Distributed Treasure: Island Economies

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- ISLAND ECONOMIES -

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cradle to cradle islands

The Interreg IVB North Sea Region Programme

"Distributed Treasure - Island Economies" is a collection of case studies on distributed economies, a concept describing sustainable alternatives to the existing business models. The authors of this publication are international Masters students of the Environmental Sciences, Policy and Management Programme at the International Institute for Industrial Environmental Economics at Lund University in Sweden. The aim of these IIIEE working papers is to explore Distributed Economies in the context of islands across the world.

Cradle to Cradle® Islands is an EU Interreg IVB North Sea Region Project with the main goal being to develop innovative solutions in the field of energy, water and materials, using the C2C® principles as a guide.

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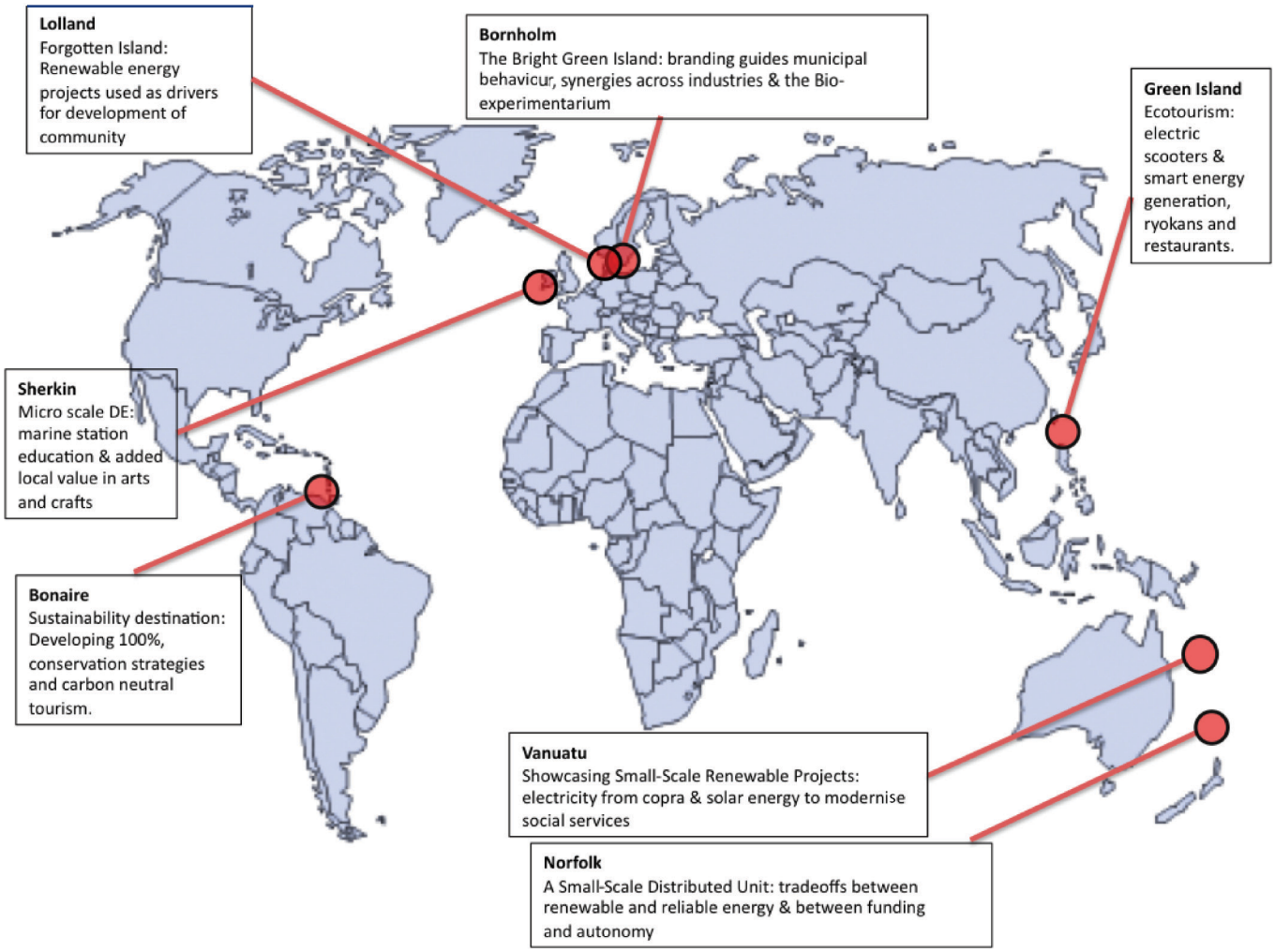

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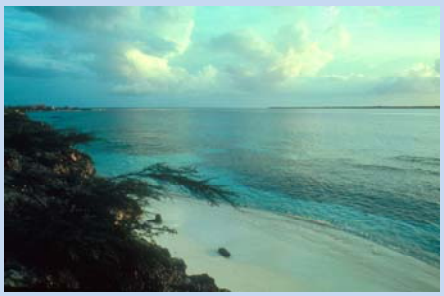

Introduction

Scenic view of Bonaire Island. Photo from Tourism Corporation of Bonaire

The authors of these reports want to take you on a journey around the world to seven islands, all on their own paths of development. A common thread among the showcased islands is a desire by, or the potential for, innovation, diversity and regionalism in their communities. It is these components that suggest a point of departure from the norm, and have allowed the islands to be explored for their contribution to discussions on the presence of distributed economic systems.

Distributed Economies (DE) is a concept that has been developed as a response to current industrial production systems, which promotes the development of small-scale, flexible units that are synergistically connected with each other and make use of local resources [1,2]. DE also strives for innovative regional development strategies. In this context, regions are defined as small-scale operating entities that are brought together into networks offering the advantage of being much more flexible and resilient to respond to change.

To further explore and promote discussion on the concept, *Distributed Treasure – Island Economies,* takes DE to the new context of islands. What can potential researchers, or those wanting to debate DE as a concept, learn from systems that islands around the globe currently work with?

The first part of the report explores seven case studies, as illustrated on the preceding map. The second contains reflections of the authors on the DE concept, in light of that journey. Both the practical island examples and the summaries provide interesting insights into the opportunities and challenges that the DE concept faces.

It is hoped that the report will provide future researchers on the topic with examples to work with. The concept is evolving and island examples contribute to expanding the body of knowledge on the subject. What the authors are attempting to do is invoke debate and conversation around the DE framework, and continue to challenge established centralised systems. In doing so, they also seek to promote innovation and creativity.

The reports build on previous literature and seminars by authors such as Allan Johansson, and last year's publication "*The Future is Distributed: A vision of Sustainable Economies*" [3]. Further, it is hoped that the report can contribute to the Cradle to Cradle Island Project (C2CI), through showing innovative solutions from islands around the world. The authors would also like to thank C2CI for sponsoring their study tour to Bornholm, the Bright Green Island, in Denmark.

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Sustainability in Bonaire

By María Rosell and Neisha Manickchand

Photos by Dos Winkel & Tourism Corporation of Bonaire (TCB)

Bonaire is an island in the southern part of the Caribbean and it aims to be the first island in the Caribbean to run on 100% sustainable energy. This was one of the main factors that motivated these authors to research and analyse the sustainable elements of the island. In addition to this, Bonaire received the Sustainable Tourism award in 2008 which illustrates steps that the island is taking to increase its sustainability. Thus, this article will focus on the sustainability aspects of energy and tourism on the island of Bonaire. Energy sustainability in this context means 100% renewability. This article will address the aspects of how Bonaire is achieving 100% renewability and how tourism is carried out in order to accomplish sustainability in this sector.

In addition to the aforementioned, this article will also analyse what aspects from the energy sector and tourism apply to Distributed Economies (DE) and how Bonaire could sustainably improve these two economic sectors using some of the elements related to DE.

Brief characterisation

Situated 87 km from the Venezuelan northern coast, and 40 km from eastern Curacao, Bonaire belongs to the "ABC islands" group (Aruba, Bonaire, Curacao), its surface area is 288 km^2 and the maximum altitude is 2 440 metres [1]. The population is approximately 14 000 [1] and the number of households are 3 300 [2], its capital is Kralendiijk, and the second urban agglomeration is Rincon. The official language is Papiamento but Dutch is widely spoken and the majority of its inhabitants also speak English [3]. Klein Bonaire also forms part of the territory; it is a 6 km^2 inhabited islet located in the west side of Bonaire [4]. Bonaire's primary economic activities are tourism, oil transference and salt production.

The recent geopolitical change of status of Bonaire occurred in October 2010, which consisted of the dissolution of The Netherland Antilles [5]. Currently, the island is a special municipality of the Netherlands, a factor that has a direct impact in areas such as education, and the public health system [6]. Furthermore, the adoption of the United States dollar as the official currency in the island after the dissolution is considered to increase the attractiveness of Bonaire as a tourist destination, since 45% of the tourists in the island are from the United States. In addition, change of currency is predicted to increase investment in sectors such as tourism [6]. Nevertheless, the change of status does not affect noticeably the way the economy is run, especially in the tourism sector since it is locally managed with no intervention from The Netherlands [6].

Energy

Islands are generally dependent on external sources of energy and are vulnerable to price fluctuations and a reliable supply of fuel for electricity generation. Although islands are not significant contributors of greenhouse gases, they are in a position to illustrate to countries

how sustainability can be achieved by using the resources available to them. Bonaire is seeking to do just this.

Bonaire is in a unique position where it is aiming to be the first island in the Caribbean to supply all of its electricity needs sustainably. Bonaire intends to supply the whole island with electricity from renewable sources of energy. This strategy in turn reduces the island´s carbon footprint and creates a range of other advantages as well which will be illustrated further in this article.

These authors consider that such a plan is interesting as the island is using its local resources to supply electricity in a sustainable manner and not depending on external sources of fossil fuels which can have a negative impact on the economy and the environment.

Aims and goals

The objective of the island is to be powered by 100% renewable energy by the year 2015 [7]. The island intended to construct a hybrid wind energy and diesel power plant which would consist of an 11 MW wind farm supplemented by a 14 MW diesel power plant, and a 3 MW energy storage system [8]. Bio-fuels are expected to be introduced at a later stage to complement the wind energy thus reaching 100% renewability [7]. Implementing such a system also aims to reduce greenhouse gases and increase the recognition to encourage tourists to the island [7].

Windmills near Washington Slagbaai National Park

The pre-existing situation

Bonaire imported fuel to use in their electric plant before developing renewable energy on the island. In the past, WEB B.V. was the energy supplier of Bonaire. WEB is the Water and Power Company of Bonaire. Bonaire had a conventional diesel power plant until it burned down [7] and now the island is increasing the use of renewable energy.

The current energy supply situation

The diesel plant and wind farm are operational and from August 12, 2010, Ecopower Bonaire BV, became the sole provider of electricity on the island. Ecopower Bonaire BV is currently in a testing phase and the maximum wind share that has been reached is approximately 40% [7]. It is, however, expected that with sufficient wind the wind farm in the future would be able to supply up to 70% of the total island´s energy consumption [7]. If Bio-fuels are introduced at a later stage, the island will become 100% renewability.

The combined diesel/wind power generation facility has an installed capacity of approximately 23 MW and the peak demand is approximately 12 MW. The island is using low sulphur HFO but in the future bio-fuels will be used which is 100% renewable [7].

Bonaire is currently fine tuning their power management and battery system. These systems are expected to take care of wind fluctuations and guarantee efficient use of the diesel engines. The battery system helps to stabilise the island's grid [7].

Future

Biodiesel is expected to increase and diesel is expected to be phased out. The country is still in the testing phase with regard to biodiesel but

Flamingo Sanctuary, Washington-Slagbaai National Park

it is looking at using algae as a bio-fuel to provide energy and therefore achieve 100% renewable energy [7].

In order for Bonaire to achieve the target of 100% renewability, it plans to obtain biodiesel from salt-water algae to power the diesel plant.

Ecopower Bonaire BV mentioned that they are currently quite involved with getting the most out of the wind farm and their power management system. Using algae to derive fuel is a promising next step as it presents a great opportunity to achieve 100% sustainability [7].

Advantages

The general advantages of achieving a renewable energy supply is that it would eventually help to reduce the country's high energy costs as well as encourage tourists that support green destinations [7]. The cost of electricity production by renewable means for the country is expected to be lower than the cost of utilising fossil fuels.

According to Ecopower Bonaire BV, one advantage of this scheme is that in cooperation with WEB B.V., the island´s grid has become more stable. In addition to the aforementioned, the remote location of the power plant reduces the environmental burden as the noise produced is negligible. This is of importance because in the past, the power plant was located near to hotels and a residential area.

Other advantages to take note of include jobs created in the construction of the wind farm and projects related to it including the upkeep of the farm. Also, jobs related to researching the use of algae as a bio-fuel on the island are created. Having a diversified energy economy with various energy jobs is beneficial to the economy as various skills are learned and practiced. The knowledge and skills obtained can also be exported.

Disadvantages

According to Ecopower Bonaire BV, there are not any real weaknesses or barriers to the scheme. The power plant and wind farm are operational but the only problem identified was the probable lack of wind. These authors believe that a lack of wind is a great limitation unless it rarely occurs.

Analysis

Bonaire is a small island in the Caribbean that has an endearing aspiration of attaining 100% renewable energy in the future. Whilst it is an achievable goal, in reality it is difficult. It is vital to obtain support from various stakeholders including the government. The island has increased the supply of energy from wind but it needs to complement this with biodiesel before it becomes 100% renewable.

Many islands face the problem that Bonaire faces: that is, the time it takes before measures are implemented. It is important to have unceasing support from the government and other stakeholders to bring a vision to fruition. As noted before, Bonaire is taking steps to achieve the plan to become the first island in the Caribbean to have a 100% renewable electricity supply. One thing that Bonaire should be mindful of is that other islands in the Caribbean may achieve this goal before Bonaire actually finishes the project. Many other Caribbean islands are introducing projects to develop grid-tied renewable energy alternatives

Diver observing coral reef in Bonaire

and thus there may be competition to reach 100% renewability.

The energy projects being undertaken in Bonaire are aligned with some of the concepts in Distributed Economies. For instance, the island is using local resources such as wind to provide self-sufficient energy and it is also adamant to utilise algae to produce bio-fuels. The projects are rather innovative but the energy grid is centralised and this is not entirely in keeping with the idea of DE. Although the island has a centralised grid, the island is so small that a centralised grid actually is more beneficial and economical than one that is distributed.

Reaching Sustainable Tourism

The most relevant economic activity in the island is tourism; more than 85% of the inhabitants of Bonaire work in this sector [9], and in 2009, 7% economic growth was derived from tourism. Within this activity, diving tourism is predominant, with 86 marked diving sites and a visibility which exceeds 30 metres [10], it is a unique diving destination in the Caribbean. Divers constitute 55% to 65% of the total tourist arrivals within 1999-2008 [10], with roughly 25% of the divers as repeat tourists [10]. Besides diving, tourism activities in the island are: windsurfing, kite surfing, snorkelling, kayaking, swimming, hiking and bird watching [9].

BONAIRE TOURISM FIGURES	
Number of tourist arrivals (2008) *	74 342
Average Length of Stay by night (2000-2004)	9.3
Arrivals to Hotels (2004)	55.2%
Arrivals to guest houses (2004)	31.5%
Cruise passenger arrivals per year (2009) **	213 191
**TCB Report (2008) [12] **CTO (2010) Reports [13]*	

In recent years, Bonaire has received prizes such as the Sustainable Tourism Award (2008) by the Caribbean Tourism Organisation (CTO) for their successful practices of ecotourism, such as the integration of marine ecosystem conservation and benefits for the community within the tourism sector in Bonaire National Marine Park (BNMP) [10]. Also in the years 2004 and 2007, magazines such as National Geographic and Island Magazine have acknowledged Bonaire as a worldwide top destination for sustainable tourism [10]. Moreover, the island has won the Award for Scuba Diving in the Caribbean and Atlantic destinations for 8 years in a row [6]. On top of that, a study in 2008, the National Oceanic and Atmospheric Administration (NOAA) concluded that Bonaire has the healthiest reefs in the Caribbean; a result derived from effective marine protection policies [6]. All these accomplishments indicate that there have been efforts made in the island towards sustainability; nevertheless, an attempt to describe sustainable tourism (ST) is outlined below.

There are various concepts of sustainable tourism ST; however, for the purpose of this paper, the authors consider that the following two principles within ST have a strong connection with DE; maximisation of benefits for local communities, and minimisation of negative social and environmental impacts [11]. These authors also consider that for the accomplishment of ST the following elements are essential: promotion of local communities' cultural heritage, financial support to conservation pro-

grammes, self-sustained energy efficiency, locally produced food, and efficient waste management [11]. In addition, certification schemes for ST are also a step forward to incorporate and apply elements of DE.

In this sense, examining programmes and strategies from the different stakeholders in the Island should provide a better outlook of what the concrete actions are in order to improve ST in Bonaire.

Carbon-neutral tourism on Bonaire

The Carbon Neutral Programme (CNP) is an initiative from the Tourism Corporation of Bonaire (TCB) that aims to promote Bonaire as the first destination in the region to have a carbon-neutral tourism industry [14]; the starting point will be January 2011, and the time period for the achievement will be 2 years [14]. The way to accomplish this is to identify, quantify and reduce the GHG emissions from the tourism sector [14]. Throughout a combination of energy efficiency, renewable energy and reforestation programmes, the private and public institutions are working together to set actions and implement the project.

The goal of this programme is to create an effective informational channel for tourists to raise awareness regarding their carbon footprint, thus, the implementation of the standards will be based on TCB carbon footprint analysis [14]. TCB is planning to use this as an on-line information tool to encourage tourists to contribute either towards the improvement of energy efficiency/renewable energy projects or through a reforestation program [6]. Besides the informational strategy, TBC and associated organisations plan to reduce 20% of waste produced, as well as the promotion of energy efficient consumer products [14].

The TCB authorities perceive CNP as an innovative strategy at least in the Caribbean region, since it is intended to change tourists' behaviour through information [6]. Currently, the rough estimations made by TCB point out that 71 024 metric tonnes of carbon dioxide are produced by tourist and travel activities, which means almost one metric tonne per visitor. If the CNP succeeds, the emissions will decrease by 0.048 metric tonnes per tourist [14].

In addition, there is a project which will be implemented along with the CNP, to protect various indigenous populations of trees, since introduced species such as goats, and donkeys have negatively affected the arid ecosystem in some areas of the island [14]. Planting 125 indigenous trees will be carried out where the majority of the visitors can see the trees to encourage them to participate in the reforestation project from the CNP [14].

Marine conservation strategies and fees for divers

In regard to preservation of marine resources, Bonaire is a leader within the Caribbean region. The conservation strategies started from 1961 with the turtle protection programme, then in 1971 the banning of spear fishing and finally the coral protection in 1975 [14].

In BNMP there are two marine reserves where divers are not allowed to enter. Dropping anchors is prohibited in most of the area of the park. Prohibition is in place for live capture of fish, commercial fishing and coral mining. BNMP further promotes "no touch diving" by prohibiting the use of gloves by divers, to pro-

Christmas Tree Worm – Spirobranchus giaganteus

French Angelfish

tect corals or marine species [15]. Furthermore, all the divers receive orientation regarding the rules of BNMP [14].

The Netherlands Antilles National Park Foundation (STINAPA) is the entity that operates the protected areas in Bonaire, and the improvement of BNMP was due to the implementation of an admission fee of EUR 7.5 in 1992 [15], a factor that made this marine park area to become self-funded, being the first in the Caribbean to accomplish this [15]. Currently, the fee for divers is EUR 19 and for all users of the area remains EUR 7.5. The money collected by the implementation of this policy facilitates research, monitoring programmes and also environmental education, not just for BNMP but also for the management of Washington-Slagbaai National Park, which is a flamingo sanctuary and it is also a responsibility of STINAPA [14].

Analysis of tourism in the island

With regard to the CNP and conservation strategies, they have a common goal: to encourage ST, changing tourist behaviour or preserving the marine life, which is the island's primary resource. These authors consider that there is a connection among these actions and elements within DE, in accordance with the essential elements of ST previously discussed. Nevertheless, Bonaire still has to accomplish some tasks in order to completely achieve ST.

The different stakeholders within the tourism industry in Bonaire have successfully promoted cultural heritage and environmental education among tourists through a series of learning and interactive activities with the community as well as information campaigns [16]. Another positive aspect to highlight is the general aim to become energy efficient, a factor that will influence how the tourism industry will be run.

The relative independence of the STINAPA institution to self-fund conservation strategies throughout the "nature fee" is an aspect that can be related to DE, since it is a way to preserve the natural resources in an efficient manner without much intervention of the public sector. Nevertheless, in accordance with ST elements, these authors consider that there should be an effective waste management programme, an aspect that the island has not completely fulfilled [17]. Bonaire possesses a landfill, and some of the residues are sorted (glass, construction material, cars), however, there are still problems concerning the sorting system, for instance with batteries or car tyres [17]. Also, the landfill is not properly located since it is significantly close to the sea, creating negative effects on the water table and also to the marine ecosystem because of the toxic runoff from the landfill which is found in the soil in nearby areas, and affects terrestrial and marine species [17]. Furthermore, there are no active recycling programmes in Bonaire [17]. The waste generation issue is partially addressed in the CNP, by setting reduction targets (20%).

