Final Conference
Online | 01.12.2021

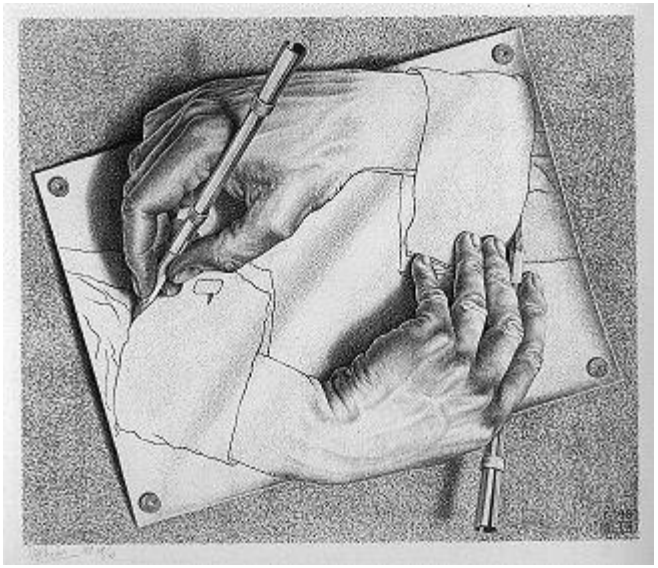
A functional approach to energy transition planning

PROSPECT2030 | Manfred Hotwagner | Giulio Cerino Abdin

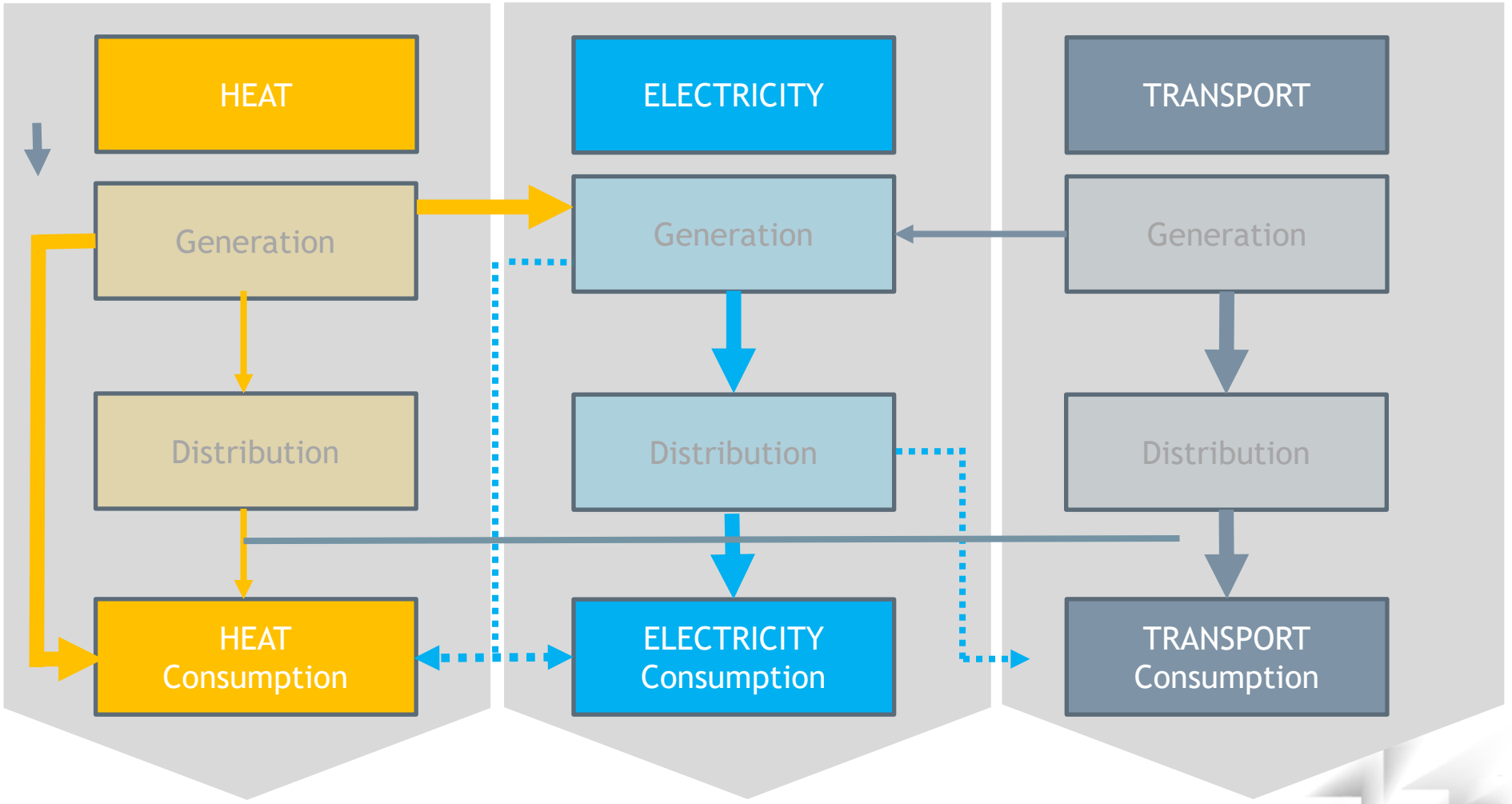
CONTENT

Practice determines mindset

Mindset determines practice

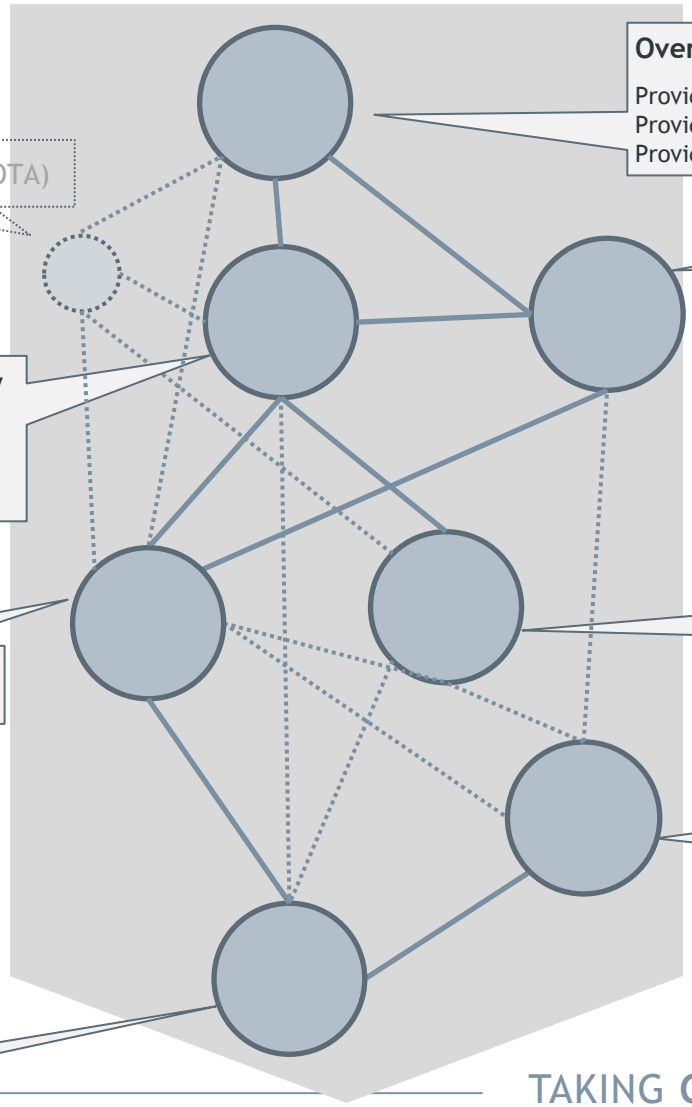


VERTICAL – SECTORAL SUPPLY



VERTICAL - SECTORAL PLANNING

Public planning



Overarching territorial authority (OTA)
Providing/managing framework conditions
Providing/managing financial resources
Providing/managing funding schemes

Funding agency (connected to OTA)

Research & development sector

Public / semi-public energy agency
(connected to OTA, sometimes executive body)
Monitoring, coordination, planning, communication etc..

Subordinated territorial authority (STA)
Occasinally having own development departments (mainly urban/metropolitan spaces etc.)

