Social sustainability assessment for a stakeholder-centered building retrofit

Claudia Di Noi[1], Veronika Zavratnik[2], Jure Vetršek[2], Davide Brandolini[3], Martino Gubert[3], Andreas Ciroth[1]

1 GreenDelta GmbH, Berlin, Germany

2 Institute for Innovation and Development of University of Ljubljana, Ljubljana, Slovenia

3 Eurac Research, Bozen/Bolzano, Italy

The need for building renovation

- The EU building stock is old and often shows a poor energy performance [RICS]
- The EU building stock must decrease greenhouse gas emissions by 60% and final energy consumption by 14% compared to 2015 to achieve the climate targets [European Commission]
- **GHG emissions and energy are not the only issues:**

-> energy poverty

-> unhealthy environments

-> lack of thermal and psychosocial well-being

-> social inequalities

Building stock renovation is crucial to achieve environmental objectives, social justice and well-being

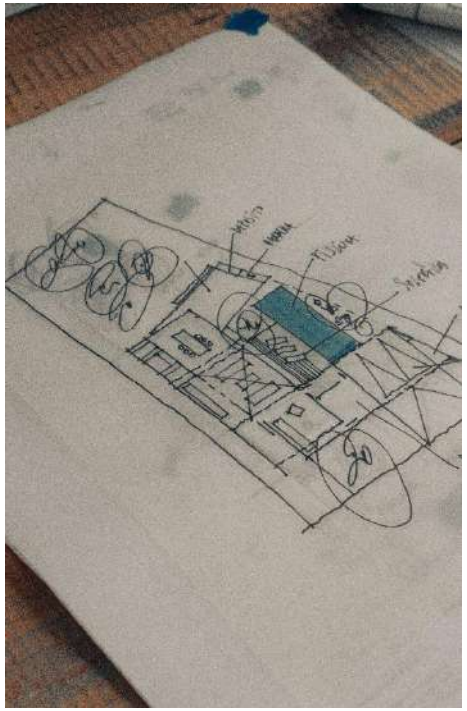
How do we renovate the EU building stock?

- Traditional retrofitting may not be suitable:

Health and safety at the construction site

Material and waste management on site

Disturbance for residents



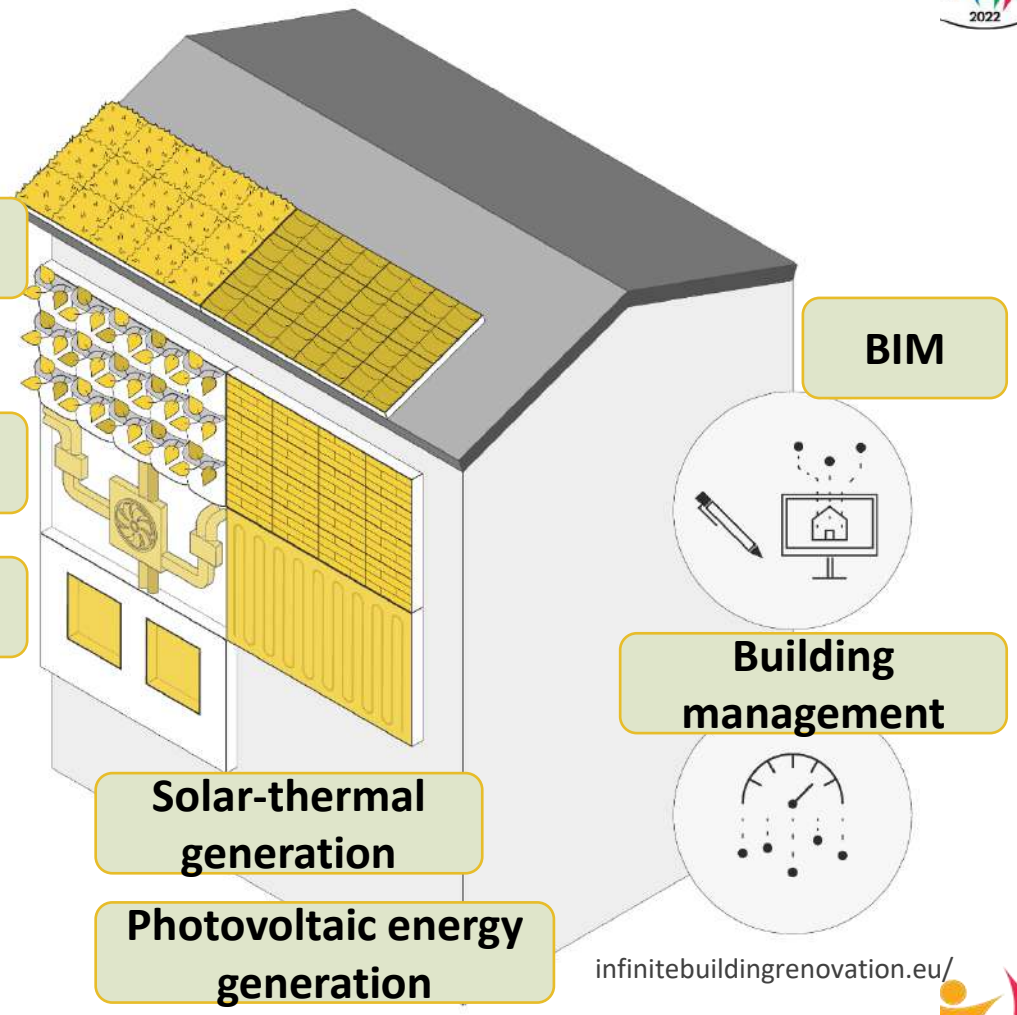
Mismatch between project and reality

Residents´ needs ignored

Industrialized building renovation: the INFINITE project

- H2020 EU project (2020-25)
- Focus on building envelope
- Industrialized retrofitting principles:
- **OFF-SITE PREFABRICATION**
- **MULTI-FUNCTIONAL ENVELOPE**
- **DIGITALIZATION**

- 3 case studies (residential buildings):
- **ITALY**
- **SLOVENIA**
- **FRANCE**



infinitebuildingrenovation.eu/

Goals of the social assessment

1 To understand residents´ socio-economic issues and needs, perception and potential impacts of novel technologies

RESIDENTS

Recommendations for technology design

2 To compare impacts of industrialized and traditional renovation on different stakeholders in the building life cycle

RESIDENTS

WORKERS

LOCAL COMMUNITY

VALUE CHAIN ACTORS

SOCIETY

Validation of INFINITE from a social perspective and orient technology development

The Italian case

- Location: Greve in Chianti, Tuscany, Italy
- **Destination: social housing**
- 2 twin buildings with 4+4 dwellings
- Year of edification: 1978-79
- Reinforced concrete frame structure
- Autonomous heating and domestic hot water systems
- Number of residents: 15
- **Resident composition: elderly, retired (most residents have lived there for 30-40 years)**

Role of anthropology in the social LCA study

- Social assessment in the project combined with anthropologically-inspired studies for on-site activities and interaction with residents

Interview with building managers

Survey distributed to residents

3 site visits:

- workshop with residents and project manager;

- workshop with residents and social researcher + interviews;

- visit with project consortium

INPUTS FROM ANTHROPOLOGISTS:

- **What to ask and how to ask -> start from basics**
- **Role of observation -> cross-check what people tell**
- **Understand why people behave in a certain way**
- **Field trip dairy**
- **Social LCA expert interviewed by anthropologists**

Residents: findings and recommendations

- Residents spend most of the time at home (mainly kitchen)
- Familiarity with **technology** is generally poor
- Main problems: **poor balcony status, old windows, and inefficient thermal performance of the building in winter and summer, high energy bills**
- Photovoltaic panels and smart windows encountered the most positive reactions among the residents
- Residents are afraid of the economic implication of the novel technologies

RECOMMENDATIONS:

