



**Centre of Excellence - Innovation  
Operational and Technical Excellence**

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# **The Mine of the Future - a Rio Tinto Vision**

## **Invisible Mining? Rock Factory?**

*Chris Cross*

*Bergforsk 8 June 2006*

# Rio Tinto operations



# Rio Tinto business units





# Rio Tinto research style

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- In-house

- Product related e.g. industrial minerals
- Process development, often at operation with OTX and external partners

- External

- Global programme identifies centres of excellence
- Match with research strategy
- Establish direct relationship with such centres
- Collaborative research to form best team
- Use of collaborative research brokers e.g. AMIRA, MIRO, CAMIRO, INAP in general, pre-competitive research

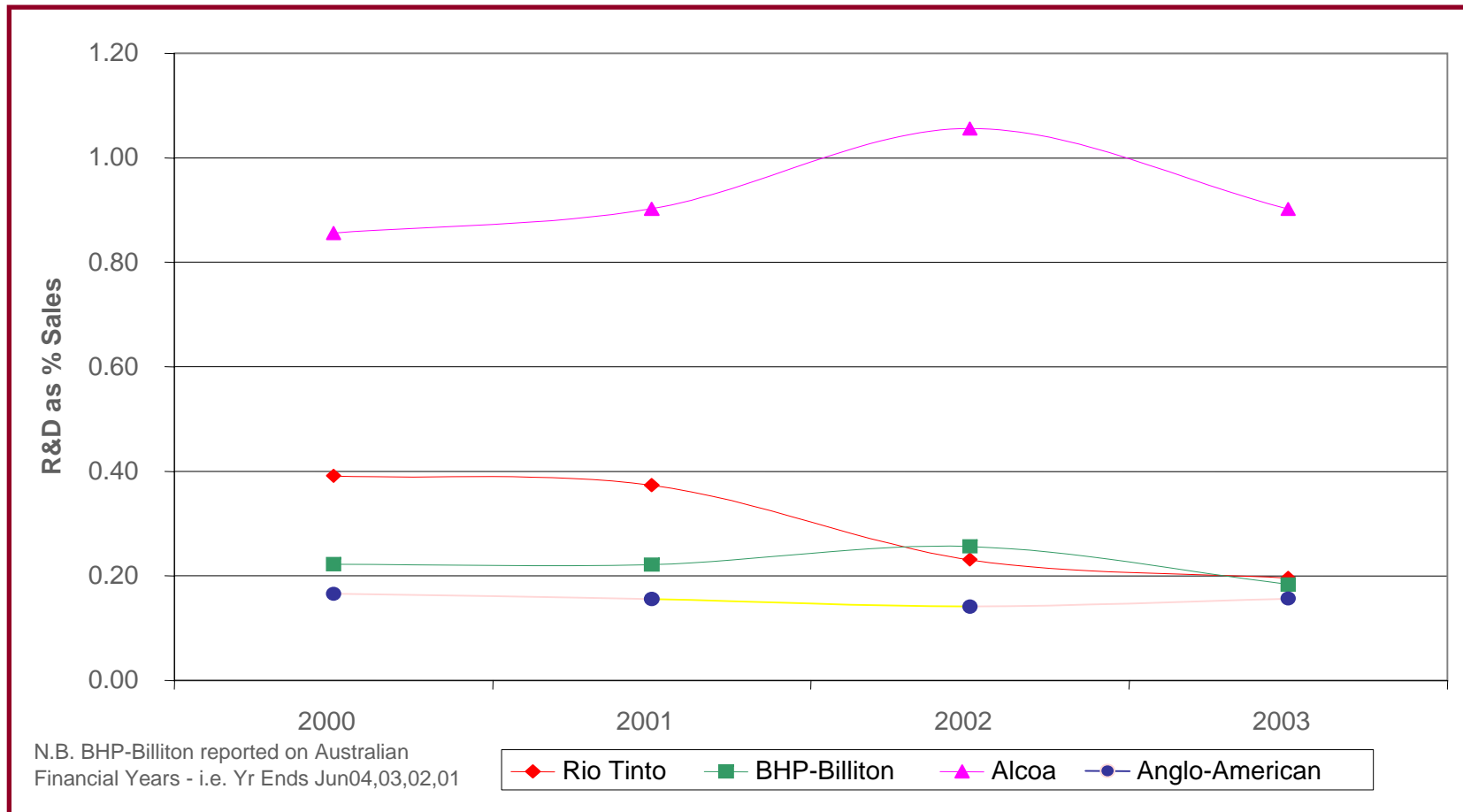
# Recruitment in Australia

- Shortage of mining engineers is not just confined to underground mining engineers.
- In Australia we will be recruiting this year about 163 new graduate engineers (206 total graduates) as follows

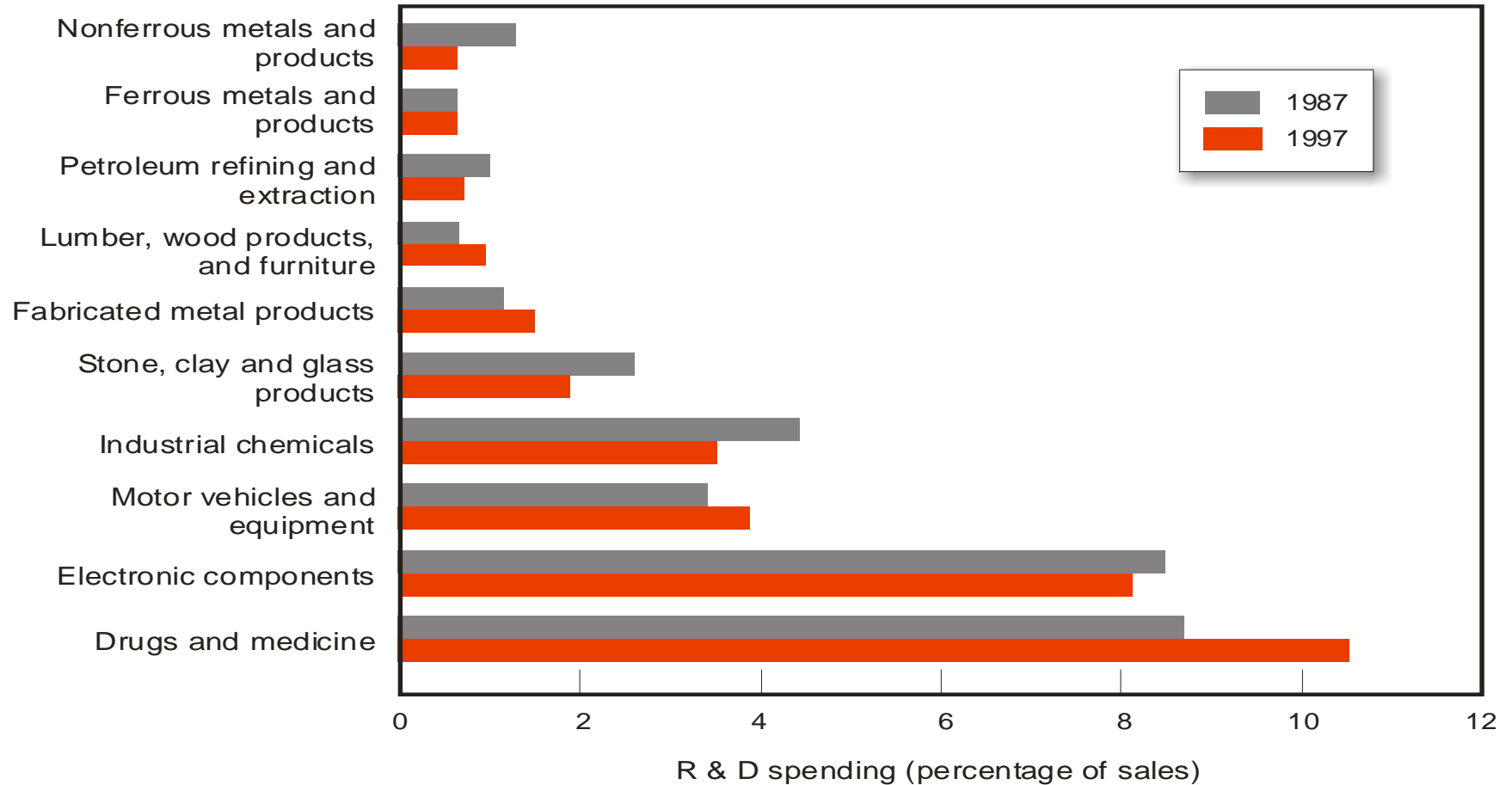
chemical/process	29
chemistry	1
civil	6
electrical	26
environment	10
geology	12
health sciences	11
mechanical	32
metallurgy	6
mining	30

