Many hamsters: how the EU can enable private firms to provide renewable energy

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Abstract

This paper investigates the energy investment needs of the European Union (EU), including renewable energy. Europe currently has little or no economic growth, and interest-rates are expected to rise. Given the state of many EU countries' economies, this is a good time to encourage investment because – according to Keynesian economics – extra spending can stimulate economic activity. The current economic situation limits options for many governments in EU countries, so new approaches may be required. This paper uses ideas from the European Commission, on how a 'smart' electricity grid can enable renewable energy – such as solar power. The EU Parliament could enable a market-provided solution by offering incentives to the private sector. Private investment will be encouraged if the EU gives long-term low-interest-rate loans for renewable energy generation. Also, a Europe-wide grid makes it profitable to locate solar panels in low-wage countries in southern Europe, and sell electricity in richer countries.

Key words: **renewable energy; solar power; wind power; smart grid; European Union; European commission; economic recovery**

EES classifications: 3.5 3.7 3.9 3.10 3.18

JEL classification: **E62; H120; Q42**

1. Introduction

The current economic environment in European Union remains fragile. The Euro-zone economy is about to enter its third recession since 2009, with its strategy based on fiscal consolidation failing to deliver. Draconian fiscal cuts implemented in the Euro-zone countries have led to a collapse of domestic demand leading gradually, but steadily, to an erosion in Euro-zone demand, hitting hard (in particular in the last two years) the French and Italian economies. The gradual realisation of the impasse these policies led to, gives rise to the search of new policies that could potentially be utilised as a means of providing a long-term solution. The policies employed in the USA seem to offer an obvious alternative. Notwithstanding the differences featuring the USA and the Euro-zone or the European Union economies, the policies pursued so far in the USA have had a much more positive impact on the recovery of the USA economy since 2009. They present therefore a paradigm that needs to be considered by the EU authorities.

One of the unintended consequences of the EU economic policies since 2009 is the risk reduction when investing in EU countries' bond market. While this has been relatively successful, it has led to an increased risk of private sector losses, in particular when investing EU countries' bond market. As a result, the current economic environment limits private-sector investment. This includes investment in renewable energy, a sector vital for the sustainability of all EU economies.

Indeed, European consumption fell since 2008; Europe currently has little private investment (Koo, 2013: 143). Observ'ER (2012: 115-21) report Italian solar power at a standstill; German solar power subsidies cut; no immediate increase in solar capacity expected in France; UK solar panels subsidies halved in 2011; and Spanish government support for renewable energy removed in 2012. "The situation in Europe is fraught. Many medium-sized companies are going into voluntary liquidation, closing subsidiaries or plants to cut their losses" (Observ'ER, 2012: 121). Renewable energy in the EU is stalled (Observ'ER, 2012: 115-21; European Commission, 2010: 3; Pew Charitable Trusts, 2012: 52); "The ongoing debt crisis in Europe is likely to make it difficult to sustain the region's clean energy investments in coming years" (Pew Charitable Trusts, 2012: 52). "Europe's leading role in the PV market is coming to an end [...] Going forward, the driving forces will be in countries like China, the USA, Japan and India" (EPIA, 2013a: 6).

The fiscal squeeze of Portugal, Ireland and Greece in 2011-12 has caused contagion to Spain and Italy in 2012 and 2013, as reflected by the increased interest rate premium financial markets require when investing in these countries bond market. It has also led to increased interest rate in debt servicing, to a lesser extent in France and Belgium, reflecting the EU dimension of the problem. As a result, specific Euro-zone countries' fiscal and financial difficulties encountered, in particular when trying to recycle national debt, has led to an EU-wide problem with consequences not anticipated when the first bail-out was provided in Greece in spring 2010.

However, the PIIGS are endowed with solar resources to a greater extent than the northern Euro-zone countries. As a result of these resources, coupled with appropriate policies at an EU level, can provide the way forward for these countries by restoring their fiscal sustainability and financial credibility. However, the 'appropriate' policies at an EU level based on raising funds for investment in solar power are subject to a revision of the current economic orthodoxy, championed by the fiscally prudent countries in the Euro-zone namely Germany, Austria, Finland and the Netherlands, accompanied by Denmark and Sweden at a EU wide framework. In the absence of these policies, investing in solar power is rendered impossible, subjecting PIIGS to a chronic process of fiscal consolidation with no impeding end, and above all, with no guarantee that the policies will deliver.

A process is already set in motion by the economic developments and policies implemented in France that, although not diametrically opposing the policy prescriptions 'suggested' by Germany, certainly challenge them and put them to the test of delaying deficit reduction by two years, against the will of the European Commission. These developments could potentially stall current policies in EU countries, which generally impose austerity. The slowdown in German economic growth would be the decisive factor, in terms of determining the speed for such a revision.

The solution put forward in this paper therefore focuses on bringing together Keynesian economic policies at an EU and Euro-zone level, based on fiscal expansion in particular increases in government expenditure and renewable energy, in particular solar. Although it is recognised that there are many other areas requiring urgent financial assistance such as education and health care, investing in the energy sector provides several long-term benefits. First, it is conducive to limiting global warming; second, it reduces dependence on imported energy; and third, it fills in the gap resulting from the decommissioning of nuclear energy. Investing in electricity seems unlikely to crowd out (discourage) investment in other sectors. Lastly, it can boost long-term investment and employment creation in EU countries and regions that experience unprecedented high unemployment rates.

The rest of the paper is organised as follows. In section 2, a Keynesian view of recessions is provided, with emphasis placed on the 2007-09 financial and economic crisis and its implications for economic policies. In section 3, the differences in the nature of government and private sector incentives are identified. Proposals for bringing together the two types of incentives in the energy sector are also presented and discussed. In section 4, the energy from renewable sources is considered, by primarily focusing on the case of solar power. Finally, in section 5, the main conclusions are presented.

