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Modern Commons and Sustainable Mobility

A Systemic Perspective on Sustainable Infrastructure Development - Challenge: Transforming Mobility Patterns

Civilekonom
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Göteborg, 2. December 2016

Research In Cooperation with:

INSTITUT FÜR INFRASTRUKTUR UND RESSOURCENMANAGEMENT

UNIVERSITÄT LEIPZIG

LEISTUNGSZENTRUM NACHHALTIGKEIT FREIBURG

INATECH INSTITUT FÜR NACHHALTIGE TECHNISCHE SYSTEME

UNI FREIBURG

Klaus Markus Hofmann, Civilekeonom 1980
forskar med fokus på Commons, Hållbarhet, Infrakultur och Mobilitet

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Transformation towards Sustainability needs Dual Approach

A. Modern Commons

Sustainable Infrastructure Development meets Global Challenges

B. Sustainable Mobility

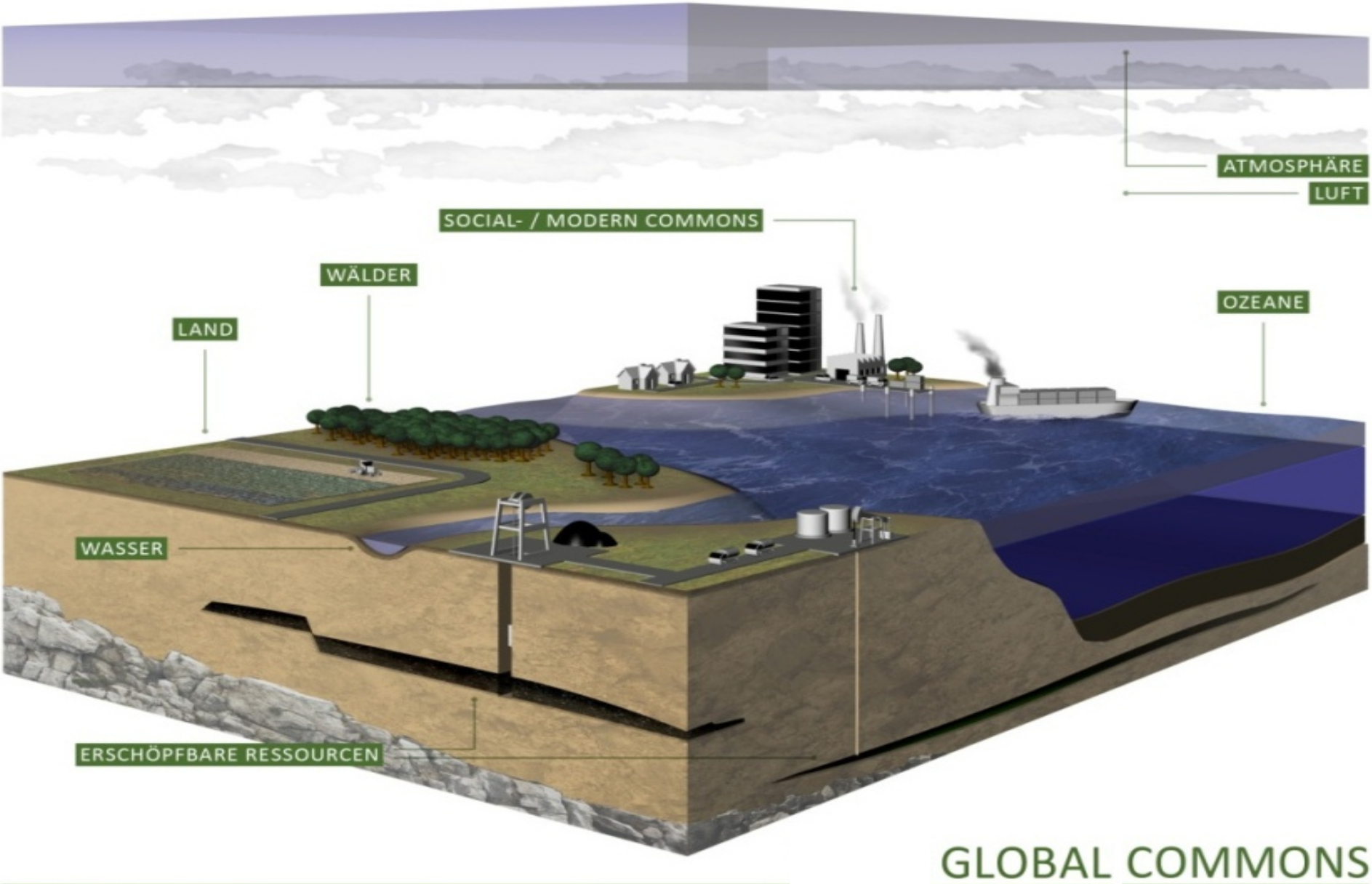
Transforming Urban Environments with glocal Strategies

Picture: Bejing Morning 17. Jan. 2014, Daily Mail Internet

A. Modern Commons:
Infrastructure Systems = Social Networks

- 52 Billionen Dollar Investment till 2030 (OECD)
- Technical and ecological Lock In over long periods
- System Interdependence of Energy, Transport and Communications
- Climate Change requires change of InfraCulture

A. Modern Commons and Global Commons interact



Source: Hofmann 2012, nach O. Edenhofer PIK 2011, drawing: Crössmann, InnoZ

[1] {Ostrom 2012: 58}

A. Common Ressource Systems
Markets work for goods that markets were made for...

Excludability

Rivalry in consuption	Excludable	Nonexcludable
Rival	**Private Goods**	**Commons Goods** Fish in open sea Atmosphere Public waterways
Nonrival	**Low-congestion Goods** Cable television Satellite radio Online WSJ	**Public Goods** Tax-based: Nuclear umbrella The law Indirect private funding: Search engine On the air TV

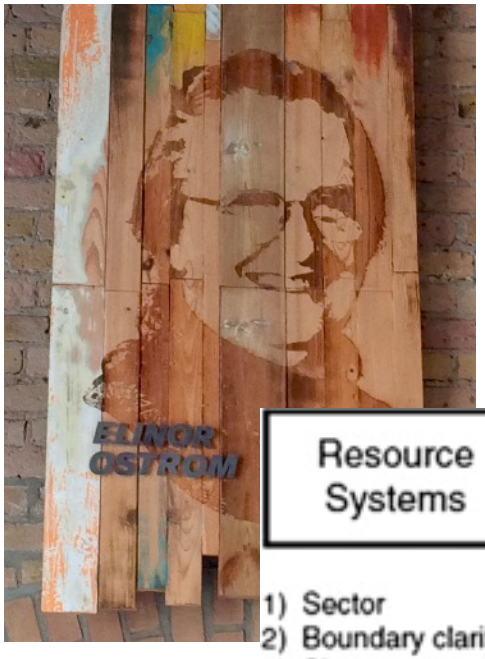
Modern Commons

Decide yourself:

- Energy grids
- Roads/Railways
- Telcos/Internet
- Parks, Seashore
- Timetable
- Power supply
- Parking/Tolls
- Stations
- Fuel stations (electric)

Market failiure occurs with unequal acces and allocation of benefits and burdens. Commons-Theory allows Polycentric Govenance of Complex Economic Systems, while Business tends to ignore external costs and social benefits.

Ostroms Variables for Governance of the Commons (SES) can be adapted for Infrastructure Systems (STS)



A core goal of public policy should be to facilitate the development of institutions *[and infrastructures]* that bring out the best in humans.

Resource Systems

1) Sector
2) Boundary clarity
3) Size
   a) Area
   b) Volume
4) Infrastructure
5) Productivity
6) Equilibrium properties
   a) Recharge dynamics
   b) Recharge rate
   c) Number of equilibria
   d) Feedbacks
      i) Positive
      ii) Negative
7) Predictability
8) Storage capacity
9) Location

Resource Units

1) Resource unit mobility
2) Replacement rate
3) Interactions
   a) Strong to weak
   b) Predatory or symbiotic
4) Economic value
5) Size
   a) Large to small
   b) Trophic level
6) Distinctive markings
7) Distribution
   a) Spatial heterogeneity
   b) Temporal heterogeneity

Governance Systems

1) Rules
   a) Operational rules
   b) Colllective-choice rules
   c) Constitutional rules
2) Property-rights regime
   a) Private
   b) Public
   c) Common
   d) Mixed
3) Network structure
   a) Centrality
   b) Modularity
   c) Connectivity
   d) Number of levels

Actors

1) Group size
2) Socioeconomic attributes
   a) Economic
   b) Cultural
3) History of use
4) Location
5) Leadership
6) Social capital
7) Knowledge of SES
8) Resource dependence
9) Technology used

Action Situations

1) Process
   a) Monitoring
      i) Environmental
      ii) Social
   b) Sanctioning
   c) Conflict resolution
   d) Provision
      i) Informational
      ii) Infrastructural
   e) Appropriation
   f) Policymaking

IAD Governance Variables for Socio-ecological Systems

Source: *E. Ostrom, 2012 The Future of the Commons S. 73 , Bezond Markets and state 2009*

