Materials Sustainability In The Future "Era of Insufficient Plenty"

(when the world economy returns)

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NOTE: Pleae open the slide notes to read the narrative for each slide.

Definition - Sustainability

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

(World Commission on Environment and Development - Brundtland Commission, 1987

Great definition, but completely ignores the fact that There are several event horizons and contexts against Which any definition of sustainability must exist.

Definition – Era of Insufficient Plenty

The last century starting with the industrial revolution has been characterized by two major processes. The first is the extraction and processing of natural resources to feed the product lines at a reasonable cost. The second was the finding and buying or negotiating for a commodity, device or knowledge fragment with confidence that it was available albeit at a price. What happens when things we need for our processes become unavailable at any price and we are not ready with the tools and knowledge of alternatives with full cognizance. This situation suggests that every major engineering discipline will be challenged to find alternative materials, methods and processes.

Setting the Stage

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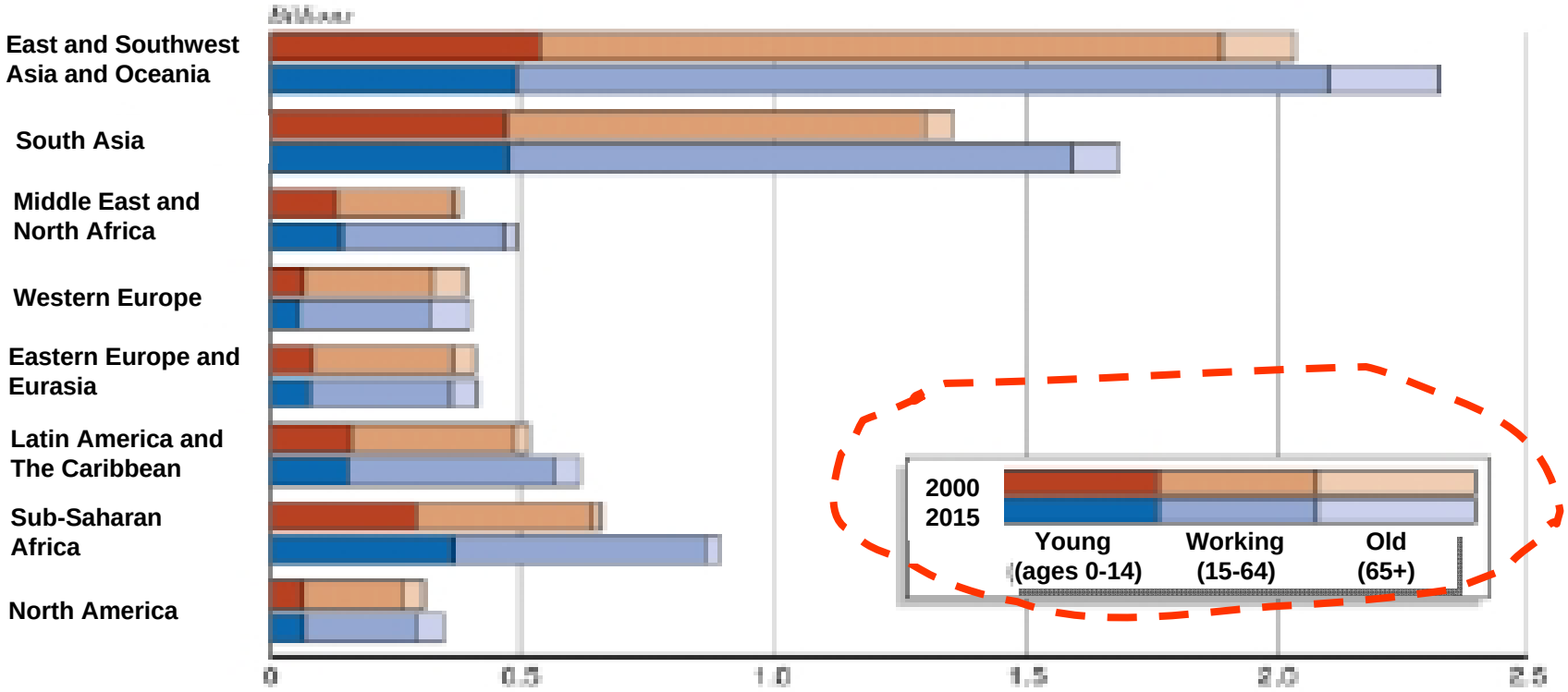
NIC - Global Trends 2015

Regional Population by Age Group: 2000 and 2015



Source: US Bureau of the Census.

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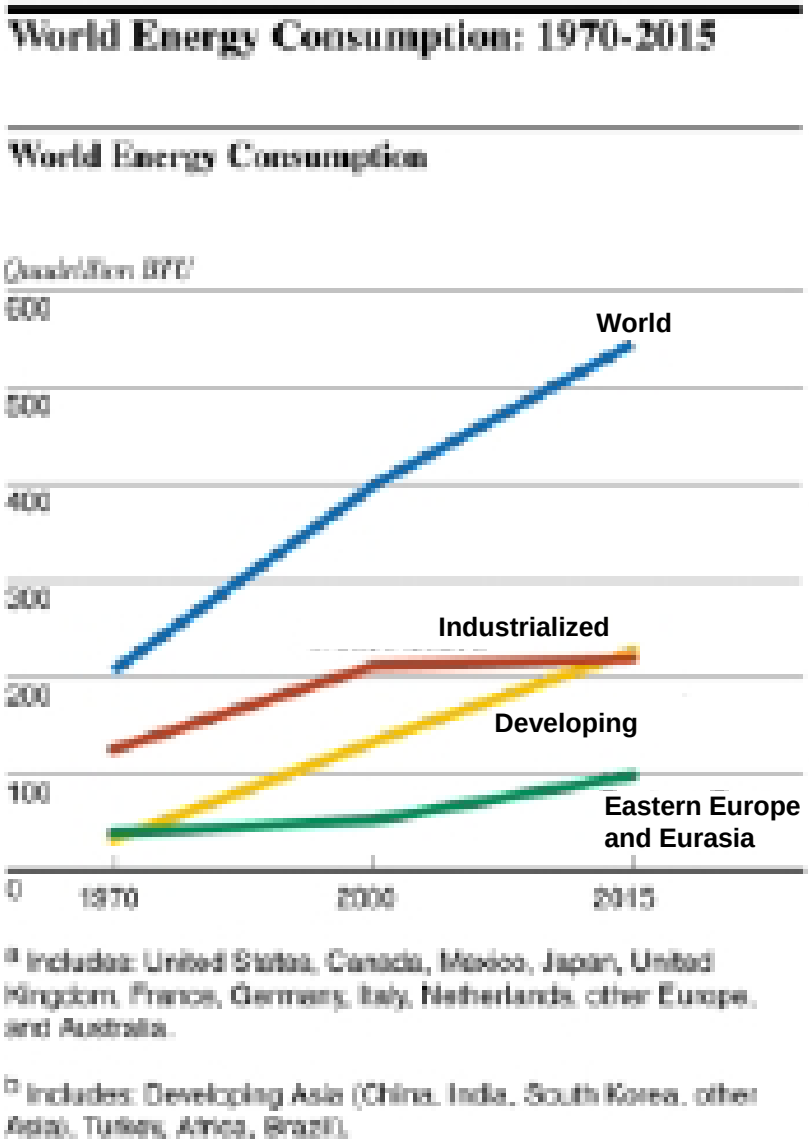
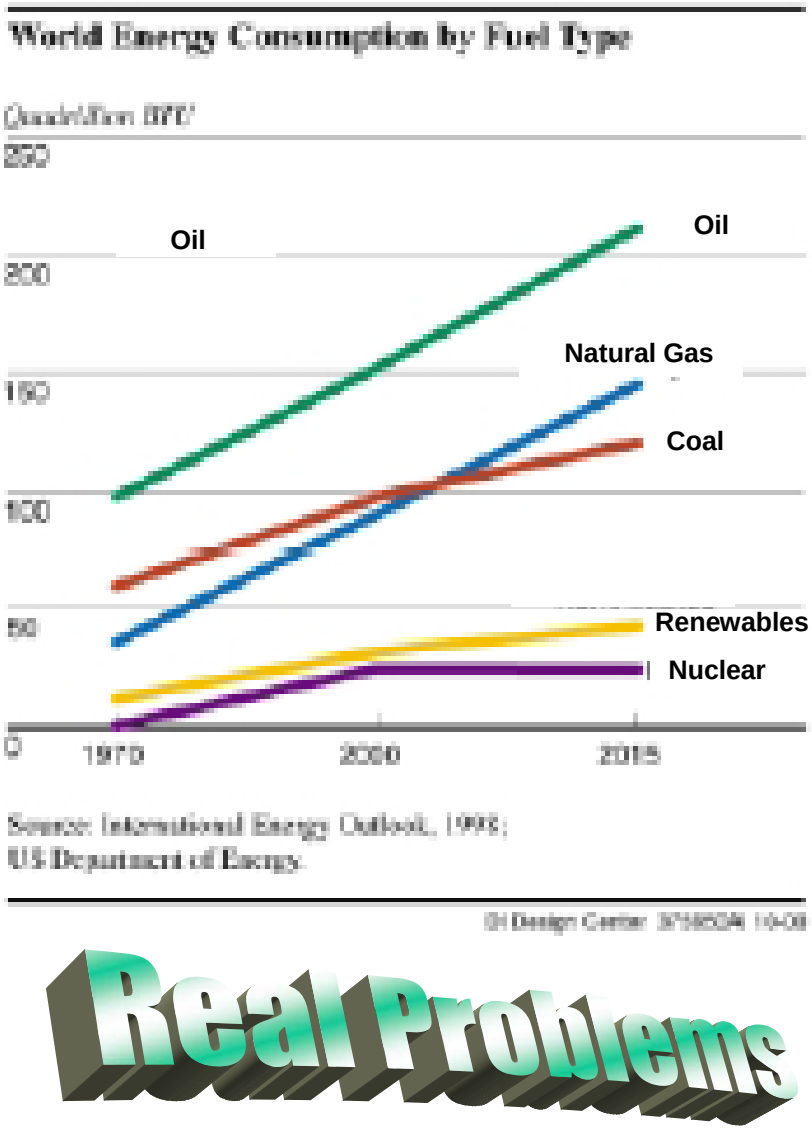
NIC - Global Trends 2015





