Global Warming

February 27, 2018

Agency for Natural Resources and Energy
Ministry of Economy, Trade and Industry
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<td>p.20</td>
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The strategies of major countries for 2050
<table>
<thead>
<tr>
<th>Country</th>
<th>Reduction Target</th>
<th>Flexibility</th>
<th>Main Strategy, Posture</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>▲ 80% or more</td>
<td><strong>Ambitious vision towards reduction target</strong> (not intended as current policy proposals)</td>
<td><strong>Increase</strong>&lt;br&gt;Variable renewable energy + Nuclear power&lt;br&gt;Large-scale electrification (20%→45~60%)&lt;br&gt;Contribution through expanding market for US products</td>
</tr>
<tr>
<td></td>
<td>(as percentage of 2005)</td>
<td>providing <strong>an ambitious vision</strong> to reduce net GHG emissions by 80 percent or more below 2005 levels by 2050.</td>
<td><strong>Securing the electricity</strong>&lt;br&gt;Hydro power + Variable renewables + Nuclear power&lt;br&gt;Large-scale electrification (20%→40<del>70%)&lt;br&gt;Looking to contribute internationally (0</del>15%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Informing the conversation</strong> (not a blue print for action)</td>
<td><strong>Securing the electricity</strong>&lt;br&gt;Renewable energy + Nuclear power&lt;br&gt;Large-scale energy conservation (half as percentage of 1990)&lt;br&gt;Contribution through international development support by French businesses</td>
</tr>
<tr>
<td>Canada</td>
<td>▲ 80%</td>
<td><strong>Possible path for achieving objectives</strong> (not an action plan)</td>
<td><strong>Increase</strong>&lt;br&gt;Variable renewables + Nuclear power&lt;br&gt;Promote energy conservation/electrification&lt;br&gt;Lead the world through environmental investment</td>
</tr>
<tr>
<td></td>
<td>(as percentage of 2005)</td>
<td>the scenario is not an action plan: it rather <strong>presents a possible path</strong> for achieving our objectives.</td>
<td><strong>Inexpensive</strong>&lt;br&gt;Variable renewables + Nuclear power&lt;br&gt;Large-scale energy conservation (half as percentage of 1990)&lt;br&gt;Maintaining and bolstering investment sentiment in LDCs</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>▲ 80% or more</td>
<td><strong>Helps players identify steps to take in the next few years by exploring potential pathways</strong> (long-term predictions are difficult)</td>
<td><strong>Increase</strong>&lt;br&gt;Variable renewables + Nuclear power&lt;br&gt;Promote energy conservation/electrification&lt;br&gt;Lead the world through environmental investment</td>
</tr>
<tr>
<td></td>
<td>(as percentage of 1990)</td>
<td>exploring the plausible potential pathways to 2050 helps us to identify low-regrets steps we can take in the next few years common to many versions of the future</td>
<td><strong>Securing the electricity</strong>&lt;br&gt;Renewable energy + Nuclear power&lt;br&gt;Large-scale energy conservation (half as percentage of 1990)&lt;br&gt;Maintaining and bolstering investment sentiment in LDCs</td>
</tr>
<tr>
<td>France</td>
<td>▲ 75%</td>
<td><strong>Point to the direction towards reducing emissions</strong> (not a search for masterplan)**&lt;br&gt;**not a rigid instrument; it points to the direction needed to achieve a greenhouse gas-neutral economy.</td>
<td><strong>Increase</strong>&lt;br&gt;Variable renewable energy&lt;br&gt;Promote energy conservation/electrification&lt;br&gt;Lead the world through environmental investment</td>
</tr>
<tr>
<td></td>
<td>(as percentage of 1990)</td>
<td>※Conduct regular reviews</td>
<td><strong>Securing the electricity</strong>&lt;br&gt;Renewable energy + Nuclear power&lt;br&gt;Large-scale energy conservation (half as percentage of 1990)&lt;br&gt;Maintaining and bolstering investment sentiment in LDCs</td>
</tr>
</tbody>
</table>

* Not yet submitted to UNFCCC as long-term strategy. Created from The Clean Growth Strategy (November 2017).
## National Long-term Strategies (United States)

### Reduction Target: ▲ 80% or more (as percentage of 2005)

Status: Ambitious Vision aimed at Reduction Targets

<table>
<thead>
<tr>
<th>Main Entries</th>
<th>Quantitative Target</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Renewable Energy</strong></td>
<td></td>
</tr>
<tr>
<td>Infrastructure and regulatory support necessary such as batteries, systems build up towards expanding variable renewable energy.</td>
<td></td>
</tr>
<tr>
<td><strong>Nuclear Power</strong></td>
<td></td>
</tr>
<tr>
<td>Necessary to extend lifespan of existing plants and invest in light water reactors and next-generation nuclear power.</td>
<td></td>
</tr>
<tr>
<td><strong>Thermal Power</strong></td>
<td></td>
</tr>
<tr>
<td>Map out future without thermal power depending on CCS technology development.</td>
<td></td>
</tr>
<tr>
<td><strong>Energy Conservation/ Electrification</strong></td>
<td></td>
</tr>
<tr>
<td>Enhance efficiency of energy system as a whole Smart grids, raising fuel efficiency, making industrial processes more efficient, etc.</td>
<td></td>
</tr>
<tr>
<td><strong>Electrification</strong></td>
<td></td>
</tr>
<tr>
<td>Greater electrification of autos, household heat demand, industrial steam, etc.</td>
<td></td>
</tr>
<tr>
<td><strong>CCUS/ Hydrogen</strong></td>
<td></td>
</tr>
<tr>
<td>Hydrogen may play important role in areas where electrification is difficult. (FCV, aircraft, industrial cogeneration)</td>
<td></td>
</tr>
<tr>
<td><strong>Overseas Contributions</strong></td>
<td></td>
</tr>
<tr>
<td>Contribute to global emissions reduction by expanding market for US goods and services.</td>
<td></td>
</tr>
</tbody>
</table>

- **Shift to Zero Emission**
  - **Renewable Energy**: Year 2015 13% (VRE 5%) → Year 2050 55~65% (VRE 45~59%)
  - **Nuclear Power**: Year 2015 19% → Year 2050 17~26%
  - **Thermal Power**: Year 2015 0% (CCS thermal power) → Year 2050 0~25% (CCS Thermal power)
  - **Energy Conservation/ Electrification**: Year 2050 ▲ 24~30% (as percentage of 2005)
  - **Electrification**: Year 2015 21% → Year 2050 45~60%
  - **CCUS/ Hydrogen**: No Quantitative Target
  - **Overseas Contributions**: No Quantitative Target