2. A Keynesian analysis of recessions

Global financial crisis dominated Europe since Lehman Brothers bank collapsed (Schäfer, 2012: 181); Worth (2010) called it the 'second Great Depression'. An economy in a mild recession may repair itself, but Keynes (1936: 324) suggested it could take 25 years to achieve optimal employment and investment. Japan shows that an economic slump can last for decades. The European economy or at least the Euro-zone economies seem to be following Japan's demise from its economic apogee in the mid-late 1980s. Six years from the onset of the Euro-zone debt crisis in 2009, the grim economic outlook of the area, including Germany, makes the prospect of a 'lost decade' a realistic outcome with immense consequences for employment, let alone the evolution of EU institutions.

Kitromilides (2011: 526) claimed "If the markets form the view that the "age of austerity" strategy is counterproductive, this may strain further rather than calm down market nerves, and change perceptions of what constitutes a "credible" government policy to deal with ballooning deficits." Koo (2013: 145) claimed in the current recession, "government borrowing and spending becomes absolutely indispensable in saving the economy". IMF (2012) estimated that "in coming years, additional global financing of potentially $1 trillion could be needed [..] countries like Italy and Spain, that are fundamentally able to repay their debts, could potentially be forced into a solvency crisis by abnormal funding costs". Delong et al. (2012: 235) wrote "Financial crises and demand-induced recessions appear to have an impact on potential output even after normal conditions are restored. This makes it plausible that measures that mitigate their effects would have long-run benefits."

If consumer spending and investment are too low, Keynesians recommend more government spending, to create jobs; this could include public works, like the US government's 'New Deal' in the 1930s. Recession could be improved if governments "boost the public-spending component of environmental policies" (Kennet, Drosos & Tsotsolas, 2013: 318). Government debt-financed expenditure may be appropriate in a recession (Todorova, 2013: 70); fiscal policy is more effective than monetary policy in a recession (Koo, 2013; Blanchard & Leigh, 2013). Kitromilides (2011: 523) and Blanchard & Leigh (2013) suggested government spending helps an economy recover from recession. Delong et al. (2012: 235) wrote "at moments like the present – when interest rates are constrained by the zero bound, the output gap is large, and cyclical unemployment is high – fiscal policy is likely to be more potent than standard estimates suggest. This conclusion boosts the benefits of expansionary fiscal policy in a depressed economy substantially."

In response to the 2008 global crisis, "At year-end 2008, about $6.8 trillion in new federal government loans, liability guarantees or asset guarantees to financial services firms was outstanding that had not existed a year

earlier" (FDIC, 2009: 17); renewable energy was part of the stimulus package (European Commission, 2010: 8). Since 2008, "the Obama administration allocated more than ninety billion dollars (of nearly eight hundred billion dollars total) in grants and tax incentives for a host of clean energy programs" (Simmons, Coyle & Chapman, 2014: 38). EU governments spent much less: $3.2 Billion in 2010 and $2.6 Billion in 2011 (Pew Charitable Trusts, 2012: 31). Since 2008, President Obama's Keynesian policies (e.g. supporting the U.S. car industry) seem successful, because USA experienced about 2% growth per year from 2009 (OECD, 2014b). Other countries such as Germany enacted similar stimulus packages, and "many countries' economies started to recover quickly after the enactment of stimulus packages" (Dullien, 2012: 8). However, some European countries (such as Greece, Italy, Ireland, Portugal and Spain) had to reduce government spending (Dullien, 2012: 10): austerity was forced on Eurozone countries after 2008, because of balance-of-payments deficits; rising national debts (due to nationalisation of troubled financial institutions); and fear of financial markets (Kitromilides, 2011: 520). If a Eurozone country defaults on its debts, it could initiate a chain of events leading to the end of the Euro (Strobel, 2005) – causing chaos. Many economists have argued that reform of financial institutions in Europe is needed (Syrrakos, 2010). Issing (2000) argued that the Euro requires political union. The European Financial Stability Facility and the European Stability Mechanism may help, but are not sufficient for the current crisis: the existence of the Euro currency and even the EU are threatened (Syrrakos, 2010). Capital flight occurred from peripheral Eurozone countries to Germany, lowering German interest-rates (Koo, 2013: 147). Some European governments were downgraded by ratings agencies such as Standard & Poor (Bastasin, 2012: 94-5), raising their cost of borrowing. Many observers, such as Griffith-Jones & Jolly (2013: 46), argue Europe must change course and follow President Obama's lead: "François Hollande, the new President, has suggested a new program for European growth, which in principle has been accepted by European leaders at the summit in late June 2012. The program adopted by the leaders would represent an increase in investment of as much as 1 percent of GDP in the European Union (EU). It is key that it be implemented quickly and on a sufficient scale so as to have sufficient impact soon on growth and employment."

The European Commission (2010) argues for intervention by the European Parliament, to facilitate recovery from economic crisis, and tackle problems facing the energy sector. "The urgent task for the EU is to agree the tools which will make the necessary shift possible and thus ensure that Europe can emerge from recession on a more competitive, secure and sustainable path" (European Commission, 2010: 3). Griffith-Jones & Jolly (2013: 50) wrote "Coordinated by the international organizations in the 2008 crisis, governments acted as a banker of last resort – but not as an employer of last resort for protecting workers and stimulating employment. In this respect, the treatment of labor was totally different from the treatment of finance and capital. The banks gained, but the

people suffered. More serious, the lack of broader action means that the crisis still continues".

3. Government versus private investment?

In order for European governments to become the 'employer of last resort' in terms of enhancing the regions' growth potential and promote policies conducive to job creation, a change in the way they view fiscal injection for investment projects should take place. While 'old-fashioned' above-inflation wage increases in public sector employees should be ruled out as an option, raising funds for investment programmes may be the only viable solution to the current impasse. The energy sector provides an excellent framework for such investment projects.

Indeed, since 2010 the European Commission (2010) has a plan to address energy problems and help Europe survive economic crises, estimating the cost by 2020 as €1 Trillion. This amount seems arbitrary; but the European Commission is the only agency which can write EU legislation. Data comparing USA with EU expenditure is indicative of this. The U.S. federal government deficit was 10% of GDP in 2009, 9% in 2010, and 8.7% in 2011 – a total injection of about 28% of GDP (Obama, 2012: Table 15.6): that is, the USA invested 28% more than Europe did. The U.S. fiscal injection far exceeds the European Commission (2010) recommendation of €1 Trillion, which is 8.3% of EU GDP in 2013 (Eurostat, 2012b).

