WP 4
Deliverables
D4.1: Policy Briefs on best practices for green procurement, on plastic, on wood and other supply chains (1 per year: M12/M24/M36)
D4.2 - Scale up of prototypal ESG stakeholder participated approaches for SMEs entering public procurement; Guidelines (M36)

Logo

Research Lines

- (i) empirical analysis on different scoring auctions adopted by Italian PBs for green public procurement, comparison with state-of-the-art international best practices; EcoStep; School Canteen Pagnozzi/ Pacelli/ Russo/Orazzo (Unina); Spagnolo (Uni TorVergata); Valbonesi/Bafundi/Camboni (Unipd)
- (ii) analysis on factors affecting SMEs participation to public tenders for environmentally sustainable purchases; (iii) measurement of SMEs' participation in sustainable procurement; (v) development of policy rules fostering the development of bottom-up part participated approach to ESG rating from SMEs; Piga/Fazio (Uni Tor Vergata); Valbonesi/Bafundi/Camboni (Unipd)
- (iv) measurement of environment friendly approach to support circular economy in Italian productive sectors; survey and experiments (Bettiol/Danese – Unipd)
- (vi) empirical assessment of the carbon footprint from plastics' supply chain – Gross/Mazzi (DISC – Unipd), Intesa
- (vii) empirical assessment of carbon sequestration from wood products supply chain – Pettenella/Gatto (Unipd/TESAF)

Milestones

- Empirical analysis on standardized green procurement mechanisms **(M08)**
- Online surveys on sustainable supply chain e. plastic and domestic wood chain) and sustainable procurement access **(M18)**
- Small firms Empowerment Program. Enlargement of existing database of ESG rating of SMEs entering public procurement. Empirical analysis. **(M24)**

Targets

- **Release of a dataset on indicators for best practices for sustainable and green procurement (M12).** Policy briefs (1 per year, M36)
- **Release of a dataset on indicators for best practices to reduce CO2 emission from plastic sector, wood supply chain, data center and energy intensive business (M24).** Policy briefs (1 per year, M36)

1 st Spoke Meeting - Padova

GRINS FOUNDATION

GREENING SUPPLY CHAINS: INDIVIDUAL EFFORTS V. JOINT COMMITMENTS

MARCO BETTIOL & GIUSEPPE DANESE

dSEA DIPARTIMENTO DI SCIENZE ECONOMICHE E AZIENDALI 'MARCO FANNO'

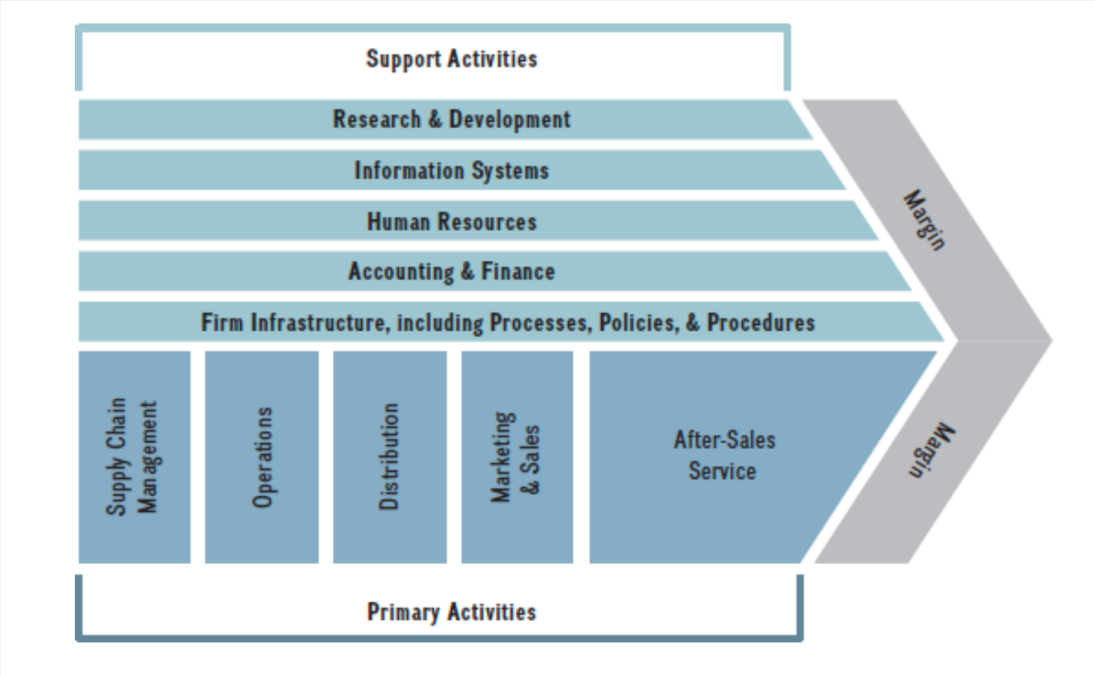
UNIVERSITÀ DEGLI STUDI DI PADOVA

Finanziato dall'Unione europea NextGenerationEU

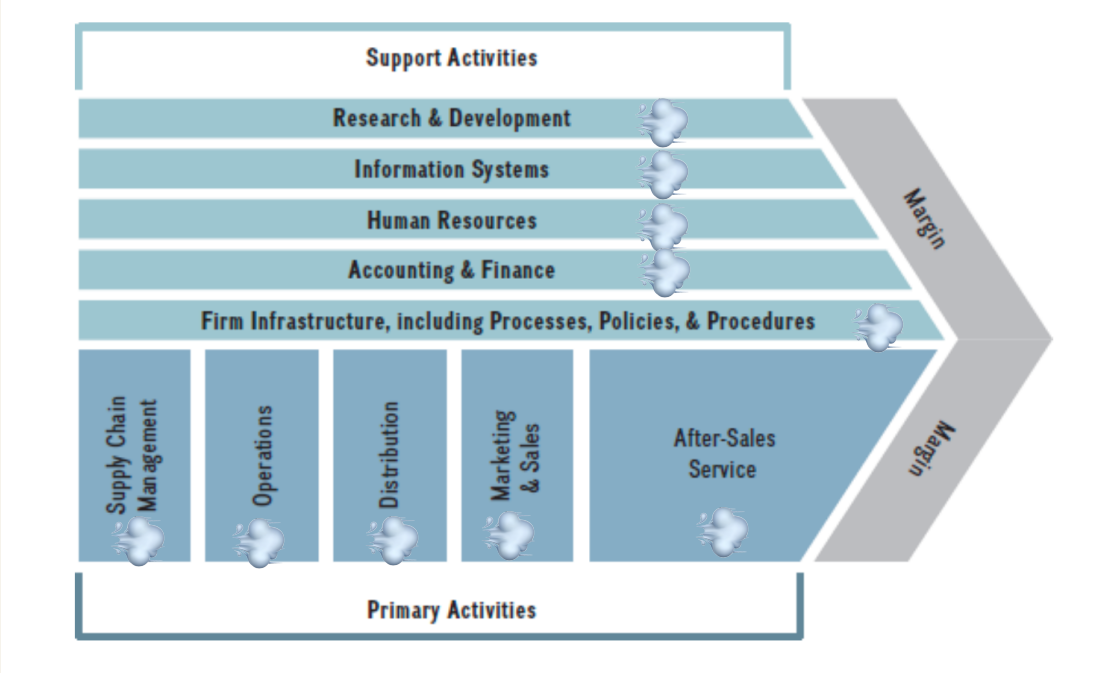
Ministero dell'Università e della Ricerca

Italiadomani

THE VERTICAL CHAIN: A SEQUENCE OF VALUE-ADDING ACTIVITIES



THE VERTICAL CHAIN: A SEQUENCE OF EMISSION-ADDING ACTIVITIES



"VERTICAL CHAIN DILEMMAS"

- "Social dilemma"… on a smaller scale
- Scope 3 emission management crucial: ESRS, CSRD and CBAM
  * emission accounting "from cradle to …." (eliabilities, Kaplan-Ramanna)
- "Restraint" needed:
  - Behavioral research on social dilemmas and common pool resources
  - Emissions as a "supply chain bad" requiring governance

Our plan for Amelia

- A survey in 2 parts
- Web-scraping + website mining
- Financial data (AIDA/Orbis)
- Social and environmental life cycle assessments

A rich snapshot of Italian SMEs

THE SURVEY/1

1,500 ITALIAN SMEs (MANUFACTURING)

- ✓ ID
- ✓ GPP
- ✓ Strategy
- ✓ Circular economy
- ✓ Mitigation

1. Scope 1
2. Scope 2
3. Scope 3

- ✓ Adaptation
- ✓ Industry 4.0

THE SURVEY/2

300 ITALIAN SMES (RECALLED FROM PHASE 1)

1. Supply chain "structure": which one is yours?
2. Effectiveness of interventions
3. A simple gain of emissions (after Holt et al.'s "tragedy of the common canal")

- A sequential game of "carbon release"
- Once a carbon-intensity threshold is exceeded, an environmental bottleneck arises (product too "dirty," price too high because of CBAM)

