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UNIVERSITY OF ICELAND

Industry 4.0 and 5.0, sustainable development, and sustainable and unsustainable business models

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Agenda

- Industry 4.0, 5.0 and society 5.0
- Sustainable development and the sustainable development goals
- Sustainable business models
- Unsustainable business models
- Driving forces of proactiveness
- Stakeholders
- Circular Economy

Industry 4.0

- Industry 4.0 focuses on manufacturing/ production from economic point of view:
  - Digitalization of manufacturing
  - Decentralization of manufacturing
  - Vertical and horizontal integration of the value chain
  - Increased productivity
  - Flexibility (real-time production, customization, etc.)
- Components include:
  - Cyber-Physical-Systems (CPS)
  - Internet of Things (IoT)
  - Technological innovations such as Big Data, cloud computing, Artificial Intelligence (AI), collaborative robotics, etc.

Speringer and Schnelzer, 2019

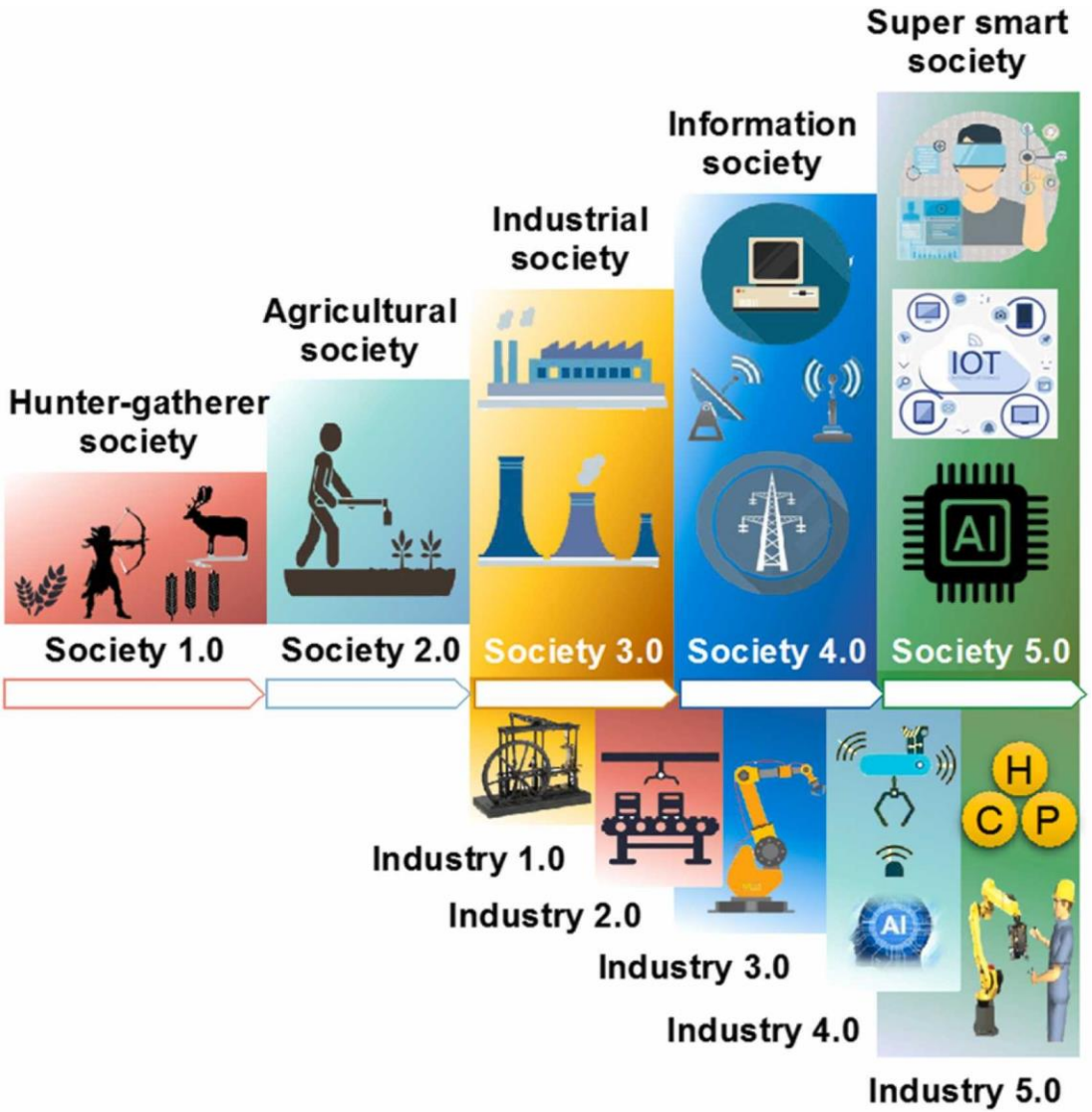
Industry 4.0, 5.0 and Society 5.0

- Industry 4.0 Techno-centric
- Society 5.0 Human-centric
- Industry 5.0 Balanced techno and human centric

- "Society 5.0 aims to place **human beings** at the midpoint of **innovation**, exploiting the impact of **technology and Industry 4.0 results** with the technological integration to improve **quality of life, social responsibility and sustainability**".

