Engineering with Social Sciences and Humanities;

Necessary Partnerships in Facing Contemporary (Un)Sustainability Challenges?

Edmond Byrne
Chair Professor of Process and Chemical Engineering
University College Cork

SHiFT COST Action Webinar, 17 April 2023

Transformations from unsustainability
Knowledge co-production via transdisciplinarity

SHiFT proposes the creation of a **transdisciplinary Hub** to address existing challenges in **advancing timely societal transformations** in the face of **climate change**.

The Hub comprises a core group of **Social Sciences & Humanities (SSH)** transdisciplinary researchers and practitioners and their extended networks ..engaging with transformation in practice ideas across different **social, political, economic, environmental**, and **technological contexts.**

Working Group 01 Reflect on critical practice interventions
To explore **concepts and theoretical framings** for inclusive, reflexive and hybridized approaches to **knowledge co-production** in critical practice

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"Our world stands at an inflection point where the choices we make today are literally going to determine the future or the history of this world for the next four to five decades — literally, not figuratively."

US President Joe Biden, Address to Oireachteas, Dublin, 13 April 2023

"Look what's happening with artificial intelligence right now. It holds enormous promise and enormous concern."

US President Joe Biden, Address to Oireachteas, Dublin, 13 April 2023

> "The single existential threat to the world is climate change. We don't have a lot of time, and that's a fact."
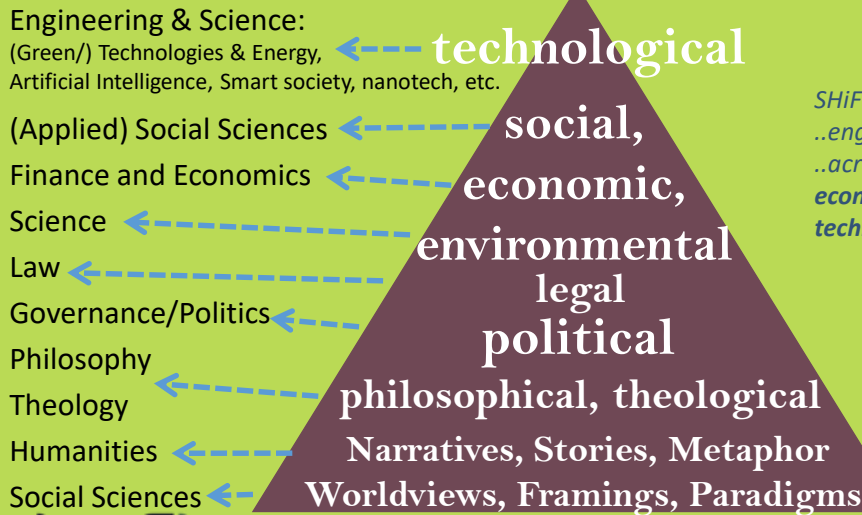> *US President Joe Biden, Address to Oireachteas, Dublin, 13 April 2023*

SHiFT:
*"**transdisciplinary** researchers*
*..engaging with **transformation***
*..across different **social, political, economic, environmental**, and **technological contexts**."*

shift social sciences and humanities for transformation and climate resilience

SHiFT COST Action Webinar, 17 April 2023

UCC University College Cork, Ireland Coláiste na hOllscoile Corcaigh

(Re/)Orienting towards '(Un/)Sustainability'?

Engineering & Science:
(Green/) Technologies & Energy,
Artificial Intelligence, Smart society, nanotech, etc.

technological

(Applied) Social Sciences

Finance and Economics

Science

Law

Governance/Politics

Philosophy

Theology

Humanities

Social Sciences

**social,
economic,
environmental**
legal
political
philosophical, theological
Narratives, Stories, Metaphor
Worldviews, Framings, Paradigms

*SHiFT: "**transdisciplinary** researchers ..engaging with **transformation** ..across different **social, political, economic, environmental**, and **technological contexts**."*

shift — social sciences and humanities for transformation and climate resilience

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Philosophy of Engineering and Technology

Steen Hyldgaard Christensen · Anders Buch · Eddie Conlon · Christelle Didier · Carl Mitcham · Mike Murphy *Editors*

Engineering, Social Sciences, and the Humanities
Have Their Conversations Come of Age?

