

CLEAN ENERGY TRANSITION AGENDA

Aran islands

Version October 2019

CLEAN ENERGY FOR EU ISLANDS

Secretariat • Rue d'Arlon 63, BE-1000 Brussels
Phone: +32 2 400 10 67 • E-mail: info@euislands.eu
Website: <https://www.euislands.eu/>

Preface

The Island Clean Energy Transition Agenda is a strategic roadmap for the transition process towards clean energy. It is designed by the local community, for the local community. Starting from an examination of the current dynamics on the island, the Clean Energy Transition Agenda spells out a vision of the island that is shared by the members of the island community. The perspectives of different island stakeholders are aligned to work towards this common vision by identifying possible pathways, including common goals and effective strategies.

The Clean Energy Transition Agenda for the Aran Islands was developed by Comharchumann Fuinnimh Oileáin Árann Teo (The Aran Islands Energy Co-Operative), who is the main member of the islands' Transition Team, on behalf of and with the input from local stakeholders, in particular the development cooperatives and organisations of the three islands Araínn, Inis Oírr and Inis Meáin. They were supported by the Clean Energy for EU Islands Secretariat who facilitated the writing of the document and provided technical advice.

This document is the first version of the Clean Energy Transition Agenda for the Aran Islands. It illustrates the strategies developed and considered by the Transition Team to accelerate the clean energy transition. In case new decisions are agreed with the transition team, the Transition Agenda can be modified to reflect these developments.

In 2018, an Energy Master plan was developed for the islands Árainn and Inis Meáin. This Master Plan provided technical input for the creation of the Transition Agenda and can be considered as a technical annex to it. This Energy Master Plan is available [online](#).

The Clean Energy for EU Islands Secretariat is an initiative on behalf of the European Commission aimed at catalysing the clean energy transition on EU Islands. The Secretariat is managed by Climate Alliance, REScoop.eu and 3E, and collaborates with a wide range of local stakeholders, authorities, academia and citizens. The work done by the Secretariat is done in close collaboration with local, regional, national and international partners, with particular support from the Technical Educational Institute of Crete and the University of the Balearic Islands.

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List of abbreviations

ACER	Agency for the Cooperation of Energy Regulators
CFA	Comharchumann Forbartha Árann (Aran Islands Development Co-Operative)
CFOAT	Comharchumann Fuinneamh Oileáin Árann Teo (Aran Islands Energy Co-op)
CCT	Comhar Caomhán Teo (Inis Oírr Development Co-Operative)
EMD	Electricity Market Design
EU	European Union
EV	Electric Vehicle
MW	Megawatt
PSO	Public Service Obligation
REDII	Renewable Energy Directive
SACs	Special areas of Conservation
SEAI	Sustainable Energy Authority Ireland
SEC	Sustainable Energy Communities
	National University of Ireland (NUIG),
	Galway Mayo Technical Institute (GMIT),
	photovoltaics (PV)

Part I: Island Dynamics

1. Geography, Economy & Population

Geographic Situation

The Aran islands are a group of three islands located approximately 10-13 km from the coast of County Galway, Ireland, as shown in Figure 1.

As shown in Figure 2 the largest of the Aran islands is Árainn, followed by Inis Meáin, and the smallest island Inis Oírr. Covering around 46 km², the islands are a unique habitat for fauna and flora alike and they are protected as SACs (Special areas of Conservation) under Natura 2000, the European network of nature protection areas in the EU. As the islands are so exposed to the elements, and the strong winds coming in from the Atlantic Ocean coupled with the fact that they have very shallow soil, there is very little tree cover on the islands. The islands are a karst limestone region, almost identical to that of the Burren in neighbouring County Clare and have a very rich archaeological heritage. The south, and most exposed side of the three islands, are protected by cliffs, some of which are more than 300 ft high. All over the world, the effects of climate change on weather conditions has been noted, and unusual meteorological changes have been seen here too.



Figure 1 The Aran Islands are located in Galway bay on Ireland's West coast. (Source: Google maps)



Figure 2 The Aran Islands consist of three main islands. (Source: Google maps)

Demographic Situation

The islands are home to approximately 1300 permanent residents, but welcome thousands of tourists daily during the busy summer months, almost tripling the permanent resident population of the winter season. Árainn has the largest human settlement with a population of 840 permanent residents and with facilities to receive visitors such as B&Bs and shops. Inis Meáin, even though it is not the smallest island, presents the smallest population with 160 permanent residents. Finally, Inis Oírr is the smallest and most eastern of the three Aran Islands. It has a population of around 260 citizens and features several touristic sites like an ancient monastic site, a church and a lighthouse.

The tourist season typically lasts from May-September on the three islands. While most inhabitants live on the islands year-round, there is an increase of permanent inhabitants during the summer season. This is mainly due to students returning home during the school holidays to work. All three islands have primary and secondary schools, but students must leave if they wish to attend university. In general, most of the islanders are of an older demographic, but there has been an increase in the number of births and families choosing to live on the islands in recent years. Unfortunately, once university studies are completed many young people have little choice but to move to the mainland or further afield to gain employment related to their chosen field.

Local Government

The islands are governed by Galway County Council, and do not have any local government of their own. Each of the islands have their own development company/co-operative which organises several important public functions. However, these do not have legal jurisdiction on the islands.

Economic Activities

The main economic sector on the three islands is tourism. This can be divided into three sectors;

- Hospitality – B&Bs, Hotels, Restaurants etc
- Transport – Bus tours, Bike rentals, Horse and Carriage tours
- Retail – Craft shops etc

This is followed by farming, with close to 200 small farms on the three islands. Farming is generally not sufficient to sustain families living on the islands, and many also have other sources of income.

Other than that, there are some small scale fishing boats based on the islands, there is a knit wear factory on the islands, hosting Irish students is an income for some families and people work in the public sector in the schools and the nursing home.

There are also some small-scale food production facilities on the islands, which sell locally and export to the Irish mainland or further afield.

Connection to the mainland

The islands have no physical connection to the mainland, and the only means of transport is by sea or air. There is no car ferry. Passenger ferries and planes run at least 2 return journeys daily in the winter months, and far more frequently during the summer. These services are operated on a Public Service Obligation contract with the Irish Government to ensure the continuity of service to the Aran Islands. Large goods and shipments of supplies are transported by cargo ferry from Galway City three times a week when weather allows.

The islands' electrical demand is met by a 3 MW sub-sea cable from the mainland, which comes to Árainn and then branches off to the other two islands Inis Meáin and Inis Oírr. This is shown in

Figure 3. The three islands were entirely dependent on diesel generators until the late nineties, when the cable was installed.

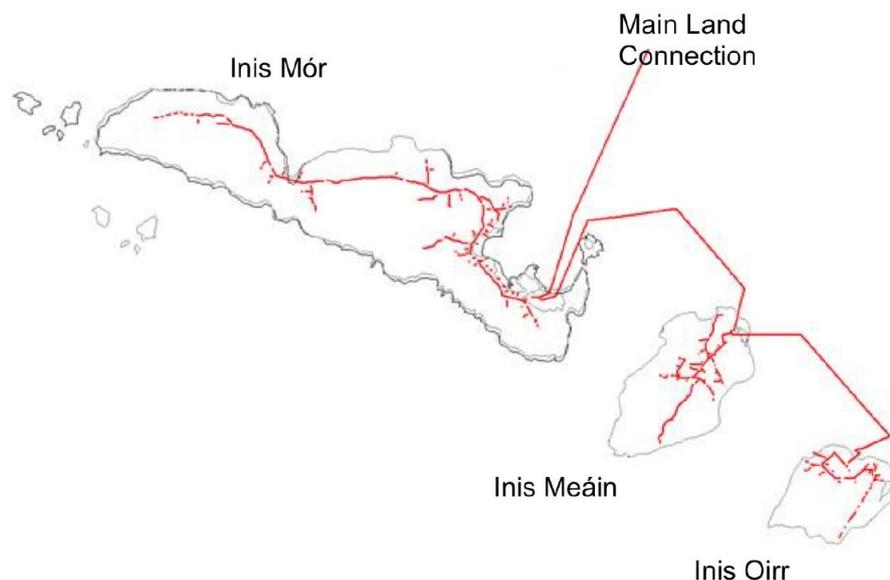


Figure 3 Electrical connections between the Aran Islands and the mainland. (Source: Energy Master Plan 2018)

2. Energy System Description

As part of the Sustainable Energy Authority of Ireland's Sustainable Energy Communities network (SEAI's SEC), the Aran Islands have undertaken an energy master plan, funded through the SEAI. CFOAT commissioned the master plan to be written for Árainn and Inis Meáin, and the local energy committee on Inis Oírr has commissioned its own, which is now (September 2019) underway.

The energy master plan gives an overview of the major sources of consumption per fuel type for the two largest islands. It also identifies the CO₂ equivalent emissions with which the energy consumption corresponds. The major findings of the Energy Master Plan for Árainn and Inis Meáin are summarised below. Interested readers are referred to the [website of CFOAT](#) where the complete Energy Master Plan can be found.

The energy consumption and CO₂ emissions breakdown per sector, as extracted from the energy master plan, are shown in Table 1. The energy consumption and CO₂ emissions for Inis Oírr will be included at a later stage, once its energy master plan is finalized.

