Just transition pathways in major coal economies

Insights from the Coal Transitions research project

Jesse Burton

EERC
ENERGY RESEARCH CENTRE
University of Cape Town

COAL TRANSITIONS
www.coaltransitions.org
Coal transitions are already happening

Coal dependent regions are not always prepared for the pace and scale of change that they face

Not having transition support is also a policy choice
Protecting livelihoods and creating decent work
Building inclusive & resilient economies
What is needed?

- Support for national and sub-national entities to engage in social dialogue and to design institutions to explore context-specific vulnerabilities and economic resilience opportunities in coal dependent areas
- Macroeconomic analysis of the effects of climate policies needs to be supplemented by sector-specific and microeconomic assessments of local impacts on workers and communities and new possibilities
- Political and economic analysis of who bears the costs and benefits of the transition, contextual factors defining potential interventions, and the role of finance in mitigating the impacts of a disorderly transition are important areas of further research
- Reallocation of resources (eg from fossil fuel subsidy reform)
Fossil fuel subsidy reform and investment in social protection – lessons for a Just Transition

Laura Merrill
3rd December 2018
Katowice
lmerrill@iisd.org
Countries where GSI works

Countries where GSI has worked 2015-2017

[Map showing countries where GSI has worked 2015-2017]
Case studies from transition in the coal sector IISD

FFSR and investment in social protection – lessons for the Just Transition from Indonesia, Laura Merrill Dec 3rd, 2018
Countries where there have been reforms

In 2015-2017, at least 40 countries undertook some level of fossil fuel subsidy reform

Sources: GSI research, World Energy Outlook 2016, IEA and GIZ data
FFSR and SDGs

Global fossil fuel subsidies could finance the global energy access funding gap 7.5 times over.

$425 BILLION IN 2015

$56 BILLION PER YEAR UNTIL 2036

Fossil Fuel Subsidies
Universal Energy Access

Getting on Target:
Accelerating energy access through fossil fuel subsidy reform

© 2020 International Institute for Sustainable Development | IISDergylit

FFSR and investment in social protection – lessons for the Just Transition from Indonesia, Laura Merrill Dec 3rd, 2018
Indonesia fossil fuel subsidy reform

- Subsidy size and scale
- Process of reform
- Mitigation of price increase measures
- Reinvestment of savings measures
- Climate co-benefits of FFSR
Strategy for reform and phase out

- **Get Prices and the Policies right**
  - Remove subsidies and appropriate taxation
  - Coal phase out or moratorium

- **Build Support**
  - Cross party support
  - Local constituencies

- **Manage the Impacts**
  - Community training and investment
  - Planned transition

**KEY**
- Political mandate and internal organization

**Getting the Prices Right**
- Explore options for pace and change of pricing system: gradual vs. “big bang,” strategic timing, consider the four dimensions of pricing

**Building Support for Reform**
- Consultations: map stakeholders, gauge views

**Managing the Impacts of Reform**
- Communications: general awareness raising
- Project impacts and explore mitigation options: direct and indirect impacts, mix quantitative and qualitative approaches, consider the three types of mitigation measure

**Demand Side: Consumers**
- Cross party support
- Local constituencies

**Supply Side: Producers**
- Community training and investment
- Planned transition
Indonesia: subsidies compared to social spending

- Regular price adjustments, at first to 50% (Wahid) and then 75% (Megawati) of market prices
- Monthly formula-based pricing system introduced
- System disbanded
- Ad hoc price increases, Mar & Oct
- Diesel subsidies for industry removed
- Unconditional cash transfer (BLT) used for first time, Oct
- Ad hoc price decreases, Dec & Jan
- BLT used
- New formula-based pricing system, Jan, monthly changes, not applied from Mar
- Ad hoc price increase, Jun
- Improved BLT (BLSM) introduced
- Ad hoc diesel price decrease, Oct

- Regular price adjustments, at first to 50% (Wahid) and then 75% (Megawati) of market prices
- Monthly formula-based pricing system introduced
- System disbanded
- Ad hoc price increases, Mar & Oct
- Diesel subsidies for industry removed
- Unconditional cash transfer (BLT) used for first time, Oct
- Ad hoc price decreases, Dec & Jan
- BLT used
- New formula-based pricing system, Jan, monthly changes, not applied from Mar
- Ad hoc price increase, Jun
- Improved BLT (BLSM) introduced
- Ad hoc diesel price decrease, Oct

