



IANAS



Innovation and development

Professor Anthony Clayton

IANAS Energy Program Workshop

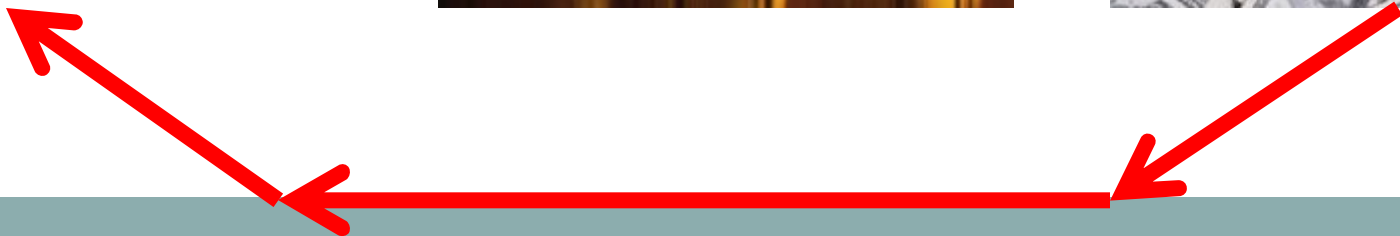
La Paz, Bolivia April 16th -19th, 2012

The case of Jamaica



- Small island nation, population 2.6m
- Depends on imported oil for >90% energy
- Oil went from US\$10/barrel in 1998 to US\$147/barrel in 2008 – Jamaica suffered.
- Significant RE resources – solar, wind, deep ocean current, possibly biomass etc.
- Very little development of RE, in spite of high price of energy.
- Why is this?

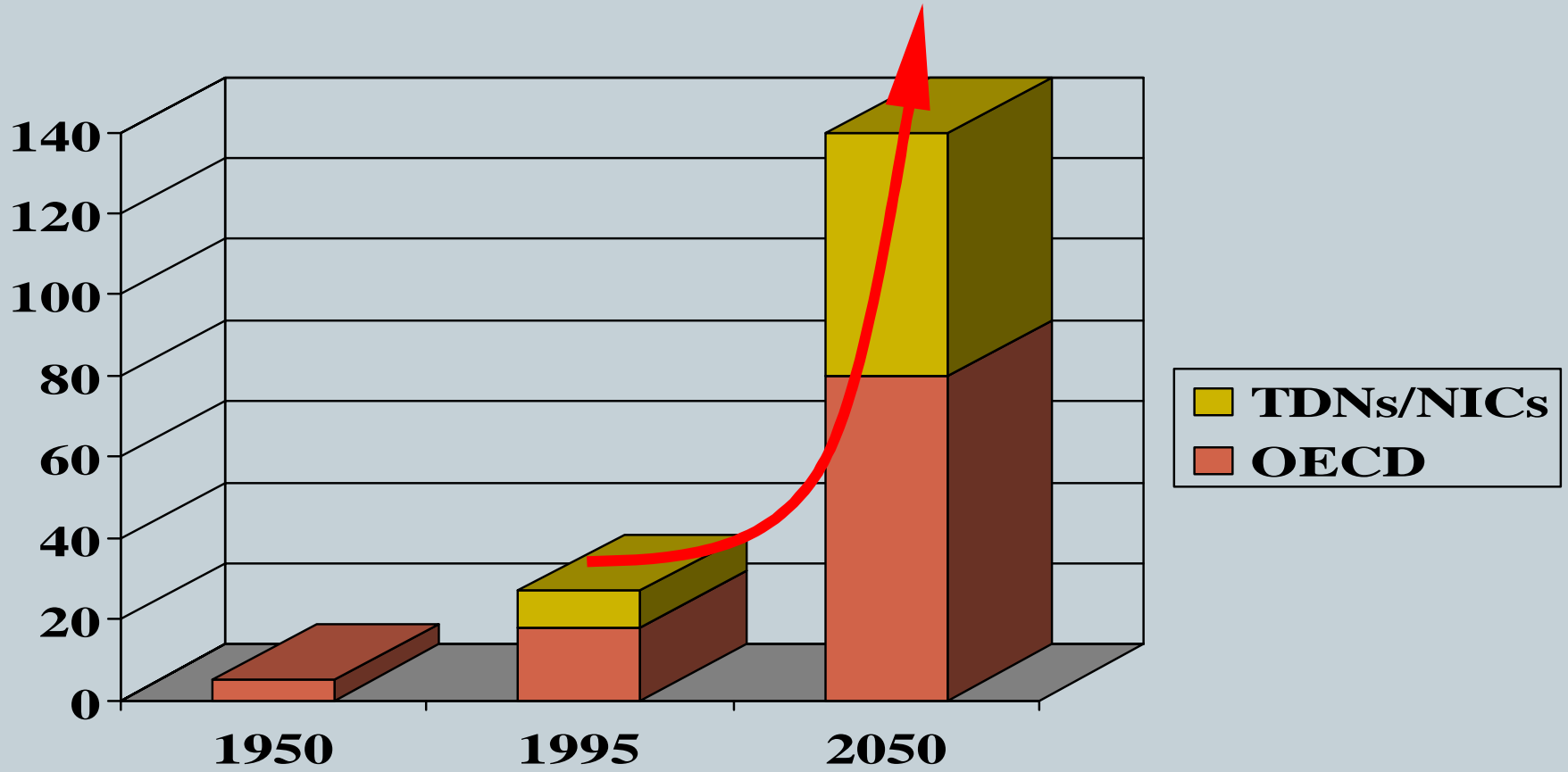
How are innovations disseminated?



The world is getting richer...



Projected increase in Gross World Product (US\$1 trillion, \$1995)



