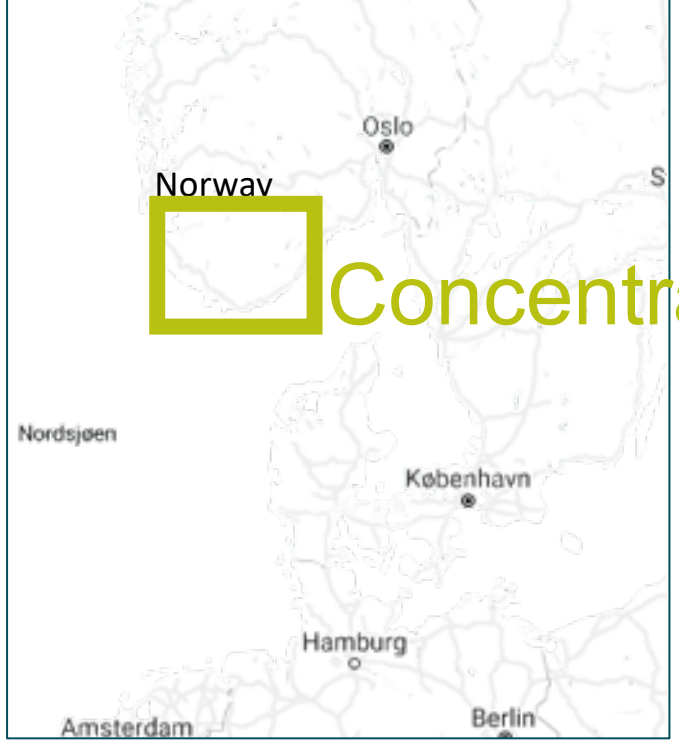
Established 2007
80 members (approx):
- 17 Core companies
- 45 innovative suppliers
- 7 Start-Up/Scale-Up
- 10 R&D&I

Ca 14 000 employees (5000 i Agder)