Pew Charitable Trusts (2012: 39-43) reported public and private spending on solar power in 2011 as $4.4 Billion in France, $19.9 Billion in Germany, and $28 Billion in Italy. Solar power generating capacity in these countries in 2011 increased by 2.7, 7.4, and 10.2 Giga-Watts (GW) respectively; 'Feed-in' tariff systems varied between EU countries (Observ'ER, 2012: 115-21). These figures imply the cost of solar power (in $ Billion per GW) was 1.63 in France, 2.69 in Germany and 2.75 in Italy – a weighted average of approximately €1.85 Billion (using exchange-rate €0.79 per US$: OECD, 2012). Hence, €1 Trillion should pay for 540 GW of solar power peak generating capacity (output is lower when skies are cloudy, and at night: Grossmann et al., 2012: 168). Solar electricity generating capacity in EU was 51 GW in 2011 (Observ'ER, 2012: 114), so an additional 540 GW would increase solar power to about 15% of EU electricity needs. This would create jobs (one firm had 3,690 employees per GW of solar electricity production capacity: Grossmann et al., 2012: 177).

Renewable energy has 'public good' aspects: benefits are non-excludable (every EU citizen would gain from cleaner air, reduced risk of global warming, and less dependence on imported fuel). The EU could pay for

solar panels directly; but many economists advocate production by private firms.

Cherrier (2013) investigated economics-as-engineering, including "engagement with policy making", to nudge private firms towards socially desirable outcomes. Minsky (1992: 5) wrote "increasing complexity of the financial structure, in connection with a greater involvement of governments as refinancing agents for financial institutions as well as ordinary business firms (both of which are marked characteristics of the modern world), may make the system behave differently than in earlier eras. In particular, the much greater participation of national governments in assuring that finance does not degenerate as in the 1929-1933 period means that the down side vulnerability of aggregate profit flows has been much diminished". Griffith-Jones & Jolly (2013: 46-7) suggested a balanced-budget multiplier could help Europe: increase tax and government spending by similar amounts, in richer countries such as Germany.

Electricity from solar energy is no more expensive than generating electricity from fossil fuels in parts of Italy and Spain (Grossmann et al., 2012: 167), so investing in solar power could be profitable. The price of electricity generated by solar panels fell in recent decades, but is still not quite competitive with other forms of electricity generation such as gas (Borenstein, 2012: 86; Grossmann et al., 2012: 167). Observ'ER (2012: 131) predicted solar power will reach 'grid parity' by 2016 for the residential sector; but for investment to occur before 2016, subsidies may be needed, like the feed-in tariffs for rooftops solar panels on houses (Pew Charitable Trusts, 2012: 6). The cost of maintaining solar power facilities is below US$10 per Mega-Watt hour (Grossmann et al., 2012: 168).

Renewable energy systems often have very large initial investments (such as installing solar panels or a wind farm, and connecting cables to the electricity distribution network), followed by decades of profits from selling electricity – there is a long payback period. Market interest-rates are currently low, but it would be risky to borrow for such long-term investments using commercial loans. EU policy is "a failure due to the lack of long-term price signals to induce large investments in low-carbon technologies" (Edenhofer et al., 2013: S14). "Without European cooperation, public funds will not be able to channel investment into technologies of the future which are still too risky for investors. [..] A genuine common European energy policy is the only solution" (EU, 2012: 14). Since the 2008 global crisis, Bastasin (2012: 62) wrote of "The timidity of the European Commission in the wake of real emergencies". "**Renewed political resolve is needed to restore investor confidence, remove bottlenecks and maintain a reliable but dynamic framework for the remuneration of PV**" (EPIA, 2013a: 57; emphasis in original).

The European Investment Bank (2013) announced a €0.65 Billion 'Climate Awareness Bond'; the European Central Bank could arrange for much

larger loans. Griffith-Jones & Jolly (2013) and European Commission & EIB (2013) suggest compromise between state and private investment is desirable. European Commission & EIB (2013: 11-2) discussed three ways to lend to SME (Small and Medium Enterprises), based on €10.4 Billion of public funds from 'Competitiveness of Enterprises and Small and Medium-sized Enterprises' (COSME) & Horizon 2020, and European Structural and Investment Funds (ESIF) with EIB & 'European Investment Fund' (EIF) resources:

- Option 1 is for new loans, blending 75% of guarantees with 25% of securitisation. Portfolios would be built up by banks in 2 to 3 years, generating about €55 Billion of lending: a leverage ratio of 5.

- Option 2 allows securitisation of new and existing SME loan portfolios. This would increase the impact, allowing lending about €65 Billion: a leverage of roughly 6.

- Option 3 is like option 2, but adds existing SME loans and working capital. Pooling risks allows for a better portfolio diversification, so this option generates lending of €100 Billion: a leverage of about 10.

Griffith-Jones & Jolly have put similar suggestions forward (2013: 46-7), suggesting Keynesian intervention using one or more of three 'paths':

- First 'path': raise the EU budget by €5 Billion, which the EIB could use as a risk buffer, lending an extra €10 Billion via 'project bonds'. EIB money (using a mezzanine or intermediate tranche) forms 25% of total investment, with 25% by private investors, and 50% by insurance companies and pension funds. €40 Billion of new investment flows from a €5 Billion injection: a leverage ratio of 8.

- Second 'path': increase EIB capital by some EU member states injecting loans. Participating EU country governments pay 5% of desired total spending. For an initial €11.6 Billion public investment, the EIB lends €95 Billion initially, and €105 Billion in the following three years. The EIB often co-finances with the private sector, so this €200 Billion could increase by a further €190 Billion.

- Third 'path': add existing European Structural Funds which have been agreed, but not yet been used. This could add €25 Billion per year from 2014.

