# The Traditional Industries Dilemma with Disruptive Innovations

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# Creative Destruction

**Nobel Prize 2025 in Economic Sciences:**

**Joel Mokyr, Philippe Aghion und Peter Howitt**

They investigated the impact of innovations on the sustainable growth in economies.

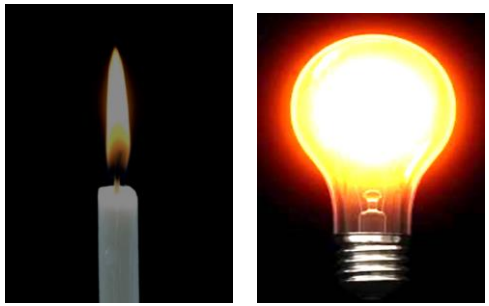
“Creative Destruction” describes the disruption, when traditional industries start to fail and become replaced by new players using new technologies.

# A few Basics on Innovation

- Innovation is the successful **market entry** of a new or improved product
- Often confused with **invention** (research, discovery)
- The term “Innovation” has been in use in the German language since 1961, following the translation of **J. Schumpeter's works** (Business Cycles, 1939)
- **Incremental Innovations** are small continuous improvements
  - success story in traditional German industry (German Engineering)
  - inventions easy to implement in the existing high degree of vertical integration
- **Disruptive Innovations** (C. Christensen, 1995) are radical new products followed by large socio-technological transformations
  - destruct established businesses
  - complete new value chains complicate the implementation of inventions
  - success difficult to predict

# Disruptive Innovations – Example 1

**The Light Bulb:**



- Was not a continuous improvement of the candle
- **Invented** by Joseph Wilson Swan in 1879 and Thomas Alva Edison made it suitable for mass production shortly thereafter (**innovation**)
- Needs electricity: **Power generator** developed by Werner von Siemens in 1866 and the construction of an **electricity grid**
- Complete **new materials** and **production technologies** compared to candles
- Major **societal changes** with the broad availability of good lighting everywhere

# Disruptive Innovations – Example 2

**Digital Photography:**


- Digital photography and the **end of Kodak`s success story**
- Kodak developed one of the first digital cameras
  (invented 1975, market entry with DCS 100 in 1991; price 25.000 DM)
- **Agile** Asian consumer electronic **companies** took over the business and Kodak had to file bankruptcy in 2012 after 100 years of success
- Follow on disruptive innovations: **Smartphones** (iPhone, 2007), high resolution screens, **fast internet** and mobile communications
- Huge **societal changes** and the creation of todays most powerful companies of the world (Apple, Amazon, Meta …..)

# Disruptive Innovations in Transportation (I)

**Steam engines** replace horse drawn vehicles and sail boats
1st industrial revolution*, 19th century

- Coal as fuel, water for steam generation
- Fast printing press to communicate manuals, time tables …
- Societal changes through easy long distance transportation and travelling

**Combustion engines** replace steam engines and horse carriages
2nd industrial revolution*, early 20th century

- Petrol as fuel & refuelling infrastructure
- Telephone for global communication (business)
- Societal changes through mobility for every one and global automotive business



* Defined by Jeremy Riffkin

# Disruptive Innovations in Transportation (II)

**Electric drive trains** replace combustion engines
3rd industrial revolution*, early 21st century

- Renewable fuels (electricity, hydrogen, e-fuel)
- Fast internet and satellite based communication
- Autonomous driving, Transportation as a Service
- Societal changes to come


* Defined by Jeremy Riffkin

# The Strategic Mistake

Often heard statement:

*“This new product is way to expensive and unreliable”*

But, the reality shows:
Cost will go down by scaling up production volume and technological improvements, called:

**The Experience Curve:**
10 to 30% cost reduction by doubling of the cumulated production volume; includes technological improvements;

proven since many decades in all technical products from freezer to aircraft and valid for incremental as well as disruptive innovations!

