

MAT_STOCKS – Understanding the Role of Material Stock Patterns for the Transformation to a Sustainable Society

KickOff Workshop 12.04.2018

Module 1: National level data and indicators

Fridolin Krausmann, Dominik Wiedenhofer & Gerald Kalt



Universität für Bodenkultur Wien
Department für Wirtschafts- und
Sozialwissenschaften
Social Ecology Vienna



European Research Council
Established by the European Commission

“This project has received funding from the European Research Council (ERC) under the European Union’s Horizon 2020 research and innovation programme (grant agreement No 741950).

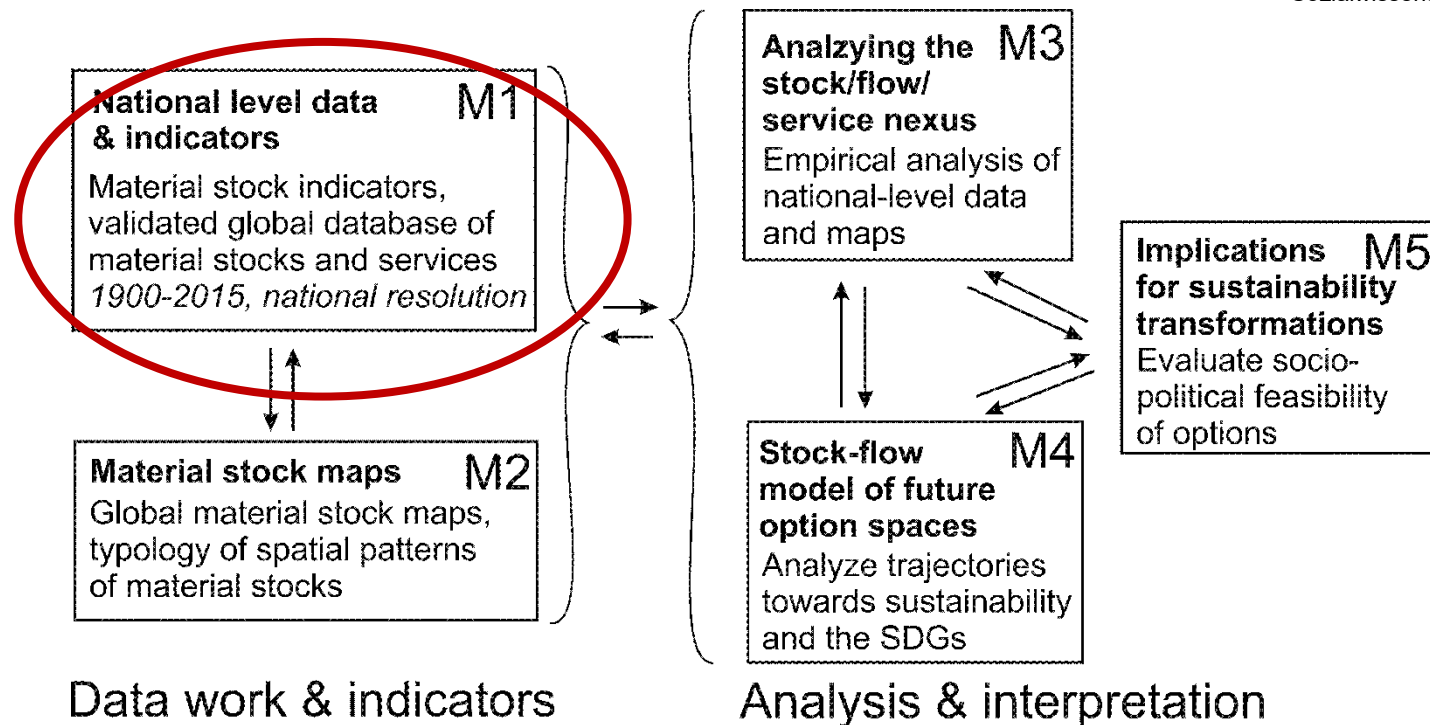
Project structure of MAT_STOCKS



European Research Council
Established by the European Commission



Universität für Bodenkultur Wien
Department für Wirtschafts- und
Sozialwissenschaften
Wien



