WEBVTT

00:00:10.376 --> 00:00:20.916
<v SPEAKER_2>Hello, everyone, and welcome to Energy Security Cubed, one of the world's foremost energy security podcasts presented by the CGAI, or Canadian Global Affairs Institute.

00:00:20.916 --> 00:00:24.596
<v SPEAKER_2>I'm Kelly Ogle, Managing Director here at CGAI.

00:00:24.596 --> 00:00:32.536
<v SPEAKER_1>And I'm Joe Calnan, Vice President of Energy and Calgary Operations at the Canadian Global Affairs Institute.

00:00:34.476 --> 00:00:46.636
<v SPEAKER_2>For today's podcast, we're featuring a discussion with Kathryn Porter, where we had a great conversation about the Spanish blackout, broader issues of aging grid infrastructure and grid frequency, and the question of Europe's nuclear future.

00:00:46.636 --> 00:00:53.516
<v SPEAKER_2>But before we dive into that, let's quickly discuss with Joe some of the new stories affecting global energy security this week.

00:00:53.516 --> 00:00:54.956
<v SPEAKER_2>What's up with you, Joe?

00:00:54.956 --> 00:00:58.356
<v SPEAKER_1>Well, I am feeling a little bit nervous these days, Kelly.

00:00:58.356 --> 00:01:04.776
<v SPEAKER_1>I'm feeling quite a bit similar to the way I felt when the Russian invasion of Ukraine was just rampant.

00:01:04.776 --> 00:01:05.976
<v SPEAKER_2>Yeah.

00:01:05.976 --> 00:01:06.996
<v SPEAKER_2>You're not alone.

00:01:06.996 --> 00:01:08.196
<v SPEAKER_2>You're not alone.

00:01:08.196 --> 00:01:08.536
<v SPEAKER_1>Yeah.

00:01:08.536 --> 00:01:12.156
<v SPEAKER_1>It seems as though the shoes keep falling.

00:01:12.156 --> 00:01:24.476
<v SPEAKER_1>The Russian invasion of Ukraine, the attack on Israel by Hamas, and now this real escalation of the war between Israel and Iran.

00:01:24.476 --> 00:01:28.236
<v SPEAKER_1>And so yeah, there's tons of things going on here.

00:01:28.236 --> 00:01:28.416
<v SPEAKER_2>Yeah.

00:01:28.416 --> 00:01:30.096
<v SPEAKER_2>Let's talk about that.

00:01:30.156 --> 00:01:30.476
<v SPEAKER_1>Yeah.

00:01:30.476 --> 00:01:38.416
<v SPEAKER_1>So we really, and I really wanted to get into what I would say is the worst-case scenario for this.

00:01:38.416 --> 00:01:45.316
<v SPEAKER_1>And worst-case scenario, meaning what's worst for the world in general, especially from the energy security perspective.

00:01:45.316 --> 00:01:51.316
<v SPEAKER_1>And this is a potential closure of the Strait of Hormuz by Iran.

00:01:51.316 --> 00:01:58.256
<v SPEAKER_1>So let's start off with a quick review of the Iranian nuclear and energy facilities, which have been struck by Israel.

00:01:59.096 --> 00:02:15.816
<v SPEAKER_1>According to the Critical Threats Project from the American Enterprise Institute and the Institute for the Study of War, Israel seems to be striking targets with the purpose of undermining the regime's legitimacy more broadly, which means the Iranian regime under the Ayatollahs.

00:02:15.816 --> 00:02:20.756
<v SPEAKER_1>And this includes strikes on the production of desperately needed fuel.

00:02:20.756 --> 00:02:36.156
<v SPEAKER_1>On the nuclear side, Israel has conducted successful strikes on the Nanan's nuclear site with the IAEA, assessing that up to 14,000 Iranian centrifuges may have been damaged or destroyed in these strikes.

00:02:36.156 --> 00:02:46.436
<v SPEAKER_1>While this is a big setback for Iran's nuclear program, the country also has a second uranium enrichment site at Fordow, which is thought to be 80 to 90 meters underground.

00:02:46.436 --> 00:02:53.216
<v SPEAKER_1>And only one country in the world is thought to have a conventional weapon which could destroy Fordow, and that is the United States.

00:02:54.136 --> 00:03:01.756
<v SPEAKER_1>I like to also note, though, that Iran has a substantial amount of highly enriched uranium already manufactured.

00:03:01.756 --> 00:03:07.416
<v SPEAKER_1>I'm not entirely sure where this would be stored, probably in the Fordow facility as well.

00:03:07.416 --> 00:03:19.876
<v SPEAKER_1>And let's just say that there's some thought that Iran would actually be able to make a nuclear weapon in under a month with this already enriched uranium.

00:03:19.876 --> 00:03:23.016
<v SPEAKER_1>So we're talking about a timeline here which could be awful fast.

00:03:23.396 --> 00:03:29.536
<v SPEAKER_1>And Iran still has quite a few ballistic missiles which are capable of carrying a nuclear weapon.

00:03:29.536 --> 00:03:32.676
<v SPEAKER_1>So we should be very clear about that.

00:03:32.676 --> 00:03:38.816
<v SPEAKER_1>Israel has also struck Iranian missile launchers, missile production facilities and electronics manufacturing.

00:03:38.816 --> 00:03:44.176
<v SPEAKER_1>However, Israeli strikes are not only targeting Iranian missile and nuclear facilities.

00:03:44.176 --> 00:03:56.916
<v SPEAKER_1>Israel has also struck a major oil refinery and oil storage facility near Tehran, as well as onshore natural gas processing infrastructure for the massive South Parz gas field in the Persian Gulf.

00:03:56.916 --> 00:04:02.476

<v SPEAKER_1>Even before these strikes, Iran was facing a major fuel shortage, especially for natural gas.

00:04:02.476 --> 00:04:10.956
<v SPEAKER_1>These strikes on South Parz gas processing facilities in particular could have a huge immediate impact on Iran's economy.

00:04:10.956 --> 00:04:15.716
<v SPEAKER_1>And this could be extraordinarily difficult for the Iranian government to deal with.

00:04:15.716 --> 00:04:20.316
<v SPEAKER_1>And here we can see how Iran has managed to support its various proxies.

00:04:21.296 --> 00:04:34.236
<v SPEAKER_1>Despite being one of the richest countries in the world for energy resources, Iran has largely diverted oil export cash flows into supporting its proxies in Syria, Lebanon, Yemen and Gaza.

00:04:34.236 --> 00:04:49.176
<v SPEAKER_1>And it has also, because of this, I mean, partially because of this, there's other things that it was spending its money on, it is underestimated in the base requirements for domestic energy supply, and let alone redundancy that is required for energy security.

00:04:49.396 --> 00:04:57.656
<v SPEAKER_1>So let's just say, if you're going to be picking a fight with an actor like Israel, you better have a lot of redundancy and resiliency in your energy system.

00:04:57.656 --> 00:05:00.676
<v SPEAKER_1>And Iran has not built that.

00:05:00.676 --> 00:05:08.476
<v SPEAKER_1>The Ukrainians were much, much, much more intelligent than Iran around their strategic requirements around energy security.

00:05:08.476 --> 00:05:20.776
<v SPEAKER_1>As a result, Israel is able to wreak havoc on Iran's economy, potentially posing an existential threat to the regime's legitimacy and to its support among the Iranian population.

00:05:20.776 --> 00:05:30.956
<v SPEAKER_1>Importantly, Israel has signaled that its ultimate goal with this war is not just the end of Iran's nuclear program, but the end of the regime itself.

00:05:30.956 --> 00:05:41.716
<v SPEAKER_2>History has told us that regimes under existential threat

can take extreme measures to preserve their power, control and safety from internal and external challenges.

00:05:41.716 --> 00:05:49.896
<v SPEAKER_2>This opens the door to the threat of a closure of the Strait of Hormuz, a nightmare scenario for global energy security.

00:05:49.896 --> 00:05:53.176
<v SPEAKER_2>Let's go through the Strait of Hormuz with some numbers.

00:05:53.176 --> 00:06:06.656
<v SPEAKER_2>According to the Energy Information Administration, or EIA, not the IEA, around 20 million barrels per day of crude oil, 20 million condensate and petroleum products move through the Strait of Hormuz every day.

00:06:06.656 --> 00:06:16.716
<v SPEAKER_2>That is around 20% of the world's 102 million barrels per day of consumption of petroleum and other liquids, and 25% of global oil moved by ship.

00:06:16.716 --> 00:06:23.996
<v SPEAKER_2>A sustained disruption similar to the crisis in the Red Sea would have an immediate catastrophic impact on the global economy.

00:06:23.996 --> 00:06:26.596
<v SPEAKER_2>We shouldn't forget natural gas as well.

00:06:26.596 --> 00:06:38.316
<v SPEAKER_2>The 11.5 BCF per day of liquid natural gas flows through the Strait of Hormuz account for roughly 20% of global LNG trade as well.

00:06:38.316 --> 00:06:49.136
<v SPEAKER_2>Countries which are large net importers of seaborne crude would be the hardest hit, in particular, the major economies in Asia would be scrambling to secure alternative supplies.

00:06:49.136 --> 00:07:01.116
<v SPEAKER_2>China, India, Japan, South Korea would very quickly be in dire straits, bidding up prices of spot cargoes and likely even attracting contracted ships to change their destination.

00:07:01.116 --> 00:07:10.756
<v SPEAKER_2>Remember, seaborne crude is very, very, not just fungible, but it's very agile in that it can turn on a dime, well, turn a two or three.

00:07:10.896 --> 00:07:17.016
<v SPEAKER_1>Well, as fast as you can turn a tank, let's just say that

it's more flexible than pipelines.

00:07:17.016 --> 00:07:18.696
<v SPEAKER_2>Yeah, it certainly is.

00:07:18.696 --> 00:07:24.676
<v SPEAKER_2>A fuller partial closure of the Strait of Hormuz would
therefore have an immediate price impact, which it already has.

00:07:24.676 --> 00:07:30.296
<v SPEAKER_2>The potential of it is already baked into the prices in
the last week or two.

00:07:30.296 --> 00:07:45.696
<v SPEAKER_2>With big questions as to how high prices could go for oil
and LNG, a ceiling on prices will likely be associated with demand
destruction via fuel switching and a global recession, with the
poorest countries always hit the hardest.

00:07:45.696 --> 00:07:51.016
<v SPEAKER_2>However, this all assumes that Iran has the capability
and the will to close the Strait of Hormuz.

00:07:51.016 --> 00:07:56.396
<v SPEAKER_2>Here I think the example of the Houthis in Yemen is
instructive.

00:07:56.396 --> 00:08:05.776
<v SPEAKER_2>Since October 2023, the Houthi movement in Yemen have
been extremely effective at disrupting commercial shipping through the
Baabil and Mandab Strait.

00:08:05.776 --> 00:08:11.696
<v SPEAKER_2>To this day, transits of that Strait are about half of
what they were prior to the beginning of the Israel's war in Gaza.

00:08:11.696 --> 00:08:20.556
<v SPEAKER_2>Yemen is one of the poorest countries in the world with
an estimated GDP per capita of $464 per person in 2024.

00:08:20.556 --> 00:08:28.496
<v SPEAKER_2>Nevertheless, with Iranian help, the Yemenis were able to
sustain attacks with missiles and drones and shipping in the region
for over a year.

00:08:29.876 --> 00:08:41.596
<v SPEAKER_2>Israeli attacks on Iran's missile production and launch
sites in Iran's declining missile stockpiles could quickly take this
capability away from both the Houthis and Iran itself.

00:08:41.596 --> 00:08:51.556
<v SPEAKER_2>Expending scarce missiles on attacking ships in the Strait of Hormuz may be less important for the survival of the regime than attacking Israel directly.

