Transition to a Data-Driven Circular Economy

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Bournemouth

Introductions

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Research Interests

- **Principal Academic in Computing**
  - Distributed Systems & Ad-Hoc Networks
  - Algorithmic aspects; Architectures; Testbeds/Pilots; Standards

- **Focus Areas**
  - Internet of Things / 5G
  - Crowdsensing / Crowdsourced Systems
  - Wireless Power Transfer in Ad-Hoc Nets
  - other Future and Emerging Networks

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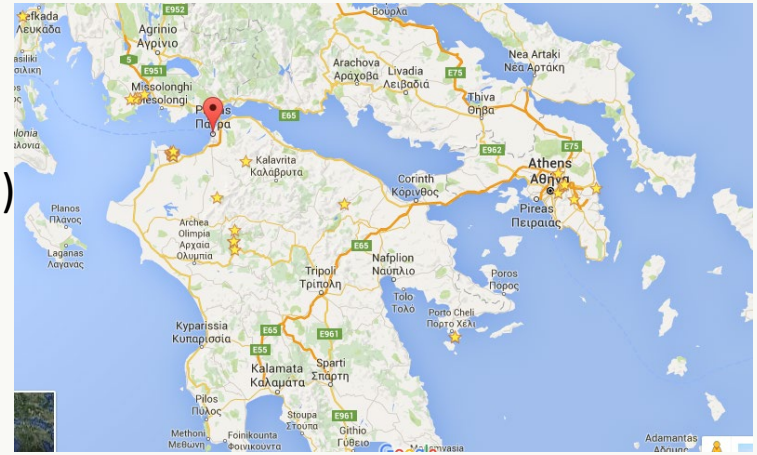
Background

- Ing. Diploma and PhD in UPatras (GR)
- Postdoc Excellence Scholarship in UNIGE (CH)
- Principal Academic in Bournemouth University (U.K.)



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Roles and Activities

Founder of three MSc programmes on Internet of Things

- MSc Internet of Things
- MSc IoT with Data Analytics
- MSc IoT with Cyber Security

Open Innovation Lab

- Focus on IoT as an Innovation Enabler
- IoT Space – 150+ IPv6-enabled sensor motes

International Scope

- ITU-T SG20 “IoT and Smart Cities” – Q5 Assoc. Rapporteur & SG20 Liaison Co-Rapporteur to SCV
- Alliance for IoT Innovation (AIOTI)
- IoT Forum
- IEEE Access Associate Editor

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Motivation

What is the most influential invention in human history?

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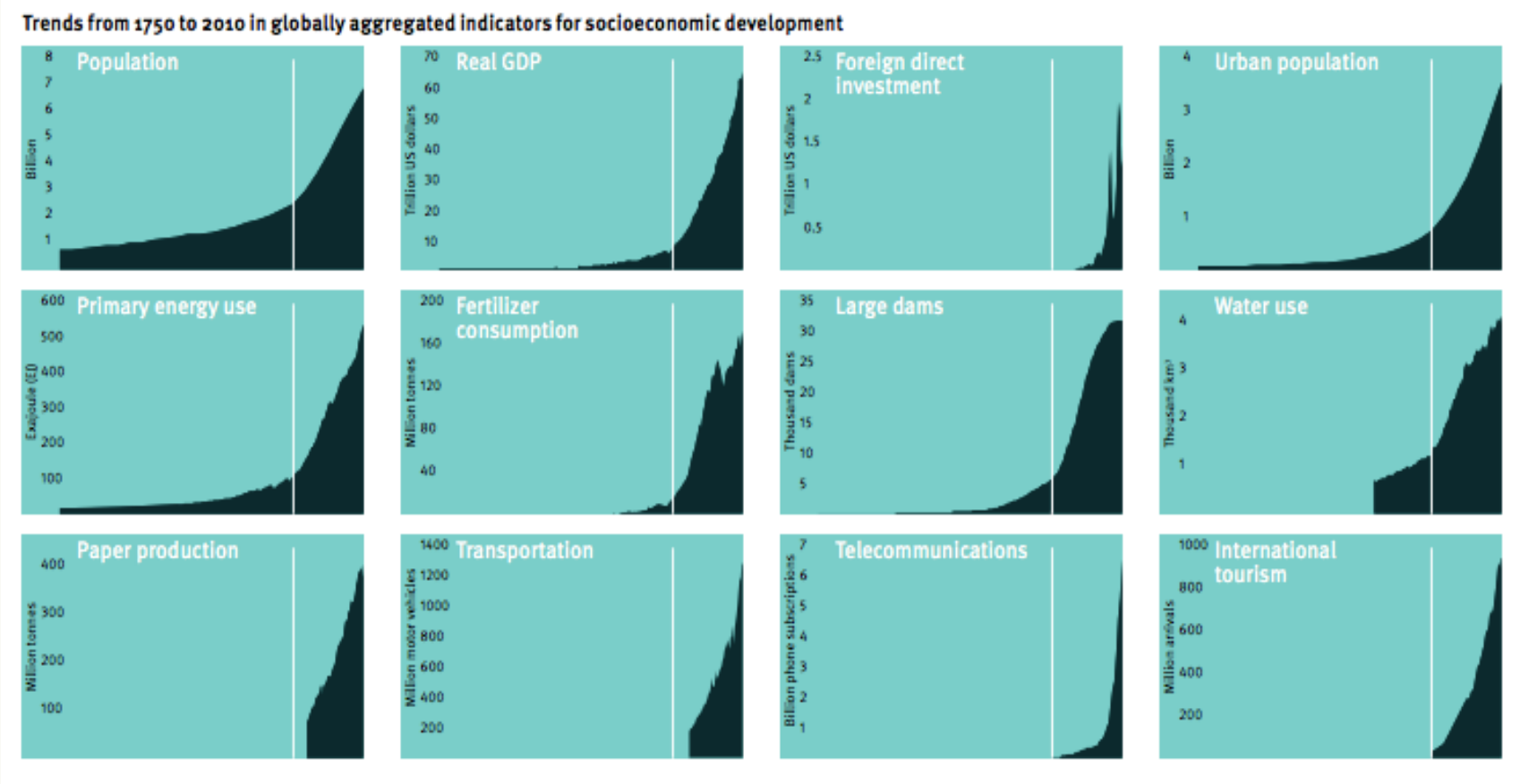
A Combination of Risks and Opportunities

