Linking Renewable Energy to Rural Development

Executive Summary
Brief for Policy Makers

Executive Summary

Renewable energy (hereafter, RE) is being championed as a potentially significant new source of jobs and rural growth in OECD countries, and a means of addressing environmental and energy security concerns. In most countries, governments have invested large amounts of public money to support RE development and are requiring significant quantities of it to be sold by energy providers. But what are the economic impacts of these policies and investments? Can RE really help to develop rural economies? These are some of the questions explored by this report, which presents the results of a two-year study of the impact of RE on rural development. Drawing on case studies in 16 regions across Europe and North America, it finds that while RE indeed represents an opportunity for stimulating economic growth in hosting communities, it also requires a complex and flexible policy framework and a long-term strategy. RE is not going to create lot of jobs, but rather some additional employment opportunities in rural areas. Making a positive connection between RE development and local economic growth will require more coherent strategies, the right set of local conditions, and a place-based approach to deployment.

What does renewable energy offer rural areas?

The global deployment of RE has been expanding rapidly. For instance, the RE electricity sector grew by 26% between 2005 and 2010 globally and currently provides about 20% of the world's total power (including hydro-power). Rural areas attract a large part of investment related to renewable energy deployment, tending to be sparsely populated but with abundant sources of RE. The case studies have found that RE deployment can provide hosting communities with some benefits, including:

- New revenue sources. RE increases the tax base for improving service provision in rural communities. It can also generating extra income for land owners and land-based activities. For example, farmers and forest owners who integrating renewable energy production into their activities have diversified, increased, and stabilised their income sources.
- New job and business opportunities, especially when a large number of actors is involved and when the RE activity is embedded in the local economy. Although RE tends to have a limited impact on local labour markets, it can create some valuable job opportunities for people in regions where there are otherwise limited employment opportunities. RE can create direct jobs, such as in operating and maintaining equipment. However, most long-term jobs are indirect, arising along the renewable energy supply-chain (manufacturing, specialised services), and by adapting existing expertise to the needs of renewable energy.
- Innovations in products, practices and policies in rural areas. In hosting RE, rural areas are the places where new technologies are tested, challenges first appear, and new policy approaches are trialled. Some form of innovation related to renewable energy has been observed in all the case studies. The presence of a large number of actors in the RE industry enriches the "learning fabric" of the region. Small and medium-sized enterprises are active in finding business niches as well as clients and valuable suppliers. Even when the basic technology is imported from outside the region, local actors often adapt it to local needs and potentials.
- Capacity building and community empowerment. As actors become more specialised and accumulate skills in the new industry, their capacity to learn and innovate is enhanced. Several rural regions have developed specific institutions, organisms, and authorities to deal with RE deployment in reaction to large investment and top-down national policies. This dynamic has been observed both in regions where local communities fully support RE and in regions where the population is against potentially harmful developments.
- Affordable energy. RE provides remote rural regions with the opportunity to produce their own energy (electricity and heat in particular), rather than importing conventional energy from outside. Being able to generate reliable and cheap energy can trigger economic development.

Key challenges

Renewable energy policy is expected to deliver in three areas: energy security, climate change mitigation, and economic development (job creation). However, this is not always the case and there can be significant trade-offs among them. For instance, large biomass heat and power plants can generate new employment opportunities in rural communities, but may have a negative CO_2 balance due to land-use change and transportation of feedstock over relatively long distances. Similarly RE is in most instances a capital-intensive activity, and energy as a whole represents a small share of employment in regional economies. Small-scale installations typically source labour and equipment from international suppliers, so the impact at the community level in terms of job creation is rather limited. Listed in the table below are some of the factors helping or hindering renewable energy in achieving its three goals. Focusing on ensuring the supportive ingredients are present will be a step forward in putting renewable energy to work in rural communities.

Supportive	Impeding
High quality RE resource	Low to moderate quality RE resource
Relatively expensive current energy	Low-cost conventional energy
Provision of small subsidies	Provision of large subsidies
Ability to link RE to existing economic activity	RE is a standalone sector within the regional economy
Good existing energy transport/transmission infrastructure	Project produces stranded energy that cannot be exported
Strong local community support	Significant local opposition
Integration of RE within a broader energy framework that facilitate dispatch	Inadequate backstop energy for intermittent power sources
Mature technology	Novel or infant technology
RE relies on regional inputs that have limited current uses/RE complements existing input uses	Inputs for RE project have high opportunity cost in current use
RE policy aims at producing cheap energy (renewable heat)	Excessive focus on job creation absorbs large quantity of public resources that could be better spent connecting RE to the rural economy

Putting renewable energy to work in rural areas

A well-designed framework for regional policy could offer a real opportunity to reconcile policy trade-offs and identify potential complementarities among the three objectives of energy security, climate change mitigation, and job creation. These findings underline the need for a shift in the approach to rural development policy in many OECD countries away from a model that emphasises sectoral policy and subsidies, to one that is place-based and grounded in local conditions and opportunities and that focuses on the competitiveness of rural areas. Specific factors to bear in mind include:

- Embed energy strategies in the local economic development strategy so that it reflects local potentials and needs. Environmental and energy security arguments tend to be the main impetus for promoting renewable energy, and the local economic benefits tend to get overlooked.
- Integrate RE within larger supply-chains within rural economies, such as agriculture, forestry, traditional manufacturing and green tourism.
- Limit subsidies in both scope and duration, and only use them to induce RE projects that are close to being viable in the market. If subsidies are too high, they can attract “rent-seeking” investors, can lead to high-cost energy that is only viable as long as high levels of subsidy are sustained, can have a negative impact on land use and displace other activities such as agriculture and tourism.
- Avoid imposing types of RE on areas that are not suited to them. For example, wind power is only appropriate in certain places – more care is needed to identify those places rather than adopting policies that somewhat arbitrarily spread RE projects across national landscapes.
- Focus on relatively mature technologies such as heat from biomass, small scale hydro and wind. These proven technologies are not likely to experience big jumps in technology that can make recently completed plants instantly obsolete.
- Create an integrated energy system based on small grids able to support manufacturing activities. Policy should take into account backstop technologies for intermittent power sources. In several regions, the capacity to deploy RE is constrained by grid limitations; however, there are no incentives to improve transmission infrastructure.
- Recognise that RE competes with other sectors for inputs, particularly land. Poor siting can adversely affect local residents and disrupt tourism, which is typically a much larger source of income and employment.
- Assess potential projects using investment criteria, and not on the basis of short term subsidy levels.
- Ensure local social acceptance by ensuring clear benefits to local communities and engaging them in the process: this is crucial, as local opposition can slow construction and may increase the difficulty of subsequent efforts to introduce RE projects.

To conclude, the research demonstrates that there are no shortcuts to rural development. Policy makers should always take into account the overall cost of energy, and implement the least expensive energy solution that can also satisfy carbon emission reduction requirements. Only a coherent and integrated development strategy can achieve the goal of promoting growth together with a better environment.

Linking renewable energy to rural development
A brief for policy makers

Renewable energy is increasingly being championed as a new source of jobs in OECD countries, as well as addressing concerns with energy security and climate change. In most OECD member countries, governments have invested large amounts of public money to support renewable energy development, and have also required that significant quantities of renewable energy be sold by energy providers. With most renewable energy facilities located in rural areas, what are the economic impacts of these policies and investments? Can renewable energy really help to develop rural economies?

These are some of the questions explored by this report, which presents the results of a two-year study of the impact of renewable energy on rural development. Drawing on case studies of renewable energy in 16 rural regions across Europe and North America, the report shows that renewable energy does not automatically create employment in rural regions. For renewable energy to trigger rural economic growth requires a coherent policy framework and the right set of local conditions.

Positive impacts

- Local revenue
- Local jobs
- Innovations, in products, processes and policies
- Capacity building and local empowerment
- Affordable and reliable energy

Challenges

The overall impact on economic growth is generally much lower than expected. National and regional renewable energy policies have set very ambitious targets and high incentives for renewable energy production that have caused distortions. Incentives have triggered rent-seeking behaviours, and installations often compete with agriculture and tourism for the use of land or landscape amenities. In this context, many local communities have started opposing further deployments.

Recommendations

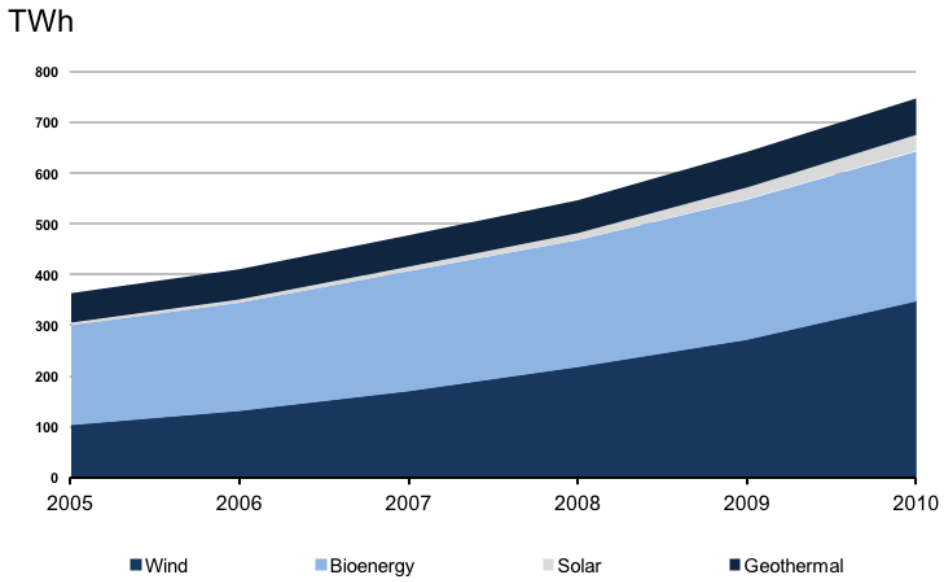
The report recommends putting renewable energy to work in rural areas. This implies a new paradigm for rural development. Reducing the use of spatially blind incentives, introducing a flexible policy framework, and taking into account the characteristics and specific needs of hosting economies could be a way to capitalise on the investment in renewable energy in terms of economic development. In particular, alternative energy should not be considered as a standalone sector within regional rural economies. Potential backward and forward linkages with rural industries such as forestry or manufacturing should be developed through an integrated approach to renewable energy deployment. Collective action should be stimulated through intermediate institutions active in rural communities and policy makers should aim at involving a larger number of stakeholders in policy interventions to stimulate sustainable development and improve local support.

The global boom in renewable energy: some facts and figures

The global deployment of renewable energy has taken off. The renewable energy electricity sector grew by 26% between 2005 and 2010. Today it provides about 20% of the world's power. Hydro-electric power generates 84% of the world's renewable electricity, while the other newer renewable energy electricity technologies have also grown rapidly, doubling their production between 2005 and 2010 (Figure 1). Wind has grown most rapidly in absolute terms. Solar photovoltaic has grown at a rate of 50%, and installed capacity reached about 70 GW by the end of 2011.

Renewable energy for heating, cooling and transport fuels is also steadily growing. The production of heat from renewable sources grew by 6% between 2005 and 2009, with the use of biomass (*e.g.* wood) still the dominant technology. However more "modern" heating technologies – particularly solar heating, but also geothermal heating – have seen an overall growth rate of nearly 12% between 2005 and 2009. The production and use of biofuels for transport have also been growing rapidly, providing 3% of road transport fuels (2% of all transport fuels) in 2009. Biofuel production and consumption are still concentrated in Brazil and the United States (ethanol) and in the European Union (biodiesel).

