

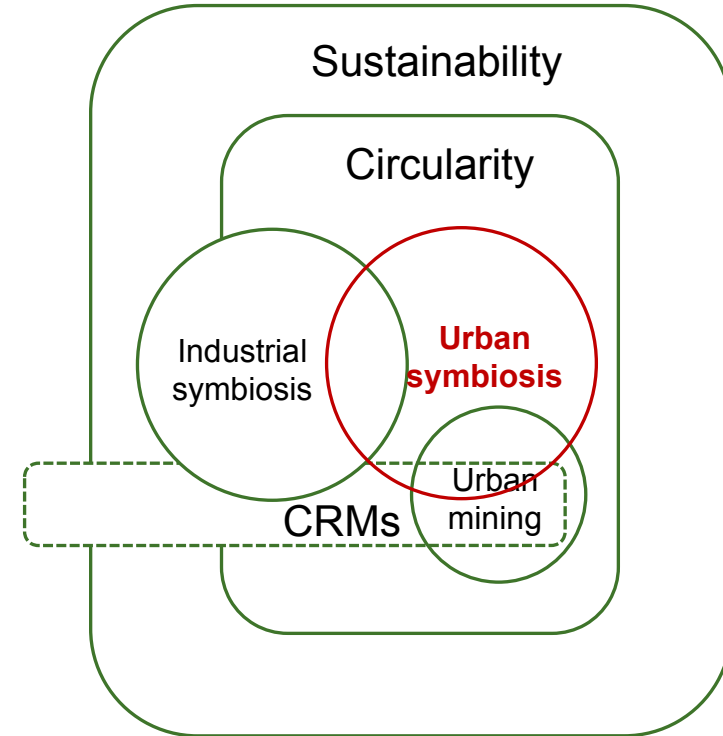
Urban symbiosis concepts for sustainable circular loops of CRMs containing products

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15/09/2023 VTT – beyond the obvious

