

# Possible Shapes and Rates of Change in Austria in the Next 30 Years

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# On May 5, 2006 I said to the COV

Over the next 20 years the people of Vienna will see more changes than they experienced during the entire 20<sup>th</sup> century – changes in politics, environment, economy.

# In That Speech I Omitted The Impact Of Many Possible Shocks

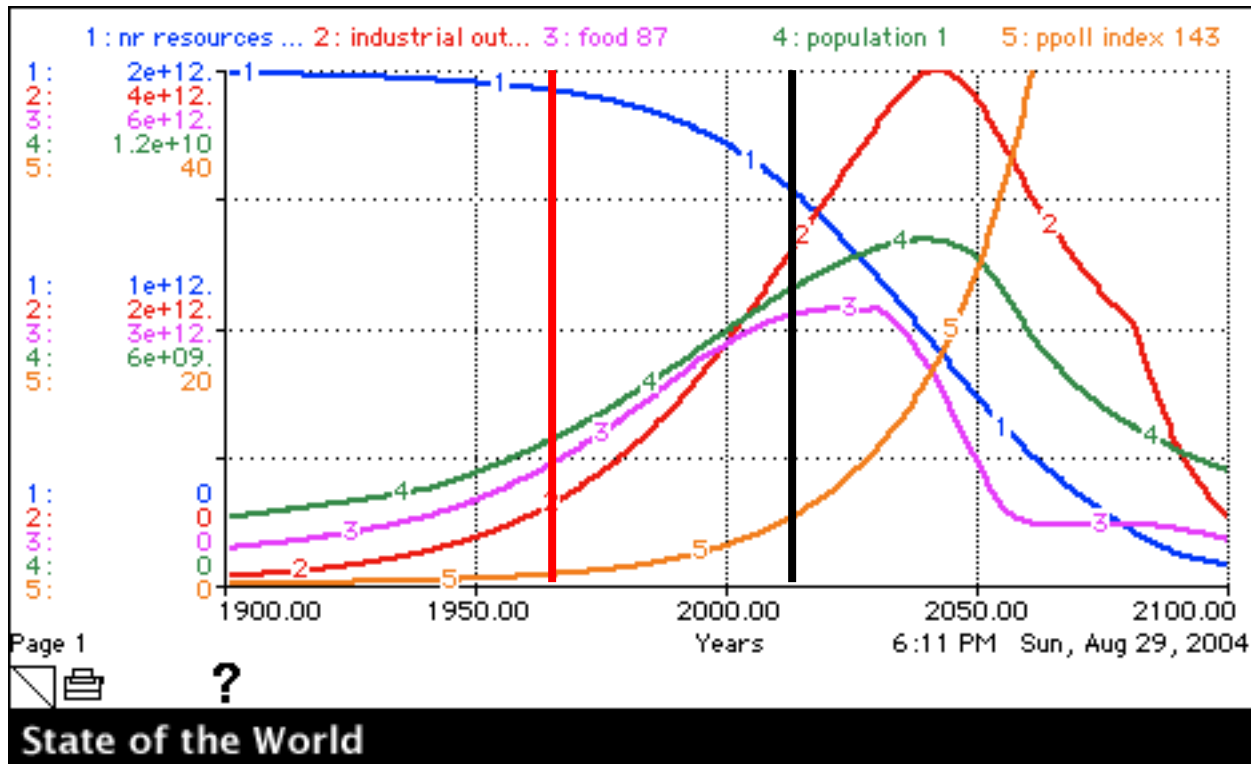
- Epidemics
- Significant military conflict
- Sudden, large disruptions from climate change
- Erosion of the US dollar status as the world's reserve currency
- Global financial crisis

***All of those shocks have happened in the past 8 years and we are only at the very beginning***

# My Main Points

- We are in the first decade of a century that will see enormous change as pressures rise to stop physical growth on our finite planet.
- It is impossible to predict the future, but we can identify some potential forces for change.
- Sustainable development is now impossible; it is essential to raise resilience.