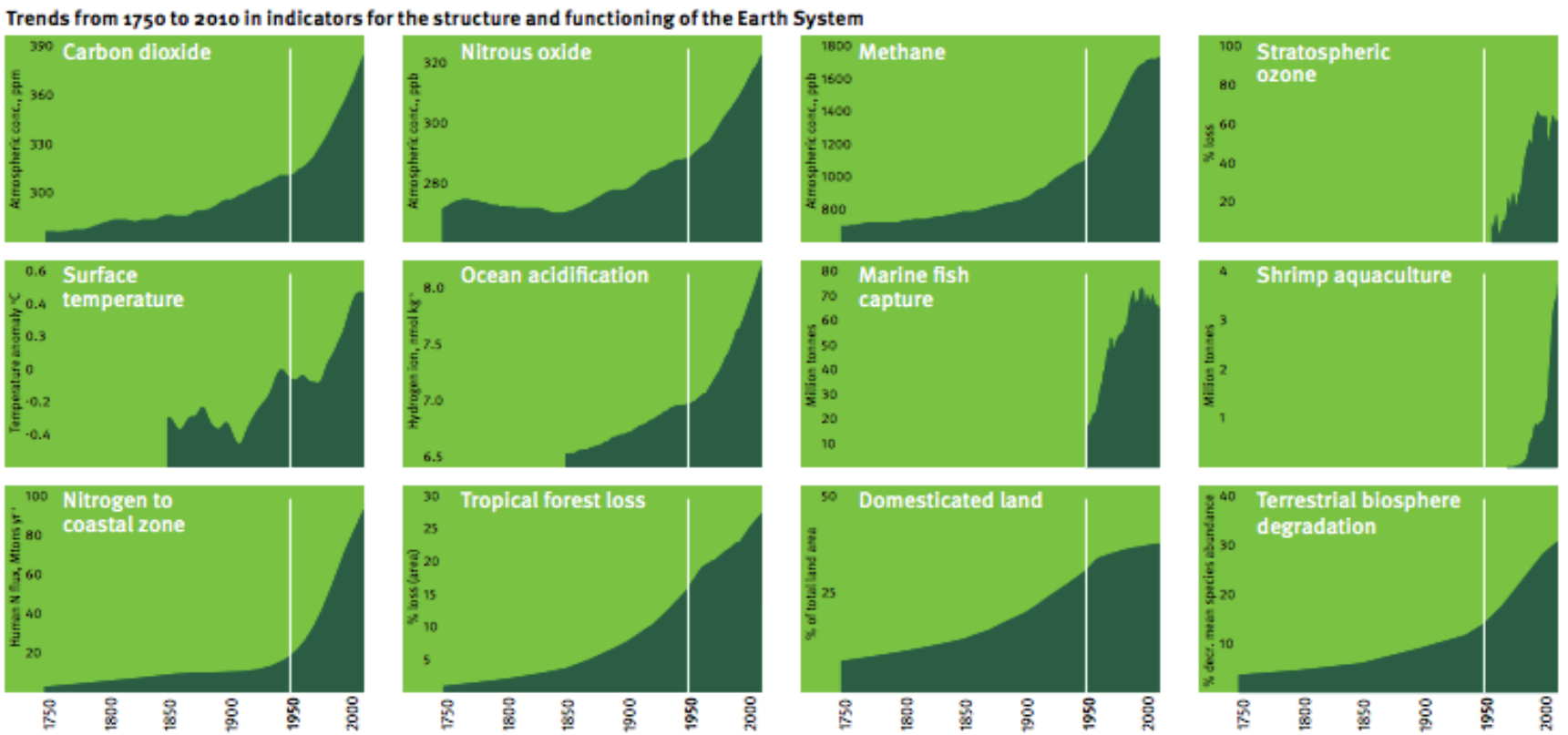
By 2050, 75% of the population will reside in cities. Cities are also a major engine for economic growth, as about 85% of global GDP is generated by cities today. Such rapid growth puts an enormous pressure on urban resources, carrying capacities, and quality of life.