Social assistance capacity changes ("complementary")

- ...some targeted...
- ....some diffuse...
- Intro of good new welfare tools is biggest threat to opp.?
- Any welfare policy has its own pol. econ., e.g. min. wage, UCTs
Indonesia: Reforms, with targeting and poverty reduction

The number of poor decreased 4.8 million in 5 years

One of episodes with most dramatic decrease in number of poor since 1998 Asian Financial Crisis

POVERTY IMPACT

32.53
32.53

27.73
14.15%
10.96%

2009
2014

Number of poor (million)

Poverty rate (%)

JUNE 2013

June 21, 2013 the price of gasoline rose from Rp.4.500 to Rp.6.500 while the diesel from Rp.4.500 be Rp.5.500.

NOVEMBER 2014

November 2014 premium gasoline price rose from 6,500 into Rp.8,500 while diesel from Rp.5,500 be Rp7,500.

UDB include names and addresses of bottom 40% of Indonesian population (~96 million individuals)

40%
35%
25%

PBI-JKN (Health Insurance for the Poor)

UCT, Education, Rice

Poverty Line (September 2016)

CCT Program (PKH)

Exclusion Error

Inclusion Error

# of Households:
25,771,493

# of Families:
27,046,374

# of individuals:
93,026,921


Effectively since November 2014, the fuel subsidy as close to zero...
Savings from fuel subsidies Indonesia, 2015

Fuel subsidy savings in 2015 allowed to major investments in social welfare and infrastructure through increased budgets for ministries, state-owned enterprises and transfers for regions and villages.

IDR 211 trillion: Money Originally Allocated to Fuel Subsidies in 2015: IDR 2011 (10% of Total State Expenditure).

IDR 631 trillion to state-owned enterprises, largely for investment in infrastructure

IDR 24.7 trillion to regional transfers and villages

IDR 148.2 trillion increase for ministries, linked to special programs to boost growth and reduce poverty

Coal Phase Out: UK

In the UK, *inward investment* promoted job creation in other industries.

- **Coal workers**: 250,000 in 1976, 2,000 in 2015
- **Coal production**: 124 M tonnes in 1976, 4 M tonnes in 2015

UK Department for Business, Energy & Industrial Strategy, Coal statistics
Coal Phase Out: UK, South Wales

**Strengthen local economy**
- Focus communities + local suppliers
- Diversification
- Local entrepreneurs
- Retraining
- Higher education + business

**Improve physical infrastructure**
- Prioritize infrastructure needs
- Recognize opportunities from landscape as an asset for tourism and outdoor activities
- Improve and manage housing stock

**Community cohesion**
- Welfare
- Cultural identity
- Strategic government support

**Good institutional support**
- Long term
- Clear institutions for inward investment
- Specialist body for regional investment
- Right people
Lessons learned: Be prepared

- Planning
- Compensation, safety nets and an organised package of mitigation measures
- Long term regional investments into poverty reduction and infrastructure
- Retraining
- Communication
## Challenge One: Different Motivations, Different Conceptions

### Motivation

<table>
<thead>
<tr>
<th>Political</th>
<th>Ethical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain support from those harmed by transition</td>
<td>People harmed by CC policy should be compensated</td>
</tr>
</tbody>
</table>

### Concept of Just Transition

<table>
<thead>
<tr>
<th>Transitional</th>
<th>Transformative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic system is unchanged; only energy source changes</td>
<td>Economic transformation along with changes in how energy is produced and used</td>
</tr>
<tr>
<td>FF workers should be compensated and retrained</td>
<td>Not just workers but also fenceline communities are part of this: Equity is a top concern</td>
</tr>
<tr>
<td>More narrow strategy, focuses on FF workers and FF-centered communities</td>
<td>Broad strategy, coalitions of EJ, social justice, economic justice</td>
</tr>
<tr>
<td>JT brings allies on board for CC action</td>
<td>CC action is embedded in larger movement for justice</td>
</tr>
</tbody>
</table>
Challenge Two: Who to include within the JT boundaries?