# The Reference Scenario



Pollution

Resources

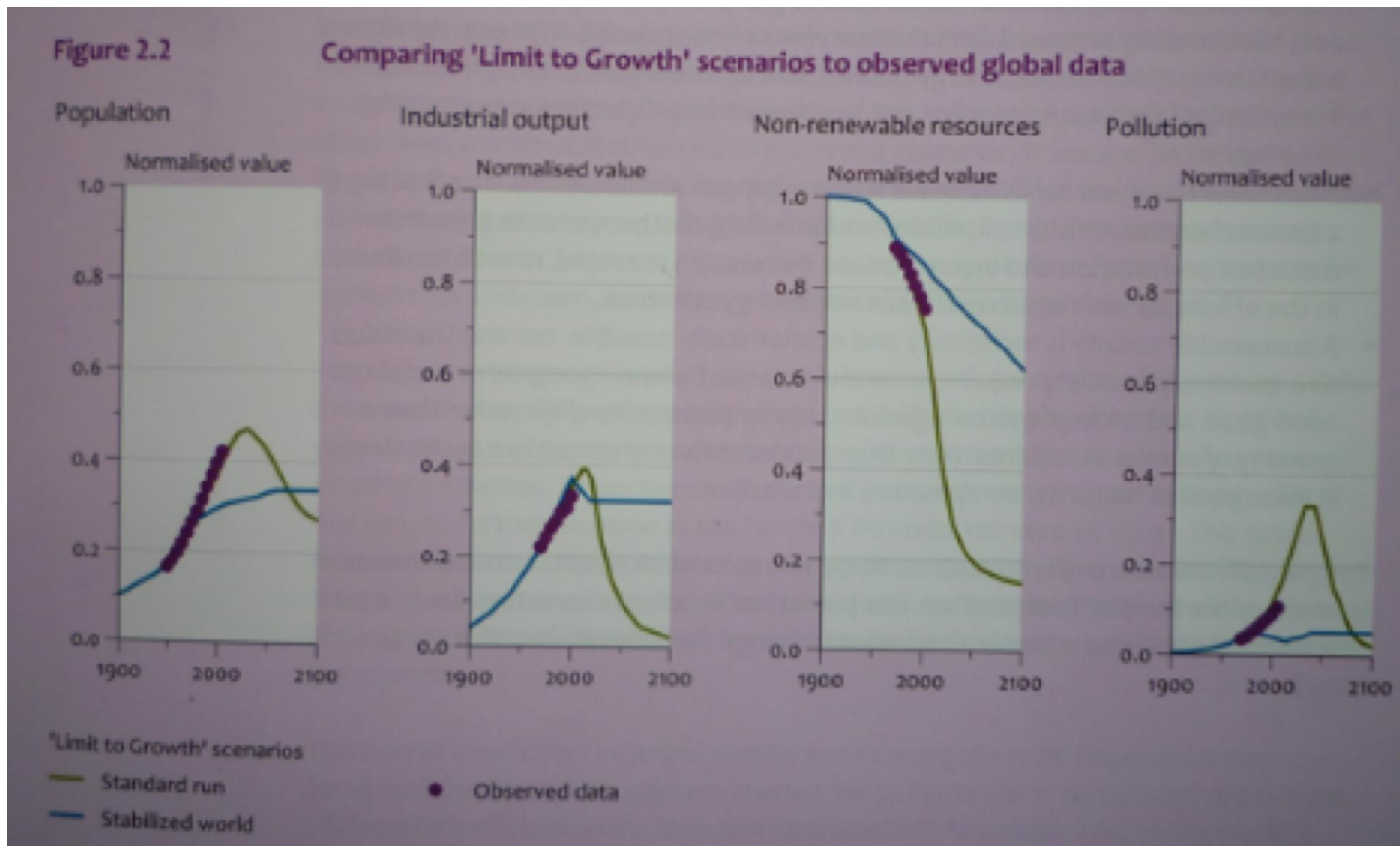
Population

Industrial Output

Food

Resources

# We are following the collapse scenario



From: *Growing within Limits*, Netherlands Environmental Assessment Agency, October 2009, page 23.

# The Time of Greatest Stress

- Most people assume that the major global difficulties would occur after the end to growth.
- This is not correct.
- The globe's population would experience the most stress prior to the peak, as pressures mount high enough to neutralize the enormous political, demographic, and economic forces that now sustain growth.
- We are in the early phases of that period now; you will experience more change over the next 20 years than occurred during the past 100 years.

# The Pressures Will Have Many Forms

- Rising energy and resource costs
- Growing debt
- Eroding status of the US dollar as a reserve currency
- Growing population dependency ratio
- Declining food production
- Declining energy return on investment
- Falling reliance on the market to exchange goods and services