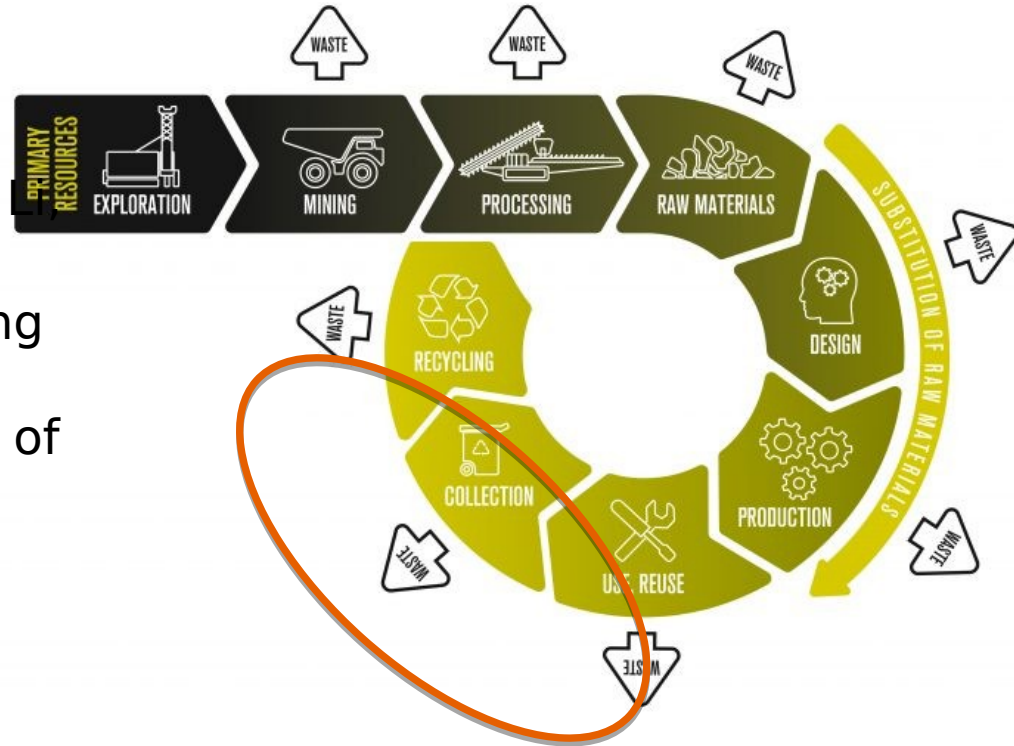
Urban symbiosis - aim and motivation

- Cities:
 - 56% of the world's population
 - Generates 80% of global GDP
 - Hotspot for consumption and waste:
 - 7 % of land area
 - 70 % of global waste generation
- Explore sustainable value creation models in cities which would keep CRMs in tighter loops
- Extend the lifetime of the high technology products



Circular (?) CRMs

- Less than 3 % recycled (REs, Si...)
- Recycling materials or re-using components could provide significant indigenous supply of technology-critical metals
- Technological, economic and regulatory barriers
 - Diluted; occur in minute amounts in products
 - Economy of scale?
- IPR (components)



CrEAM Network 2021

Case e-bike

- 21-22 million bikes sold in Europe yearly
 - Strongly increasing (linear) market (22 % per year)
 - Opportunity to develop circularity while growing
 - Contain CRM (battery, traction motor, screen)
- China, Africa and Latin America provide the majority of raw materials required for the e-mobility sector
- China the major supplier (66 %) of batteries components (i.e. cathode, anode, Li-ion cells)
- China and Japan dominate the production of permanent magnets and



Raw materials in traction motors

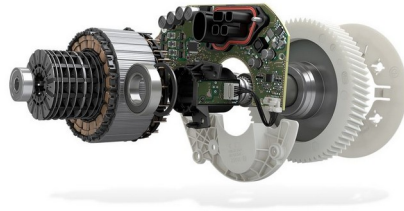
Critical in Permanent magnets:

Boron in NdFeB magnets

Dysprosium additive in NdFeB magnets

Neodymium in NdFeB permanent magnets in motor's rotor

Praseodymium together with Nd in permanent magnets



Iron in casings and in NdFeB magnets

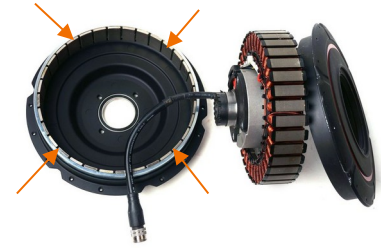
Silicon in electronics and Al-alloys

Aluminium in casings

Copper in cables etc

Chromium in steel and alloys

Molybden in steel and alloys



European Raw Materials Act 2023

1. producers must publish the necessary information on the volume, type and chemical composition of magnets, their location and the coating, glues and additives used, as well as information on how to remove the permanent magnets from the product.
2. a minimum quantity of recycled content should be set after a dedicated assessment of the appropriate level and likely impacts.

E-bike batteries

- Mostly Li-based
 - Lithium Cobalt Oxide (LCO), Lithium Iron Phosphate (LFP), Nickel Manganese Cobalt (NMC)
- Lithium 1-1.5% of the battery material
 - 40-150 g (max)/battery
- The EU is fully dependent on imports of battery cells
- New battery regulation (> 2 kWh)
 - Product passport
 - Recycled content

