Resource Revolution

Capturing the Biggest Business Opportunity in a Century…

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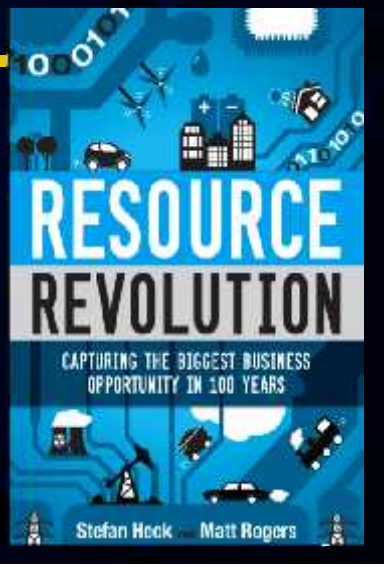
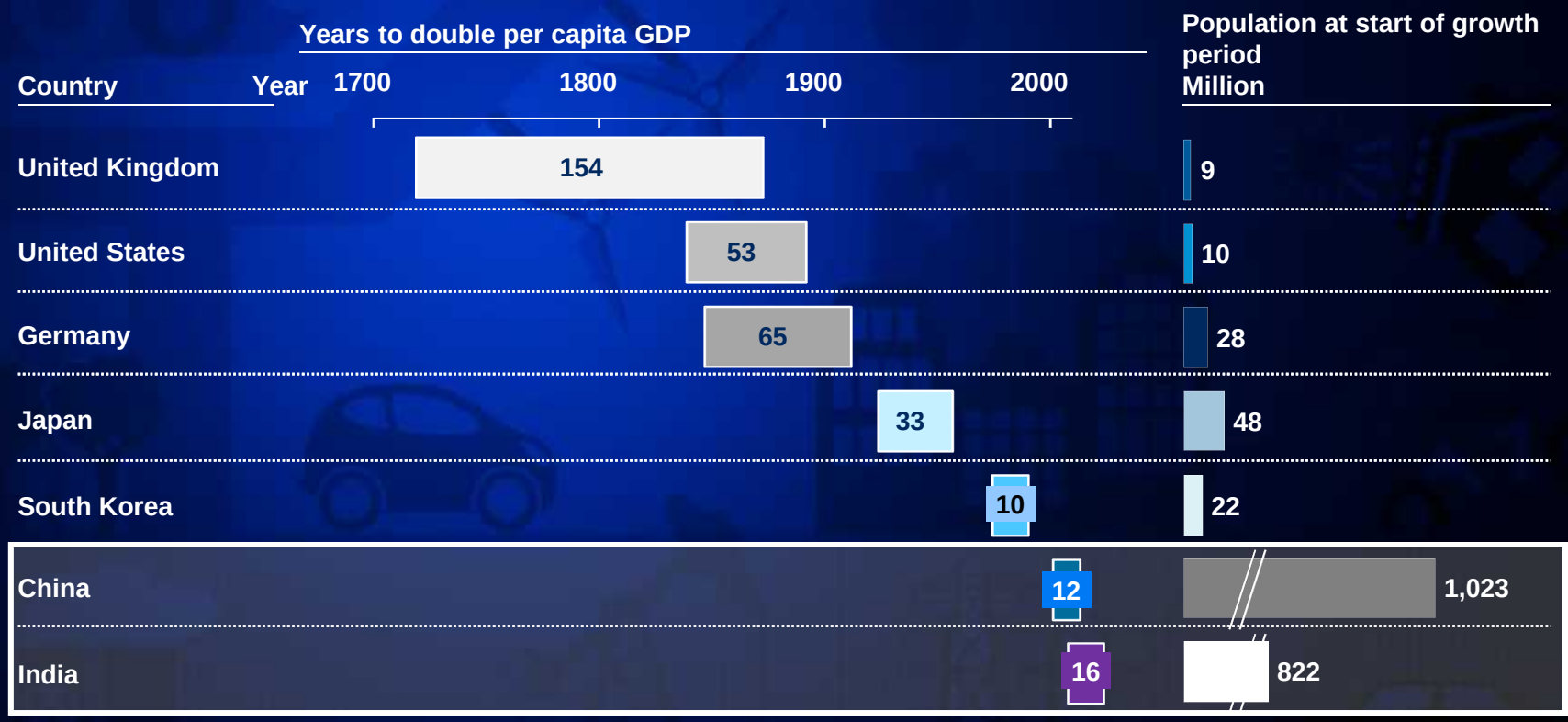
McKinsey & Company
Global Outlook Norway
Arendal August 2015



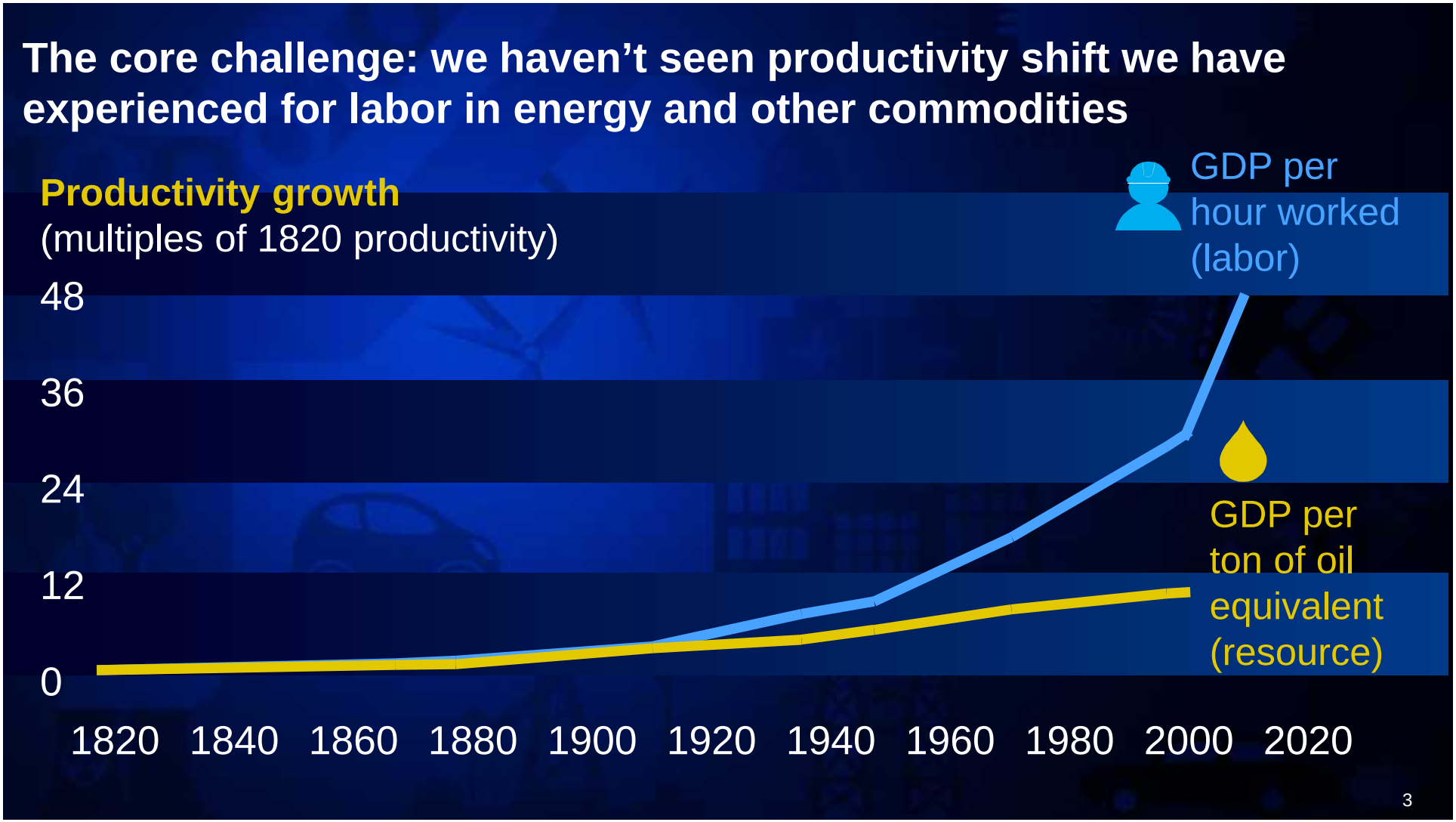
Resource Revolution – the Basics

- 2.5B people entering the middle class, even as resources get harder to produce—companies need to **improve resource productivity 3-5% annually to keep up**
- **The opportunity:** Combining information technology with industrial technology can drive 10x productivity improvements on both supply and demand side
- This shift in the way we produce and use resources will restructure most traditional industrial markets and will require a new approach to management
- **Today's examples:** Buildings, Autos,Oil, Consumer Electronics, Power, Agriculture—each industry facing a 10x productivity shift today

