## ENERGY INTENSITY IN NORTHERN EUROPE'S ECONOMIC DEVELOPMENT – CURSE OR BLESS?

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**Abstract**

It has been proven that a country's development level increases with greater access to and use of electricity. However this holds true for lower levels of development – in the light of increasing political commitments for environmental concerns and global warming it is much harder to pinpoint best energy consumption pattern for sustainable economic development. Authors of this article measure energy intensity of the Nordic and Baltic countries by observing returns to GDP from amount of electricity used; comparing this to existing electricity production opportunities and cost. Findings demonstrate that low energy-intensiveness is economically more preferred but not ultimately necessary. Countries with well developed energy supply chains can maintain energy-intensive structure of the economy if the effectiveness of the structure is optimised.

**Keywords**: energy intensity, economic development, Nordic and Baltic countries

**JEL Classification**: E29, N74

### Introduction

In a World with 7 billion people (and counting), competition for resources can only be expected to intensify. World Bank has noted that "no country in the world has succeeded in shaking loose from subsistence economy without access to the services that modern energy provides" (Lee & Chiu 2011). Also the EU Vision document for 2050 states that "people's well-being, industrial competitiveness and overall functioning of society depend on safe, secure, sustainable and affordable energy" (European Commission 2011). Despite being sparsely populated, Northern Europe is highly engaged in international business activities; its countries compete both with each other as well as with other parts of the World. This means that focus on energy as a resource constraint is a valid source for analysis also in Northern Europe – especially considering potential energy cost increase in the future.

The fact that access to electricity is vital for advancement in development holds true only in broad terms and up to a certain level of economic development. Some authors (e.g. Warr et al 2010, Lee 2005) have argued that the relative importance of energy consumption for economic growth has changed over time as industrialized economies have evolved, shifting their production structure away from energy intensive industries to less energy intensive service activities. As countries reach close to 100% electrification the cost of electricity becomes an ever more important consideration for investment decisions – i.e. evaluating the alternative cost of paying for more electricity vs. developing less energy-demanding services and products.

Indeed DeMartino & Le Blanc (2010) indicate that high development levels can be achieved while decreasing electricity consumption. Figure 1 below provides proof of a correlation between increased electricity consumption and economic advancement at low development levels; however the conclusions are far less clear at the higher end. Denmark for example is one of the least energy intensive industrialized countries in the World, at the same time having a very high level of development. Denmark's development level is only slightly lower from that in Norway, which in turn has a very energy-intensive economy (International Energy Agency 2011).

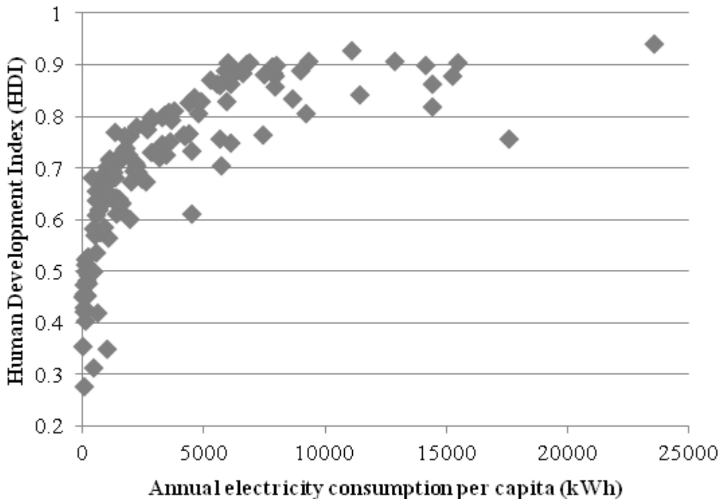


**Figure 1.** Relationship between electricity consumption and development for 173 countries where information for both measures is available (Source: Authors' drawing based on United Nations Development Programme 2012 and World Bank 2012).

Hence the topic of development and electricity consumption becomes rather ambiguous as a country reaches higher development levels, leaving room for debate and several approaches as to which path of development could be considered as „best" for a given country. This article deals with economic development and builds on size of the economy (GDP) as its indicator, investigating growth of GDP as advancement in living standards. Several studies (e.g. Tsani 2010, Zachariadis 2007, Ozturk 2010) point out the need to consider the potential causal linkages between economic growth and energy consumption. In the example above, Denmark relies on more expensive thermal and wind powered electricity, whereas Norway has access to much lower priced hydropower and can therefore have a more energy-intensive economy.

