Importance of chemicals in a manufacturing economy

"The case for the UK"

In industrial terms, the chemical industry performs essential steps in converting raw materials (animal, vegetable or mineral) into usable products. These encompass an enormous variety – from plastics to paints, from fertilisers to shampoos, from synthetic rubber to pharmaceuticals. These items then form part of other value chains - such as automotive, aerospace, construction – or are supplied direct to households.

Shape of today's chemical industry

Hydrocarbons such as naphtha, derived from processing crude oil in a refinery, and natural gas, together with minerals such as salt, limestone and metal ores, are the principal raw materials, although vegetable and animal oils and fats, as well as natural alcohol and starches, are also used for some processes.

The initial manufacturing stages within the chemical industry typically involve large volumes/tonnages of material and are energy intensive. Because of the logistical costs of moving heavy raw materials, and the energy supplies needed, the industry has historically been located in places where both were locally available. In the UK, NW England saw many developments because of local salt, limestone and coal, coupled with access to navigable waterways. In later years, as oil and its derivatives increased in importance, refineries were built in coastal locations where crude oil could be landed. The refineries in turn gave rise to associated chemicals activity.

Clusters of sequential chemical processing grow up where successive stages take their inputs from adjacent plants so that logistical costs are minimised, and the transport of potentially hazardous substances can be safely made by pipeline. Refinery linked examples in the UK include Grangemouth, Stanlow and Humberside. Modern bulk chemical plants are large, and access to suitable areas of land, and good communications to markets, are also important. These considerations were paramount when ICI was developing its petrochemicals business and bought land at Wilton on Teesside at the end of 1945. Teesside remains the UK's principal "compact" cluster, although the Merseyside region has in aggregate a greater total output spread over several locations. In later years as North Sea hydrocarbons were developed, new chemical plants at Grangemouth and Mossmorran in Scotland were built to process the associated natural gas liquids; the "cracker" on Teesside also has flexibility to use some of these as alternatives to naphtha.

The attached Charts illustrate the patterns of flow through the chemical industry and also extension of the range to include some downstream industries. Not only chemical companies, but also downstream manufacturers, see advantage in close physical proximity to key inputs. The growth of glass manufacturing in Cheshire was predicated on the availability of soda ash from the chemical plants nearby. In the modern context of "just in time" production systems, these considerations are even more important.

Chemicals in the economy; Supply chains

At each step on a supply chain it is in theory possible to substitute an imported material for one produced domestically. This would normally incur additional cost – unless the supplying location abroad enjoyed some other significant cost advantage which allowed it to match or better the price from domestic supply. On the other hand, the UK market cannot support local manufacture of every chemical (or other manufactured) product – concentration of a particular customer industry elsewhere allows suppliers also to grow and specialise in the goods supplied. Indeed, such considerations lie at the heart of international trade flows and the economic benefits they bring. Examples in the chemical industry are closure of UK methanol production because it could be made much more cheaply in locations with cheap "stranded"[1] gas, and the migration of most dyestuffs manufacture from Europe to Asia because the textiles market had already moved there. The strength of German manufacturing, particularly in motor vehicles, has seen the development and production of many engineering plastics in Germany. Specialised products with a high value to weight ratio (for example pharmaceuticals) may be manufactured in only a handful of global locations and the UK cannot expect to be home to one of these in every case, although we should aim to have as many as possible. Success factors include having the right skills as well as a reliable local supply of the intermediate products required.

Chemical supply chain characteristics; clusters

Within the chemical industry there are two further important considerations when assessing supply chains. These are the balance of supply and demand at major integrated sites – "clusters" - and the safety and health issues associated with moving quantities of hazardous chemicals over large distances. Bulk chemicals are produced on dedicated plants whose profitability depends on operating at or close to full capacity. Industrial clusters such as Teesside are at their strongest when output and demand within the cluster are balanced and all major plants are running at close to optimal rates without the need to ship excess supply expensively to remote customers. As an example of minimising risk, the transport of chlorine in bulk over long distances is avoided where possible. It would be extremely difficult to substitute imported chlorine in bulk for that from a domestic source. Production of PVC in the UK, not to mention the myriad of other downstream products for which chlorine is an essential component, would cease or be put at risk. Chlorine is also essential to the safety of UK water supplies, which rely on its disinfectant properties to remain effective all the way through the pipeline to the customer.