Sectoral stakeholders
Supply, infrasructure, industry, markets

Private planning/consultaion companies
Also acting as energy agencies on behalf of STA s

Private planning

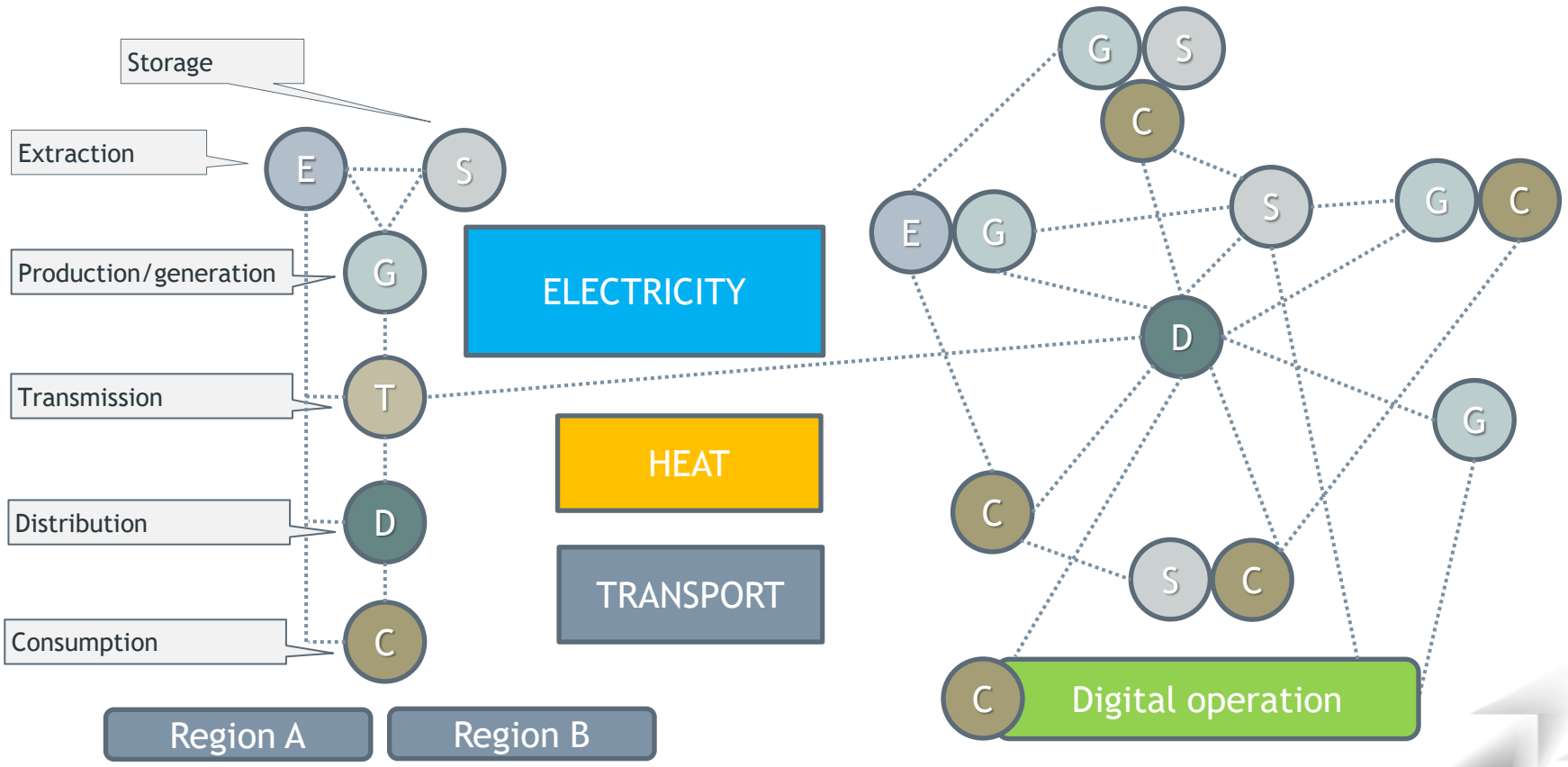
Consumers

TRANSITION: ENTERING NEW TERRITORY

Energy-driven Systems
predominately based on combustion

transforming into

Energy- and data-driven (Eco)Systems
with decreasing combustion and
an increasing share of electricity



DISTRIBUTED ENERGY SYSTEMS

General principle:

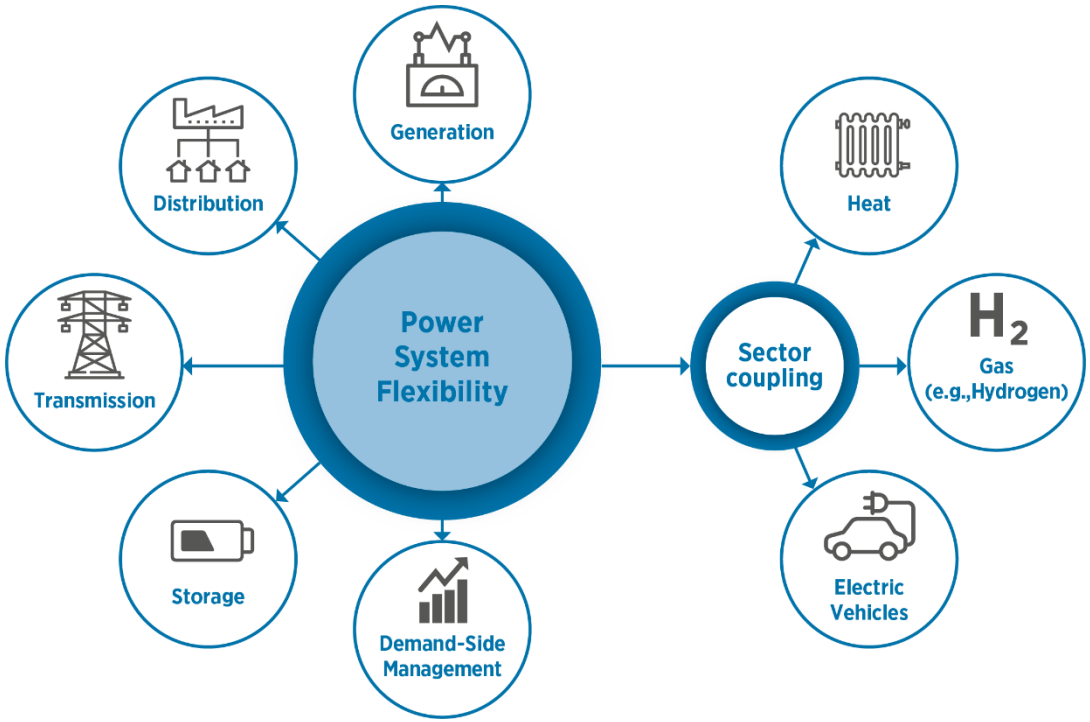


Image source: IRENA

Implementation in reality:

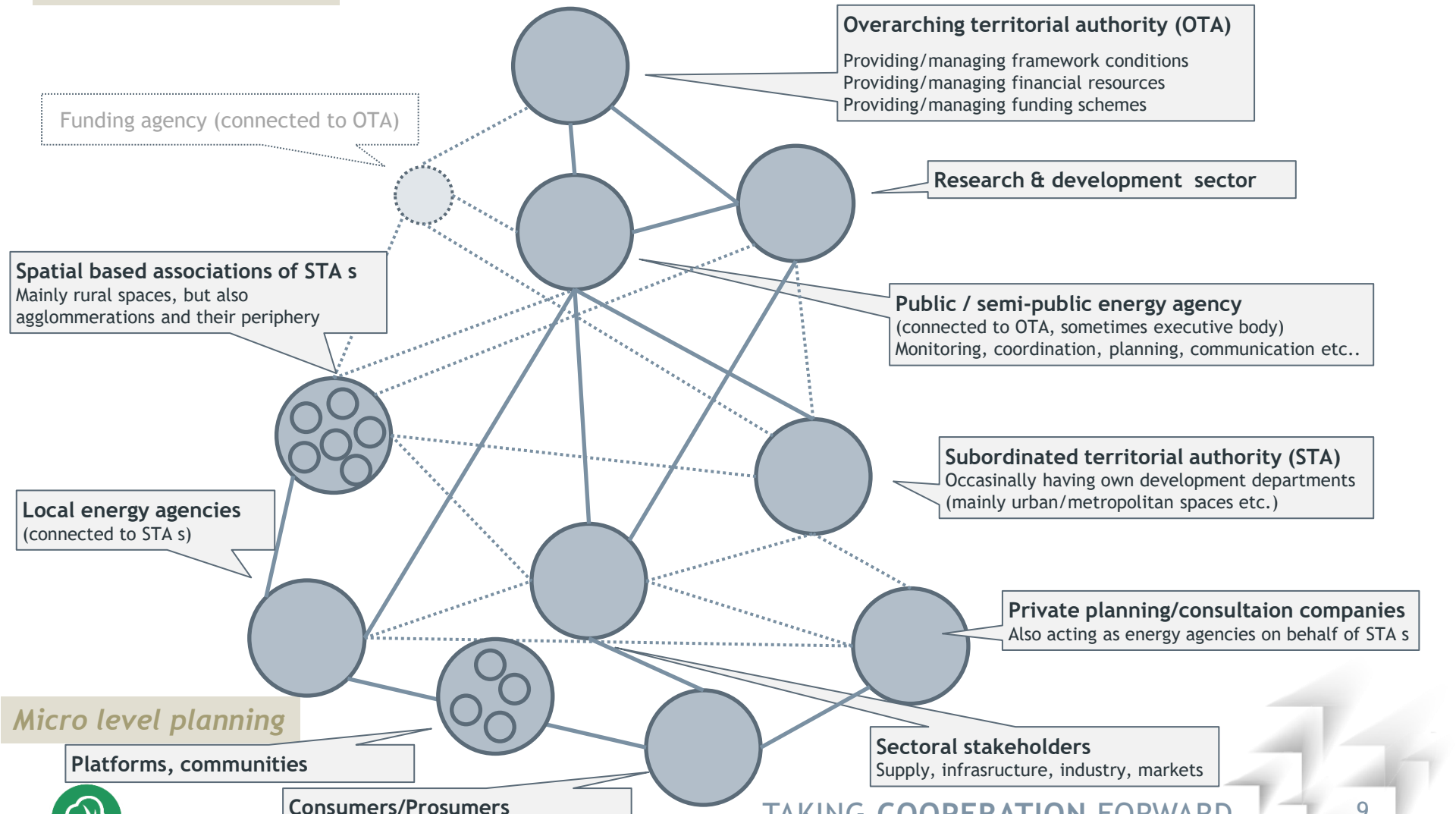
THE CHALLENGE – DISTRIBUTED PLANNING

How to carry out energy planning **simultaneously** on different levels of governance and infrastructure…

… and nonetheless being capable to achieve comparable, manageable and complementary fitting results