Combining these three 'paths', according to Griffiths-Jones & Jolly, would have injected 0.5% of EU GDP from 2013 to 2015. One of these options, or one of the 'paths' suggested by Griffiths-Jones & Jolly (2013), could fund renewable energy – but cost taxpayers less than the €1 Trillion needed to modernise EU energy, according to European Commission (2010). Griffiths-Jones & Jolly (2013: 48-9) claim rating agencies will maintain EIB's AAA status if leverage does not exceed 8. To increase financial injections to €1 Trillion, (richer) EU governments need to invest more than Griffith-

Jones & Jolly (2013) and European Commission & EIB (2013) suggest. Political decision-making is complicated, probably requiring agreement between the EU parliament and national governments of EU countries such as Germany and France. However, the recent turbulence in financial markets and the resurgence of Europe's debt problems may prompt the EU member countries' leaders to review their approach and attitude to renewable energy investment programmes.

Renewable power is intermittent, associated with 'common-mode failure' (Boisvert, 2012). The solution may be an EU-wide electricity grid. "Utilities don't like to make way for intermittent renewable surges by turning off coal, nuclear, and combined-cycle gas plants; firing up the boilers after a shut-down takes time and wastes fuel and money, and they will need those generators back on line, quickly, when wind and solar cut out" (Boisvert, 2012). Private firms are unlikely to build a Europe-wide electricity grid; but the EU could, combined with cheap loans to firms producing renewable energy.

The European Parliament could impose a centrally-planned system of electricity generation. It is difficult for a central planner to dictate power generation at each location: a small miscalculation might be costly to European taxpayers, distorting electricity generation. Many economists advocate free-market solutions to such problems: competition between firms provides good outcomes for consumers, as each firm has a strong incentive to find out if (for example) 'Concentrated Solar Power' is more cost-effective than photovoltaic power in a particular location. But due to market failures, any "decentralized market solution generated by decentralized agents like firms, consumers and investors that do not take into account relevant multiple externalities of their actions, e.g. climate damages, technological spill-overs, and security standards, cannot be expected to yield the welfare-optimal quantity" of renewable energy (Edenhofer et al., 2013: S13). If neither central planning nor free markets produces a good outcome, what might work?

"Scientific and economic experts are in increasing agreement that our current energy paradigm is no longer tenable, not least due to reserve and supply uncertainties, price volatility, and fiscal and environmental strains on the world's major markets and ecosystems" (Simmons, Coyle & Chapman, 2014: 29). We next turn to energy from renewable sources.

4. Energy from renewable sources

Gnansounou (2011: 399) and European Commission (2010) expressed concern about dependence on imported energy. Europe imports most of its energy (European Union, 2012: 5); EU is the world's largest importer of energy, and "Our standard of living requires huge amounts of energy"

(European Union, 2012: 3). Decommissioning older European electricity plants has reduced output from nuclear power, coal, and fuel oil (EPIA, 2013a: 42). Fossil fuels such as oil or gas may become less reliable and more expensive as accessible sources become exhausted. Potential for nuclear power seems limited: uranium stocks for nuclear fission may run out in the next few decades (European Commission, 2007: 26); nuclear fusion seems decades from commercial production. European Commission (2010: 3) warned that some parts of the EU could lose more than a third of their existing generation capacity by 2020, as nuclear power plants are decommissioned. Shale gas (via "fracking") might reduce water availability for farming; contaminate water supplies, soil, & air; exacerbate global warming; and cause earthquakes – "the lack of public acceptance represents a barrier to further shale gas development" (European Commission, 2014: 5-7).

PhotoVoltaic solar panels now provide about 2.6% of Europe's electricity (EPIA, 2013a: 6). Renewable energy has advantages, including less dependence on imported fuels; lower pollution, such as greenhouse gas emission; and in the long term, lower electricity prices (fossil fuel prices are expected to rise as reserves decline, whereas renewable energy is becoming cheaper) (Observ'ER, 2011). European Commission (2007: 3) wrote "Energy accounts for 80% of all greenhouse gas (GHG) emission in the EU; it is at the root of climate change and most air pollution. The EU is committed to addressing this – by reducing EU and worldwide greenhouse gas emissions at a global level to a level that would limit the global temperature increase to 2°C compared to pre-industrial levels. However, current energy and transport policies would mean EU CO_2 emissions would increase by around 5% by 2030 and global emissions would rise by 55%. The present energy policies within the EU are not sustainable."

Wind and solar power "have lower nameplate prices than nuclear" electricity (Boisvert, 2012). Renewable energy could support many objectives – including energy security, reduced environmental damage, green jobs, green growth, and poverty reduction (Edenhofer et al., 2013: S13). Solar power research is carried out in Europe, including Spain (Fernández-Reche et al., 2006), Finland (Hashmi et al., 2011), and Germany (Prucnal et al., 2012). EU support for solar power could encourage technological advances, keeping Europe at the forefront of non-polluting energy-generating technology (creating long-term jobs, and exporting renewable energy equipment to the rest of the world). Grossmann et al. (2012: 186) predicted global employment in making solar panels will increase to 2 million people by 2030.

EU support for renewable energy could provide internal and external economies of scale, and promote more research – improving efficiency from new technologies such as 'Passivated Emitter and Rear Cell' or 'Passivated Emitter and Rear Locally-Diffused' panels (Observ'ER, 2012: 125). "Europeans consider that the European Union is best placed to take effective action against the effects of the financial and economic crisis"; in

2012, 58% of respondents support "increasing the share of renewable energy in the EU by 20% by 2020" (European Commission, 2012: 20; 22). 73% of Europeans interviewed consider it important "to support an economy that uses fewer natural resources and emits less greenhouse gas" (European Commission, 2012: 21). Food production may increase due to partial shade from solar panels, because some crops are damaged by 'photoinhibition', i.e. too much sunlight (Murchie, Pinto & Horton, 2009: 541).

In 2007, the European Commission advocated every EU country "should have the flexibility to promote the renewable energies most suited to their specific potential and priorities" (European Commission, 2007: 14). But European Commission (2010: 20) had a new viewpoint: "Secure energy supplies, an efficient use of resources, affordable prices and innovative solutions are crucial to our long-term sustainable growth, job creation and quality of life. Member States have agreed that these challenges will be tackled most effectively by policies and action at EU level, by 'Europeanising' energy policy. This includes directing EU funding support towards public priorities that markets fail to meet and that bring the most European value".

