ARISAIG PARTNERS

Pricing Carbon Costs into Dairy Businesses

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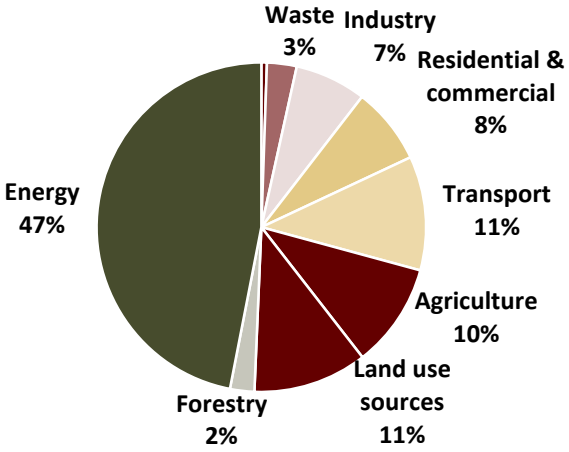
Introduction: The hidden cost of dairy

Climate change and the perpetrator - carbon emissions – are typically associated with smokestacks and plumes of pollution. However, it may come as a surprise to discover that over 20% of global emissions stem from agriculture and land use, which is more than global transport and industry combined.

Source of Greenhouse Gas Emissions by Sector (2010)



Source: UN Food and Agriculture Organization of the United Nations (FAO)

Within agriculture, cattle farming – and in turn dairy farming - holds the crown for being one of the most environmentally intensive forms of food conversion. Not only do cows require significant land resources via feed production (around 50kg/day for a lactating cow) and water (up to 5 litres per litre of milk), but they also release incredibly potent greenhouse gases in the process of converting feed and water into meat and milk. Methane (CH_4) is the most important of these and is a by-product of the enteric fermentation process that takes place in the cow's intestine as it digests carbohydrates. It is 25 times more effective at trapping heat in the atmosphere than carbon dioxide, making it a particularly troublesome greenhouse gas.

Sources of Carbon Footprint in Dairy

Category	Greenhouse Gas	Contribution to Emissions	Description
Feed	N_20, $C0_2$	36%	Direct and indirect emissions arising from production and transportation of feed (including fertiliser, crop processing, field operations)
Manure	N_20, CH_4	9%	Direct and indirect emissions arising during manure storage prior to application to land
Enteric Fermentatin	CH_4	47%	Emissions arising from enteric fermentation
Direct + Indirect Energy	CO_2	2%	Emissions arising from energy use on-farm for heating, ventilation etc.
Post farmgate	CO_2	6%	Energy use in processing and transport

Source: FAO (2013)

The result is that dairy products have amongst the largest carbon footprint of any that we encounter in our universe. In fact, as the table below shows, listed dairy companies as a group have amongst the highest carbon intensity of any sector outside of energy, materials and utilities.

S&P EM BMI - Carbon Intensity by GICS Sector – Direct + First Tier Indirect (tonnes CO2e/USD mn)

GICS Sector	Carbon Intensity
Utilities	4,667
Materials	1,972
Energy	1,612
EM Dairy Companies*	**832**
Food, Beverage & Tobacco	668
Transportation	544
Consumer Durables & Apparel	352
Household & Personal Products	173
Technology Hardware & Equipment	156
Real Estate	139
Consumer Services	131
Pharmaceuticals, Biotechnology & Life Sciences	100
Food & Staples Retailing	81
Health Care Equipment & Services	73
Telecommunication Services	72
Diversified Financials	63
Media & Entertainment	35
Software & Services	27

**Sample of 14 dairy companies within the S&P EM BMI*

Source: Trucost, Arisaig Partners

Why is this such a big problem?

It is estimated that without a change in course, **by 2030 the livestock sector alone could account for 37% of the total emissions budget required to keep global warming below 2°C** (a critical tipping point for the planet's health).

In order to ensure a more sustainable 1.5°C future, experts are now advising a 50% cut in production and consumption of dairy (and red meat). This advice is increasingly being reflected in policy discussions in the developed world, as well as in company strategy and consumer preferences. This creates significant **climate transition risk** for dairy companies.

1. **Government policy** – in the U.S. the Department of Agriculture Secretary Sonny Perdue has recently announced support for carbon pricing in agriculture as a means of encouraging farmers to improve productivity levels. The EU is debating similar measures as part of its 'Green Deal' to transition the region to carbon neutrality by 2050. Although these will take some time, they are likely to put increasing pressure on high intensity agriculture forms and encourage farmers to pursue alternative options. This may well then become the blueprint for agriculture agencies around the world.

2. **Climate transition strategies within value chain** – there is increasing pressure on companies across the dairy value chain to report and reduce their full-scope carbon footprint, which is already re-shaping future strategies. For example, Starbucks recently acknowledged dairy as its greatest source of carbon emissions and a key target for meeting its goal of reducing emissions 50% by 2030 (e.g. through offering of alternative milks). In future, grocery retailers might look to do the same as they attempt to bring down their own full-scope emissions.