Infrastructure Transformation
Once Cinderella, now belle of the ball

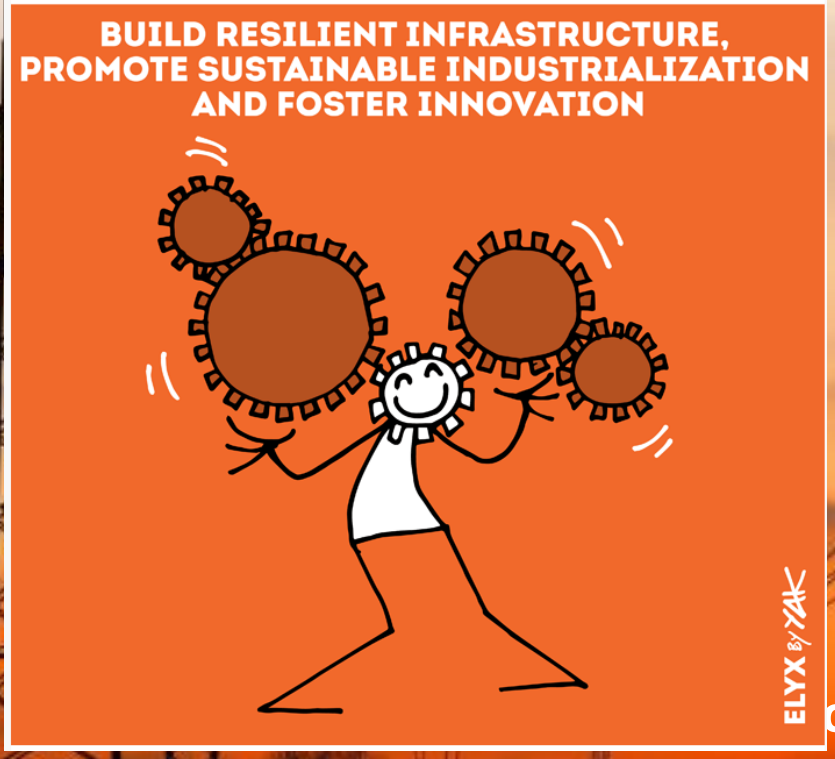
…or apple of discord

Take a


ENSURE ACCESS TO AFFORDABLE, RELIABLE, SUSTAINABLE AND MODERN ENERGY FOR ALL
ELYX BY YAK


TAKE URGENT ACTION TO COMBAT CLIMATE CHANGE AND ITS IMPACTS
CO2
ELYX BY YAK

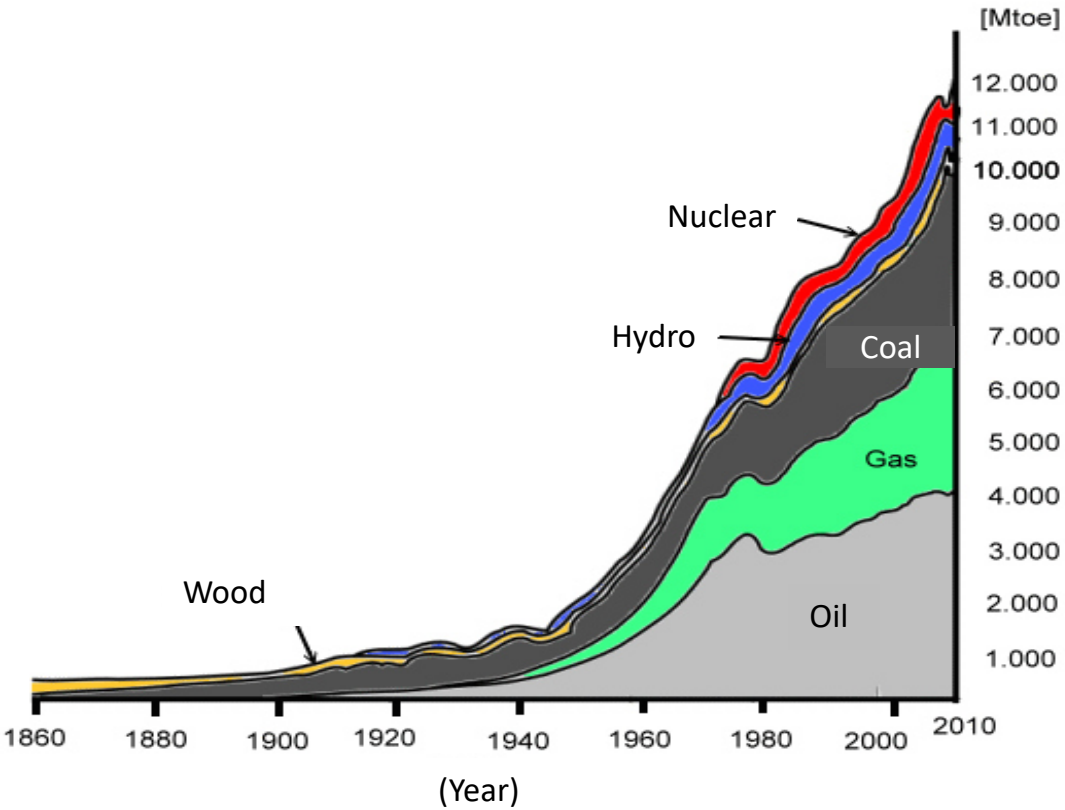

PROMOTE INCLUSIVE AND SUSTAINABLE ECONOMIC GROWTH, EMPLOYMENT AND DECENT WORK FOR ALL
ELYX BY YAK


BUILD RESILIENT INFRASTRUCTURE, PROMOTE SUSTAINABLE INDUSTRIALIZATION AND FOSTER INNOVATION
ELYX BY YAK

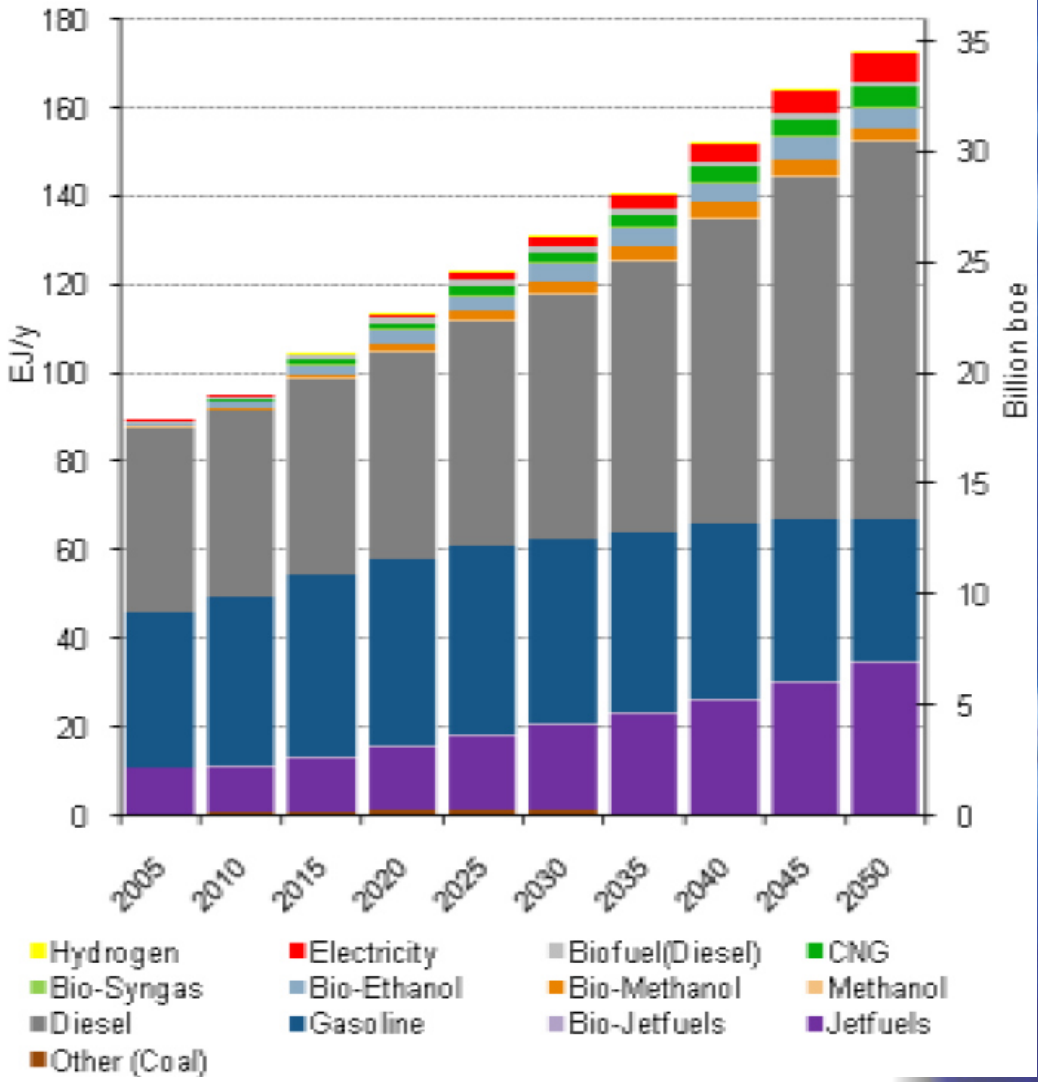
ord

Wealth depends on Energy costs, Consumption correlates with greenhouse emissions

Energy consumption since 1860 (global)



Fuels in all transport
(a) Demand between 2010 and 2050



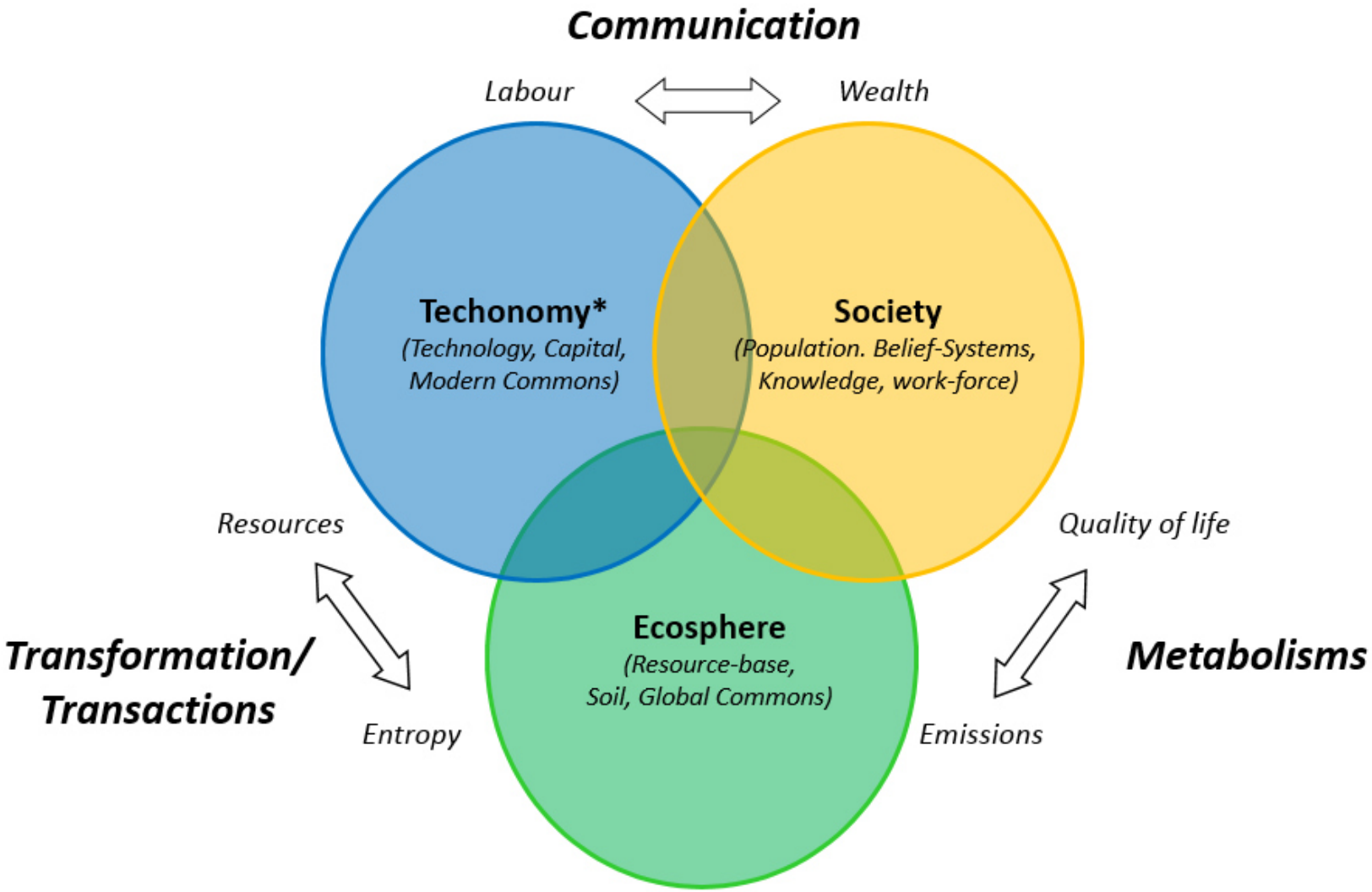
Transport shaped large technical Networks

Co-Evolution of Infrastructure-Dynamics and Range

Sector/ Infracultural Epochs	Range / System Dynamics	Transport	Energy	Telecom-munications
Transformative Networks (>2010)	*orbital / biometrisch analytisch/antizipativ*	Vernetzte, erneuerbare Mobilität	Proaktive Angebots-/ Verbrauchslenkung in transformativen Grids	Kommunikation transformativer, autonomer Systeme
Interactive Networks (>1970 – near future)	*global / Echtzeit*	Container und intermodal kombin. Transportsysteme	Smart Grids und Verbrauchssteuerung	elektronische DV - u. Übertragung, mobile Systeme, Internet
Automated Networks (>1900 – 1970)	*international / tagesaktuell*	Autobahnen, int. Luftverkehr	Kernkraft, Öl, Gas	elektrische Übertragungssysteme
Industrial Networks (>1800 – 1900)	*national/regional nächster Tag*	Eisenbahn-Netze Dampfschiff	Dampfmaschine/ Wasserturbine	manuelle-/optische Übertragungssysteme
Pre-Industrial Networks (before 1800)	*lokal langsam*	Schiffe, Wagen, Zugtiere, Menschen	Wind-/Wasserkraft	Post, Schrift, Kuriere

