SURPLUS ENERGY ECONOMICS

The home of the SEEDS economic model

#242. The dynamics of global re-pricing

IN SEARCH OF EXPLANATIONS

SUMMARY

There is a growing acknowledgement that the World economy has entered a new era. We know that the cost of capital is trending upwards, with adverse consequences for asset prices. But there's been remarkably little inclination to examine the underlying processes that are causing this to happen. Neither is there much in the way of recognition that entire sectors could be crushed, or even eliminated altogether, as re-pricing becomes more selective.

We need to **dismiss any idea that this is temporary**. There are some linkages connecting the resurgence of inflation with pandemic-era QE, and with the war in Ukraine, but these are little more than symptoms.

The underlying dynamic is that **the economic driver of the industrial era** – the supply of low-cost energy from oil, natural gas and coal – **is winding down**, and there is **no assured replacement at hand**. Transition to renewables is imperative, but there's no guarantee that an economy based on wind-turbines, solar panels and batteries can be as large as the fossil-based economy of today. **The probabilities are that it will be smaller**.

Had we been prepared to do so, we could have seen this coming. The chain of causation starts in the 1990s, when the authorities responded to "secular stagnation" with deregulation programmes that made credit easier to obtain. The subsequent financial crisis forced the adoption of QE, initially to prop up the banking system, and latterly as a self-standing form of stimulus. We were assured, quite wrongly, that QE would not be inflationary, but it has created a systemically-dangerous "everything bubble" in assets.

The fundamental issue is that **the material costs of energy supply have been rising relentlessly**. We cannot "de-couple" the economy from energy use, and this report describes a remarkable linearity between the quantity of energy that is used and the economic output that ensues. Meanwhile, and whilst economic *output* is poised to contract, material *prosperity* will be further impaired by rises in the Energy Cost of Energy (ECoE).

The true cause of inflation is **the worsening disequilibrium between the 'real' economy of products and services and the 'financial' economy of money and credit**. The only way to tame inflation is to eliminate the anomaly of negative real costs of capital. **Combined with deterioration in material prosperity**, this points towards a fundamental re-pricing of the economy.

With the real costs of energy-intensive necessities continuing to rise, two parts of the economy are at particularly elevated risk. One of these is the supply of **discretionary** products and services to consumers. The other is those parts of the corporate and financial system which rely on **flows of income** from the household sector.

19th September 2022 https://surplusenergyeconomics.wordpress.com/

INTRODUCTION

The global economy **is heading for re-pricing**, which means a fundamental change in the relationship between economic *flow* (including output, incomes and expenditures) and financial *stock* (the valuations of assets, collateral and liabilities). This process has already commenced – and is going to be chaotic - but its real causation has yet to gain recognition.

As we shall see, there is *no* non-inflationary way in which economic flow can be increased. This means that, as dynamics of this relationship change, stock valuation *must* fall.

The reduction of the global balances of assets and liabilities will be an uneven process, both geographically and between sectors, but the generality of financial stock degradation is likely to be of the order of 40-50%, measured from the start of 2022. Sectors providing necessities to consumers will fare better than those supplying discretionaries, for whom the outlook is grim.

The 'why?' of re-pricing is simple to describe, but making sense of it requires a major change in how we think about the economy. We need to move away from the economic orthodoxy which continues to assert that the economy is entirely a financial system, not subject to material limitations.

As well as meaning that there need never be any end to growth, the classical conception also asks us to believe that the flow of economic output can be measured by counting financial transactional *activity*. But transactional activity can be inflated using monetary policies, and it's perfectly possible for transactions to take place which add no economic value at all. This makes GDP a particularly poor metric for the measurement of prosperity in the economy.

The prerequisite for effective interpretation is recognition that the economy is a system which **supplies material goods and services to consumers**. The provision of these products and services is a function of the use of energy.

Once this is understood, we need to draw a distinction between economic output and prosperity. *Output* is analogous to the income of a household, whilst *prosperity* corresponds to how much of that income remains after the costs of necessities have been met.

The economic *output* side of the equation involves the conversion of primary energy into economic value. This energy conversion ratio **is remarkably static**, hardly varying at all over the past forty years. Globally, *economic output rises or falls in accordance with increases or decreases in the availability of energy*.

