Re-vitalizing Energy Transition
in Touristic Islands

ISLANDS
THE ACTUAL ENERGY CONTEXT

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Unit 2

Description

Analysis of the actual energy context in the islands and the role of sustainable energy technologies to achieve an energy transition and secure the future of islands.

This unit includes presentation of two energy scenarios, from the citizens perspective and actions: Business As Usual (BAU) and Sustainable Energy Transition (SET).

The first scenario will be used as a reference, and it will represent the continuation of actual energy policies and their impact on the future of islands.

The second scenario represents the implementation of energy transition strategies and their impact in the future of the islands. The role of the scenarios in the environment and sustainability, from the side of the citizens and tourists

CASE STUDY 1: Case studies for BAU and SET and their impact to islands from the citizens actions

Unit 2 - Introduction

Learning Outcomes

To analyse the current national energy context of the islands and the attendees, and to understand the role of energy transition in the future of islands.

Business-as-usual (BAU)

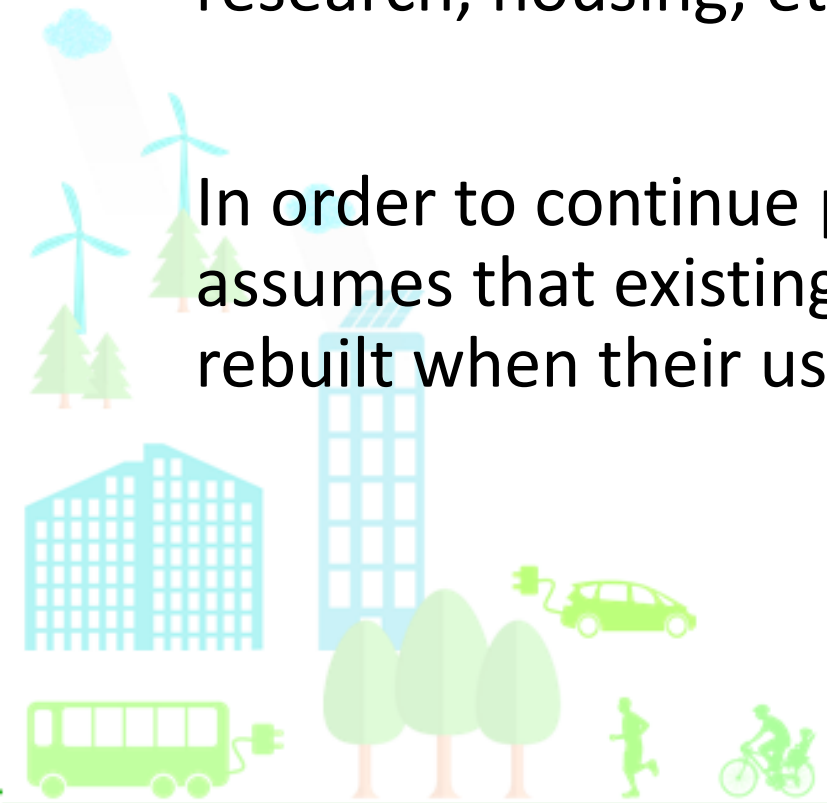
One important modelling idea that a planning team utilize to create solutions, Portfolios, and Strategies in any energy related plan is the Business-as-usual Forecast (BAU).

If the present island energy system, transport, and associated business processes continued on their current paths, the BAU develops a base-case scenario that predicts what would happen.

Business-as-usual (BAU)

Since in general, island energy needs are anticipated to continue growing until 2050, the BAU can establish the baseline growth prediction and the mix of programmatic building types (such as research, housing, etc.).

In order to continue providing dependable energy services, the BAU assumes that existing systems and equipment will be replaced or rebuilt when their useful lifetimes are coming to an end.

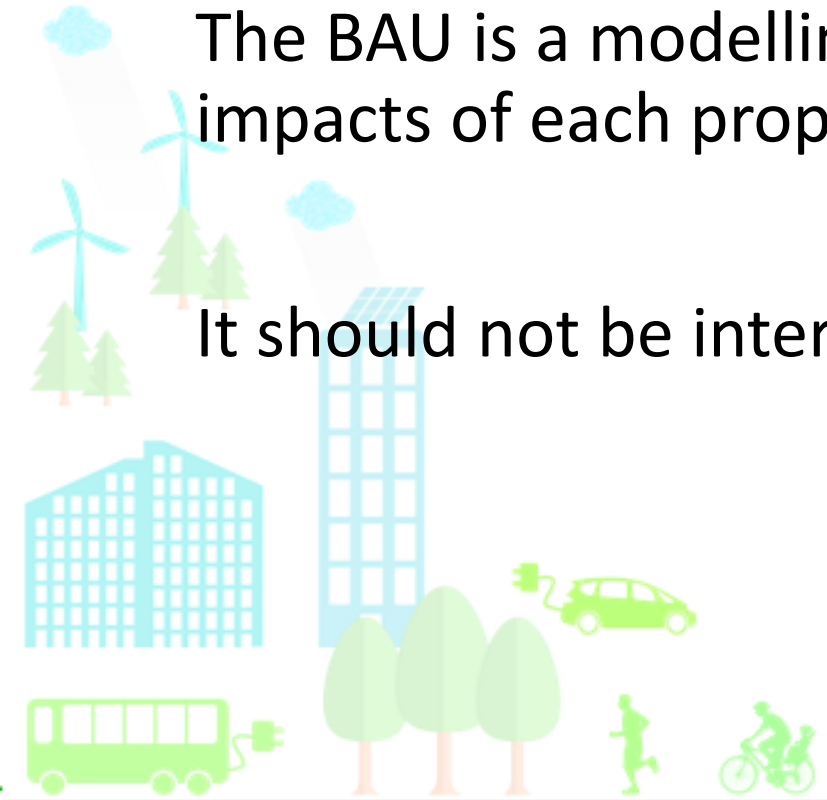


Business-as-usual (BAU)

A commodity price prediction for bought electricity, natural gas, and other energy-related commodities is also established by the BAU.