Table 1 Final energy consumption breakdown for Araínn and Inis Meáin. (Source: 2018 Energy Master Plan)

Sector	Árainn (2017)			Inis Meain (2017)			
	Total Final Consumption (TFC)			Total Primary Consumption (TPC)			
	Usage (MWh)	Emissions (tCO ₂)	Cost (€)	Usage (MWh)	Emissions (tCO ₂)	Cost (€)	
Transportation Fuel	Maritime (Ferries only)	9,541	2,519	€801,441	7,678	2,026	€664,952
	Road Diesel	2,298	607	€278,093	128	34	€15,461
	Aviation	353	89	€86,925	130	33	€32,034
	12,193	3,215	€1,166,458	7,936	2,093	€712,447	
Thermal Fuel	Residential	3,144	879	€520,103	584	151	€96,610
	Commercial	1,283	359	€212,296	266	74	€44,027
	Industrial	0	-	€-	110	31	€18,205
	Public Bldgs.	894	250	€147,846	214	60	€35,326
	Utilities	301	84	€49,794	4	1	€662
	5,622	1,572	€930,039	1,178	305	€56,741	
Electricity	Residential	537	259	€75,126	88	42	€12,311
		- 3		€54			-
		8		,26	- 8		€11,5
	Commercial	8	- 187	4	3	- 40	85
	Industrial	34	16	€4,704	47	22	€6,505
	Public Bldgs.	224	108	€31,285	46	22	€6,417
	Utilities	663	320	€92,689	139	67	€19,409
	Transport (EV)	10	5	€1,399	0	-	€-
	1,855	895	€259,467	402	194	€56,228	

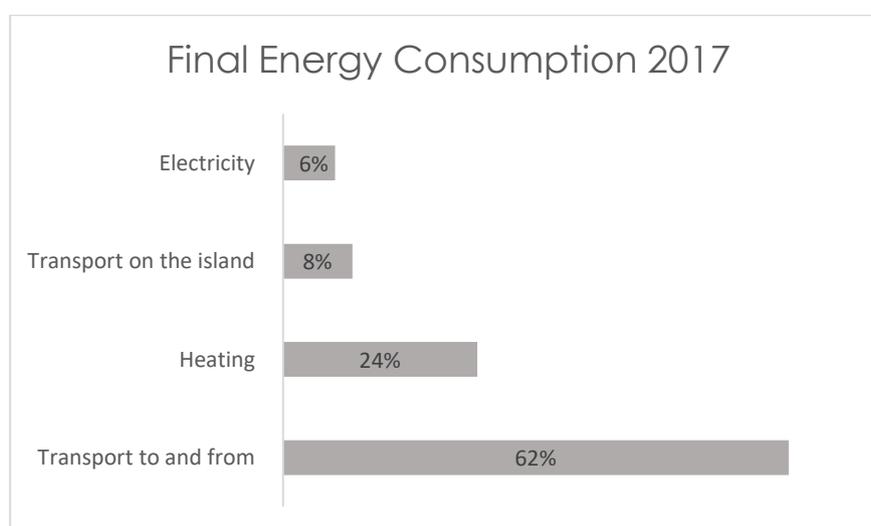


Figure 4 Final energy consumption breakdown per sector for Araínn and Inis Meáin. (Source: 2018 Energy Master Plan)

The results from the 2018 Energy Master Plan show the repartition of the energy consumption per sector for Araínn and Inis Meáin. Considering the four sectors presented in Figure 4, transport to and from the island makes up 62% of the islands' total energy consumption. Heating represents 24% of the total energy consumption while transport on the island represent 8% of the total consumption. The electricity consumption is the smallest energy sector only consuming 6%.

Transport to and from the islands

When converted to primary energy equivalents, the overwhelming share of energy consumption on the two islands is used for transportation to and from the island; on Árainn this is 51%, on Inis Meáin 83%.

The Aran Islands are connected to the main land through ferries departing from Rossaveel, Co. Galway and Doolin, Co. Clare. Depending on the season, multiple ferries per day connect the islands to the main land and provide transport between the islands.

Based on the analysis from the energy master plan, these ferries make up a major share of the islands' energy consumption. Because of Inis Oírr's smaller size, the share of final energy consumption due to ferry transport can be expected to be even higher.

This is reflected in the breakdown of CO₂ equivalent emissions. Ferry transport to the two islands is the largest source of CO₂ emissions, amounting to over half of the islands' emissions.

Transport on the island

Road transport is another significant source of energy consumption and emissions on the islands, though much smaller than maritime transport. In Árainn, the main form of public transportation is mini buses run by small companies that provide transportation to the different areas. There are also almost 100 private diesel cars on the island. These amount to 12% of the energy consumption and have significant impact on the CO₂ emissions. On Inis Meáin, energy consumption due to road transport has a much smaller relative share. As there is no car ferry, these amounts do not significantly increase during the tourist season. Despite the small mini buses operated by hotels and B&Bs, the main source of transportation are the private vehicles.

On Inis Oírr they furthermore purchased and operated one of the first electricity vans in Ireland, until it wore out a few years ago. In 2011 Inis Oírr also participated in the Aran Islands Electric Vehicle 3-year Project with the SEAI, Department of Arts, Heritage and the Gaeltacht.

Heating fuel

Heating fuels amount to the second largest source of energy consumption on the islands: 29% and 12% of the final energy consumption on Árainn and Inis Meáin respectively. These fuels include kerosene, gasoil and coal, as well as diesel and wood, all of which are imported to the island by ferry. The fuels are predominantly used for heating both in the residential sectors and the commercial properties (hotels, B&B, amongst others).

On Árainn, kerosene is the main imported heating fuel (average of 32%) followed by gasoil (26%), and coal (25%). Diesel for non-transport purposes (10%) which is used for heating and as principle fuel for generators while propane, butane and wood also is used (7%). On Inis Meáin, coal has been the main imported thermal fuel in recent years, contributing on average 58% of the overall import. This is mainly used for residential heating. Kerosene comes in second at 26% of the total import. The price paid by the island community for the import of these fuels amounts to almost 1 million euro annually. For both islands, burning these fuels results in a significant contribution to the islands' carbon footprint: 22% of the CO₂ emissions of Árainn and Inis Meáin are due to the combustion of thermal fuels.

The Inis Oírr Development Co-Operative, who are responsible for maintaining the fuel supply, reports that fuels imported to the island are on average 28% more expensive due to transport to the island and local storage costs.

Electricity

Electricity represents the smallest share of energy consumption of the two islands: respectively 8% and 4% of the final energy consumption of Árainn and Inis Meáin are in the form of electrical power. All of the electricity for the islands is supplied through a subsea cable that connects the Árainn with the mainland at Rossaveel.

The most energy intensive sectors for both Árainn and Inis Meáin are utilities, followed by residential and public buildings. The main utilities on the islands include a recycling plant, water treatment plants, public lighting, the harbour and the telecommunication infrastructure. The public sector on the island has a mix of community and office service buildings, education, health and public services, and spiritual and cultural centres. A minor part of the electricity furthermore is consumed in the transportation sector in form of electric vehicles.

The data collected for the Energy Master Plan highlight the massive losses incurred on the subsea cable, which are in the region on 50%. This means that electricity supply to the islands is highly inefficient.

A major incident with the subsea connection occurred in August 2016, when the cable to the mainland was cut which led to a general power outage on the Aran Islands. It took several days before temporary generators were brought in, and two months before the cable was reconnected. This caused a lot of hardship, isolation and disruption on the islands as communications were also cut. It badly hit the local economy as visitors left and bookings were cancelled. Food and water supplies were affected as frozen food melted and vital medicines had to be stored in a local public house fridge as this was one of the few places with a backup generator. This event showed the fragile nature of the islands electricity connection and the importance of having resilient electricity systems to the island communities. It also brought focus to the energy project, battery storage and the smart micro grid, which is now considered a priority for the islands.

Annually, the island communities of Árainn and Inis Meáin collectively pay over €300,000 for their electricity consumption.

3. Stakeholder mapping

An overview of the local actors that are relevant for the clean energy transition on the island is useful to determine the governance of the transition. A comprehensive stakeholder engagement register can be used to identify the decision makers that are important in the process. This allows to identify the stakeholders on the island whose engagement is required in developing the island transition pathways.

Civil society organizations

Comharchumann Fuinnimh Oileáin Árann Teoranta – Aran Islands energy Co-Operative

The Aran Islands energy Co-Operative (CFOAT) was established in 2012, with a view of making the islands carbon neutral by 2020. In order to achieve this, firstly - the existing housing stock needed to be upgraded, to make them more efficient and sustainable. This has been quite successful, with the co-op aiding homeowners to avail of SEAI grant schemes to upgrade and retrofit their homes. Secondly – CFOAT focuses on transportation on the islands and promotes the use of EVs. CFOAT is coordinating the Clean Energy Transition Agenda process on the islands.

Comharchumann Forbartha Árann Teo – Aran Islands Development Co-Operative

Comharchumann Forbartha Árann was established by the islanders of Árainn in the year 1991 to enhance the social and economic development of the Island of Árainn. CFA has a voluntary board which is elected each year by the shareholders/members, and a full-time administrative staff of three. The role of CFA is vast, ranging from providing essential services from early child care facilities to services for the elderly, from creating employment through new start-ups to tourism related projects. CFA established the recycling centre, the fuel distribution centre and home heating service, operate the park and playground facility, childcare facility, operate the public bus service and were instrumental in the establishment and administration of Aras Ronain, a home for the elderly. CFA provide support for local businesses and start-ups and provide an office services desk. CFA is currently very involved in the development of the "Plean Teanga" Language development plan for the Aran Islands.

CFA were instrumental in securing funding for the largest capital development invested on the island of Árainn – Cill Ronain harbour development €46 million. CFA furthermore has a strong role in lobbying for essential island services and addressing potential market failures on the Island of Árainn. These interventions have contributed to the capacity of the island to preserve the social fabric of Árainn. CFA are also members of the following organisations: The Islands Federation of Ireland, ESIN (European small islands network), CCPB (National federation of community organisations), Board of Flags (fisheries local area group – BIM), Local Link Galway (National bus service), Leader Board, Aras Ronain, Gréasáin Gnó, Coiste pleanáil Teanga and many other island committees.

Comhar Caomhán Teo – Inis Óírr Development Co-Operative

Comhar Caomhán Teo is the development co-op on Inis Óírr, the smallest of the islands. The co-operative is central to all aspects of island life and is responsible for promoting and securing services for the islands needs. It facilitates many services based on Inis Óírr. Like their counterparts on the other islands, it also lobbies government for improvements which are necessary on the islands.

Comhlacht Forbartha Inis Meáin – Inis Meáin Development Company

This organisation is newly established, and, like the development co-ops on the other two islands it also plays a central role in ensuring the islanders needs are met. As well as carrying out many of the same roles as the other two organisations on behalf of Inis Meáin, Comhlacht Forbartha Inis Meáin is responsible for the promotion of the Irish language school on the islands which operates during the summer months and which provides a significant economic boost to the island.