Springer

E. Byrne, K. Keohane, A. Revez, E. Boyle, C. McGookin, N. Dunphy, C. O'Neill, C. Harris, I. Hughes, C. Sage, J. Barry, B. Ó Gallachóir, and G. Mullally · 1

**Chapter 21
Engineering with Social Sciences and Humanities; Necessary Partnerships in Facing Contemporary (Un)Sustainability Challenges?**

Edmond Byrne, Kieran Keohane, Alexandra Revez, Evan Boyle, Connor McGookin, Niall Dunphy, Claire O'Neill, Clodagh Harris, Ian Hughes, Colin Sage, John Barry, Brian Ó Gallachóir, and Gerard Mullally

"It is a recognition of this complementary and agonistic duality (Byrne, 2017), between SSH, [and] engineering and science that has precipitated a number of academics from different disciplines at University College Cork (UCC) and beyond to reach out to initiate means of breaking down the walls between our disciplinary silos to create an authentic engagement of scholars around the issue of sustainability."

21.1 Mutual Complementarities: Engineering and the Social Sciences

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"Many [recent] **technological developments** have emanated from **economic and policy drivers**, but what has often been <u>less developed</u> has been an initial regard for **broader societal contexts**, including **ethical implications**, potential **unintended consequences**, the **precautionary principle** and/or **local public acceptability**.
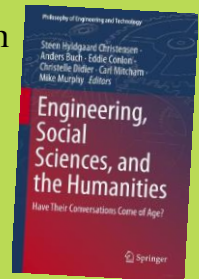
'Wicked' societal problems …are both **normative** and **deeply contested**, and which necessarily impinge upon **ethical** and **social** domains, as well as those in **environmental, technical** and **economic** spheres.

A **holistic, integrative and complexity embracing paradigm** would embrace each and all of the aforementioned **domains**."

tech
social,
economic,
environmental
legal
political
philosophical, theological
Narratives, Stories, Metaphor
Worldviews, Framings, Paradigms

Niels Bohr; Physics Nobel Prize (1922)
"for his services in the investigation of the structure of atoms and of the radiation emanating from them"

Devised 'Principle of Complementarity' in quantum physics e.g. wave/particle and position/momentum – each are inherent functions of an observer

Recipient of The Order of the Elephant (Denmark's highest-ranked honour) 1947

*Yin and yang are **opposites**, though **interdependent**;* One cannot exist without the other.

Niels Bohr (1885-1962)
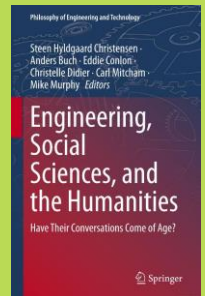
"A clear repercussion of this ['holistic, integrative and complexity embracing paradigm'], however, is a common realization of the need for the **social sciences, the humanities** (SSH), **engineering, and science** to all work together, both in concert and in complement, ***'contraria sunt complementa',*** as twentieth century Nobel prize winning quantum physicist **Neils Bohr** put it."

Necessary Partnerships in facing Contemporary (Un)Sustainability Challenges?
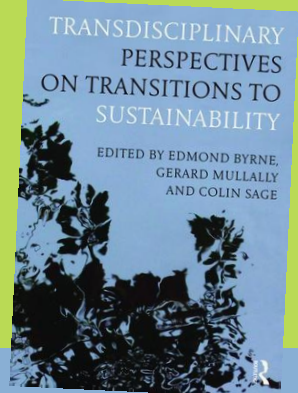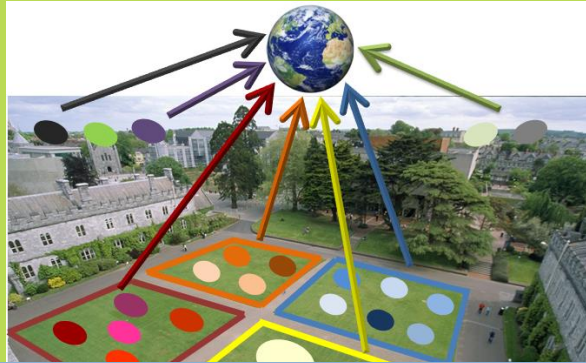
"Essentially, amid the 'silo-ised' constraints of the university (or should that be 'multiversity'?), the whole was not greater than the sum of the parts. More broadly, within a world of increasing ecological degradation, social upheaval and economic inequality we were making relatively feeble attempts to