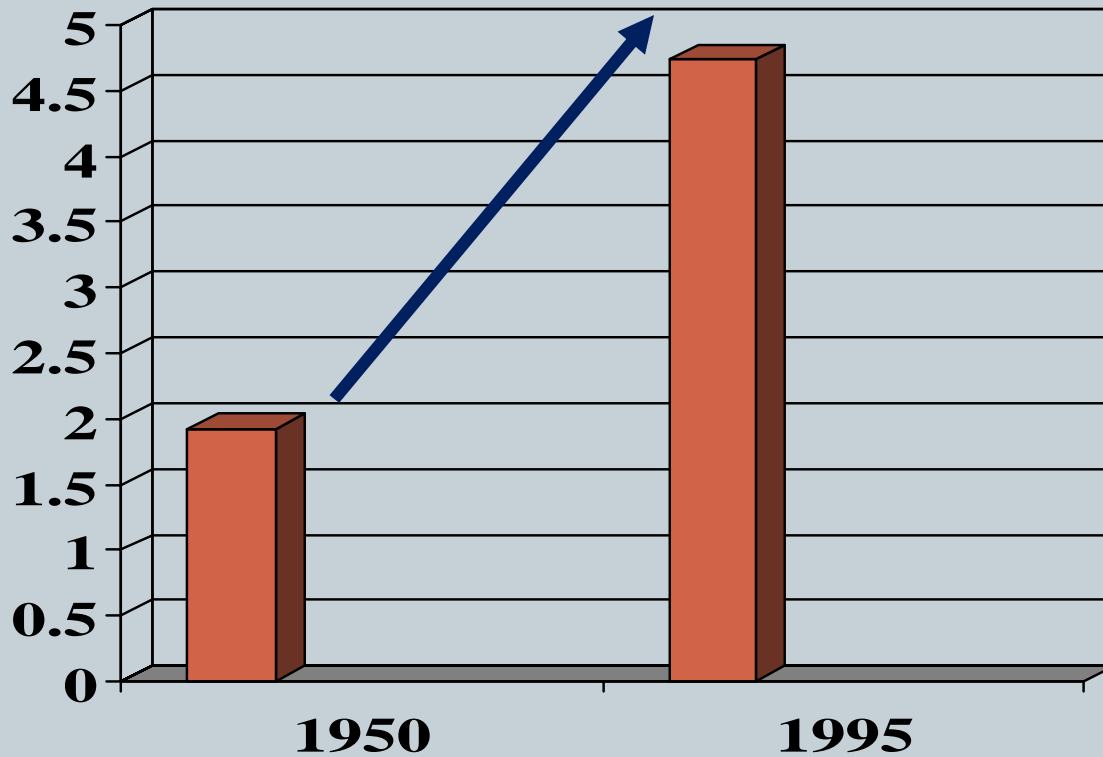
Source: World Bank





Rising GWP/capita

(US\$1,000, \$1995)



Rising GWP/capita (US\$1,000, \$1995)



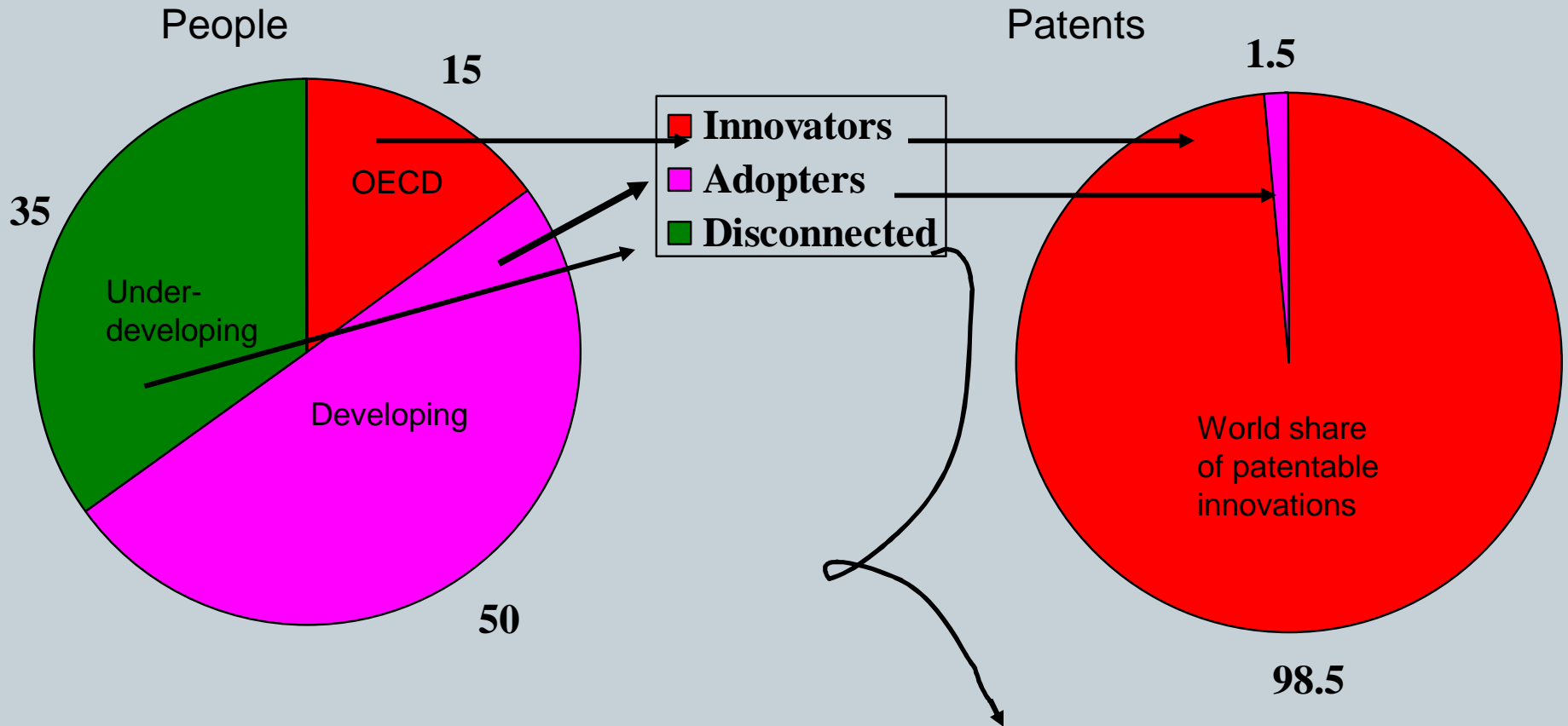
-  **GWP p/c, \$1995**
-  **Population:**
-  **1950 = 2.55b**
-  **1995 = 5.69b**

What causes rising productivity?

