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研究紀要

Profit and Potential for Community Wind Farms in Taiwan*

Bart Linssen* & ***Sammy Su*****

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** Master in Electrical Engineering; Eindhoven University of Technology Executive Director; Low Carbon Initiative – European Chamber of Commerce Taiwan Managing Director; ENERCON Taiwan Ltd.
E-mail: bart.linssen@enercon.de.

*** BA in English; Shih Hsin University, Taipei Taiwan Award Recipient; Phi Tau Phi Scholastic Honor Society of the Republic of China, 2001 Director; Low Carbon Initiative (LCI) – European Chamber of Commerce Taiwan.
E-mail: sammy.su@ecct.com.tw.

Abstract

Taiwan is an economic hub with one of the strongest tech manufacturing bases in Asia Pacific. It has high energy needs but scarce natural resources; 97% of energy is imported. Diversification into wind energy, especially in on-shore and off-shore wind farms along the coast of Taiwan, would result in higher self-sufficiency and energy security. Wind energy is well positioned to give Taiwan's people a chance to support and profit from renewable energy and electricity generation that does not come at a cost to their health. Community-invested windfarms in Europe have been around for many years and with great success. Local wind cooperatives or other participatory business models have been responsible for a large share of total wind development; in both Denmark and Germany over half of renewables are community-invested. The experience in Europe shows that participation of residents in community windfarms leads to better acceptance of the windfarms.

This article explores cooperative and community-shared ownership models for community investment and describes three successful community-invested wind projects in Europe. The article provides suggestions on how the community-invested model can be made to work in Taiwan. Financing, wind-turbine technology, maintenance companies and project execution resources are widely available in Taiwan. Experienced wind project developers capable of carrying out initial planning and permitting are harder to find. The government could take steps to better enable the development of community-based wind projects by making available a higher feed-in tariff for community-invested projects, guaranteeing grid connection, simplifying the application process, and allocating more land for wind project development. The key to a successful project however is a "trusted person:" a person trusted by the community who has the financial and business background to start up and run the community-invested cooperative.

Keywords: Community-invested Cooperative, Renewable, Wind Farm, Feed-in Ttariff, Permit

I. Introduction

A. Taiwan's growing need for renewable energy

Taiwan is an economic hub with one of the strongest tech manufacturing bases in Asia. As such, the island's energy needs have skyrocketed along with its domestic GDP growth since the Taiwan miracle kicked off in the 1960s.

Being a small island with scarce natural resources, Taiwan has met most of its energy needs through importing fuel resources from other countries. In 2017, Taiwan relied on foreign coal (46.8%), natural gas (34.7%), and oil (4.7%); alongside domestic nuclear (8.3%) and renewable energy (4.5%) (Bureau of Energy, 2018: 4). Such an overdependence on imported resources places Taiwan's energy needs in a vulnerable position in respect to international coal, gas and oil prices. The diversification into wind energy, especially in on-shore and off-shore wind farms along the coast of Taiwan, results in higher self-sufficiency and energy security.

The Taiwan Strait is blessed with one of the world's best wind resources. Wind energy is well positioned to give people in Taiwan a chance to support and profit from renewable energy; electricity generation that does not come at a cost to their health.

The ECCT Low Carbon Initiative proposes the development of Community invested windfarms to speed up Taiwan's energy transformation and to increase the participation and support of residents to create a green-energy based society.

B. Europe's community wind farms

Community invested windfarms in Europe have been around for

many years and with great success. Local wind cooperatives or other participatory business schemes have been responsible for a large share of total wind development. In Denmark, for example, approximately 86% of all wind turbines were individually or cooperatively owned in 2001 (Larsen, 2001) , and a similar pattern holds in Germany, the world leader in installed wind capacity where in 2013 47% or 34GW of renewables (of which 15.6GW onshore wind) were community invested (Borchert and Wettengel, 2018). The UK and the Netherlands have recently made forays into community wind ownership. In particular in countries where land resources are limited the scheme can contribute greatly to the success of implementation of renewable energy technologies.