Yet high environmental concerns about $CO_2$ emissions and global climate change take an increasingly central stage. Countries' commitment to international initiatives on reduction of greenhouse gas emissions such as the Kyoto protocol[1] has launched a debate and a series of actions on the implementation of energy conservation policies. Whereas the United Nations Climate Conference "COP15" in Copenhagen in 2009 failed to deliver an updated agreement on greenhouse gas reductions, it nevertheless committed World leaders to try to mitigate environmental effects from economic activities. Much of the debate has been revitalized by the upcoming Rio+20 Conference and as a result of recent launch of the Green Growth Knowledge Platform steered by the OECD, UNEP and World Bank. The European Union's "20-20-20" targets are an effective example of a political commitment to tackle environmental challenges through economic policy interference[2]. Thus prior reasoning has directed authors of this article to pose a question „can energy intensity be justified in Northern Europe?"

The article focuses on Northern Europe defined as Norway, Denmark, Sweden, Finland, Estonia, Latvia and Lithuania, also known as the Nordic and Baltic countries. These 7 countries – due to geographical and historical reasons – have several similar input variables, competences and values; and compete both with each other as well as against other countries in the World. At the same time the countries can be split into groups of two: the highly-developed Nordic countries and the Baltic states with upper-medium development levels. As the Baltics are posed to continue their higher-speed economic development and the Nordics acknowledge their need to keep developing their economies in order to maintain pace, it is not only justified but also necessary to evaluate common variables – such as electricity use – in a comparative context and discuss which level of energy intensity should be desired.

**Methods to Calculate Energy Intensity**

Warr et al (2010) argue that from a theoretical standpoint, assuming a single sector economy, conventional economic theory attributes only marginal importance to energy as a factor of production by following the logic that energy's share in total factor cost is small compared to the cost shares of capital and labour. It is then possible to argue that reducing energy consumption will not significantly impact output growth. A survey made by Payne (2010) about the electricity consumption vs growth literature during 1960-2006 in more than 100 countries shows that energy consumption and economic growth have been found to be strongly correlated almost

[1] The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change, in force since 2005. Its major feature is binding targets for 37 industrialized countries and the European community for reducing greenhouse gas (GHG) emissions. These amount to an average of 5% against 1990 levels over the five-year period 2008-2012 (United Nations, 2012).

[2] The EU's integrated approach to climate and energy policy commits member states to reduce greenhouse gas emissions by at least 20% below 1990 levels; 20% of EU energy consumption to come from renewable sources; and a 20% reduction in primary energy use from higher energy efficiency by 2020 (European Commission, 2011).

unanimously. However, there is a lack of studies which would go beyond the general energy consumption and include the total cost of consumed energy.

Following literature reviews made by Lee (2005), Payne (2010) and Madlener & Alcott (2009) there is no consensus with respect to a particular country or groups of countries considered to be energy-dependent[3] or energy neutral[4]. Therefore, as stressed by Payne (2010), the disparities across these results prove the need for taking into account the particularities of individual countries rather than blindly applying the conventional approach based on uni-directional causality running from energy consumption to economic growth (i.e. support for the „growth hypothesis“) while formulating explanations and policy implications. Additionally, the abovementioned research is based on energy consumption in energy units only, hence leaving a gap for studies which would go beyond the general energy consumption and include the total cost of consumed energy.

In this article, the terms „energy” and „energy intensity”[5] are utilized in the context of electricity use. Electricity forms a significant part in energy consumption since total electricity consumption worldwide in 2009 amounted to more than 17% of total energy consumption as per International Energy Agency, being second-biggest group after oil which contributed with 41% of total consumption[6]. In Northern Europe, electricity makes up an even larger share of total energy consumption averaging at 25% with Norway having as high as 51% of its consumption from electricity (Eurostat, 2012a).

Energy intensity can depend on either the way the economy is structured or from the effectiveness of the structure – which allows for direct comparison of economies with similar structures. In case of the former a country needs plentiful energy resources to maintain energy-intensive industries that generate wealth to the economy through exports or by providing a competitive advantage in some other ways. Such an approach can only be sustained if a country has access to plentiful production resources at a reasonable cost. In the light of mounting socio-environmental concerns – as was highlighted earlier – this increasingly means access to large pools of affordable renewable energy (e.g. hydropower), non-$CO_2$ emitting technology (e.g. wind, solar or nuclear, although use of the latter is controversial) and political will to grow economies in an environmentally friendly way.