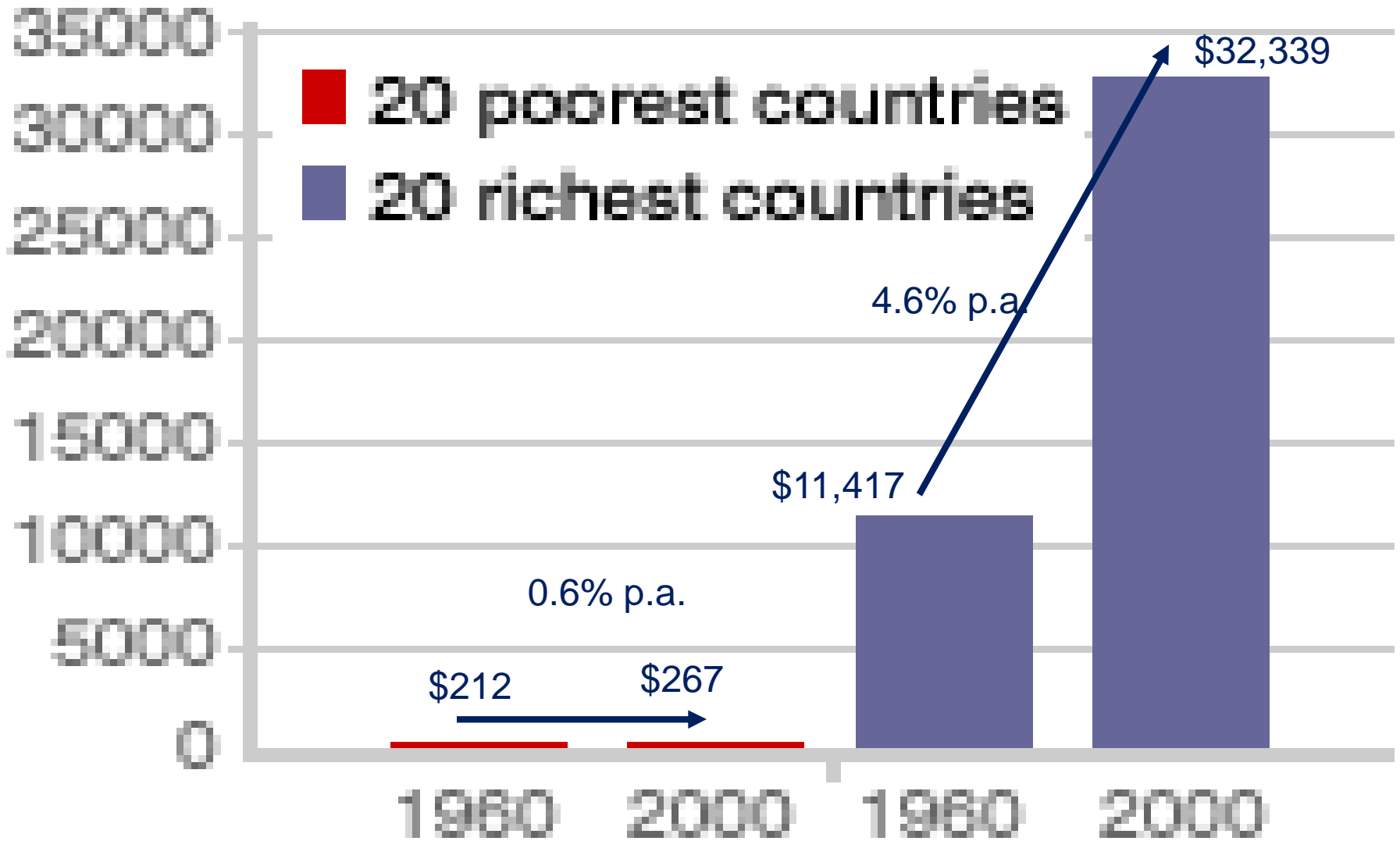


- Science and technology. Innovation now generates >50% of economic growth in the advanced economies; most of the rest results from incremental technological and managerial improvements that raise productivity and thereby increase both output and real incomes.
- This process continues to accelerate (driven by increasing capacity) and widen (driven by competition and technological dissemination).
- As a result, there are an unprecedented number of new technologies in the pipeline (ICTs, biotechnologies, nanotechnologies etc).

The technological divide...



GDP per capita in constant US \$ (1995)

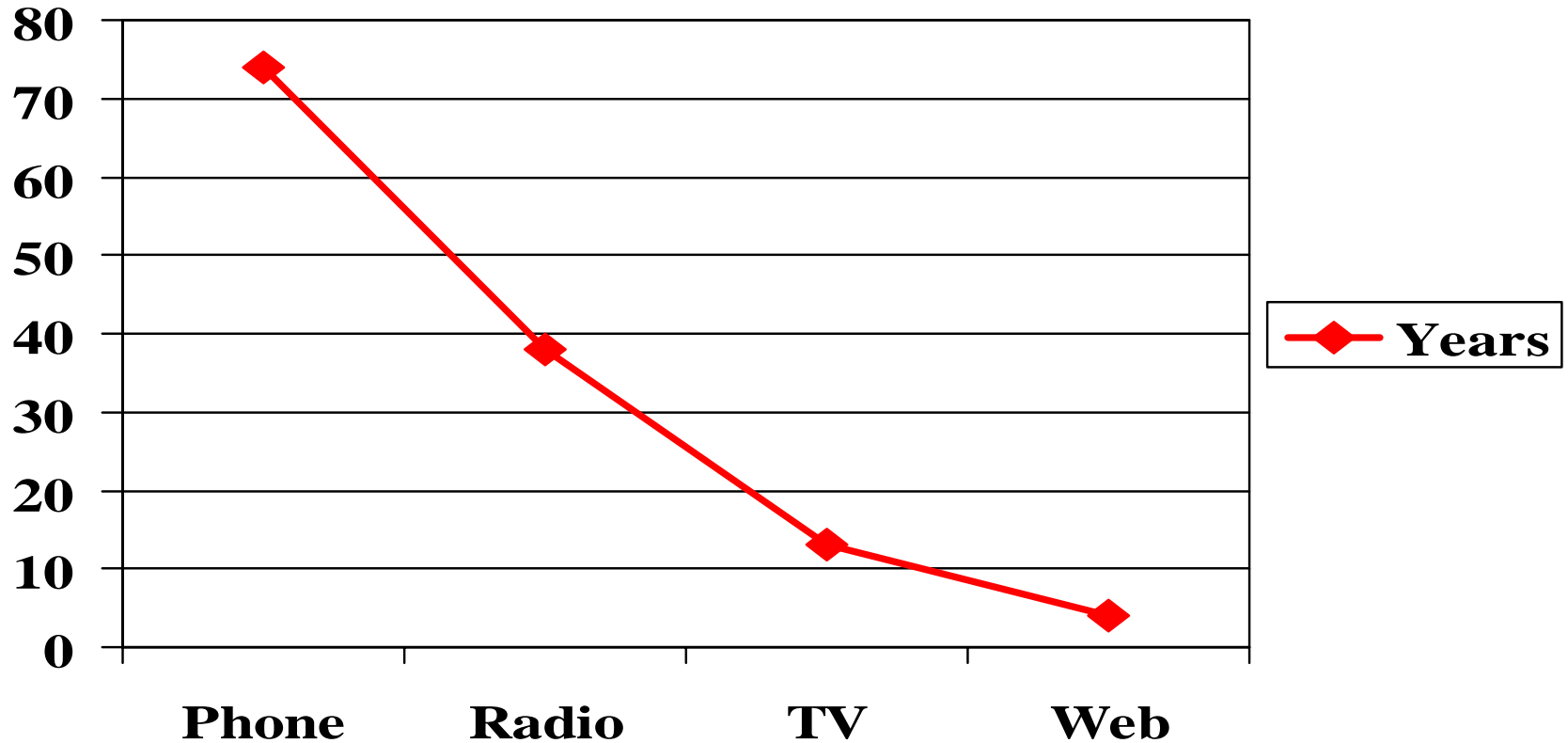


SOURCE: World Commission on Globalisation

The acceleration of innovation

- “The world is changing and to survive we have to be able to change faster than our competitors.”
- “The head of Sony told me that when he launched the Walkman in the mid-1970s it was three years before anyone launched a competitive product. So he could sell his product at high prices, which he called the founder's premium, for three years. He told me this in 1985, by which time they could enjoy the founder's premium for only six months. What is it now in the electronics industry? It's weeks, it may even be days.”

