

Development of diagnostic tools for inspectors

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Animal &
Plant Health
Agency



Department
for Environment
Food & Rural Affairs

Presentation

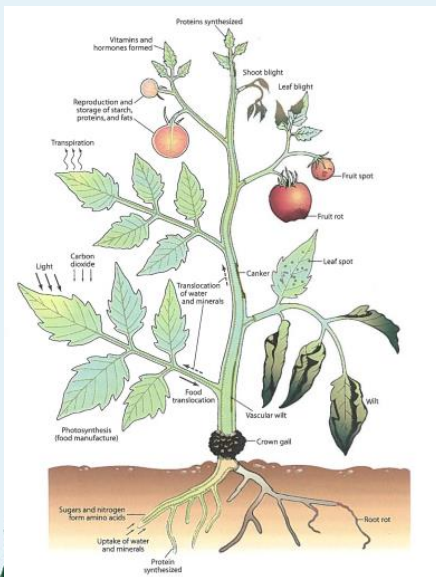
- My background
- Diagnostic tools for inspectors
- Potential barriers for uptake
- Deployment Readiness, rather than Technology Readiness
- UK examples of deployment

My background

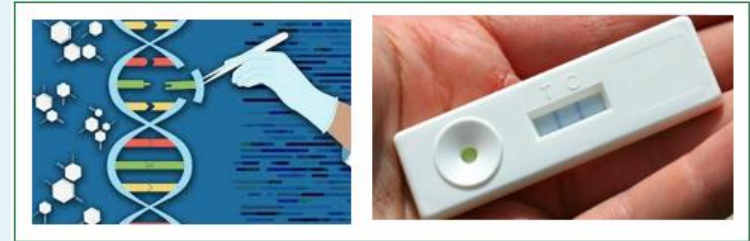
UK Civil
Servant
since 1995



Plant pathologist - Specialising in fungal diseases



- Producing laboratory methods (DNA & antibody)



- Point of sampling testing



- Producing standards & protocols



- Now oversee plant inspections for England & Wales



UK applied technologies



- APHA & Fera science partners since 1980's, developing tools for crop use & at the border
- Mainly lateral flow devices & DNA technologies
- Products work well, but challenge often with take-up



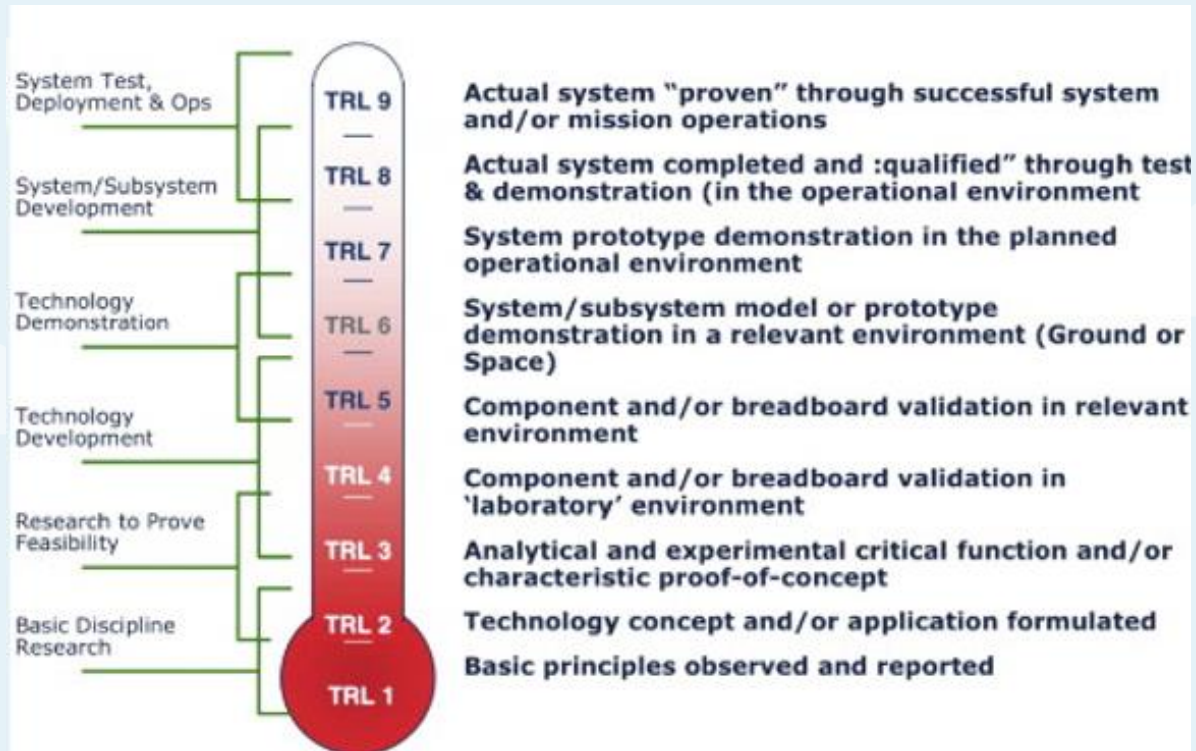
Develop of field technologies

- Plenty of reviews & assays out there:
 - Mumford *et al* 2006, Tomlinson 2016, Yadav & Yadav 2025.
- Rational:
 - Improve speed / accuracy of early identification
 - Reduces friction at the border & for down-stream stakeholders
 - Increase choice of actions
 - Helps manage outbreaks
 - Can reduce costs & pressures on labs.
- Why put in the hands of inspectors ?
 - Present at points of entry & outbreak sites.
 - Good connected with trade & their concerns.
 - Generally, inspectors mirror trade work patterns & locations

