

## Global energy sector transitions will have an impact on geopolitics

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### Major energy trends indicate that a rapid energy transition may shift geopolitical balance until 2040

Energy has always been an essential part of geopolitics. Transitions in energy markets and new technologies can have a significant impact on the geopolitical balance and national security by affecting countries' energy trade, economy and security of supply. For example, combatting global climate change has already had and will continue to have an impact on the demand for hydrocarbons. Decreasing demand can put financial pressure on countries with economies dependent on export of hydrocarbons (coal, oil and gas), and this may create political instabilities. Simultaneously, political decisions to financially support energy production from renewable sources, mainly wind, have reduced countries' dependency on fossil fuel imports and paved the way for a wave of on countries' own competitive renewable energy sources.

This policy brief is based on the first phase of a three-phase study on changing geopolitics of energy. The focus areas are the following:

- **First phase** of the study focuses on developing global energy scenarios up to 2040 and analyzing the impact of market changes (demand and supply) in energy sector on global geopolitics.
- **Second phase** will focus on the impact of these scenarios on Russian economy, energy and security policy. It concentrates especially on the hydrocarbon supply and demand in Russia, and their possible effects on Finland.
- **Third phase** will focus on Finland and analyze how Finnish energy security will develop and how Finland should prepare for the possible changes in Russia's energy trade.

The project will be finalized by the end of 2017, and it is conducted in cooperation with Pöyry Management Consulting Oy and Aleksanteri Institute of the University of Helsinki.

This policy brief focuses on the changes taking place under the rapid development scenario, which is based on a target of limiting global temperature increase to 2 degrees (IEA's 450 scenario) compared to the pre-industrial era. Based on the scenario analysis, it can be concluded that:

- Renewables and batteries are clear technology winners, as production from renewable sources increases 2.5-fold by 2040, which will in turn make power grids even more critical societal assets.
- The USA, the EU and China are in a good position to benefit from the global deployment of renewable energy technologies.
- Decreasing hydrocarbon demand may put significant financial pressure on countries (especially OPEC countries and Russia) that are dependent on exports income, and this may lead to instabilities. Russia is increasingly reliant on Asia and China for energy exports income.
- Nations' energy market interventions will change in nature and have more emphasis on technology and financing instead of focusing on traditional energy fuel exports and imports.

Significant political support and positive technological and economic development must take place in order for the energy sector to develop according to the rapid development scenario. Because of this, we believe that the rapid development and base scenario set the bounds for development and the actual development will most likely be somewhere between the two.

## THE STUDY ENABLES POLICY MAKERS TO PREPARE FOR FUTURE IN ENERGY SECTOR

The purpose of the project is to enable Finnish policy makers to prepare for future situations in energy sector, make sound decisions that will guarantee continued economic energy production and both national and energy security in Finland.

The first phase aims to make concrete observations on the impact of market changes in energy sector on global geopolitics. Three energy scenarios (base scenario, rapid development and slow development) until 2040 were constructed with projections for total energy consumption, demand for oil, gas, coal and electricity, as well as wind and solar power production (Table 1). In addition, energy policy and technological trends and new technology potential have been assessed in combination with Pöyry's market knowledge.

**Table 1 – Three energy sector scenarios**

Rapid development	Base scenario	Slow development
<ul style="list-style-type: none"> <li>• Corresponds to IEA 450 scenario</li> <li>• Constructed with a set goal – limiting increase in global temperature to 2 degrees. Scenario represents credible path to this objective</li> <li>• Policy, technology development and renewable energy uptake all support climate change prevention</li> </ul>	<ul style="list-style-type: none"> <li>• Synthesis of five different energy scenarios*</li> <li>• Represents the current mainstream view of future changes</li> <li>• Energy sector transformation continues, but at a much slower pace than in the rapid development scenario and e.g. oil remains critical fuel</li> </ul> <p>* IEA 2016, WEC 2016, BP 2017, McKinsey 2017 and EIA 2016</p>	<ul style="list-style-type: none"> <li>• Historical trends extrapolated to the future</li> <li>• Benchmark, 'no-will, no change' scenario, showing the unlikely but possible outcome</li> <li>• Requires large-scale political reversals</li> </ul>

**Focus in this policy brief**

The analysis was conducted by looking at what impact these changes would have on geopolitical balances: Which areas would benefit and which would lose from the changes. The situation in different countries and geographical areas is also examined using a so-called Rules of Six framework (Pascual, 2015). It can be used to better understand countries' abilities to intervene in the energy markets by looking at six potential actions (Table 2).

