



POINT Review Greece: **RES, Batteries & Applications** Preliminary Findings

Matthijs Janssen (Utrecht University, NL)
Yannis Tolas (Innovatia Systems, GR)

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Industrial Transition in Greece

The Review of Industrial Transition of Greece is focusing on the industrial theme of **renewables, batteries and their applications in mobility, agriculture, shipping, and/or defence**

First steps:

- building rationale
- systems analysis
- narrowing down



Features of Industrial Theme

- Theme as as a demand-pull force for steering **directionality** and **adoption** of innovation
- Multiple value creation: output system 1 (batteries / RES) as input for system 2 (transport) & probably some others
- Compatible with smart specializing: applying a widely used technology in a **locally strong sector**
- **Sustainability-enhancing** S3, instead of any type of KET for driving diversification
- Boosting **unrelated** diversification; batteries and transport sectors are rare (and very different!) strengths in the weak sectors they belong to
- Policy **additionality**: RES for linking unrelated sectors, while addressing socio-economic transition

TOTAL: \$30.2B

RES

Passenger and Cargo Ships

HS92 ID	8901
Export Value	\$161M
Export RCA	1.77

Electric Batteries

HS92 ID	8507
Export Value	\$184M
Export RCA	2.34

Recreational Boats

HS92 ID	8903
Export Value	\$54.1M
Export RCA	1.94

Trailers

HS92 ID	8716
Export Value	\$67.6M
Export RCA	1.43



Machines

Export Value	\$2.35B
Export RCA	0.44
Active Segments	11/127 (8.7%)



Transportation

Export Value	\$524M
Export RCA	0.38
Active Segments	5/34 (15%)

Fishing Ships

HS92 ID	8902
Export Value	\$2.53M
Export RCA	1.36



Contents

Introduction: scope of the Greek review

Reasons for the transition

System definition and boundaries

Headline targets & transition endpoints

Current state of the system

Orientation & Resource Mobilisation

Production (goods/services, R&D)

Consumption

How to accelerate the transition

SWOT

First thoughts on policy options

Reasons for the transition:

**Ride the wave of
decarbonisation and create
potential for innovation and
inclusive growth**

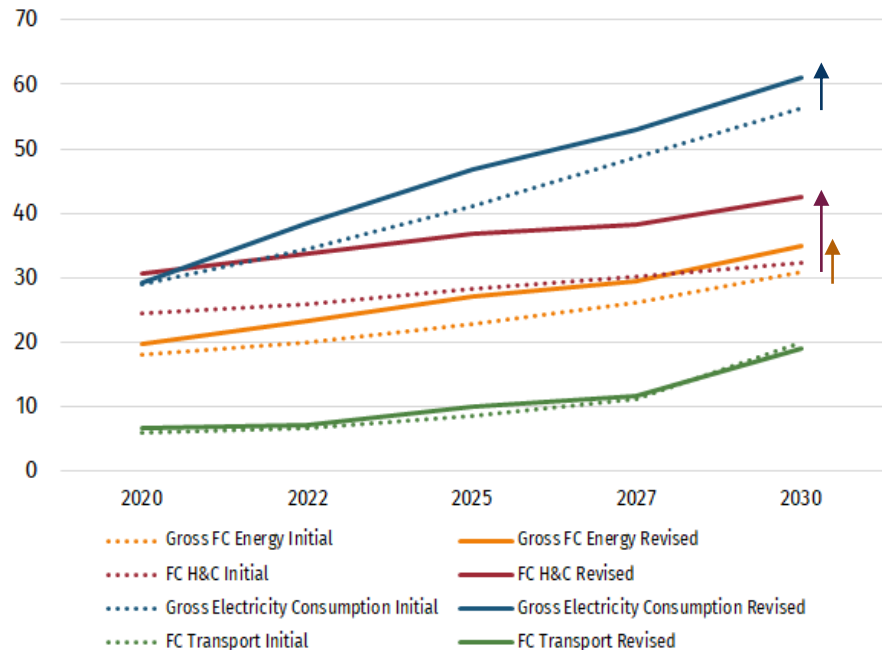
Initial and revised NECP Targets for 2030

Increasing the share of renewable energy sources in energy consumption:

- Share of RES in gross final energy consumption \geq **35%** (vs 31% in draft NECP)
- Share of RES in gross final electricity consumption \geq **60%** (vs 55% in draft NECP)
- Share of RES in covering heating and cooling needs \geq **40%** (vs 30% in draft NECP)
- Share of RES in the transport sector \geq **14%**
- **Full delignitisation by 2028** (vs 16.5% contribution until 2030 in draft NECP)

Projected Evolution of RES shares (%)

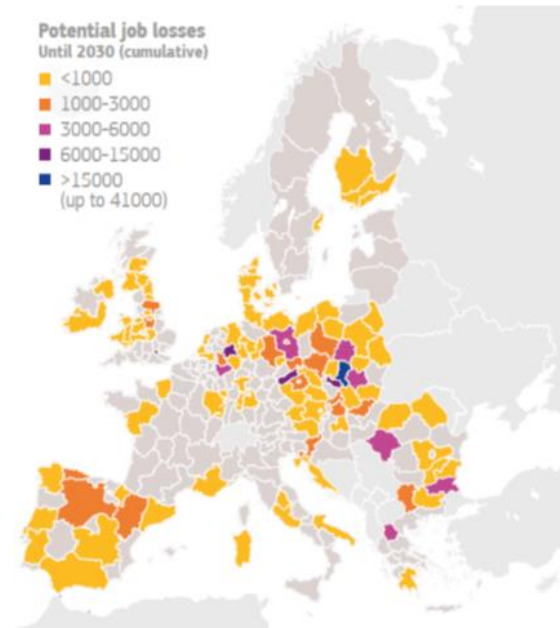
Source: Greek NECP (Initial: Jan'19, Final: Nov'19)