Businesses

Many businesses on the islands are active in CFOAT's clean energy projects and have taken advantage of the scheme, insulating and retrofitting their premises and installing renewable heating systems, similar to the residential sector. The commercial sector accounts for a large proportion of the fossil fuel consumption of the islands, particularly the passenger ferries. Ideally, these are converted to a more sustainable fuel, when the time for replacing these boats comes.

The Aran Islands Business Network

The Aran Islands Business Network was set up in 2014 to represent the interest of the different businesses on the island. Its members include many of the restaurants, bars, accommodations, stores, transport companies and tourist attractions on the island. Its aim is to promote the island as a tourist destination and to attract visitors that stay overnight.

Ferry Companies to the Aran Islands

Ferries to the Aran Islands sail from Rossaveel (Co. Galway) and Doolin (Co. Clare). They are operated by several private enterprises based on the mainland. These different carriers are in competition with each other. Engaging them into the energy transition process of the islands is an important challenge to be addressed strategically.

Public Sector

Governmental Actors

Galway county council

Galway County Council is responsible for governing the Aran Islands. Unfortunately, little or no effort has been made by the council to support the transition of the islands or indeed the whole county. There is a national authority relating to energy related matters in Ireland (the SEAI) but no such regional authority exists in Co

Galway, and thus public resources are stretched very thinly across the entire country. At present, Galway County Council has shown very little commitment and even less action in terms of the energy transition. Ireland as a whole is greatly lacking in terms of action to meet its 2020 targets, and there seems to be very little political pressure to do so.

Údarás na Gaeltachta – Gaeltacht Authority

Údarás na Gaeltachta is the public authority responsible for the economic, social and cultural development of the Gaeltacht, i.e., the Irish-speaking region of Ireland. They support economic, social and cultural development in the region. While not immediately involved in energy, they may play an important role when it comes to questions of multi-level governance on the Irish islands.

Sustainable Energy Authority Ireland, SEAI

The Sustainable Energy Authority of Ireland (SEAI) supported the CFOAT with the preparation of their Energy Master Plan 2018, through their Sustainable Energy Communities Programme. Through the programme, the SEAI supports sustainable energy communities with their own capacity building. They can receive funding in order to acquire tailored expertise they need to bring forward their energy projects. The SEAI is supportive to the energy transition process on the Aran Islands.

Schools and Academia

Higher Education and Research

National University of Ireland (NUIG), Galway

Galway Mayo Technical Institute (GMIT), Galway

CFOAT has a very strong relationship with the National University of Ireland, Galway and Galway Mayo Technical Institute. CFOAT is involved with NUIG in several EU funded research projects, aiming to advance the islands energy transition by empowering the residents to take more control of the energy they produce and consume. NUIG and GMIT are great allies to have and are very supportive of the energy transition on the islands.

Secondary Education

Secondary schools on the Aran islands

Each of the islands has its own secondary school, all of which are supportive, and interested in the energy transition. There was a competition on the islands between all the schools to win a PV array and battery storage for their school. All the schools who participated entered project proposals for their students to work on. Coláiste Naomh Eoin, the winning school, will be building a solar bench for their school which will have integrated PV panels and phone charging capabilities. The PV array and battery storage won by this school should be installed in 2019 in time for the 2019/2020 school year.

Each of these schools is open to networking with other schools involved in the Clean Energy for EU Islands Secretariat and wish to part-take in educational modules for their students relating to clean energy.

Primary Education

Primary schools on the Aran islands

There are 4 primary schools on the Aran Islands, one each on the smaller islands and two on the largest island, Aran. The schools are supportive of the transition and have expressed interest in CFOAT visiting to carry out educational classes or projects with the schools.

4. Policy and Regulation

An investigation on how the transition process on the Aran Islands is embedded in the policy and regulations from other levels of governance allows to identify the political top-down drivers that can push the transition.

Regional policy and regulation

In the Galway County Council's energy policy from January 2015, the council commits to a statutory responsibility to reduce primary energy consumption by 33% in 2020 from a 2009 baseline, and moreover commits to comply with legal requirements and national policies on energy efficiency. This has previously been supported through the *Better Energy Communities* scheme, which is an Energy Efficiency Grant Scheme available through SEAI and administrated by the Galway County Council. The Council also prepares an annual Energy Action Plan, the latest is the Climate Action Support Scheme 2019. This scheme focusses on energy efficiency and includes a community energy audit scheme and support for SEAI's sustainable energy communities. The energy efficiency focusses support renewable energy projects, LED lighting, heating control upgrades, insulation etc. through a minor works grant. The community energy audit scheme provides guidance, technical support and other information in development of community energy projects, while the support for SEAI's sustainable energy communities enable registered SEC's to apply for funding.

National policy and regulation

On June 17th, 2019, the Irish government published their Climate Action Plan 2019. This action plan sets out how Ireland will address the challenges posed by climate change. The most relevant points for the clean energy transition on the Aran Islands are:

In the **electricity sector**, the plan is to increase the share of renewables up to 70% by adding 12GW of renewable energy capacity. This capacity is expected to come both from medium to large scale projects and micro-scale generation. The action plan focuses on empowering consumers to start producing their own electricity, either through micro-generation or community-owned renewable energy generation. A support scheme will be put in place that will remunerate production from micro-generation that is sold back to the grid. This support scheme enables households, including those on islands, to invest in their own electricity production and sell excess electricity to the grid. Opportunities will be opened for communities to participate and benefit from their participation in renewable electricity projects.

Stricter requirements for new **buildings** will be introduced and a policy framework will be designed that leads to a massive upgrade of the energy performance of the existing building stock; it is planned that circa 500,000 existing homes will be upgraded to B2 BER and 400,000 will install heat pumps. In order to take advantages of economies of scale, home retrofits will be grouped to bring down the funding cost. In the future, Energy and Carbon ratings will receive more attention in all aspects of managing buildings.

In the **transport sector** the action plan anticipates an increased take up of electric vehicles which should lead to 100% of all new cars are electric and almost a million EVs on the road by 2030. There is equally a push to reduce the need for transport through better planning and a foreseen modal shift to public transport. Targets will be set for the conversion of public transport fleets to zero carbon alternatives.

Furthermore, the plan focuses on the delivery of quality employment in the new areas of opportunity being opened and aims to have a circular economy.

European policy and regulation

Energy is one of several shared competences between the European Union and the Member States. EU policy is currently based on three pillars known as the “energy trilemma”:

- Competition;
- Sustainability;
- Security of supply.

Through policy and regulation, the EU promotes the interconnection of energy networks and energy efficiency. It deals with energy sources ranging from fossil fuels, through nuclear power, to renewables (solar, wind, biomass, geothermal, hydro-electric and tidal). Three legislative packages were adopted to harmonise and liberalise the internal European energy market between 1996 and 2009. These addressed issues of market access, transparency and regulation, consumer protection, supporting interconnection, and adequate levels of supply.

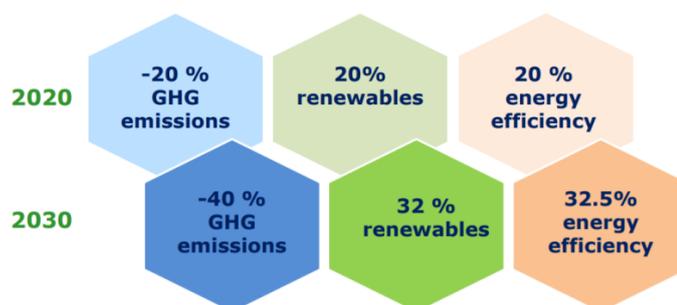
For a while now, the EU is actively promoting Europe's transition to a low-carbon society and is regularly updating its rules to facilitate the necessary private and public investment in the clean energy transition.

A variety of measures aiming to achieve an integrated energy market, the security of energy supply and a sustainable energy sector are at the core of the EU's energy policy:

- Renewables Directive: mandatory targets, national plans grid rules...
- Emission Trading Scheme, reflecting a carbon price to achieve the cap.
- Energy Union: secure, sustainable, competitive and affordable energy
- 3rd energy package: unbundling, harmonised grid operation rules, network codes etc.
- Energy Efficiency Measures
- Institutional measures: ENTSOs, ACER, CEER
- Development of the longer-term framework: 2020, 2030, 2050,

As the EU is on track to meet it's 2020 targets, the EU leaders agreed in October 2014 on new climate and energy objectives for 2030 following a proposal put forward by the European Commission. The 2030 framework aims to make the European Union's economy and energy system more competitive, secure and sustainable. It will increase certainty for investors, especially for long-term infrastructure projects, and give guidance to EU governments in preparing national policies.

European climate and energy targets



A centrepiece of the 2030 framework is the binding domestic target to reduce greenhouse gas emissions by 40% below 1990 levels by 2030. This will put the EU on the most cost-effective path towards its agreed objective of an 80-95% reduction by 2050. EU leaders also agreed on raising the share of renewable energy to at least 32%, and an indicative energy efficiency target of at least 32.5% by 2030. The proposed framework will bring multiple benefits: reduced dependency on imported energy, a lower bill for imported energy, greater innovation, economic growth and job creation, increased competitiveness and better health through reduced air pollution.

