



*Nissan Leaf*

# Building a better battery

Neil Morris  
November 2019



# TWO YEARS OF IMPACT



**91%** or **£71M** Total budget committed to research, training and analysis

**£3M** DFID funds for battery solutions in emerging economies



**9** Major research programmes

**22** UK universities  
3 in world's top 10

**50** Industrial partners



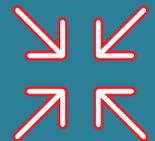
**1** Patent filed

**46** Scientific publications  
84% in top quartile

**450** Researchers  
(by ~March 2020)

**50** Undergrads in summer research internships

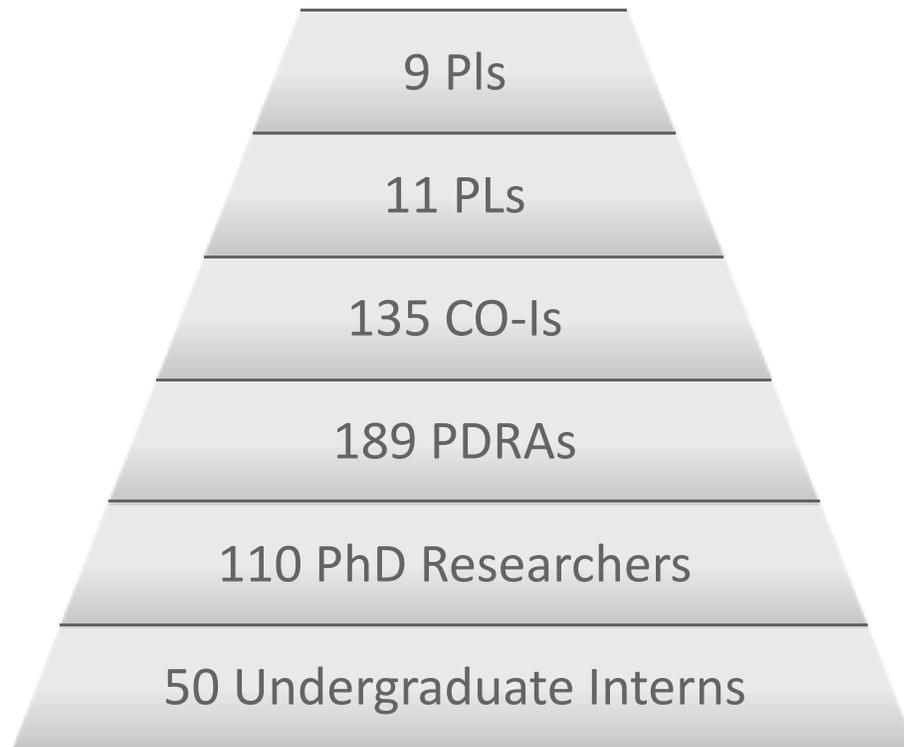
**4** Entrepreneurial fellows



**130,000** Online viewers of our Royal Institution events

**4** Disclosures made

# OUR COMMUNITY



**22**

Academic  
partners



**60+**

Industry  
partners



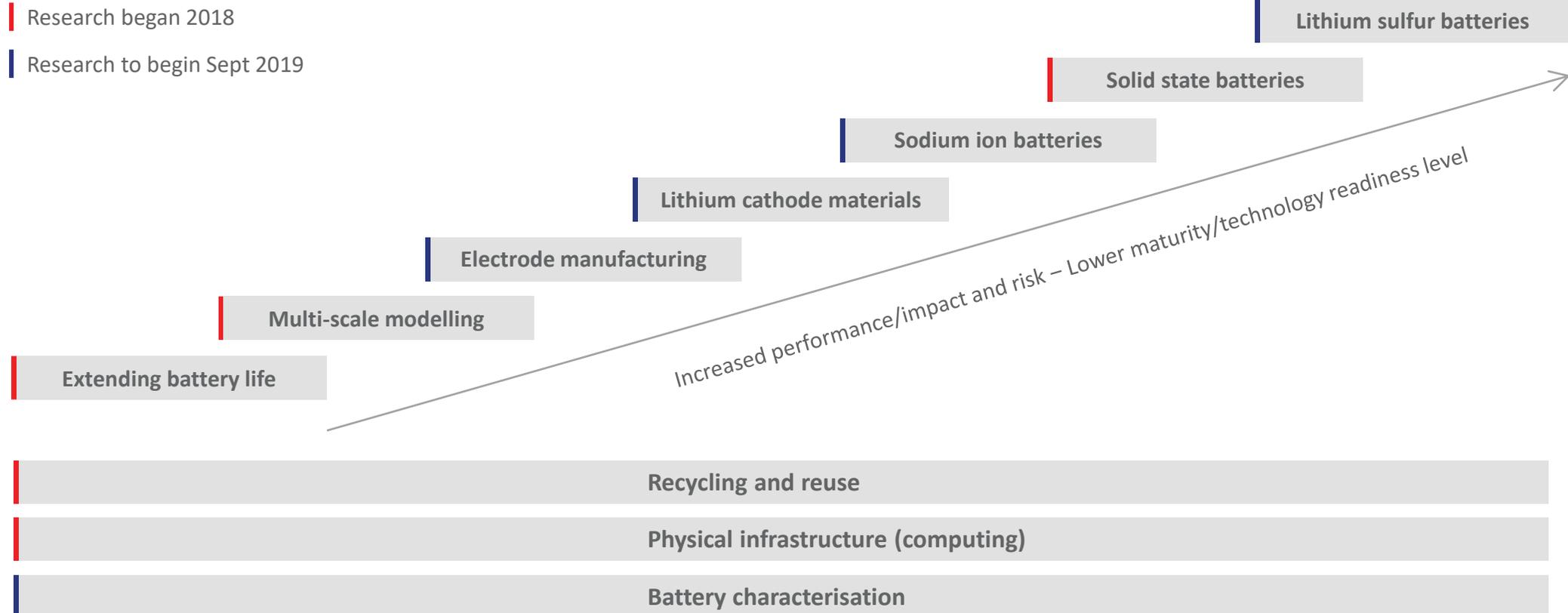
**450+**

Researchers from  
many disciplines



## Scientific research

Application-inspired research to address known technical performance gaps





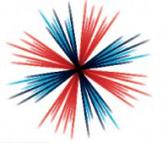
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## **Our mission**

Accelerating breakthroughs in energy storage technologies to benefit the UK in the global race to electrification

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# FARADAY BATTERY CHALLENGE – TECHNICAL AIMS



**Cost**

**2/3 cost reduction**

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Now	2035
\$130/kWh (cell)	\$50/kWh (cell)
\$280/kWh (pack)	\$100/kWh (pack)



**Energy Density**

**2x energy density**

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Now	2035
700Wh/l,	1400Wh/l,
250Wh/kg (cell)	500Wh/kg (cell)



**Power Density**

**4x power density**

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Now	2035
3 kW/kg (pack)	12 kW/kg (pack)



**Safety**

**Battery packs 'inherently safe'**

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**2035**  
Eliminate thermal runaway at pack level to reduce pack complexity



**1st Life**

**Pack life equivalent to life of the car**

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Now	2035
8 years (pack)	15 years (pack)



**Temperature**

**50% increase in operating temp. range (°C)**

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Now	2035
-20° to +60°C (cell)	-40° to +80°C (cell)



**Predictability**

**Full predictive models**

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**2035**  
Full predictive models for performance and aging of battery