Minimise negative effects in Greek lignite regions

Two lignite Regions in Greece in need of restructuring:

- Western Macedonia (EL52)
- Peloponnese (EL65)



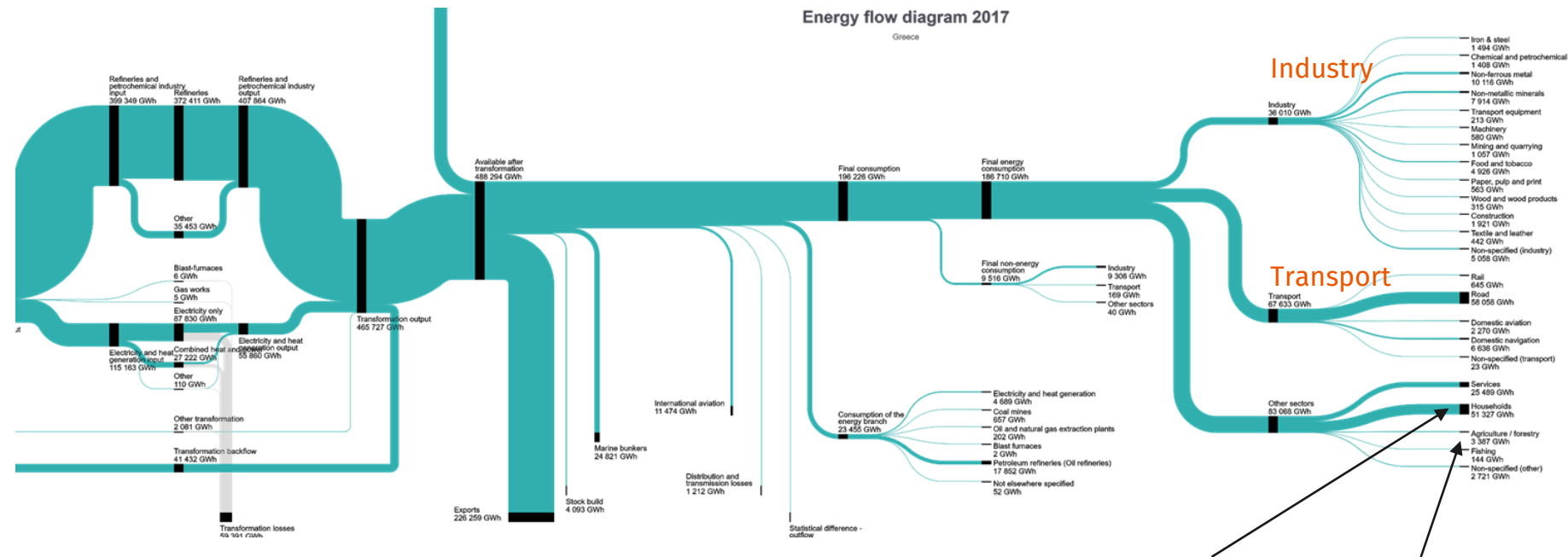
System definition and boundaries

Energy Flows (in GWh) in Greece 2017

Source: EUROSTAT

Energy flow diagram 2017

Greece



Households

Agriculture

Main actors in the system = Government +

Supply side

- Electricity (and biofuel) producers + distributors
- Manufacturers and recyclers of batteries / PV / wind generators
- Retailers and repairers of motor vehicles

Demand side

- Households, enterprises, public sector, public transport operators, energy communities,
- system integrators, solution providers

Intermediaries

- Finance sector (banks, VC, business angels)
- Technology transfer organisations
- business support services (incubators, accelerators)

