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The Great Energy Transition

Navigating the trends, risks and opportunities in this complex arena

Research **May 2023**

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1. FROM KYOTO TO CAIRO: A NEW ENERGY SYSTEM IN THE MAKING

At the time of adopting the Kyoto Protocol in December 1997 at COP 3, the first international treaty on legally binding emission targets, 86% of our total energy and 64% of total electricity came from burning oil, coal and natural gas[1]. Approximately twenty-five years later leading into the COP27 in Cairo, comparable numbers were ~83% and ~62%[2] respectively. At a global level, progress over 25 years is inconsequential and disappointing. But it also shows that undertaking energy transitions takes time. Energy assets are long-term and capital-intensive to replace. Commercialising of new alternative technologies does not happen overnight. And importantly, Governments require buy-in from their communities to undertake transitions of this scale given fossil fuels are embedded in our daily lives.

Over this period, however, significant groundwork has been laid. As of today; a) 90% of global GDP is covered by some form of net zero target[3], b) solar, wind and battery technologies have become cost competitive and are scaling up fast, c) a number of new innovative climate technologies such as carbon capture and green hydrogen have come to the forefront, and d) capital markets have a strong appetite for financing the right solutions.

While absolute growth in clean energy has been impressive in percentage terms, the world is in the early stages of transition to a zero or low carbon energy system. Climate change concerns have been driving the agenda over the last few decades, but the 2021-2022 energy market crisis, exacerbated by the war in Ukraine, has made reliance on fossil fuels an energy security issue.

Both climate and energy security concerns are now clearly strengthening regulatory and political support to build out a new energy system that is dominated (rather than supplemented) by renewables in the future.

2. A COLOSSAL OPPORTUNITY: ENERGY TRANSITION REQUIRES UNPRECEDENTED LEVEL OF INVESTMENT ACROSS POWER, TRANSPORT, BUILDINGS, AND INDUSTRY

Estimates suggest that countries globally need to invest a combined $3 trillion - $4 trillion yearly[4] (2019 real) or ~3% to ~4% of global GDP (2019)[5] yearly over the next three to four decades to transition to a zero or low carbon energy system that will underpin the global economy. The speed and level of investment required are truly unprecedented.

The transition will create opportunities for investors to deploy capital across the energy economy value chain. Some of the key sector themes driving the investment landscape over the coming decade are:

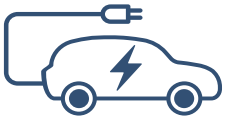
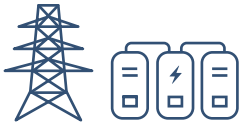
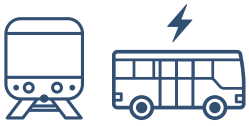
a) Increasing global share of **renewable electricity** to ~45%-50% by 2030[6] from ~28% today and the associated upgrade of grid infrastructure;
b) **Electrification of transport**;
c) **Energy efficiency**; and
d) Commercialising new **industrial technologies** to support de-carbonisation of hard-to-abate sectors such as steel, cement and chemicals.

1. Source: Energy mix – Our World in Data, Electricity Mix - Our World in Data, BP Statistical Review of World Energy
2. Source: 2021 Energy mix - Our World in Data, 2021 Electricity Mix – Our World in Data, BP Statistical Review of World Energy
3. Source: Net zero economic opportunities - GOV.UK (www.gov.uk)
4. Source: Investment Data Explorer – Data Tools – IEA – Net Zero 2050 and Sustainable Development Scenario
5. Source: Investment Data Explorer – Data Tools – IEA – Net Zero 2050 and Sustainable Development Scenario
6. Source: Outlook for electricity – World Energy Outlook 2022 – Analysis – IEA

2. A COLOSSAL OPPORTUNITY: ENERGY TRANSITION REQUIRES UNPRECEDENTED LEVEL OF INVESTMENT ACROSS POWER, TRANSPORT, BUILDINGS, AND INDUSTRY
CONTINUED

FIGURE 1: KEY INVESTMENT THEMES FOR THE CURRENT DECADE

Sector trends

Renewable Power	Supporting electrification of transport	Energy efficiency	New and alternative technologies to decarbonise hard-to-abate sectors
			
~400 GW p.a. deployment with 27% share in US, EU and UK	~8-12 Public Charge Points per 100 EVs	Average age of building stock in US, EU and UK is >50 years	Cement, iron and steel and chemicals account for ~15% of all Co_2 emissions
			