The acceleration of dissemination



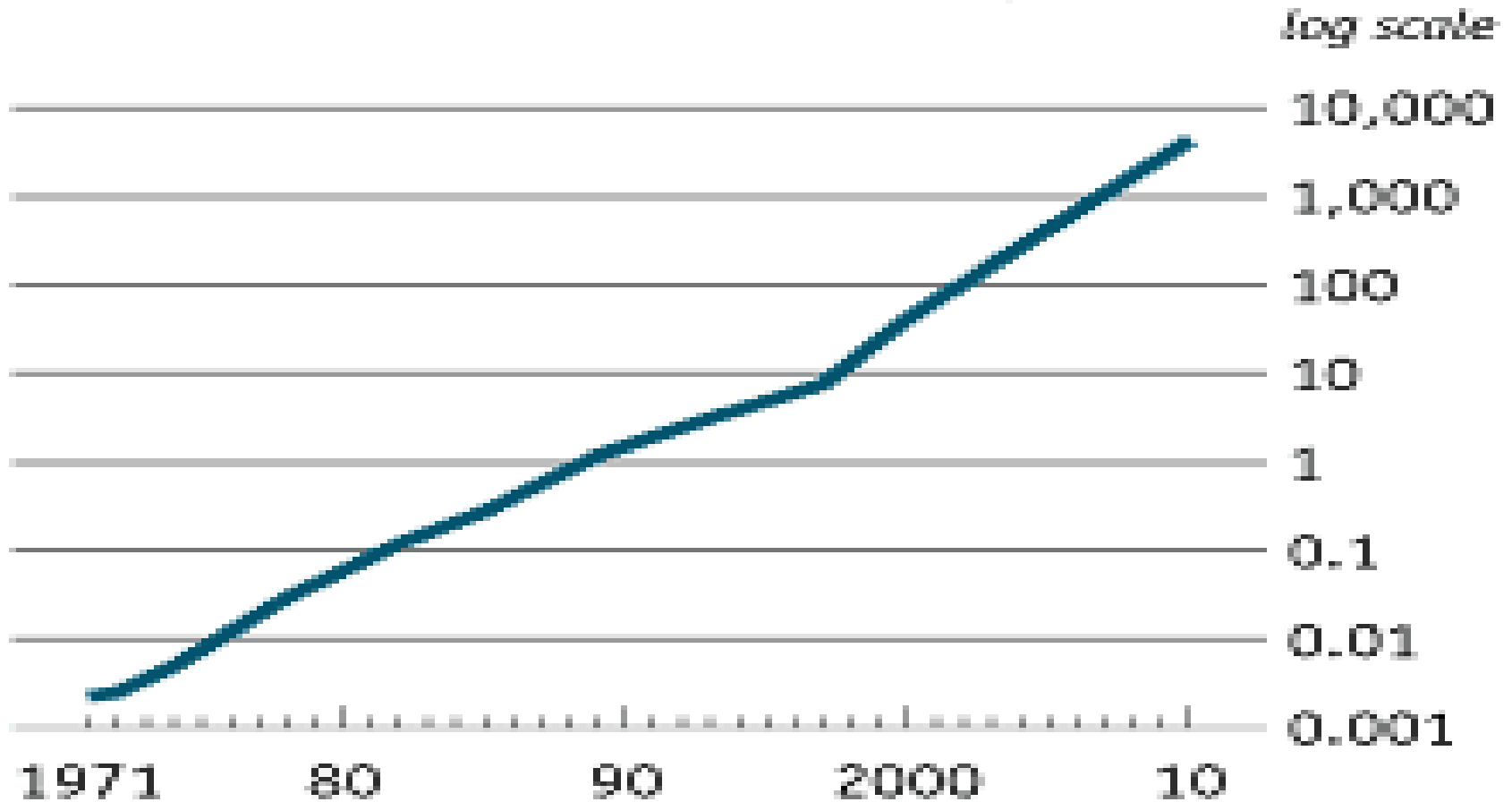
Time to reach first 50 million customers

Exponentially increasing processing power

Moore's law

1

Number of transistors on RAM chip, m



Sources: Intel; *The Economist*

Unlimited information

- According to Google's vice-president for search, Marissa Mayer, rapid technology change means we will soon be able to store vast archives on a single computer, set-top box or any other device that contains a hard drive.
- "Consider an iPod," said Meyer in her presentation at the annual UK Television festival.
- "You can now store 10,000 songs on an iPod".
- "By 2030, you'll have all the content ever created in the palm of your hand."

30th August 2006



June 2011: The world's fastest supercomputer: the K Computer at the RIKEN Advanced Institute for Computational Science, Kobe.

“We plan that 10 to 15 years from now, we're going to have a supercomputer that would fit in a sugar cube.”

Dr Bruno Michel, IBM, 12th November 2010



So by 2020-25, the computing power of all the supercomputers in the world today would look like this -



Supercomputers - everywhere



By 2020-5 a US\$1,000 pc will have supercomputer capacity.

By 2050 a US\$1,000 laptop will have more processing capacity than the human species.

Every child in school will have more processing power than currently exists on Earth.

What will we teach...

...when everybody has access to all knowledge?



Where is LAC in this?

Latin leaders

The only university in LAC to make the world's top 200 – up from 232 in 2010 to 178 in 2011

Top ten universities* in Latin America, 2011

Rank		Score
1	University of São Paulo (<i>Brazil</i>)	100.0
2	Catholic University of Chile	99.6
3	State University of Campinas (<i>Brazil</i>)	94.7
4	University of Chile	94.0
5	National Autonomous University of Mexico	92.1
6	University of the Andes (<i>Colombia</i>)	84.7
7	Tecnológico of Monterrey (<i>Mexico</i>)	83.0
8	University of Buenos Aires (<i>Argentina</i>)	82.1
9	National University of Colombia	79.5
10	Federal University of Minas Gerais (<i>Brazil</i>)	79.1