Societal Metabolism causes various Transactions

Socioecological Model of Transactions regarding Infrastructures

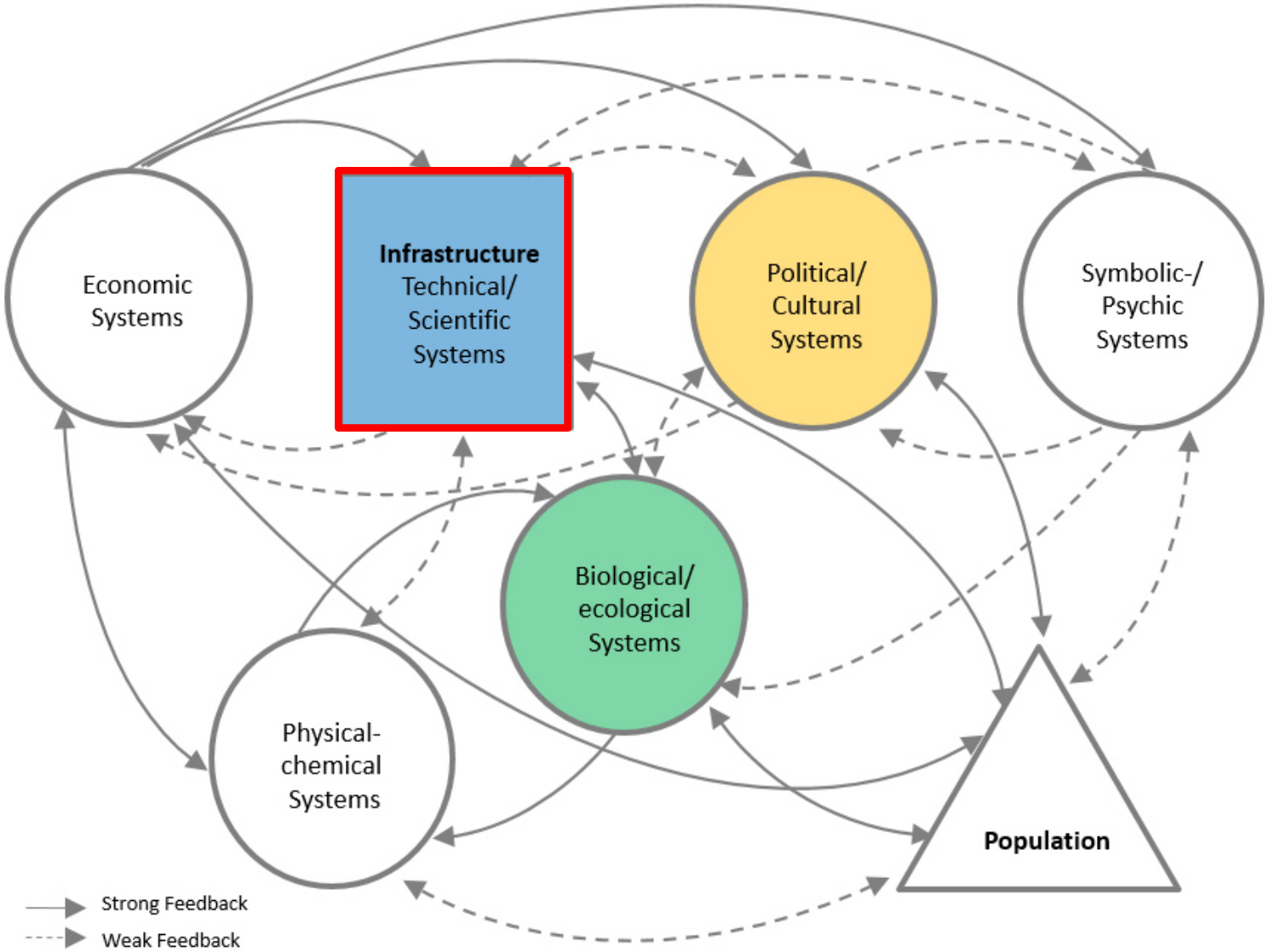


*Techonomy = technical and economic systems

Source: Markus Hofmann
Comp. Martina Fischer-Kowalski (1998):

Growth, Climate and Complex Adaptive Systems

Feedback loops between Infrastructures and Systems



Infrastructures are socio-technical Systems

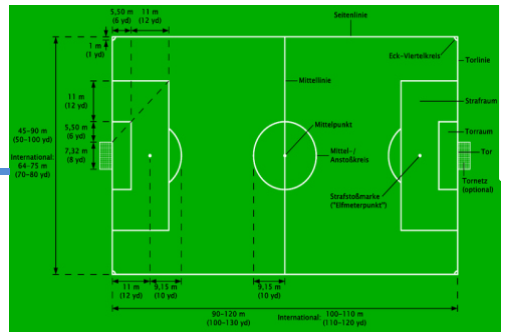
Infraculture Dimensions

Mental Infrastructure

Social, personal Infrastructure

Technical Infrastructure

Institutional Infrastructure



Environmental Infrastructure

Definitionen vgl. Jochimsen, Buhr, Frischman, Welzer

Commons Typology - Charateristics and Dilemmas

Different Types of Commons Resource Systems						
Commons-Type/ Commons-Character		**Modern Commons** *(technical)*	**Global Commons** *(natural)*	**Social Commons** *(techn., institution.)*	**Cultural Commons** *(creative, intelltel.)*	**Digital Commons** *(peer-product.)*
1.	**Emergence** of the Resource-Systems	anthropogene, inherited or build	natural Process	anthropogene, inherited	anthropogene, inherited	anthropogene, build
2.	**Excludability** from Resource Usage	Refrain from Exclusion	rarely	rarely	rarely	Refrain from Exclusion
3.	**Subtractability** of Resource Units	time/space defined, limited	time/space defined, limited	time/space defined, limited	virtual, shareable	virtual, shareable
4.	**Storebility** of Resource Units	no	limited	no	yes	yes
5.	**Spatial limitation** of Resources	yes	yes	yes	no	no
6.	**Instututionen** are negotiated Rules	yes	partially	yes	yes	yes
7.	**Ageing** of Resource-System	Technolgy deterioates	self-renewing	social Adaptation	Innovation	Software ages, Peer-Innovation
8.	**Alimentation** of Resource-Systems	Taxes. Society	Enviromental Protection	Taxes, Societal groups	Education, Research, Culture-Program	State, Charities, Crowd-funding

Source: Hofmann, comp. Helfrich 2012

Degenration not Regeneration
Dilemmas for Technical Infrastructure Systems

Dilemmas in different Commons Systems						
	Commons-Type/ Dilemmas	**Modern Commons**	**Global Commons**	**Social Commons**	**Cultural Commons**	**Digital Commons**
1.	***Asynchronity*** *of Events/Decissions*	*trifft zu - langer Nutzungszyklus*	*trifft zu Naturereignisse*	/	/	*trifft zu Gleichzeitigkeit*
2.	***Asymmetry*** *of benefits/ acces*	*trifft zu Nutzen - Lasten*	*trifft zu Klimawandel*	/	*trifft zu ortsabhängig*	*trifft zu Netzwerke global*
3.	***Aversity*** *against innovationen*	*trifft zu hoher Lock in*	/	*trifft zu Habitualisierung*	/	/
4.	***Allocation*** *of Resources /Finance*	*trifft zu polit. Prozess*	/	*trifft zu Knappheit*	*trifft zu Förderung*	*trifft zu Reichweite*
5.	***Alienation*** *from System-Effects*	*trifft zu Makro-Mikro-Ebene*	*trifft zu Zukunftsrisiken*	/	*trifft zu Individualisierung*	*trifft zu Haftungsrisiko*
6.	***Acceptance*** *of Change in Resource-Systems*	*trifft zu polit. Prozess*	/	*trifft zu Diversität*	*trifft zu Diversität*	*trifft zu Open Source*

Tabelle 11Dilemmastruktur für Commons Typen
(Quelle: Eigene Darstellung, Commons-Typen vgl. Helfrich)[1]