Cluster Management Excellence GOLD

NCE Norwegian Centres of Expertise

Concentrated in the Agder region



Kvinesdal

Farsund

Lindesnesl

Kristiansand

Arendal

Vianode

MORROW

FIVEN

eramet

ALUDYNE

Alcoa

GE Healthcare

Elkem

NIKKELVERK
A GLENCORE COMPANY

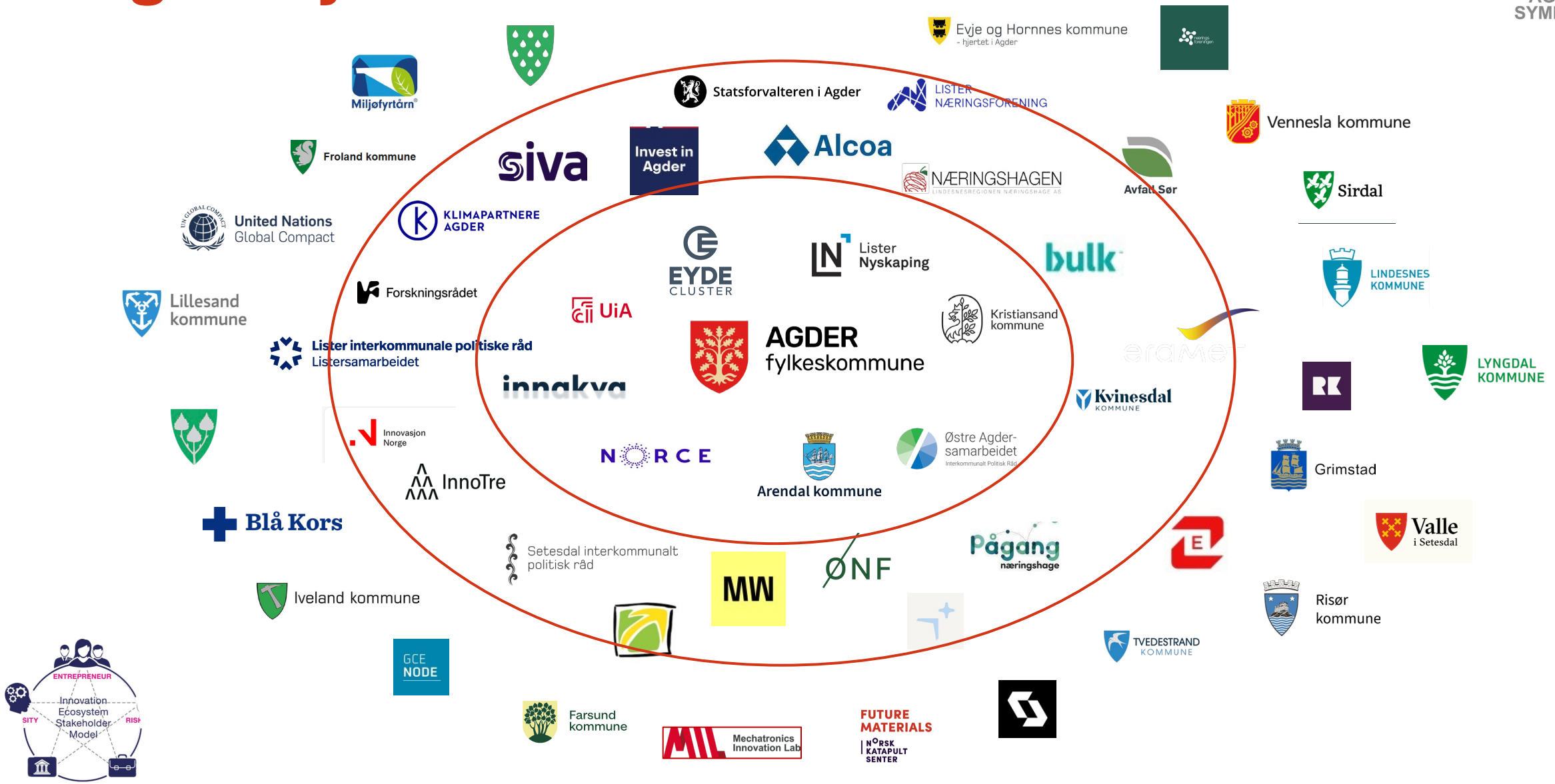
AGDER

Developing an operational model for...