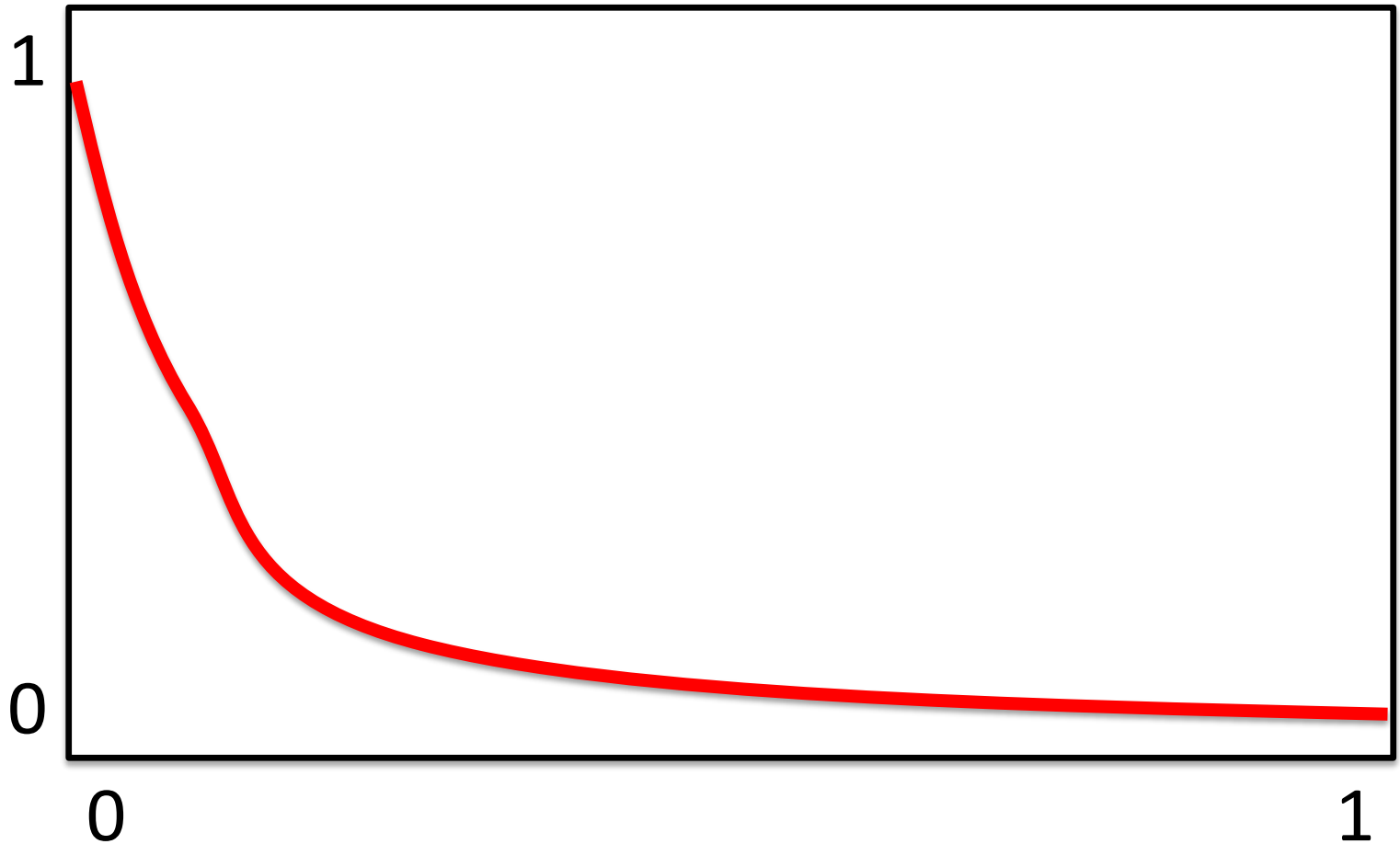
# Exercise on Secret Code

# Levels of Understanding

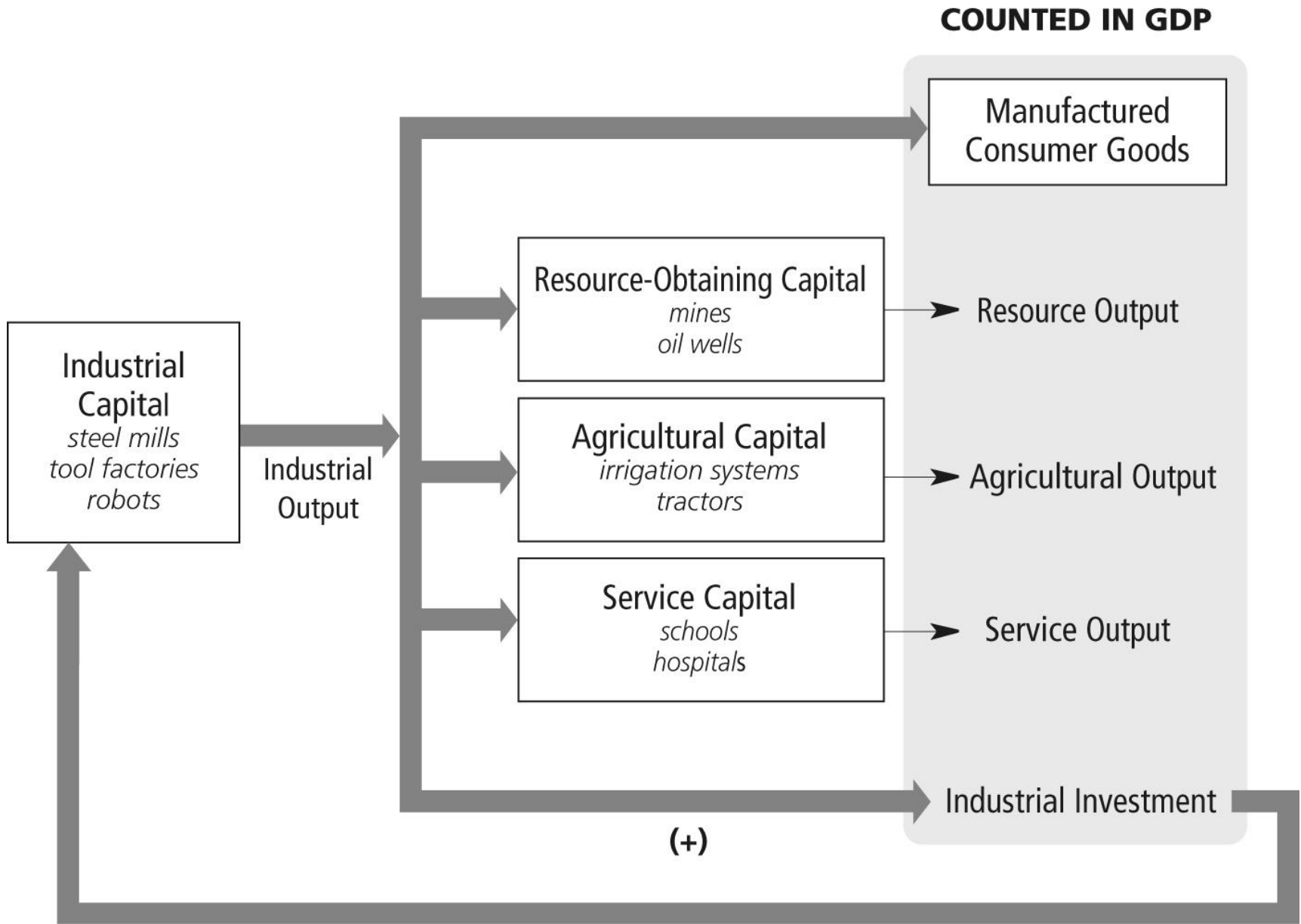
- Anecdotes and stories
- Events
- Patterns
- Underlying Causes
- Interconnections of Causes
- Dynamic Analogues
- Modeling and Experimentation

# The Nature of Natural Resource Limits

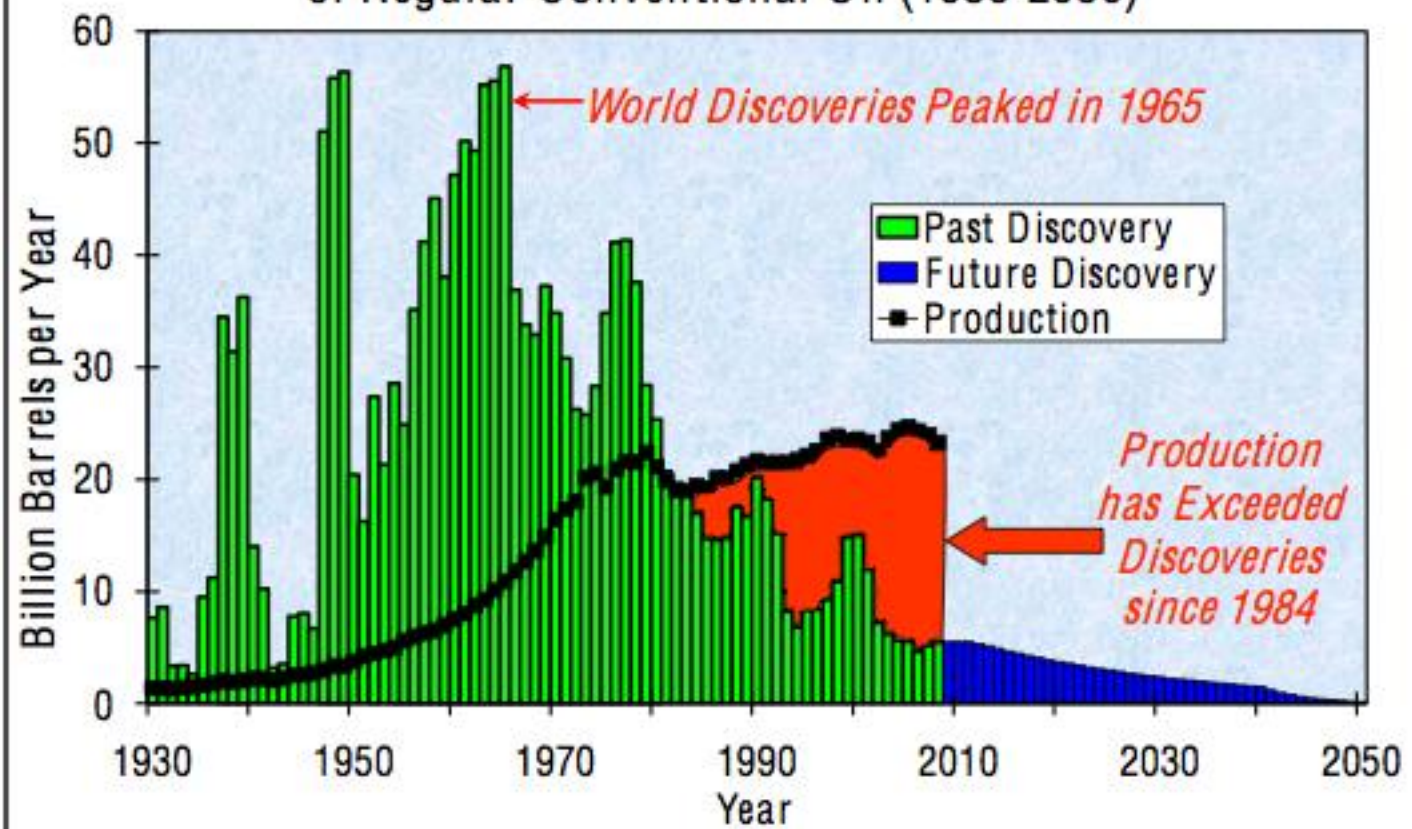
Fraction of Capital Allocated to  
Obtaining Resources