# ...Mining industry R&D investment

## R&D as a percentage of sales



# Comparative investment in R&D



Source: National Science Board, *Science and Engineering Indicators 2000*, Arlington, VA: National Science Foundation, 2000 (NBS-00-1).



# Rio Tinto vision and strategy

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- Strategy must be aligned with Rio Tinto's vision:
  - Focus on large long life low cost largely **underground** assets
  - Seek improvements through technology
  - High safety, efficiency and sustainable development targets
- Thus strategy must
  - Foster innovation
  - Improve efficiency
  - Reduce waste
  - Ensure greater reliability and predictability
  - Promote what is ethical, not just what is expedient
  - Lead, not react



# Mine of the future characteristics

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## Sustainable and economic

- Limited use of land and surface disturbance during mining
- Easy return of land to sustainable and beneficial use
- Safe conditions for employees and neighbours
- Low risks of incidents and emergencies
- Near zero impact on quality and available quantity of other natural resources
- Activities consistent with development plans and targets

## Invisible mining?

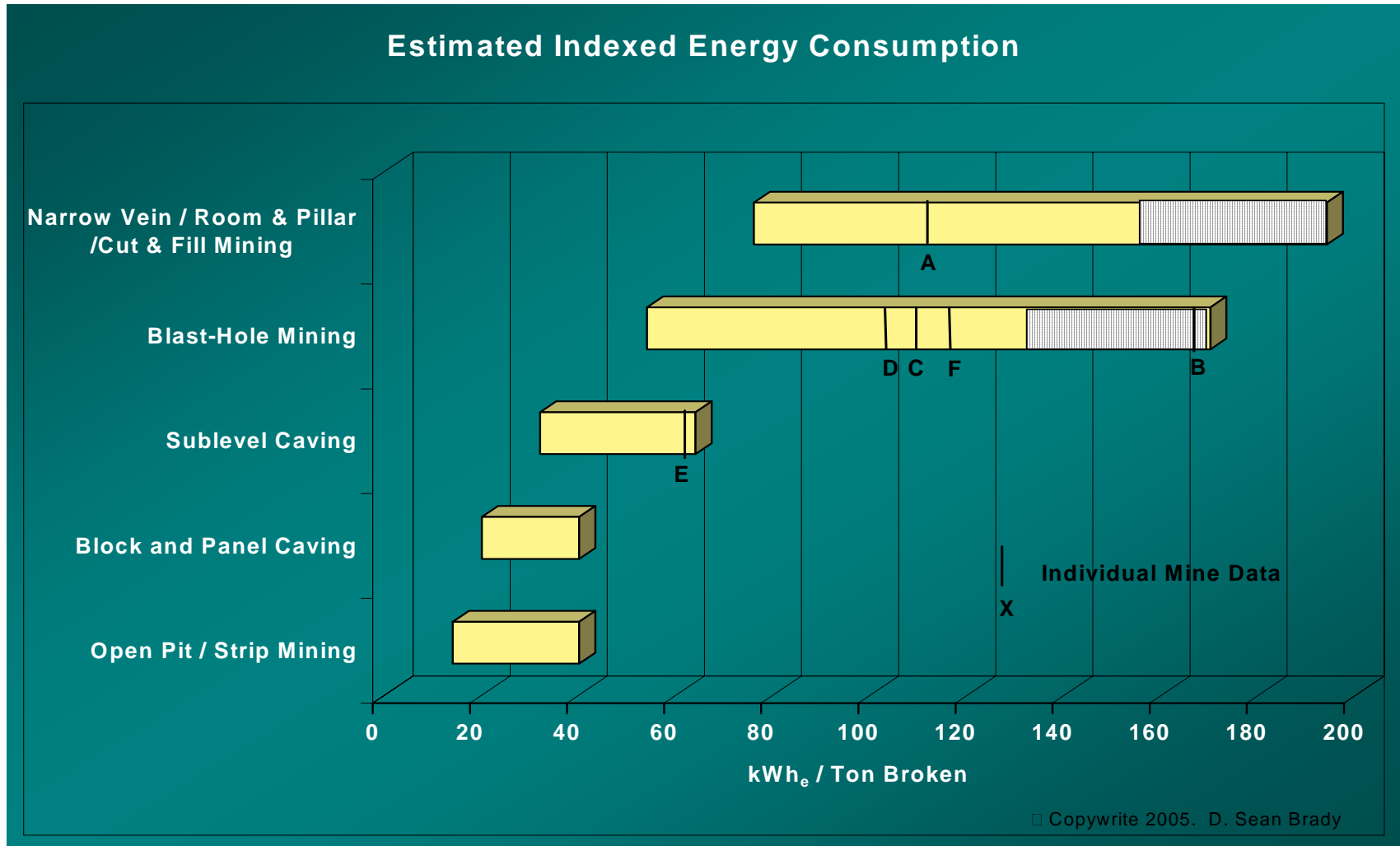
# Challenges

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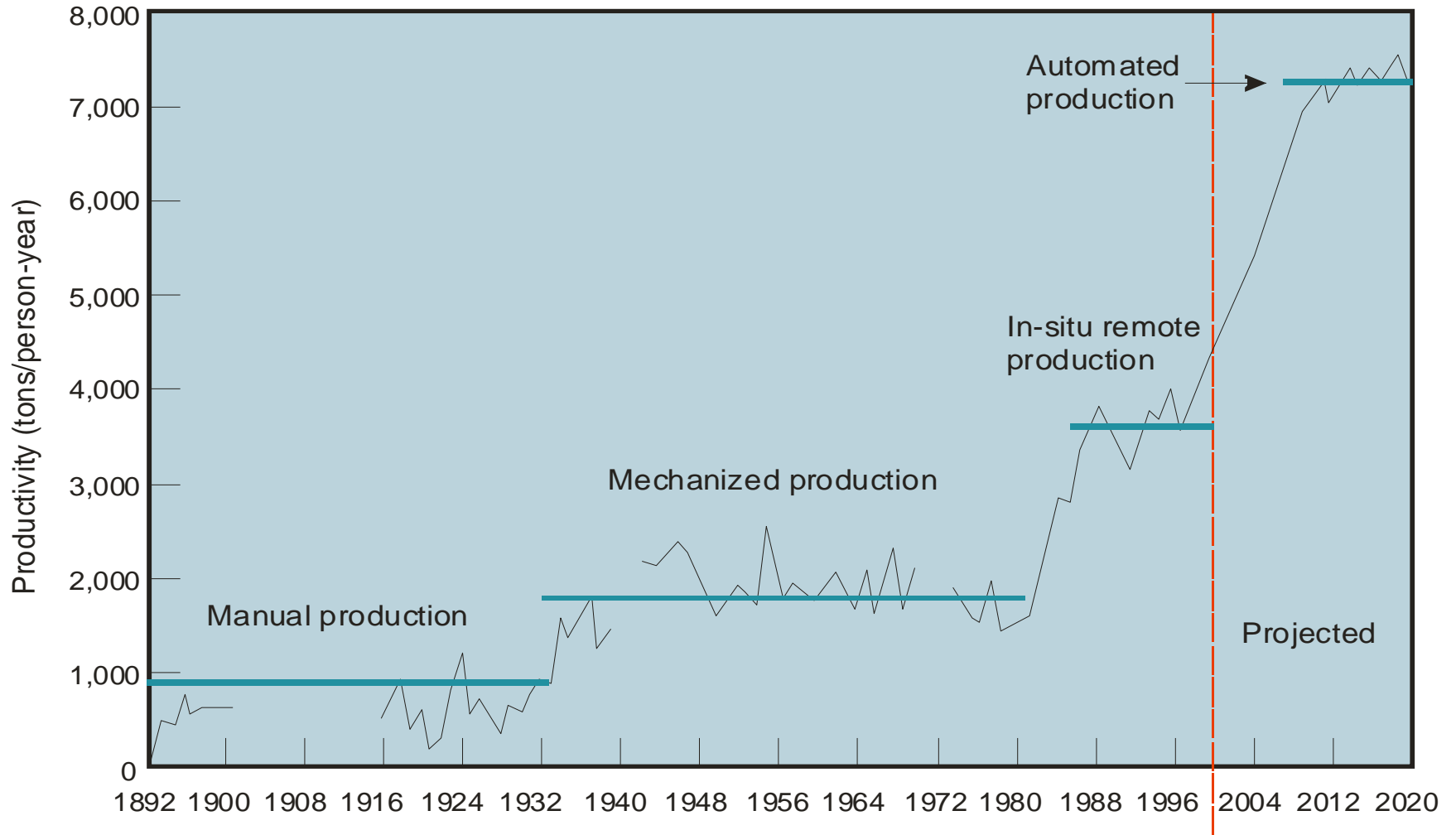
- Orebodies deeper (Resolution, Bingham, Argyle)
- Transition to underground operations (higher costs, risks?)
- Reduced available resources and increased costs (water, power, people)
- Orebodies in difficult locations (artic, underwater, close to environmentally sensitive areas) (Diavik)
- Lower grade deposits
- Zero emissions
- Possible legislative changes (vibration, noise, air, etc)

