

NET ZERO ECONOMY: WHAT'S UP WITH THAT

MARCH 2023, TODD ALLEN, PROFESSOR & SENIOR FELLOW



FASTEST PATH TO ZERO
UNIVERSITY OF MICHIGAN

WHAT DO WE WANT IN OUR FUTURE?



VS.



- Water purification
- Sanitation
- Irrigation
- Heating & air conditioning
- Vaccinations
- Pharmaceuticals
- Homes

- Clean
- Affordable
- Resilient
- Equitable

ENERGY REIMAGINED

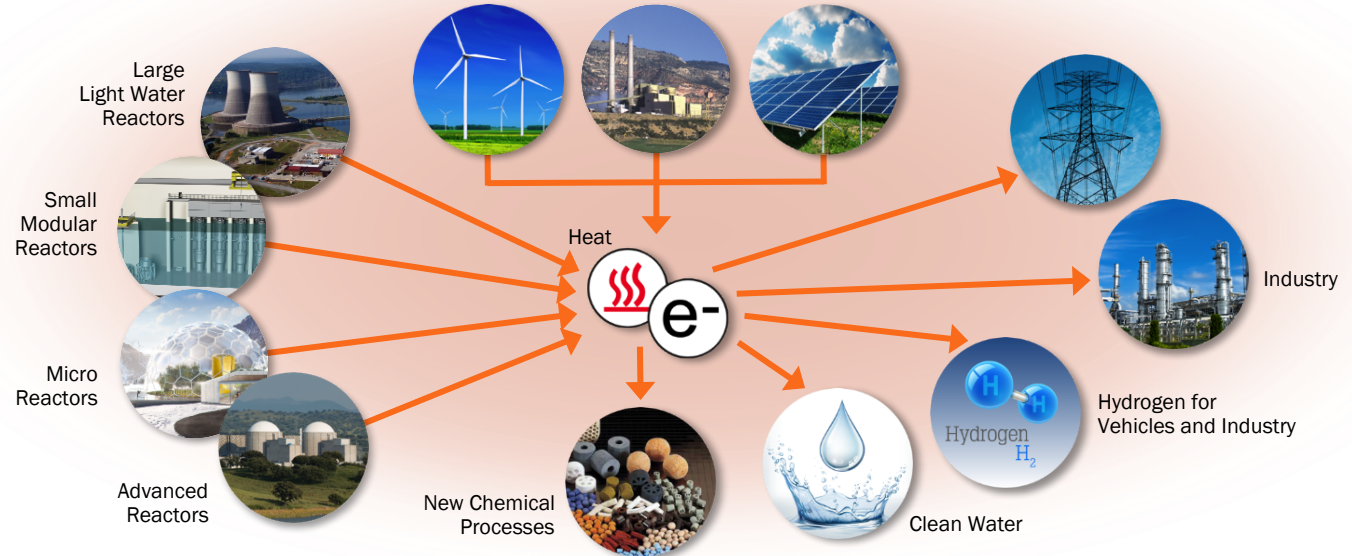
Maximizing energy utilization, generator profitability, and grid reliability and resilience through novel systems integration and process design