However, current uptakes remains low

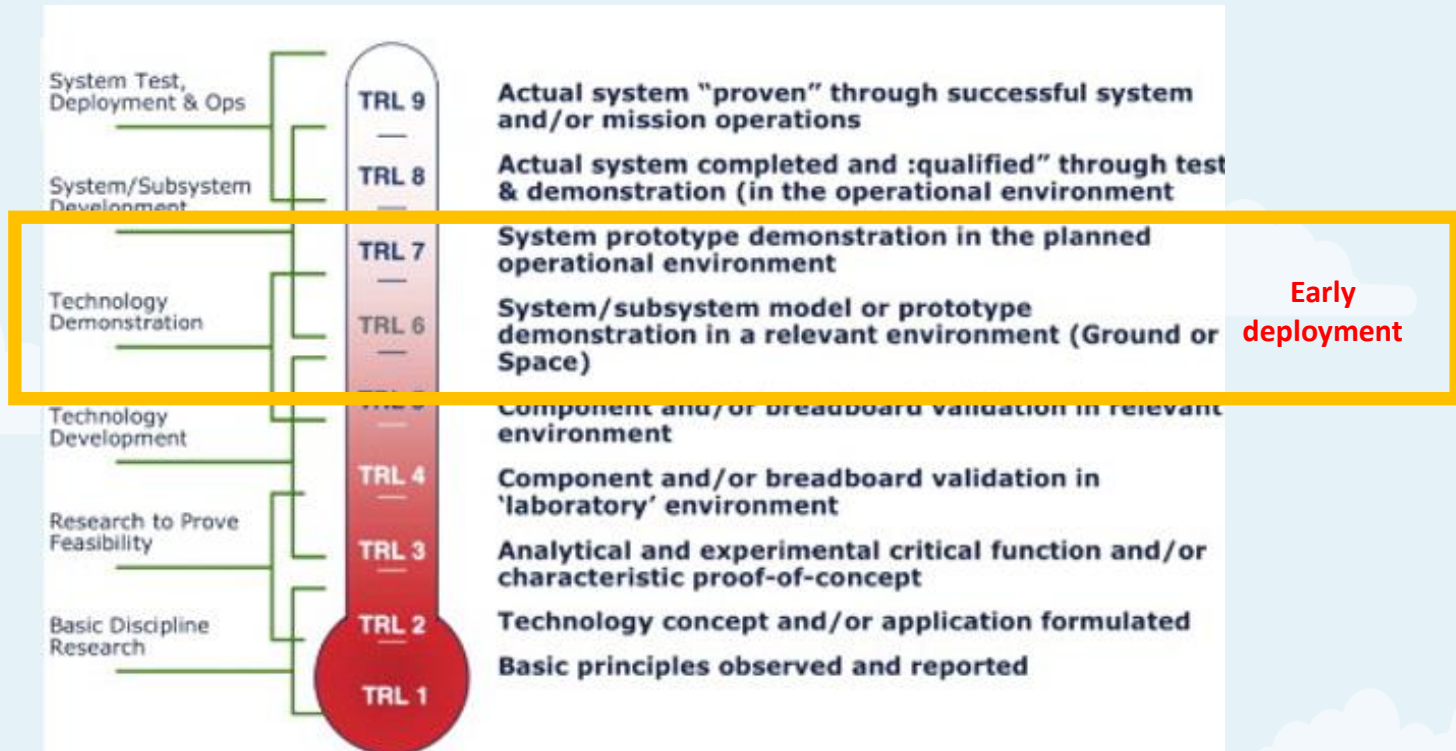
Why uptake remains low ?