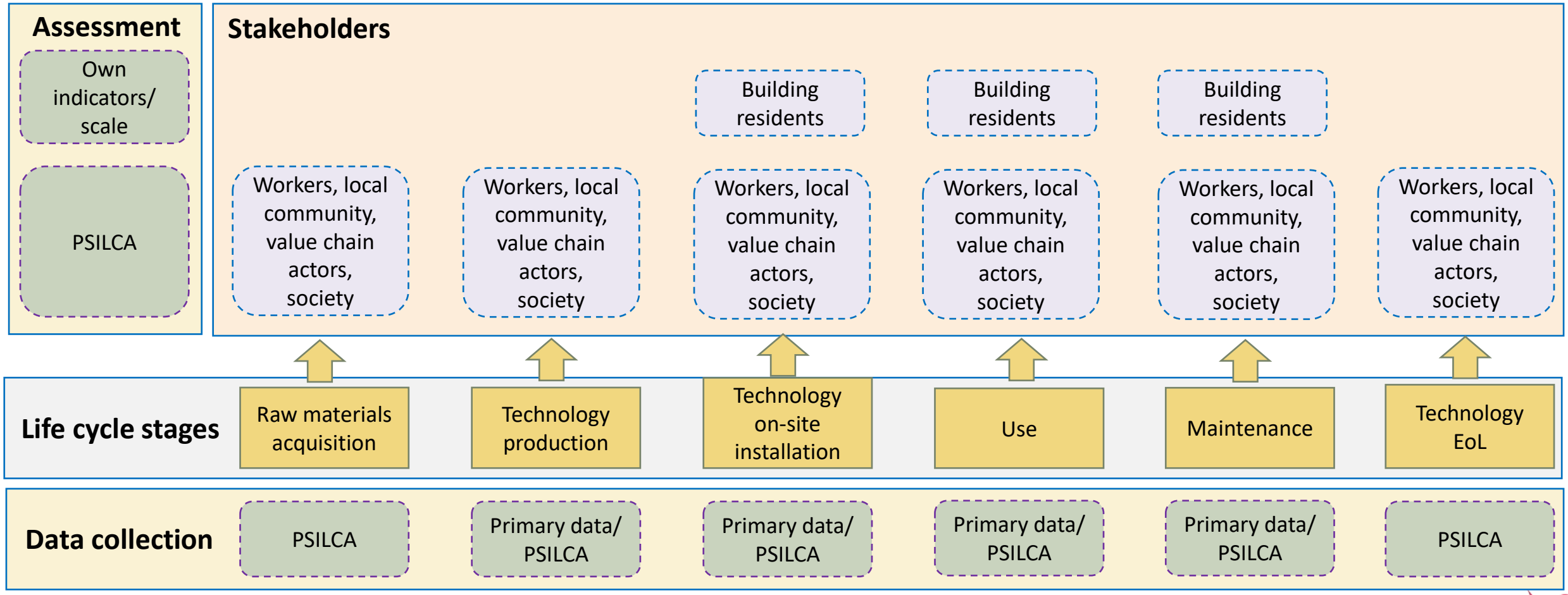
1. Pay attention to complexity of technologies -> **training** (also involving relatives of the older residents)

2. Include the **display** of parameters interesting for residents, such as weather forecasts, to increase the interest in new systems

3. **Promote benefits of technologies** -> e.g. display relation between energy and energy bills

4. **Calm technology principle** -> customization

Assess and compare impacts of industrialized renovation



Residents: social topics

- Sources: EN16309:2014; EN16978-1:2019; EN 17037:2019; EN15251:2017; screening; Touceda (2018)*

INSTALLATION

- User disturbance

USE

- Thermal well-being
- Quality of internal environment
- User interaction with building systems
- Safety and security
- Aesthetics
- Psychosocial well-being
- Socio-economic aspects
- Accessibility
- Adaptability

MAINTENANCE

- User disturbance
- User engagement
- Socio-economic aspects

* M. I. Touceda, F. J. Neila, and M. Degrez, “Modeling socioeconomic pathways to assess sustainability: a tailored development for housing retrofit,” *Int. J. Life Cycle Assess.*, vol. 23, no. 3, pp. 710–725, 2018.