Best practices and future scenarios

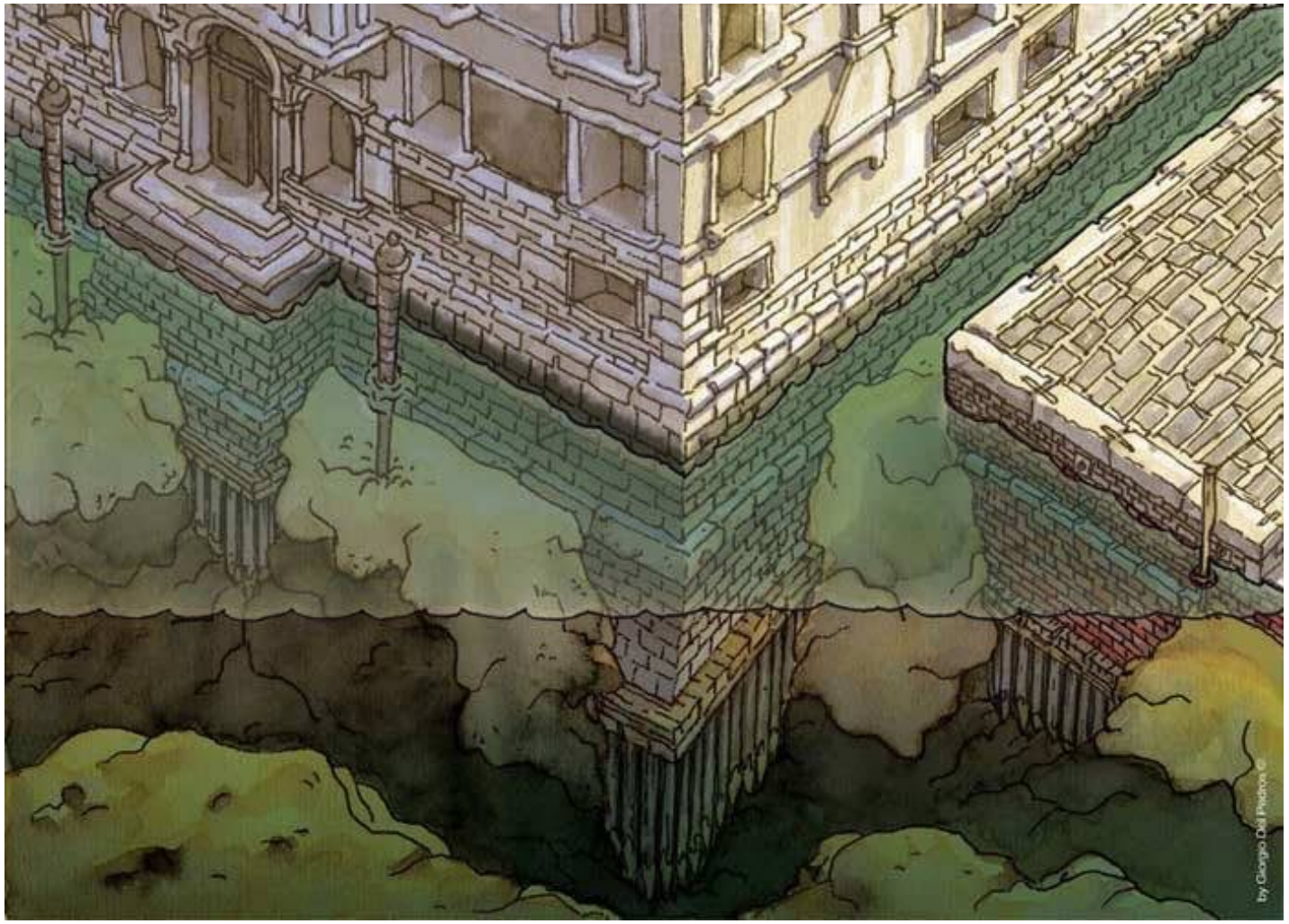
Data Centers Sustainability

Marco Bettiol

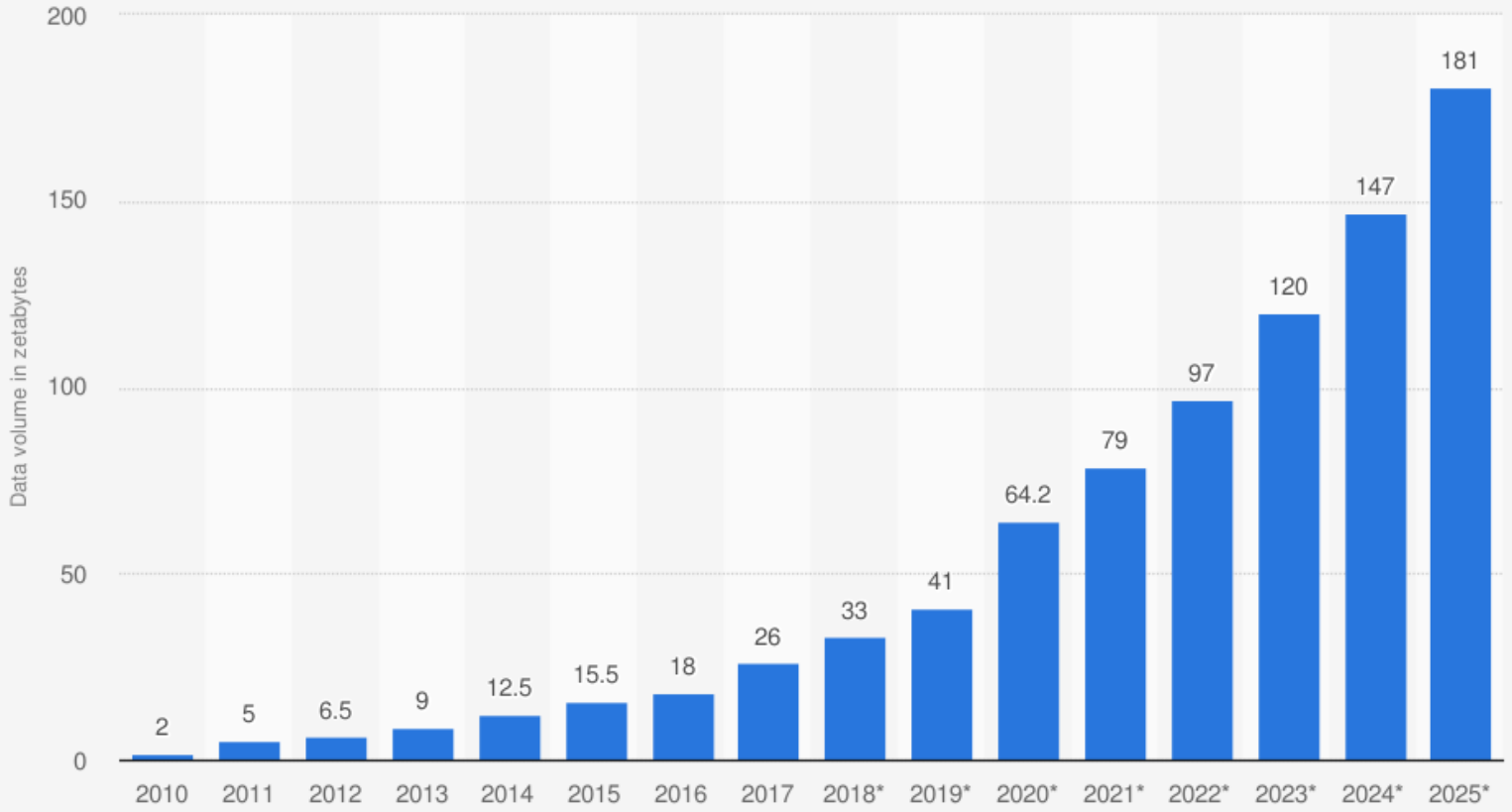
University of Padova &DSEA

Padova, 20 December 2023

Under the hood of cloud computing



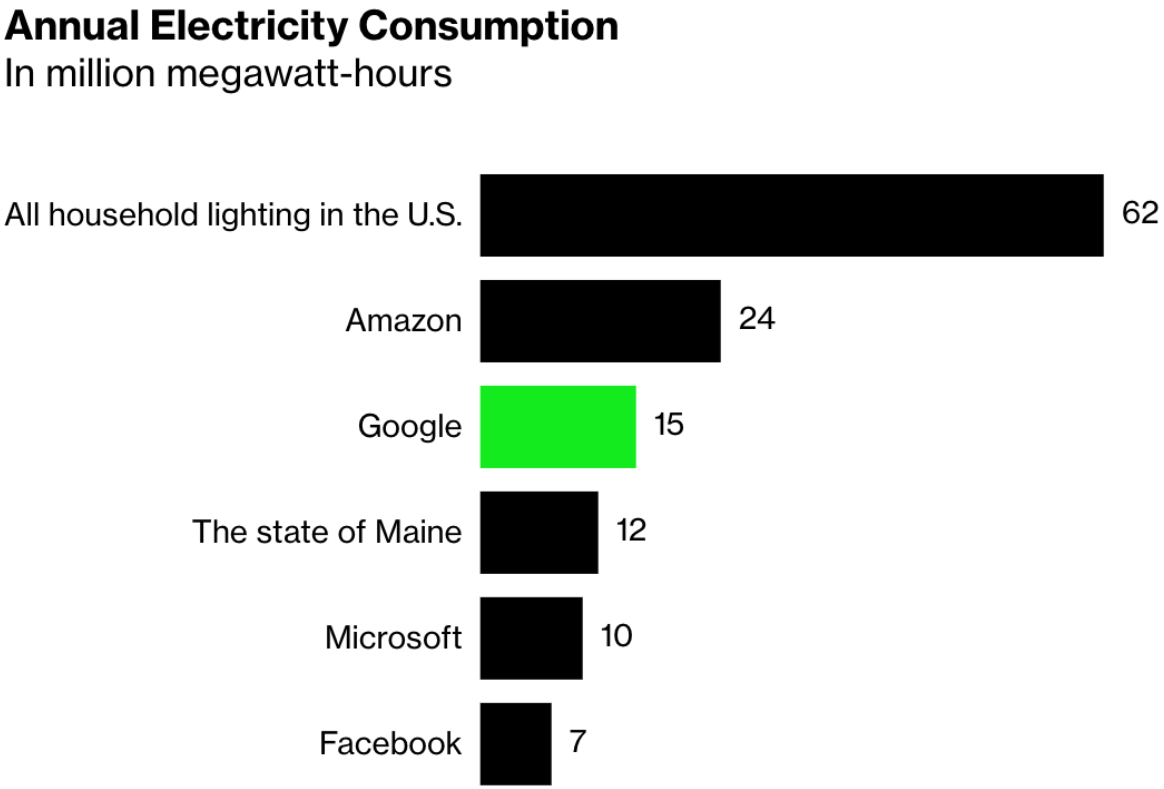
Volume of data/information created, captured, copied, and consumed worldwide from 2010 to 2025 (in zettabytes)



Sources
IDC; Seagate; Statista estimates
© Statista 2021

Additional Information:
Worldwide; 2010 to 2020

Electricity consumption



Maine electricity consumption is for 2019; all other figures are for 2020
Source: Company sustainability reports; Energy Information Administration

Source: Bergen, 2022

Objectives

- Analyze the initiatives of European Data Centers (DT) on environmental sustainability (EV)
- Identify DT managers' priority in terms EV
- Define metrics and actions to improve the sustainability of DT

Obstacles on the way

- Data centers is a relatively new and overlooked industry in the management field
- We could not find recommendation on actions or best practice to follow unless in the grey literature (European Union Join papers, industry association initiatives)
- Large digital companies shape the evolution of data center and have high level of secrecy (no data is available, no disclosure of information)

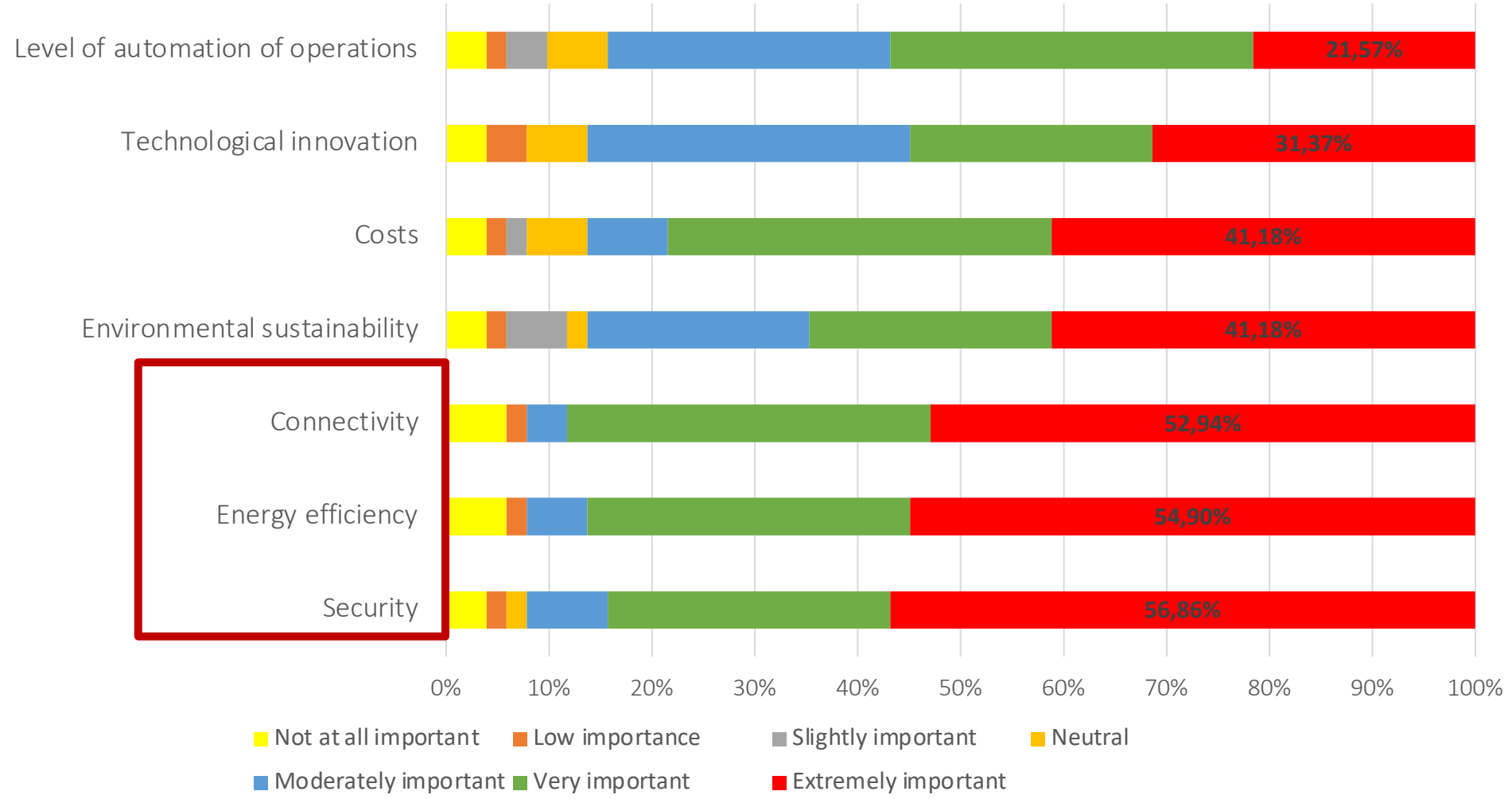
Our research strategy

- Survey on DT managers in Europe
- Text analysis of website of the DT in Europe

The methodology

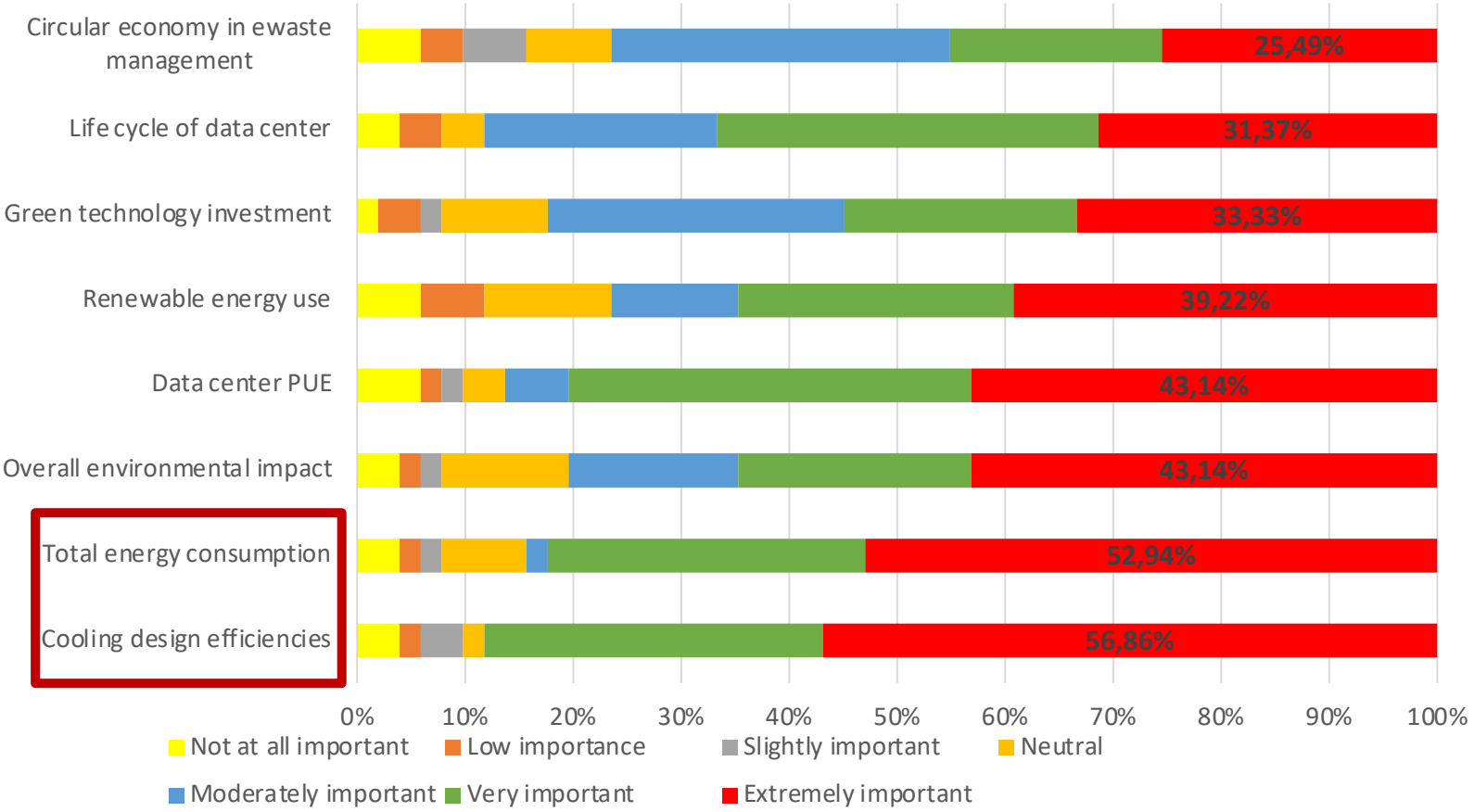
- We obtained the list of 549 data centers from different sources/databases:
  1. https://www.datacentermap.com
  2. https://www.impresaitalia.info;
  3. list of companies that are part of the European Data Centre Association (EUDCA);
  4. https://cispe.cloud/members (CISPE's members101);
  5. https://sciencebasedtargets.org/companies-taking-action
- Online questionnaire targeted to managers/owners of DC
- **74 data centers answered** (13%)