Technology Readiness Level



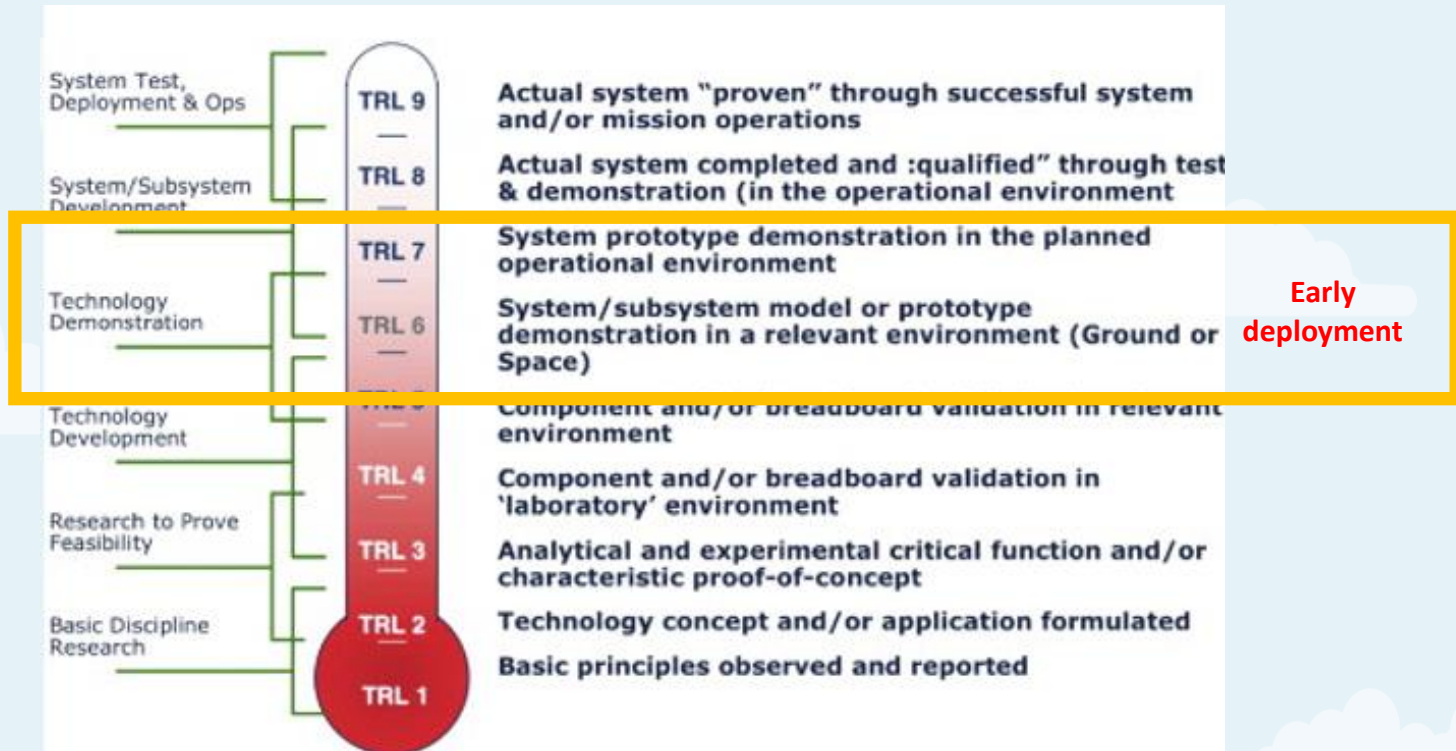
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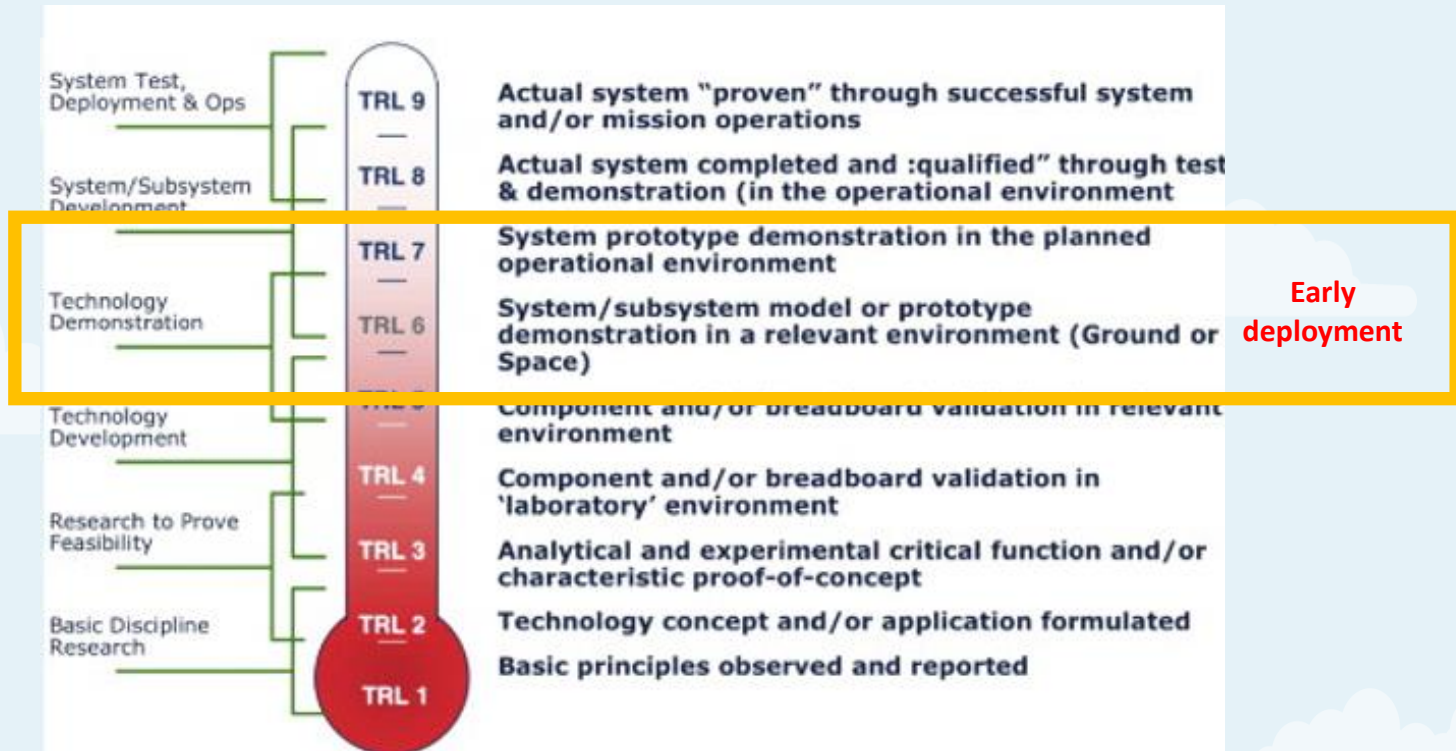
Technology Readiness Level



- Fera investigated, resulting in significant progress

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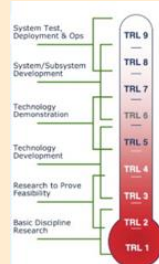


- Fera investigated, resulting in significant progress
 - Co-design with all partners; Map potential problems not just diagnostic, look to solve each before, or alongside technical issues.

