STRATEGY & CHANGE

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THE HAGUE CENTRE FOR STRATEGIC STUDIES AND TNO

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The TNO and *The Hague* Centre for Strategic Studies (HCSS) programme Strategy & Change analyses global trends in a dynamic world affecting the foundations of our security, welfare and well-being.

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1 INTRODUCTION

Oil and natural gas, water, food, and minerals are critical to ensuring our wellbeing and prosperity. Due to expanding economic activities, growing population, and climate change these resources have become increasingly sensitive to higher prices, supply shortages, and export restrictions. The mismatch between future demand and supply is crystallizing into one of the most complex and urgent issues policymakers will face in the 21st Century. Unless the challenges arising from these scarcities are confronted in a comprehensive and proactive manner, our economies will stagnate and political power will diminish in the international system. To that end, this report examines the implications of these resource scarcities for EU Member States and offers seven recommendations for addressing them.

While resource scarcity is a global challenge, as no single country is self-sufficient in resources needed to power one's economy, its effects are not equal across countries/regions. This is attributed to the uneven distribution of and variations in demand for resources by countries/regions. For instance, while energy scarcity is a pressing issue for EU Member States, water scarcity is less so in comparison to the Middle East where oil is plenty and water is scarce. Thus, given that countries do not suffer or benefit from resource scarcity in equal terms, asymmetric dependence across resources can be an important driver for cooperation or conflict in the international system.

Under conditions of resource scarcity, the realist thinking renders the future of world politics as conflict prone and raises the likelihood of wars among major powers. This gloomy interpretation of international relations is particularly worrisome, given that major powers are all resource hungry. These states regard access to resources as vital to their national security and do not exclude the use of military force to protect their interests. After all, it is widely claimed that dependence on the Middle East was a primary

factor that united the United States and Europe against Iraq in the 1990-91 war to liberate Kuwait. In the future, similar events could recur, given the increasing dependence of industrialized countries, as well as emerging economies, on energy supplies from producers inside and outside the Persian Gulf. On the other hand, scarcity can also fuel greater cooperation between states as asymmetry in resource distribution does not always translate into a power resource.

Therefore, we do not take it for granted that the impact of scarcity will necessarily lead to either conflict or cooperation. Instead, the degree of dependence and the type of resource are important variables in understanding when resource scarcity leads to cooperation or conflict. Thus, the rest of this report is organized into six sections. The first four sections examine oil and gas, water, food, and mineral, respectively. For each resource we examine global trends of consumption and production, identifying major consumers and producers. Although projection data is speculative, it provides insight into the potential demand and supply scenarios for these resources in the future. Next, we analyze the political dynamics of scarcity, zooming in on the role of the state and exploring the possibilities of cooperation or conflict. Against this backdrop, we analyze the implications for EU Member States, taking into account strategic, economic, and political considerations. Section six offers a glimpse into the complex interrelations among the four resources, describing the effects of changes in one system (e.g., price hikes or shortages) have on the others. The final section provides seven recommendations for tackling the challenges arising from these four resource scarcities.

2 OIL AND NATURAL GAS SCARCITY

2.1 GLOBAL TRENDS

Since 1965, the demand for energy has surged, growing at an average annual rate of 4.8%.[1] In 2008, the energy dependence (ratio of total imports/total consumption) of the EU amounted to 53.8%. Worldwide, economic and population growth are expected to continue, raising demands for energy, particularly for oil and natural gas.[2] Although as a percentage of total energy sources the share of oil and natural gas is expected to decline, oil and natural gas will remain the dominant source of energy for the years to come.[3]

OIL

Global demand for oil is expected to rise, on average, by 1% per year, increasing from 85 million barrels per day (mb/d) in 2007 to 106 mb/d by 2030.[4] This increase in world oil demand will mainly come from non-OECD countries, especially emerging Asian economies. With an average growth rate of 3.9% in oil demand, India sees the fastest growth, followed by China (3.5%), and the Middle East (2.3%).[5] In contrast, demand in OECD countries is expected to fall. For instance, oil demand in Japan is expected to decline by 1.4% and in both Europe and the U.S. by 0.3%.[6] Still, with a consumption of 19 mb/d in 2030, the U.S. will remain the biggest consumer, followed by China with 16.6 mb/d, and the EU with 12.4 mb/d.[7] As such, all major consumers will see their net imports rise, except for the U.S. (see Table 1). The EU will become more dependent as its ratio of total imports to total consumption is expected to jump from 82% to 92% (2007-2030).[8] In contrast, U.S. dependence will marginally decline from 65% to 62%, while China's dependence will increase from 50% to 75% and India's from 72% to 92% (2007-2030).[9]

From the supply side, OPEC countries are expected to supply 51% of the projected rise in global oil demand, with output jumping from 35.9 mb/d in 2007 to 44.4 mb/d in 2015 and 52.9 mb/d in 2030.[10] In many non-OPEC

producing countries conventional oil production is expected to peak before 2030.[11] At the same time, non-conventional oil supply from non-OPEC countries is also expected to rise.[12] For instance, outside OPEC production will increase in North America from 13.8 mb/d in 2007 to 17.9 mb/d in 2030.[13] However, European output is projected to fall from 4.9 mb/d in 2007 to 3.4 mb/d in 2015 and 2.2 mb/d in 2030.[14] Latin American output will grow from 3.5 mb/d in 2007 to 5.1 mb/d in 2015, but decline thereafter to 4.6 mb/d in 2030.[15] Thus, energy trade between regions is expected to rise during the projected period, as major consumers, such as the U.S. and China and emerging economies become more dependent on oil imports from the Middle East, Africa, and Eastern Europe/Eurasia (the Caspian region).[16]

TABLE 1: OIL TRADE IN THE REFERENCE SCENARIO (MILLION BARRELS PER DAY)

	2007	2015	2030
NET IMPORTERS			
OECD	-27.1	-27.1	-23.1
NORTH AMERICA	-10.7	9.3	-5.9
UNITED STATES	-13.2	-12.3	-11.9
EUROPE	-9.1	-10.6	-11.0
PACIFIC	-7.3	-7.2	-6.2
JAPAN	-4.8	-4.4	-3.5
NON-OECD ASIA	-8.4	-14.5	-24.7
CHINA	-3.8	-7.7	-12.5
INDIA	-2.1	-3.3	-6.6
NET EXPORTERS			
MIDDLE EAST	19.9	23.9	28.5
AFRICA	7.5	8.7	9.1
LATIN AMERICA	1.5	2.3	1.7
BRAZIL	-0.2	1.2	0.6
E. EUROPE/EURASIA	8.1	8.6	10.7
RUSSIA	7.2	7.0	6.3
EUROPEAN UNION	-11.0	-11.8	-11.5

SOURCE: OECD/IEA. WORLD ENERGY OUTLOOK 2008. PARIS: OECD/IEA, 2008. 103.

NOTE: POSITIVE FIGURES DENOTE EXPORTS; NEGATIVE FIGURES DENOTE IMPORTS.

