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Financial Stability Notes

Climate Risks in the Financial System: An Overview of Channels, Impact and Heterogeneity

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Vol. 2022, No. 7

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August 2022

Abstract

Physical damage from the effects of climate change will increase in the coming decades. However, global economies can slow this rate of increase – and potentially even reverse it – by frontloading a considerable amount of technological, infrastructural and behavioural change in the short-to medium term. Understanding such physical and transition risks for the financial system is a priority, as is the sector's role in financing the technological transition to net zero emissions by 2050. This article presents an overview of the key climate risk transmission channels. It is likely that financial sector impacts will mainly flow though the real economy, that is, how weather/climate-related damage and net zero policies affect business and household resilience and wealth. The existing research also shows that risks are unevenly distributed across and within countries. Such heterogeneity in real-economy risks is discussed in the Irish context.

1 Introduction

Climate change is a long run, intergenerational crisis, and one that can only be slowed in the short-to-medium term through significant levels of technological and behavioural change. The global climate has already experienced unprecedented changes since the start of the 20th Century (Figure 1). Increased greenhouse gas (GHG) concentrations, of which carbon dioxide (CO2) is the main contributor, have raised the earth's atmospheric energy balance, leading to warmer temperatures, rising sea levels and more frequent and extreme weather events.[3] The increasing speed of climate change is particularly salient in relation to sea level rise, which, in each of the past three consecutive decades, has increased from a rate of 2.1mm/year to 2.9mm/year to 4.4mm/year (World Meteorological Organization, 2021a). Climate change is already leading to increased damages – worldwide weather-related economic losses, 85% of which are due to storms and flooding, have risen from $175Bn in the 1970s to $1,381Bn since 2010 (World Meteorological Organization, 2021b).

Future scenario-based forecasts show that a global business-as-usual GHG emission pathway will significantly increase the likelihood of catastrophic health impacts for communities, ecosystems,

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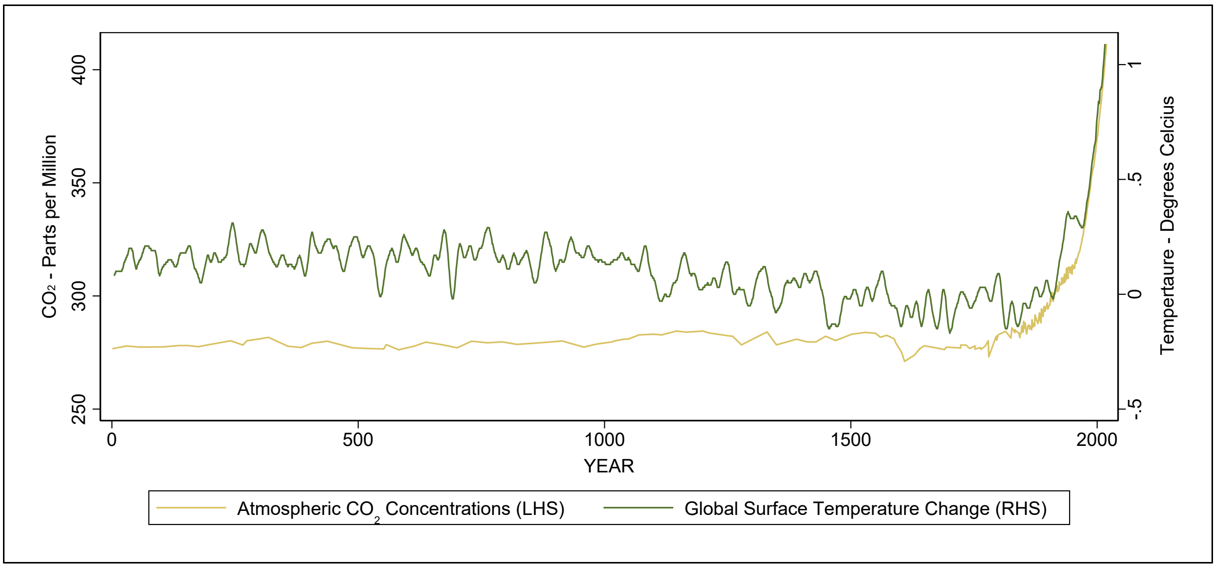
Thank you to Peter Towers, Maria Woods, Philip Brennan, Yvonne McCarthy, Niall McInerney, Fergal McCann, Vasileios Madouros and Mark Cassidy and for editorial comments and suggestions. Further thanks to Nicole Moore for excellent research assistance in relation to acquiring and cleaning climate-related data.

[3] The main greenhouse gas (GHG) components are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_20) and fluorinated gases.

food systems and biodiversity (IPCC, 2022), and it is now almost universally accepted that the magnitude of impacts post-2050 depends entirely on deep global emission cuts pre-2050. In order to keep global temperatures within 1.5°C above pre-industrial temperatures (the damage minimising best-case scenario), global GHG emissions would need to peak by 2025, decline by 43% by 2030, and reach net zero by 2050 (IPCC, 2022).

The transition to net zero is, at its core, a global change in energy efficiency (less energy per unit of output) and energy supply (less emissions per unit of energy). Success, however, will depend on the individual trade-offs of technology adopters in the real economy (the decisions of businesses, households and electricity generators) – for example, adopter expectations regarding future energy cost streams, asset values, and, for businesses, revenues and access to finance. Government policies affect the speed of transition by changing incentives and investment payoffs. For example, governments can increase the cost of using older, polluting technologies (through carbon taxes), reduce the cost of investing in existing energy-saving technologies (recycling carbon taxes into technology supports), increase the rate of innovation in new technologies (research and development supports) and ensure that there are minimum information gaps for market participants (energy labelling and emissions disclosure regulation).

Figure 1: **Atmospheric CO_2 Concentrations and Global Surface Temperature, 2,000 years**



Source: Data downloaded from US EPA and IPCC

Notes: Temperature is relative to 1850-1900 average. Chart shows trends for common years in both datasets (224 data points). CO2 data refer to direct air monitoring data (mainly Mauna Loa, Hawaii) post-1959 and estimates from arctic ice cores pre-1959. Temperature data are observed post-1850 and estimated prior.

This article presents an overview of the key climate risk transmission channels, and how they relate to the financial sector. The article is intended to complement the broader macroeconomic analysis of McInerney (2022) by considering risk and impact heterogeneity through a microeconomic lens. The discussion describes a number of financial sector risks (and mitigants), most of which start with real economy impacts. For example, an energy price shock would disproportionately affect profitability in energy intensive sectors, with consequences for credit risk (borrower ability to repay) in the banking sector. Furthermore, future physical risks for the banking and insurance sectors will come through the direct damages to physical assets experienced by their customers.