Figure 1. Global growth in renewable electricity generation, 2000-2010*



**Notes:* excluding hydro-electric

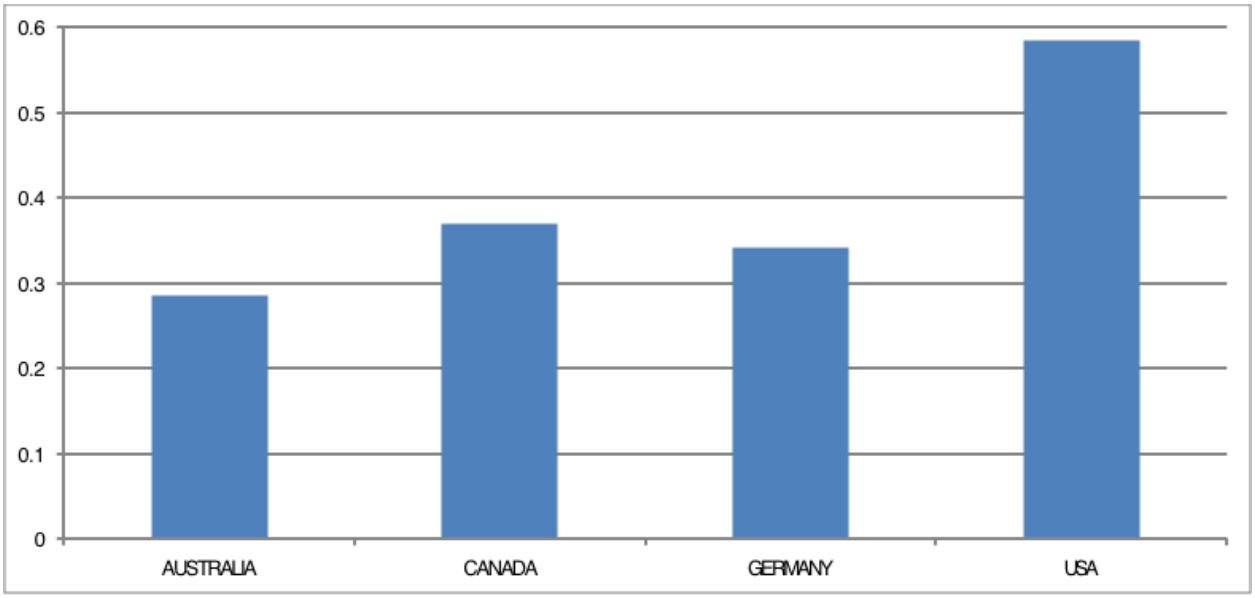
Source: IEA (International Energy Agency) (2011), *Deploying Renewables 2011: Best and Future Policy Practice*, IEA, Paris

How much of the investment goes to rural areas?

In 2011, the global public and private investment in renewable energy amounted to USD 211 billion (UNEP, 2011). The total investment exceeded USD 1 trillion between 2002 and 2011. A large share of the rural energy boom is occurring in the OECD's rural areas, which are sparsely populated, amply endowed with renewable sources of energy, and spacious enough for land-hungry developments like wind farms. For instance, in the United States the share of investment going to renewable energy in rural areas is around 55%; even in a country as densely populated as Germany, rural regions are attracting more than 20% of the

renewable energy investment (Figure 2). Investors include both the business sector (often developers taking advantage of public subsidies or tax credits for renewable energy); and the public sector, through investment in research and development (R&D), public run utilities, and demonstration projects. In some rural regions the investment in renewable energy represents a significant share of gross domestic product (GDP): up to 3% in Extremadura (Spain) in 2009, for instance.

Figure 2. Share of total investment in renewable energy going to rural areas, 2010



Note: In Australia and Canada, despite the presence of large rural areas people mostly live in big cities. As the localisation of installations is constrained by the grid, it is normal that in these countries renewable energy tends to be deployed close to urban poles. This is not true in the United States where population and infrastructure is more scattered, and of course in Germany, where all regions, including rural areas, have a relatively high population density and good grid infrastructure.

Source: OECD Regional Statistics (,www.oecd.org/topicstatsportal/0,3398,en_2825_497132_1_1_1_1_1,00.html) and Bloomberg New Energy Finance (www.newenergyfinance.com/)

The research

The OECD created an international network of case studies to assess the impact of renewable energy on regional economies, especially rural communities. The research explored the link between renewable energy production and rural development in terms of economic development and job creation, human capital and infrastructure, and empowerment of local communities in 16 rural regions in 10 OECD countries (Figure 3). The OECD selected regional case studies in close collaboration with national and regional authorities, aiming at setting a complete range of examples in terms of renewable energy sectors and also degree of rurality. The research focused on a broad range of renewable energy technologies, except large-hydro installations. The study also looked at the governance mechanisms, institutional settings and policies underpinning renewable energy deployment in rural regions. It was conducted by a broad network of international experts, peer reviewers from case study countries and regions, and OECD officials.

Figure 3. The OECD regional case studies

Note: The case studies are: Puglia and Abruzzo, in Italy; Extremadura, in Spain; Tromsø, in Norway; Regions Sjaelland, in Denmark; North Karelia, in Finland; Mellersta Norrland, in Sweden; Scotland, in the United Kingdom; Fryslân, in the Netherlands; Québec and Prince Edward Island, in Canada; Iowa, Oregon, Maine, Vermont, and Tennessee, in the United States.

Is renewable energy a development opportunity for rural regions?

