

# WHAT ARE RESEARCH AND INNOVATION?

“**Research**” is the process of creating ideas, processes, technologies, services or techniques that are new to the world.

One could thus say that transforms resources into knowledge.

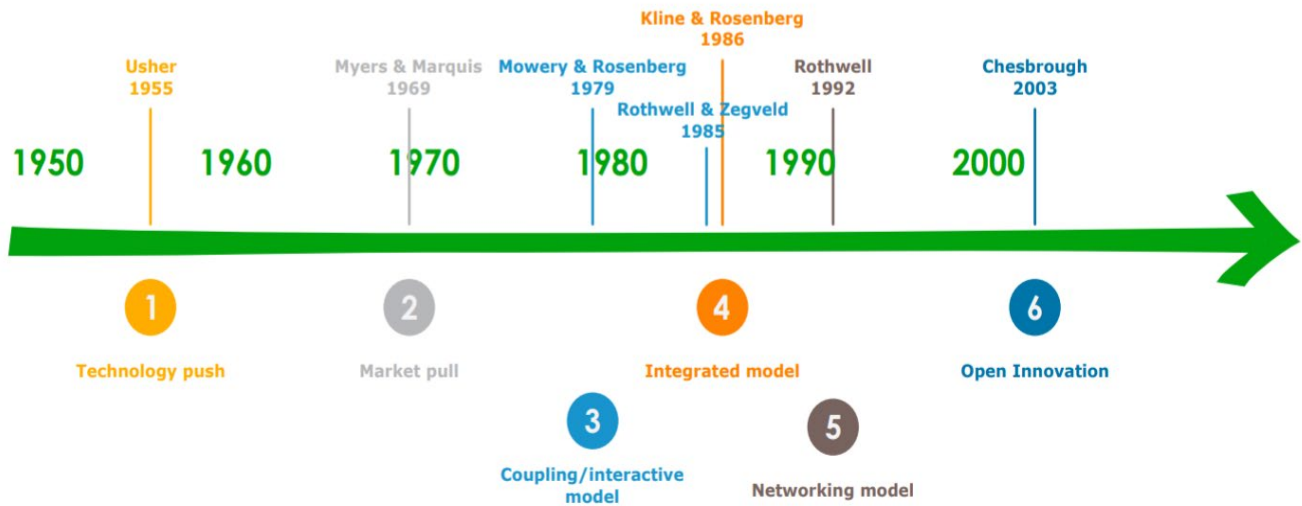
“**Innovation**” is introducing something new to a given organisation. —but not necessarily new to the world. For innovation to be beneficial, it must be useful and valuable, and can often be monetised. One could thus say that innovation is a process that transforms knowledge into resources.

Innovation can be a ‘**disruptive innovation**’ that creates new products and new markets and reshapes existing ones, it can also be an ‘incremental innovation’ or ‘sustaining innovation’ that merely makes something better, without disrupting a system<sup>1</sup>.

## How does innovation arise?

Academics has theorised several innovation processes. Those Six theories are still very influential today, including for European Energy innovation.

FIGURE 1 ► Timeline of the apparition of the main innovation models, with founding authors



Source: T. Pellerin-Carlin & P. Serkine, Jacques Delors Institute, adapted from Meissner and Kotsemir

<sup>1</sup> Clayton M. Christense, Michael E. Raynor, Rory McDonald, ‘What is disruptive innovation ?’, Harvard Business Review, December 2015.

Number 1 is the **technology push model**. It is a linear model where you push a technology forward, from the Research & Development (R&D) to production and marketing.

➔ Policy implication. You can give a technology-specific research grant to push a technology forward.

Number 2 is the market-pull model. It is also a linear model, but that reverses the direction of the previous model: it is now the market that informs R&D.

➔ Policy implication. You can set a carbon price to boost clean energy innovation.

Number 3 is the **coupling model**, which combines tech push and market pull.

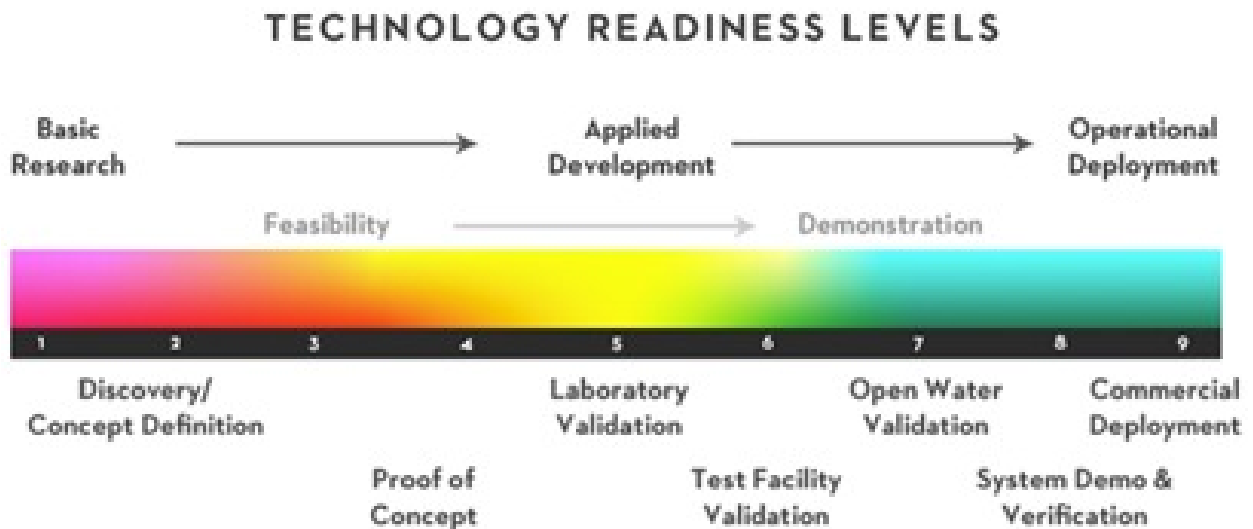
Number 4, we have the **integrated model** that look as interaction between the company and its environment.

Number 5 there is the **Networking model** that focuses on collaboration between people inside and outside the company.

➔ Policy implication: create organisations that create and nurture networks, such as EIT InnoEnergy.

Number 6: we have the **'Open Innovation'** model that builds on the networking model and puts a greater emphasis on flexibility, interactivity and interconnection. And today, the term 'open innovation' is very much used in European debates.

## The Technology readiness levels scale



At Technology Readiness number 1, a technology is not mature at all. We only observe basic principles. And it takes years, if not decades, to reach the level of readiness that makes a difference: that is TRL 9, when the actual system is proven in its operational environment.

Here, the policy implication is quite clear: 2050 starts today. If you want technological innovation to play a role in 2050, you must invest today because it takes time to develop a technology.

For H2020, the European Commission defines all TRLs as follows: • TRL 1 – basic principles observed • TRL 2 – technology concept formulated • TRL 3 – experimental proof of concept • TRL 4 – technology validated in lab • TRL 5 – technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies) • TRL 6 – technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies) • TRL 7 – system prototype demonstration in operational environment • TRL 8 – system complete and qualified • TRL 9 – actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies or in space).