

Stimulating circular public procurement: The case of second-life batteries for traction applications

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Introduction

On the roadmap to decarbonization that most countries have embarked on, circular economy has established itself as the relevant concept to operationalize the goals set by the states. Public procurement is a recognized pathway for encouraging circular innovation and creating new markets [1], [2]. Adopting circular economy practices in public procurement is therefore a promising approach for the deployment of sustainable products and services in the broader economy. Batteries are a key element of the EU's 2nd Circular Economy (CE) Action Plan and related material loops should be closed to secure resources of strategic importance for a decarbonized European economy, while reducing environmental and social impacts of raw materials extraction.

So far, research and policy focus primarily on closing loops through recycling and less on extending the life of batteries through repurposing as second-life batteries or servitization, although the latter allows capturing more value of resources. Also, second-life applications tend to be limited to the applications least demanding for batteries, for instance off-grid electricity storage. Yet small utility vehicles are a promising market for second-life batteries, provided used cells are carefully selected with respect to their state of health prior to building them back into new battery packs.

This paper aims at investigating the potential of circular practices related to batteries of small electric utility vehicles in municipalities known for their commitment to the energy transition and climate protection. Indeed, circular practices are likely to be first adopted by innovation frontrunners before their broader diffusion. According to innovation diffusion theory [3], a minority of early adopters will generate experience with new circular practices, thereby bringing down their price and making these solutions more visible and accessible to the rest of the market. The addressed research questions are:

- To what extent are these municipalities relying on electric powertrains for small utility vehicles? What are barriers and drivers for their procurement?
- How attractive are circular practices to these municipalities, with a focus on second-life batteries and servitizing batteries, i.e., adopting product-as-a-service (PSS) models?
- What are barriers and drivers of procuring second-life batteries and batteries as a service?

Materials and methods

We selected 89 Swiss political municipalities that are actively engaged in climate or energy initiatives. Survey respondents are heads of municipality workshops or public works departments, vehicle fleet managers or assume similar responsibilities.

The survey design consisted in the following, main parts:

- Electrification of small utility vehicles incl. drivers and barriers for the procurement of such e-vehicles,
- Batteries: type currently used, requirements, satisfaction level; attractiveness of second-life batteries incl. drivers and barriers for their procurement; attractiveness of servitized batteries incl. drivers and barriers for the adoption of PSS models. Both second-life batteries and PSS models were briefly explained to the survey respondents.

Literature was used to suggest drivers and barriers of small electric utility vehicles, second-life batteries, and PSS models to the respondents.

Results

Almost all large cities in Switzerland answered the survey. Otherwise, municipalities from all regions (mountains and midlands, all linguistic regions) are represented. The response rate was 70%.

Most frontrunning municipalities own small electricity utility vehicles (75%), some are planning to acquire such vehicles (10%), with the reduction of environmental impacts as main reason. A small minority is not considering this option (15%). In other words, we are observing the ongoing electrification of this kind of municipal vehicles. Not so unsurprisingly, the main barriers for procuring such vehicles are closely related to the batteries, as 72% of municipalities mentioned the high purchase cost of battery electric vehicles (BEVs) as barriers (driven by the battery cost), 67% mentioned the limited range of BEVs, and 43% mentioned the uncertainty regarding the battery lifetime.

Focusing onto batteries, another transition is visible, that of the replacement of lead-acid batteries by lithium batteries, with three quarters of municipalities relying on lithium. Here, the EU legislation (e.g., REACH) is certainly affecting the market. Interestingly, requirements most often mentioned are performance and longevity, not price and service and most municipalities are satisfied with current batteries. Figure 1 shows the attractiveness of two circular practices related to batteries of small electric utility vehicles for municipalities. Clearly, second-life batteries are more attractive than a servitization scenario, in which the battery is not procured but the service of energy storage is paid for on a usage basis (pay-per-use). While the main driver of second-life batteries is the demand from end users (mentioned by 51% of municipalities), main barriers are lack of knowledge (62%) and of a clear definition of circular public procurement (31%). A driver of pay-per-use mentioned by most municipalities is the saving of upfront costs, while barriers are a higher perception of cost of usage compared to total cost of ownership (42%) and traditional procurement rules and balance sheet constraints (40%).

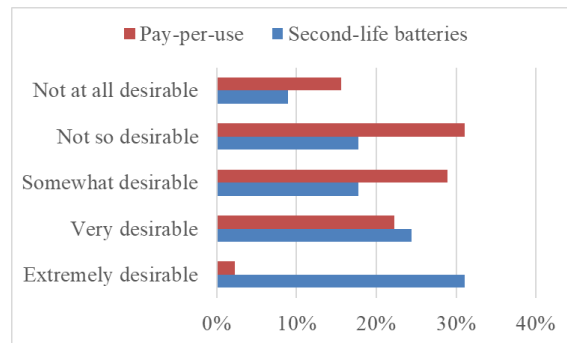


Figure 1. Desirability ratings by municipalities for two circular practices related to batteries of small electric utility vehicles.

Discussion and conclusion

Frontrunning municipalities in Switzerland are adopting electric powertrains for small utility vehicles to align with their energy initiatives and climate plans. They see batteries as the main barrier towards electrification. Second-life batteries are the most attractive circular practice related to vehicle batteries. A possible explanation is the absence of behavioural change that such a transition would imply for municipalities, while a pay-per-use system requires important adjustments, for instance in the accounting department [4]. Yet, if second-life batteries are to achieve a breakthrough in small utility vehicles, awareness raising and an effort in defining circular public procurement (CPP) will be needed. A follow-up to this survey lies not so much in the realm of research, but rather in raising awareness of respondents about second-life batteries. As for definitions of CPP, the Swiss state and/or industry organizations should take a proactive role.

Given the attractiveness of second-life batteries and their current barriers relating more to knowledge than technological or institutional hurdles, one can be hopeful about their diffusion among cities and other municipalities with a strong commitment to the energy transition and climate protection. And what about other municipalities and the private sector? Experience gained with public frontrunners could lead to efficiency gains in second-life battery manufacturing and price reductions as well as contribute to reducing concerns about second-life equipment. Ultimately, the frontrunners could stimulate circular public procurement and pave the way for broader adoption by the private sector and households. Here, research should accompany this diffusion with the aim of steering it towards increased circularity and accelerating it. On a more general level, the survey shows that the energy transition is engaged with real local benefits of reduced air and noise emissions in cities and towns of Switzerland, but what about the circular transition so crucial to reduce our dependency on resources? Reducing such a dependency will help achieve climate change goals and reduce environmental and social impacts in the extracting countries.

To conclude, the survey conducted is not only relevant to Switzerland but to the whole of Europe for which the battery sector is one that is crucial to the EU CE Action Plan. Also, volumes generated by European frontrunning municipalities adopting second-life batteries would be of significant magnitude and would surely boost the second-life battery manufacturing sector.

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