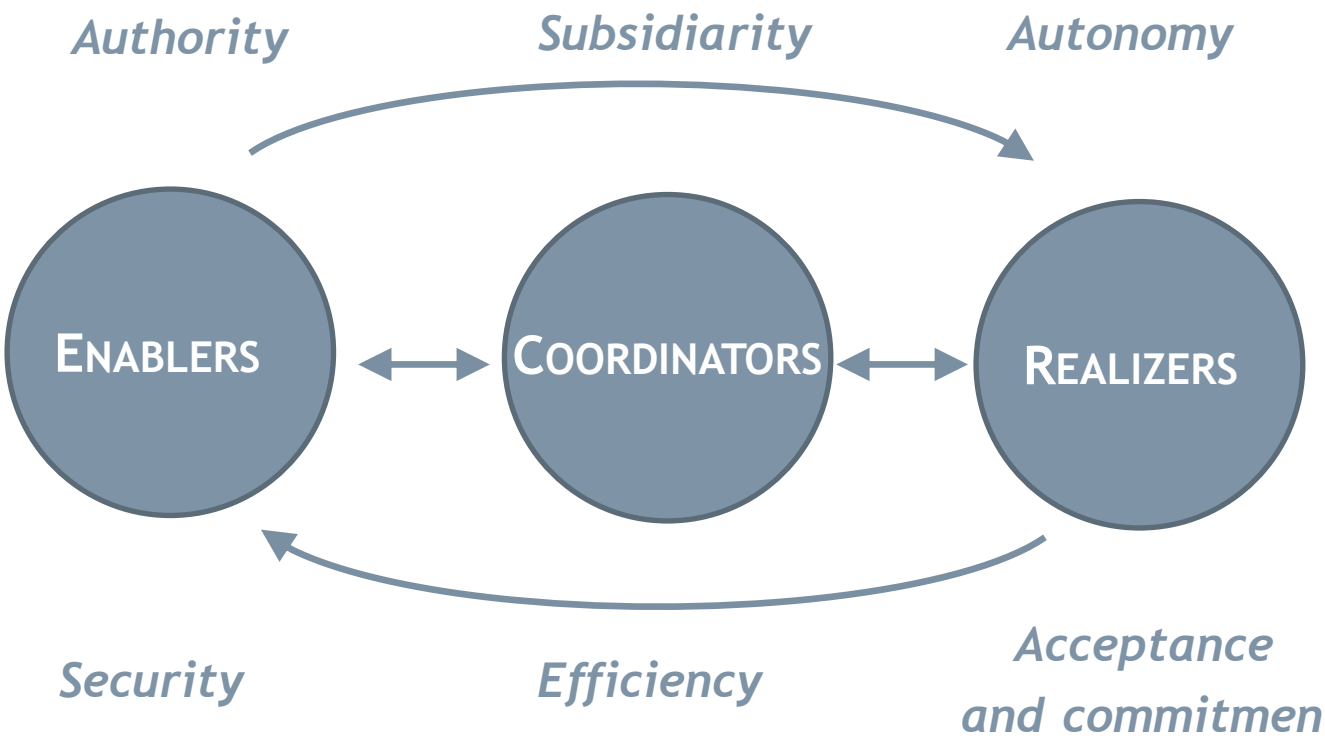
ECOSYSTEM OF DISTRIBUTED ACTORS

Macro level planning

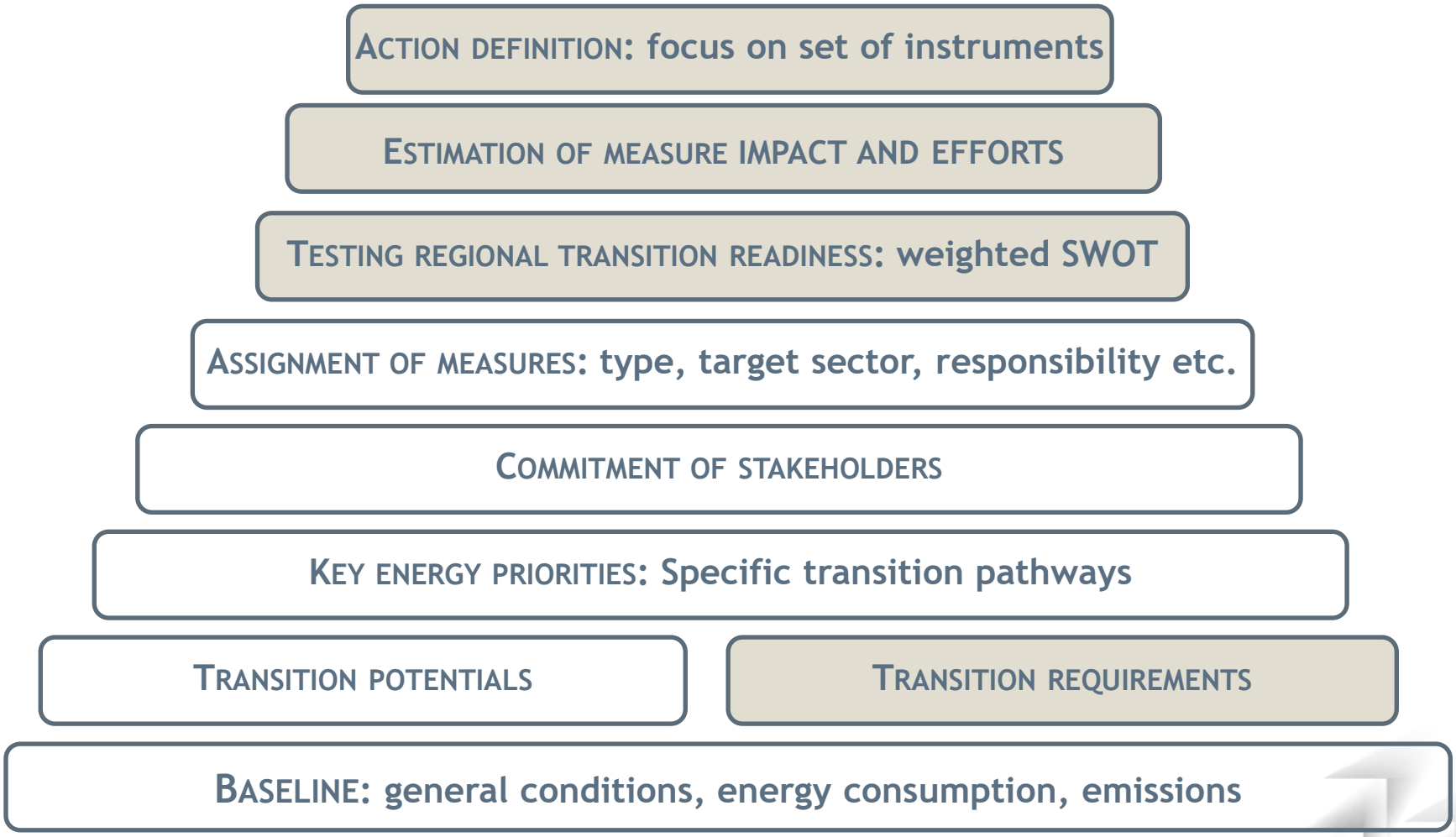


FUNCTIONAL REDUCTION OF ACTORS

Each function can be found on each level of governance
As well as across all levels of governance



PLANNING PROCESS MODIFICATION



TRANSITION REQUIREMENTS

TRANSITION REQUIREMENTS

Transformation of the power system

to one dominated by renewable energy supply and flexibility in generation, distribution and consumption

Electrification of end-use sectors

to achieve deep decarbonisation

Digitalisation

as the central chainlink of almost all activities and as a new consumption sector

Energy efficiency measures

To achieve the required carbon reductions

Circular and biobased economy

Cascadic use of resources, end-of-lifecycle energy use

TESTING TRANSITION READINESS

TESTING REGIONAL TRANSITION READINESS:

weighted SWOT

Enabling factors	
Strengths (internal)	3
Chances (external)	3

Restraining factors	
Weaknesses (int.)	2
Threats (ext.)	5

Mapping the Ecosystem

Assigning a weight to respective SWOT issue, e.g. from 1 (low) to 5 (high)

ESTIMATING IMPACT AND EFFORT

ESTIMATION OF IMPACT AND EFFORTS REGARDING MEASURES

Mapping the transition readiness

Indicating the relation of effort to achieve impact.

Decision help for action definition

SELECTION OF INSTRUMENTS TO ACT

ACTION DEFINITION:

which instruments to implement or use to ensure the transition process

- Promoting enabling factors impact
- Reducing restraining factors impact

INSTRUMENTS BY TYPE

- Policy (guiding)
- Planning (connecting)
- Organisational (structures)
- Financial (models and tools)
- Business (models and tools)
- Catalizers (awareness related)
- Technical (processes)

DRAFTING IMPACT SCENARIOS

Scenario modelling tool:

SHIFT

from fossil to renewable energy sources in consumption

CHANGE

of energy system towards more efficiency and renewable generation

ESTIMATION OF NEEDED INVESTMENTS

Scenario modelling tool delivers results of SHIFT and CHANGE in numbers

Key figures for estimating average investment per unit are available:

Average annual full load hours by technology

€/kW power, €/MWh storage, €/m² thermal refurbishment, €/charging station, €/vehicle, €/ DH connection etc…

As well as public costs for transition promotion

DRAFTING THE MONITORING PROCESS

Monitoring bodies

Monitoring periods

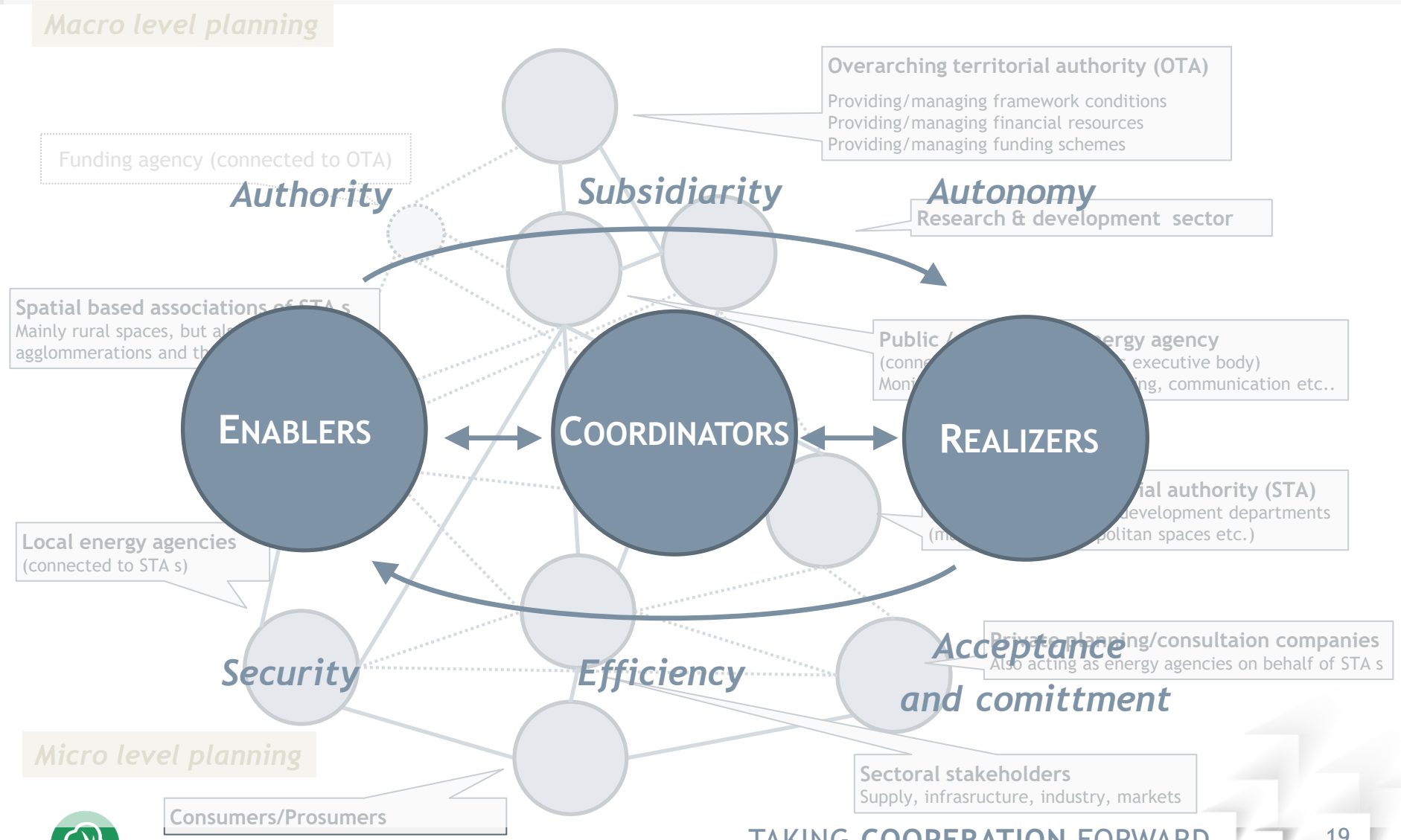
Key performance indicators for evaluation

Possibility:

Looping the Weighted-SWOT and Impact-Effort process

Can be used for evaluation

GETTING STRUCTURED



SCENARIO MODELLING TOOL

Presented by Giulio Cerino Abdin
(Politecnico di Torino)

Your PC ran into a problem that it couldn't handle, and now it needs to restart.