**Table 2 – The Rules of Six framework (Pascual, 2015)**

Block exports	Constrain production capacity	Flood markets	Starve markets	Assist friends	Change the fuel mix
Attempt to deny country's markets and revenue by e.g. imposing sanctions.	Curtailing production of a country by e.g. blocking investment and trade.	Flood market in order to acquire a market share or drive out competitors.	Dominant supplier attempting to manipulate the market by reducing output.	Helping target country through e.g. exporting at a lower cost in case of difficult situation.	Attempt to get other nations to change their fuel mix.

Countries' ability to efficiently use above mentioned interventions depends on six distinct factors: 1) Market scale, 2) Investment flow, 3) Coalitions, 4) Ability to sustain, 5) Speed and 6) Self-risk.

## RESULTS AND CONCLUSIONS

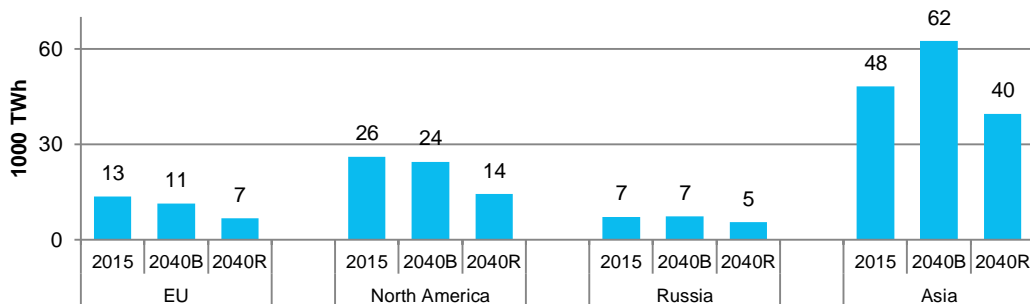
The rapid development scenario represents a highly optimistic scenario from the perspective of climate change mitigation, whereas the base scenario does not lead to huge changes compared to the current state of affairs. We believe that the outcome will be somewhere between the two and the rapid development scenario gives a good understanding of the outcome domain.

### How would the world with a huge amount of renewable energy look like?

The world under the rapid development scenario will see considerable changes to the current state of affairs. Total primary energy demand growth slows down from historical 1.9% p.a.

(1990 – 2014) to a much smaller 0.3% p.a. Both oil and coal demand will decrease significantly and only gas demand will grow, as it is needed as regulating power for the increased amount of renewable energy generation. The situation differs between areas, and for example the largest drop in demand for hydrocarbons is expected in Europe and North America (Figure 1).

**Figure 1 – Total demand for oil, gas and coal in selected locations (2015 and 2040 base (B) and rapid (R) development scenario)**



Renewables and batteries are clear technology winners. Production from renewable sources will increase 2.5-fold by 2040, driven in part by increasing demand for electricity and accompanied by increase in battery usage in both grid solutions and vehicles. Demand for electricity grows as vehicles become increasingly electrified as the transport sector is moving away from oil. This will in turn make power grids even more critical societal assets. Together with the need to transfer power from areas of abundant potential for renewables production, the world may see increased interconnection between countries, especially in Europe where the trend has been towards more integrated power system, and super grids that connect vast areas together. Conversely we may also see expansion in off-grid and micro-grid solutions powered by combinations of renewable production and batteries.

Decreasing demand for hydrocarbons, especially oil, will put significant financial pressure on countries that are dependent on the exports income of hydrocarbons (Table 3). This can lead to economic difficulties, which in turn may lead to instabilities in the countries affected. Economic downturn in Middle Eastern countries can lead to not only instability in the affected countries but also – via reduced financing for anti-terrorism activities and general support for troubled countries – to more instability in the area as a whole and even bring about new refugee waves from conflict zones. Instabilities in general will lead to the affected countries becoming more unpredictable in their foreign energy and general policy. Diverse economy can soften the impact, and for example countries like U.A.E. and Malaysia have undertaken economic reforms in recent years in attempt to reduce exposure to oil income. Conversely countries like Russia and Venezuela will be under more threat unless they will manage to transform their economies.