Flexible grid and digitisation of power infrastructure	Upgrading of mass transit infrastructure	Global landfill + open dump waste at >70% today	Sustainable alternative fuels

Source: IEA, COP27: UN report shows pathways to carbon-neutrality in “energy intensive” steel, chemicals and cement industries | UNECE, What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050 (worldbank.org)

3. CREDIT TO THE FORE: A SIGNIFICANT ROLE FOR PRIVATE INFRASTRUCTURE DEBT

Advanced economies[1] alone require private capital investment of approximately $1 trillion+[2] annually for the energy transition. Debt markets are a vital pool of capital today for the energy sector and their role will only increase as new technologies mature and their commercial models de-risk.

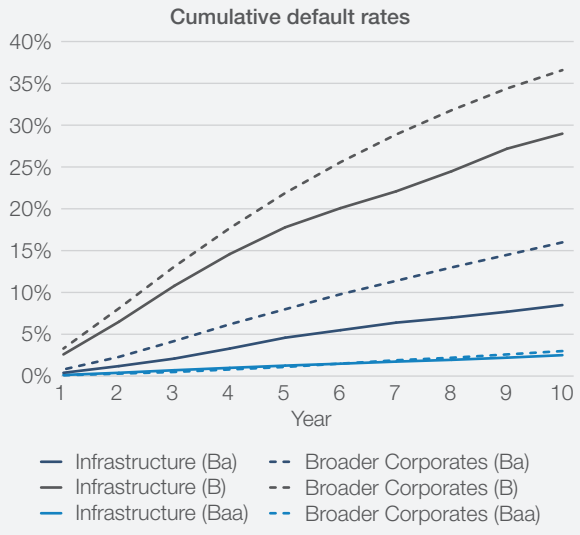
The market opportunity for private infrastructure debt is immense. Although public debt markets offer deep liquidity, they tend to have higher barriers to entry and offer less flexibility to borrowers as compared to private debt markets. Public markets tend to cater to large issuers and typically require a standardised product in terms of documentation and structure. Projects in the energy sector vary considerably in terms of commercial complexity, technology and financing size. Successful financings in the sector, particularly those with greenfield risk, require practical ways for borrowers and lenders to engage and work through unexpected deviations from the plan. Such changes are more challenging to implement under a public bond route with a large lender club than a private transaction with fewer lenders. Transactions in various sectors, such as solar, on-shore wind, EV public charge point infrastructure, tend to have financing requirements smaller than levels suitable for tapping into the public debt markets. As a result, the sector has huge demand for capital that can offer bespoke financing solutions. The 2008 Global Financial Crisis also resulted in commercial banks reducing their footprint. Private infrastructure debt has increasingly been filling this widening gap in the lending market.

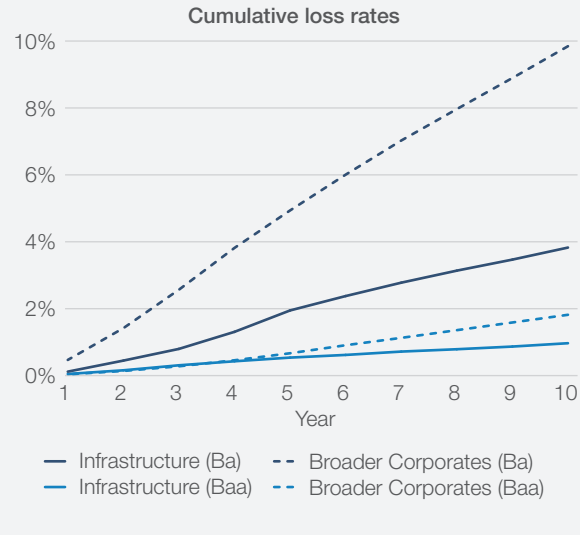
Private debt managers typically construct tailored credit strategies and in return, seek appropriate risk, complexity, and illiquidity premium. Lenders in a private transaction typically get security over hard assets, and financing documentation tends to be heavily structured with bespoke covenants. This gives lenders additional control in downside scenarios.

Private infrastructure debt has demonstrated a strong track record of risk-adjusted returns. As an asset class, data shows that Infrastructure loans outperform general corporate issuers across equivalent ratings with:

- Lower **default rates**;
- Higher **recoveries after default**; and therefore,
- Lower **loss rates**.