Civic society

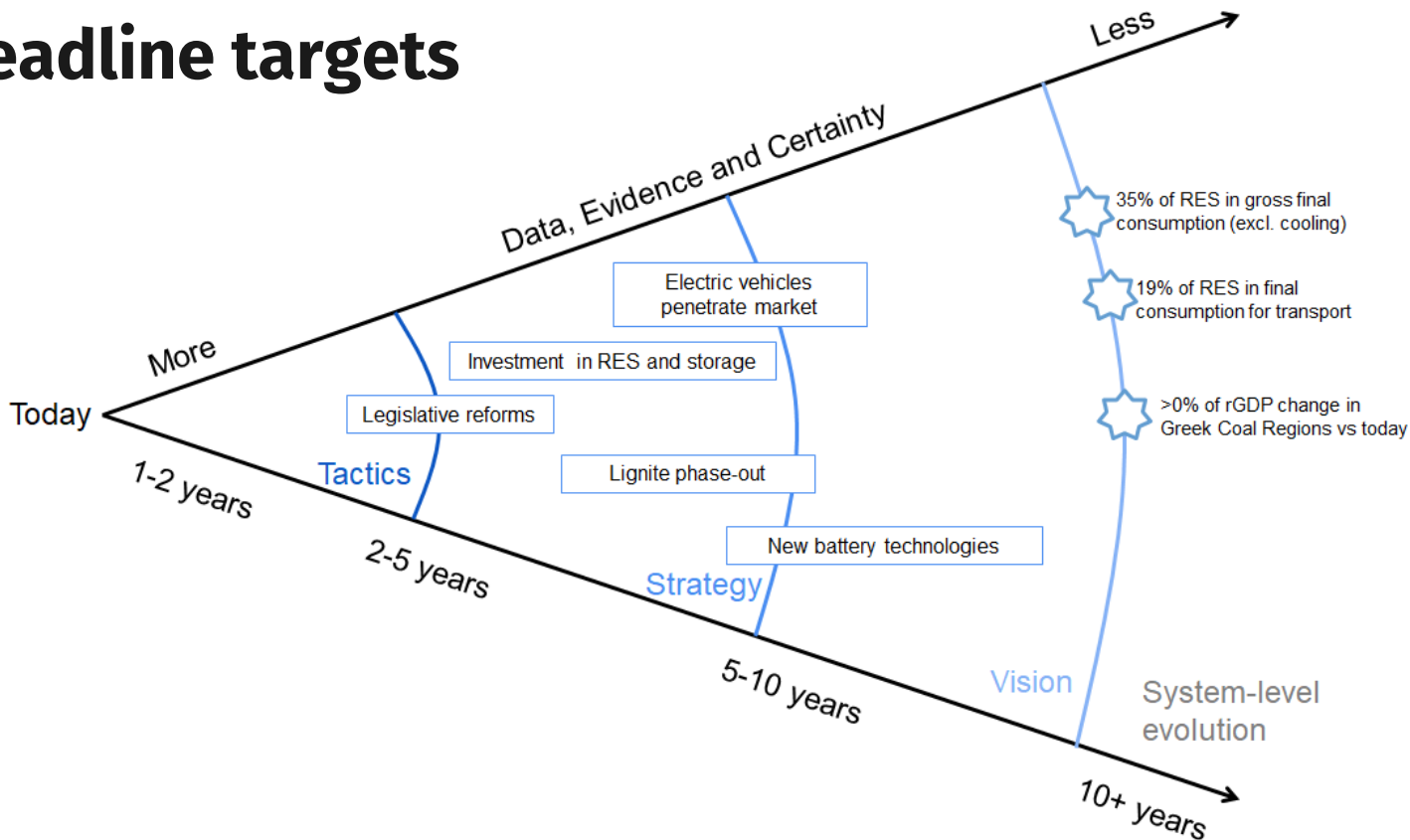
- NGOs in the field of the environment
- business associations, trade unions;

Research

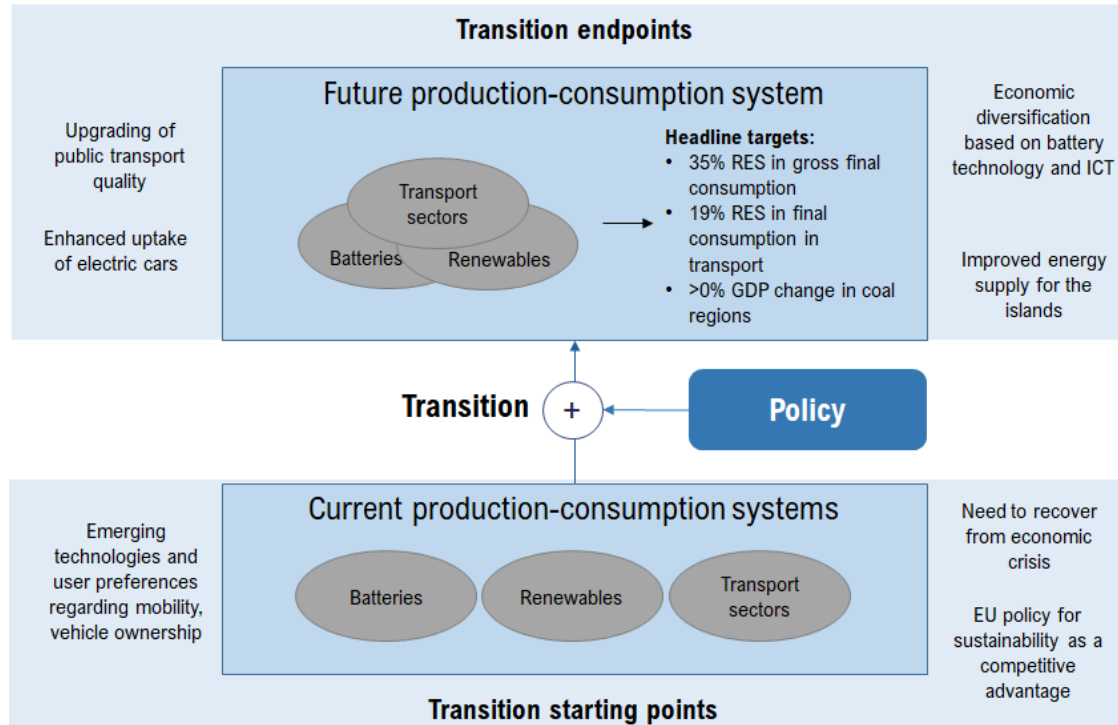
- Higher Education Institutes
- Public Research Organisations



Headline targets



Headline targets and transition endpoints



Resource Mobilisation

Public Policy

Main Actors

- Ministry of Environment & Energy
- Ministry of Development and Investment
 - National Development Strategy
 - Strategic, public & private investment
 - Research and Development
 - Public Procurement
- Ministry of Infrastructure and Transport
 - Railroads, public transport, vehicle registrations, ...
- Ministry of Finance

Other actors

- Ministry of Education
 - Higher Education
 - Lifelong Learning & VET
- Ministry of Labour and Social Affairs
 - Social Solidarity and reduction of poverty
- Ministry of Rural Development & Food
 - Energy efficiency in the primary sector
 - Energy crops (--> biomass)
- Ministry of Maritime Affairs and Island Policy

Public Policy outputs and outcomes

Lots of policy measures...

