



Interreg



2 Seas Mers Zeeën SOLARISE

European Regional Development Fund



Low-carbon
technologies

TOTAL PROJECT
BUDGET:

4.35 M €

INCLUDING AN
ERDF BUDGET OF:

2.61 M €

Prof. dr.ir. Emilia Motoasca
KU Leuven – TC Ghent
14.05.2019



**Residential buildings
(social housing)**

**Historical buildings
(monuments or not)**

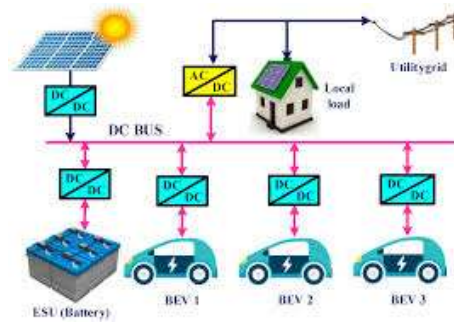
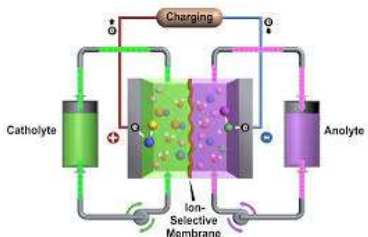
**Public buildings
(schools, city-hall)**

Solar farms in peri-urban environment



Smart (micro) grids, smart energy management V2G, energy storage systems

**Unobtrusive integration in buildings
(BIPV, transparent...)**



**Hybrid systems (electricity & heat)
Transparent, Bi-facial PV, ...**



PROJECT

WP1: Contextual Framework

WP2: Feasibility case studies

1. 3 Living Labs
2. Domestic, Historical & Public Buildings
3. Solar farms

WP4: SOLARISE installations

WP3: Accelerating solar uptake

WP 5: Project Management

WP 6: Communication

Start:03/18

End:09/21



KU Leuven TC Ghent



Leader of WP1 (Contextual framework) with activities and deliverables :

- **Guidelines** for benchmarking and pilots
- Technical report on **smart grids**
- Report regarding **solar energy market analysis, legal issues and future potential**
- Report regarding solar energy harvesting **cost and investment models**
- Technical report on **hybrid PV/T systems**
- Technical report on **innovative solar technologies**

- **Database** as inventory of existent pilots, of benchmarks and of good practices

Output 1: Guide package

on legislation, market, technologies and best practices in the 2Seas



**Residential buildings
(social housing)**

**Historical buildings
(monuments or not)**

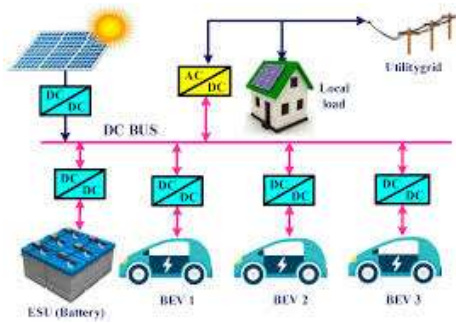
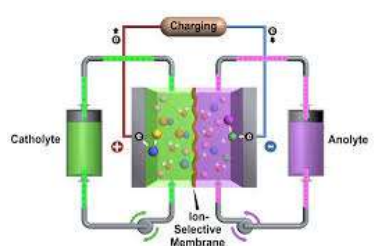
**Public buildings
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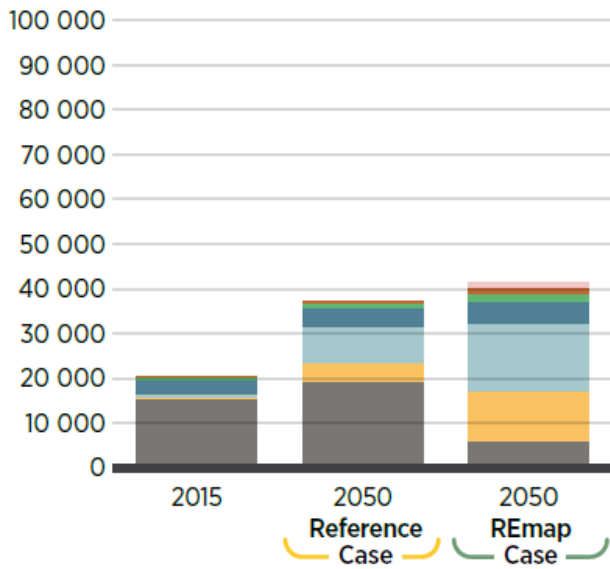
**Unobtrusive integration in buildings
(BIPV, transparent...)**



**Hybrid systems (electricity & heat)
Transparent, Bi-facial PV, ...**

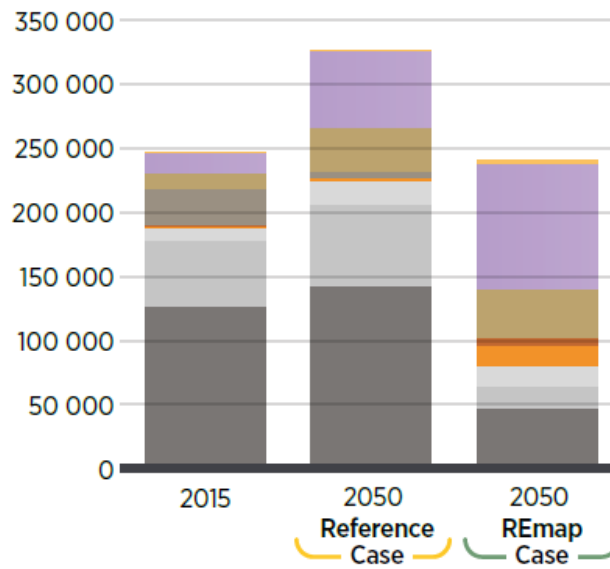
Global energy context: RE roadmap 2050?

Electricity consumption (TWh)



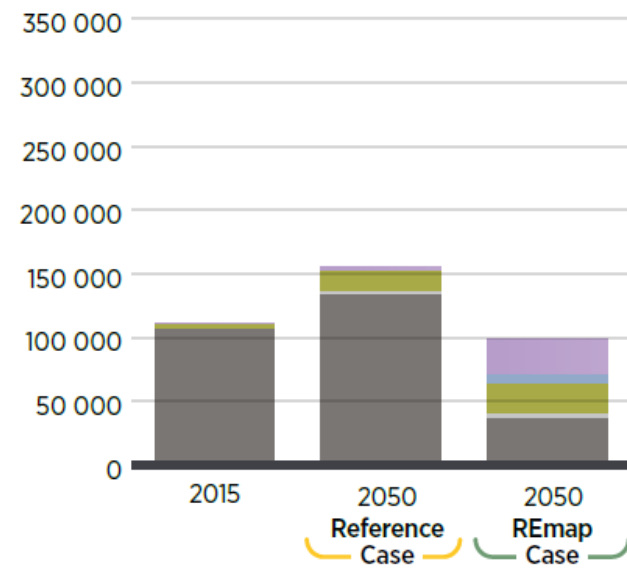
- Others (incl. marine and hybrid)
- Geothermal
- Bioenergy
- Hydro power
- Wind
- Solar PV (incl. CSP)
- Non-Renewables

Industry and buildings final energy consumption (PJ/yr)



- District heat: Renewable
- Electricity: Renewables
- Modern biomass
- Traditional biomass
- Geothermal heat
- Solar thermal

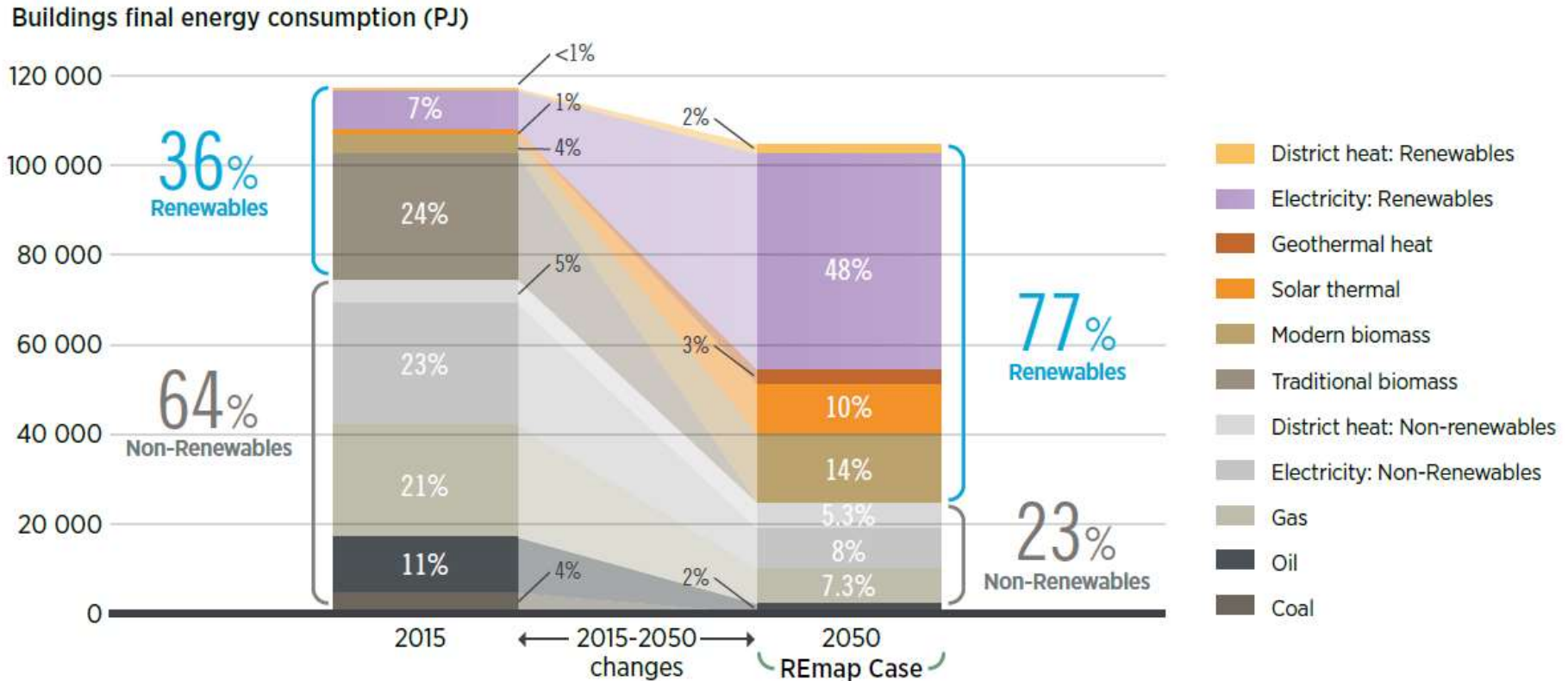
Transport final energy consumption (PJ/yr)



- Hydrogen
- Liquid biofuels/biogas
- Non-Renewables
- District heat: Non-Renewables
- Electricity: Non-Renewables

Source: IRENA 2018 'Global energy transformation: A roadmap to 2050'

