

Maintaining the balance of power – through engineering

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ECONOMIC



TECHNO-
LOGICAL



SCIENTIFIC



ENVIRON-
MENTAL

SUMMARY

Renewable energy offers the promise of harnessing environmentally sustainable power from wind, sun and ocean. But switching power systems over to renewable sources needs planning in order to avoid the danger of power outages.

Associate Professor Damian Flynn at University College Dublin School of Electrical & Electronic Engineering is taking a detailed look at how power systems can turn up the dial on renewable energy sources, particularly wind energy.

The research will inform how Ireland moves towards sustainable energy goals in the 21st century without compromising the reliability or stability of the power supply.

“We need to balance environmental sustainability, the economics of keeping the power affordable for citizens and business and ensuring that the supply is robust.”

Models for reliable, sustainable energy

Fossil fuels spell trouble. When hydrocarbons, such as oil or gas, are taken from the ground and burned for fuel they release pollutants that can affect human health and carbon that acts on Earth’s climate system.

The renewables - wind, solar and ocean energy - provide cleaner and greener sources of power.

Ideally, we would derive all the power we need for our electricity, heating and transport from these renewable sources, but turning up the dial on renewable sources in power systems needs to be managed carefully.

That is where Associate Professor Damian Flynn’s research at UCD School of Electrical & Electronic Engineering is making an impact. His group creates computer models to figure out how best to **manage power as the proportion of energy coming from renewables increases, without compromising consumers, societies, economies and the environment.**

“When you are operating the power system, you need to be confident that it is reliable,” explains Associate Professor Flynn. “A power outage is at the very least frustrating for people when their lights and appliances and computers go off, and **potentially damaging for businesses as well as key services such as hospitals and transport.**”

Much of the focus on renewables in Ireland is on wind, which is in plentiful supply as a natural resource. “Ireland has 2020 targets of 40% of power being provided by renewables, and increasingly we are looking ahead to 2030 and 2050,” explains Associate Professor Flynn. “You have to have plans in place to do that, though. In general, if you have less than around 10% of renewables (other than hydro) in your power system you can balance things out easily enough - if it is a windy day for example you just scale back your conventional generators. But as you add more renewables this balancing gets trickier.”



It is relatively easy to predict the demand for power in a system – we tend to be creatures of habit when it comes to using electricity, transport and heating, and unusual events like bank holidays, the ad break in The Late Late Toy Show (when people put on the kettle) and the impact of Ireland making it to an Olympic or World Cup final can be anticipated.

On the other hand, forecasts for the exact timing and location of wind power are not always accurate enough to fine-tune the balance in the power system when renewables provide a large chunk of the incoming energy. “The forecasts may be a little out, and if you have a power system that is dominated by renewables you need to take that into account,” says Associate Professor Flynn.

His research at UCD **models potential scenarios for future systems including Ireland**, a system which is viewed internationally with strong interest. “The power system in Ireland is one of worldwide interest because of the challenges we face,” he explains. “As an island, Ireland has to be largely self-sufficient and solve its own problems, and because we are a relatively small system when things go wrong they could escalate quickly.”

Part of his research looks at how to **anticipate the behaviours of smart, consumer-side devices** that can take power from the system at the most cost-efficient times.

“When you have a network and devices are making the decisions about when to use electricity, they may all ‘decide’ to start the moment that cheaper rates become available, and this could be an issue,” explains Associate Professor Flynn, whose work has attracted interest from not only the system operator **EirGrid** but also **commercial companies such as Glen Dimplex, Electricite de France, Gaelectric and General Electric**.

Informing energy policy and practice

As Ireland and other systems move more towards renewable sources of energy, the challenge is to model the best way forward for policy and practice, and there remain many unknowns in the long-term system, according to Associate Professor Flynn.

“We are looking now towards 2050, which is more than 30 years away,” he says. “The lifetime of a conventional power station or wind farm might be 20-30 years, and a transmission network might have a life of 50 years, so by 2050 much of the infrastructure we have today will no longer exist, so that gives you lots of freedom to think of and analyse new scenarios.”

Add to that the possible societal, technological and consumer-related trends: “Perhaps globally there will be a mindset change about nuclear options, solar power is becoming ever cheaper, largely untapped synergies exist

with the gas and water networks, new technologies could revolutionise how we harness and store power and more and more people may make their next car an electric vehicle with perhaps system balancing achieved through Blockchain and crowd balancing technologies.”

Keeping the power supply on an even keel will have societal and economic impact, not only on citizens going about their lives and work but also for the longer-term economy of Ireland and other systems, notes Associate Professor Flynn. “Ireland’s reliable and clean power supply is attractive for investment by large manufacturing companies such as Intel and also companies that need data centres such as Amazon,” he says. “It is anticipated that data centres could represent more than a quarter of Ireland’s energy demand in future years. So we need to balance **environmental sustainability**, the **economics of keeping the power affordable** for citizens and business and **ensuring that the supply remains robust**.”

Research References

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