

Waste management & Circular Economy

Threat or opportunity?

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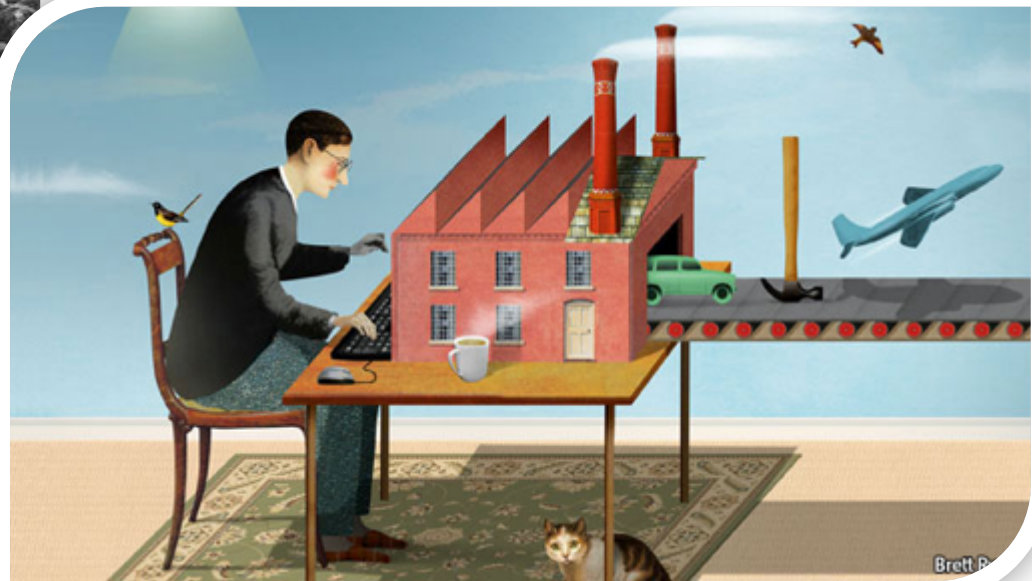
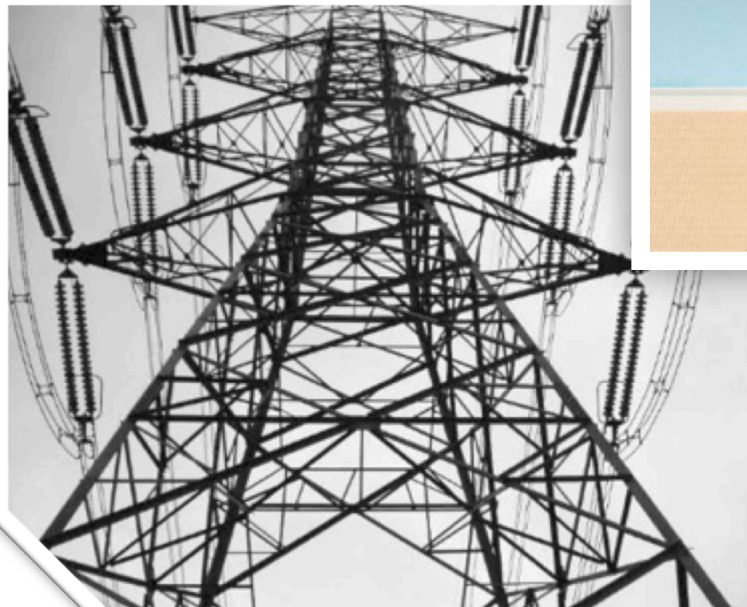


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CONTENTS

- Towards a third industrial revolution
- The concept of Circular Economy
- SWM and Circular economy
- A note on business models
- Conclusions

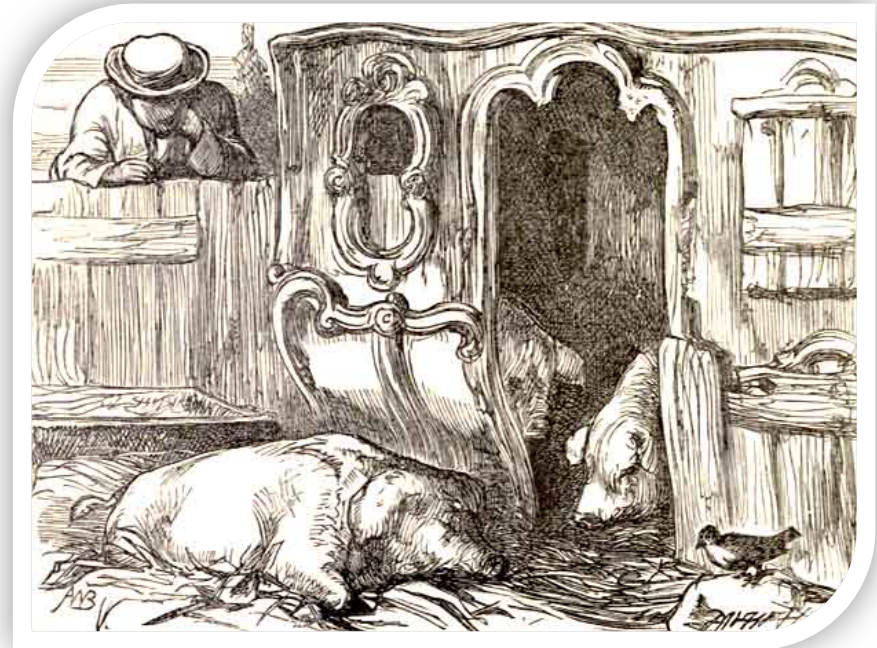
1. Towards a 3rd industrial revolution



SWM during the 1st industrial revolution

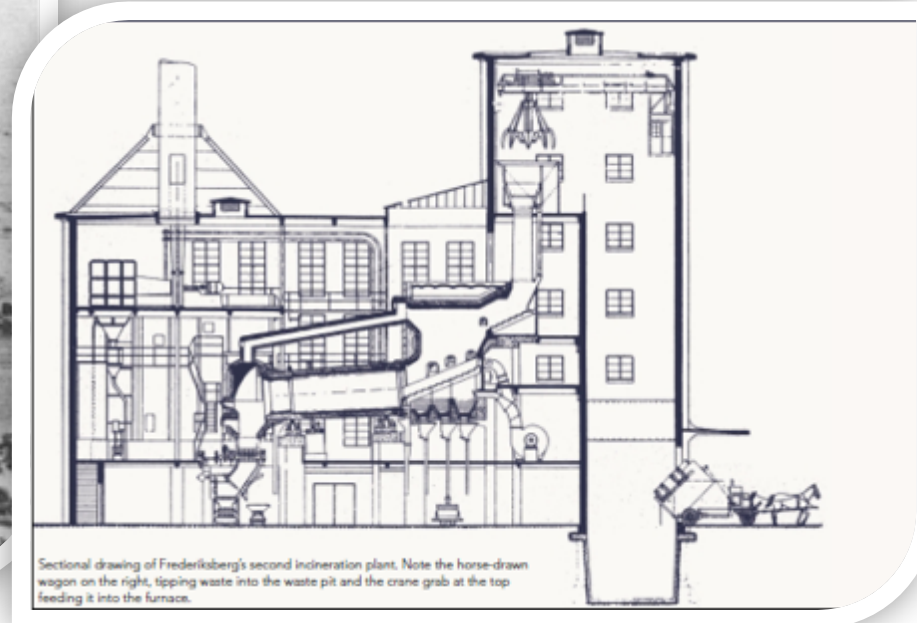
“... streets, elevated **a foot, sometimes two**, above the level of the causeway, by the accumulation of years, and stagnant puddles here and there, with their foetid exhalations. causeways broken and dangerous, ash-places choked up with filth, and excrementitious deposits on all sides as a consequence, undrained, unpaved. unventilated, uncared...**Can we wonder that such places are the hot-beds of disease**, or that it obtains, upon constitutions thus liberally predisposed to receive it, and forms the mortality which Leeds exhibits”

Source: Chadwick's Sanitary Report 1842



WASTE & PUBLIC HEALTH

SWM during the 2nd industrial revolution



**FIRST SWM COMPANIES
REGULATIONS**

Elements of the 3rd Industrial Revolution

- Resource scarcity & new reserves
- Internet of Things & system integration
- Driverless vehicles & drones
- 3D printers & wasteless production
- Renewable energy & oil scarcity
- Robotics
- **Circular Economy**

A useful comparison

	1 st revolution	2 nd revolution	3 rd revolution
Fuel	Coal	Oil	Renewables
Communication	Telegraph	Telephone, radio	Internet, mobile phone
World impact	13%	16%	37%
Industries	Iron, textile	Car, Steel, Electricity	Silicon Valley, Energy, Media
New massive products	Clothes, crafts, glass	Telephone, radios, cables, cars, razors, pens	Nanomaterials, electronics & gadgets, drones
Waste industry	Waste & Health Informal sector	WM companies Regulations Environment	Circular economy?