II. Community initiated wind projects

For the term "community initiated wind project" there is no clear specified definition (Holstenkamp and Radtke, 2017: 372), but the following characteristics are important when talking about community energy; The citizens should be involved throught the planning stage, during the project phase and in defining profit participation. The possibility of participation should be limited to a specified municipality, district or area and participation should be available for citizens without high barriers (Radtke, 2016: 193).

So while there are many ways to organize citizen participation in a wind-energy project, they are most commonly constructed in one of the following ways:

1. Windfarm Cooperatives**:** Community wind started as an initiative of the citizens. Key drivers may be individuals, community groups, civil society actors like associations or public institutions like schools or universities.
2. Windfarms with Community Shared Ownership: Development or investment companies, independent planning offices, banks or

public administration initiate a wind farm project and offer opportunities of participation towards the citizens in the form of a public tender.

3. Municipal Windfarms: Windfarms owned by the municipality, publicly owned and tax exempt.

Table 1: Comparison between the 3 most common structures of community invested windfarms

	Cooperative	Community shared ownership	Municipal
Initiated by	Residents Residents are involved from the start and take the also the initial development risk	Developer The developer takes the initial development risk. Residents purchase shares after the windfarm has been completed.	Local government The project is development and risk is taken by the local government.
Resident participation	Very high From the initial idea until completion residents are involved.	High Residents get involved after project completion and may only own part of the project	Medium Resident participation is only indirect through the local government.
Complexity	High Since residents carry the project from the beginning, the structure is complex and experience is gathered as the project develops.	Medium The developer is experienced in realizing the project. The windfarm may only be partly transferred to residents.	Medium The government is the single entity developing the windfarm, generally with the help of an experienced developer.

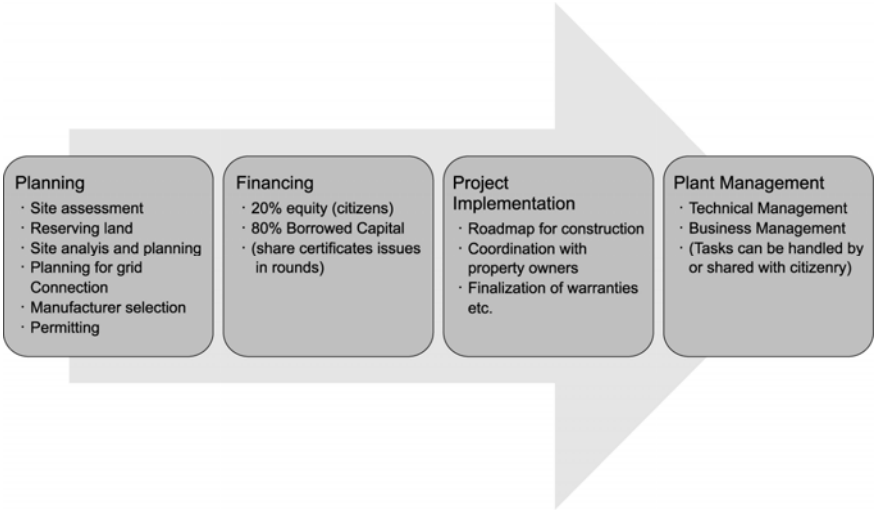
In this article we will focus on the initiatives with the highest resident participation; the cooperative and community shared ownership

A. Community initiated wind project by citizens for citizens

Of the three approaches to a community windfarm, the cooperative, where citizens take the initiative and organize the windfarm themselves, has the strongest appeal and support. In this chapter we shall discuss the main steps that lead to the realization of such a project.

Citizens are invited to participate in each step of the process.