Effectiveness relates to efficiencies in production, lean processes in the industry and/or general alignment of various components in a national economy. For example the Baltic countries hosted a number of large energy-intensive and inefficient

[3] Energy dependent in the context of this article refers to a country whose GDP growth appears only in conjunction with equal or bigger growth in energy consumption.
[4] Energy neutral in the context of this article refers to a country whose energy consumption and GDP growth are not directly related.
[5] Energy intensity of the economy equals gross inland consumption of energy divided by GDP. Eurostat formula: kilogram of oil equivalent (ktoe) per 1000 Euro of GDP.
[6] Calculations derived from (International Energy Agency, 2011)

factories until 1991; many of them catering for the needs of the entire Soviet Union. Since the mid-1990ies most of such production has been shut down or rejuvenated to reflect less energy-demanding national interests (which helps explain the ease of fulfilling Kyoto protocol obligations), but the overhaul of the entire economy with a view of decreasing „waste" (as it is known in the lean concept) and lag in the system takes much longer to accomplish. This is often directly driven by political commitments (such as the EU "20-20-20" targets) and market needs, e.g. the cost of energy.

Even though European Union has clearly defined its willingness to achieve a 20% reduction in energy intensity by 2020, it has also been acknowledged by the EU's leaders that converting the EU's economy from manufacturing to low-carbon-based research activities and service-based industries is unrealistic – transferring all heavy duty production facilities outside EU will not be a viable solution (European Commission, 2010). Furthermore such move would have high impact on the employment of population currently engaged in such industries; as well as the future technical development ability of the EU.

Authors of this article wish to underline the importance of understanding „usefulness" of energy intensity in growing the national economies. In fact when it comes to energy intensity calculations, one often finds charts indicating use of MWh per capita or tonnes of oil equivalent (toe[7]). These two measures are informative, but require more in-depth consultation of national data to really understand a country's competitive position.

Hence the authors view sample countries' energy intensity from the point-of-view of returns to GDP and compare results with each other. Similarly to return on investment (ROI) calculated for companies, the authors calculate productivity of a unit of consumed energy and use it to determine the relative position of countries. As the returns are dependent on the cost of capital (WACC[8]) in companies, the returns to GDP are among other things similarly dependent on the cost of energy in a particular country. In this article the authors have used total cost of electricity excluding all taxes (e.g. "green fees", VAT etc) as reported in Eurostat in order to ensure comparability of cross-border data. Inclusion of taxes would have allowed for less transparency in comparing each country's access to energy, as countries can nurture some market participants (e.g. larger companies) by allowing for tax reductions internally. Such behaviour might have a considerable impact on the growth and size of a country's economy – hence for simplification purposes all taxes are excluded.

[7] Definition available in (Eurostat, 2012f)

[8] WACC – weighted average cost of capital, used to measure cost of financing in a given company

The applied calculation follows the below logic:

(1) First, the authors calculate total cost of electricity in a given country. This is directly dependent on the total consumption (MWh) and total cost per MWh:

$$Total\ electricity\ cost = Total\ consumption \times Cost\ per\ MWh$$

(2) The productivity of 1MWh in a country's GDP is derived by dividing Total GDP with total MWh consumed:

$$Productivity\ of\ 1MWh = \frac{Total\ value\ of\ GDP}{Total\ MWh\ consumed}$$

(3) Cost of electricity to generate 1 euro in GDP is based on the total cost of electricity as shown in (1) divided by the country's GDP:

$$Cost\ to\ generate\ GDP = \frac{Total\ electricity\ cost}{Total\ value\ of\ GDP}$$

(4) Finally, for simplification purposes the result from (3) is converted into a percentage, hence indicating the return on using electricity to generate every 1 euro in GDP (at current cost levels):

$$Return\ from\ use\ of\ electricity = 100\% - \frac{Cost\ to\ generate\ GDP}{100\%}$$

The above formulas are relatively simplistic and hence easy to use, at the same time offering an alternative view to energy intensity (because use of electricity is taken as an investment).