Fraction of the Initial Resource Remaining



### The Growing Gap between Production and Discovery of Regular Conventional Oil (1930-2050)

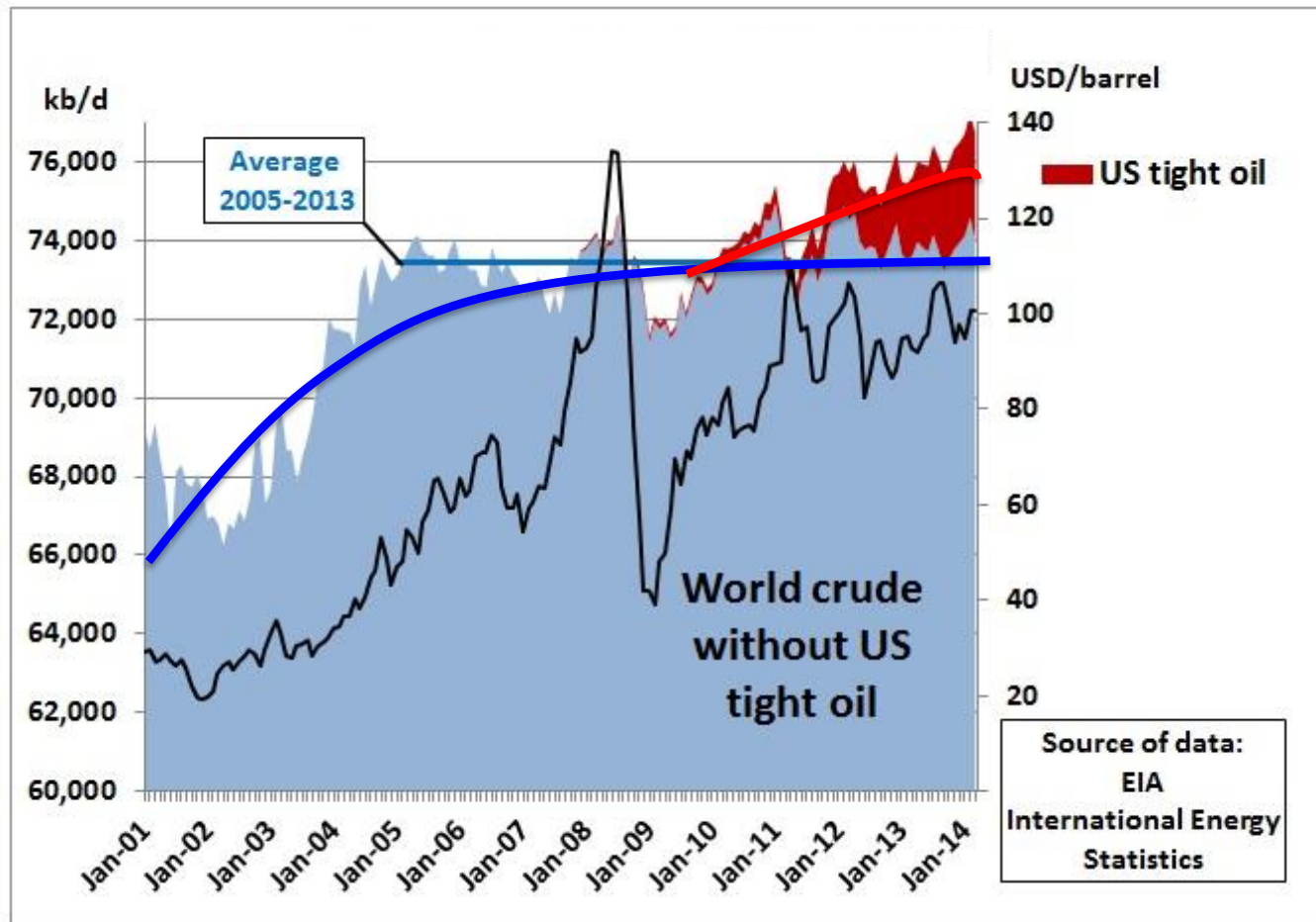


Past discoveries have been backdated with revisions to reflect "Reserve Growth"

© Hughes GSR Inc, 2009

(data from Campbell, personal communication, October, 2009)

