THE CIRCULAR TRANSITION:
DEVELOPMENT OF A CIRCULAR ECONOMY MODEL FOR THE WASHING MACHINE INDUSTRY

PhD GIANMARCO BRESSANELLI
G.bressanelli002@unibs.it
University of Brescia – RISE Laboratory
Research & Innovation for Smart Enterprises

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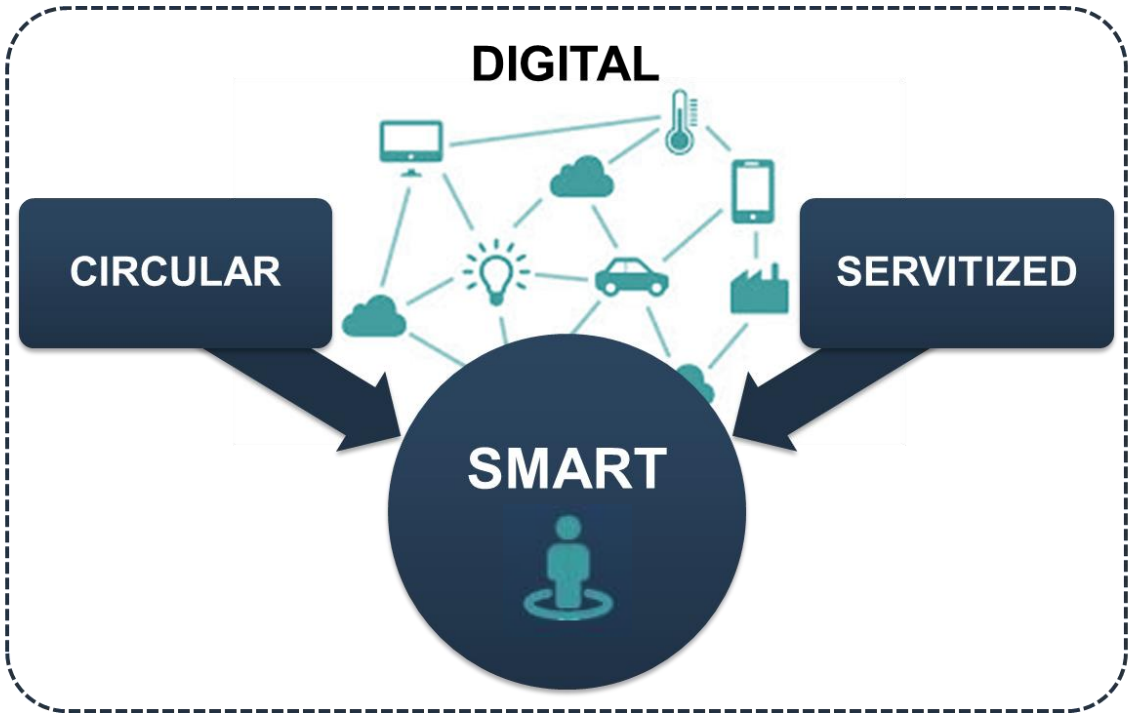
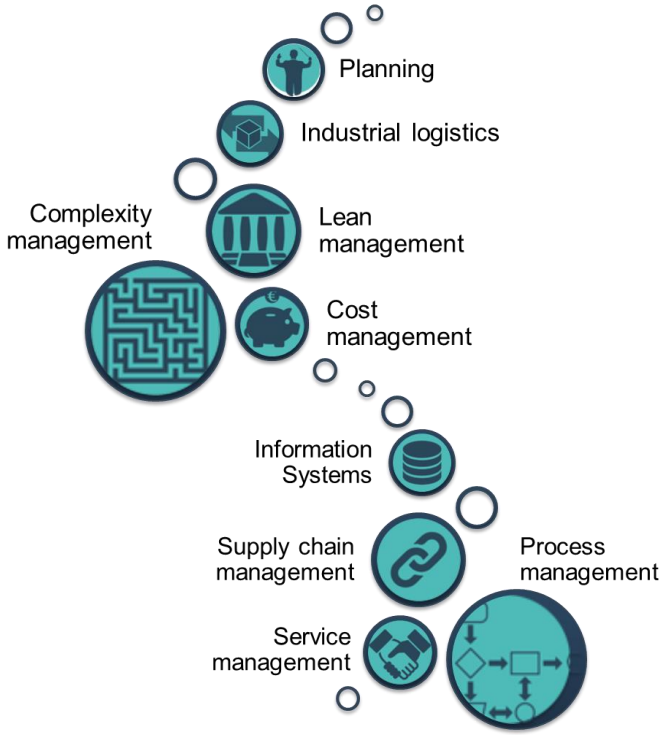
RISE LABORATORY @UNIVERSITY of BRESCIA