Latest legislation package

On 30 November 2016, the European Commission published its so-called "Winter Package" with eight proposals to facilitate the transition to a "clean energy economy" and to reform the design and functioning of the European Union's electricity market. This package of proposals can be divided into three categories:

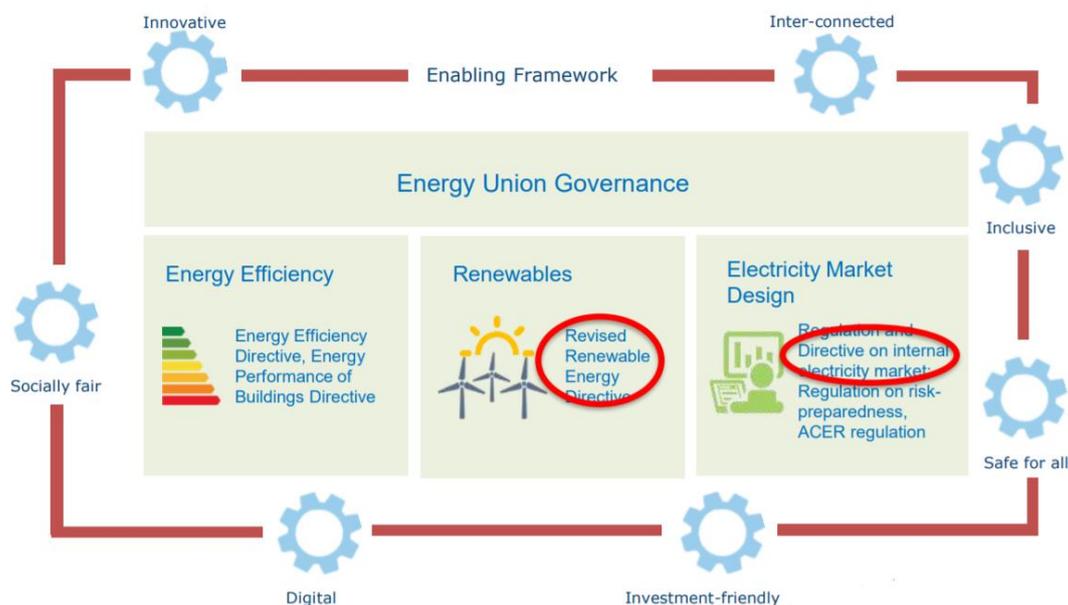
- proposals to amend the existing energy market legislation;
- proposals to amend the existing climate change legislation;
- proposals for new measures.

In the autumn of 2018 and spring of 2019, several directives were adopted under the Clean Energy for all Europeans Package. The eight legislation measures can be placed in four groupings:

1. Energy Efficiency:
 - The Energy Efficiency Directive; and
 - The Energy Performance in Buildings Directive
2. Internal Energy Market Reform:
 - The Internal Electricity Market Design Regulation;
 - The Internal Electricity Market Design Directive;
 - The Agency for the Cooperation of Energy Regulators (ACER) Regulation; and
 - The Risk Preparedness in the Electricity Sector Regulation.
3. Renewable Energy:
 - The Renewable Energy Directive (REDII);
4. Governance:
 - The Governance of the Energy Union and Climate Action Regulation.

These new Electricity Market Design (EMD) rules make the energy market fit for the future and place the consumer at the centre of the clean energy transition. The new rules are designed to empower energy consumers to play an active role in driving the energy transition and to fully benefit from a less centralised, and more digitalised and sustainable energy system. The new rules enable the active participation of consumers whilst putting in place a strong framework for consumer protection.

The Clean Energy Package



1. Energy communities

For EU Islands, relevant new rules are those that empower citizens and small producers under the new concept of Renewable (REDII) or Citizens (EMD) Energy Communities. These are groups of citizens, social entrepreneurs, public authorities and community organisations participating directly in the energy transition by jointly investing in, producing, selling and distributing renewable energy.

What?

- Generation of energy from renewable resources and technologies, which are partly or wholly owned by local communities

Who?

- Groups of citizens, social entrepreneurs, public authorities and community organisations participating directly in the energy transition by jointly investing in, producing, selling and distributing renewable energy

What can they do?

- Produce, consume, store and sell renewable energy, including through renewable power purchase agreements;
- Share, within the renewable energy community, renewable energy that is produced by the production units owned by that renewable energy community;
- Access all suitable energy markets both directly or through aggregation in a non-discriminatory manner

It is noticed throughout the EU that the participation of local citizens and local authorities in renewable energy projects through renewable energy communities has resulted in substantial added value in terms of local acceptance of renewable energy and access to additional private capital which results in local investment, more choice for consumers and greater participation by citizens in the energy transition. Therefore, the RED II and the EMD state that the Member States should ensure that renewable energy communities can participate in available support schemes on an equal footing with large participants. To that end, Member States should be allowed to take measures, such as providing information, providing technical and financial support, reducing

administrative requirements, including community-focused bidding criteria, creating tailored bidding windows for renewable energy communities, or allowing renewable energy communities.

It is up to the Member States to set the fees and tariffs to be borne by the CEC. They can allow the CEC to be a distribution system operator or a closed distribution system operator, and they must facilitate the roll-out of RECs by removing market barriers and taking account of RECs in support mechanisms.

Part II: Island Transition Path

1. Transition Governance

The governance of the clean energy transition of the Aran Islands is shared between different organisations.

Aran Islands Energy Cooperative – Comharchumann Fuinneamh Oileáin Árann (CFOAT)

- The main objective of the energy cooperative is to make the islands carbon neutral and self-sufficient in terms of energy.
- The energy cooperative acts as a facilitator in the islands' clean energy transition with a strong focus on the secondary benefits of the community owning its own renewable generation project.
- The cooperative facilitates the retrofitting of homes and businesses on the islands, making them more efficient and improving their comfort levels.
- The cooperative aims to represent the views of all islanders that are interested in the clean energy transition.
- The cooperative is a vehicle for community engagement.

The cooperative is fully transparent; its annual general meetings are open to the public, not just to shareholders. Its accounts are fully audited each year and it fully complies with the Code of Governance. (<https://www.governancecode.ie/about.html>)

Other key stakeholders involved in the transition process on the Aran Islands are the local development cooperatives on Árainn and Inis Oírr and the development company on Inis Meáin. Currently all three of these organisations are actively supporting CFOAT on their journey to carbon neutrality.

It is envisioned that these three organisations will all play a very important role in the future, particularly when it comes to community engagement and public consultation as they are a vital intermediary between CFOAT and citizens from all demographics across the three islands.

Secondary schools on all three islands are also very engaged in the transition process and take their role very seriously. Some schools have undertaken significant retrofitting work, installing battery storage and educational tools to further engage their students. Coláiste Naomh Einne, on Árainn, along with CFOAT have developed a module on Energy and Climate Change for their students.

Schools are seen as a key catalyst for change as it is believed that the youth on the islands are very supportive of the transition process. Going forward, schools enabling students to reflect on the current and future status of the islands and educating them on the changes that are taking place around them will result in future generations of islanders who will continue to be a driving force for change and improvement.

Comharchumann Forbartha Árann - Aran Development Co-operative (CFA):

Comharchumann Forbartha Árann in previous years has always shown a keen interest in sustainable energy related matters - as far back as back as 1996 they applied for planning permission to erect wind mills on the Island of Árann, but unfortunately were refused by the local planning authority.

In 2010-2013 CFA were involved with SEAI in the "Wind to wheels project" – which involved the monitoring of 6 electric vehicles on the island of Árann. They are currently involved in the EU Project REACT (Renewable Energy for self-sustainable Island communities)

CFA plays a pivotal role in the social and economic development of the island of Árann and wishes to be central in any future plans for the island. Comharchumann Forbartha will support Comharchumann Fuinneamh in any way possible in further developing the Clean Energy Transition Agenda. CFA depend on the profits gained from the fuel distribution to continue to employ staff and to subsidize many of the island's social services – i.e. the bus, the playground etc.

CFA's current role in the EU clean energy transition is a role of support as a stakeholder. They are more than willing to attend meetings, forums etc.

Comhar Caomhán Teo – Inis Oírr Development Co-Operative (CCT)

Cómhar Caomhán Teo (CCT) and the community of Inis Oírr have a long history of managing and looking after the island energy and electricity supplies. CCT coordinate and import all fuel supplies for the island and are responsible for maintaining supplies. At the moment, CCT is compiling its own Energy Master Plan, which will be completed by the end of 2019. They also facilitate retrofitting schemes and promote the idea of a low carbon future.

In 2012, CCT became the Islands coordinators for the Aran Islands Energy Independence 2022 Project and partnered with a private company in the sector. This has developed into a very strong and important partnership which has transformed the entire community's outlook and understanding of the environmental and financial costs of energy.

CCT purchased and ran one of the first electric vans in Ireland until it wore out a few years ago. In 2011 they also participated in the Aran Islands Electric Vehicle 3-year Project with the SEAI, Department of Arts, Heritage and the Gaeltacht.

They received a number of awards for their environmental policies:

- 2014: Chambers Ireland Excellence in Local Government Awards Tourism award. Winners: Comhar Caomhán Teo and Galway County Council.
- 2013: Gold Medal winner and Criteria Award winner for a healthy lifestyle at the prestigious international LivCom competition in Xiamen China. LivCom is the World's only Awards Competition focusing on International Best Practice regarding the management of the local environment. Winner: Inis Oírr,

CCT furthermore have developed great connections with academic institutions in Galway NUIG and GMIT and have worked closely with them to facilitate studies and research such as; *Best-Practice Framework to Facilitate the Development of a Sustainable Energy Community in Inis Oírr*

Island, Ireland; Best-Practice Framework for the Introduction of Sustainable Energy Communities in Europe: Lessons from Initial Field Studies in Denmark and Ireland; Best Practice Framework to Facilitate the Development of Sustainable Energy Communities in an off-shore island in Ireland.

Cómhar Caomhán Teo will continue the work in the Inis Oírr community. As recent as July 2019, they have carried out retrofitting in its offices by installing a 6kW photovoltaic system and a 14kW air to water heat pump. They are ready to assist in collecting information and details of energy installations and electricity consumption data from individual buildings as well as assisting in collecting and providing feedback on the community's experience of the various technologies. They will actively encourage their members and local businesses to participate and will help identify suitable buildings for inclusion in this study.

CCT will work closely with NUIG to identify suitable business/ownership/management models for a smart microgrid that allow to safeguard the future income as fossil fuel imports are reduced and phased out. CCT will furthermore actively support and enable any relevant testing of the models for different microgrid operating and management scenarios.

2. Vision

CFOAT developed a clear vision at the time of their founding in 2012.

“Comharchumann Fuinnimh aims to make the Aran Islands self-sufficient in clean locally owned energy and build its economy on the related benefits that accrue from this”

This vision is still relevant today. Energy independence is one of the strong guiding principles of the activities of CFOAT.