The BAU is a modelling tool that helps understand the potential impacts of each proposed solution and portfolio of solutions;

It should not be interpreted as a forecast.

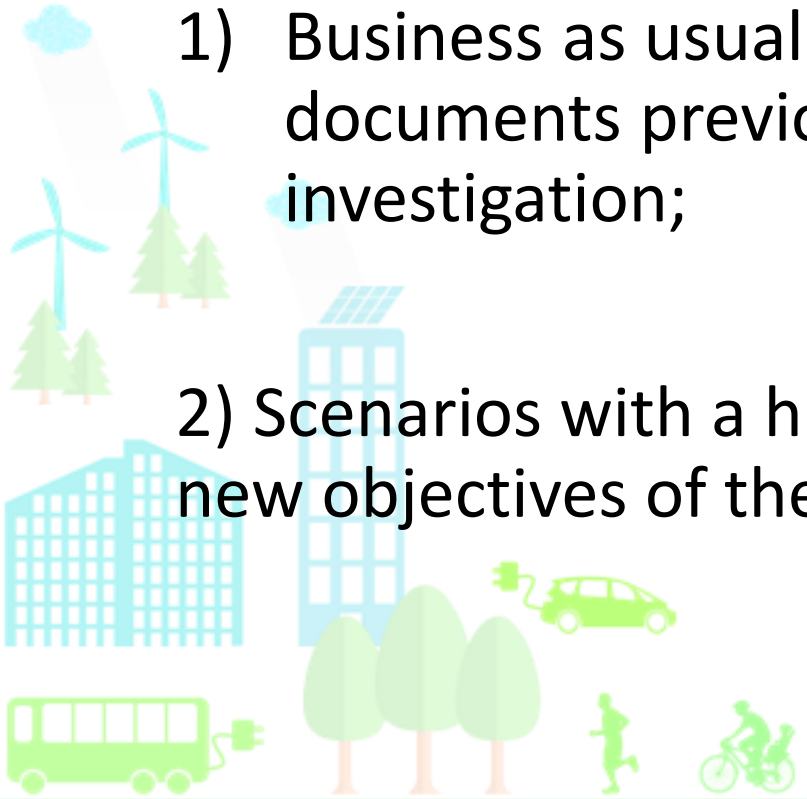


Business-as-usual (BAU)

The potential directions for the energy system's evolution are examined using a scenario technique. The following are the main scenarios:

1) Business as usual (BAU) scenario, in accordance with the strategic documents previously established for the region under investigation;

2) Scenarios with a high level of RES integration in order to meet the new objectives of the EU energy and climate framework.



Future scenarios - Sardinia

The BAU scenario was developed to address the guidelines of the Energy and Environmental Plan of the Sardinia Region, indicating several energy measures for the reduction of CO2 emissions of 50% by 2030 compared to the values estimated in 1990.

In the plan the following General Objectives (OGs) were identified:

- OG1. Transformation of the Sardinian energy system towards an integrated and intelligent configuration (Sardinian Smart Energy System);
- OG2. Energy security;
- OG3. Increased efficiency and energy savings;
- OG4. Promotion of research and active participation in the energy field. To address these OGs, the following technical strategies are implemented for each energy sector.

Technical strategies of the BUSINESS AS USUAL SCENARIO 2030.

Heating sector

1.Increase of 20% in the efficiency of buildings isolation;
2.Reduction in LPG, biomasses and oil fueled applications;

Electricity sector

1.Self-consumption of electricity production from household-installed RES;
2.Decommissioning of 876 MW of thermoelectric power plants running on coal and oil.

Transport sector

1.Reduction of diesel and petrol consumption;
2.Replacement 50% of petrol cars with Plug-in Hybrid Vehicles and Battery Electric Vehicles;
3.Conversion to methane of the fleet of hybrid LPG cars;
4.Encouraging the use of car-pooling, car sharing and public transport

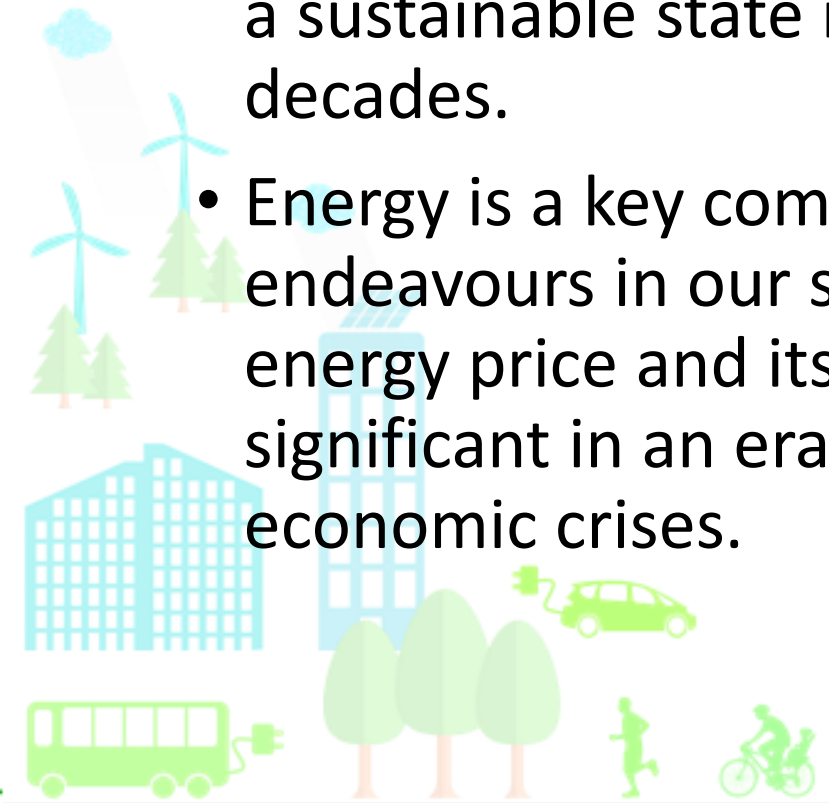
Adjusted from: F. Calise, N. Duic, A. Pfeifer, M. Vicidomini, A.M. Orlando, Moving the system boundaries in decarbonization of large islands, Energy Conversion and Management,
Volume 234, 2021, 113956, ISSN 0196-8904.

