Public Building Energy Hub

Working together to decarbonise public buildings in Wales

Llywodraeth Cymru
Welsh Government

RHONDDA CYNON TAF

Challoch ENERGY

Contents

Our Vision:

A resilient, affordable and locally owned energy future for Wales – powered by our natural resources, public assets and communities working together.

Llywodraeth Cymru
Welsh Government

RHONDDA CYNON TAF

Challoch
ENERGY

How to guide: renewable energy systems (RES) innovations for public buildings

Taking a whole systems approach to decarbonisation in Wales

This guide provides practical step by step advice for local authorities, public sector organisations and their partners to plan, develop and deliver renewable energy solutions for public buildings-as part of a local energy market that connects nearby consumers and generators, rather than as a standalone project.

It has been developed from the real-life experiences and learnings of WSRID feasibility and demonstrator projects delivered as part of this challenge; run in Rhondda Cynon Taf County Borough Council during 2024–2026

Purpose

Offer clear, practical guidance to develop and implement renewable energy projects on public buildings, helping communities reduce emissions, cut costs and build local energy resilience.

Why It Matters

Public buildings are ideal for clean energy innovation. They are trusted community assets, have predictable energy needs, and can help drive local economic, social and environmental benefits.

Whole System Research, Innovation and Decarbonisation (WSRID) Challenge

This guide was funded by Welsh Government Climate Innovation's WSRID Programme. It supports the Welsh Government's commitment to accelerate whole system decarbonisation through place-based collaboration and innovation.

What You'll Find Inside

- ✓ Practical Guidance and Tools
- ✓ Case studies and lessons learned
- ✓ Pathways to Collaboration and Funding
- ✓ Support for delivering real-world impact

> "This guide is for everyone involved in shaping a cleaner, fairer and more resilient energy future for Wales.

Who this guide is for

Understanding the primary and secondary audience

This guide was designed to help local authorities, schools, community groups and solution providers replicate a proven approach to local energy delivery. It draws on real-world delivery in Rhondda Cynon Taf as part of the WSRID Challenge — Maximising Renewable Energy Generation for Community Benefit — where a micro-hydro scheme, rooftop solar, heat pumps and a private wire network are being combined to create a community energy hub centred on a school.

Insights gained from this WSRID challenge have been translated into a practical, replicable framework for Wales, relevant at different levels to the different users outlined below.

1

Local Authorities

- ✓ **Lead local energy projects**
- ✓ **Integrate net-zero technologies**
- ✓ **Coordinate stakeholders**

- Local Councils
- Local Authorities
- Public sector estate managers

2

Schools & Public Buildings

- ✓ **Act as anchor asset**
- ✓ **Host renewable energy**
- ✓ **Enable community energy sharing**

- Schools
- Council offices
- Community centres
- Public sector buildings

3

Community Groups

- ✓ **Support community initiatives**
- ✓ **Facilitate local engagement**
- ✓ **Develop co-operative models**

- Community energy groups
- Local development organisations
- Energy co-operation

4

Solution Providers

- ✓ **Provide technical expertise**
- ✓ **Support project delivery**
- ✓ **Build renewable assets**

- Renewable energy developers
- Energy service companies
- Engineering consultants
- Technology and innovation providers

> “This guide is useful for solution providers working in partnership with local authorities and communities.

Replication Framework

A step-by-step framework enables the replication of successful local energy projects by providing a roadmap for councils and organisations.