TABLE 2: NATURAL GAS TRADE IN THE REFERENCE SCENARIO (BILLION CUBIC METERS)			
	2006	2015	2030
OECD	-353	-496	-741
NORTH AMERICA	-15	-53	-143
EUROPE	-241	-333	-477
PACIFIC	-97	-111	-121
OECD ASIA	-115	-143	-179
OECD OCEANIA	18	32	58
NON-OECD	353	496	741
RUSSIA	198	205	270
CHINA	-1	-17	-106
INDIA	-8	-16	-71
MIDDLE EAST	55	105	323
AFRICA	99	162	284
LATIN AMERICA	16	8	35
EUROPEAN UNION	-305	-435	-582

SOURCE: OECD/IEA. WORLD ENERGY OUTLOOK 2008. PARIS: OECD/IEA, 2008. 116.
NOTE: POSITIVE FIGURES DENOTE EXPORTS; NEGATIVE FIGURES DENOTE IMPORTS

NATURAL GAS

Demand for natural gas is expected to increase by 52% between 2006 and 2030, from 2.916 billion cubic meters (bcm) to 4.434 bcm.[17] In non-OECD countries, demand is expected to increase by 2.5% per year, growing from 1.451 bcm in 2006 to 2.607 bcm in 2030.[18] Specifically, key growth will come from China (676 bcm), India (221 bcm), and the Middle East (117 bcm).[19] In OECD countries, demand will jump from 1.465 bcm in 2006 to 1.827 bcm in 2030, averaging an annual growth rate of 0.9%.[20] Japan will experience the largest growth with an average of 1.3%, followed by the EU (1.0%), and the U.S. (0.1%).[21] Due to a lack of sufficient domestic supply to meet growing demand, imports will rise for all current net importers (see Table 2).[22] Between 2006 and 2030, dependence (ratio of total imports/total consumption) of the EU will jump from 57% to 86%, China's from -1% (net exporter) to 48%, and India's from 26% to 61%.[23]

On the supply side, most of the projected growth in production is expected to come from non-OECD countries.[24] The Middle East, which holds the largest reserves and has the lowest production costs, will account for 46% of the projected growth in gas production.[25] Its output will reach almost one trillion cubic meters by 2030, with most production coming from Iran, Qatar, Iraq, and Saudi Arabia.[26] The remaining increase in world output will come from Africa and Russia, with each contributing 17% and 9%, respectively.[27]

2.2 POLITICS OF OIL AND NATURAL GAS

What makes oil and natural gas politically volatile is the role of the state in these markets. Of the 25 oil companies, 17 are state-owned national oil companies, including Saudi Aramco (Saudi Arabia), North Oil Company (Iraq), National Iranian Oil Company (Iran), and Kuwait Petroleum Corporation (Kuwait).[28] Between them, these national companies own 50% of the world's total reserves, and are responsible for 45% of total world production.[29] All together, the 17 national oil companies' share of total reserves is 77% and 52% of total world's production.[30] Similarly, natural gas resources are also highly concentrated in the hands of a few national companies.[31] For instance, Gazprom, National Iranian Oil Company, Saudi Aramco, and Qatar Petroleum own 46% of total natural gas reserves and are responsible for 26% of total world production.[32] The same 17 national oil companies own 63% of total natural gas reserves and produce 40% of the world's gas.[33]

From the consumer end, the state has at its disposal several instruments for influencing oil and natural gas supply and demand issues. These instruments range from economic measures and military interventions to building up large reserves, such as the Strategic Petroleum Reserve. Moreover, consumers may also resort to either granting or withholding markets access. In sum, governments of both consuming and producing countries continue to micromanage transnational energy relations.

In a world in which there is a voracious and growing appetite for energy and no abundant, cost-effective substitutes, countries are viewing oil and gas supply security as a top national security issue. In recent years, environmental issues have gained some importance. However, for the moment, energy security continues to trump such concerns. For instance,

even President Obama, who has vowed to reduce carbon emissions, authorized drilling for oil and natural gas in the Atlantic Ocean and the Gulf of Mexico.[34] In the words of President Obama: "Given our energy needs, in order to sustain economic growth and produce jobs, and keep our businesses competitive, we are going to need to harness traditional sources of fuel even as we ramp up production of new sources of renewable homegrown energy."[35] Less than a month later, however, because of the oil spill in the Gulf of Mexico the Obama administration suspended new offshore drilling.

However, the reality is that domestic production in many top consumers will hardly keep pace with consumption. To make matters worse, as dependence on imported oil increases the number of producers is expected to decrease.[36] This creates a situation of radical politics and raises the potential for conflict. In the past and present, linkages have been used by both importing and exporting states for political purposes. For instance, on the producer end, the U.S. imposed an oil embargo against Japan in 1941, the Soviet Union placed an embargo on China in 1964, and the Arab oil producing states placed several embargos on Western countries (1956, 1967, and 1973). On the other hand, consumers on many occasions have also placed oil sanctions on producers, such as the U.S. sanctions on Iran, Libya, Iraq, and Sudan. Finally, the use of force to secure energy resources has not been uncommon. For example, Japan invaded the Dutch East Indies in reaction to the U.S. embargo of 1941. In 1973, Secretary of State, Henry Kissinger, threatened to use force to end the Arab oil embargo. In 1991, European countries and the U.S. joined forces to liberate the oil rich Kuwait.

2.3 IMPLICATIONS FOR THE EUROPEAN UNION

Instead of cooperation, oil and natural gas resources will likely fuel conflict among nations, and promote a foreign policy guided by power politics. Under such conditions, we have singled out five challenges for EU Member States:

EU military interventions in producing countries: Much of future oil and natural gas supplies will come from unstable regions, such as the Middle East and Africa where some of the deadliest and longest conflicts today are taking place. For instance, in Nigeria there is the Delta conflict, in Sudan

the Darfur genocide, and Equatorial Guinea is dubbed a criminalstate. Civil wars also broke out in Chad, Angola, and the Republic of Congo. As for the Gulf countries, the world's largest oil and natural gas producers, they too suffer from several internal and external security problems — the Arab-Israeli conflict, Islamic terrorism, political instability in Iraq, and Iranian hegemonic ambitions in the region. Thus, violent conflicts and other forms of political instability could lead to major disruptions in energy supply, which, under certain circumstances, would necessitate the use of military force to protect the flow of oil and natural gas.

Political constraints on EU foreign policy: In times when the threat of terrorism and proliferation of nuclear weapons is urgent and growing, some producers pose a major dilemma for the EU: balancing the necessity to punish oil and natural gas producers for sponsoring terrorism or for violating the Non-Proliferation Treaty with the pressing need for ensuring access to energy supplies. For example, Iran and Libya, both are major oil and natural gas producers, were accused of sponsoring terrorism. Nuclear power is another issue, which might complicate relations between producers and major powers, including the EU. Iran's nuclear program is a case in point. The EU foreign policy is cornered between Iran's perceived nuclear threat and its potential of becoming a major supplier of oil and gas to EU markets.[37] Increasingly, energy producers are considering developing nuclear energy programs in order to allow for more exports of oil and gas. With the same technology, however, enriched uranium can be used for developing nuclear weapons.

Political blackmailing by producers: It is only recently that the usage of economic instruments as a foreign policy weapon has been noted in the security debate. Yet, economic instruments have been widely used in the past and present for political purposes. The 1973 oil embargo is a case in point. The most recent example is the Russian showdown with Ukraine. The Russian-Ukrainian crisis left millions of Europeans without natural gas. In many of the Arab Gulf countries, Islamic fundamentalists pose a serious threat to political stability. If Islamic fundamentalists succeed in wrestling power out of the hands of moderate ruling families in the Gulf, 54% of the world's oil and gas reserves will be under the control of anti-Western regimes. For its part, Russia is in search for influence and authority in world politics. This aspiration is clearly articulated in The National Security

Strategy of the Russian Federation (NSSRF) to 2020, which claims that Russia's long-term interest is to become a world power. One of the main characteristics of Russia's expansive foreign policy has been the usage of energy as an instrument of economic pressure for political gains. Thus, there are no assurances that Russia will not disrupt natural gas and/or oil supplies to the EU in the future, should Moscow deem it necessary.