00:08:51.556 --> 00:09:03.176
<v SPEAKER_2>Furthermore, closing the Strait of Hormuz would have a crippling impact on Iran's own oil exports, cutting off a vital source of cash needed to sustain imports of manufactured goods.

00:09:04.476 --> 00:09:12.096
<v SPEAKER_2>I think lastly, it should be noted that much of the oil transported through the Strait uses Middle Eastern and Asian owned ships.

00:09:13.816 --> 00:09:25.216
<v SPEAKER_2>While the Houthis has some plausible deniability for their targeting, Iran would be putting its relationship with its neighbors and its customers on the line if it starts attacking these ships.

00:09:26.656 --> 00:09:40.556
<v SPEAKER_2>And finally, if the United States enters the war on Israel's side with the goal of regime change, which is a whole other topic, we could see many options which were previously considered unthinkable on the table.

00:09:40.556 --> 00:09:44.896
<v SPEAKER_2>I wonder if this is partially why Trump only spent one day at the G7, Joe.

00:09:44.896 --> 00:09:47.836
<v SPEAKER_1>I think it's absolutely why Trump only spent one day at the G7.

00:09:47.836 --> 00:09:53.416
<v SPEAKER_1>I mean, you know, this is, let's just say this is more important stuff than a social event with some other Western countries.

00:09:53.876 --> 00:09:54.976
<v SPEAKER_1>Right.

00:09:55.036 --> 00:09:57.296
<v SPEAKER_2>And another about how great they are.

00:09:57.296 --> 00:09:58.136
<v SPEAKER_1>Like, don't get me wrong.

00:09:58.356 --> 00:09:59.536
<v SPEAKER_1>I appreciate it.

00:09:59.536 --> 00:10:00.256
<v SPEAKER_2>No, I'm with you.

00:10:00.256 --> 00:10:00.856
<v SPEAKER_1>You're right.

00:10:00.856 --> 00:10:01.896
<v SPEAKER_2>You're absolutely right.

00:10:02.536 --> 00:10:06.296
<v SPEAKER_1>Yeah, normally, normally this intro would be about the
G7, but this is a bit more relevant.

00:10:06.296 --> 00:10:08.756
<v SPEAKER_2>No, no, this is prescient and relevant.

00:10:08.816 --> 00:10:12.976
<v SPEAKER_2>It's really with a powder cake there.

00:10:13.056 --> 00:10:19.156
<v SPEAKER_2>I understand Israel's position.

00:10:19.156 --> 00:10:28.976
<v SPEAKER_2>Iran's been a thorn in the side of peaceful operations of
the world in geopolitics and real politics since 1979.

00:10:32.076 --> 00:10:33.616
<v SPEAKER_2>This will end badly.

00:10:36.036 --> 00:10:37.736
<v SPEAKER_1>Yeah, we'll see.

00:10:37.736 --> 00:10:47.176
<v SPEAKER_1>I mean, the hope is, I'm not taking, maybe I shouldn't
take a position on the validity of regime change or anything of that
sort.

00:10:48.856 --> 00:11:04.796
<v SPEAKER_1>But a scenario where we have a new leader, like now the
one in Syria coming to the fore in Iran, one that's willing to do
business with the West, if not be aligned with the West, I think that
that would be a good outcome.

00:11:04.796 --> 00:11:23.156
<v SPEAKER_1>But what I worry about is if Iran, either A, the Iranian
regime holds on an even more hardliner stance than it had before and
actually gains the ability to launch nukes on ballistic missiles, that
would be a really bad outcome.

00:11:23.156 --> 00:11:43.256
<v SPEAKER_1>Or alternatively, a scenario where the Iranian regime collapses completely, and the entire Iranian state capacity also collapses, in which case you would have a more Yemen style situation with certain factions controlling parts of this territory of 80 million people and spreading instability throughout the region.

00:11:43.256 --> 00:11:52.876
<v SPEAKER_1>That would also be a very, very bad outcome, and would create a power vacuum that, well, we could even see Russia filling that power vacuum or something of that sort.

00:11:53.256 --> 00:12:02.576
<v SPEAKER_2>I was just thinking that, and China sits back and watches it all unfold and has its own mobile operating die.

00:12:02.856 --> 00:12:12.396
<v SPEAKER_1>Like if you cut the head off the snake, a snake could still ride the round and maybe you'd realize that some stability is better than no stability.

00:12:12.436 --> 00:12:13.136
<v SPEAKER_2>We'll see.

00:12:13.336 --> 00:12:17.256
<v SPEAKER_2>I just, it's interesting.

00:12:17.256 --> 00:12:20.996
<v SPEAKER_2>Now, anyways, thanks for bringing up this story, Joe.

00:12:20.996 --> 00:12:22.176
<v SPEAKER_1>Now, for sure.

00:12:22.176 --> 00:12:27.796
<v SPEAKER_2>It's a very important part of today's geopolitical discussion.

00:12:27.796 --> 00:12:30.596
<v SPEAKER_1>Well, something I'm worried about, for sure.

00:12:31.196 --> 00:12:45.016
<v SPEAKER_1>I suppose to our listeners, if you're interested in these quick updates, please do subscribe to our free Energy Security Forum newsletter on our website, and you can receive an overview of the stories shaping energy security and energy geopolitics in the world.

00:12:45.016 --> 00:12:46.936
<v SPEAKER_1>And this is released every Thursday.

00:12:46.936 --> 00:12:49.436

<v SPEAKER_1>So please do subscribe on our website.

00:12:49.436 --> 00:12:58.696
<v SPEAKER_2>I want to say, Joe, as you know, I've been at other board meetings the last couple of days on another board that I'm on, and I had two people compliment me on the quality of your newsletter.

00:12:58.696 --> 00:12:59.536
<v SPEAKER_2>So there you go.

00:12:59.536 --> 00:13:00.436
<v SPEAKER_1>Fantastic.

00:13:00.436 --> 00:13:01.936
<v SPEAKER_1>Great to hear.

00:13:01.936 --> 00:13:02.416
<v SPEAKER_2>Okay.

00:13:02.416 --> 00:13:11.516
<v SPEAKER_2>Let's go talk to Kathryn Porter about the vagaries of the energy grid, the electrical grid in Europe.

00:13:12.916 --> 00:13:16.596
<v SPEAKER_3>Hi, I'm Dave Perry, the President and CEO of The Canadian Global Affairs Institute.

00:13:16.596 --> 00:13:21.116
<v SPEAKER_3>I hope you're enjoying Energy Security Cubed, Canada's leading podcast on energy issues.

00:13:21.116 --> 00:13:30.696
<v SPEAKER_3>If you're listening and you'd like to help us keep bringing informed discussion of Canadian energy issues to key government decision-makers, thought leaders, and the business community, then consider sponsoring the podcast.

00:13:30.696 --> 00:13:35.996
<v SPEAKER_3>Reach out to us at contact at cgai.ca for options and pricing.

00:13:36.356 --> 00:13:38.796
<v SPEAKER_3>That's contact at cgai.ca.

00:13:40.456 --> 00:13:54.276
<v SPEAKER_2>For today's interview recorded June 13, 2025, we discussed the rising risk facing European electricity grids, including some takeaways from the Spanish blackout, aging infrastructure problems, and the future of nuclear power.

00:13:54.276 --> 00:13:57.856
<v SPEAKER_1>With us to talk about this is Kathryn Porter.

00:13:57.856 --> 00:14:07.816
<v SPEAKER_1>Kathryn is an independent energy consultant with extensive experience in energy markets who analyzes physical and financial electricity, gas, and oil.

00:14:07.816 --> 00:14:11.656
<v SPEAKER_1>I strongly recommend listeners check out her work at wattlogic.com.

00:14:14.256 --> 00:14:17.336
<v SPEAKER_2>Great to have you on the podcast again, Kathryn.

00:14:17.336 --> 00:14:18.316
<v SPEAKER_4>It's really great to be here.

00:14:18.316 --> 00:14:20.556
<v SPEAKER_4>Thank you for having me.

00:14:20.556 --> 00:14:26.276
<v SPEAKER_2>I'd like to start off with a story from a while back, the Spanish electricity grid outage.

00:14:26.276 --> 00:14:34.576
<v SPEAKER_2>While this outage was world news at the time, it is out of the headlines now, which is really unfortunate because there have been a few interesting updates.

00:14:34.576 --> 00:14:39.816
<v SPEAKER_2>From your perspective in Europe, can you give us an update on the increase into the causes of this blackout?

00:14:41.796 --> 00:14:45.236
<v SPEAKER_4>I think we still don't know what the initial cause was.

00:14:45.236 --> 00:14:55.116
<v SPEAKER_4>It's interesting that there's been some recent speculation, actually, that the Spanish grid operator was experimenting with low inertia running at the time.

00:14:55.116 --> 00:15:02.676
<v SPEAKER_4>We know that they'd had a day of 100 percent renewables not long before that, with great fanfare.

00:15:02.676 --> 00:15:11.236
<v SPEAKER_4>On the day of the blackout itself, they did have some gas on the system, so they were definitely not at 100 percent renewables, but they were operating with very low inertia levels.

00:15:11.236 --> 00:15:15.436
<v SPEAKER_4>They haven't made public what the initial fault was.

00:15:15.436 --> 00:15:19.836
<v SPEAKER_4>Now, it could be something mundane, but the question is
if it was something mundane, why have they not told us?

00:15:19.836 --> 00:15:22.016
<v SPEAKER_4>Because they will have known this immediately.

00:15:22.016 --> 00:15:28.896
<v SPEAKER_4>They will have known within minutes, if not hours, of the
incident what the actual original cause was.

00:15:29.156 --> 00:15:37.616
<v SPEAKER_4>Particularly, if it was something on the physical
infrastructure, it doesn't take that long to go and find the source of
the fault on your grid even if it's in a remote area.

00:15:37.756 --> 00:15:42.616
<v SPEAKER_4>The fact they haven't made this public yet is some course
of speculation.

00:15:42.616 --> 00:15:51.016
<v SPEAKER_4>But I think the reason that then went on to have a
blackout across all of Iberia is very much linked to the low inertia
running.

00:15:51.016 --> 00:16:04.276
<v SPEAKER_4>It's no coincidence that once the fault propagated into
France, it was very quickly contained because France has high inertia,
so yes, a small region of France experienced a blackout, but it was a
very small region.

00:16:04.276 --> 00:16:15.596
<v SPEAKER_4>The geographic spread was halted and power restored to
that small region quite quickly, whereas all of Iberia had a full
blackout requiring a full black start, and that took many hours.

00:16:15.596 --> 00:16:18.396
<v SPEAKER_4>So that's what you get when you're running on low
inertia.

00:16:18.396 --> 00:16:24.156
<v SPEAKER_2>Could you explain, just for layman's terms, Kathryn,
explain what low inertia means?

00:16:24.156 --> 00:16:32.936
<v SPEAKER_2>Because I think I have an idea, and I think many people

have an idea, but can you just give us a little bit of a taste of what that means?

00:16:32.936 --> 00:16:33.356
<v SPEAKER_4>Yeah, sure.

00:16:33.356 --> 00:16:39.996
<v SPEAKER_4>So I actually just put a video on my pretty new YouTube channel about inertia, just to get that little plug in there.

00:16:39.996 --> 00:16:42.936
<v SPEAKER_4>I'm not monetizing my channel, so there's not really any reason to plug it.

00:16:43.856 --> 00:16:47.716
<v SPEAKER_4>But yeah, so inertia comes back to how we generate electricity.

00:16:47.716 --> 00:17:02.756
<v SPEAKER_4>Our power grids use alternating current, and that alternating current fundamentally is generated when you rotate one magnet inside the magnetic field of another magnet, and all our magnets are put on top of the onto turbines, which are big heavy lumps of metal.