Today
Electricity-only focus



Potential Future Energy System

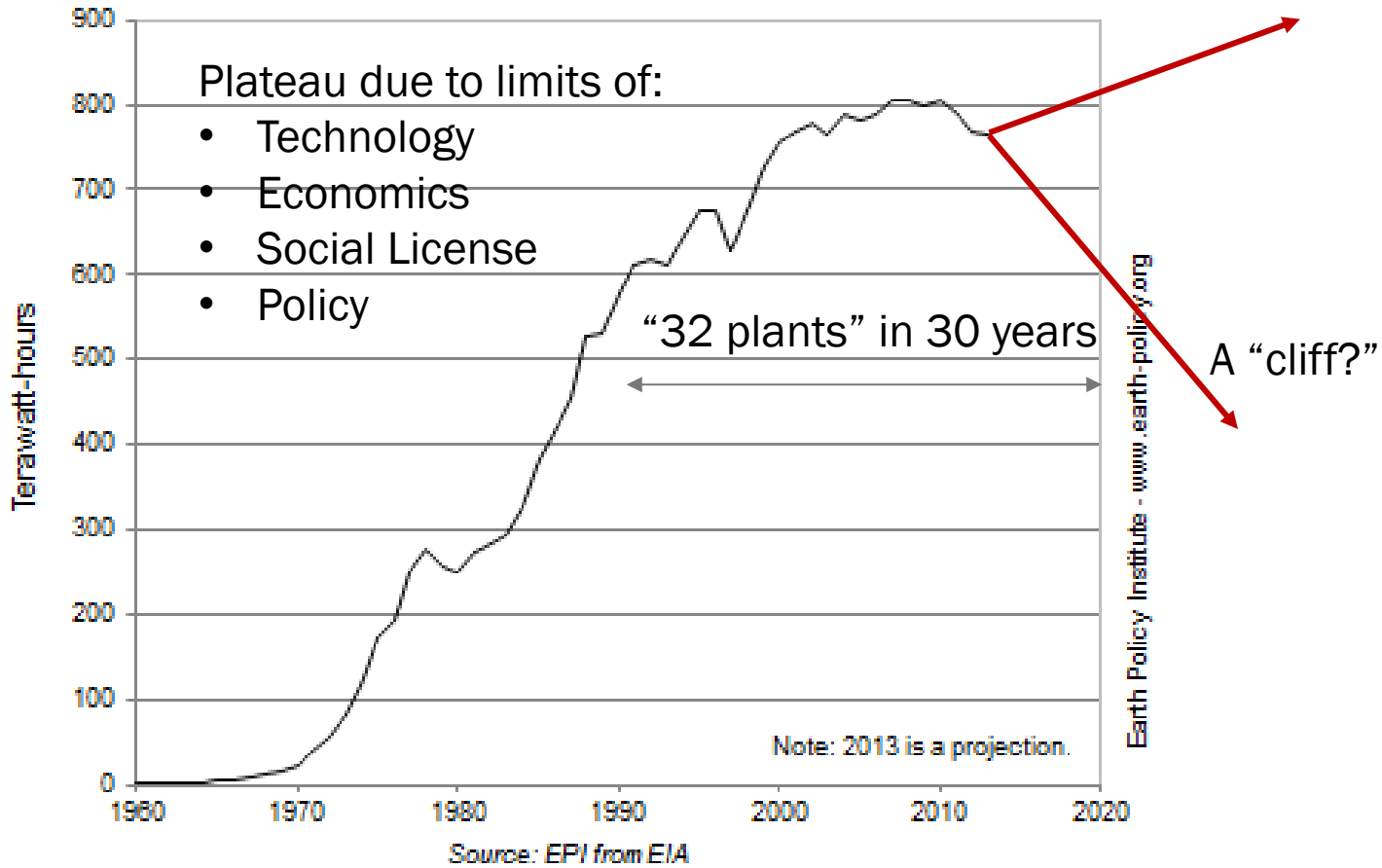
Integrated grid system that leverages contributions from nuclear fission beyond electricity sector



Flexible Generators ❖ Advanced Processes ❖ Revolutionary Design

TRAJECTORY OF ATOMS FOR PEACE GENERATION

U.S. Net Electricity Generation from Nuclear Power, 1960-2013



CONFIDENT EXPERTS

Paul Krugman



“Recently Bill Gates declared, ... that we need an “energy miracle”.... But we’ve already had that miracle: the cost of electricity generated by wind and sun has dropped dramatically, while costs of storage, crucial to making renewables fully competitive with conventional energy, are plunging as we speak.

The result is that we’re only a few years from a world in which carbon-neutral sources of energy could replace much of our consumption of fossil fuels at quite modest cost. .”

CONFIDENT EXPERTS



Lewis Strauss

*“It is not too much to expect that our children will enjoy in their homes electrical **energy too cheap to meter**, will know of great periodic regional famines in the world only as matters of history, will travel effortlessly over the seas and under them and through the air with a minimum of danger and at great speeds, and will experience a lifespan far longer than ours as disease yields and man comes to understand what causes him to age.”*

CONFIDENT EXPERTS

William Stanley Jevons

*“[Coal] is the material energy of the country, the universal aid the factor in everything we do. It can be matter of surprise that year by year we make draughts upon a material of such myriad of such miraculous powers...**All things considered it is not reasonable to suppose or expect that the power of coal will ever be superseded by anything better.** It is the naturally best source of power as air and water and gold and iron are each for its own purposes the most useful of substances and such as will never be superseded.”*