The *prosperity* dimension of the equation is determined by the Energy Cost of Energy. This has been rising relentlessly over a very long period, and there are **no** realistic grounds for expecting it not to carry on doing so.

The pricing of assets is a function of a process of the *futurity* which links *current* prices with *forward* value expectations. The consensus forward projection has been, and remains, one of continued economic expansion, albeit with minor setbacks along the way.

But **material trends are invalidating the money-only notation of classical economics**. As this reality sinks in, the consensus futurity will be degraded, introducing a wholly new dimension into equations linking current pricing and forward expectations.

This is going to induce the equivalent of vertigo, as market participants realise that we've been **pricing a future that cannot happen**. The degradation of futurity will trigger chain reactions right across the interconnected, collateralized World financial system.

How can we know that this is going to happen? The answers lie, not in the ebb and flow of market sentiment or, for that matter, of policy, but in the fundamentals.

The effective interpretation of economic processes requires some straightforward foundation principles.

The first of these is that **the economy is an energy system**, because *nothing* that has any economic utility whatsoever can be supplied without the use of energy. This applies, not just to products and services, but to the entirety of the economy. The creation and maintenance of infrastructure and capacity is entirely reliant on the availability of energy. Access to raw materials - ranging from minerals, chemicals and plastics to food, fertilizers and water - is a function of the energy required to supply them.

The second principle is that *energy is never 'free'*. Whenever energy is accessed for our use, some of that energy is *always* consumed in the access process. This 'consumed in access' component is known here as the Energy Cost of Energy. This is **the principle of ECoE**.

Oil isn't 'free' because it exists beneath your land – you still need wells, pipelines, refineries and the rest of the supply system. Solar and wind power aren't 'free' just because the sun shines and the wind blows – we still need solar panels, wind turbines and distribution systems, with the added complication of storage capacity to offset intermittency. *None of this infrastructure can be built or maintained without the use of energy*.

The third foundation principle is that money has no *intrinsic* worth. Rather, it commands value **only** as a 'claim' on the output of the material economy. This is the principle of **money as claim**.

From these principles, two conclusions naturally follow.

First, material *prosperity* is a function of the *surplus* energy which remains after ECoE has been deducted from total supply.

Second, the economy, as presented financially, is a representation or *proxy* of the underlying material economy determined by the supply, value and cost of energy.

This wouldn't be a problem if conventional financial notation was an *accurate* representation of the material economy.

Unfortunately, though, **it is not**. We have to take a brief journey into history to see why.

DIVERGENCE - ‘THE CLASS OF ‘76’

The widening gap between material fact and financial representation can be traced all the way back to 1776. The huge, complex and energy-intensive economy of today began when James Watt unveiled the first really efficient device for converting heat into work, giving us access to the vast energy resources contained in fossil fuels.

Adam Smith’s *The Wealth of Nations*, published in that same year, was the foundation treatise for a school of economics which seeks to explain everything in terms, not of energy, but *of money alone*.

Writing as he was in an agrarian, low-energy economy, Smith cannot be blamed for not anticipating the transformation that would result from work that his fellow Scot was at that moment completing just a few miles away. But his successors can, and should, be criticized for a blind adherence to precepts which, by insisting on the financial, rigorously exclude the material.

With material factors disregarded, it becomes perfectly possible to predict infinite economic growth on a finite planet, a proposition which no sensible person should accept. Perhaps Kenneth Boulding, co-founder of general systems theory, put it best, when he said that “[a]nyone who believes exponential growth can go on forever in a finite world is either a madman or an economist”.

On the flimsy foundation of immaterial, money-only interpretation, classical economics has erected what its adherents are pleased to call the “laws” of economics. These, of course, are simply *behavioural observations* about the human artefact of money, and are in no way analogous to the laws of science.

One example is the assertion that price is the outcome of the interaction of demand and supply, both of which are, of course, stated financially. The inference is that price movements create an automatic adjustment whereby *supply increases in accordance with rises in demand*.

If demand increases, this logic runs, prices rise such that producers have sufficient incentive to deliver a corresponding increase in supply. Higher prices also reduce demand, but the assumption remains that *rising prices create additional supply*. Supply is thus a function of demand, mediated by price.

But this could only work if the possibility of unlimited expansion of monetary demand was *matched by a correspondingly infinite potential for material supply*.