4.1 Calculation

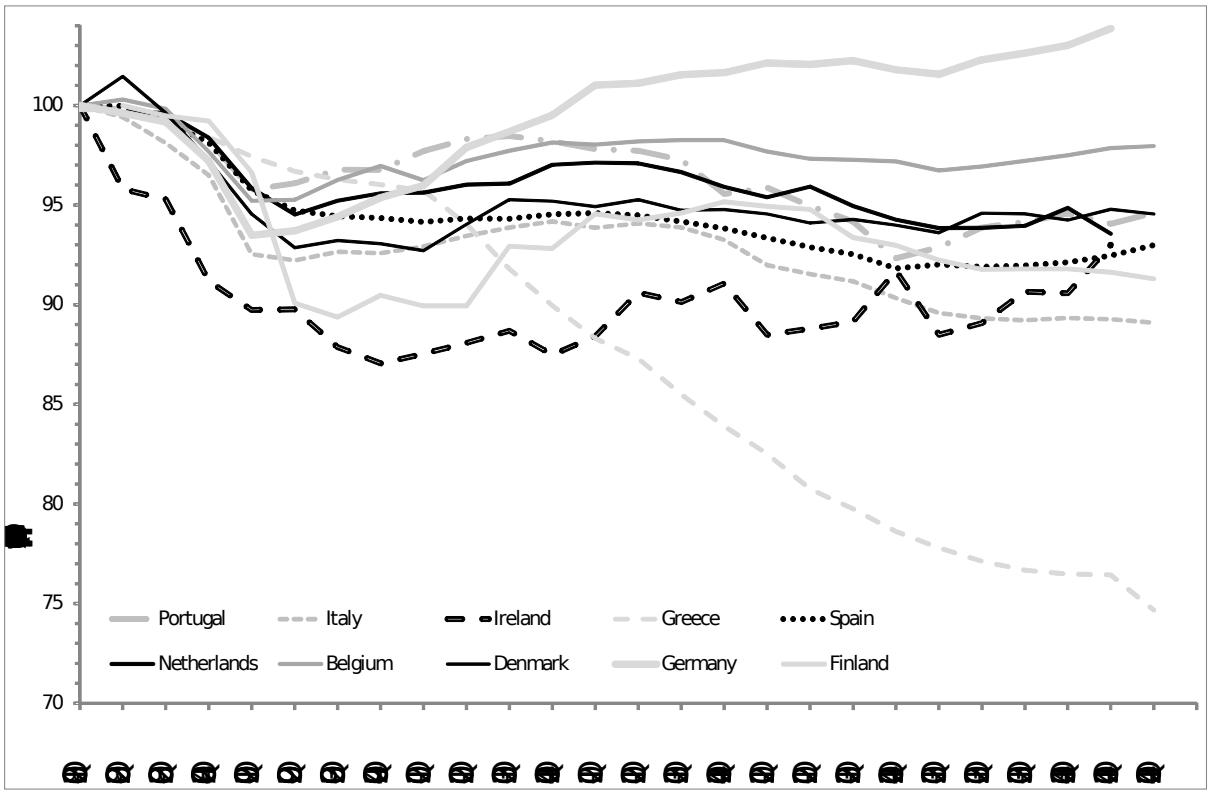
To provide a geographical perspective on this plan to help Europe, we now report statistical evidence in the form of graphs and maps. This paper uses ten countries as case studies. The 'PIIGS' (Portugal, Ireland, Italy, Greece, Spain) are often used as examples of troubled EU countries; the other five (Netherlands, Belgium, Denmark, Germany, Finland) experienced much better economic growth since 2008. Figure 1 shows national income per person at constant prices (OECD, 2014a: series LNBQR): Gross Domestic Product (GDP) using the expenditure approach, in national currency. The authors divide GDP by population (series POPNC); and then convert this to an index, equal to 100 in 2008 quarter 1. Equivalent Greek data are unavailable, so Greece data in Figure 1 are from OECD (2014a: series VOBARSA: in national currency). The authors smooth the data, using a 'Moving Average' process.

Map 1 was produced by the authors, using software on the Eurostat (2014b) website; Map 1 uses youth unemployment as a proxy for poverty in general. Countries are indicated using NUTS1 boundaries; NUTS2 regions are also shown.

4.2 Results

Evidence in this section allows us to assess links between geographical, economic, and political factors in Europe; in particular, the question of whether policy decisions should be taken at national level, or by the European Union.