Business-as-usual (BAU)

- In the BAU scenario's estimated configuration, the Sardinian energy system's dispatchable unit installed capacity is 960 MW, while in 2017 it was 1836 MW.
- The end effect is a reduction of almost 14% in regional electricity consumption compared to the 2014 number. This indicates that by 2030, an annual consumption of 7.2 TW h is anticipated.
- Physical constraints could be loosened due to the immediate, flexible consumption of excess energy from RES, which would allow for a local increase in the share of RES and a direct profit for both the producer and the user. Additionally, transmission congestion would be reduced, which would lessen its effects on the regional electricity energy system.

Sustainable Energy Transition

- For very small islands, switching to sustainable energy systems is a major obstacle.
- Indeed, achieving energy independence and making the transition to a sustainable state must be the goal of these areas in the upcoming decades.
- Energy is a key component of many economic and development endeavours in our society. Strong fluctuations in the short-term energy price and its long-term predictable growth have become more significant in an era of rarefaction of fossil resources and recurrent economic crises.



Small Island Developing States

- There are 57 SIDS included in the (United Nations Department of Economic and Social Affairs) UN-DESA, distributed between the Caribbean, the Pacific and Africa, the Indian Ocean, the Mediterranean, and the South China Sea (37 UN members and 20 non-UN).
- Due to their remote location, small size (which restricts economies of scale), and high susceptibility to the effects of climate change (such as rising water levels), these territories are unique.
- The islands have created some ambitious energy policy frameworks to transition to renewable energy throughout the past 20 years.

- It is emphasised how urgent it is to take efforts in order to increase small islands' resilience.

- Islands provide the chance to look forward and offer guidance for a sustainable solution to the issues that all regions that will have to deal with climate change must deal with.

- Because of their geographic location, the majority of these territories are not connected to any continental electrical network.
  - As a result, a number of natural or economic factors make their geographic environment (region, location) extremely vulnerable. an early research was conducted that examined the susceptibility of such isolated regions by classifying islands and determining their level of vulnerability using an economic index.

- Volatility in oil prices has a major negative impact on the production of electricity, which is mostly dependent on fossil fuels.

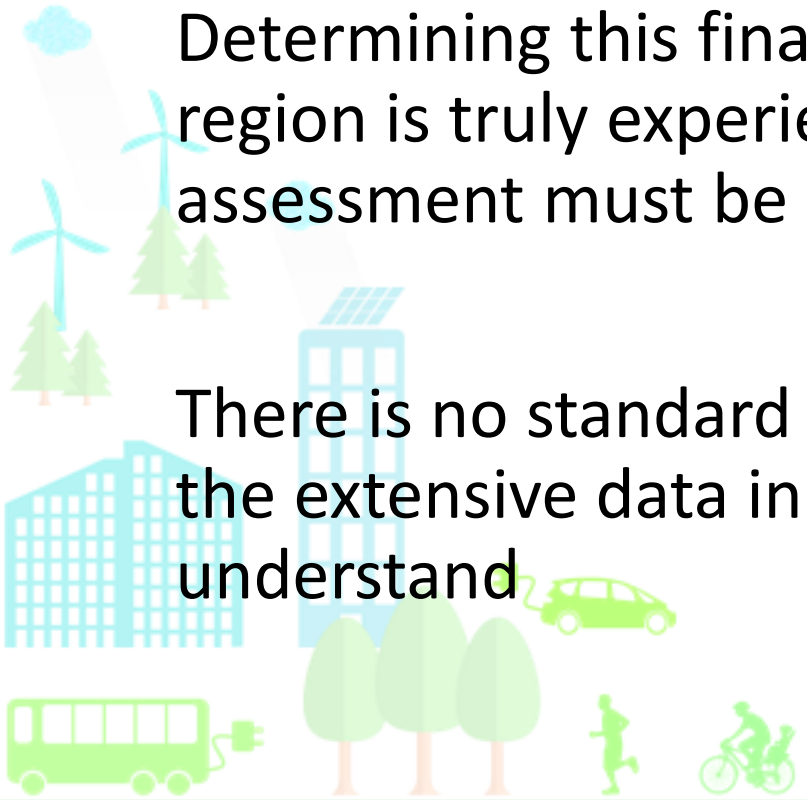
The significance of expanding access to sustainable energy-based manufacturing was reaffirmed by the UN in 2012.

- In fact, these areas are in a vulnerable position because of their very low energy use. Public health services, education, and economic activities are all made possible by electricity.
  - Therefore, minimal environmental impact, economic viability, and social acceptability are the three main facets of the islands' sustainable development.

At the moment, sustainability assessment and sustainable development are tightly related.

Determining this final step is very difficult. To determine whether a region is truly experiencing an energy transition, a sustainability assessment must be carried out.

There is no standard definition for an index. The many perspectives on the extensive data in sustainability indicators make this simple to understand



Recent research has emphasized how crucial it is to comprehend the forces behind SIDS' energy transition from the perspective of developing strong energy policies in order to maximize the potential of renewable resources

To investigate and talk about a thorough analysis of small islands' sustainability from the perspective of renewable energy, a statistical technique is always used.