- 21 to reduce greenhouse gas emissions;
- 45 to support penetration of RES;
- 40 to support energy efficiency;
- 42 to secure energy supply;
- 49 for the efficient operation of energy market and other issues

...of questionable effectiveness

- The cost of energy is **65 EUR/MWh**, vs the EU average of 43 EUR/MWh;
- It takes 6-24 months to interconnect a small RES facility with the grid;
- It took 10 years to complete a 154 MW wind park in Central Greece after its initial licencing in 2009, while the actual installation took only 2 yrs

Finance

Private-sector projects

- Joint Ventures (mostly in the 2000's)
- EIB loans
- Private equity
- Corporate bonds and similar
- Greek banking system not able to provide loans for actors not having access to the above
- FDI inflows for energy-related projects unknown

(Quasi-) Public-sector projects

- EIB loans (IPTO, PPC, ...)
- Own funds / cashflows
- EU (ERDF, CEF, Junkers Plan, etc)

Research and Development

- Project financing is the norm; budget is very limited wrt the challenges, discontinuities between programming periods
- Main sources: H2020, ERDF, ESF



Civil Society

Many actors, usually small- or medium-scale associations of stakeholders, **limited capability** of being able to influence public debate through evidence-based policy recommendations

WWF Greece is a notable exception; Greenpeace and ClientEarth less active

General Federation of the Public Power Corporation Workers (GENOP-DEI), the most influential labour union in the country, is very critical towards delignitisation

The **Association of Energy Municipalities** is also very critical towards delignitisation citing a forthcoming “violent transition”

Planning

An unprecedented opportunity and four challenges

Attract Investment and identify financing opportunities

- Provide clear, quantitative time-bound and localised investment needs
- Address bottlenecks in the development of projects
- Exploit all available funding opportunities

Support industry, competitiveness and innovation

- Understand and quantify the functioning of the value chains
- Address flexibility, demand response, storage & aggregation
- Focus on a small number of R&D objectives & provide funding

Fully integrate the social dimension

- Training and new skills for the population affected
- Balance short-term relief with medium-term impacts

Explore synergies among policy portfolios and adopt a holistic approach

- Establish a delivery unit at the highest level
- Set clear objectives and align actors at various levels of central and regional governments

Production

Structural Business Statistics

Relevant NACEv2 Codes
EL.STAT data for 2016

NACEv2	Description	Legal Entities	Turnover (mil EUR)	Employment	
19.2	Manufacture of refined petroleum products		35	12 510	3 561
20.5	Manufacture of other chemical products		168	394	1 458
27.2	Manufacture of batteries and accumulators		13	177	638
29.1	Manufacture of motor vehicles		14	7	414
35.1	Electric power generation, transmission and distribution		6 369	18 114	31 295
38.1	Waste collection		440	264	3 083
38.2	Waste treatment and disposal		103	153	1 872
38.3	Materials recovery		203	262	1 969
45.1	Sale of motor vehicles		2 494	3 494	11 593
45.2	Maintenance and repair of motor vehicles		14 640	946	32 296
45.4	Sale, maintenance and repair of motorcycles and related parts and accessories		2 487	410	5 312
46.7	Other specialised wholesale		12 926	15 334	42 075
47.3	Retail sale of automotive fuel in specialised stores		4 981	6 244	17 197
49.1	Passenger rail transport, interurban		9	262	943
49.2	Freight rail transport		5	12	33
49.3	Other passenger land transport		35 052	1 464	70 882
49.4	Freight transport by road and removal services		17 083	2 315	36 493
50.1	Sea and coastal passenger water transport		1 411	1 224	8 776
50.2	Sea and coastal freight water transport		567	775	7 851
72.1	Research and experimental development on natural sciences and engineering		4 200	305	10 887

Production: Goods and Services

Mining of non-ferrous metal ores

- Neodymium and praseodymium for EV / hybrid cars but not batteries

Manufacture of batteries and accumulators

- Sunlight has 95% of the sector's turnover

Recycling of batteries

- 4 alternative management systems; collecting but not recycling lithium

Production and trade of electricity

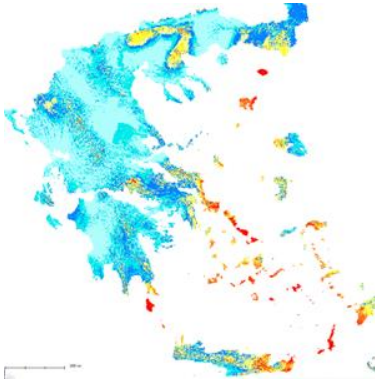
- An ailing incumbent, 3 major business groups, plenty of small actors
- Electricity price is 65.5 €/MWh (vs 43.3 €/MWh in EU)

eMobility

- 2018: 88 EVs sold
- 2019: 250 EVs sold
- 2025: 72k (LeasePlan) vs 20-24k (revised NECP)
- 2030: 66-82k by (revised NECP)

