SURPLUS ENERGY ECONOMICS

PROSPECTS & PREDICAMENTS

A special report

Summary

1. Despite the established convention which presents economics in entirely monetary terms, the economy is, in fact, a system for the supply of *physical* products and services to society. The industrial economy uses energy to convert raw materials into products, using further energy to supply services as ancillaries to these material goods.

2. Material prosperity, is, therefore, a function of the primary energy available to the economy; of the efficiency with which this energy is converted into products and services; and of the proportionate cost of putting this energy to use.

3. Accordingly, economic processes can be understood *only* on the basis of "two economies". One of these is the "real economy" of material products and services whose size is determined by the use of energy. The other is the parallel "financial economy" of money and credit.

4. This distinction recognizes that money, having no *intrinsic* worth, commands value *only* as a **claim** on the material output of the "real economy". These claims may be exercised either in the present (as transactional *flow*) or set aside for the future (as a *stock* of claims).

5. Financial developments are explicable in terms of the relationship between the *two economies*. The general level of pricing is determined by the relationship between the monetary and the material. Bubbles occur when expansion in the stock of monetary claims outpaces any increase in the material economy.

6. Since its inception, the industrial economy has been powered by coal, petroleum and natural gas, and fossil fuels continue to account for more than four-fifths of all primary energy used in the economy. Through the process of *depletion*, prior use of lowest-cost fossil fuel resources has been driving up the proportionate costs – the Energy Costs of Energy, or **ECoEs** – of fossil fuels. This process has caused material economic growth to deteriorate, via deceleration and stagnation, into contraction.

7. Needless to say, there are no *monetary* 'fixes' for *material* energy deterioration. Banks cannot lend low-cost energy into existence, and neither can central banks create low-cost energy (or any other material resource) *ex-nihilo*.

8. Our best hope now, in economic as well as environmental terms, is the development of renewable energy sources (REs) such as wind and solar power. But, as is explained in this report, it is unlikely that these *lesser density* energy alternatives can provide a *complete* replacement for the economic value hitherto sourced from fossil fuels.

9. The resulting economic contraction is likely to be exacerbated by rises in the real costs of energy-intensive necessities.

Prospects & predicaments

THE SURPLUS ENERGY ECONOMY

INTRODUCTION

This report has been published to mark the tenth anniversary of the ***Surplus Energy Economics*** project (SEE). The intention is to summarise what we now know about the functioning of the economy, understood as an energy system. These are "known knowns", not in the sense that everyone *does* understand the economy stated in these terms, but because everyone *can* so understand it if they choose, which is a rather different proposition.

The SEE approach commences with three principles. These are the energy basis of the economy; the critical role played by the proportionate cost of energy; and the character of money as a "claim" on material products and services.

This leads to some equally obvious inferences. One of these is the conceptual necessity of "two economies", which are the "real economy" of material products and services and the parallel "financial economy" of money and credit. Another is that the general level of pricing is a function of the relationship between these "two economies".

Our situation now is that the enormous impetus given to the economy by the development of coal, petroleum and natural gas is fading out – stated at its simplest, we've worked our way through lowest-cost fossil fuel resources and are now having to resort to increasingly costlier alternatives.

This trend has been apparent for at least a quarter of a century, and was indeed predicted by the remarkably prescient *The Limits to Growth*, published back in 1972. For much of the past twenty-five years, we have tried to sidestep this reality on the fallacious basis that *monetary* innovation can drive *material* expansion. When the first such exercise – termed here "credit adventurism" - detonated in 2008-09, our recourse was to "*monetary* adventurism".

This hasn't, of course, changed the trend of energy deterioration, but it has had several, very adverse consequences.

It has injected enormous risk into the financial economy, which has racked up forward commitments that a deteriorating real economy cannot possibly honour 'for value'. Simultaneously, it has created an "everything bubble" in asset prices, a bubble which, other than in its comprehensiveness and sheer scale, is no different from the bubbles of the past, and will end in the same way.

Thirdly, monetary recklessness has invalidated the basic presuppositions of the capitalist economic system, which requires that markets are left free to price risk, and that investors earn positive real returns on their capital.

We thus enter an era of unprecedented economic contraction on the basis of (a) continued denial, (b) extreme financial vulnerability, and (c) the lack of effective operating principles for the management of a situation which is wholly outside prior experience.

Dr Tim Morgan

August 2023

CONTENTS

PART ONE – THEORY

1.1. The foundations of rational interpretation

There are, in essence, two ways in which we can try to make sense of the economy. One of these – the orthodox approach, still generally accepted by decision-makers, academia and the consensus – portrays the economy as entirely a monetary system.