※VRE: Variable Renewable Energy
National Long-term Strategies (Canada)

**Long-term Strategy Summary**

- **Reduction Target**: ▲ 80% and more (as percentage of 2005)
- **Status**: Informing the Conversation

**Main Entries**

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Year 2015</th>
<th>Year 2050</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Renewable Energy</strong></td>
<td>Expand use of wind power, photovoltaics and hydro power.</td>
<td>63%</td>
<td>50~80% (Hydro Power 57%)</td>
</tr>
<tr>
<td><strong>Nuclear Power</strong></td>
<td>250 USD investment expected in 10 plants over the next 15 years.</td>
<td>15%</td>
<td>5~50%</td>
</tr>
<tr>
<td><strong>Thermal Power</strong></td>
<td>Thermal power equipped with CCS may exist depending on scenario.</td>
<td>0%</td>
<td>0~10% (CCS Thermal Power)</td>
</tr>
<tr>
<td><strong>Energy Conservation/ Electrification</strong></td>
<td>Improving energy efficiency and demand management are the main elements of long-term emissions reduction strategy.</td>
<td>22%</td>
<td>40~72%</td>
</tr>
<tr>
<td><strong>Electrification</strong></td>
<td>Electrification of Automobiles, buildings, heat systems, industry, etc. is essential to reducing emissions.</td>
<td>0%</td>
<td>0~32% (CCS Thermal Power)</td>
</tr>
<tr>
<td><strong>CCUS/ Hydrogen</strong></td>
<td>Room for reduction in major emitting industries (gas and petroleum, iron and steel, paper manufacturing, chemicals, etc.) with CCS potential for using hydrogen in heavy industries, shipping, etc.</td>
<td>0%</td>
<td>0~32%</td>
</tr>
<tr>
<td><strong>Overseas Contributions</strong></td>
<td>Encouraging international cooperation contributes to efficient global cost reduction. Include cross-border reduction in international contribution.</td>
<td>0%</td>
<td>0~15%</td>
</tr>
</tbody>
</table>
### National Long-term Strategies (France)

#### Long-term Strategy Summary

**Reduction Target:** ▲ 75% (as percentage of 1990)

**Status:** Possible Path for achieving Objectives

#### Main Entries

<table>
<thead>
<tr>
<th>Renewable Energy</th>
<th>Further flexibility necessary to integrate renewable energy (utilizing hydropower for peak demand, energy storage, international grids)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear Power</td>
<td>Reduce weight in electricity composition to 50% by 2025. (Energy Conversion Act) ※French government announced in 7/11/2017 that the target year will be postponed to 2030 ~ 2035.</td>
</tr>
<tr>
<td>Thermal Power</td>
<td>Shift to zero emission CCS essential in complete shift to zero emission scenario.</td>
</tr>
<tr>
<td>Energy conservation</td>
<td>Large-scale energy conservation in industry, construction and transport sectors.</td>
</tr>
<tr>
<td>Electrification</td>
<td>Electrification important to promoting energy conservation Timeframe for developing EV infrastructure, etc. important</td>
</tr>
<tr>
<td>CCUS/ Hydrogen</td>
<td>Restrain carbon intensity of products through CCS in industrial processes in iron and steel, cement, etc.</td>
</tr>
<tr>
<td>Overseas Contributions</td>
<td>Promote carbon intensity reduction through support for international development by French businesses (utilize export credit insurance, etc.)</td>
</tr>
</tbody>
</table>

#### Quantitative Target

<table>
<thead>
<tr>
<th>Year 2015</th>
<th>Year 2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>16% (VRE* 5%)</td>
<td>Year 2025 50%</td>
</tr>
<tr>
<td>Year 2015 78%</td>
<td>Year 2030 40%</td>
</tr>
<tr>
<td>Year 2015 0% (CCS Thermal Power)</td>
<td>No Quantitative Target (CCS Thermal Power)</td>
</tr>
<tr>
<td>Year 2050 ▲ 50% (as percentage of 1990)</td>
<td>Year 2025 Approx. 40%</td>
</tr>
</tbody>
</table>

※VRE: Variable Renewable Energy

※French government announced in 7/11/2017 that the target year will be postponed to 2030 ~ 2035.
## National Long-term Strategies (United Kingdom)

### Long-term Strategy Summary

- **Reduction Target**: ▲ 80% or more (as percentage of 1990)
- **Status**: Help identifying steps for the next few years by exploring potential pathways*

* Content aimed at achieving UK’s “Fifth Carbon Budget” (2028-2032). Some entries up to 2050.

### Main Entries

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Year 2015</th>
<th>Year 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Renewable Energy</strong></td>
<td>Support more renewable energy market entries such as offshore wind Develop electricity storage, DR and new grid stabilization methods.</td>
<td>25%</td>
<td>44%</td>
</tr>
<tr>
<td><strong>Nuclear Power</strong></td>
<td>Reduce cost, maintain stability (support new construction) Support innovation towards developing next-generation nuclear power, etc.</td>
<td>21%</td>
<td>28%</td>
</tr>
<tr>
<td><strong>Thermal Power</strong></td>
<td>Decommission coal-fired power plants without CCS by 2025.</td>
<td>0%</td>
<td>No target</td>
</tr>
<tr>
<td><strong>Energy conservation</strong></td>
<td>Achieve 20% energy conservation in the office and industrial sectors by 2030, raise energy efficiency in all households to specific levels.</td>
<td>20%</td>
<td>▲ 10%</td>
</tr>
<tr>
<td><strong>Electrification</strong></td>
<td>Electrify energy intensive industries, utilize heat pumps in household Promote adoption of EVs</td>
<td>21%</td>
<td>23%</td>
</tr>
<tr>
<td><strong>CCUS/ Hydrogen</strong></td>
<td>Lead the world in CCUS technology development (invest 100 million GBP) Hydrogen to be used in FCVs, industrial processes, and heat supply to households and offices</td>
<td></td>
<td>No target</td>
</tr>
<tr>
<td><strong>Overseas Contributions</strong></td>
<td>Lead the world in environmental investment (establish task force to encourage public and private investment, 20 million GBP investment in immature technologies, etc.) ▲ UK actions to date are expected to save almost 500 million tons of CO2, while they do not count these results against the domestic budgets</td>
<td></td>
<td>No target</td>
</tr>
</tbody>
</table>