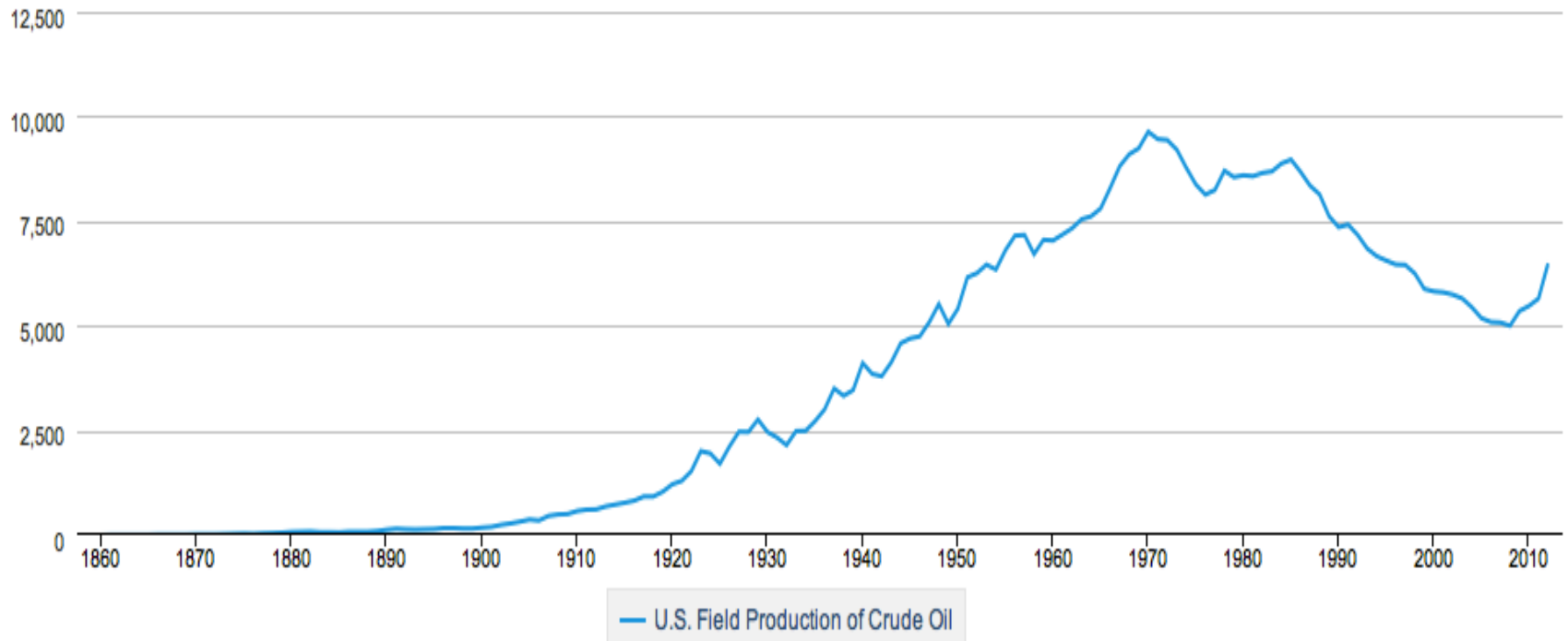
# Crude Oil Production 1/01 – 3/14



# History of US Oil Production

## U.S. Field Production of Crude Oil

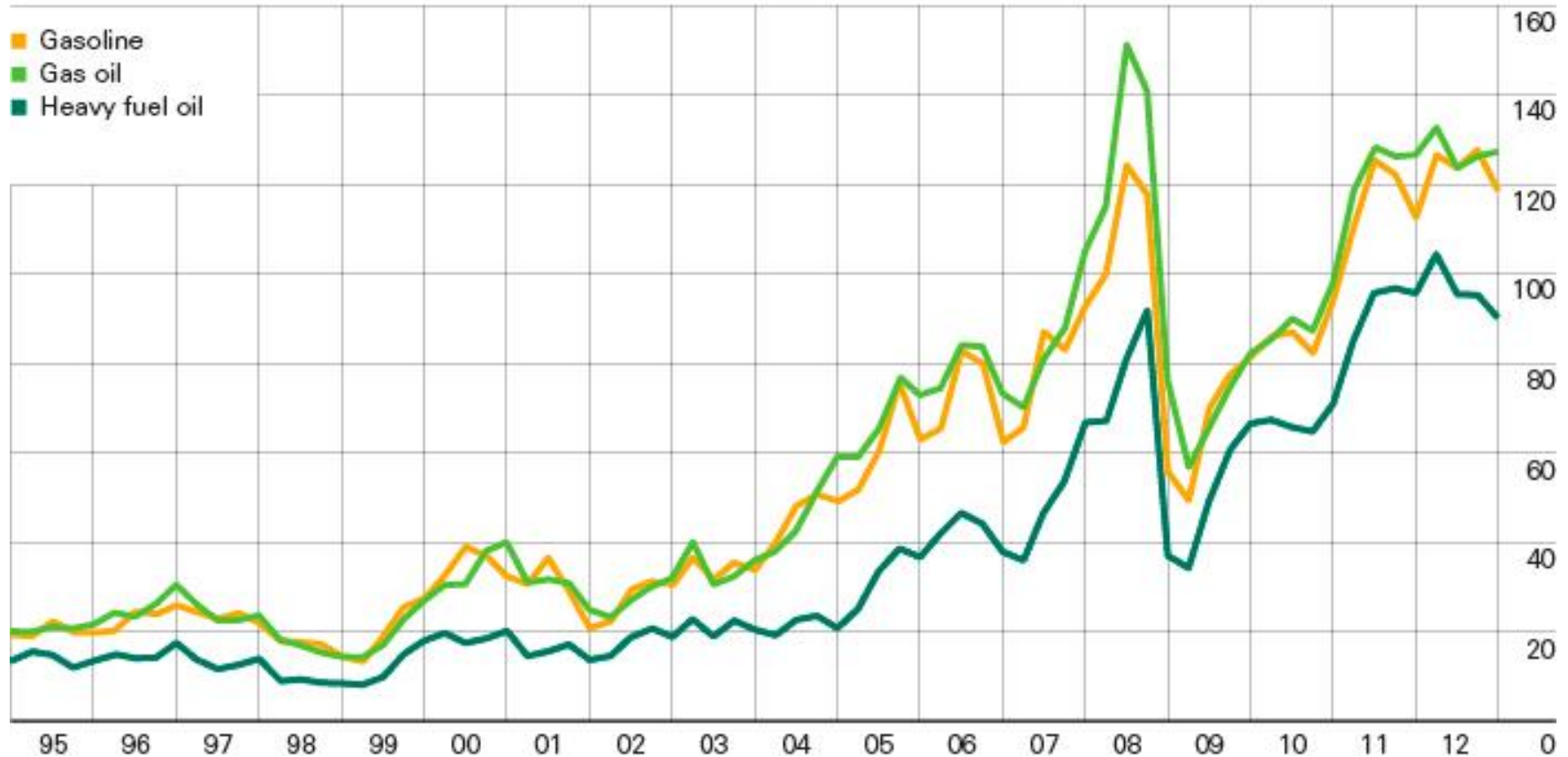
Thousand Barrels per Day



# History of US Oil Prices

Rotterdam product prices  
US dollars per barrel

Source: Platts.