1. Fossil Fuel (FF) workers (direct workers)
2. Supply chain workers (indirect workers)
3. Communities built or centered around a FF industry
4. FF workers in other countries or outside of the policy zone
5. “Fenceline communities” who are currently suffering from pollution and other harms from a FF-based economy

→ Who gets included in policy is related to whether model is “transition” or “transformation”

→ If policy research and implementation does not explicitly identify the boundaries, they will implicitly be decided.
Challenge Three: Organized labor can be support or opposition

- In U.S., some industries (e.g. Steelworkers) support JT, while other industries (e.g. United Mine Workers) are opposed to all CC action
- Even within supportive unions, support varies. Four relevant factors:

<table>
<thead>
<tr>
<th>More Support</th>
<th>Less Support</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>Younger workers may need to retrain/relocated</td>
</tr>
<tr>
<td><strong>Skill</strong></td>
<td>Industry-specific skills (e.g. oil rig operators) make it harder to find new job</td>
</tr>
<tr>
<td><strong>Compensation</strong></td>
<td>Higher-wage workers may find it hard to find similar well-paying job</td>
</tr>
<tr>
<td><strong>Union Leadership</strong></td>
<td>More conservative union leaders who want to block all CC action</td>
</tr>
</tbody>
</table>
**Examples and Strategies for Success**

**Transitional Program**, based on successful examples (e.g. nuclear decommissioning) and avoiding the mistakes of unsuccessful experiences (e.g. Trade Adjustment Assistance)

1. Pension guarantees
2. Job guarantees (in Clean Energy, other industries, or gov’t as employer of last resort)
3. Generous income support, retraining/education and relocation support
4. Support for communities (who rely on FF worker spending and/or tax base)

**Two Transformative Examples:**

**“Reinvest in Our Power”**
Collaboration of groups, including CJA, addresses inequity and democratizes wealth. Divests from FF companies; invests in a democratically-governed and cooperatively owned financial institution that makes loans to advance ecological restoration and community ownership.

**“NY Renews,”** a coalition of over 100 groups, working to advance legislation in NY State that would charge a “polluter fee” and use the revenues to invest in clean energy in disadvantaged communities and to support funding for FF workers and communities impacted by the clean energy transition.
REGIONAL DISTRIBUTION EFFECTS OF THE ENERGY TRANSITION IN GERMANY

Dr. Ulrike Lehr, Philip Ulrich, Institute of Economic Structures Research
Regional distribution – why does it matter?

► Identify „winners and losers“
► Tailor policies and strategies accordingly
► Enhance acceptance

Our contribution: Regional distribution of gross effects of renewable energy deployment and net effects of the energy transition

Where are new job opportunities?
Who bears the burden of new installations?
Where are jobs lost?
Gross effect in the federal states

- There is gross employment in all federal states for all energy sources and technologies.
- Relative to the size of the federal states, there is a strong concentration in the north and east.
- Wind energy is the most important pillar in almost all federal states, followed by bioenergy.
Gross effect in the federal states

- Since 2014, RE employment has developed positively, especially in those federal states,
  - where wind industry sites are present and stable
  - where PV industry was scarce in 2014
  - where strong deployment has taken place (most recently mainly wind turbines)

- Operation & maintenance is playing an increasingly important role, so federal states that already have a high per capita RE shares can expect a relatively stable development.
Net regional effects of the energy transition

► Which dimension of the cause-and-effect relationship is regionally differentiated and which can be mapped?
  ➡ Economic structures and structural change
  ➡ Distribution of energy sources in power generation
  ➡ Investment stimuli
  ➡ Region-specific multipliers (domestic shares and intermediate inputs, induced effects)

► Region-specific reactions to prices or savings?
  ➡ Different behavioral equations

► Regionalization of net effects requires integrated modelling
Results and conclusions 1/2

► The scenario comparison shows positive effects on value added and employment in all federal states at different levels.

► Structural differences in economic development in the federal states interact with effects at the national level.

► Structurally weak federal states with a high share of renewable energy experience stronger positive effects, while city states show slightly less positive effects.

► Construction sector profits from energy efficient buildings mainly in:

  ➔ regions with high relevance of the construction sector and
  ➔ regions with labor-intensive construction sector and
  ➔ regions with a high price level in construction
Results and conclusions 2/2

- Scenarios consider the whole set of measures for energy transition – renewable energy deployment AND energy efficiency

- Counterbalancing effects

- BUT: people who loose jobs in coal mining not necessarily find jobs in energy efficiency

- Transition programs, training, structural change support is necessary.
Thank you for your attention.