Llywodraeth Cymru
Welsh Government

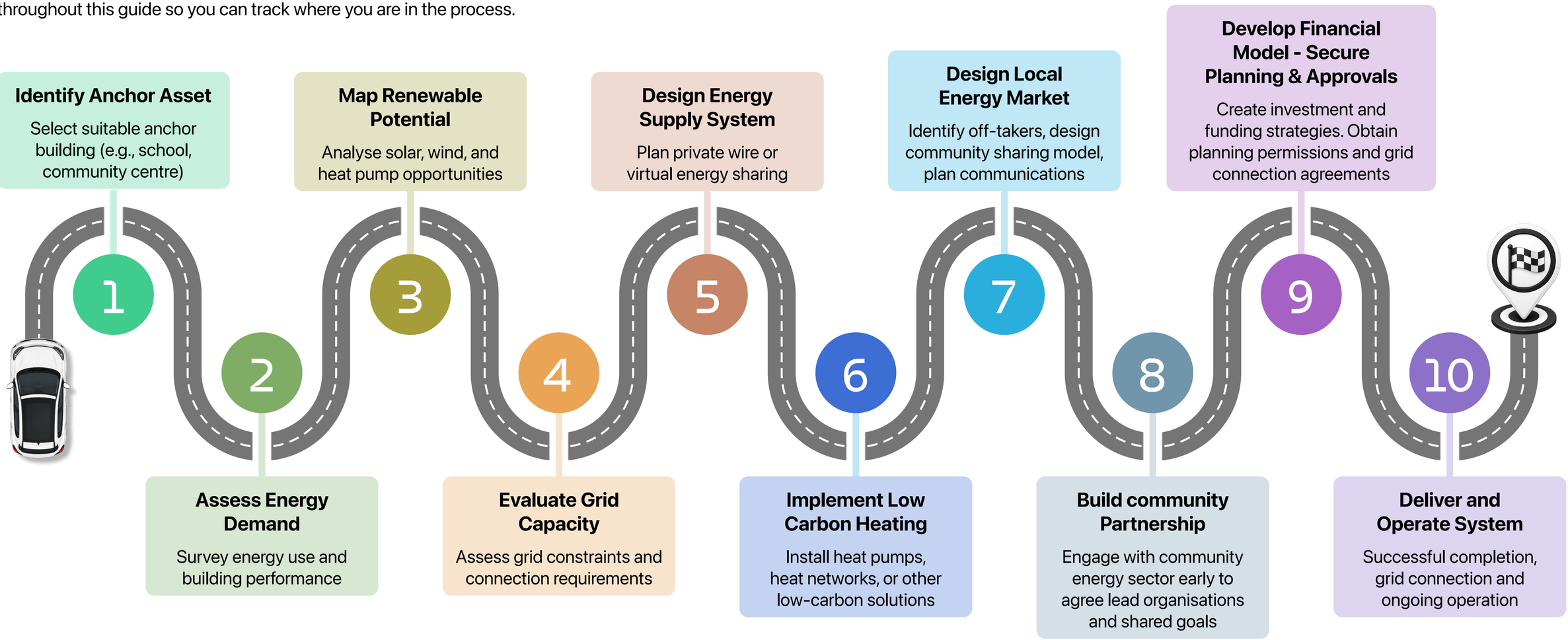
RHONDDA CYNON TAF

Challoch
ENERGY

Replication Framework

Step-by-step approach to developing school energy hubs or local energy projects centred around public buildings.

The framework below provides a structured pathway to developing a renewable energy system centred on a public building. Each step is colour-coded and numbered throughout this guide so you can track where you are in the process.



1 Identify anchor asset

Select suitable public buildings such as schools, council offices or community centres that can act as stable anchor assets for local energy projects. Consider buildings with consistent energy demand, suitable roof space or nearby land, and a strong role within the local community.

Why Public Buildings Matter

Public buildings are at the heart of our communities and have the scale, stability and trust to drive local energy transformation, this guide shows how they can be used as anchor assets to deliver affordable, resilient and low carbon energy through collaboration, innovation and long-term investment.

1 Supports LAEP and local objective

Public buildings help deliver local Area Energy Plan (LAEP) goals on affordability, local benefit and net-zero delivery.

2 Stable long-term assets

Public buildings offer long-term stability (e.g. 20-year PPA) that makes investment viable. The Egni Co-op model proves the point: Egni installs rooftop solar on Welsh public buildings at zero capital to the offtaker via long term PPAs, The UK's largest rooftop solar co-op-egni.coop.

3 Leading by example

When local authorities and schools decarbonise, they demonstrate leadership and make it easier for others to follow.

4 Strong financial case

Onsite generation increasingly makes financial sense as PV and battery cost fall and flexibility markets open up.

5 Educational benefits

Schools provide a captive-audience of knowledge hungry young people, Egni co-op includes educational days and hands on learning as part of their model.

6 Evidence from Wales

Ynni Cymru case studies show what is possible across Wales from solar in schools to community energy partnerships.

2 Assess energy demand

Understand, analyse and plan for smarter energy solutions

A clear understanding of how energy is used across your buildings and communities is the foundation of good decisions. This step helps you identify opportunities, reduce costs, and plan renewable energy and flexibility solutions that deliver real value.