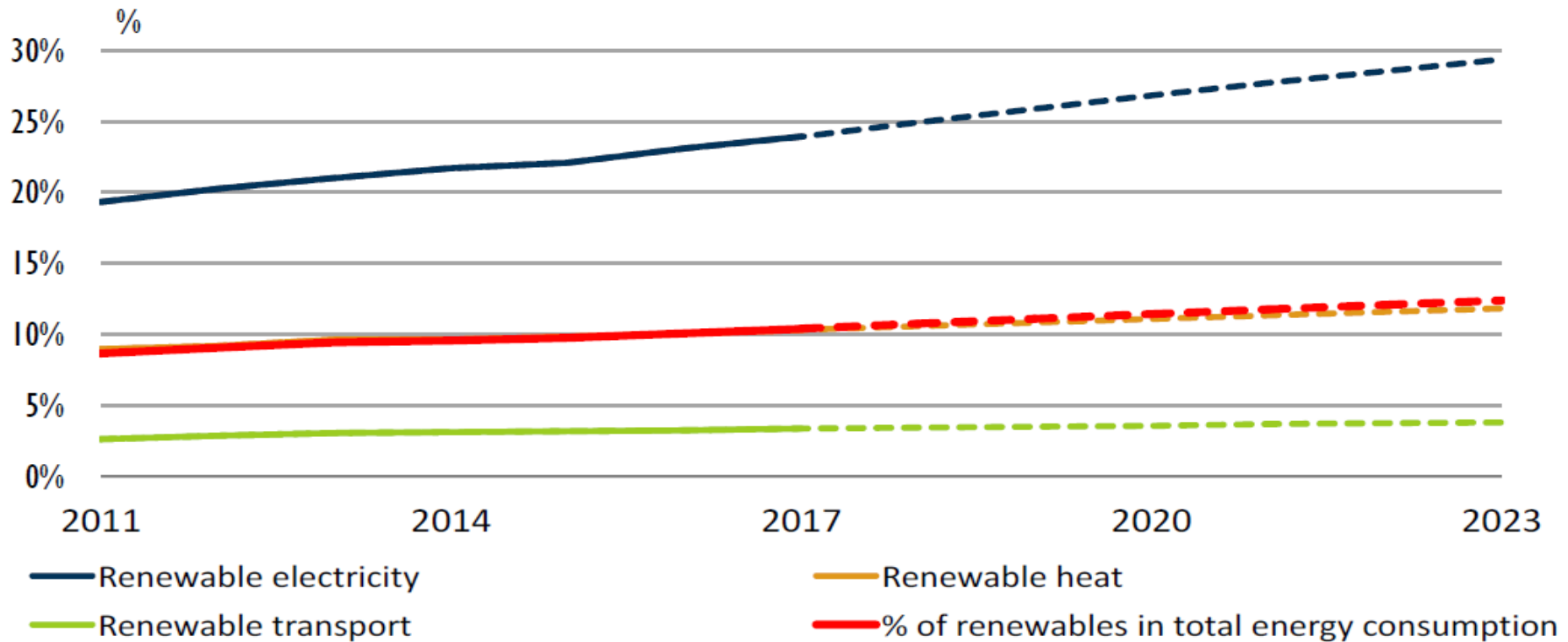
The potential of solar thermal by 2050



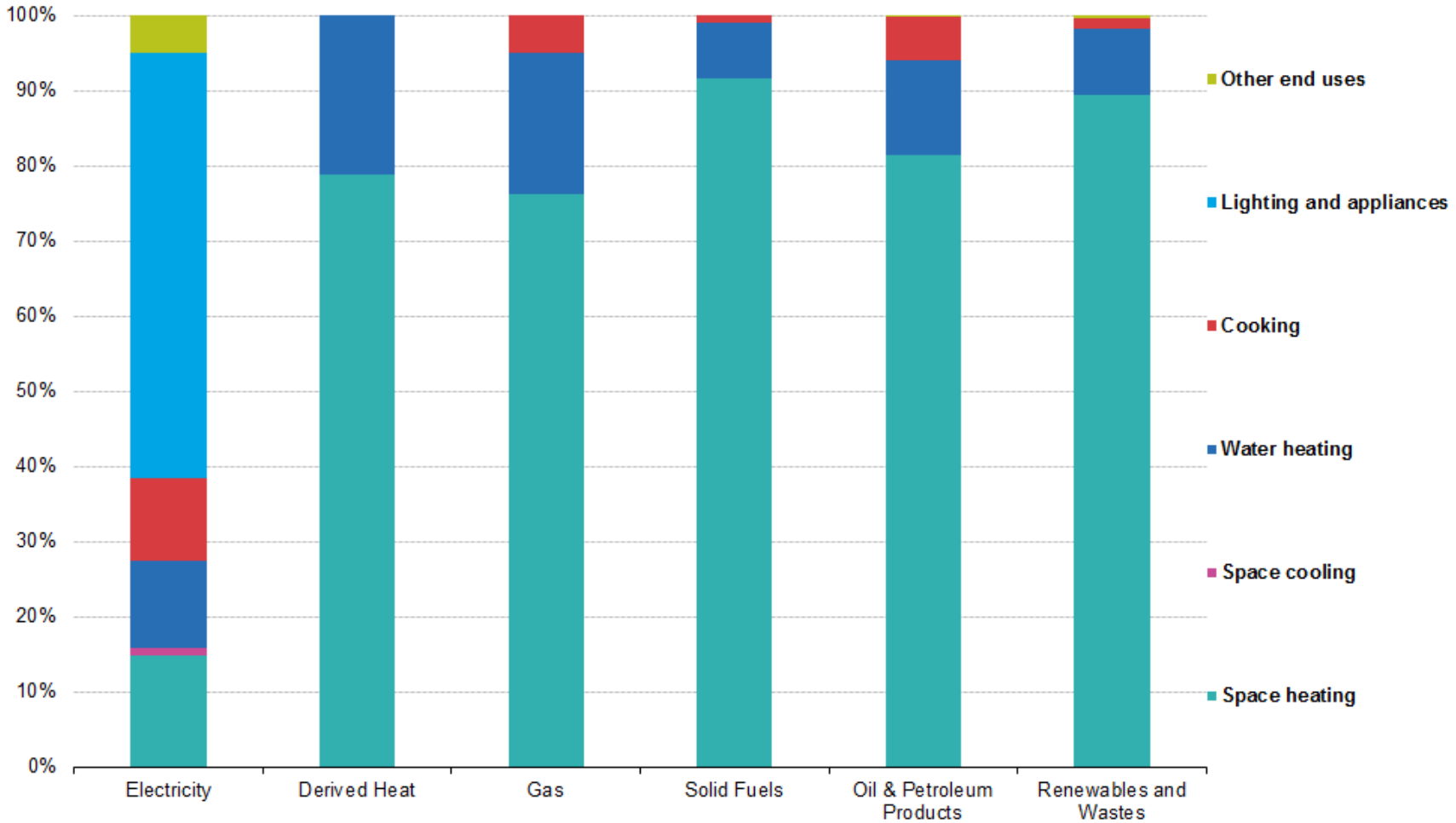
Source: IRENA, Global Energy Transformation 2018

EU target of 1 m2 of solar-thermal installations per person

EU energy context: Renewables



Global energy context: Energy consumption



EUROSTAT: Final energy consumption in the residential sector by type of end-uses for the main energy products, EU-28, 2016

2Seas energy context – embedded in EU



Investment:
extra EUR 177 billion per year
of investment from 2021
to meet 2030 climate & energy
targets Crucial role for EFSI

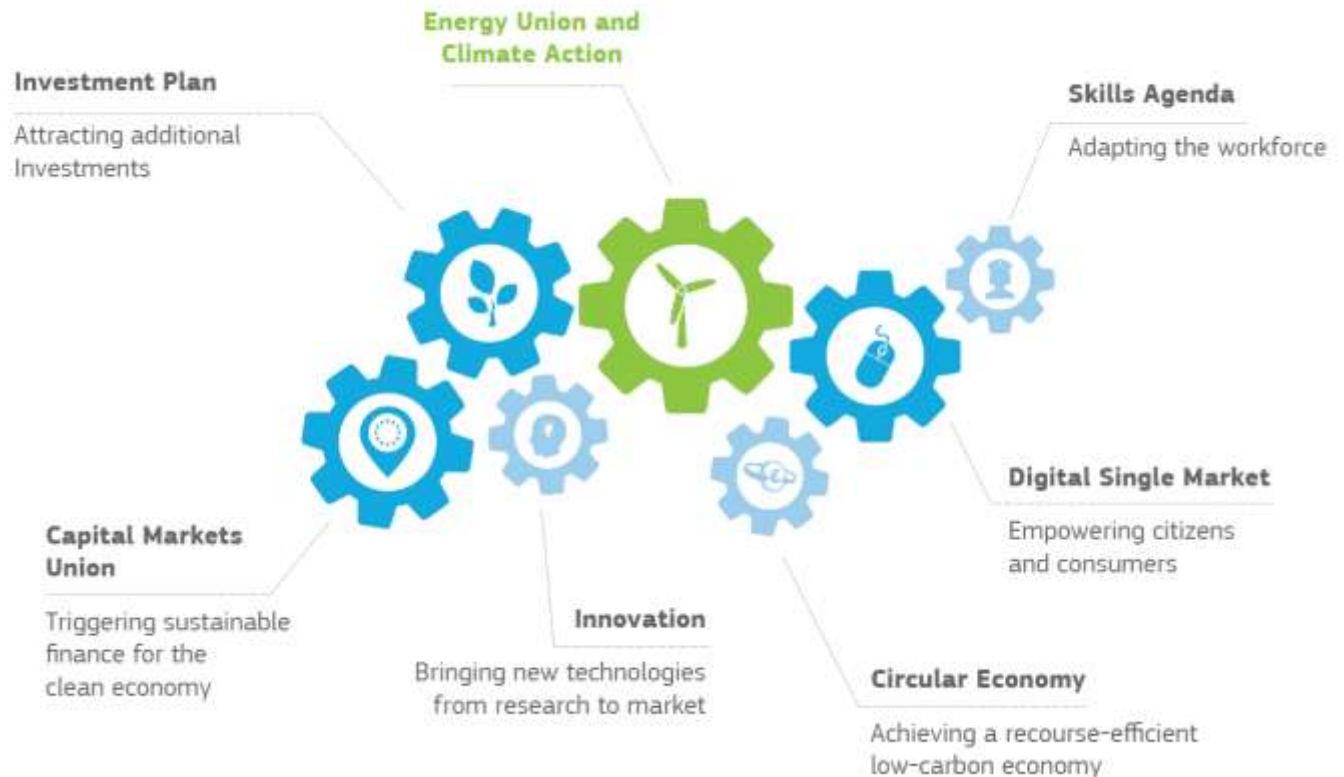


Economic growth*:
1% increase in GDP
EUR 190 billion into the
economy 900,000 new jobs
*Upper end of estimates

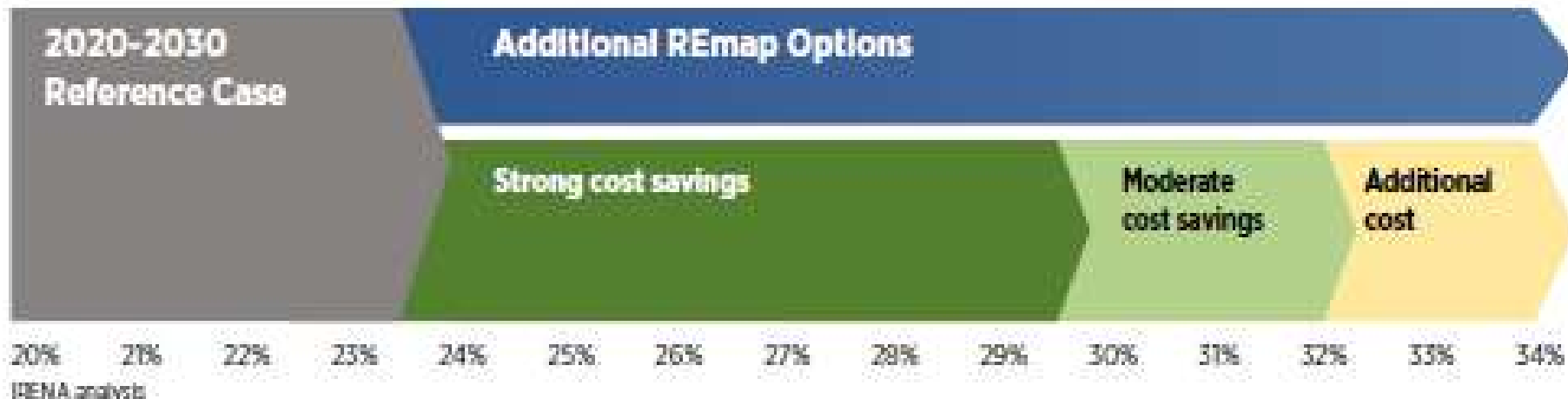


Decarbonisation:
Carbon intensity of the
economy 43% lower in
2030 than in 2015
72% share of non-fossil fuels
in electricity generation in 2030

2Seas energy context – embedded in EU



Cost savings by RE-sources



Strong cost savings

- Wind power
- Solar power
- Solar thermal in buildings
- Hydro power
- Geothermal power