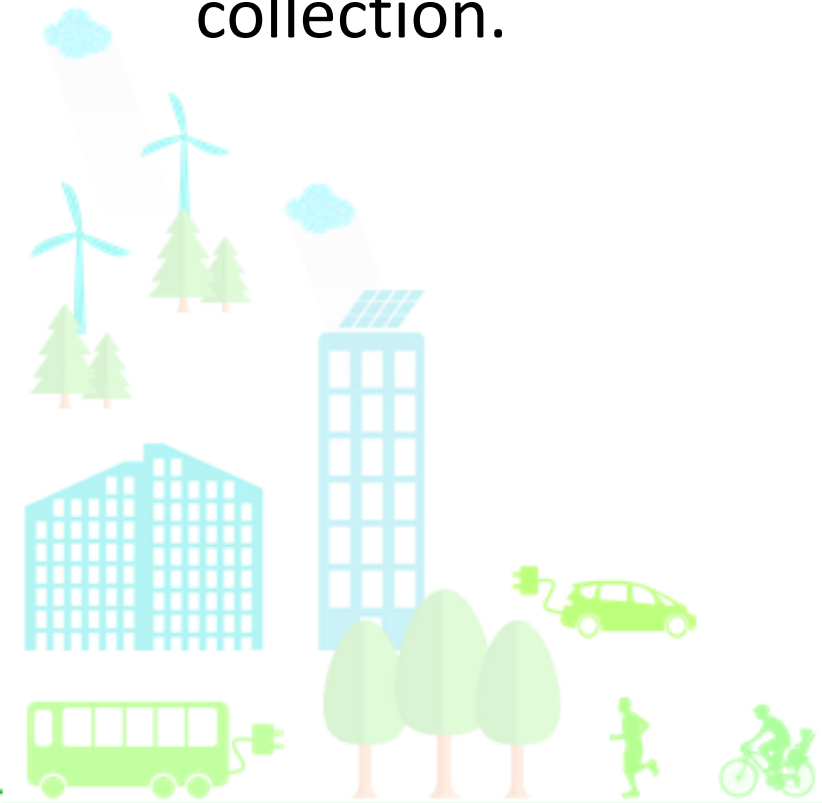
Finding out if such islands are heading in the direction of sustainability is the goal. To do this, three steps are required:

- To determine which explanatory factors significantly contribute to the percentage of data variation, a principal components analysis (PCA) is initially examined.
- Next, the island organization is highlighted in two distinct years using PCA-based hierarchical clustering. The PCA and categorization can be based on a panel of 35 SIDS or Small Islands Developing States.
- Establish a sustainability index (SI) primarily using factors that significantly impact the key components.

Hierarchical clustering analysis

- A popular multivariate statistical method for characterising a collection of quantitative data is principal component analysis (PCA).

This method is very intriguing for dimensionality reduction of a data collection.



Hierarchical clustering analysis

- On the primary elements of the factor analysis, hierarchical clustering has been carried out. One of the most used clustering algorithms, the K-means approach, forms the foundation of the partitioning technique.

- This method uses the cluster's centre of gravity as a representation. This technique's primary goal is to reduce the overall within-cluster variance. A solution is always reached by this iterative process

Hierarchical clustering analysis

- The economic dynamics of the regions and their reliance on fossil fuels alone are insufficient to comprehend the sustainability of the islands.

RES Technologies implementation

- Island states frequently rely on fossil fuels, which comes with a hefty transportation expense in addition to their reliance on outside supplies.

This provides an additional incentive to investigate the degree to which island states serve as the main sites for RES technology.

- As a result, long-term investments in RES may benefit the energy mix as a whole.

- This rapid expansion can occur without the addition of additional subsidies, but as the results highlight, the current socioeconomic impediments must be addressed through the strategic design of financial and economic tools as well as capacity building.

According to the United Nations (UN), sustainable development is the concurrent advancement of three interrelated objectives:

- environmental preservation
- social progress
- economic development

Because of the negative consequences of global climate change, island states are often more vulnerable than mainland locations in all three areas.

The majority of the population of many island states, which are low-lying coastal nations, lives along these shores and has little ability to adjust to climatic changes.

According to the Intergovernmental Panel on Climate Change (IPCC), the predicted effects of climate change and sea level rise under the business-as-usual scenario would have more detrimental effects on island states' human, social, and economic well-being than comparable mainland nations.

In terms of socioeconomic growth, these islands are not solely and immediately exposed to the threats posed by global economic trends due to their lack of adaptability capacity.

Island states also follow the general development trend that shows that per capita power consumption increases in direct proportion to GDP.

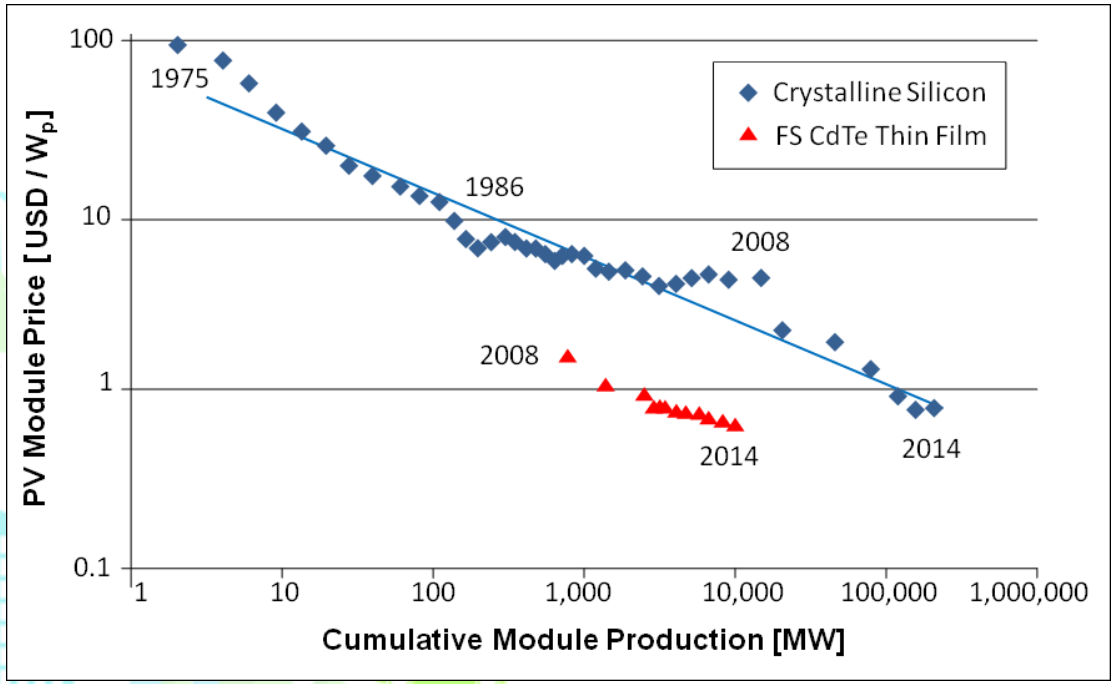
For island states, data in reliable time series isn't always accessible. As a result, only those nations whose at least fundamental energy-related data could be extracted from the sometimes inconsistent and fragmented data for islands were examined in this study.