3. **Consumer substitution** - Animal dairy has many attractive qualities, most notably its natural nutrient offering which has put it at the forefront of many government health agendas – most famously in the 'Got Milk' campaign in California in the 1990s. The problem with dairy is that it offers very little that can't be found in readily available less environmentally intensive foods.

   There is growing publicity of the contribution that changing diets away from the meat and dairy could have on the planet. The IPCC estimates it could contribute 20% of the mitigation needed to hold warming below 2°C.

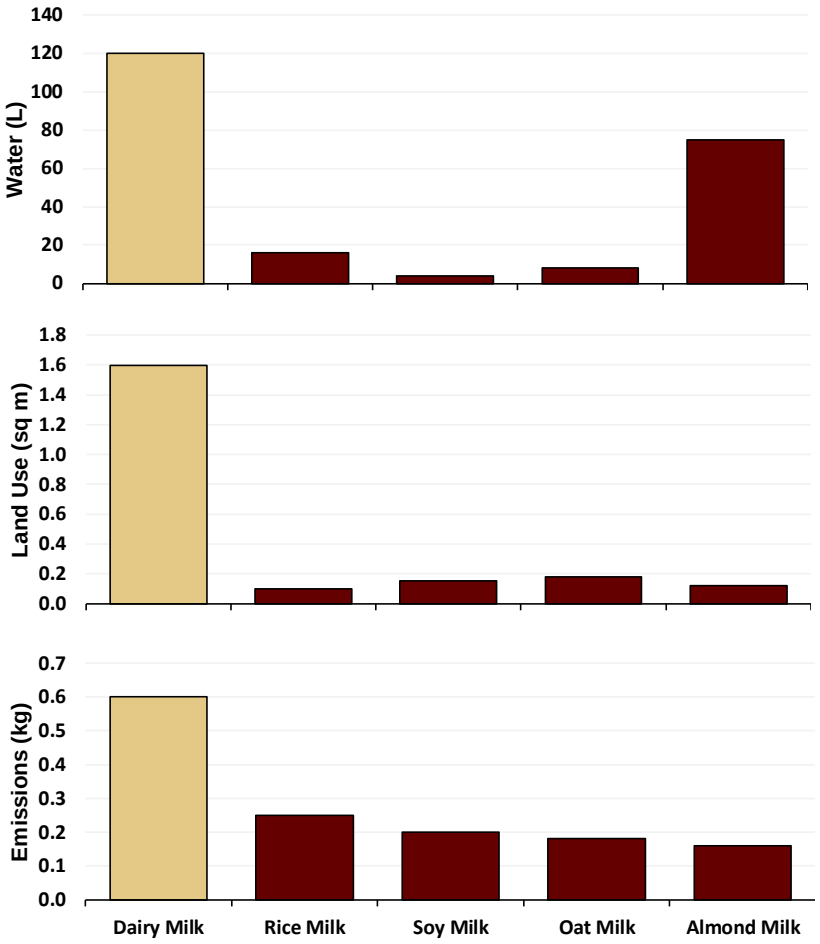
   This has helped to support a surge in availability and demand for plant-based dairy alternatives – e.g. soy, oat and nut-based products – across both the developed and emerging world. These products have significantly lower footprint in terms of water, land use and emissions, while also containing a comparable (in some cases better) nutritional profile.

Nutritional Profile of Milk Alternatives (per 240ml)

	Rice Milk	Coconut Milk	Soy Milk	Almond Milk	Cows Milk
Carbohydrates (g)	25.3	1.2	5.0	1.3	11.5
Sugars	13.1	0.6	3.4	0.1	–
Fibers	0.0	0.3	1.0	0.6	0.0
Fats (g)	2.3	4.4	4.4	2.7	9.1
Proteins (g)	0.9	0.0	8.7	1.7	8.1
Minerals (mg)	0.0	0.0	0.0	0.0	0.0
Calcium	245.5	244.8	205.9	325.3	294.2
Iron	0.1	0.1	0.8	0.2	0.1
Vitamins	0.0	0.0	0.0	0.0	0.0
Vitamin C (mg)	0.0	0.0	0.0	0.0	3.7
Vitamin B6 (mg)	–	–	0.1	–	0.1
Vitamin B-12 (µg)	1.0	0.8	0.7	1.0	0.9
Vitamin A (µg)	67.5	60.0	32.6	77.1	82.0
Vitamin E (mg)	3.0	–	4.0	3.8	–
Energy (kcal)	133.0	48.8	95.0	36.4	158.0

Source; Vanga SK, Raghavan V (2018)

Environmental Impact of One Glass (200ml) of Milk Alternatives



Source: BBC; Poore and Nemecek (2018), Science

Based on the plant-based food and beverage developments we have seen in Europe (the most advanced market in this trend), it is likely that this substitution effect will begin with the milk category before moving onto yoghurt and then potentially towards more processed dairy. In theory, this could pose more of a threat to the emerging market dairy industry as milk and yoghurt combined represent around 75% of sales (v. 40% in the developed world).