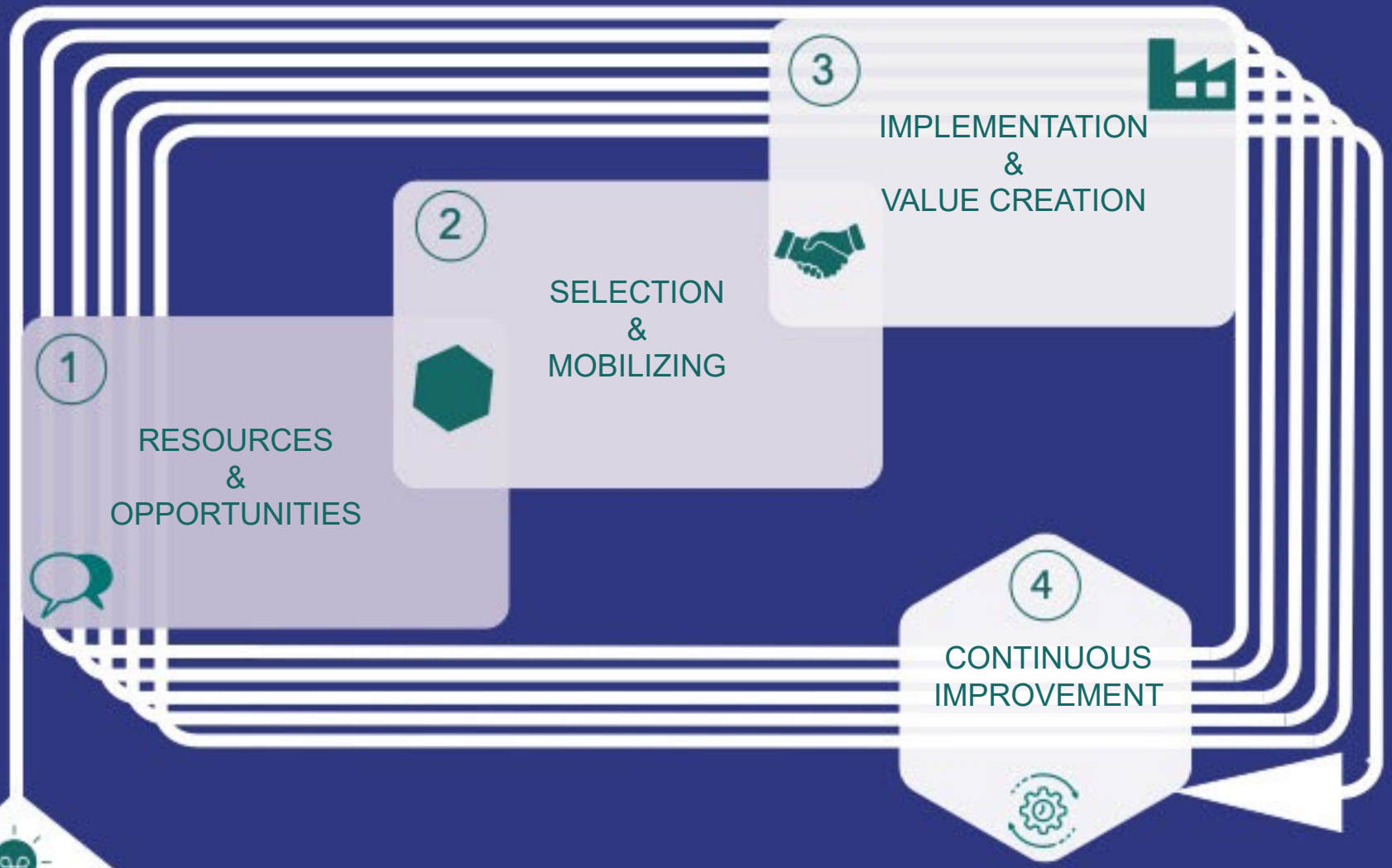
SYMBIOSE

Agder Symbiosis

AGDER SYMBIOSE

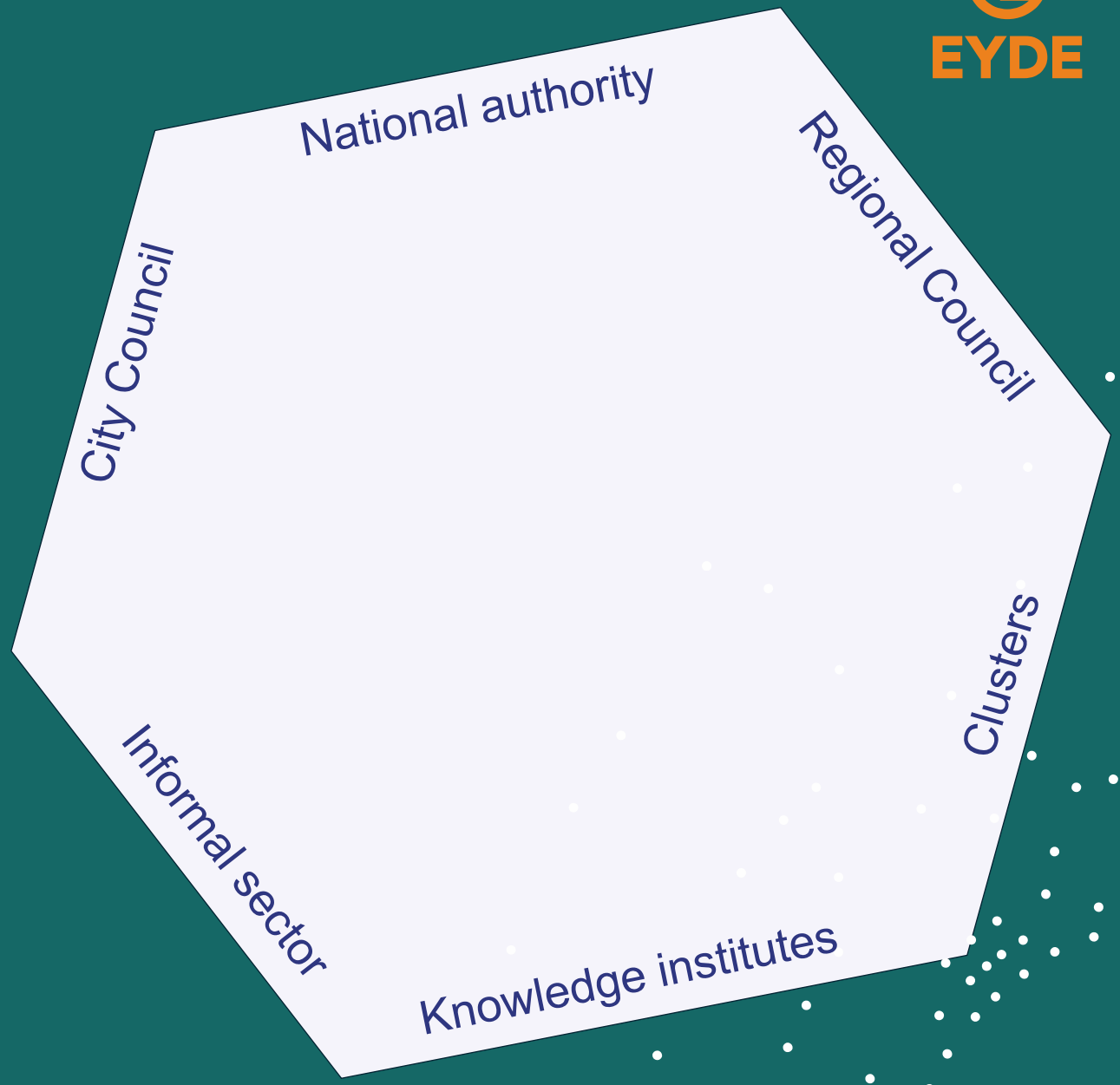


Industrial Symbiosis



Facilitator

- mandate
- Organisational form
- Connecting the dots...
- Trust and collaboration platform
- Knowledge sharing
- Build and maintain collaboration culture
- Communications



NORCE

EYDE