The potential brought forth by the RES technologies' historic price reduction over the past 15 years are the main motivator for such studies.

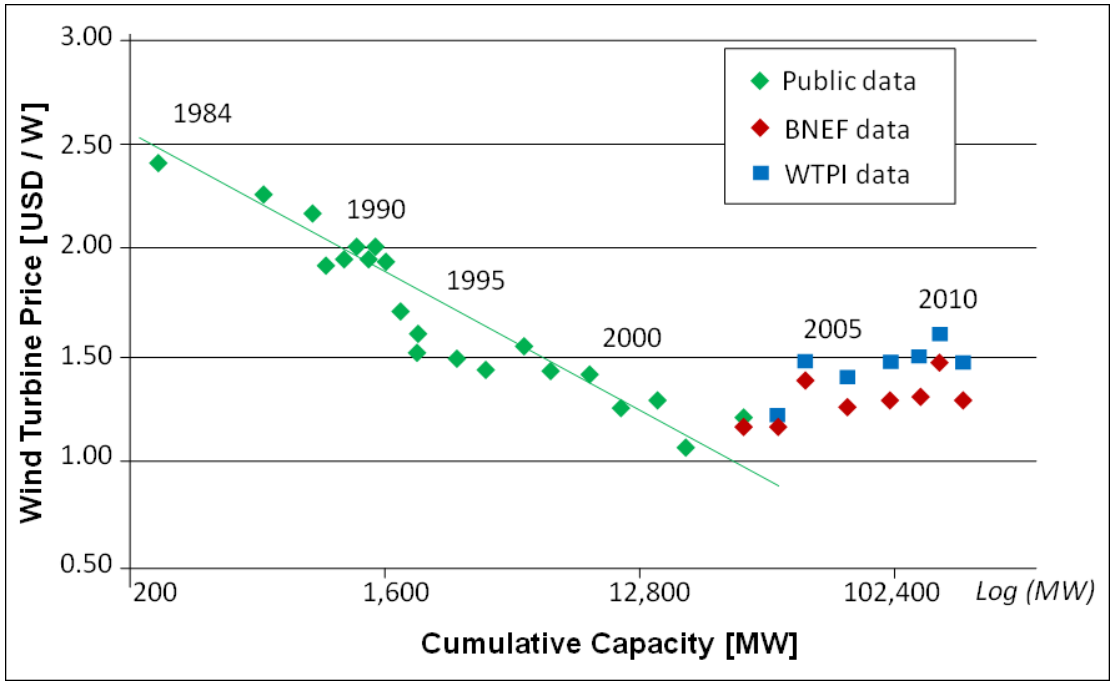
Once thought to be prohibitive, energy technologies have seen such a sharp decline in cost that they may now be the best option for the development of sustainable energy.

However, this change is not reflected in pipeline developments in island nations, where fuel producing units continue to play a major role in the energy master plans. Among RES technologies, PV has emerged as a viable choice for islands with steadily declining costs.

- Although their price has stabilised at a higher level, wind turbines, the second RES alternative, have also seen excellent price development (. Additionally, more localised information is needed for wind power siting.



Global PV module price



Global wind turbine price learning curve

Jäger-Waldau, A. PV Status Report 2014; Publications Office of the EU: Luxembourg, 2014.
Taylor, M. The Renewable Revolution: Wind Power Costs, Visual Presentation, November 2012.

- Although grid extension options represent more expensive electricity provision for locations far from the current power grids, there is mounting evidence in the literature that distributed generation options represent cost-optimal solutions for many rural areas in Sub-Saharan Africa. This may seem particularly true for island republics, which are much more removed from sources of fuel.
- The main concern with providing sustainable energy on islands is whether cost-effective renewable energy sources or the already prevalent fossil fuel power production technologies can provide the lowest-cost electricity for the users.
- These governments' economic fragility and reliance are demonstrated by the fact that, despite worldwide shifts away from oil for economic and environmental reasons, islands still rely heavily on it for the majority of their electrical production.

"Political Declaration on Clean Energy for EU Islands"

Beyond stultifying explanations that concentrate on the supply, economic, and environmental issues that arise in isolated energy systems, the "Political Declaration on Clean Energy for EU Islands" goes farther.

In doing so, it states that: "inhabited EU islands are often well placed to employ innovative solutions and attract energy investments that integrate local renewable production, storage facilities, and demand response in order to achieve interoperable, economical, environmentally friendly, and sustainable energy systems"

"Political Declaration on Clean Energy for EU Islands"

Specifically, there are several real-world examples that illustrate various transition routes and provide insight into the search for intelligent energy solutions on islands.