Chemical supply chains are closely interdependent. Loss of any link in a chain can have both upstream and downstream consequences. The closure by Dow Chemical of its ethylene oxide (EO) unit on Teesside in early 2010 rendered it impossible for the downstream surfactants plants operated by Shell and Croda to continue, and they closed at the same time. A plant manufacturing oilfield chemicals in Hartlepool, which also needed EO as an input, closed a few years later, in part

[1] A description used when there is no immediate market for gas in a remote location and its price is consequently very low. Conversion to methanol facilitates transport to industrialised locations where demand exists.

due to the additional cost of obtaining supplies of the product, which is considered an explosive hazard and difficult to import. Another EO customer in southern England still survives, but is finding it hard to source this key product because some Continental producers prefer to avoid the operational risk of cross-Channel supply and potential consequential reputational damage. At the same time cessation of EO production meant loss of a customer for the ethylene cracker upstream, weakening its operating economics. Loss of PVC production would also have the effect of reducing demand for ethylene.

The loss of one link in a chain threatens successive ones. Even when it is possible to import the material in question, for example the surfactants previously made by Croda and Shell, the need to import such intermediates begins to tip the scales against continued manufacture of formulated detergents and personal care products in the UK, with consequent further loss of employment and output, and a negative impact on the balance of payments.

Importance of the industry globally; competitive factors

Every major developed country has recognised the strategic importance of the chemical industry as the essential foundation for a wide variety of manufacturing activities, as well as supplying basic needs for cleaning, disinfection and health. Every major western European country has its own chlorine production. International trade in chemicals in 2012 amounted to $1.9trn, over 10% of all merchandise trade including raw materials and fuels.

Competition is fierce, especially on bulk chemicals, where manufacturers cannot differentiate their products and price is the key factor (assuming a minimum assured quality and reliable delivery) in achieving a sale. The know-how needed for plant design and operational efficiency is generally available for purchase, and new entrants can readily stand on a level footing with established producers. The main variable costs are the purchase of raw materials, energy for the conversion process, and delivery to market. These factors explain why most current investment is now taking place in the US and Middle East (access to cheap feedstocks and energy) or Asia (the area of greatest incremental demand) and virtually none in Europe (stagnant economy, high energy prices.)

Unlike commodities, speciality chemicals are often formulated from several different molecules – paints, adhesives and shampoos are three examples. Manufacturers can differentiate their product, perhaps even tailor the product to the needs of an individual industrial customer, and gain some control of pricing. They need access to reliable sources of the several chemicals they require for their formulations, a good understanding of their market and an ability to react quickly to changing patterns of demand. Innovation is important, as is speed to market. An efficient, non-intrusive regulatory system is a help.

Does the UK need a chemical industry?

Does the UK need any industry? Until the financial crisis of 2008, there was a body of opinion that said “no” – the UK could live off its skills in services, particularly financial services. Even then, this was a naive view which overlooked the need to generate sufficient exports to pay for all the

materials and manufactures we import. Otherwise the books are balanced by IOUs to creditors or the sale of property and businesses to foreign buyers. Today the government expresses a commitment to "rebalancing" the economy, although the dysfunctional energy policies followed for over a decade still indicate a lack of sensitivity and understanding of what is needed for manufacturing to continue on any scale. If the commitment to manufacturing is to be genuine, then a viable chemical industry – and other basic energy intensive industries – will be essential.

To take an example from another industry, without steel production in the UK it is unlikely there would be any steel strip; without steel strip it is unlikely there would be pressed automotive body panels; without body panels it is unlikely manufacturers would see fit to assemble vehicles here. Equally car assemblers need items from the chemical industry for external body parts like front spoilers and bumpers; interior trim and fabrics; tyres; specialist lightweight but temperature and oil resistant plastics for under bonnet applications; glazing and lighting; fuel tanks, containers and piping for brake fluid, coolant and screen wash and much else. Chemicals provide lightweight alternative parts, lubricants, fuel additives and specialist paints which increase fuel efficiency and give longer life by protection against rust. Car plants operating just in time systems need all the necessary components readily to hand; at each tier of the sub-assemblies and individual components, there must in turn be a reliable and competitive supply of parts, ultimately including products of the chemical industry. A manufacturer will always prefer to have at least one domestic, and preferably local, supplier of key inputs. The chemical industry and its customer industries are linked by interdependent supply chains. For some key products rationalisation over several years has already reduced UK capacity to a single site (eg chlorine and caustic soda at Runcorn) or a single manufacturer (ammonia; nitrogen fertiliser). We cannot afford to lose many more.

As well as underpinning many more manufacturing activities, the chemical and pharmaceutical industry in its own right adds considerable value to the UK economy. It represents one eighth of all manufacturing value added, provides well remunerated jobs – on average 30% higher than the manufacturing average, and 65% higher than the average for the business economy overall - and is the leading exporter with over £50bn of goods exported annually and one of very few sectors to record a positive trade balance. Although numbers directly employed are fewer than 150,000, many more service providers are also dependent on the industry. These include many contract staff in all positions, transport and distribution services, building and plant maintenance and renewal, catering, IT, legal, accountancy, insurance and more.

