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Swiss Federal Institute of Technology Zurich

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Low-carbon energy transition: Why nuclear cannot benefit

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Greenpeace Online Conference

October 14, 2020

Outline

1. Sustainability transitions: The bigger picture

2. Nuclear: A global industry in (slow) decline

3. Solution for climate change?

   Rather not: Nuclear is expensive and might come too late

1 Sustainability transitions

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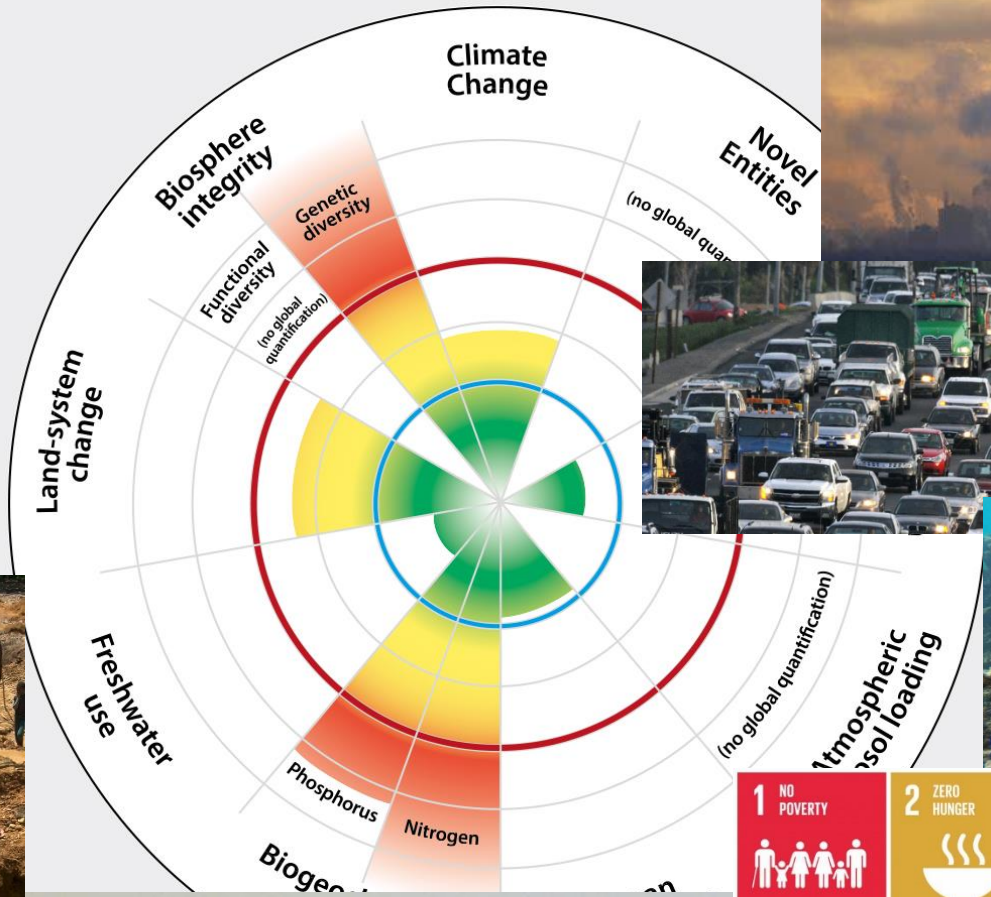
Need for Change



Sustainability Transitions

- To address grand sustainability challenges,
  we need fundamental changes
  in energy, transport, agriculture, and many other sectors
- Such large-scale changes are called
  "sustainability transitions"
- Examples of low-carbon innovations:
  - Wind & solar
  - Electric vehicles
  - Non-meat alternatives, organic food
  - Hydrogen, synfuels