The rise of *realpolitik* among consumers: In the near future, with demand for oil and natural gas expected to increase among all major powers, competition for access to these resources will have a major impact on their relations with each other and the global markets for these resources. All major powers have singled out energy security as a vital national security issue. For instance, the EU, in advancing its energy interest in producing countries and regions, has launched several initiative and dialogues, including the EU-Russia Energy Dialogue (2000), EU-OPEC Energy (2004), the Baku initiative (2004), and the South-East European Energy Community (2005).[38] In the Caspian region, where significant amount of oil and natural gas is present, major powers (China, Russia, Europe, US, and India) have been fiercely vying to secure their energy interest.[39] In the Persian Gulf, Japan, India, and China have stepped up their diplomatic efforts to secure their share of oil imports.[40] National differences on a market model for energy also exacerbate tensions and raise the prospect of conflict. The findings of one study sponsored by the Council on Foreign Relations point out that "high prices and seemingly scarce supplies create fears — especially evident in Beijing and New Delhi, as well as in European capitals and in Washington—that the current system of open markets is unable to ensure secure supply."[41] Unlike the U.S., which is a strong promoter of the free market, China has thus far circumvented the free market by securing long-term contracts.[42] For the last several years, Chinese state-controlled oil corporations have been aggressively increasing their share in overseas assets in the oil and natural gas industries in Latin America, the Middle East, and Africa.[43]

3 WATER SCARCITY[44]

3.1 GLOBAL TRENDS

Over the past century, while the world's population tripled, water usage increased six-fold, causing a shortage in the availability of freshwater supplies.[45] In 2008, consumption reached 3840 km^3. Though current available water supplies for domestic, agriculture, and industrial use range between 9000-12,000 km^3 [46], they are unequally distributed, with arid regions experiencing increasing lower supplies and quality of water, especially Sub-Saharan Africa, the Middle East and parts of Asia[47]. At the moment, water reserves are being overexploited in North and Central America, Southern Europe, North Africa, the Middle East, and certain parts of Asia.[48] By 2030, the gap between demand and supply of water will reach 40%.[49] This increase in demand will lead to a rise in physical water scarcity in regions such as Southern Europe, Sub-Saharan Africa, the Middle East, and Asia.[50] Likewise, central, eastern and western parts of Africa, as well as Asia and Oceania will experience economic water scarcity.[51] The increase in demand will be driven by the domestic, agricultural, and industrial sectors.[52]

Domestic demand for water is projected to decrease as a percentage of total water withdrawals from 14% to 12% by 2030, although it is expected to grow in specific basins, notably in emerging markets.[53] Agricultural demand is expected to reach 4.500 billion m^3 by 2030 (a slight decline to 65% from 71% of total global water withdrawals).[54] However, given the rising demand for food and projected world population, production needs to increase by 1.4% to meet this demand, which requires, among other things, intensification of farming methods such as irrigation.[55] Consequently, water consumption is expected to increase by 14%, causing local bottlenecks in areas, such as the Middle East and North Africa, where there are already signs of severe water scarcity.[56] In turn, these countries will be forced to import more food.[57] As for industrial production, withdrawals are projected

to reach 22%, being primarily driven by China, whose water demand is expected to reach 265 billion m^3 by 2030 (40% of the total additional industrial demand for water worldwide).[58]

Within the EU water availability varies across regions. Generally speaking, southern European countries suffer from acute water scarcity, while northern and western Europe enjoy plenty of supplies. For example, as a measure of water availability river flow ranges from less than 50 mm per year in places such as southern Spain to more than 1500 mm per year in parts of the Atlantic coast. However, overexploitation and global climate changes threaten to increase the intensity and spread of the scarcity even to northern Europe.[59]

3.2 POLITICS OF WATER SCARCITY

Despite the current debate over potential "water wars" in places such as North Africa and the Middle East, in reality there is no strong evidence correlating water scarcity to war.[60] A study conducted by the Environmental Change and Security Program at the Woodrow Wilson International Center for Scholars concluded: "No nations have gone to war specifically over water resources for thousands of years."[61] Instances of cooperation between riparian nations outnumbered conflict by more than two to one between 1945 and 1999.[62] Thus, instead of war, water fuels greater cooperation.[63] By coming together to manage their shared water resources, countries build trust and prevent conflict.[64] Thus, despite regional instability, the Nile basin countries continue to seek solutions through cooperative channels, such as the high-level Nile Basin Initiative and its Civil Society Stakeholder Initiative, as well as the Nile Basin Discourse and its National Discourse Forums, reinforcing the interdependence between these countries and the need to cooperate to solve the issue of water scarcity.[65]

Cooperation on water scarcity is also evident at the international level. For instance, at the World Summit on Sustainable Development in Johannesburg in 2002, "the international community acknowledged the importance of water scarcity by adopting the short-term target of developing integrated water resources management and water efficiency plans by 2005, with support to developing countries at all levels."[66] Today, there are 16 UN agencies and programs, five UN regional commissions and seven non-UN partners focusing on water scarcity, consisting of civil

society, the business sector and state representatives.[67] Furthermore, given that water resources are trans-boundary in nature many states are using bilateral and multilateral channels to reach agreements on managing them.[68] This means that military solutions are unlikely to be used for securing water resources, for they are not owned by one state, but by countries bordering the same basin.

3.3 IMPLICATIONS FOR THE EUROPEAN UNION[69]

Water scarcity is unlikely to provoke conflicts or be used as an instrument of political coercion, but it raises challenges and opportunities for the EU:

Trade relations and conflict resolution: With certain EU Member States already facing water shortages and others projected to experience a decrease in water supplies in the near future, trade in virtual water will become the predominant solution in meeting their needs. However, given the increased dependence of water scarce states (Middle East) and emerging markets (India and China) on virtual water trade, there will be increased competition in world commodity markets, especially in agricultural commodities given their water intensive properties. This will have a mixed effect on EU Member States: it will be negative for importers, but positive for exporters, as prices in such commodities are not expected to fall in the future and may even increase. Beyond the economic gains, the role of virtual water will be instrumental in resolving water conflicts. Today, for example, many countries in the Middle East do not produce enough water to meet their needs. To make up for the water shortages, many of these countries import commodities such as grains, which require large amounts of water to produce.

Water technology and know-how as a foreign policy instrument: Water management knowledge and technology, such as innovation in the area of water reuse (advanced biological treatment and membrane filtration), provide certain Member States with a strong competitive advantage. For instance, the Netherlands has and is looking to sign bilateral agreements that include the transfer of knowledge and innovative technologies for water management with countries facing water shortages, including China and India.[70] Dutch public and private sectors have also established the Netherlands Water Partnership (NWP), which aims to harmonize activities and initiatives of the Dutch water sector abroad and to promote Dutch

expertise in water world-wide.[71] Thus, the Netherlands can become a key actor in addressing water quantity and quality in water scarce areas, allowing it to develop and strengthen partnerships, especially strategic ones, for instance, with the Persian Gulf countries and with China.[72]

International agreements: As stated earlier, the nature of water scarcity provides states with powerful incentives for cooperating at the regional and international level in mitigating the problems that arise from it. The effective institutionalization of the water crisis is evident by the large number of bilateral agreements and treaties, as well as civil society and international organizations. For the EU, this means working towards signing bilateral and multilateral agreements. At the moment, the EU and other states are addressing this issue through such mechanisms, at the regional and international level, reiterating the importance of managing water resources cooperatively. For instance, in accordance with the World Summit on Sustainable Development (WSSD) goals on clean water and sanitation, the EU launched the "Water for Life" global initiative, which aims to help partners develop integrated water management plans.[73] Each year the EU provides about Đ1.5 billion to support national and regional water management and sanitation programmes in places such as the Nile basin.[74] Politically, the EU has established dialogue on policies and strategies for water and sanitation, such as the EU-Africa Partnership, which provides a framework for political dialogue on issues related to: 1) transboundary basin management, 2) flood preparedness programmes, 3) knowledge and monitoring of water resources, and 4) sustainable regional water infrastructure.[75]