FIGURE 2: CUMULATIVE DEFAULT RATES AND CUMULATIVE LOSS RATES[3]





1. Advanced economies covers all OECD member nations
2. Source: Investment Data Explorer – Data Tools – IEA - assuming 85% privately financed
3. Source: Moody's 31 October 2022 report "Infrastructure default and recovery rates 1983-2021", Sequoia analysis

3. CREDIT TO THE FORE: A SIGNIFICANT ROLE FOR PRIVATE INFRASTRUCTURE DEBT CONTINUED

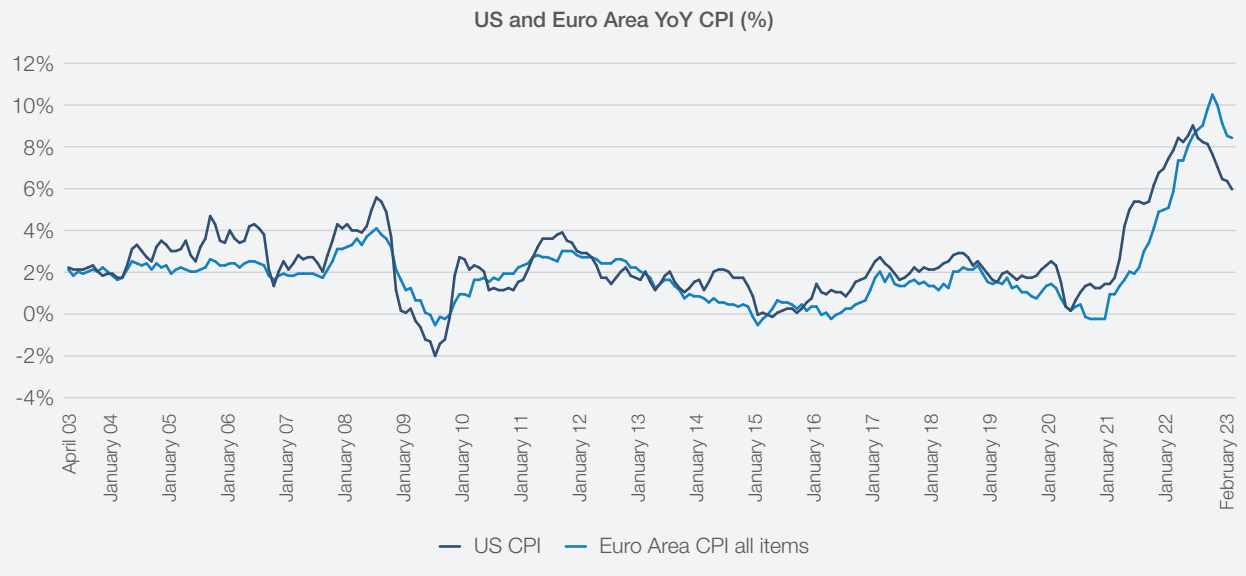
It is not surprising that investor allocations to the asset class have grown rapidly over the last decade. According to the Preqin database, total AUM in private infrastructure debt globally has grown from $8.7bn in December 2011 to $142.1bn by September 2022. The equivalent AUM for all private infrastructure strategies (including equity) in September 2022 was $1.2tn, indicating the opportunity for growth in debt.

4. NEW ERA, NEW APPROACH NEEDED: GOVERNMENT POLICIES CAN HELP OFFSET HEADWINDS FROM HIGH INFLATION AND RISING INTEREST RATES

Energy transition is going to be capital intensive and thus, cost competitiveness of new energy is highly sensitive to upfront construction costs and financing costs. Low inflation and historically low cost of debt and equity over the last decade contributed to solar and wind power achieving cost competitiveness against fossil fuels in many jurisdictions[1]. However, higher inflation and higher cost of capital risks slowing the transition.

Taming runaway inflation is essential. Project developers need stability in prices to reach final investment decisions. Financiers are unable to offer optimally priced capital due to uncertain asset valuations and the risk that high inflation will eat into their future returns. Small and medium-sized businesses, which play a critical role in construction projects, can experience significant financial stress during times of high inflation. The increase in interest rates and softening of oil and natural gas prices from their peaks is beginning to improve the inflation outlook including in the US, EU and UK – although the risk remains elevated as Europe remains exposed to the supply of natural gas for Winter 2023/24 and beyond and as OPEC makes moves to tighten supplies to reverse the recent dip in oil prices.