TRANSITIONS



NET-ZERO ECONOMY

Energy Technology

Decision-Making

Capacity Expansion

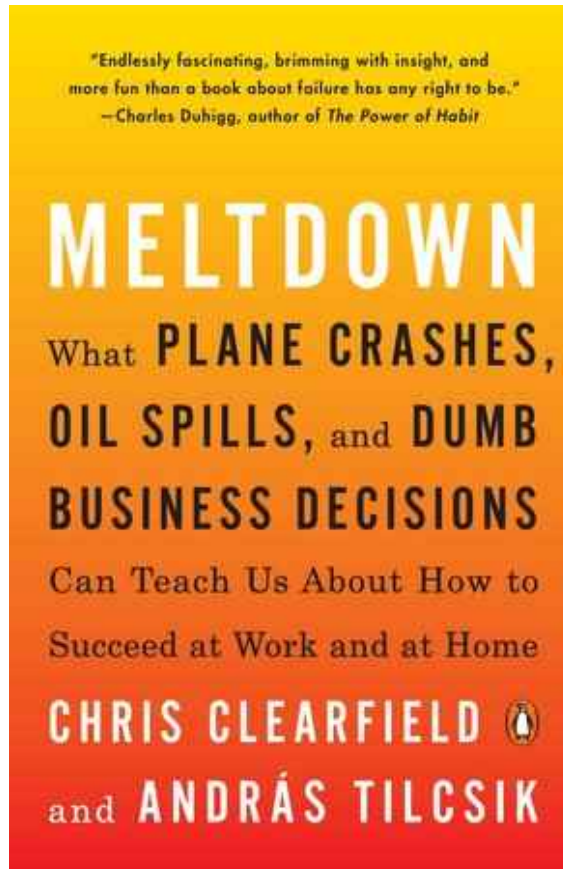
Energy Technology
Complexity

System-informed
Decision-Making

Community-appropriate
Capacity Expansion



ENERGY TECHNOLOGY COMPLEXITY



Tightly coupled systems can fail fast and in unanticipated ways

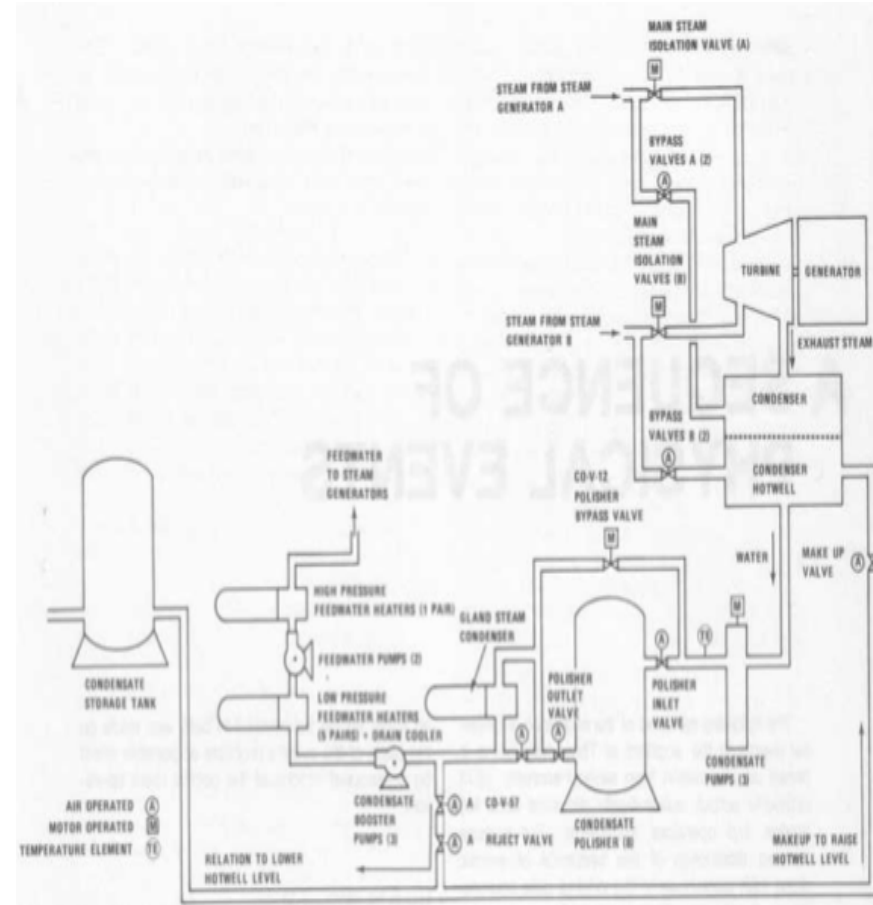
ENERGY TECHNOLOGY COMPLEXITY

THREE MILE ISLAND ACCIDENT (SLIDE 1 OF 6)

TMI-I shutdown at the time.