Design principles in DC

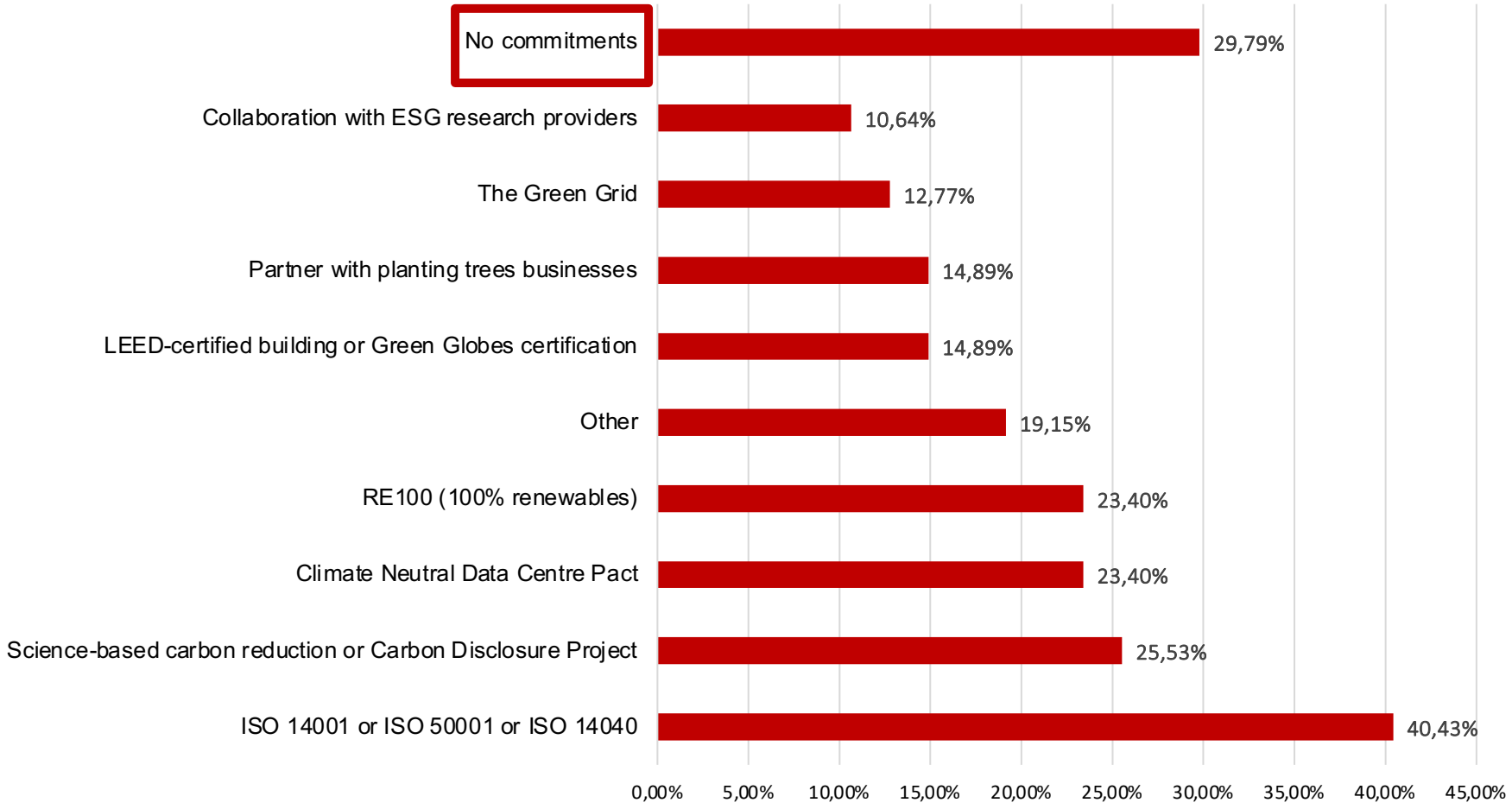


N=51

Green factors in DC design

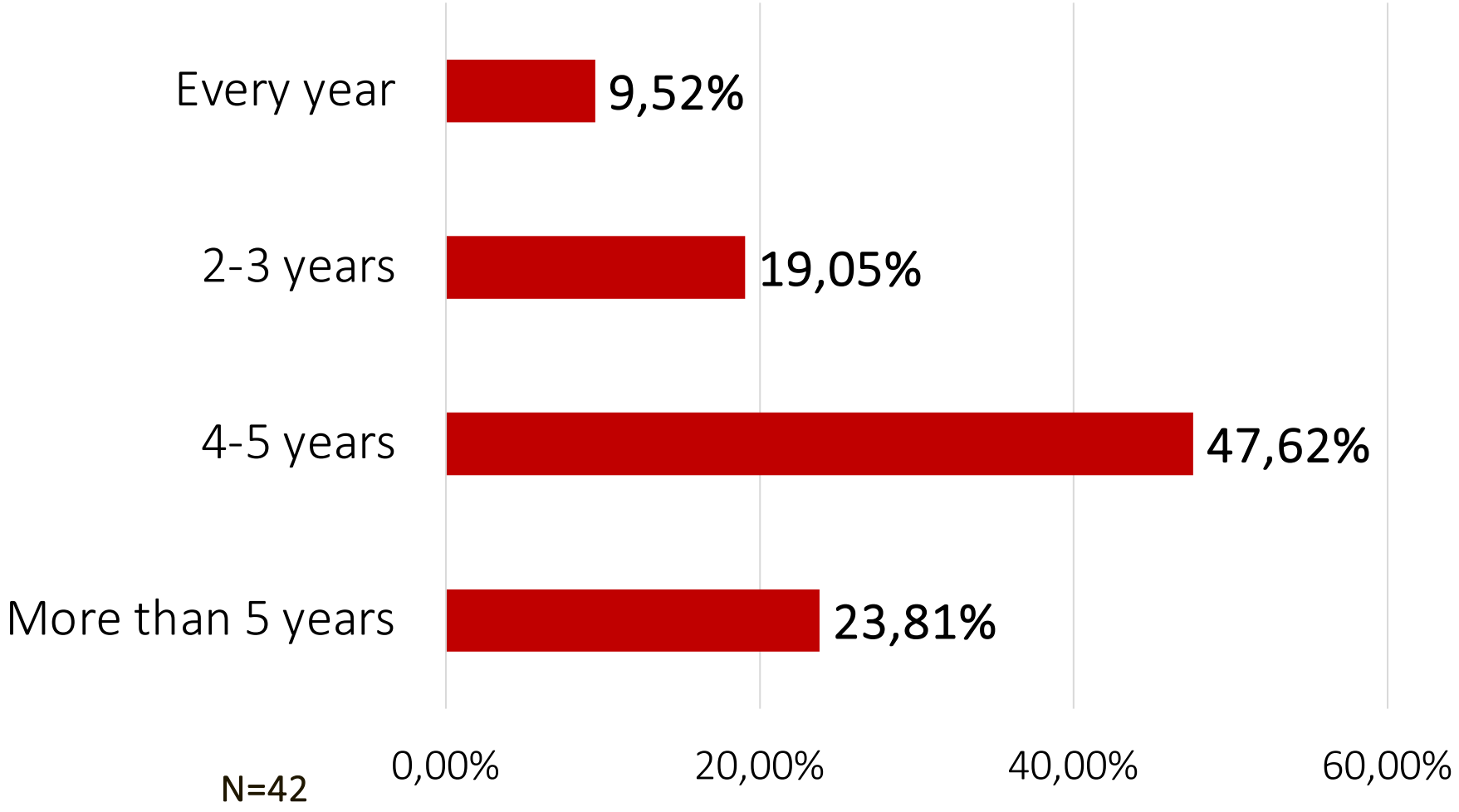


Commitments on ES

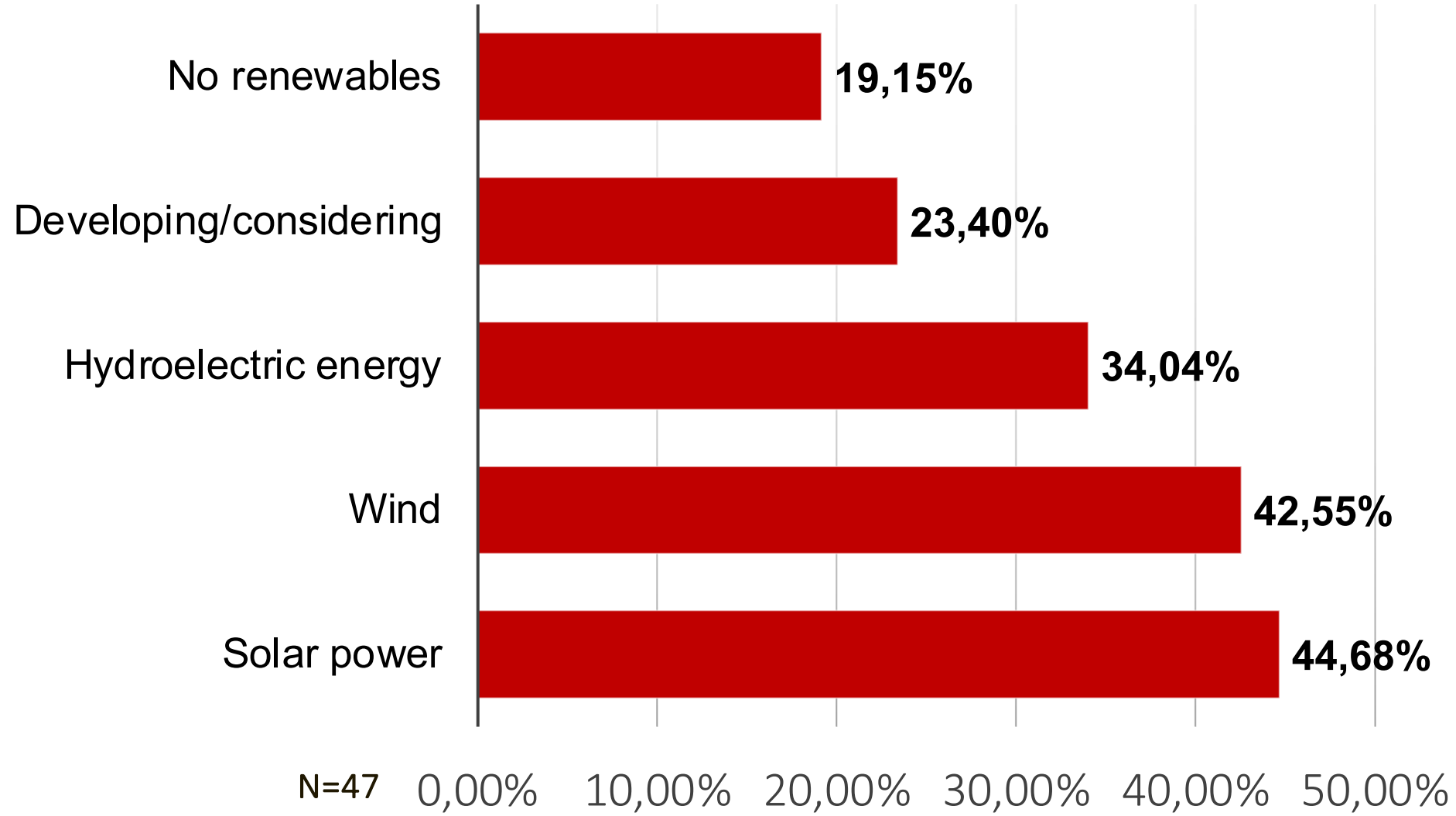


N=47

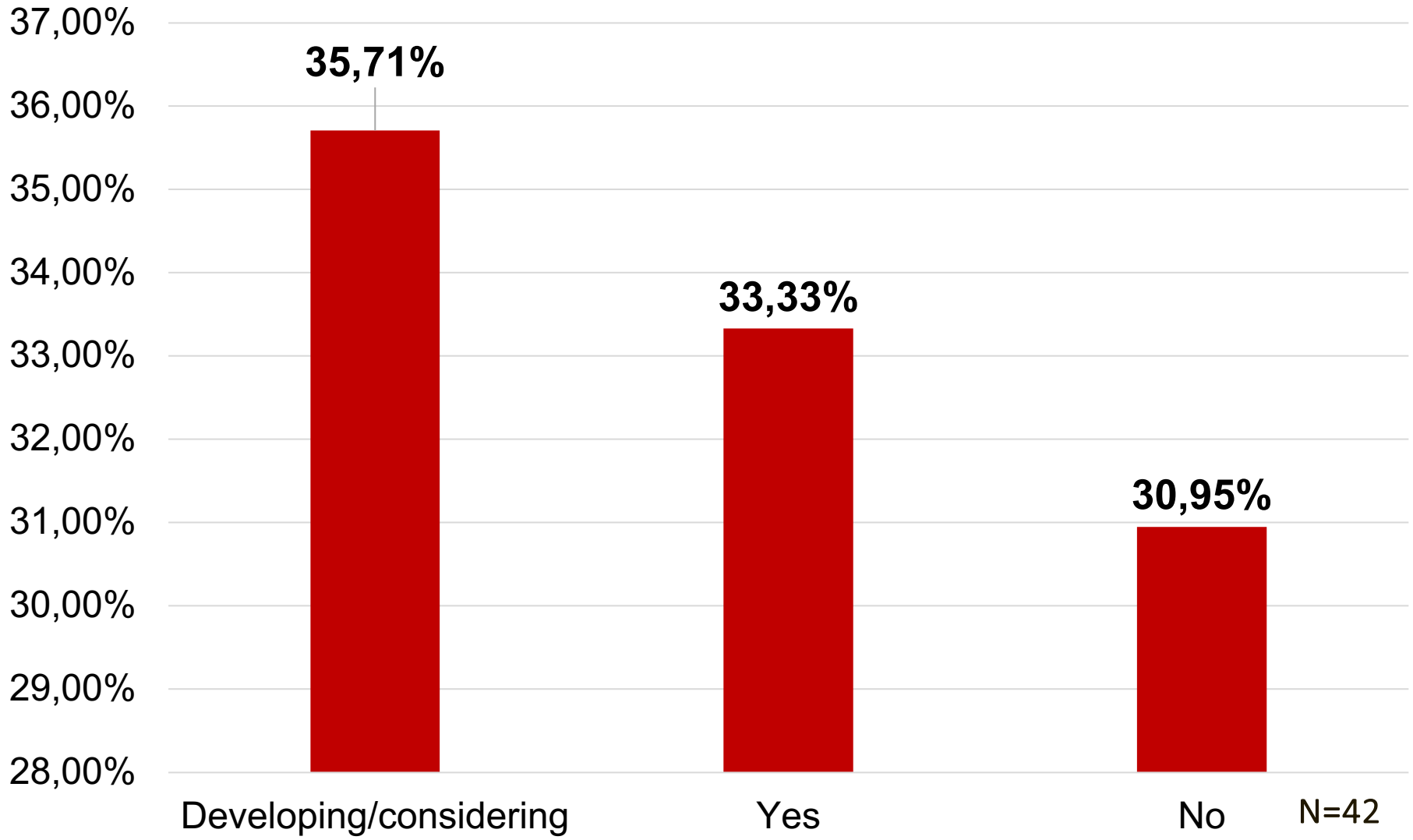
DC renovation rate



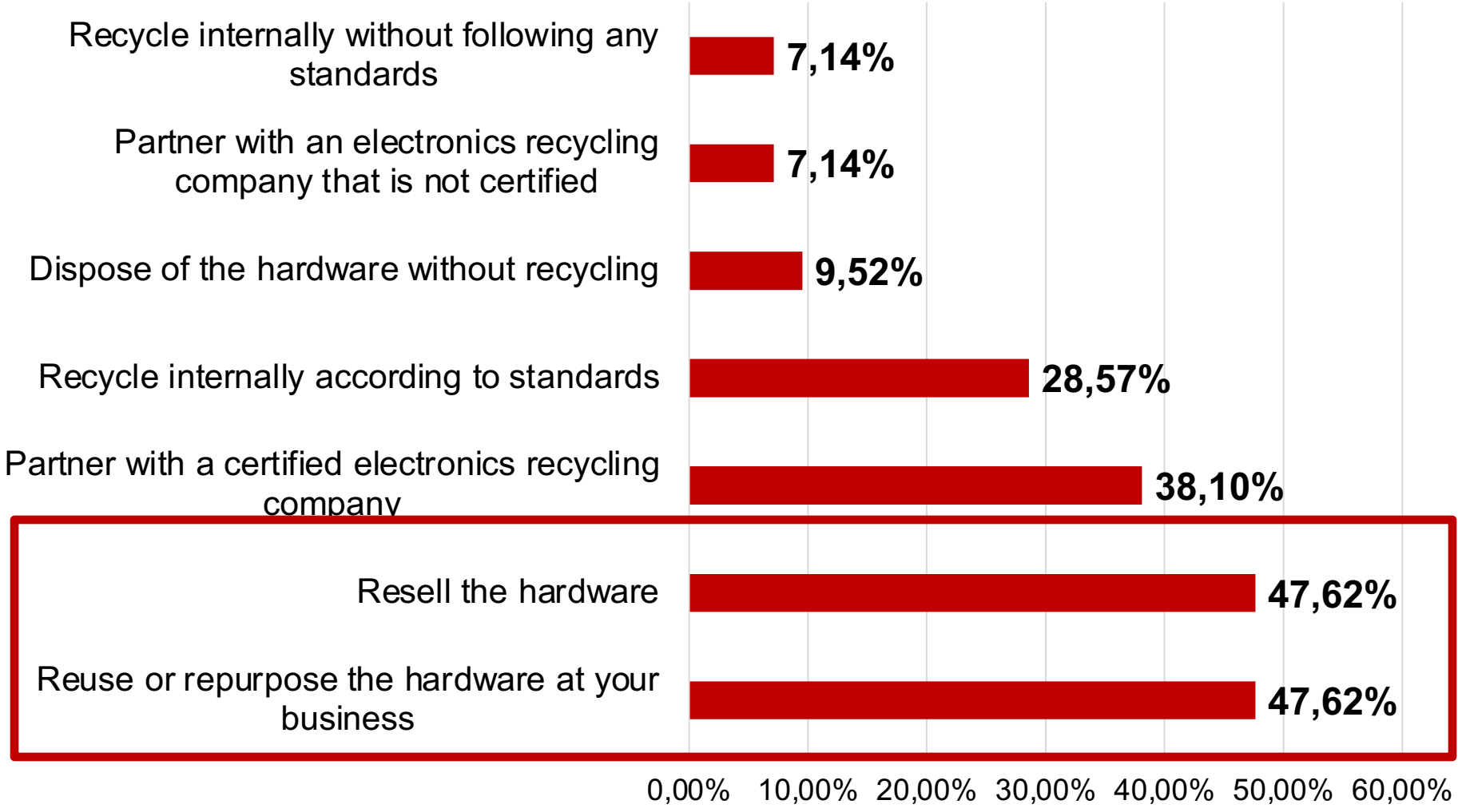
Renewables


No renewables
19,15%
Developing/considering
23,40%
Hydroelectric energy
34,04%
Wind
42,55%
Solar power
44,68%
N=47
0,00%
10,00%
20,00%
30,00%
40,00%
50,00%

Life Cycle Assessment (LCA)



Circular economy



N=42

Data

- Our original dataset consists in the text of 342 websites of Europen data centers with at least an English website

- We obtained the list of data centers from different sources/databases:
  1. https://www.datacentermap.com
  2. https://www.impresaitalia.info;
  3. list of companies that are part of the European Data Centre Association (EUDCA);
  4. https://cispe.cloud/members (CISPE's members101);
  5. https://sciencebasedtargets.org/companies-taking-action

- Data was obtained using Qiba (Quantitas Intelligent Business Analyzer), a web crawling and scraping tool.
- Text was cleaned and pre-processed to create a corpus to be analyzed (remove symbols, remove punctuation, transform into lower case…)

Data

- Websites describe data center characteristics and services offered
- But they also talk about sustainability, we see *sustainability, green, cooling*
- *Sustainability ≈5000*
- *Data services ≈50.000*

BoW: Bag of words approach

- We analyse the topic of sustainability using a Bag of Word approach
- The idea is that we can estimate the **relevance** of a topic (sustainability) in a document (website) by the **frequency** of a given set (bag) of pre-selected words. (Zhang et al., 2010)

- Given the complexity of the concept of sustainability, we identify and analyze **five subtopics**: ***metrics, green factors, footprints, circular economy and certifications***.

- In particular, given the word frequency in each BOW we compute the TF-IDF indicator (term frequency – inverse document frequency) allowing us to **rank company** websites with respect to **sustainability** bags.

Identifying sustainability sub-topics

- To identify sustainability sub-topics we implement a hybrid approach apply a two-step procedure
- In the first step we use a qualitative lexicon-based approach and identify keywords linked to sustainability for the five baskets: metrics, green factors, footprints, circular economy and certifications.
- In the second step we used a word embedding methodology to enrich the initial baskets. In detail, we used *word2vec*, one of the most popular word embeddings techniques.

Advantages:

1. enables the retrieval of terms initially missed by the researcher
2. allows to search for terms in the specific language of the corpus analyzed.

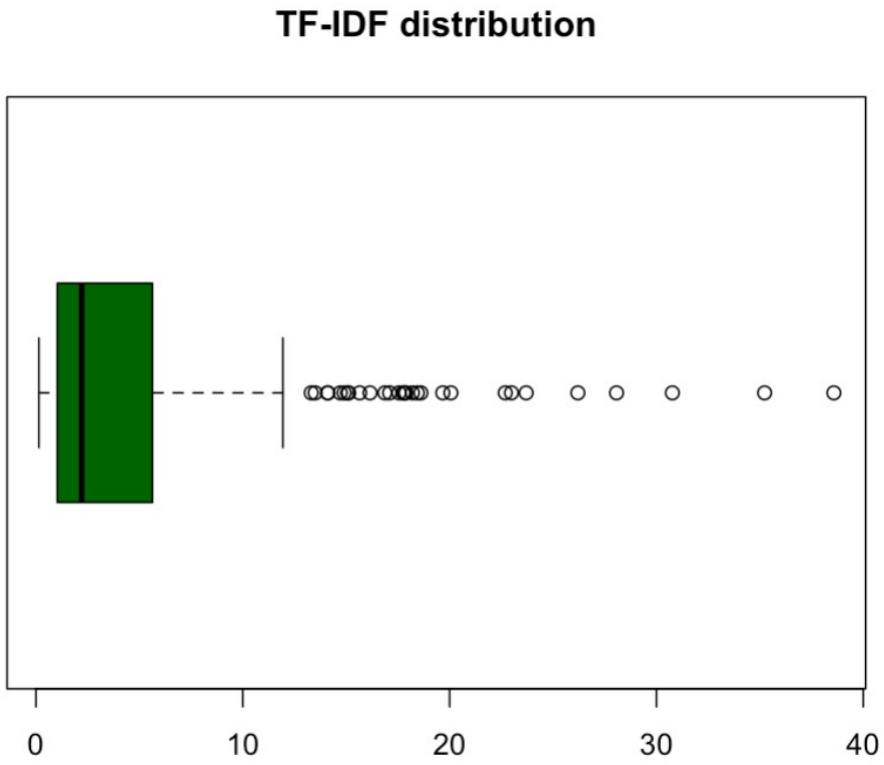
Bags

Metrics	Green Factors	Footprint	Circular Economy	Certifications
carbon usage effectiveness	clean energy	carbon	circular	certified energy efficient datacenter award
data center infrastructure efficiency	environmental policy	carbon emissions	circular economy	green globes building certification
renewable energy factor	environmental report	carbon footprint	disposal	materials analytical services certified green