Tabelle 24 Dilemmata und Gestaltungsebenen

[1]{Helfrich 12. 2009: 7}

Infrastructure Systems work in interdependent Layers

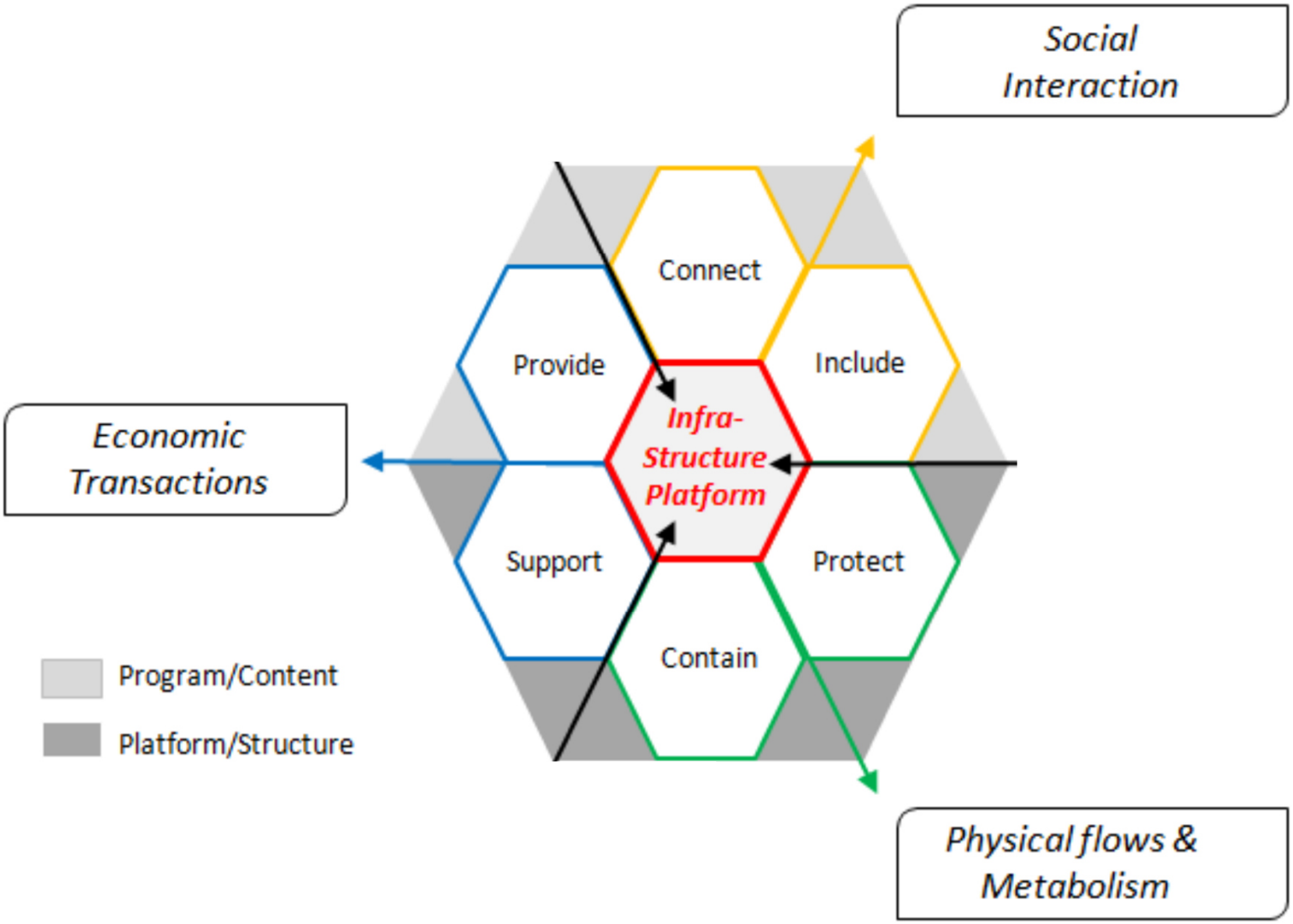
Application Layer

Programme Layer

Network-Layer Platforms

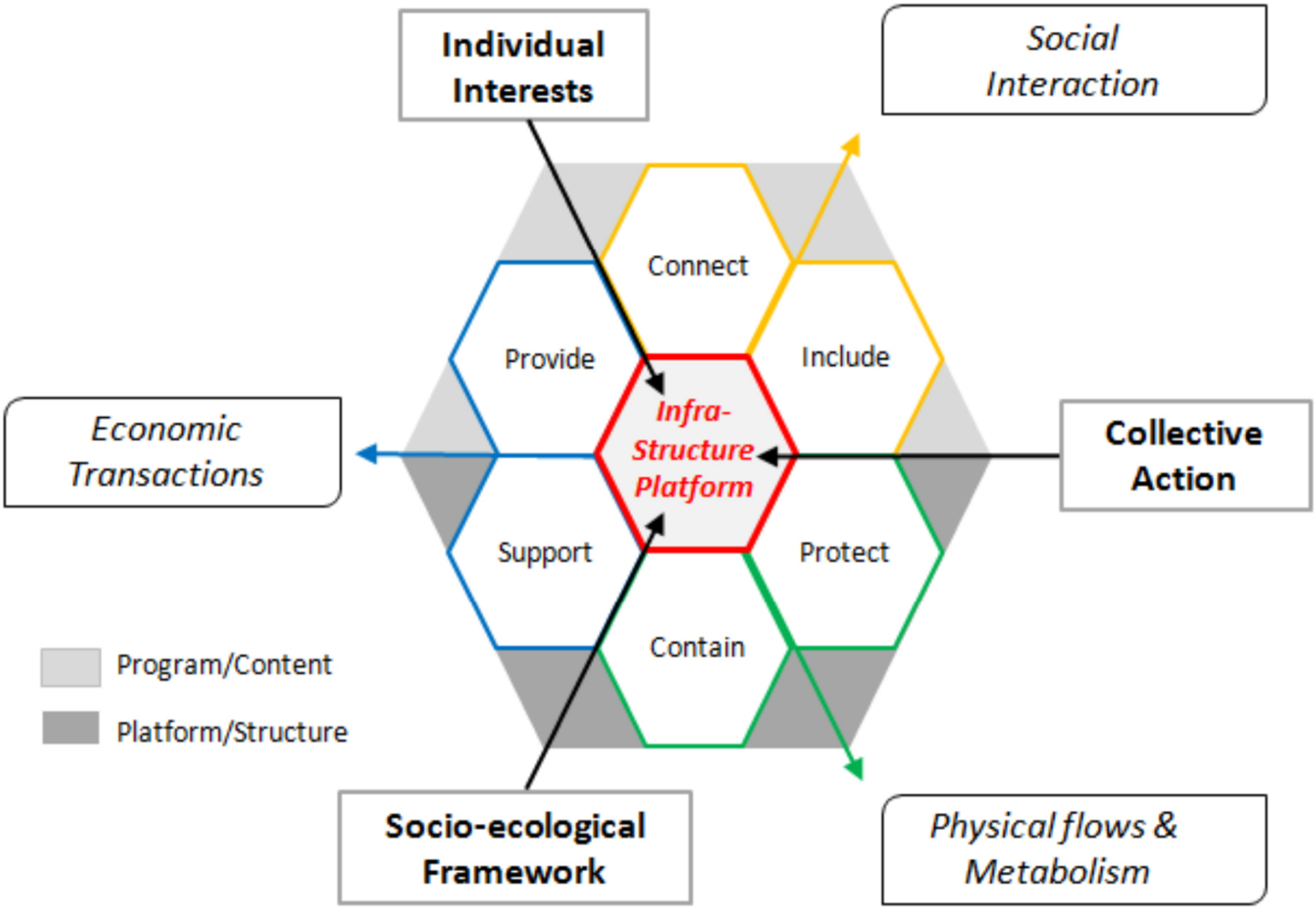
Infrastructure is shaped by Functions and Institutions

Infracultural Functions and Context (Schematic flow model)



Institutions are shaped by decissions and trust

Infracultural Functions and Context (Schematic flow model)



Modern Commons serve multiple functions

Complementary infrastructure—dimensions and infrafunctions

Functions/ dimensions	Protect	Support	Provide	Connect	Include	Contain
Mental infrastructure	• Security • Shelter • Self-esteem	• Values • Common Spirit • Personal resources	• Performance • Progress • Innovation	• Freedom • Solidarity • Responsibility	• Belief System • Identity • Belonging	• Justice • Barrier determined
Social and personal infrastructure	• Community • Service for public • Police, Defense	• Neighborhood • Platform • Social access • Welfare	• Community • Basic provisioning • Workforce	• Networks • Communication • Interaction • Travel	• Society • Access rights • Art, sports • Culture	• Laws, rights • Cultural bound. • Social, public Acceptance
Technical infrastructure systems	• Livingspace • Physical protection • Fences • Fortification	• Platforms • Transportation • Vehicles • Devices	• Transport • Water • Sewage system • Energy grid	• Telecoms, ICT • Telematics • Broadcast, TV • Broadband	• Physical protection • Access media • Devices	• Capacity • Standards • Borders • Capital
Institutional infrastructure	• Defense • Healthcare • Service for public	• Education • Knowledge • Legal system	• Service for public • Trade • Property	• Democracy • Markets • Competition • Cooperative	• Culture • Education • Service for public	• Property • Regulation • Financing • Jurisdiction
Natural infrastructure	• Physical protection • Shelter • Topography	• Water, Air • Sun, Wind • Land, Topsoil	• Global commons • Forests, • Agrarian areas	• Waterways • Valleys • Resources	• Landscape • Biosphere •Habitat	• Topography • Ecosystem • Climate • Resources

Sustainable Governance for socio-technical Systems

1. System Perspective

Transport | Energy | Communication

Converging Sectors

Applications

Programmes

Platforms

Connected Infrafunctions

2. Sustainabilty Perspectives

social

economical

ecological

Complementary Dimensions

Short term | medium term | Long term

Intergenerational Timepath

3. Actors Perspective

Local | Regional | International

Asymmetric Spatial effects

Utilisation

Provisioning

Allocation

Infracultural Governance

Managing Modern Commons across Sectors creates System Synergies

Synergy in Planning and Operation of Infrastructures			Sunstainability Contribution		
Synergy-Dimension	Type	Example for Coupling	Economic	Social	Ecological
A. Increase Resource-Efficiency					
Spatial bundling	s	Flächennutzung reduziert Footprint und Kosten	x	x	x
Site sharing	s	Trasse, Masten, Schächte (s. Infrastruktur Atlas)	x		x
Reduced Planning reduced	s	Projektent- und abwicklung, Genehmigungen	x	x	x
Resources and Landscape Consumtion	s	gemeinsame Nutzung von Brücken, Tunnel etc.	x		x
Bundling of Energy usage	s/f	Angebot und Nachfrage ausgleichen	x		x
Bundling Maintenance efforrts	s	integr. Ausblidung, gem. Service-Flotten, Lager	x		x
B. Reduce Risks - Increase Resilience					
Protect critical Infrastructures	s	Anlagen physisch sichern, Cyberprävention	x	x	
Reduce Emissions	s	Toxische, Abwärme, Strahlung, Erschütterung	x	x	x
Floods, Extreme Weather	s	Klimafolgen, Hochwasserschutz, USV	x	x	x
Reduce Noise and Vibrations	s	Emission, Schutzwände, Bündelung	x	x	x
C. Leverage Potential - Opportunities					
Innovation and Standards	s	Skaleneeffekte, LCC, Prozessverkürzung	x	x	x
Systemic Connectivity	s/f	Digitalisierung, Angebot/Kapazität vernetzen	x	x	x
Resource Management across sectors	s/f	Puffer für Spitzen, Speicherkapazität	x		x
Extended Scope of Planning	s	Integr. Standortentwicklung und Betrieb	x	x	
Reduced Administration	s	Vertrieb, Abrechnung, Personal, Administration	x		
Infraeducation increases aceptance	s	Systemverständnis, Partizipation, Identifikation		x	x

s = strukturelle Synergiepotenziale ; f = funktionale Synergiepotenziale

Tabelle 23 Synergiepotenziale durch Konvergenz

(Quelle: Eigene Darstellung)

Transformation towards Sustainability
Summary Part A: Europe may not be in the drivers seat

A. Modern Commons

Sustainable Infrastructure Development meets Global Challenges

- *China ratified UN SDG*
- *China signed Paris Agreement Dec. 2015*
- *China imposed quota for electric vehicles*

B. Sustainable Mobility

Transforming Urban Environments with glocal Strategies

Picture: Bejing Morning 17. Jan. 2014, Daily Mail Internet

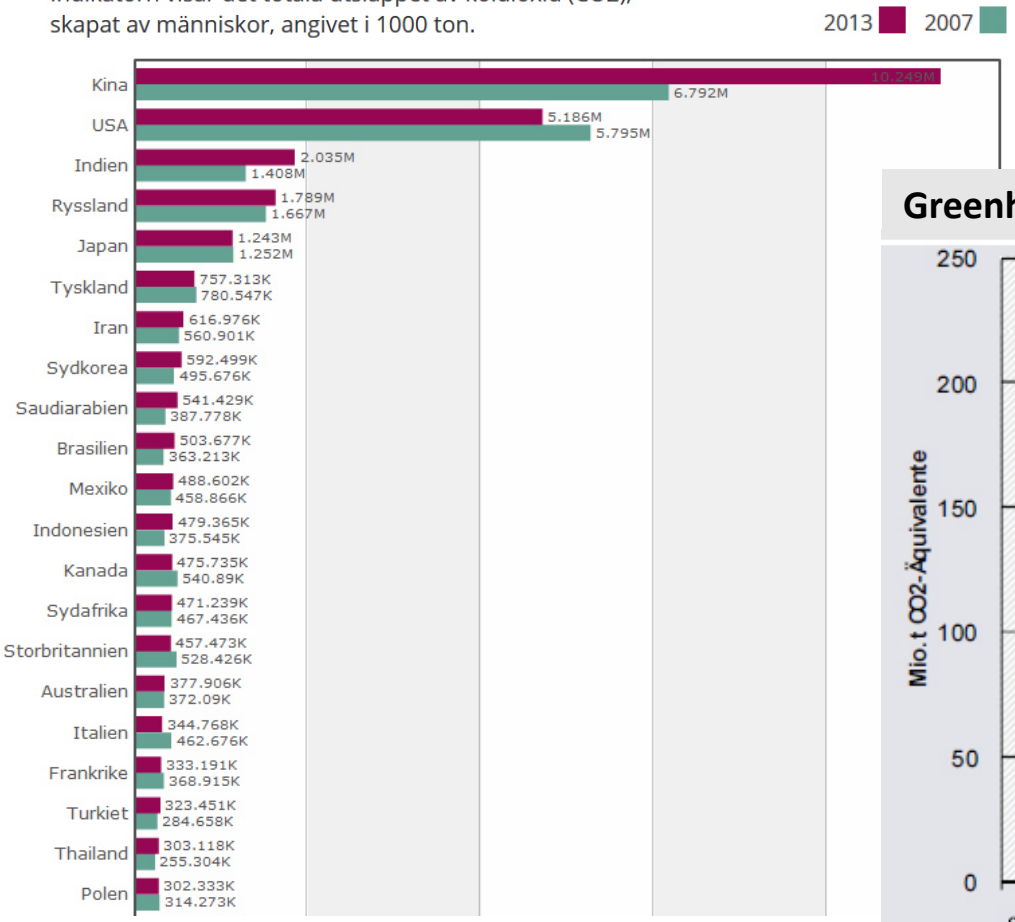
B. Intermodal and Sustainable Future of Transport

Transform Mobility by Shift in Demand

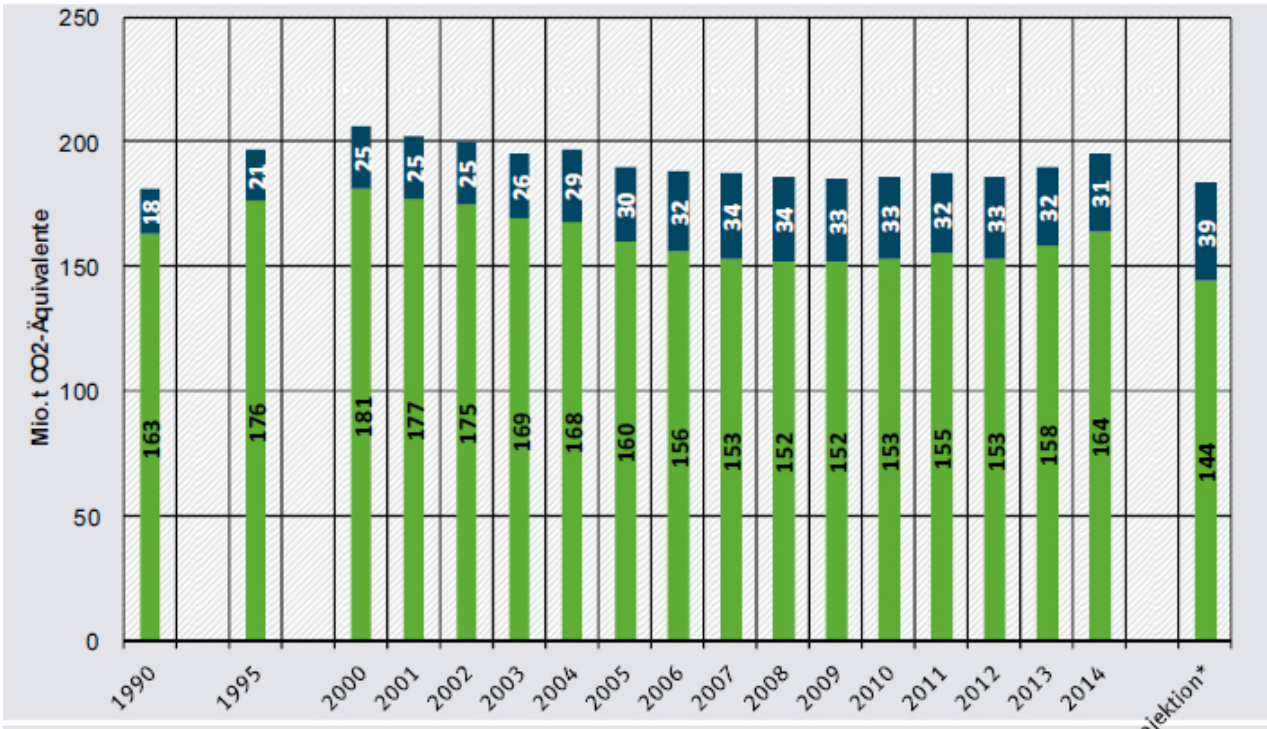
B. Greenhouse emission persist in Transport Sector
Keine Energiewende ohne Verkehrswende!

