A Historical Perspective on Strategic Resources

Techniques and Strategies Regarding Strategic Resources

Joar von Arndt

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Throughout the history of human civilization, the characteristics of strategic resources and the methods of dealing with them have changed considerably. But as our economy becomes more and more complex, and the number of materials increases together with this complexity, the application of any single material represents a smaller and smaller portion of economic activity. For this reason, the impact of any single resource on the world's supply chains is unlikely to have as significant of an impact as they might have had in the past. It is interesting however to observe how nations have dealt with the issue of strategic resources in the past and to learn how those techniques may be used in the future to protect critical industries. Historically energy has been the principal strategic resource, but in recent time the prodution of computing machines and information processing has become increasingly important.

For almost all of human history, the labour of mankind was almost entirely devoted to the production of food. Major disasters such as the collapse of Bronze Age civilizations three thousand two hundred years ago did not have insufficient bronze supply as sole cause, even if it may have contributed to the crisis[1]. Iron age societies were more self-sufficient, as iron is relatively plentiful around the world compared to the long and delicate trade networks bronze age civilizations required to obtain tin. It really took until the age of discovery for the empires of Portugal, Spain, and eventually the Netherlands and their attempt to dominate Southeast Asian spice production for a precursory form of the strategic resource to appear. This grew to become the world's most important trade[2], as the basic production of foodstuffs was still largely limited to subsistence farming and was therefore only locally disrupted by rare events like droughts[3]. Spice production and trade fueled Europe's burgeoning empires. But by and large, since so much of the economy was distributed and focused on local matters, no resource managed to be impactful enough to accurately be described as a strategic resource.

With the advance of industrial manufacturing, more effective agriculture, and rapid urbanization, and most of all the use of sources of energy not reliant on human or animal labour led to the rise in complex supply chains and the use of rarer and more advanced materials. Following the demise of the Dutch Republic, the Spanish American Wars of Independence and the Napoleonic Wars, the United Kingdom of Great Britain and Ireland emerged as the preëminent leader in the world. It did so partly on the back of Watt's steam engine from the late eighteenth century, it in turn fueled by long since exploited high-quality British coal. Other European great powers such as France, Prussia, and later Germany were all fueled by the large consumption of coal[4], partly becoming the reason those powers eclipsed their rivals such as Russia[4], the Habsburg Monarchy[5], and Italy[6]. The later use of steamships required an extensive system of coaling stations and collier ships to facilitate global trade networks that became ever more interconnected during the first globalisation. As the nineteenth-century economist W.S. Jevons wrote in 1865:

> Coal in truth stands not beside but entirely above all other commodities. It is the material energy of the country — the universal aid — the factor in everything we do. With coal almost any feat is possible or easy; without it we are thrown back into the laborious poverty of early times. [7]

Coal thus became the world's first true strategic resource, vital to not just the income of those who traded it, but critical to the stability of the entire nation's economic health. Any nation, regardless of their location in the world or state of development, needed to acquire a steady and reliable supply of coal to avoid being "thrown back into the laborious poverty of early times". But the eventual replacement of the steam engine by the internal combustion engine meant that the Europeans could no longer rely on domestic sources of energy but had to import foreign oil.

The start of the oil industry has its origins in Titusville, Pennsylvania, where the very first oil well was drilled six years before Jevons described coal as the universal aid. Oil was at first not a critical resource because it was almost entirely a product for illumination, competing with coal-based

[1] Kemp, L., & Cline, E. H. (2022). *Systemic Risk and Resilience: The Bronze Age Collapse and Recovery.* In A. Izdebski, J. Haldon, & P. Filipkowski (Eds.), Perspectives on Public Policy in Societal-Environmental Crises: What the Future Needs from History (pp. 207–223). https://doi.org/10.1007/978-3-030-94137-6_14

[2] Laurea, T. (2021) *Spices, Exotic Substances and Intercontinental Exchanges in Early Modern Times.* Venice: Università Ca' Foscari Venezia. http://dspace.unive.it/handle/10579/19714

[3] Snyder-Reinke, J. (2009) *Dry Spells: State Rainmaking and Local Governance in Late Imperial China.* Cambridge: Harvard University Asia Center.