Key-issues

- Each industrial revolution brings a **resource revolution** too
- Using new technologies, new materials are used and new products are produced
- So the **meaning** of waste is also changing during each industrial revolution:
 - Advanced resource productivity results to less or almost zero waste generation for key-industrial sectors and products
 - New types of waste are generated by new technologies that use new materials – new materials are produced by new technologies
 - New types of waste are produced due to the consumption of new products
 - Each industrial revolution creates a new huge wave of consumption
 - Industries are the main beneficiaries of those changes

2. The concept of Circular Economy

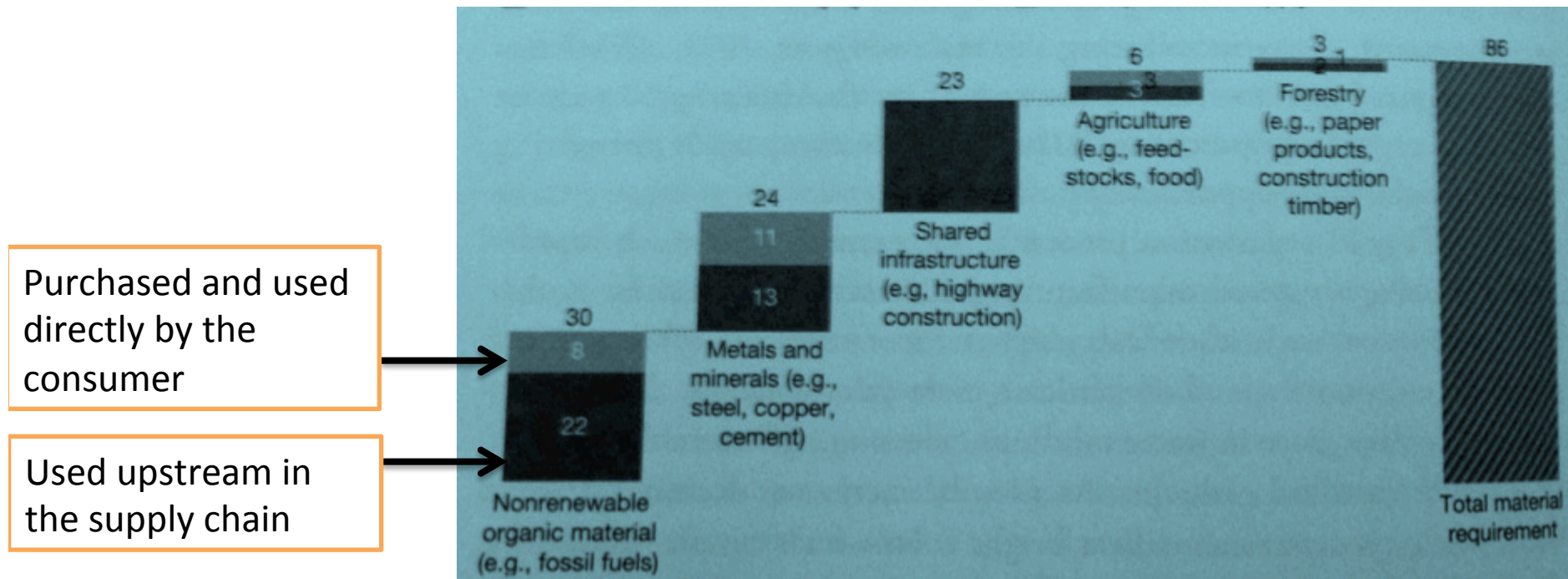


The dialectics of Circular Economy

Circular Economy as a **driver** of the third industrial revolution → improved resource productivity and controlled resource scarcity

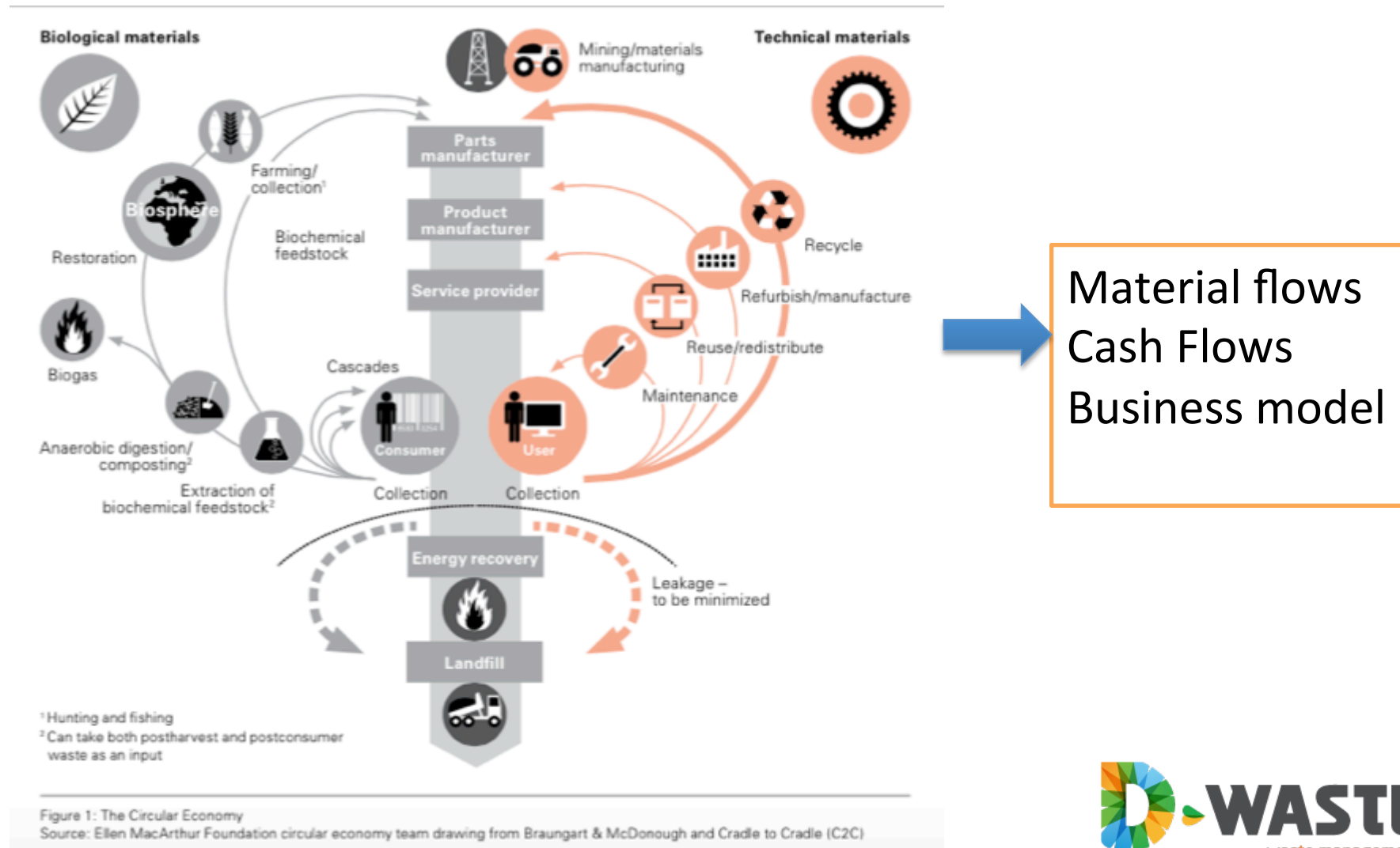
Circular Economy as a **result** of the third industrial revolution → advanced management due to automatisisation, sensors and Internet of Things