The territorial dimension of RES electricity production

Source: Regulatory Authority for Energy



Wind potential at h100



Wind Parks



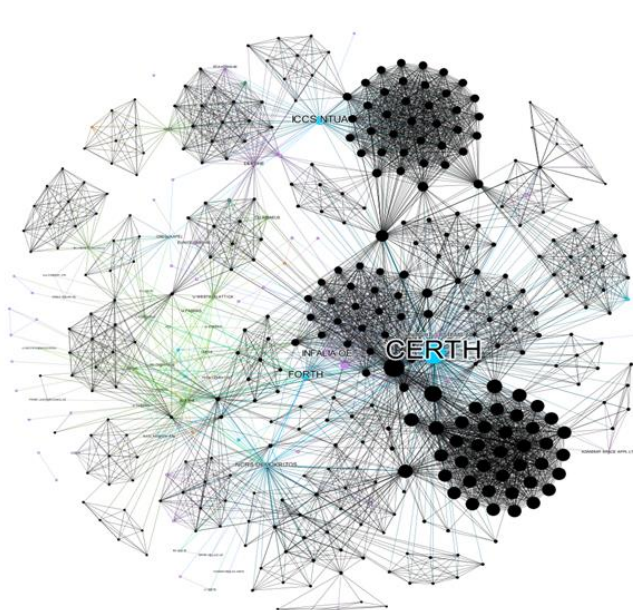
Small Hydro Plants



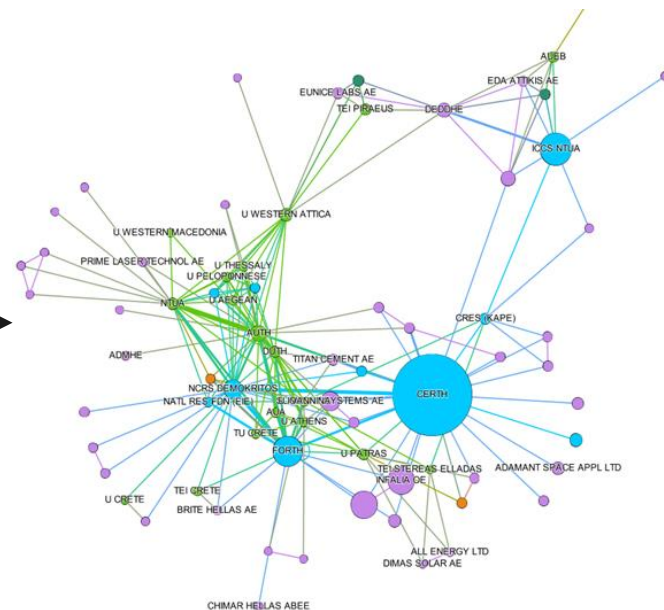
PV installations > 1 MWp

Production: R&D

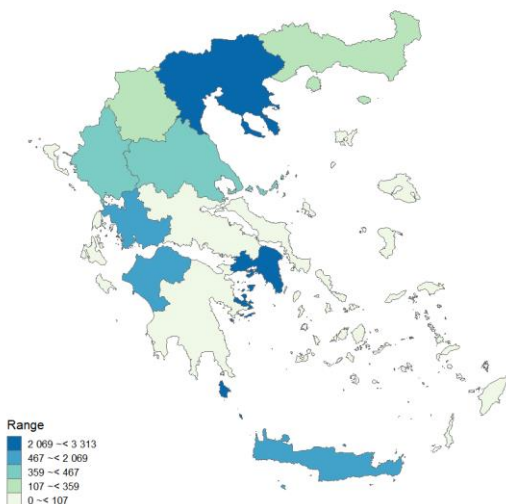
CERTH most active & networked research actor;
HEIs have less dominant role;
No energy firms in R&D;
Two distinct groups of firms performing R&D (GR- & EU-
only, only 2 participating in both)



Greek
only



Knowledge production is highly localised

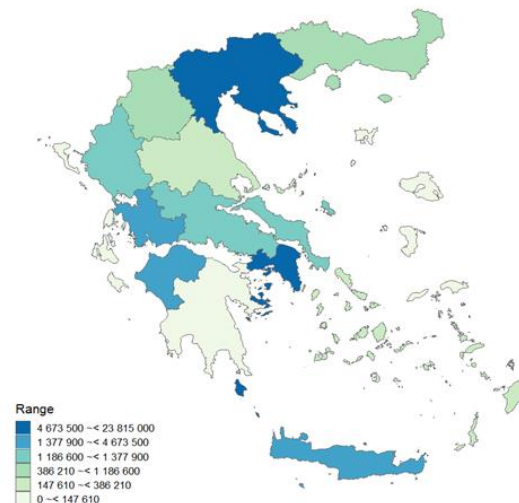


Data Source: Sachini et al. (2018)

Tier 1:
Attica (EL30)
Central Macedonia (EL51)

Tier 2:
Crete (EL43)
Western Greece (EL63)