Residents: indicator assessment

- Indicators and assessment scale for residents need to be elaborated for use, maintenance and installation
- From social topics to indicators:

Social theme	Indicator	Quantitative assessment	Semi-quantitative assessment	Qualitative assessment
Thermal well-being	Indoor air temperature (summer)	°C	PMV,PPD categories, EN ISO 7730:2006	
	Indoor air temperature (winter)	°C		
	Indoor humidity	%		
	Air velocity	m/s		
	Control of thermal comfort at dwelling level		Scale; 1-5: automatically+distinction individual rooms-1; yes (automatically)-2; manually + distinction individual rooms -3; yes (manually)-4; no-5	yes/no
	Monitor of parameters for thermal comfort at dwelling level		Scale; 1-4: yes (measured and displayed at individual room level)-1; yes (measured and displayed at dwelling level)-2; yes (measured)-3; no-4	yes/no
	Need to change temperature		Scale; 1-3: no (comfort) 1- sometimes (partial discomfort)-2; yes(discomfort)-3. Do you want the temperature in summer and winter: Higher (discomfort), no change (comfort), lower (discomfort)	yes

Residents: indicator assessment (non-quantitative)

- **Delays** in the project postponed measurements with sensors needed for quantification of indicators
- It often happens that quantitative measurements through sensors cannot be collected
- **Need to think about a preliminary impact screening to orient technology development**
- Preliminary assessment based on 2 surveys and 1 workshop with project partners

		Context assessment		
Retrofit impact		Good	Acceptable	Bad
Industrialized/ traditional retrofit	Positive	Improves something good (A)	Improves something acceptable (B)	Improves something bad (C)
	Indifferent	Does not affect something good (D)	Does not affect something acceptable (E)	Does not affect something bad (F)
	Negative	Worsens something good (G)	Worsens something acceptable (H)	Worsens something bad (I)

Residents: results

IND: industrialized renovation

TRAD: traditional renovation

Use phase of the building		Context assessment (current status building – IT case)						Reason for choice	
		Good		Acceptable		Bad			
Social theme	Indicator	IND	TRAD	IND	TRAD	IND	TRAD	IND	TRAD
Thermal well-being	Indoor air temperature (summer)					C	C	building envelope will be completely replaced and guarantee a good thermal performance in winter	
	Indoor air temperature (winter)					C	C	building envelope will be completely replaced and guarantee a good thermal performance in summer, together with ventilation	
	Indoor humidity			B	B			building envelope will be completely replaced and together with ventilation will guarantee humidity conditions (30% winter, 50% summer)	
	Monitor of parameters for thermal comfort at dwelling level			B	E			Building management system will ensure that temperature and other thermal parameters can be displayed by users at dwelling level	Sensors will be installed only for indoor temperature and the heat pump, does not imply a big change for thermal parameters

FINDINGS:

1. Major improvements in **physical and psychosocial well-being and energy bills** (IND, TRAD)
2. **Control and monitoring** of thermal, visual and air quality parameters can notably improve with industrialized retrofitting (IND)
3. Complexity of systems may increase -> **noise, easy dismantling, maintenance costs** can be affected (IND)
4. **Retrofit duration, disturbance (noise, dust), relocation risks** are expected to decrease to a large extent (IND)

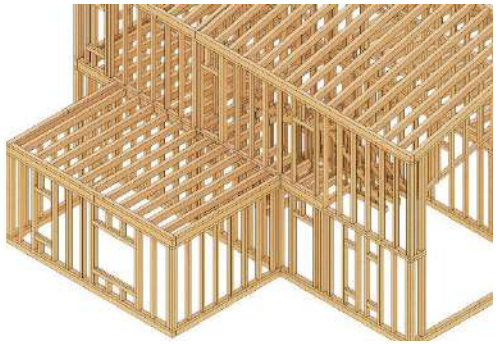
Social LCA for other stakeholders than residents

- Workers, local community, society, value chain actors: indicators contained in the PSILCA database
- **Industrialized renovation**: complete primary data for components, costs and worker hours; no primary social data
- **Traditional renovation**: secondary data for components, costs, worker hours from regional price list (Tuscany); no primary social data
- Qualitative data from project partners (survey + workshop) and building experts in the value chain (survey)

-> Test case: retrofitting 15 m² of façade (U= 0.16 W/m²K) with industrialized vs traditional approach at the Italian case