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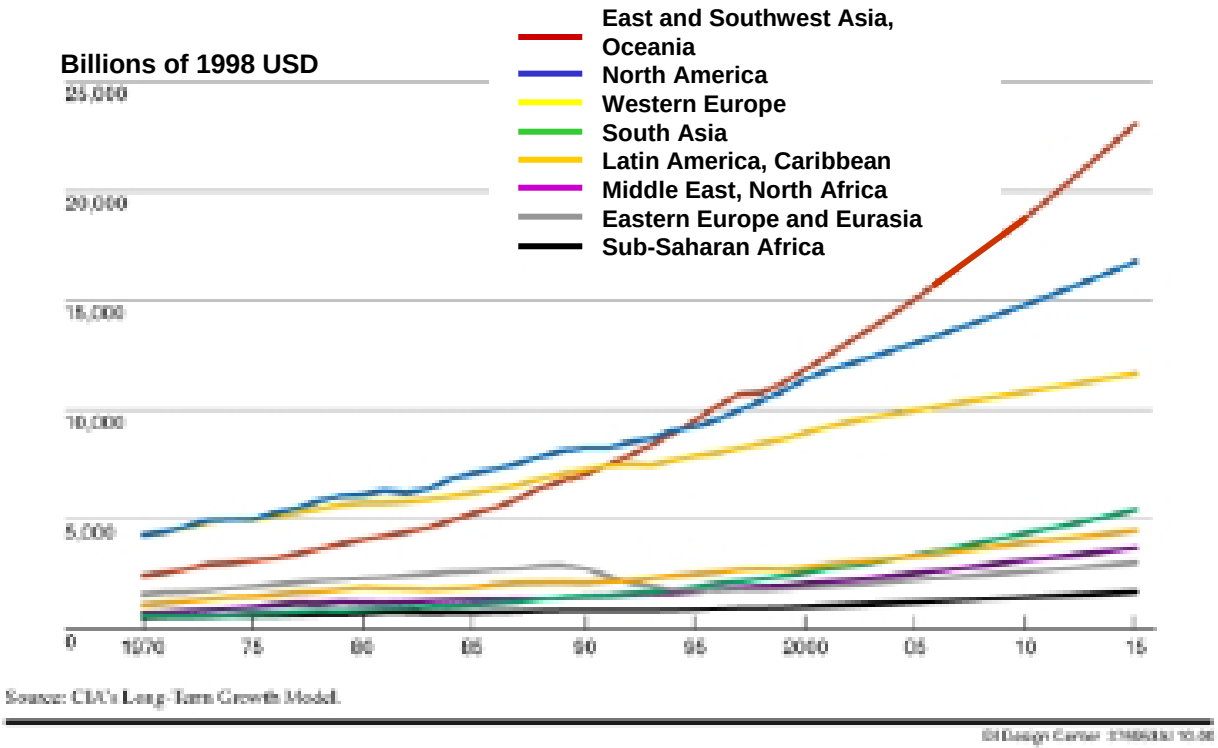
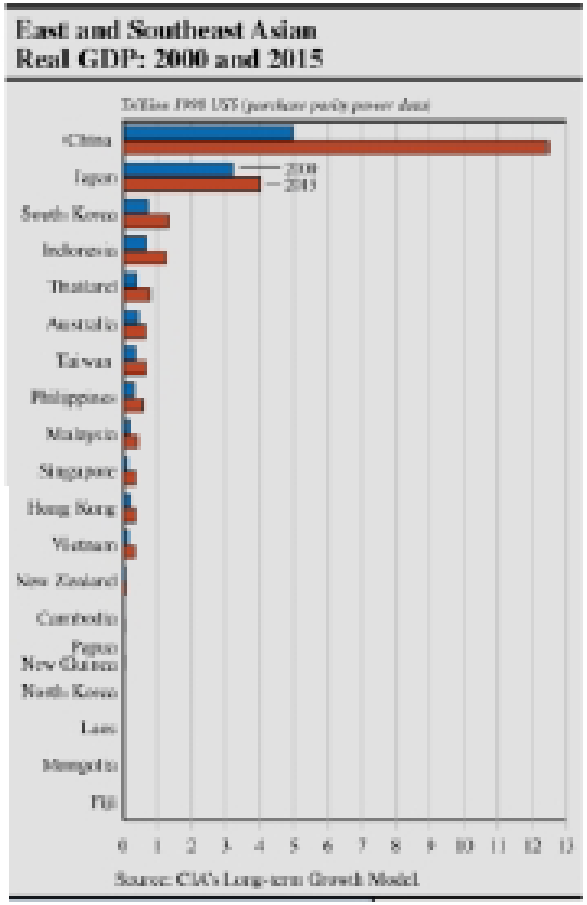
NIC - Global Trends 2015

Real Problems

Regional GDP – 1970-2015





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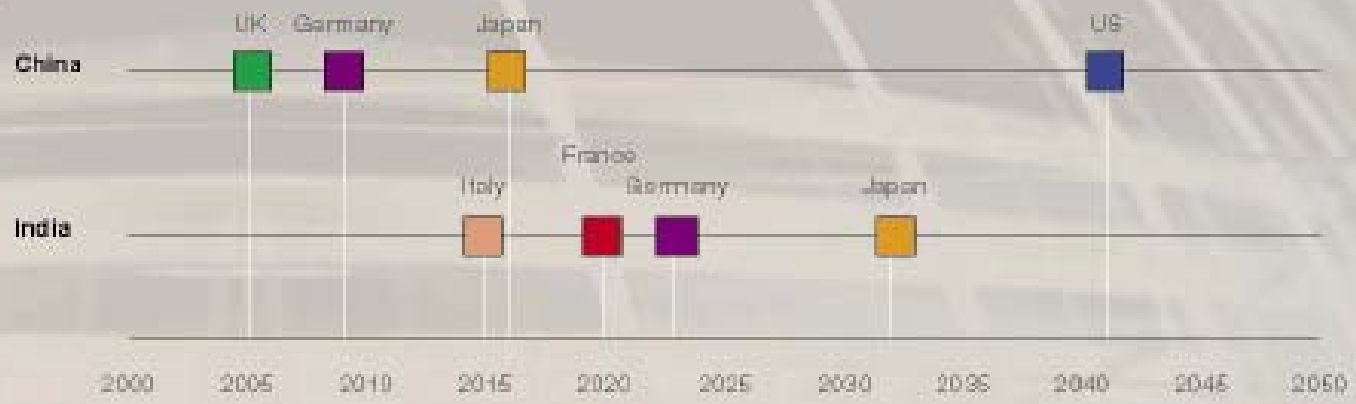
NIC 2020

When China's and India's GDPs Would Exceed Today's Rich Countries



What An Incredible Future To Embrace

Source: Goldman Sachs, *Global Economics Paper No: 99*, October 2003

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NIC 2020

China's Rise

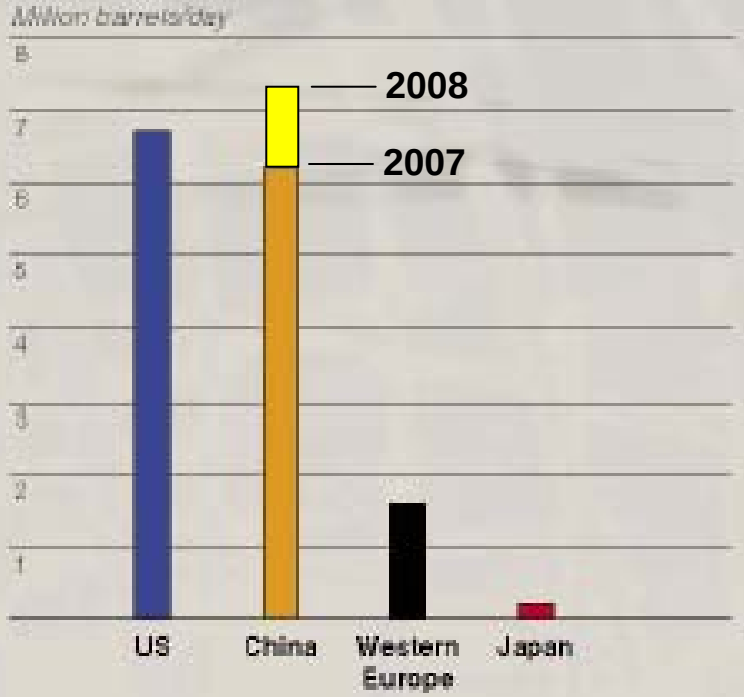
Share of World's Exports, 1980-2003

It should also overtake Japan in trade . . .

Source Global Insight

Growth in Demand for Oil, 2000-2020

. . . and nearly match the US as a dominant driver of additional oil demand.



Source US Energy Information Administration

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Basic Commodities

Many believe energy costs will retreat as demand recedes. Problem is that the only economy in the world in major trouble is the US. On the energy front, the following is fundamental:

There are 6 cars per thousand people in China today
There are 300+ cars per thousand people in the USA today

When China goes to 8 cars per thousand people, they will consume another 50 million gallons of gasoline per day

That is as much as the entire US burns in a day.