4 FOOD SCARCITY[76]

4.1 GLOBAL TRENDS

Though food became less scarce during the second half of the 20th Century, the food commodities markets are expected to remain volatile in the coming years.[77] The food crisis of 2006-2008 has heightened concerns about the future of food supply.[78] In 2006, world food commodity prices began to climb, reaching their highest levels in almost 30 years by 2007/2008 and triggering a global food crisis.[79] However, in the second half of 2008, prices began to fall as a result of several factors.[80] First, demand started to diminish under the global recession and conditions of limited credit.[81] Second, lower energy prices resulted in demand for biofuel feedstock to decrease.[82] Lastly, lower transportation costs and increased production by the Commonwealth of Independent States (CIS) countries resulted in supply to exceed diminished demand.[83] Regardless, price levels remain high in comparison with those of previous years and are projected to stay this way for the years to come.[84]

Looking ahead, there is a credible concern about the capacity of the agricultural industry to meet food demand for a projected world population of 9 billion by 2050.[85] It is estimated that meeting future demand for food in developing countries will require a 50% increase in production by 2030 and a doubling of production by 2050.[86] In the medium term, growth in agricultural output in the coming decade will not match that of previous decades as the average annual growth rate will fall from 2.0% (1999-2008) to 1.7% between 2009 and 2018.[87] As a group, industrialized countries will remain net exporters, while developing countries remain net importers.[88] However, within the former group, there is a significant variation in the configuration of trade, which is projected to persist by the year 2019/2020 (see Annex 1 and 2). For example, while the EU is a net importer of raw products, such oilseeds, rice, and corn, it is a net exporter of livestock and cereals.[89] Likewise, the U.S. is projected to remain a major exporter of agricultural products.[90]

In the coming decade, patterns of trade are projected to shift. The slowest growth is expected to occur among industrialized countries, while countries in Latin America and Asia, as well as the CIS countries will experience higher growth rates.[91] By 2018, agricultural output in these regions is projected to be 75%, 53% and 58% higher than in 2000, respectively, compared with an increase of only 12% in industrialized economies.[92]

4.2 POLITICS OF FOOD SCARCITY

While food shortages are known to instigate domestic riots (e.g., Bangladesh, Haiti, and Mozambique), no states have gone to war over prices or food shortages, and there is no indication that they will in the future.[93] As demonstrated by the recent food crisis, states took measures to increase domestic production, ensure security of food imports, and support poor consumers' access to food.[94] Nevertheless, the use of food dependence as an instrument of foreign policy cannot be dismissed. For instance, in 1975 and 1980, the U.S. placed grain embargos on the Soviet Union, and continues to embargo food to Cuba.[95] To mitigate political vulnerability and price vulnerability, for example, China is buying or leasing farmland in Africa. The same strategy has been adopted by Middle Eastern countries, investing heavily in Africa's agricultural sector.[96] However, the strategy of "land grab" can trigger problems in host countries, such as endangering food security or provoking tension over water demand.[97]

In Western countries there are different domestic interest groups that are active in shaping agriculture policies by lobbying for farming subsidies, export and import restrictions, environmental concerns, and energy independence. For example, although the U.S. (foreign offices) supports agricultural trade liberalization, a small yet politically effective group of farmers have managed to secure and maintain a large amount of government subsidies. According to the Environmental Working Group, U.S. farm subsidies reached $15.4 billion in 2009.[98] The situation is similar in Europe whereby the common agricultural policy (CAP), which is a system of agricultural subsidies and programmes, amounted to Đ53 billion of the EU's budget.[99] By the same token, the move towards an open agricultural trade policy, which would result in the elimination of import tariffs and subsidies, has become a pressing domestic issue. Internationally, this has also become a controversial issue. Disagreements over agriculture in the Doha Round illustrate that domestic issues carry great weight in foreign policy.

At the international level intergovernmental organizations are also active in the issue of food security. Today, there are three UN agencies concerned with food security: the Food and Agriculture Organizations (FAO), the International Fund for Agricultural Development (IFAD), and the World Food Program. The World Trade Organization (WTO) also plays an instrumental role in addressing food security, as trade arrangements influence the production and distribution of food. The World Bank influences food security through various measures, including Structural Adjustment Programs (SAPs). Other actors concerned with addressing food insecurity are NGOs such as Oxfam and the World Economic Forum. In 2009, countries and UN agencies endorsed the L'Aquila Food Security Initiative (AFSI), which acknowledges the importance of achieving food security for all through a cross-cutting and inclusive approach that involves all stakeholders at all levels.[100]

4.3 IMPLICATIONS FOR THE EUROPEAN UNION[101]

Issues of trade, technology, and international regimes are far more likely to shape the international agenda of food scarcity. Accordingly, several challenges and opportunities for the EU are identified:

Subsidy politics: Agriculture subsidies remain a contentious issue, exacerbating political tensions at home and complicating the link between domestic and foreign policies. At home, when it comes to the CAP funding there are differences in positions and interests. Conflicting positions can be witnessed between promoters of the CAP funding and protesters, who regard subsidies as unfair. But, even among the CAP promoters there are differences between various interest groups, such as mainstream farmers, rural interests, and green environmentalists. At the EU level, the CAP funding has been subject to heated debate. Key issues in the debate include whether or not to reduce the CAP budget and the structure of the first and second pillar. The EU budget review for 2013 is expected to introduce radical reforms, such as determining the CAP budget, addressing rural development policies, and most tenacious of all, grappling with the question of whether farms should remain entitled to receiving direct payments. Given the sharp differences in national interests, subsidy politics will remain a major point of tension among EU Member States.

Trade barriers: As both a free-trade champion and a major protectionist, the EU (and the U.S.) will increasingly find it difficult to maintain its dual policies. Protectionist policies in agriculture not only contradict the orientation of the EU trade policy, but might instigate other countries to introduce trade barriers in sectors such as manufacturing and services, which are of great importance to the EU. At the same time, the EU finds it difficult to reduce agriculture domestic support and export subsidies, unless its trading patterns take similar actions. So far, the U.S. and the EU have not managed to overcome their differences. Thus, unless trading partners first harmonize their domestic agriculture policies with the model of free trade, the food commodities markets will remain volatile.

Food dependence as an instrument of foreign policy: The mismatch between demand and supply will also create dependence between net importers and exporters. For instance, growing demand in China, India, and Brazil could make these countries dependent on the U.S., the world's top wheat producer. In turn, this dependence creates the opportunity for net exporters to use strategic embargoes and linkages in order to influence the political, economic, or security behavior of another country. The centrality of food for national security was captured by an article in the FT, asserting that food "now rivals oil as a basis of power and economic security."[102] For example, many Russian specialists worry that Russia's increase dependence on food imports might be used as a weapon by Western countries against Russia.[103]

Technology transfer: Future food scarcity will accentuate the value of knowledge and technology for countries experiencing food shortages. Technological innovation and know-how are highly significant drivers in increasing the supply of food, especially of livestock products. For example, the Netherlands has a strong innovative agri-sector and know-how in farming and rural development, which can be used to encourage dynamic agricultural development and tackle hunger in developing countries.[104] This expertise is reflected in networks such as Agri-Profocus, business support schemes like the Netherlands Management Cooperation Programme (PUM), and research.[105]

5 MINERAL SCARCITY

5.1 GLOBAL TRENDS

In recent years global demand for minerals has increased.[106] This rising demand is driven to a large extent by higher consumption patterns in emerging economies, particularly China.[107] Between 2002 and 2006, China's share of global imports for aluminum ores and concentrates increased from 11.7% to 22.6%, and copper ores and concentrates increased from 13.5% to 18.7%.[108] Although the EU is self-sufficient in construction minerals (e.g., aggregates, gypsum, and natural stone) and is a large industrial minerals producer, its domestic production of metallic minerals is limited to 3% of world production.[109] Thus, according to a communication published by the EU Commission, the EU remains highly dependent on imports of metallic minerals and high-tech metals, such as cobalt, platinum, rare earths elements (REEs), and titanium (see Annex 3).[110] What makes these metals strategic is their usage in the development of "environmental technologies," such as platinum-based catalysts for hydrogen-fuel based cars and lithium batteries for electric-hybrid cars. The demand for these materials is projected to continue in the future, which means that the EU's dependence on outside suppliers for high-tech metals will not diminish, but increase, especially from sources that do not have market-based system or deemed political/economically unstable such as China, Africa, and Russia.[111] In addition, the EU's nuclear power industry is largely fueled by imported uranium.[112] "In 2008, 25% of uranium delivered to utilities in EU27 originated from Canada, 17% from Russia, and 16% from Australia."[113]