There is growing evidence that climate-related financial risks could be significant without considerable policy and technology changes. Due to forecast uncertainties, measurement is generally scenario-based – dependent on a fixed set of future policy and economic states. For example, the recent ECB euro-area climate stress test (ECB, 2021) employs the macro-climate scenarios produced by the Network for Greening the Financial Sector (NGFS, 2021) to estimate banking sector impacts within corporate lending. The six NGFS scenarios range from the 'hot house world' with limited policy changes (2.5-3°C rise in temperatures by 2050) to the best-case 'orderly transition' scenario (1.5-1.7°C rise) which assumes rapid and immediate decarbonisation of electricity, increasing electrification and more efficient uses of resources. The assumed carbon price trajectory is a key economy-wide scenario determinant, rising steadily to almost €700/tonne by 2050 to achieve 1.5°C but with limited increases in the hot house world. Consistent with physical science forecasts (IPCC, 2022), their results show that lower physical risks which accompany an orderly transition lead to lower financial sector losses up to 2050.[4]

The article proceeds as follows: Section 2 presents a high-level overview of how climate-related impacts, policies, investments and decisions transmit to the real economy, the energy sector and the financial system. Section 3 switches the focus to Ireland by using the available data to discuss areas of higher risk, and policy plans that will limit impact. Section 4 concludes by discussing analytical and data gaps.

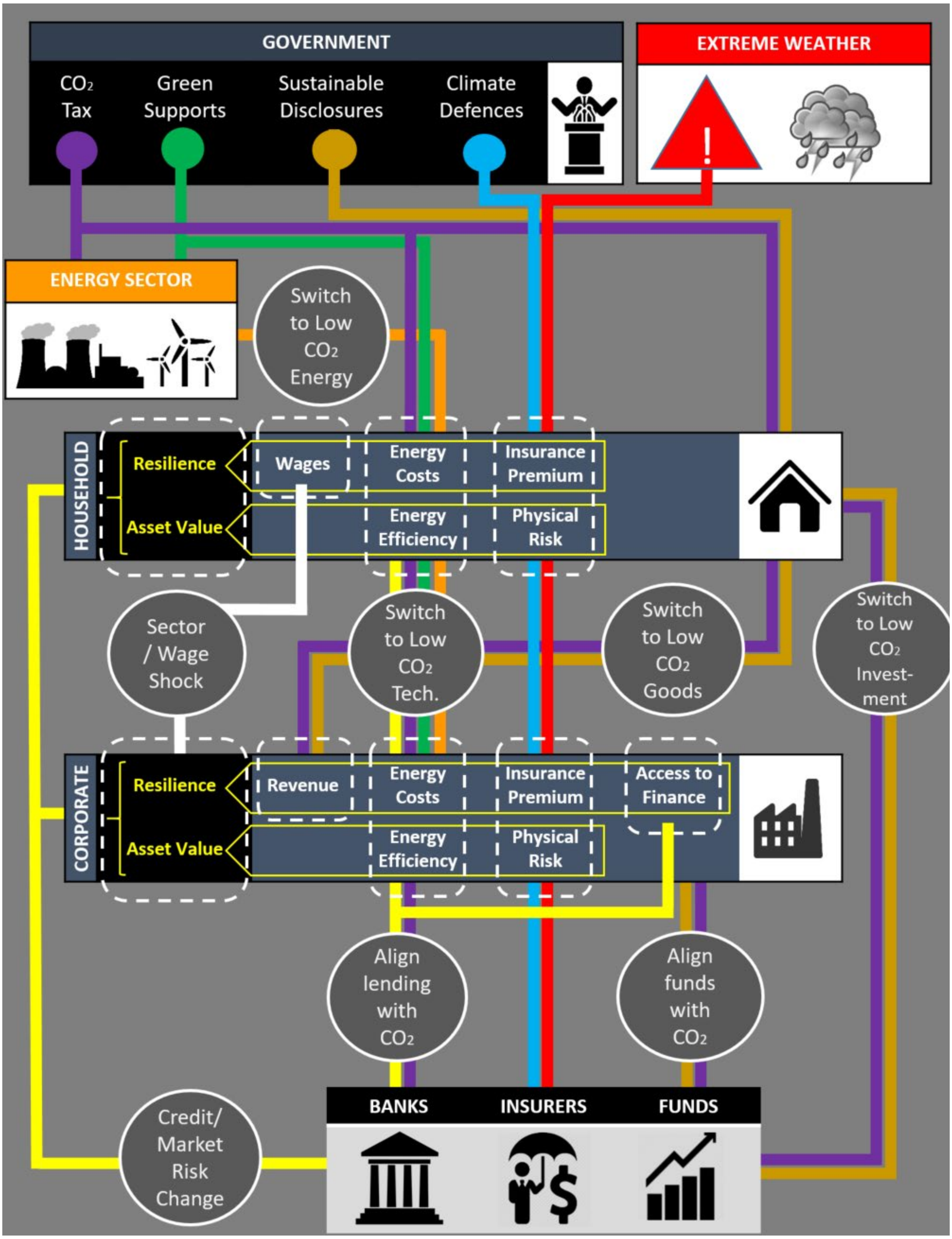
2 Financial Sector Impact Channels

Figure 2 presents a high-level view of the climate-relevant direct and indirect impact channels between government, businesses, households, the energy sector and the main components of the financial sector – banks, insurers and investment funds. This analysis adds to the theoretical background provided by ECB (2021) and BIS (2021) by applying a more granular focus to the various impact channels. The description is intentionally country-neutral – national climate impacts will be highly heterogeneous, dependent on geography and topology (physical risks), share of emission-intensive businesses and households, the carbon intensity of the energy system, and, most importantly, future climate policy commitments and local adaptation.

The analysis focuses on the more salient channels only, but serves as a conceptual baseline for extensions. For example, while not formally included in Figure 2, trade impacts are clearly important for open economies – divergent international carbon tax policies and heterogeneous international physical impacts would lead to heterogeneous import and export price effects across countries.[5] The discussion also focuses on the direct energy-related impacts of carbon taxes (or market-based price drivers), although it clear that real economy resilience could also be impacted through broader non-energy inflationary channels – the price of goods, services and inputs rising according to their emission intensities – and through broader macroeconomic changes, such as declines in aggregate demand. Furthermore, fiscal risks are not explicitly acknowledged in Figure 2 – general government finances (and capacity to support the real economy transition) would be impacted through sectoral spillovers and a wider economic slowdown.