Pricing in Carbon Emissions

David Robinson Simon, in his 2014 book 'Meatonomics', calculates that the 'true' cost of a gallon (3.8 litres) of milk – including the hidden expenses of health care, subsidies, and environmental losses – was USD 9, almost three times the USD 3.50 charged in a store. If we reflected these costs at the till, it is hard to imagine consumers sticking to conventional dairy.

Applying a similar style of analysis, we can attempt to model out the potential risk of changing regulation and consumer preferences by applying a carbon price to the current emissions of listed dairy companies. This allows us to project what level of economic hit they might expect as we transition towards a lower carbon future. Of course, this is a crude exercise, but it is a useful starting point to understand how vulnerable a given company might be and therefore how seriously they should be taking their mitigation strategy.

As can be seen from the table below, there can be wild differences in the level of carbon intensity amongst dairy companies.

Carbon Intensity of Listed Dairy Companies with S&P EM BMI

Company Name	Carbon-Weighted Disclosure (%)	Carbon Intensity (tonnes CO2e/USD mn Revenue)		
		Direct Emissions	First Tier Indirect Emissions	Direct+First Tier Indirect
Almarai Company	0.0	1,562	379	1,941
Bright Dairy & Food Co.	0.0	39	893	931
China Mengniu	99.0	47	855	902
Fan Milk Limited	0.0	42	678	720
Grupo Lala, S.A.B. de C.V.	100.0	33	477	509
Inner Mongolia Yili	99.4	77	938	1,015
Nestle Foods Nigeria Plc	99.0	52	678	730
Nestle India Ltd	99.9	144	614	758
Nestle Malaysia Bhd	99.0	45	923	968
Nestle Pakistan Ltd	0.0	43	552	595
Parag Milk Foods Limited	0.0	42	678	720
Saudia Dairy & Foodstuff Company	0.0	43	639	681
Vietnam Dairy Products	98.2	14	413	426
Yashili	100.0	58	691	749
Average	**56.8**	**160**	**672**	**832**

Source: Trucost
(Arisaig current and previous holdings highlighted in pink)

There are several key observations that are worth touching upon before further analysis:

→ **Disclosure levels vary** – as show by the carbon-weighted disclosure column, there are still many dairy companies that are failing to report their carbon emissions (NB. 100% reflects fully updated and complete reporting). In these instances, we are forced to rely on Trucost's sector-based modelling to estimate what the footprint might be.

- → **Majority of emissions are within the indirect supply chain** – around 80% of the emissions sit within the 'first tier indirect' stage of the companies' value chain, which is the first level of suppliers (i.e. dairy farms providing the milk).
- → **Business model explains much of the variance in intensity** – some companies – e.g. Almarai – own their supply chains and hence will 'own' the full impact of the dairy footprint. Equally, some companies – e.g. Vietnam Dairy and Fan Milk Ghana – primarily procure powdered milk from overseas and dilute it within production, allowing them to generate higher revenue intensities per kilogram of milk produced.

Bearing that in mind, we can then apply an economic cost to these emissions, based on the growing belief that companies should be forced to pay for this measurable externality.

Selecting the right carbon price is a very complicated process as there are numerous moving parts. What's more, the price itself can have several interpretations, depending on the objective of the analysis. For the purposes of this exercise, we have focused on the more straightforward carbon tax approach. This paints a more conservative picture of the future as it does not consider elasticities within the value chain or mitigation plans of individual companies (or indeed the sector at large). In practice this applies to companies in the following way:

a) **First tier indirect** – as mentioned earlier, there is increasing reason to believe that the agriculture industry will come under carbon pricing regimes in the coming years. This will increase the farm cost of production of high-footprint dairy products, which due to already-low operating margins, are likely to be passed directly through to branded manufacturers.
b) **Direct operations** – dairy processors and branded manufacturers are likely to see higher costs of operation as they are forced – amongst other industries - to pay for the carbon emissions created during the transportation, conversion and sale of the final product.

To keep things simple, we apply a USD75/tonne carbon price across the entire value chain by 2030. This is the mid-point of the guidance level set by the Intergovernmental Panel on Climate Change (IPCC) for global emissions in order to achieve the Paris Agreement (i.e. keeping temperatures well within 2°C of pre-industrial levels).