Potential barriers

Technical barriers

- Test performance & robustness
- Specific demands
 - Challenging & diverse test matrices
 - Diversity of targets & small business markets
 - Pest biology
- Lack of technical developments



Policy decisions

- How results will be used
- Legal basis for tests
- Uncertainty about approval processes



Operational & logistical barriers

- Costs
- Physical setting & complexity of workflows
- End user skills, training and support
- Staffing (capacity, shift patterns, staff turnover)



Cultural barriers

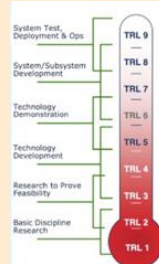
- Risk aversion
 - Tests performance different to lab
 - Limited validation
 - Interpretation & relaying of information
- Other real-time priorities
- Shift patterns / need for support



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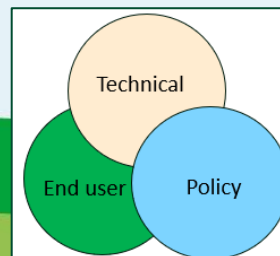


Cultural barriers

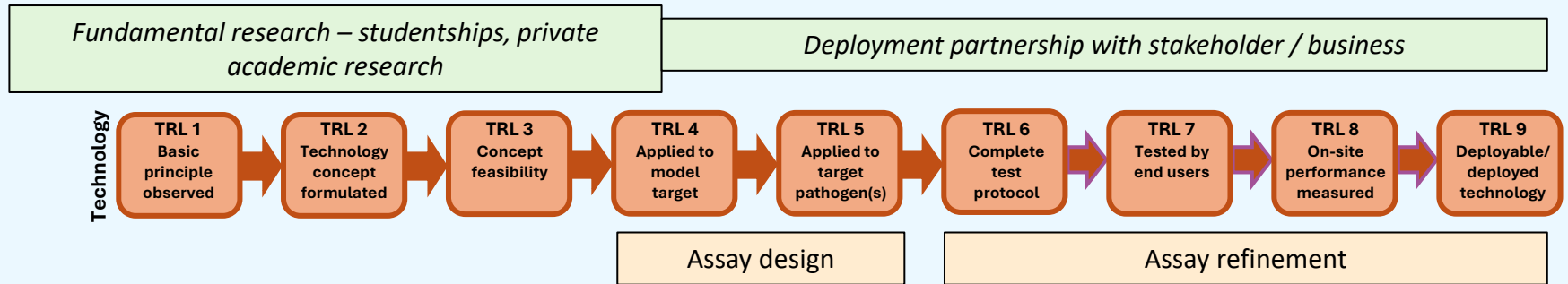
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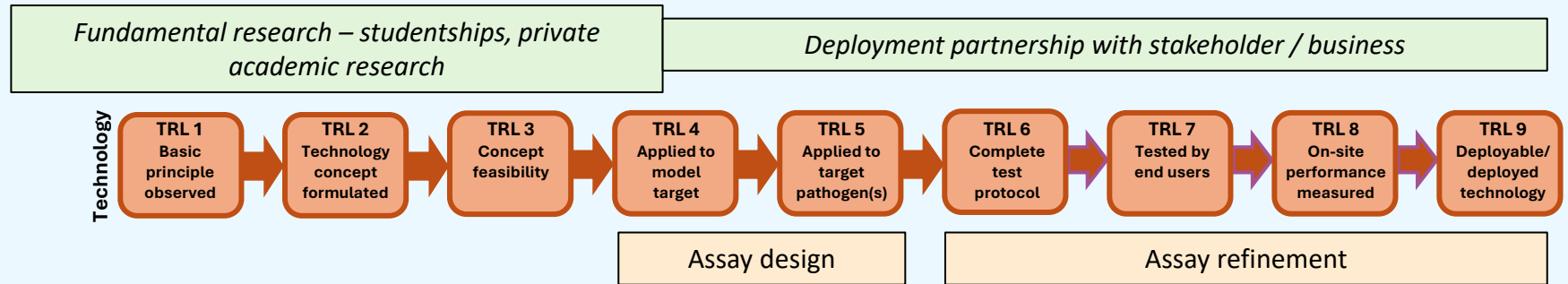
- **Main conclusion: Think Deployment Readiness Levels (DRL) not TRL.**