Source: QS University Rankings

*Based on seven indicators

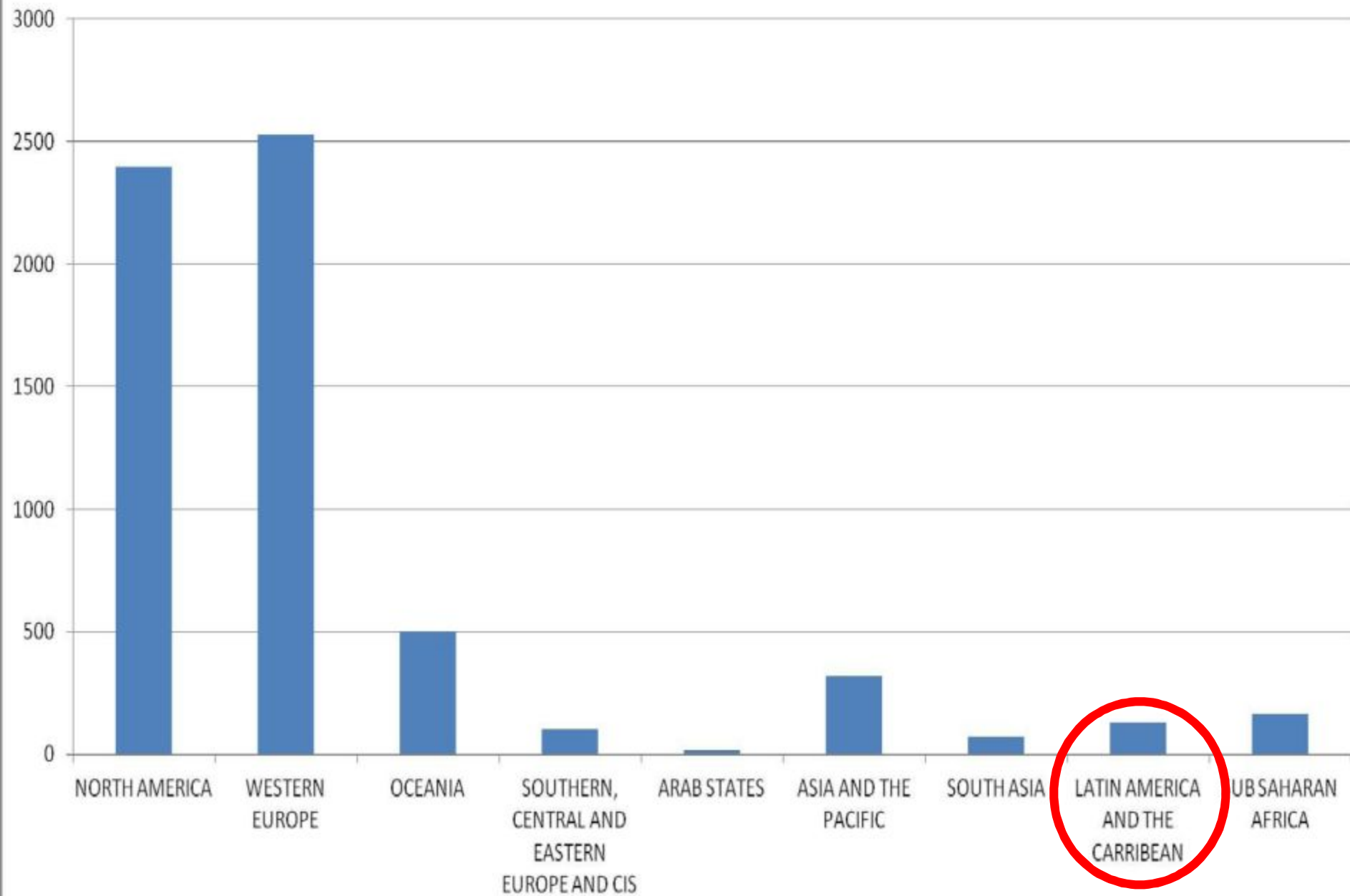
University of the West Indies world ranking: 782nd

Why are most LAC universities so weak?



- Weak governance
- Insular, don't recruit internationally
- Resist change
- Good research/teaching not rewarded with funding/promotion
- Curriculum old-fashioned, politicized
- No student fees in public sector, resulting in limited resources, low expectations, poor performance
- Staff cannot be dismissed for incompetence or laziness
- Public institutions do not lose money if student numbers or graduation rates fall
- Many faculty part-time, don't have PhDs (except Brazil)

Figure 3 Number of articles in SSCI database in the period 2000-2010 with keywords: "environmental change" or "climate change"



What do we need to do?



- Q: Should the government spend more?
- A: Singapore's unemployment rate is 2.5%, growth rate 5%, the budget is in balance, HDI very high (lowest rate of infant mortality in the world), exceptionally competitive. All that is delivered with government spending just 15% of GDP.

Why governments are bad at encouraging innovation

We must protect our companies from foreign competition. We cannot afford to lose local businesses; they create jobs for local people.



Indicators of change: the rate of failure

Thriving economies are characterized by strong growth, healthy competition..

..and a high rate of bankruptcy and failure.

In the US, 1/3rd of the Fortune 500 companies in 1970 had disappeared by 1983.

In the UK, 2/3^{rds} of the FTSE 100 companies in 1984 had disappeared by 2006 - while the total market capitalization of the FTSE 100 rose from £100bn to £1.54 trillion over the same period.

There is no status quo

- Schumpeter (1950): innovative new ideas and technologies create new opportunities, demands and markets - but simultaneously render old technologies obsolete and the associated skills redundant in a process of creative destruction.
- Where there is scientific and technological advance, there is no status quo. The economy is constantly disrupted by innovations.
- So science and technology drive the process of creative destruction.

So what should governments do?



Governments should not protect uncompetitive industries, with obsolete technology. Let them die.

Instead, Governments should:

- Encourage innovation, knowledge networks and business clusters.
- Organize Foresight/Delphi exercises to identify industries that do not have a future – and the industries of tomorrow.

Knowledge networks



Knowledge networks are the key to rapid development, dissemination and uptake of new ideas, business concepts and technologies. They link four key groups:

- Researchers.
- Investors and financiers.
- Entrepreneurs and industrialists.
- Government agencies and ministries.

Allow researchers to understand the changing needs of industry, entrepreneurs to identify opportunities, industrialists to keep abreast of developments in S&T, and government agencies to understand and remove market barriers to innovation and the entry of new technologies.

The need for foresight



Critical emerging issues

- Economic development and transformation, increasing wealth and inequality, market liberalization, economic restructuring.
- Scientific advance and technological change.
- The rise of Asia: threats, opportunities, conflicts and pressures.
- Environmental constraints, resource availability, climate change.
- Demographic trends.

Preparing for change



- It is important to map out these factors to get a sense of where future problems and opportunities might lie, identify the major drivers of change, and help governments, researchers and businesses to prepare a coherent strategy for the changes that lie ahead.
- There are mapping and planning tools that can help to address these issues.



The future price of Oil ?