**Impact of Energy Intensity**

As electricity is a universal good, its consumption can easily be proven to be price inelastic across the entire sample countries in Northern Europe (see Figure 2). Upon visual observation Denmark seems to have the most inelastic price elasticity (calculated as 0,04), where overall consumption per capita has stayed at fairly constant 6 MWh annually regardless of the price ranging from 60 to 100 €/MWh over the 10 years. Although Sweden and Finland seem to have a slightly more elastic price elasticity over demand visually, Sweden's elasticity value is in fact similar to Denmark's (0,05) and in Finland the value is even lower (0,02) over the 10-year horizon. Despite annual fluctuation when measured year-by-year, Norway's price elasticity also measures very low over the 10-year period: at 0,06. Latvia and Lithuania have elasticity between 0,1 and 0,2; only in Estonia is the value highest at 0,46 – yet still more inelastic than not. Thus it follows from Figure 2 that all countries are rather inflexible towards changing the amount of energy consumed, owing to the way the economy is structured (highlighted as the second reasoning for energy-intensity in the previous sub-chapter). However one also needs to understand the generation setup of a country, as consumption is directly dependent on production.

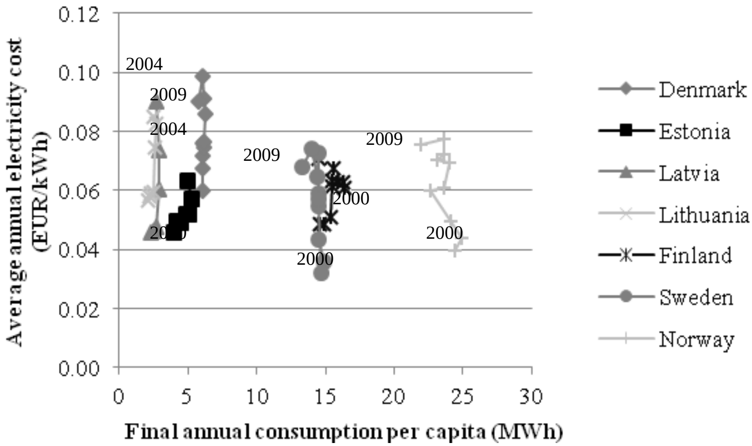


**Figure 2.** Relationship between actual consumption and overall cost of electricity use for consumer groups of 2 to 20 GWh annually in 2000-2009 **(**Eurostat 2011a, 2012g).

Due to historic and geographical nature of the countries in Northern Europe their energy production mix varies significantly (see Table 1).

**Table 1.** Comparative overview of gross generation in Northern Europe in 2010 (GWh)

| | Total | Wind | Pumped hydro | Hydro | Nuclear | Solar PV | Conventional Thermal |
|---|---|---|---|---|---|---|---|
| Denmark | **38 565** | 7 809 | 0 | 21 | 0 | 0 | 30 735 |
| Estonia | **12 748** | 276 | 0 | 27 | 0 | 0 | 12 445 |
| Latvia | **6 628** | 44 | 0 | 3 510 | 0 | 0 | 3 074 |
| Lithuania | **4 770** | 224 | 755 | 1 295 | 0 | 0 | 2 496 |
| Finland | **80 052** | 294 | 0 | 12 922 | 22 800 | 5 | 44 031 |
| Sweden | **148 575** | 3 502 | 103 | 66 487 | 57 828 | 9 | 20 646 |
| Norway | **123 385** | 895 | 382 | 113 125 | 0 | 0 | 8 983 |

Source: Eurostat (2012b)

In Norway the predominant means of electricity production is hydropower; in Denmark most electricity comes from burning coal – although the country has invested significantly in developing wind power generation. In Sweden and Finland the generation mix is dominated by nuclear, hydropower and conventional thermal. In the Baltic countries Estonia relies heavily on domestically available oil shale; Latvia has half of its needs covered from hydropower and Lithuania relies on imported natural gas, having recently shut down nuclear generation.

Much because of the diversity of generation mix, as well as the seasonality in using large-scale renewable generation from hydropower Northern Europe has been very successful in implementing a regional power pool where all electricity trading takes place – the NordPool power exchange. 5 of the 7 countries are members of the regional power pool and actively trade electricity via NordPool[9]. With the NordBalt submarine cable between Lithuania and Sweden expected to be commissioned in 2015[10], Latvia and Lithuania will also join NordPool.