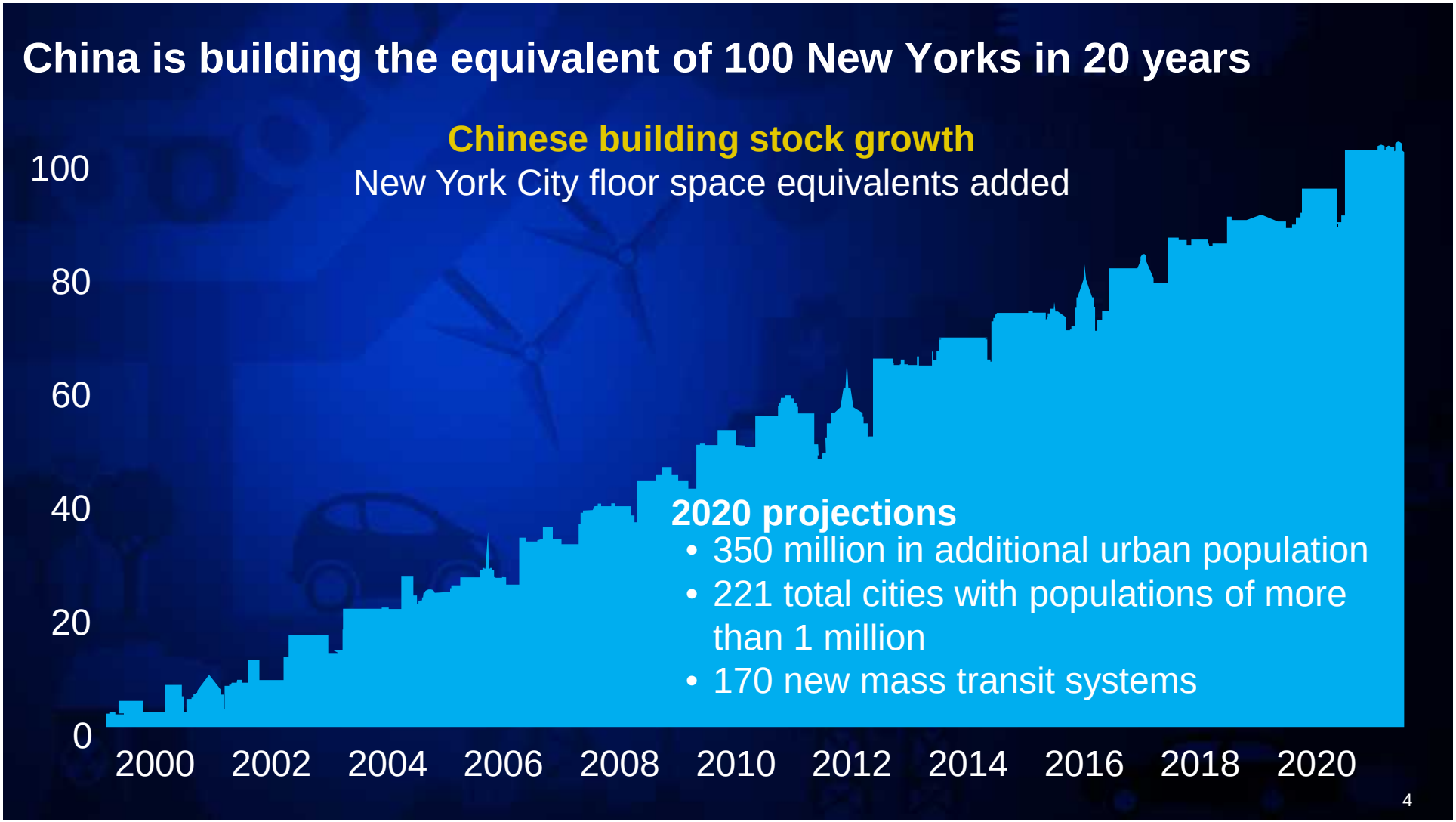
The economic revolution underway is 3000 times larger than the UK Industrial Revolution



The core challenge: we haven't seen productivity shift we have experienced for labor in energy and other commodities