Innovation partnership

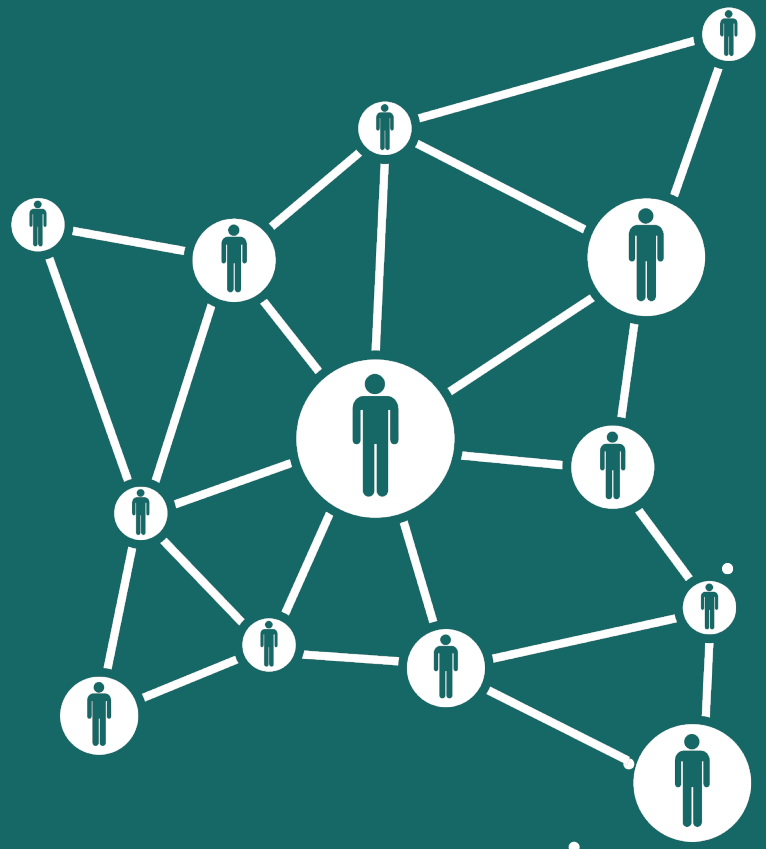
- Identify market demand
- mobilize stakeholders (feasability)
- Identify business opportunity (finance)
- Establish formalized partnership

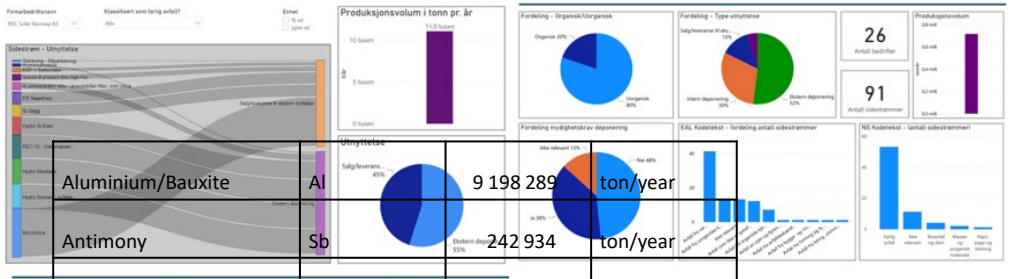
Value Creation

- Funding opportunities
- Business model
- Investmentplan
- Construction
- Production