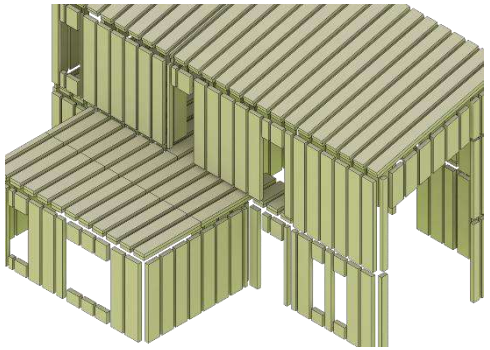
Test case: renovation of façade

Industrialized renovation



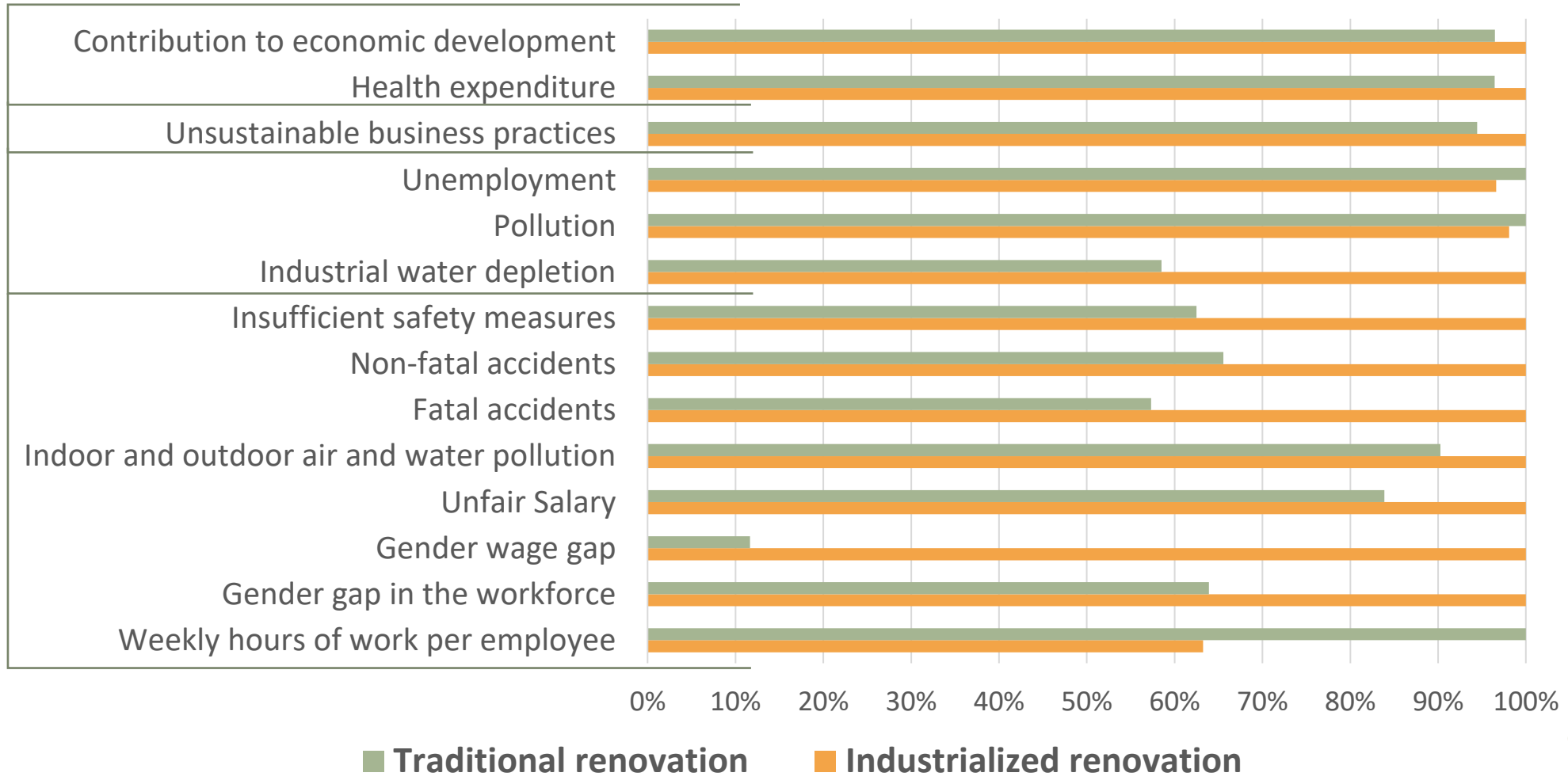
	Component production	Component assembly off-site	Installation on-site
Location	DE, AT, IT, HR, Asia	IT	IT
Social data	PSILCA	**Adapted from Construction sector - IT**	**Adapted from Construction sector - IT**