USA annual resource consumption: 86 tons / person



Source: Resource revolution by Stefan Heck & Matt Rogers, Melcher Media 2014

The conceptual model



Key-issues

- Circular Economy represents a huge challenge for each and every industrial sector
- It is one of the main ways to control resource scarcity and ensure the continuous use of crucial raw materials
- Circular Economy requires advanced control and/or elimination of the waste produced in industrial activities
- The whole concept is based on the current and potential **circularities** of materials before they become waste

Circularities require...

- Clean cycles
- Advanced **ecodesign** & **modular** design
- A **technology** shift – 3rd industrial revolution
- Full control of **material** & **chemical** flows
- Advanced **logistics**
- New **relationship**: producers- products- users
- **Costs** that will bring benefits

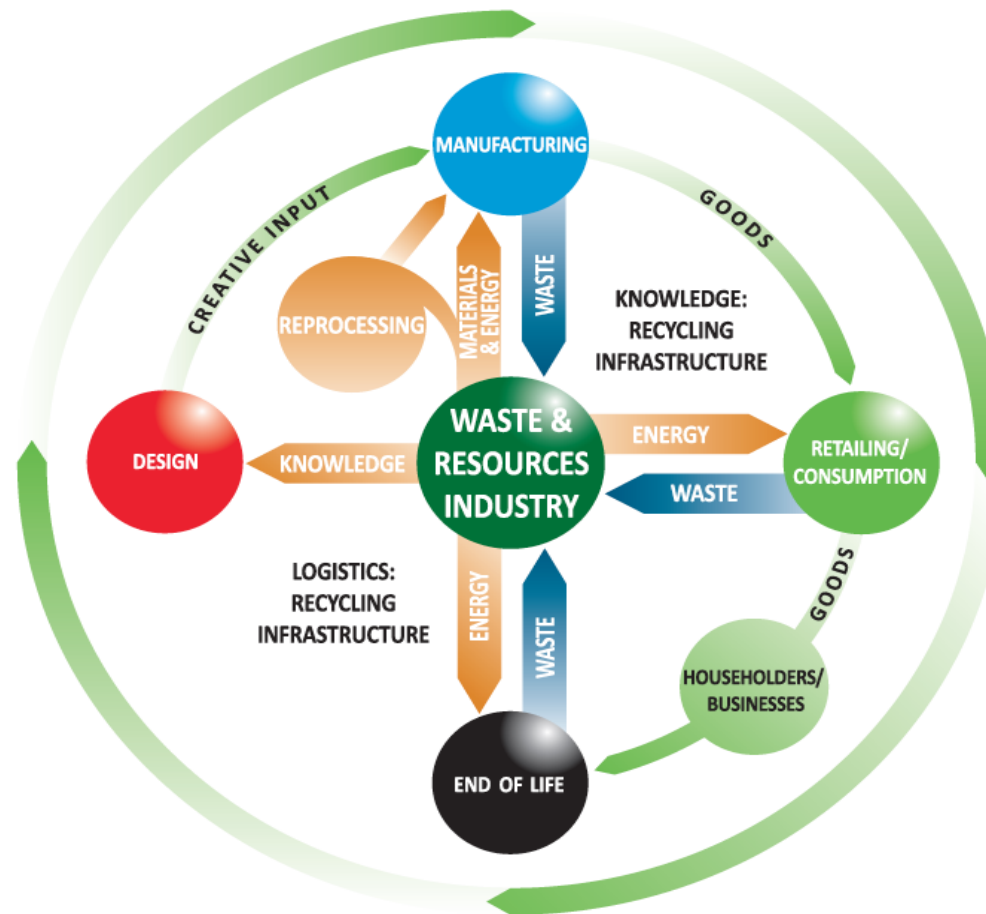
Circularities and ownership of crucial resources



Industries will:

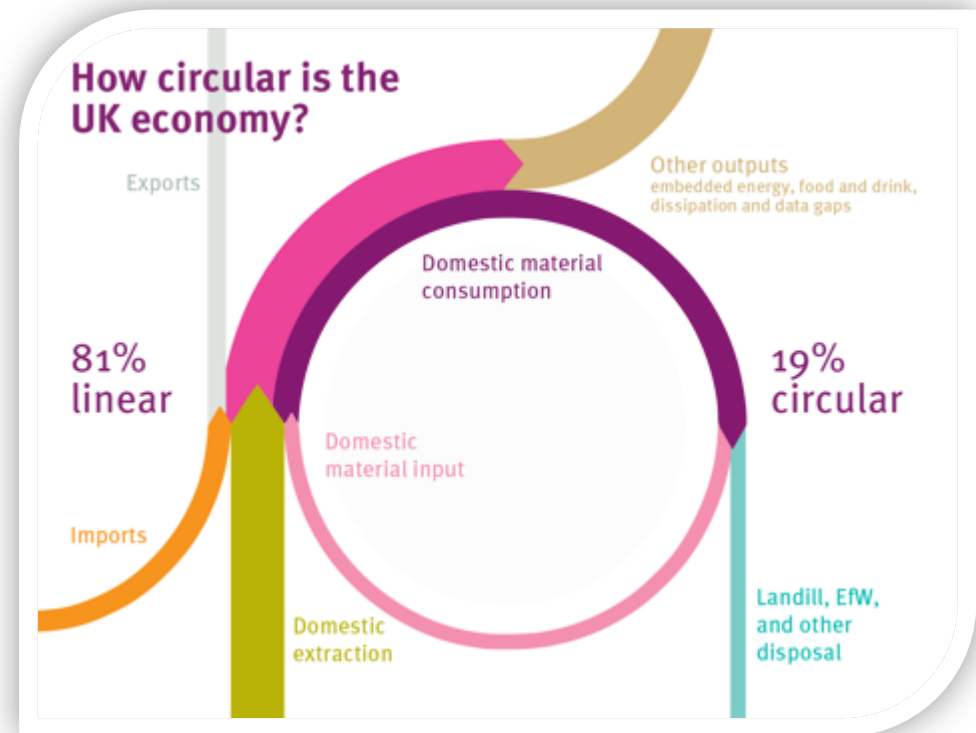
- **Internalize** waste management for their key-material needs
- **Minimize** material losses
- Try to apply **full life-cycle control** of products and materials

