Supplementary data- Planning process and outcome

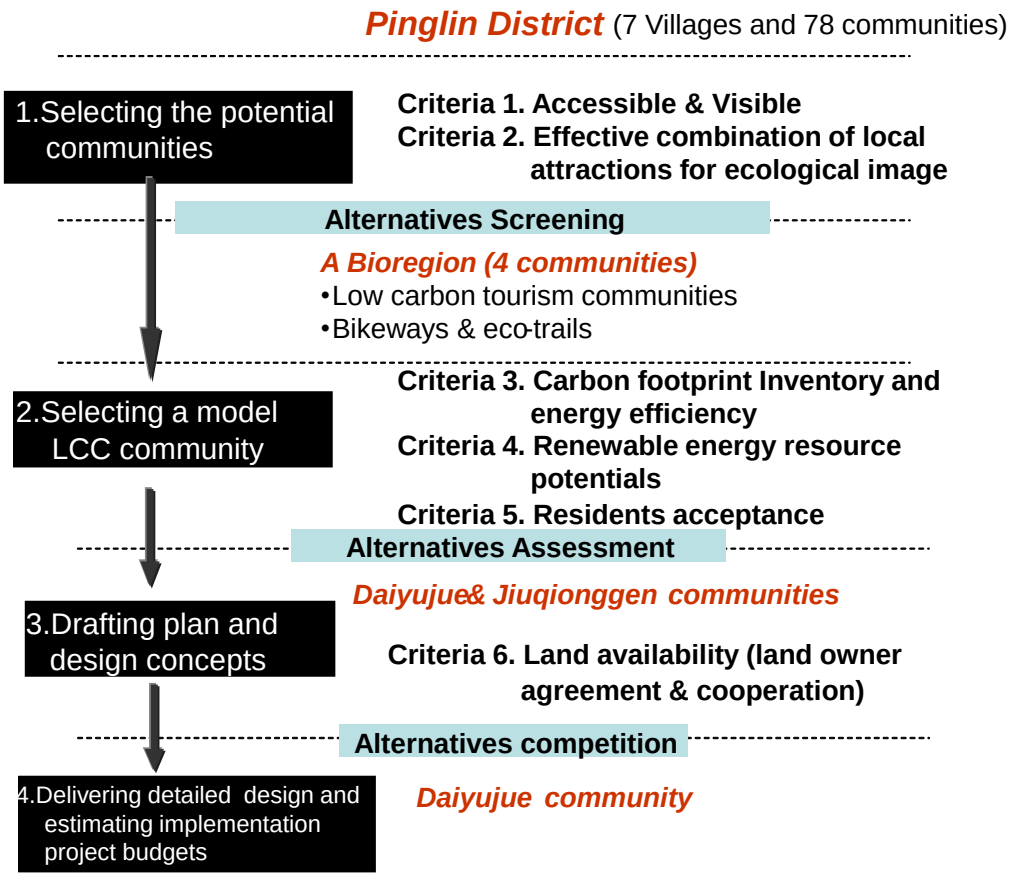

Figure S1 Pinglin LCC planning and design criteria use and procedures

Step 1. Model PLCC selection and objectives

The proposal was for a community-based and government-funded project to reduce local pollution and energy consumption and to recycle resources locally to accomplish the following objectives:

(1) address local problems associated with potential soil erosion and water pollution in tea plantation areas, high energy costs associated with tea making and poor living standards in community buildings;

(2) contribute to wider local and national government policies for achieving 50 LCCs by 2012; and

(3) act as an example for other rural, remote and protected areas willing to establish self-supporting and sustainable renewable energy systems.

The model community Daiyujue, which contains 16 buildings for 38 permanent households across a 12.4-hectare area, was chosen from among seven villages (approximately 78 communities) to represent a local government model for promoting and transferring knowledge of planning methodologies to other communities in rural Taipei. This small tea-making community was selected as an appropriate model because it provides a suitable location for accessible and visible local RE and tourism development that combines both ecological and cultural (e.g. tea-making) attractions. In addition, Daiyujue was strongly recommended by the leadership of the PDO due to the balance between the investment in public infrastructure and the fairness of the local distribution of benefits.

Step 2. Integrated assessments and planning

To strategically identify areas where community-scale infrastructure may be the most cost effective and to develop application-oriented solutions, a planning team with multiple actors proposed and analysed the feasibility of various options during the planning process. These assessments included the analysis of energy issues in CFI and RES assessment; water pollution issues in tea farm irrigation systems from spring, groundwater and community sewage systems; tourism issues in existing and potential tourist routes; and visual landscape analysis.