# The Experience Curve

- The model was developed in the 1960s by the Boston Consulting Group (Bruce Henderson), based on observations made by T. P. Wright in 1936 regarding cost reductions in aircraft production.
- The experience Curve describes the relationship between unit volume (“experience”) and cost.
- Classic experience curve: Fulfilling a demand by repetition and incremental improvement
- Experience leaps: Shaping demand by new product generations. Characteristics: New technologies and offerings based on hypotheses about user needs.

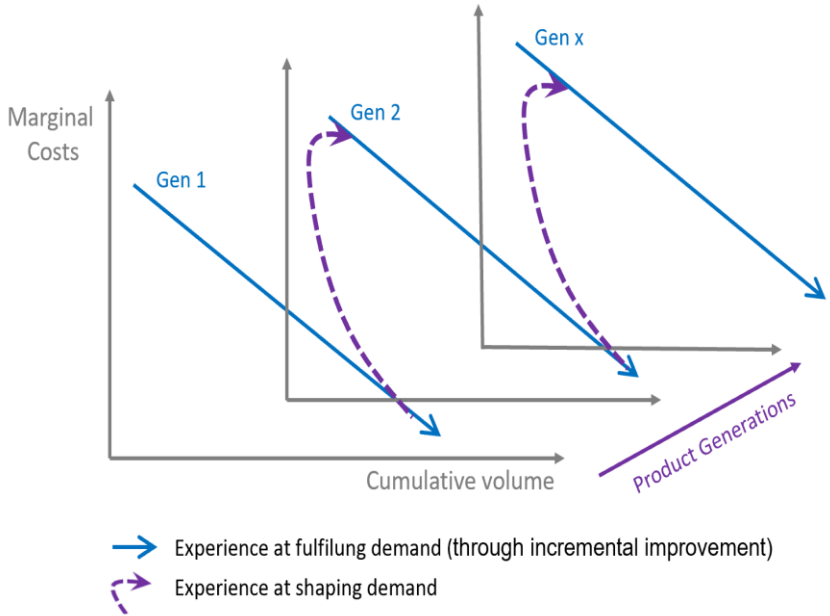



Figure: Own chart based on Boston Consulting Group [BC13]

# The Experience Curve – Example Photovoltaics

- Cost of solar modules vs. cumulative installed capacity in USD
- about **20% reduction for every doubling** of capacity
- Continuous technology improvements (e.g. efficiency)
- 2025: USD 0,1 at an installed capacity of **2,2 billion MW** (2,200,000,000 MW)

