
ESB
Energy for generations
Ardnacrusha Generating Station

Contents

Design: Zahra Media Group
2017

Welcome to Ardnacrusha Hydro Station

ESB was established in 1927 as a corporate body in the Republic of Ireland under the Electricity (Supply) Act 1927. As a strong, diversified, vertically-integrated utility, ESB operates right across the electricity market: from generation and transmission to distribution and supply.

In Generation, ESB currently operates 11 thermal stations, 19 windfarms and 10 hydro stations in Ireland and the UK, one of which is Ardnacrusha – located on the Lower River Shannon near Limerick.

The Shannon Scheme at Ardnacrusha was the first electricity generating station operated by ESB. It was developed by the Irish government between 1925 and 1929. The construction of this ground-breaking scheme played a pivotal role in the development of Ireland in the 20th Century and beyond. It also generated huge employment throughout the period, paving the way for the social, economic, and industrial development of Ireland. At the time, the 86 MW capacity was enough to meet the electricity needs of the whole country. Today, Ardnacrusha represents around 2% of our installed capacity and supplies electricity to more than 46,000 homes.

Ardnacrusha

01

The original control room at Ardnacrusha

Electricity for an Expanding Economy

In the early 1920s, before Ardnacrusha was commissioned, with the exception of a few larger cities such as Dublin and Cork, Ireland was almost untouched by electric power. The total capacity of all public electricity stations at the time was around 27 MW. With little or no natural coal deposits, the emerging Irish nation looked to harness the energy of water power to electrify the entire country in a self-sufficient way.

Ardnacrusha was chosen to become the nerve centre for the electrification of Ireland and the (110kV) national grid was built in tandem with the Shannon Scheme. By international standards at the time, the Shannon Scheme was one of the largest civil and electrical engineering projects of its kind. The construction was a mammoth undertaking, especially for a country the size of Ireland, with a state only in its infancy. However, by July 22nd 1929, construction works were completed and Ardnacrusha was handed over to ESB, who successfully began harnessing the energy of the Shannon and distributing it throughout the nation. The accomplishment quickly garnered widespread acclaim and became the model for large-scale electrification schemes worldwide.

The powerhouse construction site in summer 1926. (Credit: Siemens AG, Munich/Berlin)

Getting started: Two-phase development

Phase 1:
1925 – 1929

- Construction of a concrete weir/low dam at Parteen near Killaloe
- Creation of an artificial purpose-built canal between Parteen and Ardnacrusha
- Construction of a high concrete dam at Ardnacrusha
- Commissioning of three vertical-shaft Francis turbo-generator units

Phase 2:
1933 – 1934

- Commissioning of one vertical-shaft Kaplan turbo-generator unit

Timescale of the Shannon River Hydro-Electric Scheme:

Started 1925 → **Completed 1934**

Ardnacrusha

02

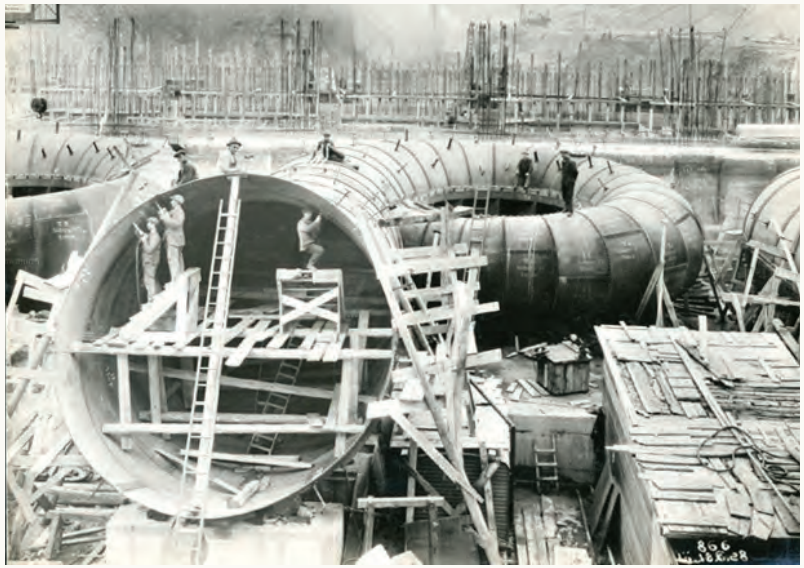
Thomas McLaughlin
ESB's first managing director.