The last element for ST that Bonaire fails to fulfil is locally produced food, since all the supplies are imported [9]. Food production is not feasible, at least for the internal consumption, (except for fish and goat meat) because of the poor soil quality and water scarcity. Therefore, alternative measures to reduce the impacts of transport, such as trade agreements with closer neighbour countries could be im-

plemented, instead of importing food from European countries or North America.

Taking into account the presence of large hotels and resorts, these authors suggest the implementation of a policy of certification scheme for ST. Although it might differ from the DE concept, an eco-label system for these large infrastructures could have a positive effect in the environment and also it might reduce the amount of large resorts in a future and motivate the creation of mid-sized, small hostels on the island, such as "Captain Dons Habitat" Hotel (only hotel with a Green Globe Certification in Bonaire) [9]. Besides the previously mentioned certification programme, in the Caribbean region, Central America and Mexico have the Great Green Deal, and Blue Flag programme which is international.

Finally, these authors believe that the main economic sector in Bonaire, which is tourism, does not seem entirely engaged with the DE concept, although, there are clear efforts to link the growth of tourism with sustainability strategies. Another aspect to improve is the articulation of civil initiatives and the private sector; there are various actions amongst Bonaire citizens, regarding recycling [18] and discussions about the state of environment in the island, but still they need more support from the public and private sector.

Conclusions

Bonaire is striving to be the first island in the Caribbean to attain 100% renewable electricity and aiming to be the first destination in the world to have a carbon-neutral tourism industry. These activities illustrate examples of sustainability strategies that islands and even larger countries can accomplish. These authors consider that while Bonaire is making steps to achieve sustainability, there are still areas where there is room for improvement as mentioned in the article. Therefore, suggestions have been made on how Bonaire can increase its sustainability.

Further analysis of Bonaire and its applicability to Distributed Economies show that the sustainability strategies in Bonaire are aligned with some of the concepts of DE such as utilising local resources and applying innovative strategies to improve the quality of life in a continuous and diversified manner.

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From the top: Coral reef; Coastal landscape; Salt flats; and Queen Angelfish

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The Bright Green Island: Bornholm, DK

By Amy Cregar

Photos by Amy Cregar

Bornholm is a remote island in Denmark which lies in the southern part of the Baltic Sea between Germany, Poland and Sweden and is in closer proximity to these countries than to the capital city of Copenhagen or the rest of Denmark. Historically, it has been occupied and possessed by both Sweden and Denmark at various times, this is reflected in both the local dialect and in the unofficial flag which is an amalgam of both Swedish and Danish emblems [1]. It has an area of 588 km^2 population of 42 154 which is distributed equally between men and women [2].

Bornholm has an aging population where more than 50% of the current population is between the ages of 40 and 70 years of age and only 23% are under the age of 20 [2]. Changes in Danish municipal reform instituted in 2007 have established Bornholm as an independent municipality under Region Hovedstaden with both autonomy and funding to manage their affairs independently [1]. As a result of this reform, Bornholm has set about to transform itself into an island of sustainability through coordinated municipal efforts and an aggressive branding strategy.

The Bright Green Island

The island of Bornholm in Denmark is showcasing itself as bright green by striving to have 100% renewable energy and to be 100% carbon neutral by 2014 [3]. The Bright Green Island's goals are in line with the European Union's thrice twenty targets of sustainable and intelligent energy by achieving 20% reductions in both primary energy use and GHG (green house gas) emissions by 2020 [4]. Bornholm offers the perfect setting as an island to observe the resurgence of a distributed economy, one in which residents by choice or necessity have nurtured systems of inter-reliance to flexibly and efficiently meet their needs. Bornholm's vision of its own future reflects lessons of the past; respect scale, work together, preserve the earth, do not waste – these are mirrored in the development and branding strategy of the island as bright green.

Global Megatrends

Bornholm seeks to align itself with the global trends of the future rather than limit its growth strategies to time static or regionally specific models. Visible responsibility is one trend whereby decisions regarding the populace are made in a transparent process; responsibility is specified rather than left amorphous.

In addition, by aligning municipal strategies with the trends of voluntary simplicity and other quality of life based movements; this harmonises with the purposeful experience promised to the creative workers the island is seeking to attract. Overall, Bornholm is pursuing a balanced and holistically integrated approach to environmentally mindful development by targeting its focus areas across a spectrum of interrelated systems; synergies among which are fostered through growth clusters.

Østkraft power plant

Development Plan

By branding Bornholm as the Bright Green Island, the municipality is creating a vision for the populace to follow. The municipality draws upon its three key strengths of: uniqueness; creativity of residents and workforce; and its environmental quality which are then further integrated as part of nine parameters by which to measure the island's success in its development actions.

The future vision and direction of Bornholm is being guided by a desire to live the vision which they strive to create, to live what the residents believe in, which is a vision of locally sustainable, technologically advanced but ecologically friendly, functionally clustered and economically distributed, satisfying lives.

In presenting itself as a beacon of green actuality, the island municipality is developing its economy by becoming a laboratory for innovative environmental technologies and strategies which are integrated into the municipal services and systems upon which the residents rely and interact with daily. Bornholm utilises its current and future residents as willing participants in greener economic systems by integrating current needs and infrastructure with future developments. The island and its ethos are the product people are buying into.

Citizen Engagement

The Bright Green Island is not just a vision of the municipality; it is not relegated to branding strategy spun out of hay by Bornholm's Rapunzel, Lene Grønning, into a golden future – it is bright green through the efforts and inclusion of local people into current and future initiatives. Community engagement and participatory planning utilise the community's needs as a point of departure for further development and population growth. The concept of *More Bornholm* provides an open invitation and medium for locals wishing to participate directly in Bornholm's Growth Forum by showcasing their personal exemplification of the island's ethos. Many if not most of the values of the municipality are citizen focused and centred on improving and maintaining quality of life.

The municipality seeks to promote nature, physical activity, general enjoyment, efficient transport, internationality, and play while discouraging and reducing noise, traffic, stress and nationalistic or exclusionary sentiments [3].

Citizen engagement is essential for the success of a distributed economy and the municipality of Bornholm is well aware of this. The Bright Green Island concept and branding strategy places the network of interconnection and nodal development square in the context of its residents and their needs – the people provide the centre by providing the framework [5]. These are all essential elements in making Bornholm an attractive place to live.

Facing a declining and aging population, the Bright Green Island must attract and retain a creative, innovative, younger and environmentally minded population in order to sustain itself as a municipality. For this reason, rural development and development strategies must be coherent with growth initiatives and thus use citizen forums and draw upon the expertise of the municipal council [3].

Island as Innovation Centre

Bornholm, as part of its branding, incorporates environmental strategies with those of population and economic growth using the island's resources and population as a "bio-experimentatium" through which to showcase green technical solutions [3]. New projects include modern sustainable housing in the form of passive housing and green housing offered on a temporary basis to newcomers to the island and tourists. These promote environmentally friendly housing by example and allow new residents the opportunity to live in low energy buildings with passive heating, gray-water systems and other innovations with which they may not yet be familiar or comfortable. Transportation is another focus area of the Bright Green Island and initiatives to green the vehicle traffic are underway. Production of bioethanol which runs free public transit occurs on island and electric cars are available free of charge to tourists with reservations. These electric vehicles tie into the energy grid of Bornholm as their batteries are part of a pilot project to test a distributed rather than a centralised energy grid.

Accomplishments

One might ask, in light of Bornholm's aggressive branding strategy, just what it has accomplished in terms of a distributed economy which furthers social, environmental and economic goals. In terms of energy, intelligent systems such as the smart grid, which uses the storage capacity of electrical vehicles to augment the needs of the grid, seeks to avoid the construction of further power generation facilities to meet the fluctuating demands of the population. Renewable energy is being used in ever increasing proportions in the form of wind and biomass to phase out fossil fuel through aggressive thermal efficiency standards in new housing and the retrofitting of existing structures. Energy is being fully utilised by recovering energy from waste, both through biogas generation and the use of waste heat for district heating [3].

Water quality is maintained through appropriate levels of groundwater treatment, which for the current time requires only aeration. This reduces the chemical load of wastewater which is purified in a distributed network of seven treatment plants and discharged clean to the

Forsyning – energy from woodchips

natural environment. Solids are treated and utilised as agricultural fertiliser for non-food crops such as straw for the district heating plants closing material cycles and cultivating synergies between seemingly disparate municipal sectors [3].

Distributed Economies & Growth Clusters

Bornholm's growth clusters are what make the island most interesting in terms of distributed economies. Clustered development is characterised by physical proximity, cooperation and the functional alliances of businesses which share various competencies generating greater employment potential, resource efficiency and follow a common growth strategy.

By grouping related sectors together into six primary clusters of: food; agriculture; tourism; machinery and technology; building and construction; and crafts – Bornholm seeks to encourage collaboration not competition to solve challenges and promote growth. Resources are limited, prioritised and allocated to each cluster which must then network within the sector and between sectors to find mutually beneficial synergies. This helps to close material cycles which are the source of waste and environmental harm, to fortify business to business (B2B) relationships and, where possible, encourage industrial symbiosis.

Cradle to Cradle

Closing material cycles accomplishes the Bright Green Island's goal of "branding by doing" [3] that characterises the municipality's commitment to follow through and puts into practice the Cradle to Cradle (C2C) ideals of life cycle analysis (LCA), social responsibility, and intelligent resource use [6]. The C2C concept examines resource and product use in the context of its entire life cycle which includes in its purview the entire process from raw material extraction to final disposal of whatever those raw materials were fashioned into. Growth is organised in such a way as to be self-organising, dynamic and respectful of naturally occurring limitations – it is centred on the vision of Bornholm as sustainable, environmentally exemplary, and satisfying for residents and businesses alike [7].

The clusters themselves represent cooperative networks. The *tourism* industry is clustered through a common website which links, co-promote and track tourist activities and expenditures. The *food* cluster links local producers with retailers, restaurants and wholesalers both on and off island to promote Bornholm's gourmet products.

Machinery and technology promotes cross-sectoral cooperation by unifying training and recruitment efforts and also by the deployment of several technologies in their test phases as experiments in progress – a strategy in line with Bornholm's desire to be innovative and creative.

The building and construction sector works together to promote and implement sustainable construction (materials and methods) and by forming an alliance with the island's business school to implement a sustainable construction training program. The *agricultural and food* sectors are being merged, but for the moment, both are focused on unifying farmers and educational institutions to institute a common agricultural strategy incorporating nature conservation with agricultural and food processing endeavours. The *crafts* cluster works in tandem with the Arts & Crafts Association of Bornholm (ACAB) to increase visibility and cooperation through joint international exhibitions and marketing. Across all sectors cooperation: influences political decisions; aids in the training and recruitment of new employees; promotes sales, marketing and branding; and promotes innovative product and service development [8].

Synergistic Growth

Growth, in the Bornholm context, is expected to yield not only positive development and economic prosperity but also to increase quality of life. By distributing and connecting economic activities, more residents are involved in the logistics of provisioning the goods and services that they require and are involved in the economic system, preventing the imbalanced distribution of wealth within the society. Gross income disparities inhibit sustainable development by distancing those with power from the resources upon which everyone relies, colouring decisions and encouraging resource exploitation as a means of increasing profit and power – distribution interrupts this cycle [7]. Bornholm's growth strategy seeks to create not only cooperation but a common identity of all economic cluster areas.

Growth is planned through networked economies of scale – capacity through interconnection and not size [7]. The local electrical utility Østkraft has the interlinked Smart Grid and Edison electric car projects which embody this ethos by attempting to meet the fluctuating energy needs of the island's residents and visitors through a distributed grid [6]. A distributed grid accommodates the erratic demands

Forsyning – energy from woodchips

of a seasonally populated region while avoiding costly and wasteful overbuilt infrastructure.

The development of renewable energy sources on the island in the form of wind turbines and biogas plants add value to local resources without degrading the environment. Bofa (the waste removal company) and Biokraft, a biogas producing subsidiary of Østkraft (local municipal service providers of energy) work to close material cycles by using agricultural and sanitary waste for the generation of energy [9]. Synergy occurs when Forsyning, the municipal water and sewer utility (who also owns and operates straw fired heating plants), is integrated to redirect and utilise the waste heat for district heating [3,7]. Regional annual capacities include [6]:

- Biokraft:
  - 14 500 MWh of electricity
  - 12 000 MWh of heat
  - CO_2 neutral
- Bofa
  - 65% of waste recycled
  - 26% of waste incinerated
- Østkraft
  - Largest global electricity testing area for Smart Grid (28 000 m)
  - 33% wind energy supply
  - 15 835 MWh
  - -7 100 tonnes CO_2
- Forsyning
  - 23 000 MWh carbon-neutral heat
  - 1 300 households
  - -5 700 tonnes CO_2

Though many steps have already been taken, there is potential to further reduce organic waste and increase energy production through bio-fuel generation and composting if residential, hospitality and institutional organic waste can be redirected. The application of inert treated sanitary waste (from livestock) and compost from organic waste to agricultural fields also has great potential for soil augmentation, increased land fertility and crop yields. Together with the incorporation of greenhouses, these measures have the potential to help move Bornholm towards agricultural self-sufficiency.

Local effort and inclusion are essential for regional vitality and the functionality of a distributed economic framework in that these elements provide both the motivation and focus on local individuals necessary to maintain and improve quality of life [7]. Bornholm accomplishes this partially through housing. Initiatives to promote energy efficient housing both new build and retrofit by Steenberg, a private architectural firm designing private passive housing, and by QualiByg who is designing energy efficient dwellings for the seasonal tourist populations which promise to deliver 90% thermal energy efficiency and seek to reduce the energy demands of current and future residents by reducing heating and cooling cost caused by thermal inefficiency.

This concept is taken further with the Cradle to Cradle conference centre which utilises contract services rather than material purchasing to build and maintain the structure such as the

provision of light, conference facilities and others. This project is currently in the fundraising phase; construction has yet to begin [9].

Conclusion

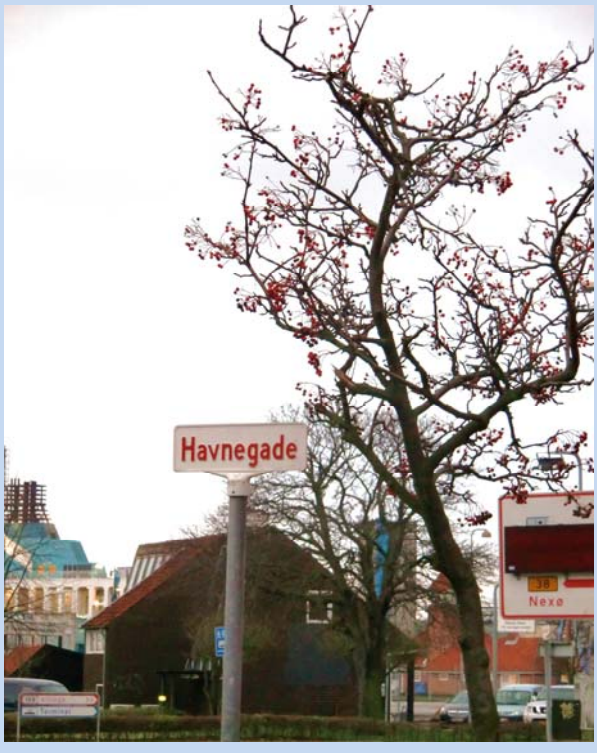
As mentioned, Bornholm's nine parameters for success offer the best possible framework for analysing its success in creating a distributed and green economic framework that respects the local population, available resources and environmental integrity [3].

Sustainability in attracting and hosting the island's seasonal tourist population is one parameter that is being met, partially by their use of Butterflies (a seasonal work force from Poland). Maintaining the *unique* quality of Bornholm's attraction is another parameter by which newcomers and tourists alike can assess the *quality product* that the island itself is offering. *Creativity* is part and parcel to the Bright Green Island's *growth* strategy which seeks to attract young professionals and families with members in *innovative* fields and with entrepreneurial spirits. *Communication*, *public services* and *accessibility* all further the strategy of innovation by attracting businesses eager to take part in innovative green systems.

Roughly half the parameters correspond directly to the interests of businesses (sustainability, public services, growth, innovation, and communication) and the other half to seasonal residents (sustainability, uniqueness, creativity, and quality) but all nine parameters are designed to appeal to new and existing residents [3], all are incorporated into Bornholm's self assessment radar.

The Bright Green Island of Bornholm is a fascinating example of how strategies of growth and development can occur responsibly and sustainably within a distributed economies framework. The island's holistic and integrated approach utilising sectoral development encourages inter-reliance and cooperation, closes material, energy and economic cycles which are directly tied to waste, and avoids problems of income inequity, influence and resource exploitation. Insisting that all development occurs within the context of citizen values ensures the social dimension of sustainability. Focusing on innovative technologies positively influences environmental sustainability. Linking economic development with green technical innovation and continual improvement through experimentation and entrepreneurship ensures economic sustainability.

What remains of interest is whether or not the municipality of Bornholm will be adept not only at enabling, but in sustaining the cooperative structure of coordination [10] which it has established between the development clusters



and thus maintain the synergies and benefits of sustainability thus far established.

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Lolland and the Rebirth of the Forgotten Island

By Jana Kovandžić & Galyna Prymak

Photos: Kaja Braun-Jacobs, Floating Power Plant A/S & Lolland Kommune

The case of Lolland is an example of how a peripheral area, driven by the enthusiasm of individuals, can transform into a sustainably developing region. Bringing together public and private sectors, a number of innovative solutions were introduced. Many projects related to renewable energy, agriculture, tourism and education were implemented under the Community Testing Facility (Lolland CTF) platform. This article aims to give an overview on how the concept of Distributed Economies (DE) can be applied to bring back to life a decaying community.

Ideas emerging

Lolland is located in the south of Denmark, in the municipal region of Zealand, which is reasonably close and well connected to the capital city, Copenhagen. It also has close connections with Germany. The island has approximately 70 000 inhabitants and an area of 1 243 km² [1].

Lolland is situated only 150km from the capital, which could potentially stimulate trade and development and create ideal conditions for economic growth, as well as create a trade connection with Germany. However, this island has suffered a severe economical crisis in the last decades of the twentieth century, followed by loss of jobs and a serious decline in population caused by migration. The unemployment rates on the island reached about 40% of the total working population [2]. To survive the tough competition in the sphere of economics, the island had to come up with a recovery plan and find its own path of development [1].

The changes in power and the social commitment of newly elected leaders created opportunities for development. What the government in the island envisioned and what has lead to success, is a target based model indicating a desired path for development. This further led to the creation of many projects which sought to achieve the established target goals. As a consequence, the social and employment pictures became more favourable and Lolland became a nest of development, attracting people from all around Denmark interested in working on thrilling projects. Today, unemployment rates in Lolland are down to approximately 3% [1].

An article published in *Focus Denmark Magazine* claims that, "today, there is no other place in the world that generates as much renewable energy per capita as Lolland does" [2]. The island authorities sought to empower local communities to create their own energy, use it and possibly sell the excess back to the grid. The aim was to reduce dependence by the citizens of Lolland on non-renewable resources, shield them from fluctuations in their prices on the global market, but also to give them an additional source of income [2].

Further development built around energy related projects serves as a starting point for development, but goes a step further, building a feeling of belonging to the community and creating a network of cooperation on a broader

level. This is done through ground level projects such as small tourism and slow food based businesses.

Lolland developing

To understand the rise and fall of Lolland and to be able to grasp the development potentials of the island, it is important to give a comprehensive overview of the projects striving for sustainability. Only then is it possible to create a full picture of Lolland and the potential it has to offer. This section will give a further outlook on the projects that aim to make the island energy independent in terms of electricity and heating.

A search for the model that would bring solutions to challenges from the past and those that may emerge in the future resulted in feeling that a coherent approach must be elaborated in order to save the island from economic fall and provide potentials for development [3]. Lolland Community Testing Facility (Lolland CTF) was created as a demonstrative platform for alternative and renewable energy technologies, and was intended to be used as a model that could potentially spread throughout the world [4].

It was decided to design this platform using the intellectual capital and experience of the Lolland community with the support of Danish government [4]. The project was developed in order to create a completely new vision of how a small island can overcome obstacles, get on the path towards sustainable development and become a positive example of a clean energy solution. The platform shows how the full-scale implementation of different energy-related projects can be successfully achieved. Additionally, Lolland CTF is an example of a case where the industry and government are in line with each other, contributing to sustainable growth and development [1].

The role of the Lolland municipality is to facilitate the coexistence of community, nature and business demands, provide opportunities for industry not only to develop new technologies surrounding energy and environmental issues, but also to apply them in real world conditions. Therefore, the project engineering does not merely remain a theory, but has the opportunity to be tested in practice and implemented on a larger scale.

One of the significant differences between the traditional flow of project development and Lolland CTF scheme is a parallel implementation of several projects at different stages, shortening the time spent from the idea generation to the actual project outcome.

According to Bjartnes [5], the island has become an arena for many companies and research institutions to test their projects. This is beneficial both for the Lolland community and for the development of technology because it allows researchers to test and improve test projects while making a contribution to island's energy demand [5]. Some of the Lolland CTF participants believe that what is happening on Lolland is a small scale example of what has to happen on a global scale. [5].

The need for skilled people who will be able to operate the desired projects on the island was correctly identified by the island authorities, and the idea of establishing an International Wind Academy emerged. This is also one of the key answers to resolve unemployment problems, which are then solved through the retention and creation of competent and skilled workers which are able to install and maintain wind turbines [6].