1 Assess Electricity Demand

- Obtain half-hourly meter data (HH data)
- Monitor usage across seasons — demand profiles differ significantly
- Understand how usage varies by time of day and day of week.
- Identify buildings or sites with high demand or volatility
- Understand existing equipment loads

2 Analyse Heating Systems

- Identify current fuel type (gas, oil, electric)
- Review efficiency and operational performance
- Consider hybrid approaches where full electrification is not yet viable
- Model impact of electrification or low carbon heat options on demand profile

3 Identify Peak Load Patterns

- Analyse peak demand periods (daily, weekly, seasonal)
- Identify drivers of peak loads
- Assess capacity constraints and upgrade needs
- Spot opportunities for load shifting and flexibility

4 Map Nearby Buildings

- Identify potential off-takers in the same geographic area or primary substation
- Understand energy needs/ load profiles of schools, homes, council offices, community centres and other public buildings
- Explore opportunities for local energy sharing and collaboration

5 Compare Demand Profiles

- Compare load profiles across sites and seasons
- Identify mismatches between supply and demand
- Assess how on-site generation and storage can balance demand

Good Practice in Action

Use Quality Data

Smart meters, building management systems and energy bills provide the most accurate insights.

Model Different Scenarios

Include future changes such as heat electrification, building upgrades and occupancy changes.

Engage Stakeholders Early

Involve facilities teams, communities and partners to understand needs and shape solutions.

Review Regularly

Energy demand changes over time. Review data and assumptions annually.

Why this matters

Understanding your energy demand and complexity early reduces risk, improves investment decisions, and ensures solutions deliver long-term value for your community.

3 Map local renewable energy opportunities

Use your LAEP to identify and prioritise local opportunities

Your Local Area Energy Plan (LAEP) is the starting point — it identifies the renewable resource available across your council area, they map resources, infrastructure and constraints. The key renewables to assess are set out below. Note that battery storage is not generation but plays a critical enabling role in all systems:

1 Use Your Local Area Energy Plan (LAEP)

- LAEPs map renewable resources potential demand, network capacity and constraints
- Refer to your local LAEP for detail analysis, spatial maps and project pipelines
- Use LAEP insights to shape local energy projects and partnerships

2 Local Renewable Generation

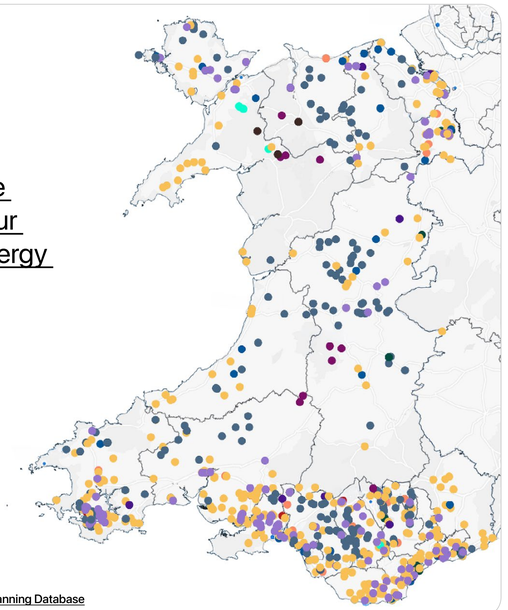
- **Solar PV**- rooftop solar on public buildings and ground-mounted solar on suitable land
- **Wind Energy** - onshore wind opportunities where resource, planning and community support align
- **Hydro-Power** - run-of-river and small-scale hydro where water resources and sites are suitable

3 Energy Storage (Separate from Generation)

- Battery storage helps balance supply and demand
- Stores excess renewable energy for use when needed
- Supports grid stability and enables greater renewable uptak

4 Want to know more?

↗ Explore renewable energy projects in your area – Renewable Energy Planning Database



Source: Derived from Renewable Energy Planning Database

How to Use This Information

Review your LAEP
Understand mapped resources, demand centres and constraints.

Identify Opportunities
Spot high-potential sites for renewable generation and storage.

Engage Partners
Work with communities, landowners, and network operators early.

Prioritise and Plan
Use LAEP insights to prioritise projects and attract investment.

Why this matters

Using LAEPs ensure local energy projects are well-informed, deliver local benefits and support net-zero, affordability and energy security

4 Evaluate grid capacity and network constraints

Understand constraints early to plan viable and deliverable renewable energy projects

Grid capacity and network constraints can limit where and when renewable energy projects can connect to the network. Understanding these constraints early helps you avoid delays, manage costs and design solutions that deliver real value to your community.

Addressing grid constraints early reduces project risk, avoids costly delays and helps ensure your renewable energy projects are feasible and financially viable.

1 The Problem/ Constraints

! Grid capacity constraints are a growing challenge for renewable energy development across Wales

! Many rural and peri-urban areas have limited network capacity to accommodate new generation

! This can restrict the amount of renewable energy that can be exported or even connected to the grid

! Grid reinforcement can be costly and time-consuming, impacting project viability and timelines

Early understanding of local grid constraints is essential to plan realistic and cost-effective projects.