00:17:02.756 --> 00:17:12.616
<v SPEAKER_4>So they rotate in North America at 3,600 revolutions per minute, and that gives a frequency of 60 cycles per second or 60 hertz.

00:17:12.616 --> 00:17:16.816
<v SPEAKER_4>Electrical equipment is pretty sensitive to this frequency property.

00:17:18.116 --> 00:17:23.996
<v SPEAKER_4>You'll get equipment failure if the grid frequency goes outside of a fairly narrow tolerance band.

00:17:23.996 --> 00:17:29.996
<v SPEAKER_4>So most system operators have a duty to keep this roughly within plus or minus 1 percent.

00:17:29.996 --> 00:17:36.276
<v SPEAKER_4>The exact amount varies in different countries, but it's a pretty narrow range that they have to target.

00:17:36.276 --> 00:17:40.196
<v SPEAKER_4>Now, there's a relationship between frequency and supply and demand.

00:17:40.196 --> 00:17:49.916
<v SPEAKER_4>So if you have more electricity coming onto the system than you're consuming, the frequency will go up, and that will tend to try to speed up the rotation of your turbines.

00:17:49.916 --> 00:17:56.376
<v SPEAKER_4>And similarly, if you have more demand than generation, it'll tend to try and slow down your turbines.

00:17:56.376 --> 00:18:06.336
<v SPEAKER_4>Now, conventional electricity turbines, gas, coal, hydroelectric nuclear, they're big heavy lumps of metal and it's difficult to change their speed of rotation.

00:18:06.336 --> 00:18:10.556
<v SPEAKER_4>And that difficulty, that resistance to change is known as inertia.

00:18:10.556 --> 00:18:16.996
<v SPEAKER_4>Now, when it comes to renewables, they don't generate alternating current in the same way.

00:18:16.996 --> 00:18:22.856
<v SPEAKER_4>So wind turbines, they do generate alternating current, but it's not at a steady rate because wind speeds aren't constant.

00:18:22.856 --> 00:18:30.776
<v SPEAKER_4>So typically what happens is that AC is turned into direct current and then reconverted into alternating current using electronics.

00:18:30.776 --> 00:18:33.056
<v SPEAKER_4>And then with solar, you don't have any moving parts at all.

00:18:33.056 --> 00:18:36.596
<v SPEAKER_4>So clearly that's not generating alternating current to begin with.

00:18:36.596 --> 00:18:39.876
<v SPEAKER_4>Again, it's converted into alternating current using electronics.

00:18:40.436 --> 00:18:52.996
<v SPEAKER_4>And these electronics simply just observe the wave form of currents and voltage that's created by your big conventional turbines and then inject or not based on whether it conforms to their expectations.

00:18:53.216 --> 00:18:56.636

<v SPEAKER_4>And these electronics are known as inverters.

00:18:56.636 --> 00:19:03.516
<v SPEAKER_4>They can be quite sensitive, even more sensitive sometimes than conventional generation and conventional equipment.

00:19:03.516 --> 00:19:09.936
<v SPEAKER_4>And if they don't like what they see, they simply will disconnect themselves or not connect in the first place.

00:19:09.936 --> 00:19:22.056
<v SPEAKER_4>So if you have a grid fault, let's say a lightning strikes a power line somewhere, and that disconnects a chunk of generation local to that area, that will cause your grid frequency to fall.

00:19:22.056 --> 00:19:30.276
<v SPEAKER_4>Now, if you have a lot of inertia on the grid and all these turbines resisting that change, that drop in frequency, then that gets limited.

00:19:30.276 --> 00:19:33.896
<v SPEAKER_4>The speed of the drop is reduced, the extent of the drop is reduced.

00:19:33.896 --> 00:19:46.656
<v SPEAKER_4>But if you don't have that property on your grid, then what happens is the next generator along, and it might be another solar farm, for example, will see this voltage disturbance, see the drop in frequency, and they'll be like, I don't really like that.

00:19:46.656 --> 00:19:48.356
<v SPEAKER_4>So they disconnect.

00:19:48.356 --> 00:19:50.956
<v SPEAKER_4>Of course, that makes the discrepancy bigger.

00:19:52.676 --> 00:19:56.096
<v SPEAKER_4>Then the next one along sees this bigger discrepancy and also disconnects.

00:19:56.196 --> 00:20:05.736
<v SPEAKER_4>Quite quickly, you get a cascading failure because all the equipment just looks at it and goes, no, this is outside of our tolerances, and the protection measures all activate, and they just disconnect.

00:20:06.856 --> 00:20:12.116
<v SPEAKER_4>Without that inertia property, you're much more vulnerable to those faults.

00:20:12.116 --> 00:20:16.616
<v SPEAKER_4>People have said, oh, well, yeah, but people have run power grids at low inertia with no trouble.

00:20:16.616 --> 00:20:22.036
<v SPEAKER_4>That's a little bit like saying, well, I haven't crashed my car in the last few years, so I don't need to buy insurance.

00:20:22.036 --> 00:20:24.616
<v SPEAKER_4>The question isn't, can you operate your grid at low inertia?

00:20:24.616 --> 00:20:29.396
<v SPEAKER_4>It's can you ride through a fault while operating your grid at low inertia?

00:20:29.396 --> 00:20:31.816
<v SPEAKER_4>In Spain, clearly, the answer was no.

00:20:31.816 --> 00:20:39.676
<v SPEAKER_4>Whether that original fault was triggered by some experiments the TSO was doing, or whether it was some other type of fault, we don't know.

00:20:39.676 --> 00:20:45.056
<v SPEAKER_4>But either way, the grid wasn't able to cope because of the low levels of inertia.

00:20:45.056 --> 00:20:47.056
<v SPEAKER_2>What a great explainer that was.

00:20:47.056 --> 00:20:47.976
<v SPEAKER_1>Yeah, that was great.

00:20:48.836 --> 00:20:55.796
<v SPEAKER_1>I'm no electrical engineer, and I think people who listen to this podcast would know that I'm definitely more on the policy side of this.

00:20:56.996 --> 00:20:59.676
<v SPEAKER_1>But I'm super interested in this concept.

00:21:00.756 --> 00:21:20.716
<v SPEAKER_1>We have this incumbent infrastructure that, like you said, it's these big spinning wheels that are extremely heavy, and they kind of provide, from what you're saying, they provide kind of automatic stabilization to the grid, so that if there's any movement in that frequency, then they'll resist it.

00:21:21.236 --> 00:21:33.916
<v SPEAKER_1>But what you're saying is that these new renewables are kind of piggybacking on this incumbent infrastructure, and kind of using this incumbent automatic stabilization.

00:21:33.916 --> 00:21:41.376
<v SPEAKER_1>But using that becomes narrower and narrower as renewables kind of displace traditional infrastructure.

00:21:41.376 --> 00:21:44.096
<v SPEAKER_1>But yeah, no, that's super important.

00:21:44.136 --> 00:21:48.216
<v SPEAKER_4>The interesting thing about it is, well, you get it for free with conventional generation.

00:21:48.216 --> 00:21:54.096
<v SPEAKER_4>You don't really pay for inertia because it's a fundamental property of how the electricity is generated in the first place.

00:21:54.096 --> 00:21:59.636
<v SPEAKER_4>As you remove that conventional generation from the grid, then you have to start paying for it.

00:21:59.636 --> 00:22:07.036
<v SPEAKER_4>And the Australian system operator, AMO, has done probably the most work on this out of everyone, followed by the British system operator, NISO.

00:22:07.836 --> 00:22:21.656
<v SPEAKER_4>And what they're finding is that, first of all, is this tension between the vendors and the system operator because the vendors don't want to release their proprietary tech and the system operator isn't being clear enough about what they actually need.

00:22:21.656 --> 00:22:23.976
<v SPEAKER_4>So specification is an issue.

00:22:23.976 --> 00:22:29.496
<v SPEAKER_4>But really, if you want to use renewables to provide inertia, you have to have headroom.

00:22:29.496 --> 00:22:38.736
<v SPEAKER_4>And so that means that your everyday maximum output effectively has to be haircut and obviously then you'd want to get compensated for that.

00:22:38.736 --> 00:22:52.476
<v SPEAKER_4>So if you're, let's say, your national capacity is 100

megawatts, but now you have to only run at, say, 92 because you need to have this 8 megawatts availability for inertia provision, then obviously that cuts your potential income by 8 percent.

00:22:52.476 --> 00:22:54.496
<v SPEAKER_4>So you need to be compensated for that.

00:22:54.496 --> 00:23:05.416
<v SPEAKER_4>And so having gone from a situation where your equivalent gas turbine can just run at 100 percent and you get the inertia for free, now you cut the capacity and you have to pay the difference.

00:23:05.416 --> 00:23:11.556
<v SPEAKER_4>And so they're struggling to come up with economic frameworks that will make this work.

00:23:11.556 --> 00:23:19.856
<v SPEAKER_1>So that this is kind of a hidden cost for when you have deep penetration renewables, you start having to pay more and more and more for this as well.

00:23:19.856 --> 00:23:20.236
<v SPEAKER_4>Yeah.

00:23:20.236 --> 00:23:21.776
<v SPEAKER_4>And you can use spinning mass.

00:23:21.776 --> 00:23:24.956
<v SPEAKER_4>So quite a lot of people are experimenting with synchronous condensers.

00:23:24.956 --> 00:23:26.596
<v SPEAKER_4>We've got some in the UK.

00:23:26.636 --> 00:23:27.976
<v SPEAKER_4>Cotts has been building them.

00:23:27.976 --> 00:23:34.196
<v SPEAKER_4>Australia, some solar farms can't get grid connections now in South Australia without a synchronous condenser.

00:23:34.196 --> 00:23:44.856
<v SPEAKER_4>So they're putting in spinning mass powered by the grid in the hope of sort of synthesizing this inertia and you can do similar things with flywheels.

00:23:44.856 --> 00:23:50.156
<v SPEAKER_4>Basically just putting big, heavy spinning things on the grid that don't generate electricity.

00:23:50.156 --> 00:23:52.096
<v SPEAKER_4>But again, you've got to pay for it.

00:23:52.136 --> 00:23:52.576
<v SPEAKER_2>Yeah.

00:23:52.996 --> 00:23:59.496
<v SPEAKER_1>So I mean, there are solutions that are feasible, but it's just about the cost then, hey?

00:23:59.496 --> 00:24:00.716
<v SPEAKER_4>Yeah, exactly.

00:24:00.716 --> 00:24:06.516
<v SPEAKER_2>When you're dealing with pennies per kilowatt, there's not a lot of room.

00:24:06.516 --> 00:24:11.416
<v SPEAKER_2>That's why the redundancy of baseload power is there.

00:24:11.416 --> 00:24:13.256
<v SPEAKER_2>Because the economics work.

00:24:15.036 --> 00:24:19.196
<v SPEAKER_2>We could go deeply into that, but we should move on, Joe.

00:24:19.196 --> 00:24:19.476
<v SPEAKER_1>Yeah.

00:24:19.476 --> 00:24:20.396
<v SPEAKER_1>Well, it's your question next.

00:24:20.476 --> 00:24:21.616
<v SPEAKER_1>We covered all of my stuff here, Kelly.

00:24:21.616 --> 00:24:22.296
<v SPEAKER_1>Oh, I guess we did.

00:24:22.296 --> 00:24:23.136
<v SPEAKER_2>I'm sorry.

00:24:23.136 --> 00:24:23.356
<v SPEAKER_1>Yeah.

00:24:23.356 --> 00:24:24.216
<v SPEAKER_1>No, it's no problem.

00:24:25.936 --> 00:24:29.056
<v SPEAKER_2>I had read the script yesterday, but I forgot already.