Traditional renovation



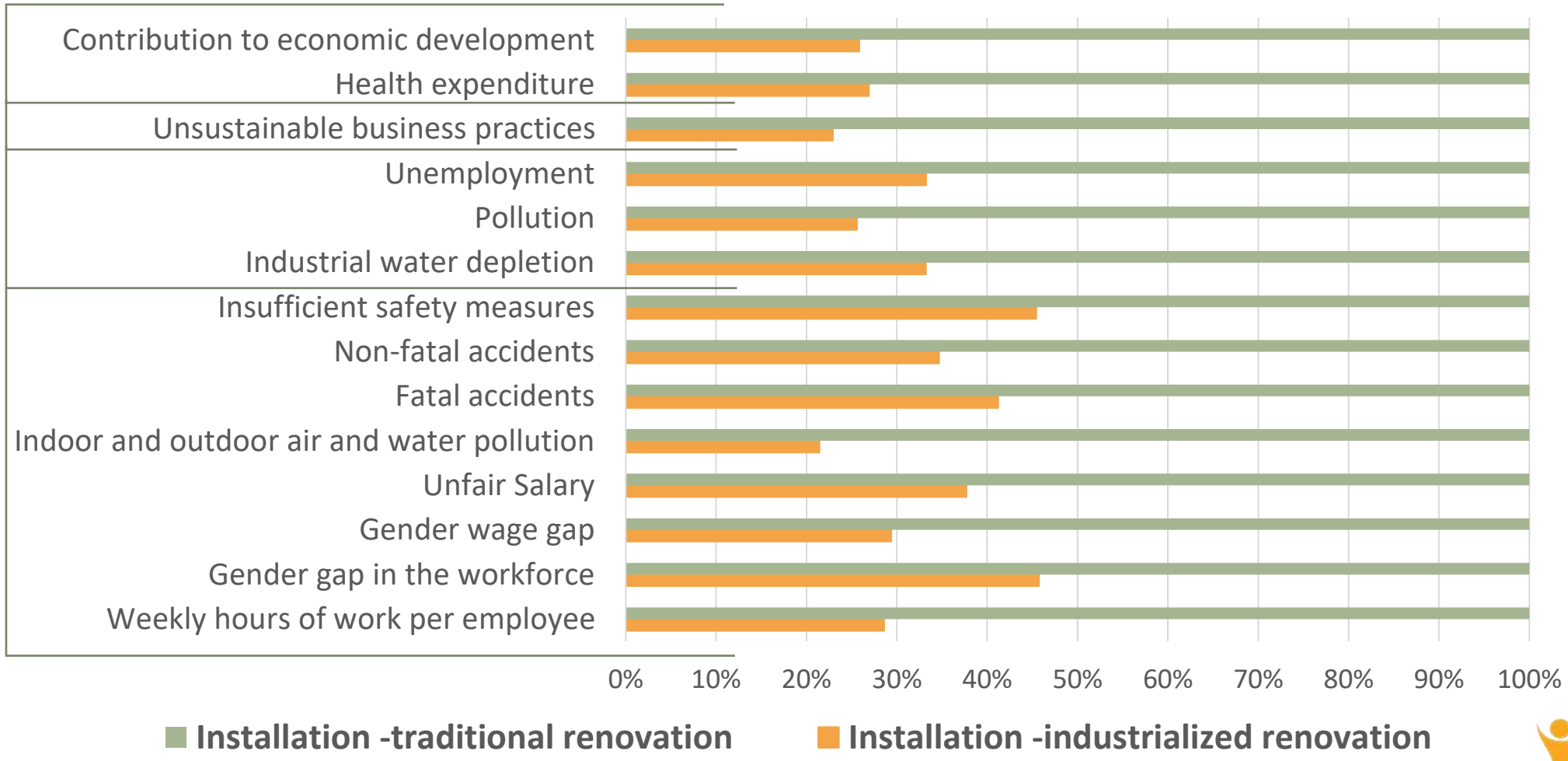
	Component production	Installation on-site
Location	IT (assumed)	IT
Social data	PSILCA	**Adapted from Construction sector - IT**

