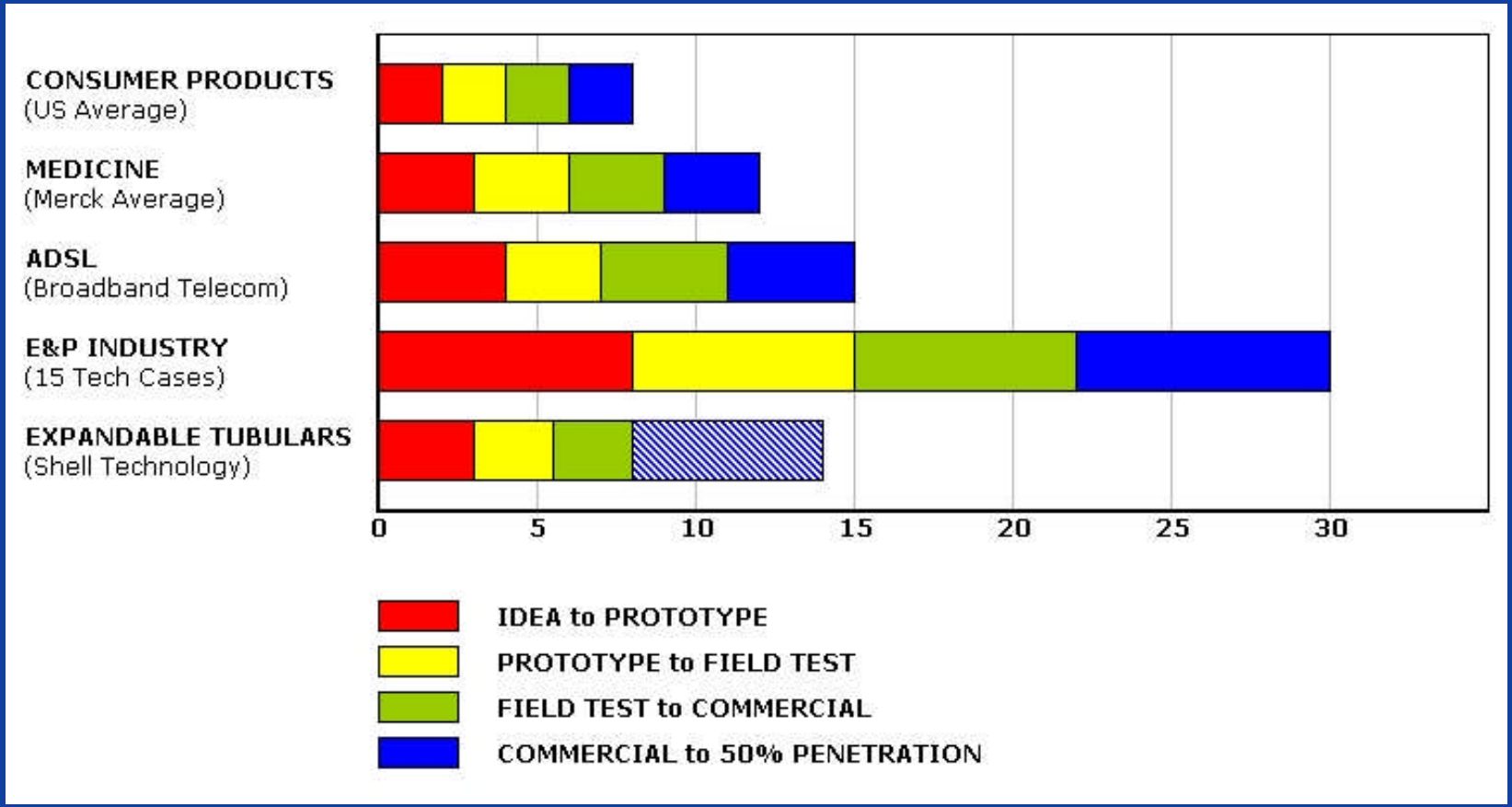
# Lack of Innovation




R&D Funding Down 50% In Last Decade

# Lack of Innovation




McKinsey

Historically Very Slow Uptake by E&P Industry

# Lack of Innovation

**E&P COMPANIES**

- Reduced R&D budgets
- Unwilling to share value
- High cost of failure
- Eroding skill pool