Does it matter if we lose domestic chemicals production?

The circumstance threatening to drive UK chemicals – and manufacturing in general - offshore are the climate and energy policies being pursued in the EU, including the UK. This has the effect of pushing up energy prices relative to competing locations – on top of the disparity with the US which has opened up as it exploits shale gas. Unless UK consumption of manufactured goods falls, the emissions associated with their production will not be eliminated but merely displaced, even possibly increased if overseas locations are less energy efficient and there are further emissions associated with transport. If those employed in the industry and its dependent value chains and purchased services could be redeployed into other activities which added equivalent value and

provided similar levels of remuneration, the direct economic loss might be mitigated, but given the high average productivity and remuneration levels in the industry, this is most unlikely. There appear to be no benefits, environmental, economic or social, to offset the damage being caused by present policies.

How can we support the chemical industry and the rest of manufacturing?

Access to raw materials

Raw material prices are generally set by global markets, for example oil and its derivatives such as naphtha. A local supply can however reduce logistical costs – as already mentioned above. A particular case in point is the low price of shale gas in the US: it is difficult to export large quantities because of the high fixed costs of investment in terminal facilities and specialised ships. Variable costs are higher too – liquefaction, transport by ship and re-gasification is more expensive than domestic distribution by pipeline. This has led to a gas "bubble" and low prices in the US market, which in turn has spurred large investments in new petrochemical capacity to absorb the advantageously priced gas. The UK now has an opportunity to develop its own shale gas reserves, and this will be of great benefit to the chemical industry, which could use the gas in already established plants which are otherwise threatened by declining supplies from the North Sea. It is imperative that the UK pushes ahead with all possible urgency. Ineos has in the meantime taken steps to secure supplies from the US for its Grangemouth plant. Logistical costs mean the plant will have higher costs than US rivals, but it will still enjoy a cost advantage relative to other European producers dependent on naphtha.

Energy costs

Energy costs are another important competitiveness factor over which producers can have some control. Unfortunately UK and European policies have created large handicaps for industry. The UK's own 2003 White Paper believed renewables were the answer and ruled out nuclear power, leading to the dissipation of our skills base – to our severe regret today. EU policies on industrial emissions such as sulphur and nitrogen oxides have forced many UK coal fired generation plants to close. The UK's Climate Change Act, which the government's own accompanying Impact Assessment clearly showed to be unwise, together with EU policy on setting a target for the share of energy from renewables, have deterred investment in new reliable forms of generation, while leading to expansion of expensive and unpredictable wind power. Unfortunately peak demand in winter comes with the coldest temperatures - most often associated with anticyclones, when the wind does not blow. Needless to say, the sun does not shine on winter evenings either. In consequence, in order to keep householders' lights on, manufacturers and other businesses now face being asked to stop production if power supplies cannot cope – euphemistically termed "demand side response". Added to this prospect of unpredictable power supply reliability, UK manufacturers face steadily higher prices resulting from the growing subsidies payable to renewables suppliers, as well as from the government's carbon price support scheme, which will make generation from fossil fuels more expensive.

Independent observers, including the Wall Street Journal (June 2013 edition, headed "*Britain's No-Energy Bill - The Cameron government puts 'decarbonization' above growth*.") and Dieter Helm,

Oxford professor of energy policy and an academic adviser to DECC (Oct 2013 comments on Labour's Energy Policy) echo these concerns.