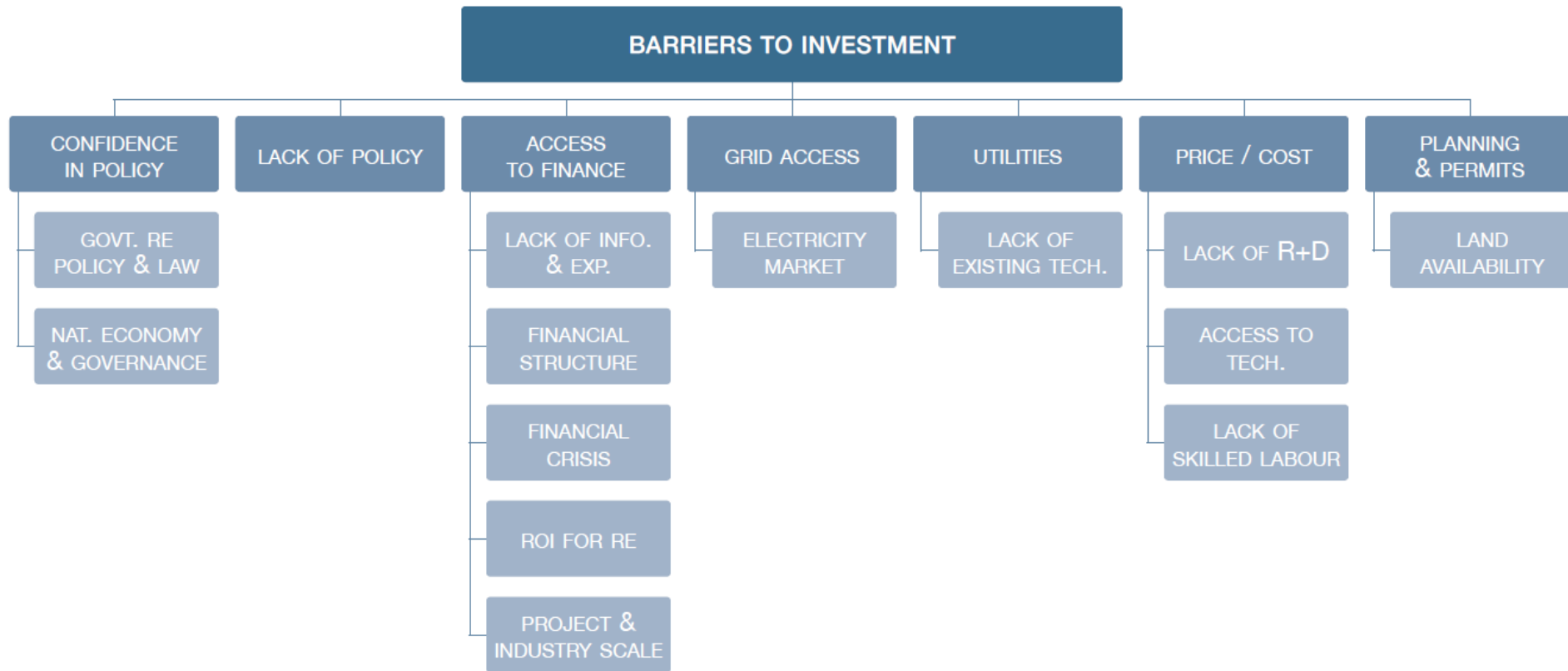
Moderate cost savings

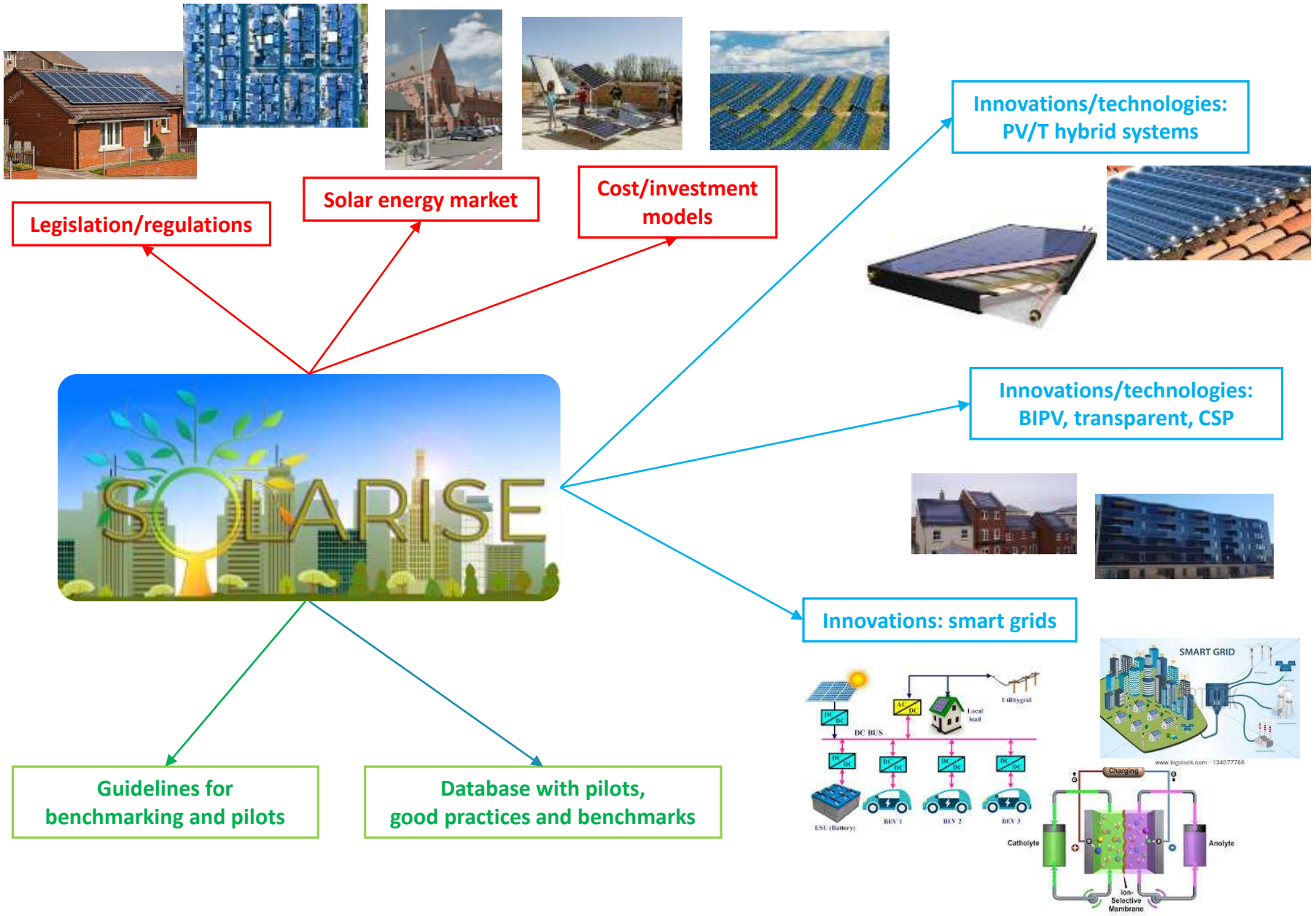
- Heat pumps
- Electric vehicles
- Biodiesel
- Geothermal district heating
- Solar thermal in industry

Additional cost

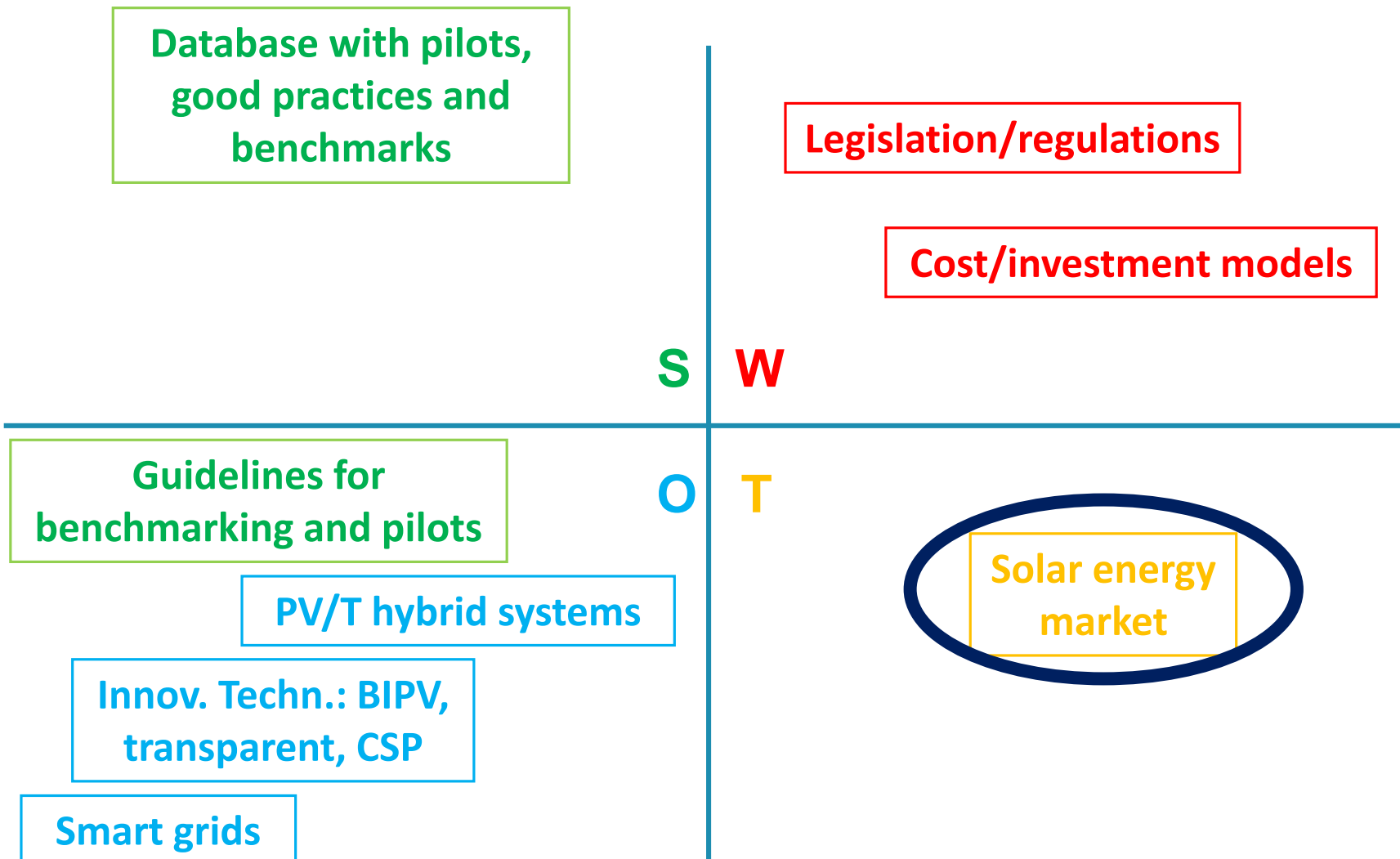
- Biomass in industry
- Conventional bioethanol
- Biomass in power and district heat
- Advanced bioethanol
- Biokerosene

