R&D needs & opportunities: 3 framing questions

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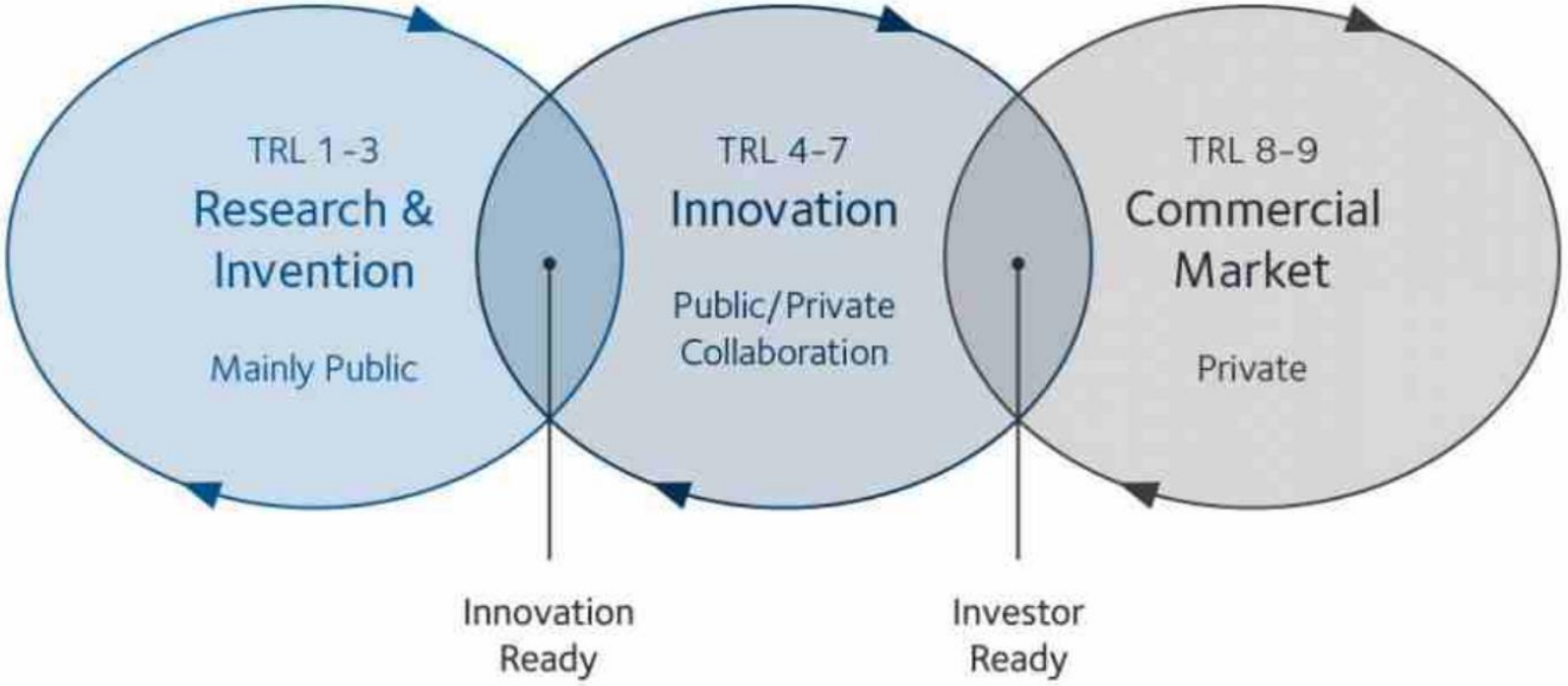
1. What should R&D seek to accomplish?

- More and more-diversified production
  - Better geoscience
  - Better mining, mineral processing and extractive metallurgy (lower cost, less polluting, less energy intensive)
- Less waste
  - Increased manufacturing efficiency
  - Enhanced recycling and re-use
- Development of substitute materials
  - . . . that take advantage of materials that are less prone to supply-chain risks

2. What are the big challenges?

- Overarching
  - Anticipating which materials may go critical
  - Increasing the speed of discovery, innovation & deployment
- More specific
  - Unlocking unconventional resources
  - Selective separations
  - More-direct processing paths for converting ore and intermediate products into high-value forms that are closer to final-application use

3. What stages of R&D should government fund?



Source: https://www.uk-cpi.com/blog/the-innovation-challenge-and-the-valley-of-death

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3 framing questions

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   - Less waste
   - Development of substitute materials
2. What are the big challenges?
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   - Selective separations
   - More-direct processing paths for converting ore and intermediate products into high-value forms that are closer to final-application use
3. What stages of R&D should government fund?
   - A key question – pilot/demonstration plants, mid-TRL work?