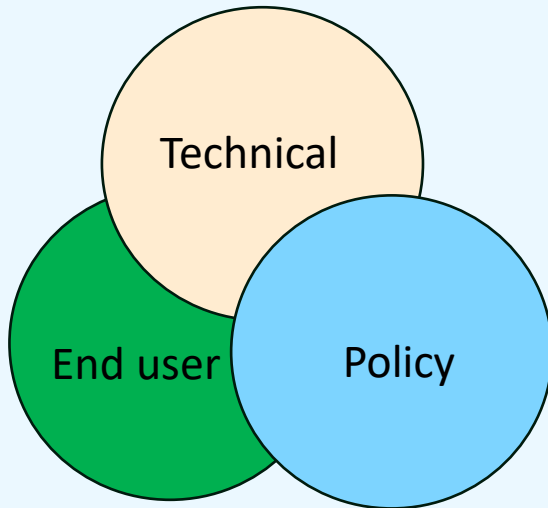
Readiness framework DRL with TRL



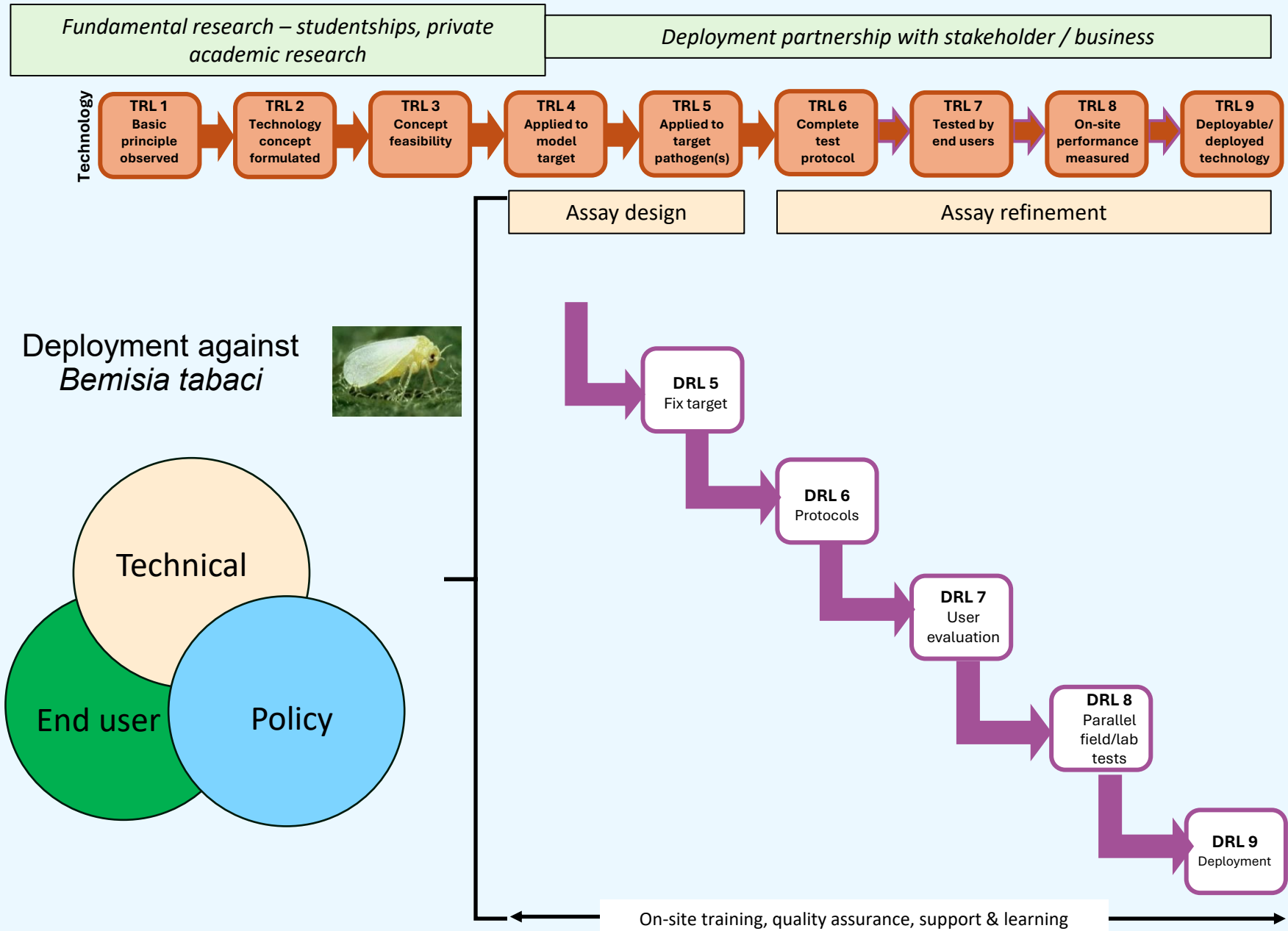
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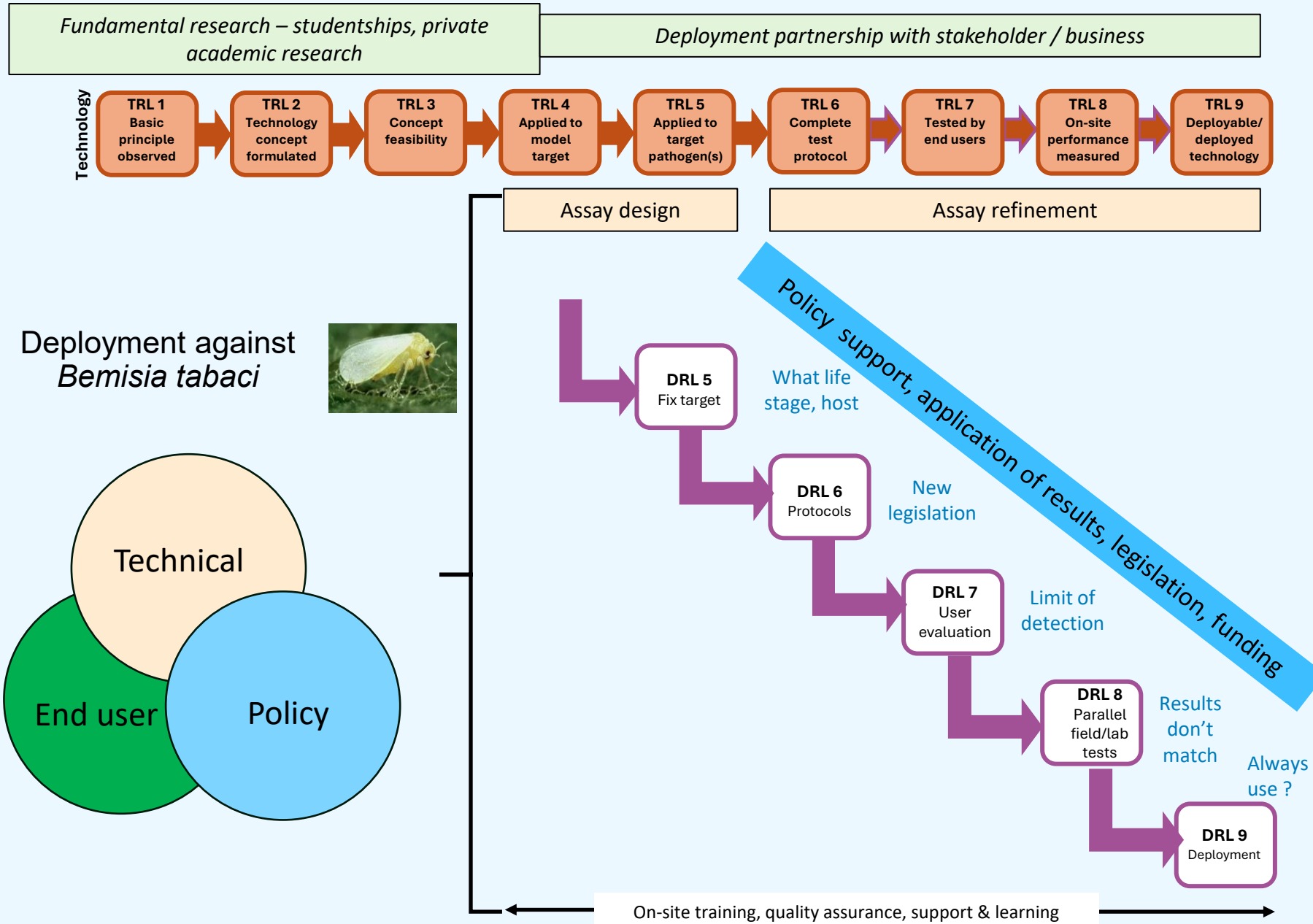
Deployment against *Bemisia tabaci*