3. 3rd Industrial Revolution, SWM industry and Circular Economy

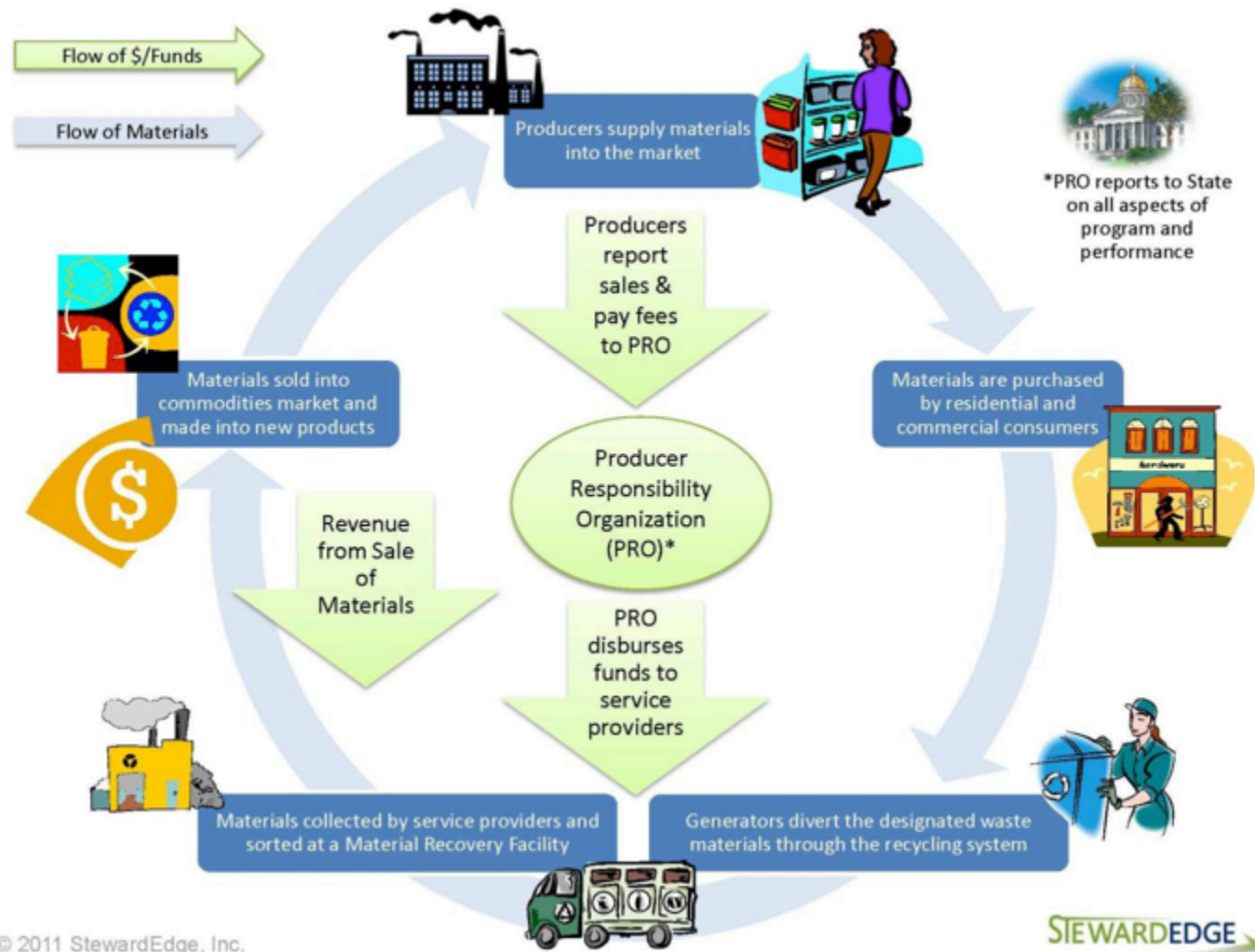


SWM industry already contributes to circular economy

Recyclables
Secondary Fuels
Compost
Energy



EPR schemes as circular agents



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waste management
for everyone

SWM industry will be transformed by the 3rd industrial revolution

Fully controlled treatment by of sensors and big data systems

Routing of vehicles through real time information on bins

Automatic landfills continuously optimizing biodegradation

Refrigerators for food waste prevention

Apps that connect recyclers to form neighborhood teams

Driverless robots filling empty bins

Household waste dryers connected to fuel brokers

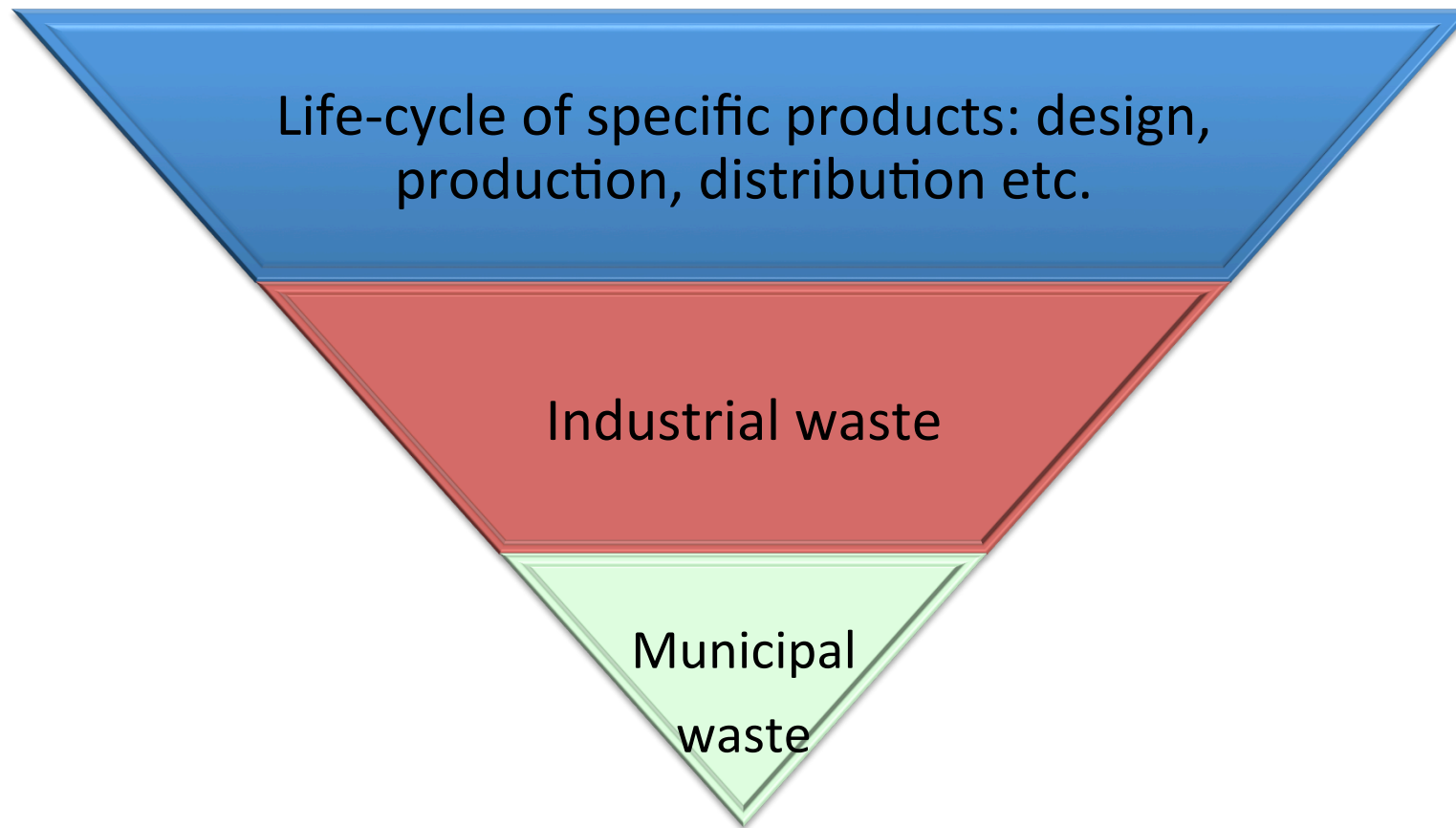
Apps for household waste management plans