Los Cuatro Postes, Ávila, Spain

Transdisciplinarity;
seeking *emergent* knowledge, built on strong *disciplinary* pillars, while *transcending* them

UNEP: Paradigmatic SHiFT needed for 'Great Transformation'

"As a result of our continued inaction, 'deep and rapid decarbonization processes **imply fundamental structural changes are needed**', changes which **can _only_ be effected** and accompanied by '**deep-rooted shifts in values, norms, consumer culture and world views**

[which] are inescapably part of the **great sustainability transformation**.' (UNEP, 2019).

That is, the changes needed are largely **non-technological** This reads as a powerful call to arms for **SSH**, and the **embedded knowledge, skills and values** therein, to work front and center and _**as equals with**_ engineering and science, in **eliciting transformative, paradigmatic change**."
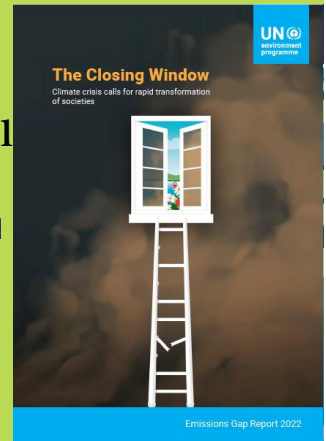
Necessary Partnerships:
for Problem Defining/Analysis _and_ Solving/Addressing

"Left to its own devices, **sociology** can often remain within **'problem defining'** or **'problem analysis'** domains, thus **constraining its real, practical and transformative potential**."

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Stories, Narratives, Myth, Metaphor are central..
(Underpinned by Worldviews, Framings, Paradigms)

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Stories, Narratives, Myth, Metaphor central..

"We are moved to act in response to **stories, narratives, myths and metaphor**, as opposed to mere **cold hard facts** (as our global incapability to cut greenhouse gas emissions makes clear, following 'this narrow approach').

While **scientists and engineers** can **identify the source** and **amount** of greenhouse gases we emit, and **calculate** how much is needed to **reduce** them, the key question of **_why_** we continue to pump them into our environment is one that perhaps **social scientists** are better equipped to address."

Philosophy of Engineering and Technology
Steen Hyldgaard Christensen ·
Anders Buch · Eddie Conlon ·
Christelle Didier · Carl Mitcham ·
Mike Murphy *Editors*

Engineering, Social Sciences, and the Humanities

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University College Cork, Ireland
Coláiste na hOllscoile Corcaigh
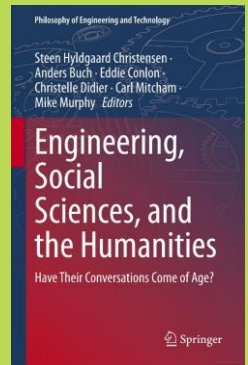
The foundational value of Metaphor

"Some propose that **metaphors** actually **frame** the very **basis** of **human understanding of the world around us** (through the right hemisphere of the brain) which in turn is **translated** (in the left hemisphere) into **words** and **language**."

METAPHOR, SUSTAINABILITY, TRANSFORMATION

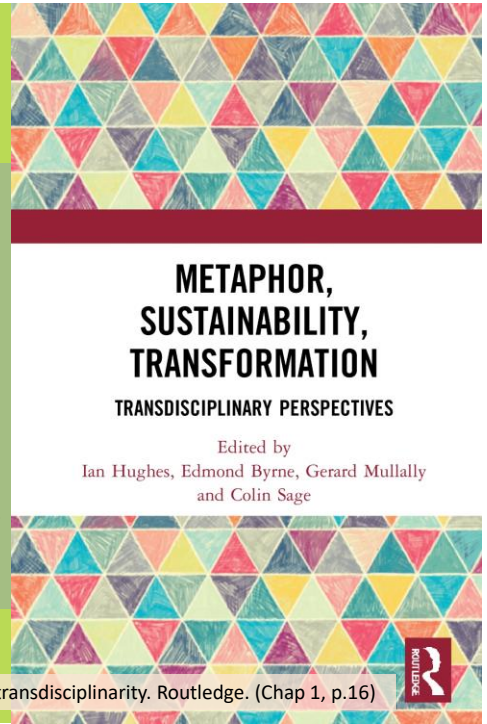TRANSDISCIPLINARY PERSPECTIVES

Edited by
Ian Hughes, Edmond Byrne, Gerard Mullally
and Colin Sage

Sage, C., Hughes, I., Byrne, E. & Mullally, G. (2022) Metaphor, transformation, and transdisciplinarity. Routledge. (Chap 1, p.3)