2 Network Highlights

Key challenges that can affect renewable energy projects include:

! Export restrictions

Limits on the amount of renewable energy that can be exported to the grid

! Curtailment

Renewable generation may be curtailed (forced reduction of output) when the network is constrained

! Expensive grid reinforcement

Network upgrades may be required to increase capacity, which can be costly and take several years

Engage early with your DNO to help identify constraints, explore solutions and shorten project timelines.

3 Planning Considerations

When planning renewable projects, consider the following:

✓ Engage early with DNO

Build a relationship and share plans early to understand constraints and opportunities

✓ Understand connection availability & capacity

Check available capacity at the connection point and potential future changes

✓ Evaluate reinforcement costs & grid limitations

Factor in the cost, timing and feasibility of any required network upgrades

✓ Assess risk of generation curtailment

Understand the likelihood and impact of curtailment on revenue and project returns

4 Strategic alternatives

Where grid constraints exist, consider alternative approaches

To enable local energy solutions:

✓ Utilising generation locally

Align generation with on-site demand, storage or local heat and transport needs to reduce export reliance

✓ DC coupling

Consider connecting generation, storage and loads using DC to avoid AC grid interaction and maximise capacity utilisation-particularly relevant for solar + battery + private wire systems

✓ Private wire networks

Connect generation directly to local sites or assets to avoid network limits

5 Design your energy supply system

Three ways to use and share local renewable energy

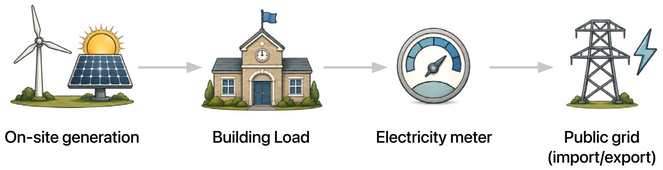
Different models can be used to deliver local renewable energy and community benefit. The right approach depends on your goals, the scale of your project, the distance between sites and the level of community involvement you want to achieve.

Key Takeaway: Private wire is the gold standard where viable, but it won't work in every case. Distance, scale and local conditions must be carefully assessed at an early stage.

1 Behind-the-Meter (BTM)

Generation and use on the same site

Renewable electricity is generated and used on-site, reducing the amount of energy imported from the grid.



2 Private Wire Network

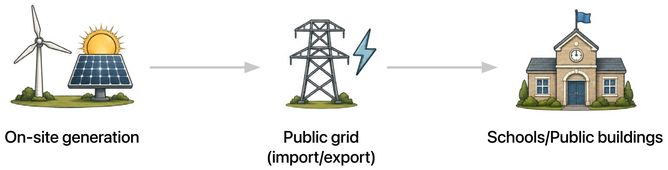
Direct physical connection between sites

Electricity is delivered via a dedicated private wire, avoiding the public grid for normal operation.

3 Local Energy Sharing

Local trading via the grid, including P441 (when implemented) or P442

Electricity flows through the public grid but is shared virtually between multiple users through a trading arrangement.



Why choose a private wire network?

- Avoids high grid connection and reinforcement costs
- Avoids ongoing use of system charges and levies
- Reduces exposure to network congestion and curtailment
- Enables predictable, long term energy costs
- Maximise local economic and environmental benefits

Distance and viability

- DC cable is typically viable up to 1.2 to 1.5 km
- AC cable at higher voltage can extend further but requires deeper trenching and more complex switchgear and control at the grid connection point, which increases cost and project complexity
- Beyond these costs for cable and groundwork rise significantly, making private wire uneconomic
- Each project must be assessed on a case-by-case basis considering distance, load profile and scale

Planning considerations

- Engage early with DNO
- Assess connection feasibility, costs and route options
- Consider future flexibility and potential to share surplus
- Ensure compliance with regulatory standards
- Evaluate total costs of ownership vs grid connection option

NB: Experienced community energy organisations and contractors may be able to share contract templates

6 Decarbonising heating systems

The next step: use clean electricity for low-carbon heat

Once you have assessed local renewable generation and energy sharing potential, the next factor to consider is to decarbonise heat. This section explains how public buildings can transition from gas boilers to efficient, low carbon heating systems-primarily heat pumps-powered by local renewable electricity.