Carayannis and Morawska-Jancelewicz, 2022, p. 1

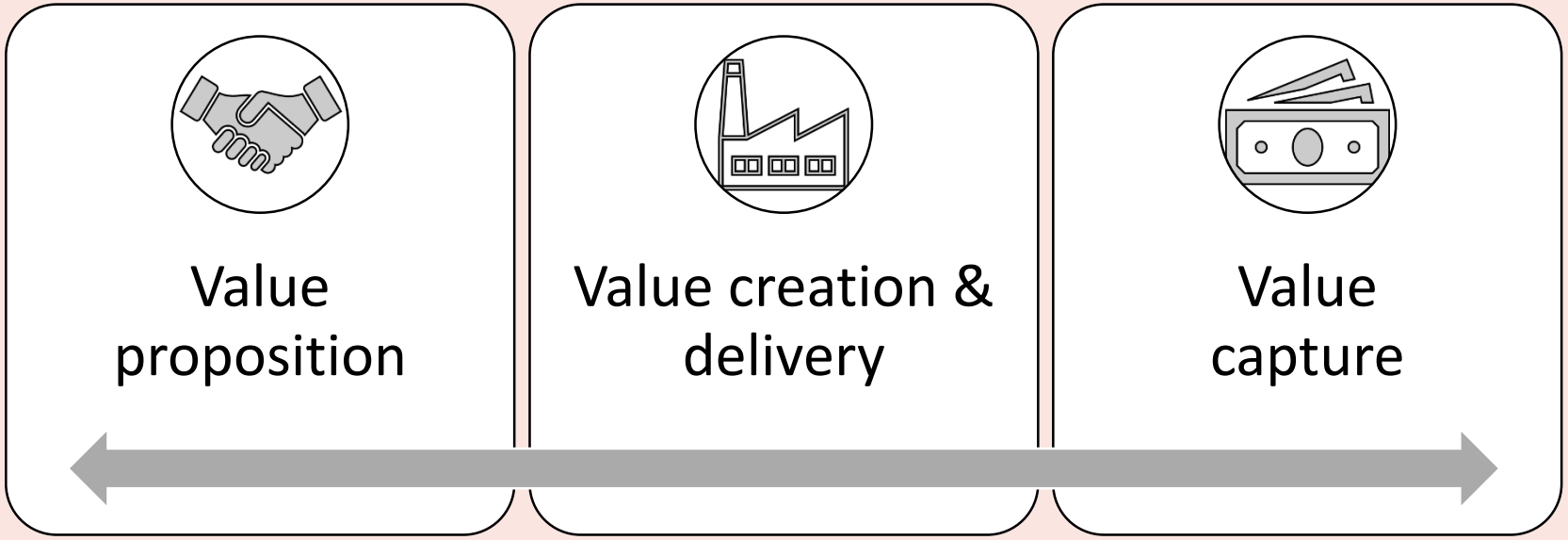
Revolution of society and industry



Sustainable development and the Global Goals

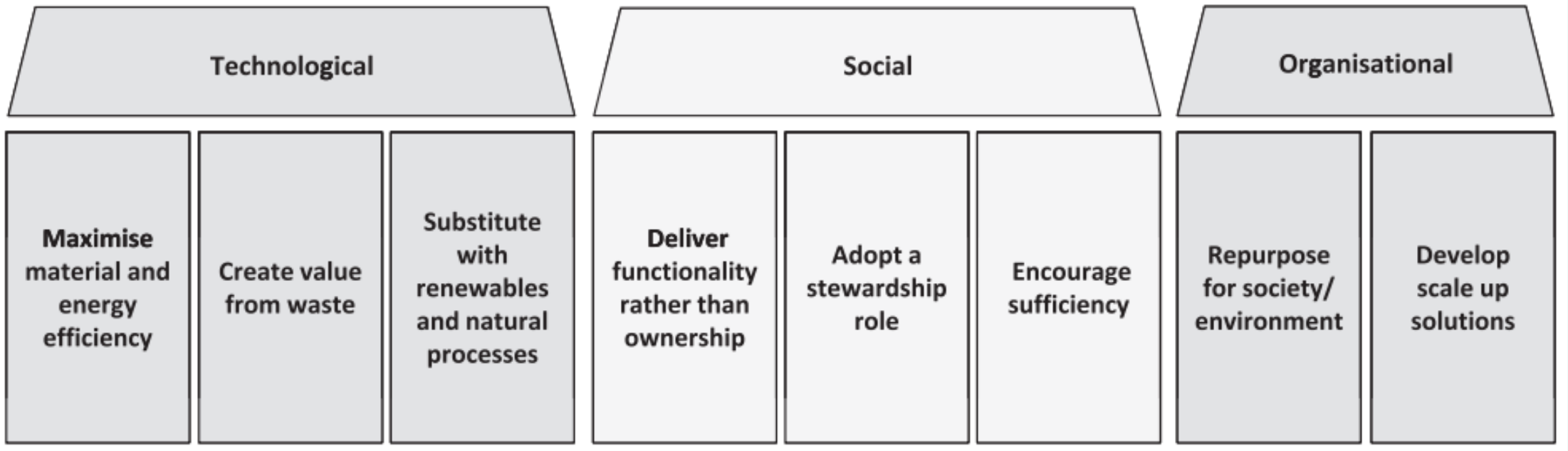
https://en.unesco.org/sustainabledevelopmentgoals

Elements of sustainable business model frameworks



Bocken et al., 2014, p. 43; Osterwalder and Pigneur, 2005; Richardson, 2008.