cue - Carbon Usage Effectiveness	geothermal	carbon free	dispose	building energy innovators council
dcie - Data Center Infrastructure Efficiency	geothermal energy	carbon neutral	e-waste management	building energy innovators council
electronics disposal efficiency	hydro	carbon reduction	life cycle assessment	ceeda
efficiency metrics	hydroelectric	climate neutral	lifecycles	certification
electronics disposal efficiency	recycle heat	co2 emission	recycle	certified
energy consumption	renewable energy	decarbonisation	recycled	certified recycling company
energy efficiency	renewables	decarbonizing	repair	climate neutral data center
energy reuse effectiveness	solar	dioxide	repairing	climate neutral data center pact
energy use	solar energy	emission	repairs	fossil free data
energy used	water conservation	emissions	reuse	gbi
energy reuse effectiveness	wind	environmental footprints	reused	green building initiative
green energy coefficient	wind energy	environmental impacts	waste	green certification
green energy coefficient		footprint		iso 14001
metric		greenhouse		iso 14040
power usage effectiveness		greenhouse gas emissions		iso 50001
power usage effectiveness		low carbon		iso 14001
ref- Renewable Energy Factor				iso 50001
sustainability metrics				leadership in energy and environmental design
water consumption				leadership in energy and environmental design
water usage				mas certified green (Materials Analytical Services) Certified Green® certifies low VOC (volatile organic compound) emitting products and materials
water usage effectiveness				sustainability certification
wue - Water Usage Effectiveness				

Results

Etichette di riga	Rank	2 Metrics	3 Green Factors	4 Footprint	5 Circular Economy	6 Certifications	Totale
Nlyte Software	1	13,88	2,08	5,30	4,51	12,81	38,58
DigiPlex	2	6,71	10,43	9,39	5,31	3,38	35,23
CONAPTO	3	2,17	10,59	7,28	4,35	6,38	30,77
Lamda Hellix	4	11,87	3,56	6,22	1,36	5,06	28,07
Echelon Data Centres	5	3,62	5,68	10,58	6,32		26,20
Lefdal Mine Data Center	6	5,49	5,67	8,33	2,54	1,67	23,70
Green Mountain Data Center	7	4,27	5,98	5,81	5,63	1,30	22,99
Dassault Systemes (DELMIAworks)	8	1,30	3,60	8,80	8,38	0,61	22,69
Atos	9	1,06	4,26	7,65	6,21	0,88	20,06
Submer	10	11,20	0,29	5,81	2,15	0,22	19,67
Tele2 AB	11	1,96	2,18	8,19	6,14	0,14	18,61
Telia Company AB	12	0,49	2,91	9,15	5,81	0,10	18,44
Google	13	1,77	3,74	6,66	4,33	1,70	18,20
IBM	14		6,50	5,99	4,80	0,60	17,89
Turk Telecom	15	2,86	4,43	5,80	2,20	2,51	17,81
EnerKey	16	3,28	1,27	5,32	5,53	2,35	17,75
Vodafone Group Plc	17	1,30	1,92	5,66	7,38	1,28	17,55
Ark Data Centres	18	3,97	2,06	6,44	1,40	3,22	17,10
Kao Data	19	2,25	3,93	6,81		3,89	16,87
Capacity Media	20	2,37	1,48	8,07	1,97	2,26	16,15
Verne Global	21		11,15	3,99		0,51	15,65
HPE	22	1,59	2,37	3,74	6,93	0,50	15,12
Workspace Technology	23	4,31	1,37	6,62	1,57	1,21	15,07
Telenor Group	24	1,03	4,80	7,52	1,56		14,90
Orange	25	1,31	2,01	5,13	6,15	0,12	14,71
EcoDataCenter	26	3,91	3,39	4,63	1,02	1,18	14,12
NDC-GARBE	27	5,34	3,30	3,75	1,71		14,09
Cisco Systems	28	0,87	2,28	5,29	4,39	0,67	13,50

TF-IDF distribution



TFIDF distribution quartiles				
Min	1st quartile	Median	3rd quartile	Max
0,14	1,1	2,2	5,6	38,6

Conclusions

Data centers have made investments in ES through:

- efficiency
- Increasing use of energy from renewable sources (solar, wind).