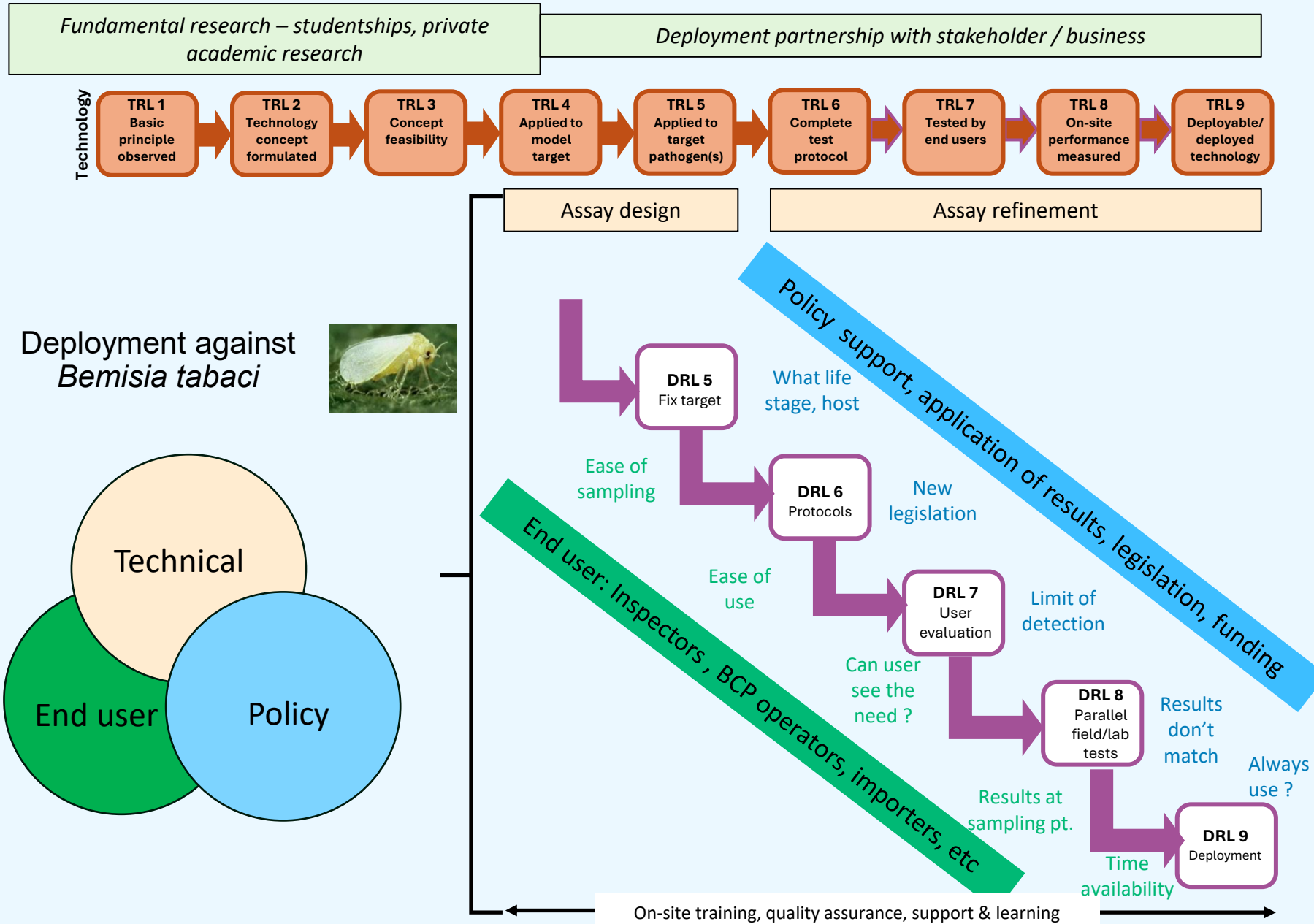
Readiness framework DRL with TRL



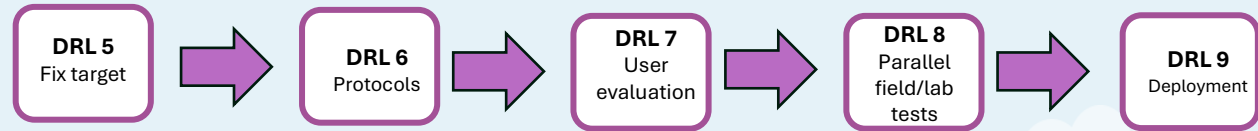
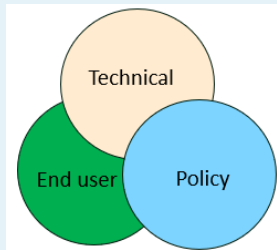
Readiness framework DRL with TRL