Typologies of Sustainable business models

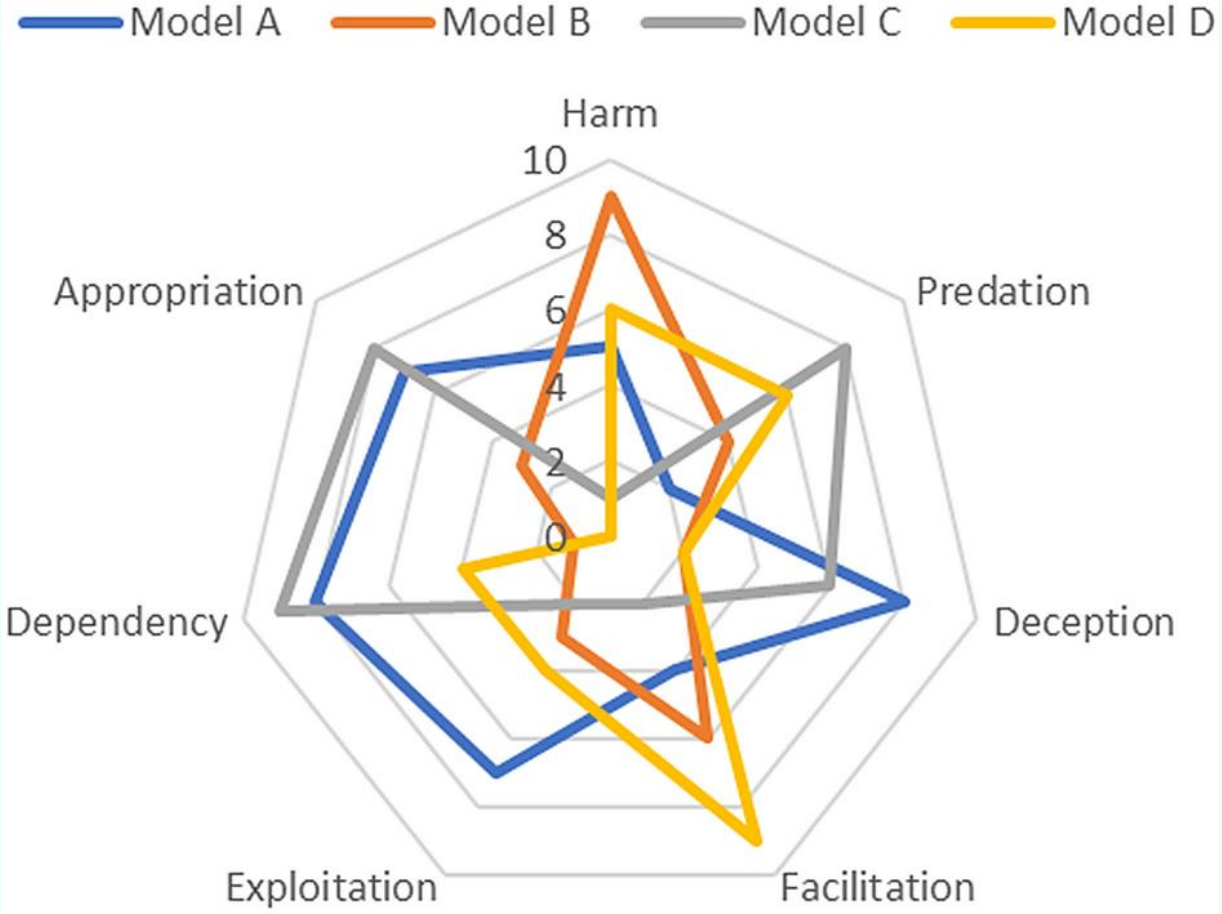


Bocken et al., 2014, p. 48

Unsustainable business models by sectors

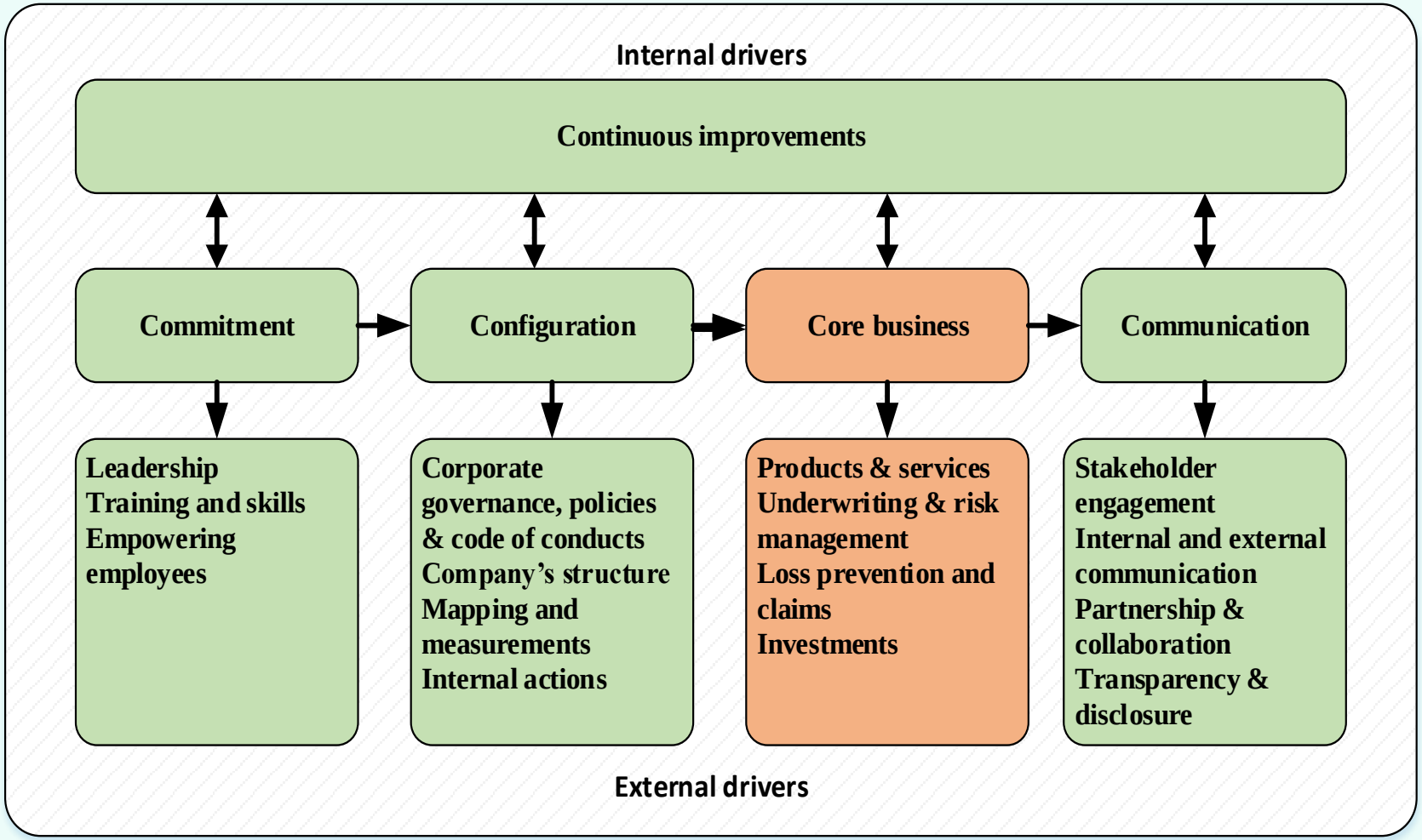
Examples of Industrial sectors	Unsustainable elements of business models
Energy supply	Exploitation of finite resources; Combustion of fossil industrial processes fuels
Transportation	Exploitation of finite resources; Combustion of fossil industrial processes fuels; Volume over value
Fast-moving consumer goods (FMCG), food and beverage	Complex opaque global value chains; Volume over quality and value; Unhealthy offerings; Take-makedispose model
Technology	Volume over value (quantity over quality, and rapid replacement cycles); exploitation of finite resources; Planned obsolescence; unsustainable material and energy usage; promoting unsustainable behaviour patterns; ‘human-replacement’
	Bocken and Short, 2021