The CFI was designed and contributed to two stages. In the first stage, four candidate communities within a bioregion, Daiyujue, Renliban, Jinguakiao and Jiuqionggen, were selected for the study area, demonstrating that the tea and tourism industries were major users of energy. Second, the selection of households of different income types was taken into consideration to understand high-emission impact factors. The results indicated that households that obtain their income from tea-making and tourism-related activities have twice the volume of carbon emissions of other families. The carbon footprint inventory in the yearly energy demand of the Daiyujue community is presented in Table S1.

Table S1. The carbon footprint inventory of Daiyujue community

Daiyujue Community	*2009-2010*
Area (ha)	12.37
Population/households	76/37
Total electricity (kWh)	127213
Total gas* (Kg)	34788
	2.99
Farming households	12
Total tea harvested area (ha)	10.00
Total tea production (catty/yr)	9,728.00
Average CF of Pinglin tea product per catty (ton CO_2 e/yr)* **	0.0167
Total Daiyujue tea-making carbon emission (ton CO_2 e/yr)	162.46
Average CF of tea-making per household (ton CO_2 e/yr)	*13.54*

* An assumption adopted from local LPG suppler interview
** The resource of carbon footprint conversion factor data adopted EPA, Taiwan.
*** The average carbon footprint per catty product of Pinglin tea was adopted from our previsions research [101].

The RES potential for each source (wind, solar, biomass and hydro) was conducted by interviewing national companies and then inviting related renewable energy technology (RET) companies to participate, within the PLCC, to implement locally produced RET in Taiwan. After site surveys, three possible sources were identified that could efficiently and effectively meet Pinglin's energy requirements. In addition, alternative low-carbon technologies, such as solar water heating (a hot water provider uses a solar collector to absorb heat from the sun and concentrate it) and eco-tea farm development, were introduced to reduce the investment in RET. The experts suggested the application of a connected power converter system from PV/wind/hydro energy sources without a battery bank. The converter provides a constant power supply from the Tai-Power Company service in uncertain conditions. The relevant information

analysis is presented below.

- Solar energy: The average solar irradiance in Taiwan is between 716 and 1,027 kJ/d m^2. The lowest electronic generation system of solar photovoltaic power can meet 80% of energy demands. The PV array requires an area of 85 x 35 m^2 for a rated capacity of 95 kWh and 95% efficiency.
- Wind energy: The wind turbine establishment is rapidly growing, but environmental issues in several Taiwanese coastal areas are under debate. In addition, wind speed is difficult to examine in the absence of long-term data on a community scale. From an aesthetic perspective, wind power has a large number of characteristics with visual impacts (e.g., size, height, outlook and number) and impacts associated with the mounting method, particularly noise and vibration. For this reason, we used an integrated solar PV system and 5 kWh vertical axis wind turbines (VAWTs) in this project.
- Hydroenergy is the least preferred source of renewable energy because the small-scale development of hydro energy applications is not technically mature, despite the enormous potential for hydroenergy use in Pinglin.

The sustainable community indicators were developed with the community to incorporate beliefs concerning such issues as enhanced awareness, trust, outcome certainty, decision-making processes and fairness, performance review and the building of relationships between actors. The developing process was expected to promote a sustainable energy system within an LCC. The outcome is shown in Table S2; a list of 10 categories with 18 criteria were presented in the coordination meetings, including energy conservation, renewable energy, water efficiency, transportation, waste reduction, food, ecology, culture, health and governance. To accommodate the lifestyle and environmental resources of the Daiyujue community, we emphasised in the concepts of the Masterplan the improvement of conditions for energy conservation, renewable energy, waste reduction, ecology and landscape as well as the development of eco-agriculture and eco-tourism, low-carbon education and community organisation.

Table S2. The sustainable community indicators for monitoring local environmental, energy and economic conditions

3E indicators	Criteria
1. Energy Saving	✓ Energy efficiency ratio
	✓ Vertical greening area
2. Renewable energy	✓ Renewable energy generation and use
	✓ Net profits of selling renewable energy credits
3. Water efficiency	✓ Water use reduction
	✓ Wastewater recycle use ratio
4. Transportation	✓ Alternative transportation service area ✓ Friendly transport system
	✓ Reduce vehicle usage and vehicle travel miles
5. Waste reduction	✓ Waste metrical recycle and reuse
	✓ Building reuse
6. Food	✓ Less food mile and local food available
7. Ecology	✓ Green cover area and accessible
	✓ Habitat conservation and restoration
8. Culture	✓ Heritage area protection
	✓ Tea industry protection
9. Health	✓ Living quality satisfaction