Readiness framework DRL with TRL



DRL framework benefits

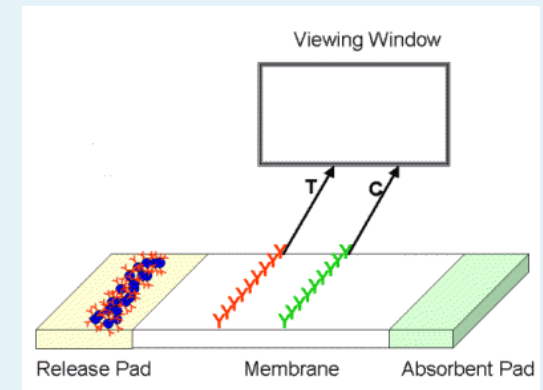


- Clear co-design leading to deployment & uptake
- Helps set deployment expectations (time, effort, costs)
- Creates pre-emptive approach to known & new barriers
 - DRL 5: What do end users want & why
 - DRL 6: Assay considered in entirety – e.g. robustness & reliability, costs & policy
 - DRL 7: Refine user requirements before application
 - DRL 8: Evaluate systems in “real world”
 - DRL 9: Deploy in “real world” with regular review

Examples

Lateral flow devices

- Inspectors preferred tool
 - Quick, robust, high accuracy, relatively cheap
 - *Phytophthora* spp device routinely being used (DRL9)
 - *Xanthomonas* spp assay being rolled out (DRL 8)
- Looking to produce new devices from:
 - Historic cell lines (DRL 5)
 - New synthetic & classic antibodies (DRL 5)
 - Use of LAMP amplicons on LFDs (DRL5)



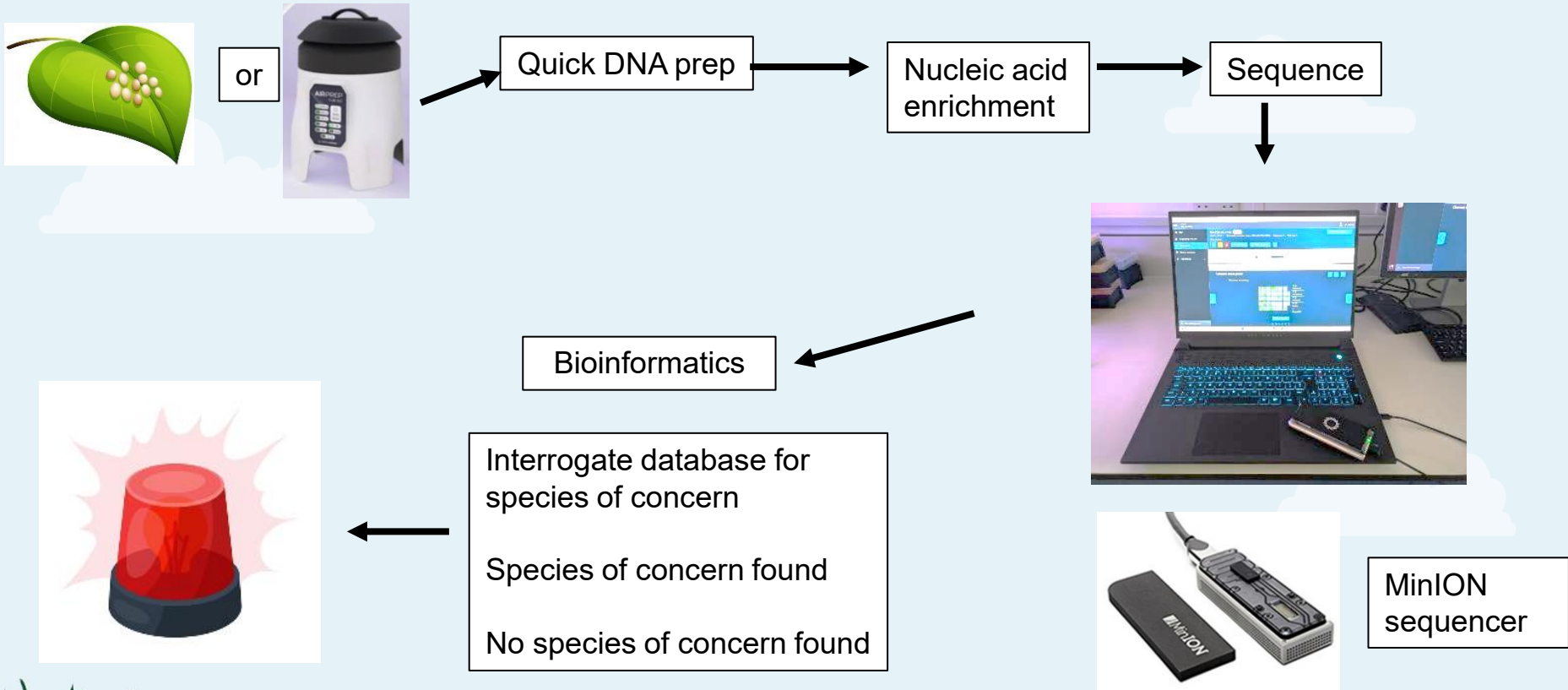
Drone use

- Multispectral & thermal cameras
- Imaging used for:
 - *Narcissus* inspections (DRL 8)
 - Colorado beetle surveillance (DRL 9)
 - Seed potato crops for PVY detection (DRL 7)
 - Yellow-Legged Hornet nests (DRL 9)
 - Avian Influenza (DRL 6)
- Advanced image processing under evaluation (DRL 3)



Molecular tools – Barcoding at the border

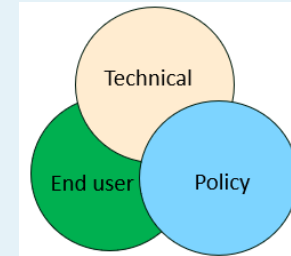
- Method development for sequencing at border points (DRL 3-4)



MinION sequencer

Molecular – LAMP / Genie

- *Bemisia tabaci* & *Liriomyza* species (DRL 8-9)
- DRL process being applied for other targets
- Other targets under evaluation:
 - *Xylella*, *Phytophthora* & *Xanthomonas* spp, various potato & tomato viruses



OptiGene LAMP cartridge system - MDX4A

- User centric design
- One step cartridge system, results < 30 min
- No to low interpretation of results
- On journey to deployment (DRL 6-9)