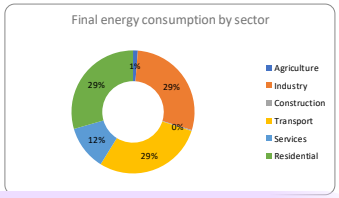
You can search for the error online: HAL_INITIALIZATION_FAILED

BASELINE DEFINITION

SECTORS

FUELS & VECTORS

	Total									
2016										Shares
	126,258,065								8,911,720	
	1,585,029	-	1,239,085	-	-	-	-	345,944	-	1.3%
	35,992,006	45,008	3,368,280	13,728,030	-	153,167	268,537	12,271,248	6,157,736	28.5%
	329,966	-	18,000	194,000	-	-	-	117,966	-	0.3%
	36,356,355	-	33,977,306	388,238	-	1,082,515	-	908,296	-	28.8%
	14,792,891	-	410,038	6,475,667	-	350,645	-	6,882,001	674,540	11.7%
	37,201,820	-	1,230,115	19,427,000	-	9,776,992	-	4,688,268	2,079,444	29.5%
		0.0%	*31.9%*	*31.8%*	*0.0%*	*9.0%*	*0.2%*	*20.0%*	*7.1%*	
		0%	93%	1%	0%	3%	0%	2%	0%	



Primary consumption

Primary energy factor (insert national values)		1.10	1.07	1.05	-	1.00	0.40	1.34	1.50

Estimation of regional primary energy demand (MWh)	Total	Solid fossil fuels	Crude oil and petroleum products	Gas	Nuclear heat	Renewable energies	Non renewable wastes	Electricity	Derived heat	
										Shares
Primary energy consumption	**144,034,087**	**49,509**	**43,059,821**	**42,223,581**	**-**	**11,363,318**	**107,415**	**33,862,862**	**13,367,580**	
Agriculture, forestry and fishing	1,790,435	-	1,325,821	-		-	-	464,614	-	1.4
Industry (without construction), energy, water sewage etc	44,045,876	49,509	3,604,060	14,414,431		153,167	107,415	16,480,690	9,236,604	34.9
Construction	381,392	-	19,260	203,700		-	-	158,432	-	0.3
Transport	39,065,754	-	36,355,717	407,650		1,082,515	-	1,219,872	-	30.9%
Services	17,843,400	-	438,741	6,799,450		350,645	-	9,242,754	1,011,810	14.1%
Residential	40,907,230	-	1,316,223	20,398,350		9,776,992	-	6,296,499	3,119,166	32.4%
Shares		*0.0%*	*34.1%*	*33.4%*	*0.0%*	*9.0%*	*0.1%*	*26.8%*	*10.6%*	
Share within transport sector		0%	93%	1%	0%	3%	0%	3%	0%	

Carbon emissions

Emission factor (insert appropriate factor)		0.330	0.267	0.202	Ren. General	-	0.333	0.215	0.253
					Transp. ren. Fuels	0.197			

Estimation of regional energy CO2 emissions (t/a)	Total	Solid fossil fuels	Crude oil and petroleum products	Gas	Nuclear heat	Renewable energies	Non renewable wastes	Electricity	Derived heat	
2016										Shares
Final energy consumption	**26,864,914**	**14,853**	**10,744,834**	**8,123,013**	**-**	**213,255**	**89,423**	**5,429,327**	**2,250,209**	
Agriculture, forestry and fishing	405,328	-	330,836	-	-	-	-	74,493	-	1.5%
Industry (without construction), energy, water sewage etc	7,973,892	14,853	899,331	2,773,062	-	-	89,423	2,642,395	1,554,828	29.7%
Construction	69,396	-	4,806	39,188	-	-	-	25,402	-	0.3
Transport	9,559,206	-	9,071,941	78,424	-	213,255	-	195,585	-	35.6
Services	3,069,803	-	109,480	1,308,085	-	-	-	1,481,917	170,321	11.4
Residential	5,787,290	-	328,441	3,924,254	-	-	-	1,009,535	525,060	21.5
Shares		*0.1%*	*40.0%*	*30.2%*	*0.0%*	*0.8%*	*0.3%*	*20.2%*	*8.4%*	
Transport shares		0%	34%	0%	0%	1%	0%	1%	0%	

Sector	Heat	Electricity	Transport	Share by sector
Agriculture, forestry and fishing	330,836	74,493		2%
Industry (without construction), energy, water sewage etc	3,687,245	2,642,395		24%
Construction	43,994	25,402		0%
Transport		195,585	9,285,196	35%
Services	1,417,565	1,481,917		11%
Residential	4,252,695	1,009,535		20%
Total	9,732,335	5,429,327	9,285,196	91%
Shares	36%	20%	35%	

PRIMARY ENERGY FACTORS

CO_2 EMISSIONS FACTORS

SHIFT

SPECIFIC CALCULATION AND ACCOUNTING FOR:

- HEAT PUMPS ELECTRICITY NEEDS
- SHIFT FROM COMBUSTION ENGINE TO ELECTRICAL ENGINE

CHANGE

GENERATION MODELLING

ELECTRICITY

		15	75,000,000		75	3				
Electric			Starting value		Baseline	Short term	Mid term	Long term	PEF	t/MWh
Source										
Solid biom		0%	-	-	-	-	-	-	1.80	-
Hydro		14%	6,524,100	561	6,524,100.0	7,437,474	7,437,474	7,437,474	1.00	-
Tide, wav		0%	-	-	-	-	-	-	1.00	-
Wind		747%	30,200	3	30,200.0	255,860	255,860	255,860	1.00	-
Solar ph		2001%	1,688,100	145	1,688,100.0	11,816,700	15,192,900	18,569,100	1.00	-
Solar th		0%	-	-	-	-	-	-	1.00	-
Geoth		0%	-	-	-	-	-	-	1.00	-
Primar		10%	555,200	48	555,200.0	-	-	-	1.80	-
Biogas		90%	1,029,900	89	1,029,900.0	514,950	-	-	2.14	0.20
Waste (		0%	170,400	15	170,400.0	170,400	170,400	170,400	1.32	-
Liquid bi		-100%	120,000	10	120,000.0	-	-	-	2.43	0.26
Solid fossi		0%	-	-	-	-	-	-	1.00	0.35
Liquid fossi		-100%	368,500	32	368,500.0	368,500	-	-	2.43	0.26
Gaseous fos		-100%	14,934,900	1,284	14,934,900.0	8,960,940	2,986,980	-	1.37	0.34
Nuclear		0%	-	-	-	-	-	-	1.00	-
Waste (notren		-100%	224,000	19	224,000.0	224,000	224,000	-	2.43	0.33
					-					
Total			25,645,300	2,205	25,645,300.0	29,748,824	26,267,614	26,432,834	70% 65%	2016
				Demand->	25,213,723.7	30,545,556	37,490,465	40,464,083		102%
					39%	68%	88%	100%		2,205
					40%	66%	61%	65%		2,168

HEATING

Heat ge			Starting value		Baseline	Short term	Mid term	Long term	PEF	
Source										
Solid biom		20.0%	102,778	8.8	102,778	102,778	123,333	123,333	1.00	-
Solar the		20.0%	75,000.0	6.4	75,000	7,738,262	11,701,143	15,401,524	-	-
Geother		0.0%	-	-	-	-	-	-	1.50	-
Primar		46.8%	1,670,011	143.6	1,670,011	1,670,011	7,461,751	7,461,751	1.00	-
Biogas		70.0%	1,142.0	0.1	1,142	1,142	-	-	1.00	0.20
Waste (		200%	0.0	0.0	-	150,000	150,000	150,000	1.00	-
Liquid bi		0.0%	-	-	-	-	-	-	1.00	0.26
Waste ha		0.0%		-		-	-	-	1.50	0.40
Solid fossi		0.0%	-	-	-	-	-	-	1.10	0.40
Liquid fossi		0.0%	56.0	0.0	56	56	56	56	1.07	0.26
Gaseous fos		-100.0%	2,528,254.0	217.4	2,528,254	2,528,254	505,651	-	1.05	0.25
Waste (notren		0.0%	-	-	-	-	-	-	0.40	0.33
Total			4,377,240.8	376.4	4,377,241	12,190,503	19,941,934	23,136,664		
				Demand->						
					42%	79%	97%	100%		

ALT. FUELS

Alternative			Starting value			Short term	Mid term	Long term	PEF
Source									
Organic mate		200%	0.1			2,446,012.60	4,892,025.10	4,892,025	1.00
Waste water t		0.0%	-			-	-	-	1.00
Water (Hydr		0.0%	-			-	-	-	1.00
CO2 (e.g. Sat		0.0%	-			-	-	-	1.00
Waste (muni		0.0%	-			-	-	-	1.00
Other		0.0%	-			-	-	-	1.00
Total			0.1			2,446,012.60	4,892,025	4,892,025	
							8,682,294	8,682,294	