Our vision: we believe that the supply chain of the future will be *circular*, *digital* and *servitized*. Therefore we focus our research and dissemination activities mainly towards these three themes.



Our Vision ▲

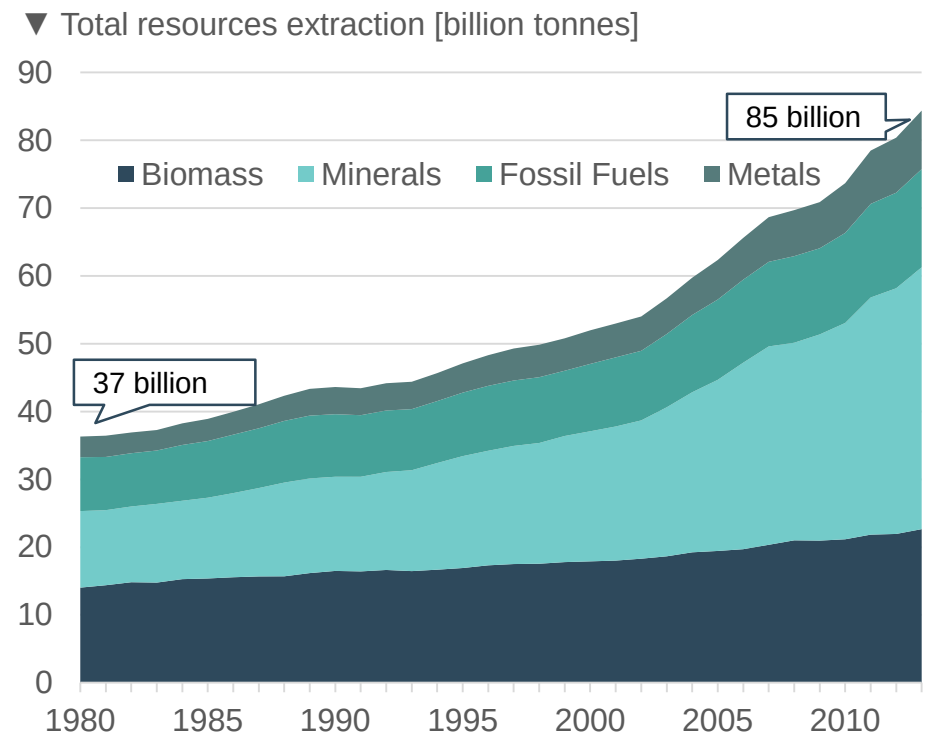


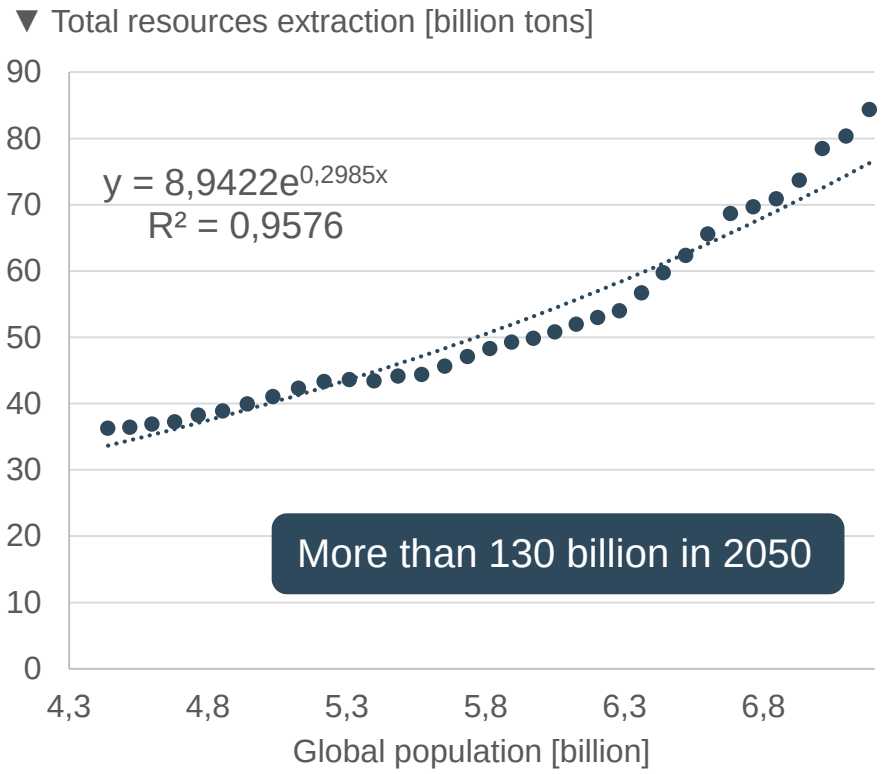
Our competences areas ▲

THE LINEAR CONSUMPTION
Limits and Constraints

The neoclassical model of production and consumption is **linear**:

- Economic growth is associated with materials and energy extraction





Source: Krausmann et al. 2009; UNEP 2011; SERI dataset 2015

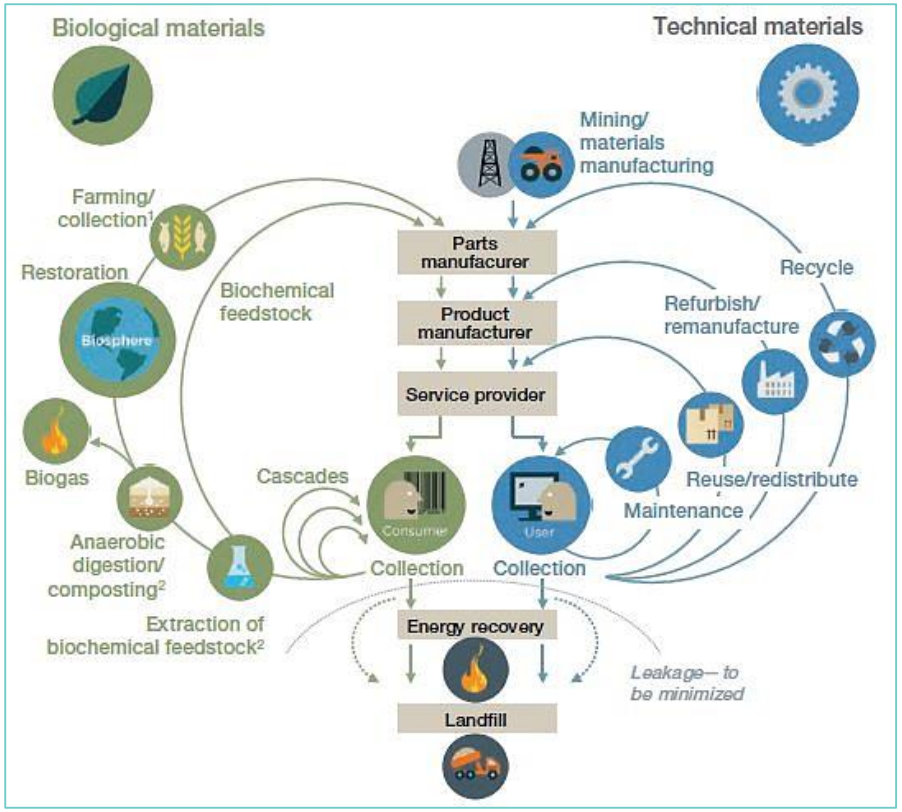
AN ALTERNATIVE
Circular economy

An economy restorative and regenerative by design, which aims to keep products, components and material at their highest utility and value at all times, distinguishing between technical and biological cycles.