The math is inescapable….

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The Future "Era of Insufficient Plenty"**

Basic Commodities

Commodity Prices Climb to 24-Year High on Global Demand Growth
Commodity prices surged to a 24-year high, led by gains in copper and crude oil, on concern that global economic growth is eroding inventories of raw materials faster than supplies can be replenished.

Copper reached a 16-year high, and oil rose to a record in New York, extending the rally in the Reuters-CRB Index of 17 commodities to the highest since January 1981.

``Everybody wants to be long of commodities,'' said Stephen Briggs, an analyst at Societe Generale in London. Hedge fund managers ``think that the potential returns in commodities are still very high,'' Briggs said.

This was occurring before the financial collapse and will return in any recovery.

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1. The total output of grain was expected to hit a historic high, leading to a fifth successive year of increase.
2. The total value added of the industrial enterprises above designated size was up 15.2 percent year-on-year (growth in September was 11.4 percent)
3. The investment in fixed assets of the country was 11,624.6 billion yuan, a year-on-year growth of 27.0 percent and investment in urban areas reached 9,987.1 billion yuan, up by 27.6 percent (29.0 percent growth in September) The investment in the primary industry, secondary industry and the tertiary industry in urban areas went up by 62.8 percent, 30.2 percent and 24.8 percent respectively
4. The total retail sales of consumer goods reached 7,788.6 billion yuan, a year-on-year rise of 22.0 percent (up by 23.2 percent in September) which was 6.1 percentage points higher than that in the same period last year. The retail sales in urban areas reached 5,316.5 billion yuan, up by 22.7 percent, and the retail sales at and below county level stood at 2,472.1 billion yuan, up by 20.6 percent.
5. Prices for food rose by 17.3 percent and purchaser's prices for raw material, fuel and power rose by 12.4 percent
6. The total value of imports and exports for the first three quarters was US$ 1,967.1 billion, up 25.2 percent year-on-year
7. the total newly increased employment in urban areas was 8.48 million people The per capita cash income of rural population was 3,971 yuan ($581), up by 19.6 percent year-on-year, or 11.0 percent growth in real term. (1 dollar = 6.83 yuan)

Taken From The Chinese Bureau of Statistics

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Monitoring Signals of Macro-Economic Climate Index (2008.08)

National Bureau of Statistics of China

Index / Month	07-09	07-10	07-11	07-12	08-01	08-02	08-03	08-04	08-05	08-06	08-07	08-08
The Index of Industrial Production	Increasing	Increasing	Increasing	Increasing	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
Investment of Fixed Assets	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
The total Retail Sales of Consumer Goods	Stable	Stable	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing
Import and Export Volume	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
Revenue	Overheating	Overheating	Overheating	Overheating	Overheating	Overheating	Overheating	Overheating	Overheating	Increasing	Stable	Stable
The Profits of Industrial Enterprises	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
Residence Disposable Income	Increasing	Increasing	Increasing	Increasing	Stable	Stable	Stable	Increasing	Increasing	Increasing	Increasing	Increasing
Financial Institutions Loans	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
Money Supply M2	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CPI	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing	Stable
Business Cycle signal Index	Increasing	Increasing	Increasing	Increasing	Stable	Stable	Stable	Increasing	Increasing	Stable	Stable	Stable
	117	117	121	121	113	113	113	117	117	115	112	108

Note: Overheating; Increasing; Stable; Decreasing; Overcooling

Please find the compilation methods and summary analysis at www.cemac.org.cn

Read >>>> Carefully

Taken From The China se Bureau of Statistics

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"China at 10% GDP growth per year, has become the largest consumer of several key metals, generating about one-quarter of the total world demand for aluminum, copper, and steel. China consumes 25% of the world's aluminum, 22% of copper, 18% of nickel, 44% of iron ore and 31% of steel. India is a close second with an economy that is expanding at a clip of more than 9% annually. Economists say a growth rate of 9% to 10% is probable for China for the rest of the decade while they say 7% to 8% is sustainable in India."

"During 2002–2005, China contributed almost all of the increase in the world consumption of nickel and tin. In the cases of lead and zinc, China's contribution even exceeded net world consumption growth. For aluminum, copper and steel, the contribution of China to world consumption growth was about 50%. The relative contribution of China to global demand for commodities has increased considerably, as a result of both its rising weight in the world economy and its particularly rapid industrial production growth—including manufacturing exports—which is closely linked to the demand for metals. Other emerging market countries also have contributed significantly to demand in specific metals markets."

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"Economists believe China's demand for metals won't be reduced by Beijing's efforts to rebalance economic growth from investment to consumption. "For an economy at China's level of income, the kinds of things that the Chinese will consume or use will be material intensive--more housing, more cars, more hard goods," according to Professor Rajan at the University of Chicago Graduate School of Business. "If domestic demand in China picks up even more than the recent levels, there would be even more demand for these metals." Economists believe that the intensity of China's metals demand will surge until per capita gross domestic product reaches $15,000 but it will be the middle of the next decade at least before China hits that target, at which point India's growth story is expected to kick in."

NYMEX Report

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InformationWeek - May 29, 2007 03:00 PM

Cohen cites the work of researchers like Armin Reller, a materials chemist at the University of Augsburg in Germany, who has predicted that supplies of indium, used in liquid-crystal displays, and of hafnium, a critical element for next-generation semiconductors, could be exhausted by 2017. The world's zinc will be gone by 2037, Reller contends.

Last week, in a presentation at the J.P. Morgan Technology Investment conference in New York, Pat Gelsinger, senior VP and general manager of Intel's digital enterprise division, mentioned the importance of hafnium to the giant chipmaker's forthcoming quad core chipsets. Related chemically to zirconium, hafnium is already used in a variety of industrial applications including as material for control rods in nuclear plants. Researchers at Intel and other chipmakers have discovered that hafnium compounds can replace silicon dioxide, which has been used as an insulator in semiconductors for several decades. The shift from silicon dioxide to hafnium could produce chips that are faster and more energy efficient.

RUSSIA: Mechel episode could signal increased risk to metals sector
30 July 2008 11:53 AM EDT

Third, the government is generally devoting increased attention to the practice, used by many Russian metals exporters, of employing transfer pricing and "tolling" schemes as a way to alleviate their Russian tax burdens. Russian legislation apparently gives some leeway for these practices, but leaves considerable room for politicized interpretation. Putin has ordered the government to tighten the rules, though conflict among the ministries is apparently hampering the process.

There are several possible broader implications of the Mechel story for the metals sector. In the short-term, political risk is likely elevated as the government appears prepared to take harsh new measures against perceived price-fixing (for inflationary reasons) and against transfer pricing and tolling schemes (for tax reasons). On 29 July it emerged that Russian steel leader Evraz-which is controlled by the prominent oligarch Roman Abramovich-and coal giant Raspadsky had also come under anti-monopoly investigations.

In the longer term, the state's increased activism could be linked to possible preparations to intervene more directly in the formation of large, consolidated champions in metals. Recent developments in the Norilsk merger story could point in this direction as well.

Putin's words were jarring for markets at a time of global financial worries and volatility in emerging markets. Notwithstanding Russia's stated ambition to become a financial "safe-haven," Putin's comments caused the RTS to drop sharply. Presidential aide Arkady Dvorkovich afterwards sought to downplay investors' fears, and first deputy prime minister Igor Shuvalov has sounded a similar tone, but Putin continued his attacks on Mechel. President Medvedev, for his part, has been almost completely silent on the issue, aside from somewhat vague reassurances about the safety of Russian markets.

Putin still wields preeminent power over Russian politics and markets. Investors will take heart only if Putin himself takes measures to reassure them. Until he does, investors should prepare for the possibility of elevated risks in Russia's metals and mining sector - and increased volatility in Russian markets generally.

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China's rare earth monopoly threatens global suppliers, rival producers claim

The Chinese acquisition of stakes in Australian rare earth miners Lynas Corporation and Arafura Resources has "caught the rest of the world sleeping," said Rod McIllree, managing director at Australian-based Greenland Minerals & Energy (GME). Following two acquisitions in the past six months for an aggregate USD 163m, Korean, Japanese and Western players may find themselves locked out of the sector, McIllree told mergermarket. Speculation is rife as to what this may mean for the high tech and green industries that rely on rare earth metal resources. With over 90% of the global rare earth resource held by Chinese companies, the country's monopoly looks unchallenged. The recent Australian acquisitions have brought China control of the majority of the rare earth deposits outside China.

Rare Earth metals are a collection of 17 different metals that occur within the same ore deposits. While China currently produces 95% of the worlds rare earth supply, the metals are also found in the US, Indonesia, Australia and South Africa. Rare earth metals are needed for the manufacturing of wind turbines, plasma televisions, mobile phones, hybrid car batteries meaning the Chinese monopoly could shift the high-tech manufacturing industry bases from Japan and Korea to China. Acquisitions of Australian rare earth miners are strongly backed by the Chinese Government, a China-based industrial banker said. Since 2004, or even earlier, the Chinese government has treated rare earth resources as strategic. In order to protect the resources available to China, the government employs a three-pronged strategy; rare earth exports are restricted, imports encouraged, and outbound rare earth acquisitions actively encouraged.

GME's Rod McIllree, said the recent Chinese acquisitions highlighted the importance of the industry. With its multi-commodity ore body, GME is one of the last independent rare earth miners. Companies like GME that lack multi-commodity ore bodies including minerals such as iron ore alongside rare earths will find it hard to operate outside of China's influence because most of the technology needed for refinement is only produced in China, he said. Japanese, US and European players now face higher barriers to entry which may prevent them from regaining a foothold.