Time plan & resources



European Research Council
Established by the European Commission



Universität für Bodenkultur Wien
Department für Wirtschafts- und
Sozialwissenschaften
Social Ecology Vienna

Table B2-1. Time plan of MAT STOCKS

Year	1				2				3				4				5			
Quarter	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
M 0 Project management																				
M 1 National level data																				
M 2 Mapping material stocks																				
M 3 Stock/flow/service nexus																				
M 4 Dynamic stock/flow model																				
M 5 Implications for sustainability																				

Resources

Module 1 18 MM Senior staff
20 MM Post-Doc
1 PhD-Projekt (3years, 75%)
5 MM PI

Team (current core persons + specific contributions by ...):

Dominik Wiedenhofer, Gerald Kalt, Fridolin Krausmann

+ Melanie Pichler, Christina Plank, Andreas Mayer, Christoph Görg, Helmut Haberl

Objectives Module 1:

National level data and indicators



European Research Council
Established by the European Commission



Universität für Bodenkultur Wien
Department für Wirtschafts- und
Sozialwissenschaften
Social Ecology Vienna

- (Build on ongoing efforts in the FWF project MISO)
- Develop consistent and systematic **indicators for the stock/flow/service nexus**
- Establish a **globally consistent national-level long term database on material stocks and services**
- **Validate results** and perform a **systematic error propagation analysis and quantification of uncertainty**
- Global analyses will yield results at different levels
- **~12 case studies** : USA, Japan, the United Kingdom, Russia (respectively the USSR or the Former Soviet Union), Austria, China, India and South Africa. ~4 additional case studies will be identified early on in the project

Stand der Planung:



European Research Council
Established by the European Commission



Universität für Bodenkultur Wien
Department für Wirtschafts- und
Sozialwissenschaften
Social Ecology Vienna

Planungsbesprechungen (HH, FK, DW): 6.2. und 8.3.

Konstituierung von zwei Arbeitsgruppen (AG):

- AG1: MISO 2.0 -> Dominik Wiedenhofer, Fridolin Krausmann, Doris Fröhlich
- AG2: Review Services -> Gerald Kalt, Christoph Görg, Melanie Pichler, Andreas Mayer, Dominik Wiedenhofer