**Table 3 – Key changes taking place by 2040 under the rapid development scenario**

**North America**

- Global (and local) oil and coal demand drop will damage U.S. oil and coal industries which may induce dissatisfaction in affected areas
- Dependence on oil import may increase because falling prices may render domestic oil uncompetitive
- High potential for renewable energy industry boom

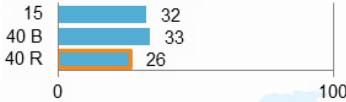
**Europe**

- Europe will see the starkest drop in oil, coal and gas demand
- European energy independence, especially independence from Russian imports, will grow significantly
- High potential for renewable energy industry boom

**Russia**

- Income from fossil fuels exports will drop significantly, especially those coming from Europe
- Increased reliance on Asia and China for energy exports where oil demand drops slower and gas demand grows
- Decreasing income from energy exports will damage economy potentially leading to instability
- Some room to patch lost revenue with exporting biomass to Europe and rare earth materials

**Total energy demand**



**Total energy demand**



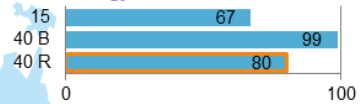
**Total energy demand**



**Asia**

- Total energy consumption grows significantly despite energy efficiency
- Demand for gas will grow significantly
- Especially China, among others, will remain dependent on energy imports
- China is in good position with potential rare earth materials and renewable energy know-how exports

**Total energy demand**



**Central and South America**

- Oil demand drop will hit some countries, primarily Venezuela
- Possible winner countries include Chile and Argentina, both with significant lithium reserves
- Gas demand will increase creating potential for Venezuela to patch lost oil exports, otherwise dependence on U.S. gas exports will likely increase

**Africa**

- Increasing demand for primary energy, oil and gas
- Renewables production also expected to increase significantly
- Lack of own resources and technology will make Africa heavily dependent on energy imports – both raw material and technology
- Some benefiting countries e.g. DR Congo with large cobalt reserves

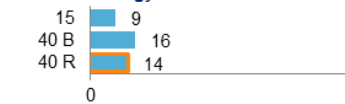
**Middle-East**

- Decreasing global demand for oil can severely cripple economies
- Decreasing income may lead to diminishment of OPEC and increased instability in the area
- Losing countries include e.g. Saudi-Arabia, Iran, Iraq
- Some countries may succeed in diversifying economy, reducing the impact

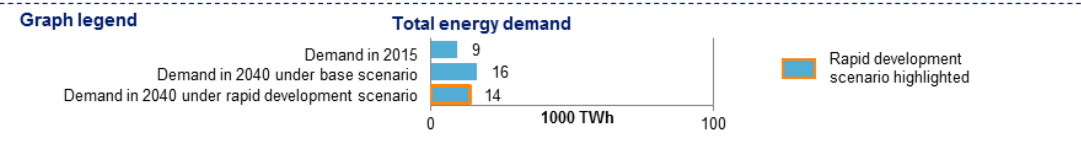
**Total energy demand**




**Total energy demand**




**Total energy demand**







**Decreasing oil exports income can lead to local instabilities**



**Dependance on electricity grows significantly and importance of grids grows**



**Renewable technologies and their developers winners – oil and coal losing**



**Old cartels diminish – new cartels may form**

Decreasing importance and demand for oil (and producers' income) will also reduce OPEC's influence, although not all countries will lose their relevance in the oil market as reducing prices means that only countries with least production costs will remain. These have traditionally been Saudi Arabia, Iran and Iraq.

The growing use of renewable energy resources will benefit two types of countries: Those with well-developed industries and know-how and those with the necessary raw materials needed for e.g. solar panels and batteries. North American and European countries and China have all had strong emphasis on creating and developing industries around renewable energy, and these areas are in a good position to benefit from the global deployment of renewable energy technologies. Many countries can benefit from their raw material resources, as these will become more critical with large volumes of renewable energy technology production. China and Russia together hold 57% of the world's rare earth materials. China currently accounts for the vast majority of all mining and processing of rare earth minerals. The Democratic Republic of the Congo provides more than half of the world's cobalt, and Chile, Bolivia and Argentina together hold more than half of the world's known lithium resources (current production in Bolivia is non-existent). Cobalt and lithium are used for Li-ion batteries.