Barriers to investments in RE-sources



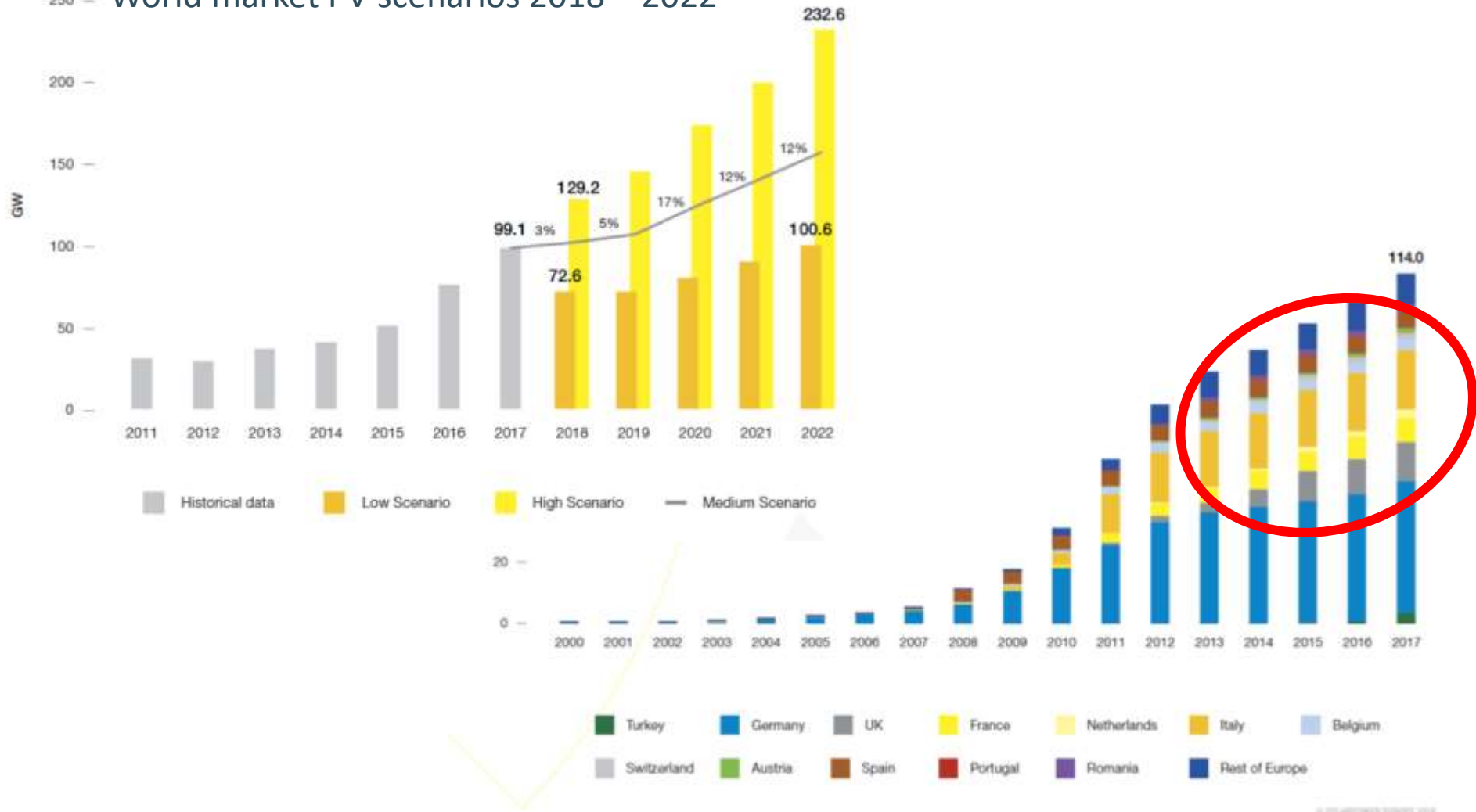


SWOT – Solar energy in 2Seas



2Seas – solar energy market

World market PV scenarios 2018 – 2022

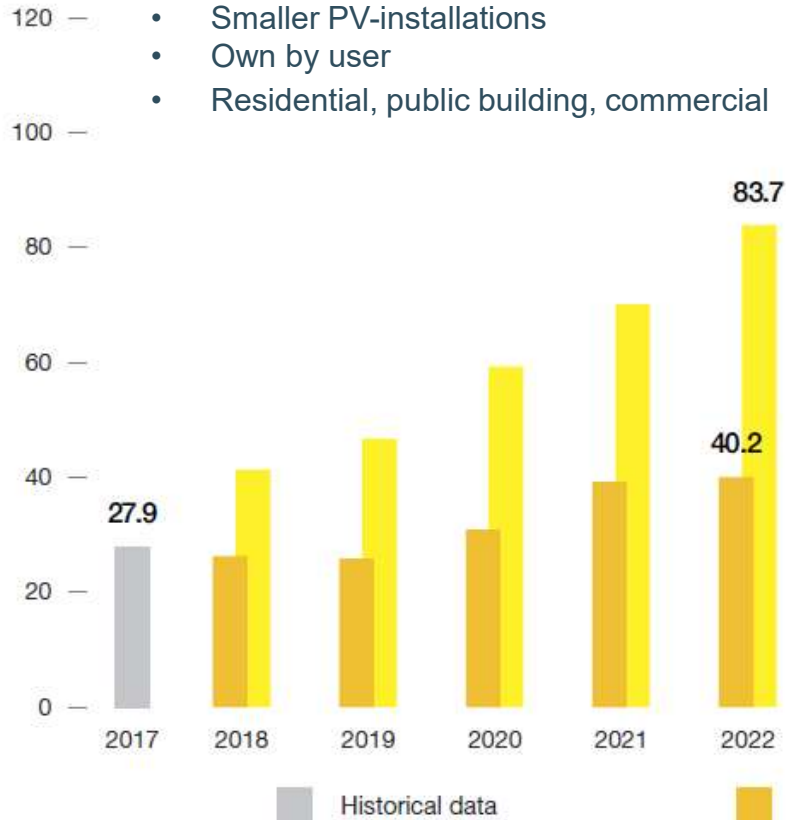


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2Seas – solar energy market

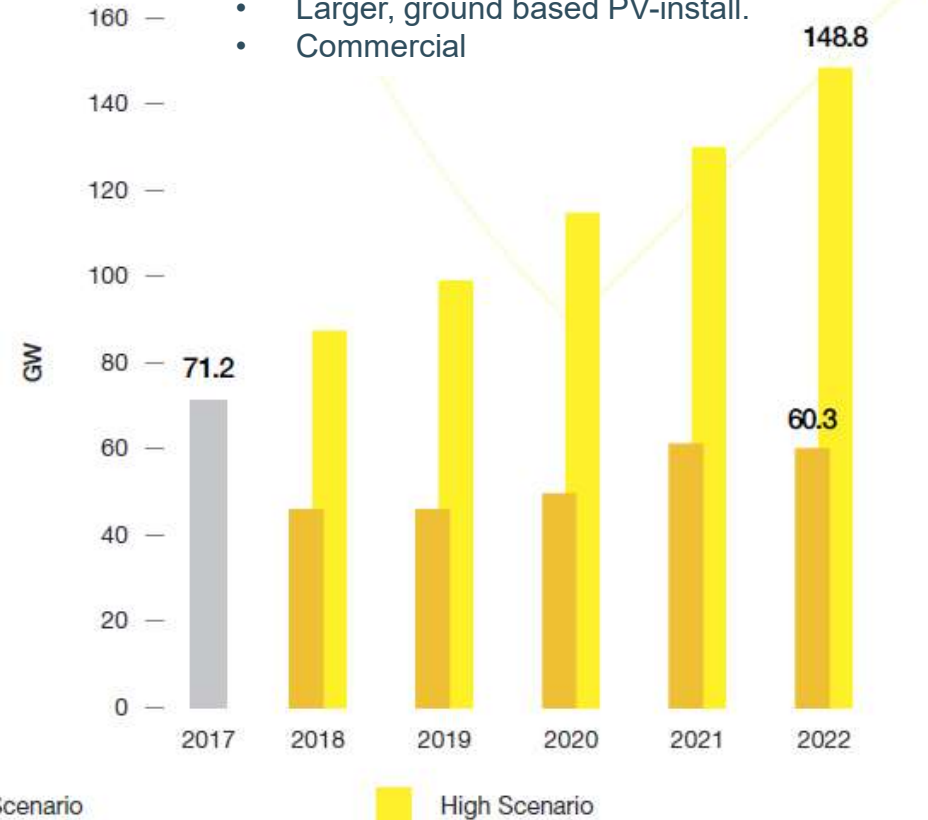
ROOFTOP PV

- Smaller PV-installations
- Own by user
- Residential, public building, commercial



UTILITY SCALE PV

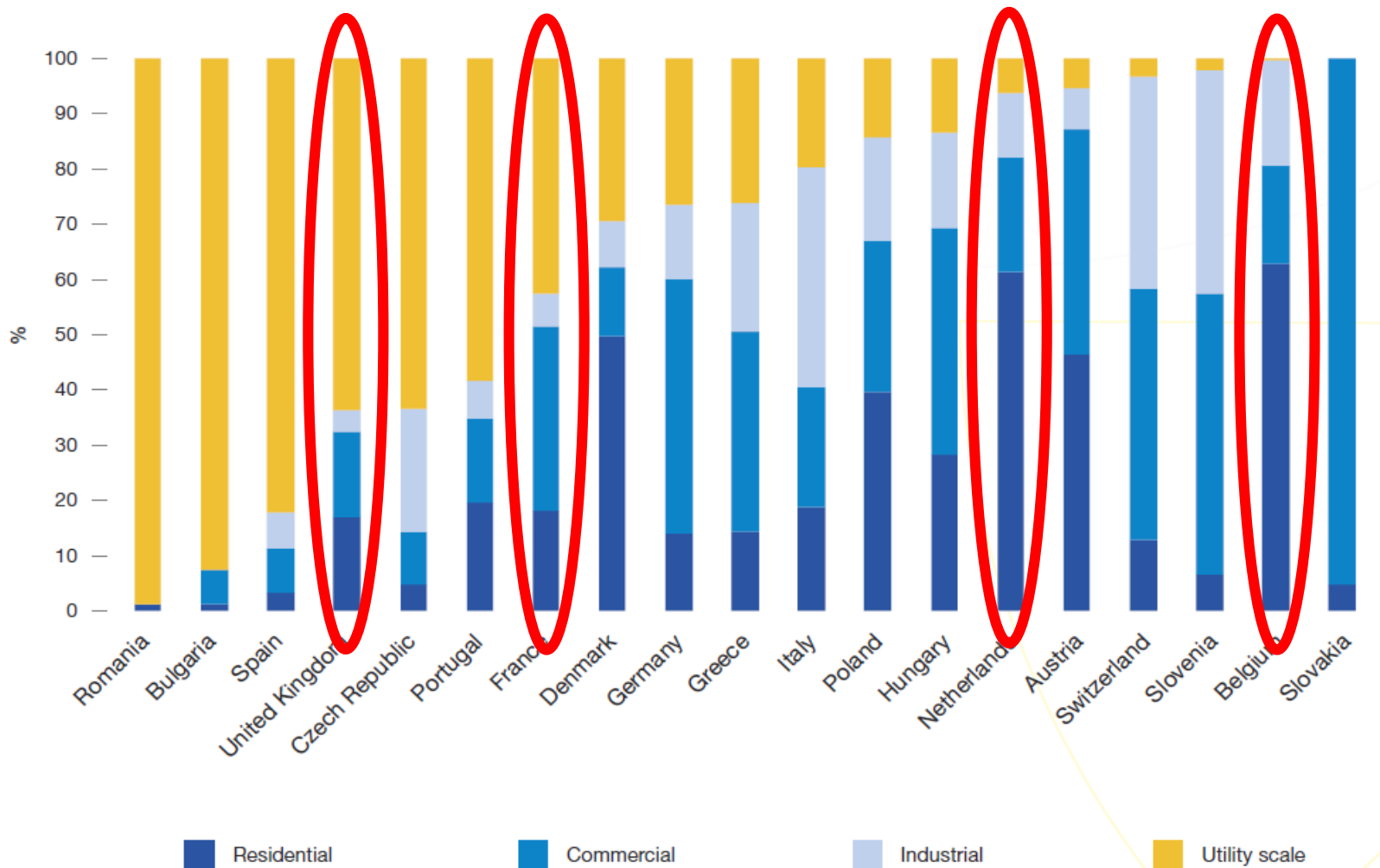
- Larger, ground based PV-install.
- Commercial



© SOLARPOWER EUROPE 2018

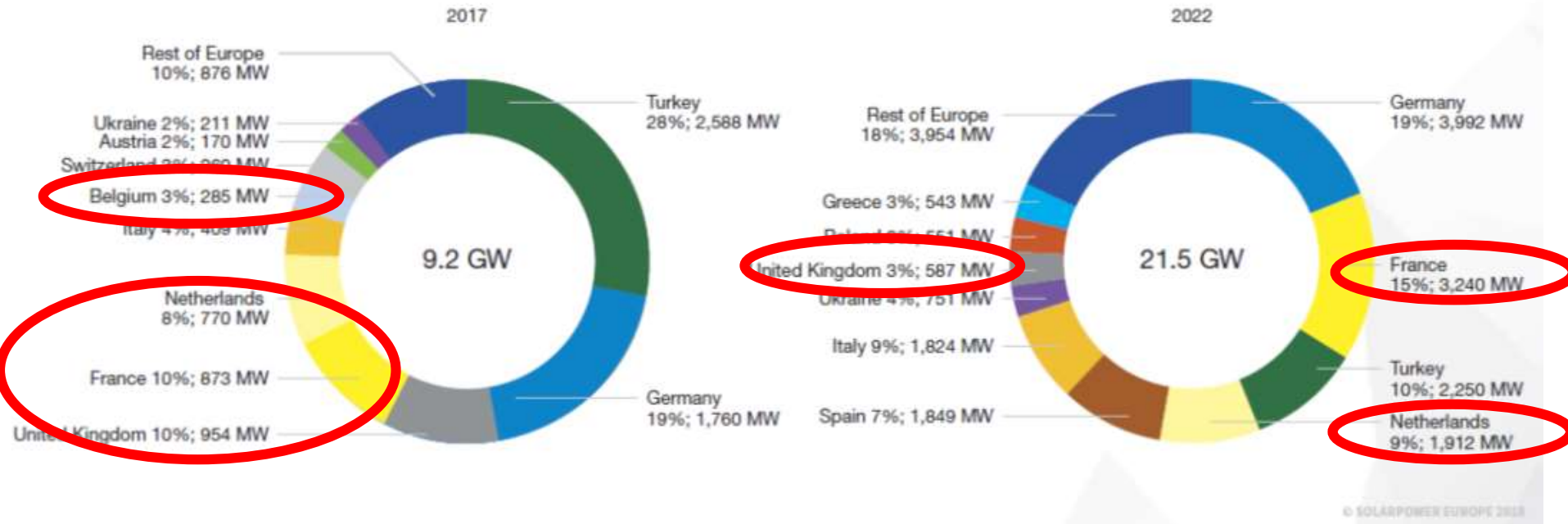
Scenarios for PV installations 2018 -2022

2Seas – solar energy market



© 501

2Seas – solar energy market



SWOT 2Seas Solar energy market

- Low(er) prices components
- Reliable products (warranties)

- (Almost) No PV-panels production
- Expensive monitoring/control solutions

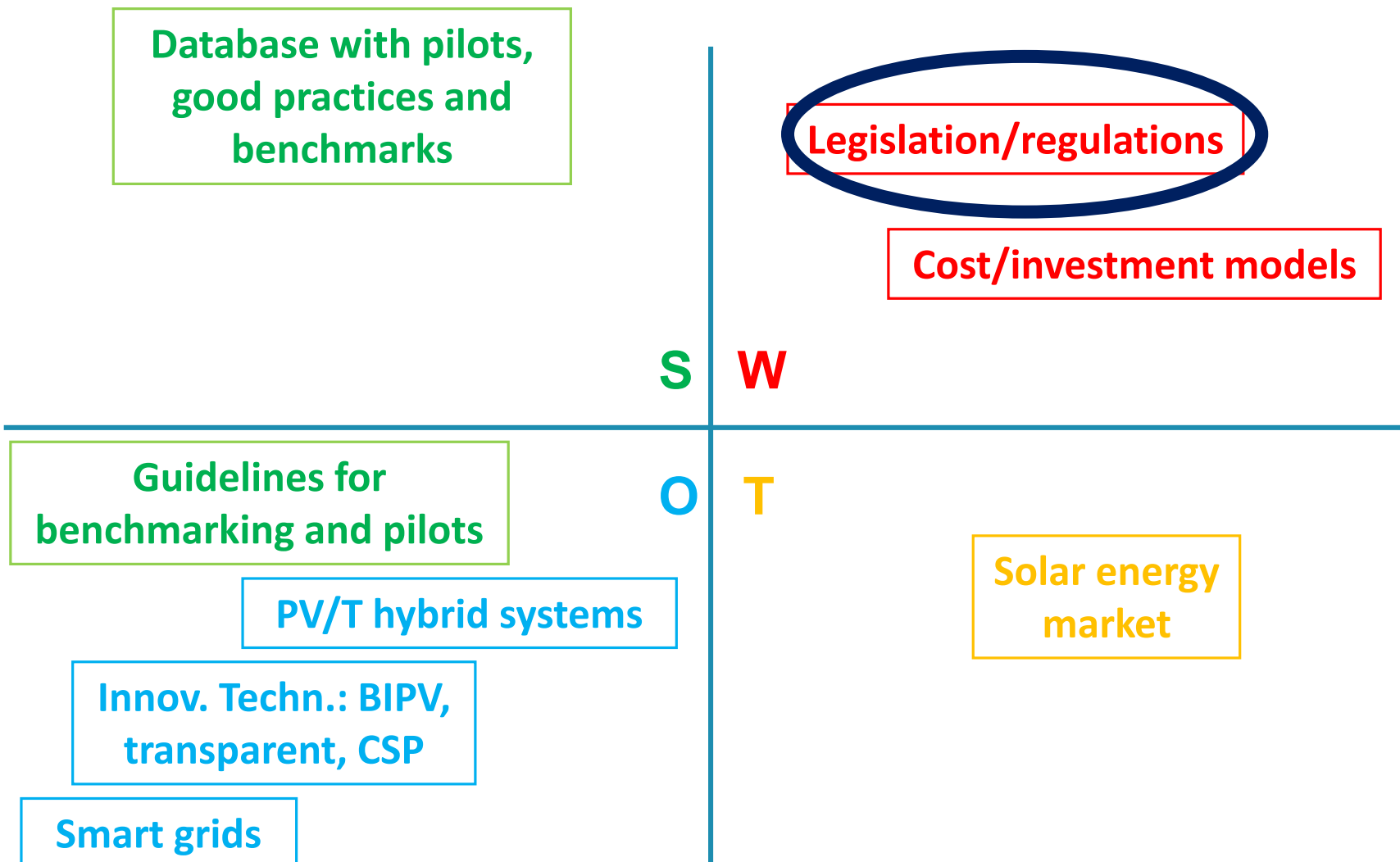
S **W**

O **T**

- Innovations to be exploited: floating PV, Agrovoltatics, PV/T,

- Dependence on (PV-panels) imports
- Missing strategy to develop market more steadily