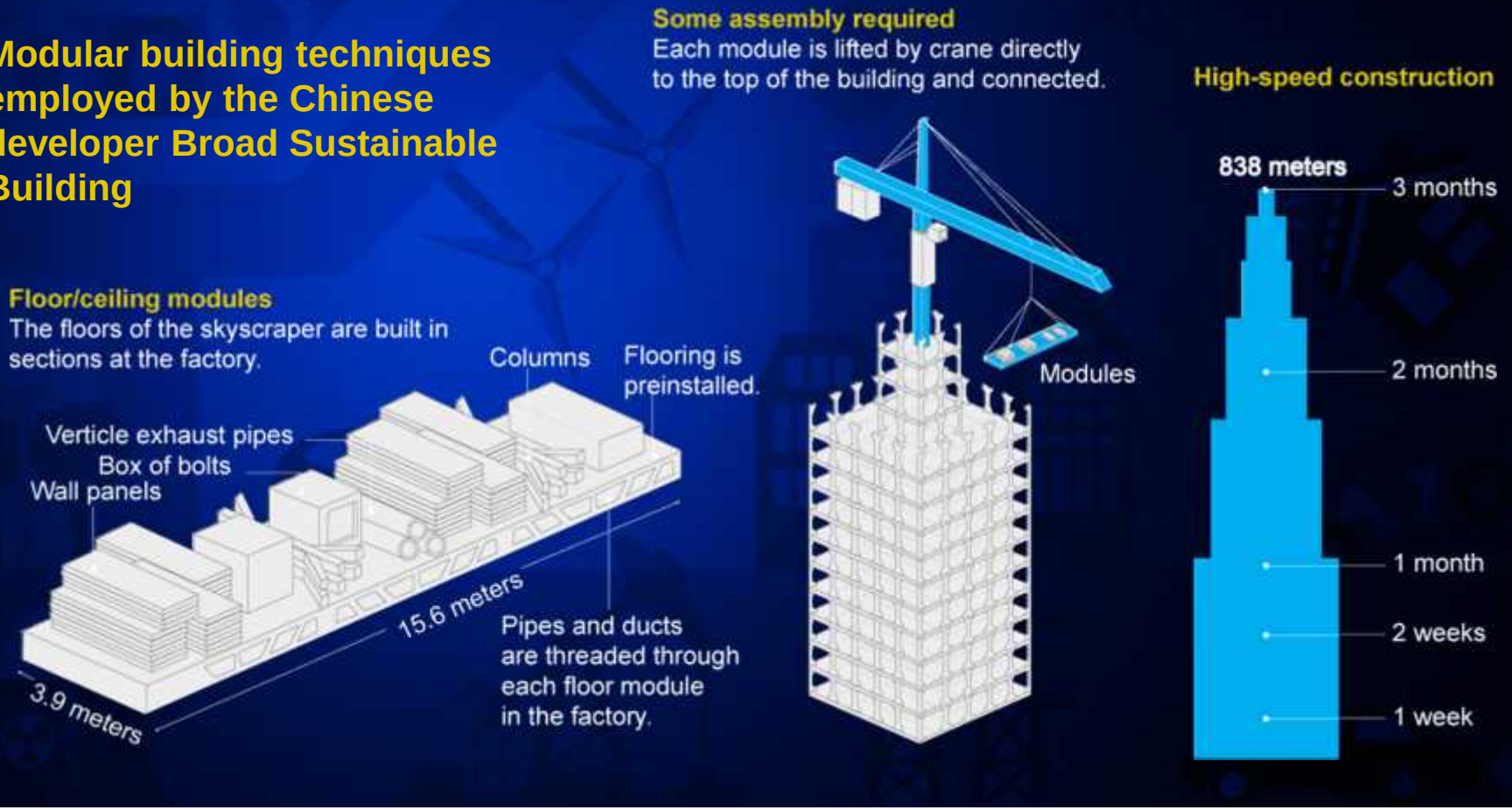


China is building the equivalent of 100 New Yorks in 20 years



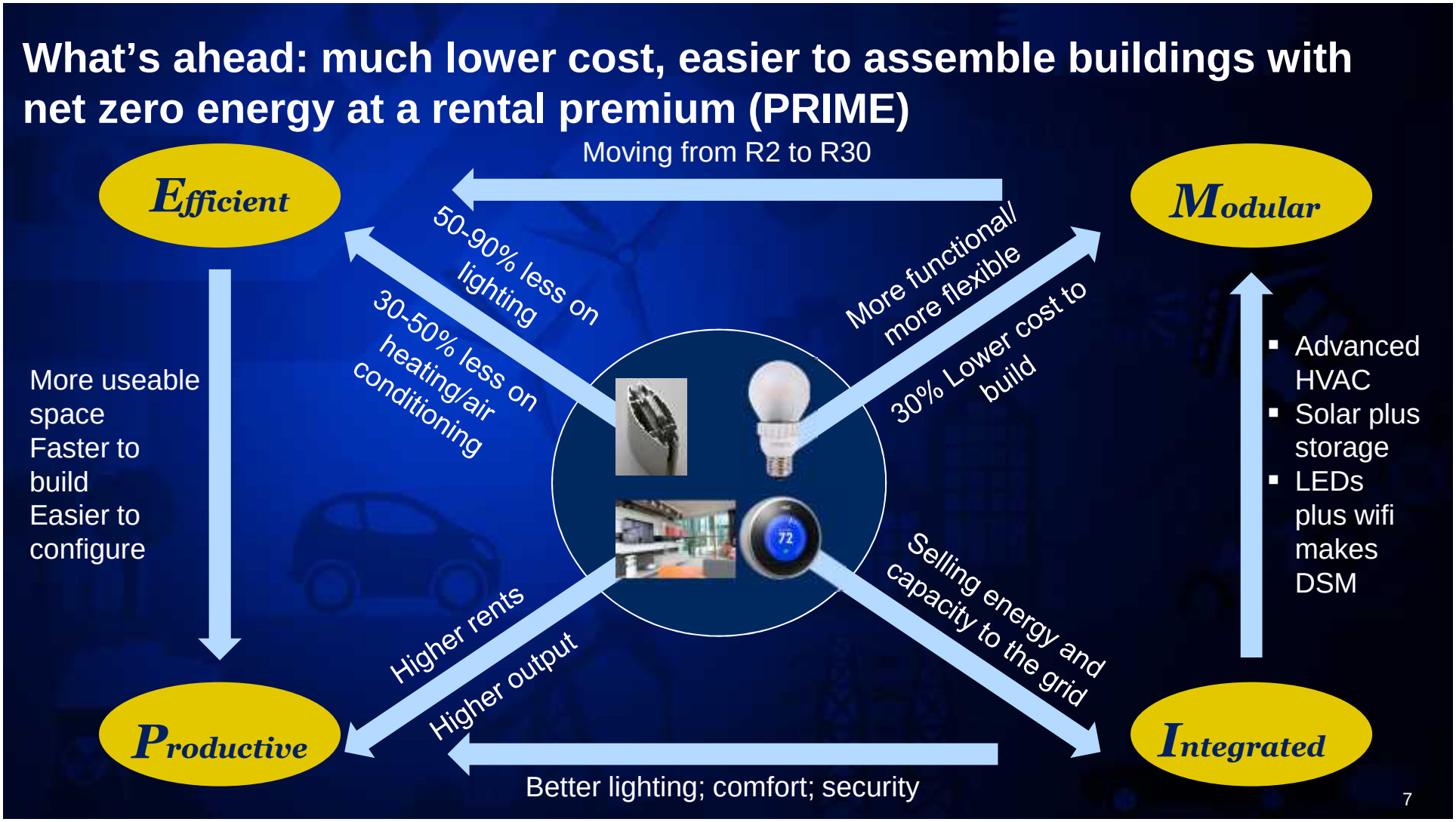
We are seeing a transformation across industries, for example, modular building can save 30-80% of energy and materials

Modular building techniques employed by the Chinese developer Broad Sustainable Building