FINAL ENERGY, PRIMARY ENERGY & CO2 EMISSIONS

Interreg CENTRAL EUROPE — European Union, European Regional Development Fund

PROSPECT2030

Final consumption scenarios

Final consumption BASELINE

Estimation of regional final energy demand (MWh)	Solid fossil fuels	Crude oil and petroleum products	Gas	Renewable energies	Non renewable wastes	Electricity	Derived heat & grid bound thermal system	Total
Agriculture, forestry and fishing	-	1,230,085	-	-	-	345,944	-	1,585,029
Industry (without construction), energy, water sewage etc	45,008	3,368,280	13,728,030	153,167	268,537	12,271,248	6,157,736	35,992,006
Construction	-	18,000	194,000	-	-	117,966	-	329,966
Transport	-	31,977,306	388,238	1,082,515	-	938,296	-	36,366,355
Services	-	410,038	6,475,667	350,645	-	6,882,001	674,540	14,792,891
Residential	-	1,230,115	19,427,000	9,776,992	-	4,688,268	2,079,444	37,201,820
Total	**45,008**	**40,242,824**	**40,212,935**	**11,363,318**	**268,537**	**25,213,724**	**8,911,720**	**126,258,065**

Short term scenario - SHIFT

Short term scenario - SHIFT	Solid fossil fuels	Crude oil and petroleum products	Gas	Renewable energies	Non renewable wastes	Electricity	Derived heat & grid bound thermal system	Total
Agriculture, forestry and fishing	-	830,187	408,898	-	-	345,944	-	1,585,029
Industry (without construction), energy, water sewage etc	30,155	-	15,047,502	153,167	268,537	12,271,248	8,216,941	35,987,550
Construction	-	12,060	199,940	-	-	117,966	-	329,966
Transport	-	15,289,787	388,238	6,179,110	-	5,438,604	-	27,295,740
Services	-	-	2,914,050	2,934,657	-	7,622,077	1,322,107	14,792,891
Residential	-	-	8,742,150	17,529,029	-	6,908,497	4,022,144	37,201,820
Total	**30,155**	**16,132,034**	**27,700,778**	**26,795,963**	**268,537**	**32,704,336**	**13,561,191**	**117,192,995**

Short term scenario - CHANGE

Short term scenario - CHANGE	Solid fossil fuels	Crude oil and petroleum products	Gas	Renewable energies	Non renewable wastes	Electricity	Derived heat & grid bound thermal system	Total
Agriculture, forestry and fishing	-	124,528	61,335	-	-	-	-	185,863
Industry (without construction), energy, water sewage etc	4,523	-	2,257,125	22,975	40,281	-	1,232,541	3,557,445
Construction	-	1,809	29,991	-	-	-	-	31,800
Transport	-	2,293,468	58,236	926,867	-	-	-	3,278,570
Services	-	-	1,311,323	1,320,596	-	333,034	594,948	3,559,900
Residential	-	-	3,496,860	7,031,612	-	1,825,745	1,608,858	13,963,074
Total	**4,523**	**2,419,805**	**7,214,869**	**9,282,049**	**40,281**	**2,158,779**	**3,436,347**	**24,556,653**

Short term scenario - SHIFT & CHANGE

Short term scenario - SHIFT & CHANGE	Solid fossil fuels	Crude oil and petroleum products	Gas	Renewable energies	Non renewable wastes	Electricity	Derived heat & grid bound thermal system	Total
Agriculture, forestry and fishing	-	705,659	347,563	-	-	345,944	-	1,399,166
Industry (without construction), energy, water sewage etc	25,632	-	12,790,377	130,192	228,256	12,271,248	6,984,399	32,430,104
Construction	-	10,251	169,949	-	-	117,966	-	298,166
Transport	-	12,996,319	330,002	5,252,244	-	5,438,604	-	24,017,170
Services	-	-	1,602,728	1,614,061	-	7,289,043	727,159	11,232,990
Residential	-	-	5,245,290	10,517,417	-	5,082,752	2,413,286	23,258,746
Total	**25,632**	**13,712,229**	**20,485,909**	**17,513,914**	**228,256**	**30,545,556**	**10,124,845**	**92,636,342**
								7,965.29
Delta	- 19,376	- 26,530,595	- 19,727,026	6,150,596	- 40,281	5,331,833	1,213,124	- 33,621,724
								7,965.29

Short term primary consumption

Short term primary consumption	Solid fossil fuels	Crude oil and petroleum products	Gas	Renewable energies	Non renewable wastes	Electricity	Derived heat & grid bound thermal system	Total
Agriculture, forestry and fishing	-	755,055	364,941	-	-	400,356	-	1,520,352
Industry (without construction), energy, water sewage etc	28,195	-	13,429,896	130,192	91,302	14,201,345	10,476,599	38,357,530
Construction	-	10,969	178,446	-	-	136,520	-	325,935
Transport	-	13,906,062	346,503	5,252,244	-	6,294,021	-	25,798,829
Services	-	-	1,682,864	1,614,061	-	8,435,509	1,090,738	12,823,172
Residential	-	-	5,507,555	10,517,417	-	5,882,398	3,619,930	25,527,300
Total	**28,195**	**14,672,085**	**21,510,205**	**17,513,914**	**91,302**	**35,349,950**	**15,187,267**	**104,352,919**
								8,972.74
Delta	- 21,314	- 28,387,736	- 20,713,377	6,150,596	- 16,112	1,487,088	1,819,687	- 39,681,168

Short term - carbon emissions

Short term - carbon emissions	Solid fossil fuels	Crude oil and petroleum products	Gas	Renewable energies	Non renewable wastes	Electricity	Derived heat & grid bound thermal system	Total
Agriculture, forestry and fishing	-	188,411	70,208	-	-	36,087	-	294,705
Industry (without construction), energy, water sewage etc	8,459	-	2,583,656	-	76,009	1,280,059	1,763,561	5,711,744
Construction	-	2,737	34,330	-	-	12,305	-	49,372
Transport	-	3,470,017	66,661	1,034,692	-	567,321	-	5,138,691
Services	-	-	323,751	-	-	760,347	183,638	1,267,735
Residential	-	-	1,059,549	-	-	530,201	609,355	2,199,104
Total	**8,459**	**3,661,165**	**4,138,154**	**1,034,692**	**76,009**	**3,186,319**	**2,556,523**	**14,661,321**
Delta	- 6,394	- 7,083,669	- 3,984,859	821,437	- 13,413	- 2,243,008	306,314	- 12,203,592

Mid term scenario - SHIFT

Mid term scenario - SHIFT	Solid fossil fuels	Crude oil and petroleum products	Gas	Renewable energies	Non renewable wastes	Electricity	Derived heat & grid bound thermal system	Total
Agriculture, forestry and fishing	-	415,093	823,991	-	-	345,944	-	1,585,029
Industry (without construction), energy, water sewage etc	15,078	-	9,223,644	153,167	268,537	12,271,248	14,051,353	35,983,026
Construction	-	6,030	205,970	-	-	117,966	-	329,966
Transport	-	-	388,238	11,275,706	-	8,836,334	-	20,500,279
Services	-	-	1,457,025	4,021,644	-	7,992,116	1,322,107	14,792,891
Residential	-	-	4,371,075	20,789,989	-	8,018,611	4,022,144	37,201,820
Total	**15,078**	**421,123**	**16,469,943**	**36,240,506**	**268,537**	**37,582,219**	**19,395,604**	**110,393,010**

Mid term scenario - CHANGE

Mid term scenario - CHANGE	Solid fossil fuels	Crude oil and petroleum products	Gas	Renewable energies	Non renewable wastes	Electricity	Derived heat & grid bound thermal system	Total
Agriculture, forestry and fishing	-	145,283	288,397	-	-	121,168	-	312,511
Industry (without construction), energy, water sewage etc	5,277	-	3,228,275	53,608	93,988	4,298,054	4,917,974	4,001,069
Construction	-	2,111	72,090	-	-	41,318	-	32,882
Transport	-	-	89,295	2,593,412	-	-	-	2,682,707
Services	-	-	910,641	2,513,527	-	1,382,022	826,317	5,632,506
Residential	-	-	2,622,645	12,473,994	-	1,170,273	2,413,286	20,680,198
Total	**5,277**	**147,393**	**7,211,342**	**17,634,542**	**93,988**	**91,754**	**8,157,577**	**33,341,873**