In the long run, it is projected that prices for almost all minerals will be higher than in the previous decades due to several trends.[114] First, demand in China, India, and other developing countries will continue to rise, especially if production approaches maximum capacity.[115] REEs will experience a constrained supply in light of increasing demand due to issues such as a lack of investment in exploration and mining.[116] Estimates of REEs

demand in 2014 range from 160 to over 200 thousand tons, whereas supply will only be approximately 180 thousand tons (see Figure 1).[117] As for metals like copper, silver and gold, demand will exceed their reserve base by 2050.[118] Second, under a situation of a relatively small market production, supply might not increase fast enough to catch up with the upsurge in demand. Third, these minerals are concentrated in a small number of producing countries, mines, and/or companies. For example, REEs, which have become indispensable inputs for high-tech applications and green technology, are concentrated in China (see Figure 1). [119]

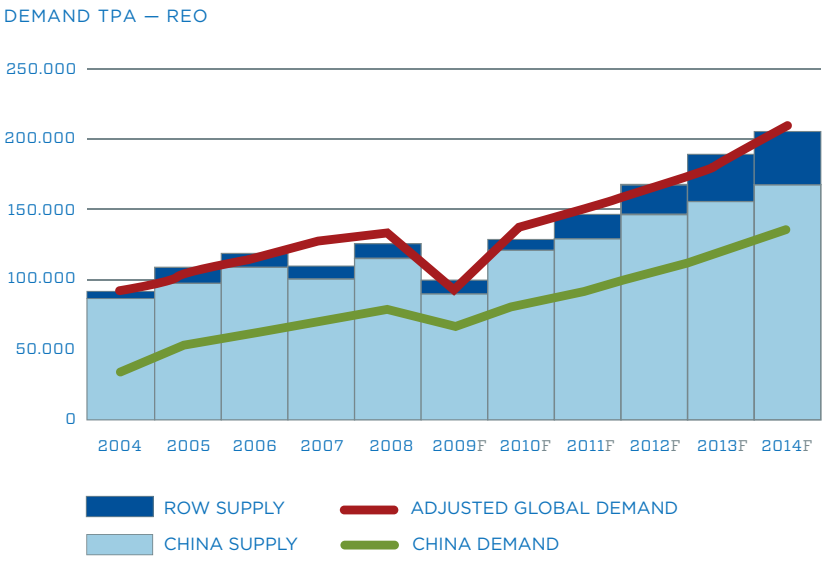


FIGURE 1: RARE EARTHS SUPPLY AND DEMAND
SOURCE: CONSTANTINIDES, STEVE. "RARE EARTH MATERIALS HOW SCARCE ARE THEY?" ARNOLD MAGNETIC TECHNOLOGIES (2010).

5.2 POLITICS OF MINERAL SCARCITY

Like oil and natural gas, minerals too are politically volatile. In addition to mineral deposits varying by country, with some minerals concentrated predominantly in a few places, such as REEs in China, the state plays an active role in the market. To a lesser extent, civil society actors are also

active in this industry, addressing issues such as the extraction processes and environmental degradation. For instance, in Europe, some exploration or extraction activities on certain sites have been denied on the grounds of Natura 2000, the Birds and Habitats Directives.[120] This being said, the role of the state is evident in three ways. First, in some countries all minerals are owned by the state, as is the case in many African and some European countries (Spain and Hungry).[121] Second, the government in mineral-rich countries controls exploration and extraction activities through legislation. For example, the National Department of Mineral Production in Brazil is overseen by the Ministry of Mines and Energy, which is responsible for granting exploration and mining licences.[122] Third, the state controls mining exports. Most recently China has cut its exports quotas for REE by 72% for the second half of 2010.[123] In sum, like oil and natural gas, minerals too could become an instrument for political and/or economic purposes.

From an economic viewpoint, countries that secure access to certain minerals at moderate prices have a greater competitive advantage than countries that do not. As such, it is no surprise that countries have been resorting to different measures to ensure their domestic needs are met. For instance, China has established several strategic partnerships with resource rich African countries and Brazil, as has India with Kazakhstan and South Africa.[124] India, the world's fourth largest producer of iron ore, has also imposed export restrictions by placing a 15% *ad valorem* export tax on all iron ore exports.[125] Such measures distort the market and undermine the competitive advantage of foreign companies by increasing their costs of imported minerals.[126]

Minerals have also been used as an instrument of coercion by some producing states. For example, in 1977, the Soviet Union suspended platinum sales, causing prices to rise from $150 to $1,000 an ounce.[127] It also suspended the export of titanium, which caused prices to increase by 500% within a year.[128] Though there have not been any conflicts between states over access to minerals, such measures could provoke trade restrictions and political tensions given the economic interdependence between states.[129] For instance, the U.S., the EU, and Mexico have filed requests for dispute resolution with the WTO regarding China's restrictions on exports of certain raw materials used for steel production, which are in violation of its commitments under its protocol of accession to the WTO.[130]

Moreover, almost 50% of global merchandise trade is covered by regional trade agreements and is not subject to most-favored-nation treatment.[131] Thus, despite the existence of an international trade regime consisting of intergovernmental organizations, such as the UN Conference on Trade and Development and the WTO, which promote trade liberalization, it has failed to address these market distortions thus far.

5.3 IMPLICATIONS FOR THE EUROPEAN UNION

The concentration of production of key minerals in a few geographical locations, in combination with increasing global demand leaves the EU vulnerable to market distortions. As such, high import dependence and a lack of substitutes, especially for high-tech metals, pose two key challenges for the EU:

Export restrictions and the risk of dependence: The proliferation of export restrictions on raw materials in the global economy will complicate EU foreign and trade policies. Because European industry relies heavily on imported minerals, the EU has sought to ensure access to and security of supply through a strategy of free trade. However, major producers are increasingly undermining free trade in the mineral market, as was the case in 2000 with tantalum, leaving the EU vulnerable to temporary supply bottlenecks, and thus a competitive disadvantage. Russia, China, Brazil, and India all have imposed export taxes and other restrictions on some minerals. By September 2009, there were 1233 export restrictions identified, originating from Argentina (888), Ukraine (80), China (40), Russia (39), South Africa (30), Kazakhstan (27), and Algeria (25).[132] These restrictions drive up global prices and create supply shortages, ultimately distorting world markets for raw materials and hurting EU industries. This means that the EU could fall behind in shifting towards a green economy, unless these market distortions are addressed.

Restrictions such as export bans or quotas can cause businesses that rely on these inputs for production to shut down, affecting the EU economy and its employment levels.[133] Export taxes, on the other hand, make these materials more costly, undermining the competitiveness of EU companies, resulting again in a loss of production, hence employment in the EU.[134] However, from the perspective of producers, there are domestic reasons for state intervention: to raise government revenue, to ensure supply for

domestic industries, or to protect domestic consumers from high prices.[135] Producing countries such as China may also use this advantage to pressure EU Member States on other issues.

Domestic politics of environmental protection: Despite growing importance of mineral scarcity, EU Member States remain under pressure to balance their demands for minerals against environmental concerns. In fact, the EU mining industry and some Member States have singled out the Birds and Habitats Directives (Natura 2000) as having the largest impact on the competitiveness of the mining industry.[136] The aim of the Habitats Directive is "to contribute towards ensuring biodiversity through the conservation of natural habitats and of wild fauna and flora."[137] In addition to land use, other policies regulate potential environmental impacts of water, air and soil pollution. Yet, in times of rising prices and growing global demand the replacement of exhausted sites will become vital for addressing Member States' growing demand and dependence on mineral imports.[138] Thus, EU regulators will face a daunting task in trying to expand mineral production in a way that satisfies the demands of both the mining industry and environmental groups.