**Recyclability**

**Closed-loop recycling system in place**

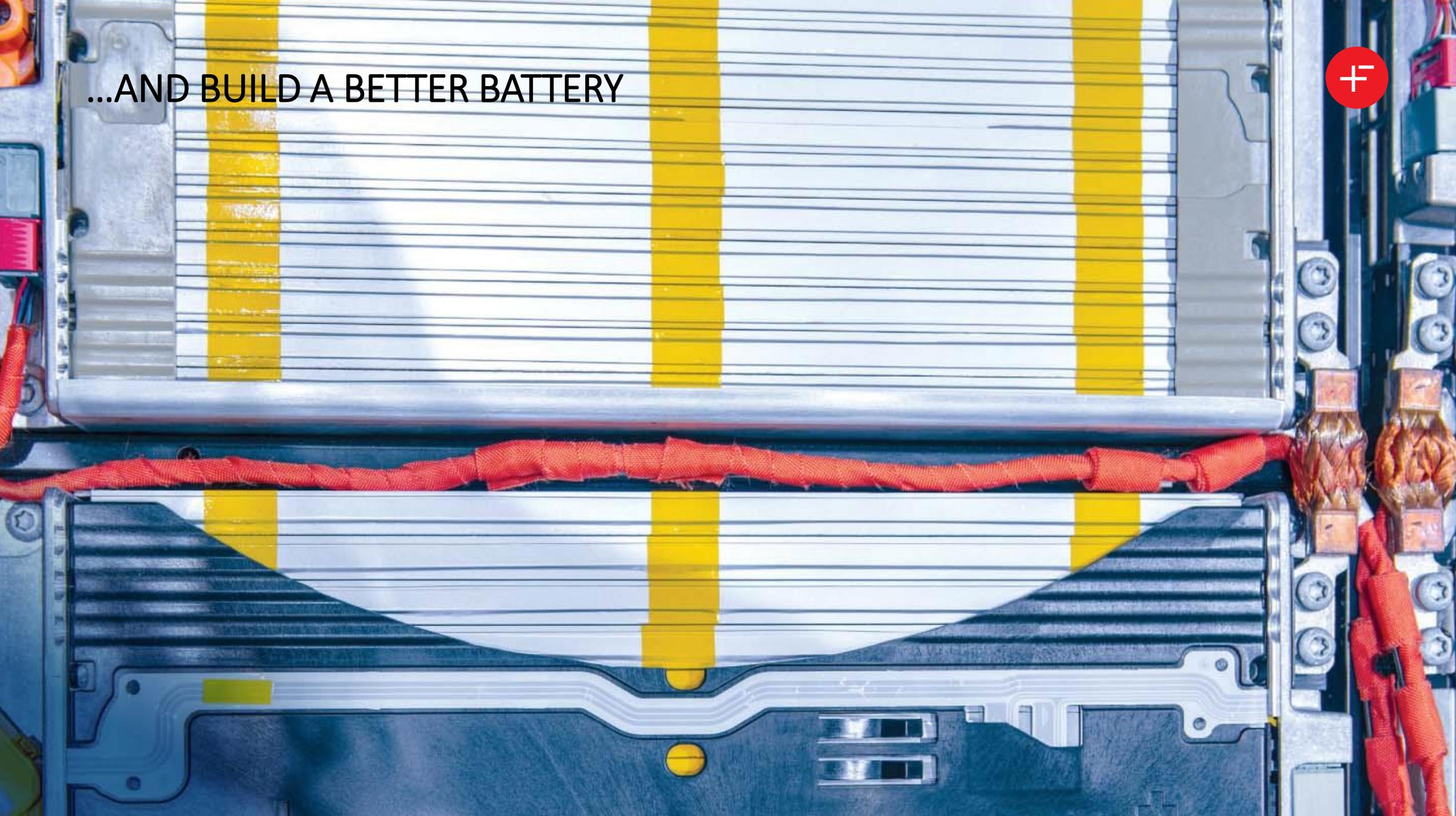
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Now	2035
10-50% (pack)	95% (pack)