<http://www.bp.com/en/global/corporate/about-bp/statistical-review-of-world-energy-2013/review-by-energy-type/oil/oil-prices.html>



# Main Energy Points from the EIA: *World Energy Outlook 2013*

- Energy demand is shifting to the LDC's
- Potential for fracking in USA >>> other countries
- Fracked oil and gas will have only short-term impact (5-10 years)
- Natural gas price in the US is 1/3 E. and 1/5 J.
- Middle East will remain the low cost oil producer
- Oil will be dominant energy source through 2035
- Oil cost \$/barrel: 2011 = \$110, 2035= \$128

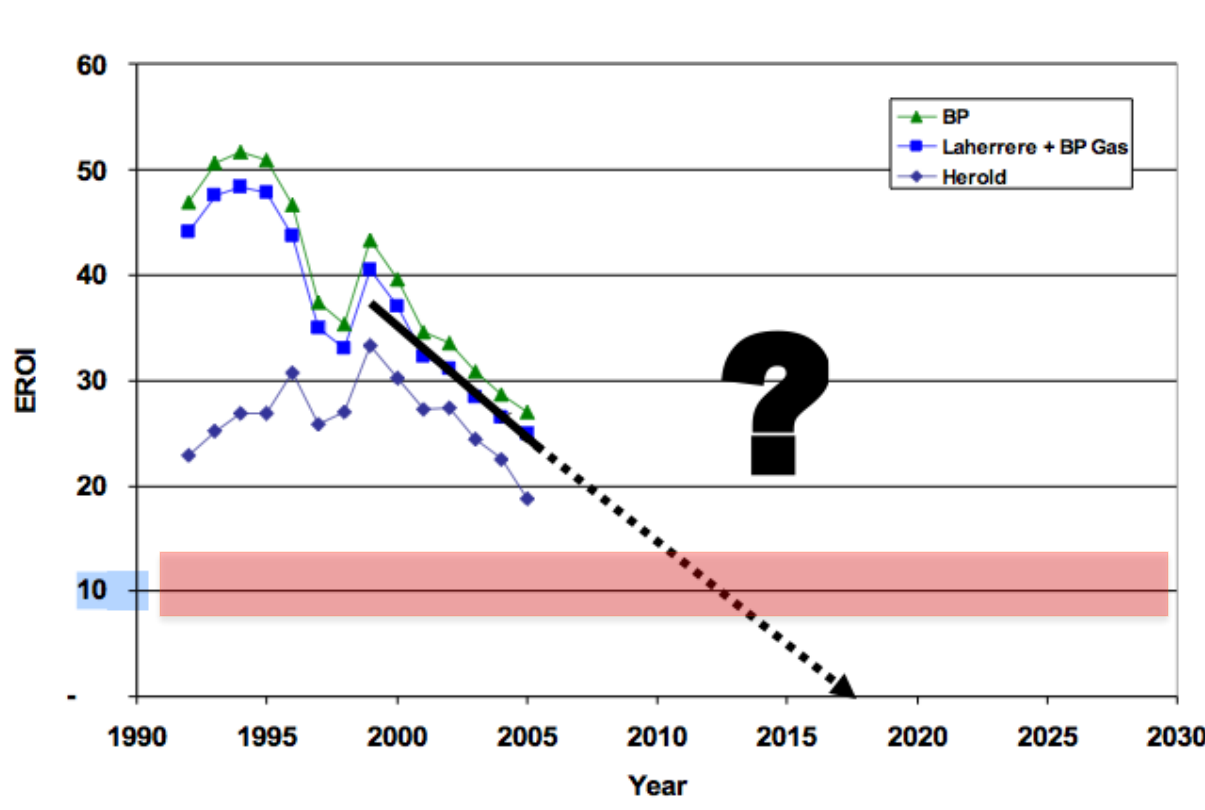
# Energy Gap

- Today ~15 TW, 2050 projected - 30
- Projected shortfall is 17 - 20 TW
- Building one 1000 MW nuclear plant/day for 50 years would give 10 TW
- Wind offers 2-4 TW
- Solar offers 20
- Biomass has 7-10 theoretical maximum