Japanese and Korean players voice fears The Chinese Government's protective moves over rare earth are likely to impact Korean high-tech industries in the next couple of years, said Daehyun Kim, chief executive of Saebo Energy, the privately-held Korean rare earths material developer. The technology gap between Korean high-tech companies and their Chinese peers is expected to close in four or five years. Rare earth mines in Australia are prime targets given their quality and the nation's low risk profile. The rare earth arm of Baotou signed an agreement with Arafura to co-develop an Australian rare earths mine at Nolans in late 2008.

Although China is home to the largest rare earth reserves in the world, it is still actively seeking chances to acquire overseas mines, a Chinese based analyst said. The purpose is to assure resources for the green energy, high-tech and defense industries. China is not the only country aggressively seeking to expand its rare earths resources; the US and Russia have similar policies, the analyst noted; the only difference is that China is leading the race.

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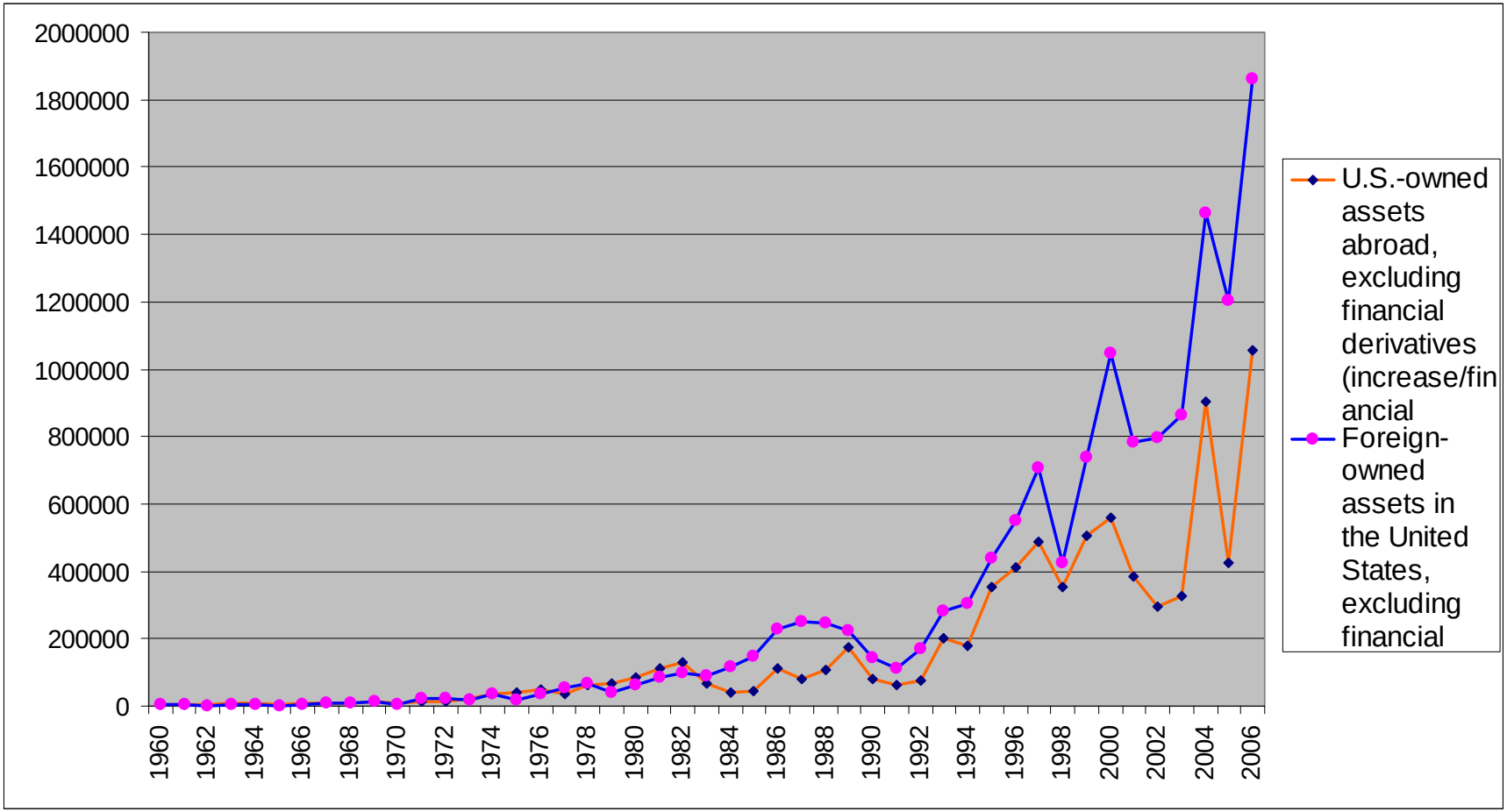
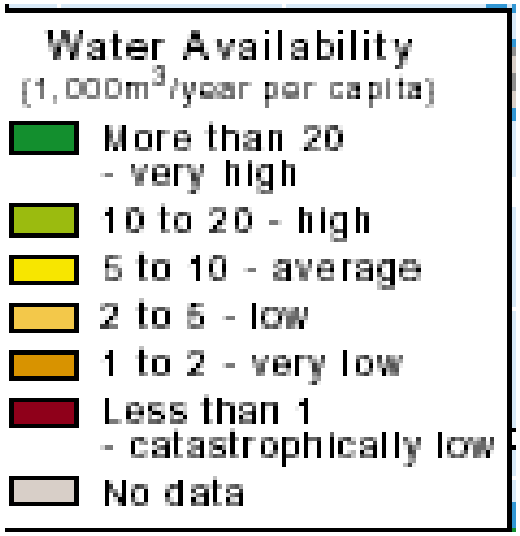
US-owned Assets Abroad Vs Foreign Assets in the US

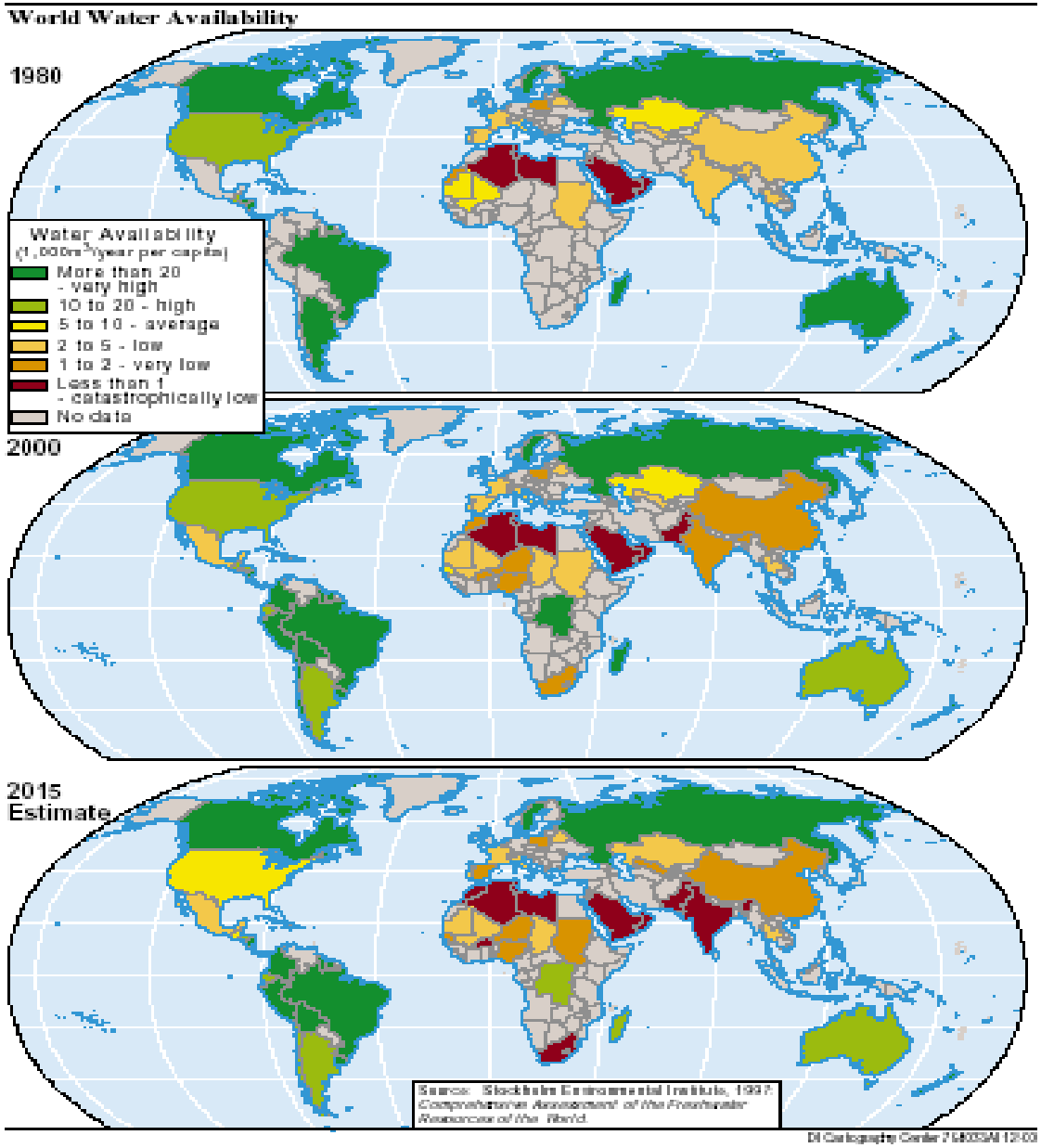


Another Little Issue

World Water Situation

NIC 2020





Is This Compelling Enough?

Instead Of Trying To Convince You That It Is, Please Spend A Few Minutes Reading Through The Next Few Slides. These are the trivial items compared to what we must do in the next 25 years.