[4] Although the orderly scenarios lead to higher losses pre-2030, these are outweighed by larger declines in losses post-2030.
[5] A further exclusion is the possibility of geo-political tensions, conflict and mass migration

Figure 2: **Climate-Economic-Financial Impact Channels in a Closed Economy**



Source: Author's design

In Figure 2, financial sector impacts are primarily indirect (flow through real economy impacts and changes). For example, the profitability of past bank lending decisions would be affected by future changes in borrower ability to repay ('Resilience' in Figure 2) and collateral values ('Asset Value'). For the insurance sector, unexpected increases in household and business weather/climate-related claims would increase year-on-year profit volatility.[6] In the funds sector, sudden changes in government policy or increases in environmental sentiment would lead to a carbon-aligned repricing of assets.[7]

2.2 Climate Policies

A continuous rise in carbon taxes is the main economy-wide transition risk driver within Figure 2. For technology adopters (businesses, households and generators), a credible and predictable commitment to higher carbon prices lowers the uncertainty surrounding the future energy saving flows of long-run technology decisions, and also raises future incentives for businesses operating in the development and supply of energy/emission-saving innovations.

Carbon taxes also affect all components of business and household emissions (Scope 1-3), proportionate to the carbon-intensity of each component. For example, to maintain competitiveness and market share in a rising carbon price environment, businesses would be forced to switch to lower-emission suppliers (to offset rising input prices), lower-emission technologies and processes (to offset rising direct energy costs), and design products with lower end-use emissions (to offset expected declines in consumer demand due to higher end-use energy costs). Furthermore, with the potential of zero-carbon electricity in the coming decades (the speed of deployment which is also partly determined by carbon price expectations), electricity consumers can largely decouple emission costs from direct carbon taxes through electrifying parts of their production process. There are clear financial market considerations, too – a clear and credible carbon price trajectory allows investors to form profitability expectations across asset types, which, over time, will align portfolios with carbon intensity.

Other government policies can reduce the burden of carbon taxes by lowering the investment cost of switching to energy-saving technologies ('Green Supports' in Figure 2), such as financial support (grants) and technical assistance in the short-run, and through policies to accelerate medium-to-long run research and development to reduce the costs of existing and new energy-saving technologies. There are also clear interactions between carbon taxes and disclosure regulation ('Sustainable Disclosure' in Figure 2) – technology adopters and investors can only form unbiased expectations of long-run future energy cost flows with accurate information on emission intensities and, for investors, a credible, unbiased disclosure of cost-feasible decarbonising plans. While there are fewer information gaps within household technology decisions (energy labelling for appliance, vehicles and properties), this is generally not the case for business and investor decisions, although disclosure requirements are rapidly increasing.[8]

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[6] The insurance sector is also exposed to the increasing rate of climate-related litigation against corporations and other entities whose activities are considered to have contributed to global warming.

[7] Direct climate/weather-related damage to a particular region/industry would also affect investor demand.

[8] Within the EU, the Non-Financial Reporting Directive (NFRD) lays down the rules on disclosure of non-financial and diversity information by certain large companies (European Commission, 2014). In 2021, the Commission adopted a proposal for a Corporate Sustainability Reporting Directive (CSRD), which would amend (extend) the existing reporting requirements of the NFRD (European Commissions, 2021). In 2020, the EU Taxonomy was published which established a list of environmentally sustainable economic activities (European Commission, 2020).

The final government policy within Figure 3 – 'Climate Defences' – relates to investments and regulations which will lower future weather-related impacts, both chronic (predictable, continuous sea level or temperature rises) and acute (extreme weather events). In the context of Figure 2, such changes relate to any public infrastructural projects that protect the physical assets of household and business (property, machinery etc.).[9]

2.3 Real Economy Impacts

In Figure 2, the climate-related drivers of household resilience are income, energy costs and insurance costs (and coverage), the latter the proxy of a household's physical risk (probability of flooding, for example). In a high carbon tax environment, wages from carbon-intensive employment sectors (with less feasible green technology options) could decline. Furthermore, the direct impact of a carbon tax increase depends on the energy efficiency of technologies, the emission intensity of fuels, scale effects (size of property, number of appliances and size/number of vehicles), and the demand for 'energy services'. For households, energy service demand (e.g. transportation, heat and light used per year) is highly heterogeneous and related to, for example, distance to urban centres, scale (e.g. size of property, number of vehicles), demographics and occupancy (e.g. lifecycle stage, composition) and behavioural/lifestyle factors (e.g. time spent in the home, desired heating temperature). Such components will be highly heterogeneous across households, as will the timing of impacts – while a large, short-run energy price shock potentially reduces resilience, impacts decline with household technological and behavioural change, and by switching to low-carbon fuel sources (renewable electricity).

For business resilience, the impact of higher carbon taxes is analogous, but equally heterogeneous. Energy-driven cost changes for a particular sector will be proportionate to the carbon intensity of each input and production method. On the revenue side, the impact will depend on the sensitivity of customers to energy-driven output price increases (for example, availability of substitutes and market competition), downstream emission intensity of output (customer energy use), and a potential change in customer preferences, for example, an environmental shift away from emission-intensive goods and services. On the latter, environmental considerations are already playing a role in consumer demand (CONSEED, 2018), and such drivers would likely increase as global physical damages increase. A final consideration for business resilience is access to finance, which, in a full emission disclosure environment, will depend on bank and investor profitability impact expectations, the feasibility of medium-to-long run decarbonisation plans and investor ESG targets/criteria.

In Figure 2, household and business physical asset values (buildings, machinery etc.) are potentially affected through two demand channels, both of which are associated with an asset's higher expected future cost flows. First, a higher likelihood of direct climate/weather-related damage is captured through the insurance market – higher physical risk leading to higher premiums (or possibly coverage gaps).[10] Second, the higher expected future energy costs associated with low energy efficiency levels is shown to be capitalised into asset prices (Hyland, et al., 2013) – a situation which would intensify in a high carbon tax environment (ter Steege & Vogel, 2021) or due to an increase in environmental motivations. An extreme outcome of such effects would be 'stranded

[9] Such policies generally come under the heading of "Climate Adaptation", which would also include, for example, changes in land use (planting practices) to prevent wildfires and switching to climate change resistant crops (flood and heat resistant, for example). While Figure 2 focuses on public sector adaptation, change will also come from the private sector.