FIGURE 3: INFLATION IN US AND EURO AREA



With respect to interest rates, it is a realistic scenario that interest rates may stay 'higher-for-longer' after staying at historically low levels over the last decade.

1. Source: Projected Costs of Generating Electricity 2020 – Analysis - IEA

FIGURE 4: CORPORATE BOND YIELDS

Even though government bond yields and credit spreads have come down notably since Q4 2022, as of Mar-23, they remain considerably higher than pre-Covid levels. In renewables, certain existing projects would have benefited from high wholesale prices, notwithstanding electricity price caps in various jurisdictions, or would have seen opportunities to lock-in attractive corporate PPAs. However, this opportunity may not be available to new projects although they face higher construction costs and financing costs. Policymakers must have tools to address such challenges to ensure that inflation and interest rate cycles do not stall progress. A recent case in point is UK's £8bn Hornsea 3 offshore wind project and doubts over its viability due to higher supply chain prices and higher interest rates[1].

An obvious area for policymakers is to design and implement carbon pricing appropriately. If the cost of avoiding future emissions increases, all else being equal, so should the cost of emitting today. But given that our lives currently depend on fossil fuels, these measures will need to be designed with other constraints in play such as the impact on consumers' affordability and asset retirements which can leave a market under-supplied. Another area to consider is de-risking greenfield projects via tax incentives, expansion of revenue floor-and-cap mechanisms to other sectors or technologies and government grants.

5. SHOCK TO THE SYSTEM: 2021-2022 ENERGY MARKET CRISIS IS DRIVING THE TRANSITION FORWARD

The 2021-2022 energy crisis has echoes of the 1970s oil crisis which accelerated innovation in energy efficiency and development of nuclear power programme in the decades that followed. Regulatory tailwinds for the energy transition post the 2021-22 energy crisis are strong. The European Union has proposed to increase the headline 2030 target for renewables from 40% to 45% under the "Fit for 55" package[2]. Certain Eastern European nations such as Poland, which lag behind European peers on phasing out coal, are now seeing strong activity in solar and wind projects on the back of a positive regulatory environment and are attracting significant capital from private institutions and development finance institutions. The United States signed the big-bang Inflation Reduction Act (IRA) into law in August 2022 making it the single most significant US federal government investment in climate and energy. The IRA will provide ~$400billion of federal incentives over a 10-year programme and aims to crowd-in private investment to finance a wide range of clean energy technologies from solar and wind to electric vehicles and carbon capture.

1. Source: Wind farm developers demand UK tax breaks to offset rising costs | Financial Times (ft.com)
2. Source: REPowerEU (europa.eu)

5. SHOCK TO THE SYSTEM: 2021-2022 ENERGY MARKET CRISIS IS DRIVING THE TRANSITION FORWARD CONTINUED

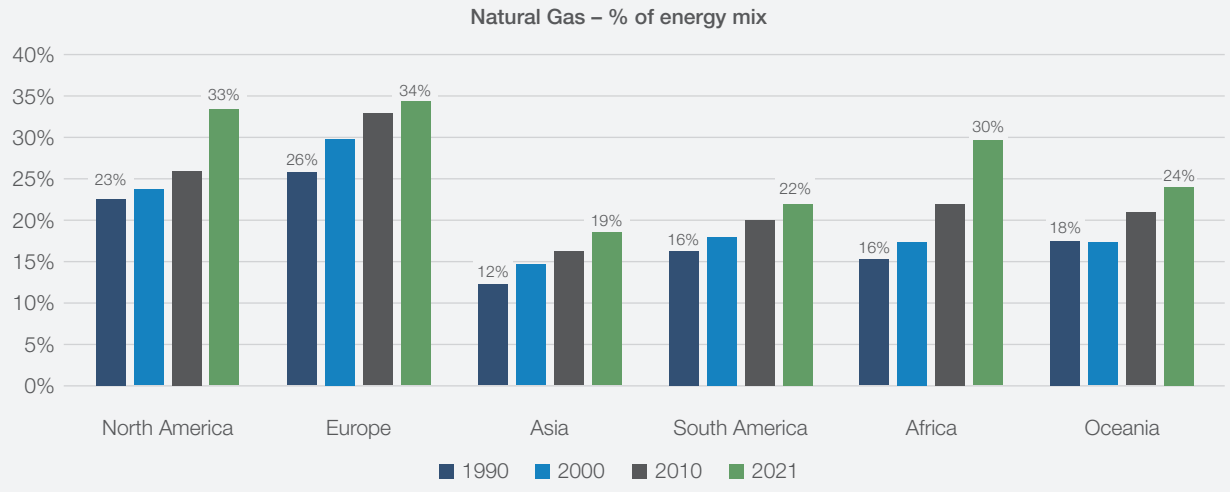
Despite strong regulatory tailwinds, supply chain could be a real barrier to sustaining progress over the coming decades. The current supply chain for many clean energy technologies is more geographically concentrated than it is for oil or natural gas[1]. China currently dominates the world in processing of critical materials and manufacturing of clean energy equipment[2].