Because money is an artefact over which we have complete control, this orthodoxy denies that there need ever be any limit to economic growth. The supposition is that any shortages can be overcome through the pricing mechanism, whereby price rises either incentivise new supply, promote substitution, or encourage the development of alternatives. The consequence is that we can circumvent any and all material constraints to economic expansion. We are thus assured of economic growth in perpetuity, and can use monetary tools to 'fix' any material economic problem.

This orthodox interpretation does not survive contact with reality. *No* rise in price can produce the supply of something which does not exist in nature. The banking system cannot lend low-cost energy (or any other resource) into existence, and neither can central banks create them, *ex nihilo*, out of the ether. As Kenneth E. Boulding famously put it, nobody but "a madman or an economist" would believe in the possibility of infinite, exponential economic growth on a finite planet.

The alternative interpretation, outlined here, *recognises the existence of material limits*, a concept which extends from finite energy and other natural resources to finite environmental tolerance of economic activities.

1.2. Starting with principle

When we apply this concept, three principles, each of which is surely undeniable, quickly emerge.

The first of these principles is that **the economy is an energy system**, because literally *nothing* that has any economic utility at all can be made available without the use of energy.

The second principle is that *energy is never 'free'*. Oil, gas or coal aren't 'free' because they exist beneath a nation's territory – they cannot be put to use without an infrastructure including wells, refineries, pipelines and mines. Likewise, renewable energy isn't 'free' because the wind blows and the sun shines – this energy can *only* be harnessed by constructing wind turbines, solar panels, distribution grids and storage systems.

All of these necessary components require raw materials, and no part of this infrastructure can be provided without the use of energy. Energy is needed, not just to access minerals and other raw materials, but to process them, and use them for the construction of everything from a refinery to a wind turbine.

In short, the application of energy is an 'in-out' process, in which we 'use' energy to 'get' energy. This is only worthwhile when what we *get* exceeds what we *use*.

What this necessarily means is that, whenever energy is accessed for our use, some of this energy is *always* consumed in the access process. This 'consumed in access' component is known here as the Energy Cost of Energy, giving us **the principle of ECoE**.

The last of our three principles is that of **money as claim**. Money has no *intrinsic* worth, but commands value *only* in terms of those material things for which it can be exchanged. This is why no amount of money - be it *fiat* currency, precious metals, cryptocurrencies or, for that matter, cowrie shells - would be of the slightest use to a person stranded on a desert island.

This definition of money, as "a human artefact, validated by exchange", applies, not just to currencies, but to *any* form of money. We can, of course, create as much money as we choose, but we *cannot* similarly create the material products and services without which money has no value.

1.3. Logical inferences

From these surely indisputable principles, certain observations necessarily follow. One of these is the concept of "**two economies**" – a "real economy" of material products and services, and a parallel "financial economy" of money and credit. This combination of the material and the monetary is *the only basis on which we can make sense of the economy*.

This concept in turn dictates a tendency towards **equilibrium**. Since the material economy alone can validate money – that is to say, monetary claims can only be honoured by a matching sufficiency of material products and services – it is apparent that the material economy and its monetary proxy *must* tend towards alignment.

If we create monetary claims that cannot be honoured by the material economy of today or tomorrow, these "excess claims" *must*, by definition, be destroyed. To the extent that these claims are regarded as 'value' by their owners, this tendency towards equilibrium can be described as 'value destruction'.

The creation of *excess claims* results in the formation of bubbles. John Stuart Mill famously said that the bursting of a bubble does not, *of itself*, destroy value, but, rather, exposes the preceding period of malinvestment during which value was destroyed as the bubble was formed.

Within the 'two economies' conception, we can define this process as a period in which *excess claims* have been created. Today's "everything bubble" in asset prices is a case in point. This bubble has been created by *the excessive expansion of the monetary economy in relation to its material counterpart*.

The elimination of excess claims can happen in one or both of two ways. The first of these is *repudiation*, where a debtor's limited resources compel failure to meet the entitlements of the creditor. The second is *inflationary devaluation*, whereby the creditor is repaid, but in money that has less value than it had at the time when the obligation was created.

The latter is termed "soft" default, to distinguish it from the "hard" default of repudiation, but the effect on the creditor is, functionally, the same – he or she does not receive the full value to which they are entitled.

The concepts of inflation (or deflation) – meaning rises or falls in prices – require us to define **prices**, a definition which our concept of "two economies" provides. Properly understood, a price is "the *financial* value attached to a *material* product or service".