The power of metaphor, narrative..

"The chapter [6] argues that **metaphor** – together with **narrative, story,** and **myth**, as well as other right hemisphere constructs such as **art** and **music** – are really the <u>only means</u> of sufficiently moving **individuals, communities,** and **societies** to embark upon the type of **transformational change** that is **required** to achieve **authentic sustainability**."

METAPHOR, SUSTAINABILITY, TRANSFORMATION

TRANSDISCIPLINARY PERSPECTIVES

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tech
social,
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Stories, Narratives, Myth, Metaphor are central..
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Framings, Worldviews, Paradigms..
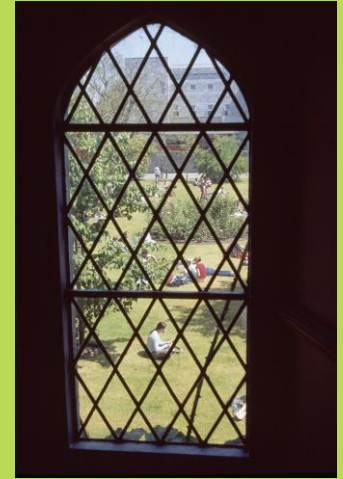
Competing paradigmatic metaphors of:

| 'Integrative' Worldview | 'Modern' Worldview |

➤ Complementary **Agonistic dualism** *vs.* **Antagonistic** (Cartesian) **dualism**

➤ Deep mutual **Interconnection** *vs.* atomistic (Cartesian) **Separation**
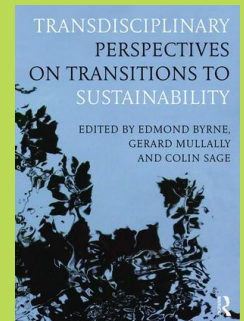
Annick De Witt's Worldviews Model

https://wvtest.com/

Framing [Reality]: De Witt's Worldviews Model

Modern
Associated with: Reductionist 'Science';
'Value free' objective logic/rationality
Techno-optimism.
Individualistic autonomous self.
Certainty+Truth: Reductionist Science

Postmodern
Associated with: Deconstructivism, Scepticism
Ineliminable Uncertainty, Relativism.
Subjective self expression as a unique being
No Certainty/No [Unique] Truth: Pluralistic
tolerance, multiple diverse narratives.

TRANSDISCIPLINARY
PERSPECTIVES
ON TRANSITIONS TO
SUSTAINABILITY

EDITED BY EDMOND BYRNE,
GERARD MULLALLY
AND COLIN SAGE

Traditional (Premodern)
Associated with: Working within and
though natural cycles, bound up with
irreducible mystery and enchantment.
Certainty+Truth: via unique Divine order
(mediated through sacred texts and
customs)

Integrative
Associated with: Transdisciplinarity,
Recognition of: irreducible complexity;
deep interconnectedness,
ongoing process change and emergent evolution
No Certainty, Truth: Integrative Science and Philosophy;
both physical/material and numinous/spiritual. Recognize
contingent, contextual, emergent and qualitative reality
('*sustainability as flourishing*')

Paradigmatic/Worldview Frameworks (Byrne, 2017, p.56), after Hedlund-de Witt and Hedlund-de Witt (2015)

De Witt's Worldviews Test (example*)

'Modern' Worldview
Personal Achievement:
Who I am is defined
by my **social position**
and/or my
achievements

'Postmodern' Worldview
Individualistic/Liberation:
I feel more like a **citizen of the world** than a citizen of a
country

'Traditional' Worldview
Community Rooted:
Who I am is defined by
my **religion** and
upbringing