Figure 1: Flowchart for establishing a community windfarm (Hentschel (2012: 11))



1. Planning phase

In the planning phase, all general information necessary to develop a wind project is collected including the review of the land development

plan and a review on the wind farm location. Information about ground and climatic conditions, wind velocities and legal frameworks are considered. An estimate of the project duration is made and the advantages to the community are reviewed. The duration of this review generally takes 1.5 to 2 years when the land-use plan is already available and may take up to 5 years if land-use plan is not available yet.

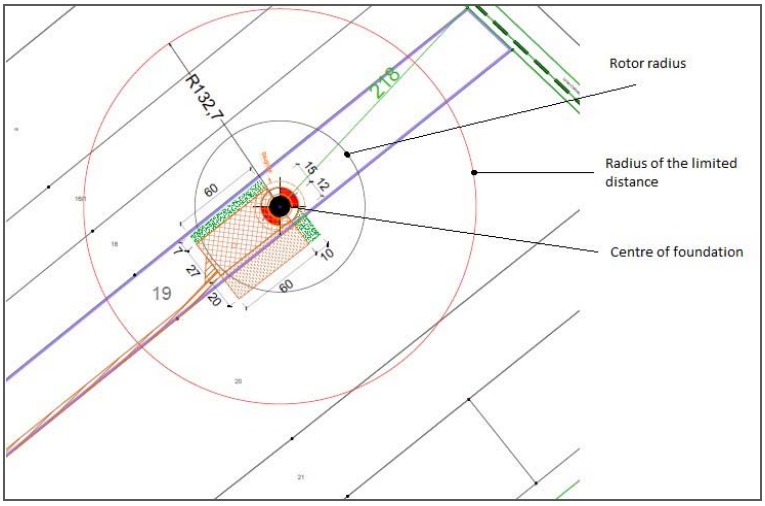
A feasibility study considers parameters such as investment, operating costs, future income, tax and factors of financing like loan term, equity ratio and interest etc. The results of those parameters are a basis for the calculation of the return on investment which is in turn the basis for the choice of the company structure and financing model.

Citizens have to agree on one common contracting partner, preliminary decisions need to be made on the type and number of turbines and a preferred wind-turbine supplier must be chosen. Landowners need to be approached whether they agree to provide and lease their lands for the project. In order that each landowner whose land is directly affected and needed for the projects, agree to the lease agreement, information provision must be transparent and complete. The leasing agreement should be made between the landowners and the one common contracting party and is generally for a duration of 25 years or more (the lifetime of a wind turbine). The compensation of the landowner can be in the form of

- fixed payments based on acreage, towers or megawatt capacity;
- royalty payments based on a percent of gross revenue;
- or some combination.

Aspects of the lease of the land are beyond the scope of this article but a guideline can be found in the article by Emanuel and Martin or the article by the Windustry Easement Workgroup (2009).

Figure 2: Example of the limited distance of a wind turbine



All lands that are within the radius of the so called limited distance of the turbine (this is all area covered by the radius of the turbine including the blades plus the area needed for construction) need agreements with the respective landowners. If no agreement is obtained with all of the landowners, the location of a planned wind-turbine needs to be shifted.

Optimal access routes have to be calculated and the effect of turbulence between turbines has to be reviewed. The manufacturer can assist and can calculate the optimal locations for the turbines with regard to yield and turbulence. The grid operator and local power provider have to be contacted to organize grid connection.

Land use has to be coordinated with the nature conservation agency, the air traffic control center and the heritage protection. Depending on the size of the wind farm, an environmental impact assessment is needed. Reports such as wind appraisals, noise pollution, shadow flicker, wind turbine turbulence and reports on affected birds and bats may be required.

B. Financing

Citizens are financially involved in a Citizen owned windfarm, this is a critical requirement for a windfarm to be called a "community" or "citizen" windfarm. The benefit of participation as opposed to compensation is the feeling of ownership and with that the motivation to support the project to succeed.