https://www.ellenmacarthurfoundation.org/programmes/government/circular-cities-network

Impact of Socio Economic Development

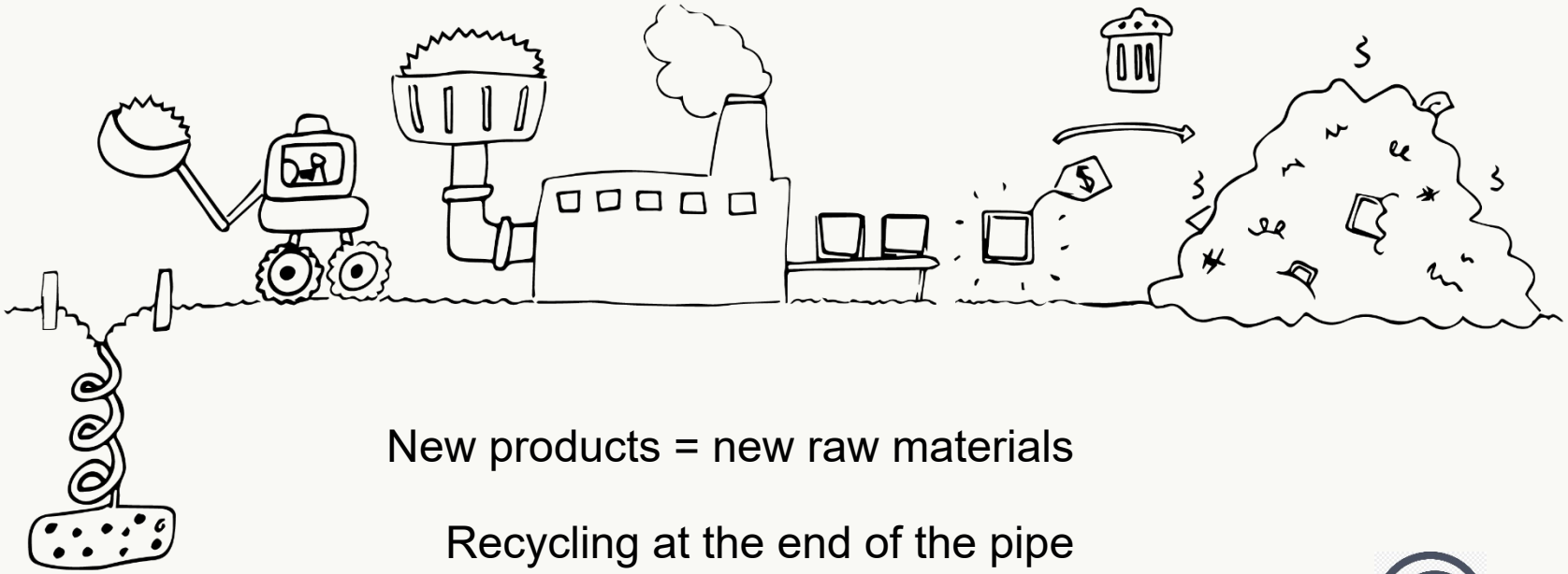


Impact on Living Systems



Images source: *The Anthropocene Review*, 2015

Today's Make-Dispose Economy



New products = new raw materials

Recycling at the end of the pipe

Waste is historically high

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ELLEN MACARTHUR FOUNDATION

A Combination of Risks and Opportunities

A further 3 billion middle-class consumers will enter the market by 2030 fueling demand ...