The reality, of course, is that *no* increase in demand, and *no* rise in price, *can supply anything which does not exist in nature*. The banking system cannot lend low-cost energy into existence, any more than central bankers can conjure it *ex nihilo* from the ether.

Instead of the outcome of some theoretical equation involving financial supply and financial demand, prices should be defined as **the *monetary* values assigned to *material* products or services**. If the balance between the financial and the material changes, *prices change with it*.

This should be obvious, even to those who insist that QE ‘doesn’t cause inflation’. To be clear about this, the use of QE during and after the GFC (global financial crisis) of 2008-09 may not have caused *consumer price* inflation, but it most certainly triggered harmful *asset price* escalation. When, during the pandemic, QE was aimed directly at households rather than, as hitherto, at asset markets, *consumer price inflation necessarily ensued*.

The mythology of economic infinity remains tenacious, and is evidenced whenever political leaders offer assurances of economic "growth" to the public. The problem at the heart of the ongoing fiscal fiasco in Britain has been the insistence that growth can be manufactured through a carrot-and-stick blend of incentive and need – if the financial framework is right, the argument runs, the better-off will have the incentive to invest, and everyone else will be compelled to work harder, thereby improving productivity. At no point has it been considered that, with global material conditions as they are, meaningful economic "growth" cannot be delivered *at all*.

Even the conventional calibration of productivity is misleading - dividing economic output by the quantity of human labour is of little real relevance, given that labour is a truly tiny component of the energy used in the modern economy.

IN SEARCH OF THE REAL ECONOMY

Until comparatively recently, the divergence between the material and the classical-financial hasn't been readily apparent. The heirs to Watt have carried on growing the economy, and the heirs to Smith have carried on representing this growth as the product of financial rather than thermodynamic processes.

Now, though, **the energy dynamic is winding down**. The supply costs of oil, natural gas and coal are rising through the effects of depletion. There is **no** assured, like-for-like replacement for the *energy value* sourced from fossil fuels. Prior growth in material prosperity has gone into reverse.

This is not reflected in financial calibration of economic flow. This calibration will become mistrusted before a new system of economic interpretation and quantification arrives to replace it.

Simply stated, **market participants will suffer a loss of faith in what they're being told about the economy**. This will result in downwards revisions of 'futurity', a term describing those perceptions of the future that are priced in to the valuation of financial stock. Rising risk premia will be the first manifestation of a much more fundamental realignment between the financial and the material.

We have a choice between getting ahead of the curve on material recognition, or hewing to the tried-and-failing notions of wholly immaterial – financial – causation and explanation.

Based on the principles outlined earlier, there are three things that we need to know. First, how much energy supply can we expect in the future?

Second, how does the use of energy translate into economic value? Third, to what extent will cost trends cause *prosperity* to deviate from *output* thus calibrated?

These are complex issues, made more so by orthodox economic conventions which, as exemplified by GDP, conflate transactional *activity* with material economic *output*.

A relatively brief set of answers to these questions requires the use of no less than three sets of charts (**Figs. 1, 2** and **3**), sourced from SEEDS (the Surplus Energy Economics Data System).

The measurement unit used here for energy is the tonne of oil-equivalent (toe). Financial numbers are stated in international dollars, converted from other currencies, not at market rates, but on the more representative basis of purchasing power parity (PPP), which is the convention used for measuring and forecasting global growth. Unless otherwise stated, financial numbers are expressed at constant 2021 values, so the notation is $PPP 2021.

ENERGY AND OUTPUT

Historically, we can observe that, whilst global real GDP almost quadrupled (+292%) between 1980 and 2021, World consumption of energy slightly more than doubled (Fig. 1A). The implication is that the efficiency with which energy is converted into economic output improved by 85% between those years (Fig. 1B). This makes it easy to understand the popularity of the mistaken notion that we can somehow "de-couple" the economy from the use of energy.

Accepting this at face value, though, would involve disregarding the rapid build-up of debt. Whilst energy use rose by 112% between 1980 and 2021, and GDP expanded by 292%, *debt exploded*, increasing by about 925% (Fig. 1C). (Comprehensive data for global debt gets hard to find as we scroll backwards from the 1990s, but the estimates used in Fig. 1C are intended to be consistent with subsequent trends – and, in any case, of the additional debt incurred between 1980 and 2021 [estimated here at $323bn], almost three-quarters [$239bn] has been taken on since 2000).