Still little awareness of upstream and downstream steps in the use of electronic product.

Limited use of LCA and circular economy

Focus on the use phase of the DT

GRINS FOUNDATION

SMEs and Sustainable Public Procurement

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Università degli Studi di Roma Tor Vergata

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani

The aim and research questions

The aim of our project is to understand how **sustainable and green public procurement may affect small and medium enterprises' (SMEs) participation in public procurement.**

RQ:

- Does the introduction of green and sustainable public procurement positively or negatively affect SMEs' participation in public procurement?
- Can public procurement increase sustainable practices among SMEs?

Two approaches, so far…

Preliminary Investigation of the Legality Rating

- A (relatively) new tool that can be used in public procurement and that should signal how much firms are legal and sustainable.
- Descriptive evidence.
- Survey Experiment with Confartigianato.

Introduction of Criteri minimi ambientali (CAM) by sector

- Exploit the CAM ‘staggered’ introduction by sector.
- DiD setup to estimate causal effects on SMEs Public Procurement participation and CAM effectiveness.

The AGCM legality rating

- The Legality Rating is an institutional tool, elaborated by the Italian Antitrust Authority (AGCM). Its aim is to rate the legality of Italian Enterprises in terms of fiscal transparency, adoption of anti-corruption practices, attention to social corporate responsibility, etc.

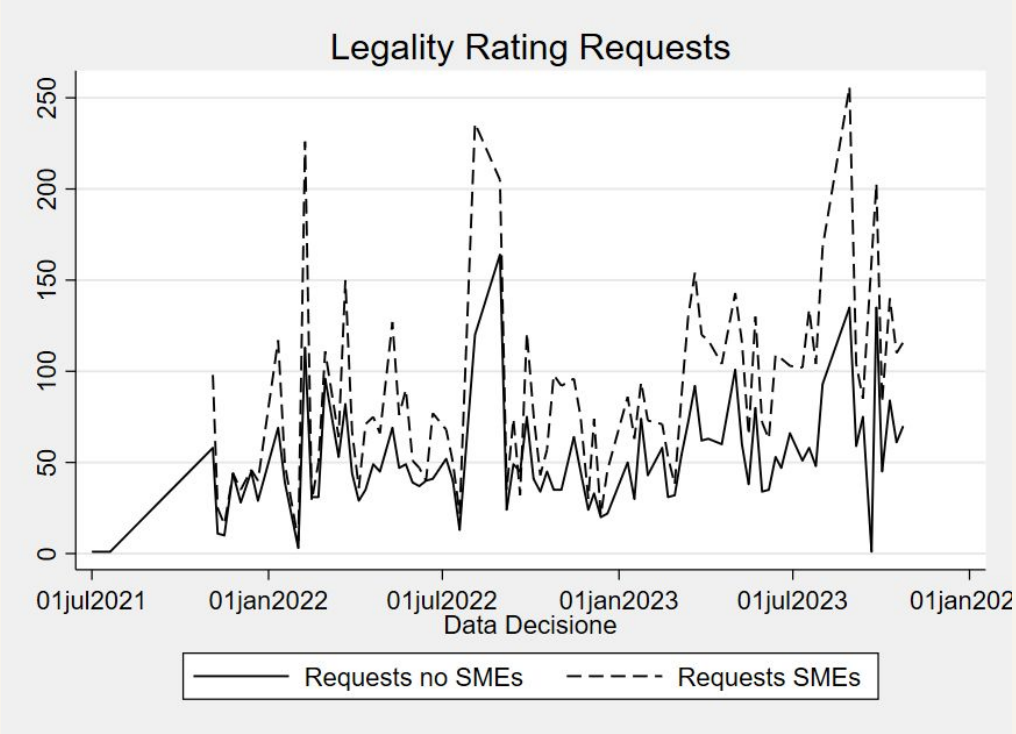
- The score of the legality rating ranges from a minimum of one star (*) to a maximum of three stars (***). To get the minimum score the enterprise must comply with the basic requirements on fiscal discipline, transparency of the records, and compliance with the health and safety regulations. The score can then be increased by providing evidence of an organizational model to prevent corruption and/or sustainable and green standards.

- By comparing enterprises' scores, by construction, we compare enterprises that have at least satisfied the minimum requirements, having the chance to understand how enterprises can differentially perform in adopting anti-corruption policies and sustainable standards.

Data

- AGCM Legality Rating
- Aida Bureau van Dijk
- In the final dataset, we have, for each firm, its legality score, the date on which the legality score is assigned, the number of employees in each year from 2011 to 2022, the revenues from 2011 to 2022, the share of female individuals in the board, the average age of individuals in the board, the municipality in which the firm is based and the sector in which the firm operates. We also have information on whether the firm is an innovative SME or not according to the Italian legal system.
- We identify SMEs in two different ways:
  - A large definition, including enterprises that have on average -over the time span considered- less than 50 employees and make less than 10 million Euros. We label this variable SMEs (1). The share of enterprises of this kind is around 60% of the sample.
  - A narrower definition, including enterprises that have on average less than 25 employees and make less than 5 million Euros. We label this variable SMEs (2). The share of enterprises of this kind is around 30% of the sample.

Rating Requests



Rating and SMEs Performance

	(1) Legality Rating	(2) Legality Rating	(3) Legality Rating	(4) Legality Rating	(5) Legality Rating	(6) Legality Rating
SMEs (1)	-0.334***	-0.335***	-0.323***	-0.323***	-0.306***	-0.305***
	(0.011)	(0.011)	(0.012)	(0.011)	(0.012)	(0.012)
Women in the board ≥ 50 %	-0.045***	-0.045***	-0.035**	-0.035**	-0.018	-0.017
	(0.014)	(0.014)	(0.015)	(0.015)	(0.015)	(0.015)
Age of the board (log)	-0.174***	-0.174***	-0.137***	-0.137***	-0.039	-0.030
	(0.030)	(0.030)	(0.033)	(0.034)	(0.034)	(0.035)
Observations	8,896	8,896	8,896	8,896	8,896	8,896
R-squared	0.106	0.106	0.264	0.264	0.432	0.469
Mean Dep. Var.	1.928	1.928	1.928	1.928	1.928	1.928
Year FE		Yes	Yes	Yes	Yes	
Municipality FE			Yes	Yes	Yes	
Sector FE					Yes	Yes
Year x Municipality FE						Yes

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.

Rating and SMEs Performance

	(1)	(2)	(3)	(4)	(5)	(6)
	Legality Rating	Legality Rating	Legality Rating	Legality Rating	Legality Rating	Legality Rating
SMEs (2)	-0.266***	-0.267***	-0.258***	-0.258***	-0.247***	-0.241***
	(0.010)	(0.010)	(0.011)	(0.011)	(0.011)	(0.012)
Women in the board ≥ 50 %	-0.059***	-0.059***	-0.047***	-0.047***	-0.033**	-0.032**
	(0.014)	(0.014)	(0.015)	(0.015)	(0.015)	(0.016)
Age of the board (log)	-0.201***	-0.201***	-0.165***	-0.165***	-0.056	-0.044
	(0.030)	(0.030)	(0.034)	(0.035)	(0.034)	(0.036)
Observations	8,896	8,896	8,896	8,896	8,896	8,896
R-squared	0.067	0.067	0.233	0.233	0.413	0.451
Mean Dep. Var.	1.928	1.928	1.928	1.928	1.928	1.928
Year FE		Yes	Yes	Yes	Yes	
Municipality FE			Yes	Yes	Yes	
Sector FE					Yes	Yes
Year x Municipality FE						Yes

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Rating and SMEs Performance

	(1) Score	(2) Score	(3) Score	(4) Score	(5) Score	(6) Score
Revenues (log)	0.019***	0.019***	0.025***	0.025***	0.084***	0.086***
	(0.007)	(0.007)	(0.007)	(0.005)	(0.006)	(0.006)
Employees (log)	0.133***	0.133***	0.123***	0.123***	0.069***	0.066***
	(0.006)	(0.006)	(0.006)	(0.005)	(0.006)	(0.007)
Women in the board ≥ 50 %	-0.043***	-0.043***	-0.031**	-0.031**	-0.003	-0.001
	(0.013)	(0.013)	(0.014)	(0.015)	(0.014)	(0.015)
Age of the board (log)	-0.250***	-0.250***	-0.222***	-0.222***	-0.124***	-0.120***
	(0.029)	(0.029)	(0.033)	(0.034)	(0.033)	(0.034)
Observations	8,896	8,896	8,896	8,896	8,896	8,896
R-squared	0.154	0.155	0.306	0.306	0.466	0.502
Mean Dep. Var.	1.928	1.928	1.928	1.928	1.928	1.928
Year FE		Yes	Yes	Yes	Yes	
Municipality FE			Yes	Yes	Yes	
Sector FE					Yes	Yes
Year x Municipality FE						Yes

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Rating and SMEs Performance

	(1) Score	(2) Score	(3) Score	(4) Score	(5) Score	(6) Score
Innovative SMEs	0.014	0.015	-0.033	-0.033	-0.006	-0.007
	(0.033)	(0.033)	(0.038)	(0.039)	(0.039)	(0.041)
Women in the board ≥ 50 %	-0.079***	-0.078***	-0.064***	-0.064***	-0.054***	-0.054***
	(0.014)	(0.014)	(0.015)	(0.016)	(0.015)	(0.016)
Age of the board (log)	-0.095***	-0.095***	-0.074**	-0.074**	0.024	0.035
	(0.031)	(0.031)	(0.035)	(0.036)	(0.035)	(0.037)
Observations	8,896	8,896	8,896	8,896	8,896	8,896
R-squared	0.004	0.004	0.183	0.183	0.375	0.417
Mean Dep. Var.	1.928	1.928	1.928	1.928	1.928	1.928
Year FE		Yes	Yes	Yes	Yes	
Municipality FE			Yes	Yes	Yes	
Sector FE					Yes	Yes
Year x Municipality FE						Yes

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Way forward…

- Standard SMEs get a lower rating.
  - Rating and SMEs participation in public procurement.
  - Ranting and SMEs perfomance in public procurement.

- Is it because of sustainable and Green Standards? Is it because of human capital?

  - Survey Experiment Confartigianato.
  - Focus on Innovative vs Standard SMEs

Additional Projects and AMELIA

- Survey on SMEs Participation in Public Procurement.

- Field experiment.
  - Mini-course on how to apply to public tenders (focus on green and sustainable procurement). Will this increase SMEs participation in public procurement?
  - Peer-preassure and SMEs participation in public procurement.

- AMELIA
  - Research outputs and policy briefs.
  - Survey data (will this remain?).
  - Mini-course on how to apply to public tenders ?

Prof. Anna Mazzi (DII), Prof. Silvia Gross (DiSC)
Fellow: Dr. Diego Zamboni (starting 2.11.2023)

UNIVERSITÀ DEGLI STUDI DI PADOVA

GRINS FOUNDATION

Assess and reduce the carbon footprint of processing of plastics: an underestimated part of the plastics supply chain

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani

The carbon footprint of plastic production: definition

- Carbon Footprint (CFP) is a method for the estimation of GHG emissions from both production and service industry activities. A CFP study should quantify the contribution of a product or service to climate change through global warming
- The assessment can cover the entire product/service life cycle. The evaluated impact is described by a single indicator the 'CFP'. The CFP is measured through its Global Warming Potential (GWP) and is valued in carbon dioxide equivalent units
- The EN ISO 14050:2010 defines GWP as "a characterization factor describing the mass of carbon dioxide that has the same accumulated radiative forcing over a given period of time as one mass unit of a given greenhouse gas". The main greenhouse gases assessed include:

- Carbon dioxide,
- Methane,
- Sulphur hexafluoride,
- Nitrous oxide,
- Chlorofluorocarbons and
- Per fluorocarbons

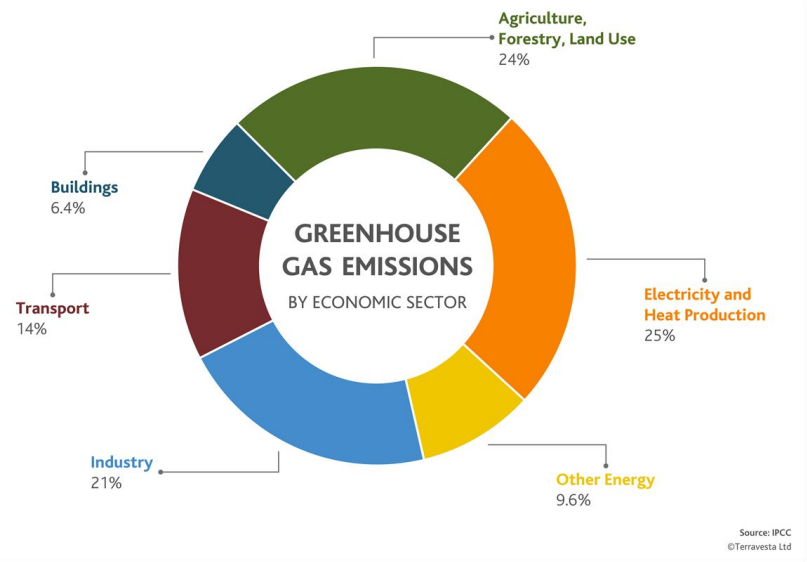
Global Warming Potential (GWP)