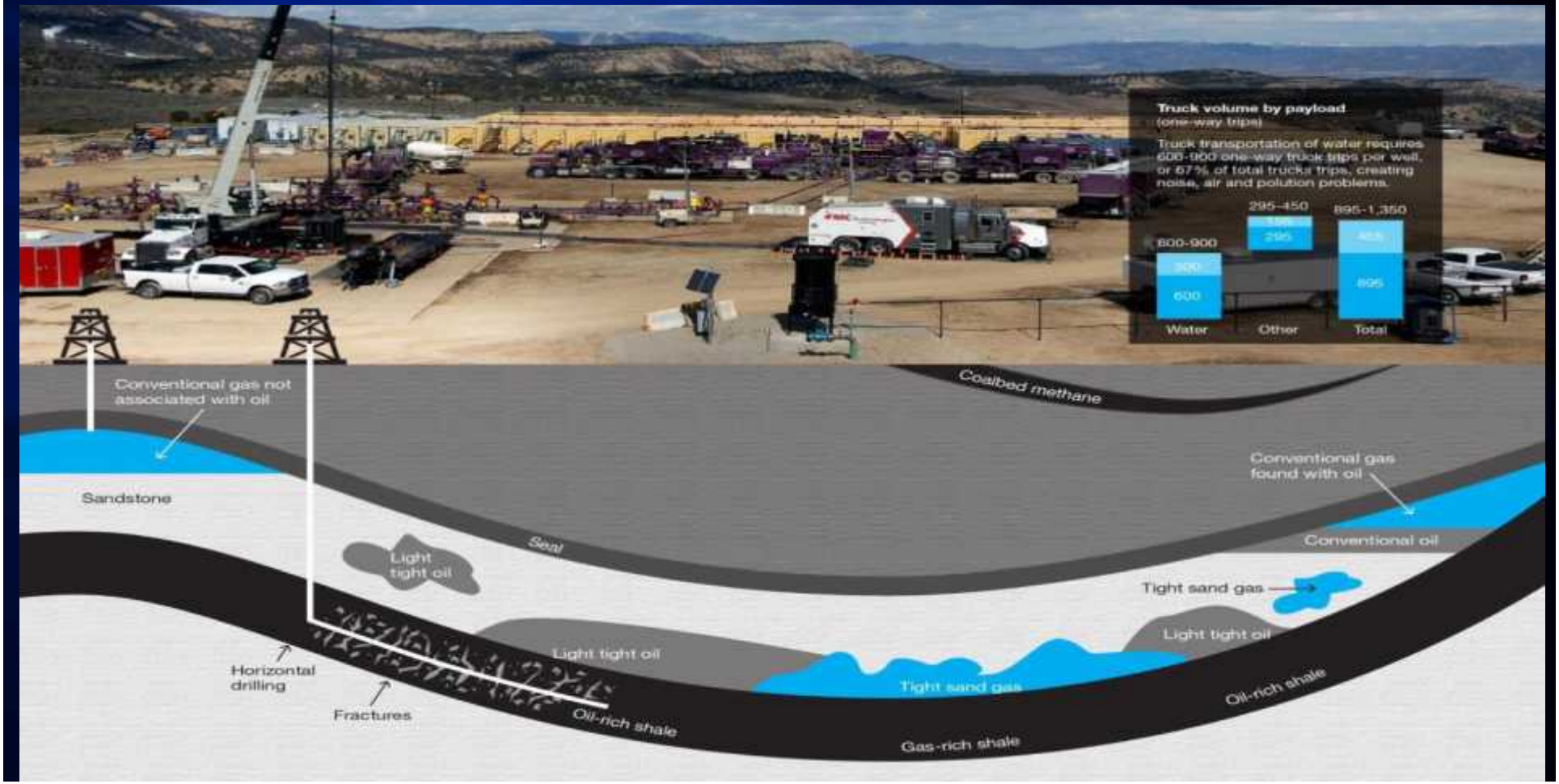


Broad Sustainable Building

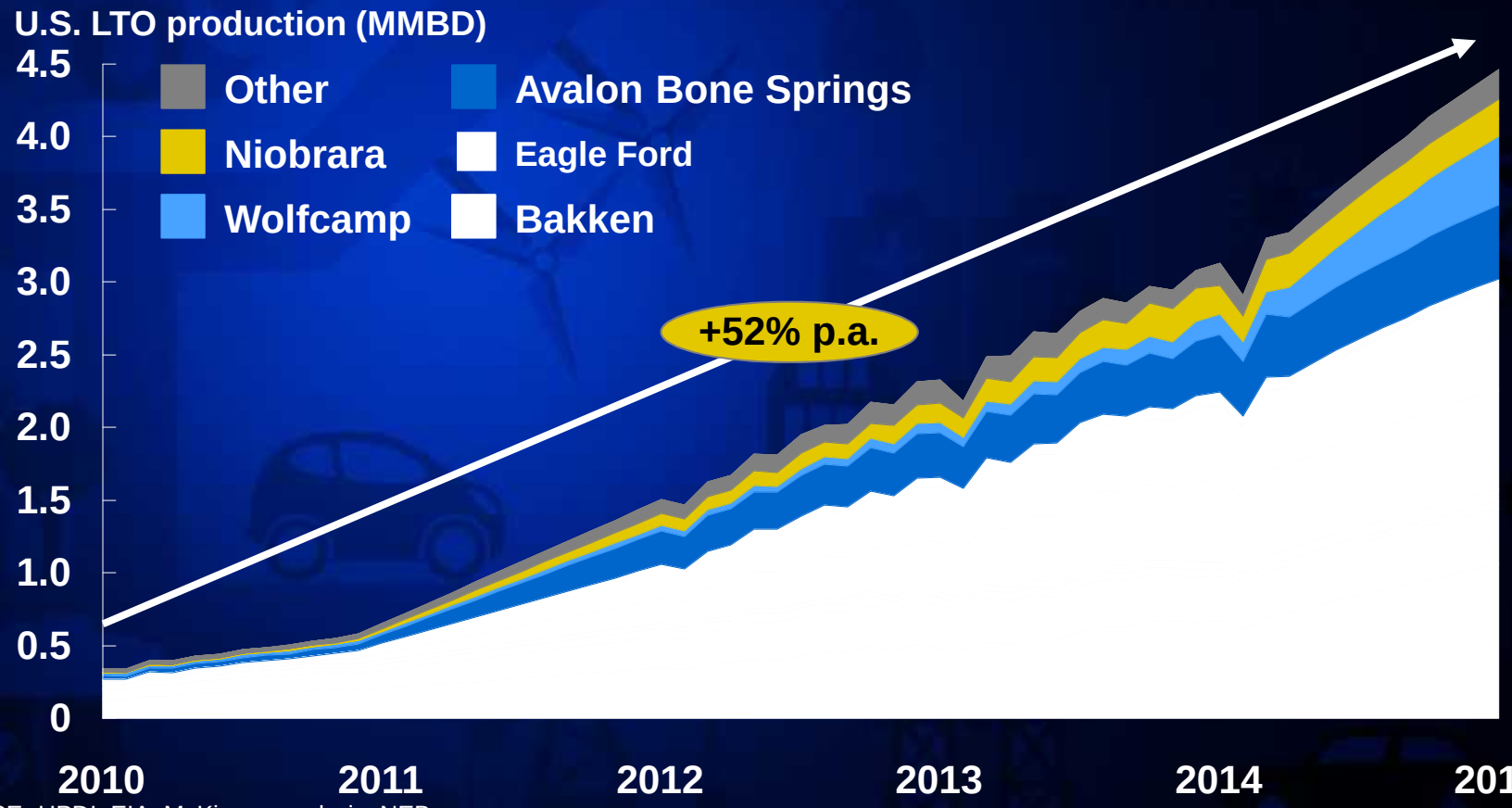
What's ahead: much lower cost, easier to assemble buildings with net zero energy at a rental premium (PRIME)



In oil, hydraulic fracturing – video game technology meets drilling

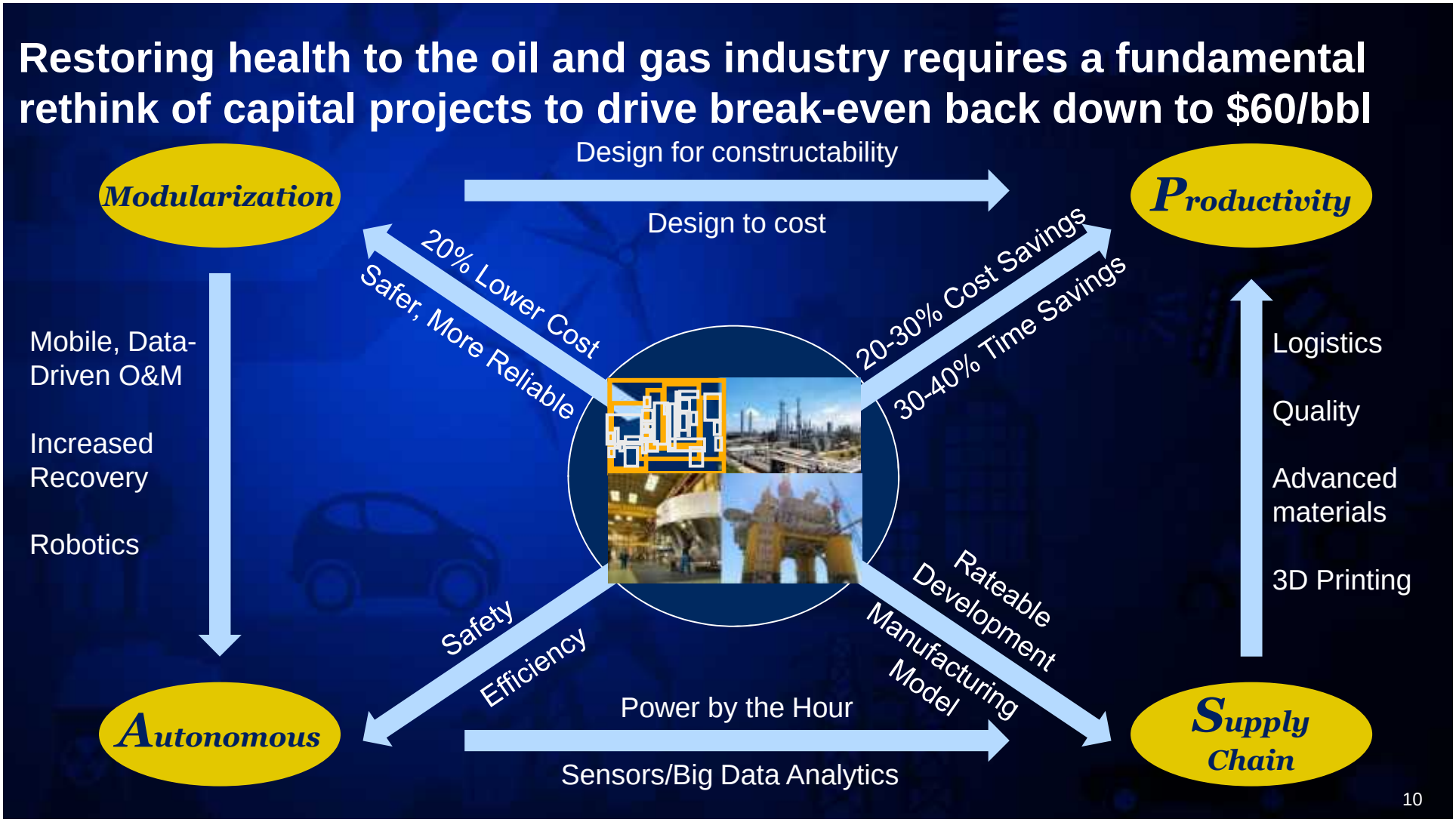


North American LTO production continues to grow, in spite of low oil prices, now surpassing 4 mmbd