Results: industrialized vs traditional façade renovation (production-transport-installation)



DRIVERS:
1. Assembly of components
2. Duration of installation

Results: industrialized vs traditional façade renovation – installation stage



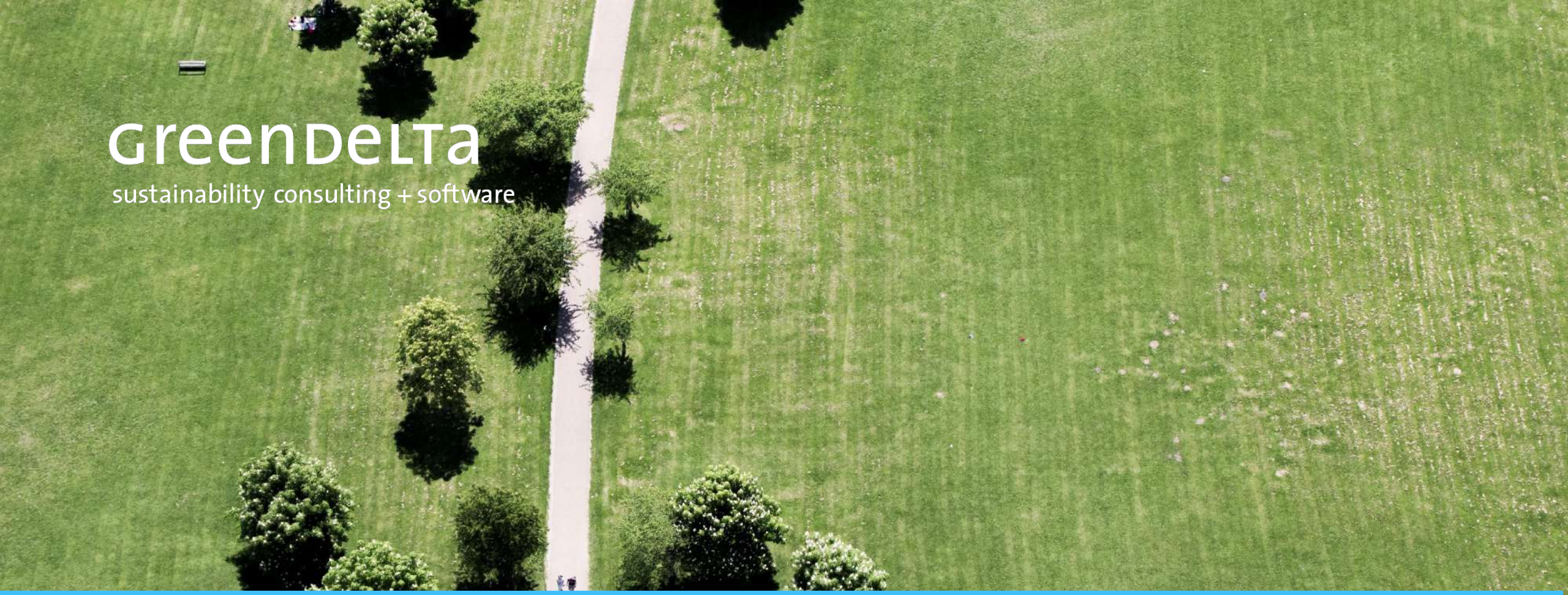
DRIVERS:
1. Material and waste on site
2. Renting of equipment

Conclusions and next steps

- Extension of analysis to operational and end of life stages is key to assess social sustainability of industrialized renovation in the whole life cycle
- Distinction of direct social risks in the industrialized vs traditional renovation scenarios can further show benefits of industrialized approach

- Health and safety improves on site <> lack of skilled workers for off-site assembly -> training, visual guidelines
- Employment <> benefits concentrated in few locations -> last steps of prefabrication within the local community
- Maintenance costs -> maintenance should be predictable -> building management systems

Public report expected in May 2023



Claudia Di Noi, dinoi@greendelta.com
GreenDelta GmbH

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