Unethical Business Models



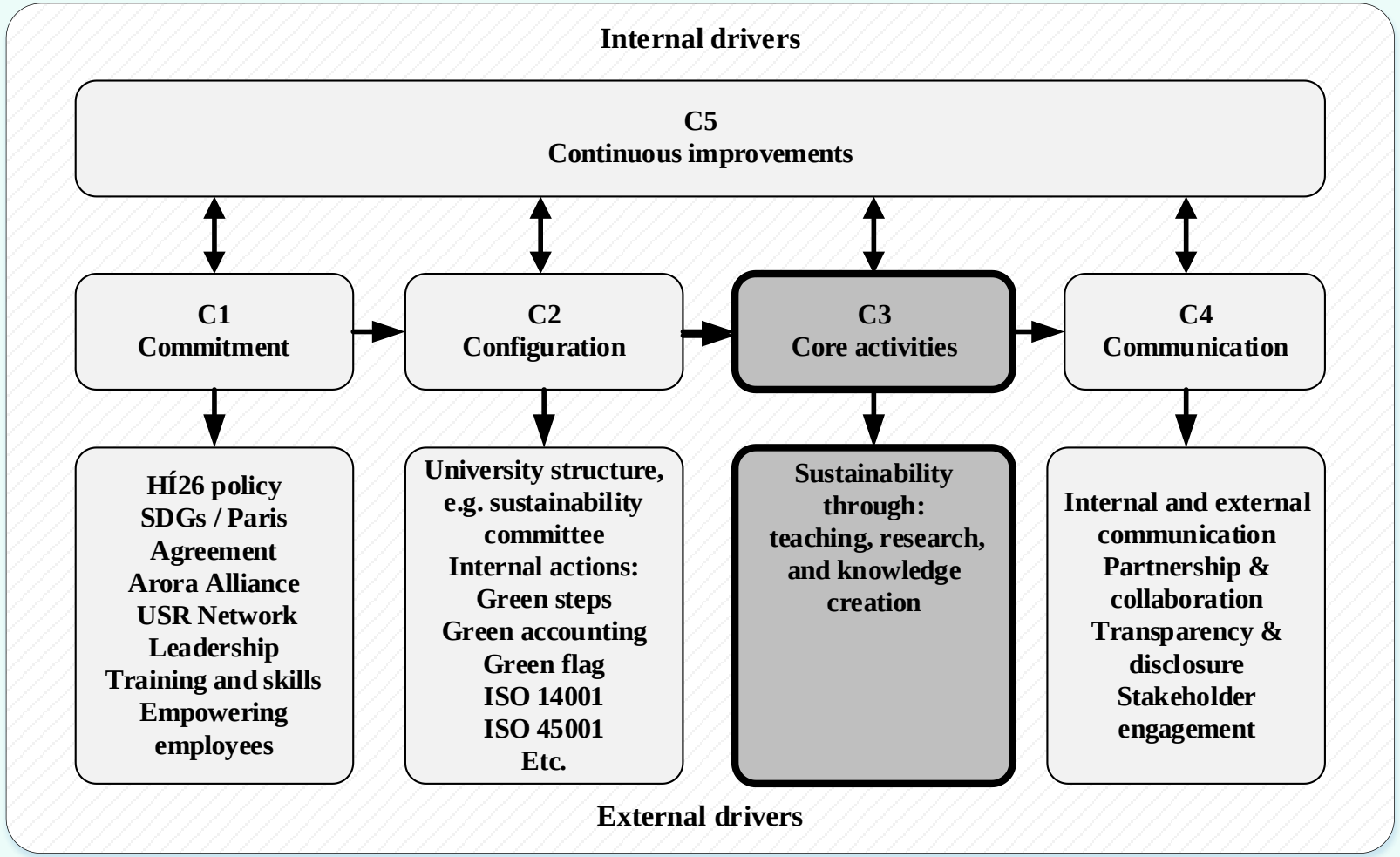
Dacin et al., 2022, p. 9

The 5C framework and core business elements I



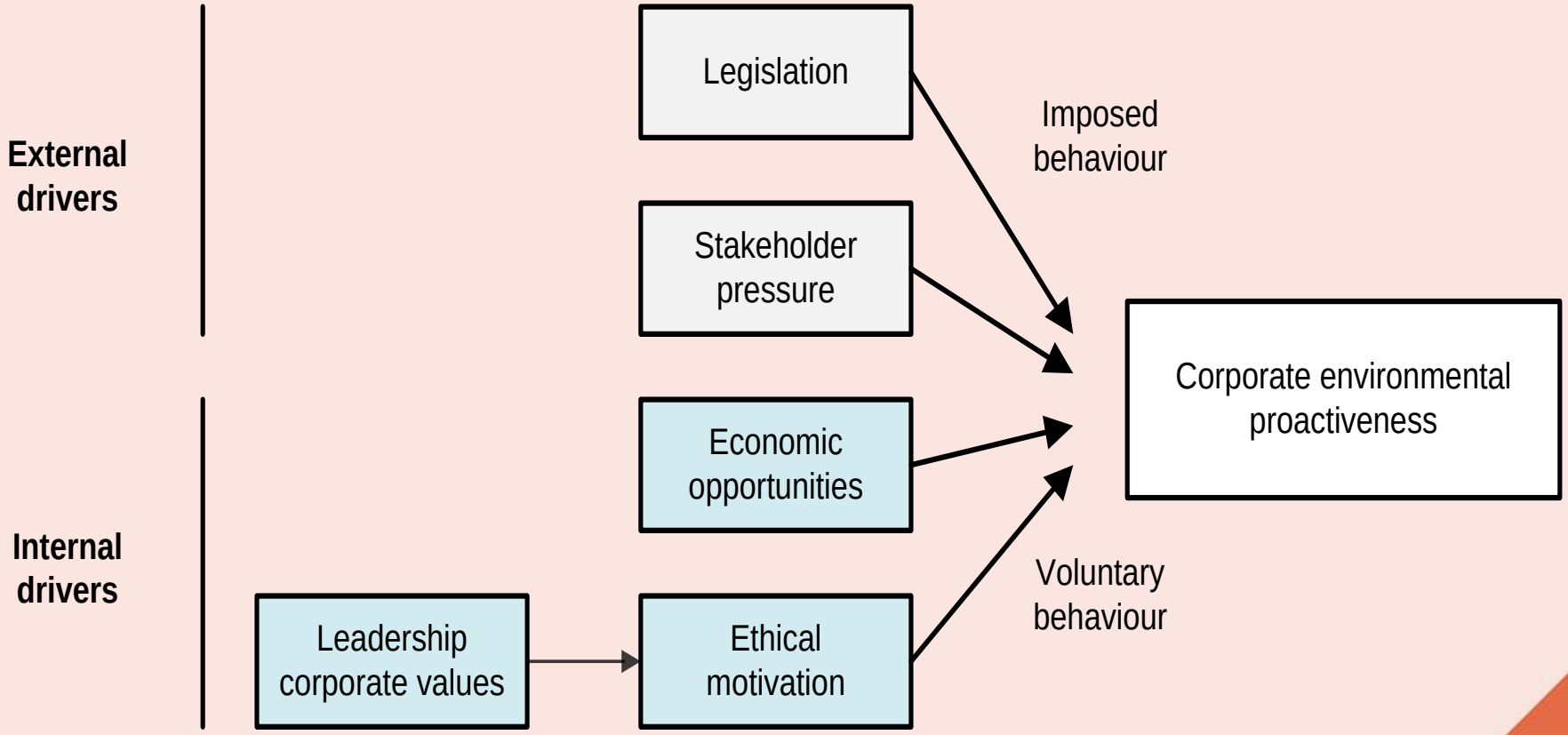