However NordPool is a common market so if some market participants are able to meet their demand at lower cost levels then this option is exercised first. Naturally, this means that cost of energy is different for each country; and this is partly reflected in the amount of energy consumed across the sample countries (see Table 2). It would be unfair to attribute levels of consumption only to the cost – naturally the level of economic development also plays a role as lower GDP per capita generally means that a country is less energy-dependent (to follow an inverted logic from Figure 1 above).

It comes as little surprise to see that Norway (which has largest share of electricity from hydropower, as was shown in Table 1) is the heaviest user of electricity per capita, followed by Finland and Sweden. Finland's higher consumption ratio might well be explained by lower cost of energy compared to that in Sweden (based on Table 2).

Although the cost of electricity is only 20% lower in the Baltics their electricity consumption differs 5-10 times from that of their Scandinavian neighbours. Much of this can be explained by the 5-8 times lower GDP per capita of the Baltics. Although electricity cost has sharply risen in all three Baltic countries over the last 10 years (as shown in Figure 2), the relative price inelasticity of demand has meant that re-structuring of the economies for lower energy intensity has not been a pressing concern and much of the cost increase has been forwarded to customers.

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[9] NordPool power exchange first opened in 1999 with Norway and Sweden trading; Denmark and Finland joined the following year, Estonia in 2009. Today all trade between these countries takes place at NordPool (NordPool Spot, 2012).

[10] For more information see (ABB, 2012)

**Table 2.** Comparative overview of sample countries

| | Cost of electricity* | Final electricity consumption per capita | Total electricity consumption | GDP per capita | Total GDP |
|---|---|---|---|---|---|
| | *EUR / MWh* | *MWh* | *MWh* | *EUR* | *kEUR* |
| Denmark | 85,25 | 5,79 | 32 070 000 | 42 500 | 235 608 600 |
| Estonia | 57,50 | 5,15 | 6 895 000 | 10 700 | 14 305 300 |
| Finland | 64,70 | 15,59 | 83 403 000 | 33 500 | 179 721 000 |
| Latvia | 83,80 | 2,76 | 6 215 000 | 8 000 | 17 974 800 |
| Lithuania | 93,65 | 2,50 | 8 332 000 | 8 400 | 27 535 400 |
| Norway | 70,05 | 23,61 | 114 682 000 | 64 500 | 315 233 800 |
| Sweden | 72,15 | 14,05 | 131 217 000 | 37 000 | 346 536 400 |

* Cost of electricity for users between 2 and 20 GWh annually; excluding all taxes.
Sources: Eurostat (2012b, 2012c, 2012d, 2012e)

The White Elephant in the sample is Denmark, which has in fact one of the lowest energy consumption ratios (per capita) among the OECD member countries (International Energy Agency, 2011). Denmark hosts a number of industries – in fact the country has a similar value added to GDP from industry as the other 6 sample countries. But Denmark has a considerable portion of GDP value added – much more than from the remainder 6 countries – from the low energy-demanding service sector (World Bank, 2011). This is the primary cause for much lower energy dependence in the Danish economy. Table 3 reveals that following Denmark's example does not have to be the only way (leaving aside all non-economic concerns). Indeed, as was constituted in the introductory chapter, heavy industries are also needed in Europe.

By using formulas indicated in the previous sub-chapter the authors demonstrate that productivity of 1MWh to generate 1 euro in GDP ranks sample countries in an unusual order. Denmark with a high GDP and low energy intensity takes the leading position followed by Latvia and Lithuania which actually have even lower levels of electricity per capita, but also smaller economies. More interestingly, productivity levels in Norway and Sweden are not too far behind: these countries use 7-10 times more electricity per capita while having 10-20 times larger economies than those in Latvia and Lithuania. Apparently the worst performers are Estonia and Finland – the former in comparison to its two Baltic neighbours and the latter in comparison to Sweden, which has in fact a lower consumption pattern and – as is seen from Table 3 – a higher productivity.