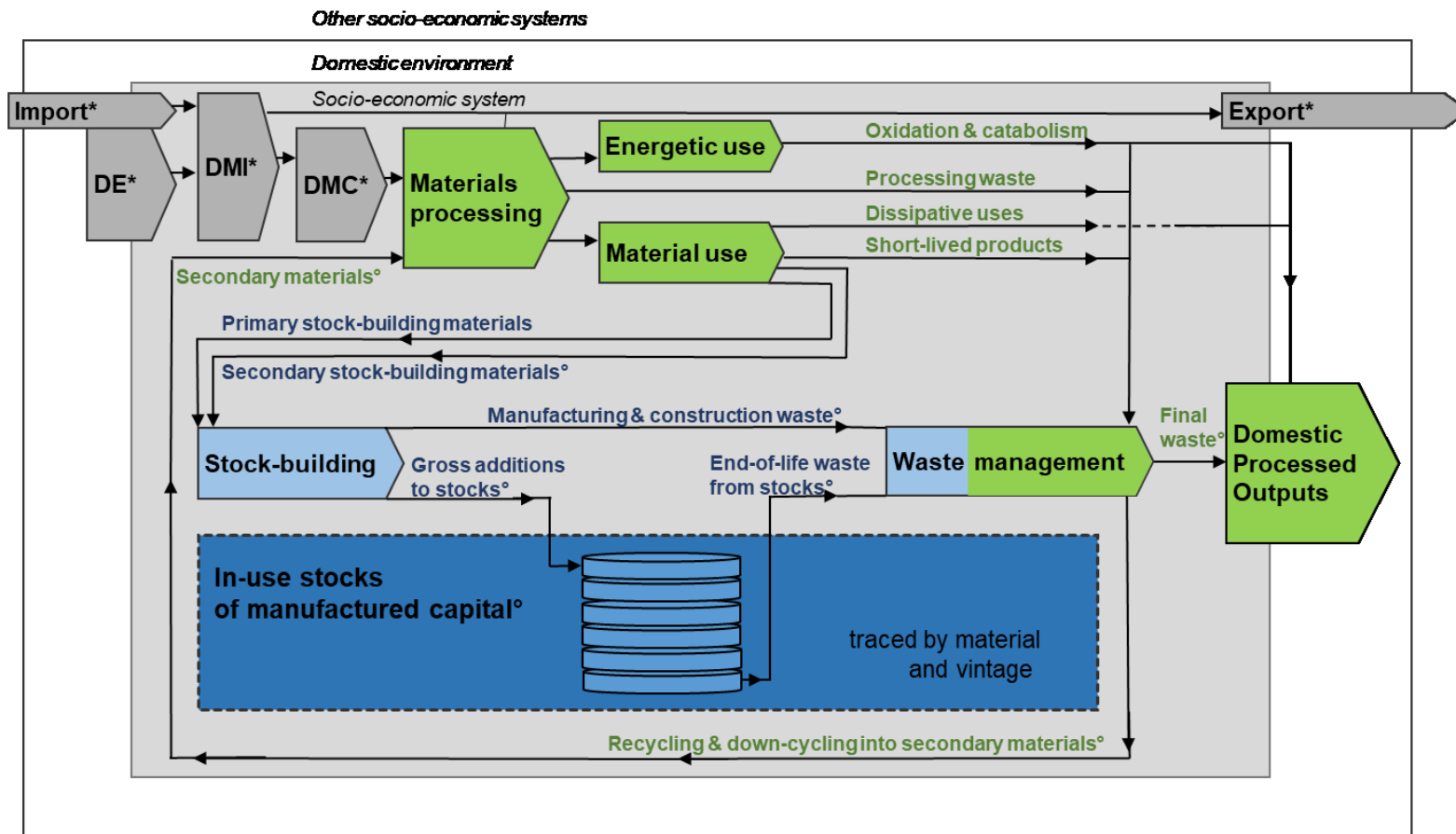
Weiterer Prozess & geplante Workshops:

- AG2 finalisiert Operationalisierung des Review von „Services“ 20.April
- AG1 <-> AG2: Input & Reflexion zur Konzeptualisierung von MISO 2.0 Möglichkeiten 5.Juni
- AG2 <-> AG1: Erste Konzeptualisierung von „Services“ und feedback zu MISO 2.0 25.September

In Vorbereitung:

- Workshop mit externen PartnerInnen: *Conceptualizing the Stock/Flow/Service Nexus* November 2018
Julia K. Steinberger et al., Univ. Leeds; Benjamin Sovacool (Univ. Sussex); N.N. ...
- Specify cooperation and subcontract with Nagoya University (H. Tanikawa) Spring 2018
- Potential recruitment of an external PostDoc to work on global database Summer/Fall 2018?
- Call for PhD position with a focus on comparative analysis of case studies Spring 2018

The Material Input Stocks and Output (MISO model 1.0)



The Material Input Stocks and Output (MISO model 1.0)



European Research Council
Established by the European Commission



Universität für Bodenkultur Wien
Department für Wirtschafts- und
Sozialwissenschaften
Social Ecology Vienna

Model input parameters (exogenous data & „assumptions“):

- Stock-building material inputs (consistent with global MFA principles and data)
- Information on lifetime distribution for each stock type
- Information on re- and downcycling of materials from discarded stocks