[4] Fernihough, A., & O'Rourke, K. H. (11 2020). *Coal and the European Industrial Revolution.* The Economic Journal, 131(635), 1135–1149. https://doi.org/10.1093/ej/ueaa117

[5] Gross, N. T. (1971). *Economic Growth and the Consumption of Coal in Austria and Hungary 1831- 1913.* The Journal of Economic History, 31(4), 898–916. http://www.jstor.org/stable/2117215

[6] Bardini, C. (1997) Without Coal in the Age of Steam: A Factor-Endowment Explanation of the Italian Industrial Lag Before World War I. The Journal of Economic History, 57(3), 633–653. https://doi.org/10.1017/S0022050700113397

[7] Jevons, W.S. (1865). *The Coal Question; An Inquiry concerning the Progress of the Nation, and the Probable Exhaustion of our Coal-mines.* London: Macmillian and Co. 2nd edition. pp. 14.

"town gas" and blubber from whales hunted at sea[8]. Pennsylvania was the Saudi Arabia of its time, and the United States produced the lion's share of the world's petroleum. But production soon started in other places around the world, and the Russian (today Azerbaijani) city of Baku became the primary supplier to European kerosene. The state of highly-developed globalisation that occurred in the late nineteenth century meant that large multinational companies could easily operate world-spanning distribution networks, and companies such as Royal Dutch, Shell Transport and Trading, and largest of them all the Standard Oil Company of New Jersey dominated the global oil industry[8]. This meant that while the UK had some presence in the logistical and distribution areas of the oil industry (so-called mid- and downstream in industry terminology) it did not possess any major oil fields known to the world at the time (and so did not have an *upstream* presence). This first became an issue when Winston Churchill (then the First Lord of the Admiralty, the political head of the Royal Navy) pushed for the transition from coal to fuel oil for the Navy's ships. This was a strategically difficult decision, but needed to counter the German investment into their *Hochseeflotte*, as oil-fueled ships were technologically superior to steam powered ones[8].

While Shell was a British company, it was dominated by the 60/40 merger with Royal Dutch in 1907 and was therefore chiefly in the control of foreign interests in the view of the British government, especially as Anglo-German relations grew more amicable at the turn of the century[9]. To create an entity that would prioritize the fleet in the event of a conflict the British government bought a controlling share in the struggling Anglo-Persian Oil Company that had used up nearly all of its capital exploring for oil in Iran. Anglo-Persian would operate as a privately owned company in practice, but would through its state-owned nature prioritize British customers, primarily those of interest to the security of the empire[8]. This is a very clear example of the state intervening to protect its position in a sector it deems as vital to the national interest. This arrangement had its obvious benefits, but was largely unnecessary. Royal Dutch Shell ended up being the primary supplier to the British during the first world war, and with the entry of the United States into the war the Entente oil supply represented close to all of global production[8]. While oil was useful during the great war, it had not yet reached its peak of usefulness in military strategy.

The rise of mechanized warfare and aviation that got its start during the first world war but really took off in the interwar period and during the second world war meant that oil became a truly critical commodity. The rise of the internal combustion engine and the mass production of the car at the turn of the century, meant that the oil industry had grown considerably. It had also saved it from the rise in electrical lighting during the same period that caused a severe decrease in kerosene revenues[8]. The Second World War cemented its status as the world's most vital strategic resource. The German *Blitzkrieg* strategy, which relied heavily on mechanized units, was directly dependent on fuel supplies. This was the main driver for *Fall Blau* whose objective was securing the oil fields of the Caucasus. Writing on his experience on the African theatre of the war, the German field marshal Erwin Rommel said the following:

> The bravest men can do nothing without guns, the guns nothing without plenty of ammunition, and neither guns not ammunition are of much use in mobile warfare unless there are vehicles with sufficient petrol to haul them around.[10]

Likewise, Japan's expansion in the Pacific was driven by its need to secure raw materials, especially oil, as its own domestic supplies were virtually nonexistent. After the United States sanctioned Japan following its invasion of China, denying it the ability to buy oil, Japanese strategic planning became centred on the security of its oil supplies. Even after the conquest of the Dutch East Indies (modern-day Indonesia) the Japanese remained afraid of American capabilities to intercept shipments of petroleum on their way back to the Japanese home islands. This was a core reason for the attacks at Pearl Harbour that brought the Unites States into the war. Even during the war, oil supplies were a constant struggle for the Japanese military. Despite attempts to make aviation fuel out of pine cones on massive scales, the Japanese air force was forced to carry out its famous *kamikaze* attacks principally due to shortage of fuel[8].