The current economic development efforts of the Lolland CTF focus on the renewable energy business development. The projects include [7]:

- Hydrogen and fuel cells;
- Algae/biomass/biofuels;
- Wind and wave energy; and
- Water treatment.

The biomass platform

One of the most fascinating projects of Lolland CTF is a bio-refinery designed for biomass exploitation. The platform consists of four phases and combines several renewable energy projects (biomass, wind energy, algae and hydrogen cells) into one interconnected system. The total installed capacity will be 6.4 MW of heat and 4.8 MW of power [5]. The generated waste heat from the production will be purchased by the city heating company which is owned by the municipality and is able to purchase waste heat for up to EUR 4 million per year [8].

The first phase starts with manure, straw and vegetable waste as inputs and results in the production of lignin and biogas for district heating, as well as fertilisers which are a useful by-product and methane for the second phase. The usage of fodder is avoided here, therefore the process is CO_2 neutral. Molasses that is being produced during the second phase is used as high value biomass for the biogas production in the first phase. The second phase itself aims to generate lignin and ethanol, but also creates by-products. Besides the mentioned molasses, this phase includes CO_2 which serves as an input for the third phase where methanol is being produced from water, hydrogen and CO_2. The power for the process is provided by wind turbines. Finally, the last fourth phase uses algae biomass and urban and industrial waste to generate biogas for district heating. Additionally, methane is a by-product here that is used to complement the third phase [9].

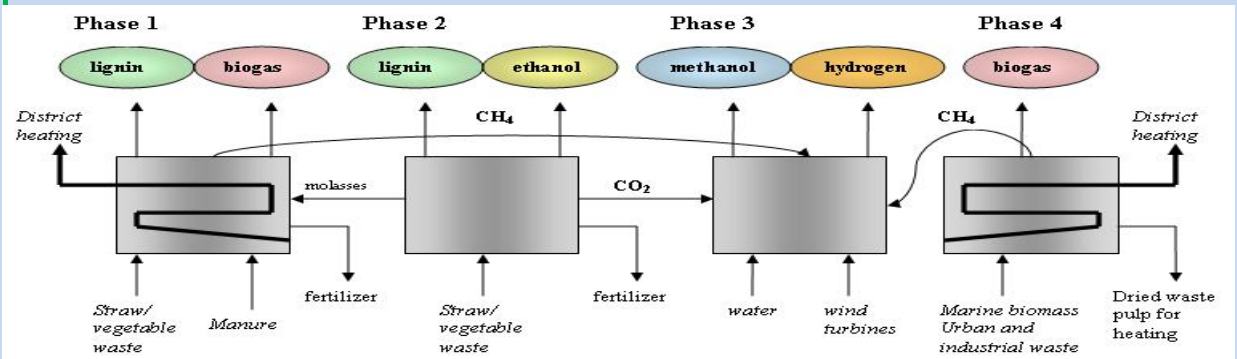
This, complicated platform is an example of industrial symbiosis combining more traditional technologies like biomass utilised for generating biogas with innovative ideas such as algae and hydrogen cells projects. As a part of Lolland CTF the platform aims to become an inspirational model that brings together district heating, agriculture and other local businesses into one system. This is a successful example of the DE concept where different initiatives are able to create a synergetic power that will provide benefits to industries, environment and the island community as a whole.

The first hydrogen city in Europe

In the village Vestenskov on Lolland, hydrogen technology is tested for usage in domestic consumption. It is planned for hydrogen to become a primary energy source, thus making the village of Vestenskov the first hydrogen city in Europe, providing electricity and heat distribution, while being completely CO_2 neutral [10].

The hydrogen energy is obtained through the process of electrolysis, converting surplus energy from wind power [5]. This is a new technology that solves the problems associated with storing the energy obtained from wind [11]. Each household is equipped with a hydrogen distribution network similar to the one used for the gas. T he hydrogen is stored in containers until it is distributed to households according to their needs through the pipeline [2, 12]. This storage system favours owners of

Biorefinery Platform: Phases of the process. The diagram created based on [9]



wind mills, since they can now store energy when there is an excess of wind and therefore prices are lower, and the energy can be used when there is a demand for it or sold when the prices are more favourable [2].

Hydrogen is converted into heat using the electrochemical processes, with an efficiency of about 50%, but, combined with the fuel cells this system provides an efficiency of about 90% [13].

The importance of these projects exceeds both the benefits to Vestenskov village and to Denmark, since this is one of the pioneer projects in this area, which aims to give more information on the usefulness and potential of hydrogen for energy production. This can be considered as a trial project, a prelude to projects of greater scale.

For the island itself, this project is one of several that the government of Lolland is conducting, with the idea being to achieve energy self sufficiency, but also to create interesting opportunities for the local population to fight against rural depopulation and brain drain [13].

The Wind-Sea-Algae project

This project is at an experimental phase, but it is argued that it could be a breakthrough in fight against the climate change. Cost is the main barrier for the project achieving success when compared with alternative projects [14].

Below the offshore wind farms on the water's surface, pallets containing algae are kept. Algae consume CO_2 and can thus be considered as a type of fuel which is carbon neutral [15].

Surface algae have great potential as biofuel, since it reproduces very fast in these surroundings. Through the process of photosynthesis, biofuel molecules are created much faster than in inland processes of the same kind. In these processes, molecules of water, nutrients and CO_2 are converted with almost no losses. In contrast, the man-made processes creating biofuels result in only about 50% of the energy production [2, 14]. Biomass obtained from algae contains oil, which at the time where the possibility of an oil crisis is high creates an interesting scientific field to be explored [15].

Here it must be noted that large investments are placed on the development of this project. This is a very costly project with high risks, where one of the leading companies has recently declared bankruptcy. However, work continues [16].

Wind and Wave energy – Poseidon 37

Poseidon 37 is a project initiated by Danish Floating Power Plant A/S. Near the coast of Lolland, an ocean power plant extracts energy from both wind and waves. It is a floating platform with uniquely stable characteristics designed for the open sea. The general idea of the platform is to provide renewable energy to land installations but is mainly intended to serve as support and backup [17].

The openness of the Lolland community to new technologies, as well as the Lolland CTF initiative, made it possible for the Poseidon developers to conduct testing of the platform. According to Anders Køhler, project manager of Poseidon 37, the waves off the coast of Lolland have the right size for this testing but not enough energy for a commercial platform [18]. Therefore it will not be a permanent installation, but an experiment and an example for other similar projects. So far, this project has

Poseidon 37: Floating Power Plant

contributed to the island's energy supply by providing electricity to the grid.

Poseidon 37 had two off-shore test phases. The platform is currently in Nakskov Harbour being prepared for the third test phase, to commence and run from May - October 2011 [18].

Stipulated development

The strive for energy independence was correctly observed by the visionaries of the island as a driving force and motor for the restructuring and development of other areas - agriculture, tourism and empowerment of the local community [8].

Lolland is developing a concept unique to the area, the "Slow food concept", which focuses on food, cultural dignity, biodiversity conservation, and encourages public debate on these issues [19]. Based on the slow food concept, Lolland became a host of the Moder Jord (Mother Earth) food festival, presenting local products to the island's visitors. The goal of this festival is to restore local identity and a sense of belonging to the community, encouraging locals to start their own production of quality food and profile their products beyond the local market. Participants in the festival include local producers of wine, fruit, marmalade, meat and meat products. Through an interactive presentation, tourists have the opportunity to find out what the people of Lolland are growing and offering during each season. Therefore, a more personal contact with consumers is established [20]. One of the leaders of the island development, Leo Christensen, noted that at this moment, sustainable agriculture is one of the fastest growing businesses on the island, with a lot of small industries involved [8]. However, he further explained that this area has yet to develop, as Lolland still exports too many raw materials, instead of creating additional value by refining the products having this as a focus point for further development [8].

Sustainable food and local production on Lolland

Many islanders got involved in a so called "small tourism" project targeting small businesses. Within this initiative, the companies involved share mutual experiences and support each other while also providing training. These small businesses involve shops selling organic wine, tours through the island vineyards, small pension-houses, farm shops, a small brewery, a sugar museum, and craft shops. The idea on Lolland is for the tourism industry to remain small, but to involve more members, creating a solid network for cooperation. This is, in a way, a strategy for promoting the island and its culture while building a stronger community and dealing with social issues [21]. These small businesses are further connected through the Tourism Network in the Zealand Region, which provides their members with adult education courses, strengthening their communication and presentation skills, which is highly necessary in the tourism business [22].

Employment and education

One of the most significant achievements of the new development strategy has been the drastic decrease in unemployment rate from 40% to 3%. Apart from other important issues, this is an example of how a well-designed system can effectively function through the engagement of a large percentage of the community. Mainly, a lot of jobs are provided to the local population through new projects. For example, according to Christensen, the building of the new tunnel or bridge to Germany for exporting the excess of generated energy will create up to 7000 jobs [8].

However, the need for proper education and training emerged, which required action from the municipality and management teams. In order to prepare people for work in these new projects, , the municipality established an IT school to provide for the education of semi-skilled workers in the field of renewable energy as well as to teach English and German language courses [8, 12]. New jobs are not only related to the energy sector. With Slow Food and Small Tourism projects, initiatives are created which combine various businesses, providing opportunities to small farmers, craft shops, hotels. Here special training courses were also introduced. The idea of these projects is not to keep growing but rather to remain small and continue sustainable activities and in a way which fits the concept of DE [21].

The drivers

Suffering from the consequences of the previous economic depression which resulted in high unemployment rate, brain drain and low economic performance, the Lolland Community decided to undertake a fundamental approach to tackle these challenges. The initial aim of the strategically developed recovery plan included issues such as job creation, raising attractiveness for business and the diversification of economic activities [1].

One of the driving forces for Lolland CTF elaboration was an expressed commitment to environmental and renewable energy based on many international and Danish agreements and protocols as well as a number of EU policies. In 2007, in particular, Lolland Municipality signed a climate change agreement with the Danish Society for Nature Conservation, under which the Municipality aims to reduce greenhouse gas emissions by 3% annually until 2025 [1]. Moreover, the municipality should present a well-developed and feasible climate plan showing how it is going to achieve this target.

Lolland CTF project aims to provide benefits in four areas [4]:

1. Social sector including employment, training and education;
2. Industry where the focus is on the more efficient life-cycle of the product development and commercialisation;
3. Research and testing; and
4. General public as a whole contributing to sustainable development of the island.

Such a large-scale project with a long-term approach would inevitably collide with the need for continuous financial support and effective planning. Lolland municipality solves these challenges by introducing specific bodies for each of these issues: LOKE (Lolland energy holding that aims to provide financial solutions for the renewable energy projects) and T21 (Integrated planning) [4].

Lolland's strategy is to become a nexus between intellectual capital development, industry and employment. The successful outcomes within these domains are anticipated to foster the economic growth of the island, thus provide a solution for brain-drain prevention, investment attraction, and commercial and tourism sectors development.

In the light of Distributed Economies

When we talk about projects that are happening on Lolland, can we connect this with the concept of DE?

To understand DE as a concept, it is important to describe its relationship with economies of small scale. It can be noted that the concept of DE establishes a strong connection with regional or even local entrepreneurial developments, thus focusing mostly on the small scale businesses [23]. This concept does envision growth and development, but in its essence, these tendencies show a stronger relationship to the issue of quality, which distinguishes the concept of DE from the business as usual concepts, from economies of scale and from classical economic doctrines. In the concept of DE a feeling of belonging to a community can be observed, meaning care for the surroundings,

for the impact it creates to the livelihood in which it operates, remaining within the sphere of business and economy [23].

Are the developments on the island of Lolland an example of Distributed Economy? Can the projects happening on the island and the efforts that the local authorities are taking be considered as DE?

The primary motivation behind creating these projects on the island was the need to eradicate problems such as unemployment and are thus connected to poverty, rural depopulation, brain drain, but also to changing the image of the island and creating a new reputation both in Denmark and internationally.

Lolland projects have a highly local dimension, with the potential for moderate growth. This together with a shift on the local political scene has created a climate fertile for change [13]. Through informed decision making the authorities have found the potential for development - as described through the paper with practical examples of activities on the island.

The goal of the project is first of all to satisfy local needs. This is in line with the concept of DE.

These are small scale projects offering services qualitatively different from what previously existed. The hydrogen project, for example, gives incentives not only for savings, but also for earning additional income through collaboration with the local grid. In the case of algae, higher efficiency is achieved, while giving a positive impact to CO_2 emissions and the environment.

Scenery at one of Lolland's harbours

The projects of the Lolland island also have an entrepreneurial dimension, since the local governments give support to all projects that meet the targets set while bringing innovation and potentially better performance and product quality (energy).

Since the concept of DE is not fully developed, some questions can be raised about the place that this project could have within this concept.

Is the purpose of the concept of DE to provide models that can be replicated again with local modifications? If this is the case, how do we deal with the costs of the projects? For example the cost of these projects makes it hard for them to be conducted in a developed country such as Denmark, although not impossible, but it may be unfeasible and inapplicable for developing countries. Still, the story of Lolland can serve as an inspiration.

We found that the case of Lolland is a good example of a system of Distributed Economy in development and we believe that this case gives further light to this concept.

Conclusion

In the light of newly developed strategies to achieve sustainable development, the case of Lolland serves as a successful example of DE concept. This model is a fascinating presentation of how the industrial system can be transformed to a more sustainable, small-scale economic activity that is favourable for the community as a whole and bring benefits through the power of synergy. The latter can be either a dragging or a driving force taking into account the strong interconnectedness of every element of the system.

Remembering the times of economic stagnation that the island has gone through and observing the significant accomplishments that are in visible today, it is hard to believe that both of these images are related to Lolland.

However, the initiatives in renewable energy, agriculture, tourism and social sectors gave rise to the concept of the island as a platform to nourish unique, challenging but very promising ideas and projects. Yet it proves that realising the effect of the added common value that synergy brings and the commitment of individuals are key factors of success on the way towards more sustainable future.

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Sherkin Island: A Distributed Economy in Action

By Mark Ryan & Nicolas Acosta

Photos by Daniel Reilly, Bernadette Burns, & Ginny Pavry

Sherkin Island (*Inis Earcáin* in Gaelic) is located in Roaringwater Bay, County Cork, off the south-west coast of Ireland. A two-km, ten-minute ferry journey separates the island from the mainland. Sherkin is approximately five km long and three km wide with an average population of 100 people, with 34 permanent households in 2006 [1].

The economy is based primarily on traditional sectors, including farming, fishing and crafts, with tourism contributing to a substantial amount of the total income on the island. Local crafts include knitwear, silverwork, jewellery, wrought iron, candlesticks and decorative silk scarves [2].

A number of leisure activities exist on the island as well as historical monuments. The local amenities on the island include a shop/post office, a roman catholic church, and a community centre containing a library, knitting cooperative, offices and a function room [4]. The island also has a Marine Station and a Development Society.

Location of Sherkin Island [3]

The authors of this paper seek to exemplify the concept of Distributed Economies in the context of Sherkin Island. For this purpose, the authors have looked into the island's four economic sectors: Primary (Farming & Fishing), Secondary (Arts & Crafts), Tertiary (Hotels, Ferry and Tourism) and Quaternary (Academia, Scientific Research and Development Society) as well as energy, water and waste. The information was collected through questionnaires, phone interviews, official documents and information available on the internet.

Farming & fishing

Farming and fishing on the island contribute to approximately 32% and 10% of the total income on the island [5]. Farming includes beef farming, oyster and muscle farming. Fishing on the island is both commercial and recreational. Commercial fishing includes fish, shrimp and lobster fishing. Recreational fishing includes

Visual Arts Students at work in the community centre

both private fishing and angling as a tourist activity.

On the island there is also a small scale producer of speciality beers and wines which are created from vegetables grown locally and wild fruits harvested from the island's pathways and shrubberies [6].

Arts and crafts

The tranquil environment on Sherkin makes it an attractive retreat location for many of Irelands well-known musicians who wish to get away from the stress of the mainland rush [2]. The picturesque scenery and the relaxed ambience make Sherkin an attractive location for artists seeking inspiration, including poets, writers, sculptors, and painters.

Two artists residing on the island have created the Sherkin Island summer art workshop, a five-day workshop which runs during the months of June and July. Included in the cost of the workshop, participants are provided with meals, accommodation, tuition and materials. Accommodation for participants is provided by the Islander's Rest as well as breakfast. Lunch during the five days includes picnics, lunch at the Jolly Roger pub with dinner being provided at the hotel restaurant, the Jolly Roger pub and the sailing club restaurant on the neighbouring island of Heir. On one of the days there is a boat trip to Heir Island, with the title of the day being "Land Art Day", this involves making art using materials from nature [7].

A number of resident artists live on the island, with most artist works being sold at the islands Craft and Information Centre in Baltimore, at the port from which the ferry departs for Sherkin [8].

Tourism

Tourism on Sherkin contributes to approximately 33% of the total income on the island [5]. The main tourist season runs from the end of June/start of July when school holidays begin through to the end of August.

Accommodation

The accommodation on the island is limited; the Horseshoe Cottage B&B has five beds all year round in three ensuite rooms with tea and coffee making facilities. Guests are always welcomed with tea and home-made products, flavoured with local organic food and fish caught in the vicinity [9].

The Islander's Rest Hotel has 21 ensuite bedrooms with a view of the Baltimore harbour. The hotel has its own pub called Murphy's Pub,

A view of the Old Franciscan Friary

serving food and drinks and allowing visitors to socialise with the local people as well as a restaurant [10].

Leisure Activities

Sherkin Sea Venture offers sea thrills, nature trips and tours of the bay [11]. The island offers three clean, sandy beaches. Facilities exist in the area for recreational fishing and sea safaris with seals and dolphins congregating in the vicinities [12].

Sherkin is considered a great place for camping with two locations offering amenities for campers that include toilets, restaurants and canteen [12].

The Jolly Roger tavern offers a fantastic atmosphere for visitors and a room for events with stunning views of cliffs and reefs [13].

The island has two distinctive historical sites. The Old Franciscan Friary built in the 15th century and the O'Driscoll's castle which both dominate the surrounding landscape.

Festivals

Eat Sherkin! Food Festival was conducted in 2008 by Dianne Curtin, a famous Irish chef who decided to explore the colours and flavours of Sherkin, taking advantage of the great products that the Atlantic Ocean offers to the island: fine oysters, shrimps, mussels, crabs and fish [14].

Sherkin Island Family Regatta is an annual event that takes place in July or August [15]. On this occasion, rowing competitions take place crossing from Sherkin to Baltimore. At the same time there is a marathon, with food & drinks, and activities for children. People from neighbouring villages and islands are encouraged to compete.

The island's community has a strong musical culture, with informal and formal traditional Irish music sessions being held at the pub. The island also hosts an annual Celtic Music Festival in May [16].

Ferry

The island's ferry company transports goods and people, making 60 trips during the summer and 50 during the winter transporting over 1 000 people during the high-season and less than 200 during the low-season. There are two different size boats, with the large boat being used to transport people during the summer and the small boat used during the winter. The small boat is used to transport goods throughout the year [17].

Education

The island has one primary school and hosts a Bachelor degree in Visual Arts, a joint initiative between Dublin Institute of Technology (DIT), Sherkin Island Development Society Ltd., and West Cork Arts Centre, funded by the Department of Rural, Community and Gaeltacht Affairs.

Primary & secondary level education

According to a report by the Department of Community Equality and Gaeltacht Affairs [1] there are twelve children attending the primary school on the island. There is no secondary school on the island, with students commuting daily between the island and the mainland. No figures were found for the exact number of secondary school students on the island.

View of Sherkin harbour

Third level education

Upon completion of secondary level education, the majority of students wishing to pursue third level education do so at institutions on the mainland or in foreign countries.

The Bachelor of Arts (BA) in Visual Arts offered by DIT is a unique programme that integrates the community's knowledge and lifestyle with academia in order to maintain the diversity that is characteristic of the island. The idea of the BA started in 1998 with a series of meetings between John O'Connor – head of the School of Art, Design and Printing, Liam Chambers – SIDS development officer, Bernadette Burns – coordinator of the BA, and the community, which led to a pilot project in 2000 that later became the BA in Visual Art in 2008. The programme incorporates state of the art education tools such as virtual classroom, online research tools, blogs, social networks as well as traditional ones such as seminars, workshops, study visits and face-to-face tutorials [18]. Where possible, the programme organisers aim to prioritise the selection of individuals from communities near the island including Sherkin islanders.

Students spend six days of each month working in the Community Hall on the island and during their spare time either socialising with the islanders or on the mainland. The programme also brings to the island other students, artists and people interested in creating important opportunities to create community networks.

While studying on the island students either commute daily from the mainland, reside in rented houses, a caravan or the Islander's Rest Hotel. Of the present batch of students in the BA programme there are three Sherkin islanders.

Socio-economically, the programme has been able to create a constant flow of people during the low-season months creating an influx of monetary resources for the ferry, pubs, hotel, and rental businesses and the indirect jobs associated with them.

Water, waste & energy

The majority of the islanders receive their water supply from a sub aqua pipeline which connects Sherkin to the mainland however a number of households still use private wells [5].

Regarding waste, Sherkin Island is at the forefront of recycling with up to 90% of all household waste being collected on the island and sent to the mainland for recycling. This includes plastics, paper, cans, tins, glass and cardboard [5]. Even visitors to the island are encouraged to bring as little potential waste as possible when for example going for a picnic. The island does not have the capacity to deal with non-recyclable waste and therefore, all non-recyclable waste is shipped to the mainland where it is landfilled.