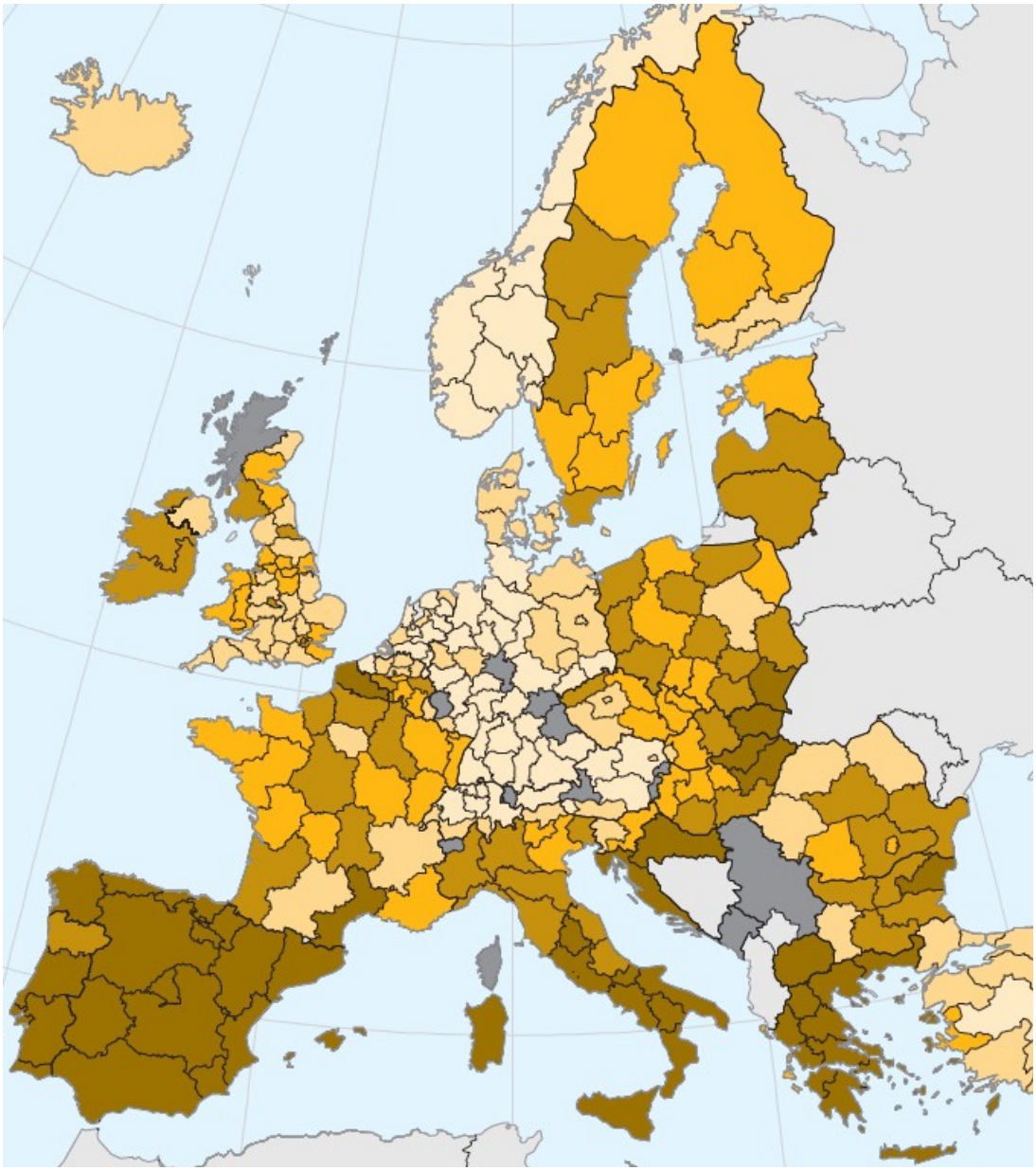
Figure 1: GDP since 2008, in ten case study countries



Source: OECD (2014a): index calculated by authors

Figure 1 depicts Germany and (to a lesser extent) Finland recovering since 2008; other countries show little or no recovery. All European countries could benefit from more investment, to reduce unemployment and raise living standards; but Figure 1 makes it clear that some countries are more in need than others. To put Figure 1 in context, Map 1 represents youth unemployment – as a measure of poverty in Europe.

Map 1: unemployment rate among young adults (age 15 to 24) in 2012



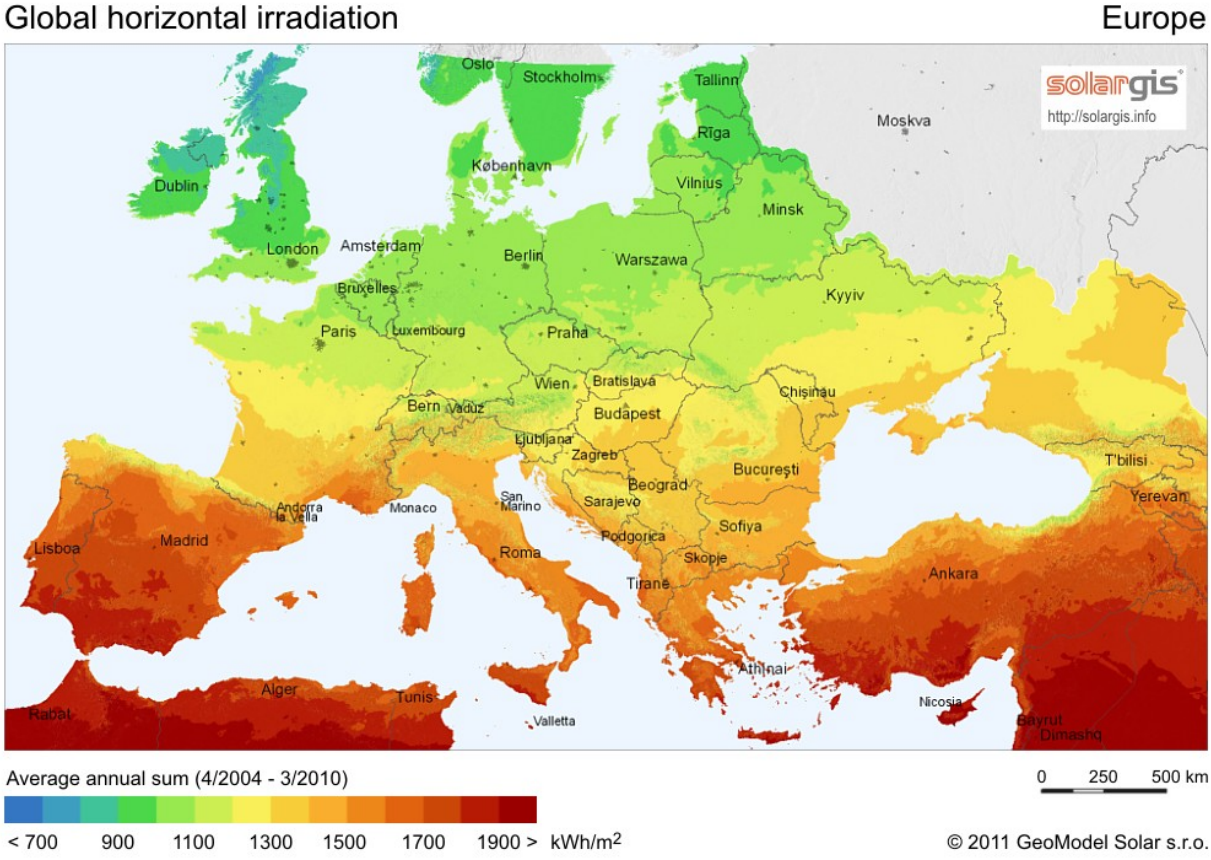
Source: authors' analysis using Eurostat (2014b).