Both during and following the war, large supplies of oil had been found in Arabia and in other places around the world. But despite the fact that oil had been proven to be perhaps *the* most important resource for mobile warfare, neither of the two superpowers saw oil supply as particularly worrying. This is because they both possessed some of the world's largest supply and the nations where these new supplies were being discovered were either neutral or somewhat aligned with the two superpowers (Venezuela and the Soviet Union, the United States and Saudi Arabia[11]). Thus the question of fuel became more of a logistical challenge rather than where control of oil fields would be the objective of the war. The new petrostates saw oil instead as deeply critical to the economic health of their nations, and fought a long battle with the large Anglo-American oil companies (the so-called Seven Sisters) over the revenue split from the sale of oil. The Iranian nationalisation of the Anglo-Persian oil company, now renamed Anglo-Iranian, prompted the intervention of the British and American governments to topple the Iranian government in 1953. This was intended to maintain both adequate levels of supply to the west, as well as avoid a cascading effect of state seizure of Anglo-American oil companies around the Persian Gulf[8]. This shows one of the possible methods of action that larger states can use to secure the supply of strategic resources in foreign countries; exploiting the internal power struggles of different interest groups. This does however risk the ire of those groups you helped overthrow, and this was partly the reason for the Islamic Republic's belligerent foreign policy toward the Anglo-Saxon nations, especially toward the United States.

But despite this lack of strategic interest oil's significance only seemed to grow. Petroleum not only powered

[8]Yergin, D. (1990) *The Prize: The Epic Quest for Oil, Money and Power*. New York: Free Press.

[9]Sterenborg, P.J.C. (2016) *The Netherlands and Anglo-German Relations*. Utrecht University.

[10]Lidell-Hart, B. (1953). *The Rommel Papers*. New York: De Capo press. pp 342.

[11]Rossbach, N. (2023) *Sällsynta metaller och stormaktsrivalitet: En översikt om nya strategiska resurser och risken för råvarukonflikter*. Totalförsvarets förskningsinstitut.

the world's cars, airplanes, industry, and electrical generation, but was also being used in an ever increasing number of products on larger and larger scales in every sector from construction, to plastic packaging, to pharmaceuticals. This increase in demand coincided with a increase in the share of U.S. oil that was imported from foreign countries. This was exploited by the major Arab oil-exporting nations, who were aggravated by staunch western and U.S. support to the State of Israel during the 1973 Yom Kippur War[8]. They, through the Organisation of Petroleum Exporting Countries (OPEC) and Organization of Arab Petroleum Exporting Countries (OAPEC), refused to export oil to those nations who supported Israel. This led to an unprecedented rise in the price of crude oil and caused a global economic recession. However, while the Arab nations were successful in their use of tactics, their overall strategy failed. OPEC has not been able to control the world oil market in the same way since, owing to factors such as the increased fungibility of oil, diversification of supply[12], and cheating by OPEC members on production quotas[8]. Since market economies are so resilient the effectivity of these instruments naturally decrease after they have been proven possible, as the actors implement de-risking and diversification strategies to limit the damage that they could potentially suffer.

The primary instrument created by the oil-importing industrial nations to tackle the immediate hold over the oil markets that OPEC had was the creation of the *International Energy Agency* and a system of oil reserves held by its member states that can be emptied as a reaction to jumps in the price of oil. Largest of these is the American *Strategic Petroleum Reserve*, which holds up to 714 million barrels of crude oil[13] and can be used at the discretion of the American president. These global reserves of oil are not a substitute for domestic production, but they allow for increased mobility within the international system for the industrial nations and gives them the ability to punish nations that temporarily lower production. Oil can be stored quite cheaply within impermeable salt domes for a long time, connected to a preëxisting network of pipelines to quickly increase supply; it is a resource that is logistically very easy to store. As oil production became ever more decentralized and the amount of control individual actors decreased, the days of John D. Rockefeller setting prices across the world was long gone, oil became less and less strategic as supply disruptions still meant that it could be bought from somewhere else, even if at a slightly higher price.

It was during this period that oil started to take a back seat to the increasingly sofisticated computer industry. During the late 20th century the commodification of information, and the machines that processed it, became increasingly valuable. The invention of the transistor in 1947, the metal–oxide–semiconductor field-effect transistor (MOSFET) in 1955, and later the integrated circuit (IC) in 1959 allowed the mass production of computing machines on an unprecedented scale. Moore's law and Dennard scaling meant that computers not only became cheaper, they also became faster and used less power as the size of transistors decreased exponentially [14]. Like oil, this industry is very capital-intensive and is used in every facet of the economy. Unlike the oil industry however, a nation does not need to posses any special resources to compete in the IC supply chain. This aspect was very attractive to some nations.