The Shannon Scheme

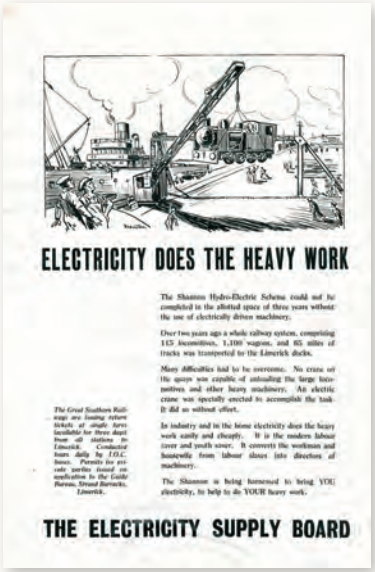
On 13th August 1925 one of the most important undertakings for the economic and social life of Ireland began when the first sod was cut at Ardnacrusha, Co. Clare, marking the beginning of the construction of the Shannon Hydro-Electric Scheme.

The driving force behind the scheme was a young Irish engineer Thomas McLaughlin, an employee of the German firm Siemens Schukert. Together McLaughlin and Siemens convinced the Irish Government of their plans to harness the river Shannon and create the first national integrated electricity system in the world. The Scheme ultimately led to the establishment of the Electricity Supply Board (ESB) on 11th August 1927. McLaughlin was the natural leader and became ESB's first Managing Director.

The construction of the Shannon Scheme was a mammoth undertaking for a country the size of Ireland, especially when the State was barely three years old. The project cost £5.2 million, about 20% of the Government's revenue budget in 1925.



Workers inside the spiral casing at Ardnacrusha 1928.



Electricity does the heavy work advertisement 1928.

Visit the Shannon Works advertisement 1928.

It was a huge undertaking, employing over 5,000 people at its peak. The logistics were fascinating. Water was diverted to the station from the River Shannon downstream of Killaloe, via a dam and intake weir at Parteen, and diverted to the power station along a new 12km head-race canal that was constructed using bucket excavators.

A dam and power station were built at Ardnacrusha. A two-kilometre tail-race canal was blasted through the rock to route the diverted water back to the River Shannon in Limerick city. Two rivers were diverted, a double navigation lock was incorporated into Ardnacrusha dam and four new bridges were constructed where the intake canal and tailrace cut across roads. The chief engineer was Frank Rishworth who had worked on Egypt's Aswan Dam.

A temporary power station was needed to power the various workshops and an electric crane. 100 kilometres of narrow gauge railway were installed, with some 100 locomotives and 3,000 wagons to move the massive amounts of clay and rock which were excavated. Three large rock crushing plants were used to crush the rock so it could be re-used as hard-core.

A public relations campaign was initiated in 1928 with regular bus tours to the scheme and a national advertising campaign was launched to educate the public on this new modern innovation.

The Scheme was officially opened on time and just slightly over budget on 29th July 1929 by President William Cosgrave. It was one of the largest engineering projects of its day and was a revolutionary infrastructural development, bringing electricity to towns and cities, setting the foundation for rural electrification and paving the way towards a brighter future.

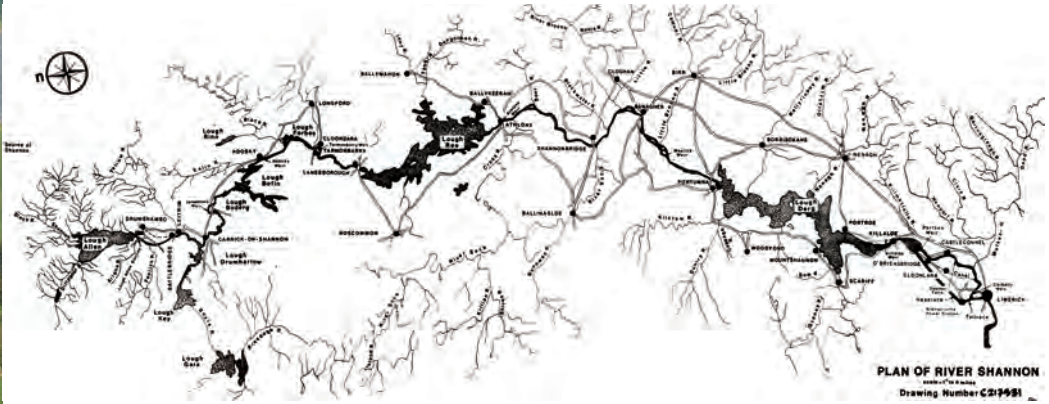
The Shannon Scheme saw the river dammed at Parteen Weir, which was constructed to raise the river level by 7.5 metres

Why was the hydro station built at Ardnacrusha?