00:24:29.396 --> 00:24:30.916
<v SPEAKER_1>It's all good, Kelly.

00:24:33.636 --> 00:24:35.856
<v SPEAKER_1>Just the general infrastructure challenges question.

00:24:35.856 --> 00:24:40.316
<v SPEAKER_2>Well, did we talk about other technologies?

00:24:40.316 --> 00:24:42.816
<v SPEAKER_1>Yeah, we talked a little bit about the flywheels stuff.

00:24:43.216 --> 00:24:44.216
<v SPEAKER_2>Right, right, right.

00:24:44.216 --> 00:24:44.456
<v SPEAKER_1>Yeah.

00:24:44.456 --> 00:24:46.076
<v SPEAKER_2>Okay.

00:24:46.076 --> 00:24:50.916
<v SPEAKER_2>Kathryn, we should also talk about general infrastructure
challenges facing grids in Europe.

00:24:50.916 --> 00:24:54.876
<v SPEAKER_2>You wrote earlier this year about the North Hyde
substation for Heathrow Airport.

00:24:54.876 --> 00:24:59.936
<v SPEAKER_2>What a schmazzle that was and the risks of aging grid
infrastructure.

00:24:59.936 --> 00:25:06.456
<v SPEAKER_2>What specifically about old electricity infrastructure
increases its vulnerability or is it more of what we've just
discussed?

00:25:08.676 --> 00:25:12.476
<v SPEAKER_4>First of all, let's say it's not just a European problem,
this is an American problem as well.

00:25:12.536 --> 00:25:13.676
<v SPEAKER_2>It's a global problem, yeah.

00:25:15.116 --> 00:25:22.796
<v SPEAKER_4>All of the developed world built its electricity grid
broadly the same time.

00:25:23.996 --> 00:25:31.456

<v SPEAKER_4>In recent decades, these same countries have been focusing on the deployment of renewables at the expense of maintaining legacy infrastructure.

00:25:31.456 --> 00:25:41.536
<v SPEAKER_4>We've had various geopolitical challenges and the pandemic and things like that which have disrupted what might have otherwise happened from an investment perspective.

00:25:42.136 --> 00:25:45.836
<v SPEAKER_4>And so legacy infrastructure has really suffered.

00:25:45.836 --> 00:25:48.636
<v SPEAKER_4>We saw that at Heathrow, the transformers at North Hyde.

00:25:48.636 --> 00:25:52.116
<v SPEAKER_4>There were basically three transformers there in a row.

00:25:52.116 --> 00:25:54.336
<v SPEAKER_4>There was one, a gap and then two.

00:25:54.336 --> 00:25:56.536
<v SPEAKER_4>The middle one blew up.

00:25:56.536 --> 00:26:03.676
<v SPEAKER_4>And then because there was no blast wall between that one and the adjacent one, then the adjacent one suffered heat damage.

00:26:03.676 --> 00:26:09.036
<v SPEAKER_4>The one that was a little bit further away was fine, but they had to turn it off because the site was on fire.

00:26:11.656 --> 00:26:23.896
<v SPEAKER_4>Those transformers were actually installed in the 1960s and predated the standards which came in to suggest that blast walls would be desirable, although that's not an actual requirement in the UK.

00:26:23.896 --> 00:26:25.496
<v SPEAKER_4>It's more of a guideline.

00:26:27.576 --> 00:26:32.676
<v SPEAKER_4>And that substation had also been operating at 106% of capacity in recent years.

00:26:32.676 --> 00:26:35.196
<v SPEAKER_4>So it was just an accident waiting to happen.

00:26:36.096 --> 00:26:43.996
<v SPEAKER_4>Now, it's interesting that 60,000 people lost electricity

to their homes and businesses and most natively Heathrow.

00:26:43.996 --> 00:26:58.616
<v SPEAKER_4>Heathrow made a whole thing about this being
unprecedented, which I take issue with because in 2017 there was a
very similar incident at Atlanta Airport and as a result of that the
US airports greatly increased their resilience to these things.

00:26:58.616 --> 00:27:04.796
<v SPEAKER_4>A lot of them put in backup generation and generation
that would power the entire facility.

00:27:04.796 --> 00:27:08.796
<v SPEAKER_4>JFK, for example, has a 110-megawatt gas CHP on-site.

00:27:10.616 --> 00:27:15.176
<v SPEAKER_4>Other airports decided to put in auto-switching between
different grid supply points.

00:27:15.376 --> 00:27:22.196
<v SPEAKER_4>Heathrow, it took them a day basically to switch from
North Hyde to its other grid supply points.

00:27:22.196 --> 00:27:35.576
<v SPEAKER_4>Airports in the US following Atlanta put in place
automatic switching capabilities that would switch over in minutes and
they just have batteries to tide them during that switchover process.

00:27:35.576 --> 00:27:42.336
<v SPEAKER_4>I think this indicates there's more than one failure here
when it comes to maintaining your infrastructure.

00:27:42.336 --> 00:27:53.836
<v SPEAKER_4>Clearly, Heathrow took its eye off the ball completely
and didn't look beyond its own immediate proximity when it was
thinking about resilience, failed to learn the lessons of Atlanta
2017.

00:27:53.836 --> 00:27:59.336
<v SPEAKER_4>But the North Hyde substation fire shows the
vulnerability of our infrastructure.

00:27:59.936 --> 00:28:07.096
<v SPEAKER_4>In the UK, or in Great Britain, I should say, a third of
our transformers were built in the 1970s.

00:28:07.096 --> 00:28:13.356
<v SPEAKER_4>Thirty percent of our switchgear was installed in the
1970s, and half of our cables come from the 1970s.

00:28:13.356 --> 00:28:19.956
<v SPEAKER_4>There was a huge investment programme in the 70s, and of course, these investments are nearing end of life.

00:28:19.956 --> 00:28:21.476
<v SPEAKER_4>Some of them obviously can go on for longer.

00:28:21.476 --> 00:28:24.436
<v SPEAKER_4>The cables, I don't think, are particularly at risk at the moment.

00:28:24.436 --> 00:28:25.736
<v SPEAKER_4>But the transformers definitely are.

00:28:27.896 --> 00:28:32.556
<v SPEAKER_4>But there's not been the money allocated to the replacement cycle.

00:28:32.556 --> 00:28:34.976
<v SPEAKER_4>So I think this is a growing challenge.

00:28:34.976 --> 00:28:44.136
<v SPEAKER_4>And then we also have a huge generation cliff coming up, because a third of our CCGT fleets was built in the 1990s.

00:28:44.136 --> 00:28:51.556
<v SPEAKER_4>And although they had major upgrades, a lot of them, that would take them to a 30-year life, by 2030, that's pretty much done.

00:28:52.136 --> 00:28:57.776
<v SPEAKER_4>So we've got a third of our CCGT fleet potentially retiring in the next five years.

00:28:57.776 --> 00:29:01.696
<v SPEAKER_4>Another third was built in the 2000s.

00:29:01.696 --> 00:29:05.376
<v SPEAKER_4>So about two-thirds of our CCGTs were built before 2010.

00:29:06.816 --> 00:29:09.056
<v SPEAKER_4>And this is a huge capacity challenge.

00:29:09.056 --> 00:29:12.836
<v SPEAKER_4>We're about to lose all but one of our nuclear reactors.

00:29:12.836 --> 00:29:19.356
<v SPEAKER_4>We think we'll get some more life extensions, but not beyond 2032, I think, at the outside, for the two newer ones.

00:29:21.616 --> 00:29:23.236

<v SPEAKER_4>This is not looking good.

00:29:23.236 --> 00:29:25.556
<v SPEAKER_4>And I think that people are taking their eye off the ball.

00:29:25.556 --> 00:29:36.516
<v SPEAKER_4>They're so focused on adding more and more wind capacity and really neglecting the backbone of our power grid, which is really what keeps the lights on.

00:29:36.516 --> 00:29:46.136
<v SPEAKER_1>Yeah, and this is a security issue, because if you talk about Heathrow Airport, that's the kind of central hub of transportation into and out of the UK.

00:29:46.136 --> 00:29:49.376
<v SPEAKER_1>Well, I mean, it's the largest airport in the UK, as far as I know.

00:29:49.376 --> 00:29:54.896
<v SPEAKER_1>And then if it's just one little point of failure is able to take that out.

00:29:54.896 --> 00:30:03.516
<v SPEAKER_1>I mean, there's tons of critical infrastructure in the UK that might also have similar vulnerabilities and that could be exploited by adversaries.

00:30:03.516 --> 00:30:11.676
<v SPEAKER_1>I'd say that's something to consider, especially as we see the Russians, they're targeting this sort of grid infrastructure in Ukraine.

00:30:12.436 --> 00:30:15.796
<v SPEAKER_1>This is something that's a strategic comparative to talk about.

00:30:17.136 --> 00:30:18.036
<v SPEAKER_4>I mean, you're right.

00:30:19.036 --> 00:30:21.096
<v SPEAKER_4>The resilience question cuts in two ways.

00:30:21.096 --> 00:30:24.476
<v SPEAKER_4>There's the, well, stuff breaks when it gets old concern.

00:30:24.476 --> 00:30:32.456
<v SPEAKER_4>And then there's the, if you have a vulnerable grid or any vulnerable infrastructure, then obviously bad actors can target

that.

00:30:32.456 --> 00:30:37.336
<v SPEAKER_4>And obviously we don't want to be giving people ideas for discussing these vulnerabilities in too much detail.

00:30:37.336 --> 00:30:39.796
<v SPEAKER_1>I'm hoping that Putin doesn't listen to the podcast.

00:30:41.016 --> 00:30:43.156
<v SPEAKER_4>Well, I'm not going to say anything that will benefit him anyway.

00:30:44.576 --> 00:30:49.736
<v SPEAKER_4>But yes, I mean, all of these things are things that have to be considered when you're thinking about resilience.

00:30:49.736 --> 00:30:56.876
<v SPEAKER_4>You've got those dual aspects, old things break, and that's nothing to do with any sort of nefarious intent.

00:30:56.876 --> 00:30:58.216
<v SPEAKER_4>That's just old stuff breaks.

00:30:58.396 --> 00:31:00.316
<v SPEAKER_4>That's just a fact of life.

00:31:00.596 --> 00:31:05.516
<v SPEAKER_4>And then you might have people with nefarious intent coming along and exploiting weaknesses.

00:31:05.516 --> 00:31:13.836
<v SPEAKER_4>So if you want to have a truly resilient infrastructure, you need to look at both of those risks and make sure that you've hardened your infrastructure against them.

00:31:15.356 --> 00:31:23.156
<v SPEAKER_2>Kathryn, could I just drill down on a specific basis with the blackout at Heathrow?

00:31:24.656 --> 00:31:28.976
<v SPEAKER_2>So the total power was lost to the airport, right?

00:31:28.976 --> 00:31:29.976
<v SPEAKER_4>Yes.

00:31:29.976 --> 00:31:31.556
<v SPEAKER_2>So it would be black, like everything would go...

00:31:31.556 --> 00:31:34.036

<v SPEAKER_2>Was it in the daytime or was it in the evening?

00:31:34.036 --> 00:31:35.496
<v SPEAKER_4>Well, it happened late in the evening.

00:31:36.036 --> 00:31:42.656
<v SPEAKER_2>So it would be about as quiet as Heathrow would get, but that isn't very quiet, even at any time of the day.

00:31:42.656 --> 00:31:47.776
<v SPEAKER_4>No, I mean, they do have some landing restrictions at night because it's a very built up area.

00:31:47.776 --> 00:31:48.396
<v SPEAKER_2>Right.

00:31:48.516 --> 00:31:49.176
<v SPEAKER_4>It wasn't...