A small group of volunteers called the Sherkin Tidy Island group meets up once a week to clear public areas of litter and undergrowth and have been busy with new plantings [19].

The general method of wastewater collection on the island is through the use of household septic tanks, although some of the more modern buildings including the school have their own eco-units [5].

The President of Ireland Mary McAleese attending the BA in Visual Arts graduation ceremony

The islands electricity comes from the mainland via a sub-aqua cable. Heat on the other hand is produced on the island using oil, coal and wood, which are all imported from the mainland [5].

Sherkin Island Development Society

Sherkin Island Development Society Limited (SIDS) was initially founded as Sherkin Island Community Development Association in 1983 and became registered as a co-operative in 1994 [20]. The group "liaises with and lobbies administrative development and government bodies at all levels, in relation to island development issues" [1].

Successes in the field of the environment which SIDS has achieved until now include a recycling project in which "all glasses, cans and plastic are collected and sent for recycling", a project which in 1995 won an Environmental Awareness Award from the Department on the Environment [20].

A weekly beach cleaning programme has also been established as well as the placement of barrels on the beach for litter which users do not wish to take home [20].

Marine Station

Sherkin Island Marine Station is located on 6.5 ha of land on the north-west facet of the island. Founded in 1975 by Matt Murphy and his late wife, Eileen, the Station was initially comprised of one thirteen m^2 laboratory and now hosts a complex of five laboratories and a library containing 100 000 books, journals, reports, reprints as well as an herbarium of plants and seaweeds [21].

The Marine Station "receives no State aid for its research" [21] allowing it to decide which research should be carried out based on what the researchers at the station believe is necessary. The station seeks advice for "scientific matters from scientists worldwide, many of whom have been to Sherkin" [21]. Staff at the station includes volunteer scientists, who generally come to the Station from April to November and are awarded full board and a small allowance.

The station has three main aims [21]:

1. "To establish baseline data on the marine life of the coastline from Cork Harbour and Bantry Bay and to record the natural changes in the plant and animal communities";
2. "To raise the level of awareness of the marine environment in Ireland and the potential of the sea to create jobs"; and
3. "To help introduce young people to nature via Sherkin Comment" (an environmental quarterly publication) "and through educational programmes".

The Station was responsible for organising "the major environmental conference in Ireland every April/May" [21]. As of 2006, the Marine Station had "organised 36 conferences and workshops on the mainland and the island" [21] including an annual environmental conference which ran for 25 years, until 2009 with topics such as: "Can Industry and the Environment Live Together?" in 1989, "Infrastructure Development – Can the Environment be Protected" in 2001, and "Energy from Waste" in 2009 [22]. The annual conference attracted speakers from 22 countries and was the longest running environmental conference in Ireland [22].

Future potential

Sherkin Island and the neighbouring island Bere both have according to Sustaining Island Livelihoods (*Comhar no nOileáin*) "the level of economic infrastructure to support local development and facilitate sustainable year-round employment" [1]. They are two of only three non-Gaeltacht (where Gaelic is not the mother

tongue) inhabited islands nationally, judged to have such a capacity.

In the future, Sherkin Island can use this level of economic infrastructure to expand its mainland catchment through appropriate support and a thorough consideration of the various enterprises on Sherkin. This will enable the island to meet the needs of its inhabitants and visitors whilst potentially becoming a service provider for both the local population and the mainland market [1].

An organisation which is well equipped to fulfil these potentials on the island is SIDS, through its liaising and lobbying activities in relation to island development issues. The organisation has already managed to successfully establish a third level education programme on the island in collaboration with DIT, which acts as a service provider for both the local population and the international market. An extension of this concept should be recognised as a means of providing public and state services, in particular with regards to new private business endeavours [1].

Regarding energy, the island has a great potential to develop wind energy, however it is not yet part of the development plans for the area [5].

At present, SIDS is "interested in developing a community kitchen for the island, where space could be rented by different food-related enterprises, thus reducing costs for individual businesses" [1].

The future of the island relies on how it manages to combine the tourism with the arts and crafts, which provide part of the unique charm of Sherkin. The economic future of the island is dependent on the community networks already in place as well as those which remain to be created, not only with the mainland but also with the surrounding islands. One such initiative could include a combined arts festival, organised in association with Heir Island which also has a strong craft sector [1].

It is very important for the resilience of the island that the primary sector (farming and fishing) remains active through initiatives such as the consumption and promotion of local products. Initiatives similar to "Eat Sherkin!" making use of culinary artists should be promoted in order for the region to discover new ways of utilising the products that Sherkin has to offer.

In order to add value to the island and attract more revenues, Sherkin could follow a similar development pathway to Murano Island, Italy where its glassware is preserved using a label based on its Protected Designation of Origin [4]. A similar distinctive characteristic could be found for products originating from Sherkin, in order to create a brand for the island which would increase recognition of the unique values that the island has to offer in the field of arts and craft. A similar brand is already in place in West Cork for food and tourism products of the region including for crafts. The brand "Fuchsia", a West Cork Regional brand was launched in 1998 and strives to represent "a symbol of quality for the food & tourism products in the region" [23].

Discussions

Sherkin region is a clear example of a small-scale economy that performs as a distributed economy. The interactions within the island, with the mainland and surrounding islands show a case of different entities working together for a common goal: survival. Sherkin Island proposes to do so by having two high value streams: arts and science; and become a regional knowledge centre.

Sherkin Island is faced with a challenge, that of preventing value creation from becoming centralised on the mainland which would lead to islanders needing to relocate, resulting in cultural and mental impoverishment. While it is obvious that certain essential infrastructural facilities and services appear too expensive to

support locally, if analysed only based on population numbers, it is necessary to recognise the essential social, economic and ecological diversity that Sherkin has to offer.

The social and ecological capital which Sherkin has at its' disposal is vast, including a pristine environment, traditional skills in arts and craft, basic infrastructure, scientific knowledge, strong will, and a sense of community.

Already this capital has been put to use through initiatives such as the SIDS which aims to use a heterarchical process to combine external ideas and skills with those on the island. This has already been achieved through the creation of the BA in visual arts in cooperation with DIT.

Sherkin's services and products do not essentially compete amongst themselves; they complement each other in a symbiotic manner, with each of them offering different characteristics that create synergistic-hybrid relationships.

The Sherkin Island summer art workshop is a perfect example of how emotional quality can become an asset in combination with material quality. Through the use of art and the environment, the workshop provides participants with an emotional product which is unique. The monetary wealth which the workshop creates is shared amongst local businesses and therefore creates a sense of team spirit. This team spirit can also be expanded to neighbouring communities including Heir Island in the case of the art workshop.

This sense of team spirit is obvious in the case of the Sherkin Tidy Island group which aims not only to improve the quality of life for islanders but may also serve as a means for attracting more tourists and monetary influx.

Another important actor in the community is the Marine Station which plays a significant role in the fields of natural science and education. The experience which it has in research and awareness raising provide value to the island and may help identify areas where the island can improve its environmental and economic performances. The Marine station can play a key role in sustainable development by monitoring and safeguarding the marine environment. The independence of the Marine Station is essential to ensure that it is the concerns which are most pressing for the island which are addressed.

Conclusions

In our analysis we have discussed ten principles of the concept of distributed economies (DE) that apply specifically to Sherkin Island's economic model:

- Small scale production
- Common goal
- Diversity incentive
- Sense of community
- Heterarchies that promote innovation
- Symbiosis
- Emotional quality
- Team spirit
- High value products
- Sustainable development

We have found that the concept clearly applies to the economic model of the island .We forecast that thanks to the two high value streams – arts & craft and science – development on the island will continue under the DE concept. Nevertheless, a great effort is still needed to further promote the island and especially to keep developing the local businesses. How Sherkin survives the pressures of globalisation and human migration will depend on how the community is able to best make use of the natural and societal assets it has at its disposal.

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Ecotourism in Green Island

By Yunwen Bai & Xiao Li

Photos by Kai-Chen Chen & Yuan Yi

Green Island (Lyudao), a small but charming volcanic island in the Pacific Ocean, is a paradise for people hoping to escape from the hustle of urban life and a must-visit for tourists coming to Taiwan.

Overview of the island

Green Island is approximately 33 km off the south-eastern coast of the main island of Taiwan. It has an area of about sixteen km^2 with a length of four km and a width of three km. Its population is around 3 200 [1].

Location of Green Island (Image from Google Earth)

Well known for its beautiful island scenery, abundant marine biodiversity and rich aborigines' culture, Green Island is a tourism hotspot in Taiwan. Surging flows are surrounding the coast, creating the curving coastline. The island is right on the pathway of the northern channel of Japan Current, with the average temperature of 29 °C in summer and 20 °C in winter. Given such natural conditions, coral reefs and various marine creatures are active along the shore. The island is occupied mostly by hilly slopes. Only 15% of the whole island is flat land, where most of residential villages are clustered. Green Island Township, including three administrative villages, is under the governance of Taitung County [1].

In the past, the island long depended on self-sufficient, traditional farming and fishery. These economic activities have been shrinking, and tourism has become the pillar industry of the island. Profiting from the beautiful ecological landscape and the diverse entertainment activities, such as snorkelling and scuba diving, the island has attracted approximately 300 000 tourists annually in recent years [1].

However, the tourism boom has in the mean time brought about heavy environmental burden to the island. The huge amount of waste generated from tourism has become a severe threat to the seawater cleanliness, biodiversity and even the whole ecosystem in the area [2].

In view of the alarming environmental pressure and the opportunity of branding the island with a strong environmentally friendly feature, the central and local authorities have started oriented the development of Green Island to a more sustainable direction. In 2009, Green Island was approved as one of the two eco-tourism demonstration areas in Taiwan [3]. Since then, more researches and discussions have been ongoing, focusing on the topic of how to develop ecotourism on the island.

Generally speaking, there are beneficial inputs from almost all these researches and discussions. However, there is still a lack of unified theme to systematically guide the development of ecotourism on Green Island. Having carried out synthesis of literature and practice, and telephone interviews with key informants, the authors hold the opinion that the concept of distributed economies corned by Johansson et al. [4] can help to shed light on the development of ecotourism and the design of the sustainable roadmap of the island.

In the subsequent sections, this paper will first provide an overall analysis of the connection between ecotourism and distributed economies in the context of Green Island. The analysis and illustration will then be decomposed into different sectors, focusing on the practice and plans aligned with distributed economies. Finally the barriers of implementing these plans will be discussed, and future improvement will be suggested.

Glimpse of the coast of Green Island

Linking with distributed economies

Green Island possesses some advantageous conditions for the building of a distributed system in tourism.

The core competitive advantage of its tourism industry lies in the local resources, considering the island as both a marine biodiversity hotspot and an original residential area for aborigines. Attractive tourism activities, such as hot spring bath, snorkeling and exposure to native culture deeply root in these local tourism resources. In the mean time, the locals have no lack of desire to pursue better wellbeing and conserve their own living environment and cultural heritage by engaging themselves in tourism business. This constitutes the core for developing eco-tourism with the idea of distributed economies: ecotourism is to be developed based on local resources, to which additional value would be added; the revenues would be better retained in the region to serve the local needs in return.

Furthermore, in its tourism practice, there have existed some elements which are aligned with distributed economies. The most obvious examples are the dominance of ryokans, a type of private-run, small-scale family hotel, in its accommodations and the prevalence of local restaurants serving cuisines made of local products.

In addition to these existing elements, many under-discussion and established plans, which are to be implemented in future, also show connection with distributed economies. The promotion of electric scooters, the awarding programme of green buildings and the transformation towards renewable energy sources are all good examples.

The existing elements and ongoing plans in different sectors will contribute to the

"Breeze Ryokan" on Green Island

achievement of local, small-scale and interconnected facilities and business to support tourism activities with less environmental impact.

Practice in different sectors

Ryokan

The prevalence of ryokans, a type of private-run, small-scale family hotel, is one of the most noticeable characteristics of the island tourism. There are 51 ryokans on the island, providing the majority of tourism accommodations [1]. These ryokans are owned and run by individual family instead of being controlled and managed by certain tourism agencies. The profits from tourist accommodation are retained in these local families. Although they can only provide limited number of rooms, tourists can enjoy much closer experience of local scenery and culture. Besides, with the competition among the ryokans, many of them have attempted to get differentiated from each other by developing and branding their unique tourism services. For example, some ryokans involve local cuisine catering, snorkeling and hot spring activities in their service package; some even provide educational activities to tourists about marine biology and nature protection. It can be well perceived that the variety of ryokans itself has become an important selling point of the tourism on Green Island.

In addition, joint plans have been established to encourage the refurbishment and rebuilding of ryokans in an environmentally friendly way. The planned awarding programme of green ryokans sets criteria on energy saving performance, using of "green" materials and the promotion of local culture. It will help provide incentives for the transformation towards "green" tourism accommodations.

Local restaurants

There are nineteen restaurants on the island, and they all serve and promote local cuisines [1]. The raw materials, including various fishes, sea plants, grains and vegetables, are mostly produced by the local fishery and farms. Some vegetables are directly planted by the restaurants themselves. This helps to reduce the transportation cost of the raw materials and increase the self-sufficiency of the island. Besides, local restaurants provide not only food, but also an experience of local culture, which is also an attractive element to tourists.

Electric scooters

Because of the tropical climate, population density, limited space and transportation habits in Taiwan, scooters are widely and intensively used. Green Island is of no exemption. Especially for the holiday season, most tourists would like to rent scooters instead of cars. According to the statistic of the Tourism Bureau, Green Island, with approximate 3 200 residents,

Cuisine of local-produced fish

has over 3 600 registered scooters [1].

The conventional scooters used on the island are powered by gasoline. They not only require high import of fossil fuel but also cause air pollution. It is evidently challenging the transformation towards ecotourism on Green Island.

However, such problems are to be solved by introducing fuel cell technology for motorcycles. In May 2010, the Ministry of Transportation and Communication of Taiwan decided to implement a plan providing a total amount of subsidies of TWD 860 million (EUR 21 million) to both Green Island and Lamay Island for replacing petrol-driven vehicles with electric scooters and electric buses over next four years [5]. The plan aims to reduce CO_2 emissions from both Green Island and Lamay Island by 2 000 tons by 2012 [5]. Although the current development of fuel cell technology may be not appropriate to be applied to vehicles for high-speed and long-distance driving in some bigger cities, for Green Island, electric scooter is obviously rather a market niche.

Besides reducing CO_2 emissions, electric scooter is viable for the travelling within short distance on the island, and well satisfies the basic need for tourism mobility. The flexible and relatively low-speed scooters could also help to foster an atmosphere of slow pace sightseeing instead of "appreciating flowers on a running horse" [6].

However, some aspects still remain to be improved in the next stage. Firstly, the electricity used for charging scooters is generated by conventional thermal power plant. Exploring alternative power generation from renewable sources is necessary to achieve zero-emission objective in transportation sector for the island. Fortunately, local authority has already been considering solar and wind power development on the island [1]. Secondly, owing to the steep mountain paths on the island, difficulties lie in the demanding power load when electric scooter climbs steep slopes. So, battery technologies need to be advanced. Finally, it should be pointed out that, as the promotion of electric scooters was just launched this year, more convenient facilities need to be constructed to meet the increasing charging demand.

Intensive use of scooters in Taiwan

Custom green building plan

In order to attract more tourists with the beautiful scenery, it is encouraged that old residential houses made of metal materials under severe corrosion should be rebuilt, and new houses and tourism facilities with creative, attractive appearance should also be constructed.

Consequently, "Custom Green Building Plan" has been released, and it is supposed to be implemented next year [1]. The plan aims to adopt "Green Island custom green building principles" for new buildings, which requires the compliance with some general criteria, such as energy saving, CO_2 emission reduction, waste reduction, material selection and indoor environment. Also, incorporating traditional culture, respecting local living habits and using local resources, are highly appreciated in building design. Encouragingly, the subsidies on transportation of building materials will be provided to residents who decide to go for green buildings. Although this plan has not been formally launched yet, several ryokans have taken the initiative in applying certain principles in their refurbishment and construction. It can be expected that this green building

programme will help to improve the environmental performance of buildings and strengthen culture conservation in communities.

Smart generation of renewable energies

At present, electricity is produced by thermal power plants with the total installed capacity of 7 500 kW. The power generation relies on diesel imported from outside of Green Island by shipment [1]. In order to match the growing energy demand from tourism and to find alternative, clean energy sources, "Renewable energy master plan" has been formulated for the island in 2008 [7]. In the plan, both solar power and wind power are particularly prioritised. The possibility of building a tidal power station by utilising Kuroshio Current is discussed as well. The plan has been implemented since this year, and will be accomplished by two phases gradually increasing capacities of electricity generated from renewable energy sources. It is estimated that 32.9% of conventional energy sources will be replaced by the end of 2020.

In order to achieve the renewable energy objective, smart installations of power generation facilities based on renewable energy sources have been carried out to meet the energy demand. These installations are different from conversional constructions. They are more adapted to the specific local conditions and more economically viable by taking into account factors like the topographical constraints and the economic acceptance and consumption habits of residents. Issues, such as where to install the facilities and which specific appropriate technology to adopt, have been thoughtfully analysed in the master plan [7].

The island is located in the pathway of Pacific Ocean typhoon which may destroy big, tall wind turbines, and wind direction convergence in summer time is lower. As a result, the county's authorities point out that it is more appropriate for the island to construct small wind energy conversion system less than ten kW. For example, a 1.5 kW vertical wind turbine composed of a brushless Direct Current (DC) generator was established and has been in good use in the primary school of Gong-guan village [7]. This equipment can avoid destroying the local ecological landscape and generating much noise, which is more suitable to be installed on a tourism island.

Besides the generation of electricity, renewable energies can also be produced for heating. The promotion of solar water heaters among ryokans is an example. Tourism season normally starts from June and lasts till September, during which time thousands of tourists come to the small island, so there are usually problems to meet the high demand for heated water. At present, there are about eighteen ryokans with an accommodating capacity of less than twenty guests. It is ideal for such small-size ryokans to use solar water heaters during summer time when the average sunlight condition and the corresponding capacity of solar water heaters can just match the hot water demand. Moreover, the facilities do not require much effort for operation and maintenance, and the investment can be afforded by ryokan owners due to an acceptable payback period of shorter than five or even three years [7].

Finally, it is worth mentioning that in additional to intelligent power generation systems, smart approaches in electricity consumption should also be considered in future planning. Given the fact that the daily peaks of energy consumption generally appear in the morning and evening, there could be some dynamic systems that help smooth the demand and supply gap. For example, the time for electric scooters charging can be set at the off-peak hours to use the excess supply capacity.

Conclusion

Based on the analysis above, there have been existing practice and ongoing plans aligned with distributed economies in the development of ecotourism on the island. These are encour-

aging, positive elements appreciated by the authors. However, it can also be noticed that for some programmes there is still distance between plan and implementation.

The barriers for implementation can be identified. First, the start of transformative programmes usually requires a considerable amount of investment, as shown in the electric scooter and renewable energy plans. The profitability of such businesses is normally inadequate without governmental subsidies, especially at the starting stage. Thus the lack of financial support can be a big obstacle for the plan enforcement. Similarly, some programmes require land for construction, which is a limited resource on this sixteen km^2 island. Besides, resistance from the locals could be expected if the benefits from such programmes were not sufficiently linked to the improvement of local wellbeing. Last but not the least, on the island which has long depended on the business-as-usual path of development, there is lack of knowledge and capacity among the locals, the local authority in particular, to foster and implement the change.

Considering the high ambition to develop ecotourism, the current progresses and potential barriers, it is suggested by the authors that smart approaches that would best satisfy the necessity of the island and be best adapted to the local conditions should be prioritised. Besides, testing and dynamic adjustment work during implementation will be beneficial in promoting a transformative change.

Sunset on Green Island

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Norfolk Island: A Small-Scale Distributed Unit?

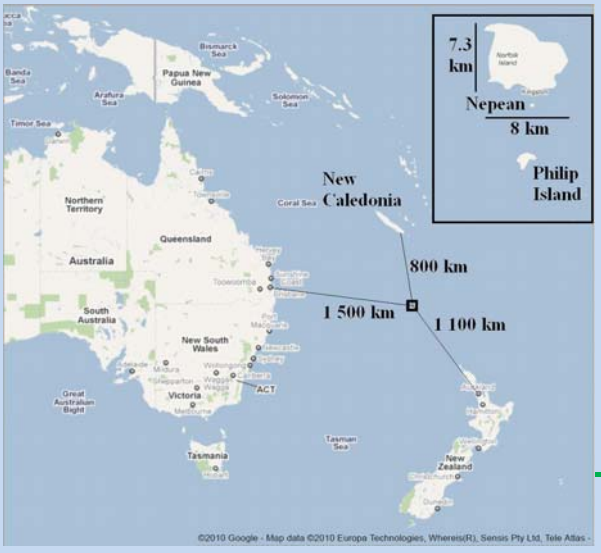
By Anton Smit and Ole Bondesen *Photos from Dr. Manfred Lenzen and the EcoNorfolk Foundation. Printed with permission*

Norfolk Island is an Australian Territory in the south Pacific, 1 500 km from Australia, 1 100 km from New Zealand and 800 km from its nearest island neighbour, New Caledonia. The Territory of Norfolk Island consists of three islands: Norfolk, Nepean and Phillip, which are close enough together to be considered a single geographical and political unit and in total cover 34.6 km^2[1].