There are 4 requirements to citizens' financial participation

- The citizens who invest in the project need to belong to the local community.
- Financial participation has to be available equally for every citizen without barrier.
- Each participant has the right to be involved in the decision-making process.
- Participating citizens need to have the voting majority in the company (Holstenkamp and Radtke, 2017: 283)

The estimated investment volume should be determined in this stage of the project. Generally 20% is in equity from citizens and 80% debt component (WindEurope, 2017: 7). The financing plan considers the expenses, income, the taxation and 20 to 25 years of operation. Project developers have to provide evidence that the installation will run unobstructed for at least 20 years and give their creditors details on the used technology to estimate possible outages and maintenance costs. Most wind-turbine manufacturers guarantee an operational availability of 97% and compensate for wind turbine yield loss if the availability is not reached. In Europe interest in wind energyhas picked up significantly from both institutional and strategic investors who are now looking at wind projects for their steady, predictable returns.

Citizens purchase shares of the wind farm and become shareholders

of the founded company. The citizens buy the shares in rounds where each round is limited to one share certificate per person. The intention is that the shares are evenly distributed within the community and not in possession of only a few shareholders (Hentschel, 2012: 9).

In case the required equity is too high for the citizens, it is possible to expand the geographic radius for participation of the project, but you generally want to keep the investment opportunities as local as possible. The definition of the increase of the geographic radius is up to the initiators of the project. Citizens who want to participate after the founding of the company or after the realization of the project, are registered on a waiting list. If shares become available again due to leaving shareholders, there is then the possibility to distribute it within the company or sell it the citizens on the waiting lists.

The transfer of shares to people outside the community needs the approval of the general or shareholders assembly because it could be disadvantageous if undesired external investors purchase shares of the company and get participation rights.

1. Project Implementation

After the planning phase the installation schedule and the construction plan are executed by the developer and the manufacturer in coordination with the landowners.

For the installation of the wind turbines and construction of the wind farm it is possible to contract the entire installation and construction works to the manufacturer in the form of an EPC contract (Engineering, Procurement and Construction).

Alternatively, specific installation and construction works can be subcontracted to individual companies, e. g. companies for excavation

works, cabling works for the grid connection etc. by individual contracts. Which option is chosen depends on the project goals; whether costs are to be kept to a minimum, or if it is important to maximize the value chain within the community by keeping work and supplies within the community, municipality or region.

2. Plant Management

Technical management of the turbines may be kept in own hands or subcontracted. Wind turbine manufacturers offer long-term contracts (up to 20 years) that cover maintenance and repair services of all wind turbine parts against a fixed fee and with a guaranteed wind turbine availability. Under such a contract, operating risks are born largely by the manufacturer and risks to the cooperative are kept to a minimum.

Commercial management of the windfarm covers accounting, administration of insurance contracts and compliance checks. The windfarm management reports to a supervisory board.

For investments or major changes, management needs the approval of the shareholders. The majority needed has to be determined in the bylaws at the founding of the company.

C. Community shared ownership

Expenses arising before the project completion e.g. costs for wind measurements, location verifications or other expert reports could be considered venture capital. Worst case those investments will be lost if the wind project cannot be realized. For a fully community owned windfarm as described in 2.1, this kind of risk may not be acceptable (Hentschel et al., 2013: 10)

It is possible for a developer to develop the project on behalf of the

community. With exception of the landowners, citizens are in such case not involved in the initial planning, financing, implementation, commissioning and operational management of the farm. Landowners receive a fixed lease price or a profit sharing arrangement. After commissioning of the farm, the developer makes available a number of turbines for citizen ownership.

Citizens then found a company that will own the acquired wind turbines. The citizens can purchase shares of this new founded company. Financing starts when the wind turbines are put into operations. If the costs are too high and/or a high equity ratio is needed, it is possible to expand the radius for the participation of the project.