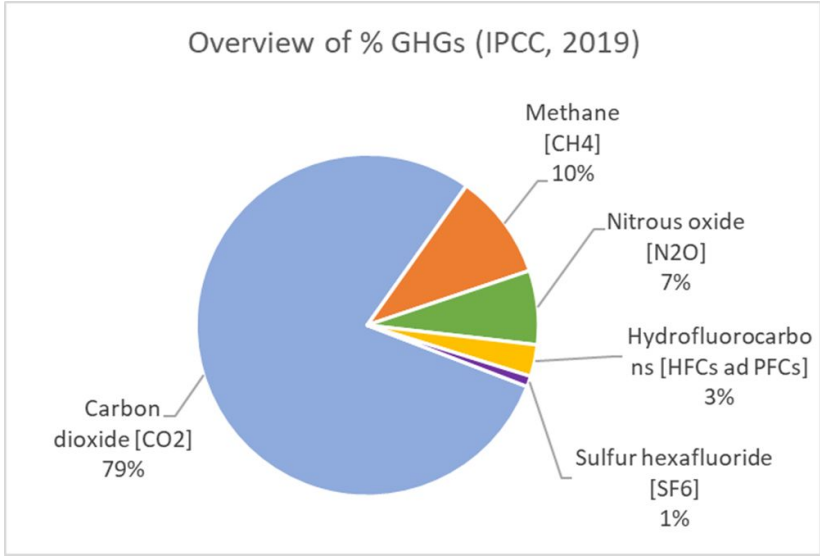
Greenhouse Gas (GHG)	Atmospheric Lifetime (yrs)	Global Warming Potental (GWP)	Primary Current Sources
Carbon dioxide (CO_2)	50-200	1	Fossil fuel use, land use, cement
Methane (CH_4)	12±3	21	Fossil fuel use, agriculture
Nitrous oxide (N_2O)	120	310	Mostly agriculture, ~1/3 are anthropogenic
Hydrofluorocarbons (HFCs)	1.5 to 209	150 to 11,700	Alternative to ozone depleting substances
Perfluorocarbons (PFCs)	2,600 to 50,000	6,500 to 9,200	Primary aluminum production; semiconductor manufacturing
Sulfur Hexafluoride (SF_6)	3,200	23,900	Used in electric power transmission, magnesium and semiconductor industries

High GWP gases

Carbon Footprint: proxy index of climate change

GHGs emissions by economic sector (IPCC, 2019)





The carbon footprint of plastic production: the starting point

- impact of plastics on climate and health is bigger than originally thought
- the global carbon footprint of plastics has doubled since 1995, reaching 2.2 billion tons of CO_2 equivalent (CO_2e) in 2015. (4.5% of global greenhouse gas emissions).
- In Europe, 99% of virgin plastic is produced using oil and natural gas as raw materials and fossil fuels are also used to generate the heat needed during the production process → emission into the atmosphere of about 1.2 kg of CO_2 for every kg of plastic, considering the production phase alone.
- Considering the CO_2 emissions related to the extraction and refining of fossil fuels, for the production of 1 kg of plastic there is a total of about 1.7 kg of direct CO_2 emissions


nature sustainability
ANALYSIS
https://doi.org/10.1038/s41893-021-00807-2
Check for updates
OPEN
Growing environmental footprint of plastics driven by coal combustion
Livia Cabernard[1,2], Stephan Pfister[1,2], Christopher Oberschelp[1] and Stefanie Hellweg[1,2]

The carbon footprint of plastic production: the starting point

- Processing and disposal of plastics also produces emissions. It is therefore paramount to thoroughly analyse the whole supply chain of plastics production and also processing in order to implement rational decarbonisation strategies.

- **PROCESSING OF POLYMERS**
- Injection molding
- Extrusion molding
- Thermoforming
- Compression molding
- Calendaring
- …….

- **TYPE OF POLYMERS**
- Polyurethanes
- ABS
- Polyolefins
- PET

GCSM 11th Global Conference on Sustainable Manufacturing
2013 23rd - 25th September Berlin - Germany

9.3 Product carbon footprint in polymer processing – A practical application.

D. Khripko[1*], A. Schlüter[1,2], M. Rosano[3], J. Hesselbach[2]
[1] IdE Institute decentralised Energy Technologies gGmbH, Kassel, Germany
[2] Department for Sustainable Products and Processes (upp), University of Kassel, Germany
[3] Sustainable Engineering Group, Curtin University, Perth, Australia

Targets of the project

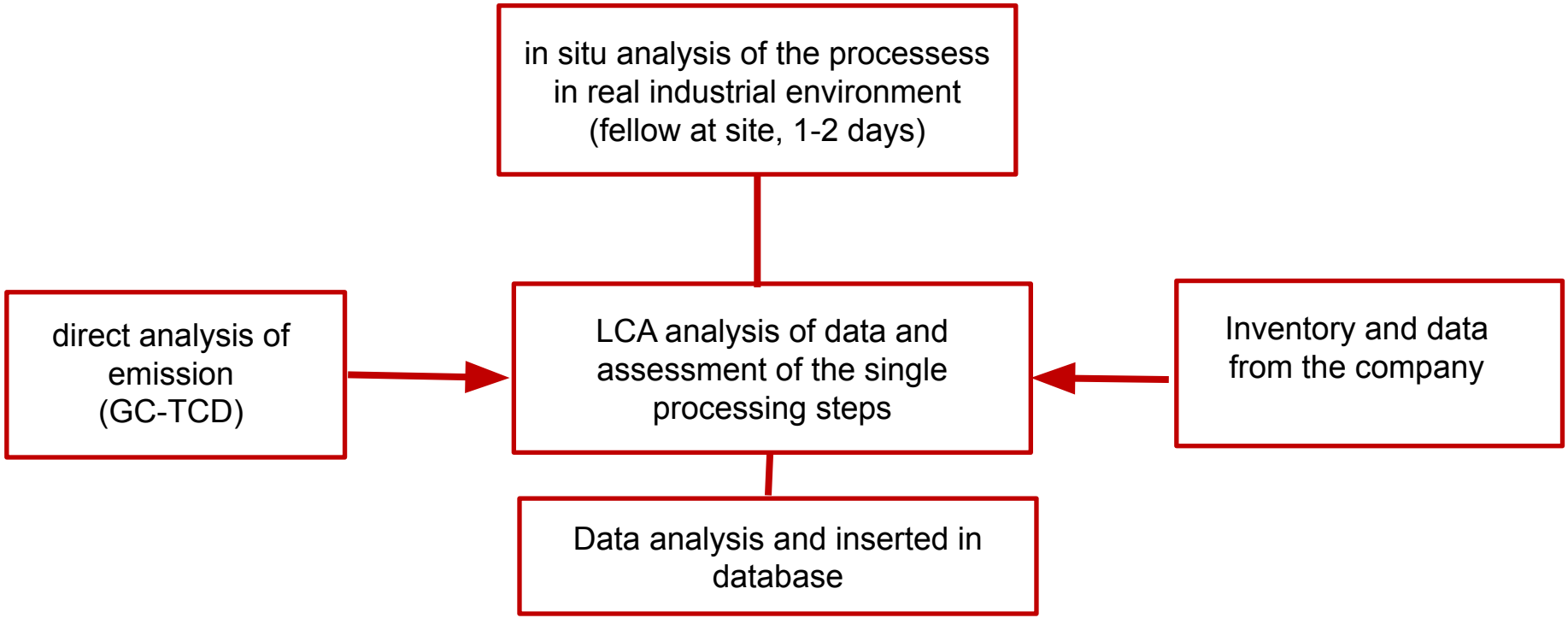
- assessing the carbon footprint (CFP) [according to ISO 14067 and ISO 14040-44] of the upstream processing step of plastics-based products in five model companies, chosen in different parts of Italy, and processing different kind of polymers.

- first phase devoted to thorough chemical characterization of the upstream polymers production and secondly acquisition and collection of data on emissions (also experimentally)

- CFP assessment will utilize both the well known software and inventories, but will also rely on experimental determinations.

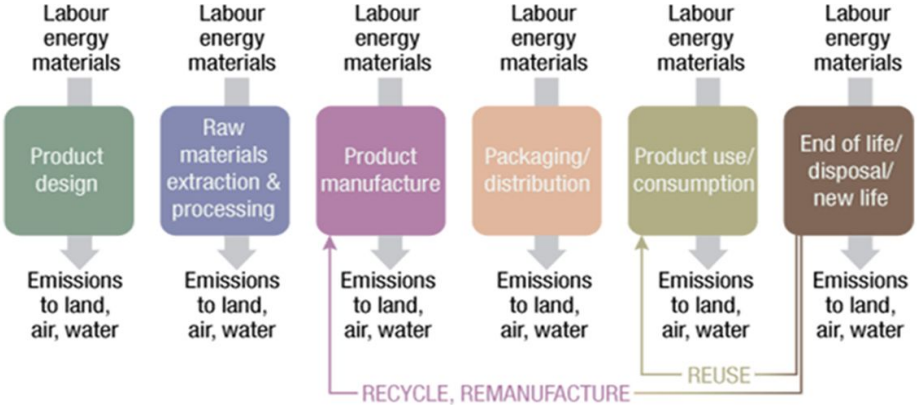
- for all those data which are not available in the data inventory, in situ chemical determination of the actual GHG emissions will be carried out using specific equipment and gas chromatography (GC) or total carbon (TC) analysis.

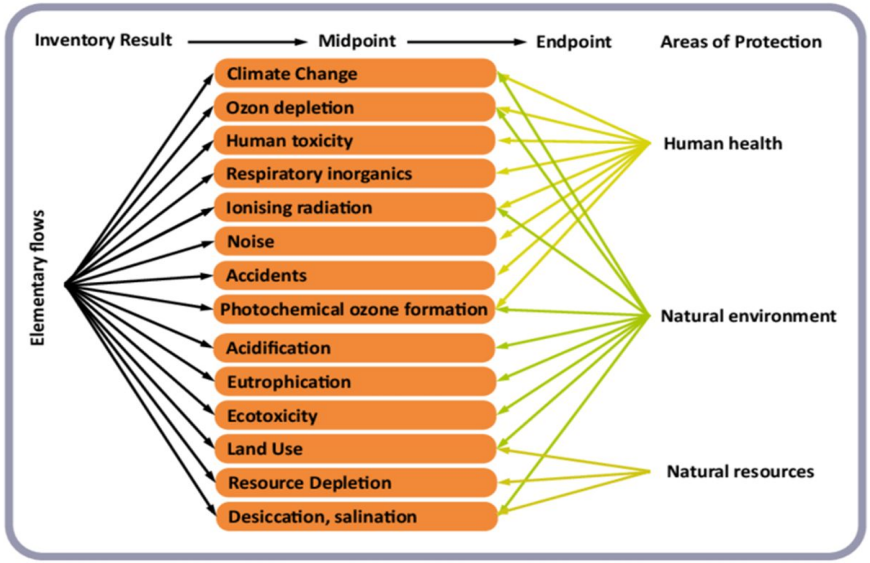
Approaches


in situ analysis of the processess in real industrial environment (fellow at site, 1-2 days)
direct analysis of emission (GC-TCD)
LCA analysis of data and assessment of the single processing steps
Inventory and data from the company
Data analysis and inserted in database

The product is analyzed according to the flows of matter, energy and emissions of the activities that accompany it throughout its life cycle

Objective: estimation and assessment of environmental impacts considering the most relevant materials and resources using average data



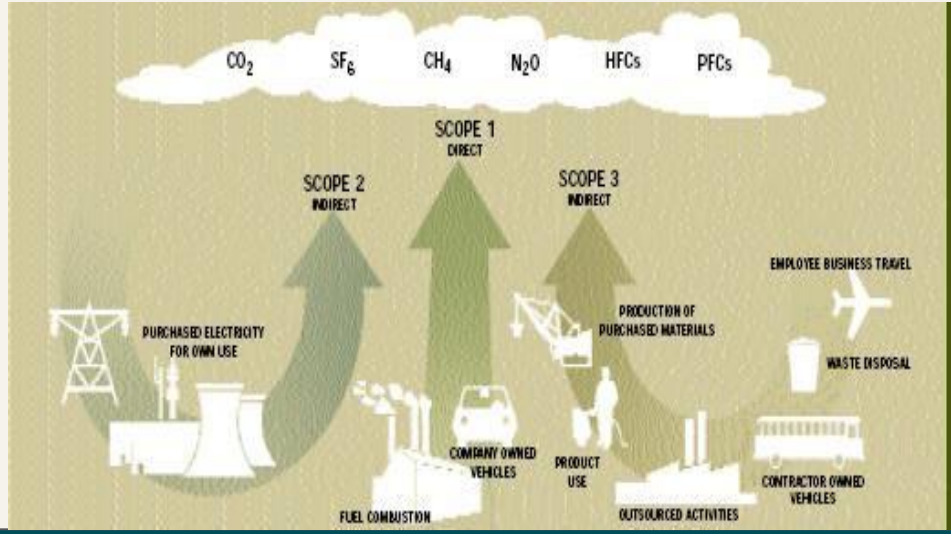


Carbon Footprint: «single issue LCA»

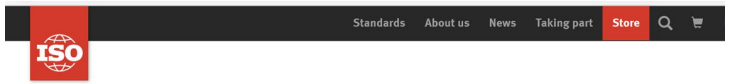
Carbon Footprint: "sum of GHG emissions and removals in a product system expressed in terms of CO_2 equivalent and based on a life cycle assessment using only the environmental category of climate change"