'Integrative' Worldview
Communally Integrated:
I feel part of the **vast, interconnected whole** that
is **life** and the **universe**

(*Q.12)

Competing paradigmatic metaphors of:

➢ Complementary **Agonistic dualism** *vs.* **Antagonistic** (Cartesian) **dualism**
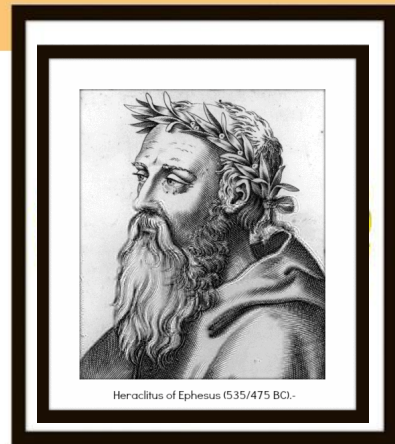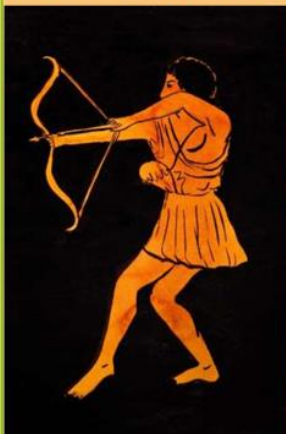
'Integrative' Worldview   'Modern' Worldview

Complementary Agonistic dualism

Fragments of Heraclitus (Fragment 51*):

**Integrative Approaches;
Embracing Interconnection**

*"The **harmonious** structure of the world depends upon **opposite tension** like that of **the bow** and **the lyre**."*

Heraclitus of Ephesus (535/475 BC).-

*Heraclitus, translated by John Burnet (1912)

Antagonistic (Cartesian) dualism

The Project of Modernity;
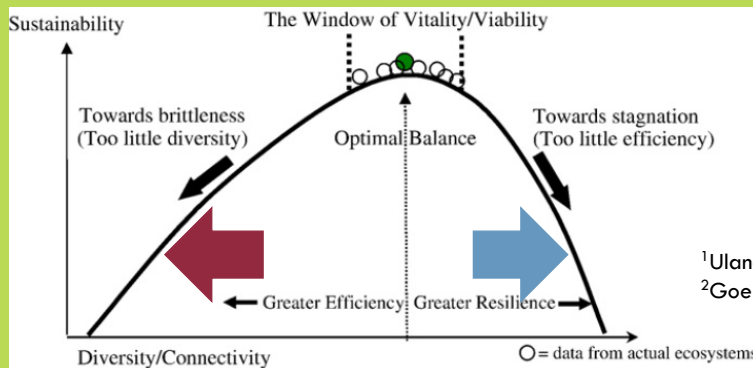**An Age of 'Reduction and Separation'**

Descartes' (1596-1650) philosophy sought **certainty** through **rationality;** based on an **antagonistic dualism** and distinct **separation** between the *objective* **physical mechanical body** and the *subjective* **mind/soul**.
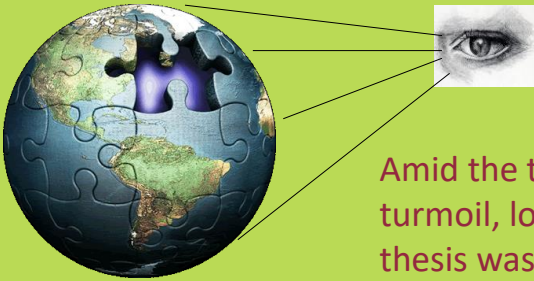
Amid the turmoil of early 17th Century Europe (war, turmoil, local temporal climate change) Descartes' thesis was a resounding success, and continues to be..

Complementary Agonistic Dualism in Systems Ecology

In systems ecology, it has been <u>quantitatively</u>[1] shown that sustainable ecosystems maintain a dynamic *balance* between opposing but necessary tendencies of efficiency and redundancy/resilience (a complimentary dualism).