The island was uninhabited when the British established a penal colony there in 1788 only to abandon it 26 years later. The penal colony was re-established in 1825 and abandoned again in 1855. In 1856, the British government resettled the entire population of Pitcairn Island on Norfolk (though some were to return 11 years later) and their descendants inhabit the island to this day. The Pitcairners are descended from the Bounty mutineers and Norfolk, a mixture of seafaring English and Tahitan, is still spoken alongside English as an official language [2].

According to the 2006 census there are 1 576 permanent residents on Norfolk, 60% of whom were not born there and originate mainly from Australia or New Zealand. The population is not shrinking but is getting older as the young increasingly migrate and are replaced by retirees [3]. Norfolk is wealthy by Pacific Island standards. The average income of AUD 30 000 (EUR 21 000) is slightly higher than that on the Australian mainland, but lower in real terms. Although residents do not have to pay federal income and sales taxes, those levied by the Government of Norfolk Island are regressive and the total tax rate is almost double that in the rest of Australia. At the same time, living standards and pubic services are similar to those on the mainland [4,5,6].

Although well developed, the Norfolk economy faces a number of challenges, many similar to those on other remote island states. The island has a significant trade deficit with imports exceeding exports by a factor of five to eight every year [7]. The main import is diesel fuel for electricity generation. The rest consist of natural gas for cooking and heating, as well as some foodstuffs [5,6]. The economy is also heavily reliant on the tourist industry, which accounts for 90% of employment and there is a need to diversify it [4].



Map of Norfolk Island showing its remote location in the South Pacific

Agriculture is not the mainstay of the economy, but is an important element as it reduces the dependence on food imports and also serves as an alternative occupation to tourism. Today, almost all vegetables and meat are produced locally, with only certain items including potatoes, onions, garlic and some meat being imported [8]. Farming on the island is of a small-scale nature and any significant expansion is hindered both by high energy costs and overall lack of demand, as distances limit exports and the local market is small. Nevertheless, the island is more or less self-sufficient in terms of food [8].

Norfolk's economic problems are not minor. In 2005 and 2006 the island faced financial meltdown. The negative balance of payments and dwindling tourist numbers had led to a situation where the island required federal support [9]. The last three decades had seen a three-fold increase in the CPI only accompanied by a 50% increase in income [5]. Matters came to a head and the Australian Government announced a review of the island's self-governing status.

Many Norfolk residents resent the idea of mainland authority and the administration came up with a plan to enhance the economic sustainability of the island. This was adequate enough for the Australian Government to recommend that no changes be made to the governance structure in place [9]. Nevertheless, the Government of Norfolk Island voluntarily surrendered the right to self-government in November 2010 citing economic necessity [10]. It is too early to tell how this will affect the island.

Remote islands such as Norfolk are a significant challenge for sustainable development. This paper is a system level analysis applied to two of the developmental challenges the island faces. These are the large diesel imports and the reliance on tourism. As the bulk of diesel imports are for electricity generation, the power supply is the main focus. The aim is not to propose a best solution, but rather to apply DE theory to what already exists in the literature on the island.

The electricity system

Electricity is supplied from a central power plant that houses six 1 MW diesel generators. These consist of three Caterpillar units installed between 1987 and 1996, and three Cumins units purchased second-hand in 2000. The Cumins units are preferred, being simpler to operate and maintain. The base load of the island is 650 kW and the maximum load is 1 750 kW. The rise in demand for electricity is around 2% per decade, which is low. The plant is largely unautomated, owned by the authorities and has a profit of around AUD 300 000 (EUR 210 000) per annum [5,6].

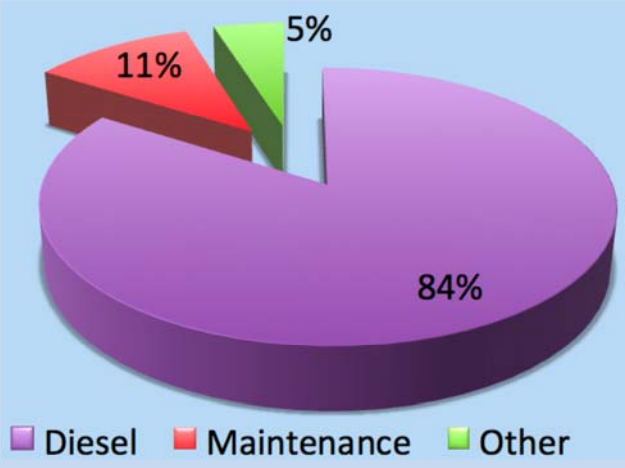
It is expensive to import diesel and as a result the cost of electricity is high. Residents pay 50 AUc/kWh (35 EURc/kWh) as opposed to 12 AUc/kWh (8.4 EURc/kWh) on the mainland [5]. Diesel procurement accounts for 84% of power plant expenditure (see pie chart) and is the main reason why the utility predicts even higher prices in the near future [11,12]. A lower electricity price would have a ripple effect on the economy, lowering the CPI, bolstering the agriculture sector and improving the competitiveness of tourism.

Diesel Generators inside the powerhouse on Norfolk Island

Due to high electricity prices, Norfolk has been identified as an area where renewable energy is competitive on a cost basis [6,13]. The island also has an abundance of renewable resources and wind and solar energy, in particular, have been assessed as cost-competitive and feasible [5,6,11,14].

There is limited use of renewable energy on the island. Solar panels for water heating are common, but their use is declining as salt from sea spray corrodes the systems and gas heating is perceived to be equally competitive [6]. This probably presents a business opportunity for entrepreneurs with more robust solar heating systems. The cost of grid connection is borne by households and standalone solar systems are used to a small extent on remote properties [6]. A law forbidding feedback into the grid was recently revoked and the use of solar panels is increasing, not least because there is a federal government rebate of 50% on any renewable energy infrastructure [6,14]. This is an Australia-wide rebate and probably not designed with Norfolk in mind.

The renewable energy penetration potential on Norfolk, with the current load management control systems, is around 40% [13]. Achieving this would result in a significant decrease in the electricity price, as well as reduce diesel imports, correcting the trade balance [14]. There are also environmental benefits to renewable generation. These do not need to be listed, but as discussed in a later section, reducing the ecological footprint of tourism would be beneficial to the island in terms of both the economy and environment. The various options available to the island are discussed under the following sub-headings.



Breakdown of power plant expenditure in 2009. Diesel imports are the largest cost to the facility. Data taken from [12]

Biogas

There is a pig farmer on the island who has taken steps to diversify his business [5]. This farmer has installed a biogas digester and uses the effluent from his pigs to produce the gas he uses to cook his meat products. He wanted to install a gas generator to meet his electricity needs as well. However, the island authorities would not let him do so even if he did not feed back into the grid. This is because he would not always be self-sufficient and would have to switch himself on and off in an unpredictable manner which would destabilise the grid. Therefore, the utility would be required to constantly produce enough electricity for the farmer regardless of whether or not he is connected to the grid. Thus, with its current technology the plant would have to run at the same capacity, but the famer would not always be paying for the diesel [5,15]. As he is the only pig farmer, investing in expensive grid reinforcing technology is not justifiable and the biogas generation potential has probably been reached.

If, in the future, the grid is sufficiently stabilised, the farmer may not only be able to feed-in, but could expand his operation and possibly contribute to both electricity generation and organic waste disposal. The latter presents an interesting opportunity. It is possible that involvement in waste disposal would not only mean another income stream for the farmer, but create a driver for the up-scaling of biogas as an energy source.

Feed-in solar

Feed-in-tariffs have been used quite successfully in expanding renewable generation capacity in many areas, most notably Europe. The 50% federal rebate and the high price of electricity on the island make solar cost competitive. Even if households do not receive a subsidy, but rather pay for the net amount of electricity they use, the payback period for a solar investment is short [6]. Feed-in systems were previously banned due to islanding[1], but this problem has now been surmounted and the ban has been lifted [6]. The Australian Government has also recently trained some residents to install the systems, as this has to be done by an accredited electrician if the household is to be eligible for the 50% rebate [11,16]. This will likely facilitate the implementation of feed-in solar on Norfolk. To date, it is not a significant electricity source, but does present a possible, future alternative to diesel [6].

Wind-diesel hybrid

Another possibility, preferred by the Australian Government, and more common on remote islands, is a wind-diesel hybrid system [13]. Two areas on the island have been identified as suitable for this scale of wind energy [14]. Under this scenario, the wind turbines would still be owned by the power authority and generation would be more centralised.

Non-technical factors to consider

It appears to be in the best interest of the island to install at least some renewable capacity. However, an important question is how distributed that capacity should be. Two factors are essential when considering the electricity system of Norfolk. First, the supply needs to be completely reliable in order to avoid economic disruption. The second is that any technology should be as simple as possible.

Simplicity was stressed in an interview with Prof. Manfred Lenzen from the Centre for Integrated Sustainability Analysis at the University of Sydney [15]. Prof. Lenzen has studied renewable systems on remote islands including Norfolk and spent time there when he authored a sustainability report for the EcoNorfolk Foundation [5]. He pointed out that maintaining adequate skills to run technically complex facilities is a challenge on small islands. There is a tangible risk that complex systems with heavy maintenance requirements and/or vulnerable to breakdown fall into disrepair or increase reliance on costly expertise from the mainland.

Dr. David Barton did his PhD on renewable energy on Norfolk and Lord Howe Islands [6]. As part of his research, he explored why, in spite of the high price of diesel and the existence of several positive feasibility studies, renewable generation on the island was still almost negligible. The power supply is of utmost importance to any remote community. Disruptions weaken the economy, reduce the competitiveness of the tourist industry and, in extreme cases may require emergency supplies to be flown in from the mainland as regular imports do not arrive daily. Switching to alternative electricity generation is therefore considerably harder than on mainland locations where consumers often have little idea where their electricity comes from.

Many complex factors come into play when considering Norfolk [13]. In fact, a third of Norfolk residents still view the current diesel system as the best option and their opinion is valid [6]. There is also a dichotomy of stakeholder views. For example feed-in solar would create a social situation where more people benefit from using renewable energy, but the profit from the power plant represents a significant income stream for the government

[1] Islanding occurs when a section of a power grid remains live even when the central supply is cut off due to feed-in from distributed generation sources. It is a hazard to utility workers.

which they do not wish to lose [2]. The relationship with mainland Australia is also uneasy and was aggravated by the review of self-government in 2006 and probably also by the loss of self-government in 2010. Further, how residents perceive ideas from the mainland needs to be taken into account [2,6,13]. The main message is that the solution to the problem is not purely technical.

Grid stability

While solar feed-in is technically possible, the Norfolk grid is small and therefore vulnerable to variable feed-in [15,17,18]. Fluctuations in renewable supply can easily be absorbed by larger grids but can create instability in small grids. According to Prof. Lenzen, distributed renewables without storage have limited potential for small grids including Norfolk's because of their variability. However, they could be viable on islands with larger populations, such as Palau which has 20 500 inhabitants [15].

This was confirmed by Gregory Eve at the International Institute for Industrial Environmental Economics in Sweden and energy consultant Mats Malmberg [17,18]. Mr. Eve has recently completed a thesis on the electricity system on the Hawaiian Archipelago, where in spite of a much larger population (130 000), grid stability is still an issue. According to Mr. Eve, for large scale distributed solar to be possible on Norfolk, significant investment to reinforce the grid would probably also need to be complemented by interaction with end-users to manage demand. Mr. Malmberg stressed the high costs and maintenance requirements of grid reinforcing technology. Both experts were also wary of the life-cycle implications of using storage systems with batteries.

Given the current financial status of the island, large upgrades to the grid could only be justified if they could offer a significant advantage to using the central wind-diesel hybrid option. They do not. Willing user interaction should also not be assumed, particularly because the island is not faced with an energy shortage, but enjoys a plentiful and reliable, albeit expensive supply [11]. The capacity of the island to maintain a smart grid also needs to be considered, as a higher reliance on the mainland for expertise would be self-defeating.

It is likely that the wind-diesel hybrid system will be given the go-ahead [13], although to date, nothing has happened. This is a proven technology for remote locations, is simpler to implement and run and can produce a more stable output, particularly if it is combined with storage [13,19]. The system would also be easier to maintain as it would use standardised equipment and would not be scattered all over the island [13]. These are, quite likely, reasons for selection as the better option for the island.

Demand-side management

Reducing the amount of diesel imported can also be achieved by reducing the amount of electricity used. Dr. Barton identified energy efficiency improvements as the cheapest and most effective means of saving energy and money particularly with the high and rising electricity price on Norfolk [6]. Areas for improvement include space and water heating, efficient appliances and lighting. His PhD research revealed that there was almost no uptake for this on the island. Shops seldom sold appliances with an energy rating of more than three stars out of a possible six and business with an energy reduction agenda were atypical [6].

Given the price of electricity, the lack of uptake probably does not represent a lack of demand and this presents an opportunity for the island. On paper, there are strict rules prohibiting the use of electrical appliances such as rated above 2.4 kW. However, this may be flouted if appliances are imported and installed [6]. Enforcing or threatening to enforce this ban more rigidly may stimulate the market in energy efficiency.

Prof. Lenzen also points out that the energy supply most freely available on many remote islands is the waste heat from the power plant. This raises an interesting possibility for Norfolk. The biggest end-use of electricity is the large refrigeration systems that consume between 10 and 20% of supply. If a single, large co-generation cooling system was installed next to the plant and supermarkets collected what they needed from this every day, diesel imports could be reduced substantially. In the long term, other commercial users of heat could be relocated next to the power plant as well. Importantly, centralised refrigeration makes use of proven technologies which are simple to run and maintain [15].

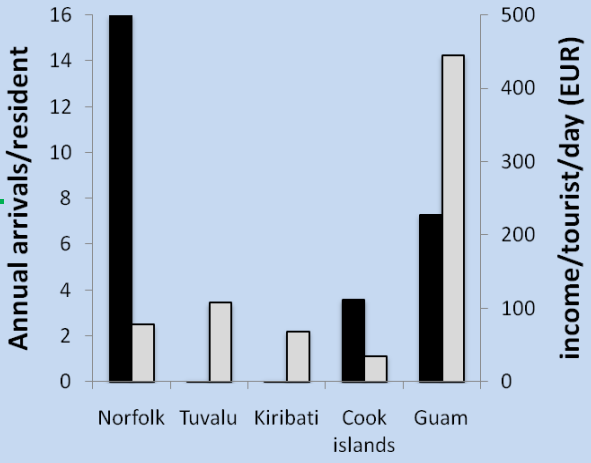
Tourism

Most tourists visiting Norfolk are from mainland Australia or New Zealand. Tourism is a finite market and can therefore often be an unstable source of income. Norfolk is no exception in this regard as it suffers particularly from competition with other Pacific Island States, many of which offer cheaper destinations [4]. Norfolk was particularly hard hit by the bankruptcy of low-cost airlines that previously served the island and a steady decline in tourist numbers in the period 2000-2006 was cited as one of the reasons for the economic decline that lead to the review of self-governing status [9]. While the decline in tourist numbers appears to have reversed in recent years [4,11], there is still a need to grow other sectors of the economy while at the same time strengthening the tourism sector.

The appeal of this island lies in its remote location and natural beauty. There are no large resorts on the island, with tourists instead hosted in small-scale hotels, lodges and bed and breakfasts [11]. The island has distinctive characteristics including the unique language and its history as a penal colony. A general lack of streetlights provides exceptional night time views and some tourists are even attracted by the absence of mandatory seatbelts. Furthermore, 40% of the island is National Park and the Australian federal government funds the upkeep of heritage sites such as Kingston Military Barracks [9].

The prescription for the island's economic woes has for a long time focused on increasing tourist volumes [4,5,15]. Indeed, tourists account for approximately 20% of the island's population at the height of the tourism season [3]. What this fails to consider is that ever-increasing tourist volumes are ultimately unsustainable, not least due to the physical limit of people the island is capable of holding.

Tourists will typically consume more resources during their stay than the local inhabitants. They use electricity, consume diesel and other imported items and produce waste [5]. This may not be fully compensated by their spending. In fact, compared with visitors to other Pacific islands, tourists spend less money on Norfolk (see graph) [5]. This has been identified as an issue of *branding* as many visitors come on package deals purchased on the



Annual arrivals per resident (black bars) and tourist yield (grey bars) for various Pacific Islands. Norfolk has the highest number of tourist arrivals per resident, but does not earn as much income from each visitor as other islands. Reasons for higher yields on other islands could be a subject for further research. Data taken from [5].

mainland. These packages usually include airfares, accommodation and island tours and lead to less money being spent on Norfolk, with much of tourism's generated revenue never reaching the island [5,15].

What appears to be lacking is not just a high level of tourist *volume*, but also tourist *yield* [5]. This is the amount of income each tourist actually brings to Norfolk. To increase the yield per tourist, Norfolk should seek options to rebrand the island as a tourist destination in order to ensure that revenue generated reaches the island. For example, targeting younger age groups with eco-tourism options. This does not necessarily mean that the island will become a more expensive and hence less competitive destination, but rather that more income will be generated locally. In the larger picture, the burden per tourist should also be decreased by making more efficient use of the island's resources [5].

According to Denise Quintal, the founder and CEO of the EcoNorfolk Foundation, tourism in its current form has limited potential and a new innovative thrust is required to stimulate it. The foundation has identified Ecological Footprinting as an option and is trying to promote the concept in tourism and education [20].

EcoNorfolk is currently working on a new form of marketing called "Ethical Adventures" which includes footprinting of tourist activities. Their approach is holistic, not only do they distribute Triple Bottom Line software to businesses on the island and organise training in its use, but they are trying to get the concept of the ecological footprint introduced into the school curriculum. Their marketing approach targets highly skilled individuals to come to Norfolk and train others in a more sustainable form of tourism [21]. If this takes off, the island will become a centre of innovation and set an example for sustainable tourism which could be exported to other remote islands.

Conclusions and links to DE

For reasons of grid stability and simplicity, Norfolk appears to be developing in a more centralised manner. The power supply will remain largely central and the centralised refrigeration system, if implemented, will reduce diesel imports. While the farmer did diversify his energy supply, the limited scale of agriculture and being the sole pig farmer, hinders possibilities for distributing the economy via integration with agriculture. Improving the tourist yield also has little relevance to the debate whether the economy should be centralised or distributed.

DE theory states that small-scale units should be strengthened with less reliance on a large central supply [22]. Whether or not the case of Norfolk Island is relevant to DE depends on the definition of said small-scale units. This paper treated Norfolk as the system and the various facets of its economy as units. Based on this assumption the island can develop sustainably without DE.

However, these authors still conclude that Norfolk adheres to DE theory. This is because switching to a renewable energy supply and increasing the yield and sustainability of tourism reduce the reliance of the island on imports from the mainland. If Norfolk had been treated as a small-scale unit dependant on a central supply of fossil fuel and goods from the mainland, this conclusion would be reasonable as all the options discussed above reduce the reliance on the mainland. If the "Ethical Adventures" concept takes off, this small unit will be a centre of innovation in accordance with DE. In this case, when analysing the local economy, the debate would have, perhaps more productively focused more on how best to reduce reliance on the mainland rather than how to distribute the local economy.

Therefore, this case study of Norfolk Island has identified an important question for those developing the DE concept: Namely how

should the small-scale unit be defined. At the same time, the island also presents an opportunity to address this problem. If Norfolk does become more self-reliant, and particularly if it can attain a positive trade balance, then it could serve as proof that a community of 1 500 people can be treated as a distributed unit, which could set a precedent for the development of other small-scale, distributed units of 1 500 people for sustainable development elsewhere.

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Small-Scale Renewable Energy Projects in Vanuatu

By Emily Dowding-Smith, Arijit Paul & Raquel Salazar-Bejarano

New Solar panels at Coconak School. Photo by SPC

Distributed economies (DE) is an evolving concept that aims to rethink the relationship of large-scale and local production systems to create more flexible and innovative production and service system schemes [1].

Vanuatu provides an interesting case study for examining if, or how, the DE theory can be applied to "real-world" situations. Recently, numerous small-scale renewable energy projects have been initiated in communities, with the aim of meeting international obligations and reducing reliance on diesel generators.

The island was selected because the authors have an interest in renewable energy systems and they were able to make direct contact with colleagues working there. There are, of course, other South Pacific islands with similar examples of self-sufficient energy systems in place.

Projects in Vanuatu are briefly outlined for researchers of the DE topic to see what can be learnt from the systems in place on the islands.

First, an overview of the country and its energy situation is provided, followed by case studies illustrating the opportunities for renewable energy. Some of the major challenges in implementing these projects are then discussed, and finally the concept of DE is analysed in light if the case studies presented.

Context and overview

Comprised of some 80 islands scattered over 1 300 km of ocean, the archipelago of Vanuatu boasts astounding biological and cultural diversity and plays host to the highest diversity of languages per capita of any country in the world. Vanuatu's social and geographic diversity causes difficulties with access to energy technology and infrastructure [2].

Vanuatu has two major urban centers: Port Vila, situated on Efate; and Luganville located on Espiritu Santo [3]. Agriculture dominates the economy with nearly 80% of households dependent on subsistence agriculture [4]. Aid funds represent between 20-30% of Vanuatu's budget, and it receives around USD 110 million per annum from other sources for the development of specific projects [3]. The latter has influenced the growing trend of developing renewable energy systems throughout the islands.