PROCESS

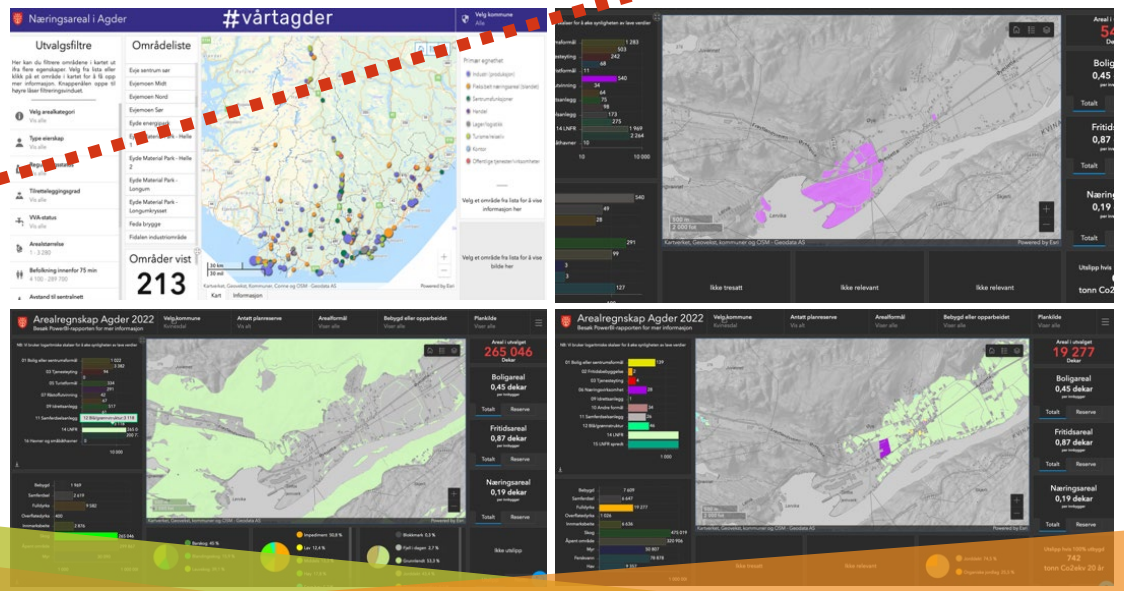
- Improvement
- Networking (reg. & int.)
- «Bank of opportunities»
- New intiatives