Past transition: example

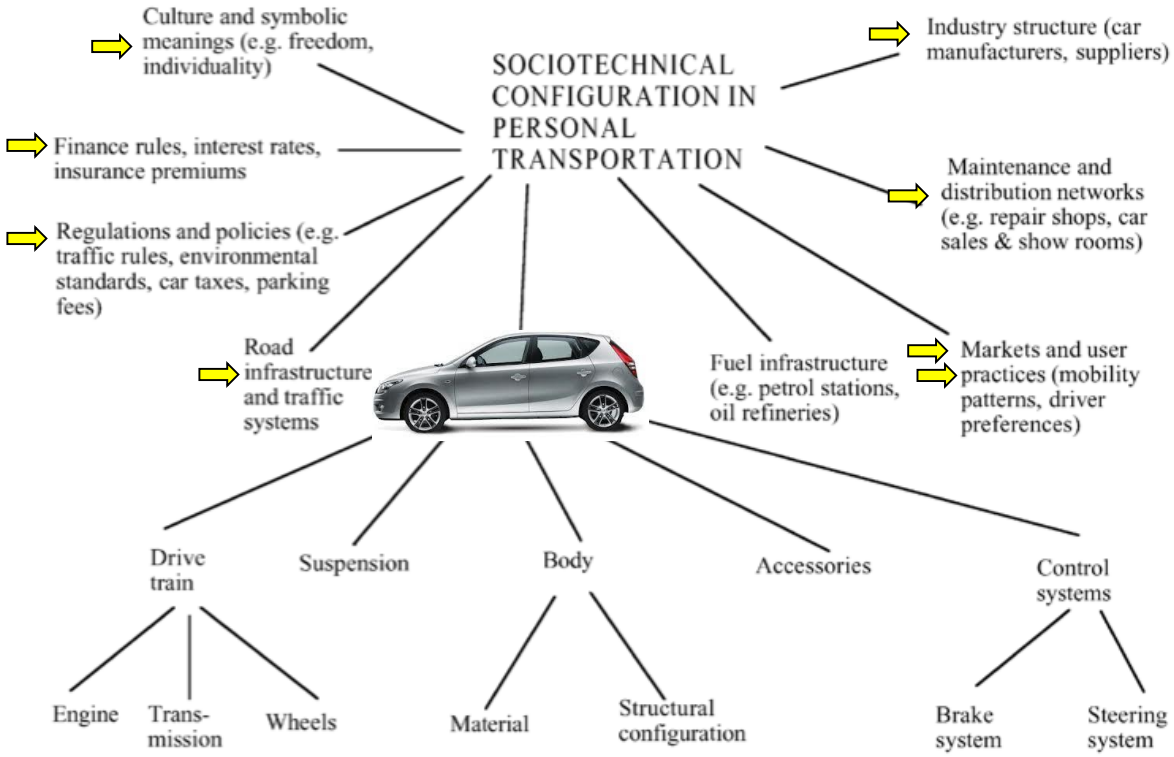
Development of (core) technology

Development of infrastructure

Central concept: Socio-technical system

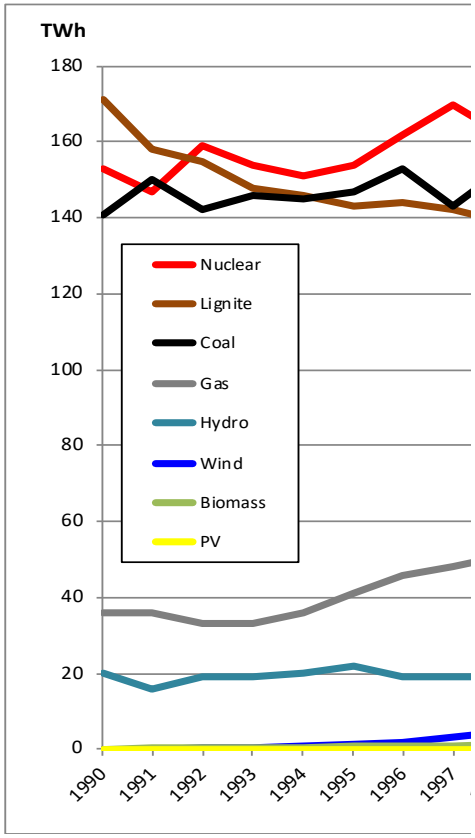


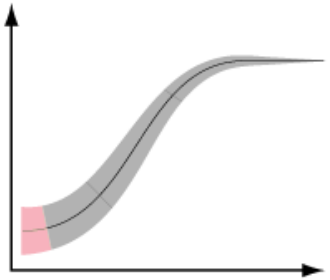






Example: Germany

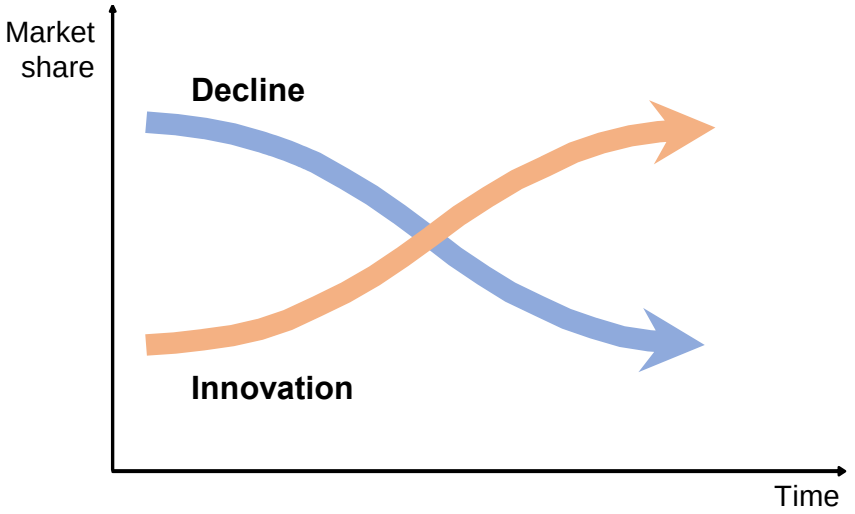




pre-development

Sustainability Transitions: Characteristics

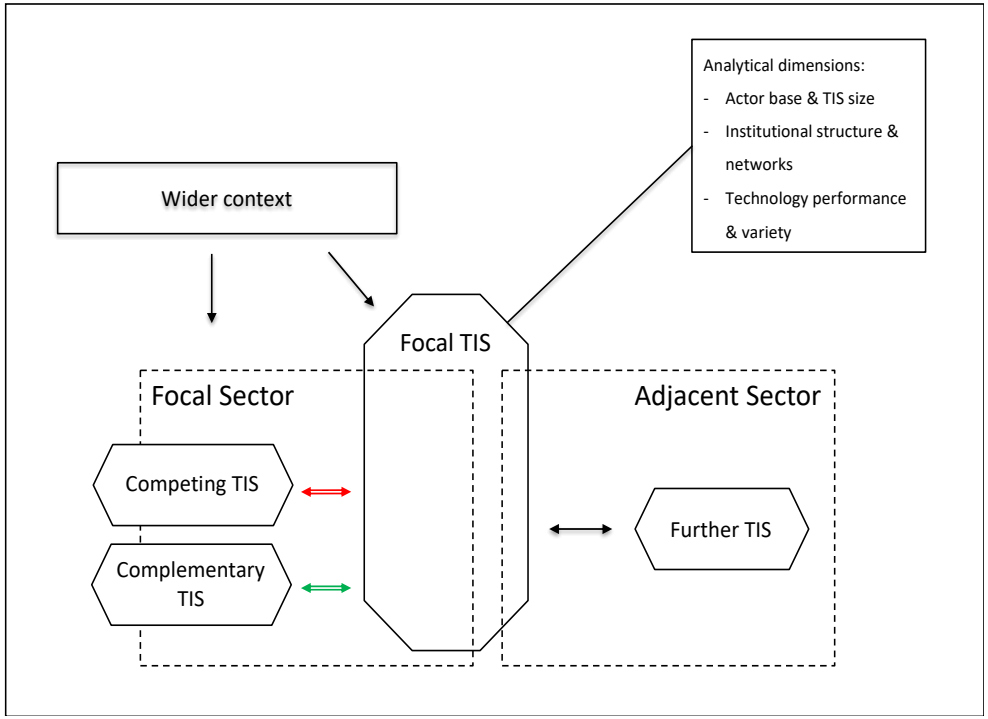
- Complex interplay of
  different technologies
- Different phases of transitions
- Changes in several dimensions:
  Technology, policy, markets,
  businesses, consumers
- Transitions include
  innovation & decline