The power station was built near the mouth of the largest river in the British Isles which has a substantial average annual flow of 180 cubic metres per second.

Ardnacrusha was selected because, in conjunction with the 12km long head-race, it was the most suitable location to harness the 30 metre fall between Lough Derg and the Shannon Estuary.

The Shannon Scheme saw the river dammed at Parteen Weir, which was constructed to raise the river level by 7.5 metres. The river's flow was then diverted into a 12km canal (the head-race) and conveyed to a point (Ardnacrusha) where the 30 metre fall was concentrated. The station was built and the turbines were installed here. The canal was designed to deliver a maximum of 400 tonnes of water per second to the power station via four penstocks. After passing through the turbine, the water is then returned to the main river by another artificial canal (the tail race).

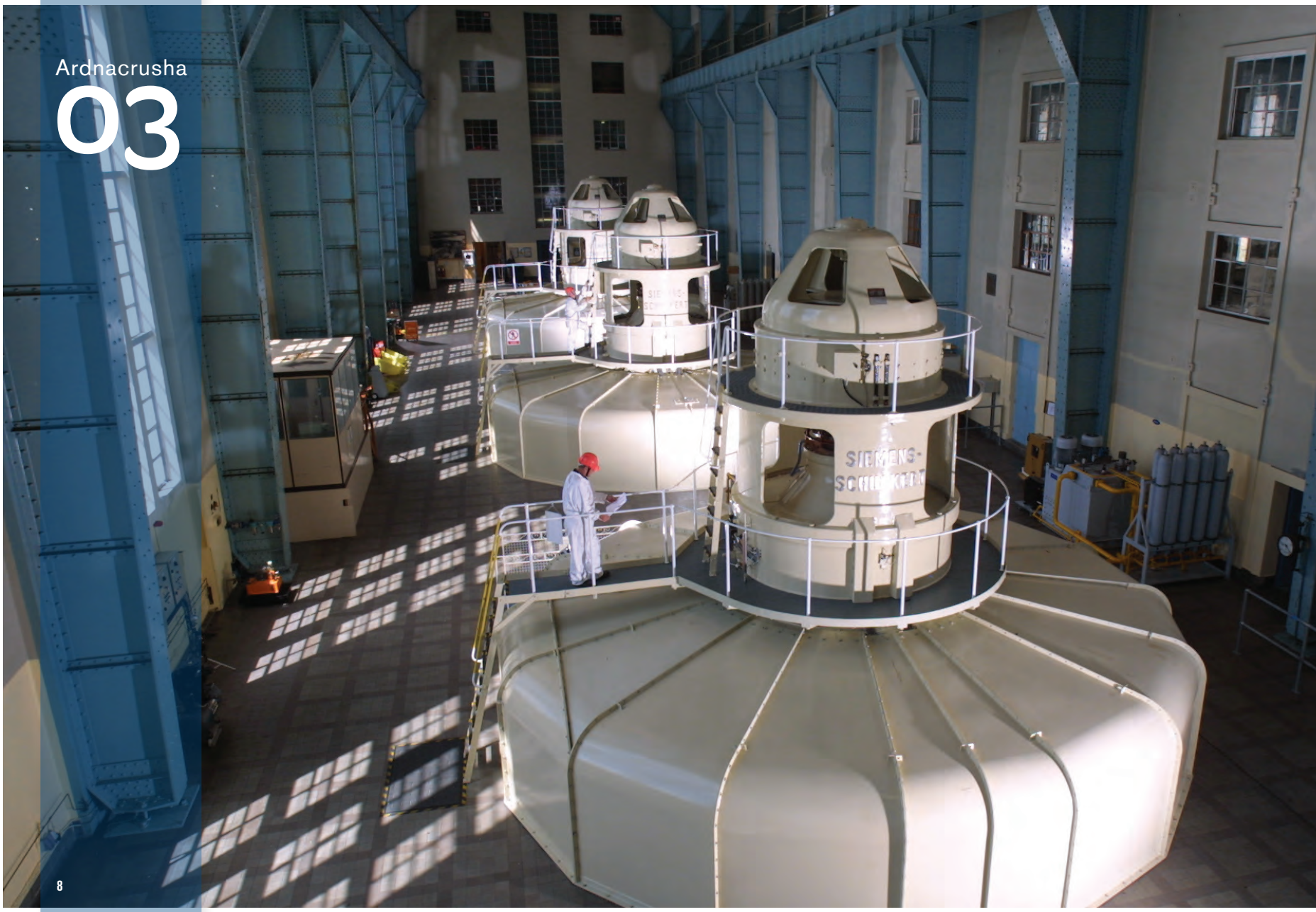


The Shannon catchment is mostly rural and covers 17% of the country, with an economy based on farming, fishing, and tourism. As a result, ESB liaises with many stakeholders in the catchment including Government Departments, Waterways Ireland, Office of Public Works, Local Authorities, Inland Fisheries Ireland, farming, boating and fishing