Budget Distribution per Region
All sectors of performance



Data Source: GSRT and NDC

Highly-cited publications in relevant fields

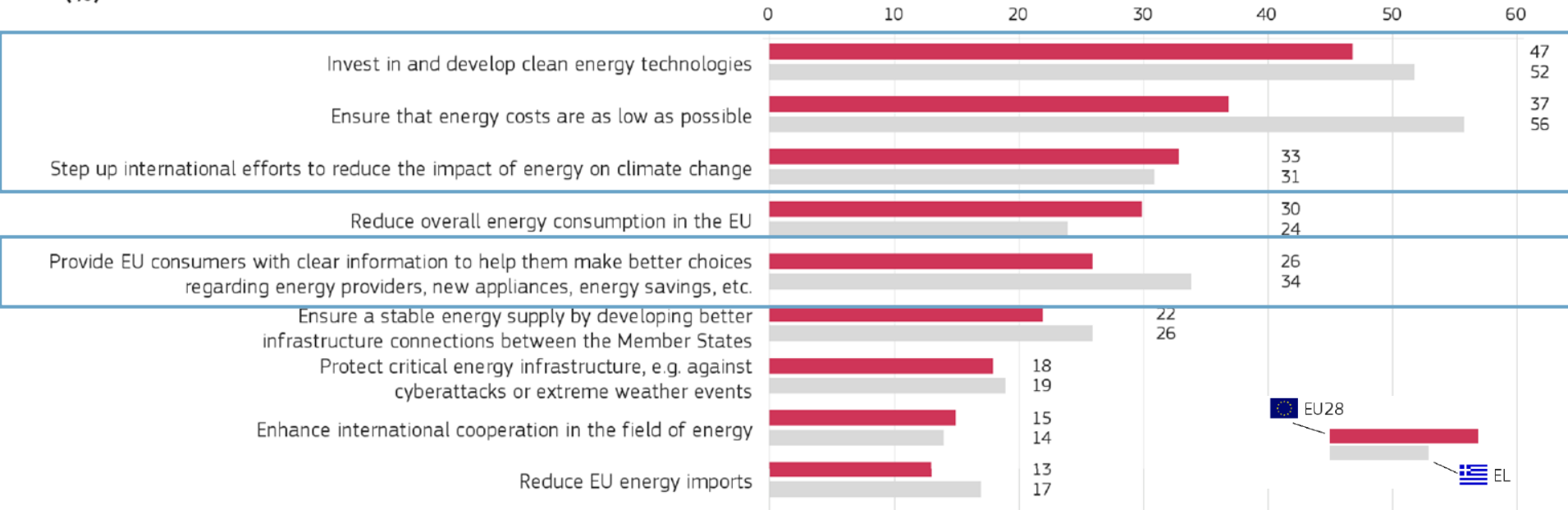
Data: GSRT & Natl Documentation Centre

Budgets of H2020 and GR projects in relevant fields

Consumption

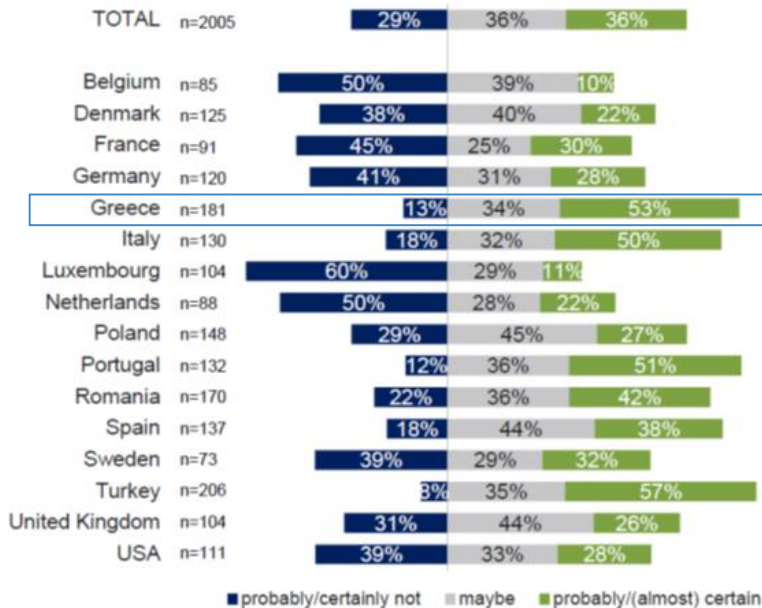
Consumer perceptions: RES (Eurobarometer 492)

QB9 In your opinion, which of the following energy issues should the European Union tackle as a priority over the next 10 years? (MAX. 3 ANSWERS)
(%)



Consumer perceptions: Battery Electric Vehicles

Intention to buy an electric car



53% consider buying or leasing an EV within 5 yrs;

Lower running cost and reduced CO2 emissions are key influencing factors;

Cost of purchase and limited availability of public charging spaces are key barriers;

Policy Implications:

- Remove price barriers
- Support the development of public charging places

SWOT Analysis

STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
<p>NECP has high ambitions</p> <p>Ministry of Investments coordinates EU Structural Funds and consults widely within government</p> <p>RIS3, though the EDP, also involved thematic ministries in agriculture, energy, transport</p> <p>Pockets of visionary intellectual leadership in academia</p> <p>Min. of Energy and Environment: E-mobility plan (April 2020)</p> <p>Creation of new 'Digital ministry' may spur interdepartmental coordination.</p>	<p>Policy investments in energy and transport do not follow an industrial development logic: rather spasmodic responses to chronic and pervasive underprovision of public infrastructure</p> <p>No clear overall framework for coordination for the range of portfolios and instruments impinging on industrial policy</p> <p>Electric mobility plan is not holistic and still not in place. Electric vehicle projections part of NECP is underestimated by orders of magnitude.</p> <p>Associations/federations of industry players have little institutional capacity to influence policy</p> <p>Inability to scale up successful innovative (RES) projects</p> <p>Resistance, frustration and disastrous delay of the transition by powerful energy system incumbents</p> <p>Need for ministries to take responsibility might go against cooperation</p> <p>Ministry of Defense can play a role in spurring adoption, but is poorly connected to other ministries</p>	<p>EU funding can also provide long-term financing and orientation, as part of future RIS3</p> <p>City councils can play a leading role in orchestrating the electrification of mobility, motivated by improvements in air quality, noise levels and human health, and opportunities electrification offers for urban regeneration</p> <p>Especially on the islands there are some successful experiences with demonstrator experiments; pilot findings might be exportable to other non-interconnected islands</p>	<p>Other players (countries / firms) might respond quicker to market opportunities, set the direction and reap the benefits</p> <p>Greek investments in electricity and EV infrastructure might be incompatible with global direction of electrification of mobility</p>

Orientation and Planning

STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
<p><u>Finance:</u> ESIF and other (structural) funds, part of which are earmarked for sustainability</p> <p>Renewables investments by Hellenic Petroleum (and other big players in the fossil fuels sector)</p> <p>Increasing trend on R&D investments, esp. BERD</p> <p><u>Human resources:</u> High-quality tertiary graduates ICT skills? Vocational needs programme?</p> <p>Resource Mobilisation</p>	<p><u>Finance:</u> Many barriers to private investment: cost of capital, regulation, rule of law.</p> <p>Historical difficulties in attracting FDI</p> <p>Need to service excessively high external debt constrain public investments</p> <p>Public transport corporations financially constrained</p> <p>Low share of energy in R&D and innovation budgets; incongruency between demand and public research spending</p> <p><u>Human resources:</u> Chronic misalignment of education system with market needs</p> <p>Weak and out of date vocational skills; system for training is underperforming</p> <p>In-firm training is lacking</p>	<p>International abundance of capital ready to be invested</p> <p>Low interest rates across EU</p> <p>Equifund (equity funding for knowledge-intensive businesses)</p> <p>New EU financial instruments (e.g. from EIB)</p> <p>Leveraging private investments by utilising EU funding in effective policy schemes</p> <p>Strong focus on cutting barriers to FDI by current government</p> <p>EU promotion of public procurement of innovation is gaining attention, e.g. via Digital innovation Hub of Ministry of Investment</p>	<p>All other EU countries are looking for finance as well; investors will be picky</p>

STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
<p>Local presence of rare raw materials useful for magnets and EV production</p> <p>Strong science base in electrical and environmental engineering</p> <p>Battery recycling policies & systems in place</p> <p>Presence of various local renewables companies</p> <p><i>Presence of substantial ICT sector</i></p> <p><i>Pockets of excellence in energy startups (smart grids, hydrogen)?</i></p> <p>Production</p>	<p>Battery industry dominated by single major player</p> <p>PRO & HEIs dominate research (and generate few startups); little involvement of major firms</p> <p>Mostly local recollection of batteries, recycling occurs elsewhere</p> <p>Energy production/trade market dominated by large incumbent (PPC), in dire financial situation; unclear role in sustainability transition</p> <p>Relatively high energy price hampers industrial activity</p> <p>Regulation: obstacles to innovation on energy distribution; regulatory instability hampers investment</p> <p>Lack of manufacturing base (and diverse capabilities): <i>linked to inability to sustain scale economies</i></p> <p><i>Business networks around batteries, RES and transport seem weak</i></p>	<p>Relatively high energy prices invite for local sustainable energy production</p> <p><i>Law on energy communities</i></p> <p><i>Potential for biomass-based electricity production and supporting rural communities</i></p> <p><i>Connecting major islands to national grid can create new capacity for RES (wind); the unconnected small islands can create autonomous local RES production facilities</i></p>	<p>Western Macedonia faces employment decline</p> <p>Energy security issues due to phasing out lignite</p> <p><i>Businesses leaving the region (country) might drive entire value chains into collapse</i></p> <p><i>Loss of domestic energy production capabilities (and associated energy ecosystem) as a result of possible failure of PPC</i></p> <p><i>Greek knowledge production system is unable to follow/apply developments at the European level</i></p>

STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
<p>Recent surge in positive attitude towards electric driving; relatively high willingness to buy or lease EV (>50%)</p> <p><i>Consumer familiarity with solar energy due to widespread and early adoption of solar hot water</i></p>	<p>EV adoption hampered by worries about purchase price, infrastructure (charging facilities) and range anxiety</p> <p>Protests against wind power energy projects</p> <p>Little public appetite for sustainable energy (incl. NIBMY for local RES); affordability is the major issue</p> <p>Large average age of cars (low replacement rate) hampers adoption of EV</p>	<p><i>Potential for EV usage in (public) niches like ambulances, military, universities</i></p> <p><i>Increasingly also tourists with EVs ask for charging facilities; this might break catch22-situation</i></p> <p><i>Fleet shortages and lack of maintenance (= investment shortage in existing system) in public transport, provides window for leapfrogging directly to electric alternatives</i></p> <p><i>Islands (globally) as archetypical niches in terms of infrastructure, demands, culture (local communities)</i></p> <p><i>Demands for EV mobility range are limited</i></p>	<p>EV price parity foreseen for 2025 is contested as long as EV use lithium-ion batteries</p>