Dr. Ulrike Lehr
T +49 (0) 40933 - 280
E lehr @ gws-os.com
Head of division energy and climate
Regional distribution effects of the energy transition in Germany

Dr. Ulrike Lehr, Philip Ulrich, Institute of Economic Structures Research

1: Regional distribution – why does it matter?

The transition to a sustainable energy system is often discussed on the national level and overall economic effects are determined. The underlying pattern of regions or federal states or any other subunit is quite often neglected. For the acceptance of the transition in the population, the consideration of regional aspects, however, is essential. The due consideration requires measurement and modeling to have a quantitative, science-based decision-making background. Thus, analyzing the regional distribution helps to

- Identify „winners and losers“
- Tailor policies and strategies accordingly
- Enhance acceptance

Our contribution to this discussion are here: Regional distribution of gross effects of renewable energy deployment and net effects of the energy transition. With this, we are aiming at answering the following questions:

- Where are new job opportunities?
- Who bears the burden of new installations?
- Where are jobs lost?

The Analysis consists of two parts: a model of gross regional effects of renewable energy (RE) deployment in Germany and an analysis of net economic regional effects of the whole Energiewende, the German energy transition.

2: Gross effects from RE deployment

There is gross employment in all federal states for all energy sources and technologies. The distribution follows the strengths of the respective federal state. It considers the whole value chain, including direct and indirect employment effects. Installation and manufacturing of the RE system is analyzed separately from operation and maintenance. The former lead to employment, if the sub-state has a producer of systems or components or installs new systems each year. The latter employment derives from systems already installed and in operation. The permanency in employment from the latter is higher. Relative to the size of the federal states, there is a strong concentration of employment in the north and east. Wind energy is the most important pillar in almost all federal states, followed by bioenergy.
Since 2014, RE employment has developed positively, especially in those federal states, where wind industry sites are present and stable, where PV industry was scarce in 2014 or where strong deployment has taken place (most recently mainly wind turbines).

The analysis of gross effects helps to compare the status of different federal states, but a net analysis has to be carried out to complete the picture. Regional net effects are methodologically challenging, in particular need the following questions to be answered:

Which of the following dimensions matter and can be mapped

- a. economic structures and structural change
- b. distribution of energy sources in power generation
- c. investment stimuli
- d. region-specific multipliers (domestic shares and intermediate inputs, induced effects)
- e. region-specific reactions to prices or savings?

A first attempt at this challenge regarding the energy transition in Germany has been successfully completed. With the developed modeling framework, a scenario comparison can be carried out, comparing the energy transition (RE and energy efficiency) with a contrafactual scenario without any particular investment in neither RE nor energy efficiency.

The results are as follows: The scenario comparison shows positive effects on value added and employment in all federal states at different levels. Structural differences in economic development in the federal states interact with effects at the national level. Structurally weak federal states with a high share of renewable energy experience stronger positive effects, while city states show slightly fewer positive effects. The Construction sector profits from energy efficient buildings mainly in regions with high relevance of the construction sector and regions with labor-intensive construction sector and regions with a high price level in construction.

The scenarios consider the whole set of measures for energy transition and therefore positive and negative effects counterbalance, so that the overall effect on employment is positive or negligible. However, people who lose jobs in coal mining not necessarily find jobs in energy efficiency. Energy transition strategies therefore need the respective transition programs, training, structural change support is necessary. In Germany, the Coal Commission will publish suggestions early 2019.
5 Lessons for a Successful Transition to a Low Carbon Economy

LUCY STONE | Agulhas Applied Knowledge
1 | Job retraining and skill development
2 | Financial compensation (e.g. early pension) who workers cannot retrain or relocate

Former oil workers retrained in offshore wind | Scotland

Former coal miners learning to code | Appalachia, United States
3 | Regional support schemes for developing alternative sectors, and state creation of new public sector jobs

Heavy industry to high tech | Shenyang City, China

Lignite Mining to Tourism | Lausitz, Germany
4 | Infrastructure investment, new cultural identities created

Post-industrial city in decline, to iconic Museum as popular tourist destination | Bilbao, Spain
5: Stakeholder participation, dialogue and co-creation