What this means is that prices are **the interface between the material and the monetary economies**. The general level of prices reflects *the relationship between* the "real" and the "financial economies", whilst *changes in* pricing are functions of *changes in* this relationship.

This makes possible the measurement of price mechanisms through the independent calibration of the "real" and the "financial" economies. The SEEDS economic model calculates *systemic* inflation, thus defined, as **RRCI**, meaning the Realised Rate of Comprehensive Inflation.

Two further observations complete our overview of central economic processes.

First, money can be used now, as *flow*, or put aside for later, as *stock*. There is no difference of concept in the continuum of flow and stock – both are claims, validated only by exchange, and a saver can change his or her mind, spending in the present money previously set aside for the future – but this introduces into the "financial economy" a temporal (over time) characteristic largely absent from the "real economy".

We can create monetary claims whose exercise may be set to occur decades in the future, and we can also extend these claims by recycling them (paying off a short-duration financial obligation by replacing it with a longer-dated alternative). We can, of course, stockpile energy or material products, but only for comparatively short periods – stocks of fossil fuels are measured in months, and those of electricity in minutes, whilst there is little rationale for businesses to incur the carrying costs of stockpiling products for sale years into the future.

We *cannot*, then, *underpin the stock of monetary claims by setting aside a corresponding stock of material products or services*. The "real" and the "financial" economies, though ultimately tending to equilibrium, operate on differing time-scales.

Second, the process of product creation has two, interlinked equations. One of these is that energy is used to access raw materials and convert them into products. The accompanying, inescapable corollary is thermal, involving the conversion of energy *from dense into diffuse forms*. Because most products are destined, usually quickly, for disposal, we can describe this as *dissipative-landfill* system.

We can observe that the dissipative-landfill economic model isn't enshrined in Holy Writ, and was largely absent before we harnessed fossil fuel energy to create the industrial economy. The dissipative-landfill system, and its consumerism corollary, are choices, made possible by the availability of abundant dense energy.

In no sense is the continuity of these processes guaranteed.

Critically, the scale of the production process is determined by the *density* of the initial energy input. If a dense source of energy is replaced with a less dense alternative, the truncation of the thermal process *necessarily* truncates the parallel productive process – in short, **if the density of energy inputs is reduced, the resulting economy is smaller**.

Before we move on to application, we need to note some definitional implications which follow from the above. Whilst economic *output* is a function of the quantum of energy use, and the efficiency with which this energy is converted into material products and services, *prosperity* is a function of the energy cost (ECoE) needing to be deducted from this output.

What this means is that, whilst *output* correlates with the aggregate use of energy, **prosperity** is a function of the **surplus** (ex-ECoE) energy available to the economy.

<u>PART TWO – APPLICATION</u>

2.1. Measuring the "two economies"

It follows from the foregoing that effective calibration of the economy requires that we make calculations for the "real economy" that can be set alongside those for the "financial economy". A suitable point of commencement for this process is the measurement of economic *output*, which we can then compare with the use of energy, and employ as the basis for calculating *prosperity*.

Unsurprisingly, we can expect little help from orthodox economics, and GDP is a case in point. Though often taken to be a measure of economic output, gross domestic product is, in reality. no such thing. Rather, it is an aggregation of financial *transactions*, which is a very different concept, and it is perfectly possible, indeed commonplace, for money to change hands without economic value being added.

As can be seen in Fig. 1A, reported global real GDP doubled, growing by 103%, or $83 trillion PPP, between 2002 and 2022. Over the same period, though, real-terms debt trebled, expanding by 209%, or $266tn, meaning that each dollar of reported "growth" was accompanied by $3.20 of net new debt.

Given the flow-stock continuum, we certainly cannot disregard credit expansion – that is to say, we cannot acquiesce in the bizarre view that debt somehow 'doesn't really matter' - and neither can the trajectories illustrated in Fig. 1A be regarded as in any way sustainable.

What has really been happening, over a very extended period, is that credit has been poured into the system, and the spending of this money has been counted as 'activity' for the purposes of measuring GDP.