Consumption

The way forward

Main directions for the transition

Headline targets: 35% RES in gross final consumption, 19% RES in transport, economic resilience

Niches / Diffusion opportunities

Public procurement of energy efficient transport

Local RES-EV experiments

Consumption (application areas)

Public transport

Private EV ownership

Energy Communities (esp. in islands)

RES-powered agriculture

Distribution infrastructure

Updated transmission & distribution networks

EV charging infrastructure

Recollection & recycling of Li-Ion batteries

Smart Grid

Production capabilities

Biomass producers (in mining areas?)

Suppliers of EV components?

Battery producers (mainly Sunlight)

Local RES supply: firms, communities

Knowledge development

Mainly PRO's: → startups?

Planning & Resource mobilization

Coordination for substantial and long-term financial commitment for coherent investments

Catalysing the transition

Legislation needs to be adapted for decentralised renewable energy production & consumption.

Regulatory sandboxes? Maintain **stability of policies and enforcement**

Presence of suitable **infrastructure** itself, like network and charging points

Demand-side management, via smart meters, city-level standards (Euro-4), EV parking facilities, etc

Energy communities: preference for small projects owned by small communities, best case for Greek mentality

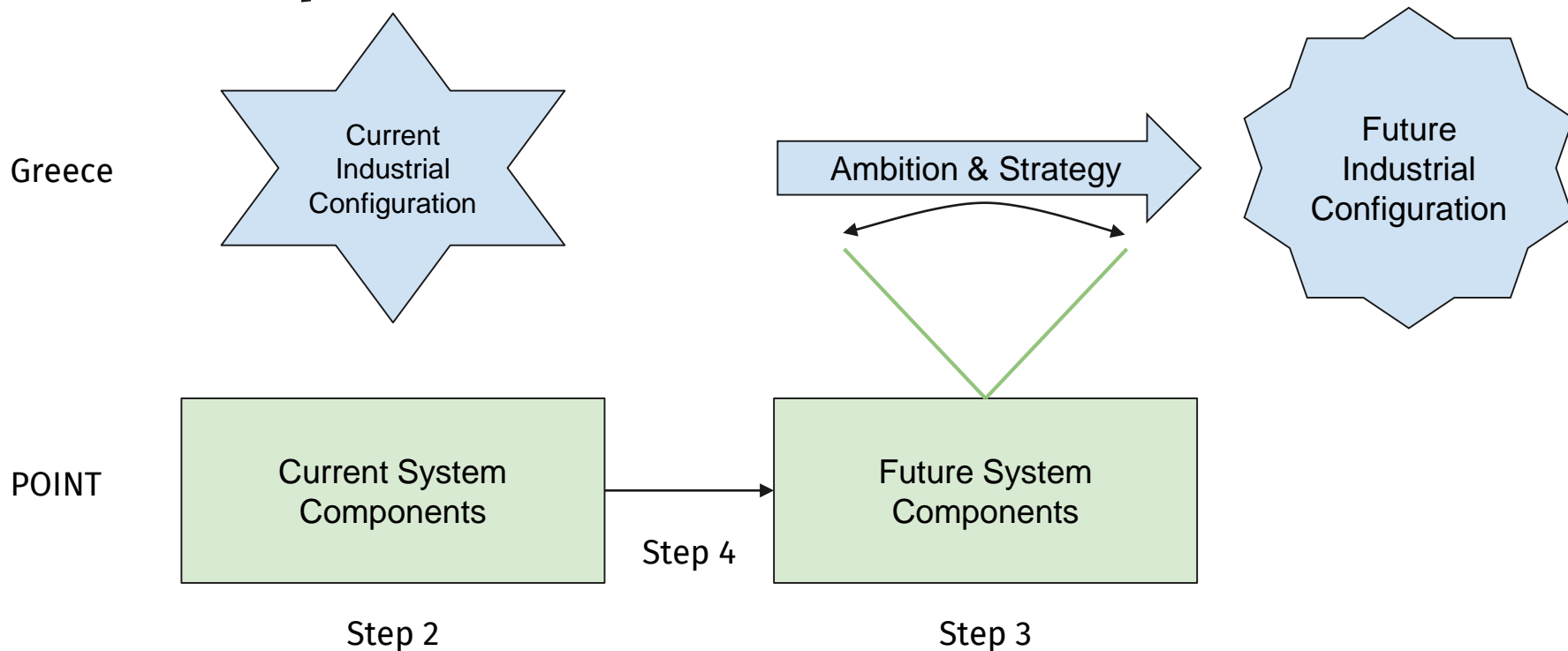
Public procurement of innovation: requires mostly capabilities, not money

Public **acceptance** of RES

Public-private collaboration; joint investments in deploying technologies

Knowledge transfer: “Great research, no patents / businesses”.

Next steps



The POINT Greece Team



Matthijs Janssen

Utrecht University

Utrecht, NL

M.J.Janssen@uu.nl



Yannis Tolias

Innovatia Systems

Thessaloniki, GR

tolias@innovatiasystems.eu