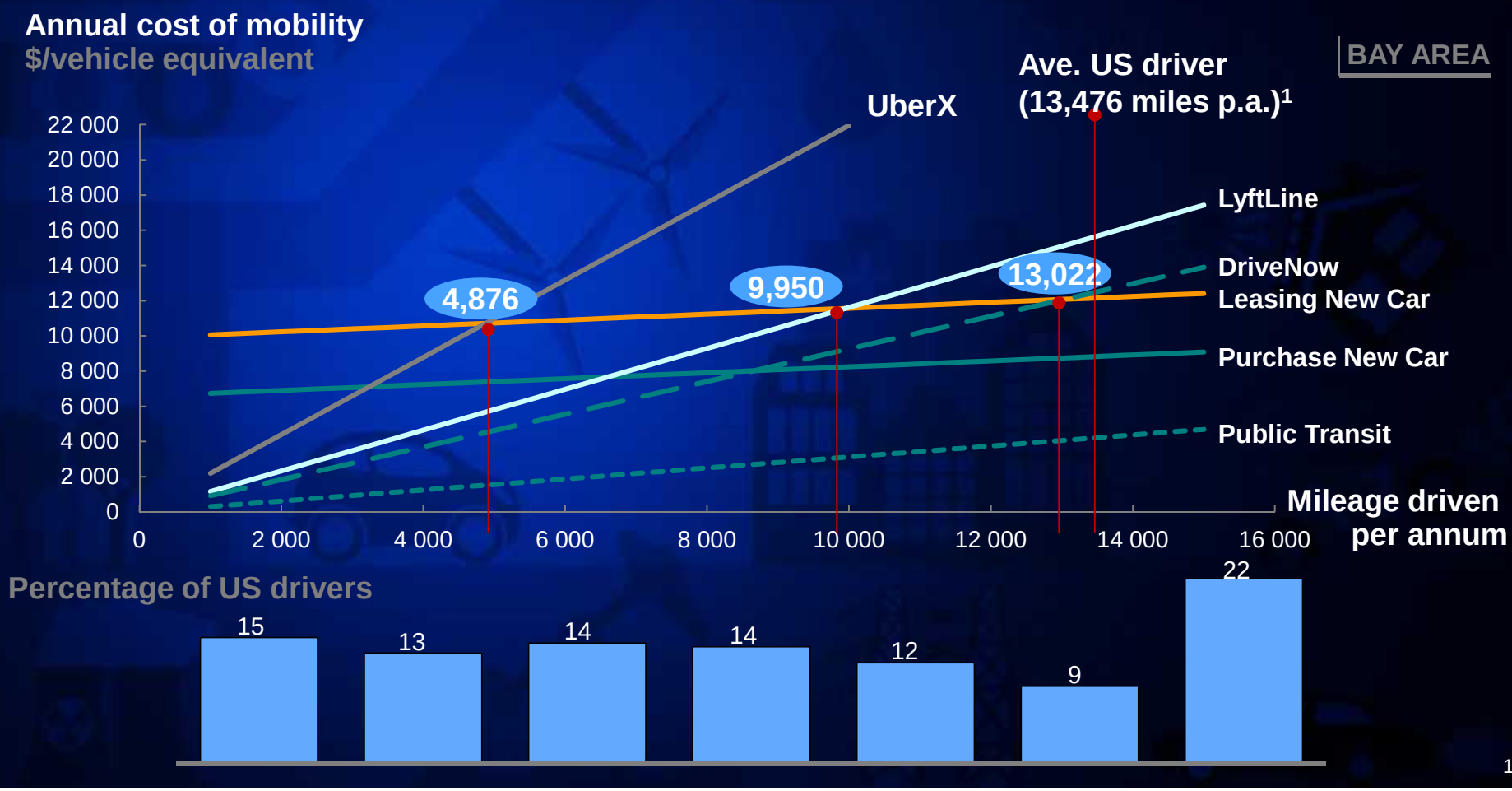
SOURCE: HPDI; EIA; McKinsey analysis; NEB

Restoring health to the oil and gas industry requires a fundamental rethink of capital projects to drive break-even back down to $60/bbl

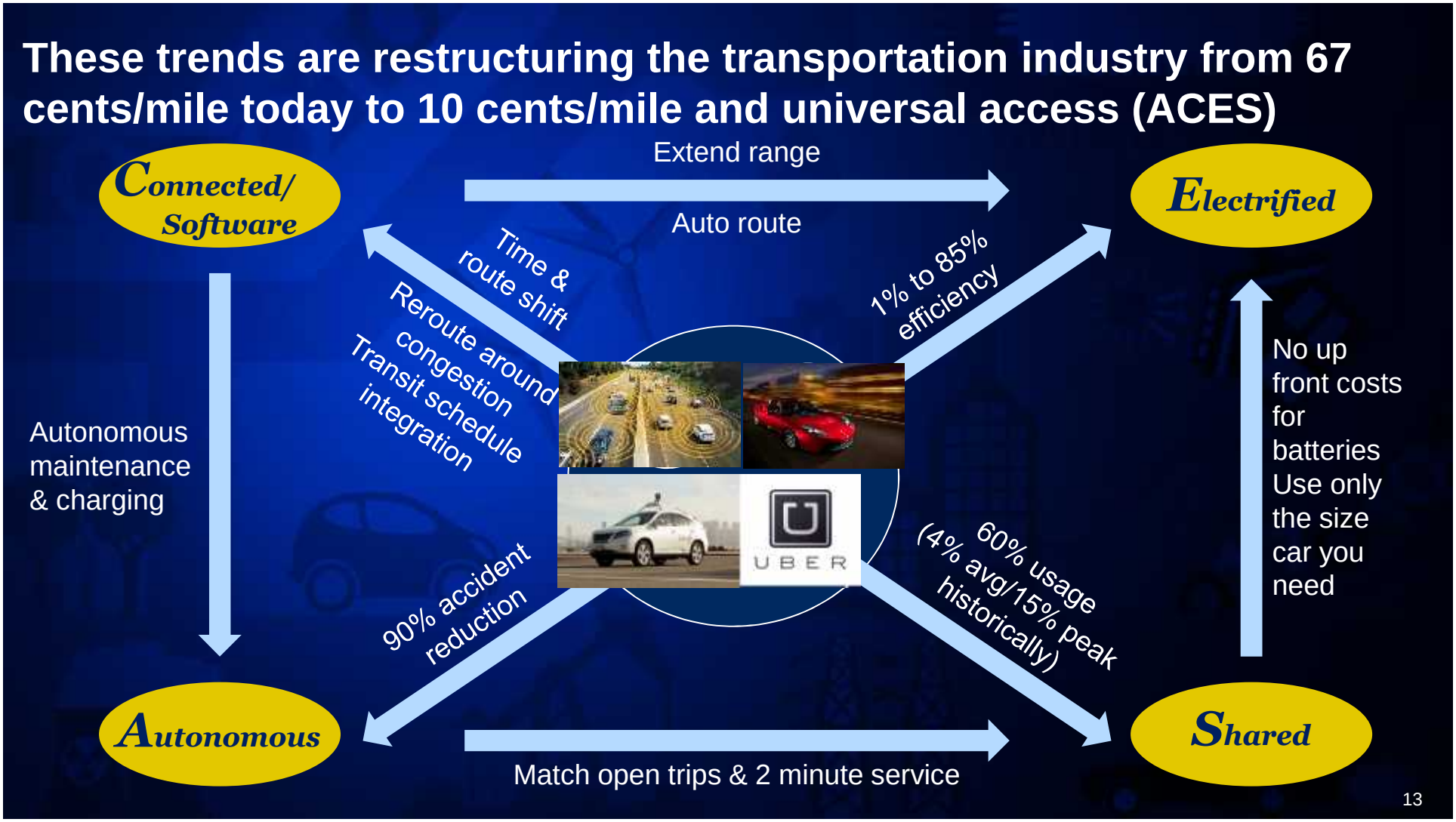


In automotive, we are seeing the development of software defined machinery, e.g. Tesla

… and sharing is “in the money” for low mileage customers



These trends are restructuring the transportation industry from 67 cents/mile today to 10 cents/mile and universal access (ACES)

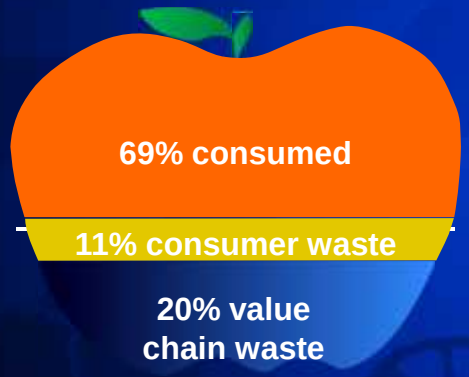


We see massive structural waste in the food system

Productive use

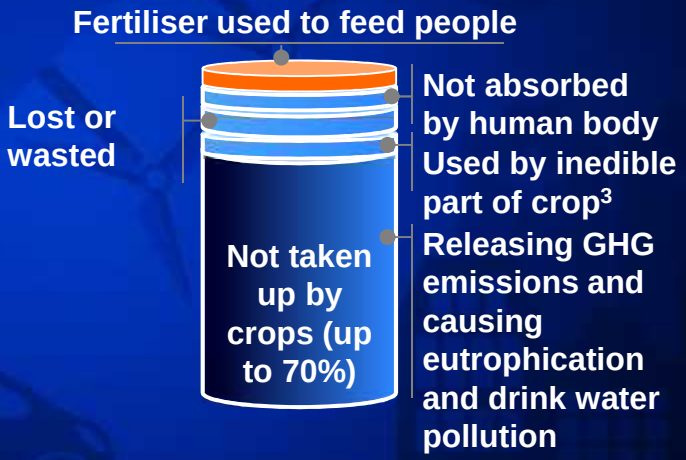
Food waste

In Europe, ~31% of edible food mass produced is lost or wasted



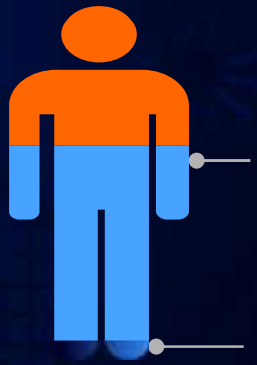
Fertilizer utilization

95% of fertilizers do not provide nutrients to human body



Malnutrition deaths and diseases

Obesity is responsible for ~5% of deaths



50+% of European population is overweight (30+%) or obese (22%)[2]