The strategic objectives of CFOAT are:

- To secure the future energy needs of the three Aran Islands by gaining a controlling interest in the local sources of alternative energy production.
- To reduce and gradually remove the dependency of the Aran Islands communities on fossil fuels (oil, gas, coal, including transport) by replacing them with alternative and more sustainable sources of energy.
- To preserve the islands' unique language, heritage and culture by providing sustainable employment and a sustainable environment for people to live in.
- To facilitate the conversion of homes and other buildings on the three islands to be more sustainable in their energy usage.
- To provide low-cost energy to industry so as to create employment on the islands
- To create, provide and encourage employment in projects of sustainable energy
- To facilitate and at least part-own initiatives and projects in research and development into sustainable energy.
- To provide education and training to both residents and non-residents in sustainable living.
- To create on the three Aran Islands an example of best practice in sustainability to the rest of Ireland and to the world.
- To use the three Aran Islands as a platform from which to promote sustainability and environmental protection worldwide.

Comhar Caomhán Teo on Inis Oírr is an active stakeholder and partner of the CFOAT and support the overall vision. They have created islands specific key goals and objectives for Inis Oírr, several of which overlap with the strategic objectives of CFOAT.

Goals:

- To be energy independent by 2022.
- To eliminate the island's dependence and use of fossil fuels in particular for space and water heating.

- To have all homes insulated to a sufficient level for the instillation of heat pumps for space and water heating.
- To start reducing the island's dependence on fossil fuels for transport and switch to sustainable fuels.
- To increase community education and learning for the future energy system and develop an energy education centre.

Objectives:

- To prioritise all houses receiving efficiency upgrades and achieving a minimum BER B level by 2022.
- To generate and supply the island's own sustainable low-carbon energy.
- To become active energy citizens, changing energy use behaviour, introduce energy efficiency measures and develop an energy management culture at the individual level.
- To prepare for the installation of a cellular smart micro grid and active demand response systems with a test bed on Inis Oírr.
- To be an example to other communities showing how to transition to a sustainable energy future.

3. Pillars of the Energy Transition

Pillar 1 – Community engagement

Objective: **To transition to a clean energy system for the Aran Islands through its communities' support and engagement.**

The Aran Islands' communities lie at the heart of its clean energy transition. Providing benefits to the islands by bringing jobs, income and a sustainable and clean environment are the principal aims of this transition.

Community energy projects are a way to emancipate and bring together the residents of the islands. Innovation and economic growth, brought about by clean energy projects, can create conditions that draw new residents to the islands and make sure that the current residents stay. The islands' economy currently depends strongly on tourism. By diversifying the economic activities, the islands will become more resilient to external shocks.

Strategy: **Reach out to the island community intensively and search for truly broad support for the strategic objectives of the cooperative.**

There is a high awareness for the need of clean energy transition on the islands and many residents are sympathetic with the goals of the Aran Islands Energy Co-op. In order to build a strong movement that is able to take on the challenge of compete decarbonisation, the transition team needs a very strong backing from the island community.

The CFOAT aims to be the vehicle through which all the island residents can share their opinion on the clean energy transition. Over the past years, much discussion has taken place on the direction of the clean energy transition on the Aran Islands. The CFOAT is facilitating several clean energy initiatives and is continuously looking to gain a stronger momentum to develop the envisaged projects.

Joint decision-making based on the acceptance of a large majority of the island community (over 75%) makes sure that the cooperative's actions reflect the island community's perspective.

Action 1: **Outreach** – Widen the group of active supporters to the co-op through a continuous outreach that focuses on the benefits of clean energy transition for the island residents. The objective is membership of all island residents.

Action 2: **Island-wide Pledge** – Invite all stakeholders on the island to sign a pledge that formalises the commitment to the clean energy transition of the islands.

Action 3: **Clean Energy Transition Agenda** – Publish the Clean Energy Transition Agenda to indicate the envisioned transition pathways for the Aran Islands.

Action 4: **Helpdesk** – Investigate the possibilities to set up a Clean Energy Helpdesk that provides reliable and impartial information on clean energy technologies to the island communities.

Action 5: **Transparency** – Emphasize the transparency in all the co-op's activities.

Pillar 2 – Electricity generation

Objective: To take ownership of electricity production on the islands in order to bring economic benefits and local employment to the island communities.

While electricity demand is the smallest type of energy demand on the island, switching to electricity generated on the islands has the potential to transform the islands' model of electricity consumption. As indicated in the energy system description, the islands spend over €300 000 annually buying electricity from the main grid. An investment in community-owned renewable electricity generation on the island can invert this drain of island resources: by collecting the revenues from a collectively-owned generation unit into a fund for island development projects, electricity can become a major driver of island development. It can also create year-round employment and contribute to an improved security of supply. Furthermore, local production, matched with local consumption, can reduce the amount of imported electricity and therefore reduce the power losses in the submarine cable. Until full energy system autonomy with electricity storage or flexible production and demand is achieved on the island, the submarine cable is needed to balance the island grid. Electricity import and export will as such still be affected by the losses occurring in the submarine cable. Investigating why and where the high electricity losses occur can therefore provide important information on how the island's electricity generation and consumption should develop to reach full decarbonisation.

The field of renewable electricity generation is progressing quickly. The performance of renewable energy technologies keeps improving and their prices are continuously dropping. These developments need to be considered when deliberating and choosing a pathway for the transition to a clean electricity supply for the islands.

Based on a process that happened on the island, led by the energy cooperative and supported by the community, the different renewable electricity generation pathways were analysed. Several feasibility studies and reports have been prepared in the past and are reviewed in the Energy Master Plan. These studies indicate that in the medium term, **wind and solar power** are the technologies with the most potential to provide local electricity production on the island.

Strategy 1: Installation of a community-owned wind turbine

The Aran Islands have a history of wind power. In 2002, three 225 kW turbines were installed on Inis Meáin. These were able to supply almost 40% of the annual electricity consumption of the three islands. In 2011, these turbines were end-of-life and were decommissioned.

Since the launch of the energy cooperative in 2012, reintroducing wind power on the Aran Islands has been one of its priorities. The excellent wind conditions on the islands means that a wind turbine can produce more electricity than the same turbine on the main land. Wind power, and onshore wind power in particular, has become a robust technology that is able to withstand the harsh conditions on the island. Furthermore, the cooperative is motivated to install a wind turbine by the following drivers:

1. To take ownership of the generation assets where this power today is generated by the state-owned Electricity Supply Board (ESB), thus creating profit that will benefit the economy of the islands;
2. Decarbonizing the electricity consumption to battle climate change;
3. Generating excess energy for future modal shifts of energy use, e.g., towards electric heating with heat pumps, shifting to electric vehicles, the local production of hydrogen as fuel for the ferry, or simply for export of excess electricity to the mainland;

4. Security of supply, in case of a cable cut with the mainland; notably, this would require dispatchable generation or electricity storage on the islands. While this also depends on the wind power plant's control settings, in case of a backup, the wind power plant only may not be able to operate the grid in a stable mode.

There have been several consultations and workshops on the island to discuss these plans and to determine a suitable location. Community approval and participation is crucial in this project. The wind turbine project will only go on if there is a consent from over 75% of the island community. This will be a first requirement to overcome the project's drawbacks: a high initial cost, a long lead-time to project delivery and a difficult project construction environment given the small project scale.

The high percentage of community participation for this project to be realised will potentially also increase acceptance of the project on the islands. The public perception and possible issues related to wind turbines will therefore have a lesser impact on the project.

The road map of the installation of a wind turbine on the Aran islands is given below:

Phase 1 - **Feasibility**

As a first step of developing wind power on the Aran Islands, the feasibility of the technology has to be investigated. This consists of finding an appropriate site and performing a high-level assessment of the expected electricity production and required financing for the project. This phase has already partially been carried out by CFOAT.

CFOAT has identified, screened and assessed the potential sites for wind power for constraints on wind power development. To continue with the wind turbine development, the most suitable site needs to be selected. Selecting a site determines many of the boundary conditions of the next steps in the turbine development.

Community support for the selected site is crucial for CFOAT. Therefore, the criteria for the site selection are:

- Not on a main tourist route;
- Not obstructing the primary view of any resident;
- Not within 500 meters of any home;
- Not in an area of visual beauty.

Finding a partner to develop the wind turbine:

As CFOAT does not have experience in wind turbine development, partnering up with a third party is recommended.

At the same time, the restrictions due to Special Areas of Conservation (SACs) and Natural Heritage Areas (NHAs) need to be considered. Once the site is selected, the owners of the site need to agree to a land lease.

There are currently 2 sites, one on Árainn and one on Inis Meáin, which are being considered. The site on Árainn has been approved provisionally by wind power company Enercon as being suitable for wind power in terms of access and construction. The site on Inis Meáin has already had turbines there before and can therefore be considered suitable as well. This site has the advantage of having more developed infrastructure, such as a roadway built to the site and a previous grid connection. CFOAT will fully consult with the public along every step of the way and no formal application for planning permission will be lodged to the local authority unless there is widespread public support.

In order to select a site, and reassure the local citizens on the islands, various studies are needed before and during the public consultation phase. These include feasibility studies,

visual impact assessments, noise level impact statements, environmental impact assessments etc. CFOAT plans to conduct these studies to provide fair, transparent and expert facts to the community during the public consultation phase.

After site selection, the owners of the land are contacted to discuss the land lease. An analysis determines the most suitable turbine type and its dimensions. This is an important parameter for the permitting phase. The results of this analysis indicate the expected electricity yield of the turbine and therefore allow to determine the expected revenue. Based on the high-level design, a financial analysis is carried out to confirm the financial viability of the project. It is important to share the results from this phase with the community before moving further into phase 2. This will also indicate if future problems will arise with the implementation of the wind turbine at the selected site and enable relevant mitigation actions.

Phase 2 - **Pre-development**

The high-level design from Phase 1 is used to carry out the impact assessments. These assessments are necessary to ask for a permit to operate the turbine on the selected site. In order to develop a wind turbine in Ireland, several permits are required:

- Environmental Impact assessment
- Grid connection
- Planning Consent
- Environmental Impact Assessment
- Natura Impact Assessment
- Subsidies application

When the necessary studies have been completed, they are submitted to the relevant authority for evaluation.

