

WHySE Compass Landmark 4

TRL - Technology Readiness Level



Why a pilot doesn't necessarily need an airline

"Dog," said Tiger, "what TRL does our pilot need?"

Monkey looked up. "Pilot? TRL? Are we flying? I thought we were testing our H₂ technology."

Tiger glanced at her. Goat smiled.

Dog looked up from his map. "Almost, dear Monkey," he said calmly. "It is about taking off. Just in a different way."

Monkey placed the paper aeroplane on the table. "So, no aeroplane?"

"No aeroplane," said Dog. "A waypoint."

He pushed the compass aside and unfolded a large map. On it, a path wound through the H₂ terrain: rough at the bottom, firmer higher up, tarmacked at the top.

Tiger leaned forward. "When can we get out of the lab?"

Goat tapped his sketches. "The idea works. Why isn't that enough?"

Dog placed a paw on the map. "That is what TRL is for."

What does Technology Readiness Level mean?

Technology Readiness Level, or TRL, describes the technological maturity of a development.

Or in WHySE terms:

TRLs show how far a technology has come from the first idea to reliable deployment.

The journey has nine stages: from basic research through research and development to pilot, demonstration and real application. Step by step, the technology leaves the protected space and shows whether it holds up in the relevant environment.

Monkey looked at the map. "So TRL tells us whether something is still on the lab bench or already out in the field?"

Dog nodded. "Exactly."

Why TRL is so important in H₂ projects

H₂ projects sit between research, development, funding, pilot plants, investment and implementation.

An idea can be well thought out, a lab test can work, a prototype can impress. And still the question remains:

Can the technology carry the next project step?

TRLs show whether a technology is still at the fundamentals, has been tested in the lab or has already gained operational experience in a real environment.

Tiger nodded slowly. "TRL helps me show investors and project partners where we stand."

"Yes," said Dog. "And it helps you take the next step with confidence."

Goat furrowed his brow. "So TRL is no brake?"

Dog pointed to the bottom edge of the map. "TRL gives orientation on the development path through the H₂ terrain. This is where the path begins."

TRL 1-2: Basic research

At the bottom of the map, rough ground, stones and a first path were marked.

At **TRL 1**, a technical or scientific principle is observed.

At **TRL 2**, this becomes a possible technological concept.

Monkey looked at the small drawings. "So this is no plant yet."

Exactly," said Dog. "This is where the idea takes shape."

TRL 3-5: Research and Development

Higher up, the path became more even. First markings showed the direction.

This is where research and development began.

At **TRL 3**, an initial proof of concept succeeds. The approach shows that it can work in principle.

At **TRL 4**, the technology is tested in the laboratory. Components or subsystems show their function under controlled conditions.

At **TRL 5**, testing moves closer to the later application. The technology is tested in a more realistic environment.

Tiger tapped the map. "So this is where we stand."

Dog nodded. "Yes. You are further than an idea. And the crucial stretch still lies ahead."

Monkey picked up the paper aeroplane again. "The pilot?"

"The pilot," Dog confirmed.

The Valley of Death: TRL 4 to TRL 7

Dog ran his paw over a narrow gorge on the map.

Between the laboratory and a robust demonstration lay a difficult stretch of terrain.

On the map it said:

Valley of Death

Tiger fell silent. Dog continued calmly: "This stretch is decisive for many technologies. The idea is mature enough to be taken seriously. At the same time, it needs more evidence, data, money, partners and patience."

Goat looked at his sketches. "Because the technology has to leave the protected lab."

"Yes," said Dog. "And because development slowly turns into responsibility."

This was the phase in which Tiger needed more than enthusiasm: a clear learning question, a meaningful pilot scope, robust data, an honest risk assessment and someone willing to walk with him.

Monkey pointed to the gorge. "Is this the moment when Dragon looks at the map?"

Dog smiled. "Most likely."