Of the ten case study countries investigated in this paper, the most serious economic

problems appear to be in southern Europe – as shown in Figure 1. Map 1 confirms this picture: areas with the highest youth unemployment tend to be in southern Europe. Perhaps by coincidence, problem areas in southern Europe seem to match areas of greatest solar power potential: as noted in section 2 above, southern Europe is the most appropriate location for solar power (for an EU-wide system). Map 2 indicates which parts of Europe have most sunlight, using 'Global Horizontal Irradiation' from SolarGIS (2014); southern Europe is appropriate for solar power: Portugal, Italy, Greece and Spain are particularly effective locations.

Borenstein (2012: 72) claimed "The three broad categories of renewable energy that are considered closest to being scalable and cost competitive are wind, solar, and biomass". Of these, "Solar power is produced only during daylight hours and tends to peak in the middle of the day. In many areas, this is close to coincident with the highest electricity demand, which usually occurs on summer afternoons" (Borenstein, 2012: 74); whereas wind power often produces most power at times of lower demand and prices. This suggests most EU funding should go into solar power; the most appropriate location for solar power is southern Europe, e.g. Spain, Portugal, Italy and Greece (Strobel et al., 2009; Nielsen et al., 2010), which (according to Figure 1 and Map 1) are currently in urgent need of support. Wind power could be also supported, especially in northern Europe.

Map 2: solar irradiation in Europe



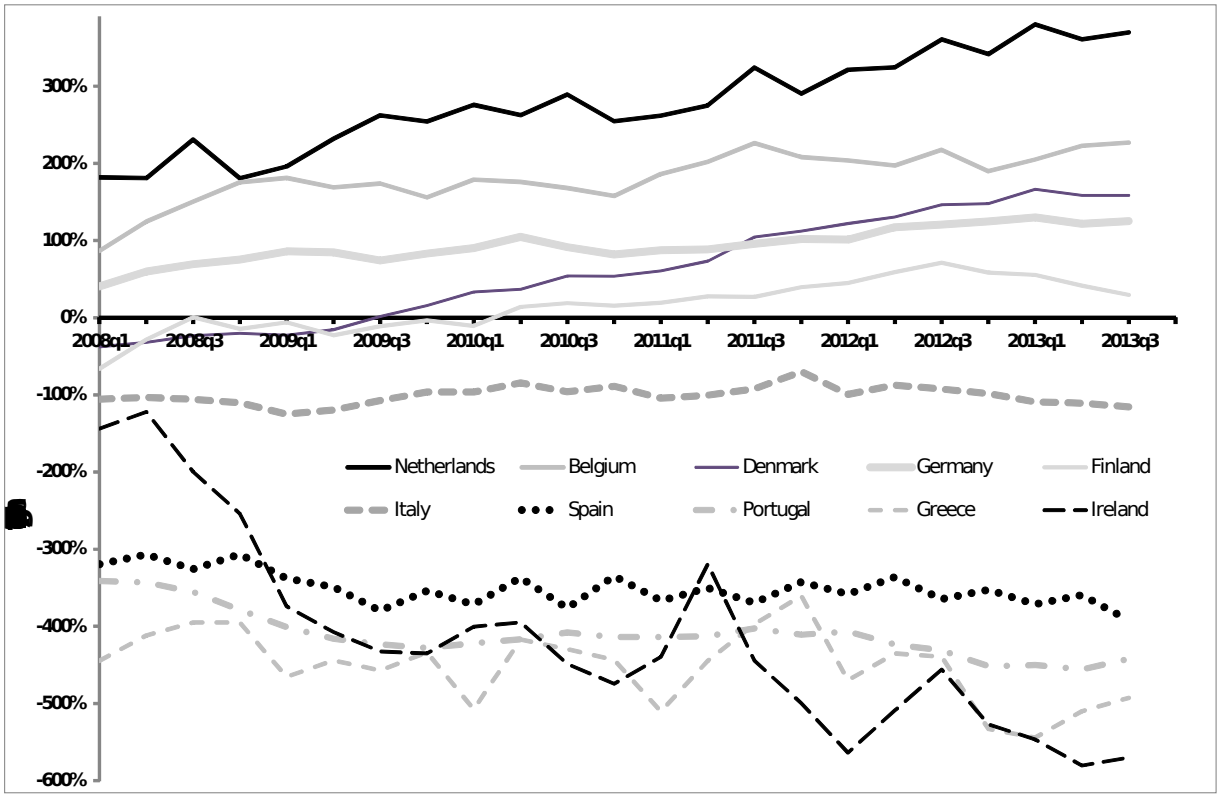
Source: SolarGIS (2014).

Southern Europe seems ideal to produce solar power – but local electricity prices may be low; areas of high electricity demand are often in northern Europe. This suggests a north-south dimension is needed, in a European electricity grid. Also, wind and solar power output is influenced by the weather (Edenhofer et al. 2013: S17). A grid could smooth solar power *supply* variation due to local clouds (EPIA, 2012: 25-8), and also smooth *demand* variations over time by combining consumption in East & West Europe. "It's a bit like having a bunch of hamsters generating your power, each in a separate cage with a treadmill. At any given time, some hamsters will be sleeping or eating and some will be running on their treadmill. If you have only one hamster, the treadmill is either turning or it isn't, so the power's either on or off. With two hamsters, the odds are better that one will be on a treadmill at any given point in time and your chances of running, say, your blender, go up. Get enough hamsters together and the odds are pretty good that at least a few will always be on the treadmill, cranking out the kilowatts" (American Meteorological Society: 2007). Hence, the European Parliament may need to pay for a 'smart grid' to distribute electricity. Brancucci Martínez-Anido et al. (2013: 207-8) wrote "the European transmission network is experiencing serious underinvestment". European Commission (2013b) claimed over 40% more capacity in Europe's electricity transmission will be needed by 2020. The electricity distribution grid must be 'smart' "to avoid the need for costly interventions in the future" (EPIA, 2012: 9). Because energy from sunshine and wind vary with the weather, more reliance on renewable energy "highlights the need to accelerate the modernisation of the electricity grid" including grid balancing and improved flexibility; electricity should be generated "where it makes most economic and environmental sense. Factors such as distance to consumption centres, implied grid needs and issues related to public acceptance and job creation clearly also play a role and cannot be ignored" (European Commission, 2011: 5). EPIA (2013b) claimed "The Renewable Energy Directive requires Member States to upgrade their electricity infrastructure in time to allow for the large-scale integration of renewable power. The European Commission should systematically control the effective implementation of this requirement. As decentralised generation will have to become a key component of the energy system, a stronger focus on the distribution grid system will be required to allow for the cost-effective integration of renewable energy sources such as solar PV". Eurostat (2014a) data confirm that in 2013, electricity prices differed dramatically between countries; suggesting an EU-wide grid could benefit consumers in high-price countries, and producers in low-price countries (for example, it would help Germany cope without nuclear power).