00:31:49.176 --> 00:32:01.956
<v SPEAKER_4>So to say a full total blackout wouldn't be entirely accurate because they have, like most airports, diesel generators that power the critical safety systems around the runway, the ILS and the control tower.

00:32:02.116 --> 00:32:13.896
<v SPEAKER_4>And there's been no information that they didn't work the way they were supposed to, you know, be complained about unsafe landings or failure to properly handle flight, incoming flights and divert them elsewhere.

00:32:13.896 --> 00:32:18.096
<v SPEAKER_4>And that's what those diesel generators are there for.

00:32:18.096 --> 00:32:24.956
<v SPEAKER_4>If you've got flights on final approach and it's not feasible for them to do a go around, you need to get them on the ground safely.

00:32:24.956 --> 00:32:33.076
<v SPEAKER_4>You need to be able to transfer your incoming flights back to the National Control Center away from the Heathrow Tower.

00:32:33.236 --> 00:32:38.596
<v SPEAKER_4>And that takes some time to do it, given the rate at which airplanes land at Heathrow.

00:32:38.716 --> 00:32:41.156
<v SPEAKER_4>And so they have these backup generators.

00:32:41.156 --> 00:32:50.276
<v SPEAKER_4>I think the FAA in the US has a four-hour requirement that the critical safety systems have to be able to run for four hours.

00:32:50.276 --> 00:32:58.116
<v SPEAKER_4>And the Civil Aviation Authority in Britain doesn't have, to my knowledge, a fixed time frame that it associates with that.

00:32:58.116 --> 00:33:11.656
<v SPEAKER_4>But nevertheless, the expectation is that you don't have an incoming aircraft suddenly left with no instrument landing system, no voices in the ears from the control tower, and no landing lights.

00:33:11.656 --> 00:33:15.176
<v SPEAKER_4>That would be a catastrophic scenario, and we didn't have that.

00:33:15.176 --> 00:33:19.616
<v SPEAKER_4>So Heathrow had its critical safety diesel generators providing backup.

00:33:19.616 --> 00:33:22.176
<v SPEAKER_4>But otherwise, the airport went dark.

00:33:22.176 --> 00:33:34.656
<v SPEAKER_4>They do have a small, about 10 megawatts biomass CHP that provides HVAC to terminals two and five, but that relies on grid power to operate, so that also went down.

00:33:35.456 --> 00:33:44.116
<v SPEAKER_4>So then Heathrow just had to reconfigure its systems to be able to pick up its power from another grid supply point that wasn't affected by the transformer fire.

00:33:45.756 --> 00:33:46.516
<v SPEAKER_2>That's great.

00:33:46.516 --> 00:33:47.736
<v SPEAKER_2>Thank you.

00:33:49.736 --> 00:33:50.676
<v SPEAKER_2>Carry on, Joe.

00:33:50.676 --> 00:33:52.396
<v SPEAKER_1>Yeah.

00:33:52.396 --> 00:34:03.616
<v SPEAKER_1>Moving to another major issue, and I think this is something that interests me because we've been doing a few things with

the Norwegians here in Canada with the Norwegian Embassy.

00:34:03.616 --> 00:34:08.076
<v SPEAKER_1>On other issues, we had an event on Arctic Security not too long ago.

00:34:08.076 --> 00:34:21.076
<v SPEAKER_1>But I'd like to touch base on Norway's growing skepticism about power interconnectors with both mainland Europe, continental Europe, as well as with the UK.

00:34:21.076 --> 00:34:30.856
<v SPEAKER_1>I think we've talked about this before on the podcast, but with growing grid challenges in Europe, as we've been discussing here, it might take on some renewed relevance.

00:34:30.856 --> 00:34:39.916
<v SPEAKER_1>So do you have any updates on the position of the Norwegians on their grid entreties with the UK and continental Europe, Kathryn?

00:34:39.916 --> 00:34:48.656
<v SPEAKER_4>So I have sort of a concrete update, but there are definitely things tracking in what we in Britain would consider the wrong direction.

00:34:48.656 --> 00:35:06.816
<v SPEAKER_4>So various analysts have put out forecasts now for Norwegian hydro levels going through the summer and suggesting that based on snowpack, expected rainfall and just generally the demand expectations, they think that reservoir levels might drop to 25-year lows this summer.

00:35:06.816 --> 00:35:16.976
<v SPEAKER_4>Now that would almost certainly trigger the Norwegians to activate the new powers they've given themselves under the Energy Act to start curtailing electricity exports.

00:35:16.976 --> 00:35:20.216
<v SPEAKER_4>So that's something we need to keep an eye on.

00:35:20.216 --> 00:35:25.536
<v SPEAKER_4>Now we have the situation with the Skagerrak interconnectors between Denmark and Norway.

00:35:25.536 --> 00:35:31.916
<v SPEAKER_4>Two of those cables are nearing the end of their lives, and it's now pretty widely accepted that they will not be renewed.

00:35:31.916 --> 00:35:39.196

<v SPEAKER_4>So the idea of Norway cutting its cross-border capacity with Denmark by up to a third is actually very significant.

00:35:39.196 --> 00:35:42.856
<v SPEAKER_4>And then we also have the parliamentary elections in September.

00:35:42.896 --> 00:35:45.036
<v SPEAKER_4>There's a big election to the storting.

00:35:47.076 --> 00:35:53.796
<v SPEAKER_4>Now in the polls that I looked a couple of weeks ago, the governing Labour Party is now in the lead.

00:35:53.796 --> 00:35:57.376
<v SPEAKER_4>They're a little bit less hawkish on interconnectors than some of the other parties.

00:35:57.376 --> 00:36:06.856
<v SPEAKER_4>The Progress Party and the Centre Party, which are in second and third place in the polls, are both so against interconnectors, they want to renegotiate the deals with Britain and Germany.

00:36:06.856 --> 00:36:16.916
<v SPEAKER_4>And even the Labour Party has said it won't do any new deals, and it's got also increasingly hostile to the idea, because it's a hot button issue for the public.

00:36:16.916 --> 00:36:26.356
<v SPEAKER_4>If you were to go into Oslo and stop a random person in the street and ask them about electricity interconnectors, they would give you an earful about how bad they are for Norway.

00:36:26.356 --> 00:36:33.736
<v SPEAKER_4>If you were to go to London and stop a person in the street and ask them about electricity interconnectors, they would say, what are you talking about?

00:36:33.936 --> 00:36:35.036
<v SPEAKER_4>Leave me alone, you weirdo.

00:36:35.036 --> 00:36:36.596
<v SPEAKER_4>I'm going to go to the police.

00:36:37.676 --> 00:36:40.676
<v SPEAKER_1>I'm assuming you're speaking about this from experience than Kathryn.

00:36:41.636 --> 00:36:43.496

<v SPEAKER_4>Well, I haven't actually tried it.

00:36:43.496 --> 00:36:52.016
<v SPEAKER_4>But in London, it's really famous that if you were, if you're approached by a stranger, they're probably an ax murderer and you'd want them to leave you alone.

00:36:53.436 --> 00:37:00.076
<v SPEAKER_4>So yeah, I mean, it doesn't have the same public awareness here as it does in Norway.

00:37:00.076 --> 00:37:07.296
<v SPEAKER_4>It is something that ordinary people have educated themselves about because of the impacts it's had on their power prices.

00:37:07.296 --> 00:37:15.396
<v SPEAKER_4>And so because they've effectively seen high volatility imported into Norway as a result of these interconnectors.

00:37:15.936 --> 00:37:26.196
<v SPEAKER_4>And their view is, we spent all our tax money in previous decades building all this hydropower, so we'd have cheap, stable, low volatility electricity prices.

00:37:26.196 --> 00:37:38.336
<v SPEAKER_4>And while we understand having some volatility when we have a dry year, and originally the cables were built to provide insurance against that, so that in a dry year, they would have some extra capacity.

00:37:38.336 --> 00:37:43.956
<v SPEAKER_4>Nobody really thought it through because the way that the pricing works is based on short-term price differentials.

00:37:43.956 --> 00:37:45.996
<v SPEAKER_4>That's what drives the flows.

00:37:45.996 --> 00:37:58.416
<v SPEAKER_4>And the pricing in Norway, you have low pricing because you look at the marginal cost of hydro, it's very low, and it stays low until you get into scarcity territory, and then it goes very high.

00:37:58.416 --> 00:37:59.696
<v SPEAKER_4>But there's no transition.

00:37:59.836 --> 00:38:01.436
<v SPEAKER_4>It's almost like a binary step change.

00:38:01.436 --> 00:38:04.276

<v SPEAKER_4>You're either not in scarcity or you are.

00:38:04.276 --> 00:38:11.536
<v SPEAKER_4>And so this means that you get driven into scarcity because they don't have any pumping capability to speak of in Norway.

00:38:11.536 --> 00:38:14.756
<v SPEAKER_4>So once the water is gone, it's gone.

00:38:14.756 --> 00:38:18.396
<v SPEAKER_4>You don't get it back until it rains or you get the next season of snowmelt.

00:38:18.396 --> 00:38:25.156
<v SPEAKER_4>And so you can, interconnectors can drive you into a scarcity situation that you wouldn't otherwise have had.

00:38:25.156 --> 00:38:34.016
<v SPEAKER_4>And so I think ultimately they're probably going to have to put some sort of a tariff onto the exports that recognizes this time value.

00:38:34.016 --> 00:38:41.216
<v SPEAKER_4>So they're not just looking at the short-term marginal cost to calculate the price that determines your exports or not.

00:38:41.216 --> 00:38:51.476
<v SPEAKER_4>But also they're going to have to add some sort of additional elements that takes account of the fact that uniquely in Norway, their electricity capability can run out.

00:38:51.476 --> 00:38:54.716
<v SPEAKER_4>It's time valued in a way that it's not in other countries.

00:38:54.716 --> 00:39:03.696
<v SPEAKER_1>Yeah, that's super interesting because hydro, of course, it's a renewable resource if you look at it through multiple yearly cycles, so it refills.

00:39:03.696 --> 00:39:08.216
<v SPEAKER_1>But on this timeline that we're talking about, it's very much a non-renewable resource.

00:39:08.216 --> 00:39:18.476
<v SPEAKER_1>So you can run out of hydropower if you're getting it all sucked away by other countries that are willing to bid up the price of power because their own electricity systems are under built.

00:39:18.476 --> 00:39:20.336

<v SPEAKER_1>So yeah, that's a good thing.

00:39:20.336 --> 00:39:29.496
<v SPEAKER_4>And if you don't have the pumping to restore it, so you could hypothetically say, oh, well, and you could import electricity, say at night and use that to pump to restore your water levels.

00:39:29.496 --> 00:39:31.576
<v SPEAKER_4>Well, not if you don't have pumps.

00:39:31.576 --> 00:39:34.956
<v SPEAKER_4>Yeah, are they building reservoirs with pumps in Norway?

00:39:34.956 --> 00:39:37.116
<v SPEAKER_1>Yeah, are they looking into building pumps?

00:39:37.116 --> 00:39:39.696
<v SPEAKER_1>Because that seems to be could be a good investment.

00:39:39.916 --> 00:39:42.136
<v SPEAKER_4>Well, it could be, but why should they have to pay for it?

00:39:42.136 --> 00:39:44.976
<v SPEAKER_2>Sure, why would you do that?

00:39:45.016 --> 00:39:46.836
<v SPEAKER_1>I suppose maybe the Germans should pay for that.

00:39:46.836 --> 00:39:48.936
<v SPEAKER_4>Britain and Germany and Denmark should be paying for this.

00:39:48.976 --> 00:39:50.296
<v SPEAKER_4>If they really want a way to continue.

00:39:50.296 --> 00:39:51.616
<v SPEAKER_2>Yeah, they want to build their own.