Dragon was not there today. His perspective was still present. Investors, funding bodies and project partners ask at this stage:

"What evidence do you have that convinces us to invest?"

Dog placed the compass at the edge of the gorge.

"In the Valley of Death, it is often decided whether a technology development continues."

TRL 6-8: Pilot and Demonstration

Above the gorge, the path became firmer.

At **TRL 6**, a prototype or system is demonstrated in a very real environment.

At **TRL 7**, the prototype runs in an operational environment. The technology shows that it can function outside protected test conditions.

At **TRL 8**, the system is fully built, tested and qualified for its intended use.

Tiger exhaled audibly. "That is the maturity level I want to reach."

"Yes," said Dog. "That is why the pilot needs good questions for its tests."

Monkey looked at her paper aeroplane. "Good questions?"

Dog nodded. "A pilot is no outing. It is a deliberately limited learning space. With hard requirements."

Tiger remembered Tuesday. "So we show what the technology delivers under real conditions."

"And what the project derives from that for the next step," Dog added.

TRL 9: Market launch

At the top of the map, the path had become a road.

It was still new. Yet it carried.

At **TRL 9**, the technology has proven itself in real use.

This is where the step into the market begins.

Goat looked up. "So TRL 9 is the goal?"

Dog tilted his head slightly. "For technological maturity: yes. For the project, it is one important milestone among several."

Tiger looked up. "What is still missing?"

Dog pointed to more symbols at the edge of the map: approval, funding, operation, market, supply chain, safety.

"TRL says a lot about the technology. An H₂ project needs the whole terrain."

What TRLs achieve - and what they classify

TRLs answer one central question:

How mature is the technology?

TRLs help in conversations about the next step. They replace neither a project decision, nor preliminary and final planning, nor an investment decision. They prepare decisions.

Monkey took notes. "So TRL is a position marker."

"Yes," said Dog. "Not a school grade."

A low TRL only shows that the technology is at the beginning of the path.

A high TRL does not automatically make a technology commercially viable. It only shows how mature it is. And whether it can enter the market.

Tiger nodded. "That helps."

"That is what the compass is for," Dog smiled.

Common misconceptions

Goat looked once more at his lab test.

"If the idea works, that is still not enough for the market."

"It is valuable evidence for the next step," said Dog. "The path continues."

Monkey raised her hand. "And TRL 9 means: everything is ready?"

Dog smiled. "Technologically, it is very far. On the project side, it still needs approval, funding, operation, safety, customers and market feedback."

Tiger looked back towards the gorge. "And if we stand in the Valley of Death?"

Dog replied calmly: "No panic. You are at a critical point. From there, clarity and patience lead the way."

The plain-language translation

Dog slowly rolled up the map. "When someone talks about TRL," he said, "they mean: where is this technology on the path from first idea to market deployment?"

Monkey nodded. "And when someone says pilot?"

Dog looked at the paper aeroplane. "Then it often means the moment when the technology leaves the protected lab. It has to show, under more realistic conditions, what it can carry."

Tiger looked at his note. "So TRL is no label."

"No," said Dog. "TRL is a landmark."

Monkey carefully tucked the paper aeroplane between the pages of her notebook. "And it does not stand for an airline," she said.

Dog smiled. "That too.""

If you only want to remember one sentence

TRLs are the landmarks between a good idea and market deployment.

Sources and references

The TRL system has its origins in spaceflight and became widely known through NASA. Today, it is used in research, innovation and funding projects.

Technical reference points for this waypoint are:

NASA Technology Readiness Levels

ISO 16290 – Space systems: Definition of the Technology Readiness Levels and their criteria of assessment

European Commission / Horizon Europe TRL system

Other maturity models look at manufacturing, investment readiness, customer readiness, legal readiness or business readiness. This waypoint stays with one term: Technology Readiness Level.

Note:

This waypoint explains TRL in general terms. It does not replace a project-specific technology assessment or an objective classification of individual maturity levels.