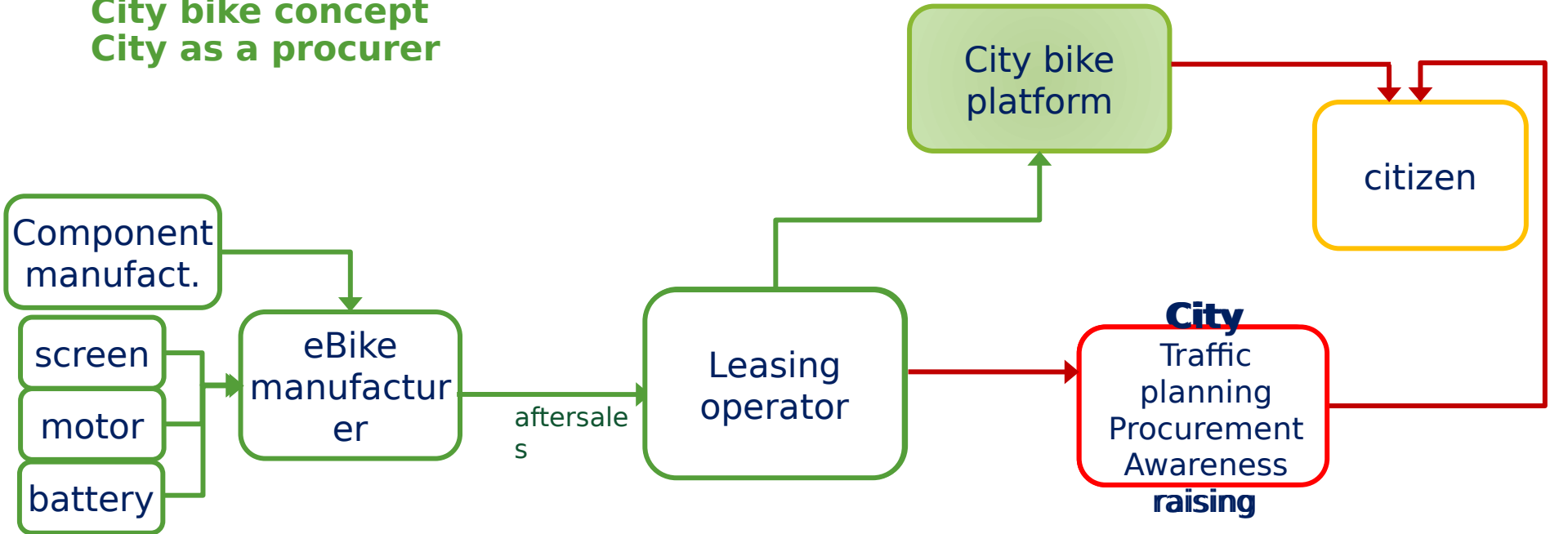


City's support for 9R strategies

Smarter product use and manufacture	R0 Refuse	Make product redundant by abandoning its function or offering the same function with a different product	
	R1 Rethink	Make product more intensive (e.g. through sharing , or by putting multi-functional products on the market)	← Procurement Sharing platforms
Extend lifespan of product and its parts	R2 Reduce	Increase efficiency in product manufacture or use by consuming fewer natural resources and materials	← Sharing platforms
	R3 Re-use	Re-use by another consumer of discarded product which is still in good condition and fulfils its original function	← 2 nd hand platforms, Repair cafés, ecocenters
	R4 Repair	Repair and maintenance of product so it can be used with its original function	← Social enterprises, recycling centers
	R5 Refurbish	Restore an old product and bring it up to date	← Vocational training
	R6 Remanufacture	Remanufacture discharged product or its parts in a new product	← Vocational training
	R7 Repurpose	Use parts of discarded product in a new product with a different function	← Vocational training
Material utilisation	R8 Recycle	Process materials to obtain the same (high grade) or lower (low grade) quality	
	R9 Recover	Incineration of materials with energy recovery	