[10] Direct climate/weather-related damage to uninsured assets is also clear resilience and asset value impact.

assets' – buildings and machinery from sectors which are no longer commercially valuable. Similar to transition risk mitigants, potential asset value declines are reduced through policy and technology – direct damage is reduced through adaptation infrastructure (flood defences and zoning, for example), while technology upgrades reduce a building's future energy cost flows and environmental footprint.

3 Real Economy Climate Risks in Ireland

Section 2 has highlighted that climate risks for the financial sector will likely stem from the interaction of policy, physical risk and real economy changes/decisions. Business and household exposure to transition risks will differ across and within countries, depending on emission intensities and the cost feasibility of future decarbonisation. Furthermore, direct physical risks depend on exact location and local adaptation planning.

The goal of this section is to provide insights into potential real economy climate risk using the available Irish data. This is balanced by a summary of the technology and infrastructural risk mitigants driven by current climate policy commitments. On the latter, the fiscal feasibility of climate plans is not discussed below, nor are the potential trade-offs between climate and non-climate policies, or the broader economic implications. While it is too early to quantify the pass-through of real economy climate risks to the financial sector, the possible vulnerabilities highlighted in this section underpin the importance of continued financial sector analysis and monitoring within the context of future policy commitments and climate scenarios.

3.1 Physical Risk

More frequent and severe flooding is a key physical risk for Ireland. Insights into future physical risks are available from the Office of Public Works (OPW) coastal and fluvial flood risk maps. This extensive nationwide analysis considers two future flood scenarios: 'Mid-Range' (50cm sea level rise plus a 20% increase in rainfall) and 'High-End' (1.0m sea level rise and 30% increase in rainfall). Figure 3 presents flood areas (shaded green and blue) for the three largest cities – Dublin, Cork and Limerick (areas of approximately 30km^2, centred on city centres) – comparing current flood risks (left panel) to those for the OPW mid-range 'medium probability' scenario (right panel).[11] The future timing of a half metre rise in sea level depends on global emission trends – under the IPCC's most pessimistic scenario, this would occur between 2045 and 2050 (global business-as-usual emission scenario), but as late as 2100 under the most optimistic scenario (global net-zero emissions by 2050).[12]

While it is clear that such risks will increase in the coming decades, the rate of increase is very uncertain, as is the wider impact on the financial sector. For example, a change in long-run physical risk expectations would affect current insurance decisions, with knock-on implications on property values. While the latest data show that 3% of Irish property insurance policies do not have flood insurance cover (Central Bank of Ireland, 2021), it is unclear whether this figure fully internalises long run flood information.[13] In terms of property value effects, recent analysis shows that the

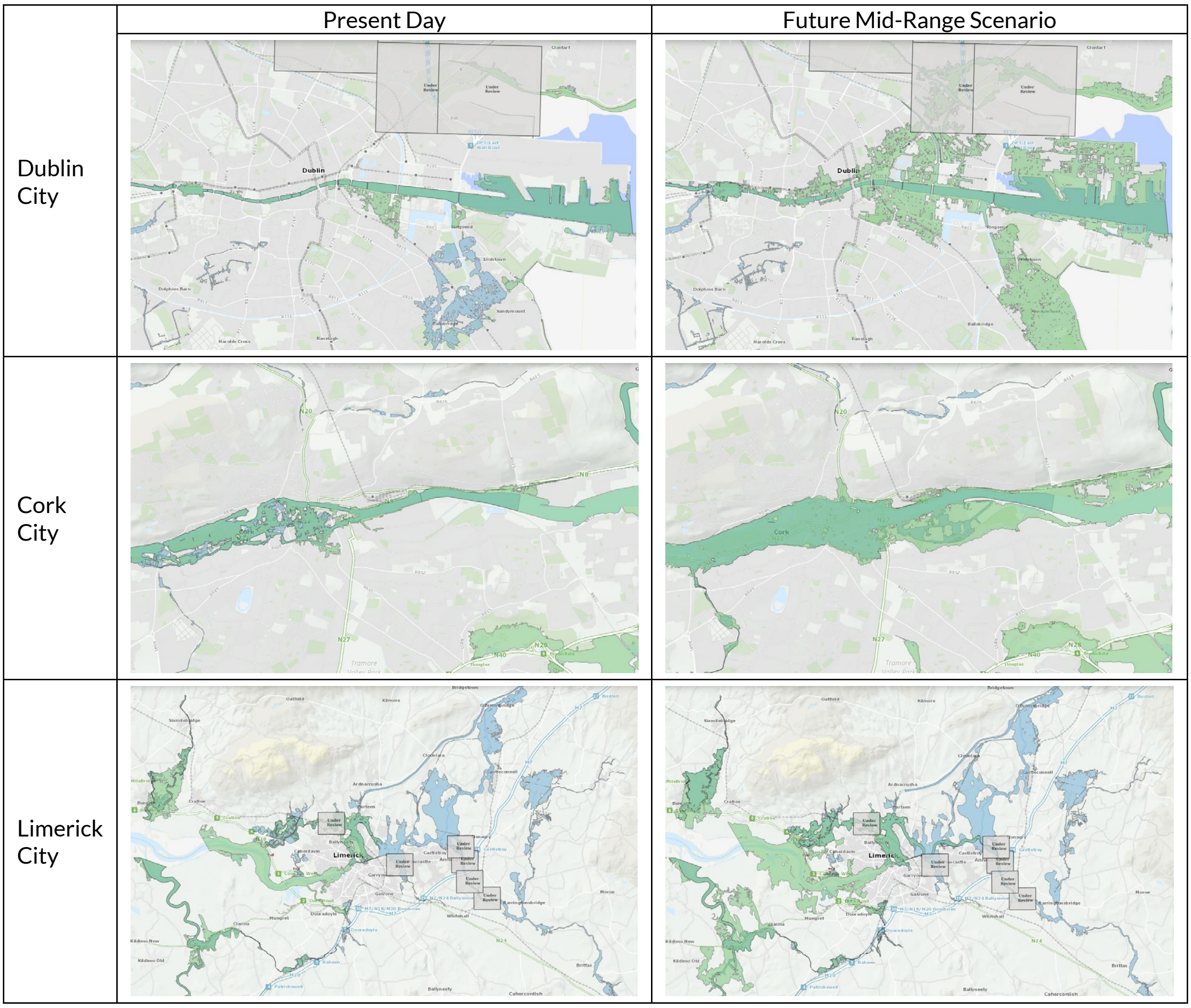
[11] For rivers, medium probability refers to a 1-in-a-100 chance (or 1% *Annual Exceedance Probability*) of occurring or being exceeded in any given year. For coasts, the medium probability refers to a 1-in-a-200 chance.