Critical to this nascent industry was the location of these companies to both acquire expertise and reduce labour costs. The early semiconductor was centred on "Silicon" Valley after Shockley Semiconductor Laboratory and its descendent Fairchild Semiconductor had pioneered the silicon transistor and integrated circuit, respectively. Since these early chips were more reliable due to their solid-state nature, their first large customer was the American military for use in the Minuteman-II ICBM. As the semiconductor industry grew, IBM emerged as the juggernaut. But the American dominance of the semiconductor industry was not to last. American efforts to offshore the "packaging" of chips meant that knowledge was continuously transferred overseas, particularly to the Four Asian Tigers of the Republic of Korea, Republic of China (ROC), Hong Kong, and Singapore; but also to the Philippines and especially Japan. The Japanese market was large and possessed a large number of companies manufacturing ICs and semiconductor components. The ruling Liberal Democratic Party (LDP) wanted to maintain Japanese competitiveness to American penetration into their market by keeping up with the developments in "Very Large Scale Integration" (VLSI) technology that was needed for the ever increasing number of components used in any given IC[14].

The LDP thus had a sophisticated plan to maintain the Japanese IC industry. To accelerate VLSI development the Japanese Ministry of International Trade and Industry (MITI) incentivized the otherwise intensely competing companies through free government loans that represented a much larger R&D expenditure than what any single Japanese company could afford, though much smaller than what the major American companies were investing in VLSI R&D[15]. Mark Shephard, the then chairman of Texas Instruments, commented on the funding of the VLSI project: "We can afford to bear, and do bear, such expenditure alone"[15] showing how the amount of capital employed was not a critical reason of success in and of itself, but rather its effect of forcing the companies to coöperate was tantamount. The effect of the money was instead was a willingness to coöperate, to obtain R&D funding, rather than bolstering the amount of resources that the project had. The project had both experienced administrative and technical personnel, researchers from different companies all worked collaboratively in the same facilities on technologies that they would all benefit from, with a clear deadline and goal; to achieve Japanese VLSI capabilities before IBM computers utilizing the technology entered the Japanese market at the latest of 1980[15]. The project was wildly successful and put Japan on parity with, if not ahead of, the United States in the fabrication of ICs[15]. It is worth noting that the identically named "VLSI Project" that started two years after

[12]The share of OPEC oil production has been eroded by the introduction of new producers or increased production in the North sea (the United Kingdom and Norway), the Canadian oil sands, the southern and eastern coasts of Brazil, as well as fracking in the United States.

[13]Office of Cybersecurity, Energy Security, and Emergency Response. (2024-10-21) *Strategic Petroleum Reserve.* Department of Energy. `https://www.energy.gov/ceser/strategic-petroleum-reserve`

[14]Miller, C. (2022). *Chip War: The Fight for the World's Most Critical Technology.* Scribner.

[15]Sakakibara, K. (1993). *R&D cooperation among competitors: A case study of the VLSI semiconductor research project in Japan.* Journal of Engineering and Technology Management, 10(4), 393–407. `https://doi.org/10.1016/0923-4748(93)90030-M`

the Japanese one in the U.S. that was also very successful focused on largely different challenges with VLSI and could perhaps be the reason for American dominance in software today, spawning things such as the Berkley Software Distribution (BSD)[16], 32-bit workstations, and the CAD tools leading to the founding of companies such as Synopsis[17].

The approach taken by the Japanese VLSI project shares some similarities with the recommendations made by Malmberg et al.[18]. While there was state expertise and resources employed in the project the main resources applied were private. This shows how the guiding hand of the state can effectivize the resources of private industry and also guide them into strategically important reasons for the state. Another, perhaps more famous, example is the founding of Taiwan Semiconductor Manufacturing Company (TSMC). While the ROC had already been instrumental in the creation of another major semiconductor manufacturer seven years earlier, United Microelectronics Corporation (UMC), UMC was not fully prepared for the change in business model that was quickly becoming apparent[19]. TSMC was the first in was is now a series of companies in the "pure-play foundry" model. As the IC fabrication facilities (fabs) became more and more expensive and required higher and higher utilization rates newer design firms opted to pay larger companies, who had their own fabs[20] to make their designs. But these companies were of course unprioritized as the companies preferred to make their own products. TSMC would never compete with their customers and did the job cheaper and better than the large IC companies did. While the government never held an outright majority in the stake of the newly founded company, it was and is the largest shareholder, contributing key capital and support at the beginning of the firm's existence. The ROC also helped secure a technology transfer agreement with the major Dutch electronics manufacturer Phillips and ministers personally called wealthy Taiwanese businessmen to convince them to invest in this new venture. TSMC was neither a project purely created by the state nor a mere corporate enterprise. Rather it was a project of the Taiwanese society whose success or failure involved both state planning and vision as well as private sector expertise and resources.