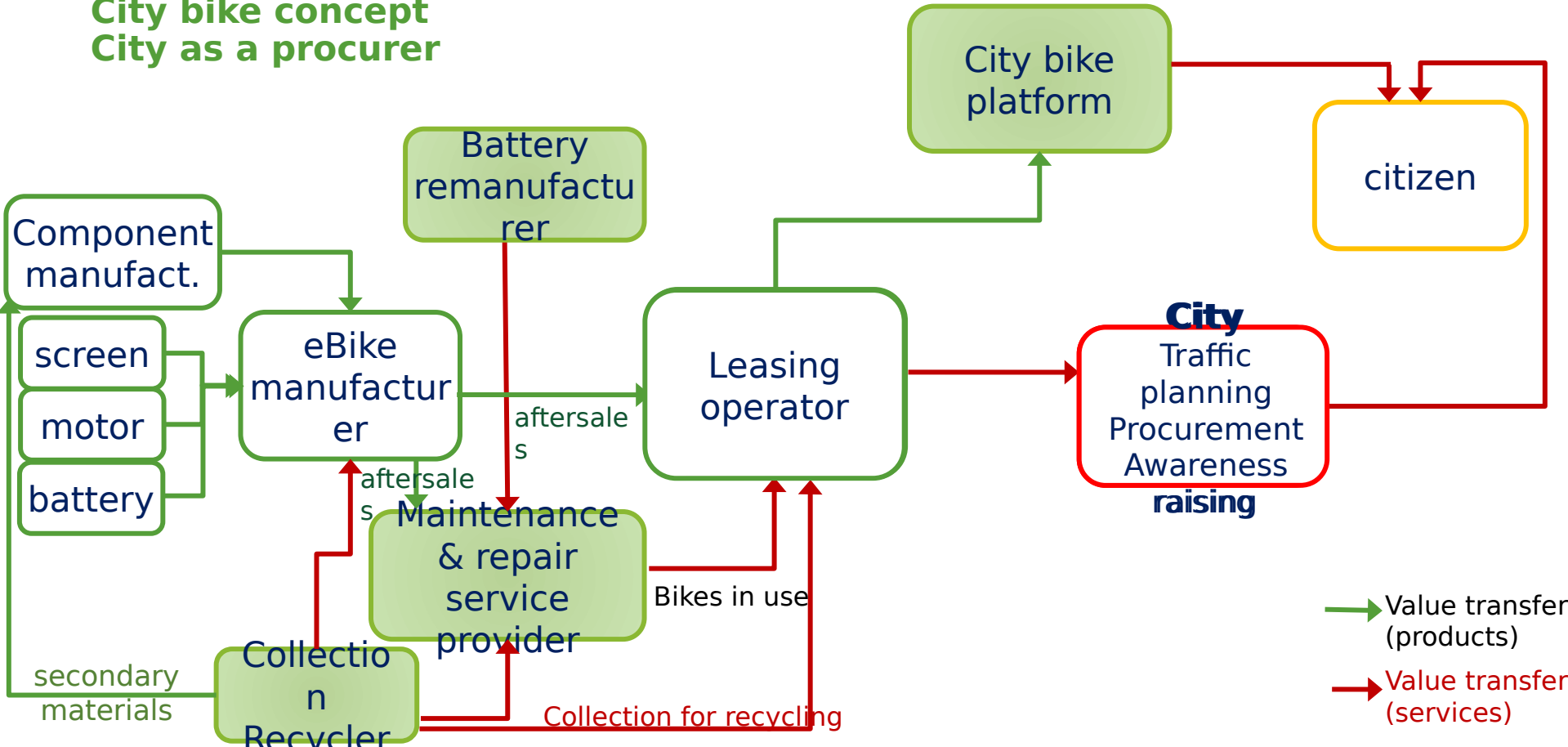
- Public procurement,
 - market shaping
- Zoning strategies and regulations
 - mobility
 - CE Hubs
- Sharing platforms
- Capacity building
 - education
 - vocational training
- Awareness raising
- Job creation programmes
 - social and eco-enterprises
 - repair shops
- Business licenses
 - CE enterprises