6 RESOURCE SCARCITY NEXUS

As shown in figure 2 the four key resources are interconnected in a complex web, so changes in one system have an impact on the other systems. Taking into account this interconnectivity between resources is essential for addressing the scarcity challenges. For illustration purposes, three linkages across the four resources are discussed below: 1) food and water; 2) energy and food; 3) minerals and energy.

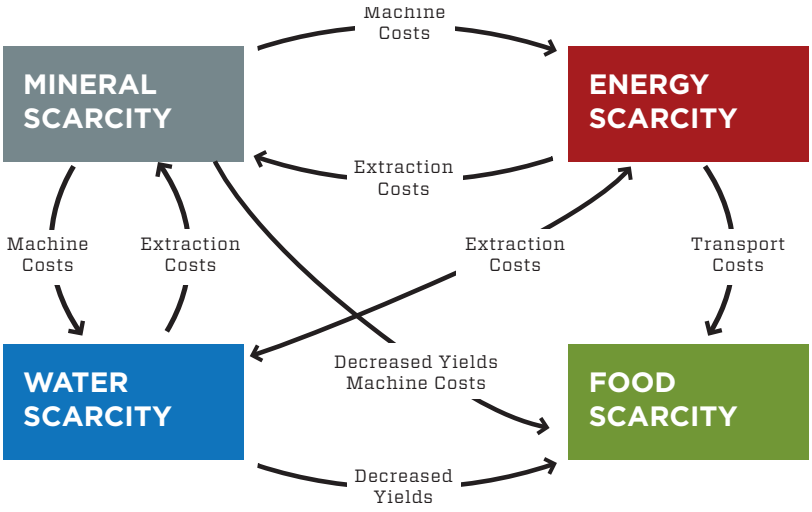


FIGURE 2: RESOURCE SCARCITY NEXUS

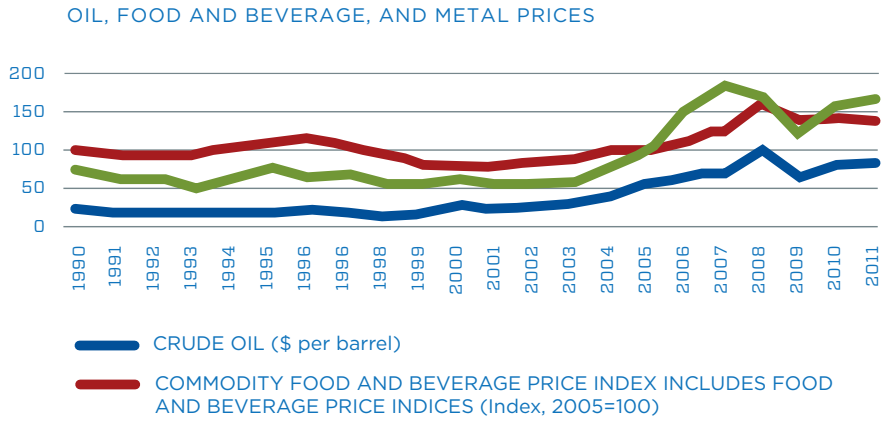
6.1 FOOD AND WATER

The agriculture sector is the largest consumer of water. According to the FAO, almost 70% of water drawn from rivers and groundwater is used for irrigation, and is projected to increase by 14% between 2000 and 2030 in order to meet future food demands.[139] Although demand for agriculture

has slowed down in recent years, due to decreasing population growth rates, higher food production will be required in the future to feed the world's population, which is expected to experience lower growth rate but nevertheless is projected to reach 9 billion by 2050. For this to happen more water is needed, especially since irrigated land is expected to expand from 202 million ha (1997-99) to 242 million ha by 2030, out of which 45 million ha will be in 93 developing countries.[140] This expansion will be accompanied by a 14% increase in agricultural water withdrawals for irrigation.[141] Yet, with water scarcity already affecting some countries and regions, one in five developing countries will experience water shortages by 2030.[142] The FAO considers the use of 40% or more of renewable waster resources for irrigation to have a major impact on municipal and industrial water usage.[143] Already 10 developing countries have crossed this threshold, using more than 40% in 1997-99.[144] By 2030, South Asia will reach the threshold of 40%, while the Near East and North Africa will be using more than 58% of their renewable water resources.[145] This increase in water scarcity will affect the agriculture sector, in turn undermining the necessary per capita food production.

6.2 ENERGY AND FOOD

Fluctuations in the energy market, notably prices, also impact food supplies (see Figure 3), as higher oil prices drive up transportation costs of food and higher natural gas prices increase the price of nitrogen fertilizers. Similarly, concerns over dependence on imported oil and rising prices have accelerated demand for biofuels production – a substitute for fossil fuels – which is placing a heavy constraint on food supplies.[146] In 2005, global ethanol production reached 9.66 billion gallons, mainly produced from sugar cane (45.2%) by Brazil and from corn by the U.S. (44.5%).[147] At the same time, biodiesel made from oilseeds reached almost one billion gallons.[148] This rise in demand for biofuels is restraining food supplies and is considered a key contributor to the drastic increase in food prices during the 2006/2008 food crisis.[149] The U.S., which accounts for almost 40% of the world's total corn production and over half of all corn exports, will have consumed almost half of its domestic corn supplies within a few years.[150] As a result, not only have corn prices risen, but the prices of wheat and rice have also gone up, as farmers are planting more corn and less of other crops.[151] According to IEA, the share of biofuels is projected rise to 118.5 Mtoe, accounting for 5% of the total energy required for road transport by



FIGUUR 3: WORLD COMMODITY PRICES 1990 - 2011. SOURCE: IMF DATA AND STATISTICS

2030.[152] Biodiesel is expected to grow even more than ethanol, especially in the EU and Asia.[153] Ironically, the drive for energy independence, which has fueled investments and subsidies in biofuels, has created another relationship of dependence on oil: unless oil prices remain strong, farmers cannot profit from planting corn and other crops used for producing ethanol. While higher prices make a worthy investment to plant such crops, low oil prices reduce the margin of profitability. In sum, the economic viability of ethanol and biodiesel is not divorced from fluctuations in the oil market.

6.3 MINERALS AND ENERGY

Mineral resources, while depending on fossil fuels, especially oil, for their extraction, are also critical inputs in green technology, which is important not only for reducing greenhouse gas emissions, but also for boosting energy efficiency. Mining and extraction require significant amounts of energy, which increase exponentially with lower ore grades.[154] In the past, when metal minerals were short in supply, the availability of cheap and abundant fossil fuels, especially oil, made it feasible to extract minerals.[155] However, today, due to energy constraints, many mineral deposits are out of reach for economically viable exploitation.[156] As illustrated in Figure 3, a rise in the price of oil has caused metal prices to increase as well, given

their energy intensive extraction process. Between 2006 and 2008, oil prices rose from $119 to $184 a barrel, while metal prices rose from $156 to $169, reinforcing the price interdependence between these commodities.[157]

On the other hand, conversion towards more sustainable forms of energy production e.g. solar and wind power requires metal minerals, which are either slowly decreasing in ore grades or are by-products of other metal minerals.[158] For instance, gallium, an important input for the production thin-film photovoltaic technology used for solar cells has a low extraction rate as it is a by-product of other metal minerals.[159] Consequently, producing these metal minerals becomes impossible, making it difficult to transition to more energy efficient methods and away from the increasingly uncertain and volatile markets of oil and gas. This implication is of critical importance for economies around the world. For instance, by 2050, the cost of energy per unit of GDP could be reduced by 30% in Europe, if it develops these green technologies, making it more competitive in the world economy.[160]