CO2-utsläpp

Indikatorn visar det totala utsläppet av koldioxid (CO2), skapat av människor, angivet i 1000 ton.



Greenhous Emissions Transport Germany 1990 – 2020



Quellen: BMUB Klimaschutzbericht 2015; Projektionsbericht der Bundesregierung 2015; UBA 2015

B. All Infrastructure is local – What are issues in Göteborg?

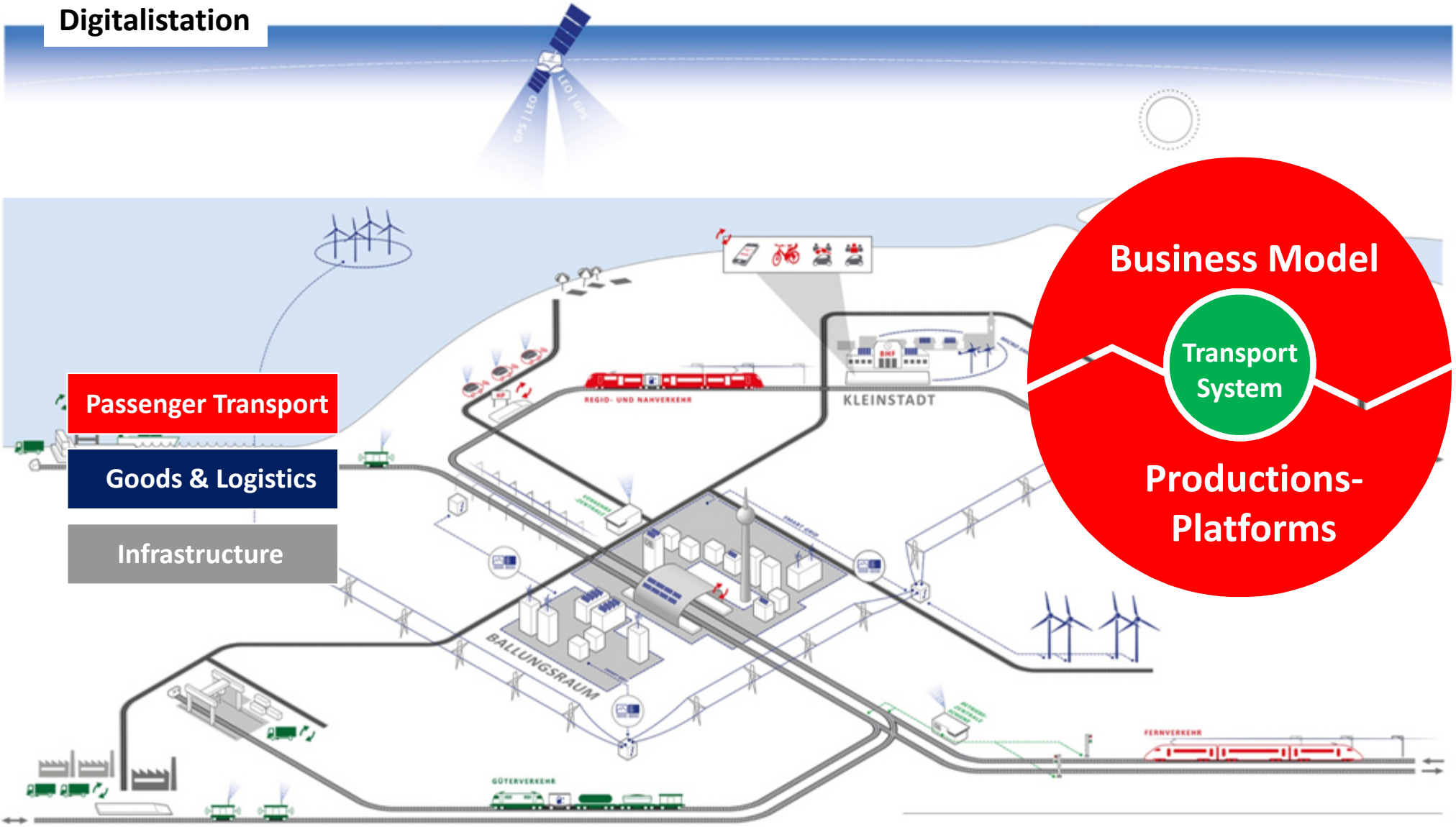
Tabell 12 Uppfattning om aktuella infrastrukturprojekt, Västsverige, 2006–2014 (balansmått)

		2006	2007	2008	2009	2010	2011	2012	2013	2014
Åsikt om beslutade trafikåtgärder	Västlänken (*tågtunnel under Göteborg*)						+34	+21	+19	+2
	Marieholmstunneln (*ny älvtunnel*)						+46	+41	+41	+39
	Dubbelspår för tåg mellan Göteborg och Borås									+47
	Trängselskatt i Göteborg						-29	-35	-14	-9
Åsikt om förslag gällande trafiken	Västlänken (*tågtunnel under Göteborg*)	+30	+31	-	+33	+27	-	-	-	-
	Dubbelspår för tåg mellan Göteborg och Borås	-	-	-	-	-	-	+53	+50	-
	Trängselskatt i Göteborg	*-34*	-38	-21	-10	-30	-	-	-	-
	Bygga ut hela E20 mellan Göteborg och Örebro till motorväg[1]	*+70*	+69	+59	+59	+61	+63	+70	+64	+60
	Bygga snabbjärnväg mellan Oslo och Köpenhamn via Göteborg	-	-	-	-	-	-	-	-	+60
	Bygga ut kollektivtrafiken	-	+81	+82	+72	+71	+72	+74	+73	+72
	Minsta antal svar	2 989	2 977	2 897	2 995	2 913	2 855	2 856	2 850	2 648

Kommentar: 2011–2014 lyder frågorna: 'Vilken är din åsikt om följande beslutade trafikåtgärder?' samt 'Och vilken är din åsikt om följande förslag gällande trafiken?'. 2006–2010 löd frågan: 'Vilken är din åsikt om följande förslag?'. 2006-2007 fanns inte alternativet ingen uppfattning med. Procentbasen utgörs av de som besvarat respektive delfråga. Balansmåttet visar andelen som tycker att förslaget är 'mycket bra' eller 'bra' minus andelen som tycker förslaget är 'dåligt' eller 'mycket dåligt'.
[1] 2006–2013 löd delfrågan 'Bygga ut hela E20 till motorväg'.
Streck (-)= frågan ej ställd.
Källa: De västsvenska SOM-undersökningarna 2006–2014.

Sustainable Mobility will change Modes of Business and Production

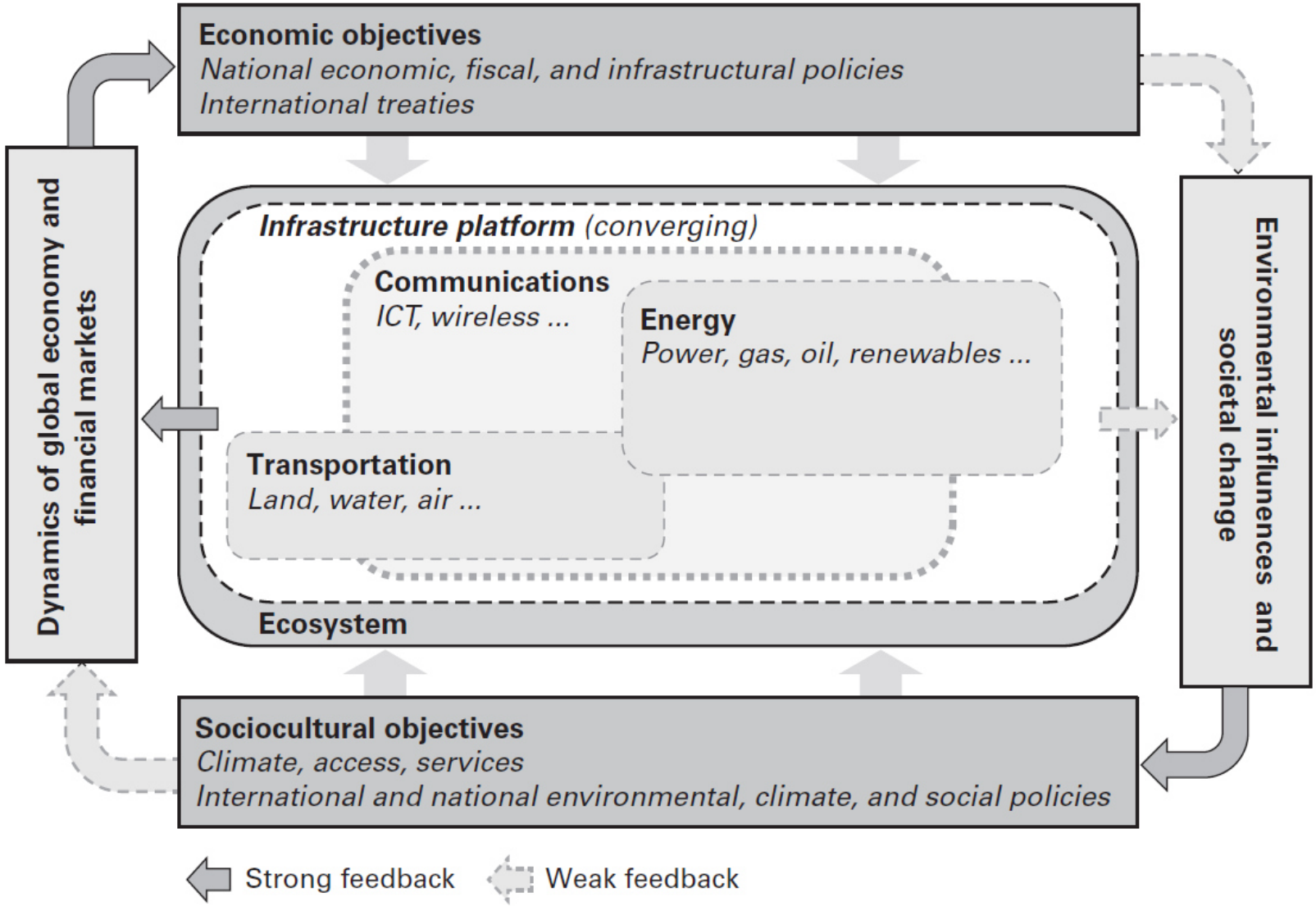
Digitalistation



Source: InnoZ

Societal Goal Attainment Systems interact
Co-Development of Society and Infrastructure

Infracultural Development Framework *(Infrakultureller Bezugsrahmen für Entwicklung)*



Source: Infracultural Framework for Research and Development (IDF), Hofmann

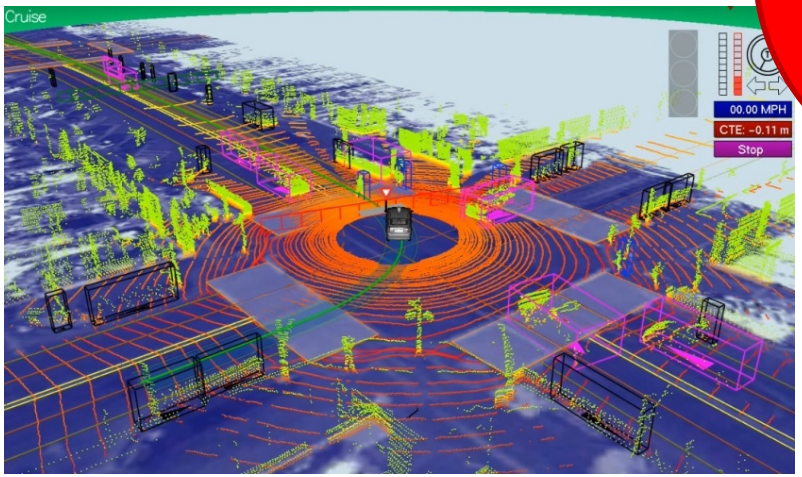
Re-thinking Mobility and Logistics in Smart Cities