We may have increased GDP per toe of energy consumption by 85% since 1980, then, but the quantity of debt carried per toe of energy use expanded **by 380%** over that same period (Fig. 1D).

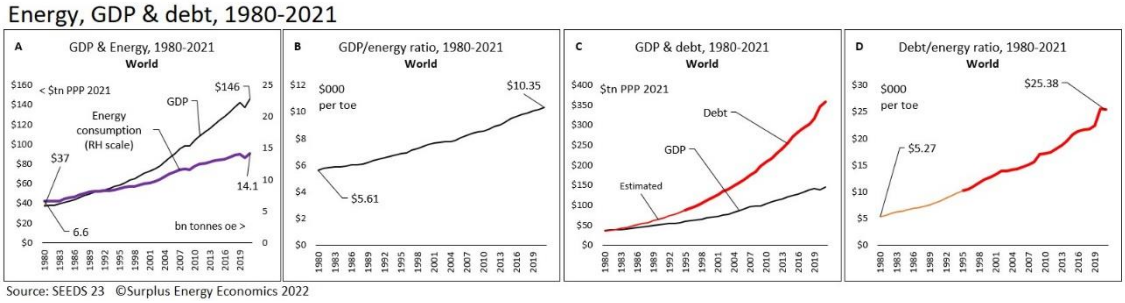
The fact of the matter is that GDP and debt are not discrete series, because increasing debt boosts the *transactional activity* measured as GDP. If we reined in credit growth, GDP would, at best, stop growing and, if we tried to *reduce* outstanding debt, it would slump.

What we have witnessed in modern times is that reported GDP has been inflated artificially by super-rapid debt expansion.

It's worth reflecting that, if this were *not* the case, we could reach a point of complete absurdity - the economy would become both extraordinarily wealthy (in terms of GDP), but also bankrupt (through the sheer weight of liabilities which the system couldn't possibly honour).

Fig. 1

Energy, GDP & debt, 1980-2021



Source: SEEDS 23 ©Surplus Energy Economics 2022

The ratio between borrowing and growth has averaged slightly less than 3:1 since 1980, meaning that almost $3 of debt has been added for each $1 of reported growth in GDP. There has been an upwards tendency in this global trend, and the ratios in many of the advanced economies of the West have been appreciably higher than World averages.

This relationship is pictured in Fig. 2A, which compares GDP growth with debt expansion, the latter expressed as a percentage of GDP. Between 1980 and 2021, real GDP expanded at a compound annual rate of slightly less than 3.4%, but the real rate at which debt increased exceeded 5.8%. Reported "growth" of 3.4% was achieved by borrowing at an average annual rate of 10% **of GDP**.

The SEEDS economic model strips out this 'credit effect' to calibrate underlying or 'clean' economic output, known here as C-GDP. The annual rate of growth on this basis was materially lower between 1980 and 2021, at slightly less than 1.9%, rather than 3.4% (Fig. 2B). Accordingly, underlying output increased by only 114% - rather than the reported 292% - over that period (Fig. 2C).

Critically, the calculated expansion in C-GDP (of 114%) tallies **almost exactly** with the increase in energy consumption (112%) over this forty-year period. Put another way, **the relationship between underlying economic output and the use of energy is linear**.

This was not an anticipated finding during the financial calibration of C-GDP back to 1980 from its previous start-date in 2000. But it reinforces the view, which has been demonstrated in various financial and non-financial ways, that **"de-coupling" the economy from the use of energy cannot happen**. The European Environmental Bureau reached this conclusion in 2019, describing the case for de-coupling as "a haystack without a needle".

In short, **if we consume less energy, the economy gets smaller**. Likewise, if we use less energy *per capita*, the average person gets poorer.