Carbon 'Earnings at Risk' of Listed EM Dairy Companies

Company Name	Loss in EBIT (%)	Margin Compression (bps)	Current PE (12m Forward)	Climate Transition PE (12m Forward)
Almarai Company	EBIT -ve	-14,558	21.8	-
Bright Dairy & Food Co.	EBIT -ve	-6,986	24.5	-
China Mengniu	EBIT -ve	-6,763	23.4	-
Fan Milk Limited	-71%	-5,402	14.4	50.7
Grupo Lala, S.A.B. de C.V.	-56%	-3,819	12.6	28.4
Inner Mongolia Yili	-83%	-7,610	22.3	133.6
Nestle Foods Nigeria Plc	-22%	-5,478	11.4	14.5
Nestle India Ltd	-28%	-5,686	58.5	80.8
Nestle Malaysia Bhd	-44%	-7,259	44.7	79.8
Nestle Pakistan Ltd	-35%	-4,463	40.9	62.5
Parag Milk Foods Limited	-70%	-5,402	3.8	12.9
Saudia Dairy & Foodstuff Company	-42%	-5,110	13.9	23.8
Vietnam Dairy Products	-15%	-3,198	15.6	18.3
Yashili	EBIT -ve	-5,184	22.1	-
Average (of profitable companies)	**-47%**	**-6,208**	**23.6**	**50.5**

Source: Trucost, Factset, Arisaig Partners

The results in this scenario are stark. The average listed emerging market dairy company would, ceteris paribus, see **a structural operating profit write-down of 50%** (often referred to as the 'earnings at risk'). This has the effect of over doubling the forward price-to-earnings multiple you are paying for most of these businesses today. Four of the 14 companies would cease to turn a profit at all and would have to seek drastic remedial action in order to continue operating.

Broadening the analysis, we can apply a range of carbon price scenarios to this analysis using the IPCC guidance level for carbon pricing (in order to keep keeping temperatures well within 2°C) in 2020 and 2040. As we roll forward, we notice a significant increase in the risk of existential crisis for dairy companies.

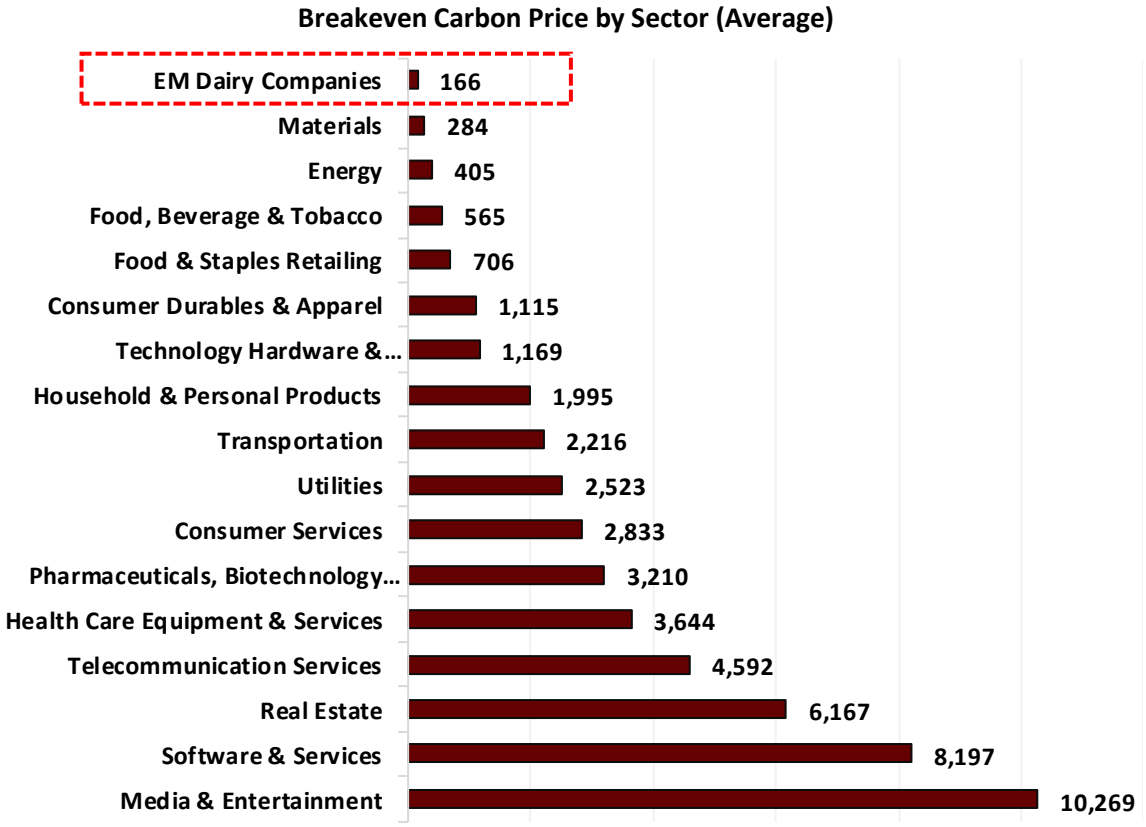
Carbon 'Earnings at Risk' of Listed EM Dairy Companies by Scenario