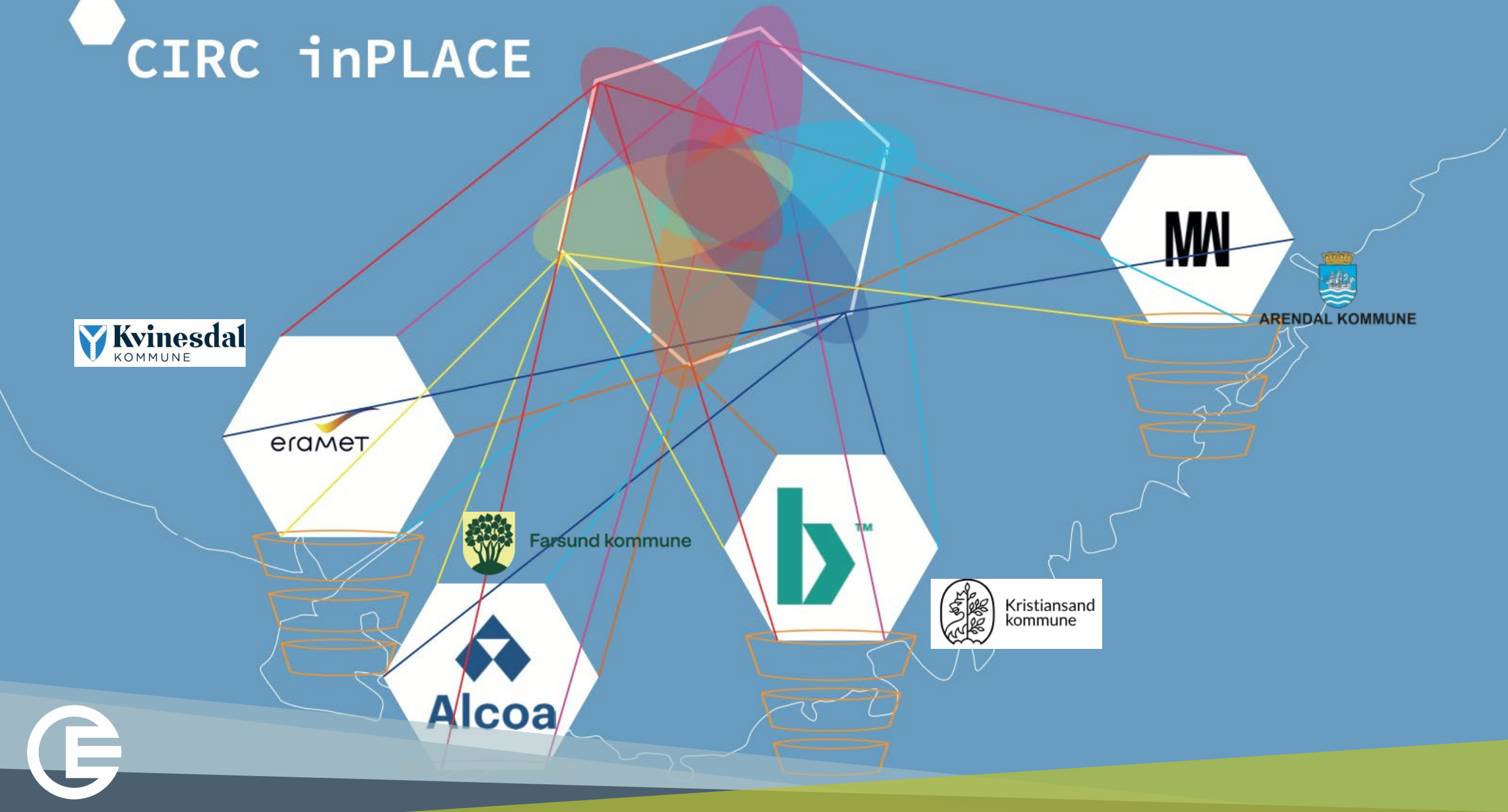


Aluminium/Bauxite	Al	9 198 289	ton/year
Antimony	Sb	242 934	ton/year
Arsenic	As	1 785 481	ton/year
Baryte	BaSO4	317	ton/year
Bismuth	Bi	1 203	ton/year
Boron/Borate	B	21 086	ton/year
Cobalt	Co	1 693 117	ton/year
Fluorspar	CaF2	40 135	ton/year
Germanium	Ge	160 000	ton/year
Hafnium	Hf	25 750	ton/year
Magnesium	Mg	14 242 928	ton/year
Maganese	Mn	15 684 706	ton/year
Natural grahite	C	296 806	ton/year
Phosphate Rock	PO4	12 200	ton/year
Copper	Cu	178 650	ton/year
Phosphorous	P	6 997 773	ton/year
Silicon metal	Si	9 108 699	ton/year
Strontium	Sr	295 962	ton/year
	La og Ce	254	ton/year
		59 986 290	ton/year

NEEDS	ALCOA	ERAMET	MICROALGAE	FERMENTATION	GREEN H2	CCUS	BATTERY RECYCLING	BIOGASS	AQUAPONICS	AQUACULTURE (LB)	HYDROPONICS	GREENHOUSE	ENERGY PROD.	DRYING	BATTERYCELLS	BLUE H2
Alcoa																
Eramet																
POWER																
grid access	x	x							x	x		x				
pricing	x	x								x						
renewable									x	x		x				
reliability									x	x	x	x				
ACCESSABILITY AND COSTS																
labour intensity																
competence needs									x	x						
proximity to resources/price																
fresh-/ saltwater access									x	x	x	x				
Area intensity									x	x	x	x				
OTHER KEY ISSUES																
harbour/ logistics									x	x						
knowledge institutions/ teknology development									x	x						
financial support									x	x	x					
acces to EU market									x	x	x					
CIRCULAR RESOURCES																
low temperature heat (under 40C)			x					x	x	x	x			x		
Middel temperature heat (40-80C)				x						x	x			x		
High temperature heat (over 80C)										x	x		x	x		
CO (for combustion?)													x			
CO2			x			x			x			x				
Material sidestreams (ENK& LISTA?)																
NPK (natrium, forsfor og kalium)			x					xx	x		x	x				
Oksygen (fra Hydrogenproduksjon)									x	x	x	x				
Biorest from microalgaeproduction?								x								
Water from fermentation/ Enzymproduksjon?			x					x								
Cold (-253C) from liquified hydrogenstorage																
Sludge from aquaculture (Stolt og Baring (NPK))								xx	x (ferskvann)			x (ferskvann)				