Modell output parameters (endogenous „results“):

- Stock size, composition and dynamics
- Gross and net addition to stocks
- Flow of secondary materials
- Waste from discarded stocks (incl. hibernating stocks)

The model currently distinguishes 14 different materials

Development of the global socio-economic metabolism: Stock-building and in-use stocks from 1900-2015

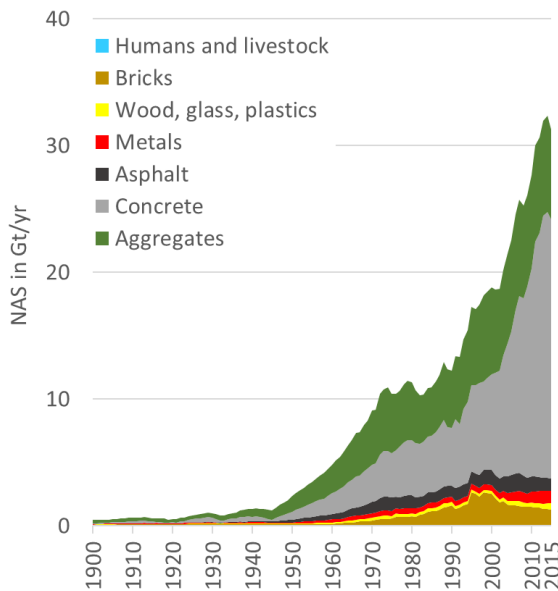


European Research Council
Established by the European Commission

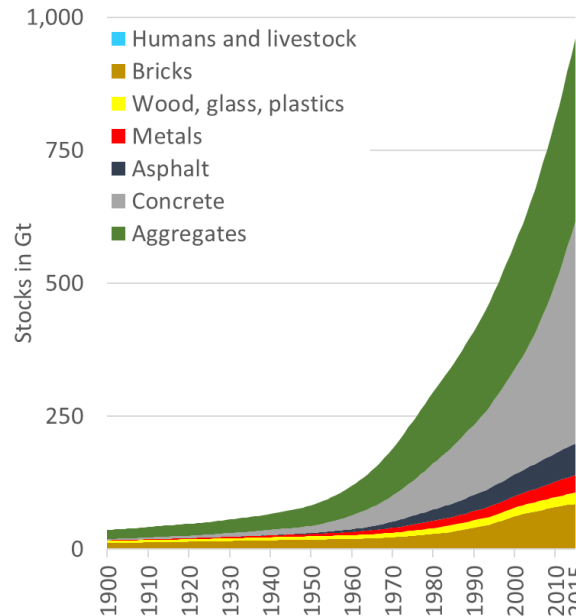


Universität für Bodenkultur Wien
Department für Wirtschafts- und
Sozialwissenschaften
Social Ecology Vienna