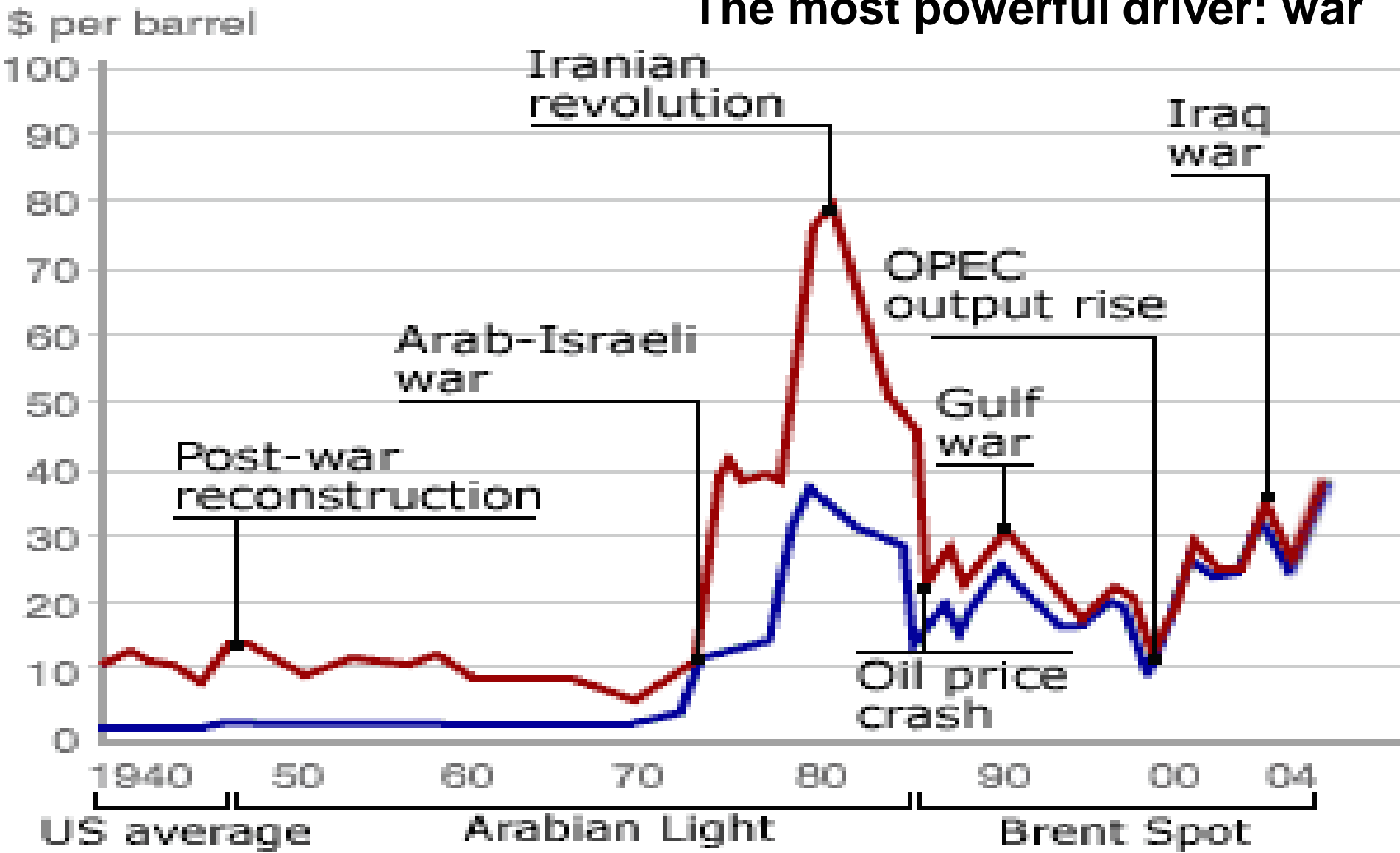
Factors: Trends in supply and demand, remaining reserves, refinery and supply-chain capacity, rate of development of new technologies and infrastructure, rates of substitution, efficiency gains, changes in regulatory and policy environment, geopolitics, hedge-fund investment strategies, possible impact of terrorism and counter-terrorism. These assessments must be integrated in a decision; invest or not invest in a particular project. There are reasons why this is difficult...

Maximum operational depth of offshore fields*, km



CRUDE OIL PRICES SINCE THE END OF WORLD WAR II

The most powerful driver: war



■ Adjusted for inflation ■ Current dollars

Source includes data from BP

These factors create uncertainty



Theory: "The key is stability so we can plan. Oil investments take a long time to come to fruition."

Abdallah Jumah, CEO of Aramco

Practice: "Where the oil price goes, nobody knows."