Technological innovation system (TIS) perspective

- Explain why a technology performs well or not so well
- Challenge: many different factors come into play,
  all changes interrelated, i.e. changes in one part of the system affect other parts

- Analytical dimensions:
  - Actors / firms
  - Policies / institutions
  - Innovation networks
  - Context



2 Nuclear power

Study together with

Nuno Bento

Noah Kittner

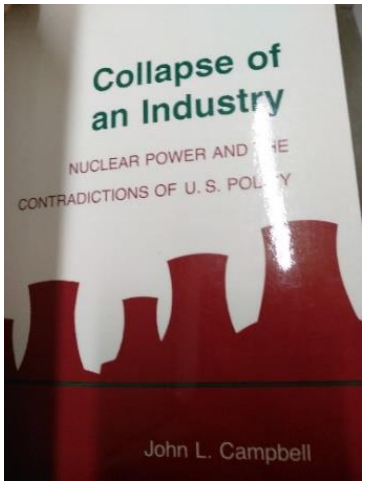
Alejandro Nuñez-Jimenez

Our study

- Is the nuclear innovation system in a phase of global decline or not?

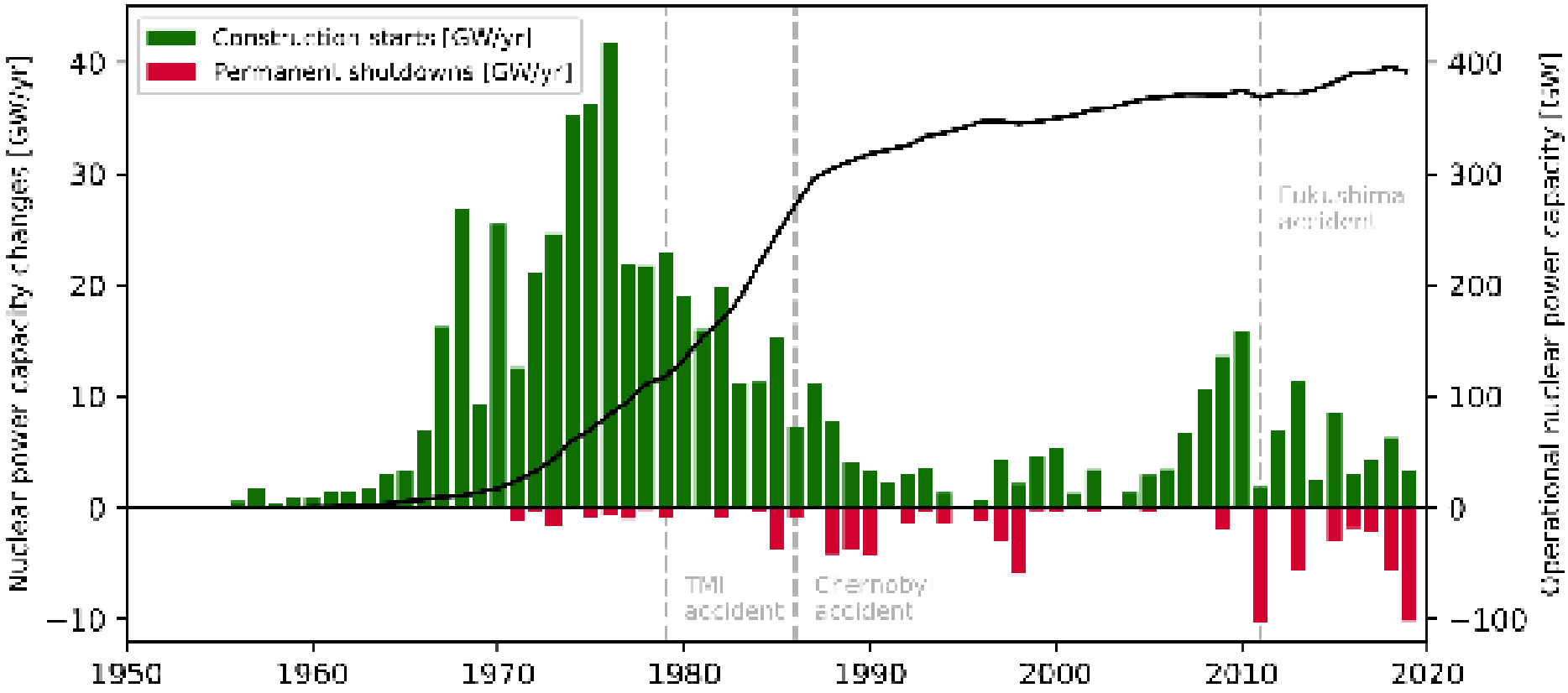
- Focus
  - construction industry
  - large reactors