Some Simple Arithmetic

Amount of water total on Earth – Fixed

Amount of recoverable fresh water on earth – Fixed without desal

Amount of desal-based water supportable with current technology – 11% of world requirements currently – limited by energy costs

Population Growth in same period – 2-3 billion

What Gaps In The Industry Exist?

Desalination – Current methods cannot be afforded or are major problems for most potential users in cost and operational limits

NTA Removal – We have things we must remove we cannot and the fate chemistry of some of the processes create new problems

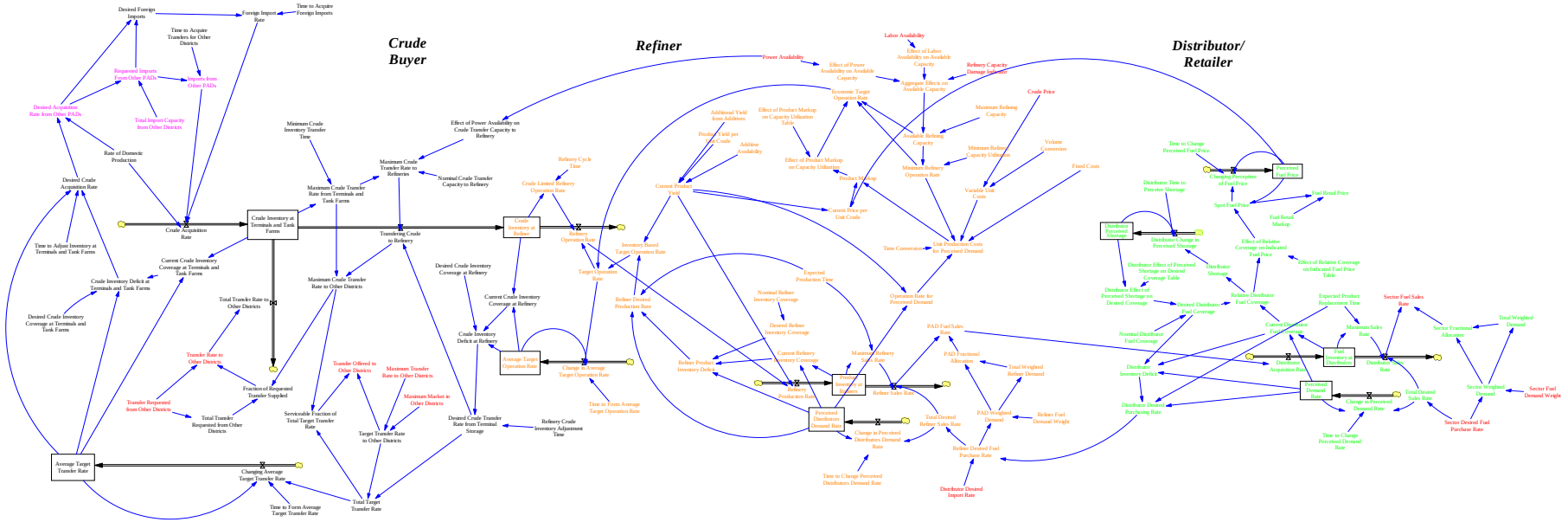
National Water Market – There is none, but we must imagine how one would work and be managed as a national asset

Distribution Pipelines – Never considered because of current water model, but different ideas and systems could make viable

Pumping Technology – Instead of 500 at $100,000, how do we double efficiency, halve maintenance and get 100,000 at $10,000.