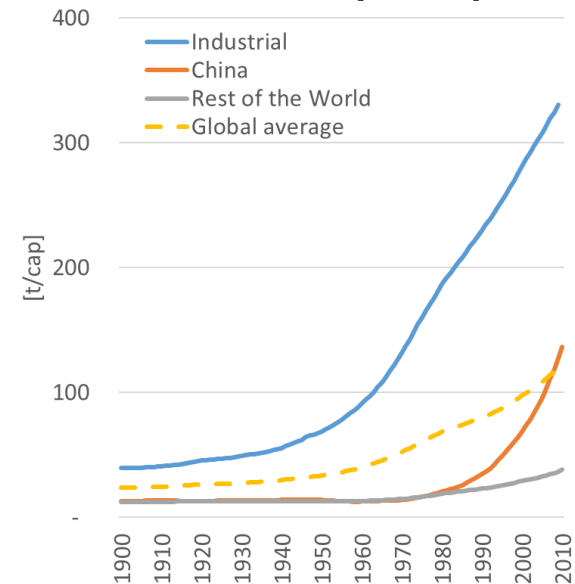
Yearly net additions to stock



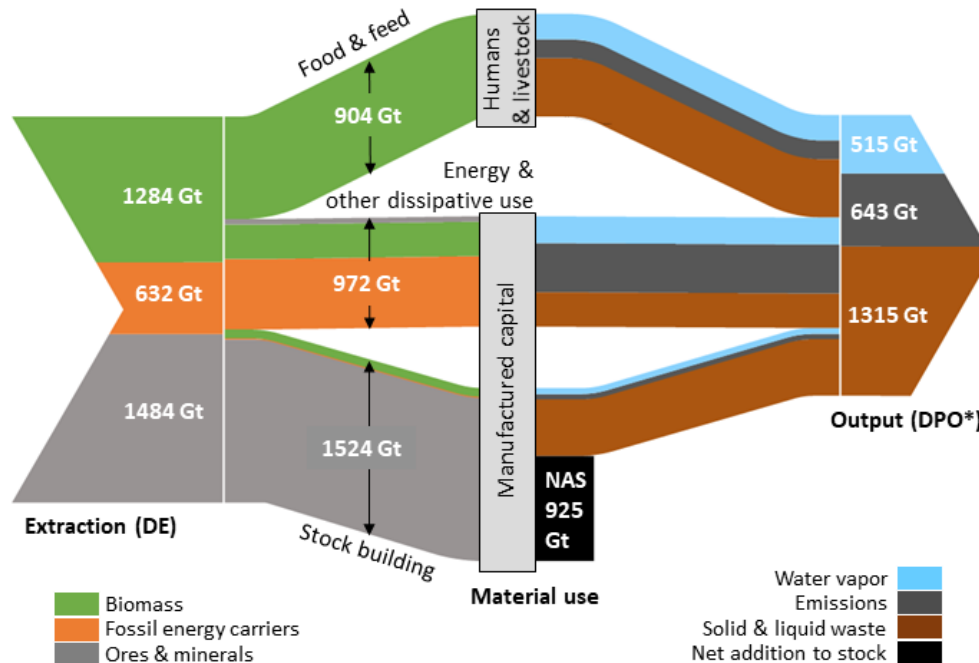
In-use stocks of artefacts



Stocks per capita



An integrated & cumulative perspective on material and energy flows and the stock-building from 1900-2015



1900–2015

$$\sum_t$$

DE, Energetic use, Material use, NAS, DPO

Ongoing MISO activities in 2018:



European Research Council
Established by the European Commission



Universität für Bodenkultur Wien
Department für Wirtschafts- und
Sozialwissenschaften
Social Ecology Vienna

The MISO project (Austrian Science Fund) ends Dec. 31st 2018

Ongoing activities with synergies with MATSTOCKS:

- Expansion, maintenance and saturation of the socioeconomic metabolism: Investigating the dynamics of 9 world-regions from 1900-2015
- Developing global biophysical scenarios about stocks & flows: contraction and convergence and other narratives ... calculation of resulting impacts on material demand, secondary material flows and waste production
- Circular Economy Assessments (global 1900-2015) and case studies (EU28)



AG1: MISO 2.0 for MatStocks – adapting the modeling approach → towards 3.0 ?



From global & world-regional to national-level databases

- **Requires intensive datawork:** data for the period 1960/70-2015 from databases from national and international organizations (FAO, UN, IEA, USGS, BGS) and industry organizations (CEMBUREAU, World Steel, Aluminum association, Plastics Europe). Improvement of data from available global MFA database (1950-2010).
- Systematic uncertainty assessments

Extending the MISO model from 1.0 to 2.0 → towards a higher resolution of “stock types”:

- Linking stock functioning to provided services (e.g. from „concrete“ to concrete in different in-uses, e.g. buildings, infrastructure).
- Based on production statistics, further differentiation already possible: stock-building material inflow data can be split into 5 to 8 functional differentiations, “which kind of stocks are built”:

Roads	Buildings & Construction
Infrastructure & Supply Networks	Machinery & Transport Equipment
Consumer Goods & Short lived Products	

National long-term country-case studies (e.g., USA, China, UK): PhD-Project

From MISO 2.0 to 3.0 – further differentiations?