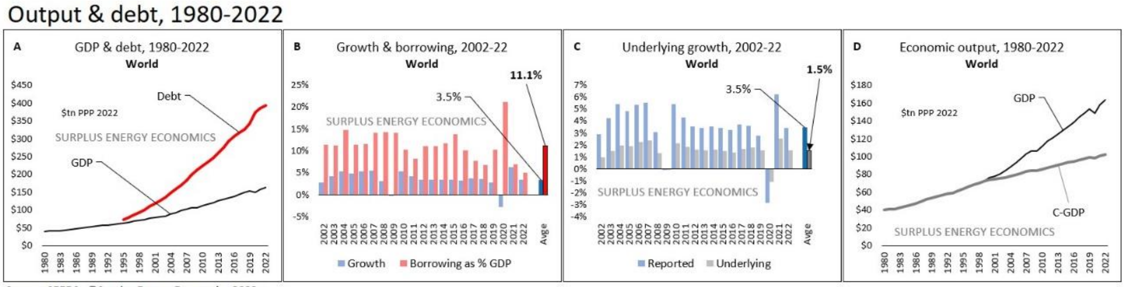
Another way to look at the relationship between borrowing and growth is illustrated in Fig. 1B. Between 2002 and 2022, when annual global GDP growth averaged 3.5%, borrowing averaged 11.1% **of GDP**. Regional analyses confirm this equation. Between 2002 and 2022, average growth in China (7.4%) was far higher than in the United States (2.0%), reflecting the fact that China borrowed at an average rate of 31% of GDP, compared with just 8.3% in America.

What this means is that, where GDP is concerned, *growth can be pretty much whatever we want it to be*, limited only by the willingness and ability to borrow.

When we strip out this 'credit effect', a very different rate of growth emerges, averaging 1.5% (rather than 3.5%) over the past twenty years (Fig. 1C). The resulting series is known here as underlying or 'clean' economic output, annotated **C-GDP** in SEEDS terminology.

Fig. 1

Output & debt, 1980-2022



Source: SEEDS ©Surplus Energy Economics 2023

The difference between 1.5% and 3.5%, compounded over twenty years, is enormous. As illustrated in Fig. 1D, aggregate growth in C-GDP was only 36%, or $27tn, between 2002 and 2022, far lower than the reported expansion of $83tn.

In effect, less than one-third of the "growth" reported over that period was organic, and *the remaining 67% was no more than the cosmetic, statistical effect of pouring ever-larger amounts of credit into the system*.

2.2. The energy connection

The level of C-GDP, and the extent of its departure from reported GDP, depends upon the date at which the calculation of underlying growth commences. Because the necessary data becomes increasingly patchy as we scroll back through the 1990s and beyond, standard practice is for the SEEDS calculation of C-GDP to begin in 2000. This provides more than enough comparative data for most analytical purposes.

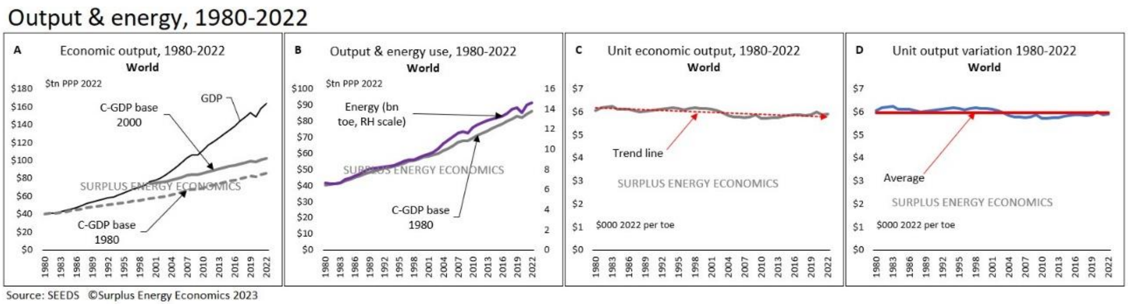
In a recent exercise, though, the clock on global C-GDP was started, not in 2000, but in 1980. This earlier series, annotated 'C-GDP base-1980', is illustrated alongside the 'base-2000' version, and reported GDP, in Fig. 2A. Because it begins earlier, the base-1980 run commences from a lower starting value than the base-2000 equivalent.

What's **really** interesting about this long-term calibration is the closeness of the relationship, shown in Fig. 2B, between C-GDP, stated financially, and the consumption of energy, stated in billions of tonnes of oil equivalent (bn toe). Remarkably, over a 43-year period containing many economic and energy supply vicissitudes, annual ratios of conversion between energy use and economic value seldom varied (Fig. 2C). Indeed, in no single year did this ratio vary by as much as +/- 5% from the period average (Fig. 2D).

This constancy of this ratio might seem surprising, given the assumption that efficiencies can be expected to improve over time. The explanation seems to be that, just as technology has advanced, *the quality of non-energy resources*, including farmland as well as mineral deposits, *has degraded*. We might, for example, have improved copper extraction techniques somewhat over the past four decades, but the effects of any such advances have been cancelled out by degradation of ore grades.