[12] The IPCC and NGFS net zero scenarios are analogous

[13] Within areas covered by 18 OPW flood defence schemes (both fixed and demountable) the majority (81%) of policies include flood cover. Insurance undertakings appear to consider fixed defences more effective in mitigating flood risk than demountable defences. Flood risks were included in 92% of policies in areas

publication of OPW flood maps (comparing pre- and post-2011) reduced property values in flooded areas by 3.1% (Gillespie, et al., 2020), while a study of flooded properties on the Dodder river (Dublin) showed similar relative discounts (Pilla, et al., 2019). Although the magnitude of these results would not point to considerable banking sector risk (collateral channel), continued in-depth analysis will be required in this area to monitor changes in risk, information disclosure and market participant awareness.

Figure 3: **OPW Flood Forecast Examples – Present Day and Mid-Range (Medium Probability) for Dublin City, Cork City and Limerick City**



Source: Contains Office of Public Works information © Office of Public Works; Contains Ordnance Survey Ireland information © Ordnance Survey Ireland
Notes: OPW's Mid-Range Scenario explores the potential effects of climate chance using an increase in rainfall of 20% and sea level rise of 50cm. Green and blue areas represent river and coastal flooding respectively. For rivers, medium probability refers to a 1-in-a-100 chance (or 1% *Annual Exceedance Probability*) of occurring or being exceeded in any given year. For coasts, the medium probability refers to a 1-in-a-200 chance.

Countries and communities will have to adapt to increased physical risks in the coming decades. Adaptation takes many forms, from infrastructural defences against extreme weather events, to changing agricultural practices to suit changed weather conditions. The OPW also co-ordinates the

protected by fixed flood defences, compared to 72% of policies in areas benefiting from demountable flood defences.

implementation of relief schemes to provide protection for communities.[14] To date, 51 flood relief schemes have been completed, 91 currently under design and construction, and a further 58 being considered for future development (OPW, 2022).[15]

3.2 Transition Risk

Scenario analysis from the NGFS (NGFS, 2021) shows that global carbon prices would need to rise to around $700 per tonne over the next three decades to reach net zero emissions by 2050 (EU ETS price was around €80 per tonne Q4 2021).[16] While the associated energy price increases raise real economy resilience concerns for the financial sector, the medium-to-long term impacts of carbon pricing will depend on the business and household technological response – changes to both the energy intensity of fuels (switching from fossil fuels to renewable electricity, for example), the energy efficiency of technologies/processes and the behavioural response. This section uses the available Irish data to explore current energy/emissions intensity differences across and within sectors. Such differences highlight current areas of higher vulnerability.

Data on national building energy efficiency has been available since 2009 following the introduction of the Building Energy Rating (BER) system. A BER audit is mandatory for all property sales and rentals (and advertisements since 2013), and the latest data show that about half of rated Irish properties are rated "D1" or below (Figure 4).[17] The difference in energy and emissions between BER categories is extremely large. For example, a "D1" property will consume three times more energy than a "B1" (225 kWh/m2/year versus 75 kWh/m2/year), and this difference translates directly into emissions (55.3kg CO2/m2/year versus 18.8kg CO2/m2/year).[18] However, in terms of individual carbon tax impacts, energy efficiency, while clearly an important determinant, must be considered alongside other determinants of energy consumption, such as scale and behavioural drivers.[19] Another consideration for total household energy consumption is vehicle use, although, in general, average property emissions are about three times higher than car emissions.[20]

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[14] The OPW is also the national authority for the implementation of the EU Directive on the Assessment and Management of Flood Risks (2007), the aim of which is to reduce the adverse consequences of flooding on human health, the environment, cultural heritage and economic activity.

[15] Figures from https://www.floodinfo.ie/scheme-info/ as of the 16th May 2022.

[16] NGFS carbon price accounts for inflation (2010 prices)

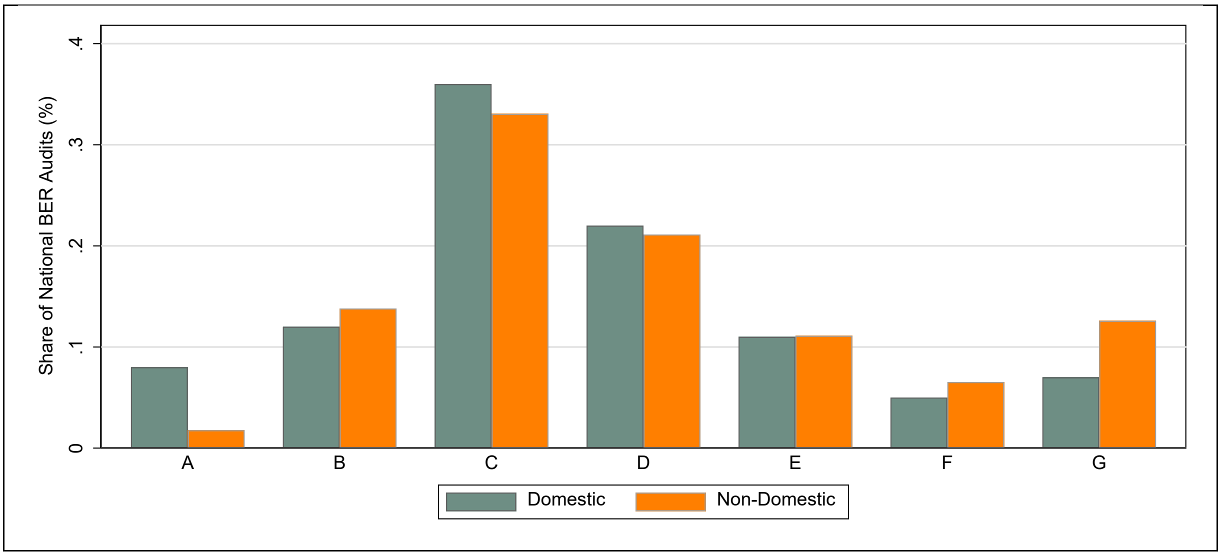
[17] A BER certificate is also required prior to applying for energy efficiency grants. The BER rating is estimated using a large range of building characteristics (including boiler, lighting, wall and window efficiency) under typical living conditions to create two indicators: energy consumption per square metre per year (kWh/m^2/yr.) which is divided into fifteen energy efficiency grades ("A1" to "G"), and kilograms of carbon dioxide emissions per square metre per year (CO_2/m^2/yr.).