Digital Mobile Customer

IoT Ecosystem

Drivers of Hyper Connected-ness

Autonomous Driving

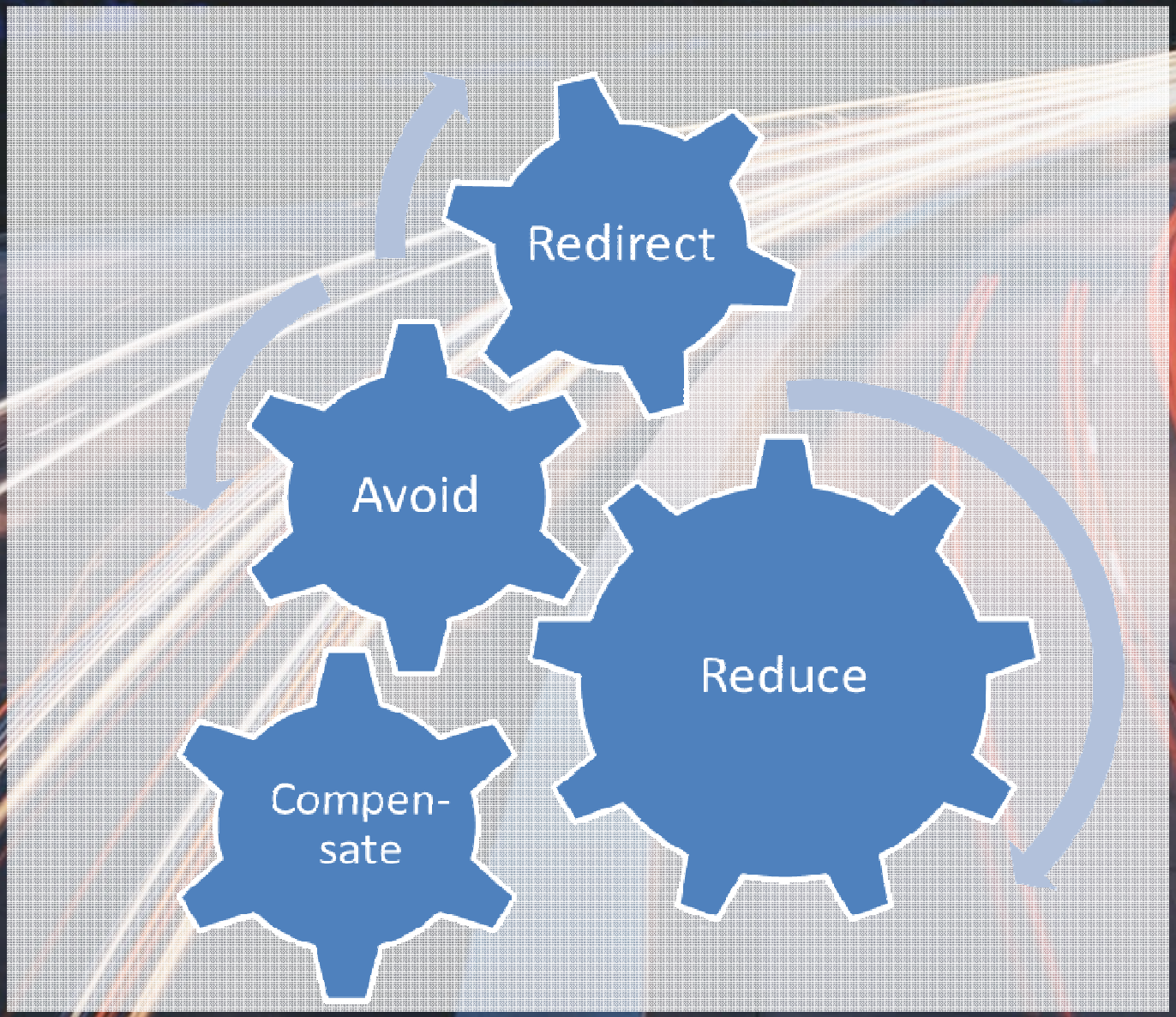


Carbon free Mobility

What are the drivers of Change –Think about Göteborg

Traffic is increasing – in Göteborg

How can traffic-emissions be reduced effectively?

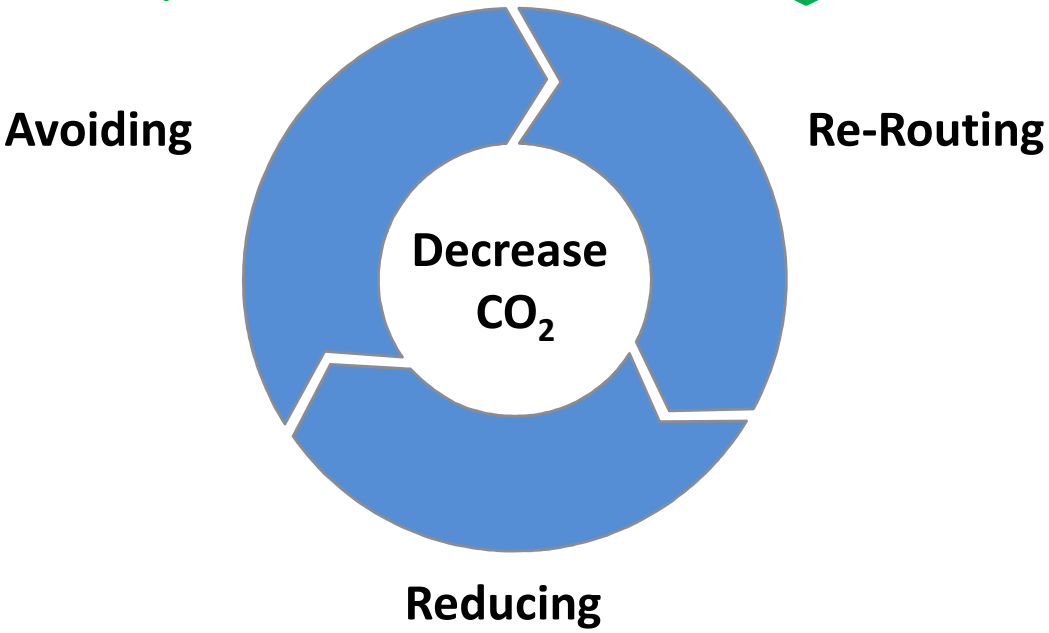


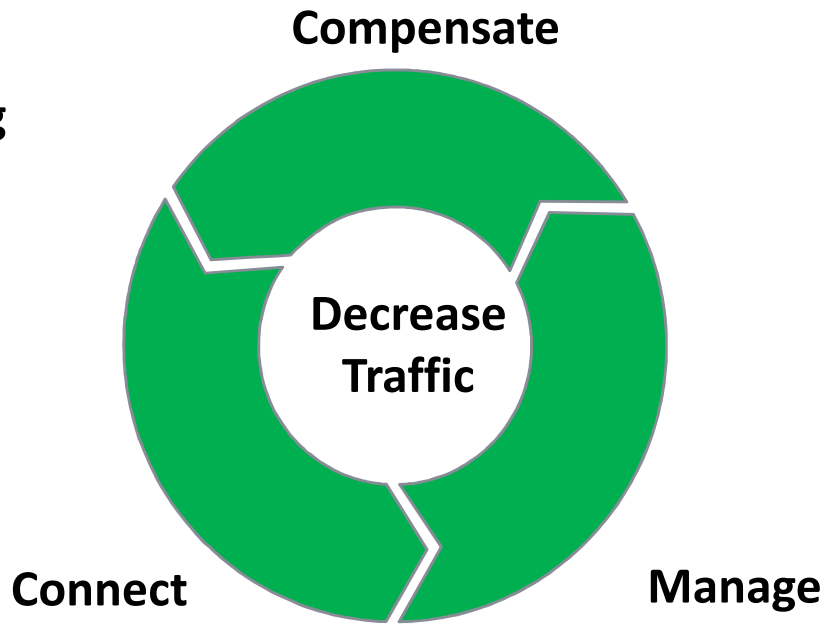
Examples of Measures to discuss

Avoid:
- Wege reduzieren, bündeln
- Fahrten bündeln wie City Logistik. CarPooling

Re-Route:
- Straße zur Schiene
- Schienenverkehr zu Ruf-Bus/ Carsharing
- Binnenschiff

Compensate
- Klima-/Flottenzertifikate
- Regelbare Energiespeicher
- Investitionsanreize
- „Schadstoff-Maut“





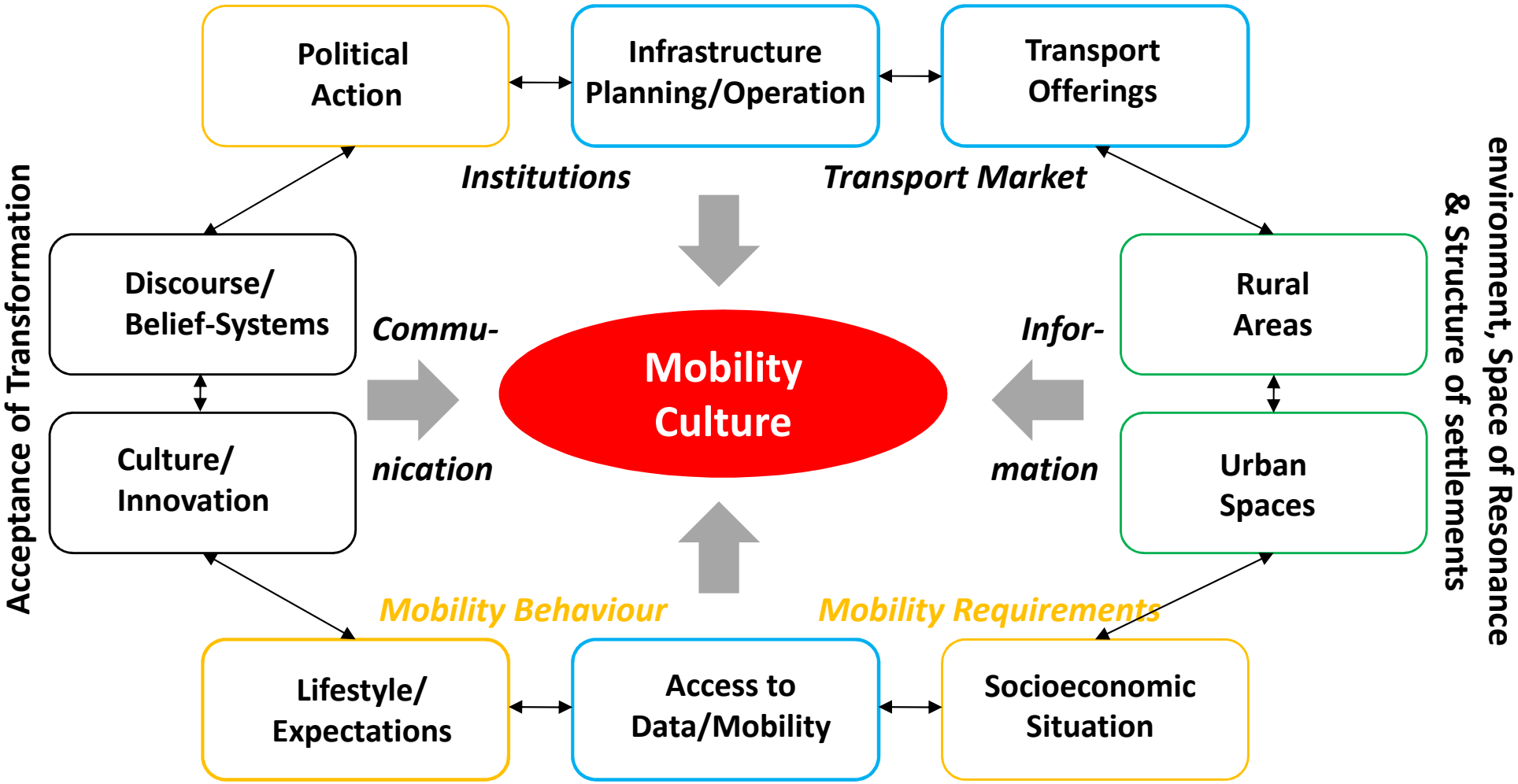
Reduce:
- Innovative Antriebstechnik
- Erneuerbare Kraftstoffe
- Effizienz steigern
- Verkehrslenkung