Heat decarbonisation is highly site-specific. Building fabric, existing systems, heat demand profiles and operational requirements all vary. Use the high-level guidance below and refer to the resources and case study for more detailed, tailored advice

! Why include heat decarbonisation?

Heating typically accounts for 60-70% of energy use in public buildings. Switching from gas, LPG or oil to low-carbon electric heating is one of the most effective ways to cut emissions and future-proof energy systems.

! How it connects to this guide

This step builds on earlier sections: once you have generation and a trading arrangement in place, local renewable electricity can be used to decarbonise heat cost-effectively.

1 Common low-carbon heating solutions

- **Air source heat pumps (ASHPs)** - efficient, proven technology for most buildings, ideal for schools and offices
- **Ground source heat pumps (GSHP)** - higher upfront cost, but high efficiency and stable performance. Suitable where conditions allow
- **Solar Thermal** - can contribute to hot water demand, reducing electricity use
- **Biomass** or **district heating** - low carbon options where heat networks or biomass supply are available

2 Key benefits

Up to 80% lower carbon emissions (vs gas boilers)

Lower running costs with efficient systems

Improved comfort and building performance

Supports net-zero and local resilience. Makes use of local renewable electricity and reduces reliance on gas

Case Study: Rhondda Cynon Taf (RCT) School Example

Rhondda Cynon Taf County Borough council (RCTCBC) installed heat pumps and sized the rooftop solar PV system specifically to make the school cost-neutral on energy.

Without the PV, the school would have been out of pocket on running costs.

Insight: Right sizing generation and storage to match heating demand is critical.

Heat pumps increase electricity demand significantly - plan early to ensure sufficient supply and cost-effective operation.

7 Design the local energy market concept

Designing a local energy market involves two distinct activities at different stages:

A. Early engagement: Work with the community energy sector early to decide who will lead and operate the project (e.g., the council, a community energy organisation, or a joint venture). This sets the governance and delivery model.

B. Market design: Once a lead organisation is confirmed, design how surplus energy will be distributed, traded or shared and agree the commercial arrangements. This step must be completed before building the formal partnership in Step 8.

1 Who Are the Off-Takers?

Identify who will benefit from surplus energy – local residents, council buildings, library, other schools. This should be a participatory process involving the local community.

Different audiences: within-council vs community groups vs residents.

Different relationships need different governance and commercial arrangements.

Map out the local demand that could use the surplus (e.g; same substation area for P441 participation).

Understand load profiles and flexibility to maximise local use.

2 Which Mechanism?

Licence-exempt supply:
Several mechanisms are available to small generators for local supply over the grid, exempt from certain levies applicable to national licenced suppliers. Smart meters are essential, to match power locally.

P441 mechanism (anticipated within 2026):
Building on the proven Energy Local model. Generators and consumers must be on the same DNO primary substation (33kV/11kV). Exempt from some network and policy fees (energylocal.org.uk)

P442 mechanism (in operation since 2025):
Already offered by licenced suppliers with Exempt Supply Notification Agents (ESNAs). No constraint on generator and consumer locations. Exempt from some policy fees.

Regulatory landscape is evolving:
Check eligibility and requirements with your facilitating licenced supplier. Make conservative assumptions in your financial modelling.

Useful resources:
Government Local Energy Market Guidance
Renewable Exchange FAQs: P441 & P442
Foot Anstey legal guide to local energy markets

7 Design the local energy market concept

Key Takeaway: A clear local energy market design including the right mechanism, trader and communications plan is essential to deliver real benefits and build lasting common effects.

3 Who Trades the Power?

Several licenced suppliers offer licence-exempt products, sometimes in combination with"sleeving" or "virtual private wire" models.

Facilitating licenced suppliers should help you to assess the eligibility of your project for licence-exempt supply (although compliance with legislation is ultimately your responsibility).

As with any procurement decision, you should obtain several competitive quotes from suppliers before selecting the best fit for your project.

As P441 and P442 grow in popularity, more licensed suppliers could enter the market, creating competition and better terms.

4 How Do You Communicate It?

Design the communication plan: how do you explain the scheme to the different audiences?

Tailor messages: technical detail for council colleagues; clear benefits for community groups and residents.

Be transparent about costs, savings, eligibility and how it works.

Engage early and often transparency builds trust and reduces opposition.

! Remember

Confirm the lead organisation first, then design the market and commercial model before progressing to formal agreement in Step 8.

8 Governance and delivery models

Strong governance, early engagement and the right delivery model drive project success

Local energy projects involve multiple stakeholders with different objectives. Choosing the right governance and delivery model help align interests, share risk, unlock finance and ensure long-term benefits for the community. Early engagement with decision makers and stakeholders is essential to build trust, shape ownership, and secure support.