- Scope
  - global
  - 1950 – today
  - broad range of indicators

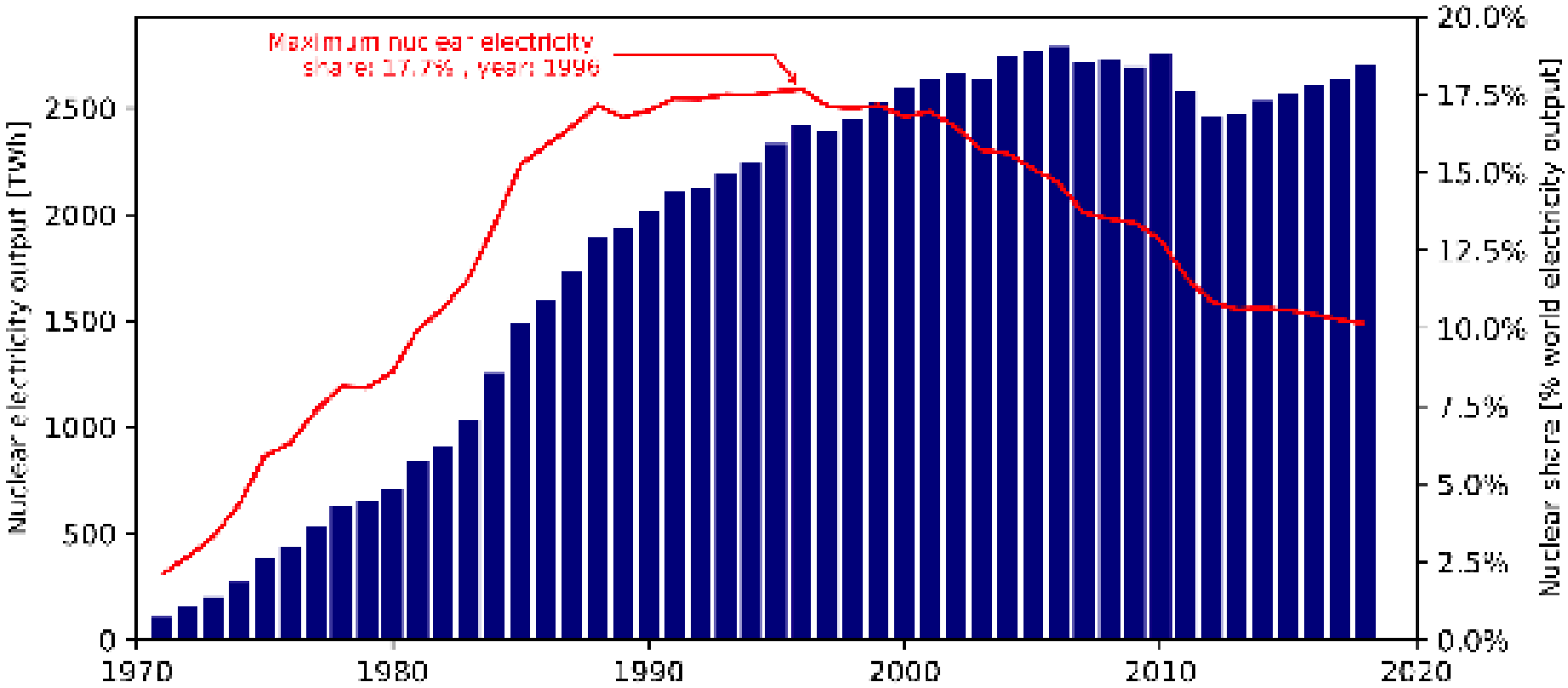


1988

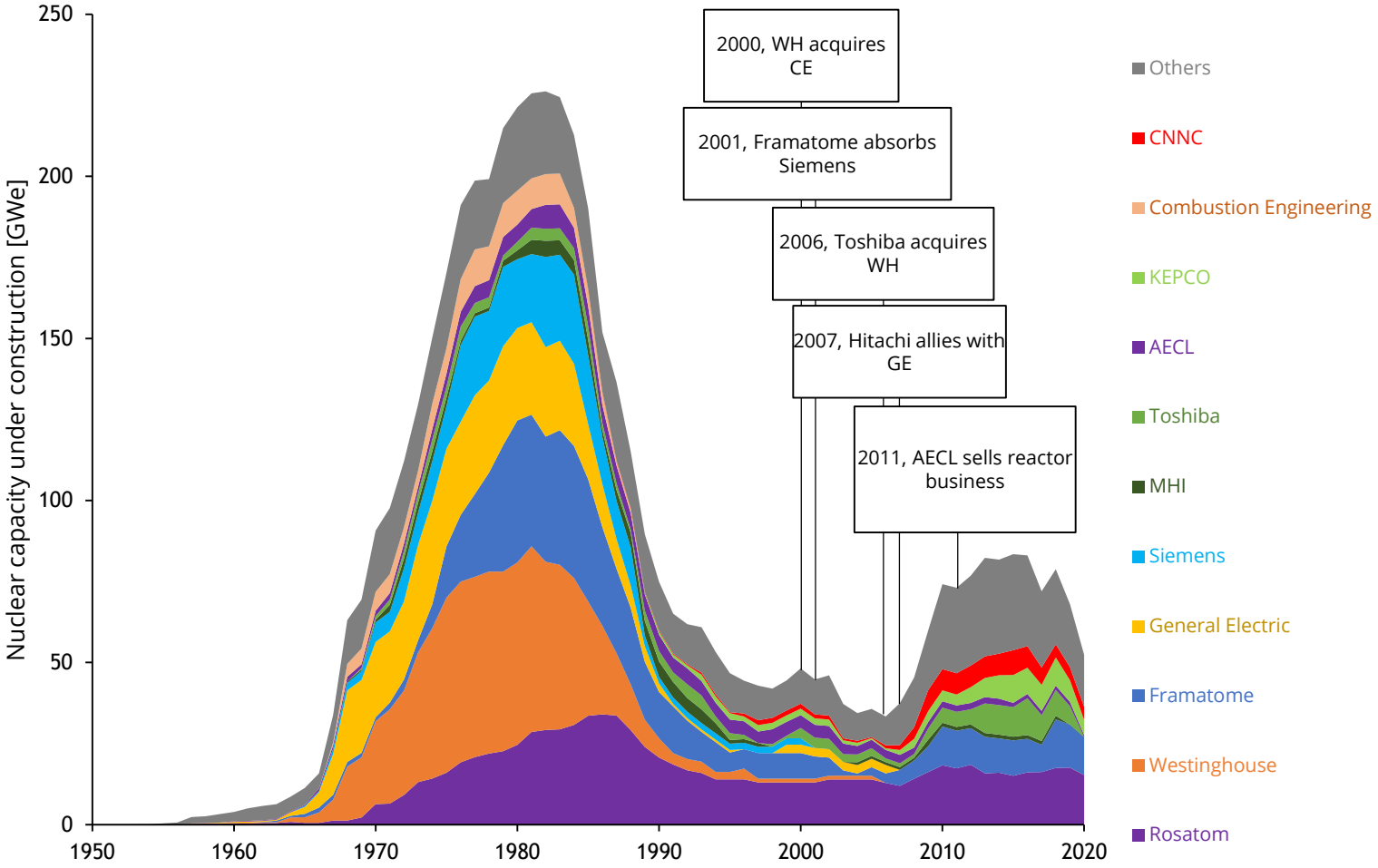
Global diffusion



Global power generation and share



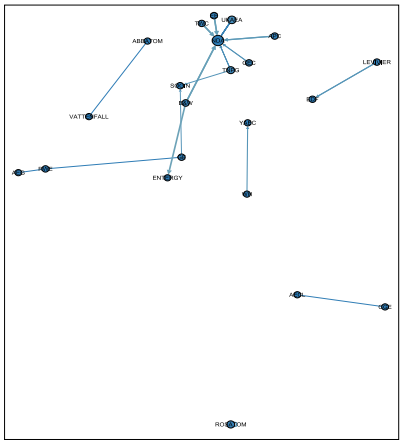
Generation capacity under construction



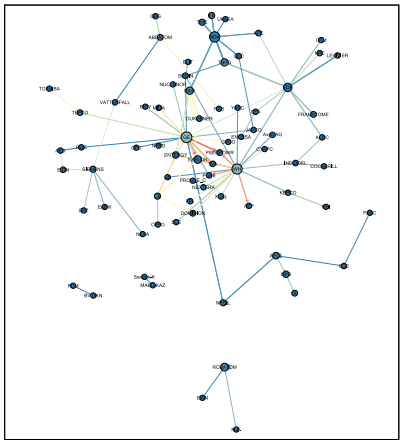