Mid term scenario - SHIFT & CHANGE

Mid term scenario - SHIFT & CHANGE	Solid fossil fuels	Crude oil and petroleum products	Gas	Renewable energies	Non renewable wastes	Electricity	Derived heat & grid bound thermal system	Total
Agriculture, forestry and fishing	-	269,811	535,594	-	-	467,112	-	1,272,517
Industry (without construction), energy, water sewage etc	9,801	-	5,995,369	99,559	174,549	16,569,302	9,133,380	31,981,958
Construction	-	3,920	133,881	-	-	159,284	-	297,084
Transport	-	-	298,943	8,682,294	-	8,836,334	-	17,817,572
Services	-	-	546,384	1,508,116	-	6,610,094	495,790	9,160,385
Residential	-	-	1,748,430	8,315,996	-	4,848,338	1,608,858	16,521,622
Total	**9,801**	**273,730**	**9,258,601**	**18,605,965**	**174,549**	**37,490,465**	**11,238,027**	**77,051,137**
								6,625.21
Delta	- 35,208	- 39,969,094	- 30,954,333	7,242,646	- 93,988	12,276,741	2,326,307	- 49,206,928

Mid term primary consumption

Mid term primary consumption	Solid fossil fuels	Crude oil and petroleum products	Gas	Renewable energies	Non renewable wastes	Electricity	Derived heat & grid bound thermal system	Total
Agriculture, forestry and fishing	-	288,697	562,374	-	-	485,553	-	1,336,624
Industry (without construction), energy, water sewage etc	10,781	-	6,295,137	99,559	69,820	17,223,417	13,700,069	37,398,782
Construction	-	4,194	140,575	-	-	165,572	-	310,341
Transport	-	-	313,891	8,682,294	-	9,185,171	-	18,181,355
Services	-	-	573,704	1,508,116	-	6,871,044	741,685	9,696,549
Residential	-	-	1,835,852	8,315,996	-	5,039,739	2,413,286	17,604,873
Total	**10,781**	**292,891**	**9,721,531**	**18,605,965**	**69,820**	**38,970,495**	**16,857,041**	**84,528,523**
								7,268.14
Delta	- 38,728	- 42,766,930	- 32,502,050	7,242,646	- 37,595	5,107,633	3,489,461	- 59,505,564

Mid term - carbon emissions

Mid term - carbon emissions	Solid fossil fuels	Crude oil and petroleum products	Gas	Renewable energies	Non renewable wastes	Electricity	Derived heat & grid bound thermal system	Total
Agriculture, forestry and fishing	-	72,039	108,190	-	-	19,189	-	199,418
Industry (without construction), energy, water sewage etc	3,234	-	1,211,064	-	58,125	680,663	2,306,178	4,259,265
Construction	-	1,047	27,044	-	-	6,543	-	34,634
Transport	-	-	60,387	1,710,412	-	362,995	-	2,133,793
Services	-	-	110,370	-	-	273,541	125,187	509,098
Residential	-	-	353,183	-	-	199,169	406,237	958,589
Total	**3,234**	**73,086**	**1,870,237**	**1,710,412**	**58,125**	**1,540,100**	**2,837,602**	**8,092,796**
Delta	- 11,619	- 10,671,748	- 6,252,775	1,497,157	- 31,298	- 3,889,227	587,393	- 18,772,118

Long term scenario - SHIFT

Long term scenario - SHIFT	Solid fossil fuels	Crude oil and petroleum products	Gas	Renewable energies	Non renewable wastes	Electricity	Derived heat & grid bound thermal system	Total
Agriculture, forestry and fishing	-	-	1,239,085	-	-	345,944	-	1,585,029
Industry (without construction), energy, water sewage etc	-	-	3,399,786	153,167	268,537	12,271,248	19,885,766	35,978,503
Construction	-	-	212,000	-	-	117,966	-	329,966
Transport	-	-	388,238	11,275,706	-	8,836,334	-	20,500,279
Services	-	-	0	5,108,631	-	8,362,154	1,322,107	14,792,891
Residential	-	-	-	24,050,950	-	9,128,726	4,022,144	37,201,820
Total	**-**	**-**	**5,239,109**	**40,588,454**	**268,537**	**39,062,371**	**25,230,017**	**110,388,487**

Long term scenario - CHANGE

Long term scenario - CHANGE	Solid fossil fuels	Crude oil and petroleum products	Gas	Renewable energies	Non renewable wastes	Electricity	Derived heat & grid bound thermal system	Total
Agriculture, forestry and fishing	-	-	681,497	-	-	242,337	-	439,160
Industry (without construction), energy, water sewage etc	-	-	1,803,882	84,342	147,695	8,596,108	10,937,171	4,442,883
Construction	-	-	116,600	-	-	82,636	-	33,964
Transport	-	-	89,295	2,593,412	-	-	-	2,682,707
Services	-	-	0	4,086,904	-	2,560,522	1,057,685	7,705,112
Residential	-	-	-	19,240,760	-	4,958,846	3,217,715	27,417,322
Total	**-**	**-**	**2,757,273**	**26,005,319**	**147,695**	**1,401,712**	**15,212,572**	**42,721,147**

Long term scenario - SHIFT & CHANGE

Long term scenario - SHIFT & CHANGE	Solid fossil fuels	Crude oil and petroleum products	Gas	Renewable energies	Non renewable wastes	Electricity	Derived heat & grid bound thermal system	Total
Agriculture, forestry and fishing	-	-	557,588	-	-	588,280	-	1,145,869
Industry (without construction), energy, water sewage etc	-	-	1,529,904	68,925	120,842	20,867,356	8,948,595	31,535,620
Construction	-	-	95,400	-	-	200,602	-	296,002
Transport	-	-	298,943	8,682,294	-	8,836,334	-	17,817,572
Services	-	-	0	1,021,726	-	5,801,631	264,421	7,087,779
Residential	-	-	-	4,810,190	-	4,169,879	804,429	9,784,498
Total	**-**	**-**	**2,481,835**	**14,583,135**	**120,842**	**40,464,083**	**10,017,445**	**67,667,340**
								5,818.34
Delta	- 45,008	- 40,242,824	- 37,731,100	3,219,817	- 147,695	15,250,360	1,105,725	- 58,590,726
	0	0	0.036677001	0.215512169	0.001785817	0.597985429	0.148095583	

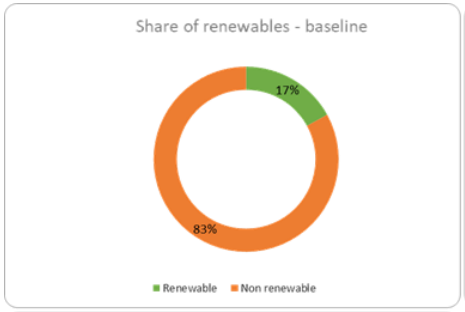
Long term primary consumption

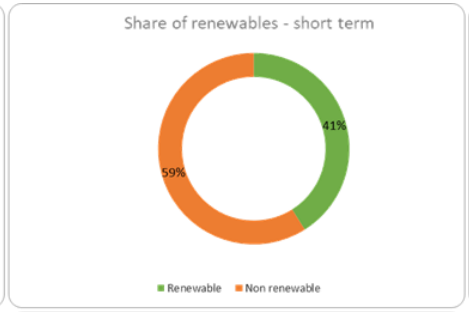
Long term primary consumption	Solid fossil fuels	Crude oil and petroleum products	Gas	Renewable energies	Non renewable wastes	Electricity	Derived heat & grid bound thermal system	Total
Agriculture, forestry and fishing	-	-	585,467	-	-	589,073	-	1,174,541
Industry (without construction), energy, water sewage etc	-	-	1,606,399	68,925	48,337	20,895,476	13,422,892	36,042,028
Construction	-	-	100,170	-	-	200,872	-	301,042
Transport	-	-	313,891	8,682,294	-	8,848,242	-	17,844,426
Services	-	-	0	1,021,726	-	5,809,450	396,632	7,227,808
Residential	-	-	-	4,810,190	-	4,175,499	1,206,643	10,192,332
Total	**-**	**-**	**2,605,927**	**14,583,135**	**48,337**	**40,518,611**	**15,026,167**	**72,782,177**
								6,258.14
Delta	- 49,509	- 43,059,821 -	39,617,655	3,219,817 -	59,078	6,655,749	1,658,587 -	71,251,910