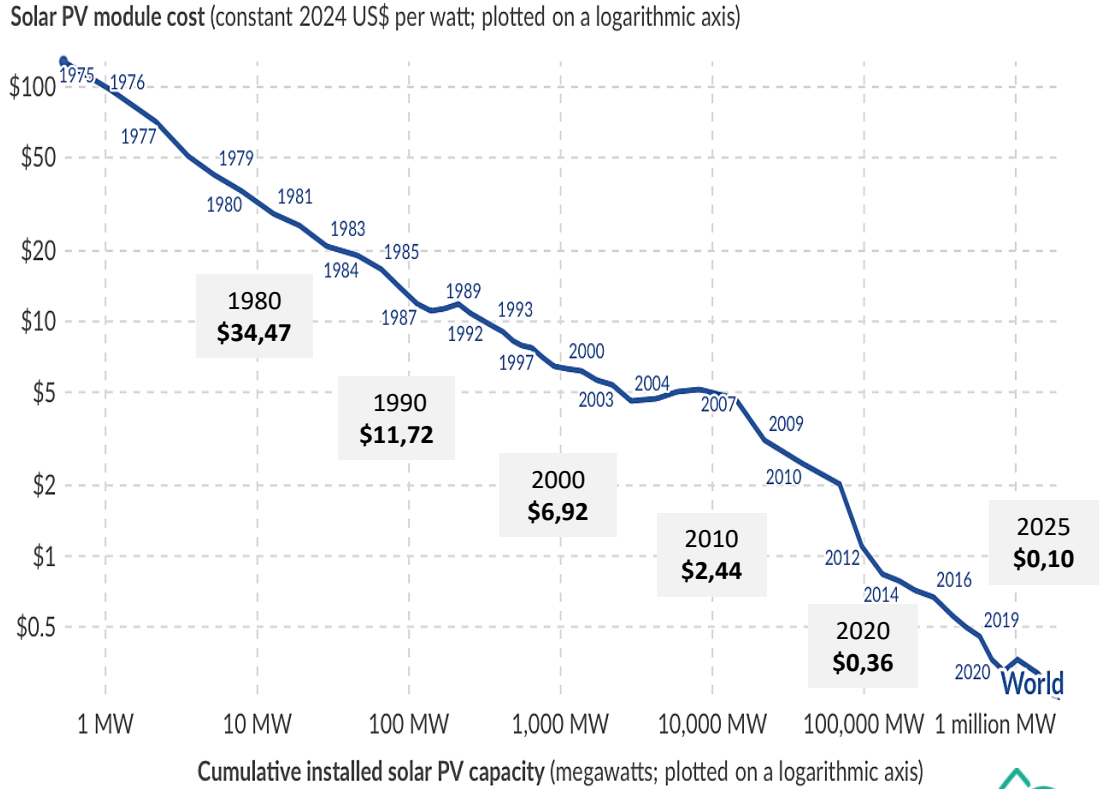



Figure: IRENA (2025); Nemet (2009); Farmer and Lafond (2016) – with major processing by Our World in Data

# The Experience Curve – Example Cost of Electricity

- Global LCOE (Levelized Cost of Electricity) from newly-commissioned, utility-scale renewable power technologies, 2010 to 2023
- Photovoltaic in the sun belt today at 0,01 USD/kWh – below cost of fossil fuels