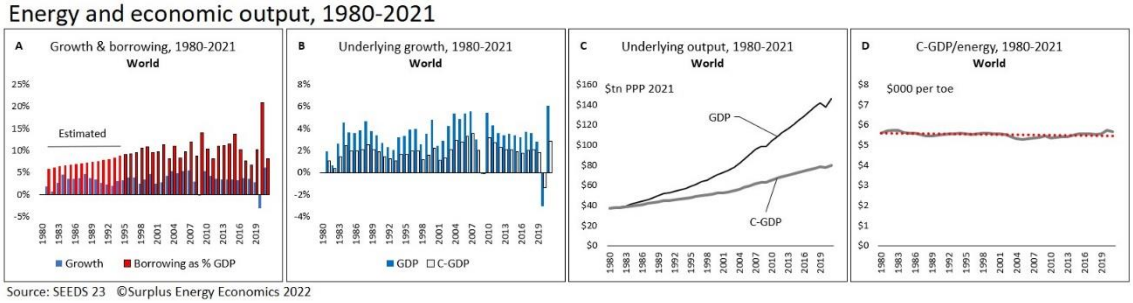
This doesn't necessarily describe individual national economies because, just as primary energy is traded between countries, so are energy-containing products. A country can, for example, consume less energy simply by importing cars and computers – or, for that matter, food – rather than producing these items at home.

Looking ahead, though, such trades are likely to be moderated by arbitrage, to the detriment of economies which rely heavily on the import of energy-intensive commodities and products.

The overall situation is what matters, and this is that *reductions in global energy supply lead to a shrinking of the World economy*.

Fig. 2

Energy and economic output, 1980-2021



Source: SEEDS 23 ©Surplus Energy Economics 2022

SEEDS projections for World energy use are illustrated in Fig. 3A. Essentially, supply is expected to be 10% lower in 2050 than it was in pre-pandemic 2019.

Within these totals, it's estimated that fossil fuel production will decline by 26%, a decrease of rather more than 3.0 bn toe. Though rapid, growth in output from renewable energy sources (REs) is likely to make up less than 1.2 bn toe of this shortfall. The combined contributions of nuclear and hydroelectric power are projected to increase by 28%, but these are too small a share of the energy slate to offset the decline driven by the falling availability of energy from oil, gas and coal.

As can be seen in Fig. 3B, there may be a very slight, and probably temporary, improvement in the conversion ratio between energy and economic value expressed as C-GDP. The assumption involved here is that a significant proportion of *energy-intensive, non-essential* economic activities *will contract rapidly* through decreases in affordability. But it's extremely unlikely that there will be material or lasting deviation from the linear relationship between energy use and economic output.

Accordingly, C-GDP is projected to be 8% lower in 2040 than it was in 2021 (the grey line in Fig. 3D), matching the expected decline in primary energy supply over that same period.

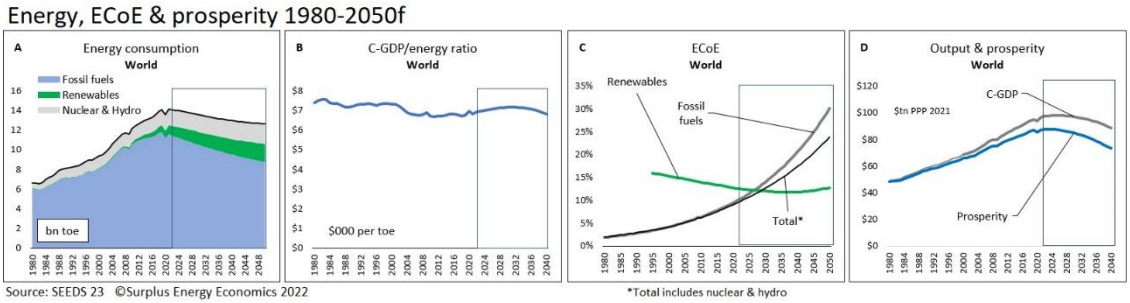
As we have seen, though, output isn't the same thing as *prosperity*, the difference between the two being the prior claim on resources made by the Energy Cost of Energy.

Fig. 3C shows the projected continuing rate of increase in overall global trend ECoE. The rates of decrease in the ECoEs of renewables are expected to slow, and *may then start to rise*. There are physical limits to the potential efficiencies of both wind (the Betz Limit) and solar power (the Shockley-Queisser Limit), limits which are well explained here. It's extraordinarily unlikely that the storage cost-efficiency and flexibility provided by a simple fuel tank are ever going to be replicated by batteries. Moreover, fossil fuels are not subject to the burdens of intermittency.