Going into the pre-development phase requires a significant amount of up-front investment, without guarantee that the permits and grid connection will be granted, or that the turbine will be installed. Finding a source of funding for this early phase in the project is difficult because of the high risk involved. Community financed early-project develop is not an option; in case the project is blocked at a later stage, this would mean a significant drain of resources from the island community. The risk is also too high for bank-financing, as banks will only provide a loan when their payback is guaranteed.

CFOAT has assessed the possibilities of financing and sees several options. Ideally, the risk in the early-development stage is absorbed by the government or another institution.

Phase 3 – **Development**

Once the necessary permitting has been approved, the project enters the development phase. The risk level of the project has decreased in this phase as all the permits have been granted. A project vehicle can be set up to organise the different stakeholders in the project. This means that it is easier to find partners.

- A detailed design of the project is used to have a bankable yield assessment. This assessment guarantee's the viability of the project to the bank or other investors.
- Tender documentation is developed and sent out to EPC contractors and turbine manufacturers.
- Operation & maintenance contracting needs to take place.

- Asset management is important: who will be the link between the turbine's day-to-day operation and the periodic O&M activities.

Phase 4 – **Installation**

Implementation of the wind turbine require high quality standards and extensive expertise in order to secure a successful implementation. Selecting appropriate partners and contractors for the projects is linked with the work conducted in phase 3. Finalising the detailed technical documents, completing the project plan and commissioning of the project plan are thus important aspects in this phase. When the project is underway it is important to regularly supervise the project plan and make sure things are going according to plan to avoid additional costs linked to delays.

Phase 5 – **Operation**

When the wind turbine is up and running, the project is entering the phase of operation with periodic operation and maintenance activities. In this phase, the project performance can be maximized, while downtime is sought to be minimized with adequate maintenance procedure which will also ensure the overall lifetime of the installed systems. The initial work from phase 3 regarding operation and maintenance contracting is carried out, and regular control with the contractor to ensure performance and the required lifetime of the project should be conducted. It is possible that the island community can perform part of the maintenance activities themselves.

Phase 6 – **Decommissioning**

At the end of the lifetime of the wind turbines, the decommission of the turbine is the final project phase. This phase requires equipment recycling, waste and facility removal including breaking up foundations, removal of access roads that are not maintained for other uses, surface recontouring, and revegetation. Depending on the project's success, some of these steps can be avoided if it is decided to keep the site for a new wind turbine. Either way it is important to allocate funds for the decommissioning phase. Investigating the laws and authorities relevant for this phase is also important to secure the decommission meets the required standards. Depending on the value of the equipment and materials, recycling the decommissioned wind turbine will either cause additional costs or create revenue. It is therefore important to decide who gets the proceeds or covers the costs before this phase is reached.

Strategy 2: **Determine the role of solar power micro-generation in the Aran Islands context and the feasibility for its implementations**

To complement the production from the wind turbine, micro-generation from solar panels can be used. Solar photovoltaics (PV) produce most electricity during the summer, which coincides with the touristic season on the islands. Micro-generation is preferred over medium to large-scale installations as it avoids extensive grid connections. Compared to wind power there is also a lower planning risk and a high community acceptance. While solar irradiance levels on the Aran Islands are moderate, PV technology is becoming more robust and low-cost.

At a national level, a support scheme is planned to be in place for microgeneration by 2021 which is meant to “tackle existing barriers and establishes suitable supports within relevant market segments”. Additionally, there will be a feed-in tariff for microgeneration to be sold back to the grid. These measures are expected to create a stable regulatory framework for microgeneration, also on the islands, that convince island residents to start generating their own electricity.

The following action points are identified to further develop this strategy.

Action 1: Investigate the potential and willingness to install solar power micro-generation on existing public, commercial and residential buildings.

Action 2: Conduct a feasibility study to create a general overview of the costs and revenues linked to installing solar power at a micro-generation scale in the Aran Island context and the potential impacts on the grid.

Action 3: Join interested stakeholders together and commence a bid for the total solar power micro-generation needed to gain savings by bulk ordering.

Strategy 3: **Other technologies**

Several other technologies for electricity generation have been discussed in the context of the Aran Islands. These are in most cases innovative technologies that are not yet fully commercialised. They therefore need to be considered on a long-term time scale.

Wave energy converters capture the kinetic energy from waves to convert it to mechanical, hydraulic or electrical energy. It is an early stage technology that has not yet been proven at large scale. Deployment costs need to be reduced significantly before a commercial project could be viable.

Tidal power converters make use of the gravitational energy due to the tides to generate electricity. However, the resource available on the islands is limited and the exploitation cost can be very high.

Innovation on the Aran Islands

While the Aran Islands can be a suitable location to carry out research projects on these technologies, the benefits that these projects bring to the islands needs to be a priority. Islands can be test beds for innovation but should not be considered 'lab rats' to experiment on. An appropriate assessment of the socio-economic impact of a project should be an essential element before the start of research projects.

Pillar 3 – Energy storage and Smart Grid Technologies

Objective: Use energy storage and smart grid technologies as effective tools to increase the islands' energy autonomy.

The production of renewable energy sources such as solar and wind power depend on meteorological conditions; electricity is only produced at times when the sun shines or the wind blows. However, in order to guarantee the stability of an electrical power system it is required that the amount of electricity consumed always equals the amount of electricity that is supplied. The Aran Islands are currently connected to the main land through an undersea cable that is able to match the electricity demand with its supply. In the case of a cable cut, the island power system is not able to function independently, regardless of how much renewable electricity is produced locally, unless the required balance between production and consumption can be maintained.

Energy storage and smart grid technologies can increase the autonomy of the islands' power system and allow an advanced penetration of renewable energy sources. By decreasing the power transmitted through the undersea cable, the electrical losses in the cable can furthermore be decreased which would lead to an increase in grid efficiency. Using energy storage, electricity can be stored during times of excess local production and be supplied when the demand exceed production. Smart grid technologies have multiple uses; advanced communication can be used to manage the power system's demand side in order to guarantee a match between local production and consumption, while smart control can permit a wind power plant to contribute to the grid's stable operation, etc.

Strategy: Determine the role that storage and smart grid technologies will play at an archipelago level in its search for energy autonomy.

In general, the development of the Aran Islands electricity system needs to be addressed integrally in order to make the adequate steps towards its decarbonisation. The undersea grid connection, including the identified losses, needs to be further investigated to quantify the benefits linked to an increase in autonomy through local generation and energy efficiency. When addressing the system balance, many technologies can be considered relevant. In the context of the Aran islands, the following technologies have been found particularly of interest.

What is a smart grid?

An electricity supply network that uses digital communication technology to detect and react to local changes in usage and production to ensure stability in the

Electrical storage can help to stabilise the local electricity grid by storing electricity at times of local excess production. Electrical storage can therefore help to integrate a higher share of intermittent renewable electricity in the system by saving renewable electricity at times of excess production for consumption at times when there is a lack of local production. Electrical storage solutions in the form of batteries are nevertheless still expensive solutions which can be a barrier for large-scale implementation.

Hydrogen is mostly created from natural gas through steam reforming, but renewable hydrogen production is also possible from water through an electricity-intensive process. Producing hydrogen in a renewable way increases the production cost, but this obstacle can be overcome by producing the hydrogen with excess electricity production. Excess electricity production,

which otherwise needs to be consumed or exported, is then utilised in the form of hydrogen instead of fossil fuels in sectors such as transport.

The Aran Islands are part of the EU project SEAFUEL (sustainable integration of renewable fuels in local transportation) which aims to demonstrate the viability of hydrogen in the local transport fleet and support the shift towards a low-carbon economy. The islands are also included in the EU project HUGE (Hydrogen Utilisation and Green Energy) which aims to provide tools to assess the hydrogen renewable energy chain opportunities and overcome barriers related to this.

Using hydrogen to power the transportation sector can therefore be a natural step towards decarbonisation of the Aran islands. It is necessary to include important stakeholders in this decision such as the ferry companies providing the transportation and the department of Culture, Heritage and the Gaeltacht who subsidises ferry services to the Aran islands.

Demand response in the electricity system is also an important way that can help to decarbonise the electricity sector on the Aran Islands. In demand response, electricity consumption is shifted to follow power production, and this can happen through voluntary rationing or price incentives during peak periods. It urges consumers to use electricity when renewable electricity production is high while discouraging consumption when the renewable electricity penetration is low.

Pillar 4 – Energy demand for heating

Objective: To facilitate the conversion of homes and other buildings on the three islands to be more sustainable in their energy usage.

More than 75% of the households in Árainn and Inis Meáin use fossil fuels (gas oil, coal and peat) as heating sources. The energy demand for heating makes up over one fifth of the two islands' final energy demand and causes more than a fifth of the islands' CO₂ emissions. Annually, the islands spend over one million euros on thermal fuels for heating. Converting the buildings on the islands to be more sustainable is therefore an important pillar of the clean energy transition of the Aran Islands.

In order to achieve this objective, a two-fold strategy is proposed:

Strategy 1: Renovation and retrofitting of homes and other buildings is the essential first step for decarbonizing the heat sector.

The energy demand for heating is reduced as much as possible by renovation and insulation of the existing building stock and using low-energy building techniques in new constructions.

Strategy 2: To roll-out heat pumps or other renewable energy heating sources for domestic hot water and space heating.

Once the energy demand has been reduced as much as possible, a heat pump or other renewable energy heating source can be installed to eliminate the dependency on imported fossil fuels.

Almost 300 of 500 homes on the three islands have been retrofitted to some degree, with many opting to install renewable heating systems such as air to water or geothermal heat pumps and solar thermal or PV panels. This work is still ongoing, with more houses interested in having retrofitting works carried out in 2019. CFOAT hopes that more people will discontinue the use of fossil fuels to heat their homes, and switch to more sustainable methods, but accepts that this will take time to achieve. The island residents have been very supportive of this initiative, which is clear by the number who have undertaken work on their own homes to contribute to it. Out of approximately 500 homes on the islands, 353 have signed up for a retrofit. The role of CFOAT is to facilitate the application of the grants and organise the group purchase of this.