1 Common governance and delivery models

Models are not mutually exclusive-many projects use a hybrid approach

Local Authority Led

The council owns or leads the project, setting strategy, retaining control and ensuring public value is delivered.

Community Energy Cooperative

Local people come together to develop, own and manage energy assets for community benefit.

Public Private Partnership

The council partners with private sector organisations to share investment, risk and expertise.

Joint Venture

A separate entity is created between public and/or private partners to develop and operate the project.

2 Why this matters

Good governance and early stakeholder engagement are critical to project success.

Builds trust and shared ownership

Identifies risks and opportunities early

Helps secure funding and approvals

Ensures **benefits are delivered locally**

Supports a **just transition** and **tackles energy poverty**

i Guidance and further reading

A range of organisations provide guidance on governance structures and delivery models. These models carry legal and regulatory implications (e.g. licensing, state aid, consumer protection) and should be reviewed early in project development.

- Centre for Sustainable Energy governance guidance
- Innovate UK- Power of places: local energy governance models
- Development Bank of Wales- Local energy fund requirements
- Ynni Cymru-governance criteria for funded projects

Key Takeaway: The right governance and delivery model, chosen early and with the right partners, is fundamental to delivering successful local energy projects that create lasting local benefits.

9 Economic feasibility and cost benefits

Investing in local energy systems can be more cost effective

Local energy projects can deliver long-term value for communities by reducing energy costs, generating income and building resilience. This slide provides a high-level view of costs and funding options to help you assess economic feasibility and build a strong business case.

Tip: Combine grants, loans and revenue streams to build financially resilient projects that deliver long-term community benefits.

1 Key Considerations

Capital investment
Assess upfront costs of local energy infrastructure & associated works.

Comparison with grid reinforcement
Analyse costs of strengthening or expanding the grid vs local energy solutions.

Long term energy cost savings
Projects reduce operational energy costs over their lifetime.

Revenue opportunities
Identify income streams; energy sales, flexibility services, or local trading.

Funding mechanisms
Explore grants, loans, community finance and co-operative models.

2 Typical cost comparison

Generate on-site

~15p/kWh

All-in cost (typical range). After capital recovery and operating costs

VS

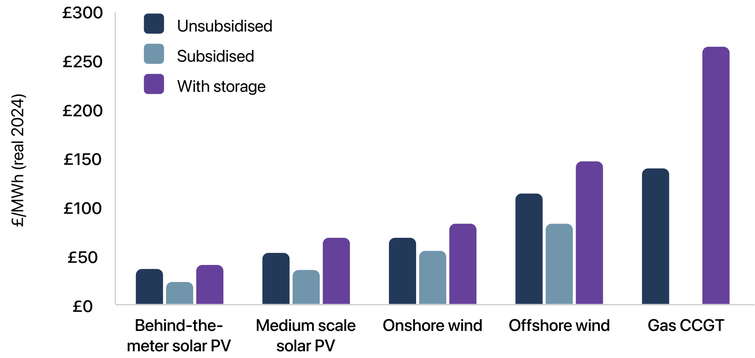
Buy from the grid

~30p/kWh

Typical all-in-cost (2025 average)

Indicative only: Actual costs depend on project specifics, location, scale and financing. The price based on typical non-domestic electricity prices in Wales (2025), including energy, network, levies and VAT)

3 Levelised Cost of Energy (LCOE+): selecting renewable energy generation technologies



Source: Lazard LCOE+June 2025, UK adjusted (real 2024 #/MWh at approximately #1=$1.27). Ranges reflect project and market variation. Behind the meter figures avoid network charges and import costs. Grid price based on typical non-domestic Welsh Tarrif 2025 (energy+network+levies+VAT)

↗ Key Findings from Lazard's 2025 LCOE+

Funding Mechanisms and Support

↗ Ynni Cymru Capital Grant Scheme
Capital grants for low carbon heat, energy efficiency and renewable projects

↗ Energy Service Grants
Grants for public sector bodies, schools and community groups.

↗ Salix Funding
Interest-free loans for energy efficiency, low-carbon heat and renewable projects.

↗ Ethex-Community Investment
Community and impact investor crowdfunding platform for renewable and community energy projects.

↗ Welsh Government Climate Innovation
Welsh Government Support funding for whole system energy innovation supporting feasibility, development and demonstration projects.