The case studies have found a number of benefits for rural communities hosting renewable energy:

New sources of revenue to support key public services and infrastructure

Renewable energy deployment increases the tax base in hosting rural communities and generates extra income for land owners and land-based activities. Developers have to pay taxes to the hosting community. Some of these taxes are paid at once, such as building permits; others are paid on a yearly basis and are related to the businesses' turn over. Local taxes provide revenue for the hosting community and can have a dramatic impact on service delivery, especially in countries – such as the United States – where local services are more dependent on local taxes. In several case studies (Abruzzo, Italy; Scotland, United Kingdom; Prince Edward Island, Canada), these tax revenues have increased the availability of key public services such as schools and senior residences. Local authorities can themselves deploy renewable energy installations in public space, taking advantage of public subsidies for alternative energy. Renewable energy in rural areas can also generate extra income for land owners, and can be integrated with specific productive processes. For instance, in several of the case study regions, farmers and forest owners are themselves producing renewable energy, allowing them to diversify, stabilise or increase their income.

Jobs and business opportunities, especially when integrated into the local economic fabric

Renewable energy can create valuable job opportunities for people in regions with few employment opportunities, although the number of direct jobs created is limited. Most of the direct jobs are in operating and maintaining the installations. Some of these jobs pay high salaries and can have an important impact on long term sustainability of rural communities. However, the largest share of long-term jobs is not in direct energy generation, but along the renewable energy supply chain – in construction, manufacturing, specialised services, and also rural activities such as farming, forestry, etc. Those regions which have policies to attract renewable energy on a large scale can generate a large enough demand for installations and components to attract supporting manufacturing services. Manufacturing companies may decide to base their operations in these regions to reduce transportation costs *(e.g* transporting pillars for wind turbines), or to benefit from subsidies, grants, and tax breaks. This was the case of Québec policy to deploy wind energy, for instance. Often, the presence of renewable energy installations can revive existing manufacturing activities not previously related to energy production. This was the case in Extremadura (Spain), where the most new manufacturing jobs were created in firms producing metal frameworks to support solar energy installations, and in Maine, where the policy aims at reviving the shipbuilding industry through off-shore wind deployments.

Biomass: an untapped opportunity

The use of biomass (*e.g.* forest and crop residues, animal manure) as a renewable feedstock for the production of electricity, heating or biofuels is an untapped opportunity for rural development. Renewable heat tends to be systematically ignored by renewable energy policy in most countries, despite being the most competitive with conventional sources. The direct conversion of a renewable power source to heat involves a relatively cheap transformation, and in many cases it offsets a relatively high-cost fossil-fuel source. Moreover, is likely to have a larger impact on local labour markets than other renewable energy technologies. In general, biomass energy requires the organisation of a specific productive process, and involves a large number of people. In the Nordic regions (North Karelia, in Finland and Mellersta Norrland in Sweden, for instance) participating in the study, the collection of forest residues has generated new and sustainable job opportunities, and improved forest management. Policy makers, however, rarely tap in the biomass potential due to the high transaction costs and the need to organise collective action.

Contrary to received wisdom, the renewable energy sector in general is more capital than labour intensive, although this is less true for the use of biomass (see inset box). The energy sector (renewable or conventional) usually represents a small percentage of regional employment overall. This was evident in several case studies, even in those where energy is an important regional specialisation, such as Québec, Canada, and Tennessee, United States. Hence, even if the renewable energy sector was able to replace the non renewable sector entirely, it would still be a small percentage of overall employment.

Innovations in products, practices and policies

Rural areas hosting renewable energy installations actively contribute to the development of new products, new technologies, and also new policy approaches. It is here that new technologies are tested, challenges first appear, and new policy approaches are trialled. We observed some form of innovation in each of the case studies (Table 1). In some regions (*e.g.* Puglia, Italy), public authorities have been able to fine tune renewable energy policy progressively to reduce distortions and rent-seeking behaviours, providing the national government with a potential reservoir of experience in the policy challenges of renewable energy deployment.

Table 1. Innovations in renewable energy products, practices and policies in the case study regions

Region	Products developed	New practices and policies
Tennessee, US	Electric vehicles, cellulosic ethanol	Collaboration between universities and national energy research centres
Maine, US	Deep sea floating windmills, tidal energy	*Ex ante* evaluation of the impact of offshore installations on maritime communities
Vermont, US	"Cow power": small-scale farm based biogas for decentralised electricity production	Branding of electricity
Iowa, US	Ethanol from maize, cellulosic ethanol	Focused systemic research strategy
Oregon, US	Small scale energy integrated into existing activity	Community-based co-ordination approach – "energy has to have a job"
Quebec, Canada	Low temperature turbine blades for wind installations	*Bureau d'audiences publiques sur l'environnement* (BAPE) to protect the interests of rural communities vis-à-vis renewable energy deployment
PEI, Canada	Smart renewable energy systems and integration with optical fibre network by municipally-owned energy company	
Tromsø, Norway	Low temperature turbine blades, tidal energy, extraction of heat from water and sewage	
North Karelia, Finland	Wood-based biofuels, efficient wood burners, related machinery and equipment, combined heat and power (CHP) and district heating	
Mellersta Norrland, Sweden,	Bioenergy from wood, with CHP and district heating. "Green transport highway" between Sweden and Norway	
Region Sjælland, Denmark (Island of Lolland)	Wind, wind installation maintenance, testing facilities; algae production for biofuels; straw based bioenergy	Local consortia to organise land-use and to link demonstration processes to regional economies
Fryslân, Netherlands	Solar powered boats and related systems for battery control, etc; green gas based partly on cow manure	Policy to develop niche opportunity (PV powered boat industry)
Extremadura, Spain	Mounts for solar installations	
Puglia, Italy	Small wind generators	Policy modifications to reduce distortions and rent-seeking behaviours; emerging policies to encourage small-scale decentralised renewable energy
Abruzzo, Italy		Aesthetic principles explicit in guidelines to site renewable energy installations in rural landscapes
Scotland, United Kingdom (Shetland Isles)	Hydrogen from wind; energy storage systems; tidal generators	