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ELLEN MACARTHUR FOUNDATION

A Model with Embedded Structural Losses

Faults in the linear model mean great economic losses and negative externalities

- Cars remain parked **92%** of the time
- When moving, they usually carry **1,5** people at a time
- **30.000** lives are lost in accidents and, 1 out of 4 times, this results in irreversible lesions

- **30%** of waste sent to landfill in Europe originates from construction (in Brasil, approximately **50%**)
- Offices are occupied only **40-50%** of the day on a working day
- **11 million** empty homes in Europe

- **>100Mi tonnes** of food lost annually in Europe
- **50%** lost along the production chain
- **97%** of global food residue is sent to landfill or **~USD 300bn**
- Soil degradation is around **30-80%** in Europe

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Drivers for Change

Various Factors Challenge the Linear Model

ECONOMIC AND STRUCTURAL LOSSES

PRICE VOLATILITY

DEMOGRAPHIC TRENDS

URBANISATION

ACCEPTANCE OF NEW BUSINESS MODELS

TECHNOLOGICAL ADVANCES

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Data-Driven Circular Economy

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Circular Economy

An Economy that is regenerative and restorative by design

…keeping products, components and materials at their **highest utility and value**, at all times

…**eliminating** the concept of **waste**, with materials ultimately re-entering the economy at end of use as defined, valuable technical or biological nutrients

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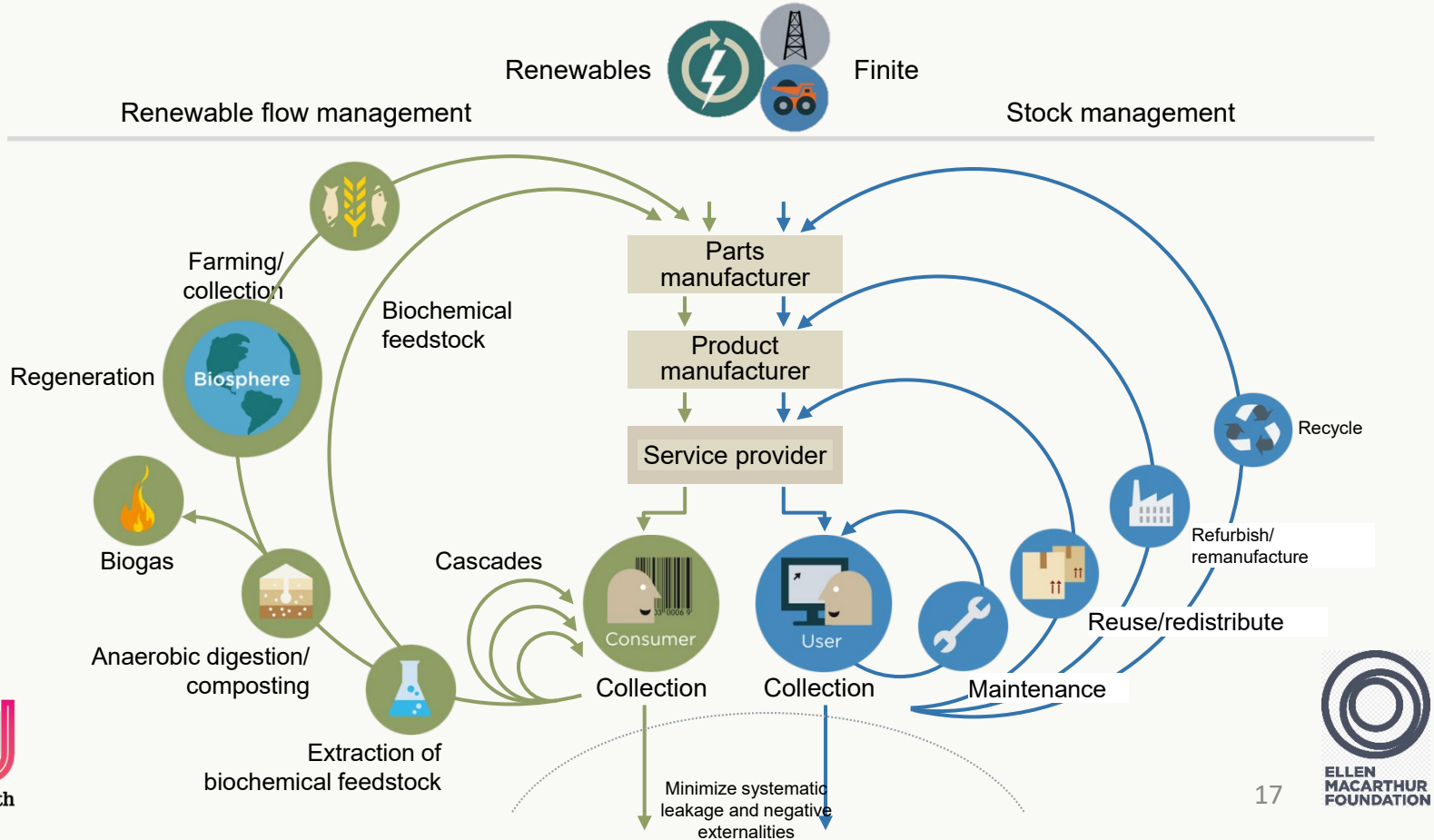
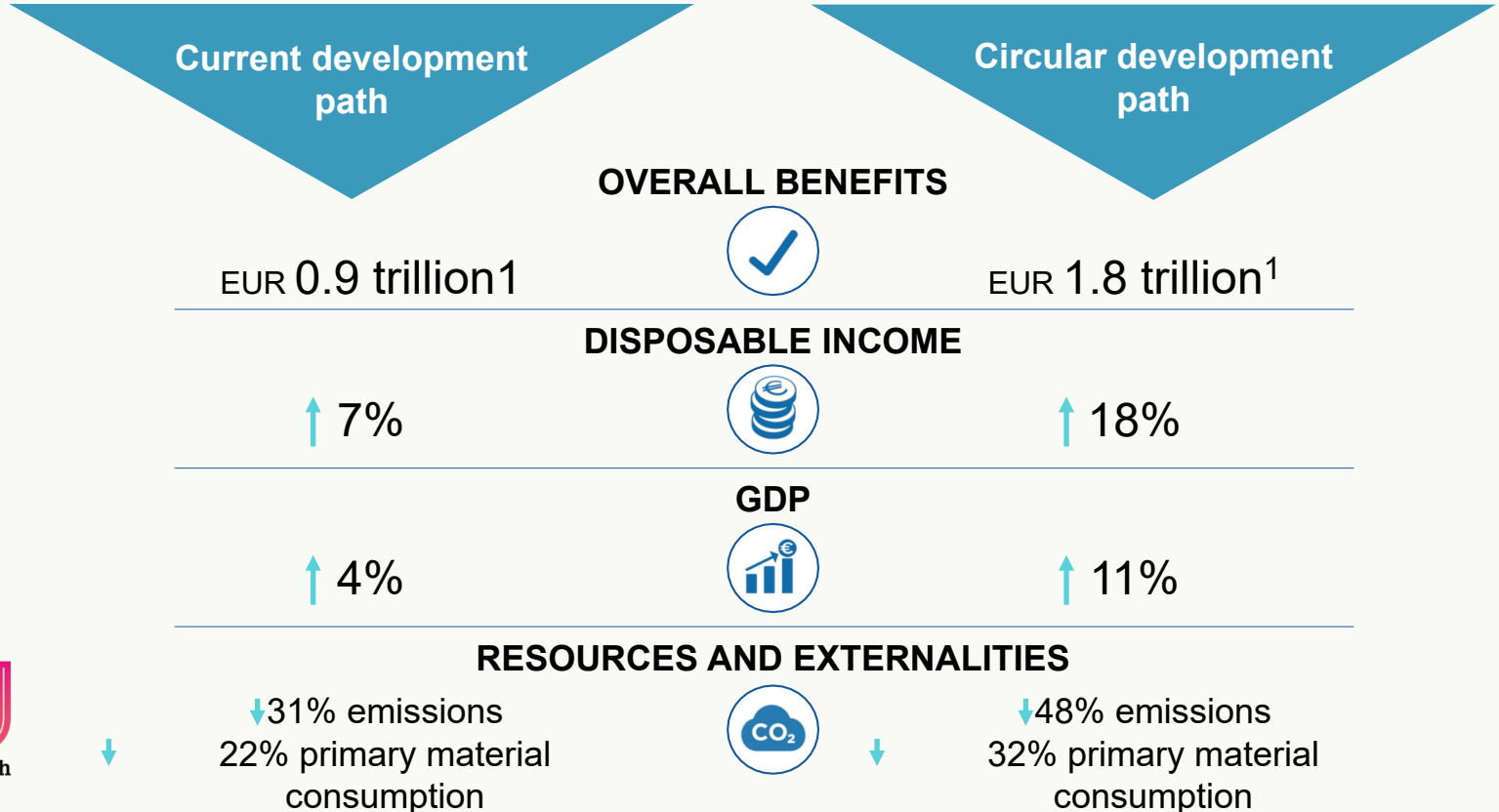
A Regenerative Economy by Design