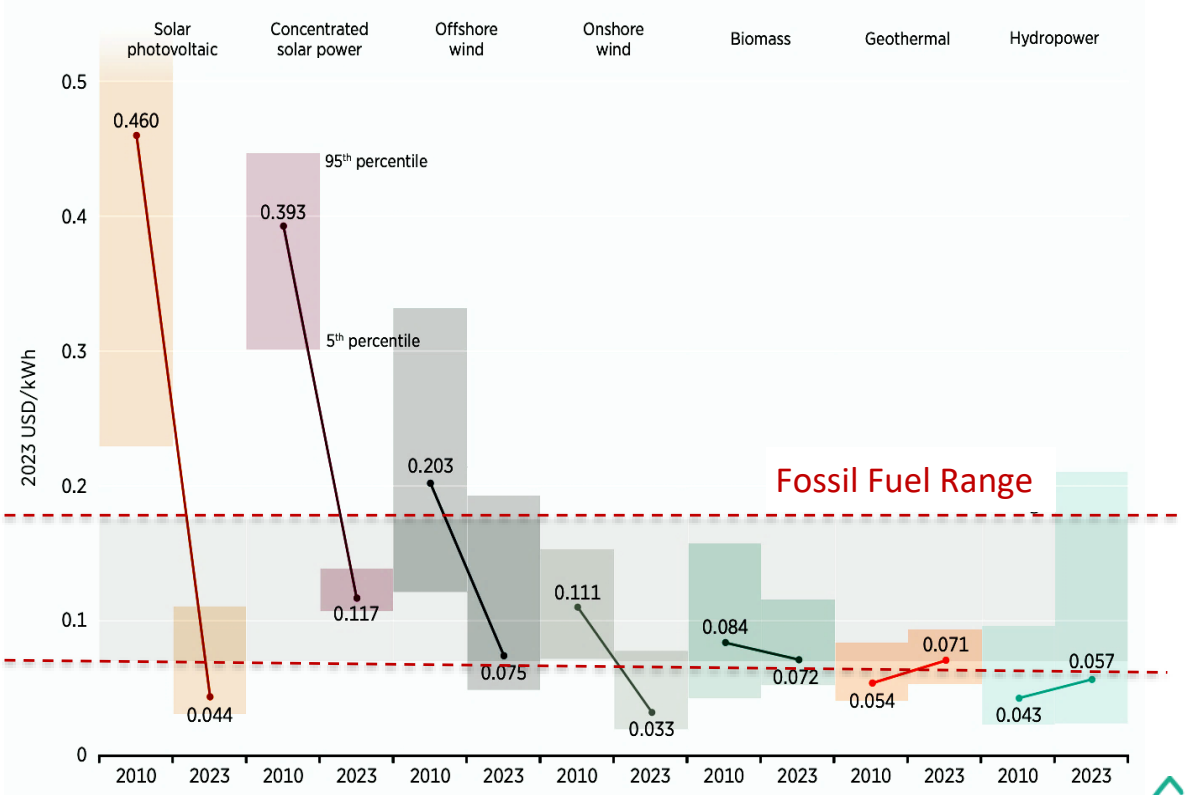
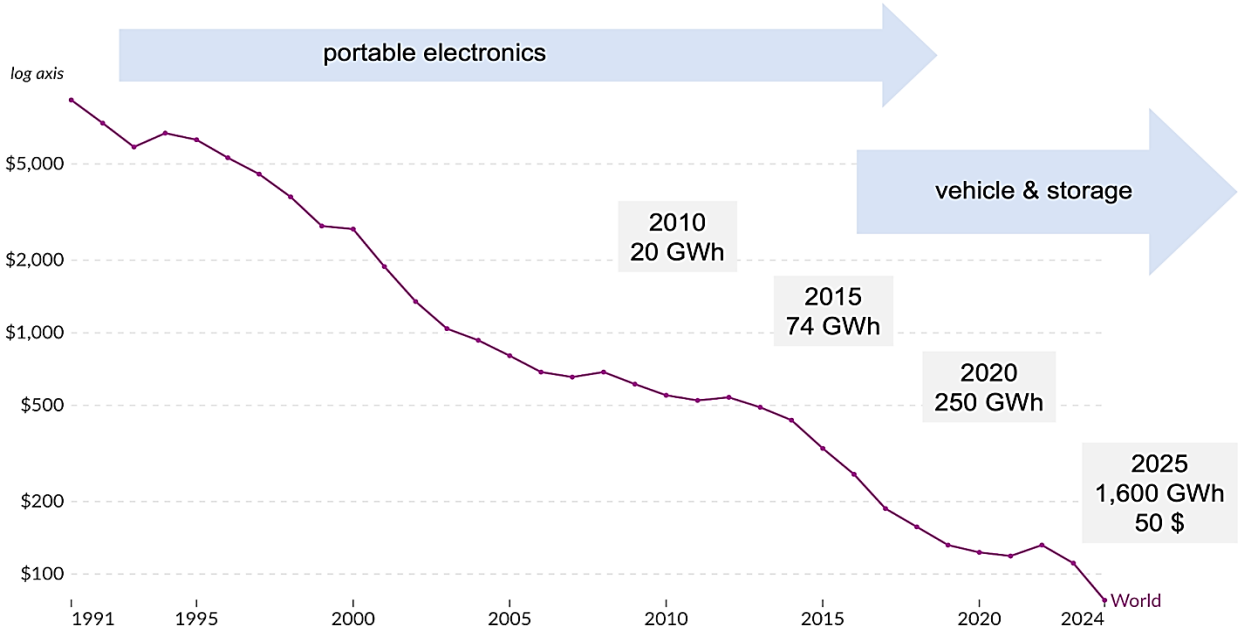



Figure: IRENA Report [IR24, p.21]: Renewable power generation costs. International Renewable Energy Agency.

# The Experience Curve – Example Li-Battery Cells

- Lithium-ion batterie cells across all major cell chemistries.
- Price has fallen by 99% since 1991 (USD/kWh; adjusted for inflation.
- Huge increase in production volumes by e-mobility and energy storage caused a massive price drop
- Ongoing technological improvements




**Data source:** Rupert Way (2026) based on Ziegler and Trancik (2021), BloombergNEF, and Avicenne Energy
**Note:** This data is expressed in constant 2024 US$ per kilowatt-hour.

Figure: Our World in Data [OW25]: Cost reduction for lithium-ion-batteries cells over time. OurWorldinData.org/energy | CC BY. Own additions.