**Table 3.** Cost of energy and its conversion to value creation

| | **Total actual electricity consumption cost** | **Productivity of 1MWh in GDP** | **Cost of electricity to generate 1 EUR in GDP** | **Return on using electricity to generate 1 EUR in GDP** |
|---|---|---|---|---|
| | *kEUR* | *EUR/MWh* | *EUR* | *%* |
| Denmark | 2 733 968 | 7347 | 0,012 | 98,84 |
| Estonia | 396 463 | 2075 | 0,028 | 97,23 |
| Finland | 5 396 174 | 2155 | 0,030 | 97,00 |
| Latvia | 520 817 | 2892 | 0,029 | 97,10 |
| Lithuania | 780 292 | 3305 | 0,028 | 97,17 |
| Norway | 8 033 474 | 2749 | 0,025 | 97,45 |
| Sweden | 9 467 307 | 2641 | 0,027 | 97,27 |

Source: authors' calculations

As per prior discussion the cost of energy varies in each country, hence productivity needs to be seen in the context of price paid. Calculating a return from use of electricity to generate 1 euro in GDP at first confirms findings from Warr et al (2010) – i.e. that the returns are above 97% for all countries, hence the actual cost of electricity is not a primary driver of GDP formulation. However the figures offer more discussion when comparing the countries to each other: after Denmark the highest returns are actually achieved in Norway and Sweden, both intensive energy users with relatively high electricity costs. The Baltic States follow, ending with Finland on the last place. One the one hand this confirms correctness of Denmark's pioneering path; on the other hand it also means that energy intensity is not a curse if countries manage to successfully utilise their use of energy at given prices to boost their economies. Finland's example shows that lower cost of electricity is no guarantee for higher returns to GDP; a country needs to ensure that the effectiveness of its structure of the economy is maintained too.

Given prior discussion on inefficiencies in the Baltic economies, it is relevant to separately evaluate the three countries. As per Table 2 Estonia enjoyed the lowest cost of energy in 2010; Latvia and Lithuania had highest costs owing to import needs. This well explains Estonia's relatively good ranking in Table 3. However raising Estonia's electricity costs from 57,70 EUR/MWh to 75 EUR/MWh (which corresponds to the average cost of electricity for all 7 sample countries) immediately lowers the return ratio by nearly 1% to 96,39%. On the other hand, lowering Latvia's and Lithuania's electricity costs from 83,80 and 93,65 EUR/MWh to 75 EUR/MWh would boost both countries' return ratio from 97,10 and 97,17 to 97,41% and 97,73%. This means that the countries' higher electricity costs have prompted for a more radical review of economic activities, but very high prices also constrain GDP development.

Table 3 demonstrates that switching to low energy-intensive activities is attractive but not ultimately necessary. Rather, it shows that countries with well developed energy supply chains can maintain energy-intensive structure of the economy, if the effectiveness of the structure is optimised. The case of Baltic countries indicates severe vulnerability to cost of energy and therefore furthermore stresses the need for a proper evaluation of effectiveness of economic structures.

## Conclusion

This article started out by declaring that growing use of energy is a determinant of growth of wealth of nations – up to a certain point in development (based on Figure 1 this seems to be the case when a country's Human Development Index reaches a value of 0,7). The best path forward is less clear and much depends on the country's options at hand.

Political and environmental concerns justify choice of an energy-conscious consumption and production because such behaviour uses fewer resources and frees them up for alternative use. This is similar to the path chosen by Denmark; the authors have also demonstrated in this article that this path is the most desired one when comparing output of 1MWh used to generate GDP even when considering energy costs.

However calculations performed in this article have also shown that energy intensity from a purely economic perspective can be successfully exploited by an economy if a country manages to productively convert it into GDP value added. This is the case with Norway and Sweden. Both countries have a relatively high cost of energy and high rates for electricity consumption per capita, yet both manage to utilise use of electricity in a way that makes returns to GDP second highest only after Denmark.

The success of Norway and Sweden is at least partly dependent on their access to large sources of domestically available less costly generation capacity. The Baltic countries offer an example where returns to GDP do not measure as favourably: high energy costs hold Latvia and Lithuania back from achieving higher returns.

Estonia and Finland both enjoy lower levels of electricity cost than other sample countries, but lag behind their neighbours in the context of the analysis performed, i.e. their current setup behind energy intensity does not allow for effective GDP value added. Although this analysis has been performed on high level, it points to the need to re-visit the structures of the economies to further validate the effectiveness of all economic activities consolidated as a whole.

## Limitations

This article offers an alternative view on comparing energy consumption and size of the economy. The authors acknowledge that such comparison has its limitations. Namely, a country's GDP is a comprehensive universe of factors ranging from demographics to nature of trade; our exercise provides a status quo comparison without investigating true role of electricity in formulation of the GDP. Nevertheless, the authors believe that an alternative view such as the one highlighted in this article can provide a useful perspective.