Sustainability

The Window of Vitality/Viability

Towards brittleness
(Too little diversity)

Optimal Balance

Towards stagnation
(Too little efficiency)

← Greater Efficiency ⋮ Greater Resilience →

Diversity/Connectivity

O = data from actual ecosystems
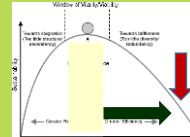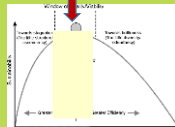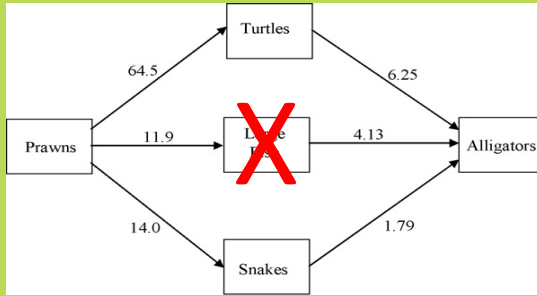
[1]Ulanowicz, 2009
[2]Goerner et al., 2009

Sustainability as a dialectical balance between efficiency and redundancy[2]

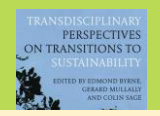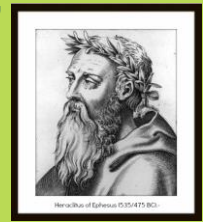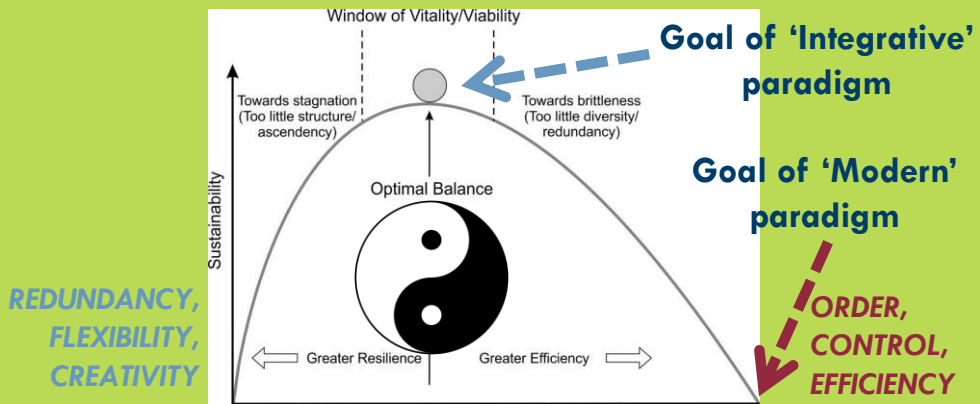# Complementary tendencies: Efficiency *vs.* Resilience

Respective ecosystems with:
(left) Higher **Redundancy/Resilience** and (right) Higher **Efficiency**

(Ulanowicz et al, 2009)

Dialectic Balance (An 'Integrative' Framing)

Goal of 'Integrative' paradigm

Goal of 'Modern' paradigm

REDUNDANCY, FLEXIBILITY, CREATIVITY

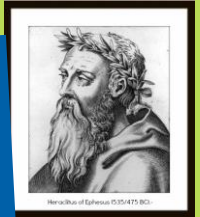**ORDER, CONTROL, EFFICIENCY**

Source: Byrne (2017), after R. Ulanowicz

System Sustainability characterised as a contingent dialectical *BALANCE* between complimentary (though opposing) opposites of *ORDER/CONTROL* (**efficiency**) and *FLEXIBILITY* (**redundancy, creativity, diversity**).

Dialectic Balance (An 'Integrative' Framing)

Goal of 'Integrative'

Edgar Morin (2008): *"In a universe of pure order, there would be no innovation, no creation, no evolution. There would be no life or human existence.*
But neither would any existence be possible in pure disorder, because there would be no element of stability on which to found an organization. Organizations need order and they need disorder."
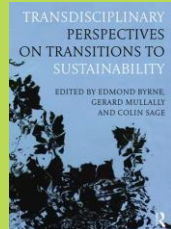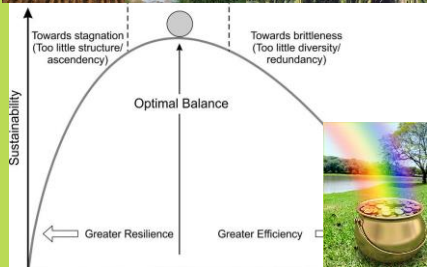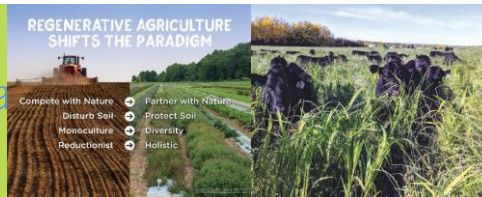
CONTROL, EFFICIENCY