Johannsdottir & McInerney, 2018, p. 1259

The 5C framework - core business elements II



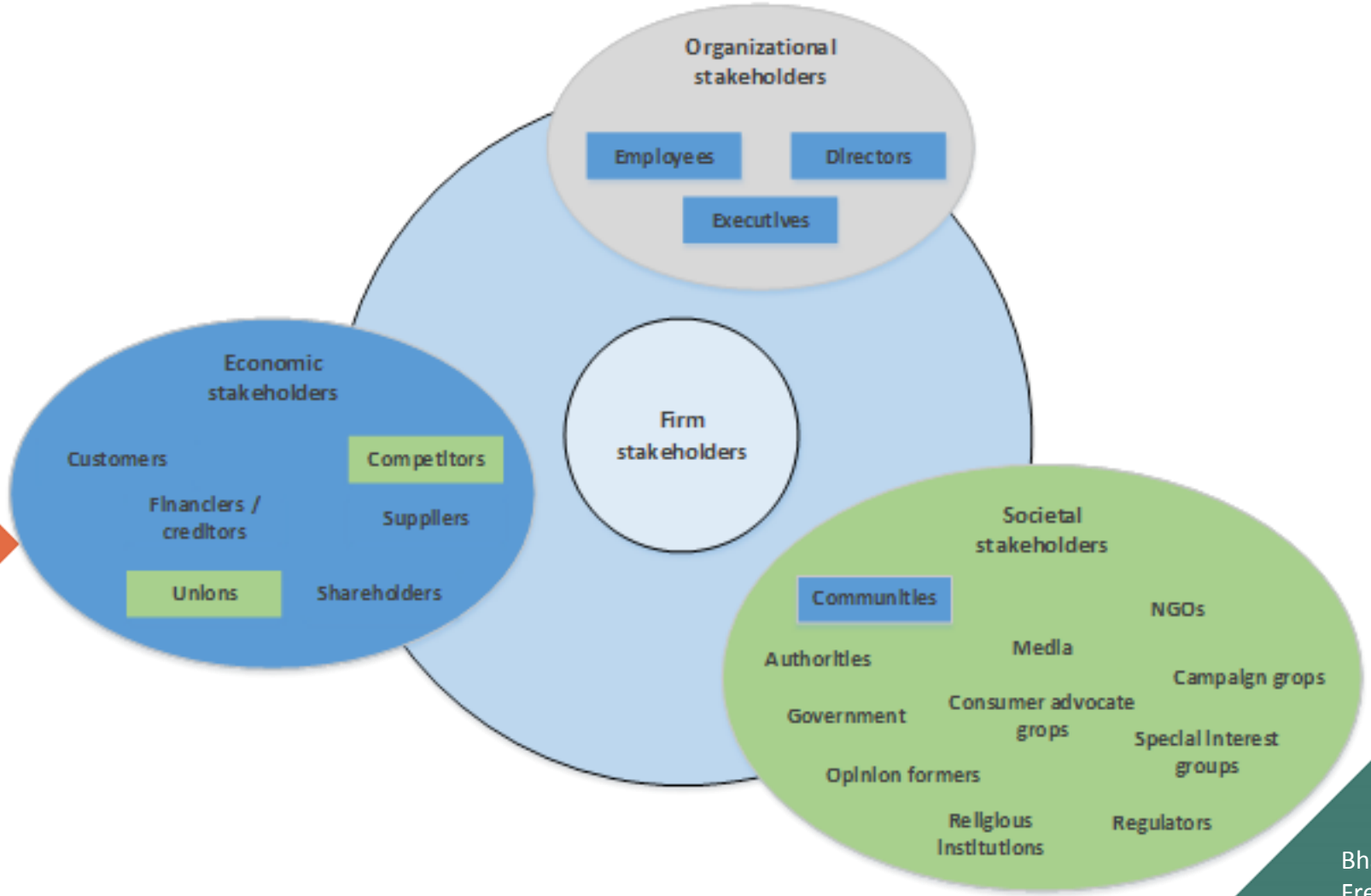
Johannsdottir & McInerney, 2018, p. 1259