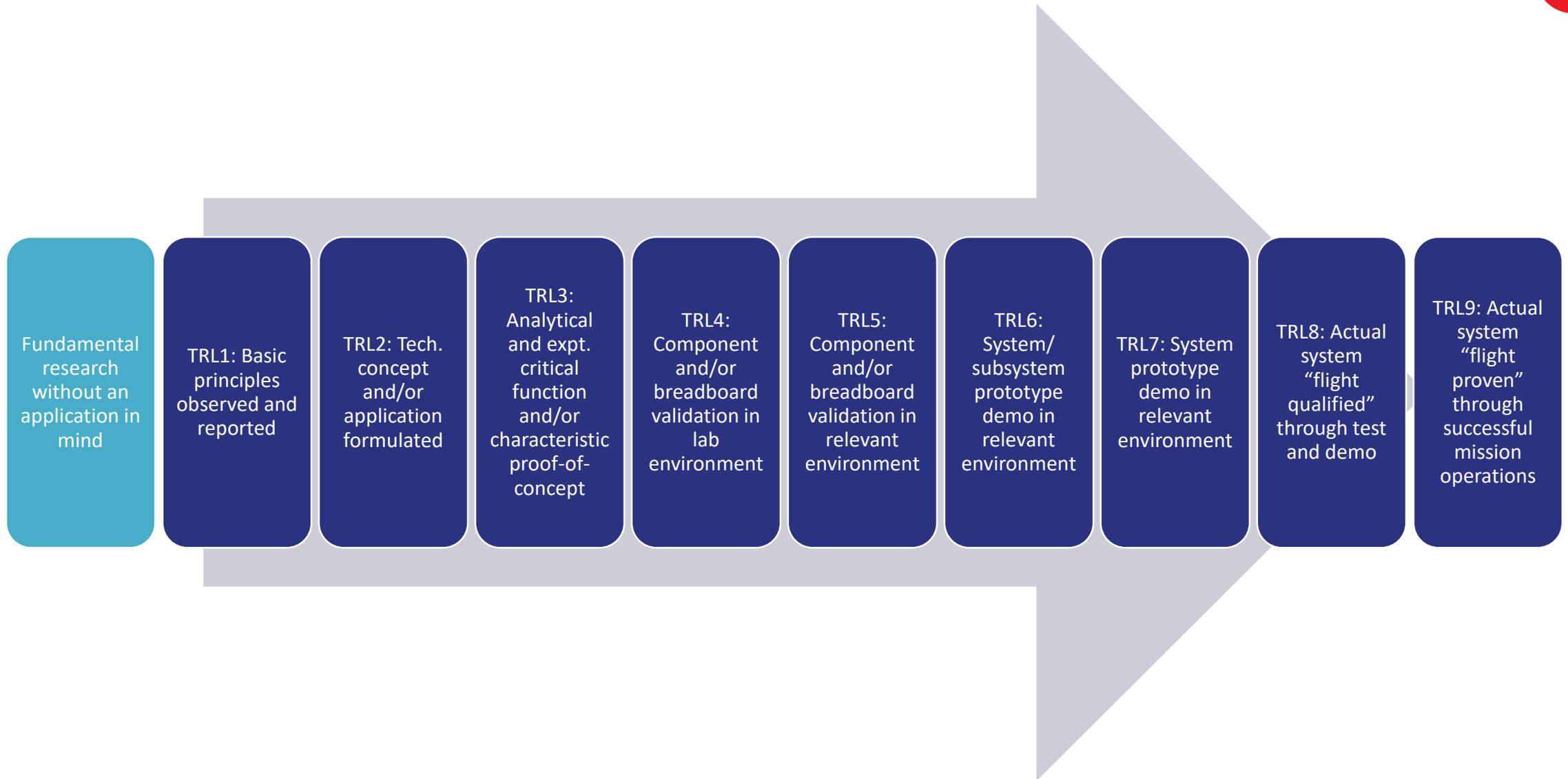
KEEP LASER FOCUSED ON THESE GOALS...