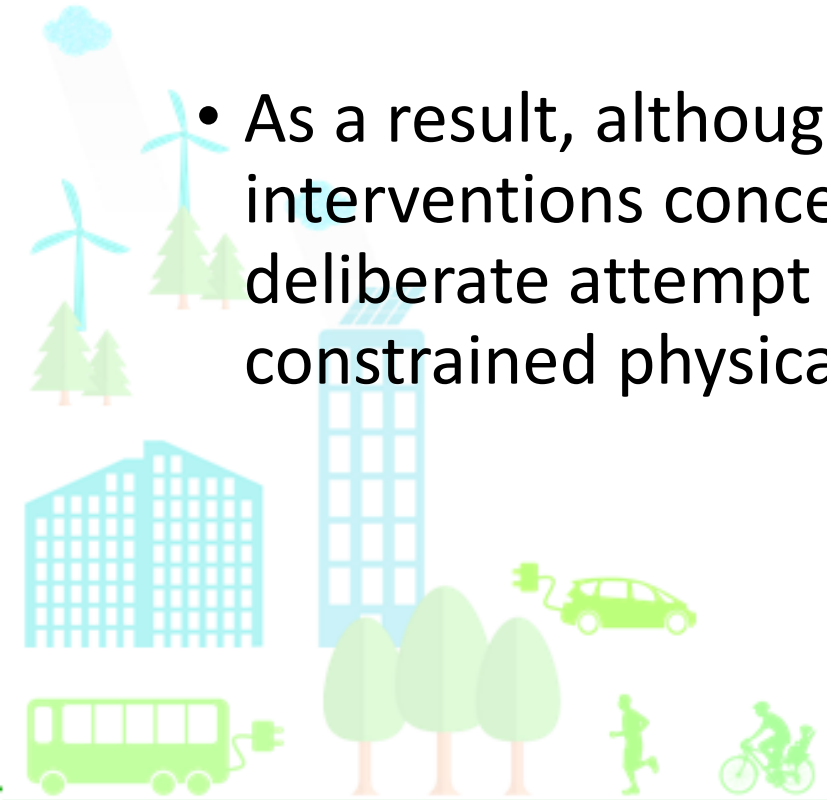
While centralised RES plant size has traditionally been the focus of study, creative and intelligent grid interventions are increasingly becoming more popular in distant island regions worldwide.

Small and large-scale modelling studies are mostly used to address the practical difficulties of such novel energy transitions. This intelligent energy shift inside isolated electrical systems has been facilitated by a variety of econometric, energy equilibrium, and optimisation analytical and modelling techniques.

IRENA

- The International Renewable Energy Agency (IRENA) claims that these advancements produce a model that may be applied to other remote settlements and, potentially, to other bigger systems.

- As a result, although the majority of the field's research and interventions concentrate on particular islands, there is also a deliberate attempt to exchange experiences outside of the constrained physical boundaries of current project locations.



The social dimensions of (island) energy Transitions

- "A favorable or positive response (including attitude, intention, behavior, and, where appropriate, use) relating to proposed or in situ technology or social-technical systems by members of a social unit (country or region, community or town, household or organisation)" is a necessary condition for the public acceptance of green energy solutions.

The social dimensions of (island) energy Transitions

It is made up of four main parts:

a) the general perception of important stakeholders and the political environment (i.e., political acceptance);

b) the public's perception of green energy solutions (i.e., social acceptability);

c) the actual acceptance of particular projects or site choices in the impacted communities (i.e., community acceptance);

d) the market acceptance of renewable power production by investors and consumers.

The social dimensions of (island) energy Transitions

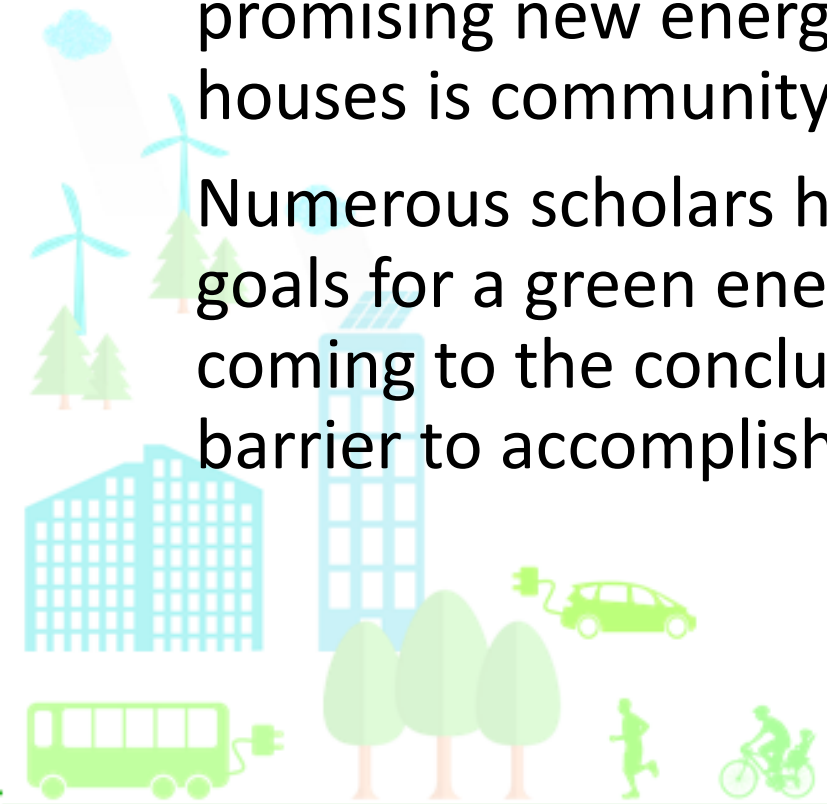
However, we do not currently view market and political acceptance as major limiting factors given the intricate financial and industrial arrangements that have developed around sustainable energy technologies and the importance of such innovations to the achievement of ambitious climate change and emissions targets at the international level.

The social dimensions of (island) energy Transitions

Innovative green energy technologies are necessary for islanders, but islanders are equally necessary for technology.

One of the biggest obstacles to the widespread adoption of otherwise promising new energy technology in many towns and/or individual houses is community resistance.

Numerous scholars have examined the discrepancy between national goals for a green energy transition and community acceptability, coming to the conclusion that societal criticism might operate as a barrier to accomplishing lofty goals.