representatives with regard to water levels and river flows. ESB has a responsibility for managing and preserving the fisheries throughout the Shannon. Parteen Weir was designed to allow a minimum of 10 tonnes of water per second to flow down the old river channel, catering for fishery, ecological and environmental requirements. In addition, there is an in-built fish pass of thirteen steps, which allows migrating fish to move safely past Parteen Weir. Additional works in 1952 and 1959 saw the development of the salmon hatchery located at Parteen Weir and a Borland type fish pass lift at Ardnacrusha – which, alongside restocking and conservation programmes, has stabilised diminishing salmon and eel numbers.

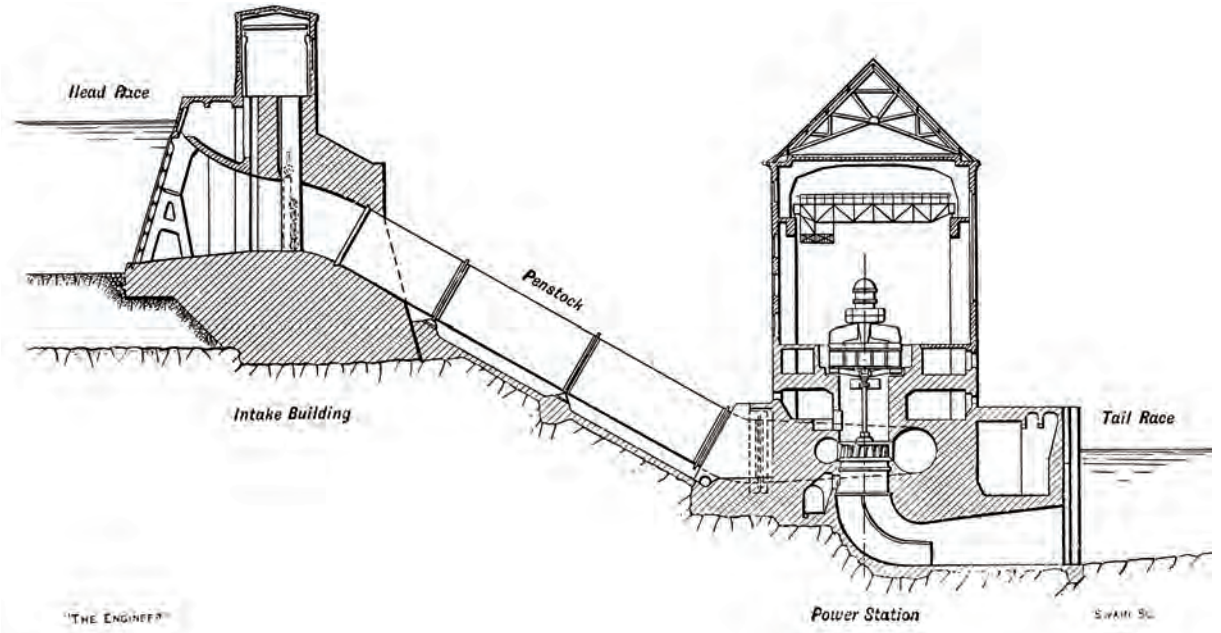
The head race canal mentioned earlier not only delivers water to the power station, but also serves as a navigation channel. Boats can navigate the 12km distance from Parteen Weir to Ardnacrusha dam. At Ardnacrusha there is a double navigation lock with a total drop of 30 metres. Boats can pass through Ardnacrusha Dam via this lock and continue navigating in the tailrace to the Shannon Estuary in Limerick city.. At the time of commissioning, it created the much-needed Dublin–Shannon–Limerick waterway navigation, which is still used today.