With this option the citizens have no risks in regard to the planning, development, construction works, performance and acceptance tests because they are only involved in the wind farm project when the wind turbines are operational. The citizen cooperative would then decide if and how to subcontract the technical and operational management.

D. Examples of community initiated wind projects

We will give here 3 examples of successful community projects in Europe, each of a different size and somewhat different approach and scope.

Table 2: Comparison between the 3 community wind examples

	Ingersheim	Hilchenbach	Krammer
Total investment	Euro 3.6 million	Euro 15.5 million	Euro 200 million
Equity/loan	80%/20%	18%/82%	No information available
Initiator	Community	Municipality	NGO
Govt support	No	No	No
Shareholders	360	88	5000+
Erected	2012	2008	2018
Return on investment for participants	Information not available	Information not available	6,0-8,0% paid back within 11.5 years
Installed Capacity	2MW	10MW	102MW

1. Ingersheim community energy cooperative

An example of small scale cooperative project is the "Ingersheim community energy cooperative" which consists of one wind turbine. The cooperative was founded in 2010 in Baden-Württemberg. What makes this project special is that almost 80% of the upfront cost were covered by equity capital from members. The members benefit in return from the profit of the wind turbine depending on the amount of the purchased shares. In total 22,920 shares were sold with a value of € 125 each share and with a minimum share of € 2500. The cooperative has around 360 members and more than 75% of those are from the community Ingersheim and the surrounding municipalities (Hentschel, 2012: 19).

The construction of the wind turbine was opposed by a neighboring community. The arguments for and against revolved around the impact on the landscape, wildlife and infrasound and are well documented in the article by Leibenath and Otto0.5 (2014: 7). The legal actions by the protesters failed and the turbine was built in 2012.

2. Hilchenbach community wind farm

An example of a medium size community wind farm is the "Hilchenbach community windfarm" by the Rothaarwind GmbH & Co. KG in North Rhine Westfalia with 5 wind turbines. The "windfarm in a forest" was finished in March 2008 with a construction duration of 13 months.

The total investment for the project was 15.5 million Euro, of which 2.8 million was raised in equity (Energie Region NRW, 2011: 9).

The shares of the company are in the hands of the municipality Hilchenbach and the citizens. Overall 87 people participated in the project and hold shares. Over two thirds of the company shares were purchased

by the citizens of Hilchenbach and their neighborhood. Landowners receive around € 75,000 each per year based on actual turbine production for the lease of the land for the turbines.

According to the executive director Günter Pulte, there was a great demand and willingness by the citizens to purchase shares and invest in the wind farm project. Furthermore the possibility of an active participation of local people helped to increase the tolerance and acceptance towards this project in the community. This project also supports the municipality and offers local benefits for the regional economy.

No protests against this project are reported. The main challenges were technical as the windfarm was built in a forest. For the construction of each turbine 0.5 to 0.7Ha of forest is cut, of which 0.3 to 0.4Ha is replanted after construction was finished. To reduce impact of the turbulence caused by the treetops and to reduce impact on birds and bats, the developer chose turbines with high hub-heights of 138m (Rijksoverheid, 2015: 61)

The project was completed successfully and the initiators have started the planning for an extension with a further 22 turbines.

3. Krammer Wind

The Netherlands has similar challenges to Taiwan in that it is a very crowded country where it is difficult to find onshore wind locations. Nevertheless the development of onshore wind in the Netherlands has been more successful than Taiwan with 3,223 MW onshore wind installed and a target of 6GW onshore by 2020 (GWEC, 2017: 52) as opposed to an installed capacity of 640MW in Taiwan and a final target of 1.2GW.

Due to the population density of the Netherlands, windfarm construction also regularly faces opposition from local residents. To achieve the ambitious future goals for onshore wind, community wind

initiatives are now also in the Netherlands seen as a way forward.

Krammer windfarm consists of 34 turbines with a total installed capacity of 102MW. The park is owned by 2 associations; Deltawind and Zeeuwind with a total of 5,000 members. Both associations are located in the region and support renewable energy by assisting their members to invest in solar and wind projects.