Data: IAEA PRIS database. Reactor constructions that involved two or more reactor suppliers appear twice (except industry consortia).

Owner-Supplier Networks

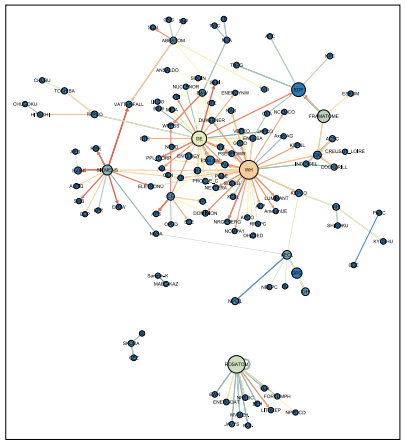
1950-1960
Reactors under construction: 30
New: 30 (3.4 GW)
Suppliers: 15 (New: 15)



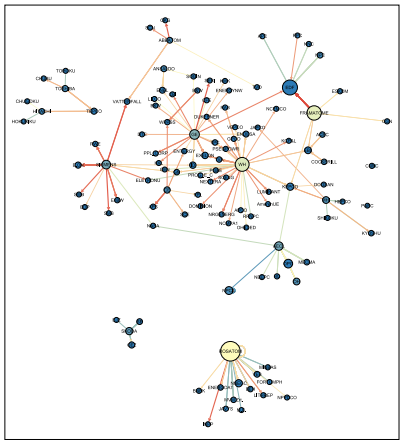
1960-1970
Reactors under construction: 137
New: 115 (67.0 GW)
Suppliers: 31 (New: 16)