In regions where renewable energy is embedded in rural supply chains, such as agriculture and forestry, advanced R&D involving private and public actors has helped to enhance the region's competitive advantage in its core energy specialisation. For instance, in Iowa bio-refineries have developed new enzymes to lower the price of second generation biofuels. In Sjaelland, Denmark, research focuses on reducing the cost of maintaining wind turbines. Other rural communities have focused on integrating renewable energy into local systems to lower energy costs (see inset box). Often, these are remote rural areas that must import expensive fuel or electricity and which therefore have a large incentive to find more sustainable and cheaper local sources.

Innovation in the Shetland Isles

The Scottish and Southern Energy smart grid project aims to treble the amount of renewable power from wind within three years by developing an innovative energy storage system. Energy storage will be managed by centrally controlled "smart" water and storage heaters in 1 000 Shetland homes. Stabilising the grid with these heaters would allow up to 10 MW of extra wind power to be connected to the Shetland's current system. Through this project, small-scale wind farm entrepreneurs in Shetland will earn feed-in tariffs by supplying electricity to the smart grid.

Such embedded innovation involves incremental engineering advances to make the technology viable, and is closely linked to the local economies and context. The R&D process is participatory, and also feeds into local entrepreneurship. Innovators and users interact constantly to improve the performance of the technology. Roles can evolve, and users sometimes also become innovators themselves, leading to new business opportunities and self-employment. This was especially true of the Italian and Spanish case studies, where rural areas are home to clusters of small and medium-sized enterprises (SMEs) (Boix and Vaillant, 2010) and the production of renewable energy is booming. The presence of a large number of actors involved in the renewable energy industry enriches the "learning fabric" of the region. SMEs are active in finding business niches as well as clients and valuable suppliers. Even when the basic technology (or the scientific information) is imported from outside the region, local actors adapt such information to local needs and potentials.

Capacity building and community empowerment

As people become more specialised and accumulate skills in the new industry, their capacity to learn and innovate is enhanced. Several rural regions have developed specific institutions and authorities to deal with renewable energy deployment, often in reaction to large investments and top-down national policies. This dynamic has been observed both in regions where local communities fully support renewable energy, and in regions where the population is against potentially harmful developments. The case studies reveal the emergence of a new governance model in which citizens (individuals or small groups) are becoming highly vocal and visible (through the Internet, for instance) and refuse to hand over decision-making power to traditional institutions, including local governments. In Fryslân, for instance, rural dwellers have started voting against wind energy almost twenty years ago, as they did not want to host new turbines in their landscape. As a result, it is no more possible to deploy new wind turbines – or to replace the old ones – in the Dutch province, despite the good quality of the local wind resource.

Affordable and reliable energy for remote rural communities

Renewable energy can reduce the "fuel poverty" that can be a common feature of remote regions, by allowing isolated communities to produce their own energy instead of importing expensive conventional fuels. In the Shetland Isles of Scotland, more than one-third (35%) of all households live in fuel poverty, meaning that household have to spend more than 10% of their income on heating; 13% of Shetland's households have to spend more than 20% of their overall income on keeping warm. The development of off-grid renewable energy systems, especially for heating (described in the box above) has helped solve this problem. Similar trends were observed in the Nordic regions (North Karelia, Finland and Mellersta Norrland,

Sweden), where the use of renewable heating (district heating systems relying on forest residuals) has reduced local energy costs by 30%.

Taking back control

Historically, Prince Edward Island (Canada) relied on imported energy; over 80% of the energy used for home heating on the island came from imported oil and electricity was expensive since it is produced on the mainland, and the capacity of the connecting transmission line is constrained. Moreover, because the island is a small player in energy markets, it has no pricing power and has little choice but to accept quoted prices. These factors prompted Prince Edward Island to become an early North American innovator in wind power. Wind conditions on much of the island are highly favourable and wind power was seen as both a way to increase energy security and to generate electricity at competitive prices. With the introduction of utility-scale wind farms, Prince Edward Island has radically altered the local electricity market. For the first time indigenous power is contributing a major share of electricity on the island. Renewable energy provides Prince Edward Island with power that has predictable costs, mainly because the majority of these costs are fixed at the time of construction.

When a remote region is able to access reliable and cheap energy, this can trigger economic development. For instance, Québec's integrated policy (Plan Nord) to provide communities in the north of the province with renewable energy, especially hydropower and wind energy should attract energy-intensive manufacturing (mining, smelting, for instance) in these remote areas. On the small Scottish island of the island of Eigg, the introduction of an integrated system mostly based on renewable energy has freed residents from dependence on diesel generators and provided them with a stable and affordable power supply. This has brought improvements in other areas, enabling several new businesses to start up, including restaurants, shops, guest houses and self-catering accommodation.

How to make renewable energy a driver for rural development?

Getting the policy framework right

Renewable energy policy is expected to deliver in three key areas: energy security, climate change mitigation, and economic development. To many, sustainable energy is seen as a *panacea* for several policy challenges, who stress that:

- Renewable energy will contribute to energy security and independence in countries and regions. OECD countries have been seeking energy security since the first oil shock of the early 1970s, and it is still on the agenda today for geopolitical reasons and the need to reduce national and regional import costs.

- Renewable energy will dramatically lower carbon emissions.

- Investment in renewable energy will trickle down to other sectors such as construction, manufacturing and services, thus creating new employment opportunities.