Source: Byrne (2017), after R. Ulanowicz

System Sustainability characterised as a contingent dialectical *BALANCE* between complimentary (though opposing) opposites of *ORDER/CONTROL* (**efficiency**) and *FLEXIBILITY* (**redundancy, creativity, diversity**).

Dialectic Bala   Framing)

"The concept of 'Sustainability' may be "posited within a (dialectical and process) Heraclitan framework, whereby contingency, change and evolution are enduring system characteristics. It fits in with broader conceptions of sustainability as an evolving and contingent quality, rather than as some ultimate point destination entailing optimisation around a unique endpoint located at the (right hand) extreme of Ulanowicz's RAINBOW, a sort of crock of gold exemplified by the mirage of 100% efficiency." (Byrne, 2017 , p.49)

Dialectic Balance (An 'Integrative' Framing)

Competing paradigmatic metaphors of:

➢ Deep mutual **Interconnection** *vs.* atomistic (Cartesian) **Separation**

'Integrative' Worldview   'Modern' Worldview

Deep mutual Interconnection*

Indigenous Worldviews

(**vs.* atomistic (Cartesian) **Separation)**

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*"Some **Native Americans** talk of being part of the **web of life**. They **connect everything to everything** and so develop a respect for everything as **sacred**.*

*...**Spirituality** leads to **practices** in daily living that reflect a sense of **connectedness** to the world. ..We have to **recover** the sense of **sacredness** of the **world**, even of the **cosmos**, that envelops us.'*

John Ehrenfeld
(*'Flourishing; A Frank Conversation About Sustainability', 2013. pp. 106-107*)
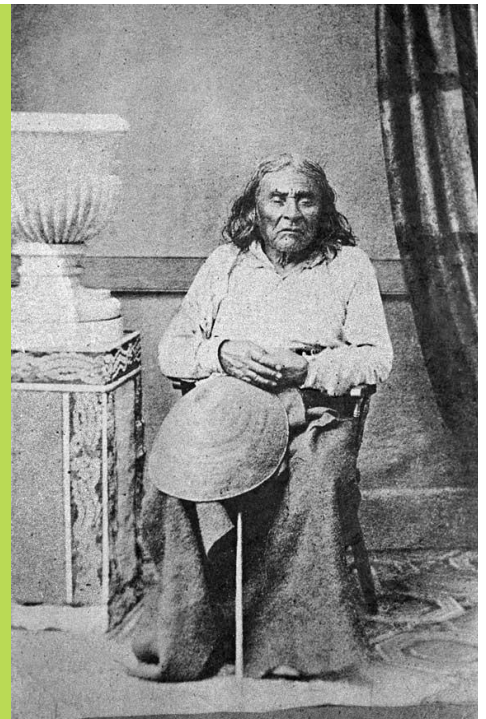
Deep mutual Interconnection*

Medieval (Pre Modern) Worldviews

(**vs.* atomistic (Cartesian) **Separation**)

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'I propose Francis as a patron saint for ecologists.'

Lynn White (1967)

Canticle of the Creatures (Francis, 1224)

Praised be you, my Lord, with all your creatures, especially **Brother Sun**, who is the day and through whom you give us light.

…Praised be you, my Lord, through **Sister Moon** and the stars, in heaven you formed them clear and precious and beautiful.

…Praised be you, my Lord, through our **Sister Mother Earth**, who sustains and governs us.