The social dimensions of (island) energy Transitions

- Unfortunately, despite these encouraging advancements, research conducted throughout Europe has repeatedly shown an attitudinal paradox: a social divide between people who are directly impacted by developments' generally positive attitudes towards sustainable energy and their acceptance of particular energy-related infrastructures.

The social dimensions of (island) energy Transitions

Since attitudes towards particular projects and attitudes towards green energy in general are different attitude objects, it seems sensible that they would differ.

In the minds of community members, each carries a distinct set of associations: while people may think about environmental quality and energy security when considering green energy in general, they also think about specific localized impacts and are influenced by subjective norms and perceptions when such developments are actually proposed in or near their community.

The social dimensions of (island) energy Transitions

Social scientists have created a wide range of conceptual frameworks to describe public attitudes around energy transitions, given the crucial relevance of local public support for green energy infrastructures.

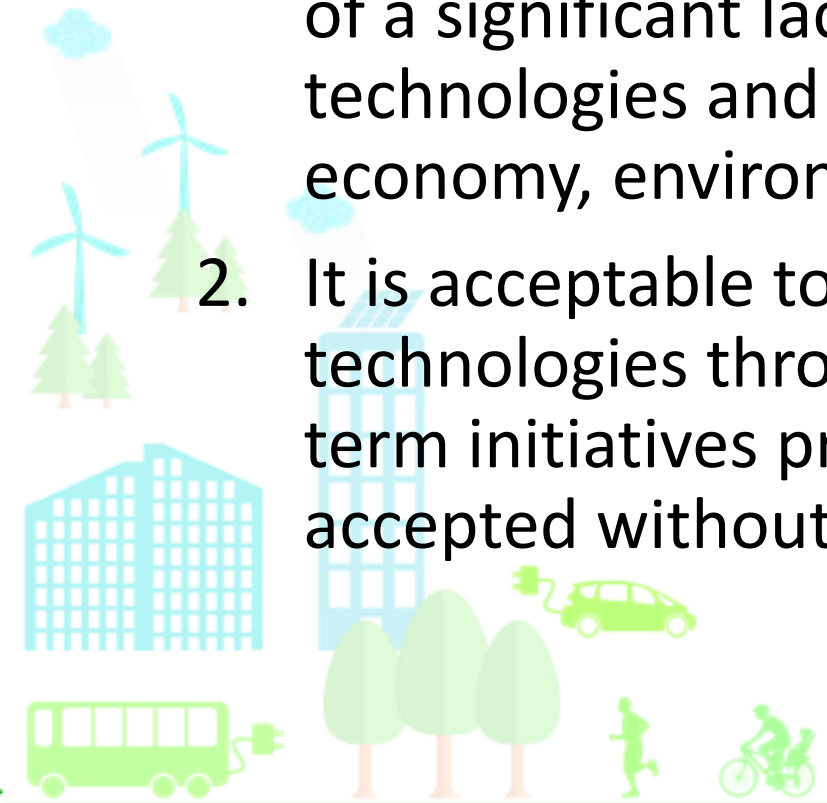
According to the "NIMBY" (Not in My Backyard) hypothesis, for example, people are prone to resist specific project proposals in their local region for particularistic and self-interested reasons, even while certain opinion polls indicate that people generally support RES initiatives.

They wish to take use of clean, carbon-neutral energy, but not in their own "backyards," where the plants are thought to be noisy, upset the surrounding area, and maybe even be harmful to the health of nearby residents.

The social dimensions of (island) energy Transitions

Some major issues seem to be preventing the public in Mediterranean countries from accepting green energy solutions.

1. Residents' resistance to new energy supply programs is a reflection of a significant lack of (available) knowledge on innovative energy technologies and their costs and advantages in terms of the economy, environment, and society.
2. It is acceptable to say that widespread adoption of these technologies throughout the Aegean does not mean that all long-term initiatives proposed by research collaborations will be accepted without reservation.



Concluding remark

Policymakers, project developers, and other stakeholders should prepare appropriately because not all members of the public are likely to embrace their ambitious transition plans.

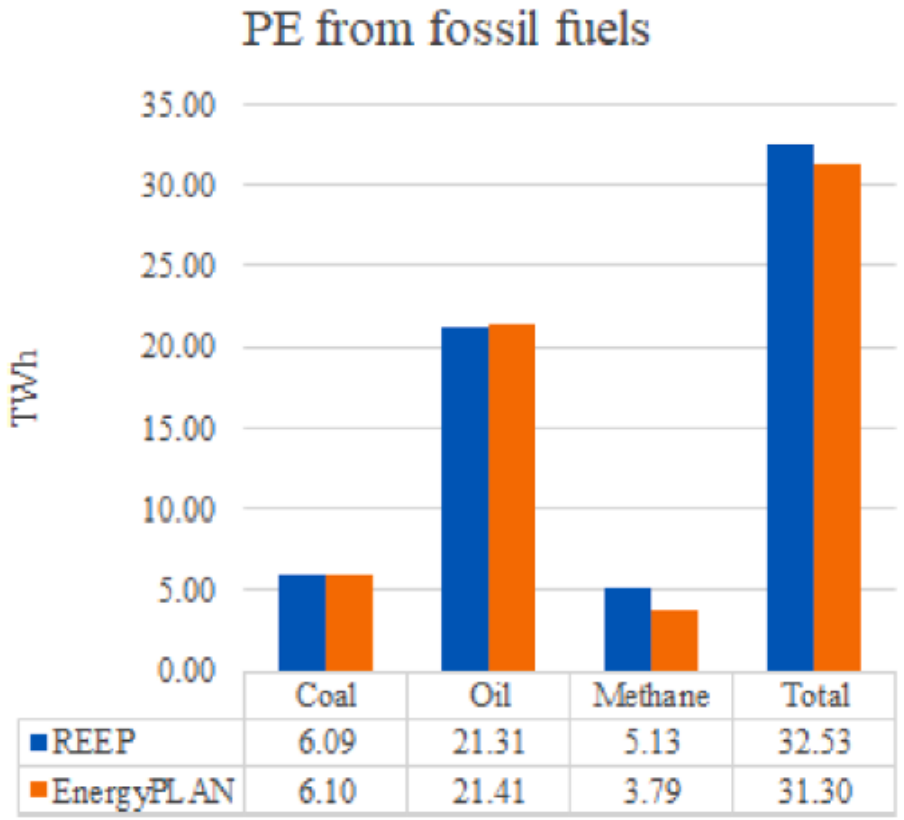
On the one hand, stakeholders are unable to alter the island demographics in order to boost support for sustainable technology.