Workers were cleaning a blockage using forced air in a polisher in a demineralizer train (**non-routine maintenance practice**). Something occurred that resulted in a low pressure (below net positive suction head) to the condensate booster pumps.

These pumps tripped and so did the feedwater pumps. With the steam generators no longer receiving water, the low flow caused the turbine and reactor to trip and SCRAM within a few seconds.



ENERGY TECHNOLOGY COMPLEXITY

Why solar ‘tripping’ is a grid threat for renewables

E&E News

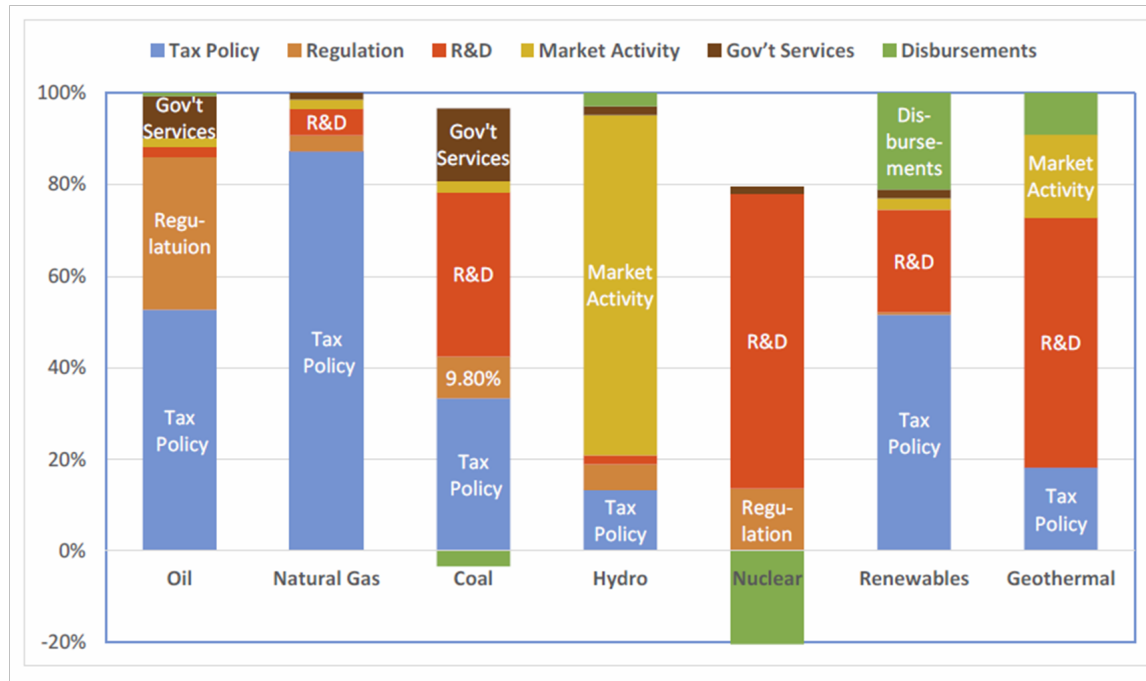
20 Sep 2022

Large amounts of solar capacity unexpectedly went offline, apparently triggered by a fault on the grid linked to a natural gas plant in Odessa, according to the Electric Reliability Council of Texas (ERCOT). The loss of solar output represented more than 13 percent of the total solar capacity at the time in the ERCOT grid region, which spans most of the state.

While all of the solar units came back online within six minutes, the incident highlighted a persistent challenge for the power sector that experts warn needs to be addressed as clean energy resources continue to displace fossil fuels.