The IRA provides financial incentives to encourage bringing industrial capacity and supply chain of critical components onshore to the US. This has created significant concerns of US pulling industrial capacity away from the rest of the world. In its response, the EU has unveiled the "Green Deal Industrial Plan" which aims to incentivise building a competitive manufacturing base in EU to support the energy transition. It is fair to say that the race to get ahead in potentially the next industrial revolution has begun.

6. NATURAL GAS IN THE MIX: THE BRIDGE FUEL ENERGY TRANSITION NEEDS

There has been a steady growth in the proportion of natural gas in the world's energy mix. The less harmful burning properties of natural gas[3] has driven coal-to-gas switching in many jurisdictions over the last three decades. Given limited alternatives available at scale today, natural gas, whether pipeline gas or LNG, will likely play a crucial role as a bridge fuel over the 2020s and probably beyond.

FIGURE 5: PROPORTION OF NATURAL GAS IN THE ENERGY MIX GLOBALLY[4]



In the electricity sector, which accounted for ~39% of global natural gas demand in 2021[5], increasing intermittent renewable capacity without additional baseload nuclear or long-duration multi-day battery storage (which is not available today) means a critical role for natural gas to provide dispatchable capacity to the grid[6]. When wind yields and solar yields are running low over multiple days and weeks, natural gas plants are critical to ensuring secure supply of electricity. Nuclear power, which is a credible alternative, plays a secondary role to gas other than in a few countries like France and increasing its supply in the electricity mix requires long lead times. And current battery technology can, at best, offer solutions over hourly and same-day intermittency issues.

1. Source: IEA, Securing Clean Energy Technology Supply Chains
2. China accounts for; a) >70% of Solar PV module manufacturing and assembly and >50% and >70% of processing Aluminium and Polysilicon required for making Solar PV modules; b) > 70% of manufacturing of EV batteries and >50% of processing Lithium, Cobalt, Graphite and Aluminium required for making EV batteries
3. Source: Natural gas and the environment – U.S. Energy Information Administration (EIA)
4. Source: Energy mix – Our World in Data, BP Statistical Review of World Energy
5. Source: Table 8.1 World Energy Outlook 2022 (windows.net)
6. Hydro power and Pumped Hydro Storage, which is a proven alternative solution, requires suitable geography

Natural gas currently dominates the role of providing grid flexibility and ensuring secure power supply in many regions including the US and the EU. It will likely remain a critical bridge fuel for the power sector in the medium-term although with renewable power scaling up rapidly, capacity factors of the baseload gas fired plants will likely see a downward trend in various jurisdictions[1].

The Building and the Industry sector, which together accounted for ~42% of global natural gas demand in 2021[2], requires a multi-pronged approach of energy efficiency, electrification of heating and progress in advancing technologies at scale such as biogas, heat pumps and potentially green hydrogen. While energy efficiency measures will provide some near-term reduction in gas demand, other technologies, where implemented, will need to scale up to make a gradual shift away from natural gas possible.

7. DETAILS MATTER: SUCCESSFUL INVESTMENT STRATEGIES WILL REQUIRE EXPERTISE IN THIS COMPLEX AND EVOLVING INDUSTRY

The energy transition is shaping up to be a multi-decade trend that is going to offer attractive opportunities for debt and equity investors. But it will require investors to manage risks stemming from a number of complex variables – from macro-economic environment and regulation to emergence of new alternative technologies and a host of asset specific considerations from local meteorological conditions to local community obligations. Investment in energy transition also needs to properly incorporate environmental, social and governance (ESG) considerations – think about the impact from disposal of end-of-life (ever-larger) wind turbines and solar panels or social and governance issues related to mining of critical minerals for clean energy equipment.