The Compelling Business Rational

€1.8 tri in benefits for Europe by 2030 in mobility, food and the built environment



Key Enabling Technologies

The key concept of CE has been around since the 70's (focus on material sciences and production management). However, today the tech landscape is totally different.

Dense Data in Space and Time

- **Big Data**
- **Internet of Things (IoT)**
- Blockchain
- **Artificial Intelligence**
- Cloud
- Additive manufacturing (3D Printing)
- Robotics
- Virtual Reality
- Autonomous Vehicles (Man or Unmanned, Land or Air)

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THE RESOLVE FRAMEWORK

REGENERATE

- Shift to renewable energy and materials
- Reclaim, retain, and restore health of ecosystems
- Return recovered biological resources to the biosphere

Examples: P-REX, Nespresso, Iberdrola, SLM, Savory Institute

SHARE

- Share assets (e.g. cars, rooms, appliances)
- Reuse/secondhand
- Prolong life through maintenance, design for durability, upgradability, etc.

Examples: airbnb, patagonia, Nearly New Car by Mercedes-Benz, autolib', BlaBlaCar

OPTIMISE

- Increase performance/efficiency of product
- Remove waste in production and supply chain
- Leverage big data, automation, remote sensing and steering

Examples: Cisco, wrap, Toyota, BSB Broad Sustainable Building, The Vauban Quarter

LOOP

- Remanufacture products or components
- Recycle materials
- Digest anaerobic
- Extract biochemicals from organic waste

Examples: CAT, patagonia, Renault, Dell, Paques, Veolia, Winsun, mazuma mobile

VIRTUALISE

- Dematerialise directly, e.g., books, CDs, DVDs, travel
- Dematerialise indirectly, e.g., online shopping, autonomous vehicles

Examples: kindle, zalando, Cisco, Netflix, skype, Google, iTunes

EXPLORE

- Replace old with advanced non-renewable materials
- Apply new technologies (e.g. 3D printing)
- Choose new product/service (e.g. multimodal transport)

Examples: DESSO A Tarkett Company, Tesla, Beyond Meat, Philips Lighting, skyTran

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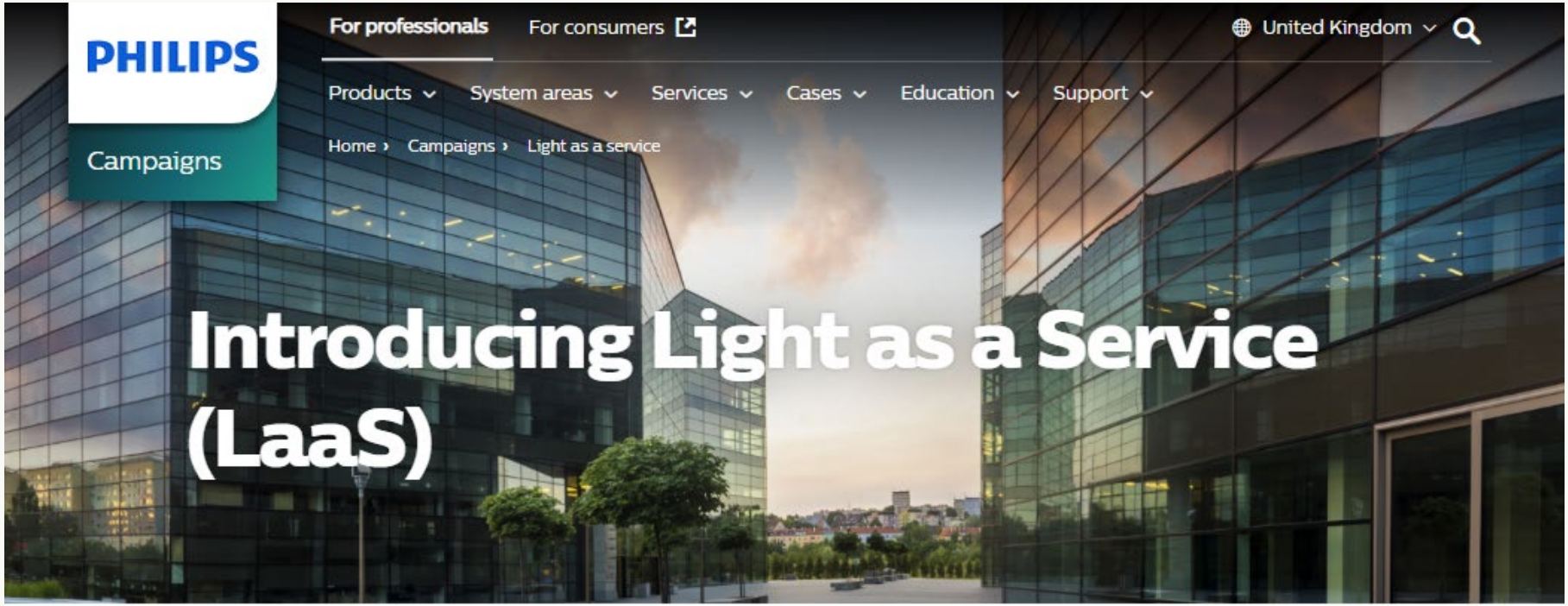
Examples