Driving forces and companies proactiveness



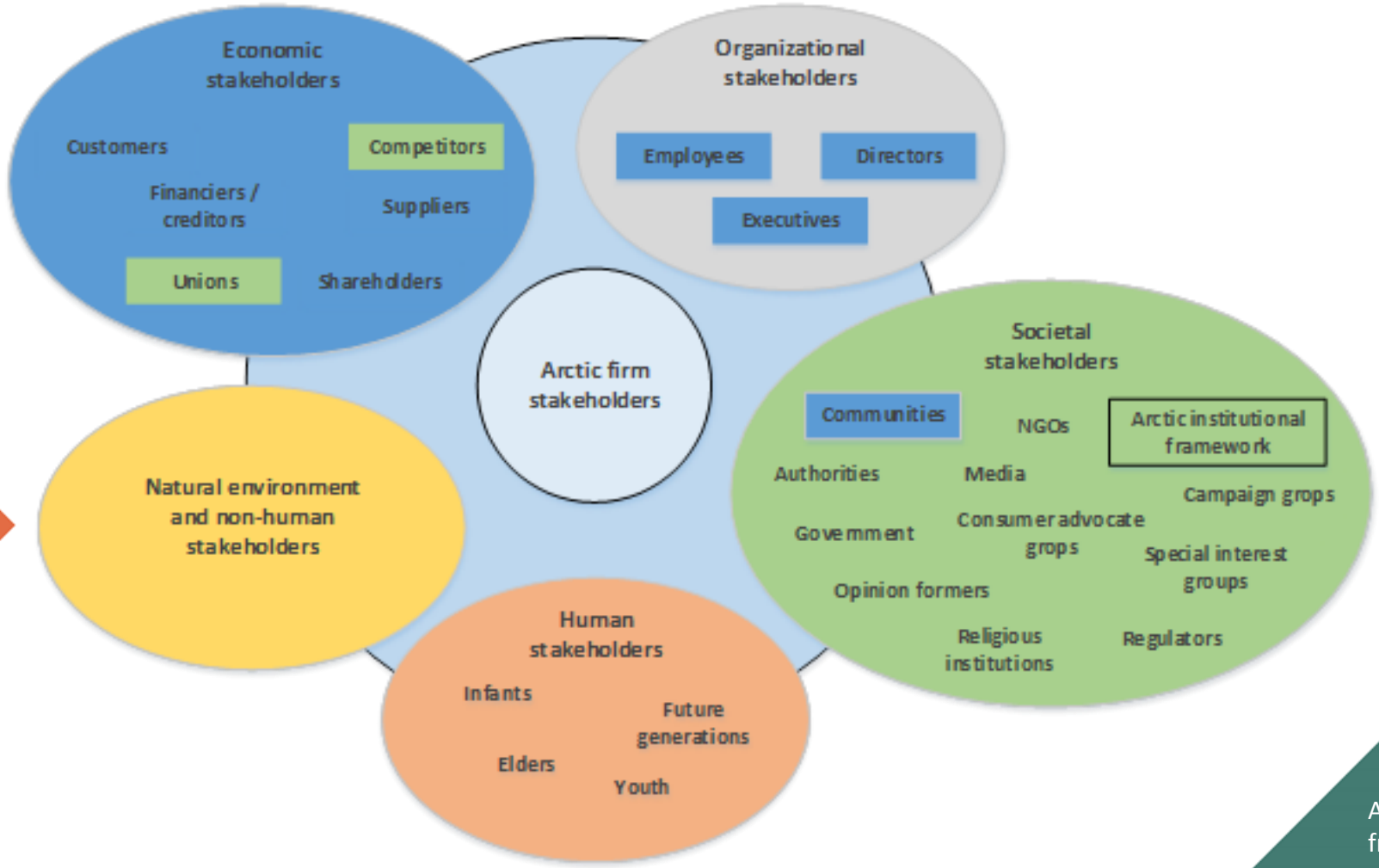
Bansal & Roth, 2000, p. 718; Tutore, 2010