**MAJOR SERVICE COMPANIES**

- Lack of Incentives
- Limited Innovation
- Established Products

**SMALL INNOVATORS**

- Lack of Funding
- Limited Market Access

# Barriers

- Fewer Academic Consortia Focusing on E&P
- Limited VC Funding For Energy Sector
- Declining Talent Flow to the Industry
- Fragmented Ownership of Projects
- “Not Invented Here” Syndrome
- Short-Term Cost Focus
- Under-Developed Risk Sharing Models
- Rising Costs & Flat-Out Production

# Common Misperceptions

- Nanotechnology is “Rocket Science”
  - What about 1st gen. “passive nanostructures”?
- Nanotechnology is (Very) Expensive
  - Raw material costs are falling
  - A little goes a long way
- E&P is a “Mundane” Business
  - Not according to NASA astronauts…
- It’s Too Early … Watch and Wait
  - First Mover advantage is available now

# Quick Wins

- Some Technology Can be Harvested Now
  - Coatings
  - Alloys & Composites
  - Chemicals & Additives
  - …

- Seek Non-Disruptive Market Entries
  - Transfer Proven Technology from Other Industries
  - Direct Substitute for Existing Product
  - Build E&P Consumer Confidence
  - Establish Industry Partnerships

# Longer-Term Possibilities

- From Evolutionary to Revolutionary
- Challenge Established Wisdom
- Re-Engineer Components and Methods
- Extend Operating Envelopes
- Make New Frontiers Viable
  - Massive Investments → Significant Opportunity
- Keep Existing Assets Viable for Longer
  - Enormous Legacy Asset Base → Significant Opportunity