### Quantitative Target

- **Year 2015**: 7%
- **Year 2030**: 23%
- **Year 2015**: 21%
- **Year 2030**: 25%
- **Year 2015**: 0%
- **Year 2030**: ▲ 10% (as percentage of 2008)

*VRE: Variable Renewable Energy*
# National Long-term Strategies (Germany)

**Long-term Strategy Summary**

Reduction Target: ▲80～95% (as percentage of 1990)

Status: Point to the Direction towards reducing Emissions

<table>
<thead>
<tr>
<th><strong>Main Entries</strong></th>
<th><strong>Quantitative Target</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Renewable Energy</strong></td>
<td>Fully promote renewable energy in areas where it is usable (mainly wind power). Optimize variable renewable energy by sector-coupling.</td>
</tr>
<tr>
<td><strong>Year 2015</strong></td>
<td><strong>Year 2050</strong></td>
</tr>
<tr>
<td><strong>14%</strong> (VRE* 18%)</td>
<td><strong>80%</strong></td>
</tr>
<tr>
<td><strong>17%</strong> (as percentage of 2005)</td>
<td><strong>No Quantitative Target</strong></td>
</tr>
<tr>
<td><strong>Nuclear Power</strong></td>
<td>No entry.</td>
</tr>
<tr>
<td><strong>Year 2015</strong></td>
<td><strong>Year 2050</strong></td>
</tr>
<tr>
<td><strong>14%</strong></td>
<td><strong>0%</strong></td>
</tr>
<tr>
<td><strong>No Quantitative Target</strong></td>
<td><strong>No Quantitative Target</strong></td>
</tr>
<tr>
<td><strong>Thermal Power</strong></td>
<td>New construction of coal-fire power plants will not be supported.</td>
</tr>
<tr>
<td><strong>Year 2015</strong></td>
<td><strong>Year 2050</strong></td>
</tr>
<tr>
<td><strong>0%</strong> (CCS Thermal Power)</td>
<td><strong>0%</strong></td>
</tr>
<tr>
<td><strong>No Quantitative Target</strong></td>
<td><strong>No Quantitative Target</strong></td>
</tr>
<tr>
<td><strong>Energy Conservation/ Electrification</strong></td>
<td>Energy conservation first. (promote energy conservation in all sectors)</td>
</tr>
<tr>
<td><strong>Year 2015</strong></td>
<td><strong>Year 2050</strong></td>
</tr>
<tr>
<td><strong>20%</strong></td>
<td><strong>Approximately 30%</strong></td>
</tr>
<tr>
<td><strong>Overseas Contributions</strong></td>
<td>Contribute through partnerships for climate action plan. (maintain and strengthen investment sentiment in LDCs and contribute to their fundraising)</td>
</tr>
<tr>
<td><strong>Year 2015</strong></td>
<td><strong>Year 2050</strong></td>
</tr>
<tr>
<td><strong>No Quantitative Target</strong></td>
<td><strong>No Quantitative Target</strong></td>
</tr>
</tbody>
</table>

※VRE: Variable Renewable Energy
Progress for mid-term CO2 targets in Europe
## Progress for mid-term CO2 targets in Europe

### Germany

**CO2 emissions trend and medium-term goal**

<table>
<thead>
<tr>
<th>Year</th>
<th>Others</th>
<th>Electricity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>7.3</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2030</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Past 3-year assessment**

<table>
<thead>
<tr>
<th>Reduction pace</th>
<th>Main factors</th>
<th>Final demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.7%/year</td>
<td>▲</td>
<td></td>
</tr>
<tr>
<td>3.6%/year</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Main background and comments**

- Growing use of renewable energy, though relying on coal thermal power due to nuclear cutbacks (RE: 23%→29% Nuclear: 16%→14% Coal:46%→44%)
- Agreed to withdraw the 2020 reduction target (press report) (Between CDU/CSU and SPD)

### UK

**CO2 emissions trend and medium-term goal**

<table>
<thead>
<tr>
<th>Year</th>
<th>Others</th>
<th>Electricity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>3.9</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2030</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Past 3-year assessment**

<table>
<thead>
<tr>
<th>Reduction pace</th>
<th>Main factors</th>
<th>Final demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.5%/year</td>
<td>▲</td>
<td></td>
</tr>
<tr>
<td>3.3%/year</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Main background and comments**

- Low-carbon electricity ⇒Reduction rate ahead of the target pace (RE: 11%→25% Nuclear: 20%→21% Coal:40%→23%)
- Though likely to be higher emissions than budgets in 4th and 5th carbon budgets with current policy proposal (Prof. Jim Skea; 3rd Session)

### France

**CO2 emissions trend and medium-term goal**

<table>
<thead>
<tr>
<th>Year</th>
<th>Others</th>
<th>Electricity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2030</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Past 3-year assessment**

<table>
<thead>
<tr>
<th>Reduction pace</th>
<th>Main factors</th>
<th>Final demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5%/year</td>
<td>▲</td>
<td></td>
</tr>
<tr>
<td>2.2%/year</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Main background and comments**

- Emission from power sector is currently very low ⇒Government postponed a reduction target of nuclear share (RE: 15%→16% Nuclear: 76%→78% Fossil:9%→7%)
- Needs to lower emissions from other sources to reach the target (further promotion of electrification, etc.)