SYSTEM-INFORMED DECISION-MAKING

Exhibit 4 – Mix of Federal Expenditures for Each Energy Source

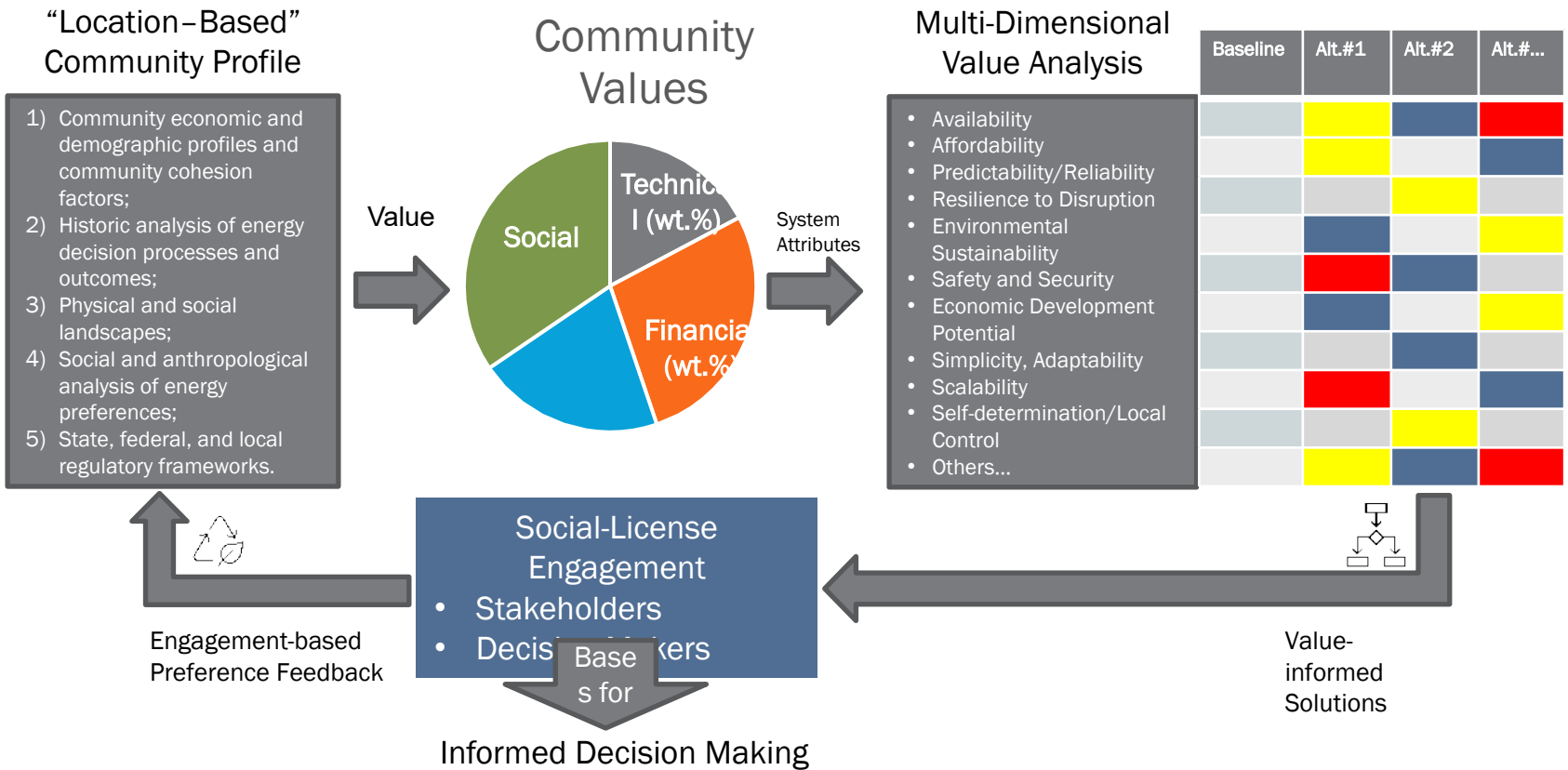


Expenditures for nuclear need better balance between R&D and tax policy

SYSTEM-INFORMED DECISION-MAKING

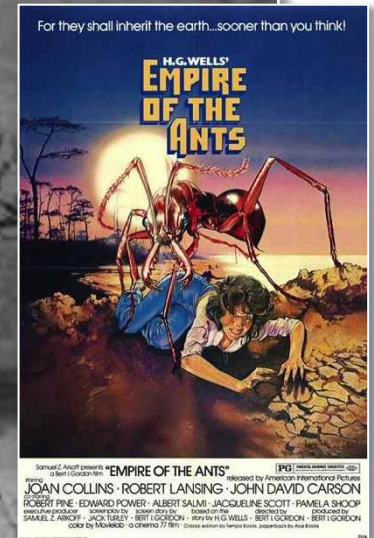


Framework for Value-Informed Decision Making

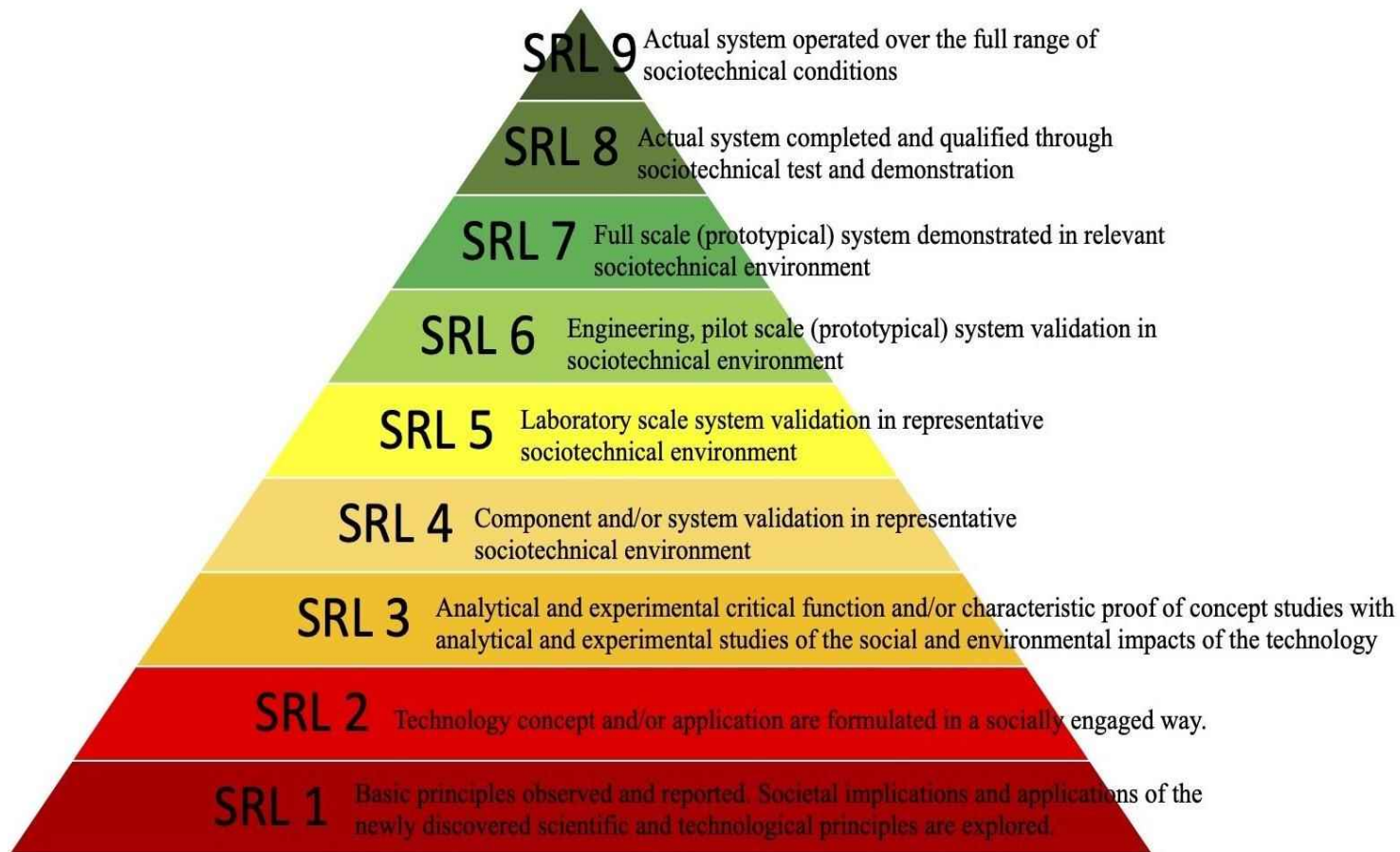


COMMUNITY APPROPRIATENESS

A first entertainment use of radiation-induced mutant creatures



COMMUNITY APPROPRIATENESS



NET-ZERO ECONOMY

Energy Technology

Decision-Making

Capacity Expansion

Energy Technology
Complexity

System-informed
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Community-appropriate
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END