## Technology answers?

# Block caving as the technique of choice

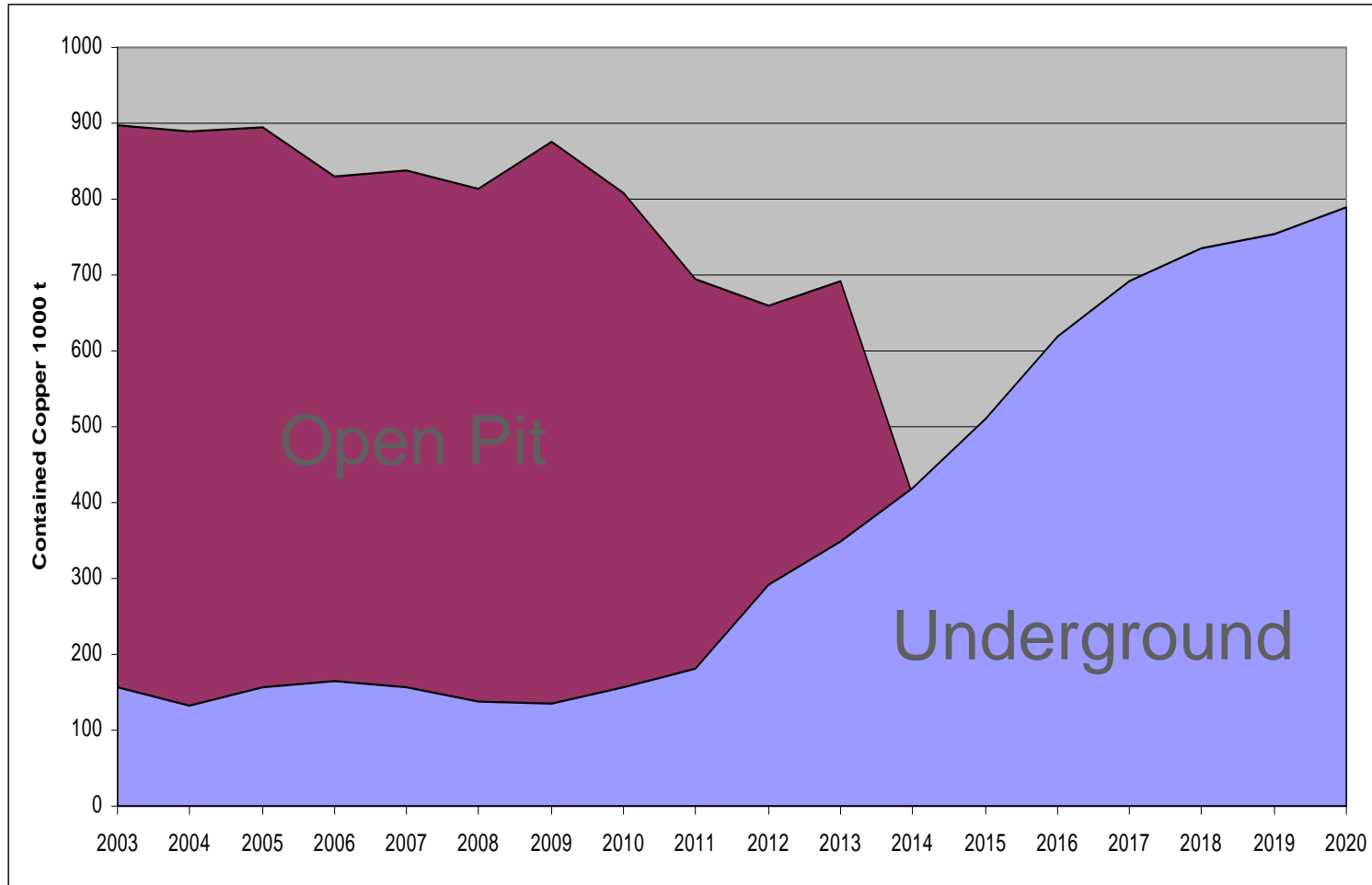


# Productivity



# Rio Tinto Copper output

## Rio Tinto Production Share



# Copper Mining

## Challenges

- Orebodies deeper (Resolution, Bingham)
  - Transition to underground operations
  - Reduce environmental impact
  - Improve safety
  - Lack of people
- R&D gaps/focus areas (underground and surface)
- Orebody to mill system optimization
  - Rapid underground infrastructure construction (block cave)
  - Automation and communication systems
  - Material transport systems
  - Mining method – what is after block caving?



# Mine of the future

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- Economic evaluation, mine design, operation and closure will be treated in a completely integrated manner, taking into account local community and ecology before, during and after mining.
- Underground mining and processing with limited use of land and minimal surface disturbance
- Mining will be on a very large scale at high rates using new techniques, such as block caving and automation, with high levels of technology
- Efficient use of energy with high extraction efficiencies of minerals
- Water use will be minimised – recycling, minimisation of losses, development of dry concentration, dry containment
- Operation will be safe for employees and neighbours.
- Low to zero impact on other natural resources
- The mine site will be easy to return to sustainable and beneficial use

## The rock factory?



# Barriers to the future

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- *Lack of innovation*

Collaborative research required between industry, suppliers and universities (*universities tend to be the idea generators*)

- *Shortage of staff*

There is a world shortage of mining, geotechnical and metallurgical graduates due to lack of interest by young people and the consequent closure of courses

At the same time the industry is expanding whilst its ageing work force is retiring (*again the universities are the key*)