### Japan

**CO2 emissions trend and medium-term goal**

<table>
<thead>
<tr>
<th>Year</th>
<th>Others</th>
<th>Electricity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>9.3</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2030</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Past 3-year assessment**

<table>
<thead>
<tr>
<th>Reduction pace</th>
<th>Main factors</th>
<th>Final demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.9%/year</td>
<td>▲</td>
<td></td>
</tr>
<tr>
<td>1.4%/year</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Main background and comments**

- Emission reduction through increase of zero-emission power ratio and decrease of final demand (RE: 10%→14% Nuclear: 2%→1% Fossil:88%→85%)
- Important to pursue both supply-side (low carbon energy) and demand-side (energy saving) countermeasure in a good balance

### Others

**Electricity**

- 0.7%/year
- 5.5%/year
- 2.5%/year
- 4.0%/year

**Main factors**

- Low-carbon power
- Electrification
- Final demand

**Medium-term target pace**

- 3.6%/year
- 3.3%/year
- 2.2%/year
- 1.4%/year

**Final demand**

- 9.2
- 5.2
- 6.2
- 14.3

**Main background and comments**

- Growing use of renewable energy, though relying on coal thermal power due to nuclear cutbacks
- Agreed to withdraw the 2020 reduction target (press report)
- Low-carbon electricity ⇒Reduction rate ahead of the target pace
- Though likely to be higher emissions than budgets in 4th and 5th carbon budgets with current policy proposal
- Emission from power sector is currently very low ⇒Government postponed a reduction target of nuclear share
- Needs to lower emissions from other sources to reach the target (further promotion of electrification, etc.)
- Emission reduction through increase of zero-emission power ratio and decrease of final demand
- Important to pursue both supply-side (low carbon energy) and demand-side (energy saving) countermeasure in a good balance

(IEA Energy Balances, CO2 Emissions from Fuel Combustion; Comprehensive Energy Statistics etc.)
Transition of electricity market
(1990 -> 2010 -> 2015)
### Transition of Germany’s CO2 emissions from power generation

<table>
<thead>
<tr>
<th>Year</th>
<th>Power Generation</th>
<th>Renewable</th>
<th>Nuclear</th>
<th>Thermal</th>
<th>CO2 Emissions (Power generation)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1990</td>
<td>2010</td>
<td>2015</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>550 TWh</td>
<td>19 TWh</td>
<td>150 TWh</td>
<td>380 TWh</td>
<td>340 Million tons (0.64 kgCO2/kWh)</td>
</tr>
<tr>
<td></td>
<td>+80 TWh</td>
<td>+90 TWh</td>
<td>-10 TWh</td>
<td>+10 TWh</td>
<td></td>
</tr>
<tr>
<td></td>
<td>630 TWh</td>
<td>100 TWh</td>
<td>140 TWh</td>
<td>380 TWh</td>
<td>300 Million tons (0.48 kgCO2/kWh)</td>
</tr>
<tr>
<td></td>
<td>+10 TWh</td>
<td></td>
<td>-50 TWh</td>
<td>-20 TWh</td>
<td></td>
</tr>
<tr>
<td></td>
<td>640 TWh</td>
<td>190 TWh</td>
<td>92 TWh</td>
<td>360 TWh</td>
<td>290 Million tons (0.45 kgCO2/kWh)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Numbers are rounded. Totals may not match due to rounding errors.
- Source: Produced from IEA Energy Balances, CO2 Emissions from Fuel Combustion

- Thermal breakdown change: +10
- Thermal generated volume change: -50
- Thermal generated volume change: 0
- Thermal generated volume change: 20
### Transition of the UK’s CO2 emissions from power generation

<table>
<thead>
<tr>
<th>Power Generation</th>
<th>1990</th>
<th>2010</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Renewable</strong></td>
<td>320 TWh</td>
<td>380 TWh</td>
<td>340 TWh</td>
</tr>
<tr>
<td><strong>Nuclear</strong></td>
<td>6 TWh</td>
<td>26 TWh</td>
<td>84 TWh</td>
</tr>
<tr>
<td><strong>Thermal</strong></td>
<td>250 TWh</td>
<td>290 TWh</td>
<td>180 TWh</td>
</tr>
</tbody>
</table>

#### CO2 Emissions (Power generation)

<table>
<thead>
<tr>
<th>Year</th>
<th>Thermal Volume</th>
<th>Thermal Breakdown</th>
<th>CO2 Emissions (Power generation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>(coal 200, gas 10, oil 30)</td>
<td>(coal 200, gas 10, oil 30)</td>
<td>220 Million tons (0.69 kgCO2/kWh)</td>
</tr>
<tr>
<td>2010</td>
<td>(coal 110, gas 180, oil 10)</td>
<td>(coal 110, gas 180, oil 10)</td>
<td>170 Million tons (0.45 kgCO2/kWh)</td>
</tr>
<tr>
<td>2015</td>
<td>(coal 80, gas 100, oil 10)</td>
<td>(coal 80, gas 100, oil 10)</td>
<td>120 Million tons (0.35 kgCO2/kWh)</td>
</tr>
</tbody>
</table>

*Numbers are rounded. Totals may not match due to rounding errors.*

Source: Produced from IEA Energy Balances, CO2 Emissions from Fuel Combustion
Transition of the EU’s CO2 emissions from power generation

<table>
<thead>
<tr>
<th></th>
<th>1990</th>
<th>2010</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power Generation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Renewable</td>
<td>310 TWh</td>
<td>680 TWh</td>
<td>940 TWh</td>
</tr>
<tr>
<td>Nuclear</td>
<td>790 TWh</td>
<td>920 TWh</td>
<td>860 TWh</td>
</tr>
<tr>
<td>Thermal</td>
<td>1,500 TWh</td>
<td>1,700 TWh</td>
<td>1,400 TWh</td>
</tr>
<tr>
<td><strong>CO2 Emissions (Power generation)</strong></td>
<td>1,290 Million tons (0.50 kgCO2/kWh)</td>
<td>1,170 Million tons (0.35 kgCO2/kWh)</td>
<td>1,010 Million tons (0.32 kgCO2/kWh)</td>
</tr>
</tbody>
</table>

- **Transition of Thermal Power Generation**
  - Thermal generated volume change: +300
  - Thermal breakdown change: -350

- **Transition of Nuclear Power Generation**
  - Thermal generated volume change: +100
  - Thermal breakdown change: +300

- **Transition of Renewable Power Generation**
  - Thermal generated volume change: +400
  - Thermal breakdown change: -350

*Numbers are rounded. Totals may not match due to rounding errors.