7 WHERE DO WE GO FROM HERE?

Our societies are living through a transitional period, marked by imbalances in demand and supply of key resources critical to our wellbeing and economic prosperity. This report attempted to heighten the relevance of scarcity challenges of these four resources for the EU and to provide an early warning for action. To that end, our analysis examined four key resources (oil and natural gas, water, food, and minerals) in terms of global trends of production and consumption, explored their political dynamics, and considered their implications for the EU. Our analysis focused on the likelihood of these resources to generate conflict or cooperation. In doing so, we discussed key implications that capture the nature of conflict or cooperation for each resource. In light of the report's findings, we offer seven recommendations for addressing the challenges generated by these scarcities:

1. DEVELOP A COMPREHENSIVE APPROACH

The interconnectedness of key resource — oil and natural gas, food, water, and minerals — creates a major challenge for policymakers. It necessitates the development of a comprehensive approach, with the aim of achieving a long-term sustainable balance between different resources. An effective response does not only tackle the scarcity problem of each resource compartmentally, but also takes into account the interrelation between resources. Thus, ensuring the enactment of a policy does not accelerate the depletion of another resource or intensify market competition.

2. MAKE RESOURCE SECURITY A FOREIGN POLICY PRIORITY

To a large extent mitigating the vulnerability of dependence and ensuring security of supply require incorporating resource scarcity into the EU common foreign policy framework. Formulating a common foreign policy for resource scarcity would strengthen Member States' position in the international arena vis-á-vis other consumers and producers. Making

resource scarcity a priority would also ensure that other policy areas such as human rights and environmental concerns do not undermine security of supply. Generally speaking, the EU must strive for equilibrium among different policy areas to avoid spillover effects, which could undermine its other strategic interests such as energy and minerals supply.

3. DIVERSIFY GEOGRAPHIC SOURCES OF AND TYPES OF ENERGY RESOURCES

With oil and natural gas posing the most serious challenges for the EU, it is important that geographic sources and the mix of energy resources are diversified to minimize the vulnerability that arises from high dependence of these inputs for economic growth. For geographic diversification to function properly, the EU must guarantee Member States access to oil supply from as many producers as possible. This means that Member States have to anticipate and be prepared to respond to political and economic challenges in key producing countries. For example, on the political front, Member States should cooperate with producing countries to reduce the risk of supply disruptions by pacifying domestic tensions and social unrest. On the economic front, Member States should lobby oil producing countries to open up their oil and gas sectors for foreign direct investment. Equally important is increasing the share of alternative energy resources through investments in technology and innovation.

4. INCREASE ENERGY EFFICIENCY

On the demand side, increasing efficiency in transportation, homes, and factories is instrumental in reducing dependence on fossil fuels. With more than 40% of world oil consumption in 2006, road transportation is the largest oil consuming sector, and is projected to experience the fastest growth in oil demand, as car and commercial vehicle ownership is expected to surge. Thus, increasing fuel efficiency in the transportation sector will have a major impact on total oil consumption.

5. ENHANCE COORDINATION OF OIL AND MINERAL POLICIES AMONG EU MEMBER STATES AT ALL LEVELS

Ultimately, the aim is to work towards formulating common internal and external EU strategies in the areas of oil and natural gas, water, food, and minerals. Internally, more attention is needed to promoting cooperation among Member States on issues supply and demand (increasing supply

and reducing consumption). By continuing to pursue separate, diverging national interests, the overall political and economic weight of the EU in the international system will be undermined. As challenging as it might be, the development of a common approach to external energy matters will go a long way to enhancing the EU' position in international negotiations and improving Member States' access to strategic resources.

6. ESTABLISH RELATIONS OF ECONOMIC INTERDEPENDENCE

Resource imbalances can act as an impetus for conflict or cooperation. One way to mitigate the negative impacts of imbalances is for Member States to develop stronger economic and business relationships with countries that are major energy and mineral producers, but vulnerable to food and water scarcity. For instance, while the EU depends on China for REEs, China depends on the EU for importing its wind power machinery.[161] Similarly, EU depends on oil from the Gulf region, which is a net importer of food. As such, Gulf countries can benefit from EU technological innovation in agriculture production and water management in return for secure access to oil exports. The value is both economic and political. Economically, by producing and selling goods and services it has a comparative advantage, the EU gains from trade. Politically, by increasing relations of symmetry, the EU reduces the risk of over dependence, which could be exploited by other states for political and/or economic purposes.

7. INVEST IN TECHNOLOGY AND INNOVATION

Investments in technology and innovation are crucial for mitigating the impact of scarcity on food, water, minerals and energy. The role of technology in increasing productivity and addressing resource scarcity is well noted. In the words of IEA, "technological innovation and the rate of deployment of new technologies for supplying or using energy have a major impact on energy balances, both in terms of the overall amount of energy used and the fuel mix."[162] This also applies to food, water, and mineral scarcity.

ANNEX 1: PROJECTED EXPORTS OF AGRICULTURAL PRODUCTS BY THE US, THE EU, BRAZIL, RUSSIA, INDIA AND CHINA (THOUSAND METRIC TONS)

	COUNTRY	2019/2020
WHEAT	US	20.964
	Russia	18.563
	EU	12.554
RICE	China	1.437
	US	2.152
	India	7.072
COARSE GRAINS		
- CORN	Brazil	4.051
	China	-3.420
	US	61.819
- BARLEY	EU	2.058
	Russia	2.316
	US	-157
OILSEEDS AND PRODUCTS		
- SORGHUM	US	3.272
- SOYBEAN	Brazil	42.279
	India	5
	US	35.322
- SOYBEAN MEAL	Brazil	13.347
	China	648
	India	3.817
	US	11.142
- SOYBEAN OIL	Brazil	1.397
	US	1,210
COTTON TRADE	Brazil	702
	India	1.946
	US	3.217
SUGAR TRADE	Brazil	27.963
	India	373

BIOFUELS		
- ETHANOL	Brazil	4.148
	China	-13
- BIODIESEL	Brazil	58
	US	122
MEAT		
- BEEF AND VEAL	Brail	2.747
	China	-36
	EU	-408
	India	765
	US	-204
- PORK	Brazil	1.071
	EU	1.220
	US	2.278
- BROILER	Brazil	3.579
	EU	-29
	US	3.536
DAIRY PRODUCTS		
- BUTTER	EU	72
	India	-1
- WHOLE MILK POWDER	EU	305
- NONFAT DRY MILK	EU	223
	India	120
	US	394
- CHEESE	EU	349

SOURCE: FOOD AND AGRICULTURAL POLICY RESEARCH INSTITUTE (FAPR). "FAPRI 2010 U.S. AND WORLD AGRICULTURAL OUTLOOK." JANUARY 2010.

ANNEX 2: PROJECTED IMPORTS OF AGRICULTURAL PRODUCTS BY THE US, THE EU, BRAZIL, RUSSIA, INDIA AND CHINA (THOUSAND METRIC TONS)

	COUNTRY	2019/2020
WHEAT	Brazil	6.192
	China	-2.988
	India	-667
RICE	Brazil	-533
	EU	1.539
COARSE GRAINS		
- CORN	EU	1.173
	India	775
	Russia	594
- BARLEY	Brazil	485
	China	2.192
OILSEEDS AND PRODUCTS		
- SORGHUM	India	16
- SOYBEAN	China	59.512
	EU	12.031
- SOYBEAN MEAL	EU	24.923
- SOYBEAN OIL	China	2.674
	EU	1.183
	India	1.716
COTTON TRADE	China	3.774
	EU	8
	Russia	79
SUGAR TRADE	China	1.822
	EU	4.021
	Russia	1.733
	US	2.191
BIOFUELS		
- ETHANOL	EU	655
	India	76
	US	2.470

- BIODIESEL	EU	559
MEAT		
- BEEF AND VEAL	Russia	829
- PORK	China	138
	Russia	451
- BROILER	China	418
	India	-1
	Russia	779
DAIRY PRODUCTS		
- BUTTER	Brazil	-10
	China	79
	Russia	161
	US	-30
- WHOLE MILK POWDER	Brazil	-130
	China	-88
	Russia	44
- NONFAT DRY MILK	Brazil	-60
	China	134
	Russia	74
- CHEESE	Brazil	-92
	China	138
	Russia	327
	US	-12

SOURCE: FOOD AND AGRICULTURAL POLICY RESEARCH INSTITUTE (FAPR). "FAPRI 2010 U.S. AND WORLD AGRICULTURAL OUTLOOK." JANUARY 2010.