# Size of the Prize

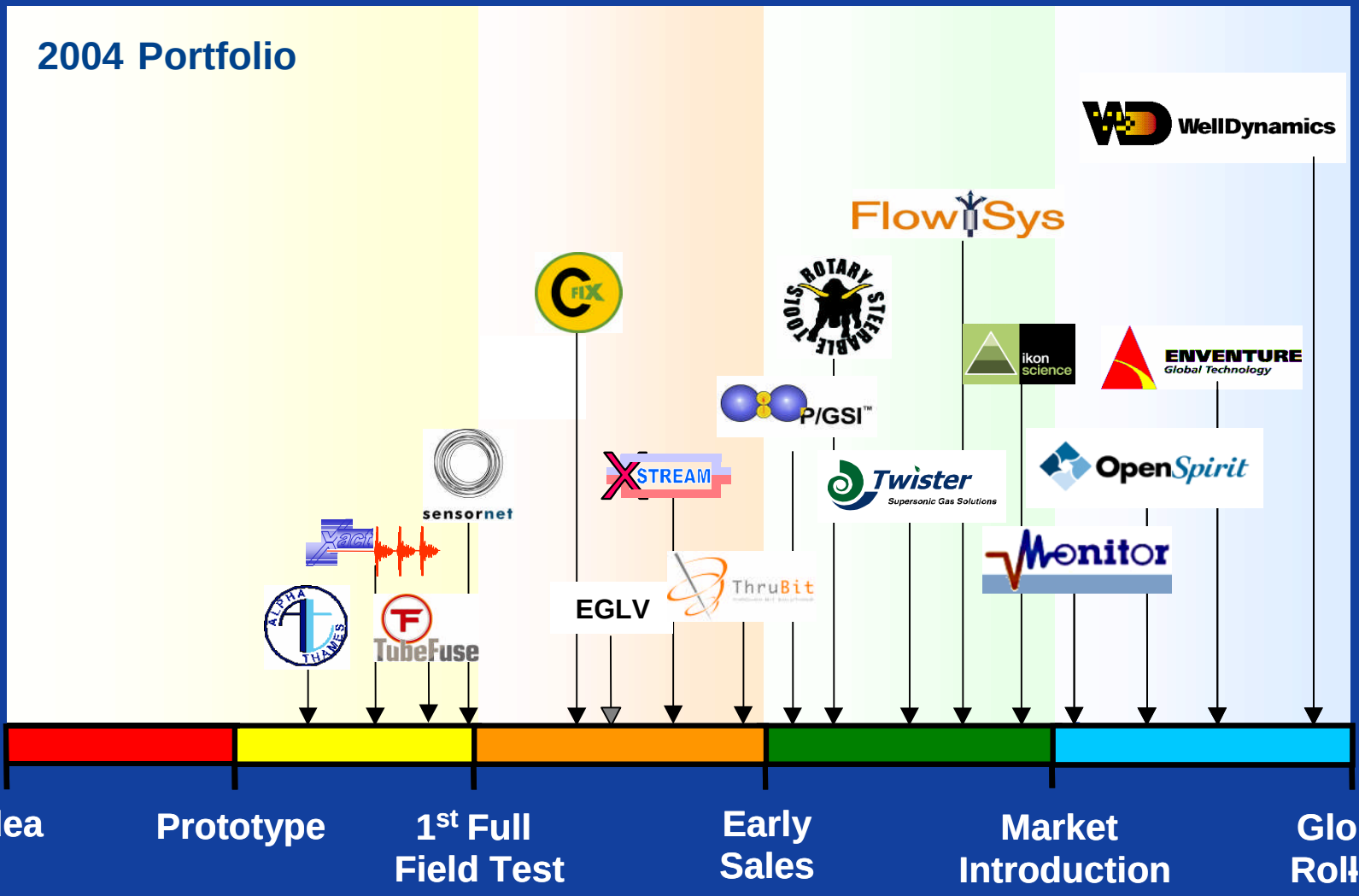
- 2004
  - 75,000+ New Wells Worldwide in 2004
  - Total E&P Expenditure > $ 144 billion
- 2005-09
  - 15,000 Offshore Wells Costing > $ 180 billion
  - 4,500 Exploratory Wells Costing $ 75 billion
  - Deepwater Will Represent 15-20% of All Activity by 2008
  - Multiple New Field Developments Costing > $ 10 billion each
- Cost-Effective Enhanced Materials
  - Will Benefit Almost Every Well & Production Facility
  - Impact CAPEX, OPEX and HSE

# Strategic Changes

- Communicate, Collaborate, Converge
  - E&P Operators & Service Companies + Nano Developers
  - Understand E&P Challenges
  - Identify Applicable Nanomaterials
  - Share Long-Term Visions
  - Build Partnerships

- Capital
  - E&P Must Engage Earlier (Pre-Spinout?)
  - Nano Should Proactively Engineer Products
  - Risk-Reward:  First Mover Advantage

# Shell Technology Ventures



# Shell Technology Ventures

- Seeks
  - Step-change Technology
  - Strategic Value to E&P
  - Entrepreneurial Team
  - Credible Business Plan
  - Significant ROI Potential
  - Exit Options
- Offers
  - Domain Expertise
  - Active Investment
  - Links to In-House R&D
  - Access to Field Trials
  - Focused Implementation
  - Investment Capital

Must secure VC to avoid the “valley of death”

“Mind The Gap…”

Congressman Mike Honda

# Conclusions

- The E&P Industry Faces Significant Challenges:
  - Costs are rising & operations are materials-constrained
- Nanotechnology is Conspicuously Absent
  - Lack of innovation, investment, and awareness
- Mature Nanomaterials are Available Now
  - Limited disruption, low barrier to entry
- Build the Bridge from Both Sides
  - E&P must engage with Nano to understand & co-develop
  - Partnerships must be built at early stage
  - Investment risk necessary for both sides to benefit

# Questions?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