Source: Produced from IEA Energy Balances, CO2 Emissions from Fuel Combustion
### Transition of the China’s CO2 emissions from power generation

<table>
<thead>
<tr>
<th>Power Generation</th>
<th>1990</th>
<th>2010</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal</td>
<td>490  TWh</td>
<td>+2800 TWh</td>
<td>3,300 TWh</td>
</tr>
<tr>
<td></td>
<td>(coal 400, gas 0, oil 100)</td>
<td>(coal 3200, gas 100, oil 0)</td>
<td>(coal 4100, gas 100, oil 0)</td>
</tr>
<tr>
<td>CO2 Emissions</td>
<td>520 Million tons (0.85 kgCO2/kWh)</td>
<td>+2660 Million tons (0.76 kgCO2/kWh)</td>
<td>3,840 Million tons (0.66 kgCO2/kWh)</td>
</tr>
</tbody>
</table>

| Renewable        | 130 TWh | +700 TWh | 780 TWh |
|                  | (coal 400, gas 0, oil 100) | (coal 3200, gas 100, oil 0) | (coal 4100, gas 100, oil 0) |
| CO2 Emissions    | 0 Million tons (0) | +70 Million tons (0) | 74 Million tons (0.76 kgCO2/kWh) |

| Nuclear          | 0 TWh | +70 TWh | 74 TWh |
|                  | (coal 400, gas 0, oil 100) | (coal 3200, gas 100, oil 0) | (coal 4100, gas 100, oil 0) |
| CO2 Emissions    | 0 Million tons (0) | +70 Million tons (0) | 74 Million tons (0.76 kgCO2/kWh) |

*Numbers are rounded. Totals may not match due to rounding errors.

Source: Produced from IEA Energy Balances, CO2 Emissions from Fuel Combustion
### Transition of the Japan’s CO2 emissions from power generation

<table>
<thead>
<tr>
<th></th>
<th>1990</th>
<th>2010</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power Generation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coal</td>
<td>870 TWh (+200 TWh)</td>
<td>1,100 TWh (-100 TWh)</td>
<td>1,100 TWh</td>
</tr>
<tr>
<td>Gas</td>
<td>98 TWh (+10 TWh)</td>
<td>110 TWh (+50 TWh)</td>
<td>160 TWh (+100 TWh)</td>
</tr>
<tr>
<td>Oil</td>
<td>200 TWh (+100 TWh)</td>
<td>290 TWh (+100 TWh)</td>
<td>20 TWh (-280 TWh)</td>
</tr>
<tr>
<td><strong>Renewable</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Nuclear</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Thermal</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(coal 100, gas 200, oil 300)</td>
<td>(coal 300, gas 300, oil 100)</td>
<td>(coal 300, gas 400, oil 100)</td>
<td></td>
</tr>
<tr>
<td><strong>CO2 Emissions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Power generation)</td>
<td>350 Million tons (0.46 kgCO2/kWh) (+80 Million tons)</td>
<td>430 Million tons (0.42 kgCO2/kWh) (+80 Million tons)</td>
<td>500 Million tons (0.52 kgCO2/kWh) (+80 Million tons)</td>
</tr>
</tbody>
</table>

* Numbers are rounded. Totals may not match due to rounding errors.
* Definition of kgCO2/kWh in METI and IEA may be different.

Source: METI statistics, IEA Energy Balances etc.

**Notes:**
- Thermal generated volume change: +90%
- Thermal breakdown change: -10%
- Transition of Japan's CO2 emissions from power generation.
### CO2 Emission per kWh and Composition of Electricity Sources for Major EU Members and Japan (2015)

<table>
<thead>
<tr>
<th>Country</th>
<th>CO2 Emission per kWh</th>
<th>Stable RE (%)</th>
<th>Nuclear (%)</th>
<th>Variable RE (%)</th>
<th>PV (%)</th>
<th>Wind (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweden</td>
<td>11 gCO2/kWh</td>
<td>88%</td>
<td>53%</td>
<td>10%</td>
<td></td>
<td>10%</td>
</tr>
<tr>
<td>France</td>
<td>46 gCO2/kWh</td>
<td>88%</td>
<td>11%</td>
<td>5%</td>
<td></td>
<td>4%</td>
</tr>
<tr>
<td>Denmark</td>
<td>174 gCO2/kWh</td>
<td>15%</td>
<td>15%</td>
<td>51%</td>
<td>2%</td>
<td>49%</td>
</tr>
<tr>
<td>Spain</td>
<td>293 gCO2/kWh</td>
<td>33%</td>
<td>12%</td>
<td>23%</td>
<td>3%</td>
<td>18%</td>
</tr>
<tr>
<td>EU Average</td>
<td>315 gCO2/kWh</td>
<td>43%</td>
<td>16%</td>
<td>13%</td>
<td>3%</td>
<td>10%</td>
</tr>
<tr>
<td>Germany</td>
<td>450 gCO2/kWh</td>
<td>25%</td>
<td>11%</td>
<td>18%</td>
<td>6%</td>
<td>12%</td>
</tr>
<tr>
<td>Japan</td>
<td>540 gCO2/kWh</td>
<td>12%</td>
<td>11%</td>
<td>4%</td>
<td></td>
<td>1%</td>
</tr>
</tbody>
</table>

Source: IEA CO2 emissions from fuel combustion 2017, Comprehensive Energy Statistics

※EU28
### Emission coefficient and the electrical power generation mix of US states

<table>
<thead>
<tr>
<th>State</th>
<th>CO2 Emission per kWh</th>
<th>Stable Zero Emission</th>
<th>Variable Renewable Energy</th>
<th>Thermal Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Washington</td>
<td>106 gCO2/kWh</td>
<td>76%</td>
<td>6%</td>
<td>17%</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>183 gCO2/kWh</td>
<td>62%</td>
<td>2%</td>
<td>36%</td>
</tr>
<tr>
<td>New York</td>
<td>235 gCO2/kWh</td>
<td>52%</td>
<td>3%</td>
<td>45%</td>
</tr>
<tr>
<td>Illinois</td>
<td>435 gCO2/kWh</td>
<td>50%</td>
<td>6%</td>
<td>44%</td>
</tr>
<tr>
<td>US average</td>
<td>498 gCO2/kWh</td>
<td>27%</td>
<td>5%</td>
<td>67%</td>
</tr>
<tr>
<td>Texas</td>
<td>541 gCO2/kWh</td>
<td>9%</td>
<td>10%</td>
<td>81%</td>
</tr>
</tbody>
</table>

**Stable Zero Emission**
- **Washington**: Stable RE: 69%, Nuclear: 7%
- **New Hampshire**: Stable RE: 14%, Nuclear: 47%
- **New York**: Stable RE: 20%, Nuclear: 32%
- **Illinois**: Stable RE: 0%, Nuclear: 50%
- **US average**: Stable RE: 8%, Nuclear: 19%
- **Texas**: Stable RE: 1%, Nuclear: 9%