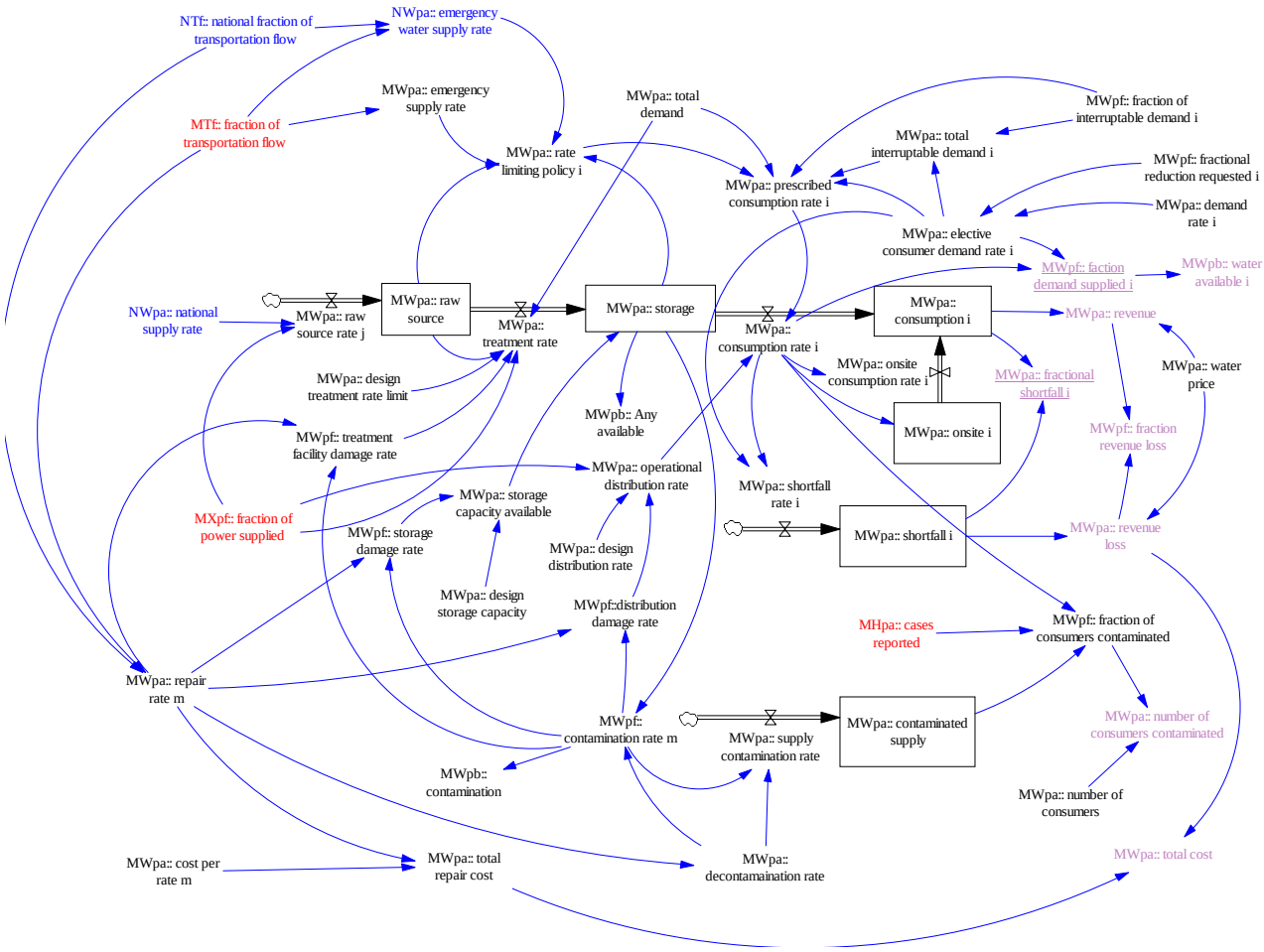
Considering Options

Petroleum Process Model

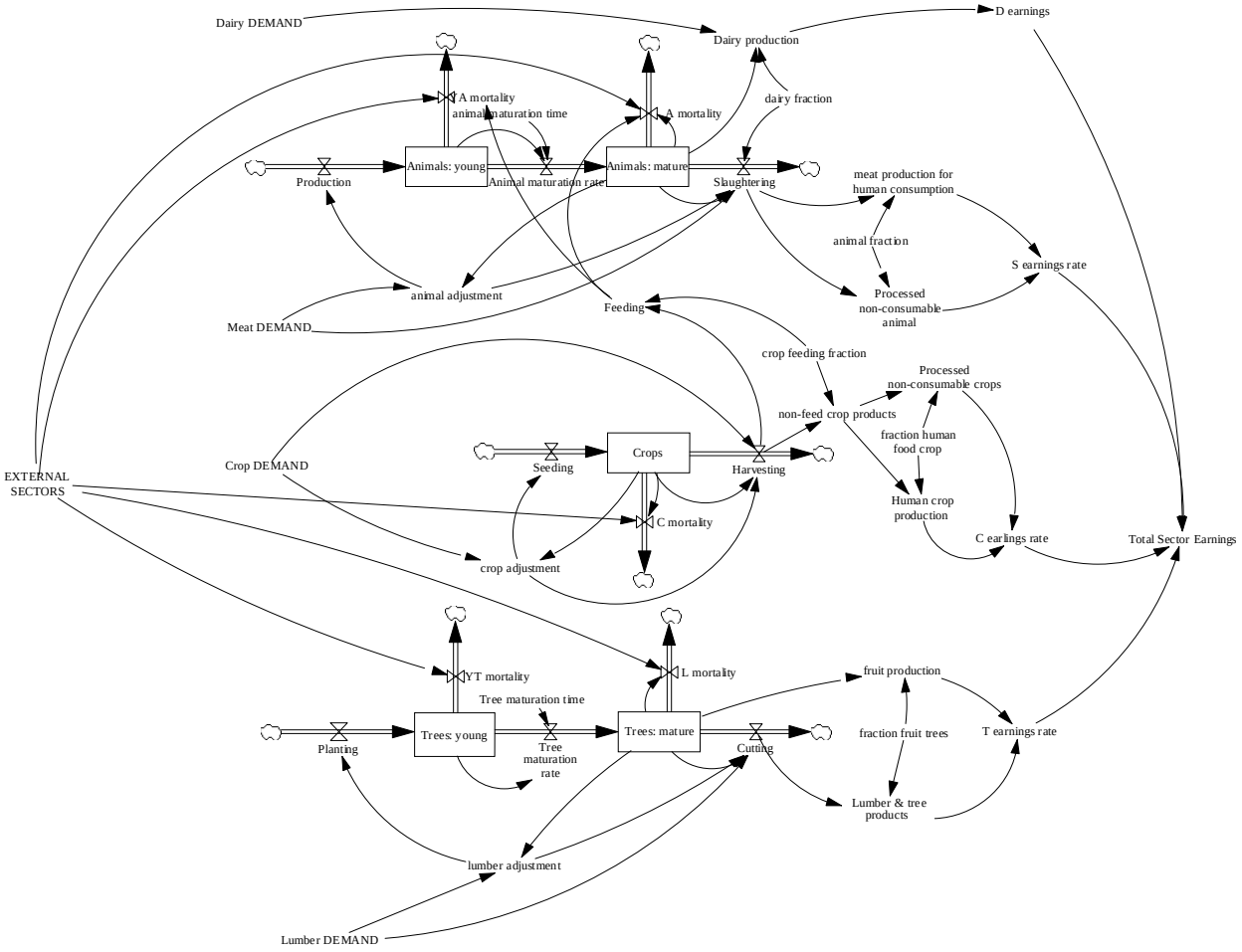


NOTE: Zoom to 300% to see details

Water Simulation Model



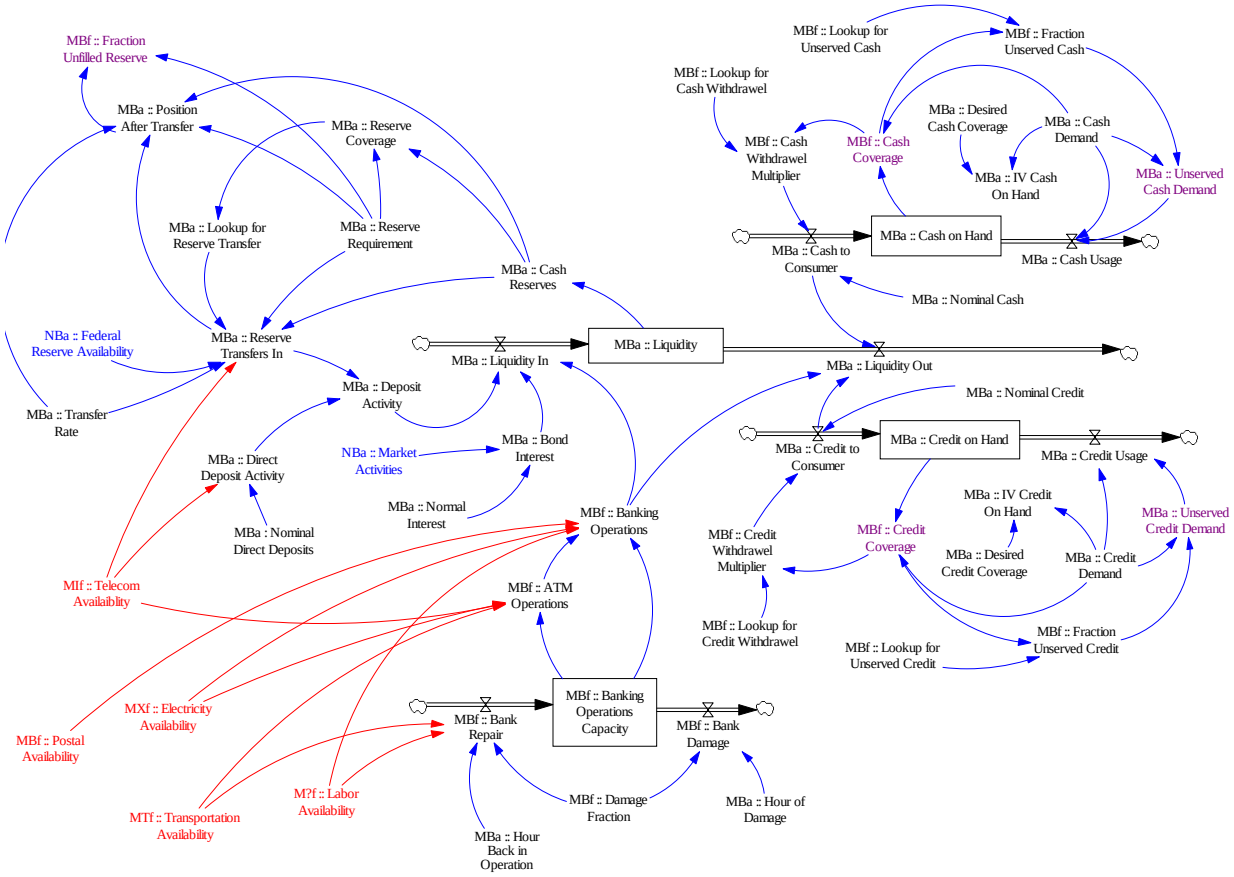
Agriculture Simulation Model



Liquidity Simulation Model

Metropolitan Banking & Finance Sector (MB): Liquidity

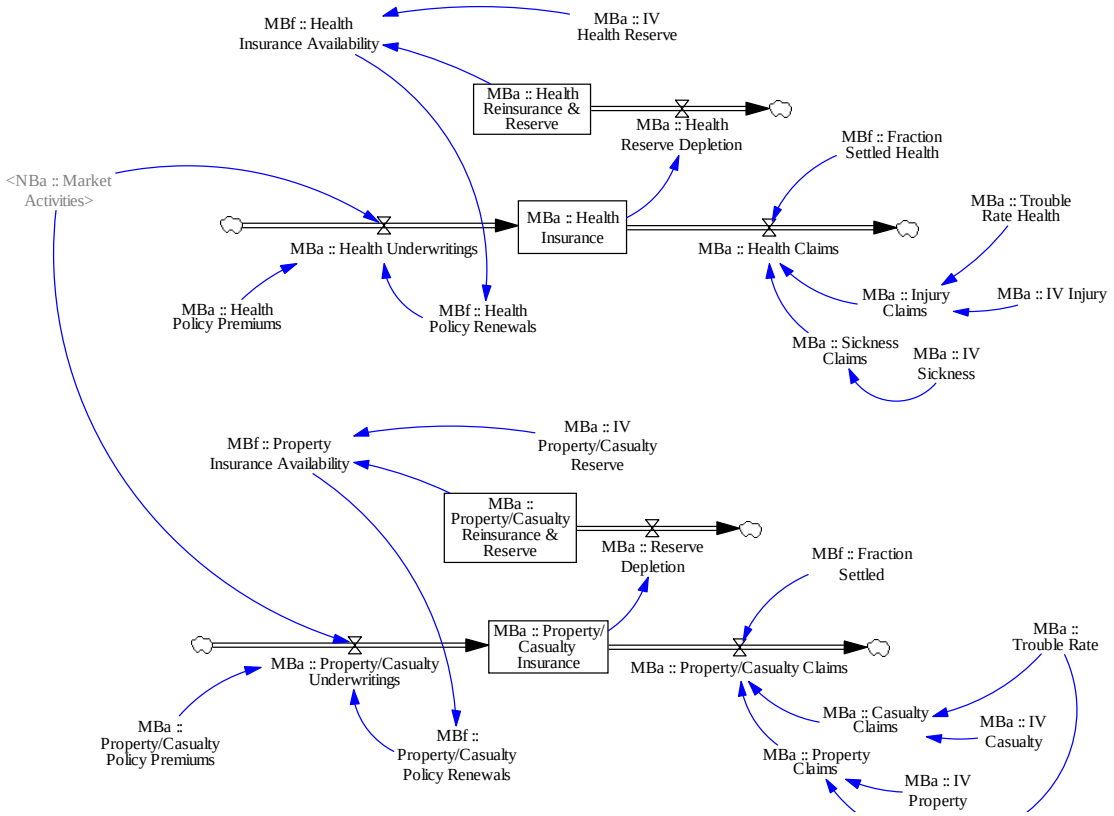
KEY: bold = external inputs; bold italic = external outputs; red = other sectors; blue = national model; gray = other views (subsectors)



Insurance Simulation Model

Metropolitan Banking & Finance Sector (MB): Insurance

KEY: bold = external inputs; bold italic = external outputs; red = other sectors; blue = national model; gray = other views (subsectors)



Can Technology Help

Key Ingredients So Fundamental They Are Missed

- **Doing More With What You Already Have To Do**
- **Making All Ingredients Organic And Proactive**
- **Inserting Proactive Thinking Wherever Possible**
- **You Don't Need To Possess It To Leverage It**
- **Neutral…Neutral…Neutral For Everything is True Open Source**
- **Make Sure You Understand Ubiquitous and Omnipresent**
- **If You Can Teach A Computer To Do It, Do It Now**
- **From 1000 yards, What Is It You Really Do**
- **Linear Is Unreal – even light can be bent with sufficient mass**
- **Binary Is Baby Steps**
- **Gutenberg Is Passe'**
- **Carlin's View Of Stuff**
- **Change Is….**
- **Tomorrow Arrives Every Morning**

What Are Some Nations Doing In Innovation

Europe Has Expanded Esprit To Globus And Making Inroads To True Global Execution

Japan Has Broken The Language Limitations And Now Have National Access To The World's Innovations

China Has Announced A National R&D Knowledge Base Containing Everything They And Others Do In One Massive Dynamic Taxonomy – This Will Make Them Formidable and They Will Vend Access To It

What One Country Has Done To Make The Future Come True Faster Than Others

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Humanoids With Attitude
Japan Embraces New Generation of Robots
By Anthony Faiola
Washington Post Foreign Service
Friday, March 11, 2005; Page A01

TOKYO -- Ms. Saya, a perky receptionist in a smart canary-yellow suit, beamed a smile from behind the "May I Help You?" sign on her desk, offering greetings and answering questions posed by visitors at a local university. But when she failed to welcome a workman who had just walked by, a professor stormed up to Saya and dished out a harsh reprimand.