Critically, the vast material inputs required for RE expansion can only be provided through the use of legacy energy from fossil fuels. This creates *a linkage between the ECoEs of fossil fuels and the ECoEs of renewables*.

It should never be forgotten – though it almost routinely is – that the potential capabilities of technology **are limited by the laws of physics**.

Fig. 3



These are important points, because it's all too easy to assume that the economy can transition, seamlessly, from fossil fuels to renewables. This mistaken *assumption* – and it's no more than that – **informs vast swathes of corporate, financial and government planning**.

The application of ECoE to the projected outlook for C-GDP reveals that economic prosperity – shown in blue in Fig. 3D - is set to fall a lot more rapidly than material output itself. By 2040, **global prosperity is projected to be 16% lower than it was in 2021**. If population numbers continue to rise, albeit at historically low rates, prosperity per capita could decrease by 27% between 2021 and 2040.

At no point since 1776 – not even during the Great Depression between the wars, which caused severe hardship, but was temporary – have we *ever* had to confront anything even remotely comparable.

None of this, of course, is yet incorporated into the futurity currently priced by the markets. But the unfolding deterioration in underlying economic conditions can be expected to **compress the gap** between financial expectation and material economic reality.

OUTLOOK

The foregoing should have made it clear that two diverging trends have shaped the economy over an extended period. On the one hand, the material economy of products and services, determined by energy, has been decelerating towards involuntary de-growth.

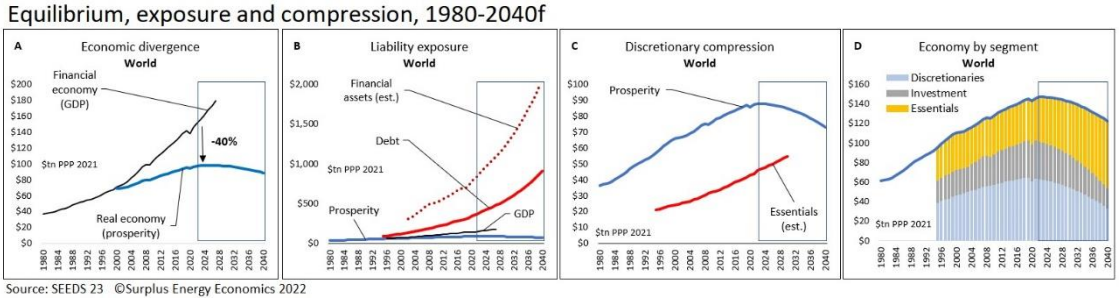
On the other, extraordinary levels of financial commitments have been taken on in an ultimately-futile effort to counteract or deny this tendency. These trends, and some of their future implications, are illustrated in **Fig. 4**.

Since the late 1990s, the financial economy, measured as GDP, has diverged from the material or 'real' economy to the point where the downside between the two has widened to 40% (Fig. 4A). **There can be no indefinite prevention of the *restoration of equilibrium* between the material and the financial**, and this has direct read-across implications for the levels of liabilities depicted in Fig. 4B.

Though the global debt mountain is serious, real exposure needs to be referenced to those broader 'financial assets' which are the *liabilities* of the government, household and business sectors of the economy. These broader liabilities include the NBFI (non-bank financial intermediary) sector, sometimes called the "shadow banking system".

Fig. 4

Equilibrium, exposure and compression, 1980-2040f



Source: SEEDS 23 ©Surplus Energy Economics 2022

As we saw in a recent article, available data is incomplete, accounting for 85% of the global economy, but quite possibly excluding major asset exposure in specialist financial centres not included in reported numbers. A best estimate is that total financial exposure stands at about 575% of World GDP, **but 925% of global *prosperity***.

Perhaps the single most disturbing aspect of worsening imbalances is **the extent of leverage** embodied in the economy and the financial system.

As we have seen, a projected decrease of 8% in energy supply between now and 2040 produces a corresponding decrease in real global economic output. But rises in ECoEs leverage this into a **16%** fall in aggregate prosperity.

This implies that prosperity per capita will be about 27% lower in 2040 than it was in 2021. But the cost of energy-intensive necessities will carry on rising markedly, in response to increases in ECoE. This is illustrated in Fig. 4C. This implies a **near-50% fall** in the affordability of discretionary (non-essential) products and services, even though *top-line* economic output is only projected to fall by **8%**.