**Variable Renewable Energy**
- **Washington**: PV: 0%, Wind: 6%
- **New Hampshire**: PV: 0%, Wind: 2%
- **New York**: PV: 0%, Wind: 3%
- **Illinois**: PV: 0%, Wind: 6%
- **US average**: PV: 1%, Wind: 4%
- **Texas**: PV: 0%, Wind: 10%

**Thermal Power**
- **Washington**: Coal: 5%, Gas: 12%, Oil: 0%
- **New Hampshire**: Coal: 5%, Gas: 30%, Oil: 1%
- **New York**: Coal: 2%, Gas: 41%, Oil: 2%
- **Illinois**: Coal: 38%, Gas: 6%, Oil: 0%
- **US average**: Coal: 34%, Gas: 32%, Oil: 1%
- **Texas**: Coal: 28%, Gas: 53%, Oil: 0%

Source: EIA Statistics
Power demand and supply in Denmark, Germany and UK
Power demand and supply in Germany (2017/4/29~4/30)

Electricity balance in 2017/4/29~4/30 in Germany

Flexibility (kW) and power generation (kWh) for the 2 days

<table>
<thead>
<tr>
<th>Cross section 1 Flexibility (up)</th>
<th>Cross section 2 Flexibility (down)</th>
<th>Cross section 1 + 2 (total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fossil 5 GW (45%)</td>
<td>Fossil 13 GW (45%)</td>
<td>Fossil 18 GW (45%)</td>
</tr>
<tr>
<td>Pumped 2 GW (18%)</td>
<td>Pumped 4 GW (14%)</td>
<td>Pumped 6 GW (15%)</td>
</tr>
<tr>
<td>Ex/Import 4 GW (36%)</td>
<td>Ex/Import 12 GW (41%)</td>
<td>Ex/Import 16 GW (40%)</td>
</tr>
<tr>
<td>Total 10 GW (100%)</td>
<td>Total 29 GW (100%)</td>
<td>Total 40 GW (100%)</td>
</tr>
</tbody>
</table>

Flexibility (kW)

<table>
<thead>
<tr>
<th></th>
<th>With Ex/Import (actual case)</th>
<th>Without Ex/Import*</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewable</td>
<td>1,200 GWh</td>
<td>900 GWh</td>
<td>▲300 GWh (▲25%)</td>
</tr>
<tr>
<td>Fossil</td>
<td>920 GWh</td>
<td>860 GWh</td>
<td>▲60 GWh (▲7%)</td>
</tr>
<tr>
<td>Nuclear</td>
<td>300 GWh</td>
<td>300 GWh</td>
<td>±0 GWh (±0%)</td>
</tr>
<tr>
<td>Total</td>
<td>2,500 GWh</td>
<td>2,100 GWh</td>
<td>▲400 GWh (▲15%)</td>
</tr>
</tbody>
</table>

Source: ENTSO-E “Transparency Platform”

*Preliminary calculation assuming fossil power increases as alternative energy of import, fossil decreases for 4/29 and renewables are curtailed for 4/30 instead of exporting power.
Power demand and supply in Denmark (2017/5/11~5/13)

Electricity balance in 2017/5/11~5/13 in Denmark

Flexibility (kW) and power generation (kWh) for the 3 days

<table>
<thead>
<tr>
<th>Cross section 1 Flexibility “up”</th>
<th>Fossil (GW)</th>
<th>Pumped (GW)</th>
<th>Ex/Import (GW)</th>
<th>Total (GW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 GW (40%)</td>
<td>0 GW</td>
<td>1.5 GW</td>
<td></td>
<td>2.4 GW</td>
</tr>
<tr>
<td>Cross section 2 Flexibility “down”</td>
<td>0 GW</td>
<td>0 GW</td>
<td>2.8 GW</td>
<td>2.8 GW</td>
</tr>
<tr>
<td>Cross section 1 + 2 (total)</td>
<td>1.0 GW (20%)</td>
<td>0 GW</td>
<td>4.3 GW (80%)</td>
<td>5.3 GW</td>
</tr>
</tbody>
</table>

*Totals might not match due to rounding

Source: ENTSO-E “Transparency Platform”
Power demand and supply in United Kingdom (2017/3/18~3/19)

Electricity balance in 2017/3/18~3/19 in UK

Flexibility (kW) and power generation (kWh) for the 2 days

<table>
<thead>
<tr>
<th></th>
<th>Fossil</th>
<th>Pumped</th>
<th>Ex/Import</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cross section 1</td>
<td>8.5</td>
<td>1.9</td>
<td>5.3</td>
<td>15.6</td>
</tr>
<tr>
<td>Flexibility “up”</td>
<td>(54%)</td>
<td>(12%)</td>
<td>(34%)</td>
<td>(100%)</td>
</tr>
<tr>
<td>Cross section 2</td>
<td>5.8</td>
<td>0</td>
<td>3.2</td>
<td>9.0</td>
</tr>
<tr>
<td>Flexibility “down”</td>
<td>(64%)</td>
<td>(0%)</td>
<td>(36%)</td>
<td>(100%)</td>
</tr>
<tr>
<td>Cross section 1 + 2</td>
<td>14.2</td>
<td>1.9</td>
<td>8.5</td>
<td>24.6</td>
</tr>
<tr>
<td>(total)</td>
<td>(58%)</td>
<td>(8%)</td>
<td>(35%)</td>
<td>(100%)</td>
</tr>
</tbody>
</table>

Power Generation (kWh)

<table>
<thead>
<tr>
<th></th>
<th>Renewable</th>
<th>Fossil</th>
<th>Nuclear</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>With Ex/Import</td>
<td>430 GWh</td>
<td>600 GWh</td>
<td>340 GWh</td>
<td>1,370 GWh</td>
</tr>
<tr>
<td>(actual case)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Without Ex/Import*</td>
<td>410 GWh</td>
<td>810 GWh</td>
<td>340 GWh</td>
<td>1,560 GWh</td>
</tr>
<tr>
<td>Difference</td>
<td>▲20 GWh</td>
<td>+210 GWh</td>
<td>±0 GWh</td>
<td>+190 GWh</td>
</tr>
<tr>
<td>(▲4%)</td>
<td>(+34%)</td>
<td>(±0%)</td>
<td>(+14%)</td>
<td></td>
</tr>
</tbody>
</table>

*Totals might not match due to rounding.

