Era of 100% Renewables
<table>
<thead>
<tr>
<th>Objective</th>
<th>2016</th>
<th>2030</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emission reduction from 1990</td>
<td>+13%</td>
<td>-20%</td>
<td>-100%</td>
</tr>
<tr>
<td>Renewable share in final energy</td>
<td>16%</td>
<td>42%</td>
<td>100%</td>
</tr>
<tr>
<td>Electricity from renewables</td>
<td>41%</td>
<td>74%</td>
<td>100%</td>
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</tbody>
</table>
## NATIONAL INTEGRATED PLAN ENERGY AND CLIMA: OBJECTIVES 2030

### Parque de generación del Escenario Objetivo (MW)

<table>
<thead>
<tr>
<th>Año</th>
<th>2015</th>
<th>2020*</th>
<th>2025*</th>
<th>2030*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eólica</td>
<td>22.925</td>
<td>27.968</td>
<td>40.258</td>
<td>50.258</td>
</tr>
<tr>
<td>Solar fotovoltaica</td>
<td>4.854</td>
<td>8.409</td>
<td>23.404</td>
<td>36.882</td>
</tr>
<tr>
<td>Solar termoeléctrica</td>
<td>2.300</td>
<td>2.303</td>
<td>4.803</td>
<td>7.303</td>
</tr>
<tr>
<td>Bombeo Mixto</td>
<td>2.687</td>
<td>2.687</td>
<td>2.687</td>
<td>2.687</td>
</tr>
<tr>
<td>Bombeo Puro</td>
<td>3.337</td>
<td>3.337</td>
<td>4.212</td>
<td>6.837</td>
</tr>
<tr>
<td>Biogás</td>
<td>223</td>
<td>235</td>
<td>235</td>
<td>235</td>
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<tr>
<td>Geotérmica</td>
<td>0</td>
<td>0</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>Energías del mar</td>
<td>0</td>
<td>0</td>
<td>25</td>
<td>50</td>
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<tr>
<td>Biomasa</td>
<td>677</td>
<td>877</td>
<td>1.077</td>
<td>1.677</td>
</tr>
<tr>
<td>Carbón</td>
<td>11.311</td>
<td>10.524</td>
<td>4.532</td>
<td>0-1.300</td>
</tr>
<tr>
<td>Ciclo combinado</td>
<td>27.531</td>
<td>27.146</td>
<td>27.146</td>
<td>27.146</td>
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<tr>
<td>Cogeneración carbón</td>
<td>44</td>
<td>44</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cogeneración gas</td>
<td>4.055</td>
<td>4.001</td>
<td>3.373</td>
<td>3.000</td>
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<tr>
<td>Cogeneración productos petrolíferos</td>
<td>585</td>
<td>570</td>
<td>400</td>
<td>230</td>
</tr>
<tr>
<td>Fuel/Gas</td>
<td>2.790</td>
<td>2.790</td>
<td>2.441</td>
<td>2.093</td>
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<tr>
<td>Cogeneración renovable</td>
<td>535</td>
<td>491</td>
<td>491</td>
<td>491</td>
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<tr>
<td>Cogeneración con residuos</td>
<td>30</td>
<td>28</td>
<td>28</td>
<td>24</td>
</tr>
<tr>
<td>Residuos sólidos urbanos</td>
<td>234</td>
<td>234</td>
<td>234</td>
<td>234</td>
</tr>
<tr>
<td>Nuclear</td>
<td>7.399</td>
<td>7.399</td>
<td>7.399</td>
<td>3.181</td>
</tr>
<tr>
<td>Total</td>
<td>105.621</td>
<td>113.151</td>
<td>137.117</td>
<td>156.965</td>
</tr>
</tbody>
</table>

**Legend:**
- **Wind:**
- **FV:**
- **CSP:**
- **Coal:**
- **CCGT:**
In 2017: 8 GW were auctioned at zero support incomes will be exclusively the market price
CHALLENGE: ELECTRICITY MARKET DESIGN CANNIBALISATION

Source: Axpo
CHALLENGE: CURTAILMENT
Diversity of actors:

- Increases sources of funding
- Increases social acceptance
- Maximise socioeconomic impact
- Diversify technologies and territories
PART OF THE SOLUTION: AUCTION DESIGN

• At least one auction per year
• At least the equivalent of 3,000 MW
• Bidding energy
• Pay as bid
• Auctions for dispatchable energy
• Auctions for diversity of location (also coal mining)
• Accession process for community driven projects
CHALLENGE: VERY LARGE SCALE DISTRIBUTED GENERATION

- Stage 1: Grid Modernization
  - LOW DER Adoption
  - Aging Infrastructure Refresh
    - Advanced grid technologies

- Stage 2: DER Integration
  - Moderate to High Level of DER Adoption

- Stage 3: Distributed markets
  - Very High DER Adoption

- Multi-Party Transactions & Market Operations

- DER Integration & Optimization; Dist. Platform Development
Aggregators: prosumers, demand side management, e-mobility

1. Access to markets, definition of services:
   • Existing
   • Requested by the DSO
   • Provided ad-hoc by the aggregator

2. Access to data:
   • Producers from 10 kW
   • Data hub
DIRECTIVE 2001/42/CE DU PARLEMENT ET LE CONSEIL DE L’UNION EUROPÉENNE

relative à l’évaluation des incidences de certains plans d’aménagement.

LE PARLEMENT EUROPÉEN ET LE CONSEIL DE L’UNION EUROPÉENNE,

vu le traité instituant la Communauté européenne, et notamment son article 175, paragraphe 1;

vu la proposition de la Commission (1);

vu l’avis du Comité économique et social (2).
Maximising the electrification of the economy

Increasing role of natural gas as a bridge fuel for providing flexibility

Key role of Hydrogen as enabler for sector coupling (using existing natural gas infrastructures)

Possible role of Hydrogen to provide flexibility being used in industrial processes

Carbon capture and storage maybe needed for emissions from processes
CONCLUSIONS

Very large share of renewables are feasible and it is not a technical challenge

There is the need to coupling energy uses through electrification of the economy

There is a need to re-design markets

Increasingly will be a social and environmental challenge

Frist pillar is energy efficiency and saving
Era of 100% Renewables

REvision 2019: Renewable Revolution

Hugo Lucas
Head of Regulation and corporate Strategy for the Energy Transition - IDAE
Tokyo | 6 March 2019