Coal dependent community to solar industry | Port Augusta, Australia

Oil sands workers formed Iron & Earth organisation | Alberta, Canada

Oilsands workers supporting renewable energy
## Employment in 2030 associated with energy sustainability, compared with the business-as-usual scenario (millions)

<table>
<thead>
<tr>
<th>Sector</th>
<th>Jobs created</th>
<th>Sector</th>
<th>Jobs lost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>6.5</td>
<td>Petroleum refinery</td>
<td>-1.6</td>
</tr>
<tr>
<td>Manufacture of electrical machinery and apparatus</td>
<td>2.5</td>
<td>Extraction of crude petroleum and services related to crude oil extraction</td>
<td>-1.4</td>
</tr>
<tr>
<td>Mining of copper ores and concentrates</td>
<td>1.2</td>
<td>Production of electricity by coal</td>
<td>-0.8</td>
</tr>
<tr>
<td>Production of electricity by hydro</td>
<td>0.8</td>
<td>Mining of coal and lignite; extraction of peat</td>
<td>-0.7</td>
</tr>
<tr>
<td>Cultivation of vegetables, fruit, nuts</td>
<td>0.8</td>
<td>Private households with employed persons</td>
<td>-0.5</td>
</tr>
<tr>
<td>Production of electricity by solar photovoltaic</td>
<td>0.8</td>
<td>Manufacture of gas; distribution of gaseous fuels through mains</td>
<td>-0.3</td>
</tr>
<tr>
<td>Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods</td>
<td>0.7</td>
<td>Extraction of natural gas and services related to natural gas extraction, excluding surveying</td>
<td>-0.2</td>
</tr>
</tbody>
</table>

Source: ILO calculations based on Exiobase v3.
For a transition to be just, regulatory frameworks and social dialogue are vital

**International labour standards:**
- Facilitate the green transition;
- Protect the most vulnerable (workers affected by the transition, in green sectors, and displaced by climate change);
- Ensure equity and inclusion, incl. through social dialogue; and
- Protect the environment.

**Social dialogue:**
- Both workers and employers are increasingly recognized as “climate actors”.
- Social dialogue can help to put into action environmental policies, plans and actions within an enterprise.
- Social dialogue can prevent and reduce the environmental impact of enterprises.
- More and more negotiated agreements include environmental clauses.

**A key role for national legislation is to reconcile economic, social and environmental objectives:**
- Examples: legislation in Brazil, France, Mexico, Philippines, etc.;
- A visible trend to include labour issues in climate legislation and policy.
Social protection supports mitigation and adaptation efforts

Environmental degradation and climate change

- Disasters and loss of ecosystem services
- Green policies which lead to structural changes

Income insecurity and health risks

- Income insecurity due to job losses (in specific sectors)

Adaptation

Mitigation

Need for social protection measures

- Unemployment benefits
- Cash transfers
- Public employment programmes (PEP)
- Payment for ecosystem services (PES)
Without skills development there will be no just transition

Benefits:
- Fundamental driver of green transition
- Productive employment and decent work
- Virtuous cycle of innovation, investment and competitiveness

Challenges:
- Lack of systematic skills needs identification for green transition
- Unsuccessful policy coordination
- Participation of social partners

**Case study: Energy sector**

Indonesia: Number of graduates certified as energy managers and auditors, 2012-16

**Graph**

- Industrial energy manager
- Construction building energy manager
- Energy audit
- Construction building energy audit

Assessing Ambition and Inclusiveness of Different Just Transition Approaches
Just Transition Research Collaborative

Qualitative mapping of Just Transition, its history and different approaches

- Report:  
  http://www.unrisd.org/jtrc-report2018

- Online Forum:  
  medium.com/just-transitions
Differing Levels of Ambition

- Narrowly defined compensation of affected workers
- Enhancing workers’ rights, social protection, distribution of benefits and costs
- Addressing inclusive/equitable decision making, procedural justice
- Fundamental overhaul of existing economic and political system for eco-social justice
Who Deserves a Just Transition?
Outlook

- Meanings of justice are not trivial – requires bargaining and contestation
- Rapid decarbonization needs supportive and ambitious policy framework and recognizing impacts of response measures
- Silesia Declaration – important step for tackling justice implications of transition
Thank you for your kind attention!