Detailed analysis of product-related processes throughout its life cycle

Identification of all GHG emissions and removals related to the processes affecting the product system



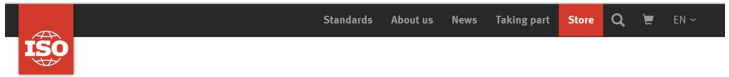
ISO 14067 requirements



ICS › 13 › 13.020 › 13.020.40

ISO 14067:2018

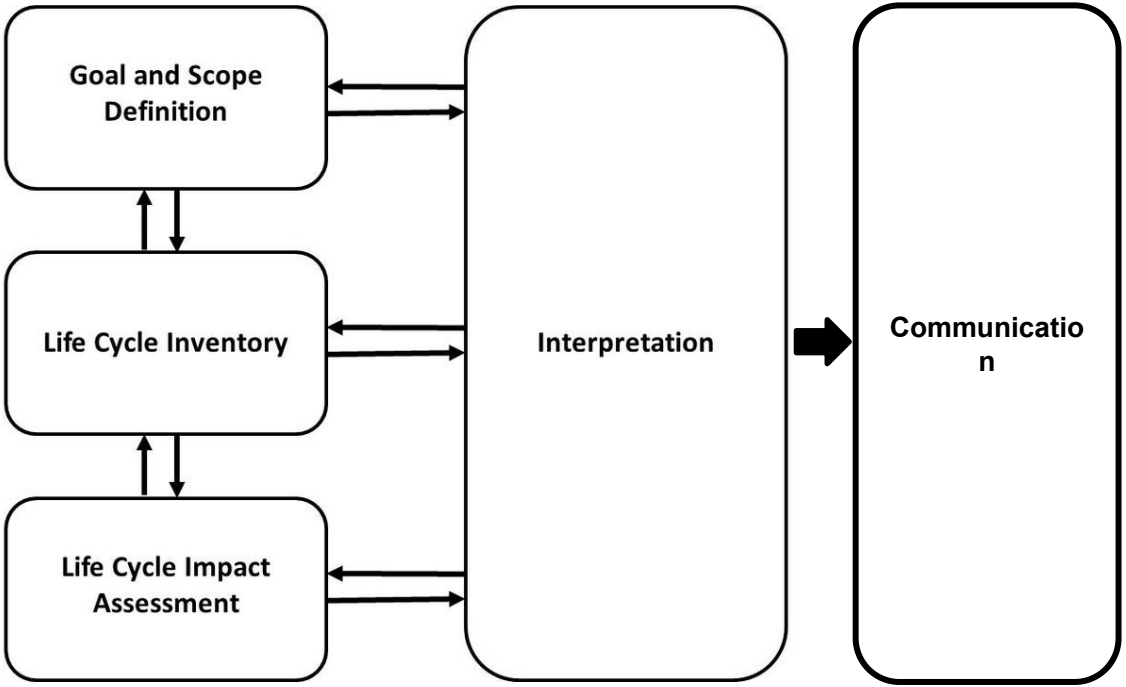
Greenhouse gases — Carbon footprint of products — Requirements and guidelines for quantification



ICS › 13 › 13.020 › 13.020.50

ISO/TS 14027:2017

Environmental labels and declarations — Development of product category rules



Activity	1st year												2nd-3rd year											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1.1 Selection of 5 model companies																								
1.2 Analysis and evaluation of production process																								
1.3 Training on LCA																								
1.4 Chemical characterization of the upstream polymers production and secondly acquisition and collection of data on emissions																								
1.5 LCA-based CFP assessment																								
1.6 Writing of reports																								
1.7 Implementation of the platform																								

High intensity

Medium intensity

Planning of activities (remodulated on 24 months)

- Recruitment of the fellow: 2.11.2023
- Meeting with Prezero-Eletrolux: Begin Dec 2023
- Meeting with other companies: Mid of Jan 2023
- First visits at plants: Dec 2023 / Jan 2024

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA
logo
GRINS FOUNDATION

Spoke 6 Workshop, Padova, 20-21 November 2023

GRINS FOUNDATION

Modelling the forest-wood value chain for analysing decarbonization- path scenarios

Davide Pettenella, Paola Gatto, Tayyab Khan

Università degli Studi di Padova | TESAF

Finanziato dall'Unione europea NextGenerationEU

Ministero dell'Università e della Ricerca

Italiadomani

Team

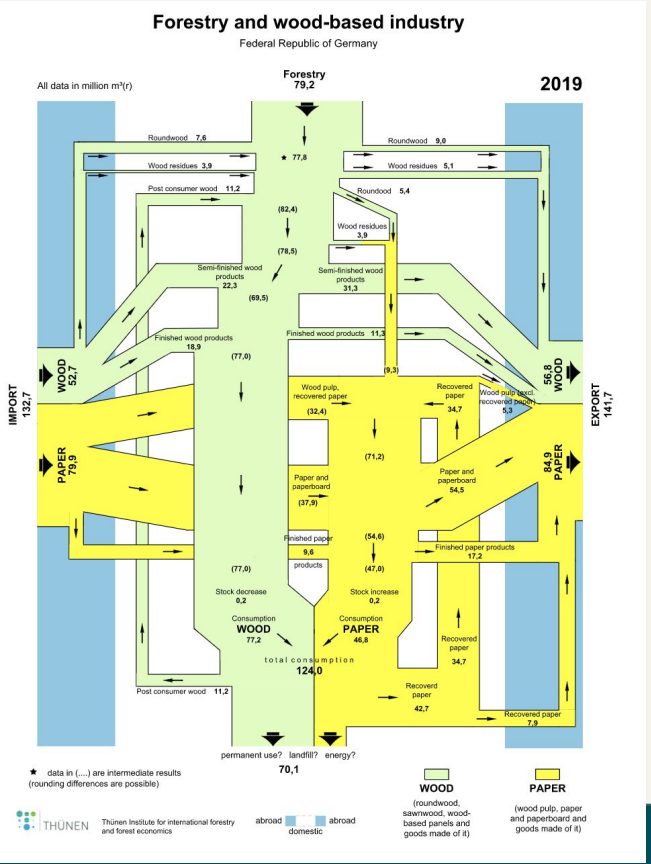
- (Davide Pettenella)
- Paola Gatto
- Muhammad Tayyab Khan (PhD student)
- ETIFOR (service provider)

External support

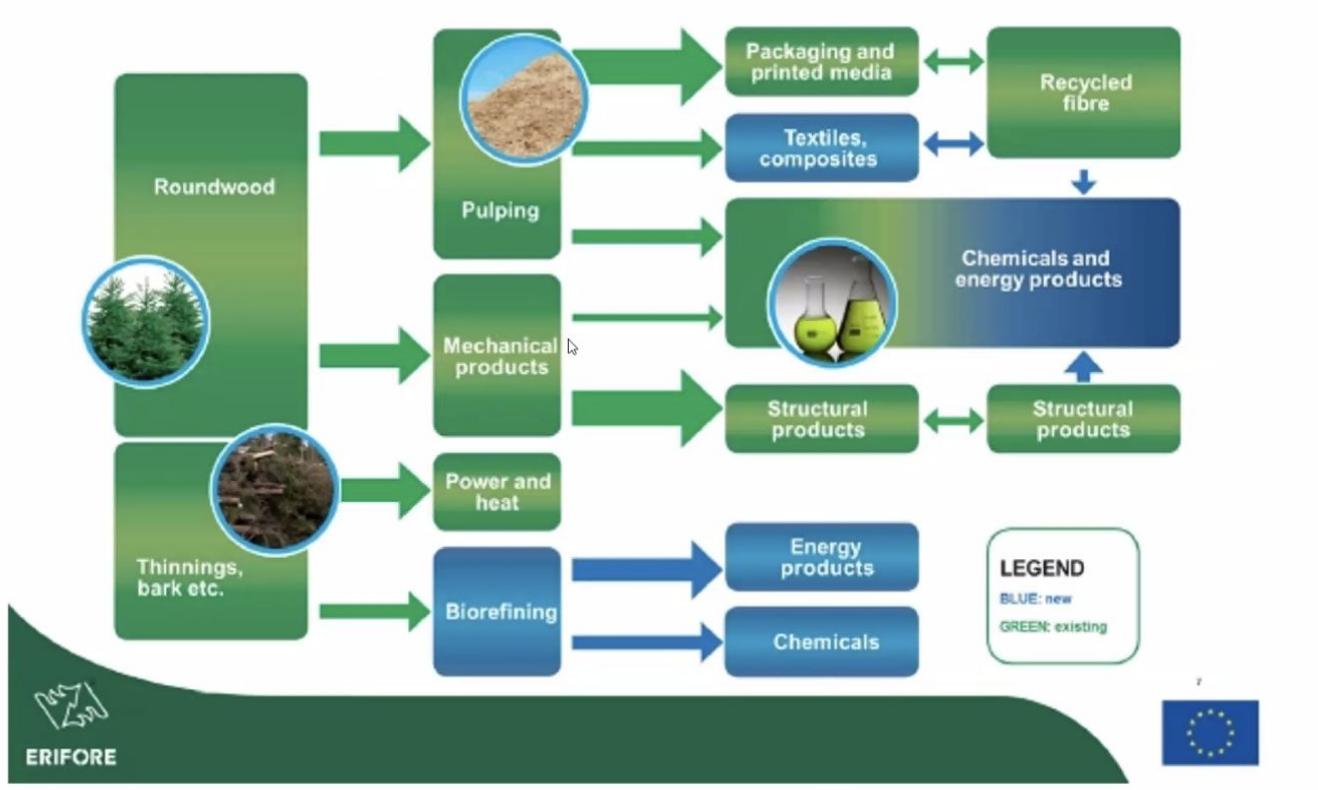
- Fulvio Di Fulvio (Int. Institute for Applied System Analysis)
- Holger Weimar (Thünen Institute of Forestry)

Objectives

To describe the **domestic wood supply chain**, through a model based on forest inventory data associated to wood harvesting activities, wood industry production, trade and domestic consumption.
To assess the potentials for strengthening the **role of domestic forests** in the **Italian decarbonization policy** (carbon sink in the forests, in the HWP – harvested wood products – and in fossil energy substitution)



Forest-based bio-economy




NEW EUROPEAN BAUHAUS
beautiful | sustainable | together

The construction materials pyramid

https://www.materialepyramiden.dk/

Global Warming Potential (GWP)

10000kg $CO_{2\ eq}/m^3$

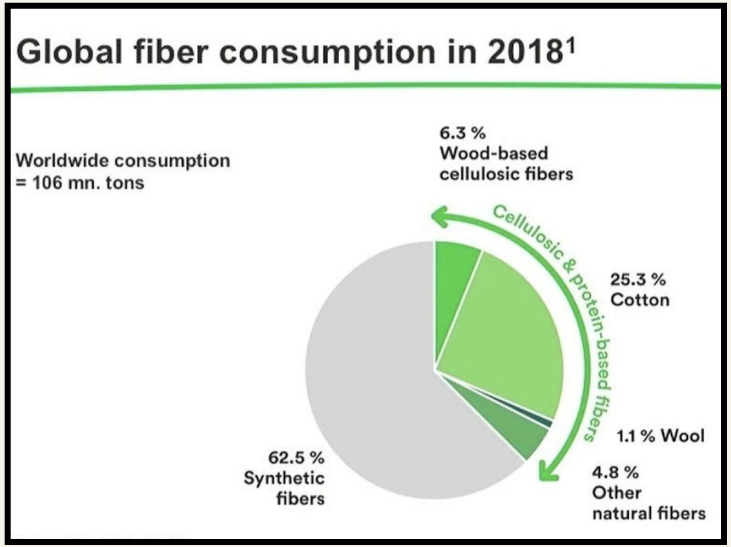
1000kg $CO_{2\ eq}/m^3$

100kg $CO_{2\ eq}/m^3$

10kg $CO_{2\ eq}/m^3$

0kg $CO_{2\ eq}/m^3$

Decarbonization: the role of bio-textile



Source: M.Palahì (2023) on ICAC, CIRFS, TFY, FEB data

UNECE/FAO (2021) is forecasting in 2040 a consumption of 30% (80 M m^3) of the total consumption of industrial wood in Europe

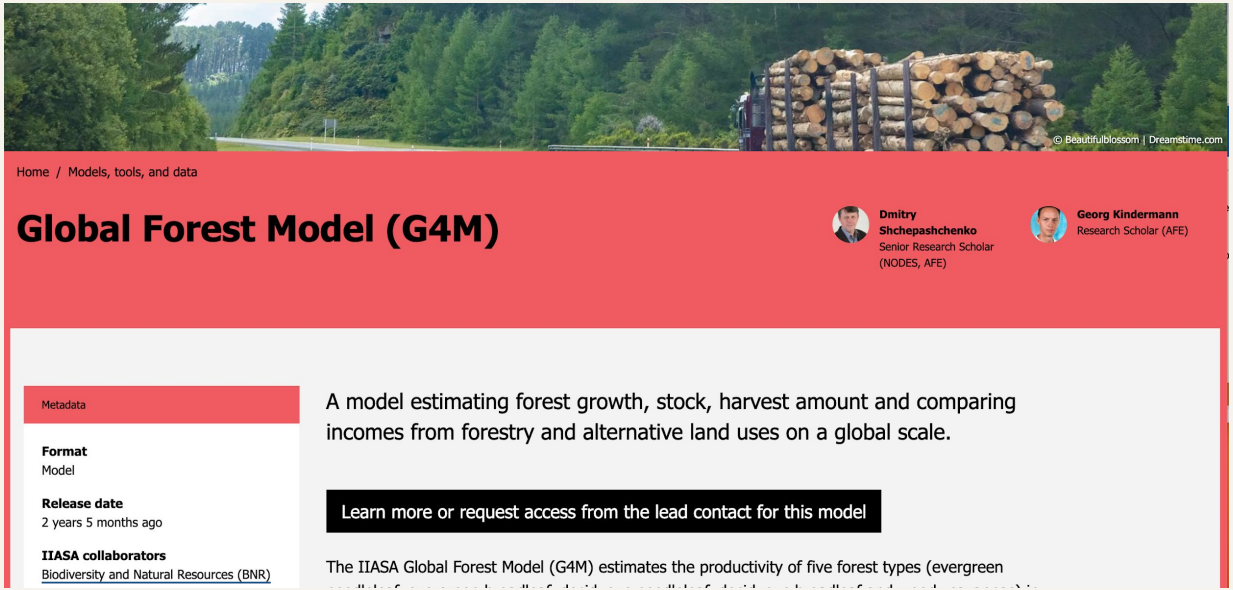
Steps

Mass balance at 2017
Mass balance model 2010-2022

Economic structure of the system (turnover, added value, no. of companies, employees, … at 2017)
Econometric model 2010-2022