General stakeholder diagram



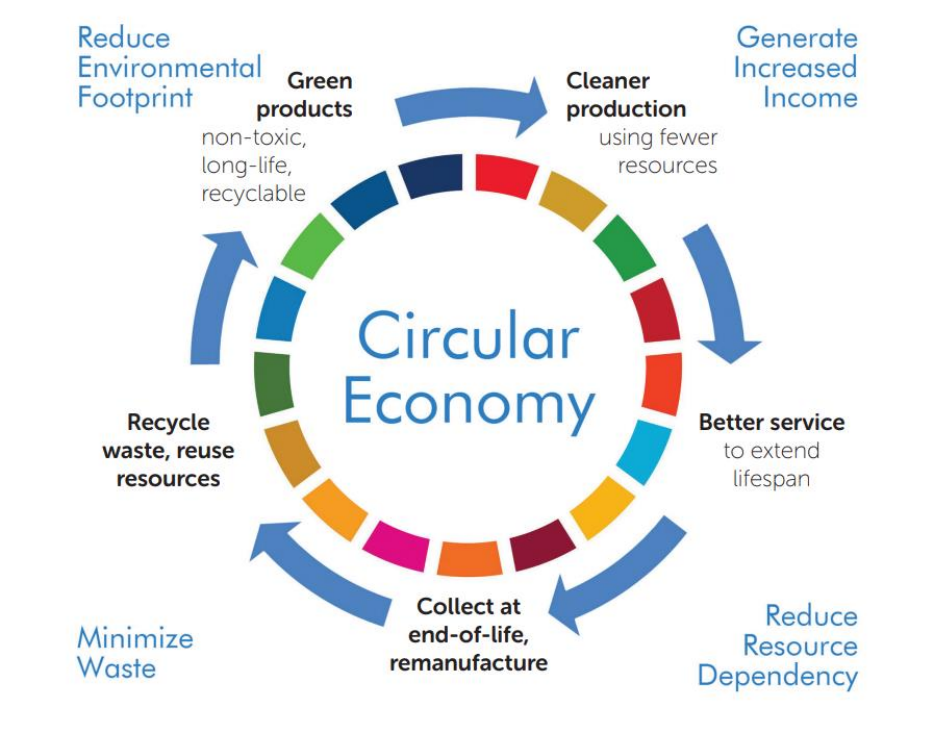
Bhattacharya et al., 2011; Hopkins, 2016 ; Freeman et al., 2017

Sustainability (Arctic) stakeholder diagram



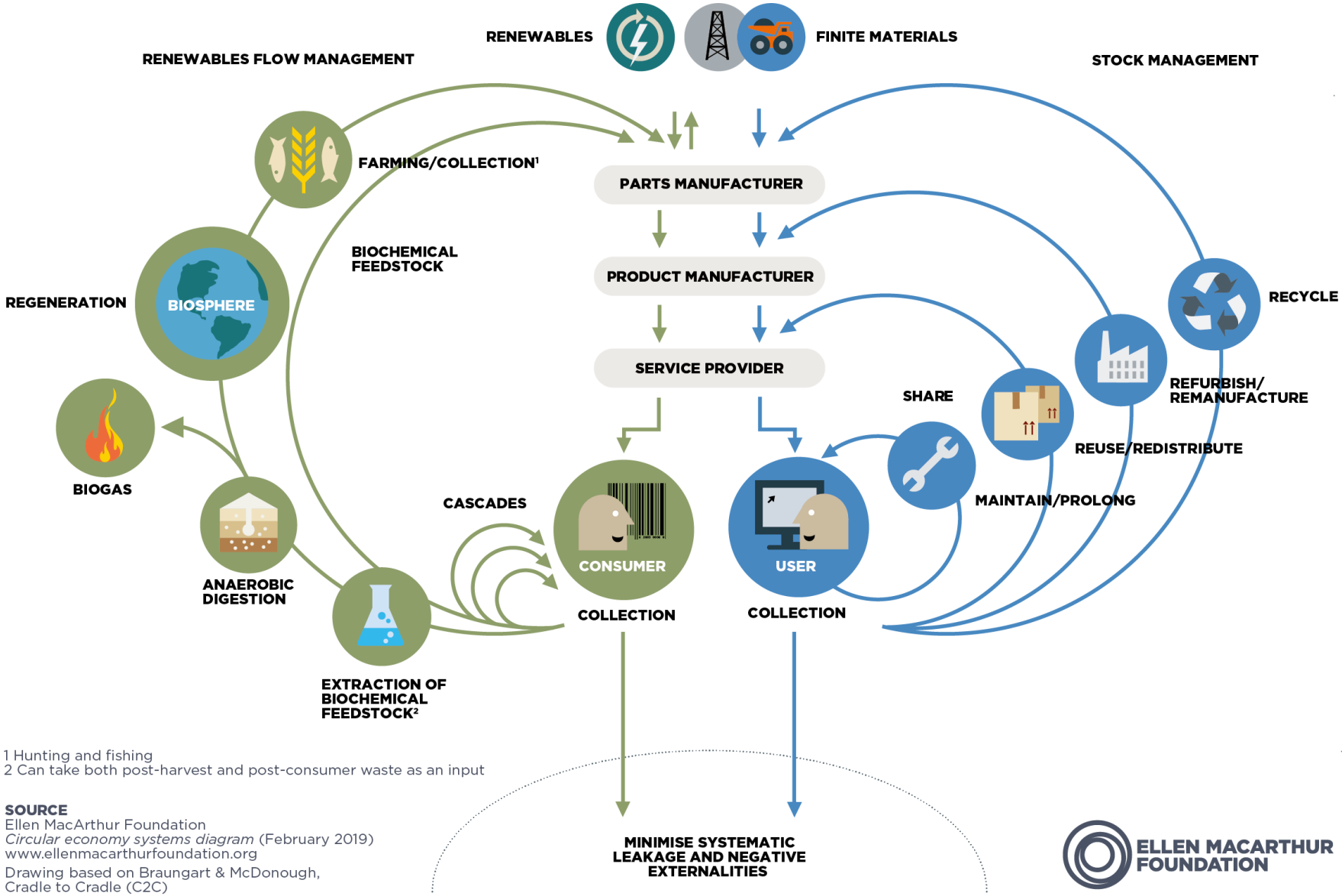
Arruda & Johannsdottir, 2021; adopted from Bhattacharya et al., 2011; Hopkins, 2016 ; Freeman et al., 2017

Circular Economy (CE)



- *"The circular economy is a new way of creating value, and ultimately prosperity. It works by extending product lifespan through improved design and servicing, and relocating waste from the end of the supply chain to the beginning—in effect, using resources more efficiently by using them over and over, not only once"* (p. 3).
- *"In a circular economy, however, products are designed for durability, reuse and recyclability, and materials for new products come from old products"* (p. 3).

United Nations Industrial Development Organization (UNIDO), n.d.