Vanuatu's total population is 234 023 inhabitants. The majority, just over 75%, of the population live in rural areas [5]. In urban areas, 36% of the houses use kerosene for lighting and 53% cook with liquefied petroleum gas (LPG) fuel. Only 7% of rural households are electrified: 86% use kerosene for light, and over 95% cook with wood fuel [4].

Overall, a limited part of the population, around 27%, has access to electricity. Many households cannot afford to connect to the electricity supply, and, once they are connected, consumption is very low [6]. The electricity service is provided by UNELCO, a private company. The Energy Unit is the government agency in charge of formulating energy policies and is responsible for rural electrification [3,4,6].

Until recently, the electricity tariffs were some of the most expensive in the world [4]. To overcome the challenges of access and high electricity tariffs, the Utility Regulatory Authority (URA) was created in 2008 with a mandate to ensure the provision of safe, reliable and affordable regulated services and maximise access to those same services throughout Vanuatu [7].

As in many South Pacific nations, an absence of local sources of fossil fuels renders Vanuatu highly dependent on the importation of diesel for power generation, a significant burden on the economy. It is estimated that transport accounts for 64% of petroleum fuel use, while electricity generation represents nearly 30%. Accordingly, the Government has recently begun to redirect the energy sector toward local solutions, to reduce the reliance on external supplies [8].

Vanuatu has good renewable energy potential in most of the major areas, including: wind, geothermal, solar, hydropower, biomass, and wave energy [4]. Numerous renewable energy projects are present on several islands and there are further projects proposed over the coming years. Examples are:

- Epau: solar and biogas energy (from cow manure and human waste) used for cooking and lighting [9];
- Port Vila: Tagabé power plant and coconut mill (a converted diesel site that now provides part bio-diesel electricity), and Devil's Point wind farm providing 2.5 MW [9];
- Sarakata hydro power is complete and has a capacity of 1.2 MW [10]; and
- Talise Hydro: This project is to supply power to go to three villages on Maewo with a population of about 2 600 people [10].

Small-scale renewable energy projects are seen as a necessary and effective solution to provide a more secure and sustainable energy supply to local communities. Director of Vanuatu's Energy Unit, Leo Moli, notes that in the past three to five years the government has focused on renewable energy, not only for economic and development reasons, but also as part of its response to global climate change [8].

Given the intricacies of such systems for communities in South Pacific islands, what can islands like Vanuatu offer DE researchers? To answer this question, two case studies from Vanuatu are outlined below: Port Olry's (Espiritu Santo) coconut-fuelled bio-diesel plant and Tongoariki Island's solar panel powered school and health centre.

The context and facts of each are specific to local communities and situations, and not illustrative of all the islands of Vanuatu. They are, however, illustrative of the potential for analogous projects in South Pacific countries to contribute to the broader discussion of DE. This research was primarily undertaken through the use of semi-structured interviews with key contacts at organisations such as UNELCO and the Energy Unit. Although these authors note that they do not represent an exhaustive sample of key stakeholders, they do provide a more nuanced perspective on secondary energy sources and allow targeted assessments of the applicability of DE theory to energy provision in Vanuatu.

Port Olry: coconut oil bio-diesel electricity generation

Located on the northeastern side of Espiritu Santo Island, the Port Olry 40 kW coconut oil

driven bio-diesel plant has been in operation for two years and has the potential to be run on 100% locally sourced coconut oil. The electricity is then supplied directly to the local community. When the supply of coconut is restricted, the plant can run on conventional diesel. The plant contains one mill, and two to four small powerhouses. The system is based on technical standards, which have been adapted to be used on a low budget without compromising safety [11]. The locally produced coconut (which grows abundantly on the island) is sent to the mill to be converted to oil. This is in turn converted into electricity and passed out over a low voltage network to the village, which utilises pre-pay meters to access electricity [11]. A similar project in Fiji, is converting part of the coconut oil into value-added products, such as soaps and lotions to fetch higher prices for local communities [12].

Technically, the Port Olry plant has been a success and has proved itself capable of supplying clean, efficient and locally sourced electricity to what is a remote community. However, there have been several ongoing and unresolved challenges at the management level, which continue to hinder the success of the plant, and which are likely to manifest in similar projects elsewhere in Vanuatu [11].

One key issue is that the Australian-owned coconut mill at Luganville (approximately two hours drive away) often pays a higher price than the local mill is able to buy at. In order to continue running, the Port Olry mill must purchase its oil from Luganville at an inflated price, and must sometimes mix it with diesel. Moreover, local producers often keep only low quality coconut for sale to the Port Olry mill, which impacts on the efficiency of the plant and has the potential to damage the engines [8].

Several further issues continue to impede the successful running of the plant:

- The cost of the pre-pay is prohibitive for many families, meaning that only 160 of a predicted 260 households have signed up;
- Low demand means the plant is often running below capacity. In particular, while nighttime demand (for lights, stereos etc.) is steady, daytime demand is virtually non-existent;
- Many community members are not familiar with technology such as light bulbs and pre-pay meters, meaning the maintenance and uptake of these technologies is slow;
- Local management issues stemming from intra-community differences, land disputes and local politics have impeded the functioning of the board running the plant. The previous chairman of the community board running the plant absconded with funds earmarked for the maintenance of the plant; and
- Trained engineers are difficult to attract and retain, and many stay only a short while before moving to other locations within Vanuatu and around the world.

Coconak School and health centre's solar panel installations

Tongoariki Island is located in the Shefa province of Vanuatu and has five villages, with a

Preparing coconut oil.
Photo by Kitty Garden at Climatee Parliament

total population of 511 people. The main income generating activities on the island are handicrafts (mats and baskets), agriculture (yam and kava), animals (fowl and goats) and other commercial activities such as boat rental. The villages and households have no electrical grid. Food is cooked predominantly with biomass in ground ovens. To overcome the challenges of providing light to houses, the purchase of solar powered D-light lanterns with LED bulbs has replaced traditional kerosene lamps in many households. The community has also photovoltaic (PV) solar power system to improve the education services at the primary school, and for the local health centre [13].

The project "Energy to Modernise Public Services, Schools and Health Centres" commenced in 2010 and aims to provide electricity and office equipment to the school and health centre through funding coordinated by the Pacific Islands Forum Secretariat (PIFS) and Pacific Islands Applied Geoscience Commission (SOPAC). It is now managed by SPC. The location of the school, on a plateau that receives many hours of sunlight each day, makes it appropriate for the use of solar energy to assist in educating the school's 85 students and to help run the adjacent health centre.

Currently, four 65 W PV panels are installed outside the Teacher's quarters, ten 65 W PV panels at the school, and one 40 W PV panel outside the health centre. The predominant use of the electricity generated from this is for lighting and office equipment, mobile phone battery recharging, DVD, television, and speakers [13].

The benefits of the Coconak project thus far have included an improved education system (use of photocopier/printer and computer facilities); more time for teachers to plan lessons in the evenings; increased communication through mobile phone usage; improved performance by students who are now able to study at school in the evenings under lights; ability to run computer education classes; reduced costs as there is no longer a need to hire and run diesel generators to power the school; and an ability to use the health clinic at night under lights (particularly important for childbirth) [6]. A flow-on effect of the project comes from the school using the PV system for raising revenue through fees for people recharging their mobile phones [12].

Despite the initial set-up costs being reliant on external funding, the community is taking steps to be self-sufficient with the project. To ensure the longevity of the solar-based system, training on the maintenance and upkeep of the batteries and equipment has been carried out to ensure the equipment is well managed. The school committee created a fund to assist the community. The fund is for the maintenance costs of the solar PV systems.

The project fund will be sourced from the monthly fees from the teachers' quarters, revenue raised from charging services which currently covers mobile phones and fundraising activities undertaken at the school. The Energy Unit in Vanuatu will provide the maintenance assistance to the community [12].

Solar panels at Coconak School. Photo by SPC

Analysis in the context of distributed economies

Potential Opportunities

Some of the key features of DE systems are that they are: small-scale, local, innovative, community-based, resilient and symbiotic [1]. Eight criteria for energy projects to meet in the DE framework, as proposed by Mirata *et al.* [14], are: (1) increasing the share of renewable resources in economic activities; (2) increasing wealth creation for a large number of people; (3) decreasing pollutant emissions and waste generation at the local to regional level; (4) increasing the sustainable use of local resources in economic activities; (5) increasing the value addition to local resources; (6) increasing the share of added value benefits retained in the regions; (7) increasing the diversity and flexibility of economic activities; and (8) increasing the diversity and intensity of communication and collaboration among regional activities.

It must be noted that further research of a more longitudinal nature is required in order to establish clear connections between these criteria and the projects. However, where this, somewhat brief, study highlights notable potential is how the installed energy projects may: increase in the *wealth creation* of a number of people (Criterion 2), alter the *pollutant emission levels and waste generation* (Criterion 3), and increase the diversity and intensity of communication and collaboration among *regional activities* (Criterion 8). What can also be learnt is that there is a clear opportunity for further research into this field to explore some of the suggested synergies that are noted below. This will become even more relevant as projects become well established and time goes on.

The synergies that can be identified at this stage are illustrations of potential ways to: *increase the value added to local resources* (Criterion 5); and how *to increase the use of local sustainable resources in economic activities* (Criterion 4). The case studies suggest that through the use of locally produced coconut oil, in the case of bio-diesel, and abundant solar energy, for PV projects, that there is the potential to utilise and add value to local products in South Pacific Islands with flow on effects for economic activities.

The Coconak project illustrates the potential to *increase the share of added value benefits retained in the region,* while *increasing the diversity and flexibility of economic activities* (Criteria 6 and 7). The benefits of electrification in the school in Coconak, in the form of improved levels of education and its many associated benefits to the children of the community are entirely retained in the region. Further, the charging of cell phones to raise income, along with new markets for light bulbs, suggests diversity and flexibility in the economic activities.

Additionally, where value-added products (such as cosmetics from coconut oil or making handicrafts), or other synergistic relationships between the projects and new business generation can occur in the communities, there is even *further* potential for these case studies to contribute to DE theory. There is also the possibility to fund synergistic projects and businesses that tap into this distributed network, which is being developed (e.g. loans, fair trade networks, and finance initiatives).

Challenges

However, DE researchers could also learn from the challenges that projects such as these face. The case studies from Vanuatu highlight two important barriers to the long-term success of the projects within the DE framework: the importance of local engagement in the projects; and the influence that external markets have on self-sufficient projects.

Clearly, without local commitment, there is a risk that the local community will abandon the process. This is especially important for donor-funded projects and is paramount to achieve social engagement from the communities

where the projects are situated. These challenges can be overcome through initiatives such as the ones in Coconak community, whereby local ownership of maintenance and upkeep is transferred to the community to ensure they have control and commitment to its success. Initial engagement by the community in the process does not guarantee continual success. It is also important to ensure that there is a demand for electricity in the first place.

Heavy reliance on external markets can also seek to undermine the ability of local communities to benefit from their projects. While the projects do create opportunities to increase wealth for different groups in the community, in the case of coconut farmers supplying the mills, it is not always due to supplying local communities. For example, potentially greater income can come from selling oil to mills elsewhere, which may suggest the overall benefits to the local community of having locally sourced high quality electricity do not outweigh this for some local farmers.

The bio-diesel operations illustrate how the market will influence renewable energy projects. For example, Vanuatu has large bio-diesel potential from its coconut plantations but in practice, sustained supply of coconut oil is largely linked with the international market price for bio-diesel, with fluctuating market prices. In seasons with a low local market price, coconut oil farmers do not produce the oil for local supply, instead they send it elsewhere, thus affecting the continuous supply of bio-diesel for local energy production.

Photo by Kitty Garden at Climate Parliament

Further, the market for coconut oil in Vanuatu is not regulated. Thus farmers are free to sell coconut oil in the international market if that gives them a better price. This competition also creates bottlenecks for the sustained supply of coconut oil for local energy production. This challenge is compounded by the ageing supply of coconut palms, which in many areas is currently only sufficient for another ten years of oil supply. Therefore, in order to ensure continuous supply of coconut oil for local bio-diesel projects, it is necessary to replant coconut on a large scale. Unfortunately, no such initiative for the replantation of coconut has been under taken thus far.

Conclusion

There is potential for DE researchers to learn from countries like Vanuatu, in the South Pacific. At the moment, demand for electricity is somewhat low. However, as an increase in infrastructure, tourism, water supply and other government priorities reach through the communities, a corollary of this is that it is likely that demand for electricity also will increase. Therefore, given that the situation on the islands could change, the presence and development of DE throughout the island – for more than just the energy supply – also has the potential to grow. In this regard, the islands may not need to resort to a centralised system (of energy and other networks), but instead could build and develop infrastructures and networks in a manner akin to DE. For this reason it is important to show the potential for South Pacific island systems to this field of research.

Further, overall lessons can be learnt from these networks of isolated communities already trading and sharing without centralised management. But with caution, because a failure to

tap into, and understand, those networks, could be precisely what causes projects like Port Olry to falter. Of course, the true success of a project cannot be measured for some years and these projects are in their initial period of establishment. As has been found at Port Olry, technical success and initial enthusiasm does not always mean the project will continue to work in the long-term.

Accordingly, these limitations and challenges suggest that not all established systems can, or do, fit perfectly into a framework of theories such as that of DE. But, certain aspects will be transferable and the researchers on the topic can seek to use well established and distributed by default, communities such as those in South Pacific island nations to further develop, illustrate the theory.

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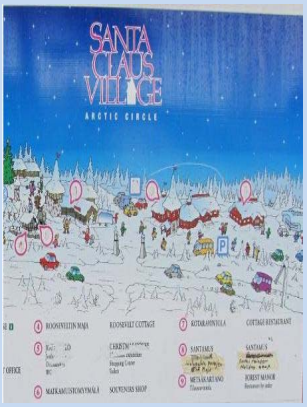

Thoughts on the Concept of Distributed Economies

By Mark Ryan

Photo by Nicolas Acosta

The term *Distributed Economy* (DE) automatically awakens the notions of scale and economic systems. The author of this paper feels that both of these notions are essential components, which must be accounted for in order to describe and understand the concept.

The term *distributed* contrasts with the designations *centralised* and *decentralised*. *Distributed* represents a scale at which there exists no strong centralised actor, rather a web of actors with an element of interconnectedness amongst them. These interconnections are what form the basis for the economic system. This author is reluctant to state that the concept is applicable at any scale, but that there exists a maximum scale at which the concept can be implemented. Ideally, beyond this maximum scale, distributed economies can essentially become part of a decentralised system, in which a number of distributed systems co-exist. However, the author feels that the concept is most applicable in situations where there is a sense of community, sufficient local resources, and determination to overcome the initial obstacles associated with the entrepreneurial action required to implement a DE. The application therefore of such a concept, seems most straightforward on a small-scale where co-ordination tends to encounter fewer obstacles.

It is often indicated that economies are made up of four sectors. These are the primary sector (extraction and production of raw materials), the secondary sector (transformation of these raw or intermediate materials into goods), the tertiary sector (provision of services to consumers and businesses) and the quaternary sector (research and development).

This author understands that in the context of DEs each regional entity, whether a village, a town, a city, a county or a nation for example should ensure that the resources which it has at its disposal locally are made use of in as efficiently a manner possible, where the benefits are shared across the economy. Therefore resources which an economy has at its disposal locally should be prioritised over those which must be imported. However, it is obvious that such an ideal situation is not always possible, with costs presenting a real barrier. It is the role of the quaternary sector to ensure that costs are not prohibitively expensive and that the use of local resources both physical and mental is, where possible, achieved through innovation. In turn, innovation can provide a means for the primary, secondary, and tertiary sectors to function using local resources and provide a livelihood for those in the region.

Initially, despite innovation being possible, competition represents a strong barrier, preventing the implementation of this concept. This author however, understands that there is a key difference between external and internal competition within an economy. It is through collaboration, that internal competition can be

overcome in a DE. Collaboration allows each actor to focus on their strengths, whilst acquiring knowledge and assistance from other actors in the economic system. External knowledge and assistance can also be incorporated into the system, increasing the innovation potential. Two benefits associated with collaboration regionally are that it can increase regional competitiveness outside the region and provide a means for wealth creation within. Therefore, through the creation of synergistic collaborations within a local economy, internal competition can be avoided. This synergistic relationship between actors is a key element of the DE concept as noted by Johansson *et al.* [1], and if implemented correctly, can allow the wealth which is created, to be distributed amongst them, based on the products and services which each actor has to offer.

The power to govern within a distributed economy, as understood by this author should, where possible, remain within the realm of the region. The concept of resilience explains partly why this is the case. Local governance allows an economy to reduce its dependence on external actors and to choose how resources and benefits are allocated within the economy. Resilience could be considered highest in economic terms, when a region has control over all four sectors of the economy. This in turn is dependent on how vulnerable these sectors are. Local innovation should aim to strengthen each sector. A DE should therefore strive to ensure that each of its sectors has the capacity to fulfil its role given the resources available.

External competition which cannot be overcome, despite innovation on a regional level, is part of the DE concept. Innovation has its limitations and regions can only compete with external forces where they have the means to do so. An example of this would be that, not every region can commercially manufacture its own computers, as well as it being prohibitively expensive, they may not have the raw materials, including the expertise to do so. The DEs concept however strives to achieve a balance between distributed small-scale production and large-scale centralised production [2] such as computer manufacturing.

The concept of DEs therefore describes economies where, through innovation and the strengths of a region, the utilisation of local resources is maximised, and wealth is distributed across the economy, reducing internal competition, promoting collaboration and resilience, and creating a synergistically connected economic system. There are however limits to the scale at which this concept can be applied, with it being most applicable to small-scale economies, beyond which a broader decentralised system of distributed entities becomes apparent.

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The Potential of the DE Concept

By Emily Dowding-Smith

The ideas comprising Distributed Economies (DE) stem from encouraging creativity and innovation in technology systems. As a theoretical set of concepts, the components were not developed with a goal of "sustainability" or other environmental benefits to accrue *per se*. But of course, a corollary of the concepts DE seeks to promote is that there can, and will be, of course, such benefits. It may be difficult to judge how "environmentally friendly" the projects that satisfy the requirements of DE would be, but that, Professor Johansson notes, is not actually the point. Instead, the concept stemmed from contemplating how we can encourage and strive for innovation in the product and service systems surrounding us [1,2].

Johansson *et al.* [1] suggest DE can concern areas including: (a) creating wealth for a large number of people; (b) reinventing quality and prioritising it before production efficiency; (c) distributing knowledge and creating diversity (heterarchies); (d) having flexible, small-scale production units; (e) diversifying needs and wants and new consumers; (f) industrial symbiosis and other relationships; (g) social, economic and ecological diversity as pre-requisites for production; and (h) integrated design and innovation.

The literature on DE so far suggests that researchers in the field do not consider that traditional large-scale production systems should cease entirely. In contrast, DE has the potential to co-exist with these systems where possible and communities are willing and have the capacity to include this diversity. Further, they suggest that socially, employees and communities will be happier with such an approach. Variety, it seems, is the spice of life, for the concept. And quality of produce to ensure long lasting benefits is equally important.

Understanding these justifications for creating the concept may assist in working out what its purpose is, aside from challenge the traditional way economies work. That approach, of the current neo-classical economics framework, the authors suggest, has stifled our ability to create and left us running the risk of having too many eggs in one basket. This is at the expense of innovation and potential security of supply for core sectors such as horticulture, agriculture, fisheries, energy, and goods and services.

Strengths and weaknesses

Strengths of the concept are that it is flexible and can be interpreted broadly. As it is a new concept, and quite diverse, there is the potential for numerous projects or businesses to be studied or form part of a distributed economy network. In addition, what I like about the concept is that it inherently brings potential empowerment to smaller, regional and potentially isolated communities. These tend to have been discarded slightly as economies of scale take production away from them to other areas. Moreover, I consider that there is a potential for the DE idea to shift from being a concept to more of a dynamic movement. This could perhaps extend to formulating practical steps for communities and regions to follow, in the absence of government led initiatives. A set of concrete criteria on how communities can be empowered to take such steps could assist this (similar to the process that the Transition Towns movement has done around the world).

Weaknesses of the concept at this stage are that it can be vague. While flexibility and wide interpretation are strengths for its potential applicability, here it is also a drawback for understanding concrete examples of the concept in action to date. Further, the DE concept has not, so far, really been challenged by neoclassical economics discourse – instead rejected as it is counter to reaching economies of scale [2]. Therefore, an absence of a real debate on the matter renders the concept up in the air and without challenges to rebut, strengthen and re-invent it.

Reflections and potential

There are some difficulties applying the concept to island systems. Isolation does not necessarily equate to being distributed for the DE concept. These examples could therefore really only assist DE where such systems can also be transferable to larger systems [2]. However, despite the unique culture within islands, it is quite feasible that some systems in place on them could offer examples for DE in more mainland systems. Of course, not all examples will have perfect synergies with the concept, but the point of this exercise was to see what potential researchers in the field can take from the examples shown and with such a diverse selection of islands and initiatives show cased, there is definitely plenty of food for thought.

In light of this, there is further potential to study sectors that move away from large-scale production systems. Examples include: distributed, local urban agriculture initiatives; local water and waste-water programmes; regional fisheries management programmes for sustainable fishing; interconnecting local art and crafts with initiatives such as agri- or eco-tourism; regional small-scale renewable energy projects that add value to local products and communities; and small-scale agriculture farms providing produce to local communities.