Connectivity
- Aktive Verkehrstelematik
- Virtuelle Leistungsverkettung
- Phys. Bündelung v. Flüssen
- Intermodal optimieren

Demand-Management:
- Entzerren von Lastspitzen
- Harmonisierung Durchsatz
- Stauen/Speichern/Lagern
- Wandelspeicher

Transport mirrors individual Preferences and Options underlying Infracultural preconditions and belief systems

Factors influencing sustainability of Transport



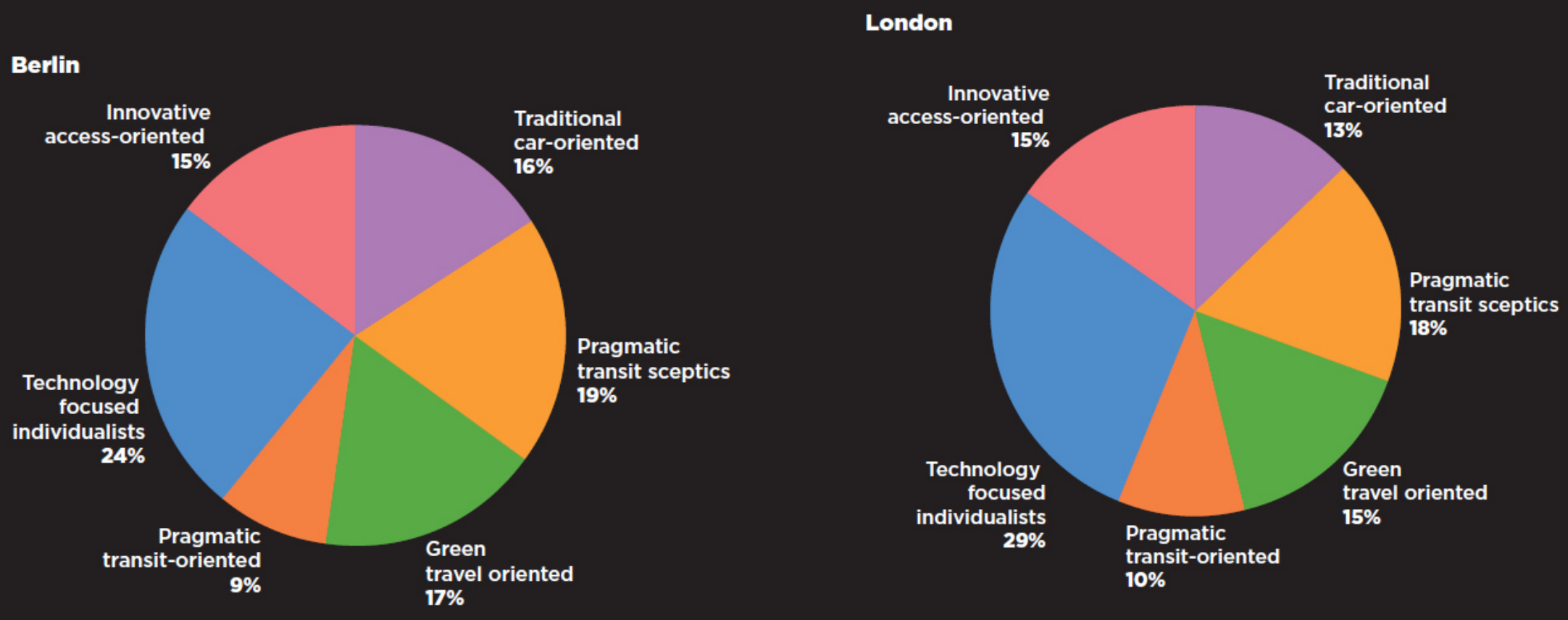
LSE Study shows Change in Mobilty Patterns

Fig. 2.3. Sampling regions in Berlin and London
Source: LSE Cities

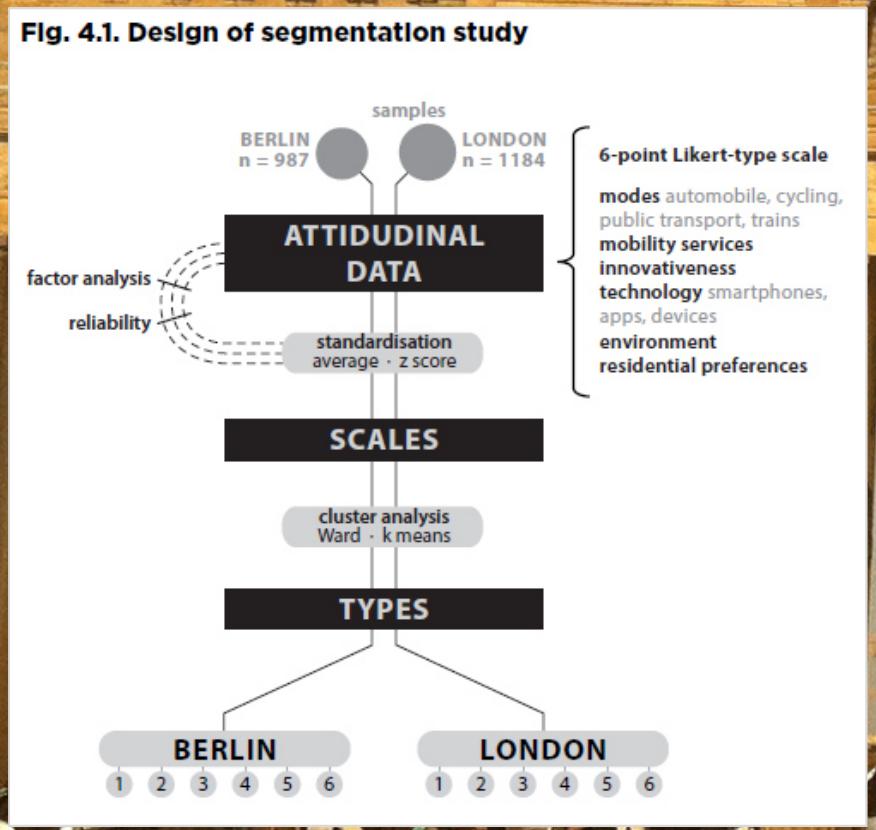
London	modal share in all trips 1998 (%)	modal share in all trips 2013 (%)	net change (%)
public transport	33	45	+12
driving	45	33	-12
walking	22	21	-1
cycling	1	2	+1
Berlin	**modal share 1998 (%)**	**modal share 2013 (%)**	**net change (%)**
public transport	27	27	-0.1
driving	38	30	-8.4
walking	25	31	+6.0
cycling	10	13	+2.5

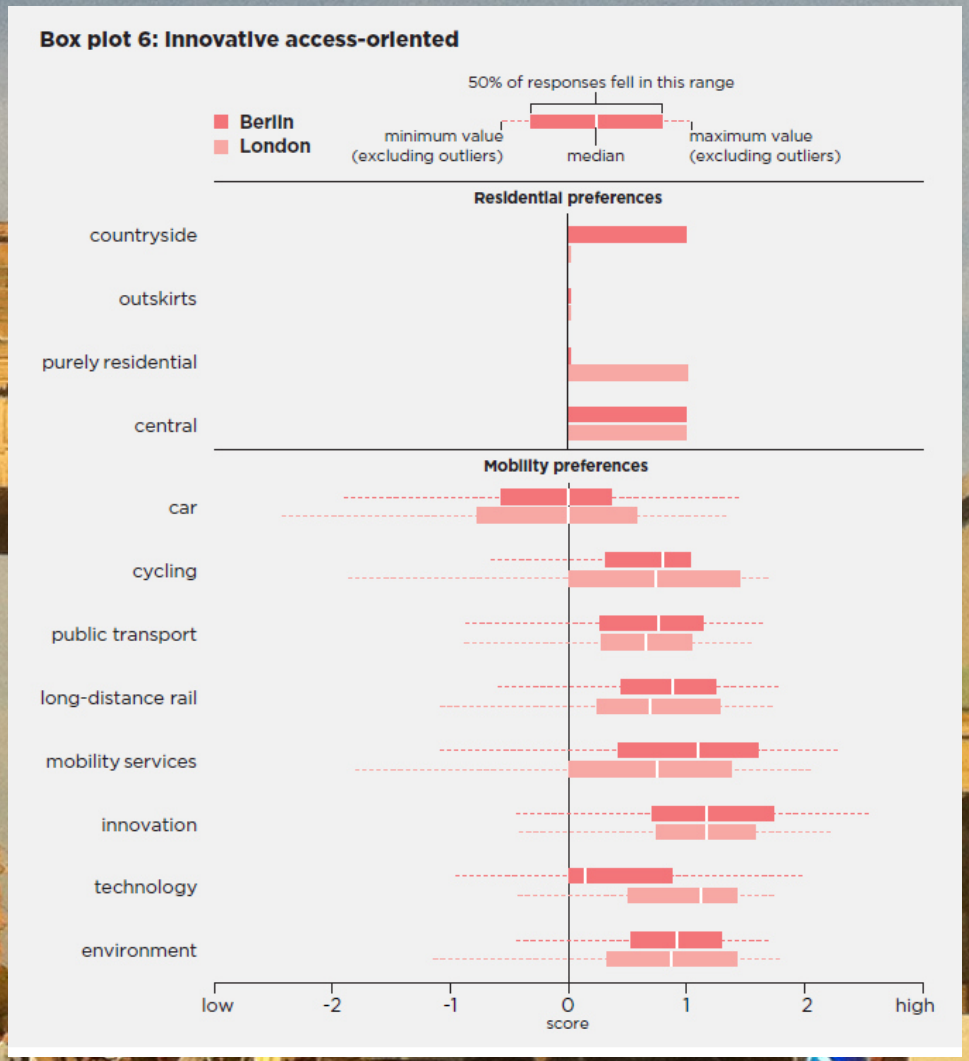
Mobility Preferences differ between Cities

Fig. 4.2. The six mobility attitude groups in Berlin and London



Redefining economic distances by walkability & connectivity





Source: LSE 2015, Prof. Larry Frank, Vancouver 2015

Valid data allows to formulate Policy Options

5. Policy implications

Traditional car-oriented (1)

policy goal: mitigate and compensate
- compensate for environmental impact
- reduce environmental impact
- reduce driving and car ownership where possible

potential alternatives
- electric cars

policy options

Pragmatic transit sceptics (2)

policy goal: mitigate
- reduce environmental impact
- reduce driving and car ownership where possible

potential alternatives
- electric cars
- car sharing
- cycling (Berlin)
- public transport (London)

Green travel oriented (3)

policy goal: affirm and encourage
- maintain and expand cycling and public transport use
- London: reduce car use and ownership further

potential alternatives
- walking
- cycling
- public transport

Pragmatic transit-oriented (4)

policy goal: affirm and encourage
- maintain and further encourage cycling and public transport use
- Berlin: reduce car use and ownership further

potential alternatives
- public transport
- cycling, bike-and-ride
- car sharing

policy options
- sustain positive public transport experience
- target with specific offers to trial new services
- affordable public transport
- encourage technology use

Technology focused individualists (5)

policy goal: switch
- reduce driving and car ownership
- reduce environmental impact

potential alternatives
- cycling
- electric cars
- car sharing

policy options
- highlight autonomy and fun aspects of alternatives, including public transport modes
- target through technology channels, smartphone travel apps and electronic services
- encourage cycling through campaigns highlighting personal benefits (health, fitness, fun)

Innovative access-oriented (6)

policy goal: inform and encourage
- encourage further use of alternative modes
- further reduce car use

potential alternatives
- walking
- cycling
- public transport
- electric car hire

policy options
- promote mobility services to improve travel experience, particularly online services
- inform instantly about new options and services