https://youtu.be/AYshVbcEmUc



Let your light pay for itself and cut energy costs instantly

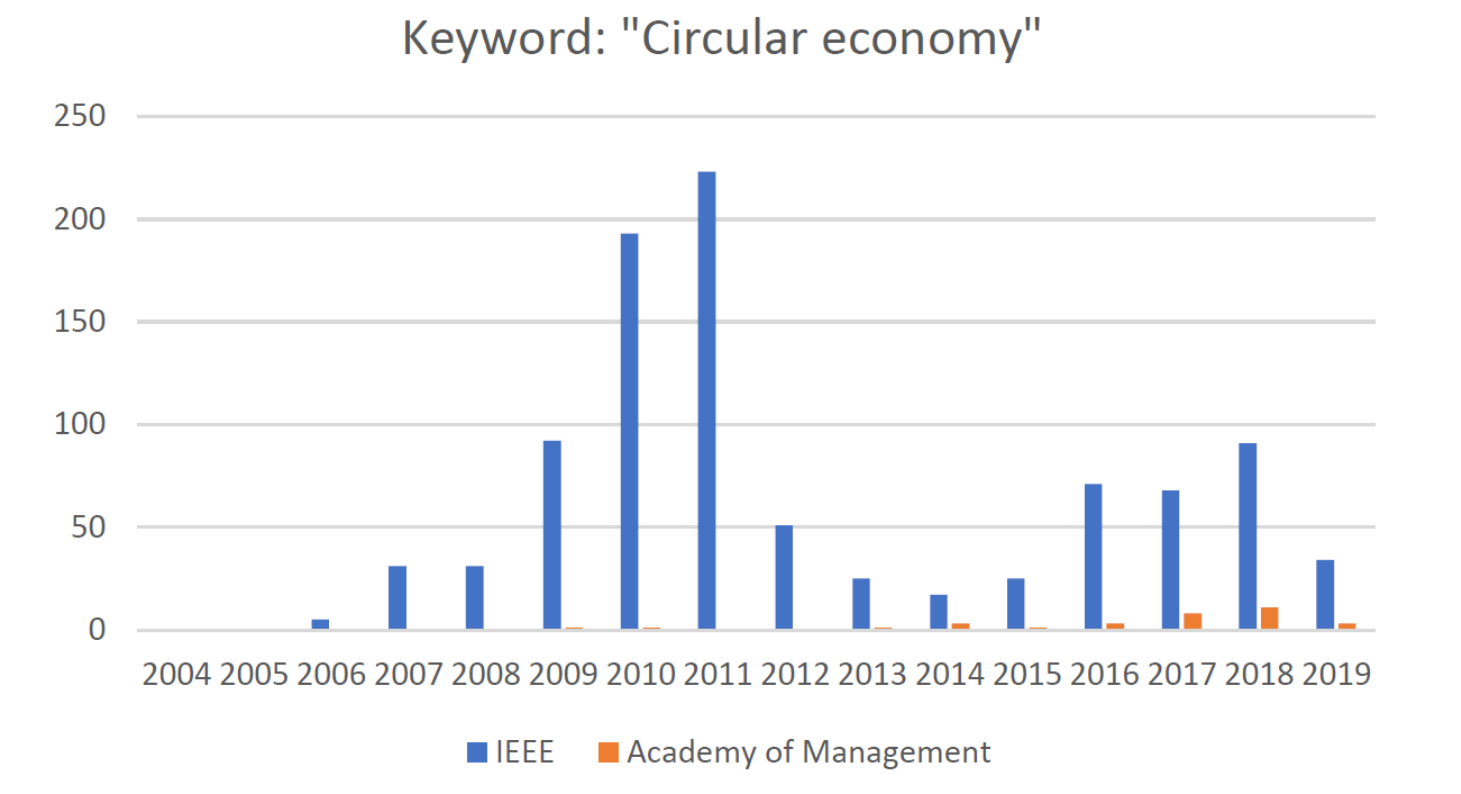
We designed Light as a Service (LaaS), a lighting solution that delivers instant energy savings with no upfront investment, a one- stop shop for performance, operations, maintenance & financing.

The Edge (Deloitte, Amsterdam)

- **The Edge** is the most Sustainable building in the world (98%)
- It includes a number of Innovations like **Light over Ethernet powered by LED system** and not from a traditional 230 Volt cable.
- The **32000 sensors** in the building enabled a tremendous data flow (big data)
- They have achieved a remarkable space optimisation given that approximately **35% of the offices** are empty during a working week
- Cleaning services are being **optimised** based on actual use of spaces Health has been also in the focus. **Airflow management** based on office occupancy and density.
- Heating is tweaked to a **precise degree** to be able conserve energy by detecting when spaces are unoccupied.
- **<u>Very important:</u>** The Edge is producing **10% more** energy than the one consuming

On-going Research

Publications on Circular Economy



Credit: Prof. David Langley; TNO – UoGroningen

Ideal Cities

Intelligence-Driven Urban Internet-of-Things Ecosystems for Circular, Safe and Inclusive Smart CITIES https://www.ideal-cities.eu/

"This project has received funding from the European Union's Horizon 2020 research and innovation staff exchange programme (RISE) under the Marie Skłodowska-Curie grant agreement No 777855"

Ideal-Cities Approach

Data-driven Circular Economy

Use cases:

1. Assisting the movement of the visually and mobility impaired

2. Increasing citizen safety through lifelogging

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IDEAL-CITIES – A Trustworthy and Sustainable Framework for Circular Smart Cities.
Angelopoulos, Katos, Kostoulas, et al. Smart Circular Economy, Santorini, 2019

Towards a Technological Framework

- **Internet of Things** will sense
- **The Edge** will react
- **Artificial Intelligence** will think
- **Blockchain** will remember

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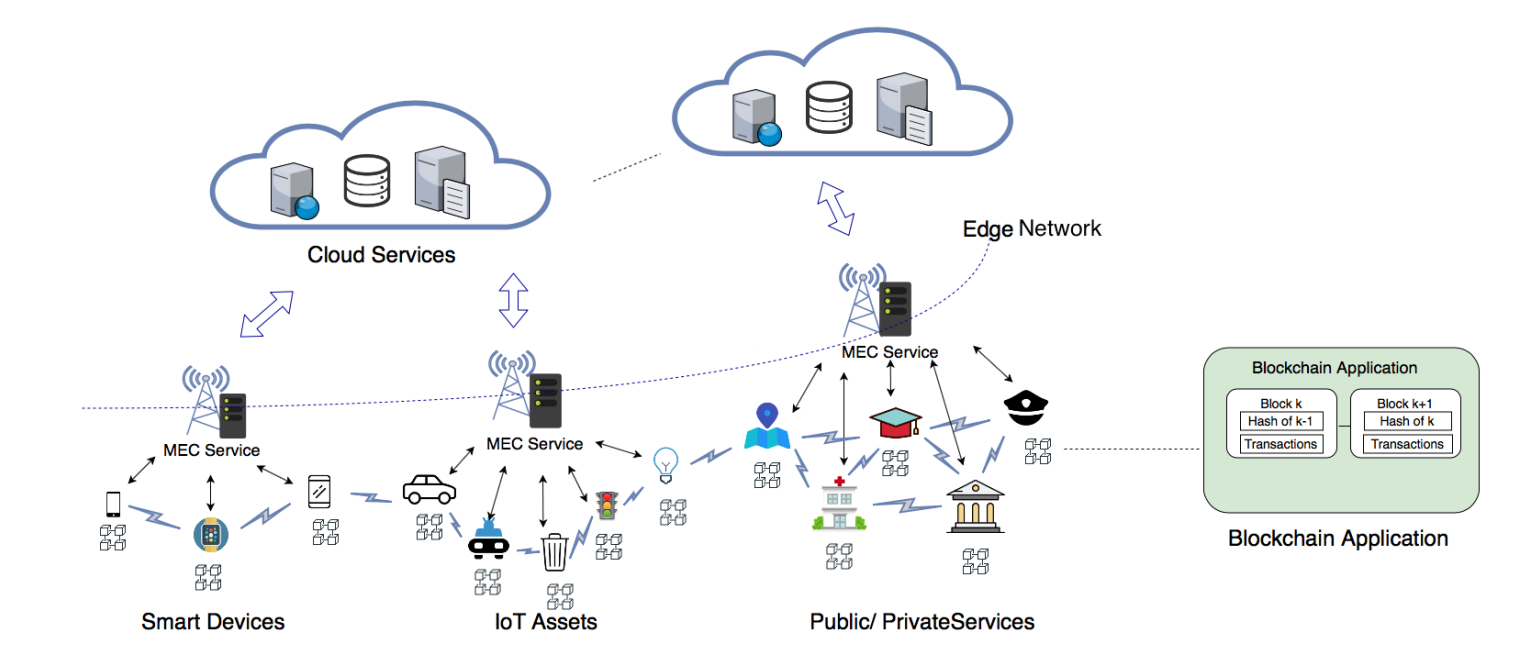
Towards a Technological Framework



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An Architecture for Blockchain over Edge-enabled IoT for Smart Circular Cities. Amalia Damianou, Constantinos Marios Angelopoulos and Vasilis Katos. Smart Circular Economy – SmaCE, Santorini, 2019

Research Agenda

Organising Committee

General Chair

Marios Angelopoulos, Bournemouth University, UK

Co-Chairs

Giorgos Demetriou, École des Ponts Business School, France

Sotiris Ioannidis, FORTH, Greece

Vasilis Katos, Bournemouth University, UK

Sotiris Nikoletseas, University of Patras, Greece

Khaled Soufani, University of Cambridge, UK

Main Community Challenges:

- To spur/engage the community
- To demystify emerging techs
- To bridge the language gap across disciplines

Main Research Challenges:

- To elicit the fundamental principles of Circularity
- Apply those on different domains
- To demonstrate added value creation

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Epilogue

Highlights

- Circular Economy proposed as a paradigm of sustainable economic development and growth
- Introduces economic incentives for eco-friendly practices
- Emerging technologies provide unprecedented access to Dense Data (space and time) => Data-driven Circular Economy
- Green field for interdisciplinary research

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Thank you.

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