Example I
Circular eBike
ecosystem
City bike concept
City as a procurer

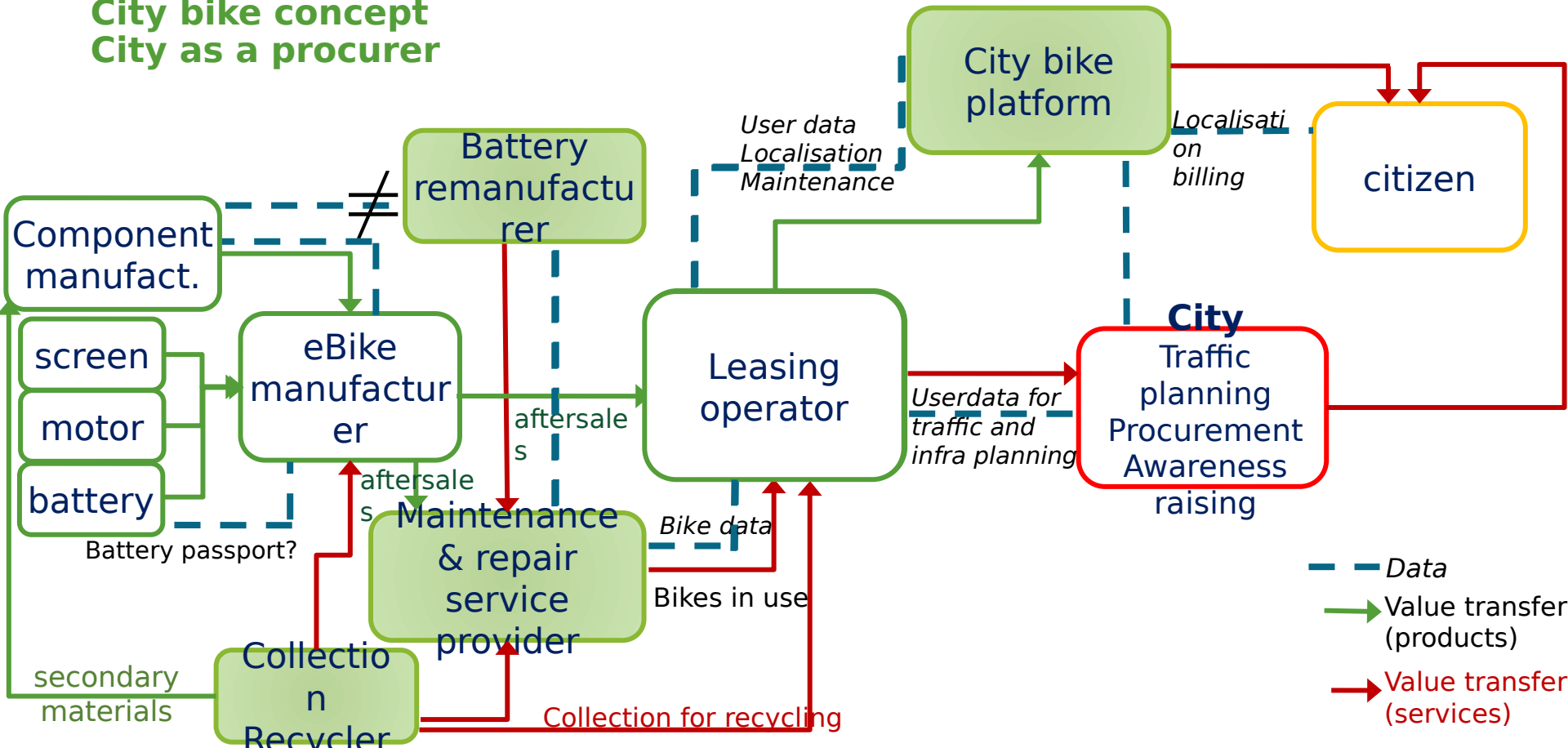


→ Value transfer (products)
→ Value transfer (services)