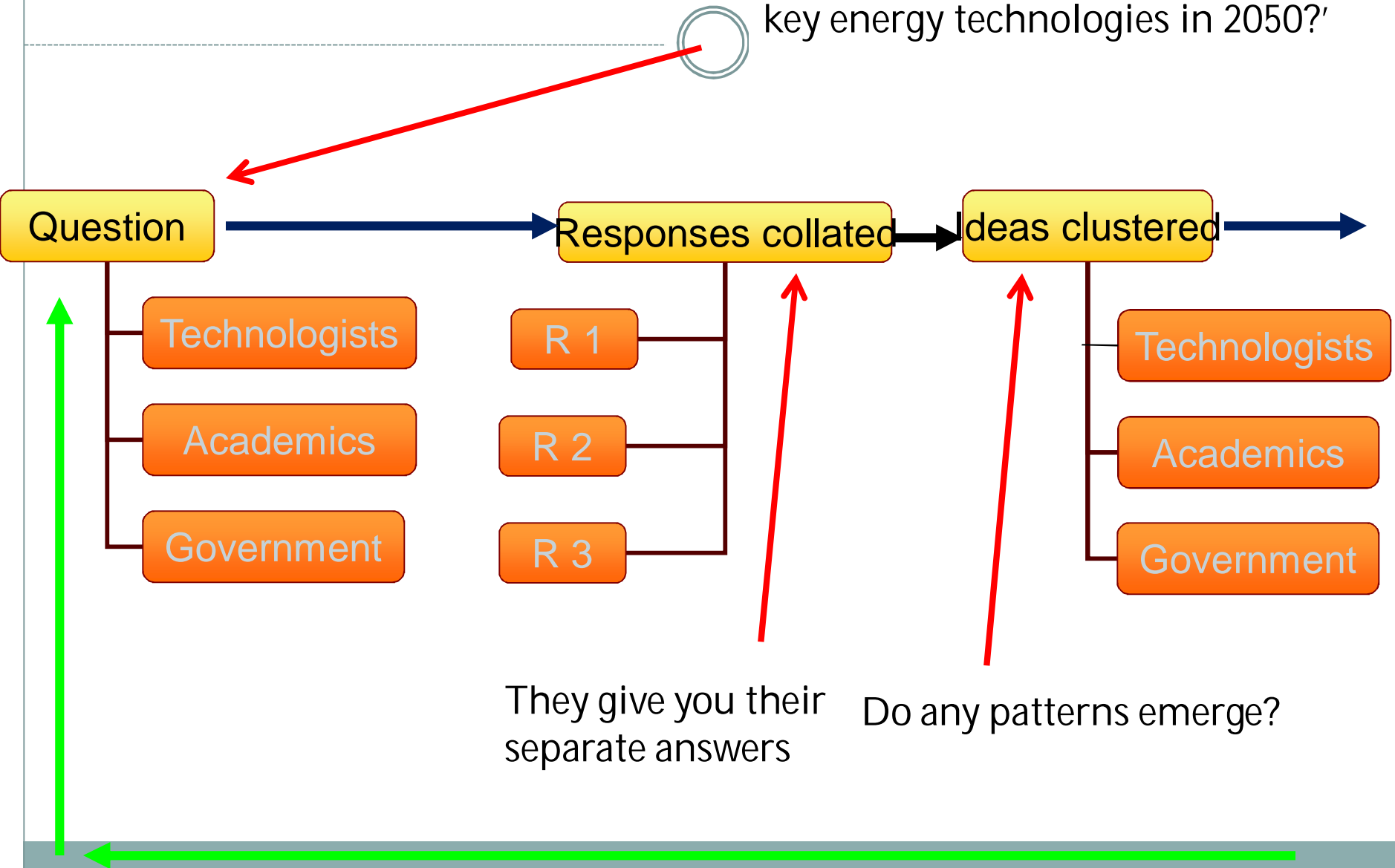
Abdallah Jumah, CEO of Aramco

Delphi surveys: used to assess future outcomes
Managed exchange between experts. Several rounds of questions, assessment, feedback.
Anonymous (so people give true opinions, avoid group-think), allows moderated feedback so opinions of others taken into account.
Panel members recruited on basis of relevant expertise, cross-section of relevant disciplines.



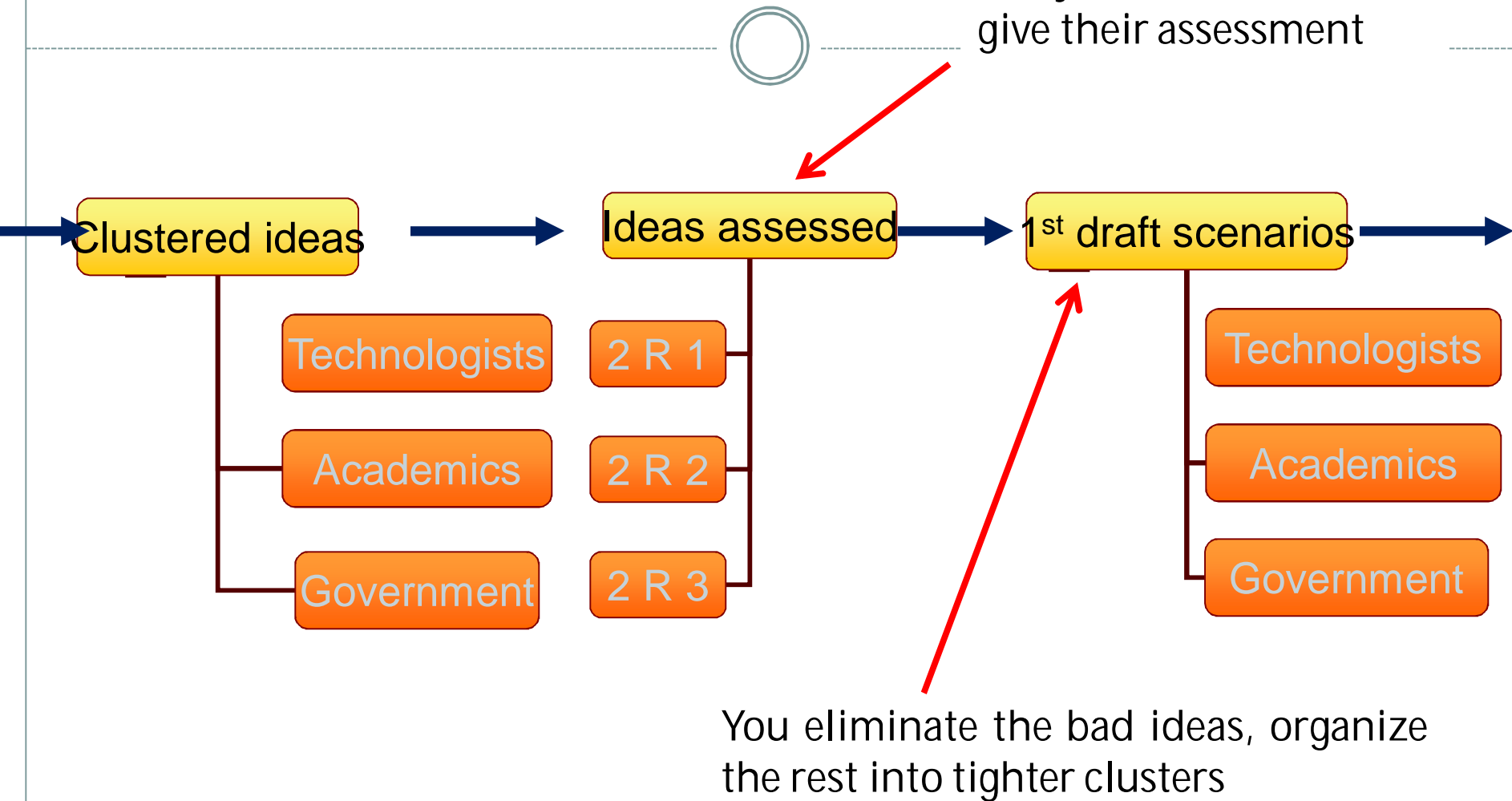
Delphi round 1

You ask everyone – independently – to give their opinion on an important question, such as ‘what will be the key energy technologies in 2050?’