*Preliminary calculation assuming fossil power increases as alternative energy of import, renewables are curtailed instead of exporting power.

Source: ENTSO-E “Transparency Platform”
## V-RE ratio and power import/export in Denmark, Germany and UK

<table>
<thead>
<tr>
<th></th>
<th>Denmark</th>
<th>Germany</th>
<th>UK</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power demand</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(annual generation)</td>
<td>30 TWh</td>
<td>600 TWh</td>
<td>300 TWh</td>
<td>1,100 TWh</td>
</tr>
<tr>
<td><strong>Ratio of variable renewables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>51% (PV2% Wind49%)</td>
<td>18% (PV6% Wind12%)</td>
<td>14% (PV2% Wind12%)</td>
<td>6% (PV5% Wind1%)</td>
</tr>
<tr>
<td><em><em>International grid [Interconnection level</em>]</em>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>44%</td>
<td>10%</td>
<td>6%</td>
<td>Not connected</td>
</tr>
<tr>
<td><strong>&lt;kW&gt; Dependence of flexibility on abroad [Ex/Import on the day with high V-RE ratio]</strong></td>
<td></td>
<td></td>
<td></td>
<td>No Export/Import</td>
</tr>
<tr>
<td></td>
<td>80%</td>
<td>40%</td>
<td>35%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.3 GW</td>
<td>16 GW</td>
<td>8.5 GW</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Export: 2.8 GW Import: 1.5 GW</td>
<td>Export: 12 GW Import: 4 GW</td>
<td>Export: 3.2 GW Import: 5.3 GW</td>
<td></td>
</tr>
<tr>
<td><strong>&lt;kWh&gt; Annual export/import</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Export</td>
<td>33%</td>
<td>13%</td>
<td>1%</td>
<td>No Export/Import</td>
</tr>
<tr>
<td></td>
<td>(10 TWh)</td>
<td>(85 TWh)</td>
<td>(2 TWh)</td>
<td></td>
</tr>
<tr>
<td>Import</td>
<td>55%</td>
<td>5%</td>
<td>&lt; 8%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(16 TWh)</td>
<td>(34 TWh)</td>
<td>(24 TWh)</td>
<td></td>
</tr>
</tbody>
</table>

* Ratio of international grid capacity and installed power production capacity

Source: ENTSO-E “Transparency Platform”, “Statistical Factsheet” etc
### V-RE ratio and power import/export in Denmark, Germany and UK

<table>
<thead>
<tr>
<th></th>
<th>Denmark</th>
<th>Germany</th>
<th>UK</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power demand</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(annual generation)</td>
<td>30TWh</td>
<td>600TWh</td>
<td>300TWh</td>
<td>1,100TWh</td>
</tr>
<tr>
<td><strong>Ratio of variable renewables</strong></td>
<td>51% (PV2% Wind49%)</td>
<td>&gt; 18% (PV6% Wind12%)</td>
<td>&gt; 14% (PV2% Wind12%)</td>
<td>&gt; 6% (PV5% Wind1%)</td>
</tr>
<tr>
<td><strong>International grid</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[Interconnection level*]</td>
<td>44%</td>
<td>&gt; 10%</td>
<td>&gt; 6%</td>
<td>Not connected</td>
</tr>
<tr>
<td><strong>&lt;kW&gt;</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dependence of flexibility on abroad</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ex/Import on the day with high V-RE ratio</td>
<td>80%</td>
<td>&gt; 40%</td>
<td>&gt; 35%</td>
<td></td>
</tr>
<tr>
<td>4.3GW Export: 2.8GW Import: 1.5GW</td>
<td>16GW Export: 12GW Import: 4GW</td>
<td>8.5GW Export: 3.2GW Import: 5.3GW</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>&lt;kWh&gt;</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual export/import</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Export</td>
<td>33% (10TWh)</td>
<td>&gt; 13% (85TWh)</td>
<td>&gt; 1% (2TWh)</td>
<td>No Export/Import</td>
</tr>
<tr>
<td>Import</td>
<td>55% (16TWh)</td>
<td>&gt; 5% (34TWh)</td>
<td>&lt; 8% (24TWh)</td>
<td>No Export/Import</td>
</tr>
</tbody>
</table>

*Ratio of international grid capacity and installed power production capacity

Source: ENTSO-E “Transparency Platform”, “Statistical Factsheet” etc

1. **Expand system capacity**
2. **Increase the rate of renewable energy**
### Transition of Electricity mix, CO2, Price in EU countries