SWOT – Solar energy in 2Seas



2Seas – solar legislation/regulations

Barriers for solar energy uptake

- **Uncertainty of incentive schemes**

Investment companies, citizen not sure whether it is worth to invest in solar

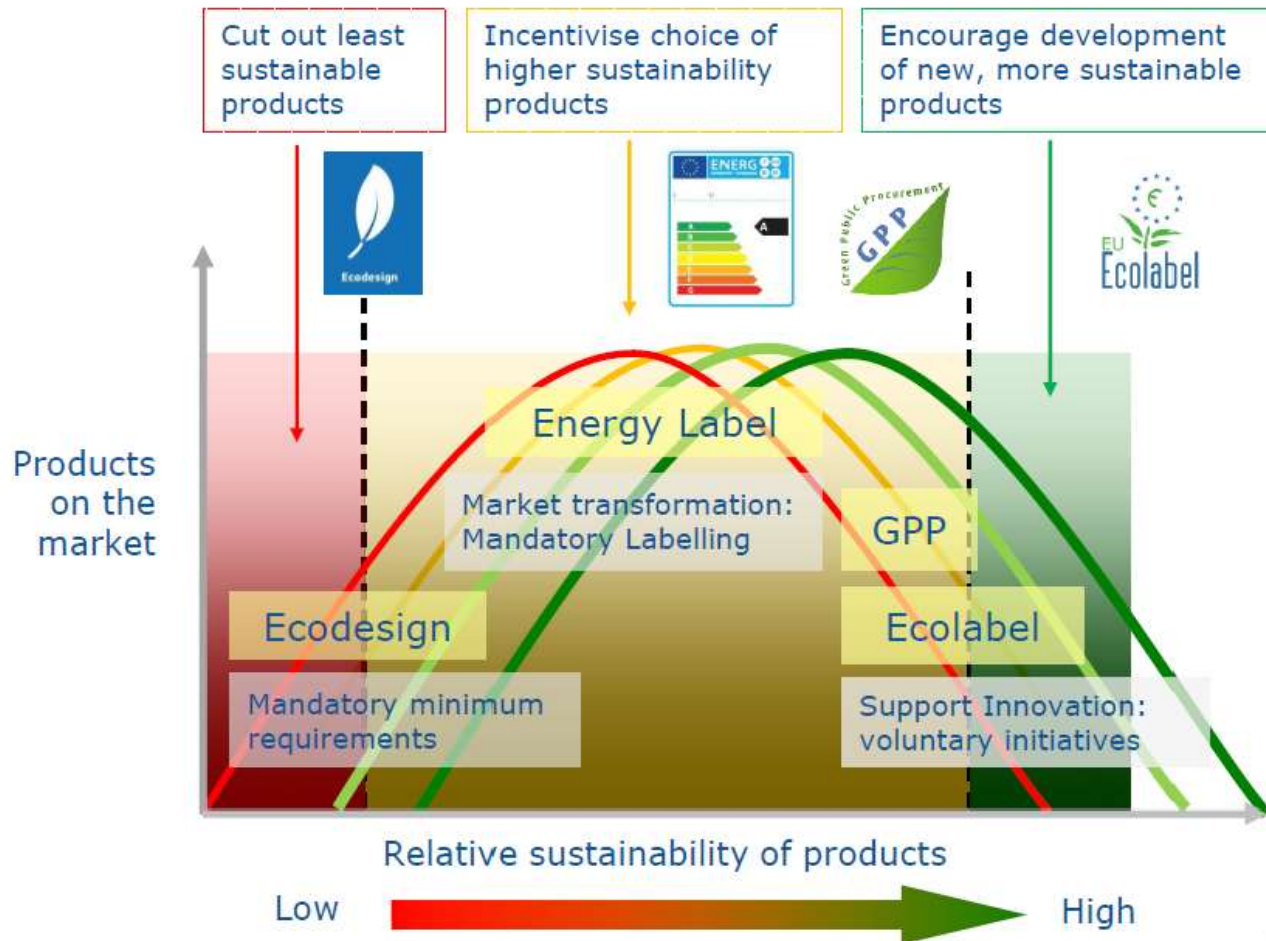
- **Environmental planning**

Specific regulations for rooftop PV systems - eg historic buildings, monuments
Environmental issues for solar farms – preservation of biodiversity, agriculture

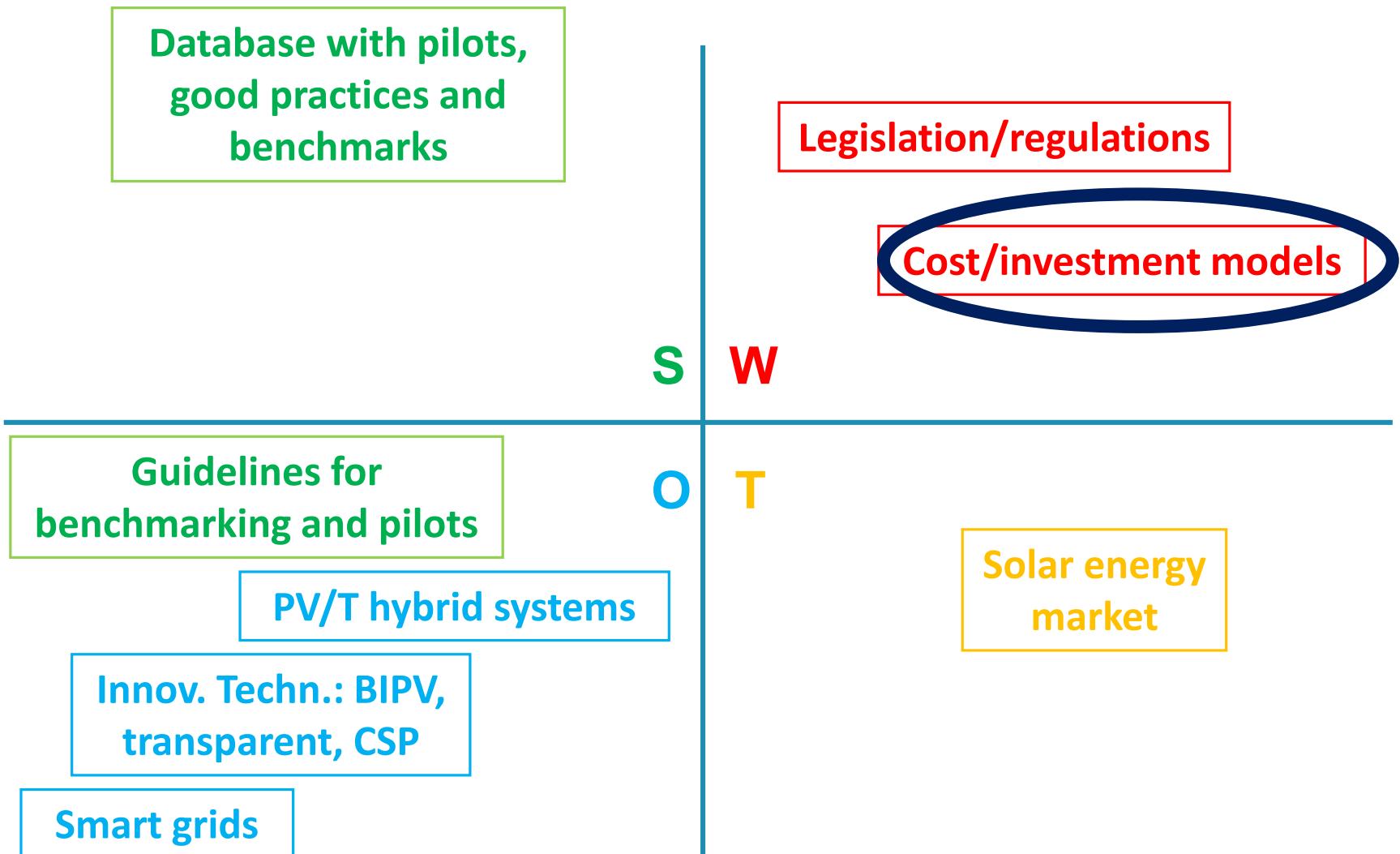
- **Lack of integrated climate policy**

Eg responsibilities are split amongst different federal, regional and local authorities in Belgium

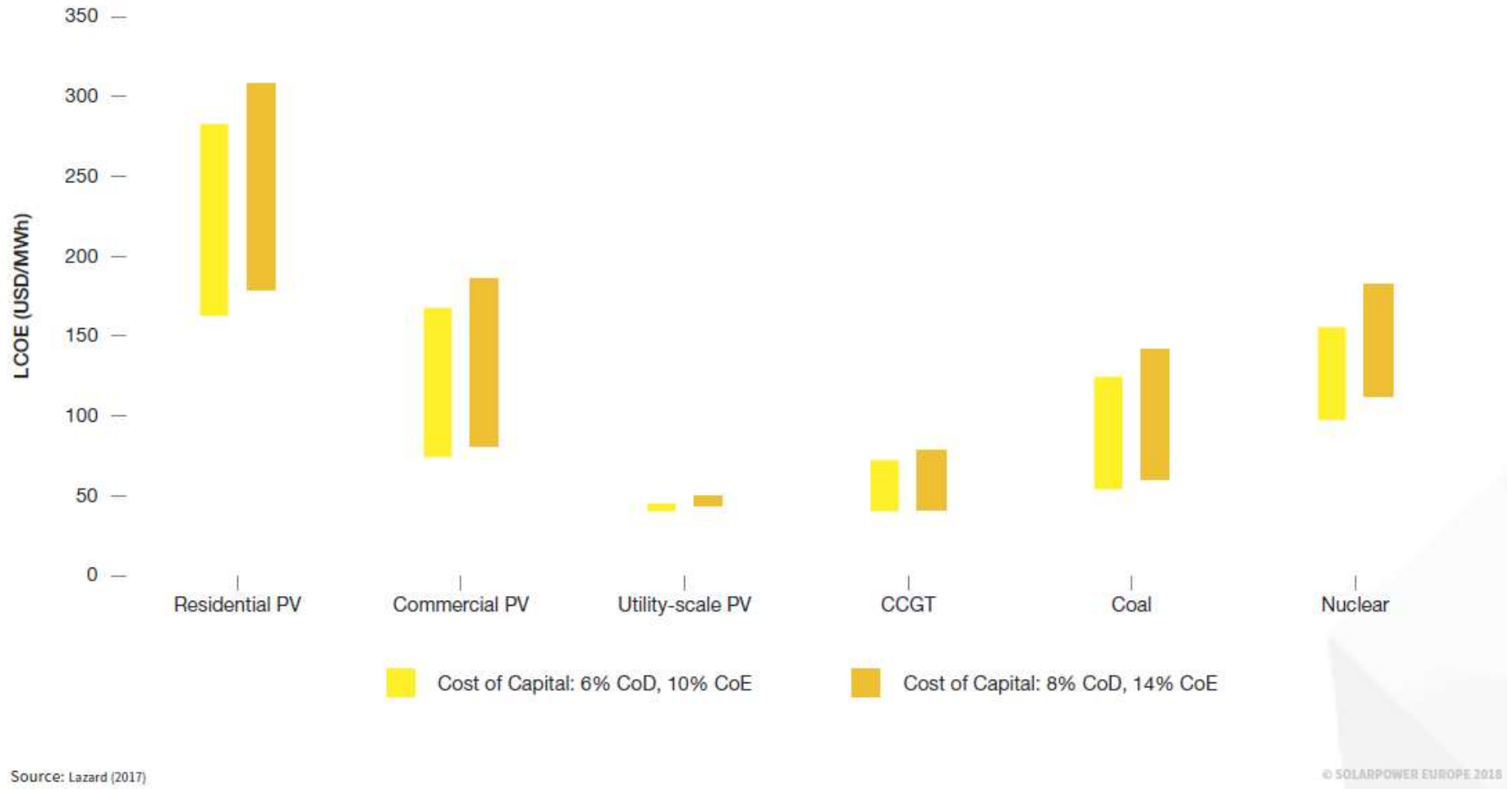
2Seas – solar legislation/regulations



SWOT – Solar energy in 2Seas



2Seas – cost/investment models



Solar electricity generation costs in comparison with other renewables

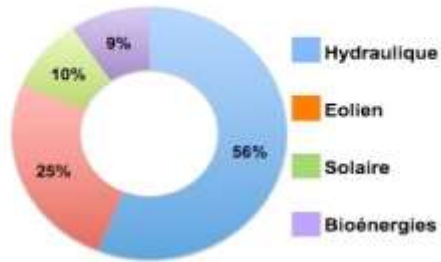
2Seas – cost/investment models

BELGIUM:

- 2018 188 MW newly installed PV capacity mostly
- residential PV systems < 10 kWp under net metering selling energy
- PV systems > 10 kWp – green certificates; Flanders urgently needs large solar projects with a capacity of more than 750 KW.
- VAT rate on electricity 21%
- 2017 - 3.2 TWh through solar energy about 4% of total power demand.
- largest growth in solar demand between 2009 and 2012 - green certificate scheme to support solar
- Expected PV power of up to 18 GW by 2040.

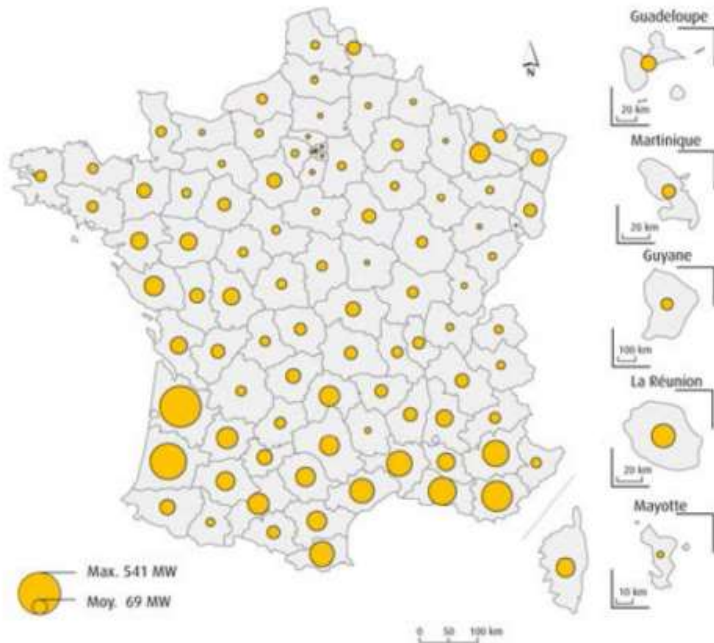
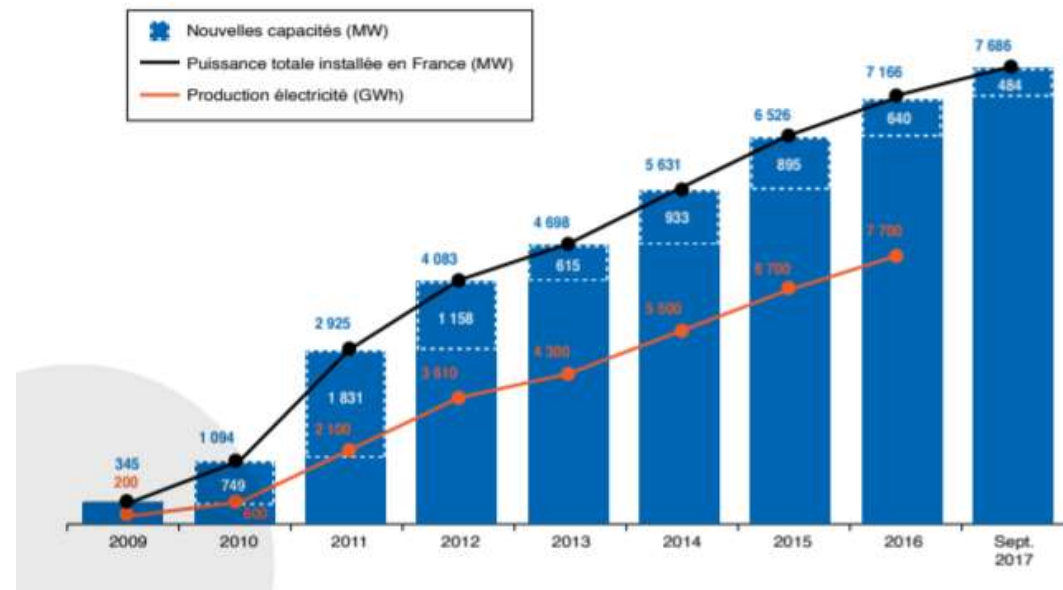
2Seas – cost/investment models

La production française d'électricité renouvelable en 2017
(Source : RTE-Bilan 2017)



According to RTE, mainland France PV production reached 8,3 TWh in 2016. PV electricity represented 1,6 % of the electric consumption of mainland France in 2015.