00:39:51.616 --> 00:39:52.776
<v SPEAKER_2>Yeah, exactly.

00:39:52.776 --> 00:39:55.376
<v SPEAKER_2>Yeah, if you want to, yeah, that's exactly right.

00:39:55.376 --> 00:39:58.696
<v SPEAKER_2>The market, that's why it's on the margin.

00:39:58.696 --> 00:40:00.616
<v SPEAKER_2>That's the difference, differentiator.

00:40:01.796 --> 00:40:07.716
<v SPEAKER_2>You know, have been pumped hydro in, topographically, geographically.

00:40:07.716 --> 00:40:12.216
<v SPEAKER_2>I don't know that Norway is suited to, you know, to reconstruct.

00:40:12.216 --> 00:40:14.996
<v SPEAKER_2>It's run of river mostly, is it not, Kathryn?

00:40:15.076 --> 00:40:20.436
<v SPEAKER_2>And their hydro is, is not, there's not pumped storage hydro in Norway.

00:40:20.436 --> 00:40:22.356
<v SPEAKER_4>There's hardly any pumping.

00:40:22.356 --> 00:40:26.596
<v SPEAKER_4>They've got 33 gigawatts of hydro, and I think 1.8 of that has pumps.

00:40:26.596 --> 00:40:33.176
<v SPEAKER_4>And of the 1.8, a decent chunk, I don't know, maybe 20 percent, something like that.

00:40:33.376 --> 00:40:39.396
<v SPEAKER_4>The pumps require some sort of manual coupling processes, so they're only used on a seasonal basis.

00:40:39.396 --> 00:40:41.576
<v SPEAKER_4>It's not something you could be turning on and off every day.

00:40:43.616 --> 00:40:46.196
<v SPEAKER_4>So, they just really just don't have the capability.

00:40:46.196 --> 00:40:51.716
<v SPEAKER_4>They do have big reservoirs, so technically, you might be able to put in place some sort of pumping capability.

00:40:51.716 --> 00:40:56.376
<v SPEAKER_4>Obviously, you need two reservoirs per hydro plant rather than just one.

00:40:56.376 --> 00:40:58.976
<v SPEAKER_4>There might be some places where that would work.

00:40:58.976 --> 00:41:02.816

<v SPEAKER_4>I don't know just how interlinked their reservoir system is.

00:41:02.816 --> 00:41:09.216
<v SPEAKER_4>But yeah, I mean, it's, as you say, yes, maybe they could do that, but why should they?

00:41:09.356 --> 00:41:10.896
<v SPEAKER_4>Why should they be having to pay for it?

00:41:12.256 --> 00:41:17.036
<v SPEAKER_4>Well, the fun fact is that the biggest hydroelectric plant in Europe is actually in Wales.

00:41:19.096 --> 00:41:25.296
<v SPEAKER_4>Yes, they have six vertical 300-megawatt turbines is actually extremely cool.

00:41:25.296 --> 00:41:26.796
<v SPEAKER_4>They used to have it open to the public.

00:41:26.796 --> 00:41:29.196
<v SPEAKER_4>Unfortunately, it's not anymore.

00:41:29.196 --> 00:41:33.576
<v SPEAKER_4>But yeah, it was extremely cool going to visit that and seeing the turbines.

00:41:33.576 --> 00:41:36.616
<v SPEAKER_4>And yeah, they can go from zero to full load in 16 seconds.

00:41:37.296 --> 00:41:37.516
<v SPEAKER_1>Wow.

00:41:37.776 --> 00:41:41.796
<v SPEAKER_1>I got to say that Wales was not my guess at all.

00:41:41.796 --> 00:41:50.016
<v SPEAKER_1>I've never been to Wales, so maybe it's very mountainous, but I've always thought it's about how much verticality you have on that.

00:41:52.436 --> 00:41:56.896
<v SPEAKER_4>It's not the most mountainous place in the world compared with the Rockies, for example.

00:41:56.956 --> 00:42:04.036
<v SPEAKER_4>But yeah, it's called Norway, it's just next to Snowdon in Clamberus.

00:42:04.036 --> 00:42:09.696
<v SPEAKER_4>So that's probably the most mountainous bit of Wales and the second most mountainous bit in Britain.

00:42:11.176 --> 00:42:16.996
<v SPEAKER_4>I mean, they've managed to build this big hydro there, and as I said, it's the biggest one in Europe.

00:42:17.276 --> 00:42:19.876
<v SPEAKER_1>Fascinating.

00:42:19.876 --> 00:42:21.456
<v SPEAKER_4>No good for skiing, by the way.

00:42:21.496 --> 00:42:25.496
<v SPEAKER_4>You can't go there and ski, not like in Alberta.

00:42:25.936 --> 00:42:27.656
<v SPEAKER_2>There's a lot of climbing there.

00:42:27.656 --> 00:42:34.016
<v SPEAKER_2>The originators of all of the early Everest expeditions all originated in Wales.

00:42:34.016 --> 00:42:37.136
<v SPEAKER_2>Those were those, I can't think of their names right now, but I really got it.

00:42:37.136 --> 00:42:38.476
<v SPEAKER_1>I really have to visit Wales then.

00:42:38.996 --> 00:42:40.696
<v SPEAKER_1>You add that to my list, Kathryn.

00:42:40.696 --> 00:42:41.376
<v SPEAKER_2>It's rugged, Joe.

00:42:41.376 --> 00:42:50.556
<v SPEAKER_4>It's actually an extraordinary country because the difference between the north and south of Wales in terms of geological properties is quite remarkable.

00:42:50.636 --> 00:42:57.276
<v SPEAKER_4>You go to Snowdonia in the north, and it's almost like you could imagine druids striding across the landscape.

00:42:57.276 --> 00:42:59.016
<v SPEAKER_4>It's quite bleak.

00:42:59.016 --> 00:43:04.916
<v SPEAKER_4>Then in the south of Wales, it's much more rolling and beautiful, and beautiful in a different way.

00:43:04.916 --> 00:43:08.076
<v SPEAKER_4>When my children were small, we used to go to Wales every year.

00:43:09.136 --> 00:43:10.236
<v SPEAKER_4>It's a fantastic place.

00:43:10.236 --> 00:43:14.736
<v SPEAKER_4>If you're into outdoor activities, it's hard to beat as long as you don't mind the rain.

00:43:14.736 --> 00:43:16.876
<v SPEAKER_1>Well, maybe we should turn this into a travel podcast.

00:43:19.616 --> 00:43:22.436
<v SPEAKER_4>This video is sponsored by the Wales Government.

00:43:24.996 --> 00:43:30.316
<v SPEAKER_2>Well, half of my heritage is Welsh, so I would welcome that.

00:43:30.316 --> 00:43:34.896
<v SPEAKER_2>Let's wrap things up by talking about nuclear expansion in Europe, Kathryn.

00:43:34.896 --> 00:43:36.576
<v SPEAKER_2>There have been a few headwinds.

00:43:36.576 --> 00:43:48.976
<v SPEAKER_2>Like last week, Bloomberg reported that the European Commission anticipates that the EU's ambition to scale up power to 2050 may cost up to $280 billion.

00:43:48.976 --> 00:43:59.376
<v SPEAKER_2>Another story from Bloomberg reported that EDF had found, and I quote, stress corrosion, unquote, at a reactor, which had been fixed just a few years ago.

00:43:59.376 --> 00:44:05.756
<v SPEAKER_2>However, countries in Europe are also increasingly turning to nuclear as the limitations of wind power become apparent.

00:44:05.756 --> 00:44:11.716
<v SPEAKER_2>Can you help parse through these conflicting signals about the future of nuclear power in Europe for us, Kathryn?

00:44:11.896 --> 00:44:14.776
<v SPEAKER_4>Okay, so let me deal with the stress corrosion issue first.

00:44:14.776 --> 00:44:19.396
<v SPEAKER_4>So this is something that has been coming up in older French reactors.

00:44:19.396 --> 00:44:33.516
<v SPEAKER_4>And it's really a symptom of the way they built out their nuclear program, which I'm so I don't criticize the way they built it out, but I do criticize what they did next.

00:44:33.516 --> 00:44:38.116
<v SPEAKER_4>So they wanted to benefit from next of a kind synergies.

00:44:39.156 --> 00:44:47.276
<v SPEAKER_4>And so they have maybe sort of five or six different reactor types, and they built a whole bunch of reactors of each reactor type.

00:44:47.276 --> 00:44:51.796
<v SPEAKER_4>Now the problem with that is, so on the one hand, you get learning benefits when you're constructing them.

00:44:51.796 --> 00:45:02.516
<v SPEAKER_4>And so you get, and what they found was they build the first one, the next few would get cheaper, and then they start getting more expensive again, because they'd sort of run out of sites that were suitable for that design.

00:45:03.876 --> 00:45:05.556
<v SPEAKER_4>And then they'd move to another design.

00:45:07.676 --> 00:45:15.116
<v SPEAKER_4>So that was great from a construction perspective, but from an ongoing maintenance perspective, what it means is that they all age at the same time.

00:45:15.116 --> 00:45:21.316
<v SPEAKER_4>And if you have age-related vulnerabilities, then they're all likely to manifest those at similar points in time.

00:45:21.316 --> 00:45:25.256
<v SPEAKER_4>And so the stress corrosion issue affected the N4 and P4 reactors.

00:45:25.476 --> 00:45:31.996
<v SPEAKER_4>And of course, the regulator forced them to take them all off line for testing and remedial works.

00:45:31.996 --> 00:45:35.796
<v SPEAKER_4>And the French regulator had said, These will not be unique problems.

00:45:35.796 --> 00:45:40.076
<v SPEAKER_4>We will have more similar problems as through the fleet as it ages.

00:45:40.076 --> 00:45:47.896
<v SPEAKER_4>And the market should expect to see whole classes of reactors taken out of service, so that these age-related issues can be addressed.

00:45:47.896 --> 00:45:55.016
<v SPEAKER_4>I mean, it didn't specify obviously what those age-related issues might be, because it could vary across the different technology types.

00:45:55.016 --> 00:45:59.456
<v SPEAKER_4>But nevertheless, the regulator is pretty clear that that is something that people should expect.

00:45:59.456 --> 00:46:01.656
<v SPEAKER_4>And also that's just common sense, right?

00:46:02.016 --> 00:46:06.336
<v SPEAKER_4>As I said before, old equipment breaks, and these reactors are getting old.

00:46:06.336 --> 00:46:13.936
<v SPEAKER_4>They're not particularly safety concerns, because these things are picked up in the annual inspection programs, and they're addressed ahead of time.

00:46:13.936 --> 00:46:16.816
<v SPEAKER_4>So there's no real concern from a safety perspective.

00:46:16.816 --> 00:46:19.036
<v SPEAKER_4>It's just one of those things you have to keep on top of.

00:46:19.036 --> 00:46:24.396
<v SPEAKER_4>And where the French dropped the ball was that they built up the nuclear fleet, and then they stopped.

00:46:24.396 --> 00:46:35.976
<v SPEAKER_4>So instead of constantly having new reactors coming online and new generations coming into the market, so that as the old ones started encountering the age-related issues, you'd have new ones stepping in.

00:46:35.976 --> 00:46:36.916
<v SPEAKER_4>They didn't do that.

00:46:36.916 --> 00:46:40.516
<v SPEAKER_4>They had a huge 20-year hiatus before trying to build
anything.

00:46:40.516 --> 00:46:45.356
<v SPEAKER_4>They finally managed to get Flammeville Sea over the
line, but now it keeps breaking.

00:46:46.516 --> 00:46:48.316
<v SPEAKER_4>This has not been a success story.