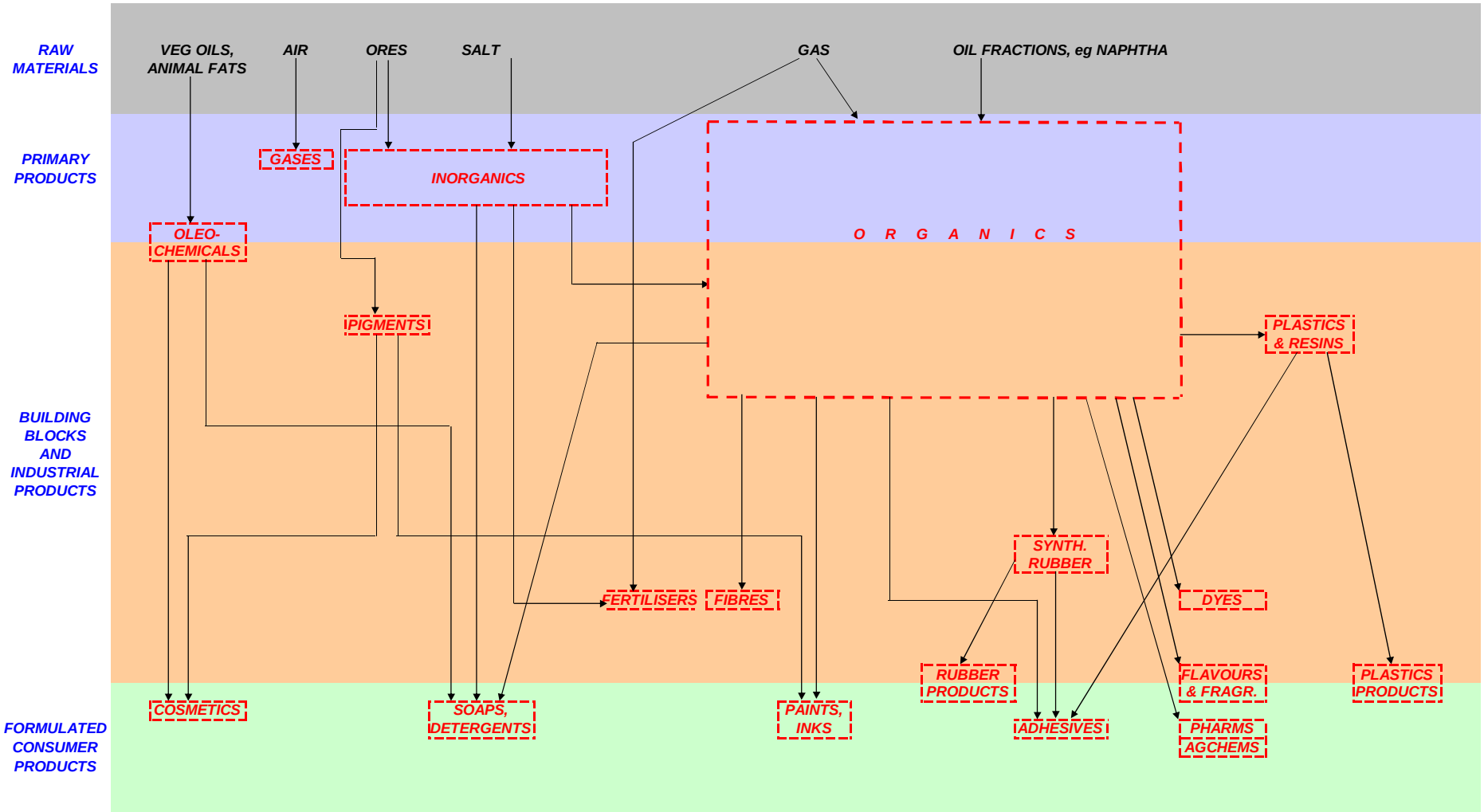
If the UK wants economic growth, it urgently needs to rethink its energy and climate policies. Displacement of production overseas will not reduce global emissions. In the absence of more nuclear capacity, seemingly an ever distant prospect, gas will be required both for baseload capacity and to provide back-up for renewables on a close to one for one basis. The back-up function is already recognised by the government in its draft proposals for (inevitably expensive and administratively complex) capacity payments. Shale gas clearly helps in this context and its development should not be seen as an alternative to renewables: on the contrary, more renewables need more gas as back-up. Although the UK is unlikely to see a "bubble" such as that in the US, because existing pipeline connections to Europe are an easy export avenue, significant domestic shale supplies would help energy security and reduce price spikes when other longer distance supply routes were interrupted, in turn putting downward pressure on prices in forward markets.

Conclusions

In the short term, energy intensive industries expect tangible support emerging from the Budget beyond the welcome, but limited, compensation commitments around the European Emissions Trading Scheme, Carbon Price Floor and Electricity Market Reforms. The momentum building behind shale gas too is very welcome but that will not address the real "pinch points" likely to be felt over the next three to five years (a point made very clear in BIS's own mid-2012 study comparing the impact of climate change policies on UK manufacturing opposite other countries/regions of the world). Tangible support in the Budget should, we believe, include a flattening of the trajectory of the Carbon Price Floor out to 2020 and exemption from the impacts of the Renewables Obligation.