However, this will only be the case with the right policy framework. Without this, there can be significant trade-offs. For instance, while large biomass heat and power plants can generate new employment opportunities in rural communities, they may have a negative CO_2 balance due to land-use changes and if the feedstock needs to be transported over long distances. Similarly, without the right policies renewable energy does not automatically create jobs. If small-scale installations source labour and equipment from international suppliers, the local development impact is rather limited. In the same vein, old transmission systems that cannot cope with new energy inputs limit the potential offered by renewable energy to increase security.

Finally, without the right safety nets in place, the expansion of relatively high-cost renewable energy projects can have important consequences for low-income citizens. If the higher costs of renewable energy are blended into market prices for energy, as is the case with feed-in tariffs, this raises the overall cost of energy. If government subsidises the production of renewable energy with scarce tax revenue, then there is less money available for other policies. In either case the poor are more exposed, since they spend a larger share of their income on energy and are more dependent on support from government programmes. Thus, while governments may intend to stimulate economic growth by renewable energy expenditures, they may have the opposite effect if these factors are not properly addressed.

Dealing with a complex policy environment

The three drivers cut across several policy sectors, raising co-ordination challenges. This demands a strategic approach to rural renewable energy to optimise economic development and environmental spillovers. Many regions have a very complex policy context for renewable energy, usually encompassing a number of sectoral policies – such as energy and environmental policies – and more holistic ones, such as regional and rural development policy. In general, the incentive schemes for renewable energy come largely from the national energy sector and the emphasis is on increasing the level of deployment. This policy has to percolate through different levels and policy frameworks, with every tier adding complexity to the general policy target. Multiple objectives driven by different policies can generate confusion. For instance, in some case study regions renewable energy policy is considered as a "hard" industrial policy, supporting mostly large-scale installations. In Extremadura (Spain) the regional government considers the deployment of renewable energy as "an industrial revolution for the region", and in Québec, Canada, where the provincial government focuses its efforts in creating an industrial supply-chain specialised in the production of wind

installations. Considering renewable energy deployment as a top-down industrial policy risks renewable energy becoming an isolate sector, poorly linked to the broader rural economy.

Farming photovoltaics instead of food

Balancing the pace of deployment with regional capacity

In many regions, policy interventions aim at creating manufacturing jobs in renewable energy technologies in a very short time, creating a large and concentrated demand for components and installations hoping that the business community will immediately react to this opportunity. Often, rural economies struggle to generate the institutions and accumulate the knowledge to meet this demand in time. Small local labour markets, "sticky" skills, and a lack of intermediate institutions to co-ordinate collective action may force rural regions to rely on workers and investors from outside the region. In this way, long-term impact on regional development path is limited, external investors absorb most of the benefits generated by the public investment or subsidies, and the long-term impact on rural development is very limited, despite the cost of the policy.

Moving beyond subsidies

Where renewable energy deployment in rural areas is largely incentive-driven, it is unclear if deployment levels can be maintained once current public incentives are phased out. In this context, specialisation in the production of renewable energy responds to the economic opportunities associated with public incentives, rather than a demand for additional energy. Extremadura, Spain, and Puglia, Italy, have only specialised in solar energy (photovoltaic and concentrated solar power) because of the high feed-in tariffs provided by central government between 2008 and 2010. It seems that public incentives are not catalysing a regional specialisation, but rather entirely supporting it. There is the risk that rural economies enjoying the "boom" of renewable energy might experience a "bust" once public support expires. In this case, the policy question is how to orient and use public support in a way that can trigger regional specialisation without creating long-term dependence on public money.

Another problem is that public incentives do not always take into account the maturity of the renewable energy technology being promoted, thus raising deployment costs. Some technologies, like wind turbines, are now mature and relatively stable in terms of innovation. This means that the cost of installations has reached its peak and will now begin to decline. Some other technologies, such as photovoltaic or concentred solar power, are still relatively immature; the potential for breakthrough innovations could dramatically affect the efficiency and cost of installations. These differences should be taken into account when designing incentives for alternative energy. For instance, the level of feed-in tariffs (which compensate producers with a stable – and relatively high – price for the renewable energy they produce) can be set for longer periods for a stable technology, but should be used cautiously for immature technologies, where it is expected that future cost-reducing innovations will make current feed-in tariff rates extremely profitable. Otherwise there is a risk – which has occurred in more than one OECD country – of triggering massive, rapid deployment, which in turn increases overall energy costs and may consequently reduce social acceptance of installations. It may be more efficient for the public sector to subsidise investments in new technology and let markets determine which technologies are cost-effective.

High subsidies to renewable energy often affect relative prices at regional level in unintended and sometimes undesirable ways, such as intensifying competition for natural resources and other inputs (see inset box).

Some intensive renewable energy installations can compete with tourism activities. While wind turbines can be compatible with farming activities, their impact on landscape can be intense. In reality it is very difficult to assess the real impact of wind turbines on landscape values in an objective way. To some, they are a symbol of sustainable development – to others, a blot on the landscape. None of the case studies revealed clear damage caused by renewable energy installations to tourism, but this could also depend on the relatively short research period (two years) and on the lack of precise information. One of the problems is that wild, remote, scenic areas often tend to also be windy and sparsely populated. In this context, overly high subsidies to wind energy could shift the balance in favour of wind power, despite local opposition of local communities and the potential damage to tourism activities.

In Puglia (Italy), high national feed-in tariffs for photovoltaic energy encouraged farmers to install PV panels on their agricultural land. A one-hectare photovoltaic field could generate up to EUR 5 000 per year (virtually without any risk), representing a higher income than could be earned from farming, requiring fewer inputs and lower risk. The large uptake by farmers and rural communities reduced the available agricultural land and also absorbed part of the local water resource.