Follow us @JTRC2018

Side Event tonight: 18:30 – 20:00, Room Vienna at EU Pavilion
The Price to Pay for Lignite and How To Take Just Transition to The Next Level
SOCIAL AND ECONOMIC RISKS OF ENERGY TRANSITION IN POLAND

Jan Witajewski-Baltvilks
Consumption of coal expected to drop

Electricity mix minimizing the cost of generation

Electricity mix permitting a 3-fold reduction in CO2 emissions

Source: Witajewski-Baltvilks et al. (2018a)
Drop in consumption implies phase-down of coal sector, unlike in most EU countries.

Coal phase-down will take 30 years – no massive lay-offs expected

Source: Witajewski-Baltvils et al. (2018b)
Cushion for the regional economy

- Educational policy: direct new cohorts to growing sectors
- Help laid-off workers to find new jobs
  - 10,000 additional jobs in Silesia may be created with ambitious retrofitting programmes
  - individual skill diagnoses will ensure that workers receive tailor-made retraining
- unconditional cash transfers should be offered only to workers close to retirement age
Thank you

For more details, consult

• Witajewski-Baltvilks et al. (2018a). Risks associated with decarbonising the Polish power sector. *IBS research report 05/2018*

• Witajewski-Baltvilks et al. (2018b). Managing coal sector transition under the ambitious emission reduction scenario in Poland. *IBS research report 03/2018*

Email address:
Jan.witajewski@ibs.org.pl
Systems approach towards Just Transition:

the case of Upper Silesia

Maciej Bukowski, President of WiseEuropa Institute

Katowice, 03/12/2018
Long-term outlook for Silesian mining

- **Stagnating extraction productivity**, growing wage pressure and NIMBYism → **further decline of mining, even without ambitious climate policy**

- **Double challenge**: mid-term worker surplus vs long-term labour shortage

**Coal extraction**

- New mines (gov declarations)
- Coking coal
- Steam coal

**Employment, thousands of people**

Source: WiseEuropa – own projections
Mining and industrialisation in Silesia

Share of mining and manufacturing in gross value added in Silesia

Efficiency of hard coal extraction

➢ Decline of mining activities did not translate into deindustrialisation of Silesia

Source: WiseEuropa based on Local Data Bank – Central Statistical Office

Source: WiseEuropa based on Eurostat data
What drives industrialisation in European regions?

**Industrialisation vs manufacturing share in total industry in the EU regions**

**Share of key subsectors in manufacturing employment**

- **High industrialisation is driven by manufacturing, not resource extraction**

---

Source: WiseEuropa based on Eurostat data
Risk factor: demographic decline in mining communities

Change in total population in Poland and Silesia

- 2000-2017 (data)
  - Poland: 0.5%
  - Silesia - mining communities: -8.3%
  - Rest of Silesia: 0.0%

- 2000-2030 (projection)
  - Poland: -1.6%
  - Silesia - mining communities: -16.1%
  - Rest of Silesia: -2.7%


- Half of the Silesian population lives in mining communities
- Demographic trends worsen the risks associated with “stranded” workers
- Focus on attracting and retaining inhabitants – complex revitalisation, mitigating air pollution
Thank you for your attention

maciej.bukowski@wise-europa.eu
Decarbonisation pathways and just transition

3 Dec 2018 – COP 24 Katowice
## Direct electrification results by scenario

<table>
<thead>
<tr>
<th></th>
<th>2015 Baseline</th>
<th>2050 Scenario 1</th>
<th>2050 Scenario 2</th>
<th>2050 Scenario 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total EU economy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EU economy</td>
<td>22%</td>
<td>80%</td>
<td>90%</td>
<td>95%</td>
</tr>
<tr>
<td>Direct electrification rate</td>
<td>22%</td>
<td>38%</td>
<td>48%</td>
<td>60%</td>
</tr>
<tr>
<td><strong>Total transport</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct electrification rate</td>
<td>1%</td>
<td>29%</td>
<td>43%</td>
<td>63%</td>
</tr>
<tr>
<td><strong>Total buildings</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct electrification rate</td>
<td>34%</td>
<td>45%</td>
<td>54%</td>
<td>63%</td>
</tr>
<tr>
<td><strong>Total industries</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct electrification rate</td>
<td>33%</td>
<td>38%</td>
<td>44%</td>
<td>50%</td>
</tr>
</tbody>
</table>
Different starting points in the energy transition