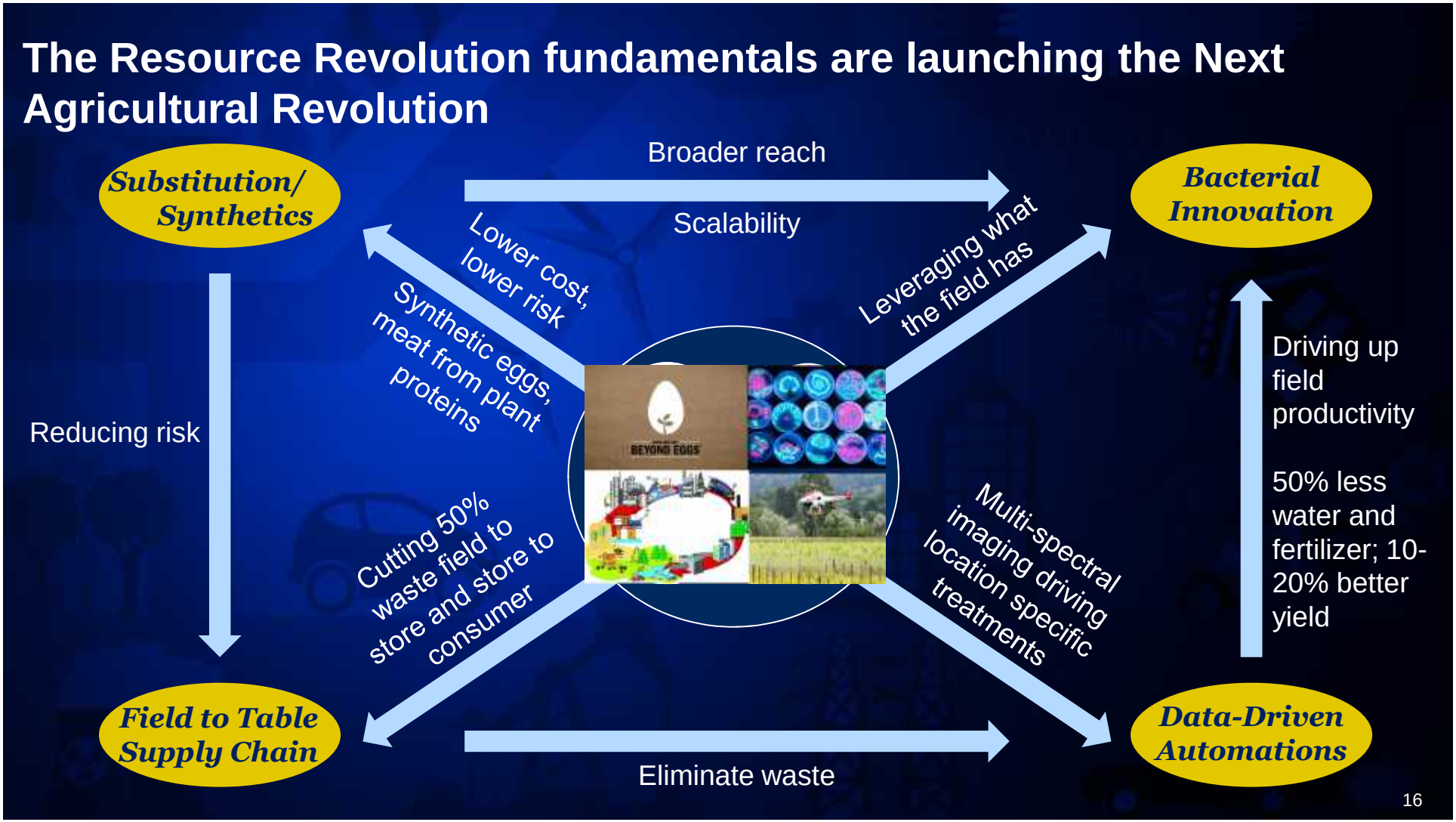
~5% of EU population is at risk of undernutrition

Land degradation

~20% of arable land in EU is affected by soil degradation

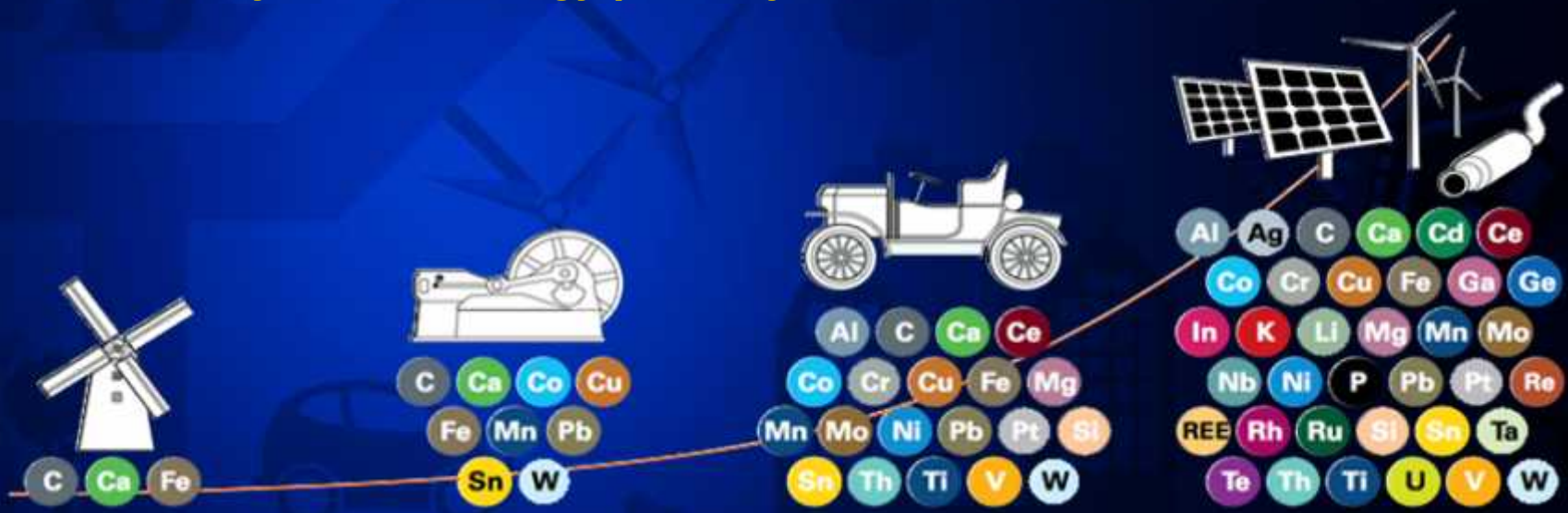
Big data meets industrial technology to change agriculture (and construction, pipeline safety, environmental monitoring, etc.)