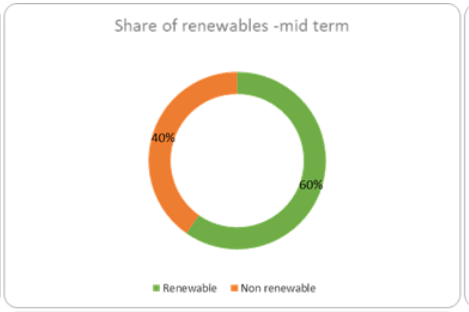
Long term - carbon emissions

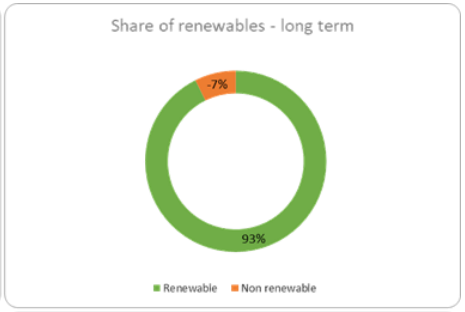
Long term - carbon emissions	Solid fossil fuels	Crude oil and petroleum products	Gas	Renewable energies	Non renewable wastes	Electricity	Derived heat & grid bound thermal system	Total
Agriculture, forestry and fishing	-	-	112,633	-	-	-	-	112,633
Industry (without construction), energy, water sewage etc	-	-	309,041	-	40,240	-	2,259,520	2,608,801
Construction	-	-	19,271	-	-	-	-	19,271
Transport	-	-	60,387	1,710,412	-	-	-	1,770,798
Services	-	-	0	-	-	-	66,766	66,766
Residential	-	-	-	-	-	-	203,118	203,118
Total	**-**	**-**	**501,331**	**1,710,412**	**40,240**	**-**	**2,529,405**	**4,781,388**
Delta	- 14,853	- 10,744,834 -	7,621,682	1,497,157 -	49,182	5,429,327	279,195 -	22,083,526

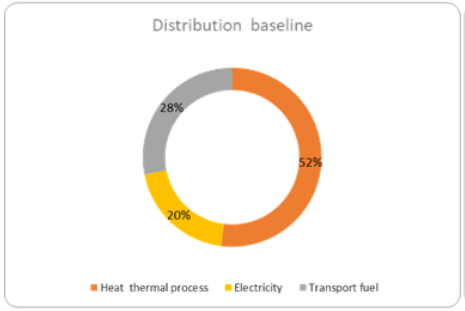
GENERAL VISUALS

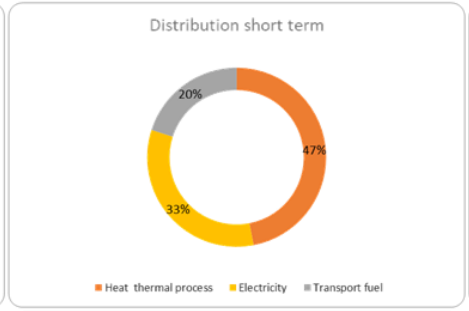


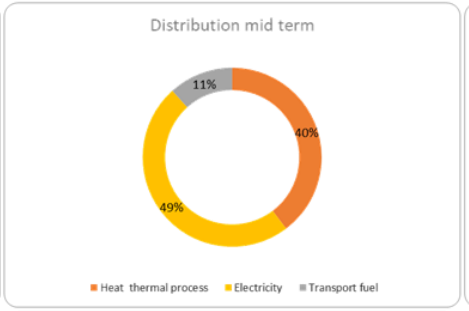


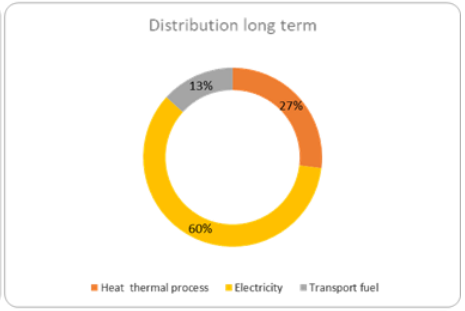


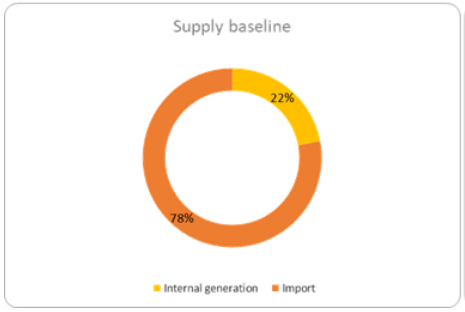


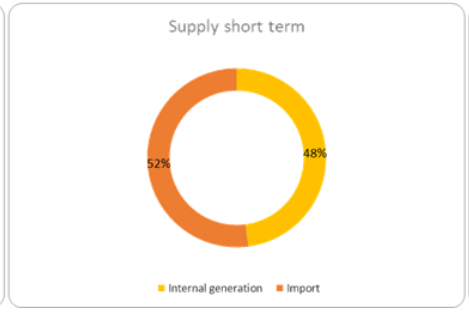


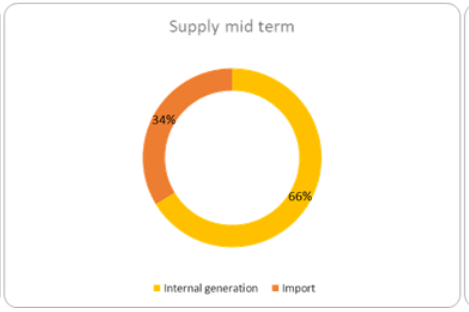


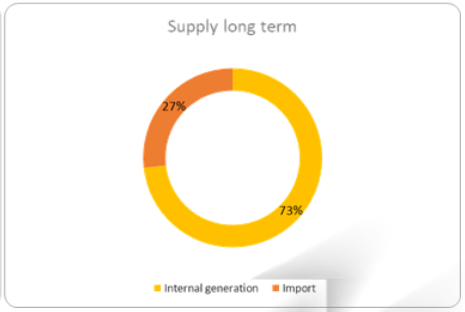






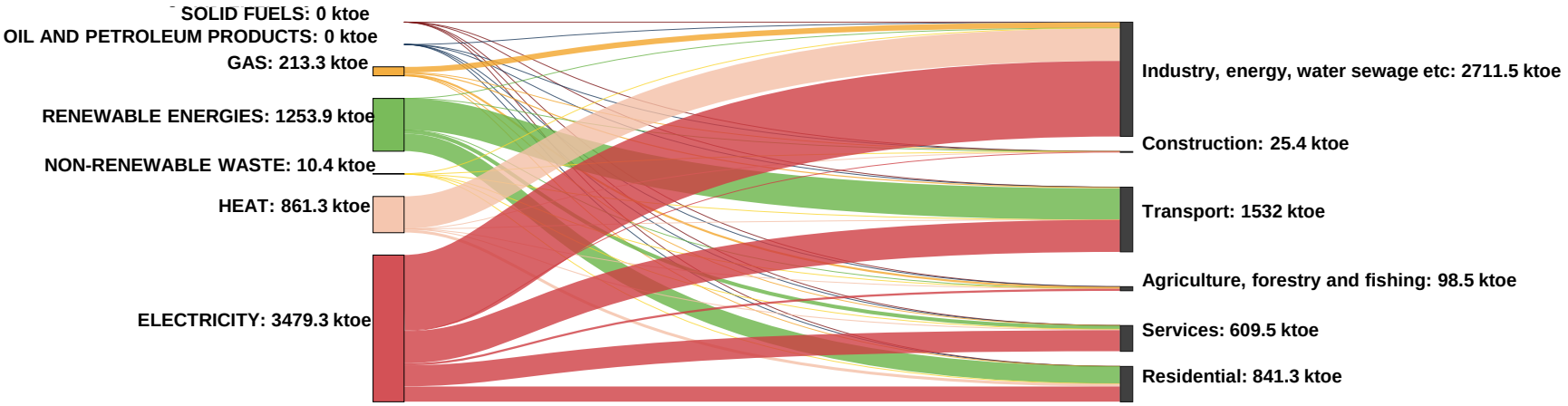






INTEGRATED SANKEY VISUALS

final energy demand | primary energy | CO2 emissions | fossil fuels shift



THANK YOU!

Politecnico di Torino
Department of Energy "G.Ferraris"

Eng. Giulio Cerino Abdin
Politecnico di Torino | DENERG

www.polito.it

giulio.cerino@polito.it

+39 011.090.4529

EUROPÄISCHES ZENTRUM FÜR ERNEUERBARE ENERGIE GÜSSING GMBH

Manfred Hotwagner
European Center for Renewable Energy Güssing

www.eee-info.net

m.hotwagner@eee-info.net

+43 677 63 03 4704

https://twitter.com/PROSPECT_2030

https://www.linkedin.com/company/interreg-prospect2030/