10. Governance	✓	Cooperation and voluntary change

Step 3. Actions and implementation

The final step was to share with different government sectors the responsibility for proposing yearly budgets and missions. The responsible sectors participated in the five implementation projects as part of a comprehensive plan to address multiple environmental issues. The five actions: education, tourism, landscape, agriculture and RE, are listed in Figure S1. These strategic actions from the analysis contained various information on the renewable energy installation areas and sizes of greatest potential; tea farm irrigation systems from spring and groundwater; community sewage systems; existing and potential tourist routes; and visual landscape analysis, mapping and analysis of land ownership for comparison with the areas required for developing an LCC. The challenges associated with the maturity and cost-benefits of the current RET development, location and land requirements are important, as is macro climate data. For example, the scale of the PV installation varies depending on the required power output. The most common method of PV application is to mount panels onto the roofs of existing buildings or to install them in open spaces. However, in Daiyujue, there are certain limitations, such as the fact that the location and direction of group housing is not effective for maximising the amount of sunlight reaching the device throughout the day. Furthermore, the optimal open space for the installation of an integrated PV/wind LC education centre was located on private property that was listed as a protected area under the NTC urban planning regulation. To change the land use condition, several discussions and interviews have occurred, revealing that a long period of time and complicated revision of the land use classification are required for the application procedure.

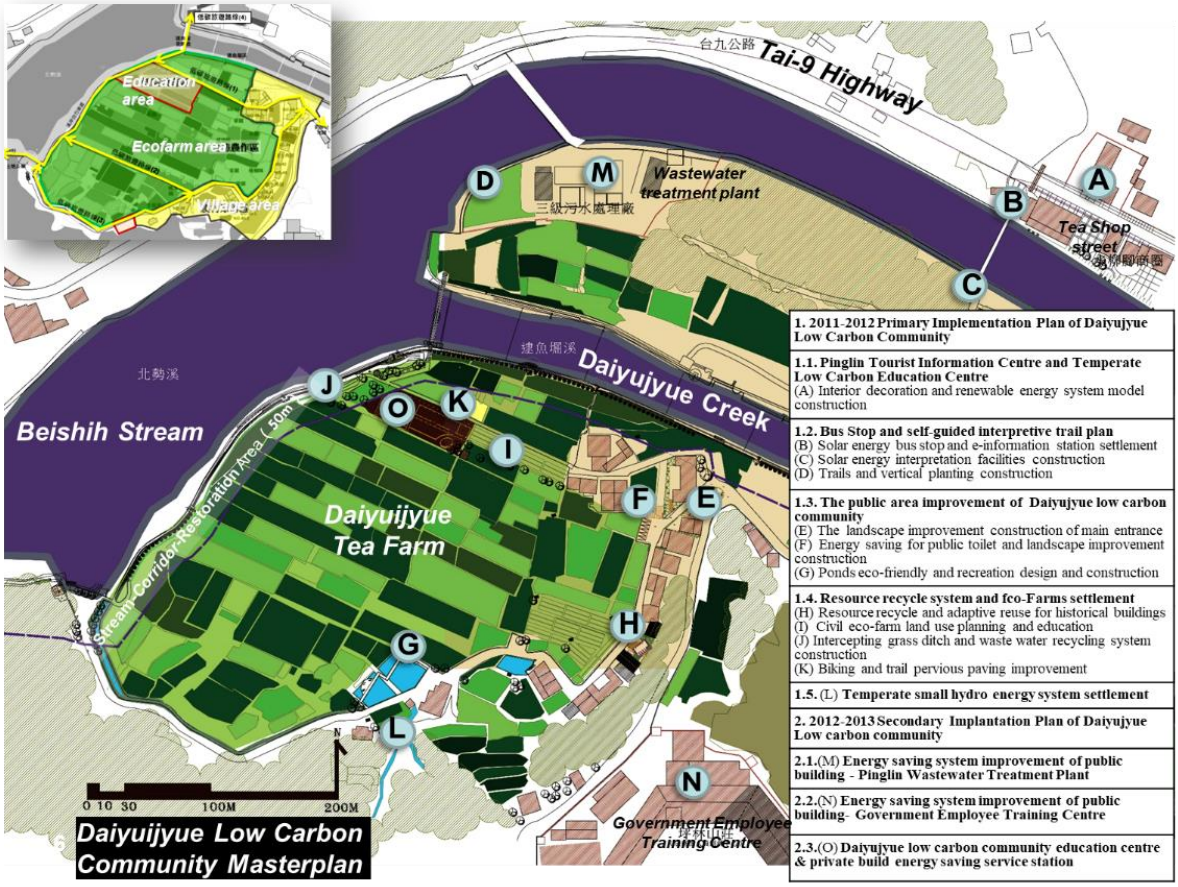

Figure S2. The Daiyuijyue low-carbon community masterplan