## **Decreasing hydrocarbon demand may put significant financial pressure on countries that are dependent on exports income, which may lead to instabilities.**

Reaching the rapid development scenario will require drastic changes to the energy sector and reversals of current development trends. For example, total energy demand (shown in Table 3) growth would need to decrease from 1.55% p.a. (in base scenario) to 0.7% p.a. in Asia. In the EU, instead of declining 0.25% p.a. in base scenario, a decline of almost 1% p.a. would be required in the rapid development scenario.

One of the key barriers to reaching this scenario is the inherent slowness of the energy sector shifts ("Energy sector quarter is 25 years") and the enormous amount of capital required. Energy sector assets have a long lifetime; coal power plants have lifetimes of around 40 years and nuclear power plants around 60 years, which means that without strong political intervention the asset base will renew slowly, slowing down the transition to renewable energy sources. Reaching the required amount of wind and solar power in 2040 will require a huge amount of investment. In addition, the development path is full of uncertainties around political, technological and economic changes. For the rapid development scenario to take place, positive uncertainties would need to happen and negative uncertainties would need to be avoided.

Reality will likely be somewhere between that and the base scenario, with significant variation between individual countries and geographical areas. Different countries have different potential for production technologies, differing needs for heating and travel and different political support mechanisms that will lead to quite diverse outcomes with regard to technologies used.

### **Tools for intervention in the renewable energy world**

Assessing the EU, Russia, China and the USA with the so-called 'Rules of Six framework', shows all of them in very different positions compared to each other (See Table 4). **EU**, as a raw material importer, exporting only technology with falling demand for hydrocarbons will only have very limited ways for energy diplomacy. One of the few tools left is to flood markets

with renewable technology through financial support, but it would be difficult as it would require the EU to significantly undercut technology prices with unrealistic financial support.

**Russia** on the other hand remains a net exporter of resources with decreasing demand and importance, heavily impacting its ability to intervene in the energy markets. While gas demand will grow in some parts of the world, demand in Europe, the main market for Russian gas, is decreasing. Development of global LNG markets will further limit the ability to intervene in the market. Russia's large resources do give it some room of manoeuvrability. It may for example, be able to undermine other countries' interventions by increasing its own exports to affected countries as its production capacity will not be fully utilised in a world of decreased hydrocarbon demand. Russia has significant resources of rare earth materials which may to some extent compensate the lost influence.

Decreasing demand for oil may push the **USA** back to being an oil net importer as more expensive oil resources will first be pushed off the market, which the USA tight oil has traditionally been. Its considerable domestic oil and gas resources together with high demand still give USA clout in energy diplomacy. The influence of both the USA and the EU is waning because of the growing importance of China. In the situation of rapid development scenario, it will be much more difficult for them to e.g. impose sanctions without the support of China (recent examples of sanctions are the ones imposed on Iran by the EU and the USA).

**China** will be a net importer of hydrocarbons, but a net exporter of many of the materials required for manufacturing renewable energy and battery technologies and exporter of the technology itself. Together with an enormous economy and large demand for oil and gas (despite reducing total demand for oil) China will be in a good position to utilise energy diplomacy. It can e.g. block exports from some countries, flood markets with renewable technology, starve markets of materials needed for renewable manufacturing and intervene financially to affect production capacities and fuel mixes of target countries. China has for example intervened in the steel markets by flooding them with own subsidised production.

## The USA, the EU and China are in a good position to benefit from the global deployment of renewable energy technologies

Overall interventions in energy markets by countries/areas will change in nature. Reducing demand for hydrocarbons will make the interventions more often about technology and financing capabilities, latter because renewable energy technologies are typically very capital intensive. As a remark – methods and tools for intervention are introduced here on a general level, without going into detail into the severity or methods of implementation. For example, intervening with financing is likely a severe method in response to a serious situation and technological intervention can be softer and directive in nature. Energy exporters will likely see their arsenal decrease but reduced oil demand may also concentrate the remaining production and influence to a selected few countries. Blocking other countries' exports will become easier because impact symmetry will change to the benefit of large importers. Energy markets too will be affected by the growing importance of China and Asia in general, meaning it will be more difficult for them to intervene in the energy markets by themselves.



