POINT Review Greece: RES, Batteries & Applications
Preliminary Findings

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Brussels, 9 December 2019
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 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
What are we looking at?
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)
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
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, entreprises, 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

Today

1-2 years

Tactics

2-5 years

Strategy

5-10 years

Vision

System-level evolution

Less

35% of RES in gross final consumption (excl. cooling)

19% of RES in final consumption for transport

>0% of rGDP change in Greek Coal Regions vs today

Data, Evidence and Certainty

More

Electric vehicles penetrate market

Investment in RES and storage

Legislative reforms

Lignite phase-out

New battery technologies
Headline targets and transition endpoints

Future production-consumption system

- Transport sectors
- Batteries
- Renewables

Headline targets:
- 35% RES in gross final consumption
- 19% RES in final consumption in transport
- >0% GDP change in coal regions

Transition endpoints:
Economic diversification based on battery technology and ICT
Improved energy supply for the islands

Transition starting points:
Emerging technologies and user preferences regarding mobility, vehicle ownership

Need to recover from economic crisis
EU policy for sustainability as a competitive advantage

Policy
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
### Relevant NACEv2 Codes

#### EL.STAT data for 2016

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

Data: GSRT & Natl Documentation Centre
Knowledge production is highly localised

Highly-cited publications in relevant fields

Budgets of H2020 and GR projects in relevant fields

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

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

- Invest in and develop clean energy technologies: 47 (52)
- Ensure that energy costs are as low as possible: 37 (56)
- Step up international efforts to reduce the impact of energy on climate change: 33 (31)
- Reduce overall energy consumption in the EU: 30 (24)
- Provide EU consumers with clear information to help them make better choices regarding energy providers, new appliances, energy savings, etc.: 26 (34)
- Ensure a stable energy supply by developing better infrastructure connections between the Member States: 22 (26)
- Protect critical energy infrastructure, e.g. against cyberattacks or extreme weather events: 18 (19)
- Enhance international cooperation in the field of energy: 15 (14)
- Reduce EU energy imports: 13 (17)
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

Source: LeasePlan Mobility Monitor 2019
SWOT Analysis
<table>
<thead>
<tr>
<th>STRENGTHS</th>
<th>WEAKNESSES</th>
<th>OPPORTUNITIES</th>
<th>THREATS</th>
</tr>
</thead>
<tbody>
<tr>
<td>NECP has high ambitions</td>
<td>Policy investments in energy and transport do not follow an industrial development logic: rather spasmodic responses to chronic and pervasive underprovision of public infrastructure</td>
<td>EU funding can also provide long-term financing and orientation, as part of future RIS3</td>
<td>Other players (countries / firms) might respond quicker to market opportunities, set the direction and reap the benefits</td>
</tr>
<tr>
<td>Ministry of Investments coordinates EU Structural Funds and consults widely within government</td>
<td>No clear overall framework for coordination for the range of portfolios and instruments impinging on industrial policy</td>
<td>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</td>
<td>Greek investments in electricity and EV infrastructure might be incompatible with global direction of electrification of mobility</td>
</tr>
<tr>
<td>RIS3, though the EDP, also involved thematic ministries in agriculture, energy, transport</td>
<td>Electric mobility plan is not holistic and still not in place. Electric vehicle projections part of NECP is underestimated by orders of magnitude.</td>
<td>Especially on the islands there are some successful experiences with demonstrator experiments; pilot findings might be exportable to other non-interconnected islands</td>
<td></td>
</tr>
<tr>
<td>Pockets of visionary intellectual leadership in academia</td>
<td>Associations/federations of industry players have little institutional capacity to influence policy</td>
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<td></td>
</tr>
<tr>
<td>Min. of Energy and Environment: E-mobility plan (April 2020)</td>
<td>Inability to scale up successful innovative (RES) projects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creation of new 'Digital ministry' may spur interdepartmental coordination.</td>
<td>Resistance, frustration and disastrous delay of the transition by powerful energy system incumbents</td>
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<td></td>
<td>Need for ministries to take responsibility might go against cooperation</td>
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<td></td>
<td>Ministry of Defense can play a role in spurring adoption, but is poorly connected to other ministries</td>
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**Orientation and Planning**
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<tr>
<td><strong>Finance:</strong> ESIF and other (structural) funds, part of which are earmarked for sustainability</td>
<td><strong>Finance:</strong> Many barriers to private investment: cost of capital, regulation, rule of law.</td>
<td>International abundance of capital ready to be invested</td>
<td>All other EU countries are looking for finance as well; investors will be picky</td>
</tr>
<tr>
<td>Renewables investments by Hellenic Petroleum (and other big players in the fossil fuels sector)</td>
<td>Historical difficulties in attracting FDI</td>
<td>Low interest rates across EU</td>
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</tr>
<tr>
<td>Increasing trend on R&amp;D investments, esp. BERD</td>
<td>Need to service excessively high external debt constrain public investments</td>
<td>Equifund (equity funding for knowledge-intensive businesses)</td>
<td></td>
</tr>
<tr>
<td><strong>Human resources:</strong> High-quality tertiary graduates ICT skills? Vocational needs programme?</td>
<td>Public transport corporations financially constrained</td>
<td>New EU financial instruments (e.g. from EIB)</td>
<td></td>
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<tr>
<td></td>
<td>Low share of energy in R&amp;D and innovation budgets; incongruency between demand and public research spending</td>
<td>Leveraging private investments by utilising EU funding in effective policy schemes</td>
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<td></td>
<td><strong>Human resources:</strong> Chronic misalignment of education system with market needs</td>
<td>Strong focus on cutting barriers to FDI by current government</td>
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<tr>
<td></td>
<td>Weak and out of date vocational skills; system for training is underperforming</td>
<td>EU promotion of public procurement of innovation is gaining attention, e.g. via Digital innovation Hub of Ministry of Investment</td>
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<td></td>
<td>In-firm training is lacking</td>
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**Resource Mobilisation**
<table>
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<td>Local presence of rare raw materials useful for magnets and EV production</td>
<td>Battery industry dominated by single major player</td>
<td>Relatively high energy prices invite for local sustainable energy production</td>
<td>Western Macedonia faces employment decline</td>
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<td>Strong science base in electrical and environmental engineering</td>
<td>PRO &amp; HEIs dominate research (and generate few startups); little involvement of major firms</td>
<td>Law on energy communities</td>
<td>Energy security issues due to phasing out lignite</td>
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<td>Battery recycling policies &amp; systems in place</td>
<td>Mostly local recollection of batteries, recycling occurs elsewhere</td>
<td>Potential for biomass-based electricity production and supporting rural communities</td>
<td>Businesses leaving the region (country) might drive entire value chains into collapse</td>
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<td>Presence of various local renewables companies</td>
<td>Energy production/trade market dominated by large incumbent (PPC), in dire financial situation; unclear role in sustainability transition</td>
<td>Connecting major islands to national grid can create new capacity for RES (wind); the unconnected small islands can create autonomous local RES production facilities</td>
<td>Loss of domestic energy production capabilities (and associated energy ecosystem) as a result of possible failure of PPC</td>
</tr>
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<td>Presence of substantial ICT sector</td>
<td>Relatively high energy price hampers industrial activity</td>
<td></td>
<td>Greek knowledge production system is unable to follow/apply developments at the European level</td>
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<td>Pockets of excellence in energy startups (smart grids, hydrogen)?</td>
<td>Regulation: obstacles to innovation on energy distribution; regulatory instability hampers investment</td>
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<td>Production</td>
<td>Lack of manufacturing base (and diverse capabilities): linked to inability to sustain scale economies</td>
<td></td>
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<td>Business networks around batteries, RES and transport seem weak</td>
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**Production**