SEGMENTAL DIVERGENCE

This leverage is critical, because the affordability connection ties the sustainability of financial liabilities, not to top-line output, **but to PXE**, the SEEDS term for "prosperity excluding essentials". When we consider, for example, the affordability of mortgage payments, it's clear that this affordability must be related, not to total household incomes, but to household *disposable* incomes, and much the same applies at the macroeconomic level.

This is why, where the business and broader economic outlook is concerned, we have entered an *affordability crisis*. This has two implications.

First, and most obviously, consumers whose disposable resources are being compressed between falling incomes **and** the rising costs of necessities experience a **leveraged reduction in what they can afford to spend on discretionary purchases**.

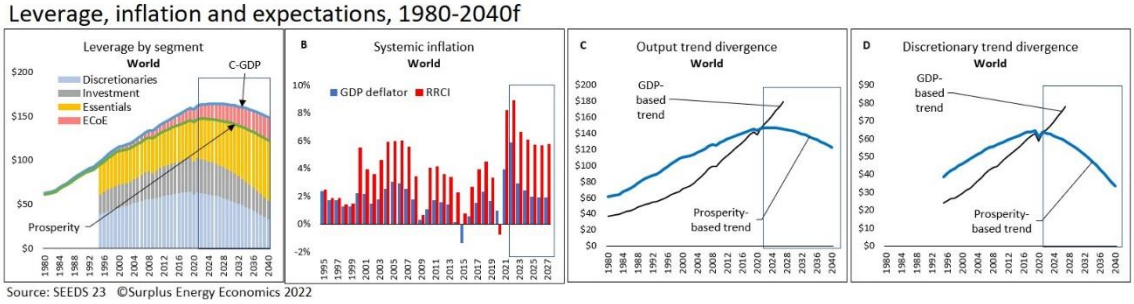
Second, it becomes ever harder for households to sustain payments on everything from secured and unsecured credit to subscriptions and staged-payment purchases.

In short, not only will sectors supplying discretionary products and services to consumers experience a relentless deterioration in volumes and profitability, but *the same thing will happen* to those parts of the corporate and financial ecosphere which rely on **streams of income from the household sector**.

Where segmental projections are concerned, it should be noted that the data in Figs. 4C and 4D is harmonized. This means that, whilst GDP in 2021 is accepted as the baseline – enabling comparison with other sources of forecasts – prior and future trends are *restated in accordance with energy-based calculations of output and prosperity*. The segmental balance illustrated in Fig. 4D shows that the affordability, not just of discretionary purchases but of *capital investment as well* faces severe compression.

Fig. 5

Leverage, inflation and expectations, 1980-2040f



Source: SEEDS 23 ©Surplus Energy Economics 2022

IN CONCLUSION

The final set of charts – **Fig. 5** – looks at the broad economic structure, inflation, and the critical **divergence between expectations and probable outcomes**.

Fig. 5A provides an at-a-glance view of the five core components of the economy. One of these is C-GDP output, which correlates closely with energy availability. The second is ECoE, a deduction which itemises the difference between output and *prosperity*. Next, in this leveraged equation, comes the estimated cost of essentials. The remaining components are discretionary consumption and capital investment, which are the residuals in this leveraged situation.

RRCI – the Realized Rate of Comprehensive Inflation – is the SEEDS tool for measuring systemic price change. Historically, this has been materially understated by the GDP deflator measure used to calculate 'real' economic output and growth (Fig. 5B).

Barring outbreaks of monetary policy derangement, the outlook is for RRCI to trend downwards, though remaining above officially-acknowledged rates of broad inflation. Though the costs of essentials will continue to rise, we should anticipate severe and worsening deflation **across the discretionary and 'stream-of-income' sectors of the economy**.

Comparing probable outcomes with expectations is a critical component of planning and strategy – essentially, good decisions can be made by those *who understand why consensus expectations are mistaken*.

As shown in Fig. 5C, past misstatement of the financial equivalent of material economic performance leads to over-optimistic expectations for the future of the economy. This applies even more strongly to the affordability of discretionary products and services (Fig. 5D), where past trends provide no effective guidance at all to the impending rapid decline of discretionary consumption.