"You're so stupid!" said the professor, Hiroshi Kobayashi, towering over her desk.

"Eh?" she responded, her face wrinkling into a scowl. "I tell you, I am not stupid!" Truth is, Saya isn't even human. But in a country where robots are changing the way people live, work, play and even love, that doesn't stop Saya the cyber-receptionist from defending herself from men who are out of line. With voice recognition technology allowing 700 verbal responses and an almost infinite number of facial expressions from joy to despair, surprise to rage, Saya may not be biological -- but she is nobody's fool. "I almost feel like she's a real person," said Kobayashi, an associate professor at the Tokyo University of Science and Saya's inventor. Having worked at the university for almost two years now, she's an old hand at her job. "She has a temper . . . and she sometimes makes mistakes, especially when she has low energy," the professor said.

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High-Tech Japanese, Running Out of Engineers

By MARTIN FACKLER, NY TIMES

TOKYO — Japan is running out of engineers.

After years of fretting over coming shortages, the country is actually facing a dwindling number of young people entering engineering and technology-related fields.

Universities call it "rikei banare," or "flight from science." The decline is growing so drastic that industry has begun advertising campaigns intended to make engineering look sexy and cool, and companies are slowly starting to import foreign workers, or sending jobs to where the engineers are, in Vietnam and India.

It was engineering prowess that lifted this nation from postwar defeat to economic superpower. But according to educators, executives and young Japanese themselves, the young here are behaving more like Americans: choosing better-paying fields like finance and medicine, or more purely creative careers, like the arts, rather than following their salaryman fathers into the unglamorous world of manufacturing.

The problem did not catch Japan by surprise. But only now are Japanese companies starting to feel the real pinch. By one ministry of internal affairs estimate, the digital technology industry will soon be short almost half a million engineers.

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Three Broad Technology Opportunities

Biotechnology – genetics, proteomics, synthetics

Nanotechnology – MEMS to Smart Dust

Quantum Technology – Incredible Capability, But…

These Are All Giant Challenges In Technology

Key Is Enough Science and Engineering To Do Them

… Not Really …

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Biotechnology – genetics, proteomics, synthetics

Incredible Opportunity To Discover A Whole New View of Life Saving, Repairing and Helping People Directly or By Improving Food, Textiles, Materials

Problem Is We Are Novices At So Much Of This We May Not Know What Questions To Ask, Much Less Answer.

… With Our Frequent Need To Pull Things As Simple As Drugs After Introduction, What Do We Do When A Proteomic Effort Goes Wrong…

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Nanotechnology – MEMS to Smart Dust

IBM Just Created A New Division To Build Technology In This Domain With Strong Focus On Sensors

Asia Is Developing Stacking and Communication Standards To Energize Development

Critical Fabrication Systems Are Finally Ready

… Question Is Are We Really Ready To Handle Even A Major Spill Of Things Smaller Than Pollen That Can Act distructively

Quantum Technology – Incredible Capability

Zero Time of Flight Communications

N-State Computing – At Least 4, Maybe More

Sensors Multiple Orders of Magnitude More Sensitive

Unbreakable Encryption No One Can Hack

… However, What If Al Quaeda Uses It To Encrypt The Social Security Database, National Archives Or Citibank's Back-up Tapes As They Are Written …

Why We May Miss These – Global No-Knows

No Ability To Coordinate Complementary Efforts

No Ability To Prevent Duplication

No Ability To Learn From Past Successes or Failures

No Ability To Know How Much We Are Spending

No Ability To Know Who Knows What

No Ability To Pre-Examine Combinations Sure To Occur

Why We May Miss These – The Them Issues

No Parallel Consideration of Legal Issues From Outset

No Parallel Consideration of Policy Issues From Outset

No Parallel Consideration Of Consequences If Any Of The Above Are Not Proactively Addressed

… Most Likely Life Cycle Will Be A Fantastic Product With High Profits For Some Years That Will Then Be Completely Absorbed By Future Litigation And Second-Guessing Of Maker Intentions …

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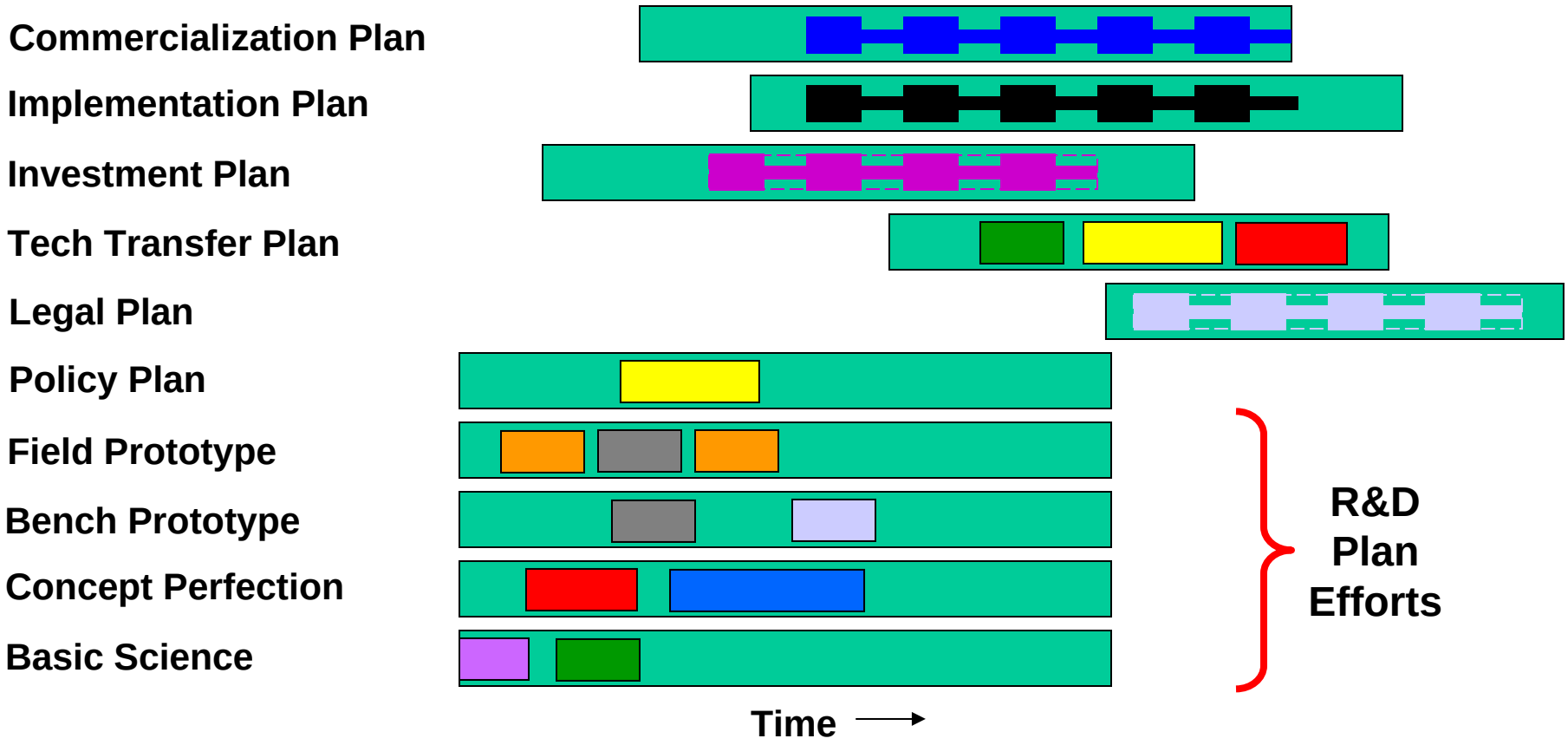
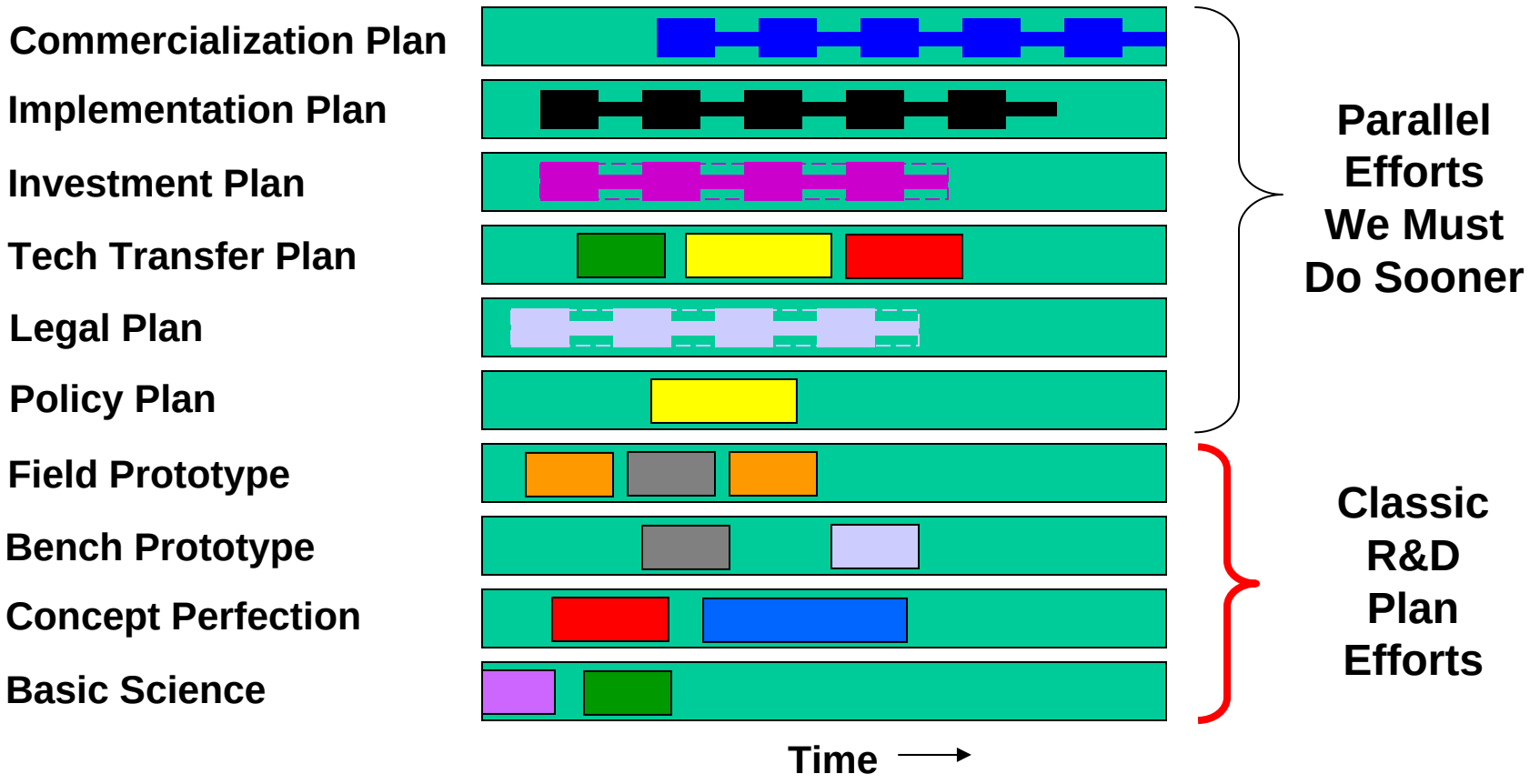