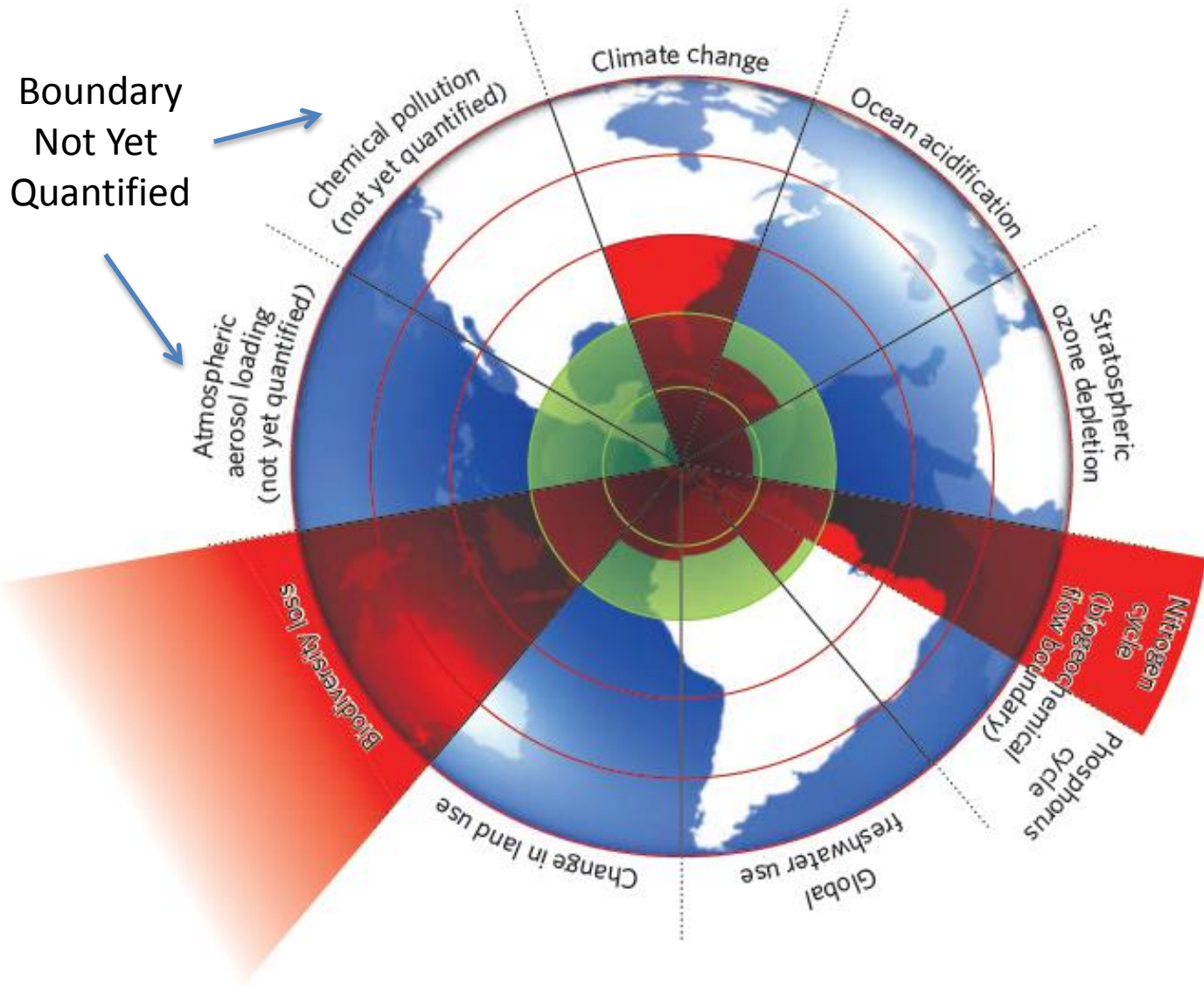
# Some EROI Values

- US Oil 1930 - 100; 1970 - 30; 2005 - 15
- Imported Oil - 30
- Coal - 10 - 80
- Nuclear - 10
- Firewood - 25
- Photovoltaics - 15-45
- Oil Sands - 2-3