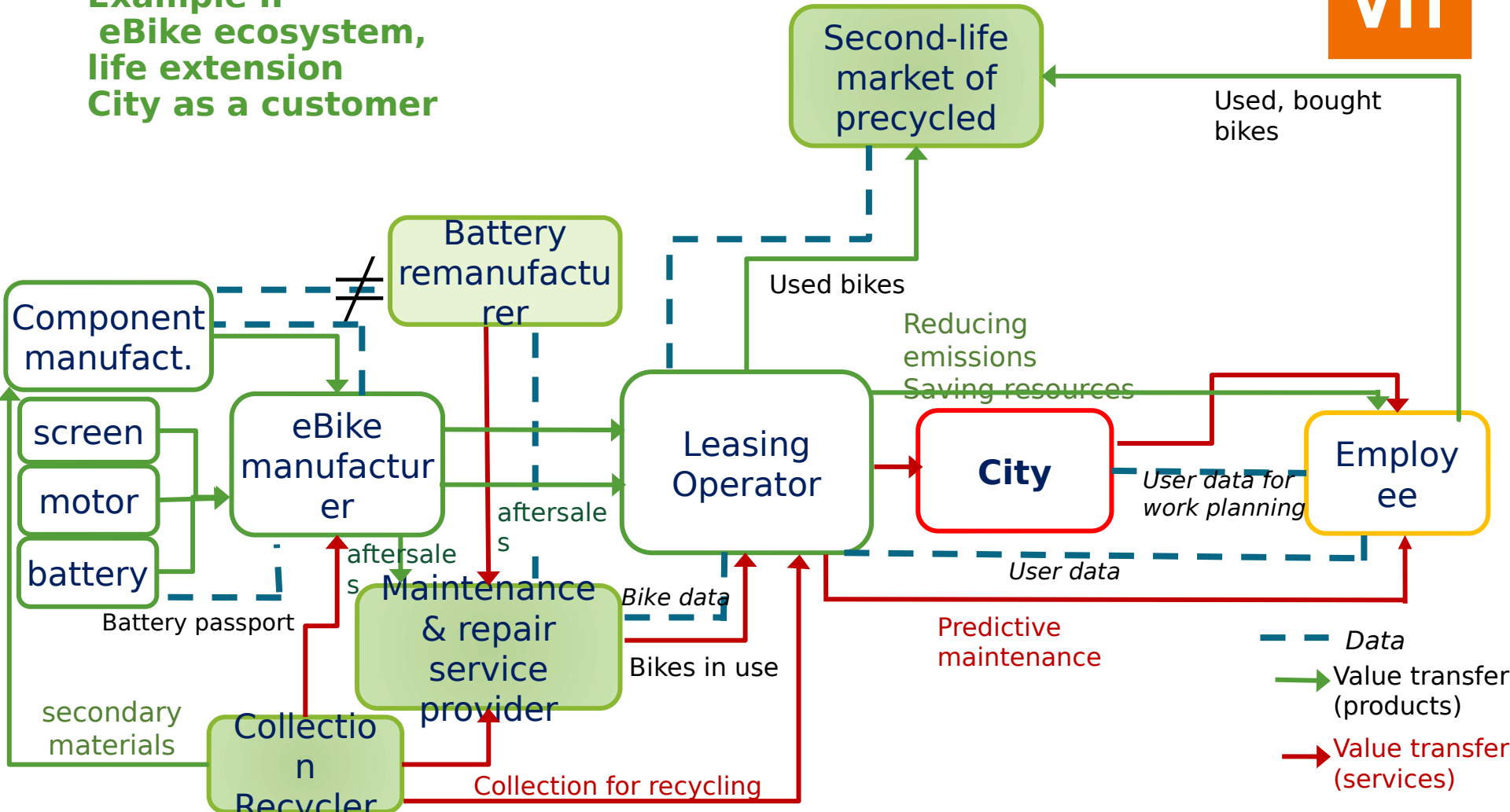
Example I
Circular eBike
ecosystem
City bike concept
City as a procurer



Example I
Circular eBike
ecosystem
City bike concept
City as a procurer



Example II
eBike ecosystem,
life extension
City as a customer



Thank you for your attention!

Mona Arnold