Apps that manage food excesses from restaurants, hotels etc

Driverless collection

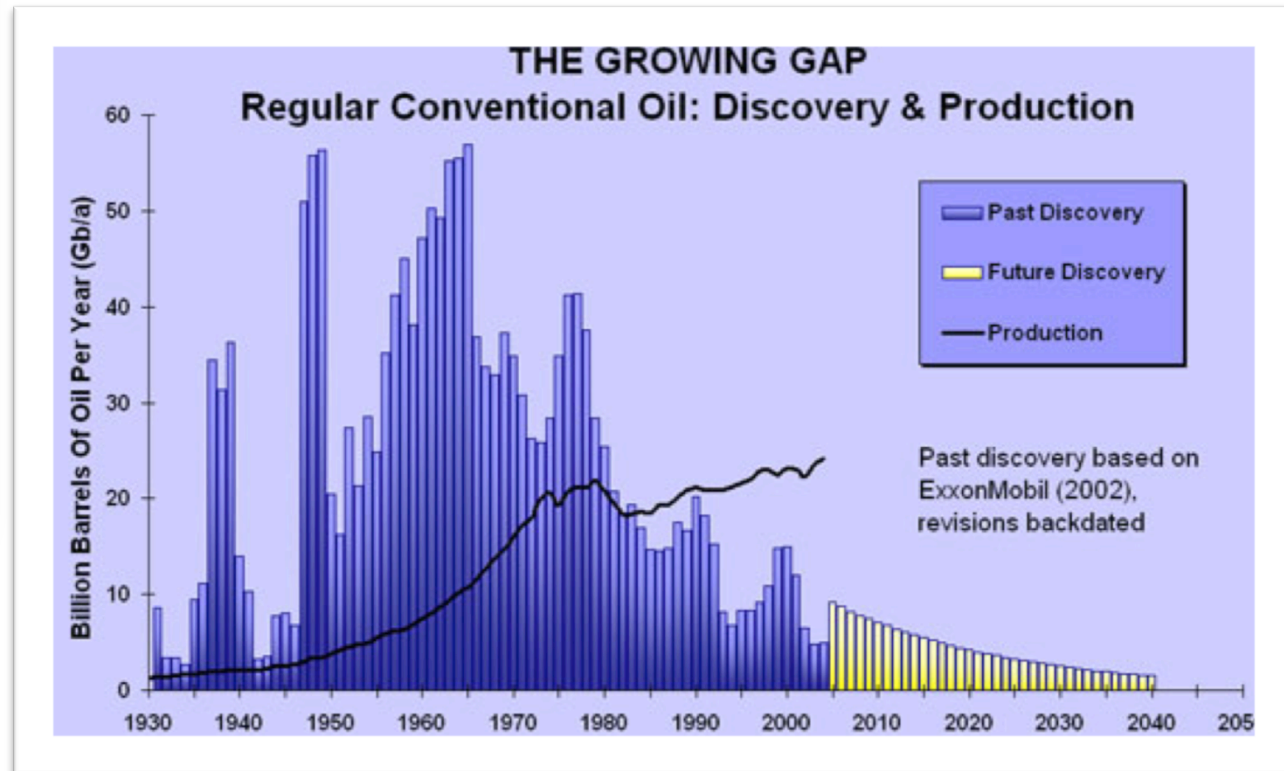
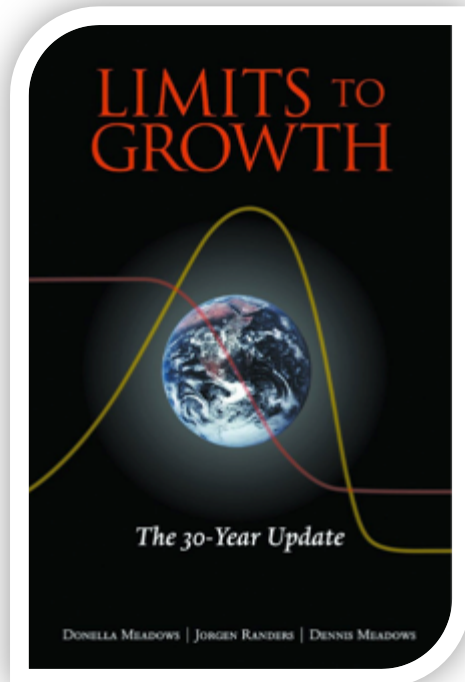
Decentralized small AD plants

Circular economy directly influences...

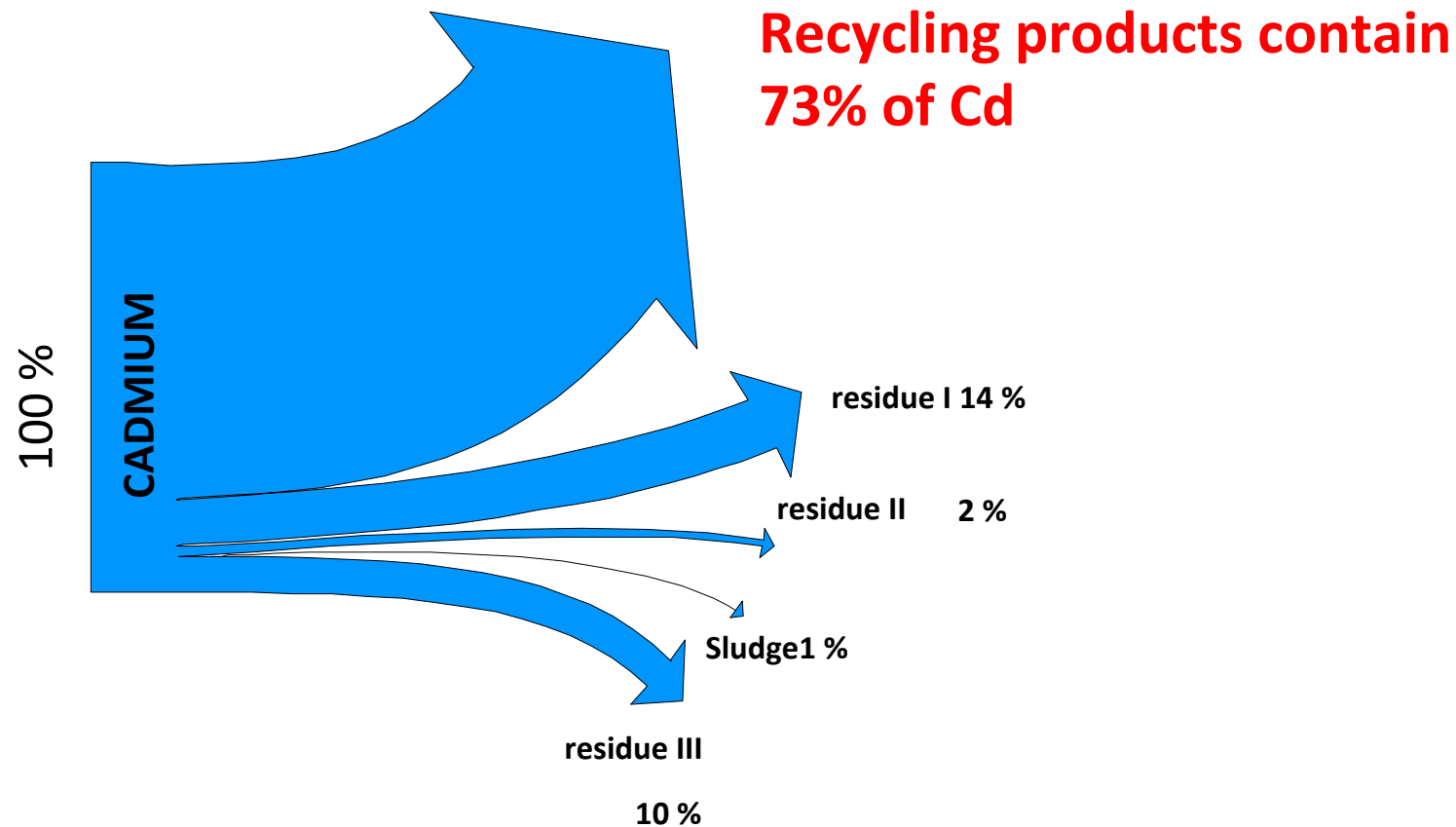


More or less consumption?