Dealing with the mismatch between renewable energy and transmission infrastructure policy

The electricity grid is a fundamental factor in a rural region's ability to benefit from renewable electricity (and even biogas, in gas grids). But in many cases, there is no co-ordination between renewable energy deployment and grid improvements. Transmission and distribution are still designed to convey electricity produced by a few large centralised power plants and cannot accommodate small-scale and localised generation. This has multiple effects on renewable energy deployment in rural regions. In general, it favours large installations over small and diffused plants. Limited grid capacity makes it very difficult to use renewable energy, even if the area is rich in renewable sources of energy and high feed-in tariffs. Thus regions already specialised in power generation may be at an advantage when it comes to renewable energy development. In both Puglia and Scotland the electricity grid cannot absorb any additional capacity, thereby stalling any expansion of renewable energy supply or requiring costly on-site storage or demand management.

Who bears the cost of transmission grid expansion is a crucial issue. Maintaining the electricity grid is generally a shared responsibility, with nation-wide bodies overseeing the (high-voltage) transmission lines and regional bodies responsible for the (low-voltage) distribution networks. Renewable energy is already more expensive than conventional power in most situations. Since most consumers lack a strong willingness to pay for renewable energy, if the costs of connecting renewable energy generation to the grid are borne by the generator, then renewable energy will be less competitive. This will reduce the amount of energy produced. But if the costs are not at least partially borne by generators, then too much will be spent on building transmission capacity to connect high-cost power and the resulting high cost of energy will have adverse economic development effects across all regions.

Many rural areas have surplus renewable energy resources, while urban areas lack sufficient space and resources to meet their energy needs through renewable energy. Without sufficient grid capacity to transport electricity from rural regions to urban consumption centres, many projects will struggle to find funding, as their revenue potential is limited to local demand. In some instances, rural areas may prefer to concentrate on meeting local demand before connecting to a grid. Another option would be to use high feed-in tariffs to cover part of the cost of developing a "smart" and diffused grid.

Dealing with public opposition

In a number of rural regions a top-down and large-scale approach to renewable energy is causing communities to oppose installations. The bad feeling created can then go on to undermine the development of other, more appropriate initiatives in the future. Often, policy makers have tried to simplify renewable energy

policy by putting a focus on large scale installations and a limited number of key actors supported by automatic incentives. However, viewing renewable energy through a lens of "hard" industrial policy limits the ability of hosting communities to feel some ownership for the interventions and share in the overall vision. Moreover, with this type of policy many hosting communities feel they have to deal with all the negative consequences while the investors and workers from outside the region get all the benefits. Many hosting communities have started opposing renewable energy installations and to vote against further deployment (in Fryslân, the Netherlands, public opposition means it is no longer possible to deploy new wind installations despite the region's abundant wind).

Renewable energy policy must do more to take into account the demand for more active participation by rural dwellers. Citizens demand direct involvement in key decisions about their territory, particularly when they concern large installations or infrastructure. With the right environment, however, they can get organised and play a more active role in the governance of renewable energy deployment (see below).

Measuring the impacts on regional economies

While CO_2 emissions and electricity generation can be calculated with relative precision, it is challenging to assess the impact of renewable energy deployment on economic development. One of the reasons is the lack of data for calculating the net impact in terms of jobs at the regional level. The indirect jobs generated by renewable energy spin-offs such as manufacturing are rarely taken into account in national and regional statistics on renewable energy and jobs. Likewise, datasets concerning economic activities are still missing an environmental, or "green", dimension. This lack of information means that public authorities still consider economic development as an automatic or implied benefit of renewable energy deployment, without having the evidence to confirm this is happening or the policy frameworks to make sure it does. Lack of information also limits the ability to evaluate (and then adjust) policies while they are implemented. In the same vein, very high expectations in terms of jobs created by renewable energy can bias the evaluation of the policy. Good results may seem disappointing if expectations had been too high to start with.

Putting renewable energy to work in rural areas

These findings underline the need for a shift in the approach to rural development policy in many OECD countries away from a model that emphasises sectoral policy and subsidies, to one that is place-based and grounded in local conditions and opportunities and that focuses on the competitiveness of rural areas. Specific factors to bear in mind include the following:

Develop a "place-based" approach that combines renewable energy with rural development

National policies, such as for climate change mitigation, set uniform targets without much concern for the potential of different regions to achieve them. There tends to be little flexibility in the goals and standards assigned to lower levels of government. Yet it is clear that different regions have different capacity for producing different types and levels of renewable energy. In this context, assigning uniform targets may impose higher economic costs than necessary. If all regions have to reduce the use of fossil fuels by the same percentage it is possible to argue that the burden of adjustment is being assigned equally. But this approach ignores both differences in capacity and differences in adjustment costs. If the main objective for introducing renewables is to reduce climate change, then it should not matter where reductions in fossil fuel use occur, as long as they do occur. Supporting those regions with the greatest potential for renewable energy is more cost-effective than forcing all regions, even those who face huge hurdles in shifting from fossil fuel dependence, to do so. This means that more care has to be taken in identifying those places with the greatest potential for renewable energy, rather than adopting policies that somewhat arbitrarily spread renewable energy projects across national landscapes.

The OECD has been developing a new policy paradigm for rural regions (known as the NRP). This new rural development policy approach is place-based and grounded in current rural conditions and opportunities in rural areas (Table 2). It moves away from a traditional rural development policy model that emphasises agricultural policy and subsidies. The NRP has four dimensions: a focus on competitiveness; adopting an investment over subsides approach; widening the scope of the rural economy beyond agriculture; and, expanding the governance framework to ensure that policy decisions are taken and considered at the appropriate level of government. Another important policy trend in the NRP is mainstreaming rural development issues within a broader policy framework, often accompanied by "rural proofing". Several sectoral policies have a considerable impact on rural development. Therefore it is important to assess this impact and adjust or (*i.e.,* "rural proof") sectoral policies accordingly. It is clear that the capacity to implement rural proofing depends on the visibility and authority of rural development policy *vis-à-vis* the other lines of policy involved in the renewable energy deployment.