<table>
<thead>
<tr>
<th>Group 1: Continental, High V-RE ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Germany</strong></td>
</tr>
<tr>
<td>2010</td>
</tr>
<tr>
<td>61% (Coal 44, Gas 14)</td>
</tr>
<tr>
<td>2015</td>
</tr>
<tr>
<td>56% (Coal 44, Gas 10)</td>
</tr>
<tr>
<td><strong>Spain</strong></td>
</tr>
<tr>
<td>2010</td>
</tr>
<tr>
<td>46% (Coal 9, Gas 32)</td>
</tr>
<tr>
<td>2015</td>
</tr>
<tr>
<td>44% (Coal 19, Gas 19)</td>
</tr>
<tr>
<td><strong>Denmark</strong></td>
</tr>
<tr>
<td>2010</td>
</tr>
<tr>
<td>68% (Coal 44, Gas 20)</td>
</tr>
<tr>
<td>2015</td>
</tr>
<tr>
<td>34% (Coal 25, Gas 6)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Power Mix</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fossil</strong></td>
</tr>
<tr>
<td>2010</td>
</tr>
<tr>
<td>Germany: 61% (Coal 44, Gas 14)</td>
</tr>
<tr>
<td>2015</td>
</tr>
<tr>
<td>Spain: 56% (Coal 44, Gas 10)</td>
</tr>
<tr>
<td><strong>Stable zero emission</strong></td>
</tr>
<tr>
<td>2010</td>
</tr>
<tr>
<td>Germany: 31% (Nuclear 22, Hydro 3)</td>
</tr>
<tr>
<td>2015</td>
</tr>
<tr>
<td>Spain: 25% (Nuclear 14, Hydro 3)</td>
</tr>
<tr>
<td><strong>Variable zero emission</strong></td>
</tr>
<tr>
<td>2010</td>
</tr>
<tr>
<td>Germany: 8% (PV 2, Wind 6)</td>
</tr>
<tr>
<td>2015</td>
</tr>
<tr>
<td>Spain: 18% (PV 6, Wind 12)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CO2 emission [kgCO2/kWh]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
</tr>
<tr>
<td>2010</td>
</tr>
<tr>
<td>0.48 kg</td>
</tr>
<tr>
<td>2015</td>
</tr>
<tr>
<td>0.45 kg</td>
</tr>
<tr>
<td>Spain</td>
</tr>
<tr>
<td>2010</td>
</tr>
<tr>
<td>0.24 kg</td>
</tr>
<tr>
<td>2015</td>
</tr>
<tr>
<td>0.29 kg</td>
</tr>
<tr>
<td>Denmark</td>
</tr>
<tr>
<td>2010</td>
</tr>
<tr>
<td>0.36 kg</td>
</tr>
<tr>
<td>2015</td>
</tr>
<tr>
<td>0.17 kg</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price for household [Yen/kWh]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
</tr>
<tr>
<td>2010</td>
</tr>
<tr>
<td>32 yen</td>
</tr>
<tr>
<td>2015</td>
</tr>
<tr>
<td>40 yen</td>
</tr>
<tr>
<td>Spain</td>
</tr>
<tr>
<td>2010</td>
</tr>
<tr>
<td>24 yen</td>
</tr>
<tr>
<td>2015</td>
</tr>
<tr>
<td>26 yen</td>
</tr>
<tr>
<td>Denmark</td>
</tr>
<tr>
<td>2010</td>
</tr>
<tr>
<td>36 yen</td>
</tr>
<tr>
<td>2015</td>
</tr>
<tr>
<td>41 yen</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
</tr>
<tr>
<td>⇒CO2 emission: Remain</td>
</tr>
<tr>
<td>⇒Price: Increase</td>
</tr>
<tr>
<td>Spain</td>
</tr>
<tr>
<td>⇒CO2 emission: Increase</td>
</tr>
<tr>
<td>⇒Price: Increase</td>
</tr>
<tr>
<td>Denmark</td>
</tr>
<tr>
<td>⇒CO2 emission: Decrease</td>
</tr>
<tr>
<td>⇒Price: Increase</td>
</tr>
</tbody>
</table>

*Points*  
✓ V-RE: Increase  
✓ Nuclear: Decrease  
✓ Coal: Remain  
⇒CO2 emission: Remain  
⇒Price: Increase  


*Rough calculation assuming EUR 1 = JPY 135*
## Transition of Electricity mix, CO2, Price in EU countries

<table>
<thead>
<tr>
<th>Group2: Island, Both RE &amp; Nuclear</th>
<th>Group3: High stable zero emission ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>United Kingdom</strong></td>
<td><strong>France</strong></td>
</tr>
<tr>
<td>2010</td>
<td>2010</td>
</tr>
<tr>
<td>2015</td>
<td>2015</td>
</tr>
<tr>
<td>Fossil</td>
<td>Fossil</td>
</tr>
<tr>
<td><strong>77%</strong></td>
<td><strong>10%</strong></td>
</tr>
<tr>
<td>(Coal 29, Gas 46)</td>
<td>(Coal 5, Gas 4)</td>
</tr>
<tr>
<td><strong>54%</strong></td>
<td><strong>7%</strong></td>
</tr>
<tr>
<td>(Coal 23, Gas 30)</td>
<td>(Coal 2, Gas 4)</td>
</tr>
<tr>
<td>Stable zero emission</td>
<td>Stable zero emission</td>
</tr>
<tr>
<td><strong>21%</strong></td>
<td><strong>88%</strong></td>
</tr>
<tr>
<td>(Nuclear 16, Hydro 1)</td>
<td>(Nuclear 76, Hydro 11)</td>
</tr>
<tr>
<td><strong>32%</strong></td>
<td><strong>88%</strong></td>
</tr>
<tr>
<td>(Nuclear 21, Hydro 2)</td>
<td>(Nuclear 78, Hydro 10)</td>
</tr>
<tr>
<td>Variable zero emission</td>
<td>Variable zero emission</td>
</tr>
<tr>
<td><strong>3%</strong></td>
<td><strong>2%</strong></td>
</tr>
<tr>
<td>(PV 0, Wind 3)</td>
<td>(PV 0, Wind 2)</td>
</tr>
<tr>
<td><strong>14%</strong></td>
<td><strong>5%</strong></td>
</tr>
<tr>
<td>(PV 2, Wind 12)</td>
<td>(PV 1, Wind 4)</td>
</tr>
<tr>
<td><strong>CO2 emission [kgCO2/kWh]</strong></td>
<td><strong>CO2 emission [kgCO2/kWh]</strong></td>
</tr>
<tr>
<td>0.45kg</td>
<td>0.08kg</td>
</tr>
<tr>
<td>0.35kg</td>
<td>0.05kg</td>
</tr>
<tr>
<td><strong>Price for household [Yen/kWh]</strong></td>
<td><strong>Price for household [Yen/kWh]</strong></td>
</tr>
<tr>
<td>18yen</td>
<td>17yen</td>
</tr>
<tr>
<td>23yen</td>
<td>22yen</td>
</tr>
</tbody>
</table>

### Notes

- **Points**
  - V-RE: Increase
  - Nuclear: Increase
  - Hydro: Increase
  - Coal (Fossil): Decrease

- ** Comments**
  - CO2 emission: Decrease
  - Price: Increase

#### Group2: Island, Both RE & Nuclear
- **Points**
  - V-RE: Increase
  - Nuclear: Increase
  - Stable zero emission: Remain
  - Coal: Slightly decrease

- **Comments**
  - CO2 emission: Decrease
  - Price: Increase

#### Group3: High stable zero emission ratio
- **Points**
  - V-RE: Increase
  - Stable zero emission: Remain
  - Fossil: Slightly decrease

- **Comments**
  - CO2 emission: Decrease
  - Price: Decrease

---

*Rough calculation assuming EUR 1 = JPY 135, GBP 1 = JPY 150

Source: IEA Energy Balances, CO2 Emissions from Fuel Combustion, Energy Prices & Taxes etc.
(Reference) Transition of CO2 emission and Electricity Price in EU countries

- Denmark (2010⇒2015)
- Spain (2010⇒2015)
- United Kingdom (2010⇒2015)
- Germany (2010⇒2015)