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**ENERGIA-INTENSIIVSUS PÕHJA-EUROOPA RIIKIDE MAJANDUSARENGUS: ÕNNISTUS VÕI NEEDUS?**

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Tartu Ülikool

Mitmete teadusuuringute tulemused on kinnitanud elektritarbimise ja majanduskasvu vahelist tugevat positiivset seost, kuid see kehtib vaid teatud majandusarengu tasemeni. Arenenud tööstusriikide puhul võib seda olulisel määral mõjutada ka energia- ja keskkonnapoliitika, mis on suunatud energiakasutamise efektiivsemaks muutmisele nii läbi majandusstruktuuri muutmise kui ka läbi olemasolevas struktuuris energia-efektiivsemate tootmistehnoloogiate kasutuselevõtu. Erinevate riikide keskkonna- ja energiapoliitika on küll mõnevõrra erinev, kuid üldiselt lähtutakse suurematest rahvusvahelistest kokkulepetest – Kyoto protokoll, Euroopa Liidu 20-20-20 strateegia ning muud direktiivid. Peamiseks energiapoliitika eesmärgiks on riigi majanduse energiaintensiivsuse vähendamine, mis tagaks majandusliku heaolu jätkuva suurenemise samal ajal kui energiatarbimine selle tagamiseks ei suurene või isegi väheneb. Seega on autorid tõstatanud küsimuse: kas Põhja-Euroopas on energiaintensiivne majandus õigustatud?

Käesolevas artiklis keskendume oma analüüsis seitsmele Põhja-Euroopa riigile Põhja- ja Baltimaades (Norra, Taani, Rootsi, Soome, Eesti, Läti, Leedu). Kuigi tegu on palju omavahel koostööd tegevate riikidega, siis laiemalt vaadates nad ka konkureerivad omavahel nii regioonisiseselt kui globaalsel turul. Siit tulenevalt on elektrienergia kättesaadavus ning hind ka üheks oluliseks konkurentsieelise allikaks. Kõik nimetatud riigid v.a. Läti ja Leedu kauplevad elektriga börsil NordPool, aastaks 2015 oodatakse ka Läti ja Leedu ühinemist (ABB, 2012). Arvestades tõenäolist energiahindade jätkuvat kallinemist on oluline uurida energiaressurssi kui võimalikku konkreetse riigi kontekstis tootmist piiravat või soodustavat tegurit.

Warr et al (2010) on väitnud, et majandusteoreetilise lähenemise kohaselt on energia tähtsus võrreldes kapitali- ja tööjõukuludega tootmisfaktorina marginaalne ning siit tulenevalt ei avalda energia hind ega tarbitav kogus märkimisväärset mõju SKP-le. Kuid Payne (2010) on erinevate uuringute tulemusi analüüsides leidnud, et energiatarbimise ja majanduskasvu vahel eksisteerib tugev korrelatsioon. Samuti on ta rõhutanud vajadust energiavaldkonda iga konkreetse riigi või piirkonna kontekstis eraldi uurida, sest tulenevalt riikide käsutuses olevate energia tootmise ressursside suurest erinevusest on keeruline universaalse mudeli loomine.

Vaatamata energia tarbimise kohta tehtud uuringute suurele arvule on need enamasti keskendunud vaid üldistele tarbimistrendidele ning ei ole võtnud arvesse energia hinda ehk energia kui tootmissisendi kulukust ettevõtete jaoks. Käesolevas artiklis oleme kohati kasutanud paralleelselt termineid ”energia” ja ”elekter”, sest kuigi keskendume empiirilises analüüsis just elektrile, siis laiemalt majanduspoliitilise tausta avamiseks on oluline vaadata seda kui ühte energia liiki. Kui maailmas moodustab elektrienergia keskmiselt 19% kogu tarbitavast energiast, siis NordPool’i riikides on see olnud viimase kümne aasta jooksul keskmiselt 25%, Norras isegi 51% (Eurostat, 2012a).