Scenarios analysis: impacts on decarbonization, natural capital value (biomass stocks), fossil energy substitution connected to policies aimed at:

- increasing industrial roundwood production (building sector – NBI)
- increasing biofules production
- increase forest aging and standing trees biomass



https://iiasa.ac.at/models-tools-data/g4m

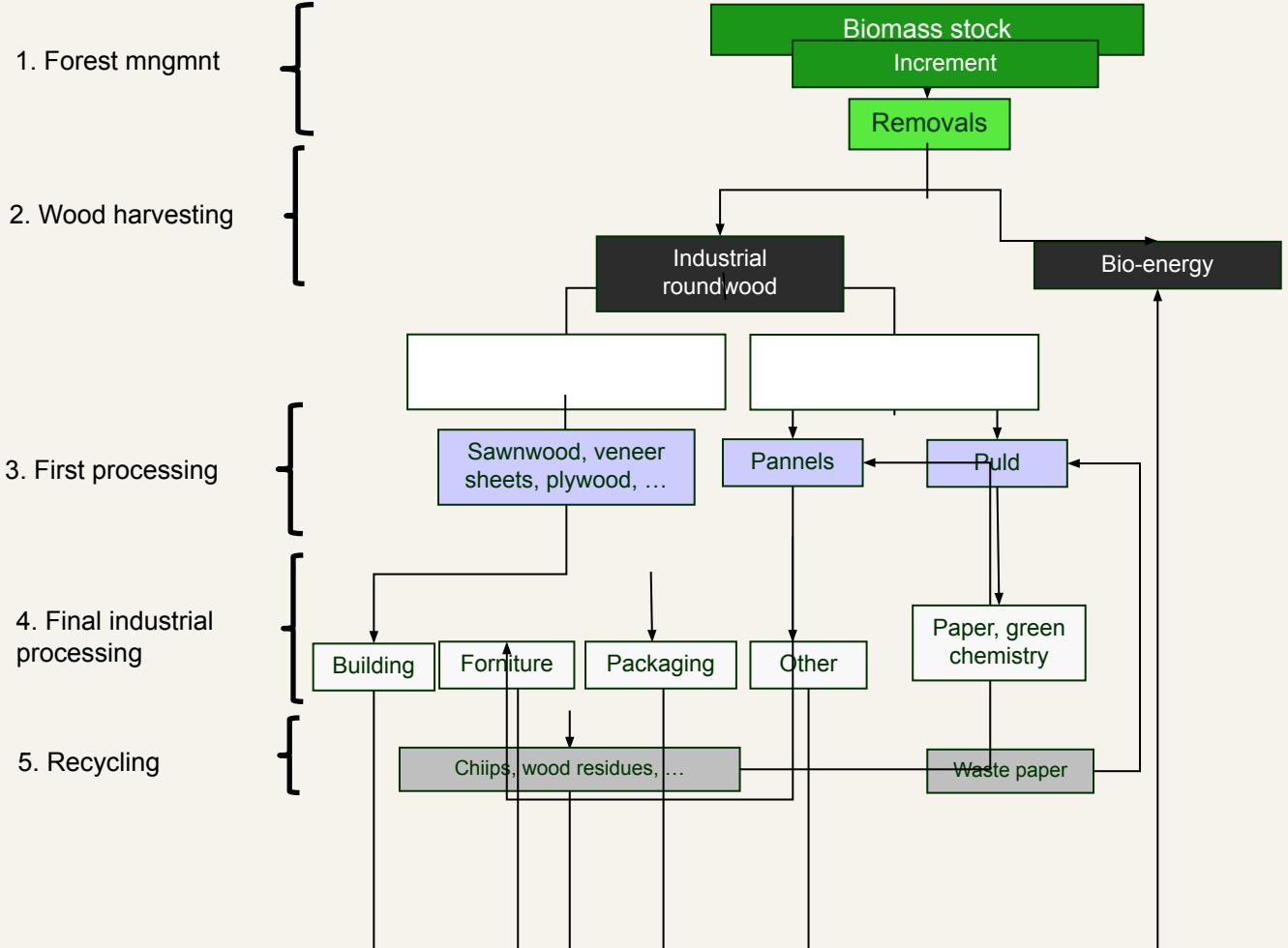
Data sources

- FAOSTAT, COMTRADE: trade and production data*
- Italian National Inventory of Forests and Carbon sinks (INFC – CUFA and CREA)*
- Orbis (turnover and employees)
- Istat (Residential energy consumption)*
- FLA, Assocarta, Confartigianato, CNA (wood industry structure)
- AIEL (wood biomass consumption)
- FIPER (wood biomass consumption in district heating)
- GSE (general data on biomass consumption)*
- RILEGNO (wood recycling) and COMIECO (paper recycling)
- MASAF (Direzione Generale Economia Montana e Foreste (wood consumption in power plants)

*: Open Access

What have we done so far?

- Selection of NACE and SIC/CN codes
- Re-classification of the forest-wood systems: 5 industrial + 1 bioenergy value chains
- Definition of 3 level ranking of the system:
  - 1st level: forest management, first processing
  - 2nd level: 1st level + building material, papers, chemical components, … and recycled products
  - 3rd level: with added segments of value creation (tourism and recreation, water purification, green care, …)
- First mass balance for 2017 and 2022

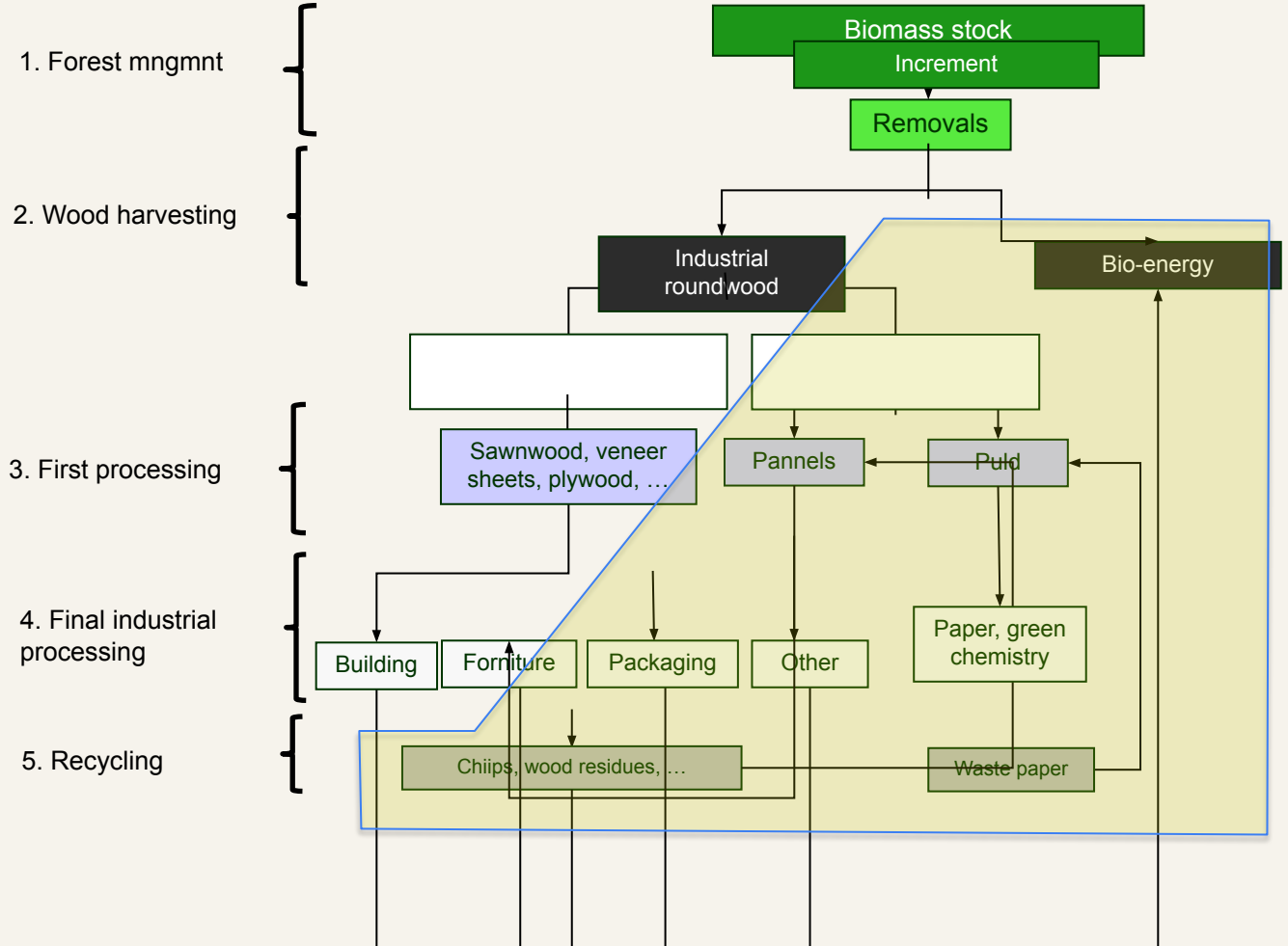

1. Forest mngmnt
2. Wood harvesting
3. First processing
4. Final industrial processing
5. Recycling
Biomass stock
Increment
Removals
Industrial round wood
Bio-energy
Sawnwood, veneer sheets, plywood, …
Pannels
Puld
Building
Forniture
Packaging
Other
Paper, green chemistry
Chiips, wood residues, …
Waste paper

Production and trade of wood products (1,000 m3 or t; 2022)

		Fattore conversione	Import	Import. (m3 eq.)	Export	Export (m3 eq)	Produzione	Produzione (m3 eq)	Consumo apparente	Tasso di autoappr.
Legna da ardere, conifere	m3	*1,00*		82		24		1.180	1.238	95,3%
Legna da ardere, latifoglie	m3	*1,00*		459		18			10.100	95,6%
Tondame industriale, conifere	m3	*1,00*		841		416		4.125	4.550	90,6%
Tondame industriale, latifoglie	m3	*1,00*		2.228		149			2.956	29,7%
Legno grezzo, conifere	m3	*1,00*		923		440		5.305	5.788	91,7%
Legno grezzo, latifoglie	m3	*1,00*		2.687		167		10.536	13.056	80,7%
Totale legname grezzo				**3.610**		**607**		**15.841**	**18.844**	**84,1%**
Carbone da legna	t	*6,00*	57	340	1		10	60	115	52,0%
Cippato e legname in particelle	m3	*2,43*	559	1.358	678		3.600	8.748	8.629	101,4%
Pellet di legno	t	*2,19*	1.916	4.195	7	15	450	986	2.894	34,1%
Altri agglomerati a fini energetici	t	*1,83*	151	277		13	20	37	181	20,2%
Segati di conifere	m3	*1,82*	5.243	9.543	193	351	400	728	5.778	12,6%
Segati di latifoglie									1.436	67,9%
Tranciati									433	48,4%
Compensati									566	107,7%
Pannelli di particelle									851	47,9%
OSB									420	40,0%
Pannelli ad alta densità									289	8,7%
MDF									2.513	68,3%
Altri pannelli di fibra									83	4,6%
Paste meccaniche e semichimiche									725	76,9%
Paste chimiche	t	*4,46*	3.352	14.949	278	1.238	13	58	3.132	1,9%
Totale parziale semilavorati legno				**39.112**	**0**	**6.705**	**0**	**15.290**	**28.047**	**54,5%**
Carta da macero	t	*1,19*	296	352	1.481	1.762	5.394		5.008	128,2%
Prodotti legnosi riciclati	t	*2,37*	525	1.245	24	56	1.717		5.258	77,4%
Totale prodotti legnosi riciclati				**1.597**		**1.818**			**10.267**	**102,2%**

Recycling is 2 times the domestic removals of industrial roundwood

Fonte: dati FAOSTAT, salvo la produzione di Prodotti legnosi riciclati (fonte: Rilegno)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Carbone da legna								60	115	52,0%
Cippato e legname in pa								8.748	8.629	101,4%
Pellet di legno								986	2.894	34,1%
Altri agglomerati a fini e								37	184	20,2%
Segati di conifere								728	5.778	12,6%
Segati di latifoglie								975	1.436	67,9%
Tranciati								209	433	48,4%
Compensati								610	566	107,7%
Pannelli di particelle								408	851	47,9%
OSB								168	420	40,0%
Pannelli ad alta densità	m3	*1,60*	283	453	19	30	16	25	289	8,7%
MDF	m3	*2,12*	1.065	2.258	269	571	810	1.717	2.513	68,3%
Altri pannelli di fibra	m3	*1,54*	85	131	6	9	3	4	83	4,6%
Paste meccaniche e semichimiche	t	*2,66*	182	485	15	40	210	557	725	76,9%
Paste chimiche	t	*4,46*	3.352	14.949	278	1.238	13	58	3.132	1,9%
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Totale prodotti legnosi riciclati				**1.597**		**1.818**		**10.488**	**10.267**	**102,2%**

79.1% of the apparent consumption of semifinished products and bioenergy is based on low quality biomass

Source: FAOSTAT and Rilegno