Table 2. The new rural paradigm

	Old approach	**Modern approach**
Objectives	Equalisation, farm income, farm competitiveness	Competitiveness of rural areas, seeking value from local assets, exploiting unused resources
Key target sector	Agriculture	Various sectors (rural tourism, manufacturing, ICT industry, etc.)
Main tools	Subsidies	Investment
Key actors	National governments, farmers	All levels of government (supra-national, national, regional and local), various stakeholders (public, private, NGOs)

Source: OECD (2006), *The New Rural Paradigm: Policies and Governance*, OECD, Paris.

For renewable energy to work for rural areas, this place-based approach could help by harmonising the drivers of renewable energy deployment; profiting from the interactions between renewable energy and rural industries; and promoting an inclusive governance system that affects long-term social acceptance and ownership.

Embed rural energy strategies in the local economic development strategy

Environmental and energy security arguments tend to be the main drivers for renewable energy, and the local economic benefits tend to get overlooked. These latter are critical for ensuring the sustainability in renewable energy in the medium to long term. There is need for a well-designed regional framework that can reconcile policy trade-offs and identify potential complementarities among different drivers. A policy approach that seeks to co-ordinate the various sectoral policies affecting a place is more likely to achieve coherent, multi-sector policy outcomes than one relying on economy-wide policies that are "spatially blind", though not always spatially neutral (OECD, 2011).

Embed renewable energy in rural economies

The research demonstrates that economic development is not an automatic outcome of the renewable energy policy. Jobs are not created by simply setting high subsidies for developers. Renewable energy works best when it develops functional linkages with core rural businesses, in particular agriculture, forestry, traditional manufacturing and green tourism. Renewable energy has to "have a job" within rural economies. This golden rule should be respected regardless of whether renewable energy is deployed for environmental and energy reasons or mostly to create new employment opportunities.

We found a few cases of renewable energy being well integrated into rural development. In these regions several things stand out (see inset box for one example):

Finland: putting renewable energy to work

North Karelia region in Finland is a forerunner in the field of sustainable energy, which accounts for 63% of total regional energy use. RE deployment has created effective development opportunities for local businesses while contributing to energy security, climate change mitigation and reduced heating costs. The large demand for biomass energy has benefited local business. Between 2004 and 2008, turnover and employment in the renewable energy sector grew by about 30%, which had a turnover of about EUR 200 million in 2010, and there are now 120 companies specialised in bioenergy. Rural energy deployment involves a multitude of regional actors. There are 22 000 non-industrial forest owners in the region and many of them produce woody biomass. The co-operatives who dominate the forest industry play a key role, providing small forest owners with information on the most profitable way to collect and put biomass on the market, and reducing transaction costs and facilitating collective action. Some of these co-operatives have entered the business of district heating systems to take advantage of the woody biomass they produce. Regional district heating systems are often based on small-scale installations with a limited impact on the environment and landscape. This improves social acceptance in a region where landscape amenities are increasingly linked to a successful tourism industry. Furthermore, the technology they use is in line with the skills available in the region, which can easily absorb investment in this sector.

- The renewable energy strategy is mainly driven by local concerns and not national policy. This means that the choice and scale of projects reflects local opportunities.
- The projects are mainly oriented to serve local demand. While energy export opportunities may exist, communities recognise that energy exports are commodity markets where viability ultimately depends upon having the lowest delivered cost of power.
- There is only limited reliance on subsidies to cover operating costs, and the focus is on relatively mature technologies, such as heat from biomass, small scale hydro and wind.
- The projects tend to have emerged locally and are managed by local networks such as co-operatives and other forms of intermediate institutions.

Use inclusive governance to ensure social acceptance

Our research found several examples of deployment being supported by inclusive governance, even where the renewable energy policy was mostly top-down. The key to success seemed to be key intermediate institutions – such as co-operatives, local governments, and universities, for instance – can disseminate clear and reliable information to the local community, can put democratic mechanisms in place to allow rural people to influence key decisions about renewables, and can co-ordinate activities. Intermediate institutions – which operate in between national/regional governments and individuals/firms – play an important role in solving market failures and promoting collective action. Intermediate institutions can adapt national policy interventions to the characteristics of a local community. They can also be important for promoting social acceptance for renewable energy (see Abruzzo example in inset box). They can also help local communities capitalise on technologies that involve a large number of actors but that require co-ordination, such as the Finland example in the box above.

Intermediate organisations in Italy

In Abruzzo, local governments play a key role within RE policy. Because of the close involvement of local communities, RE installations are usually scaled to fit the local landscape without causing a dramatic and sudden change. This is also explained by the presence of vast protected areas and explicit regional guidelines to preserve the landscape from a purely aesthetic point of view. As a result, RE deployment has occurred at a relatively slow (but constant) pace, unlike the "gold rush" mentality observed in other case studies

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In many OECD countries, governments have invested large amounts of public money to support renewable energy (RE) development and are requiring significant quantities of it to be sold by energy providers. But what are the economic impacts of these policies on the rural regions where deployment takes place? How can RE bring the greatest benefit to host regions? These are some of the questions explored by this study. Drawing on case studies in 16 regions within 10 countries, the research finds that while RE indeed represents an opportunity for stimulating economic growth in rural communities, its development benefits are not automatic. Realising them requires a complex and flexible policy framework and a long-term strategy, as well as a realistic appreciation of the potential gains from RE deployment. Making a positive connection between RE development and local economic growth will require more coherent strategies, the right set of local conditions, and a place-based approach to deployment. (www.oecd.org/rural/renewables).

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