Limits to circularities: **finite resources**



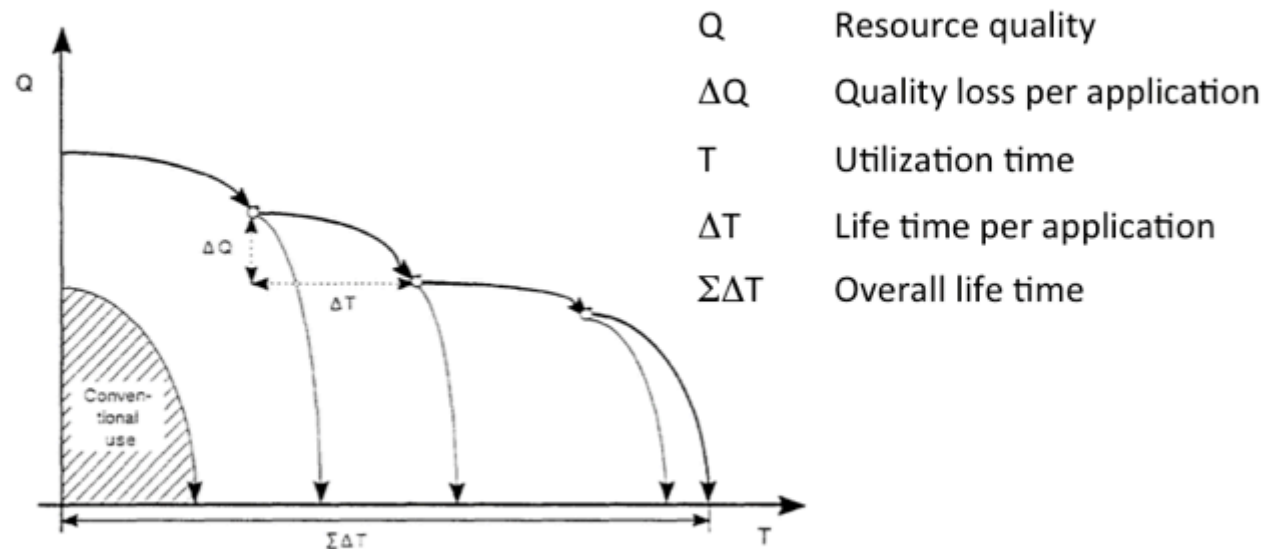
Limits to circularities: materials involve risks



Source: Recycling and sustainability, Paul Brunner, ISWA 2010 conference

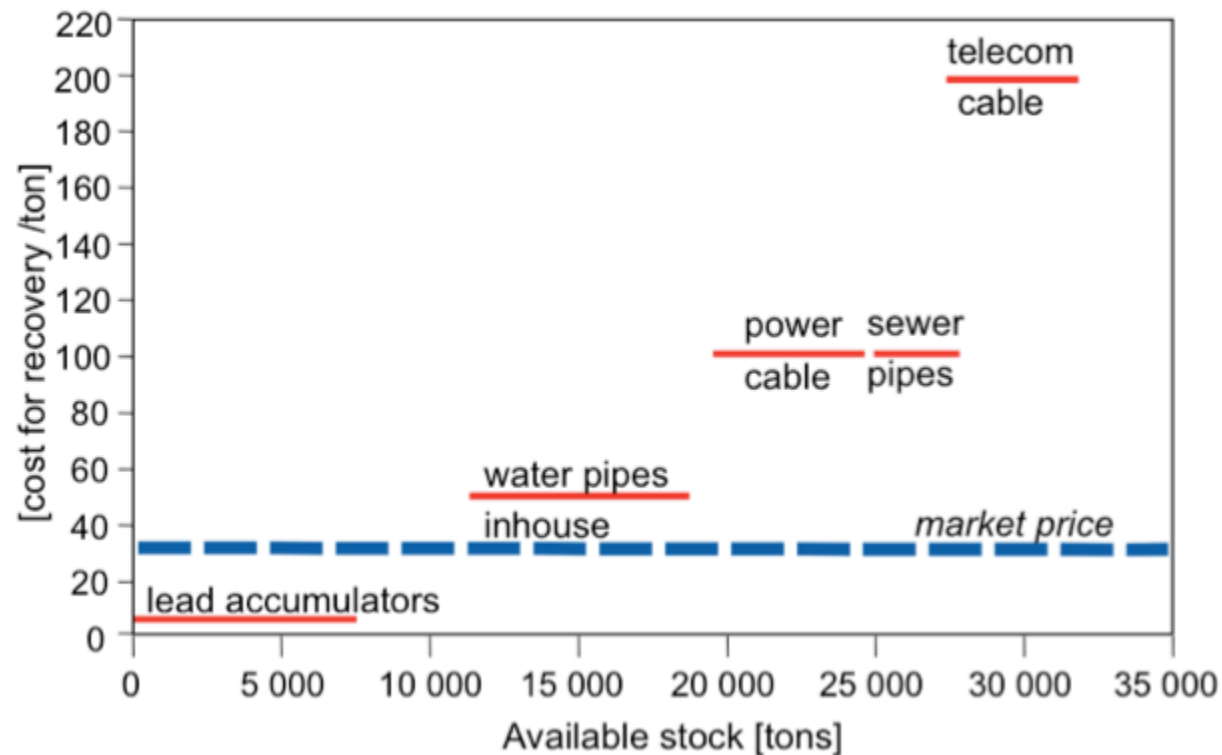
Limits to circularities: cascading

- The sequential use of biogenic raw materials to produce materials and energy



Arnold et al. (2009), Fraanja et al. (1997)

Limits to circularities: market prices



Quelle: Lohm et al., 1998

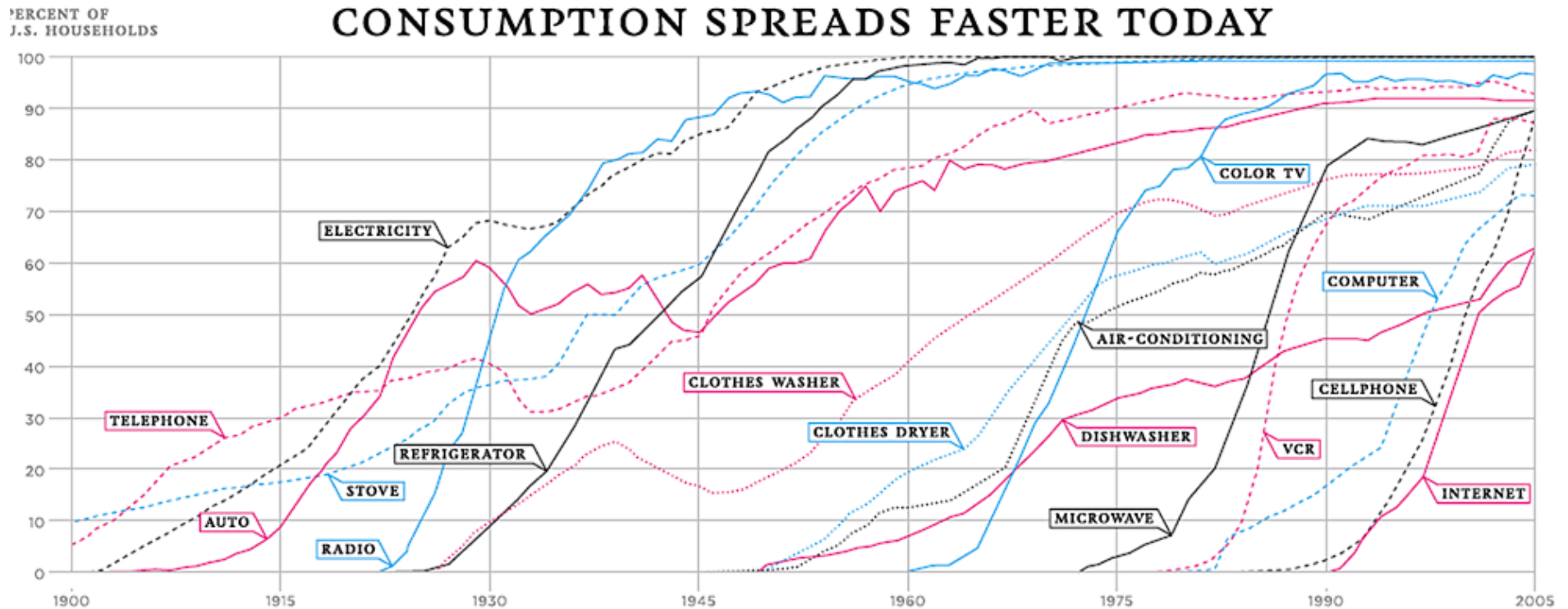
Source: Recycling and sustainability, Paul Brunner, ISWA 2010 conference

Limits to circularities: build-in obsolescence

WHAT IS PLANNED OBSOLESCENCE???