Regarding DE more generally, while I consider that in many ways the literature on the topic is re-instating classic ideas, this is not necessarily a bad thing. Producing high quality goods with highly skilled labour, interconnected with the surrounding community, where working together produces better results than competing, sounds just like the village lifestyle of small farming communities in rural areas, of numerous countries, over the past centuries. So when reflecting on the concept, I wondered what is new. The biggest difference lies in the fact that we now have increased technology available to us globally, particularly in the form of information systems.

This sounds like a good plan, with the best of both worlds covered, but I cannot help wonder if it runs the risk of being somewhat of an elitist concept, here. That risk will occur if only the affluent communities around the world can afford the aid of modern technology and slower, labour intensive methods of production. To negate that risk, DE must be tailored to suit local communities, regardless of economic status and not inherently presuppose wealth. The DE concept still notes the ability to access parts of that economic centralised system. But, I also consider that few are fortunate enough to have such luxury to pick and choose. Sadly, this is mainly due to the way the current economic system has been shaped and how informed people are of their choices to alter it. Therefore, in order for concepts such as DE to really become applicable globally we must continue to question the basis of our current economic systems and not be afraid to try out alternatives.

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Distributed Economies

By Amy Cregar

Distributed economies (DE) are networks, complex systems of economic and functional interaction in which the needs of the population are taken into consideration. Distributed economies are about the distribution of both social and economic benefit, access to technology or services, power and influence, and suppliers. They are decentralised economies with many actors fostering cooperative relationships and supplying the infrastructure which facilitates interaction and exchange.

Distributed economies look at regional or municipal scales rather than national ones and focus on networks of smaller functional areas to form a successful whole, rather than allowing the function of a few areas to make the whole, on average, functional. Distributed economies are about greater individual benefit, but of all the individuals and not just a few of them [1]. The valuation of distributed economic systems is perceptually dependent and intimately linked to the potential benefit (or cost) to each personal or entity.

Prerequisites

There exist prerequisites for a distributed economic scheme in that certain criteria must be fulfilled for DE to function. The decentralised provision of goods and services facilitates power-sharing and resilience within a system and a community [1]. Regionally based infrastructure must be in place to utilise and add value to local resources which are returned to and retained by the members of the community [2]. This is essential for the dispersion of power, resources and the socially derived aspect of life quality.

DE must have horizontal rather than vertical structures to facilitate cooperation and networking [3]. Technical solutions which are appropriate to local needs are another essential component of a distributed economy to allow for optimal scale and the redirection of waste streams into inputs for other processes. A municipal structure which facilitates interaction, exchange and cooperation is paramount to the functionality of a distributed economic system. Knowledge, wealth and resource-sharing must occur for distributed functionality, distribution must occur for resilience and balance, balance is essential for sustainability [2].

What are Distributed Economies

DE occur at the nexus of sociology, technology and economy where any of the three can provide the driver. Technology under a distributed economic system is appropriately sized to meet the needs of the community and distributed across several producers. Technological systems take into account the availability of local resources and the logistical rationale behind their use. Value is added to these resources through local processing or use, and waste is minimised resulting in a lesser environmental impact than occurs with large scale industrialised systems [4]. Thus, DE are environmentally viable solutions to technical, sociological and economic problems.

Distributed economies are mosaics of cooperation where all activities are set into orbit around the principles of localisation, mutual respect and reciprocity [3]. One crucial aspect of this is the definition of value within societies,

as value extends beyond currency and capital to include social constructs such as life quality, personal satisfaction, and even meaning [5]. DE assimilate this extended web of valuation infusing it with money, connection between industries and societies, personal and corporate responsibility and an awareness of quality in processes, resources, waste and interaction. Quality of life stems from participation, a level of control over one's surroundings and the provision of one's needs, as well as from a sense of ownership. Life quality is subjective, perceptually based, and absolutely necessary for a vibrant society. Societies are "cradles for innovation because they are where knowledge, culture and self-governance come together" [5].

Far from being socialist, distributed economies are functionalist and seek to address the robustness and resilience of functional networks [3,9]. They were the default system prior to modern industrial schemes in which economies of scale are accomplished with the size or the producer and not with the strength of the network. DE are both aware and mindful of the metabolic rates of society, seeking to reduce the throughput of materials and to economise energy use [6]. The interactions between socio-natural and techno-natural amalgams together comprise the point at which human beings, through the application of labour, metabolically consume and transform the natural world, which itself moves through socially based interchanges of wealth, material, and power [6].

How DE differ from other systems

A distributed economy differs from other systems of sustainability in that they are economic models with socio-cultural bases. Environmental quality and protection, social benefit and efficient use are all processes integral to adding value to local resources as they are utilised in the economy [1]. Distributed economies are horizontally organised, with prioritisation placed upon the interactions of peers in a network rather than structured vertically and managed hierarchically [3]. Power and benefit are shared – they are, in point of fact, linked to distribution, as both stem from the functionality and efficiency of the network rather than of the individual. Economic benefit is dispersed among many actors and serves to stabilise imbalanced and unsustainable systems [1,8]. DE differ from other systems in that the supply chains which are utilised are much shorter and are driven by regional supply and demand, eschewing globalised sourcing which displace environmental costs and social benefits [6,8]. This element of dislocation runs counter to what distributed economies seek to accomplish, localised benefit, lessened impact.

Strengths & weaknesses

There are numerous strengths associated with a distributed economic framework as well as some weaknesses. How one sees the relative benefit or detriment is largely dependent upon perspective and interests [7]. A large corporation or owner of a multinational organisation is likely to see DE in a less than perfect light, whereas an individual with smaller economic stakes is likely to see enormous potential benefit.

Distributed economies are complex systems and are therefore difficult to track, understand and influence. There are, by nature, multiple moving parts in a DE system which provide the benefits of participation, cooperation, inclusion and the localised distribution of dividends. The complexity is necessary for the functionality of the system [6]. Critics dislike this aspect and prefer instead to utilise economies of scale with source globally and conglomerate non-locally the both the management and the financial gains. Distributed economies pose a trade-off for the communities looking to utilise them but the benefits to many (employment, participation, reduced waste, added value, environmental integrity,

etc.) far outweigh the costs (administrative, loss of profit) to a few.

A perceived failure of the distributed economies approach to growth is that they promote nationalistic policies and protectionism by prioritising local inputs and local solutions rather than allowing for market and trade liberalisation [7]. If DE were promoted on a national scale rather than my community initiatives which were facilitated and supported but not mandated by the municipalities where they were put in place, this would be a problem. However, the decision to distribute an economic system is largely citizen-oriented and community-based [1].

Conclusion

The value of a DE system lies in its benefits to individuals, societies and to the natural environment. Resilience allows municipalities to adapt to a world which is changing in population, demographics, resource availability, climate, connection and countless other factors. Adding value to local resources contributes to a more appropriate system of valuation for previously non-monetised natural resources upon which all of life is reliant. Human populations are growing, so getting more benefit from fewer resources is essential – this is precisely what DE facilitate. Connection to a respect for the constraints of one's local environment leads to stewardship and environmental preservation. Connection to one another leads to mutual respect, cooperation and enhanced quality of life.

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Ecotourism and Distributed Economies

By Yunwen Bai & Xiao Li

Photo by Xiao Li

Based on the case study of the development of ecotourism in Green Island, Taiwan, it is discovered that the concepts of ecotourism and distributed economies share some elements in common. Thus distributed economies, as an innovative solution to regional sustainability, shed important insights on the development of ecotourism. In this sense, it would be necessary to explore the connection between these two concepts in the hope of adding new perspectives to both fields.

The concept of ecotourism was formulated in 1990. It was defined by the International Ecotourism Society (TIES) as "responsible travel to natural areas that conserves the environment and improves the well-being of local people" [1]. Ecotourism has been a fast growing niche market within the larger tourism industry since then, and its definition has been under discussion and development as well [2]. Although there remains criticism on the looseness of the concept, there has been some consensus on the basic components and principles for ecotourism. For instance, UNEP and TIES together provide some general principles of ecotourism to guide implementation. They can be primarily summarised as to [2]:

- Promote conservation of biodiversity;
- Create local economic opportunities and benefit well-being of local people;
- Enhance cultural integrity by including learning experience;
- Involve responsible action on the part of tourists and the tourism industry;
- Be intended for small groups and delivered by small-scale business;
- Minimise consumption of non-renewable resources and negative impacts on the environment; and
- Emphasise local participation by providing ownership and business opportunities, especially for rural people.

It can be viewed from the above description that the ideas of distributed economies and ecotourism share the same principles in terms of low environmental impact, small-scale business, empowerment of locals, creating economic benefits and welfare improvement for locals.

In light of these key principles shared by the two concepts, it can be suggested that distributed economies be referred to as a clue for the development of ecotourism. As what has been shown in the case of Green Island, the locals can be activated and engaged as a main contributor to tourism, and the supporting facilities, such as accommodation, catering, transportation and energy system should be adapted to local conditions and use of local resources.

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Distributed Economies and the Islands of Sustainability

By Jana Kovandžić

Besides the concept of Distributed Economies, which has been broadly discussed within this publication, a literature research could lead us to another, similar, concept: the concept of Islands of Sustainability. It is the aim of this paper to try to give a comparison between these two concepts, noting the similarities and differences between them. It needs to be stressed that the literature on the two concepts is not extensive and both are so far based mostly on the ideas of a few authors and a number of case studies.

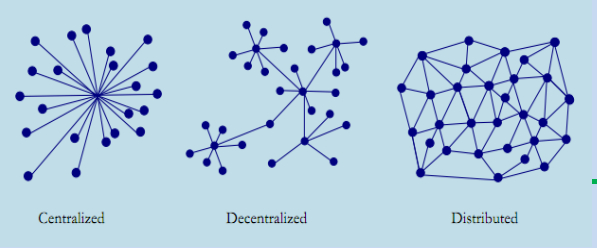
The two concepts

The concept of Islands of Sustainability (IOS) was defined in the 1990s [1]. An island here is a hypothetical island, it is an area where sustainability is reached on a small-scale level and this island lies surrounded by the sea of unsustainability. These islands interact with each other creating a networking process that is qualitatively different and this networking has a tendency to grow. Synergy and creating an additional value from these interactions plays an important role within the concept [2]. An illustration of this concept could be Honey Care Africa [3], a Kenya-based company which provides bee hives and the knowhow to the bee keepers, guarantying the purchase, while also providing health information and seminars. Their networking is based on the Fair Trade concept. Fair Trade aims to support marginalised producers and workers by providing trading conditions that are more just, thus contributing to sustainable development [4].

In 2004, Allan Johansson [5] defined one similar concept and that is the concept of Distributed Economies (DE) with very similar characteristics: small-scale regional economies qualitatively different from economies of scale, enthusiasm of individuals, and feeling of belonging to the community. Several such examples have been elaborated upon within this publication.

What both concepts share is a bottom-up approach to sustainable development [1], they both rely on the enthusiasm of committed individuals, willing to be drivers of change in society. Both concepts emphasise the idea of synergy, where additional value is created while conducting an economic activity together with other parts of the system. Interestingly enough, both concepts are represented in the literature with a similar graph, which indicates interconnectedness of actors and qualitatively different relationships which are being formed.

Both systems also tend to build on the feeling of belonging to the community. They both want to engage people in their networks, influencing the community to be more active, more eager to change and develop, with an understanding of the qualitative difference that is being created. People are those who will bring the change. Consequently, making them aware is one of the crucial points of both systems.



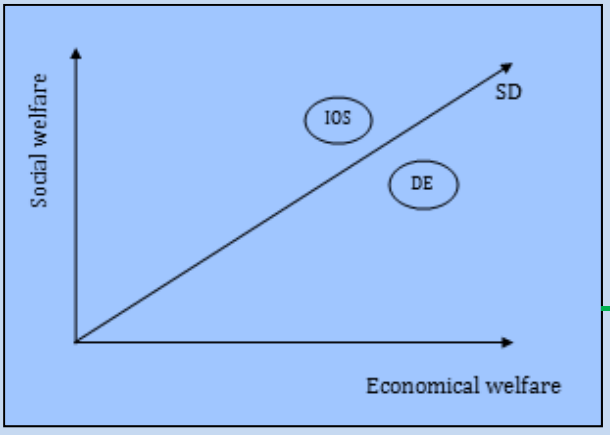
Relationships formed within different types of economic systems

Both DE and Islands of Sustainability aim to restructure torn relations within the society, the economy and the environment [1,3].

Differences

Although overlapping significantly, the differences can still be determined. To understand these differences, it is important to compare the goals that they want to achieve, that is, sustainable development. On that point, some differences can be observed.

What further struck the author is the idea that these concepts are not actually different in their scope, but that differences arise on the question of the emphasis that these concepts place on the path of achieving sustainable development. While Islands of Sustainability place a much stronger accent on the need for societal change and the impact that innovation has on society, DE stays strong in the sphere of the economy, caring more for economical wellbeing that has the ability to bring about changes in other areas. In the light of sustainable development, which envisions a balance between economy and society, profit in Islands of Sustainability is a subcategory of social advancement, while in the DE economical advancement comes prior. However, this would not mean that Islands of Sustainability does not have an economic dimension, or that DE does not cherish the idea of social advancement, quite the opposite – the two sides are very important for both concepts, but the emphasis that they place inclines more towards the side of economics in the DE and more on the social transformation in the case of Islands of Sustainability. The graph presented below indicates this relationship.



Relation of DE & Islands of Sustainability to sustainable development

Conclusion

It was shown through this paper how the concepts of DE and Islands of Sustainability meet in the sphere of sustainable development. It is clear that sustainable development plays a key role in explaining the ties between these two terms.

They should not, however, be observed as confronting or competing terms, but more like a synergy that, together, adds value to sustainability approaches.

Finally, both Islands of Sustainability and DE are parts of the general strive of humanity to achieve sustainability. It is in the field of sustainable development that these two concepts meet.

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Distributed Economies of Scale

By Galyna Prymak

Throughout human development communities have played a crucial role in providing welfare for the most of the population. Since prehistoric times people started to realise that benefits generated by a coordinated group are larger than those of separate individuals. One can point out that the physical features of human beings have not changed significantly during the last several millennia. That cannot be said about the changes in social structures, as well as scientific and economic achievements.

While the population was growing, the need for goods grew as well, both for quantity and diversity. The solution to the quantity quest become feasible by Economies of Scale (EoS), whereas the diversity quest is continually facing high pressures and is in danger of being pushed out. The problem is not only the diversity of manufactured products, but also about diversity in a nature that is being overexploited due to continuously increasing economic activities.

Consequently, many researchers are referring to the period before the industrial revolution, in order to learn how our ancestors managed to behave in a sustainable way and to come up with a new solution for the present situation.

One of the concepts that propose a new perspective is Distributed Economies (DE), however, many challenging issues still remain. In their introductory paper [1], the original developers of DE try to provide reasonable explanations for most of the questions that might arise. One of them is the question of scale. A corollary of that is how DE could provide benefits to as many individuals as possible, in the present state of the world economy where most industrial production is being carried out at a large scale.

For example, the issue of scale was an important factor in conserving a sustainable way of fishing for 1 500 years at Ts'ishaa Village on the northwest coast of North America [2]. Keeping this in mind and going through present examples of sustainable, small-scale communities, it is interesting to look at how DE deals with the issue of trade-offs with conventional production. Although the latter is not considered sustainable, it cannot immediately (if ever) be abandoned for the sake of reliant dependent society members.

DE addresses the need to keep balance between small and large-scale production and brings the idea of developing a symbiosis and coexistence. It is admitted by the DE developers that such a drastic change as a rejection of the conventional industrial system is not feasible and perhaps not reasonable as well [1]. However, some practical solutions on how to find this balance still need to be elaborated.

The DE concept states that large-scale production can be kept for products with no exclusivity, while for those where quality is an essential feature, a distributed way of economy should be applied [1]. However, some issues remain unclear. For instance, how should the distinction between exclusive and non-exclusive goods be made? The global market includes such a wide variety of production systems rendering it impossible to deal with every single case. Therefore, the strategic plan of the DE concept implementation is still missing.

Johansson et al. assert that economic development should provide a meaningful life to as many individuals as possible [1]. However, this point of view has not always been shared by many people, that is, economic development could be fruitful for one group, but bring nothing but higher dependence for another.

The miserable state of life of many people in the world, while the present economic development has reached the highest level ever, shows the inadequacy of the present system to pursue economic development that would be beneficial for the most individuals.

The reason for saying this is to show that for a large number of people, economic development is not necessarily providing benefits. On the contrary, in many cases it serves to provide benefits just for a few privileged.

This is why concepts like DE and sustainable development bring attention to a new attitude to economic development. Particularly, the question of large and small-scale activities is approached as one of the focal points that oppose the two concepts – EoS and DE. However, the ultimate goal of both of them is neither to reach as larger rate of production as possible (in case of EoS), nor as small as possible (in case of DE). Instead, experience shows that both of these concepts aim to develop a system that would provide the highest efficiency, though with some differences in meaning, to the involved individuals. In case of EoS it can be achieved through enlarging the scale of production, whereas DE proposes the opportunity to reach this efficiency even with small-scale activities.

In the view of the author, the task to convince people to switch from large-scale activities to more small-scale, sustainable ones is not easy and necessitates the creation of incentives that address personal interests.

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Distributed Economies: What is the Best Scale to Achieve Sustainability?

By Neisha Manickchand

Photo by Neisha Manickchand

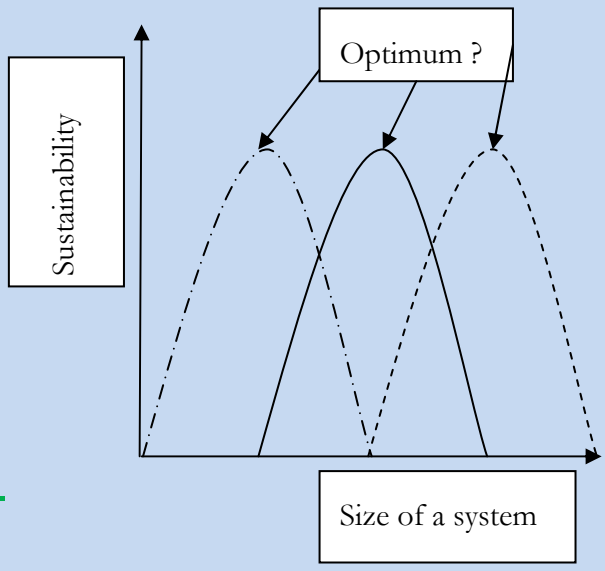
Distributed Economies (DE) is new concept that describes how development can be made more environmentally and socio-economically sustainable. It is a concept that seeks to move away from the conventional workings of a typical system, which is normally centralised and somewhat unsustainable, to a system that incorporates aspects on a smaller scale and aims to be more sustainable. This article accepts the strengths of the concept but it will also question aspects of the concept and where research needs to be done to improve the concept.

A reflection of the concept of Distributed Economies

The argument of Johansson *et al.* [1], concentrates on "finding a renewed balance between large- and small-scale" systems, but not disregarding totally the concept of large-scale systems. While the authors do not abolish the concept of large-scale systems, there is little detail defining what characterises a large- or a small-scale system. This article focuses on the fact that it is important to define these scales because they are not clear to the reader and it can be misinterpreted. For example, it is stated that regional activities mainly in the form of small-scale units allow for the local community to have greater ownership and power over these systems thereby adding quality to their lives [1]. Therefore, the question that needs to be answered in the aforementioned statement is what a small-scale unit is.

Sometimes too small or too large a system can be unsustainable; it has to be the right size to fit the type of system being looked at. For example, a solar water heating system could be applied on a small scale but a wind farm could be more sustainable for a community of a larger size. Additionally, one large centralised biogas facility can be beneficial to an island with respect to its sustainability as opposed to several small-scale operations where waste is burnt inefficiently to provide energy. Thus, what entitles sustainability on a small-scale occurs on a case by case basis.

The graph below can be used to illustrate how the various sizes of a system can be considered sustainable.



Optimal relationship between sustainability and the size of a system

The graph shows that various sizes of a system can achieve sustainability but it would vary depending on the case in question. Thus, there is some ambiguity in the concept that needs to be addressed.

In the description of the concept of DE, there is no quantitative measure of what is a large or mega system. This is therefore subjective and can be interpreted in many ways. Therefore, the concept of DE needs to be refined and made clearer with regard to defining the scale of systems.

Conclusion

This author accepts that DE withholds many strengths and advantages but there are significant limitations and room for improvement of the concept. There needs to be a greater understanding of what consists of a large or small scale system. The author does not disagree with DE, but holds the opinion that DE can be applicable on a case by case basis to justify the sustainability of the concept.

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Reflections on Distributed Economies

By Anton Smit & Ole Bondesen

Photo from the EcoNorfolk Foundation. Printed with permission.

The study on Norfolk focused on ways to distribute the economy of the island and eventually concluded that a centralised power supply was preferable and that other means of improving its economic situation and longer term sustainable development had little to do with either a centralised or a distributed economic model. At this point these authors revisited the definition of Distributed Economies (DE) and realised that if the scale of analysis was changed, the island would still fit the DE concept. If Norfolk was treated as a small-scale unit, any initiative that would decrease its reliance on a central supply from the mainland would be in accordance with DE. The study concluded that a methodology for defining a small-scale unit was missing from the DE literature and that this should be developed. This reflection goes further and argues that the concept of DE is at risk of becoming a broad umbrella term for any positive development and that in order to avoid this, the definition of Distributed Economies needs to be clarified.