ANNEX 3: RAW MATERIALS MAIN PRODUCERS AND IMPORT SOURCES TO THE EU

RAW MATERIAL	MAIN PRODUCING COUNTRIES	MAIN EU IMPORT SOURCES	IMPORT DEPENDENCE
ALUMINIUM	2008: China 34%, Russia 9%, Canada 8%	2006: Russia 27%, Mozambique 20%, Brazil 11%, Norway 11%	47%
BAUXITE	2008: Australia 30%, China 17%, Brazil 11%	2006: Guinea 55%, Australia 19%, Brazil 10%	95%
ANTOMONY	2009: China 91%, Bolivia 2%, Russia 2%	2007: Bolivia 77%, China 15%, Peru 6%	100%
BARYTES	2009: China 55%, India 15%, USA 7%	2007: China 63%, Morocco 31%, Turkey 5%	57%
BENTONITE	2008: USA 42%, Greece 8%, Turkey 8%	2006: Turkey 28%, USA 27%, India 20%	15%
BERYLLIUM	2009: USA 85%, China 14%, Mozambique 1%	Trading Partners vary from year to year and include USA, Canada, China and Brazil	100%
BORATE	2008: Turkey 46%, Argentina 18%, Chile 13%	2006: Turkey 71%, USA 18%, Chile 4%	100%
CHROMIUM	2009: South Africa 41%, India 17%, Kazakhstan 15%	2006: South Africa 79%, Turkey 16%, Albania 2%	46%
CLAYS	2009: USA 27%, Uzbekistan 10%, Germany 8%	2007: Ukraine 65%, Brazil 17%, USA 15%	23%
COBALT	2008: Dem.Rep.Congo 41%, Canada 11%, Zambia 9%	2007: Dem.Rep.Congo 71%, Russia 19%, Tanzania 5%	100%
COPPER	2008: Chile 35%, USA 9%, Peru 8%	2007: Chile 33%, Indonesia 19%, Peru 17%	54%
DIATOMITE	2008: USA 35%, China 20%, Denmark 10%	2007: USA 39%, Turkey 33%, Mexico 24%	25%
FELDSPAR	2008: Turkey 30%, Italy 22%, China 9%	2007: Turkey 98%, Morocco 1%, Norway 1%	47%

FLUORSPAR	2009: China 59%, Mexico 18%, Mongolia 6%	2007: China 27%, South Africa 25%, Mexico 24%	69%
GALLIUM		Trading Partners vary from year to year and include USA and Russia	Large changes in the statistics for different years
GERMANIUM	2009: China 72%, Russia 4%, USA 3%	2007: China 72%, USA 19%, Hong Kong 7&	100%
GRAPHITE	2008: China 72%, India 13%, Brazil 7%	2007: China 75%, Brazil 8%, Madagascar 3%	95%
GYPSUM AND ANHYDRITE	2009: China 28%, Spain 8%, Iran 8%	2007: Morocco 57%, Ukraine 19%, Bosnia-Herzegovina 14%	1%
INDIUM	2008: China 58%, Japan 11%, Korea 9%, Canada 9%	2006: China 81%, Hong Kong 4 %, USA 4%, Singapore 4%	100%
IRON	2008: China 35%, Brazil 18%, Australia 15%	2009: Brazil 51%, Russia 10%, Ukraine 9%	85%
LIMESTONE	2009: China 67%, USA 5%, Japan 3%	2006: Norway 92%, Turkey 8%	56%
LITHIUM	2009: Chile 42%, Australia 25%, China 13%	2007: Chile 64%, USA 17%, China 16%	74%
MANGNESITE	2005: China 53%, Russia 12%, Turkey 8%	2006: Turkey 70%, China 18%, Brazil 11%	2%
MAGNESIUM	2009: China 56%, Turkey 12%, Russia 7%	2006: China 82%, Israel 9%, Norway 3%, Russia 3%	100%
MANGANESE	2009: China 25%, Australia 17%, South Africa 14%	2007: Brazil 39%, South Africa 33%, Gabon 26%	91%
MOLYBDENUM	2009: China 38%, USA 25%, Chile 16%	2006: USA 47%, Chile 32%, China 10%	100%
NICKEL	2008: Russia 18%, Canada 17%, Indonesia 12%	2006: Australia 90%, Norway 4%, Turkey 4%	55%
NIOBIUM	2009: Brazil 92%, Canada 7%	2006: Brazil 84%, Canada 16%	100%
PERLITE	2008: Greece 29%, USA 24%, Turkey 15%	2006: Turkey 98%	13%

ANNEX 3: RAW MATERIALS MAIN PRODUCERS AND IMPORT SOURCES TO THE EU CONTINUED

RAW MATERIAL	MAIN PRODUCING COUNTRIES	MAIN EU IMPORT SOURCES	IMPORT DEPENDENCE
PGM	2009: (Only Pt) South Africa 79%, Russia 11%, Zimbabwe 3%	2006: South Africa 60%, Russia 32%, Norway 4%	100%
RARE EARTH ELEMENTS	2009: China 97 %, India 2%, Brazil 1%	2007: China 90%, Russia 9%, Kazakhstan 1%	100%
RHENIUM	2008: Chile 49%, USA 14%, Kazakhstan 14%	Trading partners vary from year to year and include Taiwan, USA, Malaysia and Canada	100%
SILICA SAND	2006: USA 23%, Italy 11%, Germany 6%	2006: Egypt 57%, Tunisia 14%, Morocco 12%	14%
SILVER	2008: Peru 17%, Mexico 15%, China 13%	Trading partners vary from year to year and include Argentina, South Africa, Chile, USA and Indonesia	45%
TALC	2008: China 29%, Korea, Rep. Of 11%, USA 9%	2006: China 60%, Egypt 20%, USA 7%, Dem. People's Rep. Of Korea, North 7%	11%
TANTALUM	2009: Australia 48%, Brazil 16%, Rwanda 9%, Rem.Rep.Congo 9%	2007: China 46%, Japan 40%, Kazakhstan 14%	100%
TELLURIUM	2006: Canada 59%, Peru 26%, Japan 16%	Trading partners vary from year to year and include Canada, China, Morocco, South Korea and Norway	100%
TITANIUM	2009: Australia 25%, Canada 19%, South Africa 17%	2007: Canada 28%, Norway 26%, Australia 22%	100%
TUNGSTEN	2008: China 78%, Russia 5%, Canada 4%	2006: Russia 76%, Bolivia 7%, Rwanda 13%	73%
VANADIUM	2008: China 36%, South Africa 36%, Russia 26%	2006: South Korea 90%, Japan 7%, Venezuela 3%	100%
ZINC	2008: China 28%, Peru 14%, Australia 13%	2007: Peru 33%, Australia 27%, USA 16%	64%

SOURCE: EUROPEAN COMMISSION. CRITICAL RAW MATERIALS FOR THE EU: REPORT OF THE AD-HOC WORKING GROUP ON DEFINING CRITICAL RAW MATERIALS. 30 JULY 2010

ENDNOTES

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