Principle 1: Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows

Principle 2: Optimise resource yields by circulating products, components and materials at the highest utility at all times, in both technical and biological cycles

Principle 3: Foster system effectiveness by revealing and eliminating negative externalities



Source: Ellen MacArthur Foundation, 2015; Braungart et al, 2002

HOW CIRCULAR ECONOMY WORKS
Four levers

Circular Design

- Material choice
- Design to last
- Standardisation
- Modularisation
- Easier disassembly

Business Models

- From consumer to user
- Servitization
- Access over ownership
- Product-Service Systems

Reverse Logistics

- Reverse supply chain
- Collection systems
- Treatment methods
- Remarketing

System Enablers

- Technologies (IoT, 3D Printing, Cloud…)
- Collaboration (cross cycle and cross-sector)
- Policy, Education

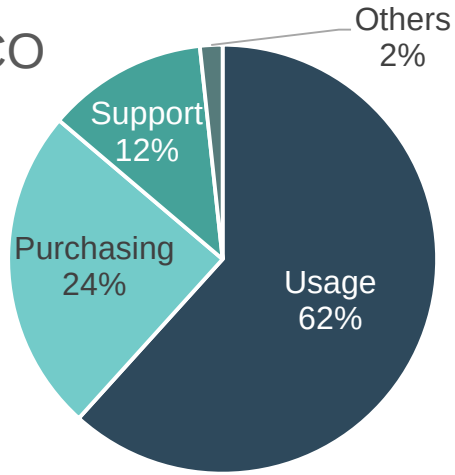
Source: Ellen MacArthur Foundation, 2012; Lewandowski, 2016; Planing, 2016

OBJECTIVE OF THE DOCTORAL PROJECT

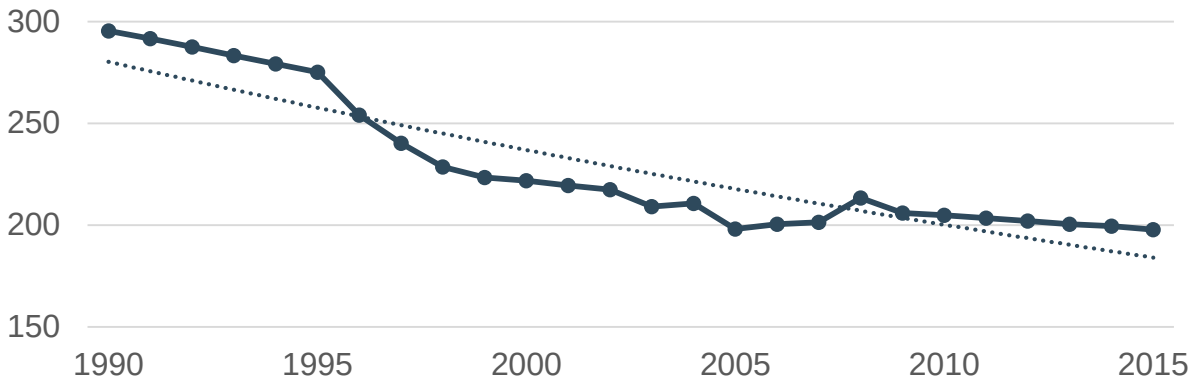
- Focus on household washing machines (WEEE category 1 – Large Household Appliances)
- Simulate the effects of several circular scenario - what-if analysis
- Demonstrate
  - Economical outcomes (for both users and manufacturers)
  - Environmental impacts
  - Social benefits