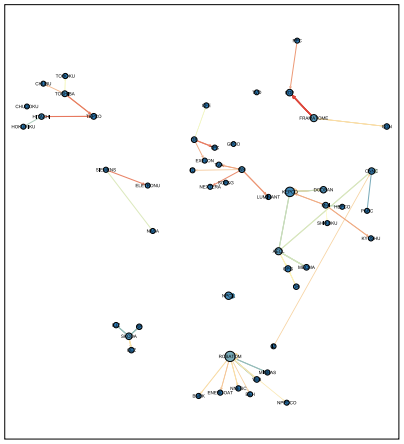
1970-1980
Reactors under construction: 346
New: 257 (226.1 GW)
Suppliers: 29 (New: 4)



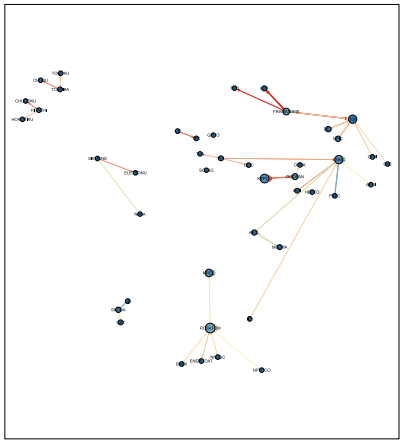
1980-1990
Reactors under construction: 328
New: 127 (118.0 GW)
Suppliers: 25 (New: 4)



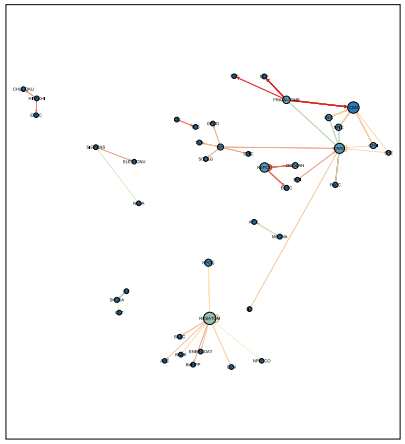
1990-2000
Reactors under construction: 114
New: 32 (27.2 GW)
Suppliers: 17 (New: 1)



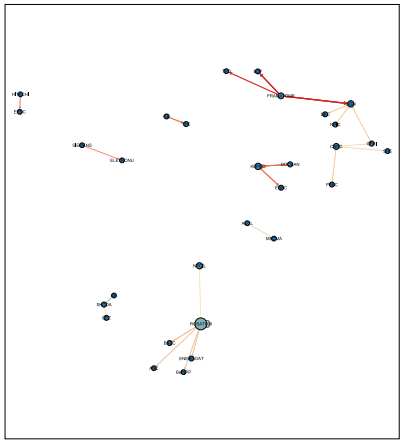
2000-2010
Reactors under construction: 103
New: 53 (49.4 GW)
Suppliers: 19 (New: 4)



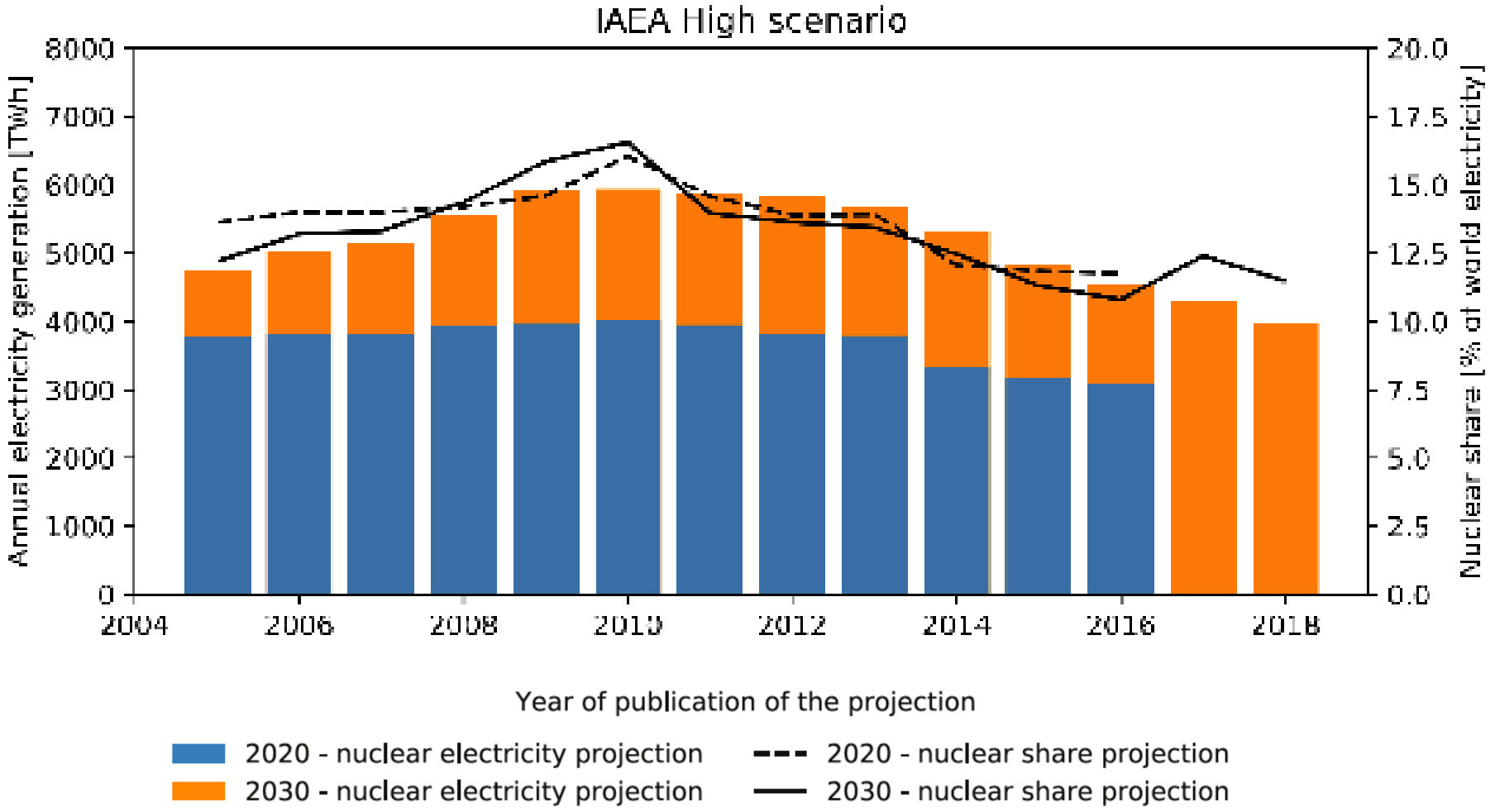
2010-2020
Reactors under construction: 129
New: 66 (69.5 GW)
Suppliers: 18 (New: 0)