The Resource Revolution fundamentals are launching the Next Agricultural Revolution



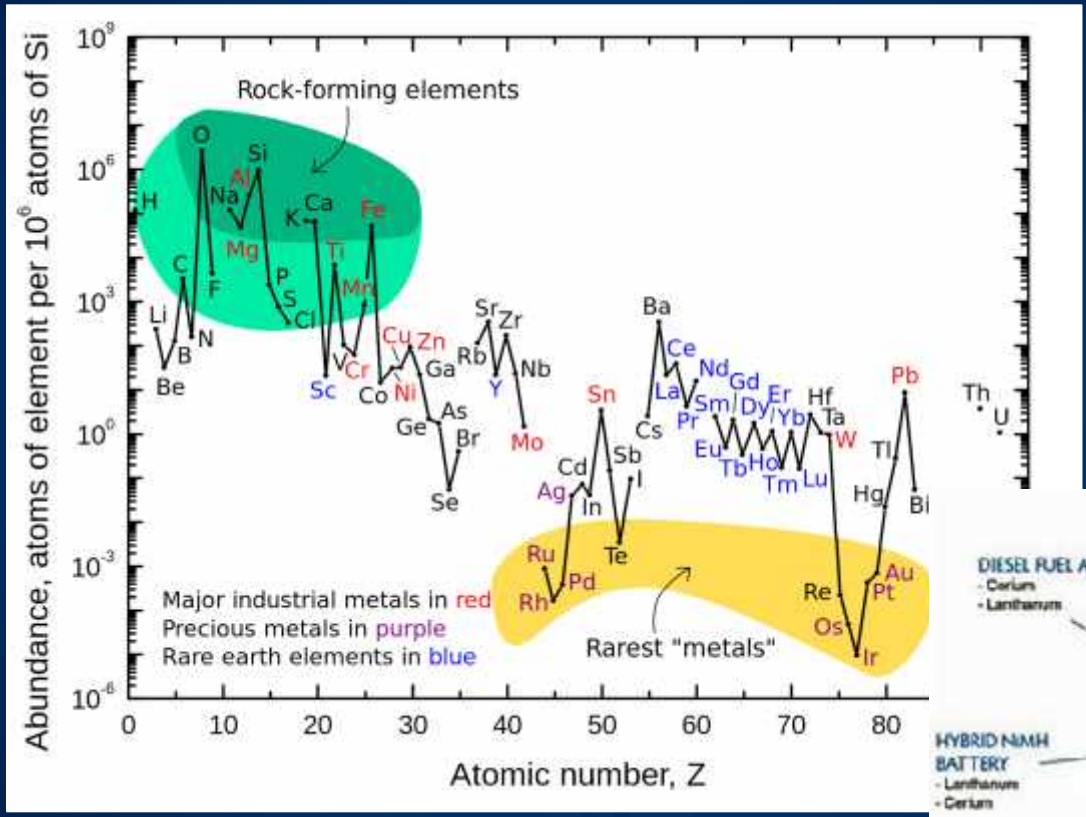
Across technologies, our materials dependency has become more complex