[18] CO_2 emissions are estimated through the analysis of the BER database (estimating CO_2 upper/lower limits for each BER grade).

[19] A 100m^2 "C3" property will emit the same as a 200m^2 "B3" property per year (holding all other factors constant).

[20] The average square meter and CO_2 emissions (per square meter per year) implies that a typical Irish house emits about six tonnes per year (55.44 kWh/m^2/yr. by 108.38 m^2). A typical diesel car emits about 2 tonnes based on typical fuel efficiency of 130g/km and Irish annual driving distances (16,000km)

Figure 4: **Building Energy Rating (BER) Distribution**



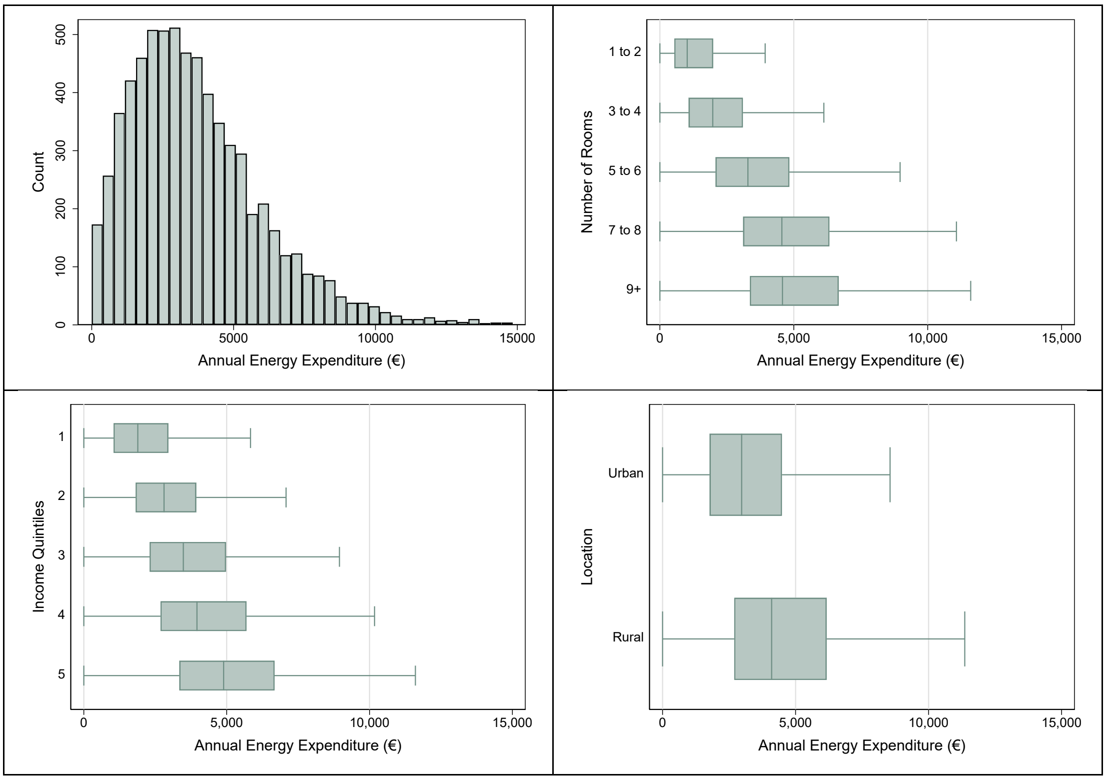
Source: Central Statistics Office (summary of SEAI BER Database)
Notes: data refers to Building Energy Rating (BER) audits conducted between 2009 and 2021

Household expenditure data also shows considerable energy consumption differences. The Irish Household Budget Survey (Central Statistics Office) is a representative national survey containing data on all household energy expenditures for both property (gas, oil, solid fuels and electricity) and vehicles (petrol, diesel and electricity). In the latest survey (2016), the average annual energy expenditure was €3,803 (representing 6.7% of disposable income), although with considerable variation across households (Figure 5 – panel 1).[21] Household energy expenditure is positively correlated with property size (panel 2 – number of rooms), income (panel 3 – gross household income) and location (panel 4 – urban versus rural). With regard to the latter, the average energy expenditure in rural areas is 40% higher (€4,695 versus €3,365), which will be partly due to higher petrol and diesel expenditure (66% higher – €2,430 versus €1,465) and larger properties (14% larger).

For businesses, carbon taxes affect costs and revenues through each emission channel. While the analysis of Scope 2 (indirect electricity) and Scope 3 (upstream and downstream) emission are impeded by data gaps, sectoral Scope 1 (direct combustion of fossil fuels) emission estimates are available across countries (Eurostat). Figure 6 compares emission intensities (Scope 1 GHG per euro of Gross Value Added (GVA)) and sectoral sizes (share of total GVA) in Ireland and the EU27 for the ten highest emitting sectors. These ten sectors cover 96% of Ireland's direct business emissions and 57% of GVA. For the majority of these key emitting sectors, the share of GVA is considerably smaller in Ireland (excluding manufacturing and support services). In addition, most sectors are less emission intensive than the EU27 average, with three exceptions – agriculture (GHG per euro 214% higher), transport and storage (271% higher) and public administration (108% higher).