Parc total photovoltaïque et production d'électricité annuelle en France
Source : Observ'ER d'après les chiffres du SDES



2Seas – cost/investment models

BELGIUM:

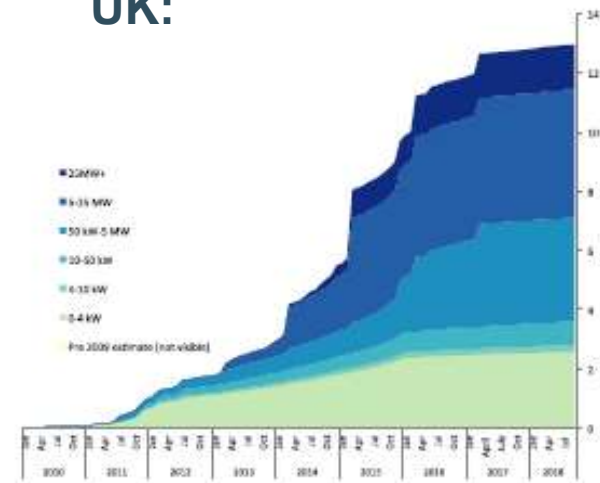
	2017 Numbers
Number of PV systems in operation in your country (a split per market segment is interesting)	<p>≤ 10 kVA: 459.854 systems</p> <p>> 10 kVA et ≤ 250 kVA : 7.009 systems</p> <p>> 250 kVA : 1.004 systems</p> <p>TOTAL : 467.867</p>

- Many small installations
- Residential/commercial
- No fancy technologies

FRANCE:

	2017		
	Peak Power range	Installations (number)	Power (MW)
Number of PV systems in operation in your country	0 – 3 kW	289 494	779
	3 kW – 9 kW	73 224	467
	9 kW – 36 kW	17 522	438
	36 kW – 100 kW	13 213	1 070
	100 kW – 250 kW	6 071	1 072
	> 250 kW	1 415	4 219
	Total	400 939	8 044
	Total Off-grid		30

UK:



2Seas – cost/investment models

Encouraging measures/support schemes:

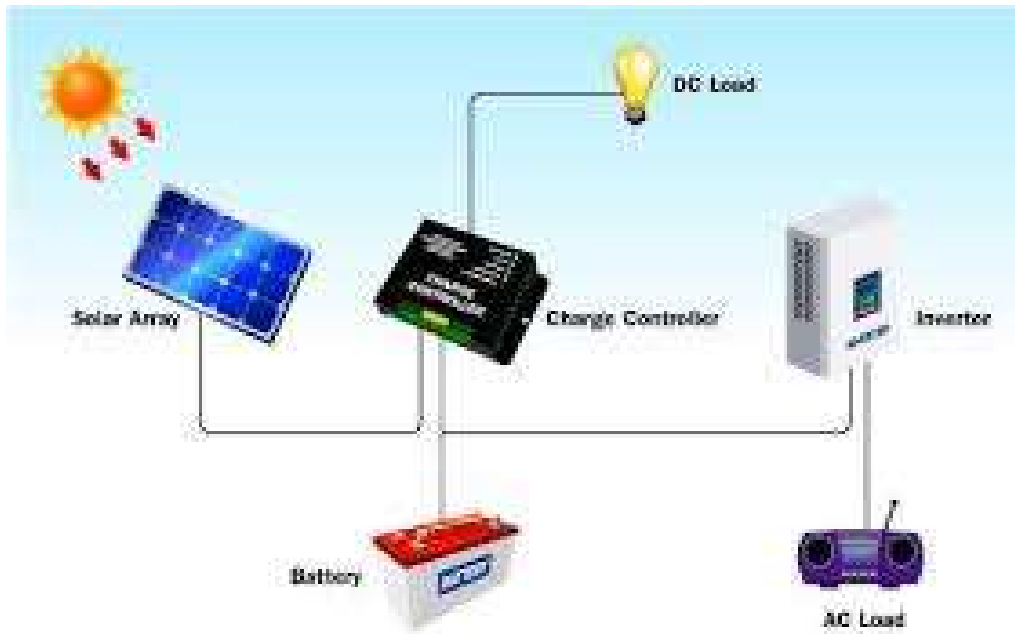
- Feed-in tariffs (FITs)
- Net metering
- Smart metering
- Green/white certificates

Elements for successful renewable energy support schemes/measures:

- a clear, bankable pricing system
- priority access to grid: clear identification of responsible for connection and incentivized
- clear, simple administrative and planning permission procedures.
- public acceptance/support.

2Seas – cost/investment models

Costs(expenditures) and income PV-installations

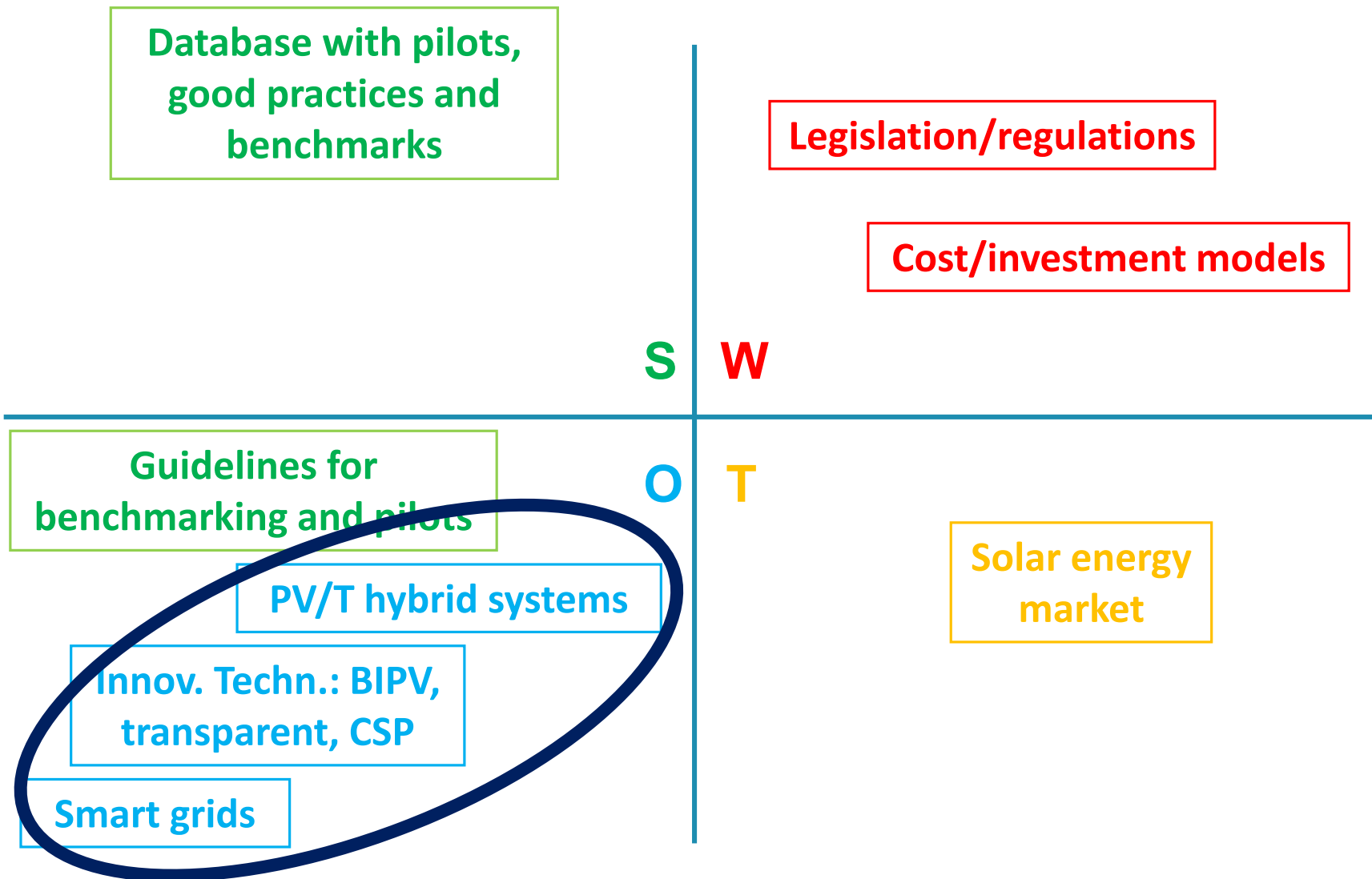


Initial costs + O&M + recycling +

+ land purchase (Solar farms)

+ roof reinforcement/renovation

SWOT – Solar energy in 2Seas

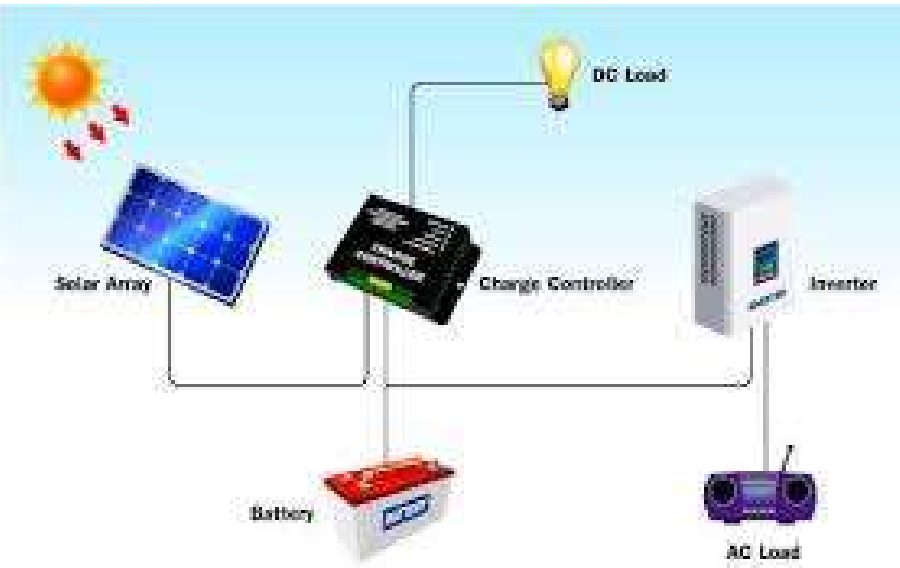


2Seas – solar technology innovations

Table A2.4. Foresight studies mapping – Energy and environment

CAN	DEU	EU	FIN	GBR	RUS
	Smart grids, overlay-grids, super-grids	Future smart cities		Smart grids	Smart networks, long-distance transfer technologies for electric energy and fuel, new-generation power electronics
Decentralised energy systems	Microenergy harvesting			Microgeneration	New-generation microprocessor devices for use in power engineering
	Electrochemical storage and conversion technologies		Rapidly charging light batteries, supercapacitors	Advanced batteries	Electrical and thermal energy storage
			Wireless power transfer		
Electric and hybrid vehicles	Electric mobility, power-to-liquid technologies for the mobility sector	Post-carbon society, carbon dioxide reuse	Self-driving car	Intelligent low-carbon road vehicles	
Autonomous and semi-autonomous vehicles	Connected mobility, car-to-car-communication, car-to-X-communication, smart mobility	Advanced autonomous systems, future mobility	Automation of passenger vehicle traffic, vactrains, magnetic or superconductor-based levitation		Smart transport and new control systems, systems to increase the environmental neutrality and energy-efficiency of vehicles
	Unconventional flying concepts	Drones	Minisatellites, quadcopters, drones, on-demand personal aviation		Micro-, nano-, and pico-satellites
	Fuel cells			Fuel cells	Fuel cells
		"Hydrogen Society"	Inexpensive storage of hydrogen in nanostructures	Hydrogen	Hydrogen production and safe storage, hydrogen for power generation
		Recycling technologies		Recycling technologies	Recycling technologies
	Energy efficiency measures				Low energy consumption buildings, novel light sources and smart lighting systems
		Carbon dioxide capture and storage		Carbon capture and storage, metal organic frameworks	