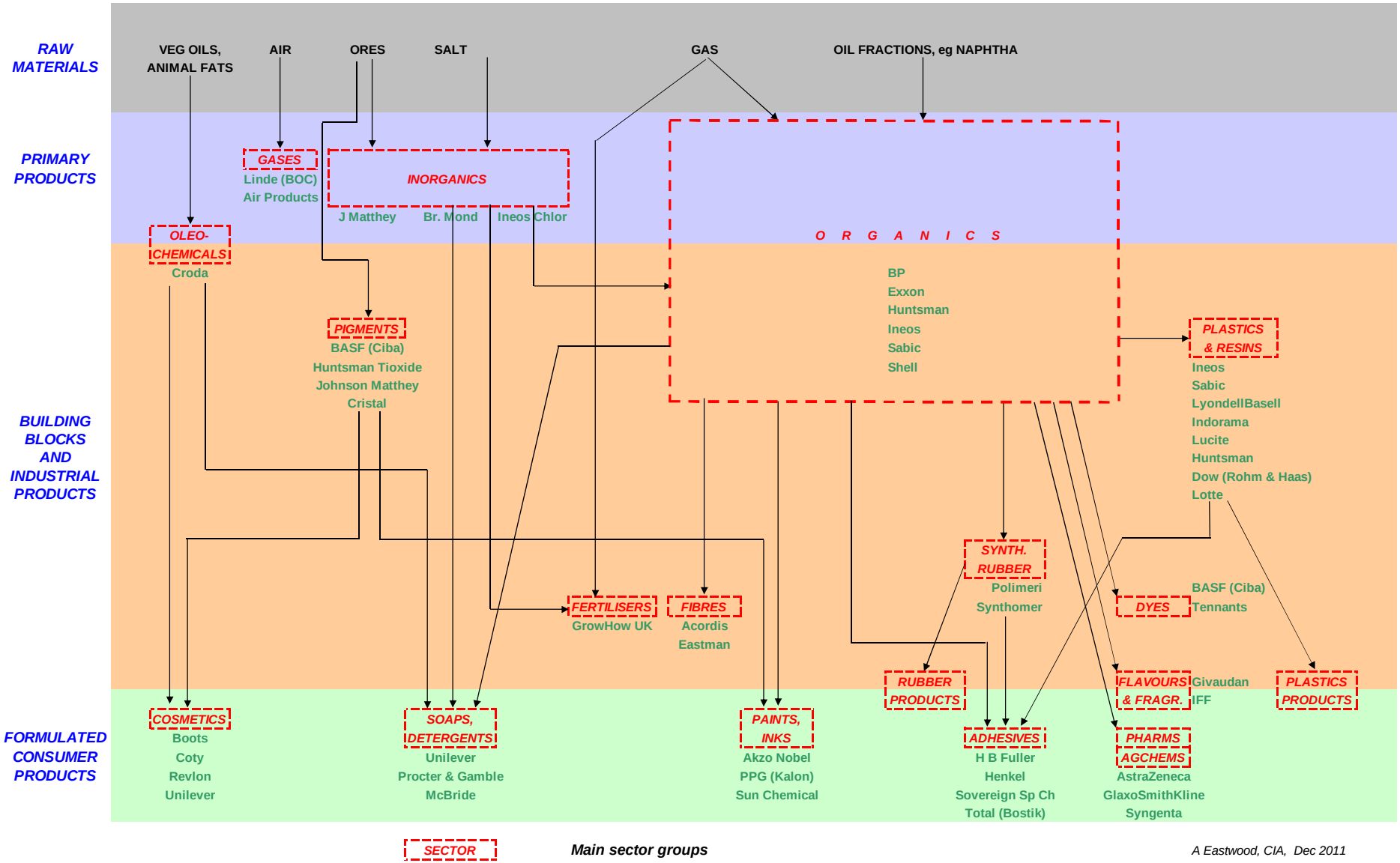
In the longer term, realisation of the Chemistry Growth Partnership's 2030 vision of a 50% increase in the gross value added provided by the chemical and chemistry-using industries, does of course depend on a range of factors including long term commercial and political commitment; consistency of action; regular goal- setting and sustained engagement with stakeholders are all pre-requisites for success. However, if there is one immediate obstacle to progress that all would agree on, it is the energy and climate change agenda – setting a hostile European policy stance against the very real competitive threat posed by energy and feedstock costs emerging from the United States as a consequence of their exploitation of shale gas. The Coalition government's actions on shale gas are very positive and the recent emergence of "big oil" interest through Total's £30 million investment is also a significant step forward. The CGP's time-line on shale gas exploitation – proof of commercial viability by end of 2014 and flows to the Grid by 2017 - is ambitious but urgent action is required by business and government if we are to secure the long –term future of energy intensive industries and their ability to underpin higher value adding customer industries that sit as recognised sectors within the government's industrial strategy focus.