**REGIONAL PERSPECTIVES**

**2015 baseline – direct electrification rate**

**UK - Ireland:**
- Historical importance of gas in the UK and oil in Ireland
- Low share of aviation and marine within TFC mix
- High potential for electrification of some industrial sub-sectors

**Iberia:**
- Significant share of nuclear and renewables
- Highest share of marine in TFC vs. other regions, with challenging electrification

**France - Benelux:**
- Large share of nuclear compared to other regions, driving current electrification rates
- High share of international marine in Netherlands and Belgium, hard to significantly electrify before 2050

**Italy:**
- Historical development of gas infrastructure (e.g. CNG)
- Significant share of renewables in generation mix

**Germany and CE:**
- Governmental push towards a more carbon-neutral economy
- High reliance on fossil fuels in electricity generation
- High retail electricity prices vs. Europe
- Nuclear phase out of Germany

**Poland:**
- The ability to fully decarbonize the power sector will heavily depend on commercial ability of key transition technologies taking into account its highest relative investment burden related to 80% share of coal in the Polish power mix, coupled with one of the EU’s lowest GDP/capita levels (68% of EU av.)
- 75% share of coal in district heating serving 53% of population
- 20% share of energy-intensive industry in the Polish gross value added employing 15% of the workforce

**Nordics and Baltics:**
- Large amount of renewable resources and low electricity prices
- Specific policies and business initiatives driving further electrification being implemented in some Nordics countries
- Large share of district heating in buildings

**South Eastern Europe:**
- Significant reliance on fossil fuels
- Moderate electricity prices vs. rest of Europe

**2015 baseline – direct electrification rate**
European countries have different starting points in the energy transition

**2015 carbon intensity of electricity**, kg CO$_2$/MWh

- **0 – 200**
- **200 – 600**
- **600 – 1,000**
- **1,000+**

**Nordics, Austria and Switzerland with significant hydro resources**

Heavy dependence on coal. Nuclear phase out and high share of intermittent renewables.

France with a large nuclear fleet

Wind, nuclear and gas capacity. Coal phasing out

Wind, hydro and nuclear fleets, in addition to significant gas capacity across Iberia

Heavy current dependence on coal in Poland, and Southeastern Europe.

Gas provides large fraction of generation

---

1 Refers to carbon intensity of domestic electricity production, i.e. does not take into account the carbon intensity of electricity mix consumed

SOURCE: Eurostat and national statistics
Norway’s power sector is already decarbonized while Poland relies on coal for ~80% of its electricity supply

Different starting points

- European countries have very different starting points in the transition towards a carbon neutral power sector
- At one end of the scale, Norway has practically already decarbonized its power sector and has high potential to expand its renewable capacity due to untapped wind potentials and still some hydropower resources
- At the other end of the scale, Poland currently relies on coal for ~80% of its electricity supply and face a more disruptive transition to achieve carbon neutrality
- Countries’ starting points imply large differences in cost and the effort and pace of transition required

2017 generation by fuel type, TWh

<table>
<thead>
<tr>
<th></th>
<th>Hydro</th>
<th>Solar</th>
<th>Coal</th>
<th>Wind</th>
<th>Biomass</th>
<th>Oil/Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poland</td>
<td>3</td>
<td>15</td>
<td>131</td>
<td>0</td>
<td>0</td>
<td>1169</td>
</tr>
<tr>
<td>Norway</td>
<td>143</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>149</td>
</tr>
</tbody>
</table>

SOURCE: Enerdata
Poland's intention to keep 40% coal in the electricity mix implies lower renewables build and higher generation cost

Poland is currently discussing a policy to maintain 40% of coal in the energy mix by 2040. We have tested the implication of this policy through a sensitivity analysis that comply with this policy.

1 Does not include storage nor transmission & distribution cost
2 Includes also small amounts of geothermal, biomass and biogas
3 Estimated as the marginal cost of abatement multiplied by Poland positive emissions (over the periods); the actual CO2 cost will be highly dependent on the future market design and whether Poland can buy emissions allowances from other countries or if it needs to comply internally
OUR FUTURE IS AN ELECTRIC FUTURE
www.eurelectric.org