	Loss in EBIT (%)			
Company Name	**2020 @$60/tonne**	**2030 @$75/tonne**	**2040 @$133/tonne**	**Breakeven Carbon Price**
Almarai Company	EBIT -ve	EBIT -ve	EBIT -ve	52
Bright Dairy & Food Co.	EBIT -ve	EBIT -ve	EBIT -ve	49
China Mengniu	-87%	EBIT -ve	EBIT -ve	69
Fan Milk Limited	-57%	-71%	EBIT -ve	105
Grupo Lala, S.A.B. de C.V.	-45%	-56%	-99%	135
Inner Mongolia Yili	-67%	-83%	EBIT -ve	90
Nestle Foods Nigeria Plc	-17%	-22%	-38%	347
Nestle India Ltd	-22%	-28%	-49%	272
Nestle Malaysia Bhd	-35%	-44%	-78%	171
Nestle Pakistan Ltd	-28%	-35%	-61%	217
Parag Milk Foods Limited	-56%	-70%	EBIT -ve	106
Saudia Dairy & Foodstuff Company	-33%	-42%	-74%	180
Vietnam Dairy Products	-12%	-15%	-26%	510
Yashili	EBIT -ve	EBIT -ve	EBIT -ve	24
Average (of profitable companies)	**-42%**	**-47%**	**-61%**	**166**

Source: Trucost, Factset, Arisaig Partners

Finally, we can determine what the breakeven carbon price is for each dairy company. This is the level of carbon price that would push the company into an operating loss (i.e. force EBIT to zero), assuming the carbon price was fully transmitted through the income statement. It is interesting to note that the Chinese dairy giants and Almarai look particularly vulnerable on this measure.

More broadly, it is worth noting that dairy companies as a group have amongst the lowest breakeven price of any sector within emerging markets (see chart below). This is due to the combined effect of high carbon intensity and relatively low margins on average.



Source: Trucost, Factset, Arisaig Partners

What can dairy companies do?

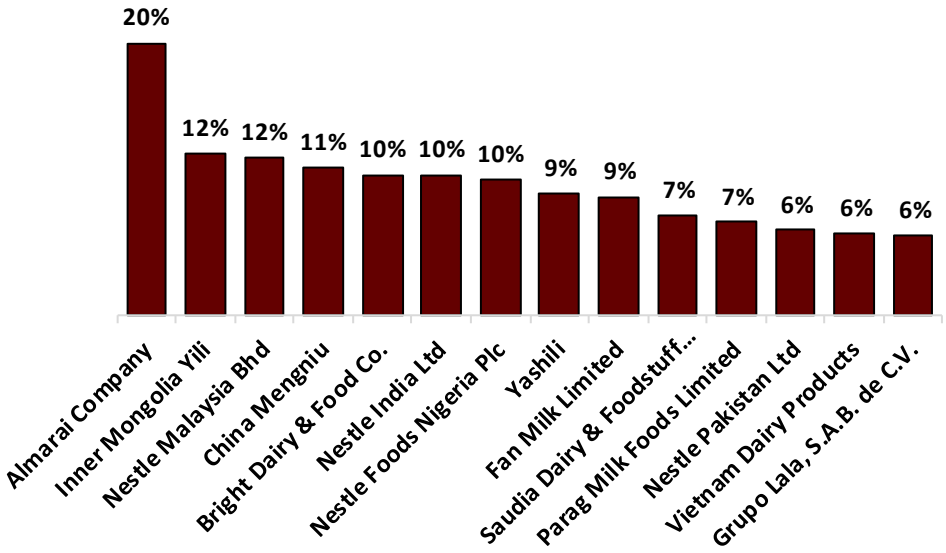
No dairy company is going to walk straight into this, and there are several steps they could take to lessen the blow and maintain their viability:

1) 'Premiumise' and diversify the product portfolio

The above analysis is crude in that it assumes a complete pass-through of the carbon price (or 'tax') onto the dairy company's income statement. In reality, there would be flexing in the value chain that would reduce this burden. Most notably, prices for end-consumers could be adjusted to pass through some of this cost. In the chart below, we estimate what level of pricing will need to be passed through by different listed EM dairy companies in order to preserve their current gross profit margins.

Complicating this is the fact that a range of academic studies from around the world suggests that the price elasticity of regular milk is high (i.e. >1, and in some cases >4). This could result in volume declines at a rate multiple to this price increase. This would lead to significant operating deleverage which would in turn unwind the unit economics and therefore return on capital.

Pricing Required to Pass Through Carbon Costs and Maintain Gross Profit Margin



Source: Trucost, Factset, Arisaig Partners

Passing through pricing this is only likely to be possible within more premium milks (e.g. organic, lactose free or fortified) or more value-added dairy products (e.g. premium yoghurts, cheese, infant formula and powdered nutrition), where price elasticities have been found to be lower (<1).