Majanduse energiaintensiivsust mõjutavad kaks olulist faktorit: (1) majanduse üldine struktuur; ja/või (2) sarnase struktuuriga majanduste puhul selle ettevõtete energia kasutamise efektiivsus (nt. kasutatav tehnoloogia). Kõrge energiaintensiivsusega majandust saavad endale lubada vaid need riigid, kellel on ligipääs konkurentsivõimelise hinnaga energiaallikatele. Lähtudes keskkonnapoliitikast tuleks seda mõttekäiku veel täpsustada, st ligipääs konkurentsivõimelise hinna ja madala $CO_2$-sisaldusega energiaallikatele. Kuigi Euroopa Liit peab majanduse energiaintensiivsuse vähendamist oma prioriteediks, siis on ka mõistetud, et energiamahuka rasketööstuse teistesse maailma piirkondadesse üleviimine mõjutab negatiivselt EL-i majandust (sh. tööhõivet, tehnoloogilist taset), ega anna sealjuures ka globaalses perspektiivis soovitud tulemust keskkonna paranemisele.

Käesolevas artiklis soovime rõhutada energia olulisust majanduskasvu tagamiseks ning vajadust seda teemat senisest enam süvitsi analüüsida. Autorid on võrrelnud NordPool'is osalevate riikide elektrienergia kasutamise tootlikkust, näidates kui palju SKP lisandväärtust loob iga riik 1MWh tarbimisest. Oleme kasutanud ettevõtte finantsjuhtimises laialt levinud suhtarvude (ROI, WACC) arvutamise üldpõhimõtteid, et võrdlevanalüüsis vaadata ostetud elektrienergiat kui investeeringut tootmiseks. Uuringu andmed pärinevad NordPool'i ning Eurostat'i andmebaasist, kasutatud elektrienergia hind ei kajasta makse ja aktsiise.

Viimase kümne aasta analüüs näitas, et energia tarbimine on Põhjala riikides mitteelastne (0,02-0,06), vaid Eestis on see 0,46 – mis on samuti pigem mitte-elastne kui elastne. Elastsusnäitajad on põhjendatavad otseselt sellega, et nii majanduse struktuuri muutmine kui ka uute efektiivsemate tehnoloogiate juurutamine on väga pikaajalised protsessid. Niisamuti on pikaajalised ka investeeringud energia tootmisesse ning muutuste sisseviimine kasutatavate energiaallikate struktuuri.

Just energiaallikate struktuuri osas on NordPool'i riikide vahel ka suur erinevus-varieerudes tuule ja hüdroenergiast kuni tuumaenergia ja põlevkivini. Paljuski tulenevalt energiaallikate varieeruvusest ja mitmete taastuvate energiaallikate tootlikkuse sesoonsusest on Põhjamaade ühisturg oma olemasolu igati õigustanud. Samas on tegu ka avatud turuga selles tähenduses, et kõigil osalevatel riikidel on alati võimalus ise enda tarbeks elektrit toota hetke turuhinnast madalama hinnaga. See toob omakorda endaga kaasa keskmiste hindade erinevuse riikide lõikes.

Analüüsi tulemusena selgus, et kõige edukam riik elektritarbimisel on Taani: igast 1MWh tarbitud elektrist suudetakse luua kõige rohkem SKP-d inimese kohta. Samas on oluline tõsiasi, et Norra ja Rootsi elektri tarbimine elaniku kohta, mis on kordades suurem, suudab toota vaid pisut väiksema hulga SKP-d. See on märk nende majanduste efektiivsest struktuurist. Lätis ja Leedus on samuti head suhtarvud, kuid väga kõrge elektri hind pärsib tootlikkuse suurendamist. Kuigi elektri summaarne tarbimine on tõusnud, siis selle mitte-elastsus näitab, et kulud on tõenäoliselt edasi kantud ja jäetud lõpptarbija kanda. Eesti ja Soome majandused jäävad sarnases arvestuses pingerea lõppu, viidates vajadusele üle vaadata mõlema riigi majandusstruktuuride efektiivsus (seda enam, et Eestis ja Soomes on naabritega võrreldes oluliselt madalamad elektrikulud).

Makromajanduslikus perspektiivis võib järeldada, et energiaintensiivsuse vähendamine on küll positiivne keskkonnakaitse aspektist, kuid puhtalt majanduslikust aspektist vaadatuna ei pruugi seda olla. Kuna antud analüüs on tehtud varasematele andmetele tuginedes, siis tõenäolise elektrienergia hinnatõusu valguses vajab see teema tulevikus kindlasti põhjalikumat uurimist.