00:46:48.316 --> 00:46:58.456
<v SPEAKER_4>Now in the recent days, France has just announced, or re-
announced, if you like, its program for EPR second generation, and
that's now going to be its focus going forward.

00:46:58.996 --> 00:47:07.556
<v SPEAKER_4>So I think that the French are definitely fully committed
to nuclear going forward, recommitted, I would say.

00:47:07.556 --> 00:47:14.036
<v SPEAKER_4>And more broadly across Europe, we're seeing similar
signs of nuclear relaysons.

00:47:14.036 --> 00:47:21.516
<v SPEAKER_4>I mean, even in Germany, they're now looking at maybe
restarting the reactors they closed, which nobody really saw coming.

00:47:21.516 --> 00:47:30.116
<v SPEAKER_4>But with the advent of hyperscalers and the higher power
requirements for AI data centers, this is going to be necessary.

00:47:30.116 --> 00:47:33.676
<v SPEAKER_4>This is a source of demand really that people didn't see
coming.

00:47:33.676 --> 00:47:35.216
<v SPEAKER_4>And it is a game changer.

00:47:35.416 --> 00:47:37.536
<v SPEAKER_4>It's proving to be a game changer around the world.

00:47:37.536 --> 00:47:43.376
<v SPEAKER_4>If Europe wants to compete within that AI revolution,
it's going to have to find a way to power it.

00:47:43.376 --> 00:47:47.996
<v SPEAKER_4>And these data centers are not going to operate on wind.

00:47:47.996 --> 00:47:57.616
<v SPEAKER_4>And if you look at places like Texas, where they are co-locating with wind, they're only doing that because they can put in gas generation alongside, to provide them with that resilience.

00:47:57.616 --> 00:48:00.236
<v SPEAKER_4>And there are plenty of places in Europe where they won't be able to do that.

00:48:00.236 --> 00:48:02.656
<v SPEAKER_4>I think Irkut is a little bit unique in that regard.

00:48:02.656 --> 00:48:05.156
<v SPEAKER_2>Yeah, Texas is unique.

00:48:05.156 --> 00:48:09.136
<v SPEAKER_4>Yeah, they have their own special way of doing things, which is very interesting to watch.

00:48:09.136 --> 00:48:12.156
<v SPEAKER_1>With some benefits, but some costs as well with the Irkut way.

00:48:12.156 --> 00:48:19.456
<v SPEAKER_4>Yeah, but actually, if you look at the topography of the market, it's quite similar to Britain, where you have a large amount of wind generation in one part.

00:48:19.456 --> 00:48:25.436
<v SPEAKER_4>In Texas, it's in the west of the state in Britain, it's in Scotland, and then you have demand located elsewhere.

00:48:25.436 --> 00:48:30.596
<v SPEAKER_4>In Texas, it's on the Gulf Coast, and here in the UK, it's in the southeast of England.

00:48:30.596 --> 00:48:34.236
<v SPEAKER_4>These things, there are big grid constraints between the two.

00:48:34.236 --> 00:48:42.436
<v SPEAKER_4>Now, Texas has full nodal pricing on its grid, so it's gone the whole way on locational marginal pricing.

00:48:42.436 --> 00:48:48.676
<v SPEAKER_4>But it still has these issues, and really, it's the proof that locational pricing doesn't really work.

00:48:48.676 --> 00:48:55.576
<v SPEAKER_4>It doesn't encourage co-location of demand and generation, because demand is motivated by other things.

00:48:55.576 --> 00:48:58.916
<v SPEAKER_4>The wind can't go on the Gulf Coast because it's not windy on the Gulf Coast.

00:48:58.916 --> 00:49:08.116
<v SPEAKER_4>You can't build wind farms in the Gulf because you either have no wind at all, or you have hurricanes, so that's totally unsuitable for wind generation.

00:49:08.116 --> 00:49:11.556
<v SPEAKER_4>The wind goes to the west of the state where they actually have wind.

00:49:12.856 --> 00:49:15.556
<v SPEAKER_4>But the demand wants to be on the Gulf Coast for obvious reasons.

00:49:15.676 --> 00:49:18.676
<v SPEAKER_4>It's access to the ports.

00:49:18.676 --> 00:49:20.116
<v SPEAKER_4>They want to get their raw materials in.

00:49:20.116 --> 00:49:21.816
<v SPEAKER_4>They want to get their products out.

00:49:21.816 --> 00:49:29.316
<v SPEAKER_4>You're not going to put an LNG liquefaction plant inland west Texas and then try and ship LNG by pipe to the coast.

00:49:29.316 --> 00:49:31.636
<v SPEAKER_4>That would be an insanely stupid thing to do.

00:49:31.636 --> 00:49:40.096
<v SPEAKER_4>You're going to put your liquefaction plants on the coast, so you can liquefy and load onto your tanker immediately to put that gas out for the export market.

00:49:40.916 --> 00:49:43.216
<v SPEAKER_4>We have similar in Britain.

00:49:43.656 --> 00:49:49.756
<v SPEAKER_4>Nobody is going to move their businesses to the north of Scotland because data centers, for example, they need telecom connectivity.

00:49:49.756 --> 00:49:52.696
<v SPEAKER_4>If you don't have that, you don't have a data center.

00:49:52.796 --> 00:49:59.536
<v SPEAKER_1>They're effectively exporting intelligence, so they need
to be close to the demand for that intelligence.

00:49:59.576 --> 00:50:00.596
<v SPEAKER_4>Well, it's not even that.

00:50:00.596 --> 00:50:06.816
<v SPEAKER_4>If you don't have good telecom connectivity, your
business doesn't exist within IT.

00:50:06.856 --> 00:50:11.056
<v SPEAKER_4>And also, they need staff, and they're not the very many
people that live in the north of Scotland.

00:50:11.056 --> 00:50:14.296
<v SPEAKER_4>So the other infrastructure does not exist.

00:50:14.296 --> 00:50:19.496
<v SPEAKER_4>And to put it there would require an entire
reorganization of the whole economy, which isn't going to happen.

00:50:19.496 --> 00:50:21.896
<v SPEAKER_4>And the Scottish are actually very against nuclear.

00:50:21.896 --> 00:50:24.676
<v SPEAKER_4>So this is really unrealistic.

00:50:24.676 --> 00:50:27.216
<v SPEAKER_4>Denmark is lifting its moratorium on nuclear.

00:50:27.216 --> 00:50:28.836
<v SPEAKER_4>That's very interesting.

00:50:28.836 --> 00:50:32.536
<v SPEAKER_4>Although the language that they've used is to say they're
now going to look at it.

00:50:32.536 --> 00:50:42.536
<v SPEAKER_4>Even that in itself is against the moratorium, because
the moratorium included looking at nuclear for planning purposes,
which clearly they are now doing.

00:50:42.536 --> 00:50:45.216
<v SPEAKER_4>Sweden wants to restart its nuclear program.

00:50:45.216 --> 00:50:48.316
<v SPEAKER_4>The Czech Republic have just signed up with the Koreans.

00:50:48.316 --> 00:50:54.636
<v SPEAKER_4>EDF tried to contest that, but just recently lost.

00:50:54.636 --> 00:50:58.316
<v SPEAKER_4>In Britain, we've just confirmed that we're going to go
ahead with size C.

00:50:58.316 --> 00:51:01.816
<v SPEAKER_4>They haven't quite taken FID yet, but that's expected in
the coming days.

00:51:03.756 --> 00:51:10.056
<v SPEAKER_4>Really, Spain is the only country holding out, and
they've had protests against the closure of their nuclear reactors.

00:51:10.056 --> 00:51:15.296
<v SPEAKER_4>Given the blackout as well, I think they're quite likely
to reconsider that in Spain as well.

00:51:15.296 --> 00:51:28.236
<v SPEAKER_4>I don't think the Spanish really want to be the only
people swimming against the tide, and particularly if Germany decide
to start restarting their reactors, then I struggle to see that Spain
will go ahead with their closures.

00:51:28.836 --> 00:51:38.996
<v SPEAKER_4>So now we're going to start moving to thinking about
who's going to supply these reactors, where's the fuel coming from,
these aren't trivial challenges to address.

00:51:38.996 --> 00:51:43.296
<v SPEAKER_4>We all need to sort out our regulatory processes.

00:51:43.296 --> 00:51:54.476
<v SPEAKER_4>And we've allowed across the West, we've allowed our
regulators to operate unchallenged for too long and become far too
risk averse in their operations.

00:51:54.476 --> 00:52:04.256
<v SPEAKER_4>Now, if you look at ALARP and ALARA, they have a
requirement fundamentally to reduce worker radiation exposure levels
for each new design relative to previous ones.

00:52:04.256 --> 00:52:05.616
<v SPEAKER_4>This is ludicrous.

00:52:05.616 --> 00:52:11.216

<v SPEAKER_4>Like nuclear worker radiation exposure levels are lower inside the plant than they are outside.

00:52:11.216 --> 00:52:18.476
<v SPEAKER_4>You get more radiation walking around in the sunshine than you do inside of these nuclear facilities.

00:52:18.476 --> 00:52:23.736
<v SPEAKER_4>So what practical purpose is solved by lowering these exposure levels within the plant?

00:52:23.736 --> 00:52:24.576
<v SPEAKER_4>Absolutely none.

00:52:24.916 --> 00:52:34.796
<v SPEAKER_4>It sounds good on paper and if you were to announce you were going to stop this requirement, you might have people questioning whether you were reducing safety standards, but actually you were not.

00:52:34.796 --> 00:52:36.596
<v SPEAKER_4>You would just be making them sensible.

00:52:36.596 --> 00:52:42.956
<v SPEAKER_4>If your government required you to wear 57 seat belts when you're driving your car, you'd think they lost their minds.

00:52:42.956 --> 00:52:46.356
<v SPEAKER_4>But that's really where our nuclear safety is these days.

00:52:46.356 --> 00:52:49.396
<v SPEAKER_4>The regulators are making people wear 57 seat belts.

00:52:49.396 --> 00:52:50.836
<v SPEAKER_4>It's expensive and pointless.

00:52:50.836 --> 00:52:51.916
<v SPEAKER_4>We need to go back to one.

00:52:53.416 --> 00:53:04.516
<v SPEAKER_4>Across the Western world, we need to get our regulators back in their boxes to look at actual safety and risk in a realistic way rather than a fully avoidance way.

00:53:04.516 --> 00:53:07.876
<v SPEAKER_4>I'm going to be very interested to see how the Darlington project progresses.

00:53:07.876 --> 00:53:12.736
<v SPEAKER_4>That's going to be the first Western small modular reactor that's being built in Canada by GE.

00:53:12.736 --> 00:53:13.616
<v SPEAKER_4>Hitachi.

00:53:13.616 --> 00:53:20.936
<v SPEAKER_4>It's boiling water reactor technology, which is simpler
than the pressurized water route that most other vendors are looking
at.

00:53:21.436 --> 00:53:23.116
<v SPEAKER_4>I think it's going to be very interesting to see.

00:53:23.116 --> 00:53:28.136
<v SPEAKER_4>I actually think it's a good idea to go down the BWR
road.

00:53:28.716 --> 00:53:30.976
<v SPEAKER_4>And yes, I will be watching that with interest.

00:53:30.976 --> 00:53:32.476
<v SPEAKER_1>Yeah, we're looking forward to that too.

00:53:32.476 --> 00:53:33.636
<v SPEAKER_1>Sorry, go ahead, Kelly.

00:53:33.636 --> 00:53:41.176
<v SPEAKER_2>No, I was just saying we should have a conversation with
Jackie Pornweg and Kathryn together as this evolves.

00:53:41.176 --> 00:53:53.036
<v SPEAKER_2>As you're right, Kathryn, it seems to me that it is the
small scale of technology that is the easiest to implement, safety,
longevity, et cetera.