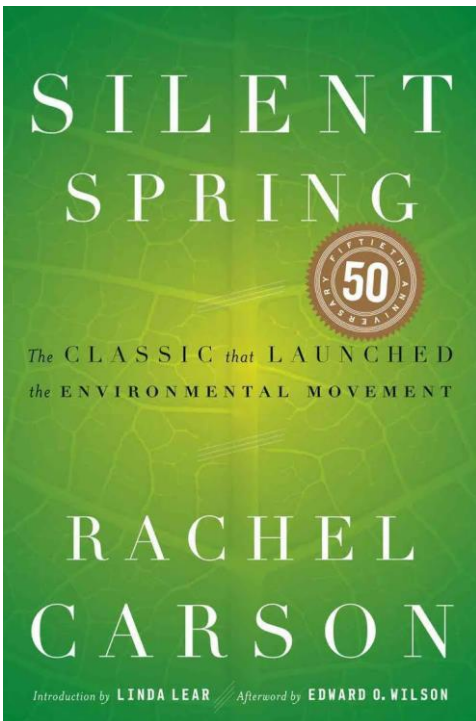Francis, Patron Saint of Ecology (Pope John Paul II , 1979)

Deep mutual Interconnection*

Science: The Birth of Contemporary Environmentalism

(*vs. atomistic (Cartesian) **Separation**)

shift — social sciences and humanities for transformation and climate resilience

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SILENT SPRING

50

The CLASSIC that LAUNCHED the ENVIRONMENTAL MOVEMENT

RACHEL CARSON

Introduction by LINDA LEAR   Afterword by EDWARD O. WILSON

1962

"The history of life on earth has been a history or interactions between living things and their surroundings."

Rachel Carson,
Silent Spring (1962)

Deep mutual Interconnection*

Politics: Awakening to the Climate Crisis

(**vs.* atomistic (Cartesian) **Separation**)

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UCC
University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

2006

"Our capacity for analysis sometimes leads us to an arrogant illusion: that we are so special and unique that nature isn't connected to us.

But the fact is, we're inextricably tied."

Al Gore,
An Inconvenient Truth

AN
INCONVENIENT
TRUTH
THE PLANETARY EMERGENCY OF GLOBAL WARMING AND WHAT WE CAN DO ABOUT IT
AL GORE

Deep mutual Interconnection*

Religion: Contemporary Theological Narratives

(**vs.* atomistic (Cartesian) **Separation**)

shift
social sciences
and humanities
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and climate resilience

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UCC
University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

2015

"It cannot be emphasized enough how everything is interconnected. ..Just as the different aspects of the planet – physical, chemical and biological – are interrelated, so too living species are part of a network which we will never fully explore and understand.

..We can once more broaden our vision [..to envision] another type of progress, one which is healthier, more human, more social, more integral."

The Encyclical Letter *Laudato Si'*

ON CARE FOR OUR COMMON HOME

POPE FRANCIS
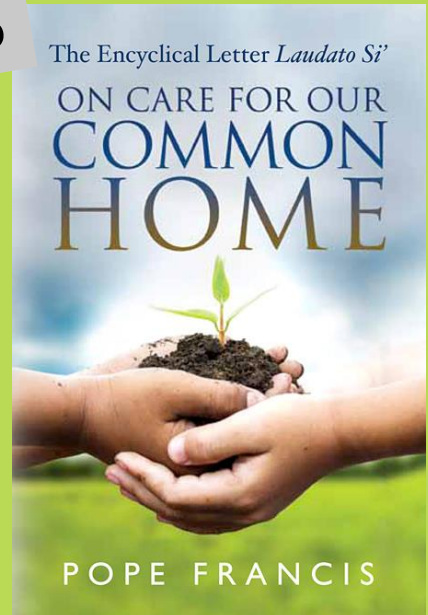
An Integral Cosmology => Universal Interconnection

"The universe is a communion of subjects rather than a collection of objects"

Thomas Berry, *The Universe Story (1992)*

"We lose our souls if we lose the experience of the forest, the butterflies, the song of the birds, if we can't see the stars at night."

Thomas Berry

SHiFT-ing the levers for transformation towards sustainability?

tech
social,
economic,
environmental
legal
political
philosophical, theological
Narratives, Stories, Metaphor
Worldviews, Framings, Paradigms

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Engineering with Social Sciences and Humanities;

Necessary Partnerships in Facing Contemporary (Un)Sustainability Challenges?

Edmond Byrne
Chair Professor of Process and Chemical Engineering
University College Cork

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