...AND BUILD A BETTER BATTERY



# TECHNOLOGY READINESS LEVELS – WHAT IS “THE MISSION?”

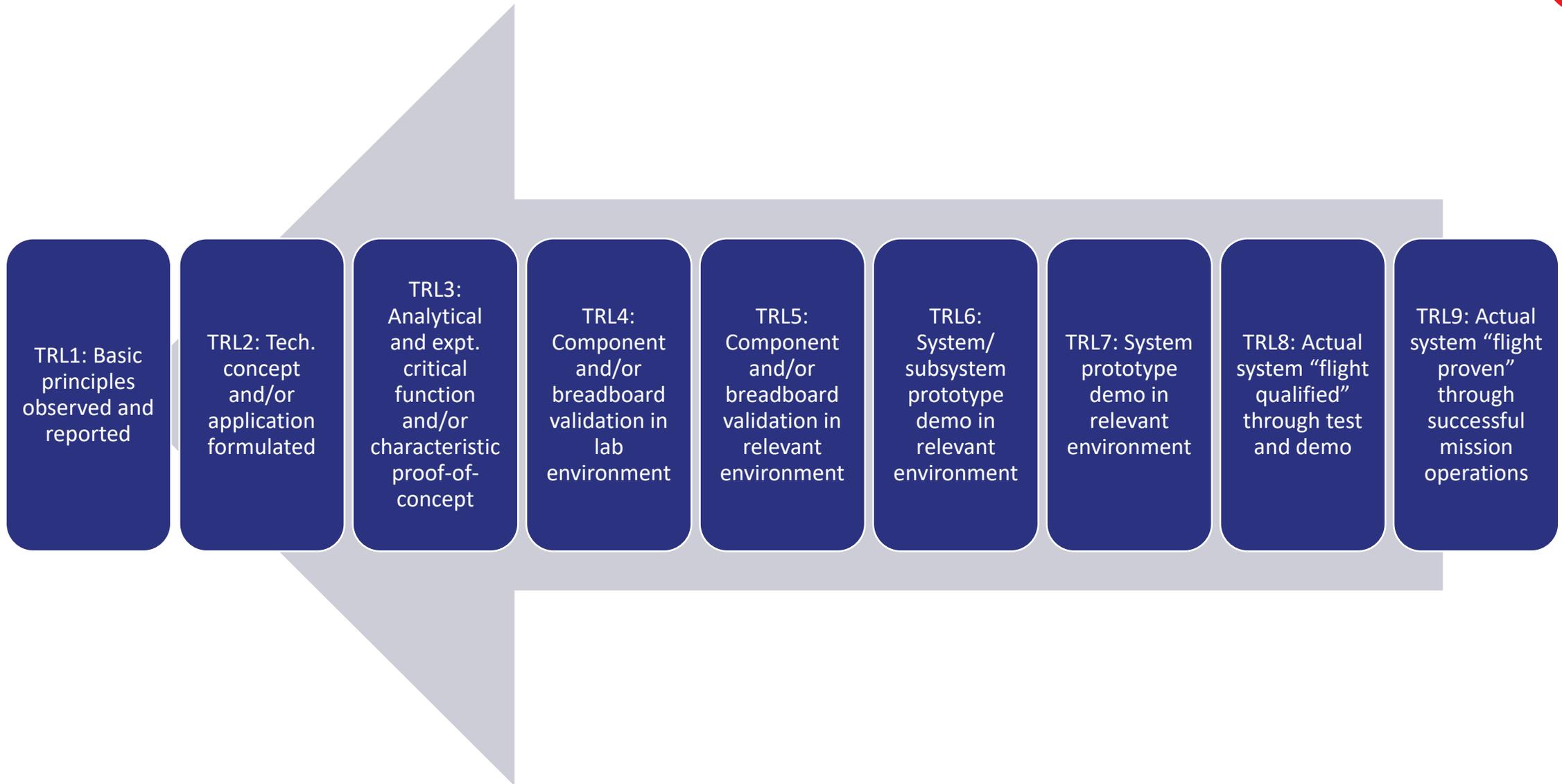


**The Mission**

WE NEED A CHANGE IN OUR PERSPECTIVE...