SIMPLIFIED DIAGRAM OF MAIN MATERIAL FLOWS AND PRODUCT GROUPINGS IN THE CHEMICAL INDUSTRY



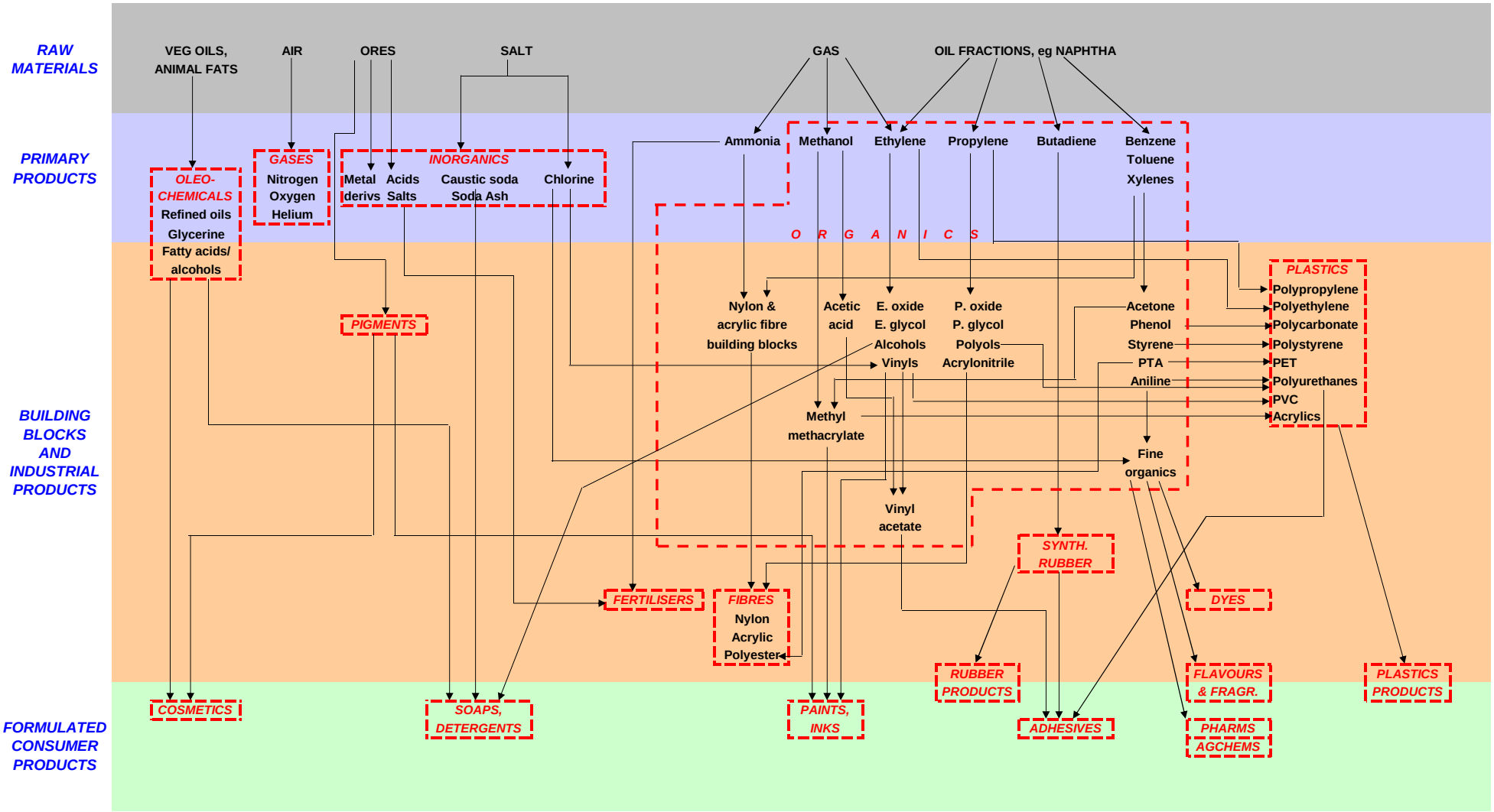
A Eastwood, CIA, Dec 2011

SIMPLIFIED DIAGRAM OF MAIN MATERIAL FLOWS AND PRODUCT GROUPINGS IN THE CHEMICAL INDUSTRY

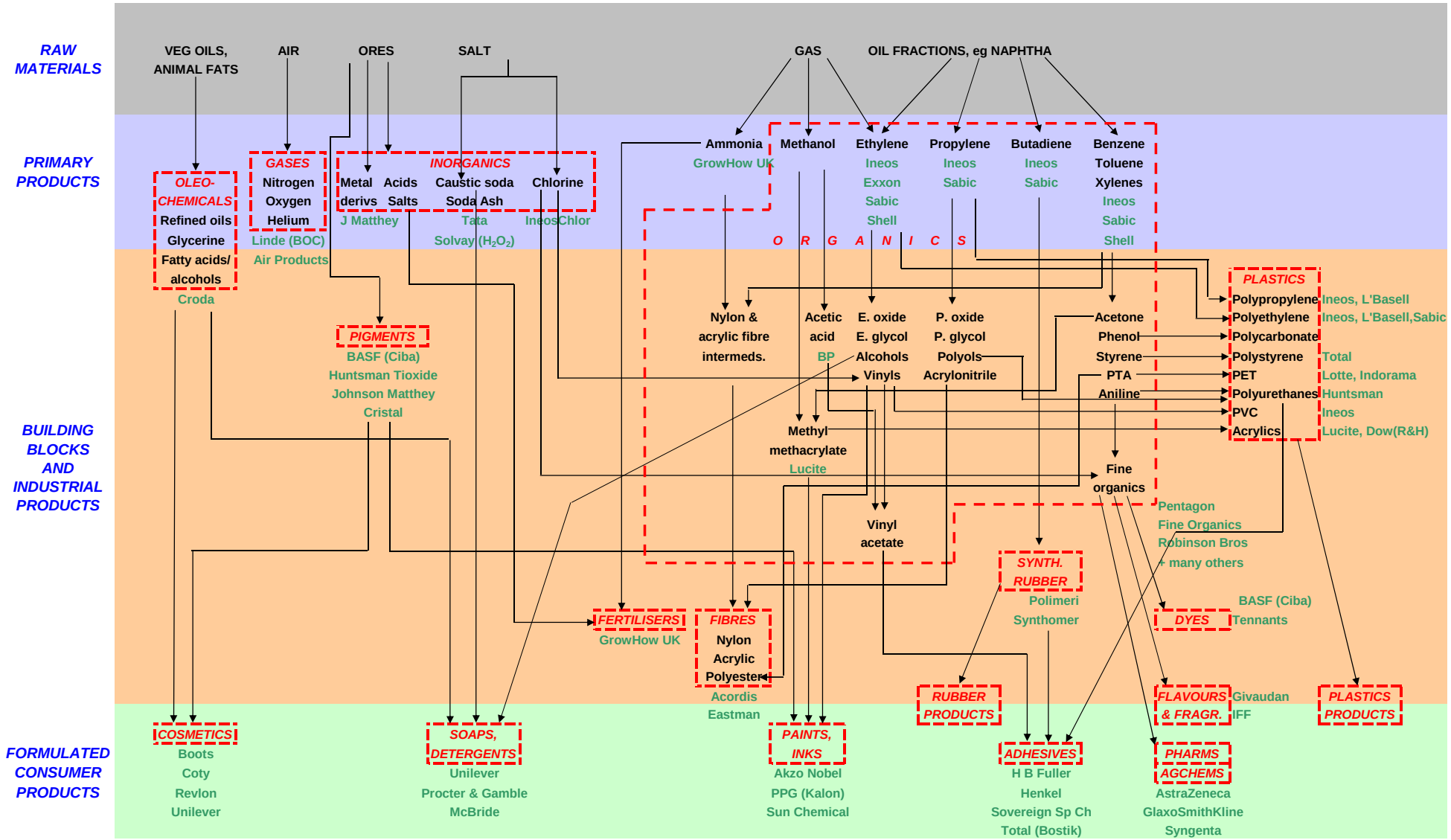


A Eastwood, CIA, Dec 2011

SIMPLIFIED DIAGRAM OF MAIN MATERIAL FLOWS AND PRODUCT GROUPINGS IN THE CHEMICAL INDUSTRY



A Eastwood, CIA, Dec 2011

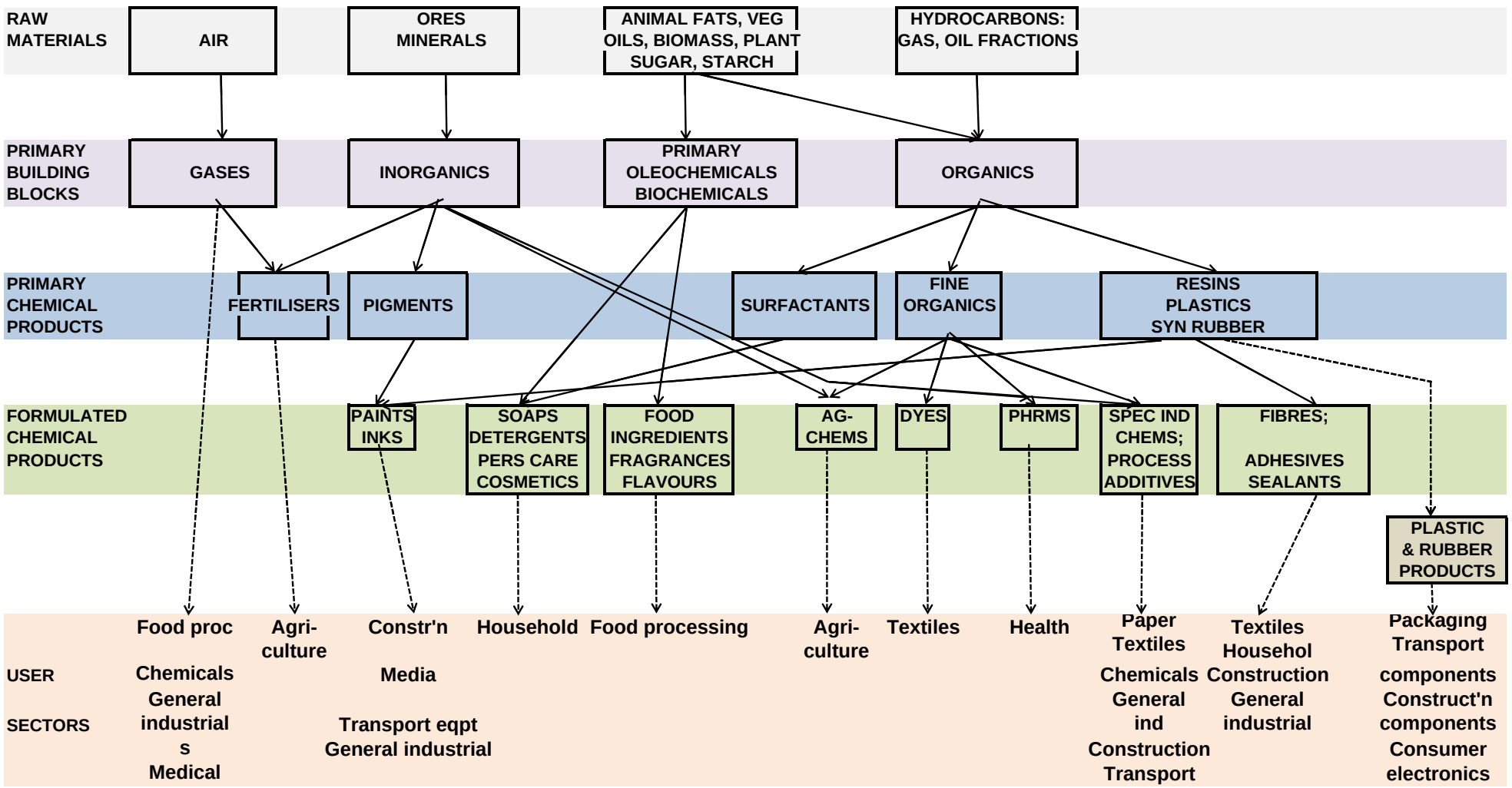


SECTOR

Main sector groups

A Eastwood, CIA, Dec 2011

EXAMPLES OF SUPPLY CHAIN LINKS ASSOCIATED WITH THE CHEMICAL INDUSTRY



	Raw materials (data covers all extractive industries)	Building blocks	Primary products	Formulated products	Major customer industries					
SIC	B	2011/3/4	2012/5/6/7	202/3/4/5/6, 21	Plastics processing 22	Food processing 10+11	Agriculture A	Construction F	Construction components 23	Transport equipment 29+30