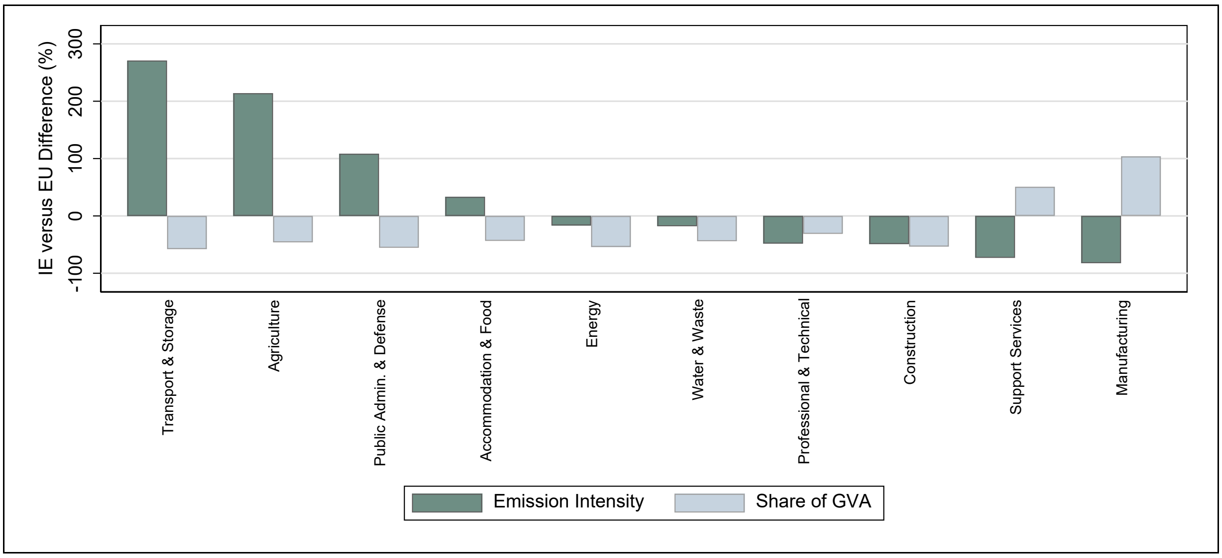
[21] Property size differences are estimated based on the number of rooms in the HBS data.

Figure 5: **Households Annual Energy Cost Variation (Panel 1-Histogram), by Number of Rooms (Panel 2 – Boxplot), Income Quintiles (Panel 3 – Boxplot) and Location (Panel 4 – Boxplot)**



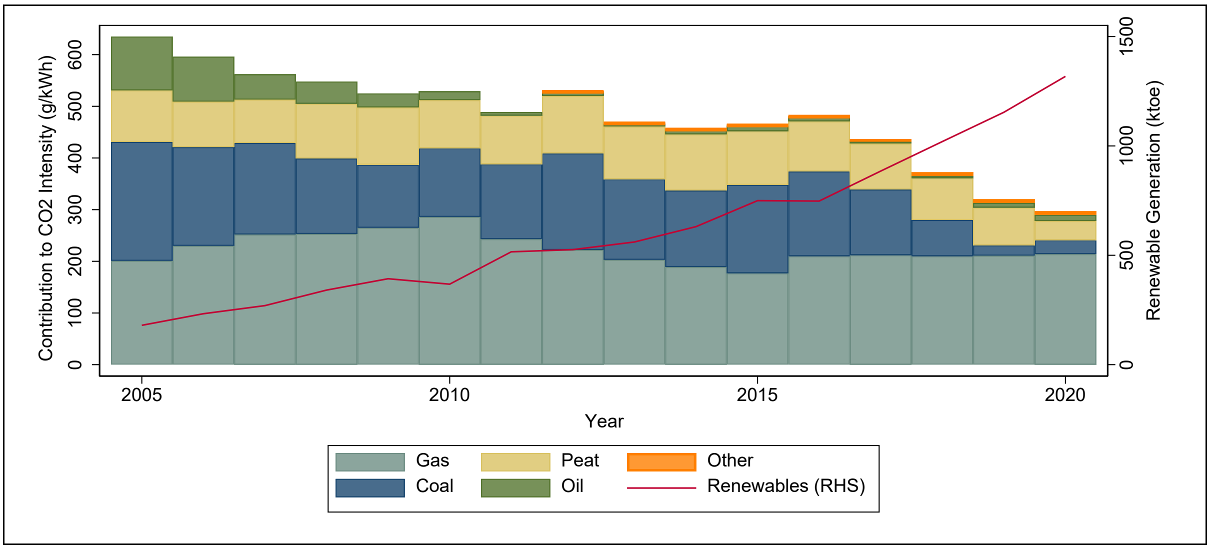
Source: own calculations based on the Central Statistics Office *Household Budget Survey* 2015/2016. Data accessed through the Irish Statistical Services Data Archive
Notes: annual energy expenditure estimated using average weekly gas, electricity, petrol, diesel and solid fuel expenditures. For bulk purchases and irregular bills, households reported their last bill.

Figure 6: **Main Greenhouse Gas Emitting Sectors, EU27 and Ireland – Percentage Difference in Intensity and Share of Gross Value Added**



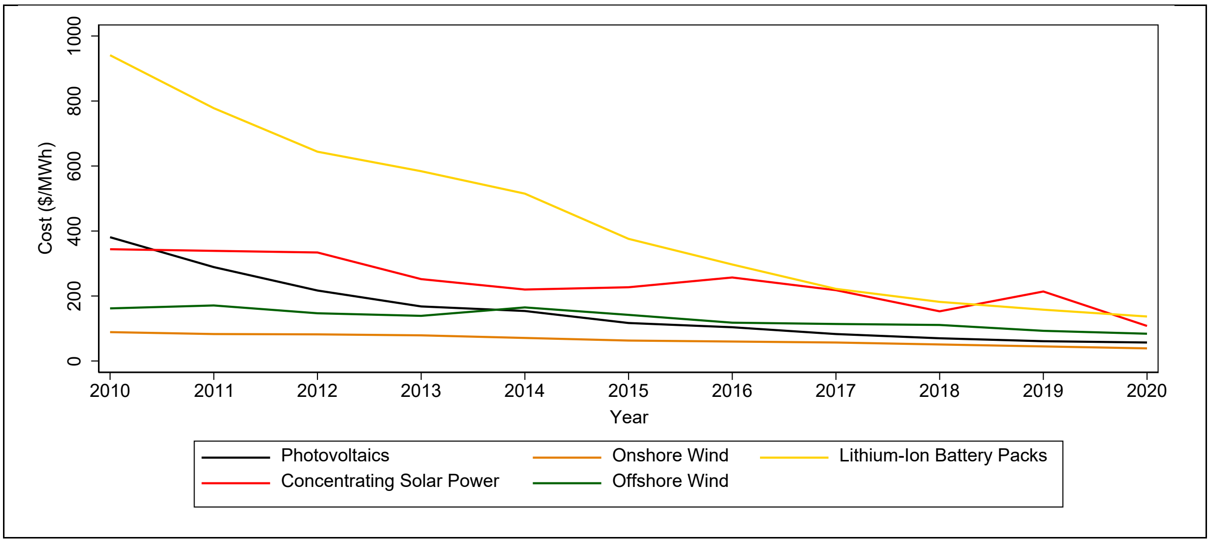
Source: national GVA and GHG downloaded from Eurostat
Notes: emission intensity is calculated as Greenhouse Gas Emissions (GHG) divided Gross Value Added (GVA). Positive values mean Ireland is more energy intense