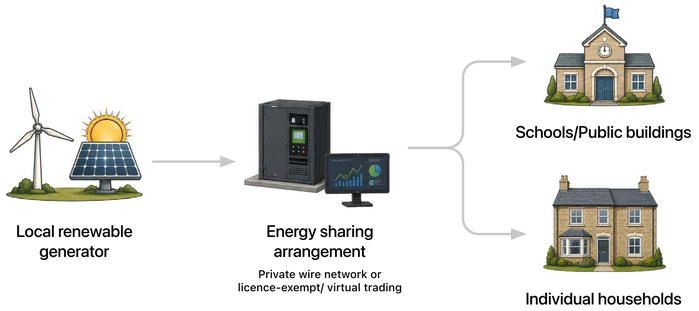
10 Energy sharing and community benefits

Optimising local energy use, reducing costs and creating lasting local benefits

Energy sharing allows renewable electricity generated locally to be shared with a range of users-from public buildings to local businesses and individual households. This approach lowers energy costs, strengthens communities and ensures local benefit is felt in people's pockets. It also creates the foundation for the next step: using clean electricity to decarbonise heat.

1 How Energy Sharing Works

Local renewable electricity is shared with multiple users through a private wire network or licence exempt/ virtual trading arrangement.



Energy Sharing is **most effective when local generation, sharing and demand work together**. It delivers affordable clean energy, supports communities, reduces energy poverty and enables a just transition.

Key Takeaway: The current Welsh Government prioritises community level action (Plaid Cymru Senedd Election Manifesto 2026).

2 Aligned with Welsh Priorities

The Plaid Cymru Welsh Government (2026) is committed to expanding Ynni Cymru to 1.5GW of locally owned renewable energy by 2035, ensuring communities benefit directly from clean energy projects.

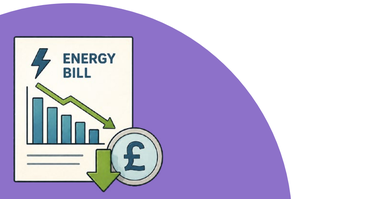
Ynni Cymru is the key programme for delivering capital funding for community energy and local benefits across Wales.

Further resources

- Ynni Cymru projects
- Welsh Government Energy Service guides
- Behind the meter solution guide
- Private wire systems guide
- Power Purchase Agreement
- Welsh Government Low Carbon Energy

10 Energy sharing and community benefits

3 Community Energy Sharing



Key Benefits

Lower energy bills across the community

Increase local resilience and energy security

Create social value and strengthen communities

Support community buildings, schools and local services

Community Energy

Efficiency gains through better local use of clean energy

Cost savings for public sector, businesses and households

Increased local value and local benefit felt in people's pockets

Help reduce fuel poverty and boost local resilience

Community Impact

Encourage local partnerships and community ownership

Boost local economy and create local jobs

Empower and involve residents in local energy decisions

Demonstrate net-zero leadership and deliver a just transition

Decarbonisation of Heat

Use local clean electricity to power heat pumps and other low-carbon heating solutions

Further reduce energy bills and emissions

Make buildings future-ready and more comfortable

FAQs and Next Steps

Your next steps – turning this guide into action

What public buildings in our area could act as anchor assets?

Start with schools, council offices, leisure centres. Look for south-facing roofs, large flat areas, and proximity to other community buildings.

Are there local renewable resources nearby?

Check your LAEP (Local Area Energy Plan) first. Look at wind, solar and hydro resources on your council estate and in surrounding land.

What are the main barriers to local energy sharing?

Grid capacity, technical complexity, and community engagement. However, there are solutions-DC coupling, P441/P442 local energy trading, and community energy sector partnerships- which this guide helps you navigate.

How can community organisations get involved?

As cooperative owners, as off-takers, as advocates. Organisations like Community Energy Wales, Ynni Cymru and the Development Bank of Wales can help.

Do we need to own the infrastructure?

Not necessarily. The Egni model shows a non-profit developer can plan, finance, own and operate renewable assets, while the council and community receive cheaper energy, decarbonisation and social benefits.

This model can be extended to other governance structures and technologies.

How long does a project like this take?

From concept to delivery, expect 3–5 years for a complex scheme. Early engagement with the DNO, funders and planners is essential to compress the timeline.

Where should I look for funding?

There are a number of funds that could be considered including Ynni Cymru, Energy Redress, internal funding.