WHY WASHING MACHINES

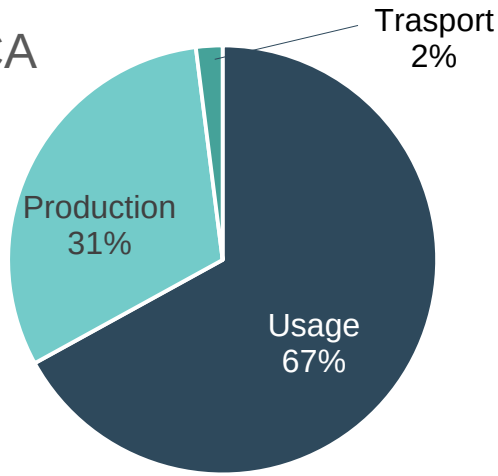
TCO



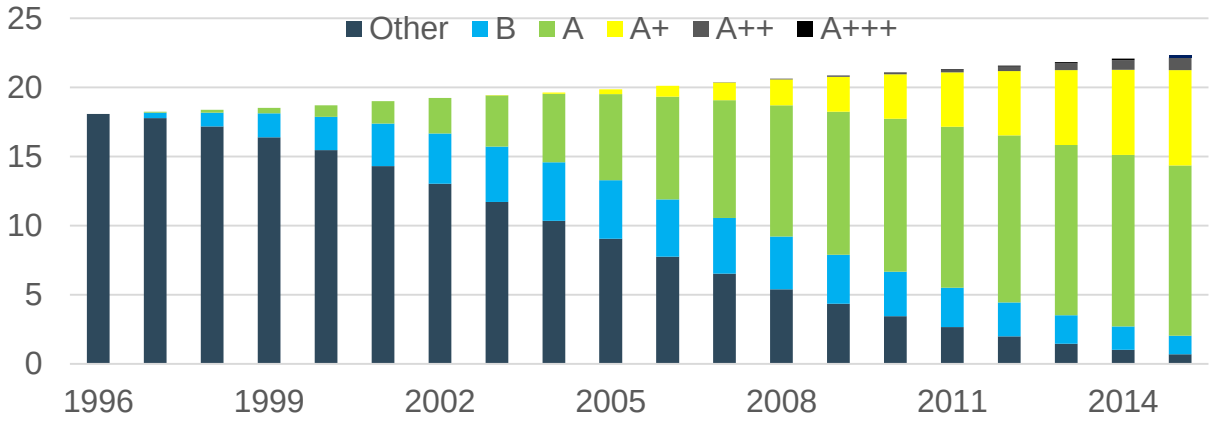
▼Energy consumption of new washing machine [kwh/year]



LCA



▼ Total UK installed stock [million]



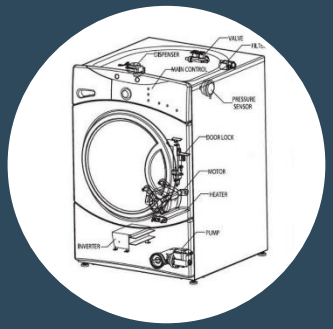
Sources: Saccani et al, 2017; Devoldere et al, 2009; National Statistics UK, 2016

WASHING MACHINES
Critical Raw Materials

20 raw materials were identified as critical by the EU:

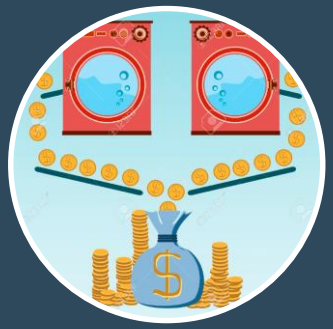
Sources: Report on CRM for the EU, 2014; Garcia, 2013