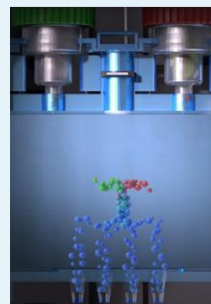
Add sample into vial & shake



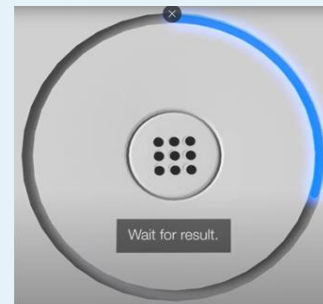
Place vial into test cartridge



Place test cartridge into device. Press start



Fully automated liquid handling and measured dispensing

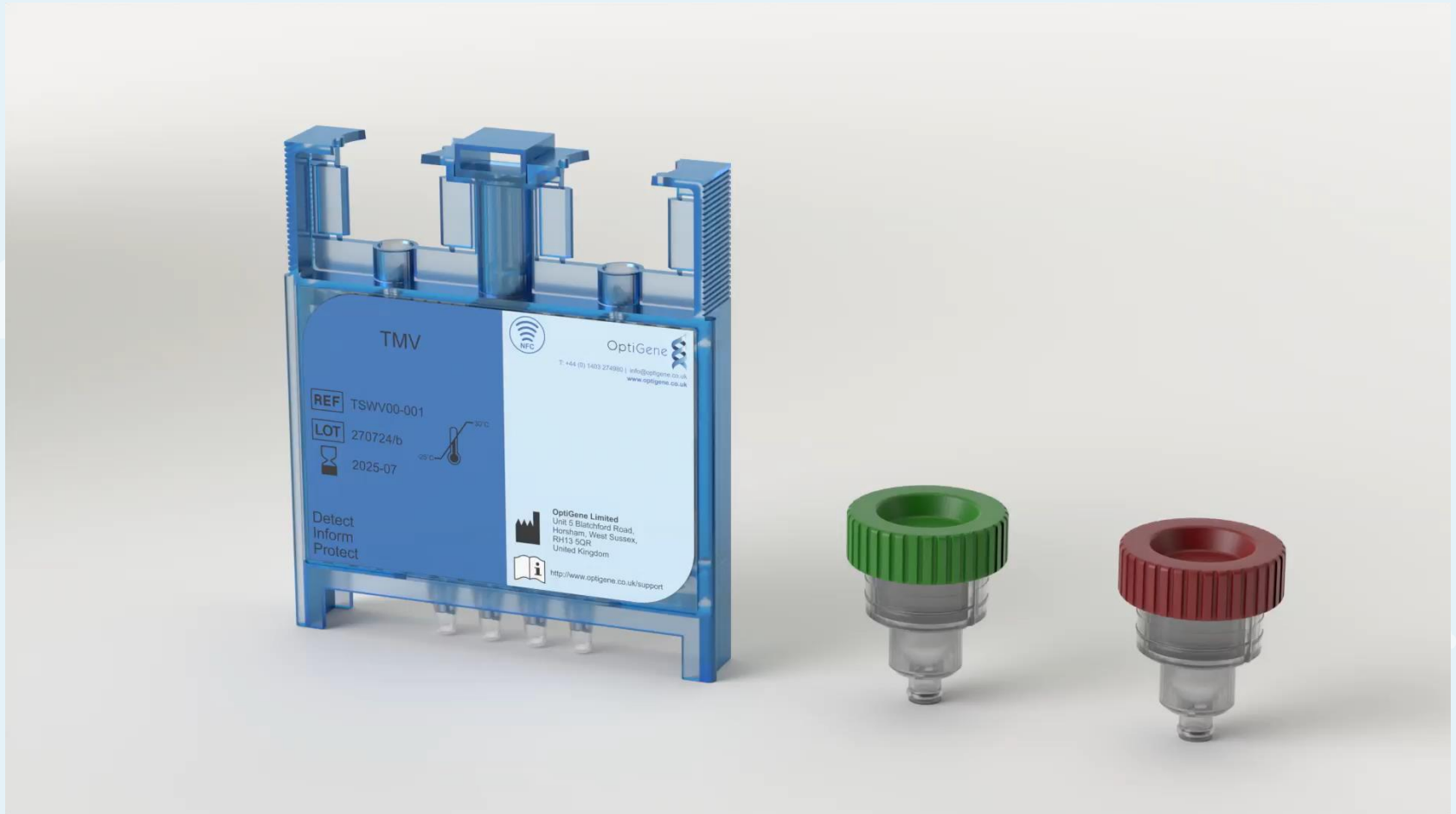


Fully automated isothermal DNA/RNA amplification and pathogen identification by fluorescence measurement



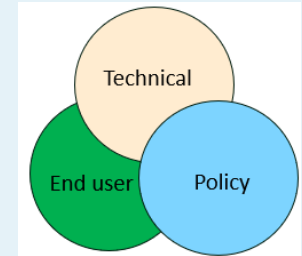
Results displayed on wireless connected smart device

LAMP cartridge system - MDX4A



Conclusions

- Often clear need for in-field diagnostics
- However, many potential barriers:
 - Technical, Policy, Operational, Cultural
- Sampling is everything
- Vital to co-design
 - Applying Deployment Readiness approach
 - Fera developing framework to help new tools be developed
- Potential for EPPO guideline for others to follow
- We / Fera looking for partners to develop & evaluate new tools (Fera QR code)



Thank you

- Jenny Tomlinson & Lynn Laurenson, Fera
(Defra Future Proofing Plant Health; Pathsafe Programme; GAP DC; Barcoding for Biosecurity)
- Victoria Tubman, Danni Marrison, Ben Walpole, Paul Beales, APHA
- Ross Haffenden & Michael Andreou, OptiGene
- Defra for funding work & attending this workshop



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