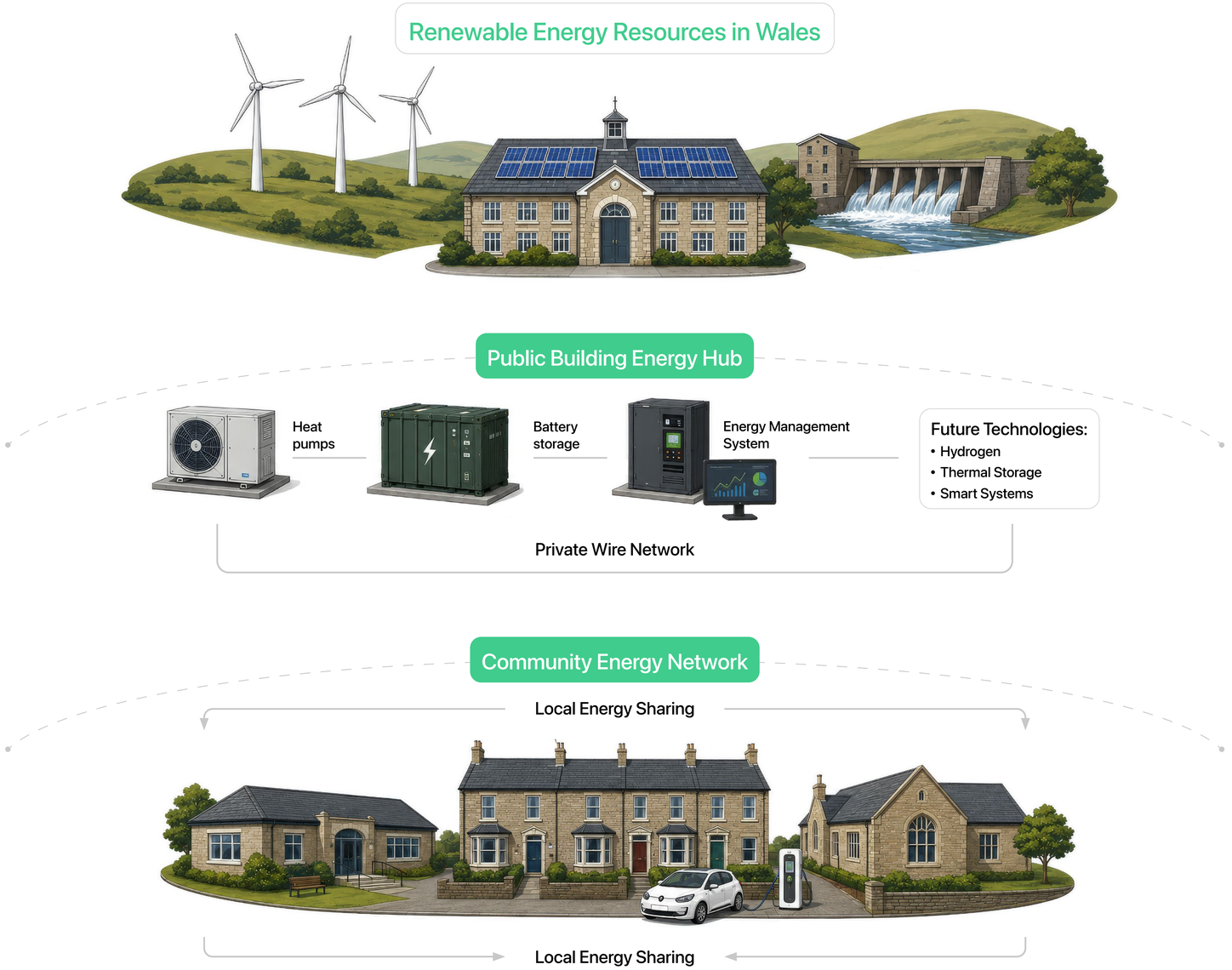
It is good to work through this aspect early on to avoid having a project that cannot be funded.

What do I do first?

Start by assessing the buildings of interest, look at their current energy use, energy efficiency status and scope for onsite energy production.

Ready to start?

- Contact your Local Authority energy team.
- Review your LAEP.
- Engage Community Energy Wales and Ynni Cymru.
- And talk to others who have done it – the projects referenced in this guide are happy to share their experience.



This guide was developed by **Challoch Energy** in partnership with challenge owner **Rhondda Cynon Taf County Borough Council**, as part of the Welsh Government Climate Innovation scheme's WSRID (Whole System Research, Innovation and Decarbonisation) Challenge.

For more on the wider WSRID Challenge and related case studies, visit **Welsh Government Climate Innovation**.

Llywodraeth Cymru
Welsh Government

RHONDDA CYNON TAF

Challoch
ENERGY