AG2: Reviewing and Conceptualizing the Stock/Flow/Services Nexus



AG2 reviews various discourses to inform theoretical work on the concept of „services“ within MatStocks and the SFS Nexus → close interaction with AG1 MISO 2.0

Macro level: societal „welfare“ and alternative measures to GDP

Meso-level: focuses on more specific services and their biophysical basis

Guiding questions for reviewing the specific discourses → to be refined 20.4.

- How are “services” conceptualized?
 - How are biophysical stocks & flows conceptualized?
 - How are their interactions conceptualized?
 - How are each of the elements delimited from each other and from other, not included, elements? (e.g. what exactly is the respective flow allocated to the specific services, where is the boundary to other flows and stocks and/or services?)
-

Discourses to be reviewed

Energy services

Ecosystem services

Nature's contribution to people (NCP), based on ecosystem services

Provisioning systems literature

Product service systems literature

Human needs-based approaches to „satisfiers“

....

.....



European Research Council
Established by the European Commission



Universität für Bodenkultur Wien
Department für Wirtschafts- und
Sozialwissenschaften
Social Ecology Vienna

Macro and meso-level „services“



European Research Council
Established by the European Commission



Universität für Bodenkultur Wien
Department für Wirtschafts- und
Sozialwissenschaften
Social Ecology Vienna

- **Macro indicators** (societal welfare and sustainability), e.g.
 - Human development index (HDI)
 - Social Progress Index (SPI)
 - SDG Indicators
 - OECD Better life index
 - Global Footprint data
 - Happy planet index
 - ...
- **Meso level indicators**
 - ...focusing on specific services
 - ...providing quantified information on service level/quality
 - ...facilitating insight into stock-flow-service-relations