One of the challenges has been to find a grant scheme that allows all island residents to participate in the programme. It costs on average €20 000 to retrofit a home, though this price can vary significantly depending on the building's building technology. The islands' traditional stone houses are particularly costly to retrofit. Overall, a grant of minimum 80% is necessary to bring down the payback period of the investment to below 5 year. Another challenge has been to find reliable contractors for the implementation of the programme.

The following actions contribute to the two-fold strategy.

Action 1: To continue the ongoing programme on home retrofitting including grant facilitation and group purchases for the island communities.

Action 2: Closely monitor heat demand in both residential and non-residential sectors and identify the residual demand which remains after the application of insulation and other heat efficiencies;

Action 3: Build local SEC capacity on renewable heat technologies, comparative analysis and economic assessment for residential and non-residential scenarios;

Action 4: **Establish a wider stakeholder heat team including residential and non-residential representatives, a SEAI contact point, the local administration, heat pump suppliers and objective advisors on renewable heat;**

Action 5: **Establish a rolling multi-year work programme for the delivery of insulation and renewable heat measures and begin the process of identifying suitable funding partners.**

Pillar 5 – Transport on the island

Objective: To eliminate the need for fossil fuels for transport on the island

Transport on the islands mainly depends on fossil-fuelled powered cars. There are about 350 vehicles on Árainn and Inis Meáin. Because the islands are small – it takes about 17km to traverse Árainn, the largest island – they are well suited for electric vehicles, even if those vehicles have a limited range. There are several bike rental outlets on the islands, which have proven to be popular with tourists visiting the islands.

Energy consumption due to transport on the islands amounts to 10% of the island's final energy demand.

Strategy 1: Increase the number of electric vehicles for both public and private transport

By electrifying transport and switching to renewable electricity, the carbon footprint of road transportation and reliance on fossil fuel can be brought down. CFOAT focuses on transportation on the islands and promotes the use of EVs. This project is successful, with new electric vehicles replacing diesel cars gradually. Árainn currently has 12 electric vehicles, which is a much larger proportion than Ireland as a whole. There is a continuous increase in interest in electric vehicles as they have become available to buy on the second-hand market, as generally islanders do not purchase brand new cars for the island roads.

There are several private shuttle buses and larger vehicles on the island that can be replaced by electric buses or – in case production facilities are installed – hydrogen. Local hydrogen production has the potential to reduce the fossil fuel dependency of the island's private transport sector.

Strategy 2: Continue to promote the use of bicycles for public and private transport

The roads on the island lend themselves to the use of bikes to get around. (Electric) bikes are readily available for rental on Árainn and tourists should be encouraged to use them during their stay. This can happen via:

- Visible signage on the pier suggesting cycling is the most sustainable means to visit the island by outlining how many trips have been undertaken by bicycle and the corresponding CO2 savings.
- Creating shelters and refuge points along the route where tourists can seek cover from wind and rain during their exploration of the island. Additional services offered near the point of rental such as wet gear rentals, bag lockers can further encourage people to cycle in changeable weather.
- Providing island-wide repair services in the case of puncture or other malfunctions of bikes and potential discounts at shops around the island

Action 1: Investigate the gross transport energy demand and the correspondent electricity demand impact, estimated capital and operational cost for the relevant infrastructure.

Action 2: Investigate the possibilities for collaboration with a second-hand electric vehicle dealer on the main land.

Action 3: Investigate the possibilities for additional services for visitors who choose to cycle around the island.

Pillar 6 – Transport to and from the island

Objective: To decarbonise ferry transport by switching to a low-carbon transport solution

Sea transport with the ferry is the major single energy demand related to the islands. Over half of the islands' CO₂ emissions are due to maritime transport. The ferry companies are long established businesses who want to exploit their existing assets as much as possible. Opportunities for this transition are expected to appear when depreciated assets need to be replaced. Decarbonizing ferry transport requires switching from diesel fuel to electricity, hydrogen or a hybrid solution.

Replacing ferry vessels requires a significant investment. Many low-carbon technologies are also still under development and will require additional research before their costs can come down. Replacing the ferries with a low-carbon alternative is therefore a particularly cost-intensive undertaking.

Strategy: Investigate use-cases and follow up on technological progress to develop a convincing and realistic strategy to decarbonize sea transport'

Developing low-carbon maritime technologies requires large research and development budgets that will need to be supported by other actors besides small-scale passenger transport. The cargo shipping industry could assume the role of innovator, possibly supported by a government contribution from the national or European level to cover the innovation risk.

The Aran Islands are part of the two EU funded projects SEAFUEL and HUGE, both of which investigate hydrogen in the island-specific context and can help to decarbonize transport to and from the island.

An important role for CFOAT will be to link these island specific EU projects with the three operating ferry companies and the department of Culture, Heritage and the Gaeltacht who subsidises these ferry services. To develop a realistic long-term transition strategy in this area the potential options for decarbonizing must be explored in cooperation with the carriers. Additional support for this can come from SEAI and collaborations with energy experts such as Tipperary Energy Agency, GMIT and NUI Galway.

Action 1: Identify the potential cost saving due to using hydrogen instead of crude oil.

Action 2: Review the potential technologies and required secondary infrastructure to facilitate a low emission ferry service.

Action 3: Include the relevant stakeholders for the long-term vision and transition

5. Transition pathways

The 6 pillars outlined for the Aran Islands involve actions in interdependent energy-related areas. Decisions made for one pillar potentially affect other pillars and all the pillars play a role in the energy system on the Aran islands. Potential futures for the Aran Islands energy system based on community acceptance, engagement and funding are illustrated in Figure 5. These outline the non-exhaustive options presented in the transition agenda. The pathways towards a clean energy transition are various and can be achieved in multiple ways.

In order to make the Aran Islands self-sufficient through clean and locally-owned energy, several steps need to be taken towards energy savings and generation of renewable energy on the island. On the demand side, determining and implementing the due measures on the island to create an efficient energy system should be the first step to avoid over-dimensioning the system. This considers the expected development of the energy demand profile which helps to scale the potential production, storage and conversion units at the adequate level. Retrofitting the remaining of the building stock and installing heat pumps in the interested households will have a beneficial impact on the islands' energy situation. An important aspect to consider is whether the islands are developing towards a future with a stronger interconnection with the mainland grid or whether a non-interconnected future is pursued.

Community support and engagement are also needed if the islands want to take ownership of the electricity production on the island. Solar and wind power are considered the technologies with the highest potential. Financing local energy production can happen through the community and can be combined with additional funding from partners, investors or other external funding to assist the community in overcoming capital barriers. Installation of local renewable energy sources such as wind turbines and solar panels, however, require flexibility power systems that can handle intermittency. These flexibility requirements can be met either through the interconnection with the mainland, through storage solutions or other conversion technologies.

Hydrogen production and storage can serve as a conversion and storage measure and help to reach the island's vision of complete decarbonisation. The hydrogen production can help to stabilise the electricity grid and can also be used in transport on the island as well as to and from the island. Another option to reach more flexibility in the system is through battery storage that stores electricity when excess occur and offload in other periods.

Regarding transportation on the island, taken the island size into consideration, getting visitors to choose a bicycle instead of other means of transportation is also part of the efficient demand measures which will reduce the overall consumption of energy for transport on the island.

Including the communities to understand the actual needs is essential to reach the Aran Islands vision. All the potential technology pathways, whether they contain hydrogen, batteries, electric vehicles, retrofitting of homes, heat pumps etc. will have to be aligned to achieve a reliable, decarbonised and community-owned energy system within the frame of the vision for the Aran islands.