Ardnacrusha

03



The Generator Hall at Ardnacrusha



How hydro-generation works

What is hydro-electricity?

Hydro-electricity is electric power generated by the gravitational force of falling or flowing water. It is the world's oldest and main source of renewable energy, supplying 16% of the total global electricity production. Ireland generates 220 MW of hydro-power, which represents 2.8% of the total connected generation capacity.

How the process works

- A hydro electric dam is typically built on a river to create a drop in elevation which is used to generate hydro electricity.
- Gates on the dam open and gravity causes water to fall through the penstock, a pipeline that leads to the turbine.
- At the end of the penstock is a turbine, which is turned by this flowing water; in other words, the power source.
- The turbine is attached to a generator above it by a shaft.
- The generator produces power through magnets inside, which produce an alternating current.
- The transformer converts this alternating current into a higher-voltage current.
- Power lines are connected to the transformer to carry the electric current to residential and commercial properties.
- The water continues past the turbine, through the draft tube and into the tailrace, and re-enters the river downstream.

Ardnacrusha

04

Parteen Weir

ESB and hydro-power generation

ESB's generation business traces its core purpose right back to the commissioning of Ardnacrusha in 1929: providing a reliable supply of electricity for ESB customers, for the economy and for the future in a safe, cost-effective and sustainable way.

Generation today

ESB continues to evolve its business in supplying electricity across Ireland. The generation part of the ESB that was responsible for Ardnacrusha still exists but its remit and activity has been expanded.

It not only operates ESB's generation assets, it also develops and trades them with the implementation model:

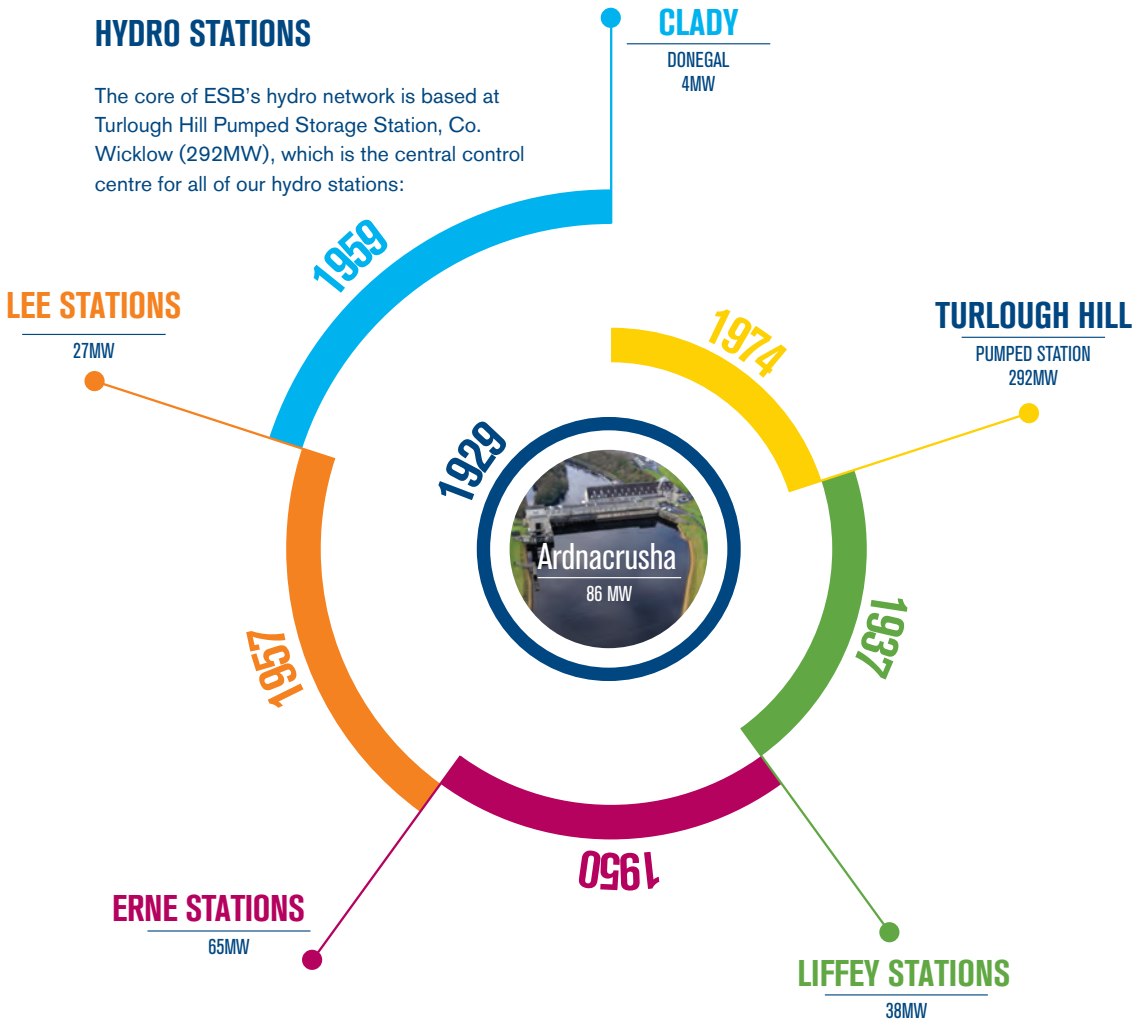
- Asset Development identifies and develops new generation assets;
- Generation manages the production of electricity from those assets; and
- Trading provides hedges and risk management.

ESB's asset portfolio includes approximately 4,370 MW of generation in the Single Electricity Market (SEM) of the island of Ireland and around 1,360 MW in Great Britain.

Overall, ESB had 645MW from renewable sources (Wind and Hydro) by the end of 2016.

HYDRO STATIONS

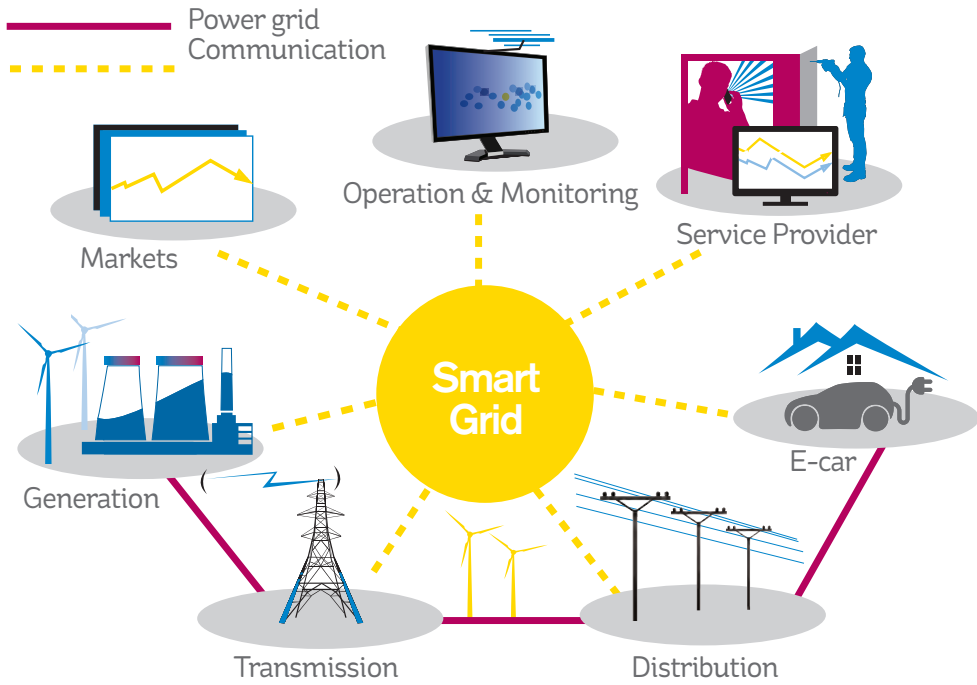
The core of ESB's hydro network is based at Turlough Hill Pumped Storage Station, Co. Wicklow (292MW), which is the central control centre for all of our hydro stations:



Ardnacrusha

05

The Control Room at Ardnacrusha



Looking into the future

ESB's generation business is on a path of growth and change with an ambition to be a company of scale in the Irish and UK markets. To help achieve that ambition, the Generation business has set the following strategic objectives:

- Build a sustainable position of scale in the Ireland and UK markets;
- Deliver a balanced low-carbon generation portfolio that reflects the balance in the Irish and UK markets;
- Integrate generation and supply operations in the Irish and UK markets to optimise earnings and mitigate risks across the value chain;
- Optimise the return from ESB's Ireland and UK assets by delivering excellent asset performance and managing costs to maximise trading and commercial opportunities.

Some examples of current activities in ESB that support those objectives include:

- Developing a project pipeline of power plants in the UK;
- Investing in renewable technologies to reduce the carbon intensity of the generation portfolio;
- Developing alternative and newer technologies, including biomass, battery storage, offshore wind, solar and wave technology.

The Shannon Hydro-Electric Scheme was the first step by ESB towards developing and maintaining sustainable and low-carbon generation portfolio and continues to play its part in ESB's renewable strategy today.

Safety

The safety record of the Ardnacrusha Generating Station is one of the best in the industry.

Your safety on site is important to us. During your visit, please remain with your group and follow the instructions of your guide. We hope you enjoy your visit.

Technical data and key facts

- River flow: annual average 180.0 m^3/sec
- Dam Height: 30m
- Catchment area: 10,400km
- Turbine type: 3 x Vertical - Shaft Francis Turbo-Generators (19MW; 21MW and 22MW)
  1 x Vertical - Shaft Kaplan 24MW Turbo-Generator
- Output: 86 MW

Key facts

In 1929 met 100%
of our electricity needs
(just under 3 million people)

In 2015 met 2.8%
of our electricity needs
(just under 4.6 million people)

(@1.6 million households/
2.8 residents per average household,
powers 46,000 households/
128,800 residents)

A map of the area around Ardnacrusha

23,000
m^3 of timber

2,670
tons of reinforced steel

10,000
tons of fuel oil

110,000
tons of coal

700
tons of explosives

80,000
tons of concrete were used in the construction

130 steam locomotives were used during the construction works

30,000
metric tons of construction machinery and equipment were brought from Germany to Ireland on three **2,000 ton chartered steamships** to complete the works as Ireland had little or no construction industry at the time.
The electricity needed to operate all the equipment was generated by a construction power plant, which had a total capacity of **4,200 horsepower**

Over 8 million metric tons of earth were excavated and used in the dams, and almost 1.2 million cubic metres of rock were blasted and carried away over the construction period

- **1994**: Became the first power station in the world to receive the ISO 9002 award by the International Organisation of Standardisation for its integrated management system.
- **1996**: Recipient of the Award for Excellence in Architecture by the Royal Institute of Architects of Ireland (RIAI). [New Control Room design]
- **29th July 2002**: Recipient of the International Milestone Award from the Institute of Electrical and Electronic Engineers (IEEE). Other recipients: Cape Canaveral Space Shuttle Programme and Japan's Bullet Train.
- **29th July 2002**: Recipient of the International Landmark Award by the American Society of Civil Engineers (ASCE). Other recipients: The Eiffel Tower and The Golden Gate Bridge.
- **21st September 2004**: Recipient of the ISO 14001 award by SGS Ireland for its environmental management system.

BUILDING A BRIGHTER FUTURE

A brighter future is built on the decisions of today. At ESB, we are committed to a carbon free energy future, powered by clean electricity.

We remain committed and focused on investing and innovating to create a brighter future for all. From reducing the carbon intensity of our generation portfolio to adapting the network to facilitate more distributed energy resources, we want to empower our customers and support the wider decarbonisation of society through the electrification of heat and transport.

It is a bright future. Together, we can make it happen.

www.esb.ie