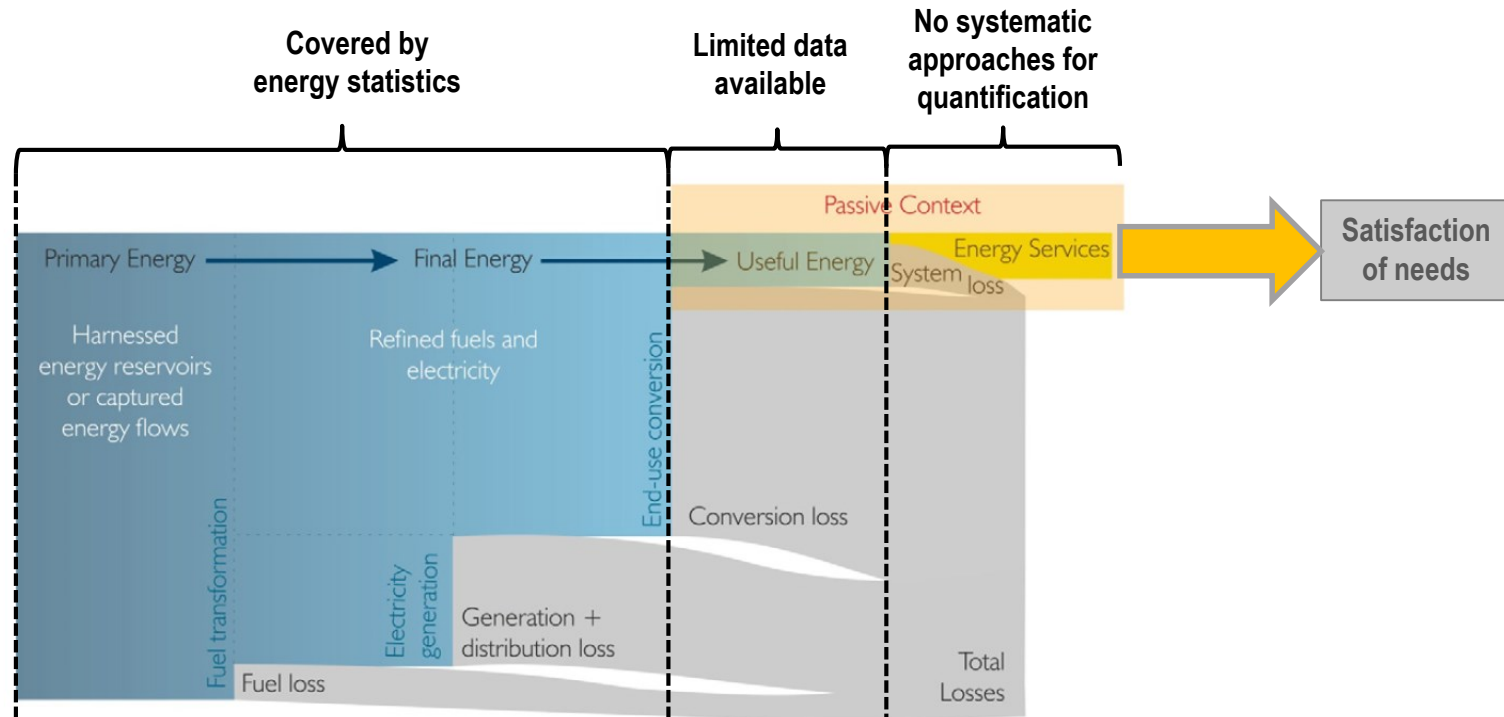
First insights for energy services



Difficulties in measuring services exemplified for the “energy chain”