The target was to have as many people as possible profit from the windfarm. Everyone was allowed to subscribe but association members and local residents got priority. The bonds were allocated in rounds of €500, to make sure that as many people as possible obtain a bond.

For the Krammer windfarm the members raised €10 million starting capital in the form of loan bonds. The bonds issue was oversubscribed by more than €8 million. €9 million was allocated to members of both associations and €1 million to the immediate residents of the windfarm. The decision on how to assign the bonds is made by the board of Krammer wind. The reason to give priority association members is because they took the initial development risk for the windfarm. Residents were prioritized because they are affected by the building of the windfarm.[1]

The loans by participants are paid back within 11.5 years with an interest of 6.0-8.0% depending on the wind turbine energy yield.

The owner of the windfarm are the initiating associations Deltawind and Zeeuwind. They hold 51% of the shares; 49% shares are held by the supplier of the wind turbines; ENERCON (windenergy Magazine, 2018)

In addition to receiving priority in financing the windfarm, direct residents get financial compensation and discounts on their electricity bills.

1 https://www.windparkkrammer.nl/.

No evidence of protests against the construction of this windfarm has been reported.

The project was completed end of 2018 and the electricity that is generated by the windfarm is sold to Google, AkzoNobel, DSM en Philips through Power Purchase agreements (Roberto Zanchi, 2017).

There is a lot of focus on transparency. The windfarm has a dedicated website. Almost any detail of the windfarm can be found on this website; project planning and project progress, people involved in the construction, financial information, turbine technical information, windfarm operation.

An APP is free for download that shows operational status and production of the turbines and is accessible to everyone.[2]

Figure 3: Screenshot of the windfarm app

[2] https://www.windparkkrammer.nl/krammer-app-live/.

III. Community Wind in Taiwan

In consideration of the fact that community initiated wind projects are a new concept in Taiwan, it will be difficult to initiate a pure wind cooperative as described in paragraph 2.1. Procedures and permits for the construction of a windfarm are complex and will require expert knowledge. A more realistic approach is therefore a community initiated wind project in cooperation with a developer as described in paragraph 2.2.

A central role in the development of the farm will be for a person that is trusted by the community and with the background and knowledge to understand the financial and operational requirements of building such a farm.

Specifically for Taiwan we will now discuss legal, financial, construction, installation, operation and maintenance aspects.

A. Legal

The legal structure that applies best to represent the interests of citizen ownership is the Company limited by shares. This will protect citizen's private assets.

Table 3: Legal aspects of a company limited by shares

Company Limited by Shares	
Liability	The liability of the shareholders is limited to the payment of their shares they purchased.
Organizational structure	Executive board with minimum three directors Supervisory board with minimum one supervisor Shareholders meeting once per year Special Shareholders meeting possible
Distribution of Profit	The distribution of profit depends on the shares purchased.
Loss distribution	Losses can be carried forward for maximum 10 years.
Capital stock / Starting capital (minimum)	There is a minimum registered capital stock.
Voting rights of the Shareholders	Usually the voting rights depending on the amount of the purchased shares.
Tax	Corporate income tax of 20% needs to be paid.

The transfer of shares does not require the approval of the executive board which is easier for projects with a high number of shareholders, but the transfer of shares has to be regulated as to ensure that shares stay in the hands of immediate residents and citizens. Special requirements for holding shares could be the condition to have a registered residence in the community or to be in specific vicinity.

The directors and the supervisors are going to be elected in the shareholder's meeting. Decisions in shareholder's meeting are made with a simple majority e. g. the election of the directors. It is possible to consider equal voting right for everyone regardless of the amount of the purchased shares. This can be realized by issuing two types of shares; Common shares with voting rights and special shares without voting rights.