# Cost Reduction in Core Technologies of the Future

- Global demand and manufacturing capacity (planned) by country/region for batteries and electrolysers
- Size of each square is proportional to demand/capacity, with each row scaled relative to 2030 manufacturing capacity
- Chinas strategic cost advantage through scaling of core technologies
- Electrolysers produce hydrogen as green fuel, for e-fuel production and for green peak power generation.

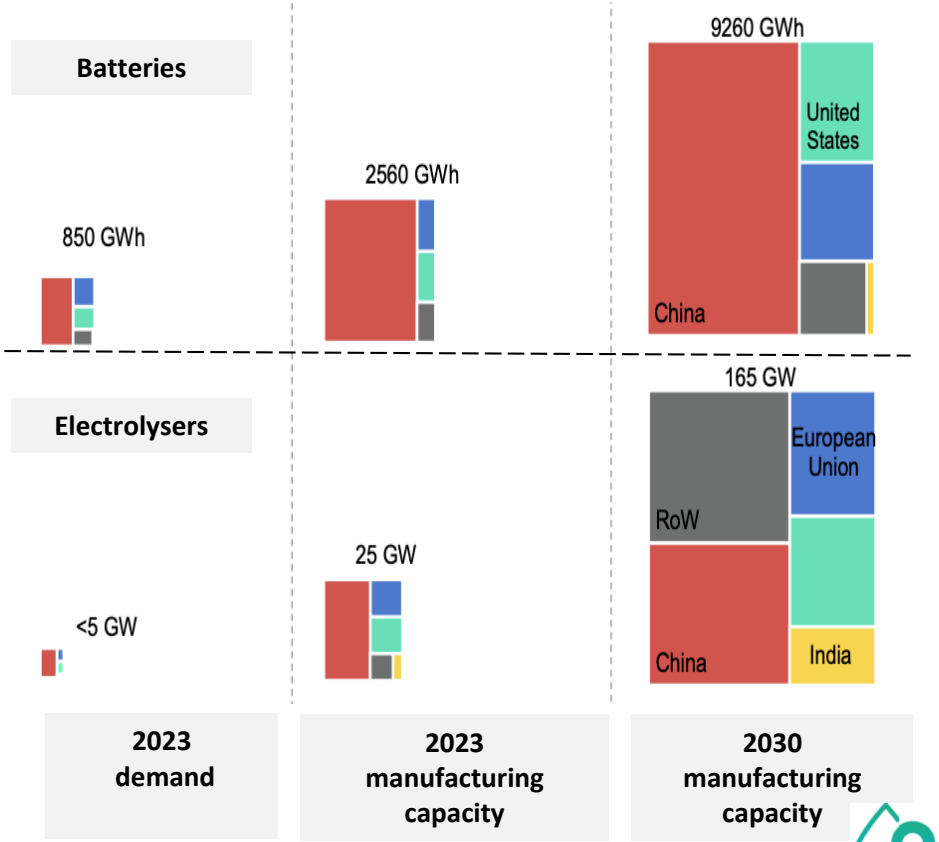



Figure: International Energy Agency [IE24, p. 42]: Energy Technologies Perspectives. Report. IEA. CC BY 4.0. Own additions.

# How may Future Transportation look like?

- Fossil fuels will face out – **Renewable fuels** and **efficient drive trains** (BEV, FCEV, EREV) will take over
- **Speed** is a key success factor & **profitability a long term target**
- Controlling the **whole value chain** from fuel generation to application is essential for success
- Research needs **access to suppliers** for implementation of results
- **Follow-on innovations** like autonomous driving and transportation as a service will continue to change the industrial landscape.

**Lock-In-Situations in established economys**

**Speed and scale in changing markets**

# Conclusion

The analysis of 100 years of disruptive innovations revealed a fundamental, consistent characteristic:

**Established corporations have almost never managed to achieve success with disruptive innovations on their own.**

They have mostly fallen victim to rapidly changing markets. This is primarily due to the structures and processes established over decades that were crucial for success with their traditional products.

Source: Clayton M. Christensen, The Innovator`s Dilemma; Harvard Business School

# Thank you very much for your attention!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For further details and references, please see our accompanying conference paper