Dairy Diversification of Listed Emerging Market Dairy Companies

Company Name	Mainstream Dairy*	'Value-added' Dairy*	Non-Dairy
Almarai Company	42%	20%	38%
Bright Dairy & Food Co.	100%	0%	0%
China Mengniu	86%	14%	0%
Fan Milk Limited	0%	100%	0%
Grupo Lala, S.A.B. de C.V.	47%	53%	2%
Inner Mongolia Yili	37%	58%	5%
Nestle Foods Nigeria Plc	0%	1%	99%
Nestle India Ltd	7%	39%	54%
Nestle Malaysia Bhd	10%	75%	15%
Nestle Pakistan Ltd	63%	15%	22%
Parag Milk Foods Limited	98%	2%	0%
Saudia Dairy & Foodstuff Company	68%	17%	15%
Vietnam Dairy Products	46%	51%	3%
Yashili	0%	100%	0%
Average (of profitable companies)	**43%**	**39%**	**18%**

Source: Company Reports, Globaldata

**Mainstream dairy consists of non-fortified milk and basic dairy byproducts (e.g. ghee); value-added dairy is all other dairy-based products*

Consequently, it is recommended that dairy companies pursue a portfolio premiumisation and diversification strategy in order to insulate themselves from this cost inflation in their key ingredient. As can be seen from the table above, many dairy companies have already begun this journey, while others remain highly dependent on mainstream dairy (primarily milk).

2) Develop portfolio of alternative products

Another strategy available to dairy companies is to diversify their portfolio away from animal-based dairy and into plant-based alternatives. This can help to provide consumers with options that are less environmentally intensive and also more amenable to certain diets (e.g. lactose intolerance). In a sign of things to come, Danone, one of the world's largest dairy companies has announced plans to triple the size of its EUR ~2bn plant-based portfolio by 2025.

Plant-based beverages – in particular soy milk – are seeing support across emerging markets such as Brazil, Mexico, China and Vietnam. It is not yet clear that there is much environmental awareness behind this, but this may come as government's reconsider what constitutes sustainable diets for their population (in many cases animal dairy is still recommended as a part of a daily basket).

Soy Milk Offerings from Vietnam Dairy Products (Vinamilk) (Left) and Grupo Lala (Right)

Leading dairy companies do have presence within this segment of the market – e.g. see soy milk offerings from Vietnam Dairy Products (Vinamilk) and Grupo Lala above – although in most cases they are playing catch-up with early-movers.

One might assume that dairy companies should have all the tools they need to succeed in this space - established nutrition know-how and R&D capabilities, and an invested route-to-market. However, it is not always in their favour. Plant-based products require separate sourcing agreements (often through international suppliers), are often not legally allowed to be produced in facilities that process animal protein (for fear of contamination), and do not require cold-chain distribution (which nullifies the competitive advantage that dairy companies have in this area).

As such, dairy companies will have to develop a comprehensive commitment to diversifying away from their traditional product portfolios if they are to succeed. This might well require inorganic acquisitions, strategic partnerships or significant capital expenditures in the short-term in order to get ahead.
There are, of course, environmental considerations with these alternative ingredients that must be considered by any company looking to jump on the trend. These include avoiding deforestation in soybean supply chains (the second-largest contributor to agricultural deforestation globally after cattle) and water stress in almonds (this water-intensive crop is found in some of the most drought-prone regions of the world such as California, Spain and Morocco).

3) Cut emissions throughout value chain

Another key step would be to remove as much of the emissions from the value chain as possible. This is no mean feat given the high starting point, but there is growing evidence to suggest this can be achieved.

Danone offers a great example of what dairy companies can do to manage this supply-chain carbon footprint. The company has committed to being carbon neutral – throughout its supply chain – by 2050. This will be achieved through:

a) **Cutting direct emissions** – removing energy use in the processing and transportation of the products and switching to renewable sources;
b) **Carbon sequestration** through the agricultural supply chain –persuading farmers to move away from the traditional model of heavy soil tilling and fertilisation towards a more traditional 'healthy soil' approach (no tilling; composting; selective grazing).
c) **Offsetting** – this is another form of sequestration through reforestation. On a related point, we have come across one solution proposed by US NGO Project Drawdown called 'Silvopasture' that integrates trees and pasture into a single system for raising livestock. This has the potential to **sequester five to ten times as much carbon** as those without trees.

This will be significantly more straightforward in certain parts of the world on account of the wide range of carbon intensities of milk production in different regions – largely on account of the feed mix, which has to be imported in some markets. Dairy farms in the US, Europe and Australasia have amongst the lowest underlying footprints and will therefore have an easier run. In fact, US-based Horizon Dairy (owned by Danone) has plans to become carbon positive as early as 2025.

The Paris Agreement calls for a 25% reduction in absolute global emissions by 2030. In order for dairy companies to play their role in achieving this, they will need to reduce their full-scope carbon intensity annually by at least 3%. Those that are projecting faster growth will have to work even harder to remove the footprint of their enlarged sales base.

Full-Scope Carbon Emissions Intensity Reduction Required to Meet Paris Agreement

		Revenue Growth CAGR to 2030				
		1%	3%	5%	7%	10%
Warming Scenario	Paris-Aligned 2.0°C	-3.2%	-5.1%	-6.9%	-8.6%	-11.1%
	Climate Goal 1.5°C	-5.2%	-7.1%	-8.8%	-10.5%	-13.0%

Source: Arisaig Partners

Concluding thoughts

As consumers become more aware of the environmental intensity of dairy and beef, we are likely to see growing pressure on demand for these products. Simultaneously, as governments tighten their commitments around climate targets, the cost of production of dairy is likely to increase. This could well evolve into a major existential threat for dairy companies.