ACTIONS FOR RESHAPING WASHING MACHINES SECTOR



Circular Design

- Design for durability
- Design for disassembly
- Design for EOL
- …



Business Models

- Sharing
- Pay per use - performance
- Leasing of refurbished appliances
- …

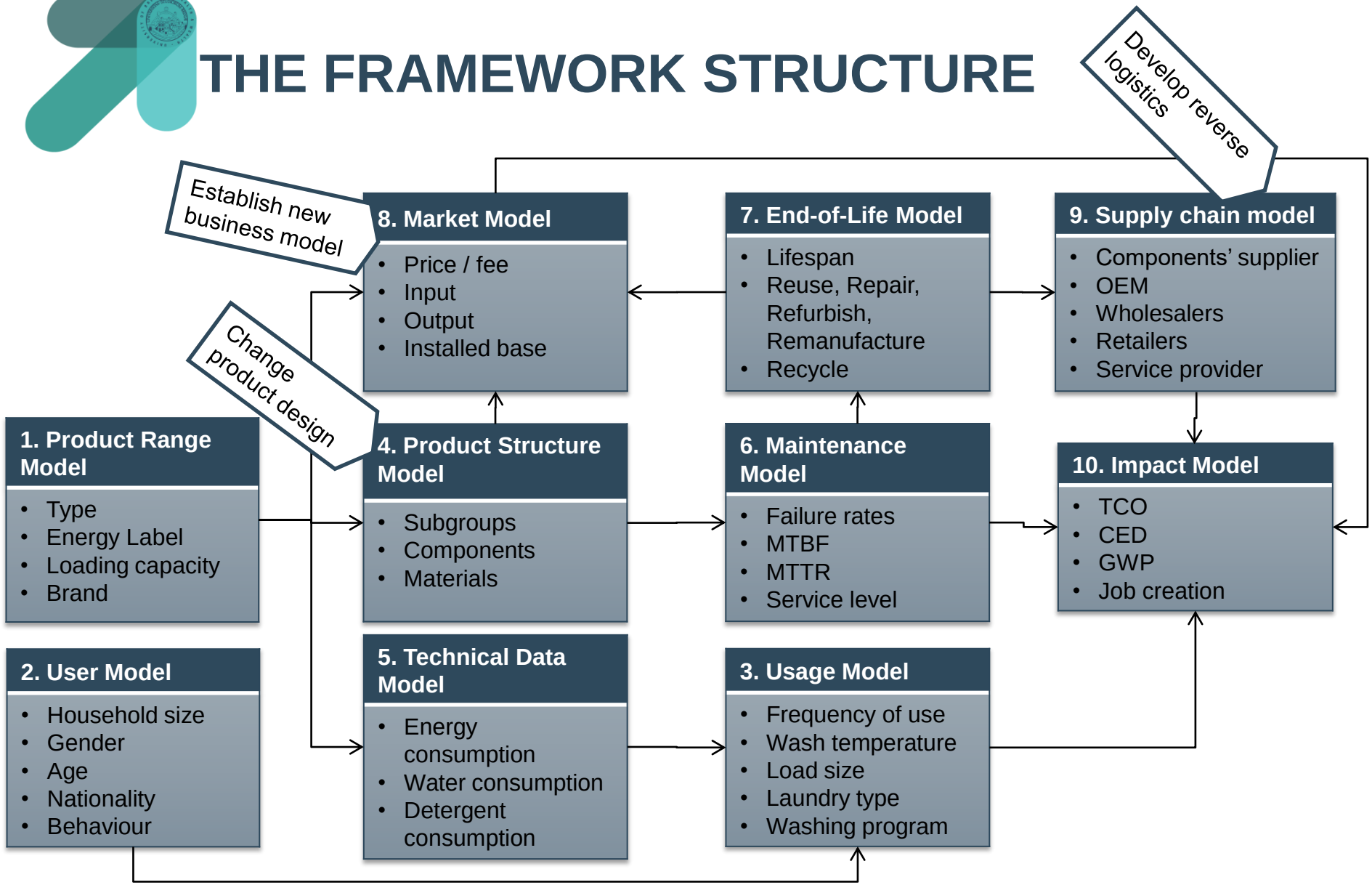
Reverse Logistics

- Collection
- Treatment methods
- Remarketing activities
- …

Technology as enabler

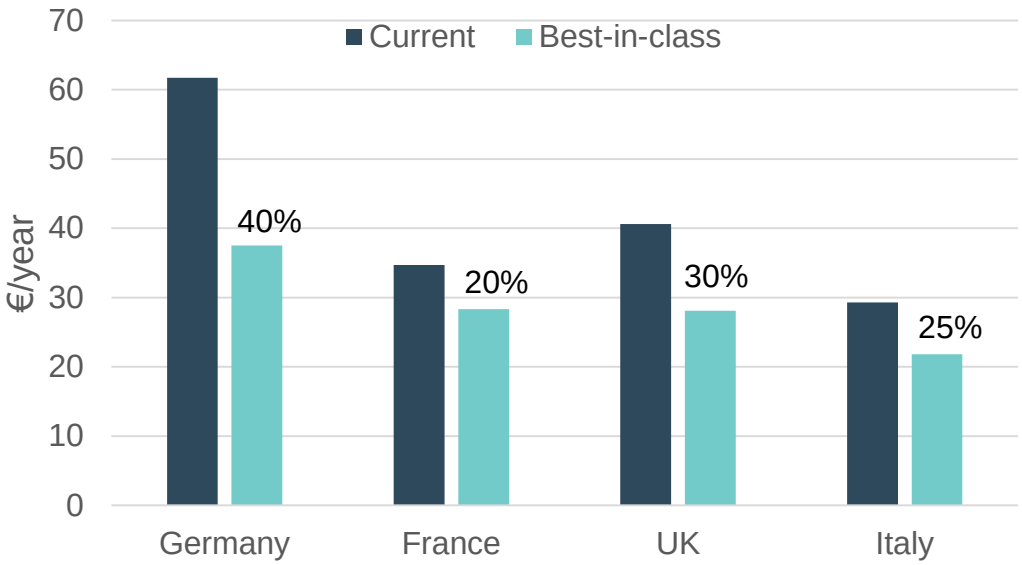
- Internet of Things
- Cloud support
- Big Data and analytics
- …