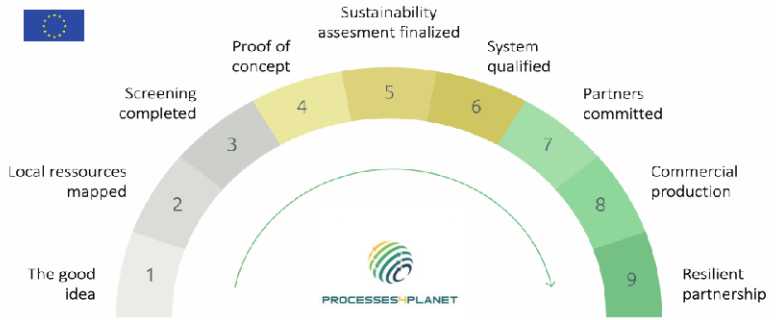
CIRC inPLACE



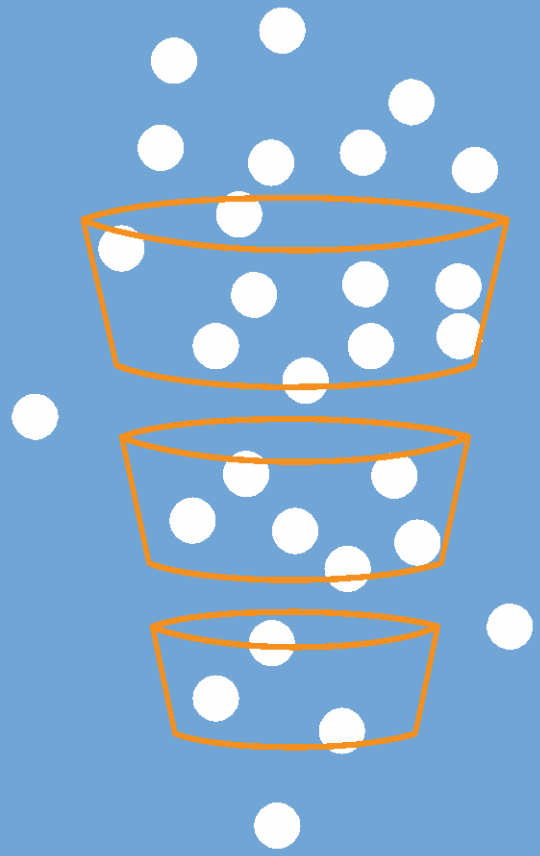
CIRC BUSINESS*

*

CIRC- activites are aligned with international practices



IDEA



INDUSTRY

Waste Heat Type	Waste Source	Average effect (kW)	Available energy (kWh)	Temperature (°C)
Hot exhaust gas from gas boiler	Steam	750	6 570 000	75
Heat from steam outlet A1 on LP turbine	Steam	5900	51 684 000	135
Heat from cooling of slag	Solids	10800	94 608 000	1500
Heat from furnace gas before venturi	Gas	4100	35 916 000	400
Hot return water from sand filters	Water	3200	28 032 000	56
Hot water from charcoal filters	Water	1260	110 376 00	53

Steam and hot water sources best suited for greenhouse production **but cannot be used directly** due to too high or too low temperatures.

Total= 97 323 600 kWh

Table 2 - Calculated greenhouse heat requirements for three round tomato production systems: season, long season, and all year production.

Scenarios	Duration (months)	Heat demand (kWh m^{-2})			Total (kWh m^{-2})
		Heating	Humidity control	Lighting	
Season	6	299,6	199,7*	0	499,3
Long Season	8	404,8	202,4**	(-)128,7	478,5
All year	12	588,2	294,1	(-)316,8	565,4