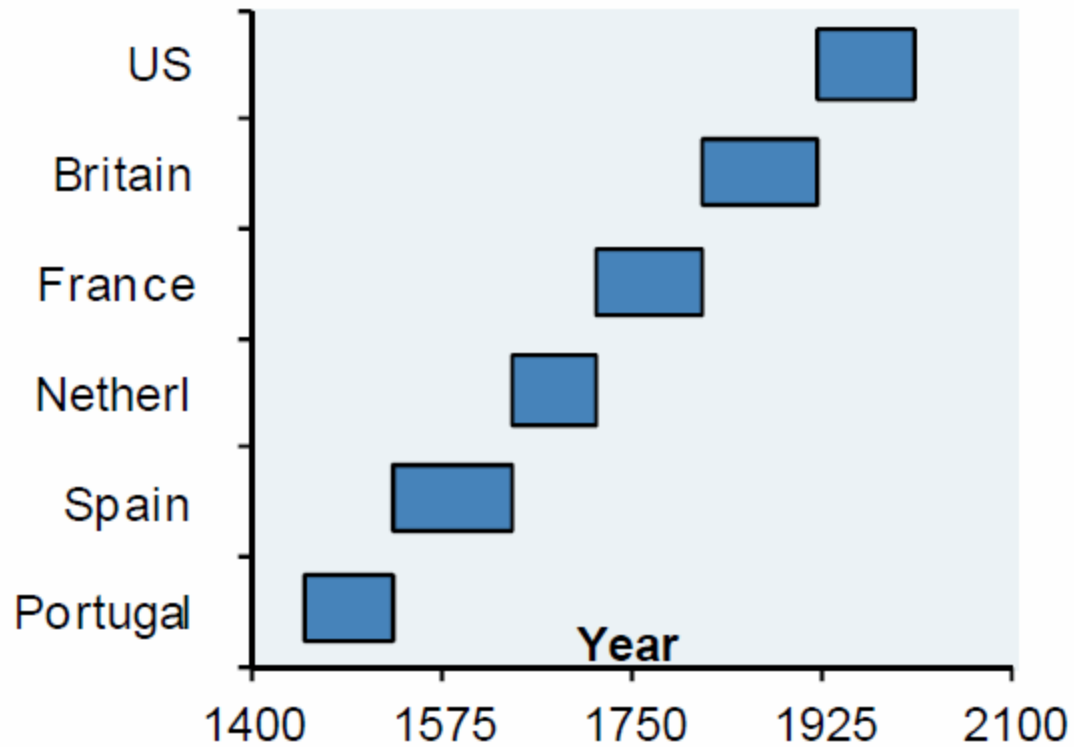
# Energy Return on Investment



# Other Indicators of Overshoot

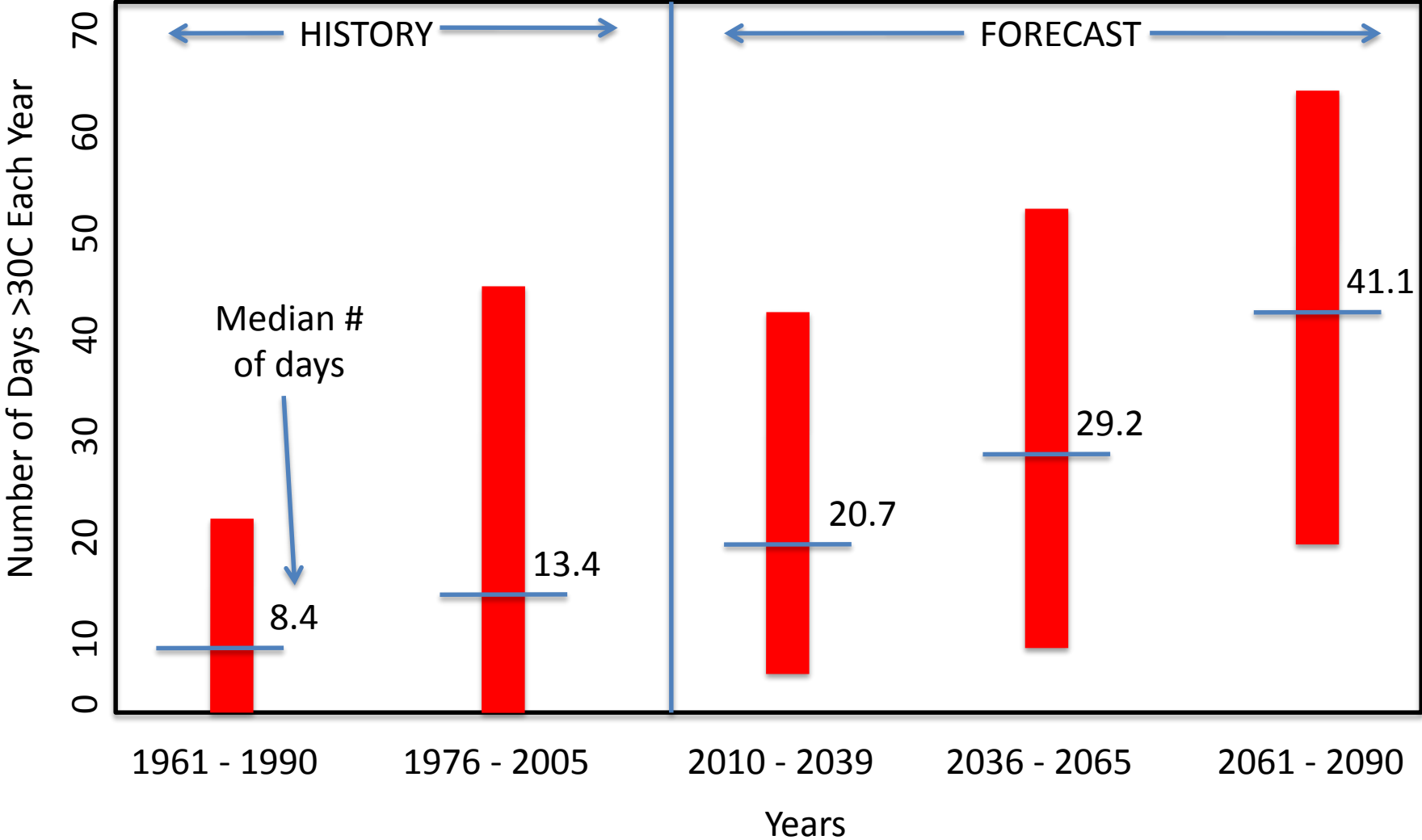


### (c37) Reserve currency status does not last forever



# Climate Change Increases Heat Waves

Number of Days Above 30C Observed In I District; History & Forecast



# Tradeoff Between Efficiency & Resilience





**Resilience** is the capacity of a system to continue providing essential functions after receiving a shock from some problem.

There are two ways to increase resilience:

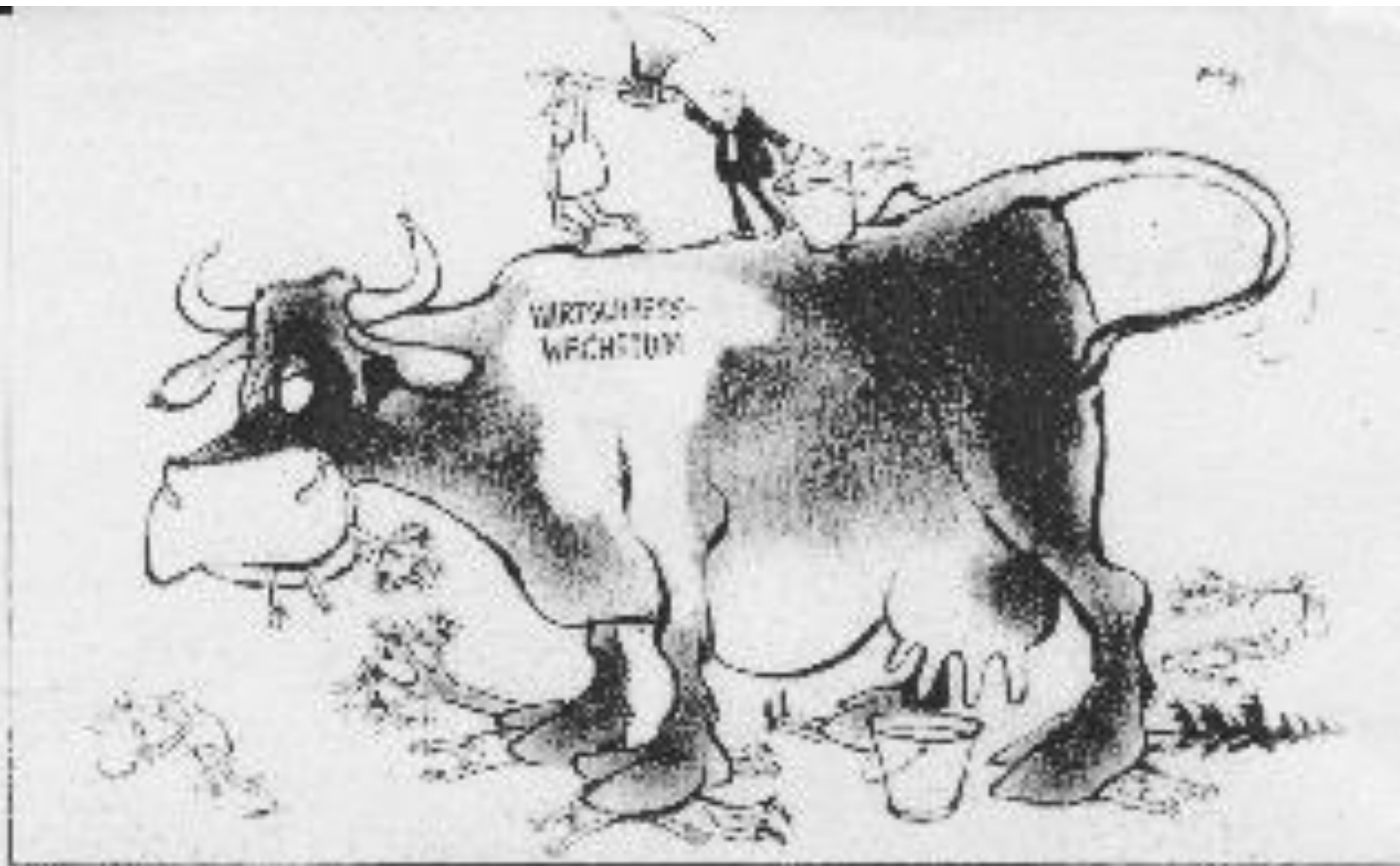
- **Change the structure of the system**
- **Define different essential functions**

# A partial list of ways to alter the structure for increased resilience

- Raise Efficiency
- Build Barriers
- Increase Redundancy
- Add Buffers
- Predict Future Shocks

These can be done at all scales and by investing in both physical and social capital

# Exercise on Habits



„Halt, won melken wir denn dann?“