Current Practice Often Carries Consequences That Destroy Much Of The Life Cycle Value

Materials Sustainability In The Future "Era of Insufficient Plenty"



Integrated Innovation – Through Planning and Completion of the overall life cycle of the contribution

Materials Sustainability In The Future "Era of Insufficient Plenty"

Is There a Country That Grasps This Issue and Is Taking Aggressive Steps To Embed It In Their Decision Making

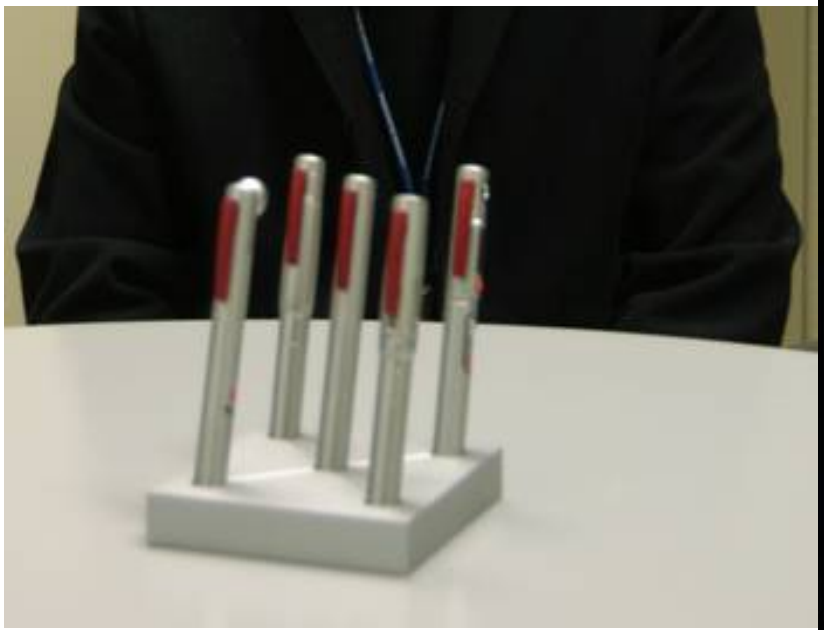
?

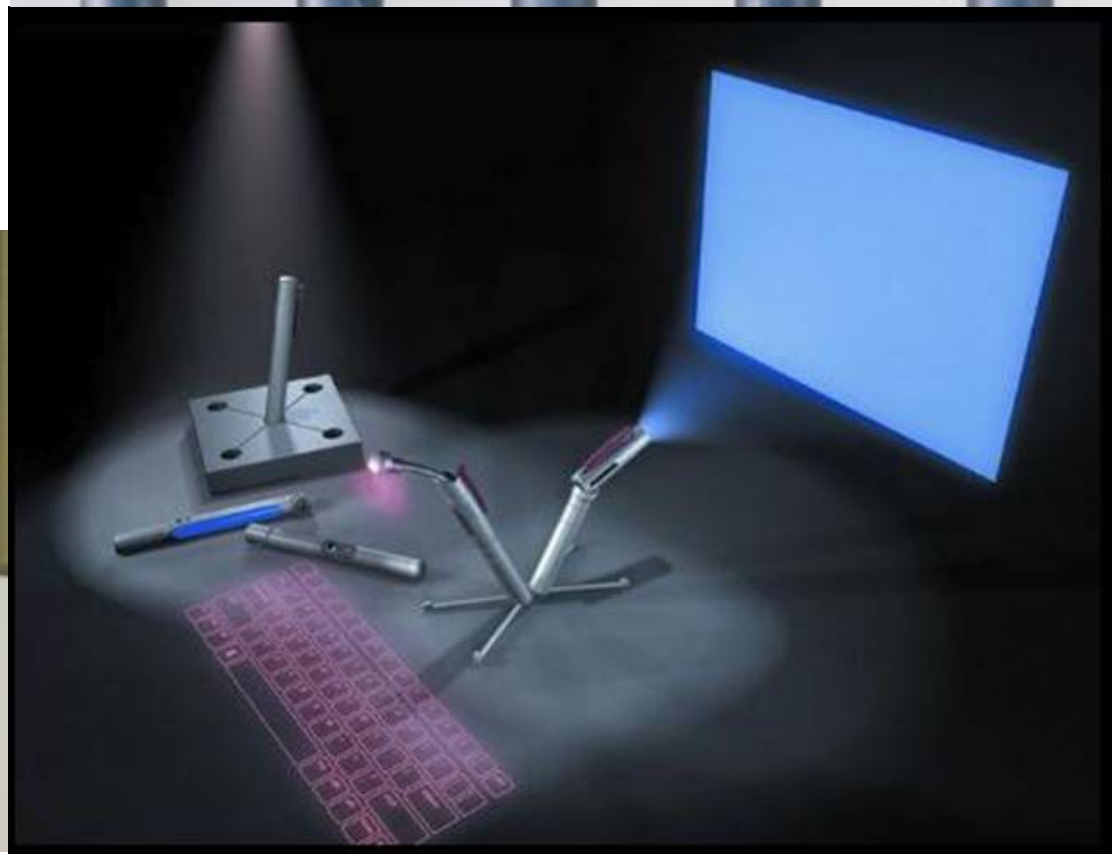
Materials Sustainability In The Future "Era of Insufficient Plenty"

The climate for full life-cycle innovation in the mature world is in desperate need of re-animation and re-organization. Regardless of the risk taking appetite of angels and investors, those that must take thoughts to actions, objects to products, markets to sales, start-ups to enterprises are all suffering from different forms of oxygen starvation and the consequences are being felt in almost every sector. There are no single solutions or simple fixes, but there is a critical element we must cultivate or we will not be able to prevent further loss of life. This element is Integrated Innovation.

This is a skill we must learn and one the Chinese already know.

INTEGRATED INNOVATION





But….

With All These Challenges and the Prospect That We Will Have No Choice But To Solve Them, When Will Venture Firms Appear That Fund People Pursuing These TNBT – not The Next Big Thing but…….
The Next Bothersome Thing.

We Must Find Ways To Get New Investment In A Future As Sure As What We Predict Here To Head Off A Future That Could Damage All Other Opportunities That People Are Hoping Will Occur

Implications For Services

The assumptions of providing identical parts and consumables will be Challenged not just in cost but availability at all

The processes of manufacturing, the alloys, cutting and grinding tools, The lubricants, coatings and catalysts are all in categories that are being Targeted for control or removal from the market

The skills and past knowledge of those providing parts and services will Be challenged

The engineering and technology people must become proactive in finding Alternatives and seeking more sustainable methods and materials even if They are not current being challenged.

Implications For Services

These challenges can become value add services for clients and even Sold to firms less skilled at doing the R&D work needed to support choices

The removal of redundant or duplicative items will become paramount as Part of the overall planning and culling process

The feedback loop from the field on alternatives chosen must be strong and Those doing field work trained and equipment to be that loop as a value add

Opportunities for simplification are very high and will not only speed the Implementation and future process costs but also lower risk.

Incorporation of these thought processes in all offshore R&D and product Development must be early, often and intense.

One Element of That Future

A New Metric

THE ***USCR*** – The consumption of any material or commodity equal
To That Of the United States In The Same Timeframe (default a year)
This is not the amount consumed on US soil, but the amount necessary
To supply all needs, direct or indirect for that material.

Real Question Is – Can The World Stand 2 or more USCR not only in
Food or Fuels but also in water, drugs, rare metals or even
Something as simple as molybdenum for lubricants

The Chinese can reach One USCR by 2013
And already exceed it in certain categories

Materials Sustainability In The Future "Era of Insufficient Plenty"

(when the world economy returns)

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NOTE: Pleae open the slide notes to read the narrative for each slide.