Be that as it may, this analysis confirms **the impossibility of "de-coupling" economic output from the use of energy**. This same conclusion has been reached by the European Environmental Bureau, whose report – entitled "Decoupling debunked" – described the case for decoupling as "a needle without a haystack". As we would expect – though this conclusion runs contrary to much widespread supposition – the economy grows where we use more energy, *and will contract if the supply of energy decreases*.

Fig. 2



2.3. The dynamics of ECoE

Output, of course, is not the same thing as *prosperity*, and the difference between them is determined by ECoEs. Between 2002 and 2022, when C-GDP output increased by 36%, global trend ECoE rose from 4.5% to 9.8%. Reflecting this, aggregate prosperity expanded by only 29%, rather than 36%, between those years. Moreover, increases in population numbers have meant that the World's average person was *only 2% more prosperous in 2022* than he or she had been back in 2002.

As well as widening the gap between economic output and prosperity, rising ECoEs also have adverse effects on the quantity of energy available to the system. At low ECoEs, it is a comparatively easy matter to set energy prices at levels which meet the needs both of producers *and* of consumers. As ECoEs rise, not only do the costs of producers increase, but there is *a simultaneous decline in the prosperity of consumers*. The narrowing of the gap between supplier costs and consumer affordability can be expected to drive supply volumes downwards.

It will be readily apparent that trends in ECoEs are critically important for economic outcomes, reinforcing the observation that *rising ECoEs are the mechanism by which the deterioration of the fossil fuel dynamic is being reflected in the economic transition from growth into contraction*. Accordingly, we need to understand the factors that determine trends in ECoEs, as well as anticipating how these trends are likely to develop in the future.

Though recent experience has been characterised by relentless rises in ECoEs, much of the earlier history of the industrial era was characterised by the opposite trend. We do not have the data required to calculate ECoEs in the distant past, but we can be sure that these fell over a very lengthy period.

The lengthy decline in ECoEs for much of the early history of the industrial era can be traced to three identifiable factors. First, the energy industries expanded their *geographic 'reach'* by exploring the world in search of lowest-cost reserves. Second, these industries benefited from *economies of scale* as their activities expanded. Third, costs fell through advances, generally incremental rather than dramatic, in energy *technology*.

It seems probable that ECoEs reached their nadir in the quarter-century after the Second World War, explaining the rapid economic growth enjoyed in that period.

Latterly, though, ECoEs have been rising. As we have exhausted the benefits of *reach* and *scale*, a new factor - *depletion* - has become the primary driver of fossil fuel ECoEs, this time in an upwards direction. 'Depletion' describes the natural process of using lowest-cost resources first, and leaving costlier alternatives for a later.

Our problem today is that *this 'later' has now arrived*.

Technology is likely to continue to progress, but we should never forget that **technology cannot step outside the limits set by the physical characteristics of the resource in question**.

2.4. The ECoE trap

Forward energy projections are set out in Fig. 3. Overall ECoEs from all sources of primary energy can be expected to carry on rising exponentially (Fig. 3A), whilst the total supply of energy is likely to trend downwards, with increases in the supply of renewables, nuclear power and hydroelectricity failing to offset, in full, the rate of decline in fossil fuels (Fig. 3B).

This means that a modest fall in total energy availability will be exceeded by the rate at which *surplus* energy decreases (Fig. 3C). Reflecting this, both total and surplus energy availability per capita can be expected to decline markedly (Fig. 3D).

These projections run counter to consensus expectations, which are that increases in the supply of renewable energy sources (REs) will outpace the reduced availability of fossil fuels, whilst the costs of REs will carry on falling in perpetuity.

It's important that we understand why these expectations are unrealistic.