2020-2030 planned
Reactors under construction: 59
New: 13 (13.3 GW)
Suppliers: 15 (New: 0)

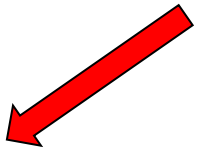


Future projections for nuclear



Context developments

- Electricity market liberalization & IPPs
- Competing technologies: coal, gas, renewables
- Climate change
- Geopolitics
- Military



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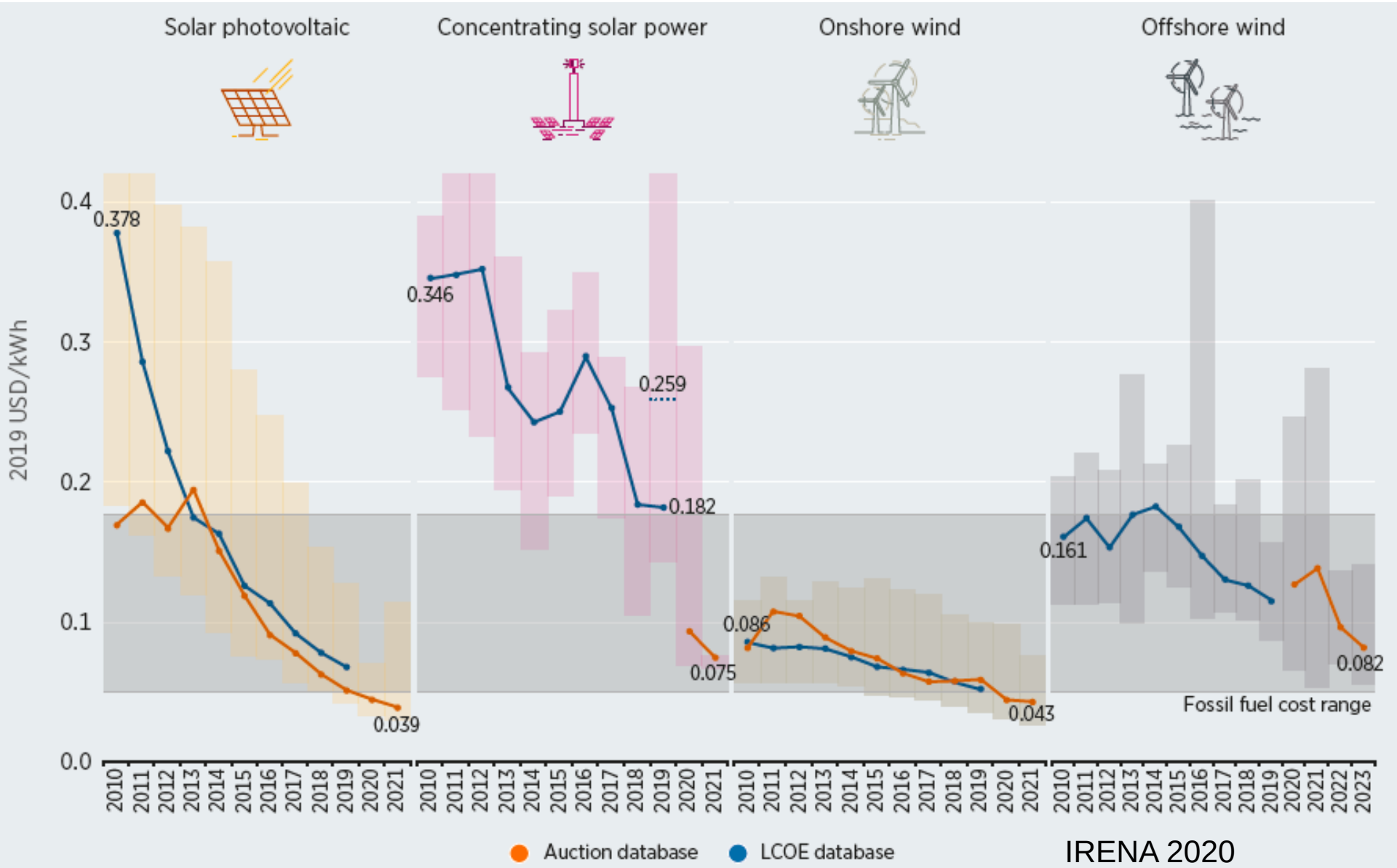
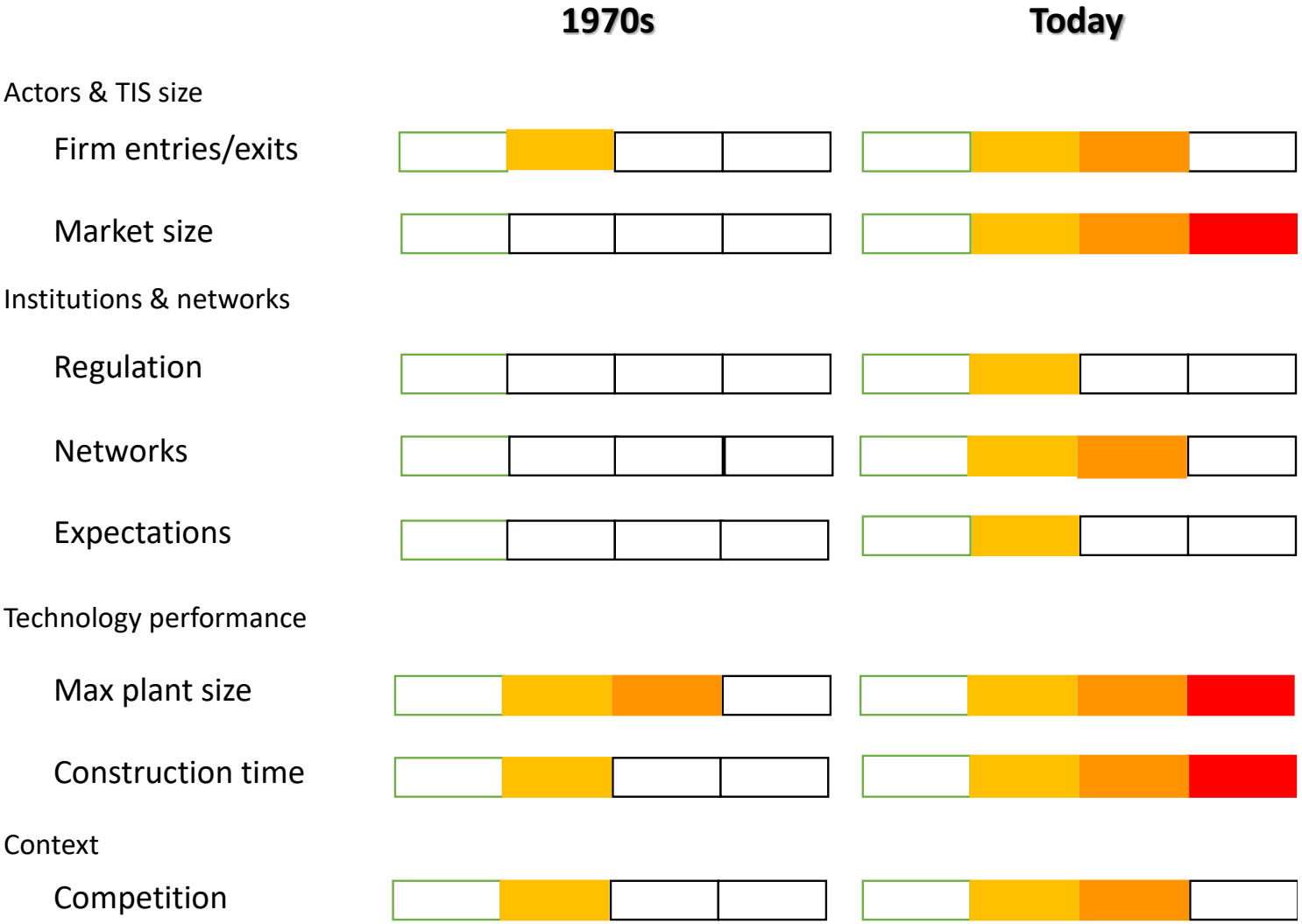
Cost reduction renewables

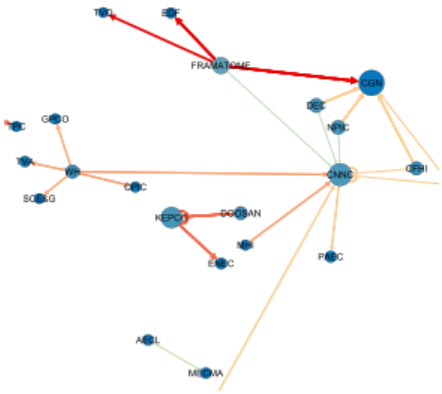


IRENA 2020

Overall assessment



Summary



- Many indicators point to a decline of nuclear
  particularly worrying: weakened industry base

- Also positive developments:
  new constructions, esp. China, hopes for SMRs

- Main challenge: cheap renewables
  → In liberalized markets, rather no new nuclear without subsidies

Conclusion & outlook

- Energy & other sectors:

  early stages of fundamental transformations

- Sector-coupling: electricity, heat, transport, industry

  plus: digitalization, demand side management

- Climate is a game changer:

  Low-carbon technologies diffuse rapidly

- Nuclear as a solution?

  Rather not: high risks, high costs, slow, might come too late

Thank You!