THE FRAMEWORK STRUCTURE

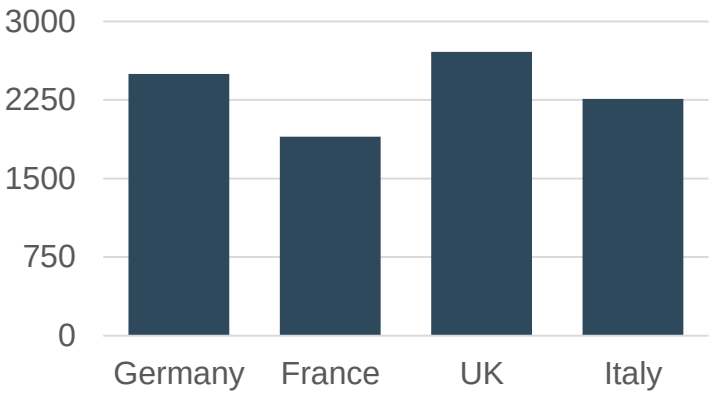


SOME (PRELIMINARY) FINDINGS

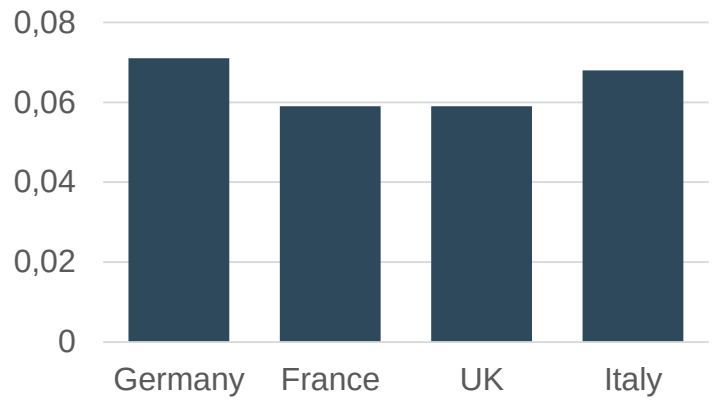
▼Reduction in water and energy costs for a single household



▼Total energy saving [Gwh/year]