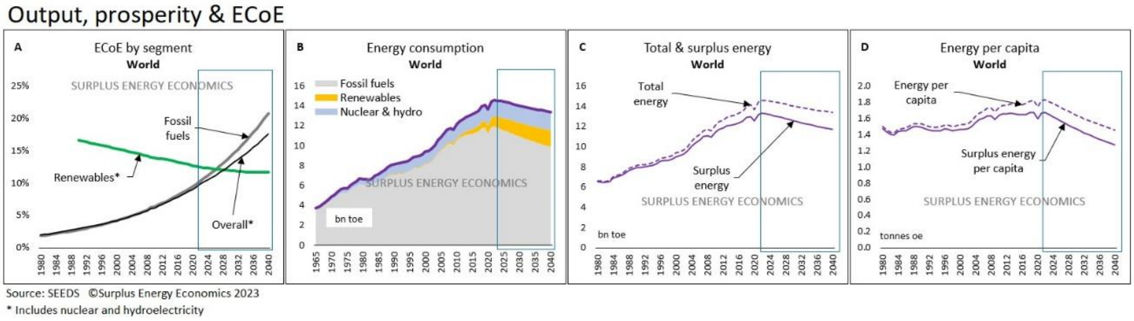
The first point to note - and one that is not, in itself, subject to much dispute - is that the cost of transition from fossil fuels to REs is likely to be substantial. According to IRENA (the International Renewable Energy Agency), limiting the rise in temperatures to 1.5°C will require the investment of USD131 trillion in energy transition. This might be affordable, though it would require the making of sacrifices - simply creating ("printing") the money to make this possible would prove self-defeating, because it would inject severe inflation into the prices of all inputs required for RE expansion.

More importantly, RE expansion on the scale widely envisaged would make enormous demands on the supply of everything from concrete and plastics to steel, copper, lithium, cobalt and numerous other minerals. Even where these inputs exist in the requisite quantities, accessing them and putting them to use would require truly gigantic quantities of energy, *which can only be obtained from legacy fossil fuel sources*. As well as raising the question of what other uses of energy might have to be relinquished to make this happen, this has the effect of *tying the ECoEs of renewables to those of fossil fuels*.

The usual answers to such questions involve extrapolation from recent trends, and assumptions of very rapid technical advances, of which the effect will be to increase energy conversion efficiencies.

Extrapolation – assuming that the future must be an infinite prolongation of recent trends - has been called 'the fool's guideline', a label that certainly applies in this instance. Past efficiency gains have occurred from a very low base, and have also benefited from historic lows in the costs of capital and the prices of fossil fuel inputs.

Fig. 3



The assumption of infinite cost-lowering advances in technology is equally misleading because – as has been mentioned before, but is all too often overlooked – **technology cannot over-rule the laws of physics**.

According to Betz' Law, the maximum rate at which wind turbines can convert kinetic energy into power is 59.3%, whilst the Shockley-Quiesser limit similarly sets the maximum potential efficiency of solar panels at 33.7%. Best practice is already close to these maxima, meaning that there remains very little scope for significant further gains in efficiency.

Ultimately, though, the principal physical restriction to the economic value of renewables is that **their densities are markedly less than those of fossil fuels**. Intermittency, the consequent need for excess capacity, and the problems involved in the storage of electricity, are reflections of this lesser density.

With their ECoEs rising, and supply availability likely to decrease, continued reliance on fossil fuels makes no economic sense, quite apart from the generally-recognised dangerous environmental and ecological effects of fossil fuel use. In this situation, it makes sense to maximise the potential of wind and solar power. A "sustainable" economy might indeed be possible, albeit at far lower levels of material prosperity and, perhaps, requiring a reduction in global population numbers.

But anyone who promises "sustainable *growth*" on the basis of energy transition is either disingenuous or remarkably ill-informed, particularly on the critical issue of energy density.

The unfolding inflexion from economic growth to contraction may be unpalatable, but it is a trend that has to be faced and managed, and there is no practical merit in denial, particularly when this denial is founded on the false premise that technological ingenuity can somehow over-rule the laws of thermodynamics.

2.5. Material contraction, financial exposure

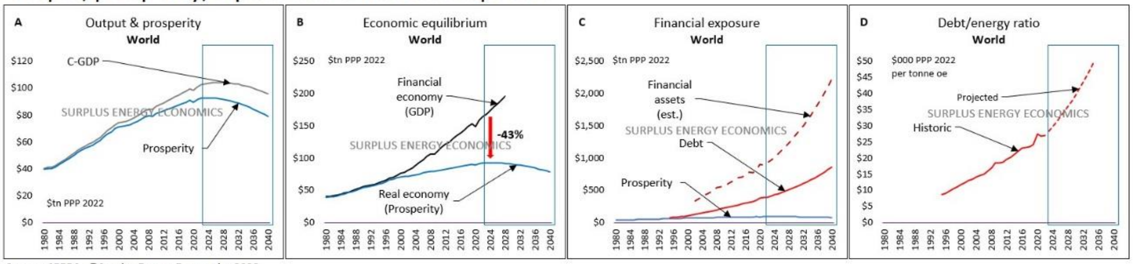
The economic effects of the deteriorating energy dynamic are illustrated in the next set of charts. The continuing rise in ECoEs will drive a widening wedge between economic output and prosperity, whilst output itself can be expected to turn downwards in line with the availability of energy (Fig. 4A).