Added value, £bn	28.4	2.5	2.2	14.6	7.9	26.4	1.7	69.5	4.5	20.2
Employment, thousands	63	23	19	120	154	420	41	1389	96	263
Lab cost/head, £ thous	74	46	45	38	26	26	15	26	29	39
Key competitive factors	Local presence of basic resource Tax regime	Feedstock cost/availability Energy cost Engineering competence Proximity to end market	Feedstock cost/availability Energy cost Engineering competence Proximity to end market	Intermediates availability Market knowledge Innovation	Size of local market Value/service flexibility	Raw inputs availability Innovation Energy costs	Local soil, climate Innovation Energy costs	Local market	Energy costs Production efficiency	Design Production efficiency Strong local supply chain
UK strengths	N Sea h/carbons; strong skills in extraction technologies Unconventional gas, coal, salt, potash, limestone, fluorspar	NG liquids/gas crackers Logistics (defensive)	Logistics (defensive)	Skills in difficult and complex process technologies Innovation to meet consumer demand Formulation skills Marketing skills	Packaging is a strong, sophisticated domestic market	Large domestic market	Efficient; many large scale producers	Actual construction necessarily takes place locally Strong regulatory push for new/better standards	Logistics (defensive)	Design Highly efficient assembly plants
UK weaknesses	Unpredictable tax regime	Energy costs Logistics (export)	Energy costs Limited range of intermediates and end products Weak downstream value	Lack of some intermediates	Limited range of advanced polymers produced locally Relatively small domestic market for engineering plastics	Energy costs		Generally low quality, poor skills in UK housing Current lack of funds for infrastructure projects	Energy costs Depressed European construction markets	Lack of depth in supply chain