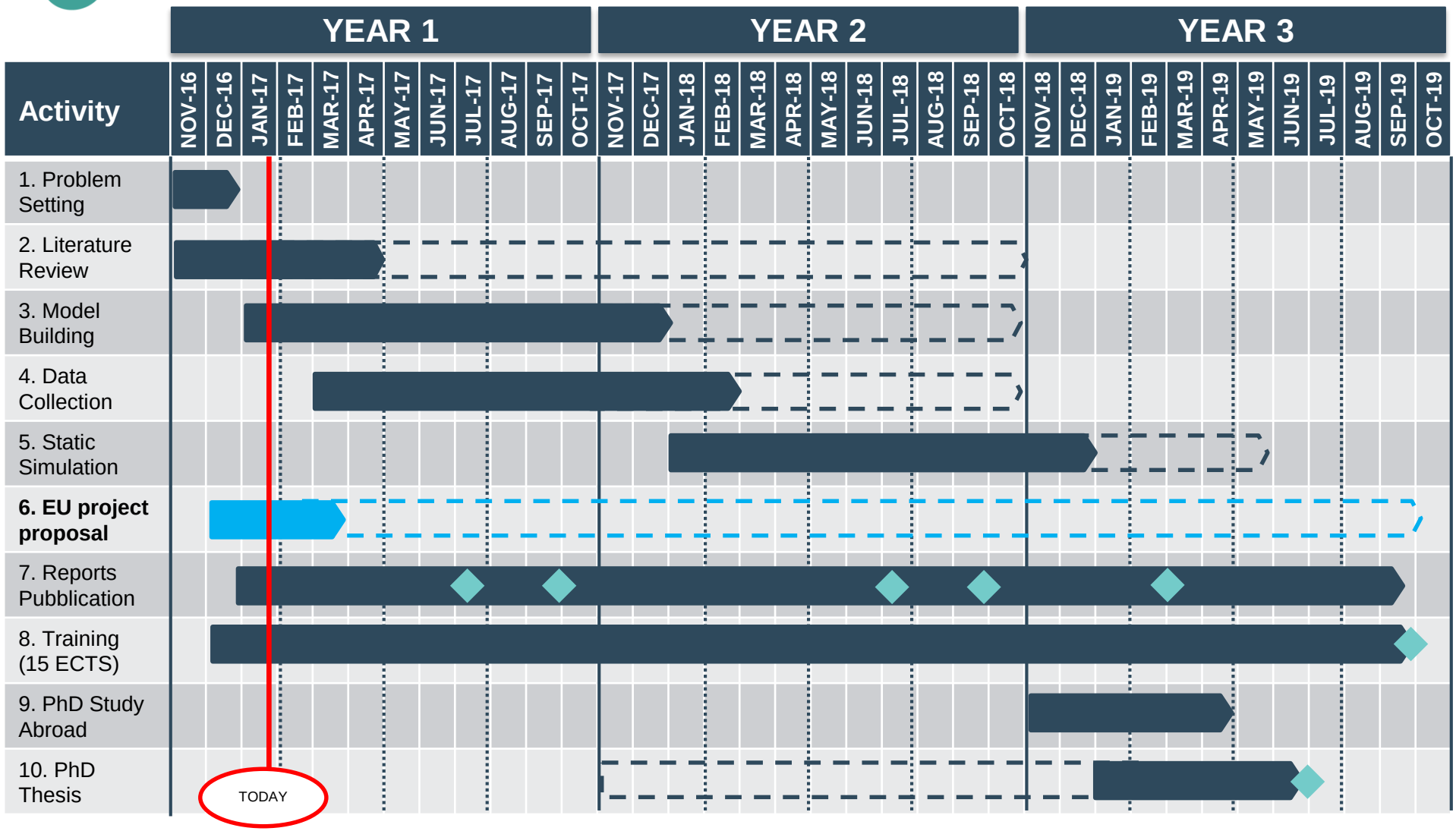
▼Total water saving [km^3/year]



- About 0.6% of the total electricity generation
- About 1.0% of the total water abstraction

Source: own calculation based on Pakula and Stamminger, 2010; Eurostat, 2015

NEXT STEPS


YEAR 1
YEAR 2
YEAR 3
Activity
NOV-16
DEC-16
JAN-17
FEB-17
MAR-17
APR-17
MAY-17
JUN-17
JUL-17
AUG-17
SEP-17
OCT-17
NOV-17
DEC-17
JAN-18
FEB-18
MAR-18
APR-18
MAY-18
JUN-18
JUL-18
AUG-18
SEP-18
OCT-18
NOV-18
DEC-18
JAN-19
FEB-19
MAR-19
APR-19
MAY-19
JUN-19
JUL-19
AUG-19
SEP-19
OCT-19
1. Problem Setting
2. Literature Review
3. Model Building
4. Data Collection
5. Static Simulation
6. EU project proposal
7. Reports Pubblication
8. Training (15 ECTS)
9. PhD Study Abroad
10. PhD Thesis
TODAY

UNIVERSITY OF BRESCIA
RISE LABORATORY
Research & Innovation for Smart Enterprises

Thank you for your attention!

RISE Laboratory – Research & Innovation for Smart Enterprises
Department of Mechanical and Industrial Engineering – University of Brescia
Via Branze, 38 – 25123 BRESCIA (ITALY)
www.rise.it - info@rise.it - +39 (030) 3715.556

CONTACT

Gianmarco Bressanelli
G.bressanelli002@unibs.it

- Member of the Laboratory RISE since 2016
- Ph.D. Student in Design and management of integrated production and logistic systems at University of Brescia
- MSc Degree in Industrial Engineering at the University of Brescia (September 2016)

https://www.linkedin.com/in/gianmarco-bressanelli-15415912b

https://www.researchgate.net/profile/Gianmarco_Bressanelli