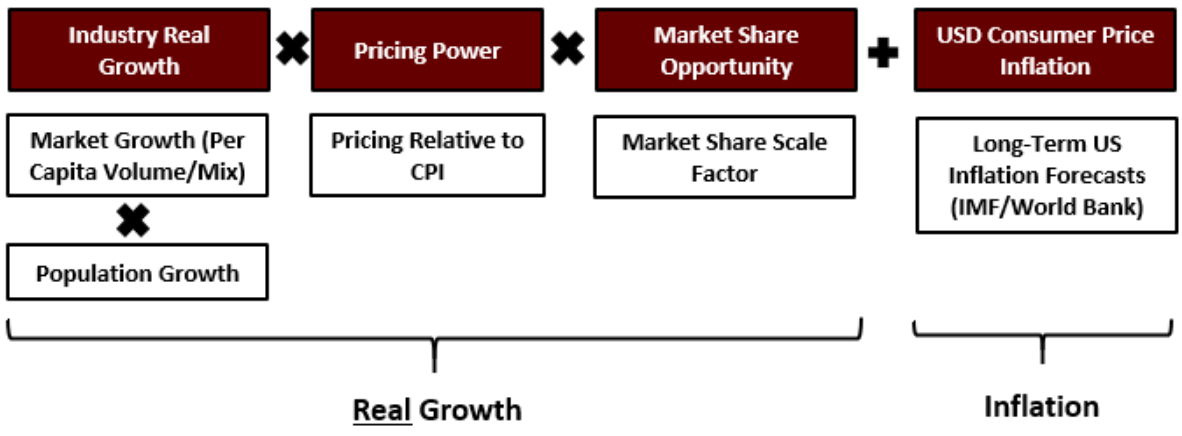
That said, the evidence suggests that this risk is long-dated and is likely to phase in gradually. This should give the more dynamic companies the time to diversify their portfolios towards 'categories of the future' such as plant-based beverages. Danone is a good benchmark to follow here as a company that fully appreciates this risk and is pulling several levers to mitigate it.

This is having direct and immediate consequences on our universe curation, company engagements and portfolio decision-making.

a) **Universe curation** – 'growth' is one of the key characteristics that define our universe. However, it is looking increasingly challenging for traditional mainstream dairy to achieve sustainable, above-inflation compounding revenue growth in many parts of the world. As such, only dairy companies that offer differentiated products in under-penetrated segments will enter our 'prime list' of likely investment candidates. This, for example, rules out the Middle Eastern and Chinese dairy players.

b) **Portfolio decision-making** – at the core of our portfolio decision-making is our long-term financial modelling system, the Arisaig Crystal Ball (ACB). The ACB is a 20-year cashflow model which is designed to force us to think about the long-term opportunities and risks inherent within each company and to factor these into our forecasts (for those who want to know more about this, please request a separate whitepaper we have written on this). Within the ACB we model out the full cashflow model, but by far the most critical element – courtesy of the power of compounding - is the revenue growth forecast. The major drivers of the nominal US dollar revenue growth within each model are highlighted below.

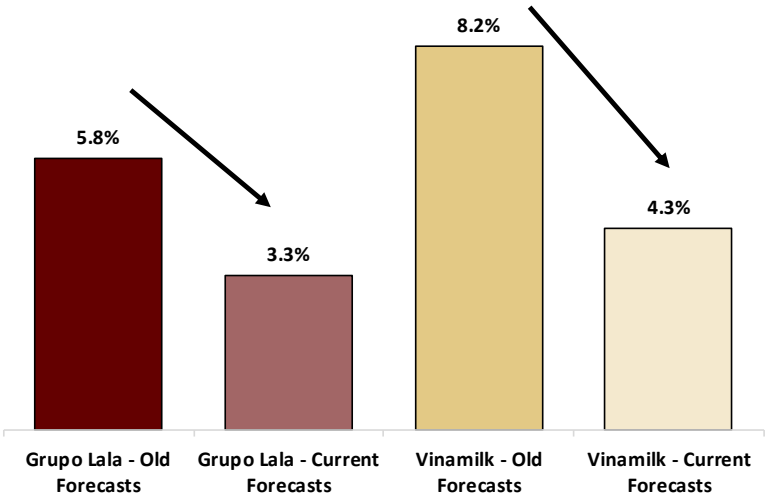
ACB Nominal Revenue Forecast Drivers (US Dollar)



When it comes to dairy companies, we have had to reconsider each of the three real growth drivers. We are seeing per capital dairy volume peaking across many markets (including wealthier emerging markets), creating concerns around the potential for further penetration opportunities. On the pricing front, we have already discussed the elasticity challenges with passing through increases (often exacerbated by retailers use of milk as a loss-leader to drive traffic to stores). The outlook is arguably less bleak on market shares, wherein tougher operating conditions going forward could lead to a shakeout of smaller players.