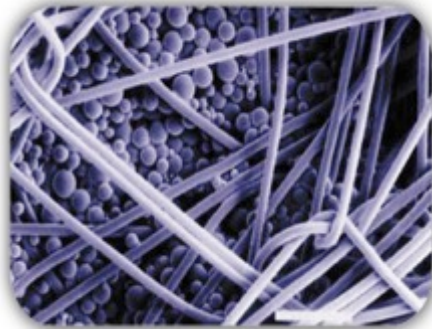
Planned obsolescence or built-in obsolescence is a policy of planning or designing a product with a **limited useful life**, so it will become obsolete, that is, unfashionable or no longer functional after a certain period of time. Planned obsolescence has potential benefits for a producer because to obtain continuing use of the product the consumer is under pressure to purchase again, whether from the same manufacturer (a replacement part or a newer model), or from a competitor which might also rely on planned obsolescence.

Limits to circularities: fast, globalized consumption

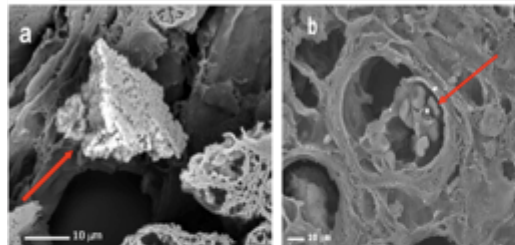


New products are rapidly consumed and create new waste globally

Limits to circularities: new composite materials



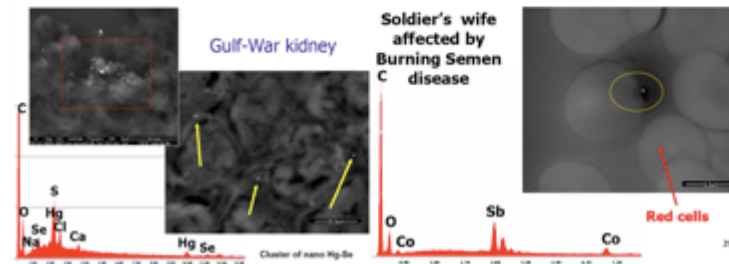
Potential Hazards of Nanomaterials to Health and the Environment



- **small size** results in better penetration
- **very large surface area** for a given mass makes them chemically very active

100 nm size particles can pass through lung into the blood can be recovered in the liver.

Source: Nemmar et al. Circulation 2002, 105:411. As shown in a presentation by Dr. Antonietta M. Gatti.



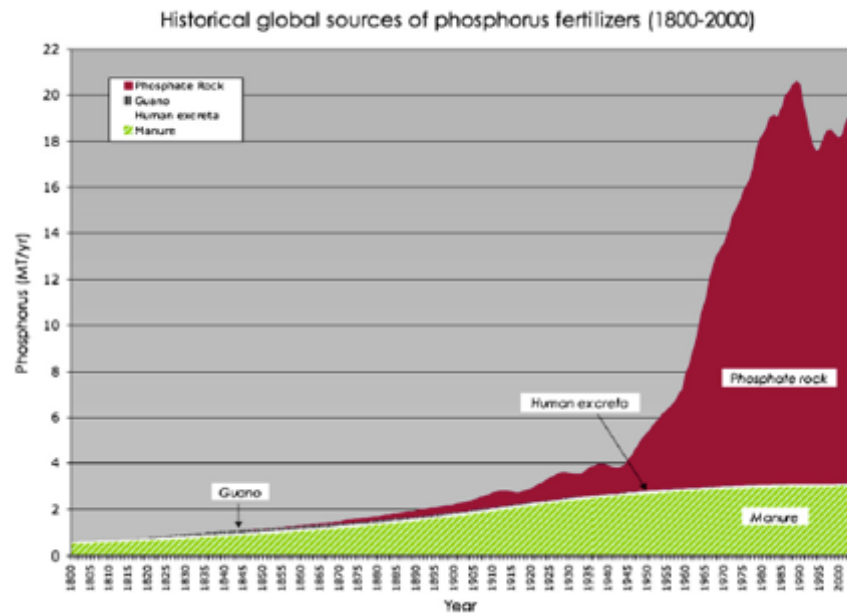
Nanoparticles in fumes of impacted depleted uranium warhead used by the military during the Gulf War found their ways into soldiers' kidney and into the blood of these soldiers' wives. The presence was correlated with backpain in the soldiers and the "burning semen disease." Photos courtesy of Professor Gatti.

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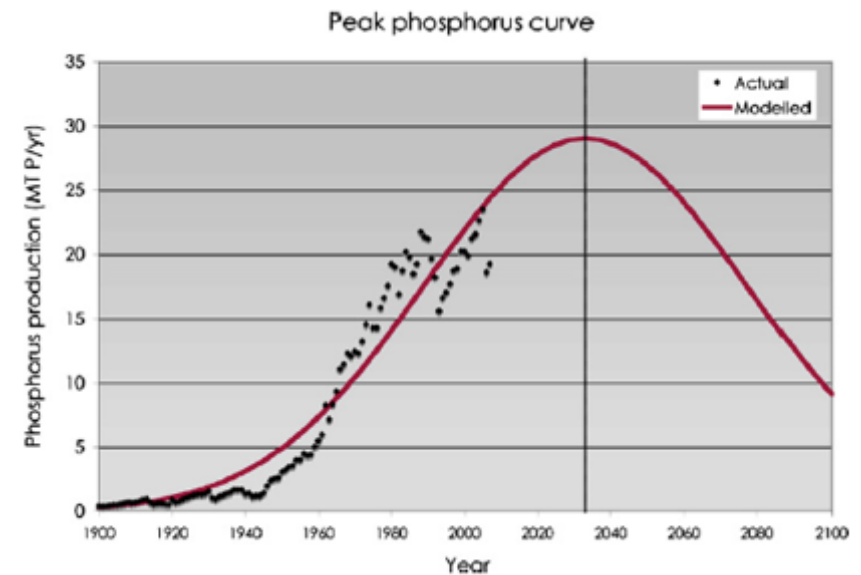
Limits to circularities: time horizon of recycling