Investing in solar power could be effective in helping Europe out of recession. But can southern European governments *afford* to support such investments? To assess this, Figure 2 uses 'financial net worth' of each country's government as a proportion of that country's GDP. Large

government debts make it difficult for state agencies in PIIGS countries to borrow – even if the Troika had not imposed spending rules on them. At the time of writing, some European governments seem powerless: due to previous borrowing (bailing out commercial banks), governments cannot borrow at interest-rates low enough to support private investment.

Figure 2: Debt levels since 2008, in ten case study countries



Source: OECD (2014b)

Figure 2 indicates a problem: the five PIIGS countries, which are most in need of fiscal injection, are least able to afford it. Figure 2 shows high levels of government debts in these five countries. But debts in many European countries are not at alarming levels, compared with historical standards: for example, UK national debt in 2013 (quarter 3) was 89% of GDP (OECD, 2014b), compared with 200% after World War Two (although average debt maturity complicates this issue). Hence, it may be plausible for countries such as Germany to borrow money, in order to support investment in southern Europe. However, such deals are difficult to co-ordinate; international electricity distribution requires a coordinated approach – which might be arranged by the European Union.

If countries most affected by crisis (e.g. Greece) are prioritised for investments by the European Union, modelling using the HEIMDAL algorithm suggests this would raise EU GDP by about 0.6% and create 1.2 million jobs in two years; indirect effects such as improved business confidence would help further (Griffiths-Jones & Jolly, 2013: 48-9).

5. Discussion

Edenhofer et al. (2013: S18) claimed "An urgent question in this context is how to bring and integrate [renewable energy] technologies into the market." Evidence in this paper suggests an EU-wide approach can solve the current energy and economic crises facing Europe. Some EU countries, such as Germany, can borrow cheaply; other EU countries, such as Greece and Spain, desperately need investment. Some EU countries (such as Germany) will decommission existing power plants; other EU countries (such as Greece and Spain) are excellent places to locate electricity-generating facilities based on solar power. In normal times, capitalist firms could use these factors as an opportunity to make profits; but in the current climate, risks of rising interest-rates and low electricity prices in southern Europe make such investments a distant prospect – unless the EU steps up to the mark.

Could Europe invest €1 Trillion to modernise its energy infrastructure? Socialist and Green MEPs might support renewable energy investment, but a majority may require a private-sector approach. Private firms won't invest unless profitability is assured. Keynesians claim Europe needs fiscal injections to generate recovery; but MEPs are unlikely to support such policies. Many politicians are against state intervention. Compromise might be possible, but would be Byzantine: for example, should MEPs persuade voters by emphasising global warming, or high unemployment?

Conventional Keynesian demand management relies on government spending. An alternative, suggested in this paper, is a compromise between government and private-sector spending: such a compromise might secure support in the European Parliament. If the European Commission (2010) estimate is correct that €1 Trillion investment is needed in Europe's energy, then EU institutions could use leverage to partly finance €1 Trillion on renewable energy (Griffiths-Jones & Jolly, 2013; European Commission & EIB, 2013). If a leverage ratio of 10 were used, this might be achieved by a loan of €100 Billion from richer EU countries, or alternatively be provided by the European Investment Bank, which can borrow at low interest-rates (Koo: 2013). Such a one-off loan would be cheaper than the EU Common Agricultural Policy, which cost taxpayers €58 Billion in 2011 (European Commission, 2013a) – an ongoing cost.

Keynes (1936: 383) wrote "the ideas of economists and political philosophers [...] are more powerful than is commonly understood. Indeed the world is ruled by little else". EU Commission President Jean-Claude Juncker might arrange legislation to achieve a majority in the EU Parliament, to move Europe from Japanese-style recession to USA-style growth. While compromise will be difficult to reach, it is not unattainable. If the current economic climate is to endure, it may be the only solution in the years to come.

The European Commission has developed plans to develop a Europe-wide system to generate and distribute electricity: an EU-wide 'smart grid'. Renewable energy investment could achieve many goals, including resolving financial problems of European countries; lowering unemployment; ensuring sustainable energy supplies; and reducing pollution such as greenhouse gases, to combat global warming. Free-market solutions have made progress in replacing some of Europe's electricity generation – but the pace is too slow to meet expected challenges, such as Germany's decommissioning of nuclear power stations. Central planning does not seem feasible for electricity generation on the scale advocated by the European Commission: innovative thinking is required. To achieve aims outlined in European Commission (2010), this paper suggests the EU enable private-sector investment, supported by low-interest-rate loans from EU agencies such as the European Central Bank.

The EU economies are experiencing a short-term problem, of recession (lowering incomes and increasing unemployment). The EU also faces a long-term problem, with energy (reliance on imported energy, and burning fossil fuels). This paper offers a pathway to solve both problems, based on EU support for renewable energy. The solution has two key elements: long-term loans to private firms for renewable energy generation; and a 'smart grid', which allows a firm to generate electricity in a location with plenty of sunshine (in south Europe), and sell the electricity to consumers in rich (north Europe) countries. It requires an agreement between the EU parliament and national political leaders. The resulting proactive policy mix that combines Keynesian policies with private sector incentives could allow the entire EU to achieve sustainable economic growth conducive to fiscal sustainability.

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