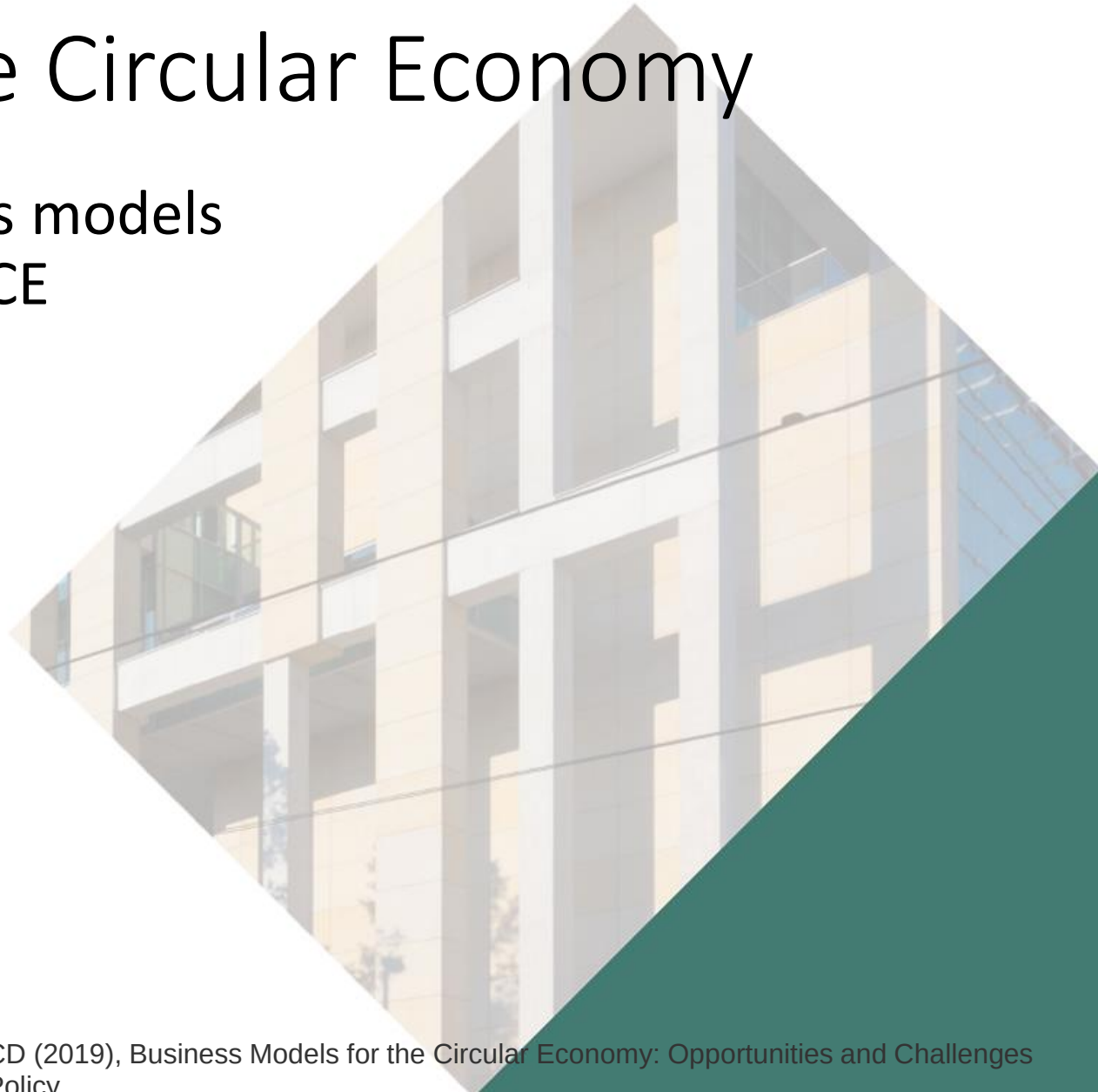
1 Hunting and fishing
2 Can take both post-harvest and post-consumer waste as an input

SOURCE
Ellen MacArthur Foundation
Circular economy systems diagram (February 2019)
www.ellenmacarthurfoundation.org
Drawing based on Braungart & McDonough, Cradle to Cradle (C2C)

ELLEN MACARTHUR FOUNDATION

Business Models for the Circular Economy

- OECD defines five types of business models supporting the transition towards CE
    - Circular supply models
    - Resource recovery models
    - Product life extension models
    - Sharing models
    - Product service system models



OECD (2019), Business Models for the Circular Economy: Opportunities and Challenges for Policy

Industry 4.0 in the context of ReSOLVE and CE

ReSOLVE	Design of products	Production of products	Logistics/reverse logistics
Regenerate	✓ Internet of things	✓ Internet of things	–
Share	✓ Cloud manufacturing	✓ Cloud manufacturing	✓ Internet of things
	✓ Internet of things	✓ Internet of things	
Optimise	–	✓ Cyber-physical systems	✓ Internet of things
		✓ Internet of things	
Loop	✓ Internet of things	✓ Internet of things	✓ Internet of things
		✓ Cyber-physical systems	✓ Cloud manufacturing
Virtualise	✓ Cloud manufacturing	✓ Cloud manufacturing	✓ Internet of things
	✓ Internet of things	✓ Internet of things	
		✓ Additive manufacturing	
Exchange	✓ Additive manufacturing	✓ Additive manufacturing	–

Lopes de Sousa Jabbour, 2019, p. 279

E-Waste and Extended Producer Responsibility

- Basel Convention is a multilateral environmental agreement
- Covers the Control of Transboundary Movement of Hazardous Waste and their Disposal
- Adopted in 1989 and came into force in 1992
  - Originally with 175 – now 188 – participatory parties
- National and regional regulations to deal with the waste
- Physical vs. financial reposibiliy

IR 5.0, design for CE, sustainability responsibility

Imaginechina Limited / Alamy Stock Photo

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Q&A