Limits to circularities: developed Vs developing world



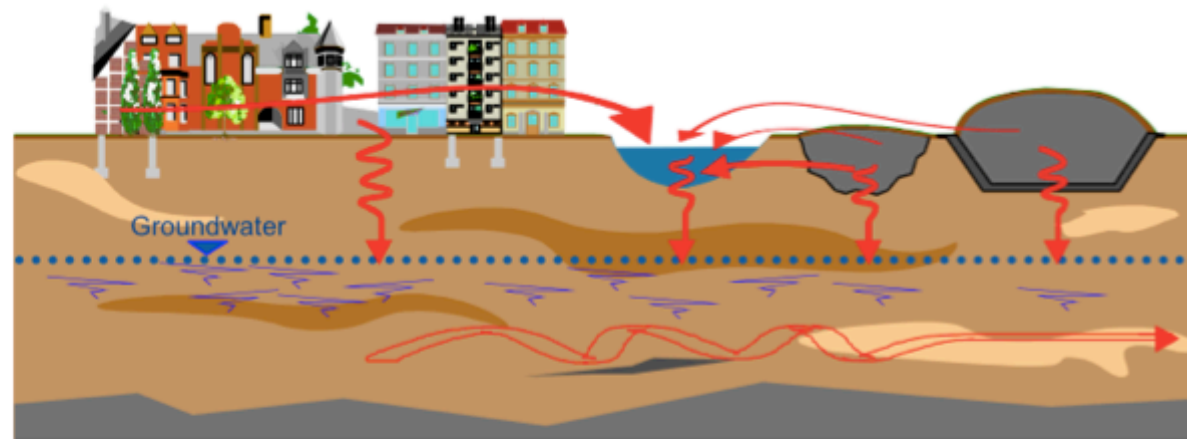
Source: The story of phosphorus: Global food security and food for thought, Dana Cordell, Jan-Olof Drangert, Stuart White, Global Environmental Change 2009



The need for final sinks

Vienna stock in use and hibernating
[kg/capita]

Stock in Vienna landfills



Source: R. Obernosterer et al, 1998

Key-issues

- The 3rd industrial revolution will re-engineer the waste management industry
- SWM industry already contributes to Circular Economy
- Circular Economy will affect seriously industrial waste management - its impact on municipal waste management remains questionable
- There are several barriers to circularities – this means that there is a need for final sinks

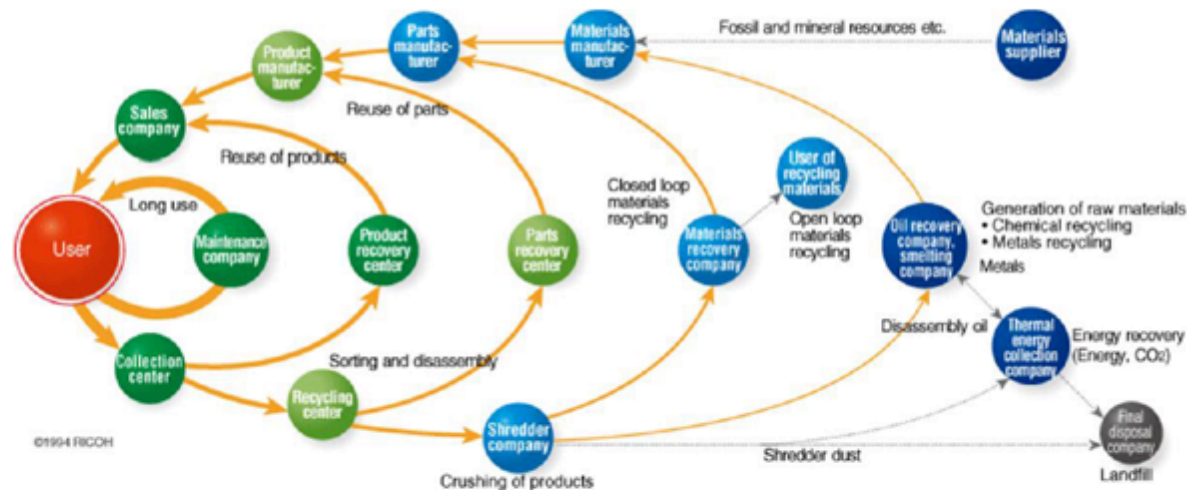
4. A note on business models



A lot of innovation to business models



Closing the loop with multiple lifecycle products

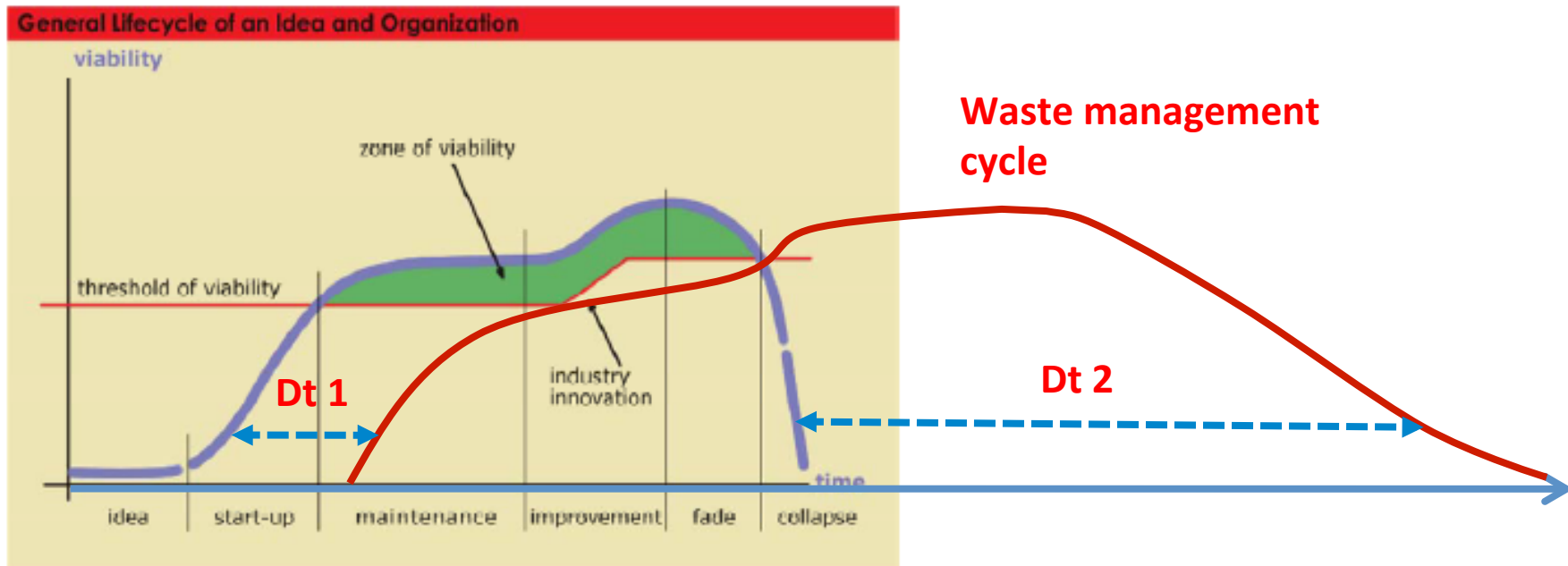


The Collaborative Economy = practices and business models based on horizontal networks and participation of a community, transforming how we live, work and create.

1	CONSUMPTION <i>the sharing economy</i>	  
2	CAPITAL & FINANCE <i>crowdfunding</i>	  
3	KNOWLEDGE & INFO <i>open knowledge</i>	   
4	DESIGN & PRODUCTION <i>open design & manufact.</i>	   
5	GOVERNANCE <i>opengov & flat orgs</i>	  
6	EXCHANGE TOOLS <i>currencies, timebanks</i>	   

The need for new approaches

Product cycle



It starts later, when there are waste (Dt1)

It keeps much more (Dt2)

Targets

Dt1 → 0

Dt2 → 0

Build in obsolescence

Key-messages

- We are living the shit towards the 3rd industrial revolution (3IR)
- The 3rd industrial revolution will redefine the term waste
- Circular Economy (CE) is both a driver and a result of the 3IR
- SWM industry already contributes to CE
- Industrial waste management will be seriously affected by CE - municipal waste management will be probably much less affected
- Circularities require clean cycles
- There are technical, market and natural barriers to circularities
- This means that there is and there will be a need for final sinks
- Innovation in business models is a key-element of the circular economy

Conclusions

- CE requires **much more and more advanced** and not less waste management
- CE will create a landscape where waste and resource management will be integrated **on each and every supply chain**
- So, CE should be considered as an **opportunity** and not as a threat for the SWM industry
- It is the opportunity to create the **SWM industry of the 3IR era**