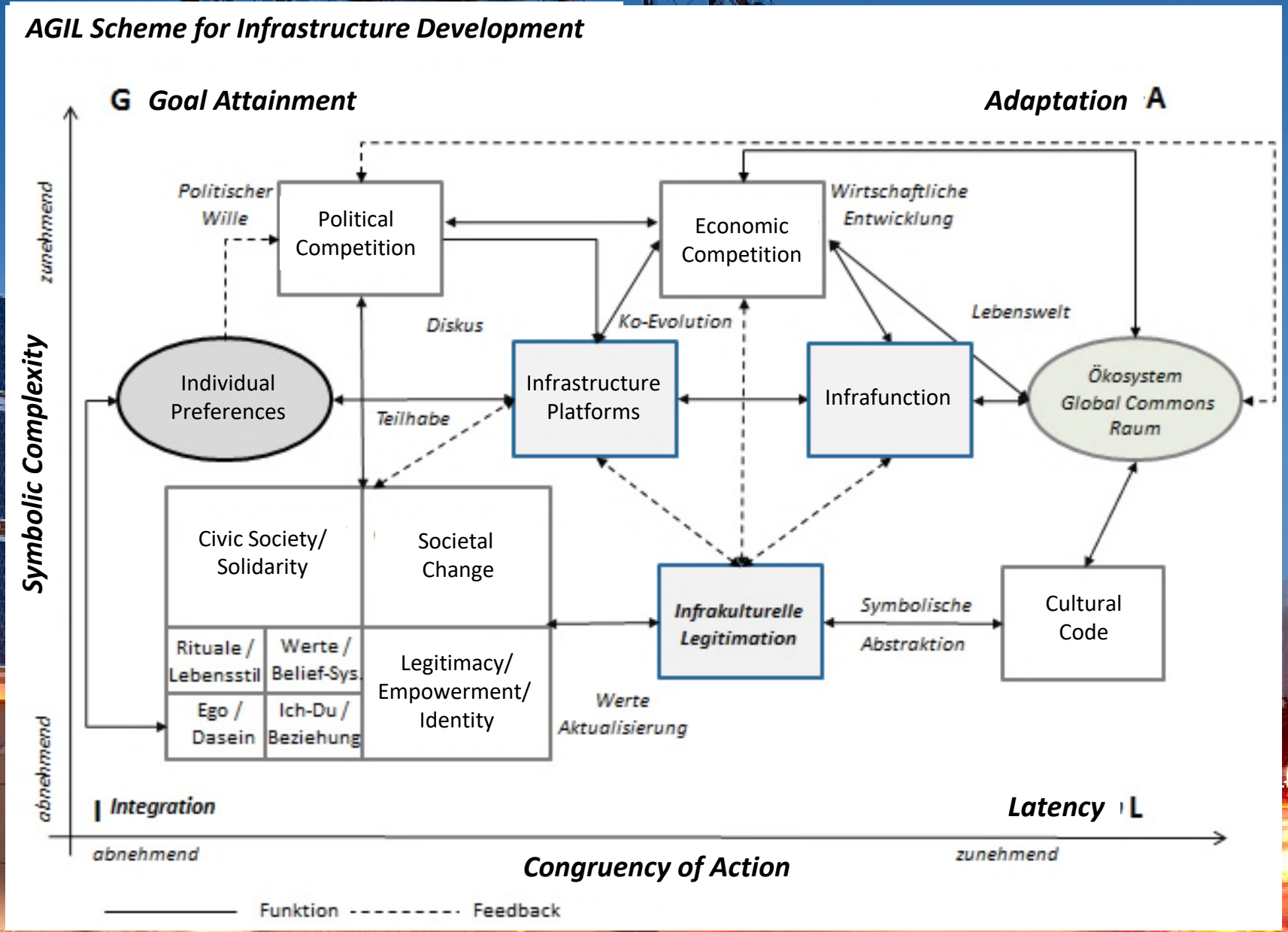
Policy objectives should focus on encour-

Walkability & Connectivity can be changed

- Study Participants After the Greenway Was Constructed Showed these Changes:
  - 32 % increase in bike trips
  - 23 % decrease in automobile trips
  - 33 % decrease in time spent in cars after the greenways
  - 16 % increase in the number of days engaged in moderate physical activity.
  - 10 % decrease in the number of days in poor physical or mental health
  - 8 % decrease in sedentary time

Source: Prof. Larry Frank, Vancouver, Seattle 2015

Revolving process of Infrastructure Planning Needs Infracultural Legitimation



Source: *vgl. Münch 1992, Allen 2008*

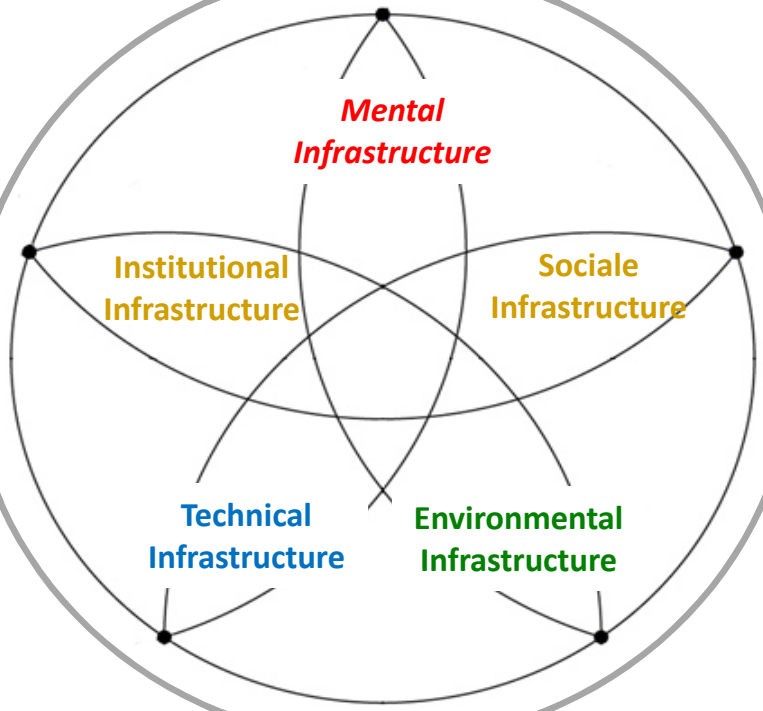
Infracultural Perspectives on Systems
Infracultural Framework for Development and Research (IDF)

Socio-cultural Framework (Cultural System)

Philosophie, Mythen, Religion, Glaube, Ideologien, Wissen, Geldsystem
Politik, Gesetze, Institutionen, Kultur, Bildungssystem, Recht, Normen, Kommunikation, Netzwerke, Verwaltung

Individual Motivation (Personal Behaviour System)

Persönliche Ziele, Präferenzen Mentale Antizipation von Veränderungen, Werte, Verhalten, Lebensstil, Resilienz, Sanktionen, *Emotion, Zugehörigkeit, Trigger, Selbstwirksamkeit*



Socio-economic Structures (Cultural System)

Wirtschafts-, Fiskal- und Infrastruktur-Politiken, Betriebswirtschaftliche Ziele, Planungssicherheit, Technik, Märkte, Regulierungsrahmen, Verträge, Sozialsysteme

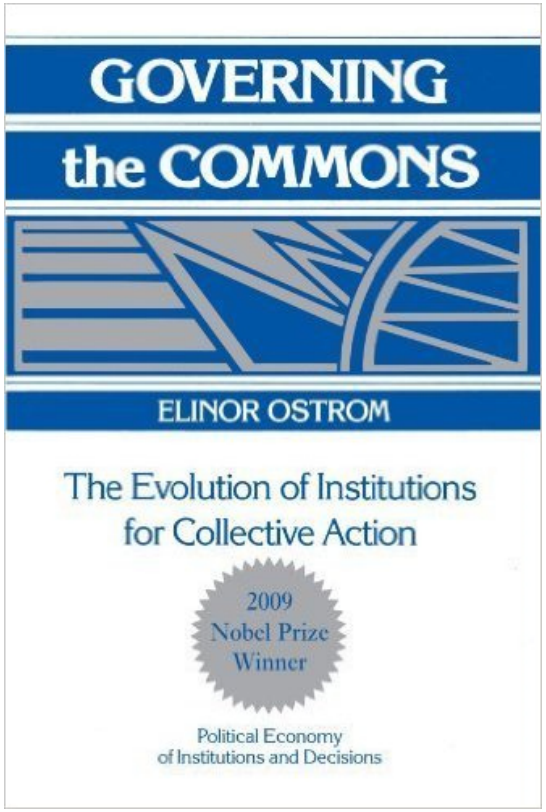
Socio-ecological Framework (System of Human-Ecology)

Bevölkerung, Bildung, Sozidemographische Entwicklung, Räumliche Verteilung, Migration, Flora, Fauna, Habitat, Städte, Land, Bodenschätze, Klima, Ökosystem, Global Commons

Kålla infrakulturen i din egen stad angående hållbarhet och resilens

- Vem svara för energiförsörjning?
- Hur stor andel har förnyelsebara köllor i el-mixen?
- Hur bestäms tidtabeller och hållplatser?
- Vem planer och vem betalar vägbygge och järnvägar?
- Hur planers bostadsområden och tillgång till transport-infrastruktur?
- Kan du cyckla eller gå dit du måste komma i Göteborg?
- Vilka sharing erbjudanden fins i Göteborg – borde finnas?
- Vad vet du om data-säkerheten – du personligen, univesitetet och stadens infrastruktur?
- Hur länge klara Göteborg sig utan el-försörjning?
- Vad händer vid översvämmingar och starkregn?
- Hur påverkar en ökning av meletempraturen med 2 grader planeringen??

Literature



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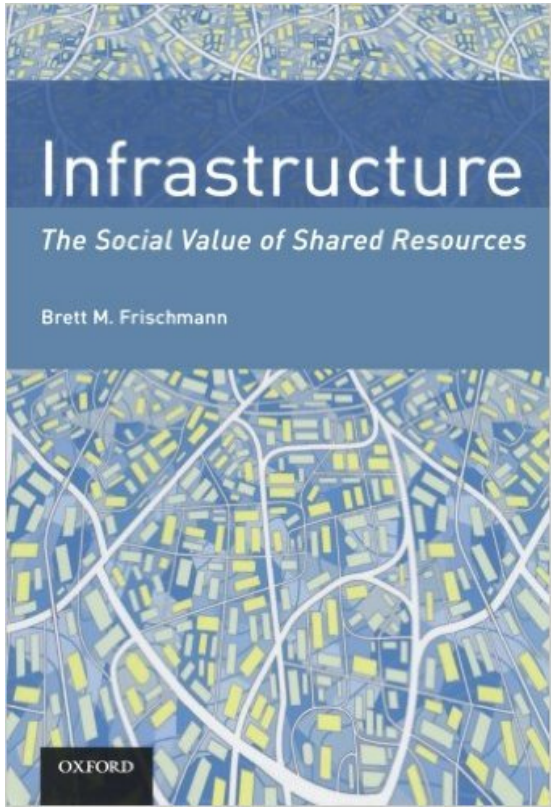

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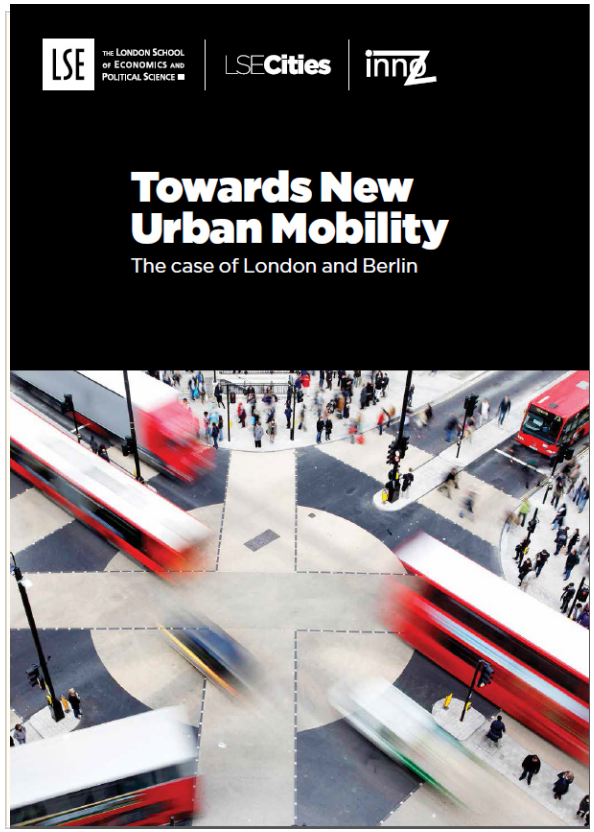

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Let´s Change Mobility Patterns
Tack för upmärksamheten