**Table 4 – Rules of Six framework (Pascual, 2015) applied to selected countries’ (EU, Russia, China and USA) possibility to have an effect on other countries (low, medium, high)**

	<b>EU</b>	<b>Russia</b>	<b>China</b>	<b>USA</b>
<p><b>Block exports</b> Attempt to deny country's exports markets and revenues</p>	<p><b>Low</b> – Falling demand means it is more difficult to influence exporters with only own import. No own production means that the EU will be affected itself by any export interventions.</p>	<p><b>Low</b> – Difficult to block with own demand, does not control the investment flow. As a net exporter Russia is itself vulnerable to someone blocking Russia's exports.</p>	<p><b>High</b> – Large demand means it can affect with own demand alone. Has own reserves potentially reducing self-harm.</p>	<p><b>Medium</b> – Relatively in good position despite decreased demand. Has own resources reducing the symmetry of possible blocks.</p>
<p><b>Constrain production capacity</b> Curtail production of a country</p>	<p><b>Low</b> – Reducing energy trade and global weight will make this more difficult.</p>	<p><b>Low</b> – Difficult, as conventionally an exporter. Reducing oil income will also limit financial weight globally.</p>	<p><b>Medium</b> – Has tools through high levels of investment and trade with other countries.</p>	<p><b>Medium</b> – Has the financial means and trade. Reducing global weight will make this more difficult.</p>
<p><b>Flood markets</b> Flood market with exports in order to gain market share or drive out competitors</p>	<p><b>Low</b> – Very little of own resources making this difficult. Can potentially do this with technology, but would be difficult.</p>	<p><b>Medium</b> – Possible with oil and gas, especially if manages to build LNG capacity. Potentially possible with certain rare earth minerals. Own economy would suffer, making it more difficult.</p>	<p><b>High</b> – Good potential with some certain rare earth minerals. Can do it with renewable energy technology.</p>	<p><b>Medium</b> – Has gas and oil reserves to do this. High cost position of own oil means it would be costly. Can potentially do it with renewable technology but would be difficult.</p>
<p><b>Starve markets</b> Dominant supplier attempting to manipulate the market by reducing output</p>	<p><b>Low</b> – Not possible because is a net importer of energy fuels. Difficult technology wise because there are other exporters, unless EU manages to increase share of world's production.</p>	<p><b>Medium</b> – Possible to some extent with oil and gas, especially to areas with gas connection. Growing LNG markets and decreasing oil demand make it harder than what it currently is. Can also attempt this with some rare earth minerals.</p>	<p><b>High</b> – Good potential with certain rare earth minerals. Can also do it with renewable technology, assuming retains global production share close to existing.</p>	<p><b>Low</b> – High cost position of oil means it won't be effective. Some room to starve markets via LNG. In a similar situation with EU with regard to technology.</p>
<p><b>Assist friends</b> Helping target country through e.g. exporting at lower cost</p>	<p><b>Low</b> – Can assist with technology and financing.</p>	<p><b>Medium</b> – Can assist with large amount of resources.</p>	<p><b>Medium</b> – Can assist with technology and financing.</p>	<p><b>High</b> – Can assist with technology, financing and even resources.</p>
<p><b>Change the fuel mix</b> Attempt to get other nations to change their fuel mix</p>	<p><b>Medium</b> – Difficult, but has the diplomatic experience, financial capabilities and the technology.</p>	<p><b>Low</b> – Very difficult because of reducing financial means (because of falling energy exports income) and position as a resource exporter.</p>	<p><b>Medium</b> – Difficult, but has the diplomatic experience, financial capabilities and the technology.</p>	<p><b>Medium</b> – Difficult, but has the diplomatic experience, financial capabilities and the technology.</p>



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**'Global energy sector transitions will have an impact on geopolitics' is part of the implementation of the 2017 Government plan for analysis, assessment and research.**

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