B. Financing

Generally, we would expect a project to be financed with 20 to 35% shareholder equity and 65 to 80% debt. The major participation should consist of the residents of the community, its local companies and the municipality of the community. In case the equity capital raised by the local community is not enough, it is possible to expand the scope of the participation to residents of the neighboring areas, interested companies, and investors.

Shares are distributed in rounds, where with each round 1 share is assigned. Further regulations can be added to set limits to minimum and maximum bids for purchasing a share. Especially maximum bids can be interesting if the project should not be owned by only a few wealthy residents, investors or companies. Minimum bids can be established if there is high demand.

Banks will require documents and approvals before giving credit including the name of the project development company, name of constructor or EPC partner, name of the electrical engineer, leasing agreements for the lands, quality standard for the materials, guaranteed availability, a Power Purchase Agreement (PPA), private assets as bank guarantee, grid analysis, feasibility study, and risk assessment etc.

C. Project implementation

During the planning stage it is recommended the community owned company cooperates with an experienced developer familiar with the permit procedure, grid analysis and feasibility study. Taiwan has several developers that are experienced in all aspects of a windfarm construction. When it comes to the project implementation stage, there are different possibilities for realization:

- Individual contracts: Work is subcontracted to individual parties directly, which will be the cheapest setup, but also comes with a higher risk as the customer is responsible for the overall project management.
- An EPC Partner: The EPC partner is responsible for the procurement of the wind turbines, civil and electrical works. The costs are higher but the risks and transactions costs are lower.

D. The operation of the windfarm

Wind turbine manufacturers in Taiwan offer full scope maintenance and service contracts with guaranteed availabilities of up to 97% and up to 20 years contract durations.

Even after a windfarm is in operation it is possible to continue to involve the community. The company can establish a social fund in which part of the profits of the windfarm are paid. The social fund can be used to improve infrastructure and pay for social projects.

The community owned company may consider to sell the generated energy directly to citizens at a cheaper electricity rate. After the implementation of the electricity act (passed on 11 January 2017) this will become feasible.

Transparency regarding the operation of the windfarm is important. Modern technology lets participants to actively monitor the windfarm. There are examples of participants of community windfarms that can actively control the operation of a windfarm, for example through an app. Residents can switch off a turbine when the turbine affects them.

Income for the windfarm comes from selling electricity to Taipower at the Feed In Tariff set at the year of commissioning of the farm or, and this is possible since the passing the of the electricity act, a Power

Purchase Agreement.

The possibility to sign Power Purchase Agreements gives onshore wind, as the renewable with one of the lowest Feed in Tariffs, the opportunity to negotiate a higher tariff directly with private off-takers. Additional electrical infrastructure does not need to be built as the generated electricity can be dispatched to the off-taker through the existing Taiwan Power Company Electricity grid against a fee. Such a fee is called a "wheeling fee" and stands currently at NT$ 0.04 – 0.0461 per dispatched kWh of electricity (Tariffs for 2019)

E. The role of the Taiwan government

The Taiwan government can enable the success of community invested wind energy by implementing regulation that has been successful in Europe, in particular Denmark and Germany:

1. Education: 79.5% of Taiwanese are concerned about climate change and 80.6% support development of Renewable Energy (TAISE, 2017). This is a good basis to encourage citizens and educate them on how to actively participate in Taiwan's energy transformation.
2. Providing a higher Feed In Tariff for community invested windfarms to encourage developers to choose for community participation when developing a new windfarm. Handouts or compensation don't work as a long-term solution against protests. Residents must actively participate. invest and get profit from each kWh that a turbine generates.
3. Shorten and simplify the application process: The application process for building and grid connecting a windfarm in Taiwan is complicated and time consuming, requiring the involvement of all levels of government. The process is too complicated for most groups or individuals that want develop a windfarm. Simplifying the process would make it easier for residents to take the

development of a windfarm in their own hands.