Meanwhile, the **disequilibrium** between the "real" economy and its "financial" counterpart has become extreme, because we have engaged in the breakneck expansion of monetary claims even as the underlying material economy has been decelerating towards contraction (Fig. 4B).

The 43% downside calculated by SEEDS gives some idea of the scale at which "excess claims" can be expected to be eliminated, a metric which, as a rule-of-thumb guide, can be applied to the liability situation illustrated in Fig. 4C. We would not be too far wide of the mark if we expected the liabilities illustrated in Fig. 4C to degrade by *at least* the 43% rate of disequilibrium shown in Fig. 4B.

Fig. 4

Output, prosperity, equilibrium & financial exposure



Source: SEEDS ©Surplus Energy Economics 2023

The extent of financial exposure is shown here in two forms. The first of these is the aggregate debt of the government, household and private non-financial corporate (PNFC) sectors. Financial assets – which are the *liabilities* of these three sectors to the financial system – further include the NBFI (non-bank financial intermediary) sector, sometimes known as "shadow banking". At the global level, financial assets totals have to be estimated, because disclosure is incomplete, provided by jurisdictions which correspond to about four-fifths of the World economy.

A useful additional metric is the relationship between year-end debt and the primary energy consumed during the year. This is illustrated in Fig. 4D, from which it is readily apparent that we have been trying to carry ever rising amounts of *real-terms* debt for each unit of energy consumed in the economy.

2.6. Regional variation

As we have seen, there is an intimately close relationship between ECoEs and prosperity, a relationship which is explored in the next set of charts, in which prosperity per capita is compared with trend ECoEs for the territory in question.

In the United States (Fig. 5A), prosperity per capita peaked back in 2000, when American trend ECoE was 5.1%. Something very similar happened in Britain, where prosperity per person turned down after 2004, when ECoE was 4.7% (Fig. 5B). But Chinese prosperity per capita has continued to improve, and isn't projected to inflect until next year, at an ECoE of slightly below 12% (Fig. 5C).

We need to be clear that these varying relationships **are structural**. Advanced economies like America and the United Kingdom are highly complex, resulting in correspondingly high maintenance demands. EM economies like China enjoy greater ECoE-resilience by dint of their lesser complexity and correspondingly lower maintenance costs.

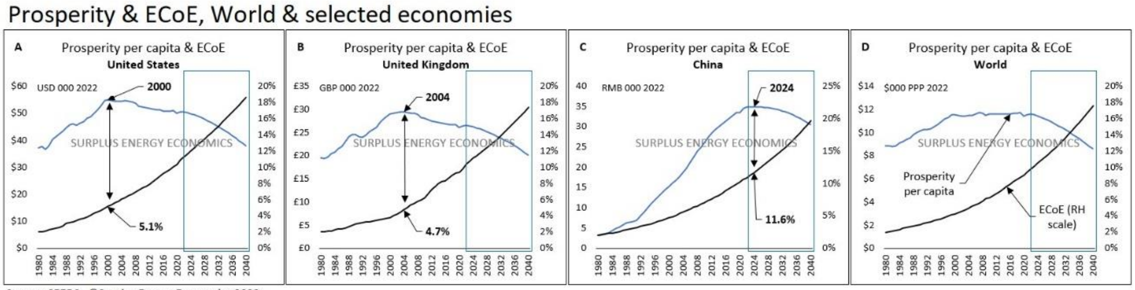
SEEDS studies of 29 different economies confirm that, whilst prior growth in prosperity in advanced Western economies goes into reverse at ECoEs of around 5%, prosperity can continue to increase in EM countries until ECoEs are between 8% and 12%.

This structural explanation should enable us to dispense with notions that the disparity of performance between regions reflects 'indolence', 'laziness' and 'complacency' in Westerners, whereas the citizens of EM countries are more 'energetic' or 'motivated' than those in the advanced economies. Like most stereotypes, these labels are misleading.

Likewise, we can similarly dispense with the notion that, whilst Western economies will continue to stagnate and contract, the EM world will carry on growing indefinitely.

Fig. 5

Prosperity & ECoE, World & selected economies



Source: SEEDS ©Surplus Energy Economics 2023

What has *really* happened is that the lower ECoE inflexion-points already encountered by the West are now being reached, at higher levels, by the EM economies. Moreover, a growing number of EM countries have reached or passed their points of inflexion in recent years.