Elements widely used in energy pathways



1700 1800 1900 2000

And we are increasingly drawing on rare materials



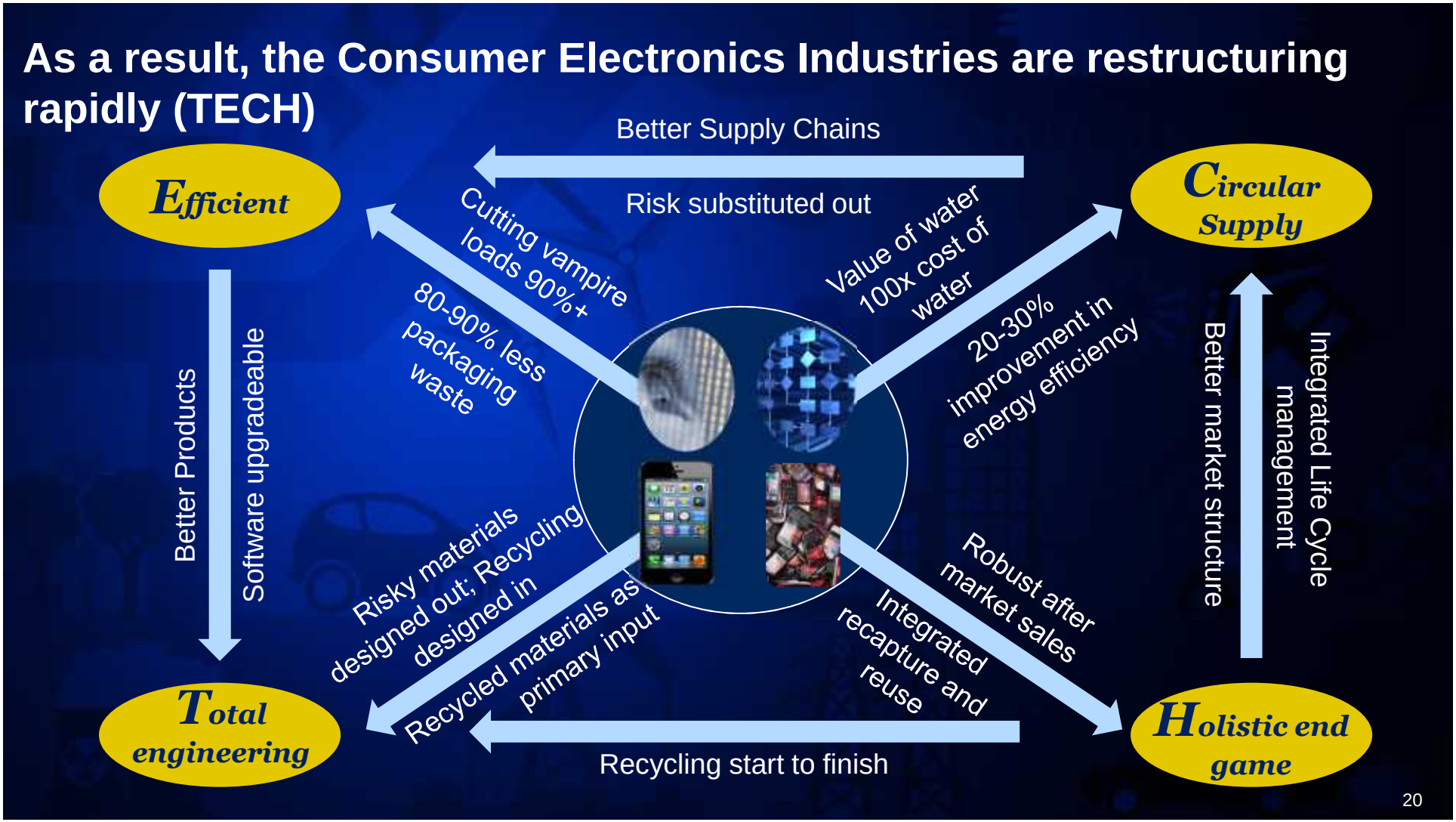
Increasing supply risk

Sustainable for now | Some concern | Significant risk/impact

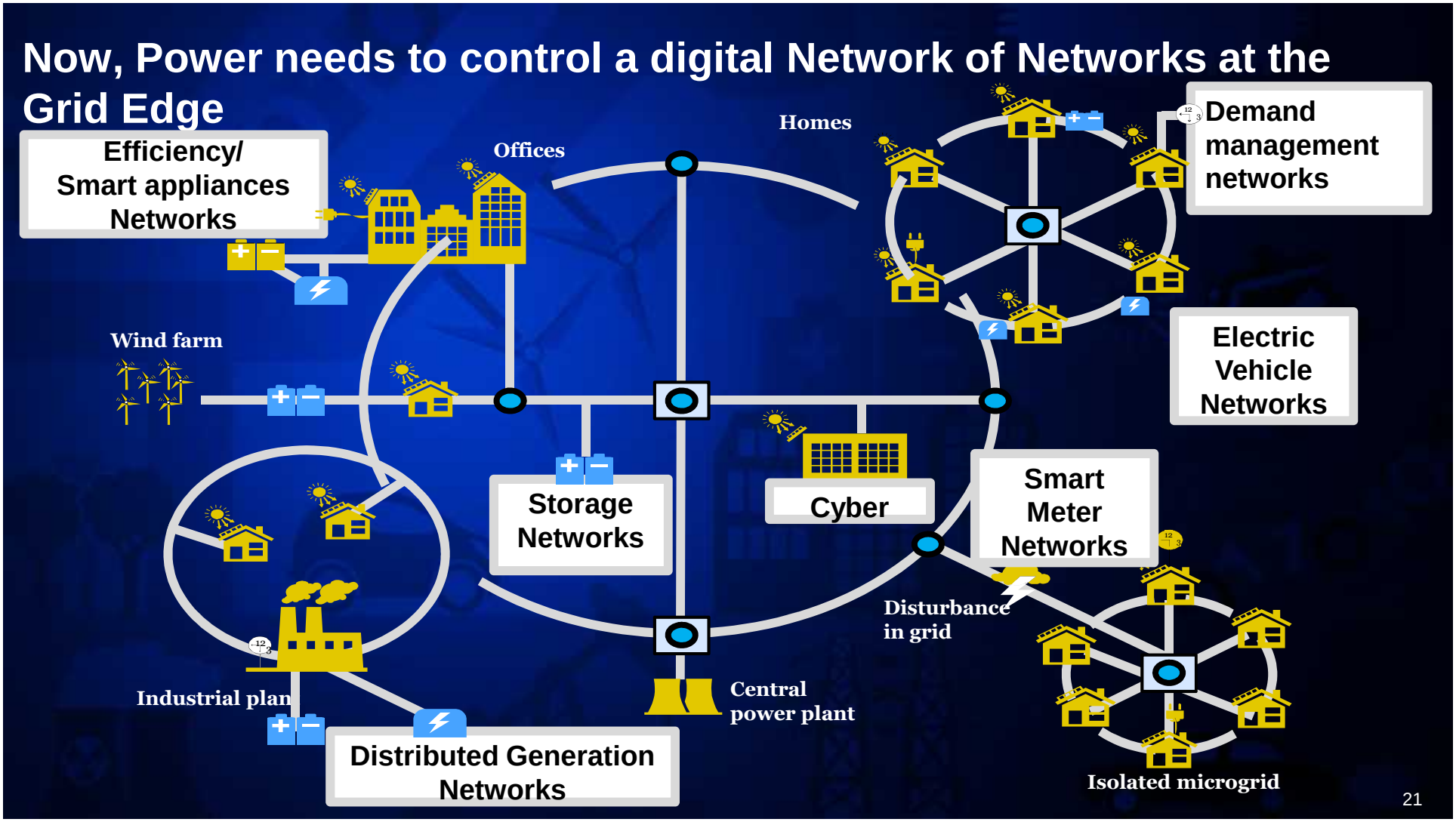
	Global market size $ Billions	Potential for shortage: Years of reserves (reserves/ annual production)	Potential for shortage: Volatility (2004-2009 standard deviation of price/mean price)	Potential for shortage: Geographic concentra - tion (number of countries with significant reserves)	Potential for shortage: Dependency (mined only as byproduct of another material)	Potential for shortage: Recyclability (classifica - tion and percent estimate for recycling)	Impact of shortage: Substitut- abiity	Impact of shortage: Contribu - tion to production processes	Impact of shortage: Resource linkages with food/ energy	Industrial uses
Phosphorous	21	406	62%	High	Low	Low	Difficult	High	High	Agriculture
Potash	18	283	68%	High	Low	Low	Difficult	High	High	Energy, fertilisers, primary constituent of gunpowder
Rare earth	11	846	42%	High	High	Low	Difficult	High	Low	Energy, glass industry as colouring and polishing agents
Chromium	44.7	16	29%	High	Low	60%	Possible	High	High	Energy, autos, textiles, construction, electronics
Vanadium	1.2	243	45%	High	Medium	Medium	Difficult	High	Medium	Energy, steels, chemical industry, ceramic manufacture
Coking coal	151	<50	34%	Medium	Low	Low	Challenges	High	High	Steel production
Iron ore	206	75	30%	Low	Low	61%	Difficult	High	High	Steel, construction, industrial applications
Germanium	0.1	N/A	34%	High	High	30%	Challenges	Medium	Low	Energy, technology, plastics
Platinum group metals	20[3]	174	24%	Medium	Medium	Medium	Difficult	Medium	Low	Technology manufacturing, medicine, glass, oil and gas
Indium	0.3	N/A	24%	High	High	60%-65%	Possible	High	Low	Energy, dental
Cobalt	3.0	83	38%	High	Medium	25%	Challenges	High	High	Energy, steel, medicine, agriculture
Molybdenum	6.0	42	34%	Low	Low	30%	Possible	High	Medium	Energy, autos, plastics
Gallium	0.1	N/A	10%	High	High	High	Challenges	Medium	Medium	Energy, technology manufacturing, medicine
Tungsten	1.6	48	33%	High	Low	30%-40%	Possible	High	Medium	Energy, high intensity industrial processes
Bauxite/ Aluminum[1]	72	133	18%	High	Low	48%	Challenges	High	Medium	Construction, manufacturing, aerospace
Nickel	29	49	42%	Low	Low	43%	Difficult	High	Low	Construction, chemicals
Copper	144	39	30%	Medium	Low	32%	Challenges	High	Medium	Energy, construction
Zinc	28	21	45%	Low	Low	30%	Possible	High	Low	Automotive, building and construction
Gold	104	20	40%	Low	Low	High	Challenges	Low	Low	Jewelry, electronics, aedical, aerospace
Lead	20	20	30%	Low	Low	77%	Challenges	High	Low	Tehnology manufacturing, lubrication and heat transfer, paint
Tin	7	20	24%	Medium	Low	34%	Possible	High	Low	Electronics manufacturing, construction, chemicals, glassware
Silver	14	23	29%	Low	Low	High	Possible	Medium	Low	Energy, household goods, coinage, jewelry, dentistry
Lithium	0.1	514	8%	Low	Medium	Medium	Challenges	Low	High	Energy, ceramics, pharmaceuticals, aerospace

1 Data for reserves and geographic risk pertain to Bauxite. Other data pertain to Aluminum; 2 Wherever possible, market size represents finished/refined metal e.g., market size is for Aluminum metal and not Alumina or Bauxite; 3 2009 data; 4 Platinum group metals includes ruthenium, rhodium, palladium, osmium, iridium, and platinum and are grouped together because of their similar physical and chemical properties as well as tendency to occur together in the same mineral

As a result, the Consumer Electronics Industries are restructuring rapidly (TECH)

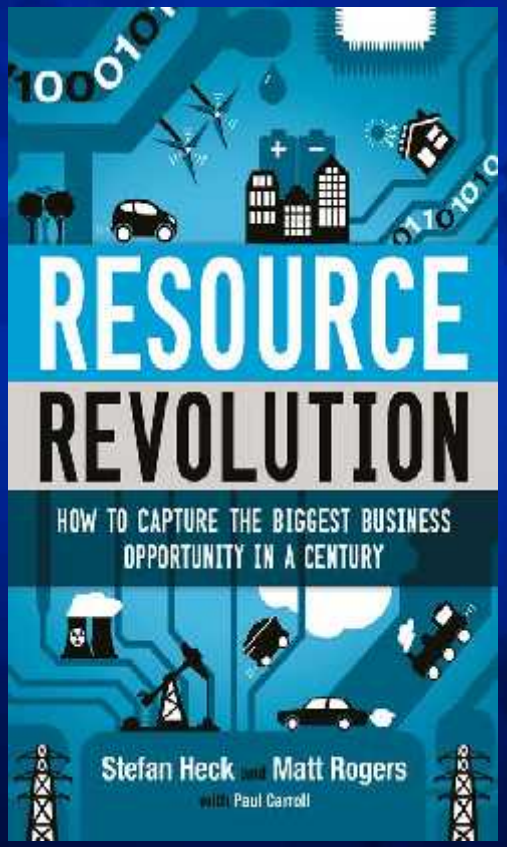


Now, Power needs to control a digital Network of Networks at the Grid Edge



So, even the mature utility industry is undergoing a major 10x productivity restructuring (4D)

Get the full story



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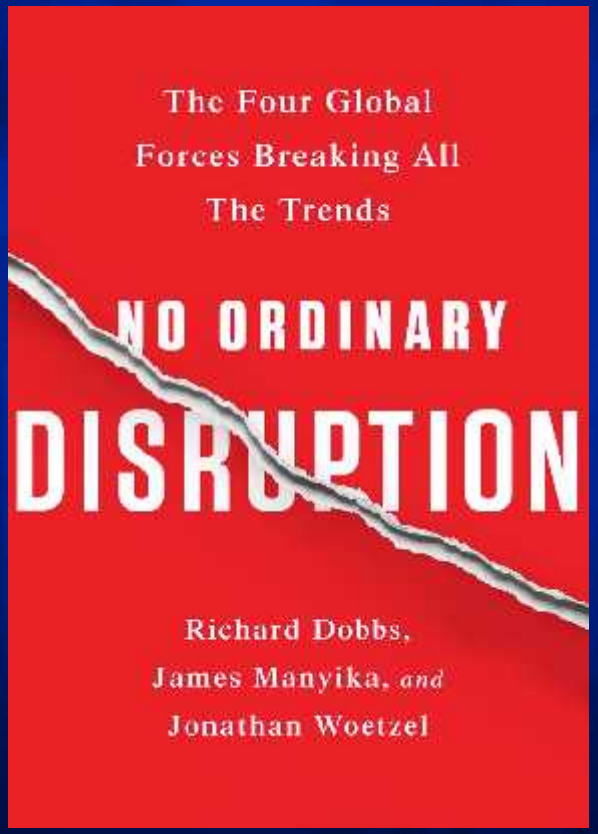
- Food and Agriculture

#ResourceRev

And the companion story



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