00:53:53.036 --> 00:53:55.896
<v SPEAKER_4>So it's interesting.

00:53:55.896 --> 00:53:58.636
<v SPEAKER_4>I'm not saying that particularly.

00:53:58.636 --> 00:54:01.776
<v SPEAKER_4>We in the UK, for example, we need to build big reactors.

00:54:02.016 --> 00:54:04.136
<v SPEAKER_4>This is our big priority.

00:54:05.596 --> 00:54:17.656
<v SPEAKER_4>The government doesn't recognize this, but the reality is
we're losing capacity so fast off the grid, and we have these big
risks around the old nuclear reactors and the gas fleet that we need

to build big stuff.

00:54:17.756 --> 00:54:24.876
<v SPEAKER_4>Actually, the only thing that we know definitely works at scale and is repeatable is the KEPCO APR 1400.

00:54:24.876 --> 00:54:34.256
<v SPEAKER_4>They've now built eight units, four in South Korea, four in UAE, and they've just started a new program in South Korea with a new reactor currently being built.

00:54:34.256 --> 00:54:37.176
<v SPEAKER_4>I think they're expecting it to open in 2032.

00:54:37.176 --> 00:54:43.396
<v SPEAKER_4>They've been building these at five to six billion dollars each and in about eight and a half years on average.

00:54:43.916 --> 00:54:46.296
<v SPEAKER_4>So this is what we all should in fact be doing.

00:54:46.296 --> 00:54:51.136
<v SPEAKER_4>We should all be queuing up at KEPCO's door, begging them to come and build their reactors for us.

00:54:51.136 --> 00:54:51.856
<v SPEAKER_1>Yeah.

00:54:51.856 --> 00:55:01.656
<v SPEAKER_4>I think this is a good future for small reactors, but with the best will in the world, Gien has actually just literally started digging, and they are far ahead of the pack.

00:55:01.656 --> 00:55:10.916
<v SPEAKER_4>I think their boiling water approach makes sense from a technology perspective because it's simpler than the pressurized water reactors and probably easier to build.

00:55:11.436 --> 00:55:18.256
<v SPEAKER_4>People question how modular it is, and they question the size of the site that you need for these reactors.

00:55:18.256 --> 00:55:21.036
<v SPEAKER_4>But still, they're far ahead of anyone else.

00:55:21.036 --> 00:55:24.256
<v SPEAKER_4>Rolls Royce isn't anywhere near ready to start digging yet.

00:55:26.016 --> 00:55:28.376

<v SPEAKER_4>I think we're going to need both eventually.

00:55:28.376 --> 00:55:33.536
<v SPEAKER_4>I do think with the small reactors, though there are some safety questions that people haven't addressed yet.

00:55:33.536 --> 00:55:38.016
<v SPEAKER_4>There's a lot of talk of co-location of small reactors in industrial sites.

00:55:38.556 --> 00:55:41.096
<v SPEAKER_4>Industrial sites are inherently dangerous.

00:55:43.976 --> 00:55:49.616
<v SPEAKER_4>Right now, our nuclear facilities in Britain have the same level of security as our high-security prison.

00:55:49.616 --> 00:55:55.156
<v SPEAKER_4>We don't have armed police in the UK, but we do have an armed constabulary guarding our nuclear facilities.

00:55:55.156 --> 00:56:03.756
<v SPEAKER_4>If you then go from having half a dozen big nuclear sites to having dozens of small nuclear sites, how do you scale that security presence?

00:56:05.296 --> 00:56:11.616
<v SPEAKER_4>And so these questions, and if I wanted to drive a tanker of dangerous chemicals to Torness, I'd get stopped pretty quickly.

00:56:11.616 --> 00:56:17.556
<v SPEAKER_4>But if I had a chemical factory, then obviously my chemical tankers will be coming in and out all the time.

00:56:17.556 --> 00:56:23.596
<v SPEAKER_4>And then if you co-locate a nuclear reactor there, you have a set of risks that you need to think about.

00:56:23.596 --> 00:56:31.356
<v SPEAKER_4>It's hard to blow up a nuclear reactor, but that doesn't mean to say you're not going to have people trying if you have these stuff all over the place.

00:56:31.816 --> 00:56:36.756
<v SPEAKER_1>Yeah, I think we could get more and more deep into this.

00:56:36.756 --> 00:56:40.816
<v SPEAKER_1>But yeah, this has been a fascinating conversation, Kathryn.

00:56:40.816 --> 00:56:41.776
<v SPEAKER_1>Thank you so much.

00:56:41.776 --> 00:56:48.876
<v SPEAKER_1>And I'd like to just state that the South Koreans tend to just put us all to shame when it comes to their industrial prowess.

00:56:48.876 --> 00:56:51.556
<v SPEAKER_1>So I'm big fans of what they're doing.

00:56:51.556 --> 00:56:55.096
<v SPEAKER_1>But I think we'll need to wrap up here.

00:56:55.096 --> 00:56:57.416
<v SPEAKER_1>And like I said, really interesting stuff.

00:56:57.416 --> 00:56:59.336
<v SPEAKER_1>But one last question for you, Kathryn.

00:56:59.996 --> 00:57:02.516
<v SPEAKER_1>And this is something our listeners are always interested in.

00:57:02.516 --> 00:57:05.596
<v SPEAKER_1>What are you reading for pleasure these days?

00:57:05.596 --> 00:57:06.076
<v SPEAKER_4>Okay.

00:57:06.076 --> 00:57:10.596
<v SPEAKER_4>So I've been reading a lot more nonfiction recently because it's easier to dip in and out.

00:57:10.596 --> 00:57:12.156
<v SPEAKER_4>I've actually just finished this book.

00:57:12.156 --> 00:57:15.216
<v SPEAKER_4>It's called The Unaccountability Machine.

00:57:15.216 --> 00:57:22.236
<v SPEAKER_4>And it talks about the way that institutions have lost accountability over time.

00:57:22.236 --> 00:57:30.476
<v SPEAKER_4>And so we see this here in Britain where Gordon Brown, for example, made the civil service independent of politicians.

00:57:30.476 --> 00:57:33.916
<v SPEAKER_4>So politicians cannot fire senior civil servants anymore.

00:57:33.916 --> 00:57:36.036
<v SPEAKER_4>So where's the accountability?

00:57:36.036 --> 00:57:37.336
<v SPEAKER_4>You see it with big corporations.

00:57:37.336 --> 00:57:38.936
<v SPEAKER_4>You see it with regulators.

00:57:38.936 --> 00:57:42.556
<v SPEAKER_4>How are they being held accountable for their actions?

00:57:42.556 --> 00:57:49.576
<v SPEAKER_4>And would they act differently if those chains of
accountability were more robust?

00:57:51.076 --> 00:57:53.056
<v SPEAKER_4>And this book really says that, yes, they would.

00:57:53.056 --> 00:57:55.496
<v SPEAKER_4>And it explores a variety of different scenarios.

00:57:56.256 --> 00:57:57.336
<v SPEAKER_4>I found it very interesting.

00:57:57.336 --> 00:57:58.916
<v SPEAKER_4>I agreed with a lot of what it said.

00:57:58.916 --> 00:58:01.096
<v SPEAKER_4>It was quite thought provoking.

00:58:01.096 --> 00:58:09.196
<v SPEAKER_4>I definitely think that our governance structures need
reform so that we do have better accountability across the board.

00:58:09.196 --> 00:58:18.216
<v SPEAKER_4>Really, it's not just politicians who are more
accountable because they can be moved out of office, but can they
deliver on their programs?

00:58:18.216 --> 00:58:23.876
<v SPEAKER_4>Or are they being blocked by bodies that are not
accountable, like regulators or the civil servants or other people?

00:58:25.676 --> 00:58:45.176
<v SPEAKER_1>Yeah, and I'm sure that everybody who listens to this is
aware of that show Yes Minister, the classic British TV show that's
entirely about how the Civil Service knows everything, and it's
completely capable, and democratic accountability isn't all cracked up
to be.

00:58:45.376 --> 00:58:49.376
<v SPEAKER_1>That's kind of the message of the show, which I'm not sure if I completely agree with.

00:58:50.096 --> 00:58:58.416
<v SPEAKER_4>So in the days of Yes Minister, the Civil Service really just wanted their comfortable life to continue, and that was really their ambition.

00:58:58.416 --> 00:59:01.756
<v SPEAKER_4>But actually, the Civil Service has now become politicized.

00:59:01.756 --> 00:59:11.696
<v SPEAKER_4>We see the environment departments, for example, deliberately hiring environmentalists because they're cheaper to hire than other people who aren't environmentalists.

00:59:11.696 --> 00:59:21.756
<v SPEAKER_4>Within the Energy Ministry, you've got people who are net zero zealots, for example, and so you're losing that independence, if you like.

00:59:21.756 --> 00:59:25.096
<v SPEAKER_4>The Civil Service has been corrupted because it's become politicized.

00:59:25.096 --> 00:59:26.916
<v SPEAKER_4>They're not corrupted in a financial sense.

00:59:26.916 --> 00:59:31.936
<v SPEAKER_4>People aren't going around exchanging brown envelopes, but it's been corrupted in a political sense.

00:59:31.936 --> 00:59:38.876
<v SPEAKER_4>And so if the government of the day has ideologies aligned with the politics of the Civil Service, then that is fine.

00:59:38.876 --> 00:59:46.056
<v SPEAKER_4>But if it doesn't, and we had this with the previous conservative government, you did see obstructionist behaviour.

00:59:46.056 --> 00:59:53.596
<v SPEAKER_4>And when you had ministers trying to actually exercise their authority over the Civil Service, they got accused of bullying.

00:59:55.336 --> 00:59:56.536
<v SPEAKER_4>So yeah, I mean, it is a problem.

00:59:56.536 --> 00:59:59.516
<v SPEAKER_4>This politicization, I think, is going to have to be addressed.

00:59:59.516 --> 01:00:00.356
<v SPEAKER_1>Yeah, absolutely.

01:00:00.356 --> 01:00:06.856
<v SPEAKER_1>And I'd like to flag, though, that I know many, many civil servants in Ottawa and in Alberta here.

01:00:06.856 --> 01:00:08.676
<v SPEAKER_1>A lot of them are great people.

01:00:08.676 --> 01:00:10.176
<v SPEAKER_1>A lot of them are very knowledgeable people.

01:00:10.716 --> 01:00:16.036
<v SPEAKER_1>But yeah, there's still some issues around that here in Canada as well.

01:00:16.476 --> 01:00:18.116
<v SPEAKER_2>No question about that, Drew.

01:00:18.116 --> 01:00:20.456
<v SPEAKER_2>Don't get me started.

01:00:20.456 --> 01:00:22.656
<v SPEAKER_2>Kathryn, so thankful to have you on.

01:00:22.656 --> 01:00:24.076
<v SPEAKER_2>What a wonderful conversation.

01:00:24.076 --> 01:00:24.836
<v SPEAKER_2>Nice to see you again.

01:00:24.836 --> 01:00:25.936
<v SPEAKER_4>My pleasure.

01:00:28.456 --> 01:00:34.616
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01:00:34.616 --> 01:00:38.456
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01:00:39.176 --> 01:00:41.316
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01:00:41.316 --> 01:00:46.556
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01:00:46.556 --> 01:00:54.216
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01:00:54.216 --> 01:00:57.816
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01:00:57.816 --> 01:01:02.896
<v SPEAKER_2>Thanks go out to our producer, Joe Calnan, and to Drew Phillips for providing our music.

01:01:02.896 --> 01:01:03.796
<v SPEAKER_2>I'm Kelly Ogle.

01:01:03.796 --> 01:01:05.876
<v SPEAKER_2>Thanks for joining us on Energy Security Cubed.