Delphi round 2

Now they see what everyone else said – and give their assessment



Delphi round 3



Let's say four plausible scenarios emerge



1st scenarios

Refined

Final scenarios

Technologists

3 R 1

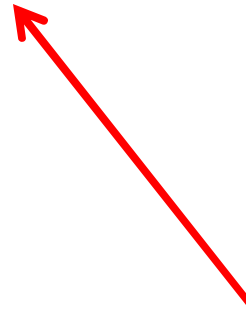
Academics

3 R 2

Government

3 R 3

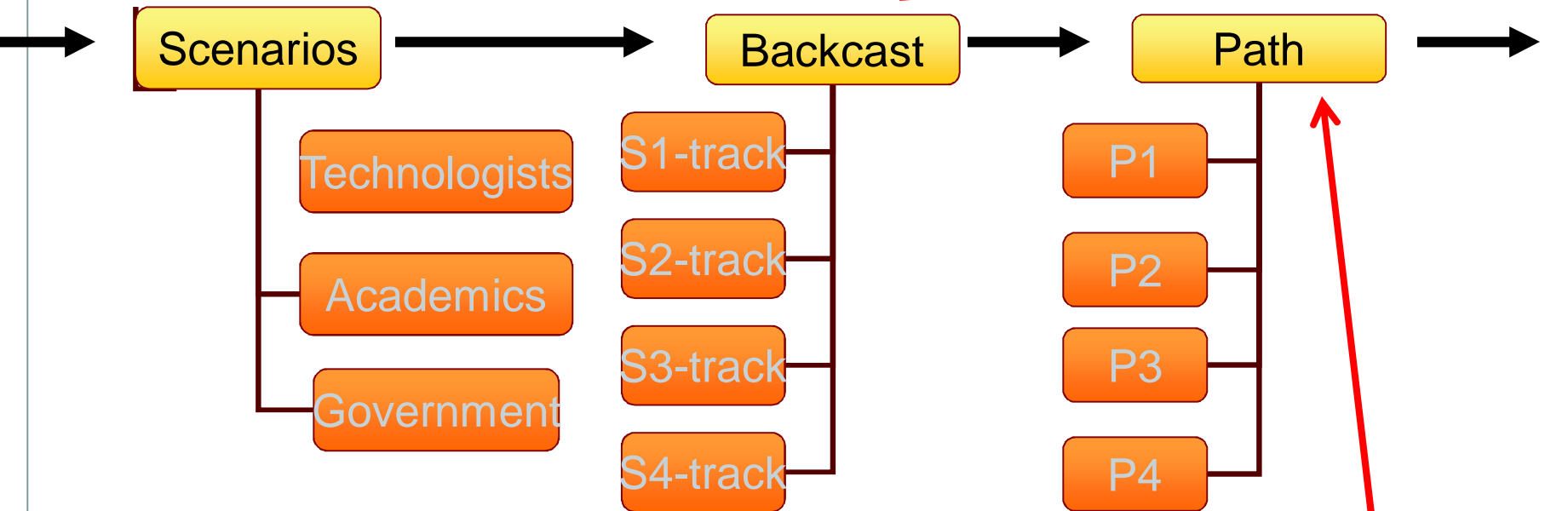
They assess the draft scenarios, some are rejected



Backcasting, action plans



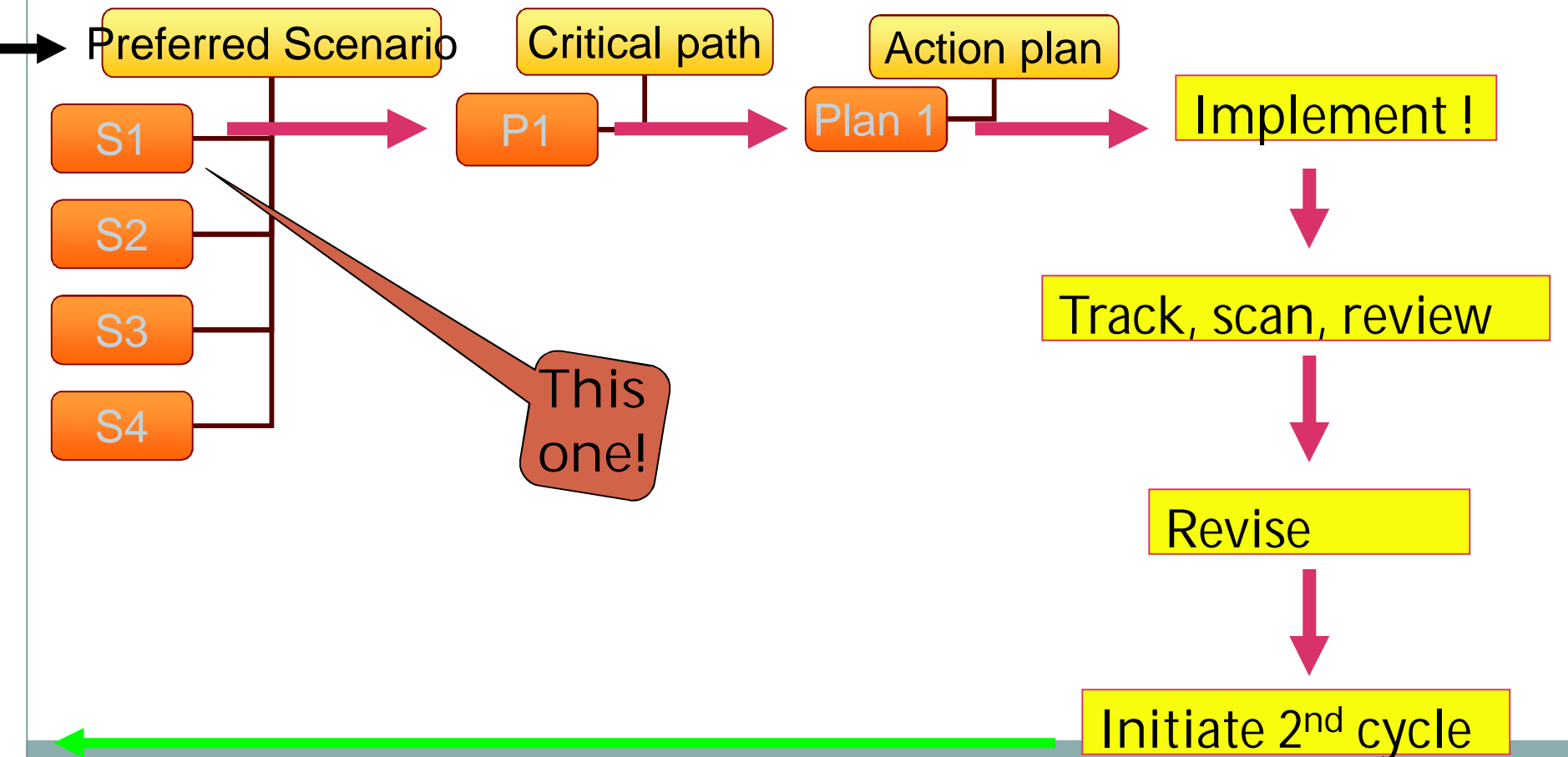
From each scenario you trace back to present day



So 4 scenarios give you 4 paths



Implementation

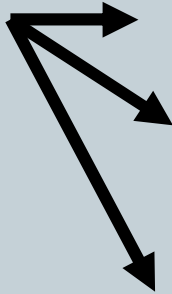


Example: energy policy

Delphi



Research projects



Strategy



1. Identify major potential changes. What might happen to the price of oil? Which new technologies might be developed?
2. Identify main factors involved. What are the drivers of change? What might influence the outcomes?
3. Identify the implications for each possible outcome. What is our preferred option?
4. Map the situation. Where are the decision/action points? List the technologies, resources, skills, contacts etc. needed to intervene.
5. Do a gap analysis – match the list in step 4 with the current circumstances.
6. Set out the strategic plan.

Thank you !