Figure 7: **Carbon Intensity of Electricity – Contribution by Fuel – and Renewable Generation**



Source: Sustainable Energy Authority of Ireland

Figure 8: **Trends in Renewable and Emission/Energy Reducing Technologies**



Source: IPCC (2022)

Decarbonisation policies can cushion the effects of future energy price shocks on the real economy.[22] In particular, Ireland has targets of one million electric vehicles (from 27,711 registrations since January 2015), 500,000 household "B2" retrofits (currently 115,842 at "B2" or above) and 650,000 heat pumps installations. The future impact of carbon prices is further reduced through lower carbon energy supply – renewable electricity generation (mostly wind) will increase from 42% today to 80% in 2030. This target comes after twenty years of rapid decarbonisation of

[22] In Ireland, the *Climate Action and Low Carbon Development (Amendment) Act 2021* intends to drastically change the economy's energy supply and emission intensity, and has committed to a legally binding 51% GHG reductions target by 2030 (compared to 2018) and net-zero emissions no later than 2050. The *Climate Action Plan 2021* sets out the policies for achieving 2030 emissions reductions, with highly ambitious goals for energy efficiency, electrification and renewable energy.

the electricity sector (Figure 7) – since 2005, the carbon intensity of electricity has more than halved (635g CO2/year to 297g CO2/year) due to high increases in renewable generation (180ktoe to 1318ktoe) and very large declines in highly emitting coal, peat and oil generation. The cost of the technological transition will be assisted if the price of emission-saving technologies continues to decline – Figure 8 shows that the price of lithium-ion batteries (key determinant of electric vehicle prices) has declined by 85% since 2010, while the price of offshore wind installations has declined by 48% (IPCC, 2022).

4 Conclusion – Status, Gaps and Priorities

This article has presented some of the more salient climate risk channels for the real economy, and how these may affect the financial sector. There is considerable uncertainty regarding future climate risks. While Irish emission targets to 2030 and 2050 are clear, the scale and speed of national technological and behavioural changes required are unprecedented (and therefore uncertain). Furthermore, given that Ireland is a relatively open economy, transition risks from abroad will likely be more prominent here – the price of imported goods and services are affected by non-domestic climate policies and technical change, with uncertainties larger outside of the EU.

Future physical risk in Ireland is also uncertain – the rate of increase in direct climate/weather-related damages (extreme weather and sea level rise, for example) is ultimately dependent on global emission reduction success. On the latter, while global policy commitments have become significantly more ambitious in the past decade, it will be important to closely monitor policy and emission progress to understand the likelihood of different future global climate scenarios. An abrupt shift in climate concern and global climate policy is also possible in the coming years as physical damages become more visible.

The potential for significant financial sector impact is apparent, not just through increased weather/climate-related damage, but also through the rapid and costly technological and behavioural transition to net zero. However, our understanding of the links between climate risk and financial risk is at an early stage, as are the potential spillovers and feedback loops for a small open economy such as Ireland. Such gaps are beginning to narrow with improved data, forecasting and analytical capabilities, both here and internationally. To this end, the Central Bank of Ireland has prioritised and commenced a broad work programme to incorporate climate change considerations into its regulatory, analytical and operational functions. A necessary point of departure is the quantification of the financial sector's exposure to physical and transition risks, some of which will be located outside of Ireland (non-domestic lending and investments, for example). Such analyses will serve as a foundation to understand the sectors an activities where risks are concentrated, in addition to providing a platform to incorporate future climate scenarios.

References

Central Bank of Ireland. (2021). Insurance Newsletter: June 2021. Retrieved 05 30, 2022, from https://www.centralbank.ie/docs/default-source/regulation/industry-market-sectors/insurance-reinsurance/solvency-ii/communications/insurance-quarterly-news/the-insurance-quarterly---june-2021.pdf?sfvrsn=4

CONSEED. (2018). Consumer's Energy Efficiency Choices for Different Consumer Groups and Geographical Locations: Survey Results. Retrieved from CONSEED: https://conseedproject.eu/conseed-survey-report

ECB. (2021). Occasional Paper Series: ECB economy-wide climate stress. Retrieved 05 25, 2022, from https://www.ecb.europa.eu/pub/pdf/scpops/ecb.op281~05a7735b1c.en.pdf

Gillespie, T., Lyons, R. C., & McDermott, T. K. (2020). Information Matters: Evidence from flood risk in the Irish housing market. Trinity Economics Papers(tep1620).

Hyland, M., Lyons, R. C., & Lyons, S. (2013). The value of domestic building energy efficiency — evidence from Ireland. Energy Economics, 943-952.

IPCC. (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability - Summary for Policymakers. Cambridge University Press. Retrieved March 1, 2022, from https://report.ipcc.ch/ar6wg2/pdf/IPCC_AR6_WGII_SummaryForPolicymakers.pdf

IPCC. (2022). Climate Change 2022: Mitigation or Climate Change - Summary fro Policymakers. Retrieved from https://report.ipcc.ch/ar6wg3/pdf/IPCC_AR6_WGIII_SummaryForPolicymakers.pdf

NGFS. (2021). NGFS Climate Scenarios for central banks and supervisors. Retrieved March 9, 2022, from https://www.ngfs.net/sites/default/files/media/2021/08/27/ngfs_climate_scenarios_phase2_june2021.pdf

OPW. (2022). Fllod Relief Scheme Information. Retrieved 05 16, 2022, from https://www.floodinfo.ie/scheme-info/

Pilla, F., Gharbia, S. S., & Lyons, R. S. (2019). How do households perceive flood-risk? The impact of flooding on the cost of accommodation in Dublin, Ireland. Science of The Total Environment, 650(1), 144-154.

ter Steege, L., & Vogel, E. (2021). German residential real estate valuation under NGFS climate scenarios. Deutsche Bundesbank Technical Papers, 09/2021.

World Meteorological Organization. (2021a). State of Climate in 2021: Extreme events and major impacts. Switzerland: World Meteorological Organization. Retrieved March 2, 2022, from https://public.wmo.int/en/media/press-release/state-of-climate-2021-extreme-events-and-major-impacts

World Meteorological Organization. (2021b). WMO Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes (1970–2019). Switzerland: World Meteorological Organization. Retrieved March 1, 2022, from https://library.wmo.int/index.php?lvl=notice_display&id=21930#.YS9CMNMzZBx

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