2Seas – solar technology innovations

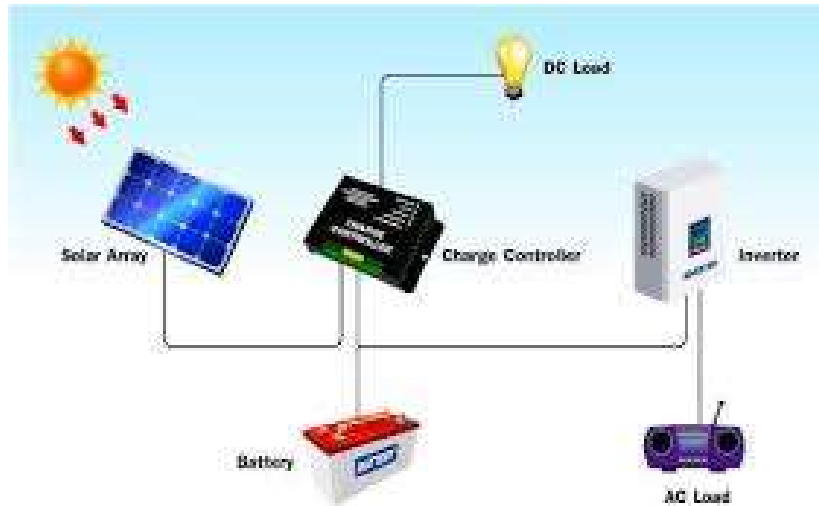


PV-modules(panels) 50 % of total system costs

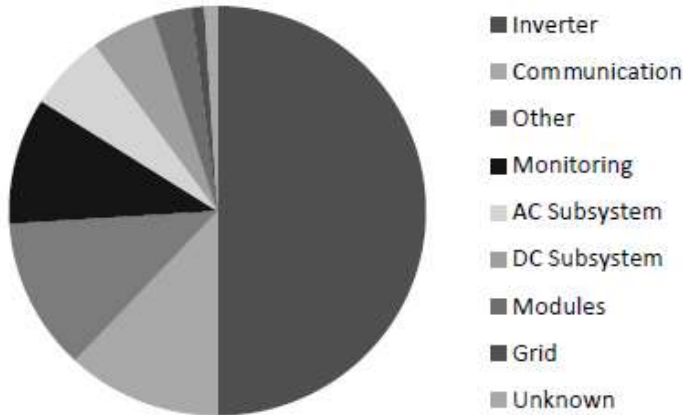


Technology	Drawbacks to future use
Crystalline-silicon	Efficiency, materials
Thin-film	Efficiency, stability, toxicity, lifetime
Concentrating PV	Stability, complexity, high cost
Organic PV	Efficiency, stability, lifetime
Third Generation PV	Efficiency, proof of concept only

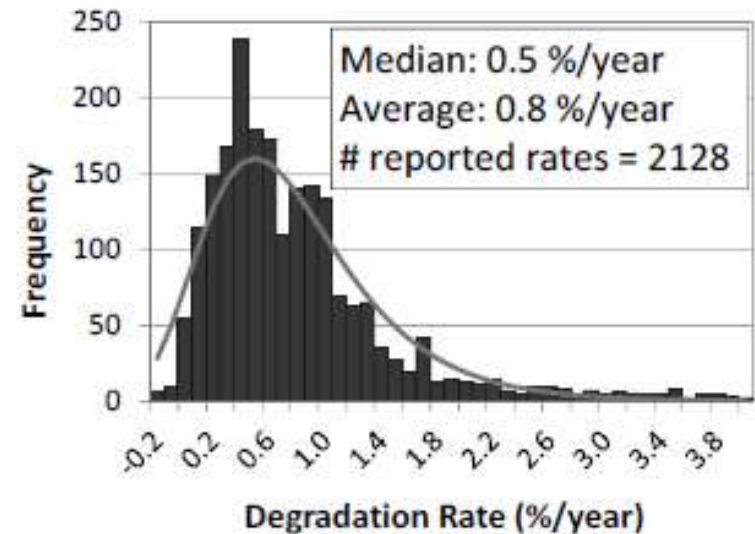
2Seas – solar technology innovations



Replacement costs (failure % in PV-installations)



Degradation of PV-panels



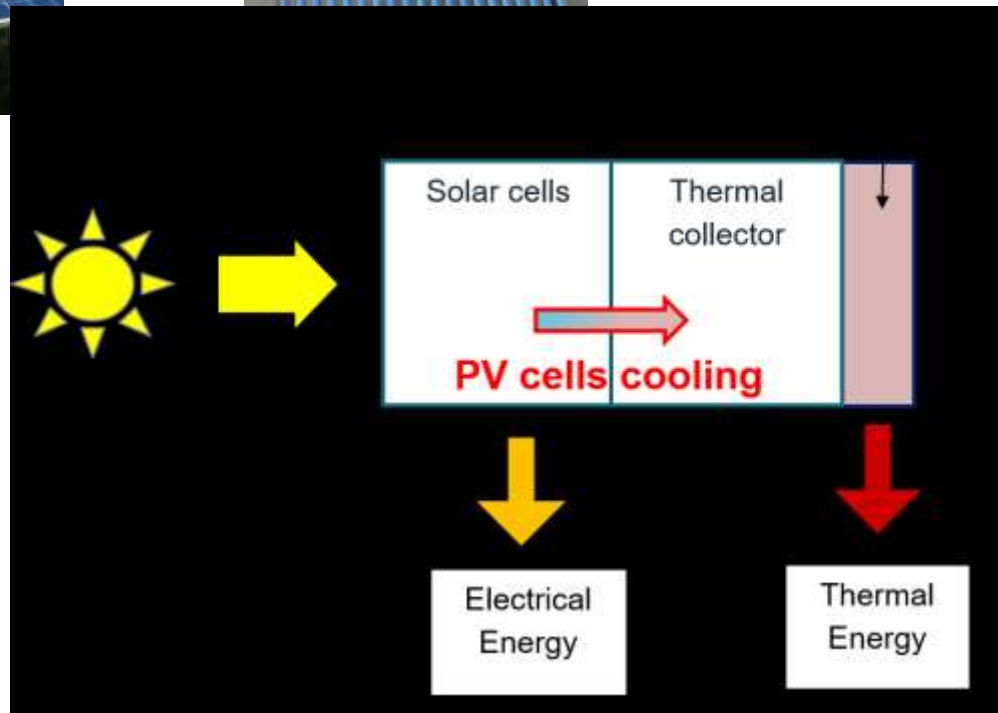
2Seas – solar technology innovations

PV/T: working principle

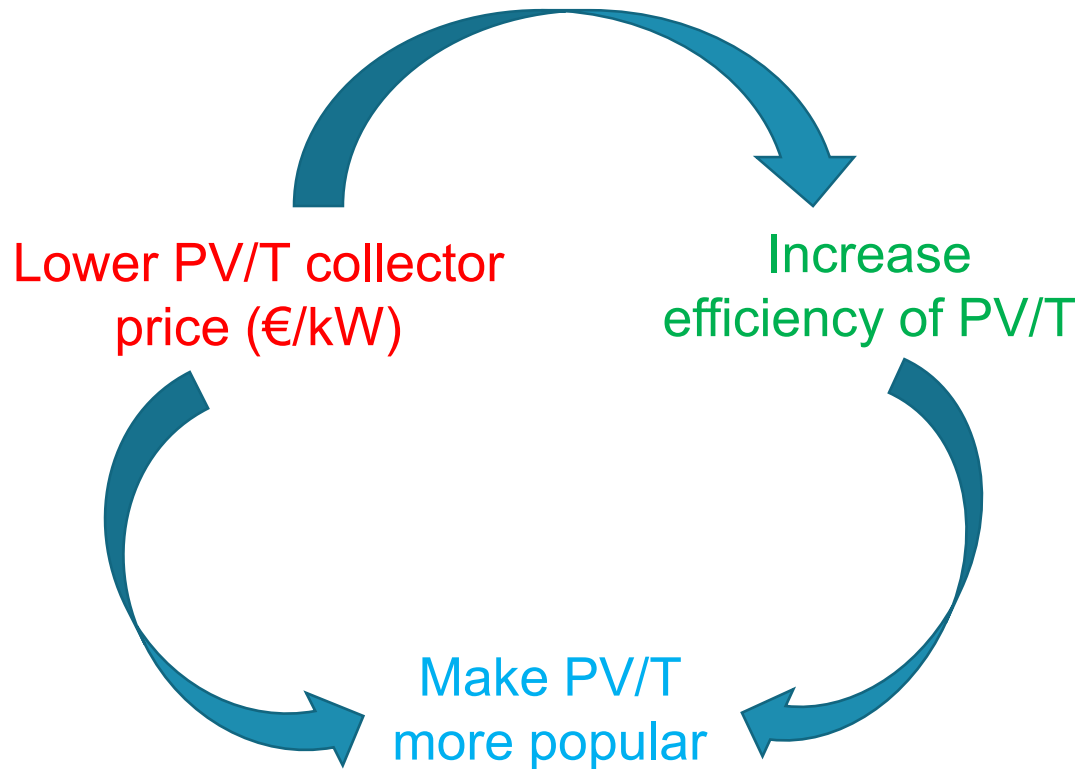
PV-array



Solar thermal collectors



PV/T uptake: challenges




Are these actually **opportunities** not challenges?

Other challenges for the PV/T uptake

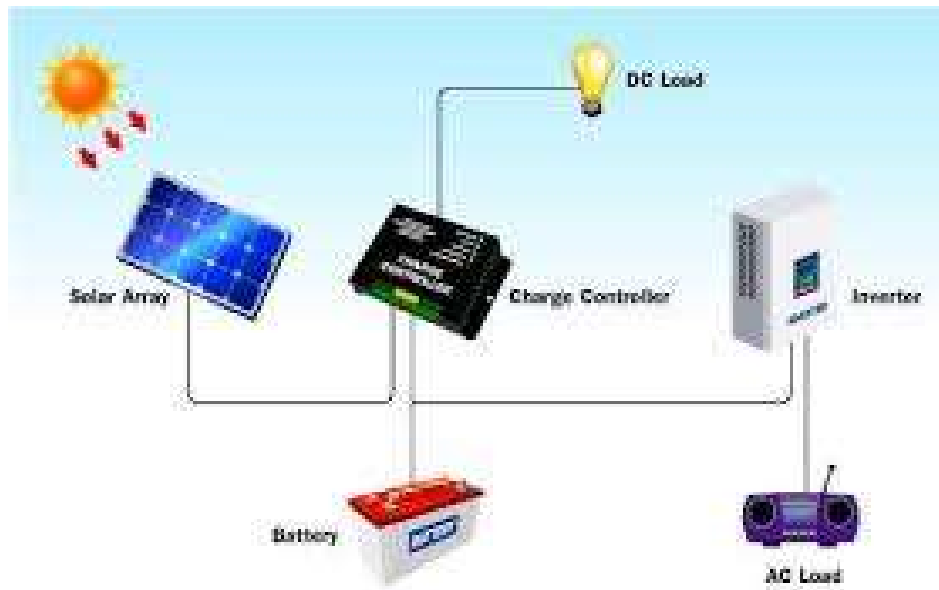
How to enhance the reliability of PV/T-systems?

- Early detection of possible PV/T failures
- Increasing PV/T-panels lifetime by better materials/design

PV panels	25-year performance warranty	
T panels	10-year product warranty	 Limit
PV/T panels	25-year PV performance warranty 10-year product warranty	

Best warranty durations on the market

2Seas – solar technology innovations

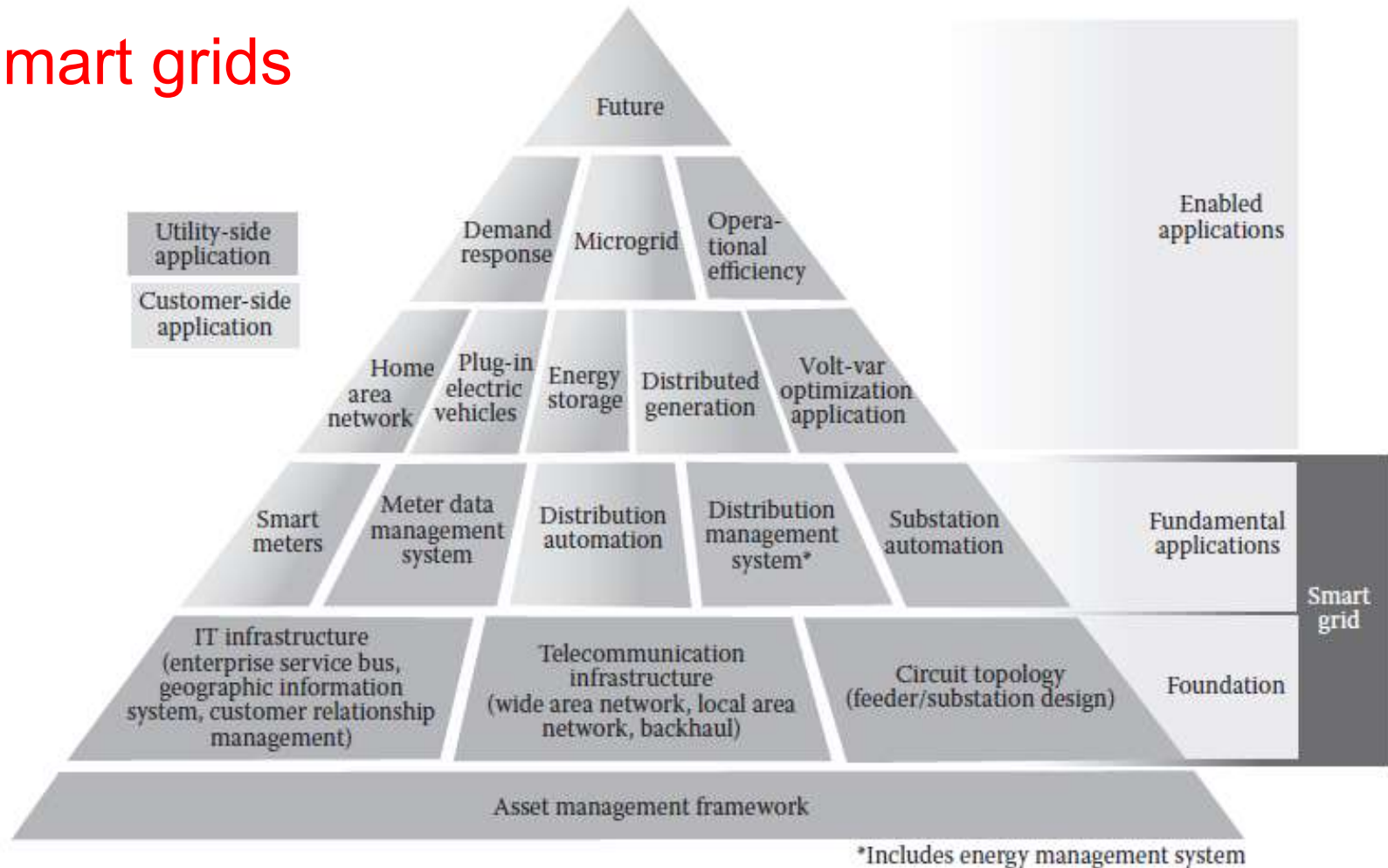


Reducing costs (EUR/kWh) means:

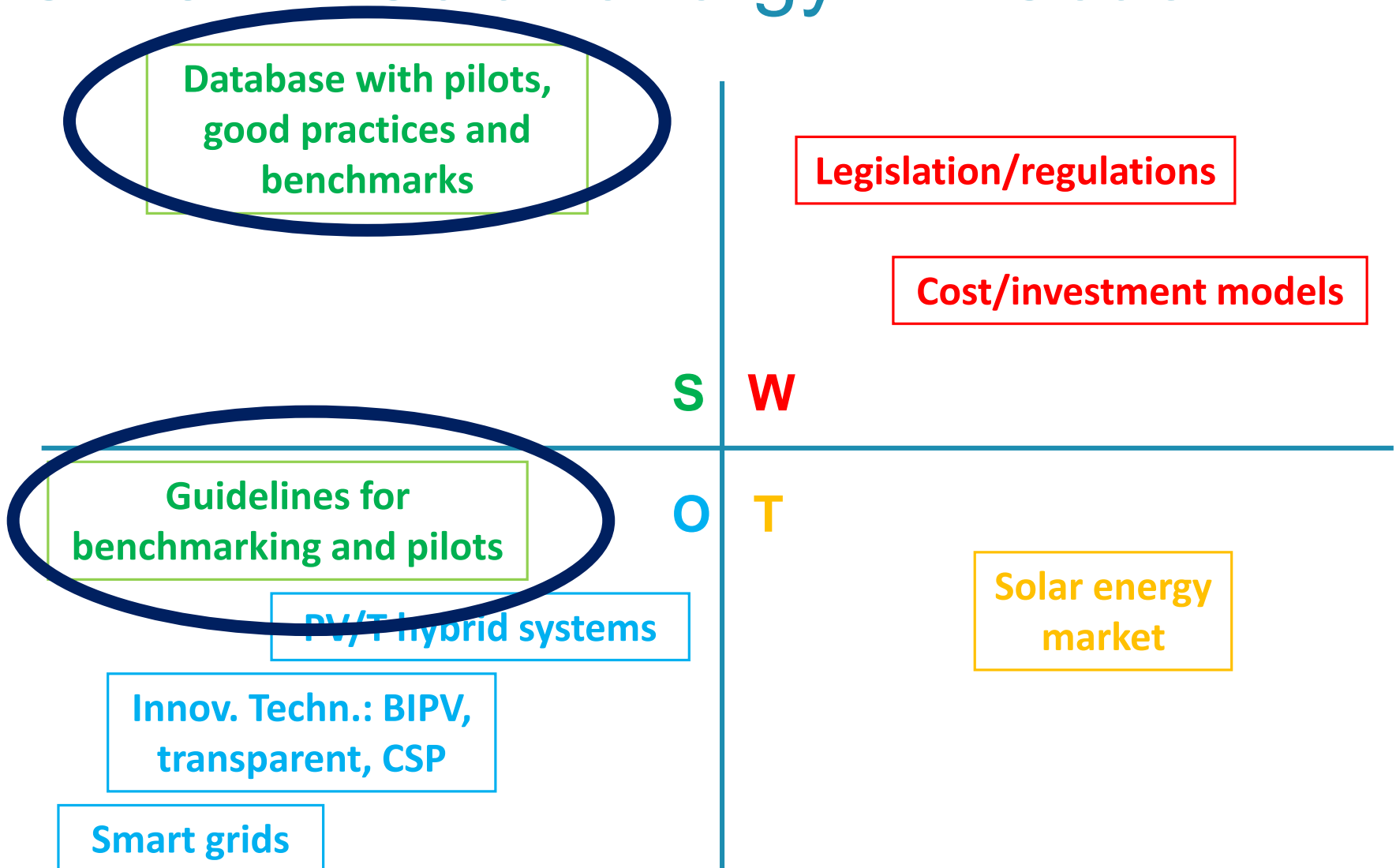
- reduce the balance of system costs (system components and installation costs);
- increase the energy **yields, stability and lifetime of the system**;
- increase the **inverter** lifetime and reliability of system components;
- not combine modules of different specifications in the same system;
- match the inverters to the modules and load profiles.

2Seas – solar technology innovations

Smart grids



SWOT – Solar energy in 2Seas



2Seas – existent solar projects, best practices, ...

Obstacles to consumers – households, businesses and industry:

- **Lack of appropriate information** on costs and consumption, or limited transparency in offers
- Increasing proportion of **network charges/taxes/levies** in average final electricity bill.
- **Insufficient competition** in many retail markets, a lack of reward for active participation, and difficulties in switching act as disincentives.
- **Insufficiently developed markets for residential energy services and demand response**
- **Preventing self-generation and self-consumption** reduces potential gains.
- **Unequal access to information** and **high entry barriers for new competitors** slow down the adoption of available advanced technologies and practices such as **smart metering, smart appliances, distributed energy sources and energy efficiency improvements.**

Guidelines for benchmarking
and pilots

Database with pilots,
good practices and benchmarks

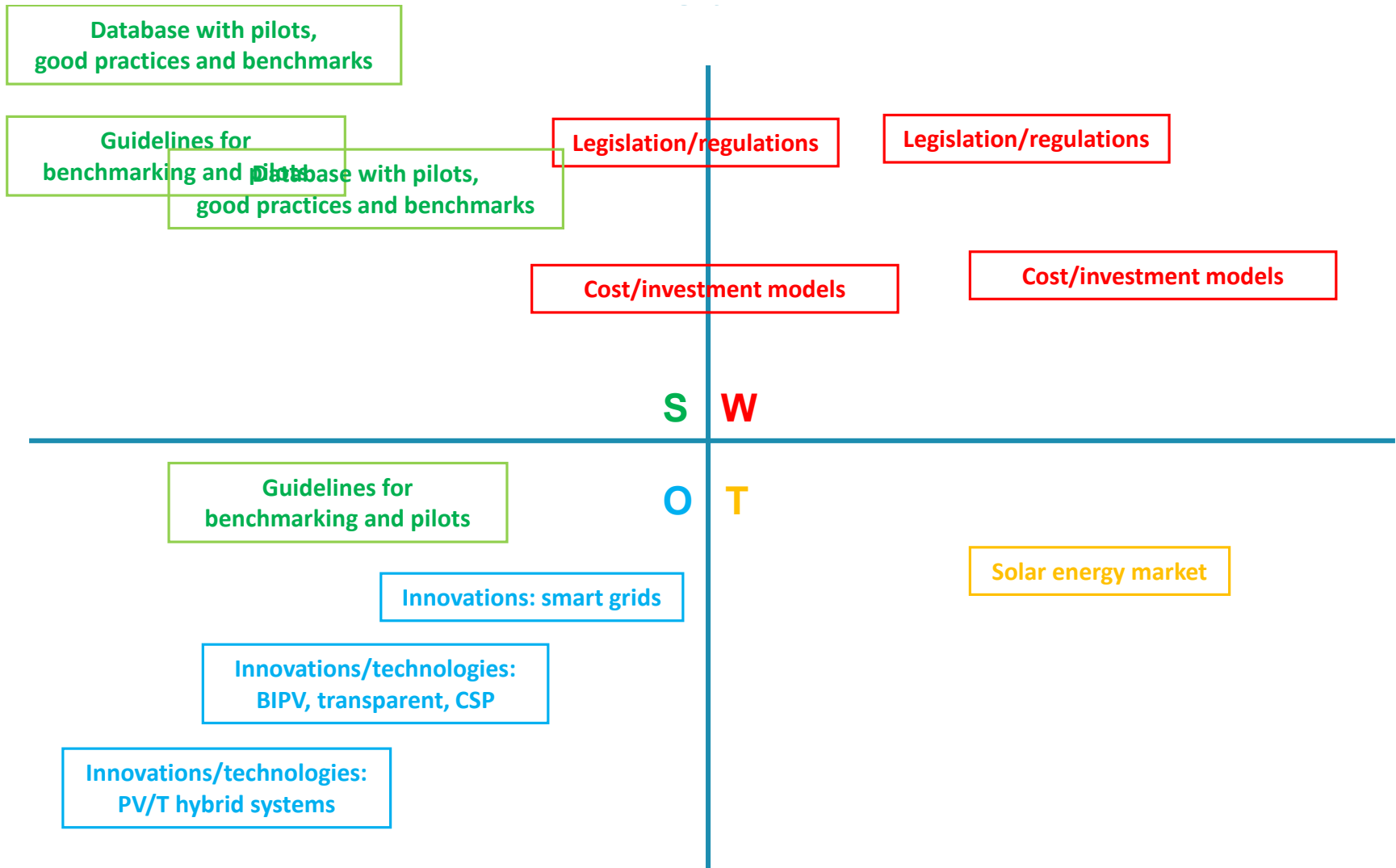
Do we (still) need these in 2Seas region?

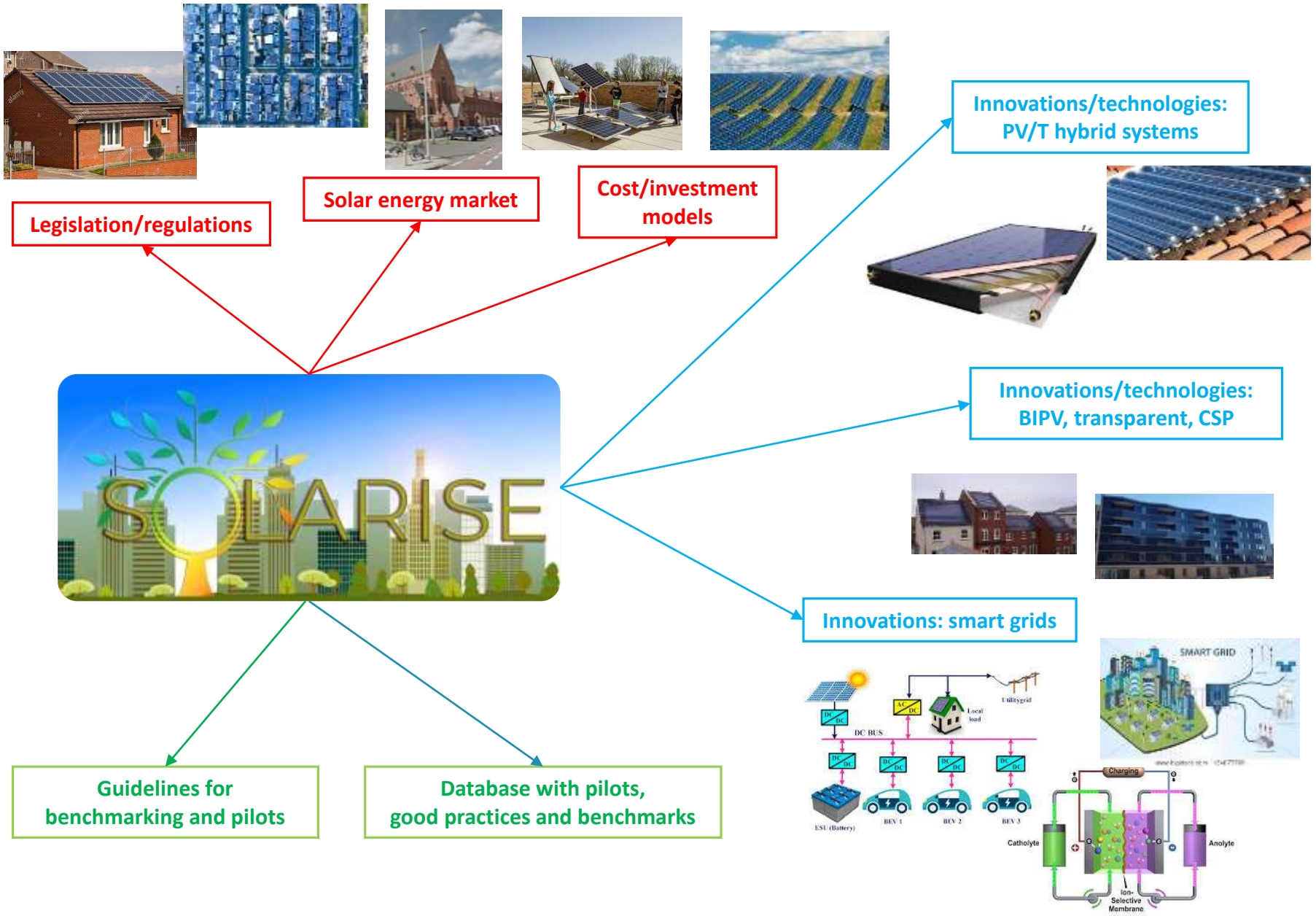


YES because

- Stakeholders are still not aware of existent knowledge/knowhow: Innovations
- Various stakeholders with various backgrounds still co-exist
- Not enough (best practices) examples close to 'your door'

SWOT – Solar energy after Solarise







OUTPUT 1

Guide package

on legislation, market, technologies and best practices

TO BE FINALIZED
by the END of JUNE 2019

Enquires/remarks/suggestions for Output 1 to:
emilia.motoasca@kuleuven.be