This dominance in a critical industry is useful in achieving foreign-policy goals. ROC control of this middle ground in the IC supply chain meant that the they could use this choke point to plausibly deter a forceful reunification by the People's Republic of China (PRC). Since dominance in IC manufacturing does not hinge on the control of a strategic geographic location, but rather delicate high-tech fabs and an equally brittle system of supply chains, an armed conflict could easily result in the destruction of these facilities and bring about large economic damages to both nations involved as well as the larger global economy. ICs are also much harder to store than oil as they are continuously updated and improved, with much of the knowledge not even written down but passed around through tradition and experience. Avoiding the upset of this thin balance is in the interest of every major economy on the planet today, and exerts enormous pressure on the actors involved. The PRC's recent attempts at cornering the market for rare metals, particularly rare-earth metals, shares this strategic thinking. Rather than being able to completely stop production of advanced technology in hostile countries, a practical impossibility owing to the small volumes of these materials, the PRC uses increased economic inefficiency as a weapon to deter countries from intervening it what it deems critical foreign policy objectives (Such as the status of Formosa). The failure of economic warfare on impacting the overall quality of war materiel[21] means that the shock tactics employed by China will do little other than undermine its monopoly in the event of a war over the Taiwan strait, like what happened with OPEC after 1973. Even those fearful of China's ability to use these materials through coërcive means will admit that illicit trade and extraction of rare metals even directly with the PRC, not counting possible routes through third-party countries, is very possible[11]. So while these resources are critical for certain industries and perhaps even the economy as a whole, it is unlikely that the targeted embargo of these resources would cause wide-spread economic collapse like that seen in 1973 or spark some sort of military intervention like in 1991.

As technology advances, so too will the division of resources and techniques employed. The days when foraging, hunting, and fishing was all that humanity did to sustain itself at the dawn of humanity has long since passed, and with it the hope of complete self-reliance. The ever increasing list of goods seen as critical to the economy, like that published by the European Commission[22] or the United States Department of the Interior[23], shows how belief on how supply disruptions of specific goods can have outsized effects on the security of nations is widespread. This belief is not new, Jevons pointed this out in regards to coal in the middle of the 19th century, however the scale of those materials involved and the number of discrete ones is unprecedented. It is on such a level that any one nation or actor can not expect to control all sources of supply, but should rather attempt to specialize in a certain focus of industries in an attempt to maintain other countries' willingness to trade, as the PRC has done with rare-earth metals. To maximize possible damage to a hostile actor, countries should aim to dominate industries that represent a large share of a country's imports, either in terms of tonnage or dollars, since they would be difficult to replace. Since low-value manufacturing and primary resources are largely fungible, it is best to target high value-add technology sectors or services, as these have historically had an outsized importance compared to the resources ventured.

[16] The ancestor of today's OpenBSD, FreeBSD, DragonFly BSD, and NetBSD.

[17] One of the companies creating the modern-day duopoly in IC design, the other being Cadence.

[18] Malmberg, P. et al. (2024) *En ny beredskapssektor - för ökad försörjningsberedskap* Statens offentliga utredningar 2024:19.

[19] Hu, J. (2024) *Taiwan's transformation into global semiconductor leadership and future challenges.* DigiTimes Asia. https://www.digitimes.com/news/a20240225PR200/taiwan-semiconductor-industry-subsidy-tsmc-umc-pure-play-foundry.html

[20] "Real men have fabs" was a common saying at the time.

[21] Mulder, N. (2022) The Economic Weapon: The Rise of Sanctions as a Tool of Modern War. Yale University Press: 27-108.

[22] European Commission. (2011). *Tackling the Challenges in Commodity Markets and on Raw Materials.* https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52011DC0025

[23] Applegate, J. D. (2022) *2022 Final List of Critical Minerals.* U.S. Geological Survey, Department of the Interior. https://d9-wret.s3.us-west-2.amazonaws.com/assets/palladium/production/s3fs-public/media/files/2022%20Final%20List%20of%20Critical%20Minerals%20Federal%20Register%20Notice_2222022-F.pdf