With this in mind, we have recently re-reviewed our forecasts for dairy growth in Vietnam and Mexico, which has forced a sizeable downgrade in the growth expectations for two of our holdings there, Vietnam Dairy Products (Vinamilk) and Grupo Lala (see below). This in turn is initiated a fundamental review of their future as investments.

ACB 20-Year Real Revenue CAGR Forecasts

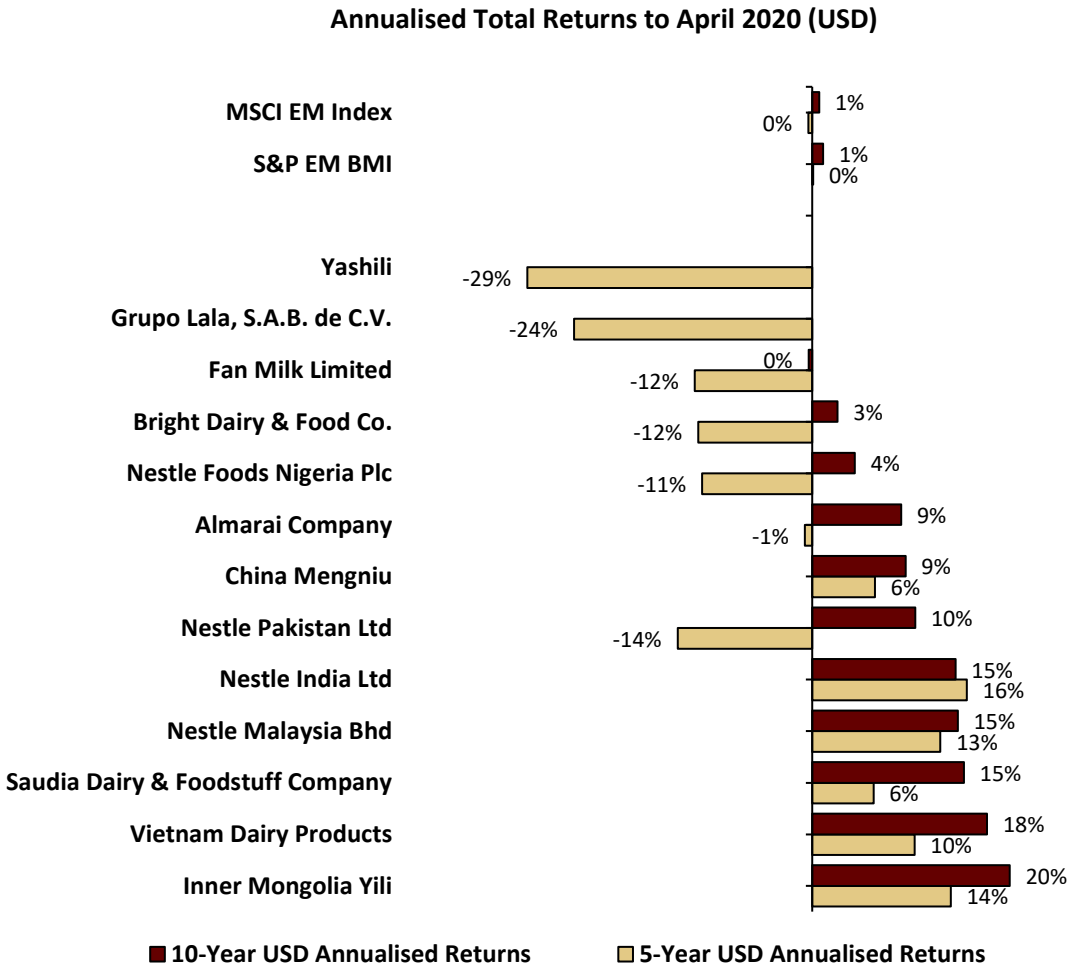


c) **Company engagements –** prior to casting judgement on a dairy company's strategy and approach to climate transition risk, it is important to meet with management and discuss it from an internal perspective. This can provide important insights into the future direction of the business and potentially uncover emerging long-term strategies that are not fully appreciated by the market. Equally, it could reveal a lack of urgency or concern that might herald greater difficulties to come.

This process is no different to any other emerging trend that we incorporate into our portfolio strategy. It also reflects our emphasis on the long-term outlook for categories and companies over short-term factors such as one-year forward valuations.

This does not close the door on the USD215 billion dairy market in the emerging world, but it does raise the bar on growth, quality and alignment. As the table below shows, listed emerging market dairy companies have for the most part been decent investments over the past decade as penetration of dairy has improved from low levels. However, in recent years, slowing growth and milk price volatility has had a dampening effect and has increased the dispersion in fortunes. With the above

risks looming, we believe this could exacerbate.



Source: Factset