Other sustainable development concepts such as resilience, carbon-neutrality, self-sufficiency and cleaner production all have clear meanings. Although the considerable body of literature surrounding them is continually growing, it serves to increase the understanding of these concepts, rather than to define them. For example, when faced with the statement, "this community is resilient", a clear message is delivered and it is easy to decide that this is a good thing. However, the statement, "this economy is distributed" lacks a clear meaning and could just as easily be describing a problem as a success story.

As an example, when Holling published his seminal paper on resilience in 1973 [1], he coined the term as the capacity of biological systems to absorb stress and persist in the same dynamic or steady state. The concept has since been taken further and is now common in the sustainable development literature. Resilience theory has now also become prevalent in other areas, where Holling probably never originally intended, such as natural disaster management and human psychology. A strong, clear definition was the basis for the growth of this concept and subsequent analysis strengthened the concept, but did not change the original definition.

In contrast to this, the definition of DE is complex and unclear:

"With DE, a selective share of production is distributed to regions where a diverse range of activities are organised in the form of small-scale, flexible units that are synergistically connected with each other and prioritise quality in their production. However, rather than the total abolishment of large-scale production, our argument concentrates on finding a renewed balance between large and small-scale and between resource flows that take place within and across regional boundaries" [2].

This backtracks on itself and describes a situation where small-scale production units should be favoured, except for when they should not. A balance could mean anything and this makes DE a weaker concept than others in the sustainable development literature.

Furthermore, the aim of DE is not to distribute the economy, but rather to achieve a balance. Current DE literature does not clarify where this balance should lie. Instead it turns to already established sustainable development principles and concepts such as wealth creation for a larger number of people; reinventing quality; social and ecological capital as an advantage, and so on [2].

In trying to define what the ideal balance actually is, DE risks becoming an umbrella term for concepts that are already well established. Those developing the theory must make a concerted effort to avoid this. Sustainable development or "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [3], is the popular umbrella term that already exists for this. Is another, vaguer term really required?

If DE is trying to establish a balance, a pertinent question would be *could this same balance be achieved without the DE concept*. Unless the definition of DE is made clearer, these authors believe that this is indeed possible. This annual publication galvanises that opinion. Each year, numerous examples of DE are found by IIIEE students, in areas where the concept has never been heard of. This is possible because the principles of DE are set in well-established aims put forth by other sustainable development concepts. DE appears to provide an umbrella definition, without adding anything unique. Governments try to redistribute wealth by pursuing a policy of equity and Rolls Royce has a smaller scale production unit than Volkswagen because it aims to produce high quality cars for a niche market while flexibly meeting the needs and wants of its customers. In neither of these cases has the most practicable course of action been taken under the notion of distributing the economy. Similarly, Norfolk Island should pursue renewable energy options simply because it is a good idea for them to do so, not because they need to pursue DE. It is time to shift the focus from looking for examples of DE in practice, to determining what DE really means.

For DE to be useful, those developing it need to avoid umbrella definitions and focus on what could make the concept unique. The idea of small communities as innovation centres is a unique attribute and this could be promoted as a central element of the concept. However, not in such a way that it becomes an idea in its own right, separate, but not integral to DE theory.

Creating small centres of innovation represents a fundamental shift towards how societies develop. At the moment, DE, which is a young concept, remains idealistic on this and other issues. Future research on transition management and the drivers and barriers to change within societies should now be conducted so that a viable path to this outcome can be determined, otherwise the concept runs the risk of being branded idealistic.

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Distributed Economies As a Route for Sustainability

By María Rosell

The pursuit of wealth has played an essential role in shaping the activities throughout the entire history of mankind. In the modern world, recent economic models confront a challenge of trying to reach development and growth as well as a better life quality for individuals without jeopardising the well-being of new generations [1]. In developing nations' societies, the issue of inequity and centralisation seems to be a problematic factor, and even more in rural areas in these regions. However, remote communities in developed countries also have experienced difficulties to successfully perform economic activities in a centralised system, where the dominating industrial structure leads to fewer benefits for the community and its people.

Distributed Economies (DE) and factors associated

The establishment of the DE concept is rooted in technical inspiration, innovation and efficiency [2]. It requires a fundamental change to approach economy, focusing on regions instead of the national level [2]. DE centres on redistribution of wealth within regions, small-scale production based on quality instead of quantity, and more stable and responsive systems. DE also focuses on the use of locally available resources, benefits of which are intended to serve larger group of people. Further, the application of DE elements facilitates appropriate solutions for localised problems.

Thus, when looking at the economic dynamics on islands, the concept of DE can be suitable to promote transformation in the different active economic sectors by applying organisational principles that are aligned with endogenous development. The latter promotes similar aspect of the DE: cultural and financial changes with an equitable production; also it aims to revival the traditions and encourages to respect the ecological component [3]. In general, islands are geographically isolated but significantly dependent on larger centralised systems, where there is neither cooperation nor symbiotic relations between stakeholders and where the interests of the small communities are not taken into account. Thus, some factors connected to DE concept can lead to a more independent economic system with a better channeling of islanders' skills to motivate creativity, technological advancements in accordance to collaboration, partnerships and technology transfer schemes [4].

Moreover, DE also aims to diversify the elements in an economy, since the more diverse the more productive the network becomes due to the complexity of the connections and affiliation among actors [5]. Collective team spirit that reflects similar aspirations in the community is vital for reaching sustainability and self-sufficiency in any sector of the economy in the context of DE. Equally important is the existence of a strong sense of ownership and leadership within the community [6], besides effective channels of communication to propel the transformation and local empowerment throughout active participation of individuals in the island's community.

In summary, the applicability of DE does not only depend on innovation and accessibility of natural resources, but relies on social aspects such as the level of independence in organisations in the community. This includes low intervention of the state, education among population, sense of individual responsibility to achieve endogenous development. All this will lead to more efficient and resilient productive sectors, and social renovation to maintain the system in constant improvement and making a step forward towards sustainability.

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Distributed Economies, Modern Feudalism?

By Nicolas Acosta

Photo by Nicolas Acosta

The concept of Distributed Economies (DE) first described by Allan Johansson et al. [1] is an interesting proposal for development. DE is a vision of how regions can pursue development through innovative strategies. These so called 'regions' are not completely defined units, yet they are transcending through new development strategies of survival in a highly industrialised and globalised economy. The authors take as an example the industrial districts in Italy that through product quality, diversification and commercialisation have proven resilient to economic turmoil. The authors claim that in order to achieve the DE status, products need to be of a high-value stream where quality is "absolutely essential". These high-value products when produced by the region in a collaborative-symbiotic way create a sense of collective spirit. In this short paper, I plan to provide some insight on how DE is not a new concept, but a description of how modern feudal society works in regions that resemble the economies of the pre-industrial era. The paper shows how the DE concept can in fact be a route of development for the regions to come from a pre-industrial to a post-industrial economy.

Industrialisation is one of the cornerstones of our modern society. Thanks to it an enormous amount of wealth has been created and we have drastically shifted from depending on animated force to perform most of the work to almost completely unanimated [2]. We no longer depend on the force of the wind, nor on animals' size and health for transportation. The costs and efficiency of the production processes have greatly improved. Nevertheless, this wealth creation process has been unequal, even within industrialised countries. There are regions where due to many factors development has been hampered, for instance isolation of a region refrains its products from having access to world markets. Those areas that have not had great economic development and that could potentially work as a DE have a societal and economical structure similar to the feudalist system [3] of the pre-industrial era. However, the system in these regions differs from feudalism in terms of governing institutions and access to welfare and infrastructure investment. These pre-industrial areas have access today to products and services that are part of our market economy and perhaps is the reason why they are not impoverished as they would have been three hundred years ago.

The limited, but still available, access to the products and services allows the regions to have mechanisation of their traditional sector, permitting agriculture to increase its efficiency and allowing it to provide plenty of food resources for the local population; also, the work of artisans through modern tools and proper equipment make this activity more efficient [2]. Transformation of local raw materials into products with high-value may take place and thanks to today's tools, unique products can be

obtained. This mechanisation of the traditional economic sectors is a key aspect for DE.

For these regions, high-value products are a promising endeavour; they should allow them to go beyond self-sufficiency and to actually be capable of producing wealth going from a feudalist-like economy to a full integration with the market economy. Nevertheless, how this process is done is not addressed by Johansson et al. [1] and remains to be seen in the future.

Thus, the DE concept must be seen as a dynamic process where the different economic actors change their activities through time and not necessarily towards sustainable development. The development that they may achieve could be unsustainable, could turn into a decentralised or even centralised system of production as it happens today with many high-end products. Indeed, the DE concept is an interesting pathway for regional development, but its outcome and applicability remains to be seen.

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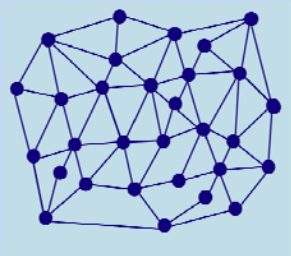


A Constructive Reflection on Distributed Economies

By Raquel Salazar

Distributed economies (DE) offers an alternative framework for development, which is embedded in the local context and is focused to foster innovation and quality of life. DE is a stimulating concept, however, it is quite broad, and this opens an area where criticism sprouts.

DE's definition is still in development. Therefore, its conception is mostly enlightened through a set of principles – which although are not new – their compilation set up a comprehensive and engaging framework for development. However, it is important to be clear that DE aims to pin point a route of development for new services and production systems, without trying to transform current centralised large-scale development systems regimes into more socially and environmentally responsible schemes. This limited scope of action can affect DE's contribution towards a greener, resilient and sustainable society.

Perhaps one of the hallmarks of DE is the idea of encouraging local and decentralised production systems without isolating them from the central system. However, the concept can gain strength if the developers of DE explicitly acknowledge and take a clear position about the fact that it is likely, that if a business or an initiative reaches a certain level of success it can be absorbed by the centralised large-scale system.

Moreover, DE is an individual-oriented theory. It places with individuals and communities the responsibility to find innovative solutions within a framework of collaboration, flexibility, and a local small-scale approach. DE does not assign to the government any role in particular. It is an important omission, which can affect the implementation of DE.

The DE approach is positive because it challenges the individuals to use their local and traditional skills, as well as to think creatively to develop projects and business. Also, DE's position can help to reduce bureaucracy and the paralysis of the initiatives that come about due to government disorganisation or inaction, as well as to achieve higher levels of engagement from the different stakeholders.

However, DE assumes that the individuals, by default, share the alternative vision that DE envisages – not just for business, but also for better quality of life. Moreover, the framework assumes that people have the knowledge and skills to create innovative production systems following DE principles, which will not necessarily be the case. For instance, the island examples in the Pacific showcased in this report clearly illustrate that they may need government intervention or another kind of external support to create and start running new projects.

DE has a strong potential in developing regions where centralised large-scale systems have not yet been implemented, where it is hard to ignore that the majority of the people or communities lack the financial capacity or knowledge to develop projects. How are communities supposed to be innovative and follow a certain development model if they do not

have information or the tools to do it? How can it be promoted for people to choose an alternative model, such as DE, instead of adopting the current mainstream scheme? However, this same situation can happen regardless of the level of development in the region.

This is, in the view of the author, where governments can play a strategic role in the implementation of a DE framework. At the national level the government can promote entrepreneurship, respect for the environment, and facilitate financing for sustainable projects. At the regional and local level the government can inform about the advantages of local small-scale business, promote collaborative schemes, as well as find financial or business partners with an investing agenda in line with DE principles.

Consequently, it can be relevant that the DE concept acknowledges governments as strategic partners, and as facilitators, whose intervention has the potential to extend and strengthen the implementation of DE systems.

A Brief Discussion on Practical Application of Distributed Economy

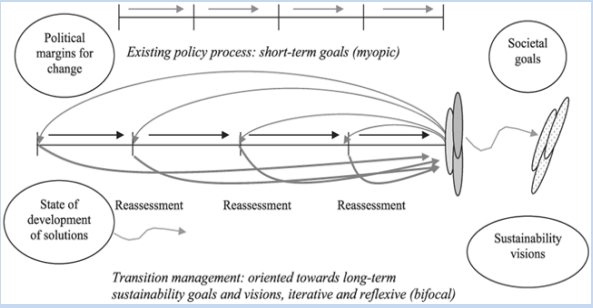
By Arijit Paul

This article briefly discusses two concepts, concerning the practical application of the Distributed Economy (DE) theory. The first discussion is, on how the theory of "transition management" can act as a catalyst for practical implementation of DE, and, its relevance for small island developing economies. The second discussion is more general in nature and briefly argues in favour of the need for the development of a composite DE index and its potential benefits in furthering the development of the DE theory.

Transition management as a catalyst for DE

Transition management is a new form of governance proposed by Dutch scholars. Loorbach [1] provides the following definition of the concept, also illustrated in the figure below [2].

The basic steering philosophy underlying transition management is that of anticipation and adaptation…Goals are not fixed but developed (through a search and learning process) by society and the systems and the systems designed to fulfil these goals are accordingly created through a bottom up approach using incremental steps directed toward a long term goal.



The synergy between the concept of DE and transition management is in their common goal, that is, sustainable development. In addition, Mirata [3] has identified a number of fundamental synergies between DE and transition management. These include the common systemic approach of both concepts to bring about structural changes in the society. However, there exists one fundamental dichotomy between the two concepts. DE is proposed as a self-organisational process [4], whereas, transition management is proposed as a mode of governance [1]. Use of transition management as a trigger to facilitate implementation of DE has been proposed as the solution to this dichotomy by Mirata [3]. Mirata identifies one particular element of transition management, namely "the strategic niche management" as the main catalytic element for operationalisation of DE. Strategic niche management has been defined by Kemp *et al.* [2] as follows.

The creation, development and controlled phase outs of protected spaces for the development and use of promising technologies by means of experimentation, with the aim of enhancing the rate of adaptation of the new technology.

Small island developing economies owing to their lack of adequate energy infrastructure, low penetration of renewable energy and geographically distributed nature provide a good opportunity to implement strategic niche renewable energy projects to catalyse the development of DE. Inception and implementation of such strategic niche projects for pilot testing might provide crucial insights into the further development of the DE as well as transition management theory.

Composite DE index: A tool to quantify DE in practice

In the development of economic theories, tools have always performed important roles in investigating, understanding and explaining practical aspects [5]. Similarly it can be argued, that the development and application of relevant tools would be an important requirement to further the growth of the DE theory.

This section proposes a tool, namely the composite DE index. The index would mainly serve two purposes. Firstly, it would provide a framework for quantification of the distributed economies. Secondly it can be used as a tool for comparative and benchmarking analysis.

The composite index would be a range bound index, with a predefined scale of minimum and maximum values. The composite index for a given distributed economy would be a single number, calculated as a weighted average value of a number of indicators. Thus, the heart of the index would be the choice of the indicators. Indicators would need to be quantitative in nature and be in line with the theoretical framework of the DE theory. The rest of the discussion in this article focuses on the choice of indicators.

Choice of indicator would be guided by the choice of criteria which are relevant for the DE theory. The criteria for DE characterisation are chosen from Mirata *et al.* [6]. These criteria include the following.

1. Increasing the share of renewable resources in economic activities;
2. Increasing wealth creation for a large number of people;
3. Decreasing pollutant emissions and waste generation at the local regional level;
4. Increasing the sustainable use of local resources in economic activities;
5. Increasing the value addition to local resources;
6. Increasing the share of the added value benefits retained in the regions;
7. Increasing the share of non-material (for instance, information, knowhow) and higher added value material resources in the cross boundary resource flow;
8. Increasing the diversity and flexibility of the economic activities; and
9. Increasing the diversity and intensity of communication and collaboration among regional activities.

Criteria 7 and 9 are found to be difficult to quantify and thus no indicators are proposed for these in this article. Indicators considered to quantify the rest of the criteria are mentioned below.

(1) Renewable energy as a percentage of the total power generation (criterion 1); (2) income per capita (criterion 2); (3) concentration of regulated pollutants (criterion 3); (4) per capita waste generation (criterion 3); (5) per capita waste recycling rate (criterion 3); (6) per capita ecological footprint (criterion 4); (7) income multiplier (criteria 5 and 6); and (8) diversity index (criteria 8).

A detailed discussion on the choice of indicators could not be performed here due to limitations of scope and space.

The above discussion on a composite DE index is only an elementary reflection on the potential of developing such an index. A significant amount of further research would be required to fully develop and apply such an index in the context of DE.

Conclusion

DE as a theory has the potential to contribute in sustainable development. The success of DE lies in making the transition from theory to practice. Hopefully this article is a small step in that direction.

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The Team

The authors of this publication are currently students of MESPOM (Masters in Environmental Sciences, Policy and Management). MESPOM is a two-year Erasmus Mundus programme which is operated by four leading European Universities: Lund University in Lund, Sweden; Central European University (CEU) in Budapest, Hungary; Manchester University in Manchester, UK; and University of the Aegean in Lesvos, Greece.

Currently, this group of authors is studying in Lund University at the International Institute for Industrial Environmental Economics (IIIEE). This publication is a part of the IIIEE Strategic Environmental Development course which sought to explore the concept of Distributed Economies applied to selected island cases around the world.

Thomas Lindhqvist and **Mikael Backman** are professors at the IIIEE and the team leaders of this project. Thomas is a specialist in Environmental Product Policy. Mikael focuses his work on the topic of Sustainable Tourism.

Neisha Manickchand and **María Rosell** researched the island of Bonaire in the Caribbean. Neisha comes from Trinidad and Tobago and pursued a BSc double major in Environmental and Natural Resource Management and Agricultural Science. Maria holds a BA in Environmental Studies and comes from Venezuela.

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Both coming from China, **Yunwen Bai** and **Xiao Li** did a study on ecotourism on Green Island, located in the Asia Pacific region. Yunwen worked for Greenpeace and Xiao has a background in Economics.

Ole Bondensen and **Anton Smit** examined Norfolk island. Ole is from Denmark and he studied International Relations. Anton is from Zimbabwe and studied Zoology and Accounting.

Emily Dowding-Smith, **Arijit Paul** and **Raquel Salazar** all share an interest in renewable energy in developing countries and they explored the island of Vanuatu in the Pacific. Emily, from New Zealand, and Raquel, from Costa Rica, are lawyers and Arijit, from India, is an engineer.

IIIEE – The International Institute for Industrial Environmental Economics at Lund University

With the firm conviction that prevention is better than cure, the International Institute for Industrial Environmental Economics (IIIEE) was funded in 1994 at Lund University, Sweden, to engage in multidisciplinary research and educational activities with the overall ambition to develop and spread knowledge about strategies and policies for sustainable solutions to the contemporary and future challenges.

The Institute's educational effort is focused on masters' level courses and is carried out through two programmes: MSc in Environmental Sciences, Policy and Management (MESPOM), and MSc in Environmental Management and Policy (EMP). The MESPOM programme is an Erasmus Mundus programme supported by the European Union. The programme is a cooperation of four universities: Lund University, the Aegean University (Greece), the Central European University in Budapest (Hungary) and Manchester University (UK).

The MESPOM programme starts with two semesters at the Central European University in Budapest, Hungary. Half the student group comes to Lund for the third semester and many of those stay for the fourth semester, the thesis work. Strategic Environmental Development (SED), of which this report is a result, is a third semester course in MESPOM.

Candidates arriving to Lund have a professional degree in subjects relevant for work with issues around sustainable consumption and production, and frequently have several years of work experience. The courses are intense and demanding but also rewarding: our graduates have done very well in the job market and essentially all move on as professionals in the environmental field. Our education aims to be applied with many interactions with industry, government and NGOs. In Lund the students are, in particular, provided with the knowledge of how to act in enterprises, government and other organisations when addressing the sustainability challenges, and the tools that facilitate this work. The fourth semester is devoted to thesis research and writing and can take place on or off-campus.

There is a variety of disciplines among topics covered: management of organisations, technical systems, economics, law and policy, etc. In-house research related to most of these areas gives excellent opportunities for research papers and theses. The educational staff is experienced and highly committed, several have gone through one of the masters programme themselves. The educational staff is also international and represents various disciplines with a common interest of making knowledge and understanding useful in practice.

The students experience close contacts with an impressive and very active alumni network for the sharing of new developments and profes-

sional achievements. Alumni continue to keep frequent contacts also after leaving Lund; sharing experiences, knowledge and information through the IIIEE Alumni Network. Every two years the alumni meet in Lund for a two-day conference.

IIIEE also runs educational programs at PhD level, participate in teaching on undergraduate level, and is involved in executive training. Research at the IIIEE focuses on policy and strategies for sustainable solutions. The research includes the design, application and evaluation of policy instruments from a governmental, as well as, corporate perspective, and special attention is given to research that identifies and supports strategies and approaches for more sustainable business practice. In recent years, research has also focused on how to better understand the power of innovation and entrepreneurship to address sustainability challenges.

The research areas are numerous and cover topics of cleaner product and production-systems, sustainable consumption, waste management, renewable energy, energy efficiency, material flows, distributed economies, industrial ecology, the built environment, city development, tourism, mobility and information technology. The research is organised to encourage crosscutting actions and to allow for activities that address topical challenges and incorporate new approaches. Many researchers are active in more than one of the research areas and several of the research projects can be attributed to more than one of the areas.

IIIEE was established by the Swedish Parliament. It is a unique and creative response to the global challenge for sustainable development. It is part of Lund University and governed by a Board appointed by the University and the Government.

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