4. Guarantee grid connection to the windfarm: Guaranteeing grid connection to community invested windfarms will allow the development of farms in agricultural areas like Penghu, Yunlin or Pingdong. These locations have good wind sites but the lack of a strong grid is often hindering development. Pingdong and Yunlin are also locations where windfarms have the potential to contribute significantly to the income of local residents and local municipalities.
5. Create a structure of tax-benefits for local municipalities where windfarms are located. The involvement and support of local municipalities is critical for the success of community windfarms. Local governments are often an obstacle to final approval in Taiwan as they seek for benefits of the development to the local community.
6. Continue to Free up the electricity market: As the cheapest form of renewable energy, onshore wind would be the technology to benefit most from a efficient scheme where electricity producers can sell directly to electricity and are not limited by the fixed Feed in Tariff of NT$ 2.5 (2019) paid by Taipower.
7. Land use: Allocate more areas where wind-turbines can be legally build and include farmland, industrial areas, areas along highways, harbors, river estuaries, sea shores and areas managed by the forestry bureau.

Experience in Europe shows that the success of one community windfarm will lead to the next one. A successful demo project could spawn further projects.

IV. Conclusion

Participation of residents in community windfarms leads to better acceptance of the windfarms. This in turn helps to achieve national

renewable energy targets. The community invested windfarm idea has existed in Europe for quite a while so it has been successfully executed in many different forms until now.

Financing, wind-turbine technology, maintenance companies and project execution resources are widely available in Taiwan, experienced wind project developers that are able to carry out the initial planning and permitting are harder to find.

The government may take steps to better enable the development community wind, by making available a higher feed-in Tariff for community wind, guaranteeing grid connection, simplifying the application process and by allocating more land for windpark development.

A central role is there for a “trusted person”, a person that is trusted by the community and with the financial and business background start-up and run the community invested cooperative. NGO’s may play a role here.

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台灣發展社區公民風場的優勢和潛力

黎森*、蘇冬蘭**

摘　要

台灣作爲一個經濟中心，是亞太地區中具備最堅實科技製造基地之一。台灣有很高的能源需求，惟缺乏自然資源，97% 的能源依賴進口。透過將風力發電納入能源多元化，尤其是台灣沿岸的陸域和海上風場，將爲台灣帶來更高的能源自足性，同時確保能源安全。風力發電爲台灣人民提供了支持和利用再生能源發電獲利的機會，卻不因此產生健康折損的疑慮。多年來，在歐洲有許多社區居民投資的風場已經取得了極大成功。在地的風能合作社或其他參與式商業模式，佔歐洲風電總體發展的絕大部分。在丹麥和德國，超過一半的再生能源是由社區投資的。歐洲的經驗證明，居民參與投資社區風場能有效提高對於風力發電的接受度。本文探討了再生能源合作社和社區共享所有權的投資模型，並提供歐洲三個成功的社區投資風電項目。本文同時建議如何讓社區投資再生能源模式在台灣推動實行。台灣在取得融資，風機技術，設備維護廠商和相關項目執行資源等十分便利，但卻

* 德國風機製造商艾納康（ENERCON Taiwan Ltd.）台灣總公司董事總經理、歐洲在臺商務協會－低碳倡議行動委員，E-mail: bart.linssen@enercon.de。

** 歐洲在臺商務協會－低碳倡議行動總監，E-mail: sammy.su@ecct.com.tw。

很難找到經驗豐富、有能力進行規劃和取得許可證照的風電開發商。政府可採取相關措施，包括爲社區投資項目提供更高的躉售電價，保證電網串接，簡化申請流程，並分配更多空間給風電開發項目，以有效促進社區風場的發展。最後，社區風場眞正能成功的關鍵是「能被信任的人」:這個被社區居民所信任的人同時需具有財務和商業背景，了解如何發起和運營社區投資的合作社。

關鍵詞：社區投資合作社、再生能源、風場、躉售電價、許可執照