However, understanding various energy-user profiles presents the chance for more specialized project development strategies, such as creating systems that only need the active participation of a small percentage of the community, placing installations in locations where there is little public opposition, focusing on the post-promising demographic segments, etc.

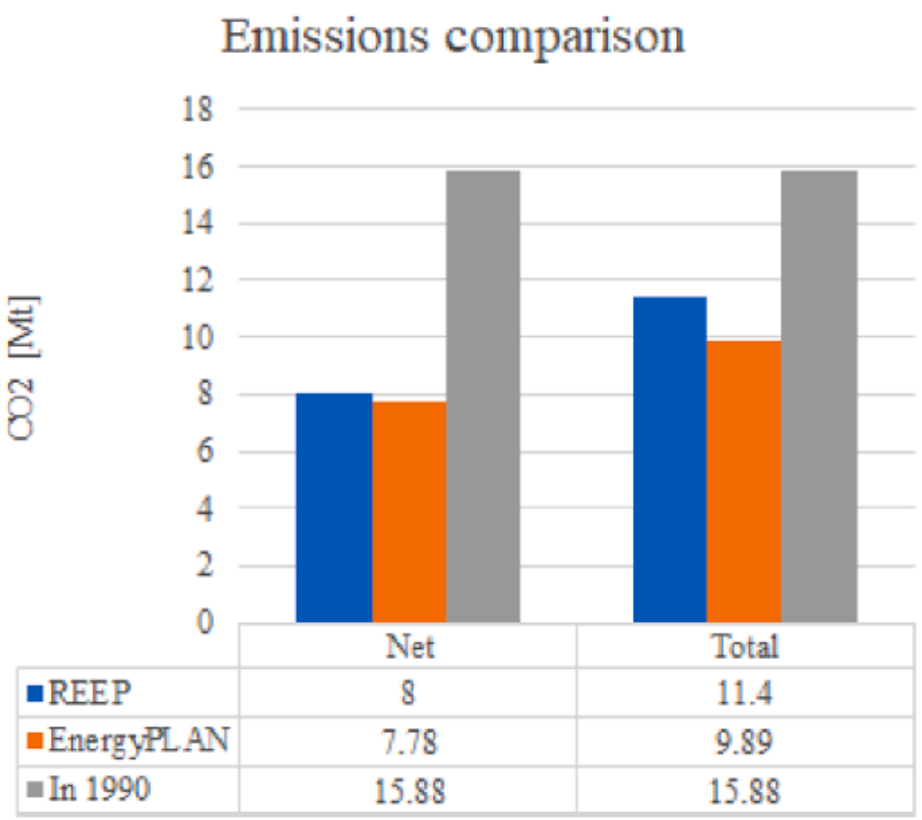
Future scenarios - Sardinia

- An apparent annual consumption of 6.1 TW h results from the application of the suggested flexible consumption hypothesis.
- Recommendations call for a 20% annual fuel reduction for diesel engines and a 50% reduction for petrol engines in the transportation sector.
- Additionally, using 400 GW to completely decommission LPG cars is being discussed.

Future scenarios - Sardinia



	Coal	Oil	Methane	Total
REEP	6.09	21.31	5.13	32.53
EnergyPLAN	6.10	21.41	3.79	31.30



	Net	Total
REEP	8	11.4
EnergyPLAN	7.78	9.89
In 1990	15.88	15.88

Primary energy consumption from fossil fuels, BAU model vs REEP forecast (left); total and net CO2 emissions comparison, BAU model vs Regional Energy and Environmental Plan forecast and vs 1990 level (right).

Future scenarios - Sardinia

- With a total primary energy consumption of 31.3 TW h/year predicted by 2030, the model in use understates the amount of primary energy derived from fossil fuels by around 3.7%
- The following presumptions are taken into account to arrive at the results: The regional Refinery consumption is excluded, and only 50% of the consumption associated with the aviation and sea transportation sectors from and to the continent is attributed to the Sardinia Region.
- The model's estimated total and net CO2 emissions by 2030 are compared to the forecast and the 1990 emission value, which is taken as a reference value, to confirm that the goals set forth in the Kyoto Protocol and by the European Commission—which are referred to as regional strategic objectives for Sardinia.

Future scenarios - Sardinia

The research unequivocally demonstrates that the BAU scenario is insufficient to meet the minimal target when compared to Sardinia's total emissions.

The net emissions only pertain to the main energy use in the area. This metric is essential for evaluating the local activities that should be taken to lower emissions in that particular area.

Since all of the energy was generated inside the island's boundaries, the 1990 net and total emissions are really coincidental.

Future scenarios - Sardinia

- Thus, in terms of reducing emissions, consumption, RES output, and infrastructure change, net emissions reflect the Sardinian energy system's effective transformation.
- Consequently, net emissions will serve as the metric for assessing the current Regional Energy and Environmental Plan’s goals.
  - In this instance, a 50% decrease in emissions is accomplished in both the plan's suggested scenario and the BAU scenario that was simulated. The impact of the suggested measures on the decrease in net emissions relative to the total ones. In summary, a 13% discrepancy exists between the total emissions predicted by the plan and those predicted by the program.
- The model's capacity to accurately predict what occurs inside the regional system is demonstrated by the almost simultaneous net emissions that were achieved.

Re-vitalizing Energy Transition in Touristic Islands

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