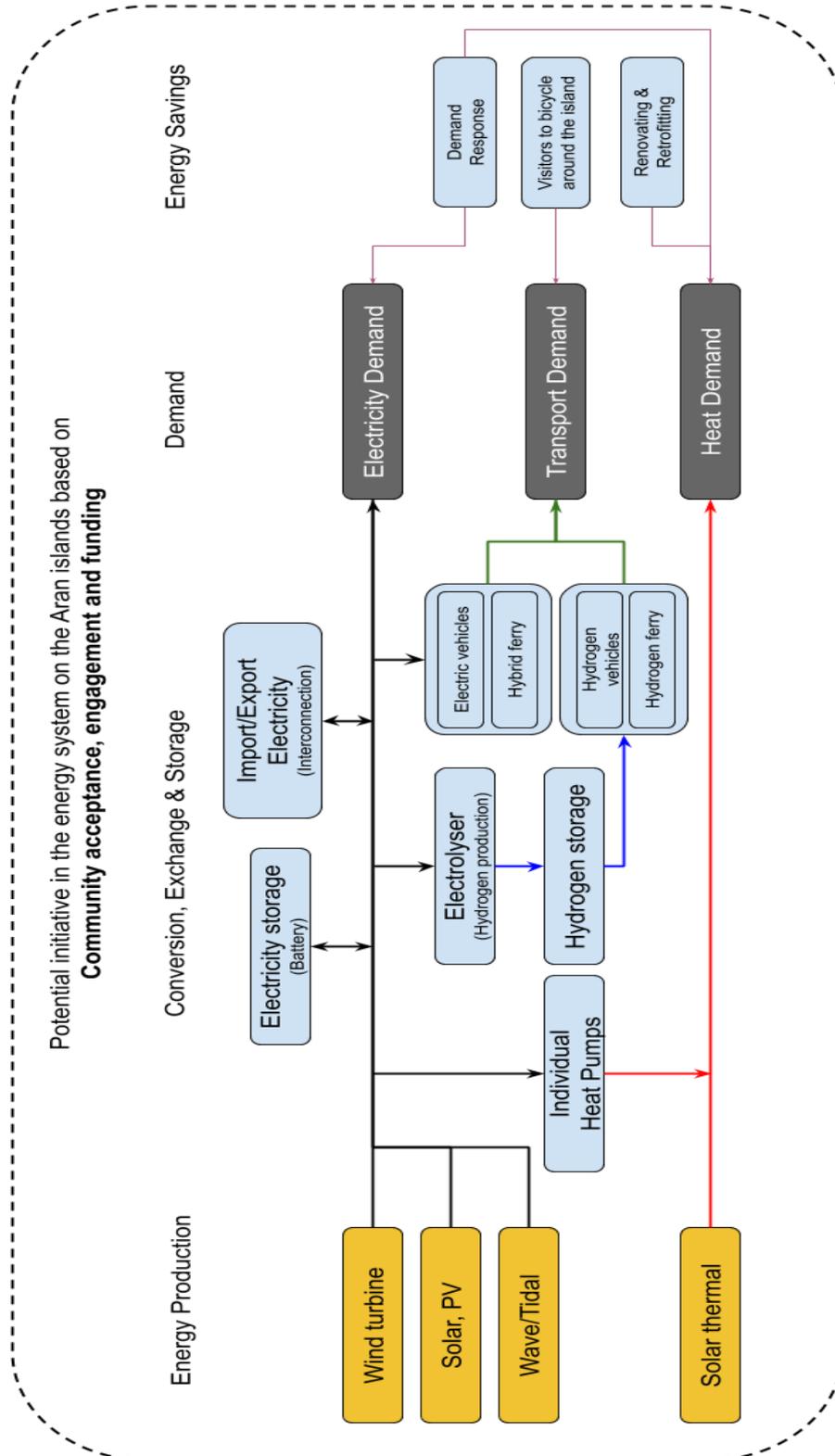


Figure 5: Possible transition pathways for the Aran Islands

6. Monitoring and dissemination

Monitoring is an important part of the learning process of any transition. The Clean Energy Transition Agenda therefore monitors both the transition itself and the way that that the process is managed. This forms the basis to determine the next steps. Monitoring happens based on transition indicators that acknowledge the transient character of the transition process and address the need for regular re-adjustment.

The transition indicators span nine areas that cover different dimensions of the clean energy transition on Salina. A bi-annual self-assessment is made by the transition team as experts of the situation on the island. This analysis helps to direct the strategic focus of the transition agenda and can be used as an indicator for the next steps.

The transition indicators for the Aran Islands were evaluated in June 2019 together with CFOAT. Figure 1 gives an overview of the results.

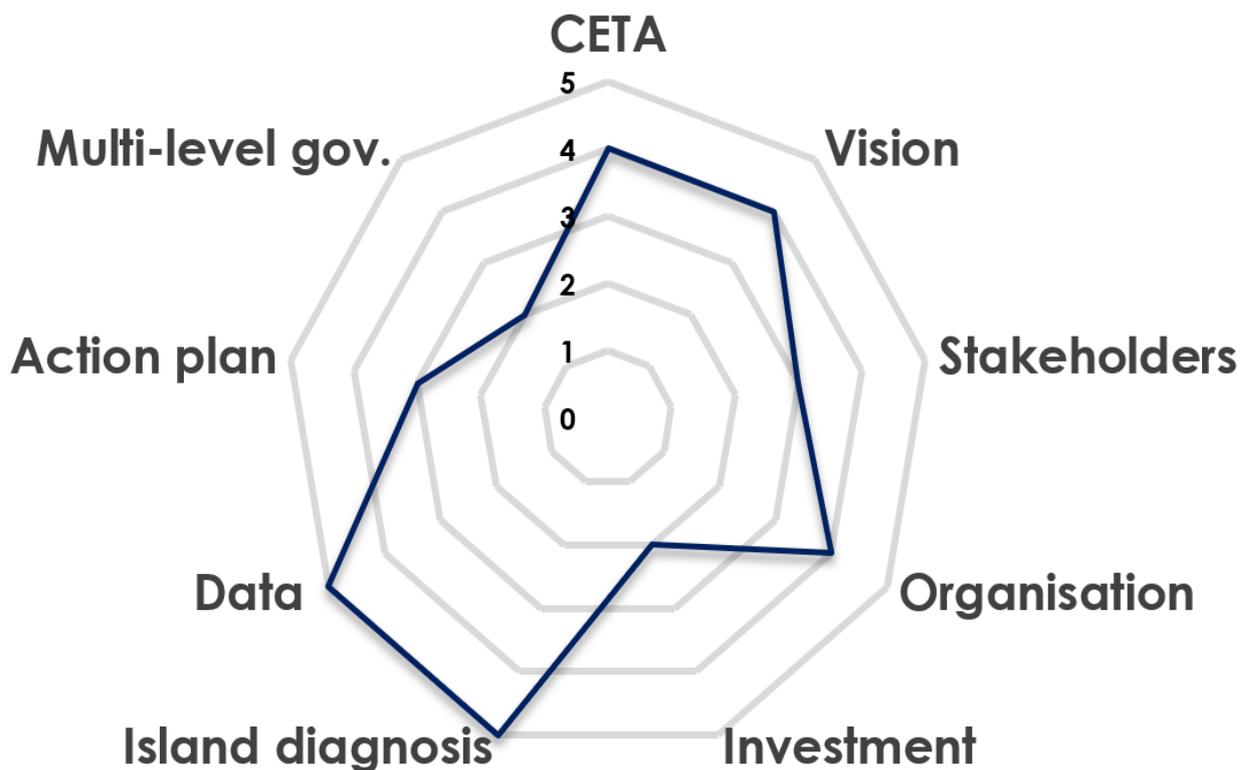


Figure 6: Transition Indicators self-assessment from June 2019

Indicator: Clean Energy Transition Agenda**4**

The transition team indicates that there is a collaborating between local businesses, schools and the CFOAT as a community initiative on moving forward the islands clean energy transition. There is a strategic dialogue ongoing on the islands in which all these actors are able to voice their perspective on the possible transition paths. The Aran Islands therefore assess themselves as 4 for this category.

In order to reach level five in this category, the Aran Islands will submit a Clean Energy Transition Agenda to the Clean Energy for EU Islands Secretariat. They foresee to do this in Fall 2019.

Indicator: Vision**4**

CFOAT has a well-developed vision that includes clear objectives: energy autonomy, local employment and decarbonisation. This vision was developed in 2012 when CFOAT was created. This vision has not been approved by the relevant authority, Galway County Council.

In order to reach level 5, explicit targets for energy efficiency, renewable energy integration and emission reduction need to be formulated. The transition team, however, considers the current vision as sufficient and prefers to focus its efforts on engaging the community and moving forward individual projects.

Indicator: Community Stakeholders**3**

Several actors on the Aran islands are strongly committed to clean energy transition. This commitment is made by individual actors. In order to reach the next level in this category, the transition team plans to sign the Clean Energy for EU Islands Pledge to formalise the commitment between the stakeholders.

Different pathways for clean energy transition have been discussed and considered. It is important to make sure that the stakeholders are aligned on which transition path are worth pursuing.

Indicator: Community organisation**4**

The CFOAT acts as an open and island-wide platform that consists of and is supported by actors from multiple stakeholder groups that drive the energy transition process. Challenges in the current organisation are that there needs to be ownership of the transition process in order to make consistent decision. For this, a larger support from the community is necessary.

The CFOAT realised that the lack of support from Galway county council makes it hard to get to level 5. This support would allow to receive support from additional programmes,

such as the Covenant of Mayors, etc. This is an important barrier for the development of the clean energy transition on the island.

Indicator: Financing concept

2

The transition team finds that there is little awareness on financing opportunities for clean energy projects on the island. While several potential projects have been identified, financing these projects is a serious challenge.

In the past, the Transition Team and CFOAT in particular, have relied on funds from different agencies to finance their projects. Retrofitting the houses was made possible by grants from SEAI.

Indicator: Decarbonisation plan – Data

5

The CFOAT periodically collects consumption parameters for the different sectors of consumption on the island. This is based on local reporting:

1. Electricity consumption is reported by ESB Networks
2. Thermal fuel imports to the islands are reported by the cargo ferry companies.
3. Consumption due to ferry transport is more difficult to gather and is therefore estimated.

In order to stay at level five, this data should be collected annually. To keep track of the progress against the baseline, also information on the clean energy projects, such as retrofitting of houses and electricity generation, can be collected.

Indicator: Decarbonisation plan – Island diagnosis

5

A Master Plan exists for the islands Árainn and Inis Meáin, and one is under development for Inis Oírr. These documents were subsidised by SEAI. They include a complete energy balance and a breakdown of consumption per sector and per energy source for the islands. They cover the sectors electricity generation, heating, transport on the island and transport to and from the island. For the purpose of strategic energy planning, this analysis provides the necessary information that allows to make informed decision and evaluate and prioritize transition pathways. Anticipating the Master Plan for Inis Oírr, the Aran Islands are at level 5 for this category.

The Master Plans need to be periodically updated in order to take into consideration the progress that is made and other evolutions on the island. It is recommended that the master plan is updated every 3 years.

Indicator: Decarbonisation plan – Action Plan**3**

The Master Plan includes a list of opportunities per technology which gives the priorities and key measures on clean energy transition on the island. However, this is limited to a general indication of the potential of different technologies on the island and does not indicate how these can be implemented.

In order to reach level 4, the individual actions for the implementation of these projects are included in the Clean Energy Transition Agenda. This is mainly done for the projects that are most concrete: developing the wind turbine and retrofitting the houses. The transition agenda focusses on the process of these individual projects.

An official Action Plan would require the approval by the relevant authorities, which in the case of the Aran islands is Galway County Council.

Indicator: Multi-level governance**2**

The Transition Team identifies that there is little multi-level governance in place regarding clean energy transition on the island. Some other levels of governance are considered regarding clean energy transition, though the interaction is limited. The transition team looks at Galway County at a local level, Sustainable Energy Authority Ireland at a national level, the Clean Energy for EU Islands Secretariat at a European level.

The limited interaction with Galway Country Council is a major limitation to the clean energy transition process and acts as a strong barrier to move forward on individual projects.

Annex I: Further reading

The Aran Islands Master Plan:

<https://documentcloud.adobe.com/link/track?uri=urn%3Aaaid%3Ascds%3AUS%3A3ac6ce69-9692-494d-9001-d8c57b620868>

Ireland's Climate Action Plan 2019:

<https://assets.gov.ie/10207/c8f59b1734af460fa310ddbe20e01388.pdf>

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The role of the Clean Energy for EU Islands Secretariat was to advice the islands transition team and to facilitate the written agenda.

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