Delivering superior returns in the energy transition will require specialist skills and active portfolio management. At Sequoia Investment Management, our investment philosophy is focussed on careful construction of diversified fixed-income portfolio strategies, while deploying specialist skills from the team and third-party advisors to thoroughly analyse investment opportunities, supported by prudent and disciplined approach to credit structuring and management.

1. Source: Table B.4b World Energy Outlook 2022 (windows.net)
2. Source: Table 8.1 World Energy Outlook 2022 (windows.net)

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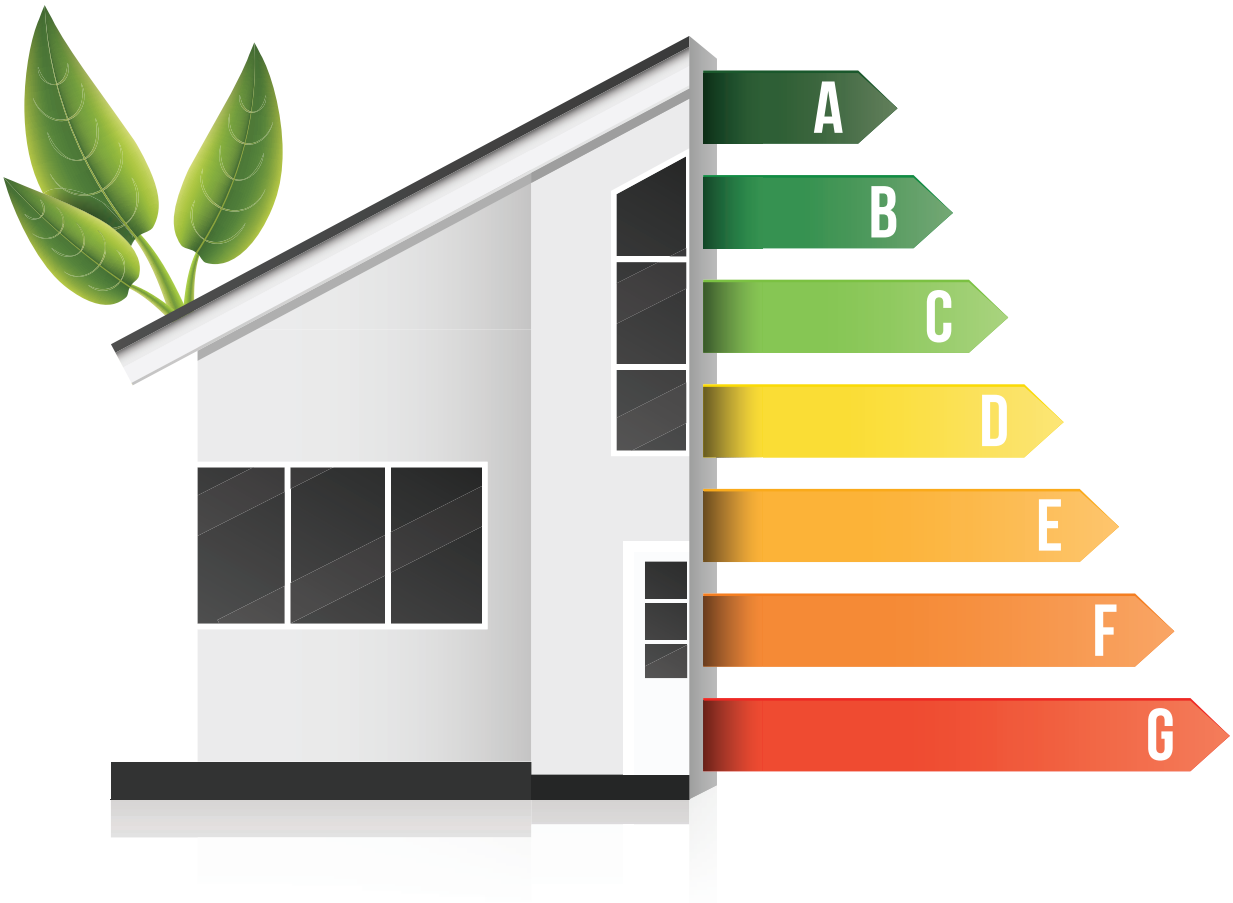

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