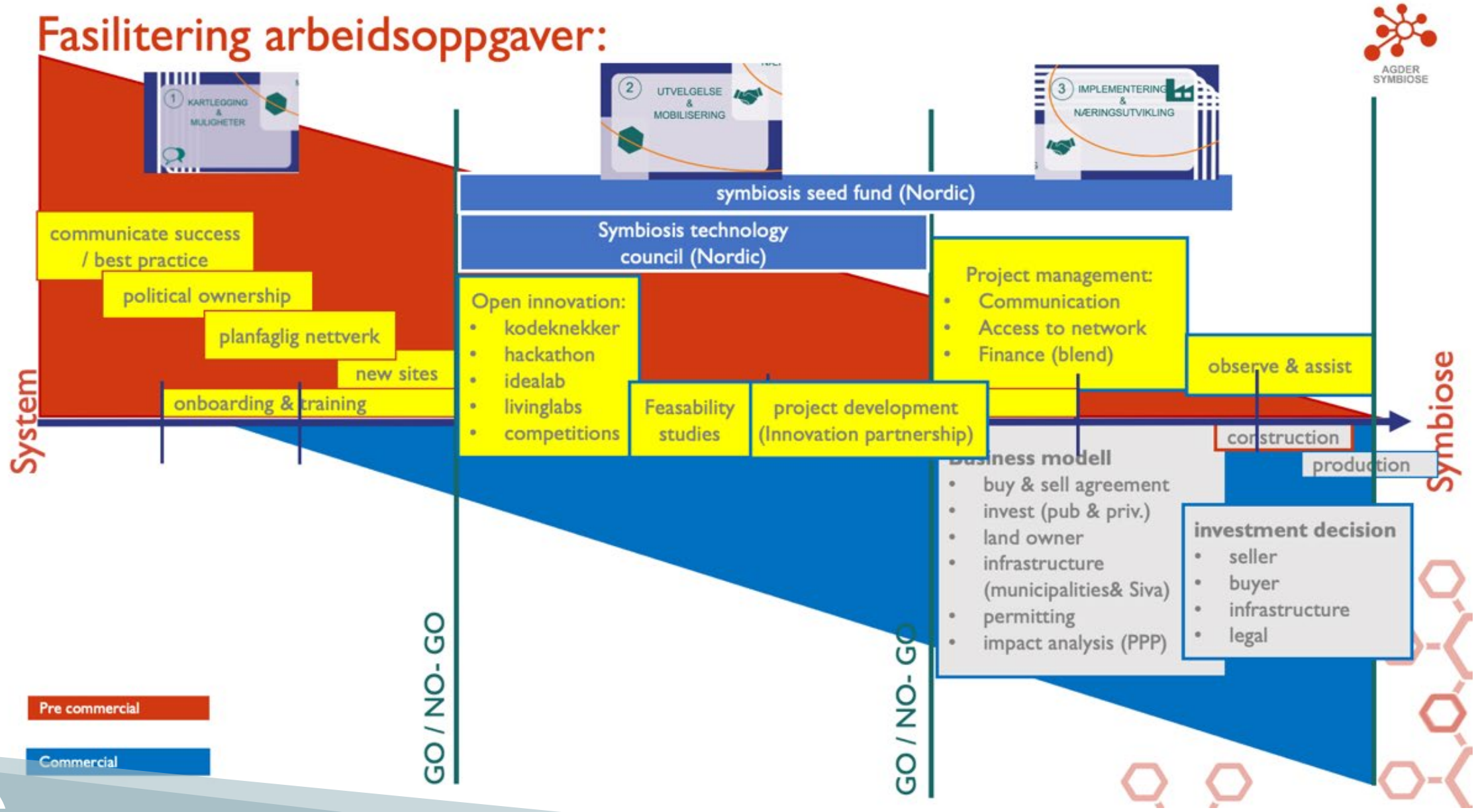
* Heat used for humidity control assumed to be 40% of total heat requirements without artificial lighting.

** Heat used for humidity control assumed to be 30% of total heat requirements with artificial lighting.

Table 4 - Savings achieved by using waste heat from industry for greenhouse production of round tomatoes.

Scenario	Turnover without waste heat (nok/year)	Turnover with waste heat (nok/year)	Savings (nok/year)
Season	22 464	3 522 464	3 500 000
Long season	2 313 040	6 313 040	4 000 000
All year	2 605 480	7 405 480	4 800 000

Fasilitering arbeidsoppgaver:



AGDER SYMBIOSE

(process)

- Coordinating regional collaboration
- Improve
- System support
- Smarter collaboration
- Sharing tasks/responsibilities
- Mobilizing new cases/sites
- Communicating externally

Feasability studies

Symbiosis accelerator (project)

- Develop new service
- Pilot support
- Commercial interest
- Demand driven / private finance

Thank you….

Christophe Pinck

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EYDE CLUSTER