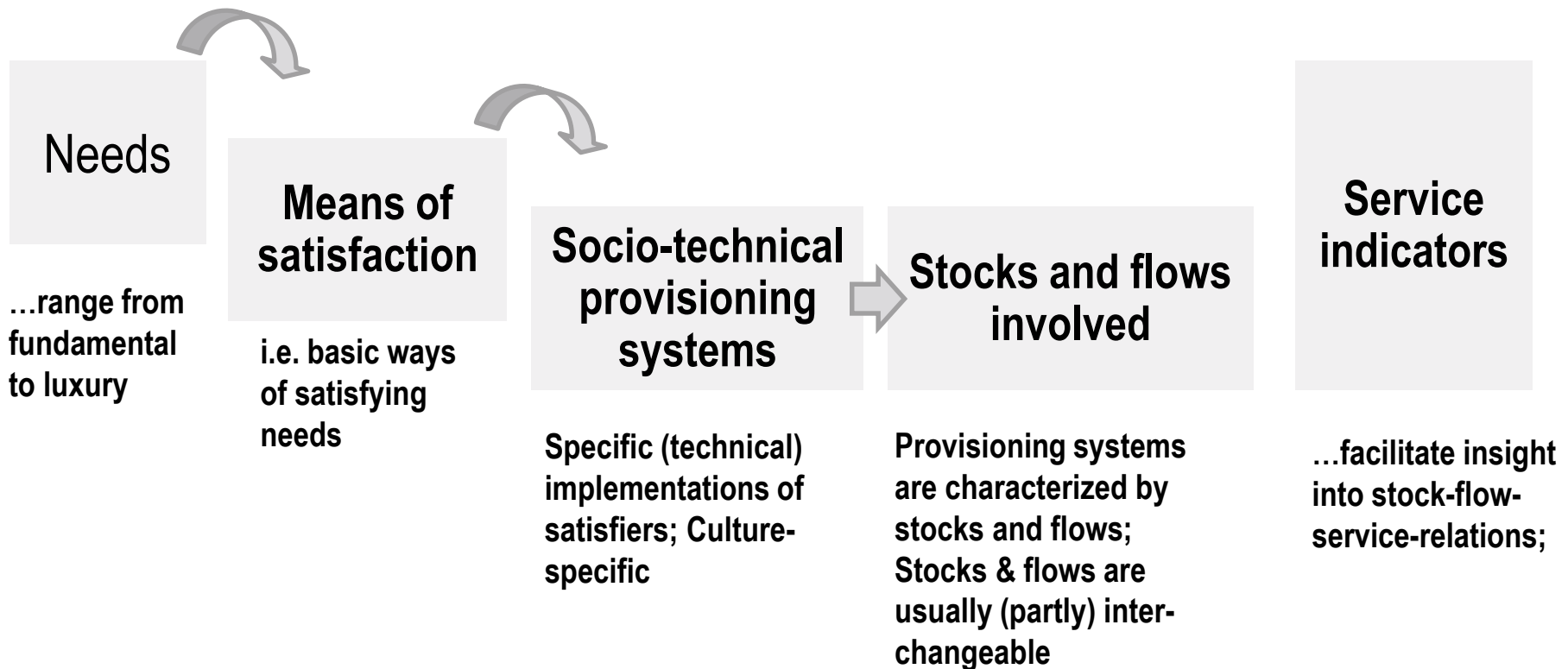


Universität für Bodenkultur Wien
Department für Wirtschafts- und
Sozialwissenschaften
Social Ecology Vienna



Adapted from Cullen and Allwood (2010a); Brand-Correa and Steinberger (2017)

First conceptual considerations on the stock-flow-services nexus?



Some examples (preliminary!)



Needs	Means of satisfaction	Provisioning systems	Stocks involved	Service indicators (examples)
Mobility	Vehicles, agility	Public transport systems Individual transport (vehicles & infrastructure), Walkway infrastr.	<ul style="list-style-type: none"> • Vehicles in use • Road/rail/walkway network • ... 	<ul style="list-style-type: none"> • Passenger-km per year (road, rail, air) • EU indicators on access to urban public transport (Working paper 01/2015)
Thermal comfort	Shelter, space heating, air-conditioning	Houses of different thermal qualities, Different space heating/air-conditioning systems	<ul style="list-style-type: none"> • Residential building stock • Heat supply systems • Energy infrastructures (gas/electricity/DH grid...) • ... 	<ul style="list-style-type: none"> • Final/Useful(?) energy consumption for heating and cooling (with consideration of heating degree days, m2 per person etc.) • "Lack of adequate heating" (SPI; EU Survey on Social and Living Conditions) • "Access to electricity (% of population)" (World Development Indicators)
Communication	Written communication, Communication technologies	Postal service, Mobile communication, Internet	<ul style="list-style-type: none"> • End-user devices • Mobile comm. Infrastructure • Data centers • Elec. supply infrastr. • ... 	<ul style="list-style-type: none"> • Access to internet (% of population) • Mobile communication subscription • ...
Sustenance	Food consumption	Food supply systems (industrialized/small-scale farming/subsistence farming; regional/global supply chains etc.)	<ul style="list-style-type: none"> • Agricultural Machinery • Transport infrastructure • Storage infrastructure • Kitchen devices • Elec. supply infrastr. • ... 	<ul style="list-style-type: none"> • Food self-sufficiency rate (FAO) • Prevalence of undernourishment (% of population) (World Development Indicators) • Inequality/poverty indicators • ...

Module 1: Objectives for year 1 (03/2019):



AG1 – MISO 2.0:

- Development of national level database as input for MISO 2.0
- Set up advanced of uncertainty assessment for ew-MFA & MISO 2.0
- Begin PhD project (case study development)
- Finalize review of approaches for functional differentiation of stocks
- Insights for MISO 3.0

AG2 – Services Review:

- Finalized review of literature streams
 - „matrix“ of conceptual considerations/coverage/data availability
 - Input into stock typology possibilities and requirements for MISO 2.0 and especially for 3.0 !
-