# WORK BACKWARDS FROM THE MISSION TO DEFINE RESEARCH



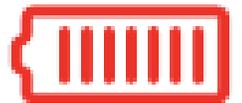
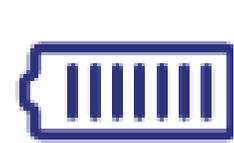
The Mission

## KEEP QUESTIONING - WHAT DOES SUCCESS LOOK LIKE?

- To constitute a full success, SOLBAT will deliver a **product** that has the potential to revolutionise the battery industry over the next decade

The product will be a lab based cell with the following key metrics which need to be demonstrated for solid-state batteries to be taken forward through development:

- store at least 50% more energy than a conventional lithium-ion battery of the same volume (higher energy density)
- non-flammable when subject to the nail penetration test and when operated at temperatures above 100°C (safer)
- can be cycled 500 times with 80% capacity retention (cycle life)



# OUR VALUES



**We are  
collaborative**



**We are  
pioneering**



**We make  
a difference**

# STRUCTURE OF THE CONFERENCE



## Today

Project updates

“Industry panel – what is state of the art”

## Tomorrow

Expert panel meetings with projects individually

Collaboration Stream

- International perspectives
- Collaborative working
- IP
- FI opportunities

Research Track

Expert panel feedback

## IN THE NEXT 12 MONTHS THE FARADAY INSTITUTION WILL...

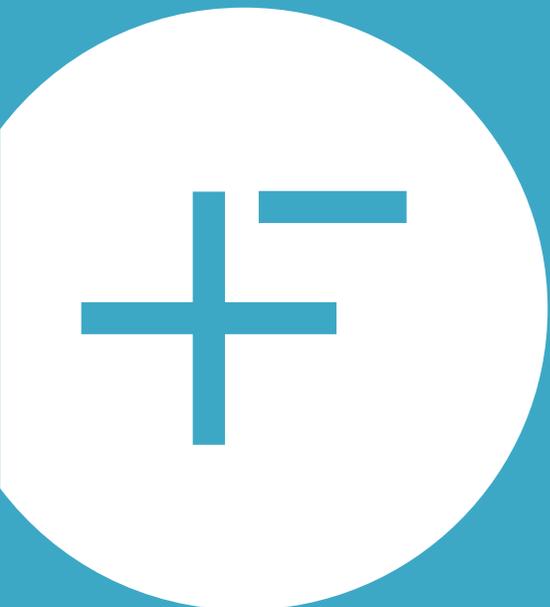


- Secure funding renewal beyond March 2021
- Define the shape and form of the initial research projects beyond 2021
- Grow research in sectors beyond automotive
- Further develop reputation as source of independent third-party advice and insights in market, economics, and capabilities
  - Including into government
  - Related to a UK gigafactory
- Extend capability building initiatives
- Further develop of international reputation and research collaborations

CONCLUSION: CONTINUALLY LOOK BACK TO OUR RESEARCH FROM MISSION REQUIREMENTS...

...to build a  
better battery





Thank you

# OUR VALUES



## **We are collaborative**

We actively collaborate to achieve shared and focused objectives.

We build connections within and between project teams, and externally with industry, government and other influencers.

We foster a sense of belonging.

We work together to develop a diverse pool of talent.

# OUR VALUES



## **We are pioneering**

We are pioneering, visionary and resilient.

To make game-changing breakthroughs  
our aspirations are bold.

We challenge conventional thinking.

We strive to work in new and smarter ways.

Our operating model is progressive and agile,  
and we adapt quickly to research results.





## **We make a difference**

We are driven to leave a legacy.

Our research is cutting-edge and mission-driven.

We are energetic, tenacious and creative in the way we make discoveries that turn research into reality.

We feel a strong sense of urgency to improve the world's economic and environmental future.