- Local presence of rare raw materials useful for magnets and EV production
- Strong science base in electrical and environmental engineering
- Battery recycling policies & systems in place
- Presence of various local renewables companies
- Presence of substantial ICT sector
- Pockets of excellence in energy startups (smart grids, hydrogen)?

**Weaknesses**

- Battery industry dominated by single major player
- PRO & HEIs dominate research (and generate few startups); little involvement of major firms
- Mostly local recollection of batteries, recycling occurs elsewhere
- Energy production/trade market dominated by large incumbent (PPC), in dire financial situation; unclear role in sustainability transition
- Relatively high energy price hampers industrial activity
- Regulation: obstacles to innovation on energy distribution; regulatory instability hampers investment
- Lack of manufacturing base (and diverse capabilities): linked to inability to sustain scale economies
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**Opportunities**

- Relatively high energy prices invite for local sustainable energy production
- Law on energy communities
- Potential for biomass-based electricity production and supporting rural communities
- Connecting major islands to national grid can create new capacity for RES (wind); the unconnected small islands can create autonomous local RES production facilities

**Threats**

- Western Macedonia faces employment decline
- Energy security issues due to phasing out lignite
- Businesses leaving the region (country) might drive entire value chains into collapse
- Loss of domestic energy production capabilities (and associated energy ecosystem) as a result of possible failure of PPC
- Greek knowledge production system is unable to follow/apply developments at the European level
### STRENGTHS
- Recent surge in positive attitude towards electric driving; relatively high willingness to buy or lease EV (>50%)
- Consumer familiarity with solar energy due to widespread and early adoption of solar hot water

### WEAKNESSES
- EV adoption hampered by worries about purchase price, infrastructure (charging facilities) and range anxiety
- Protests against wind power energy projects
- Little public appetite for sustainable energy (incl. NIBMY for local RES); affordability is the major issue
- Large average age of cars (low replacement rate) hampers adoption of EV

### OPPORTUNITIES
- Potential for EV usage in (public) niches like ambulances, military, universities
- Increasingly also tourists with EVs ask for charging facilities; this might break catch22-situation
- Fleet shortages and lack of maintenance (= investment shortage in existing system) in public transport, provides window for leapfrogging directly to electric alternatives
- Islands (globally) as archetypical niches in terms of infrastructure, demands, culture (local communities)
- Demands for EV mobility range are limited

### THREATS
- EV price parity foreseen for 2025 is contested as long as EV use lithium-ion batteries
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

Greece

Current Industrial Configuration

Future Industrial Configuration

POINT

Current System Components

Future System Components

Ambition & Strategy

Step 2

Step 3

Step 4
The POINT Greece Team

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