Globally, continued expansion in EM countries has, until recently, offset deterioration in the West, such that prosperity per capita in the World as a whole has been on a long plateau (Fig. 5D). This plateau seems to have ended in 2019 though, given events in subsequent years, this conclusion must remain somewhat provisional.

2.7. The mechanics of economic contraction

The ending of the plateau in global average prosperity per capita, repeated in Fig. 6A, coincides with continuing rises in the costs of essentials (Fig. 6B).

Calculations of essentials can only ever be estimates, not least because the definition of "essential" varies over time. Car ownership, for example, is now widely regarded as essential in the West, but was deemed to be a "luxury" in the not-too-distant past, and could return to the 'non-essential' category as the economy contracts.

Definitions of "essential" vary, not just over time, but between countries, with products and services regarded as essential in wealthier economies not so regarded in poorer nations.

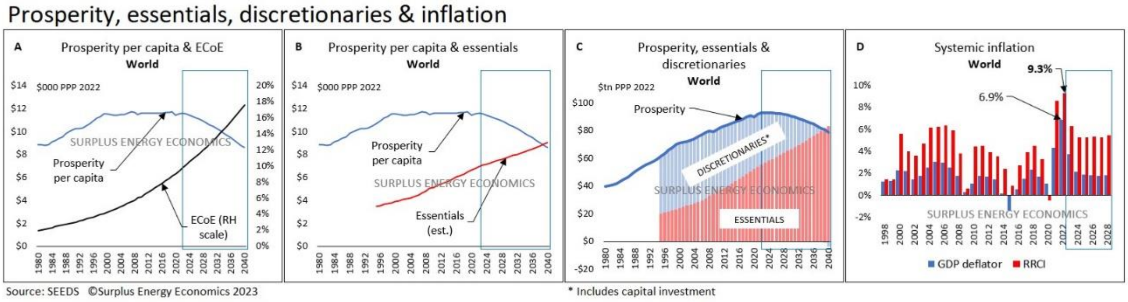
SEEDS calculations of essentials have two components. One of these is public services provided by government, which are non-discretionary in the sense that the citizen has no 'discretion' about paying for them. (This expenditure does not include inter-group transfers, such as state pensions and benefits, since these net-off to zero at the overall level). The second component is an estimated cost of household necessities.

An important point about these necessities is that *they tend to be energy-intensive*, examples including the provision of water, food, housing and the necessary transport of people and products. As a result, rising ECoEs can be expected to drive the real costs of necessities upwards, *even as top-line prosperity is declining*. The cross-over illustrated in Fig. 6B is unlikely to be experienced in this way, but, rather, through successive downwards redefinitions of what is understood by the word "essential".

Even so, we can anticipate relentless *affordability compression* over time. This has two consequences. Most obviously, there will be a steady contraction in the amounts that people can afford to spend on *discretionary* (non-essential) products and services (Fig. 6C).

Less obviously, households are going to find it ever harder to carry the financial burdens which range from secured and unsecured credit servicing at one end of the spectrum to staged-payment purchases and subscriptions at the other.

Fig. 6



The latter consideration feeds into the way in which “excess claims”, illustrated in Fig. 4, will be eliminated as the tendency towards equilibrium forces both transactions **and** the stock of claims back into line with the underlying “real economy”. The degradation of *streams of income* from households to the corporate and financial sectors will be a significant operative process within the elimination of “excess claims”.

As mentioned earlier, the concept of “two economies” enables us to calculate *systemic* pricing and price changes, known in SEEDS terminology as **RRCI**, or the Realised Rate of Comprehensive Inflation. This forms the subject of the final chart, Fig. 6D, in which global RRCI is compared with the broad-basis GDP deflator, used to back-out the effects of inflation in the calculation of real GDP and growth.

As the chart shows, RRCI has long been above the official GDP deflator number, and is calculated at 9.3%, rather than 6.9%, for 2022. On this basis, the purchasing power of the international dollar – calculated on the more meaningful basis of purchasing power parity (PPP) rather than market rates – declined by 57% (rather than the official 31%) between 2002 and 2022.

Going forward – and assuming, for our purposes, no recourse to extreme monetary recklessness – systemic inflation is likely to run at between 5% and 6%, capped by the deflationary effects of rapid contraction in discretionary sectors of the economy.

Dr Tim Morgan

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Notes:

1. This report is based on an article first published at Surplus Energy Economics on 16 August 2023.

2. Educated at Cambridge, Dr Tim Morgan spent many years as an investment analyst specialising in energy before taking on a strategy brief and becoming Global Head of Research at leading inter-dealer broker Tullett Prebon. His book *Life After Growth* was first published by Harriman House in 2013.