APEC EGNRET 48 Meeting
Jeju, Korea, 28-30 March, 2017

APERC Update

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Asia Pacific Energy Research Centre (APERC)
✓ Modelling improvements
✓ Renewables analysis improvements
✓ Renewables potential assessment
✓ Other updates
### 6th and 7th Edition of the Outlook: comparison

<table>
<thead>
<tr>
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<tr>
<td>Economies</td>
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<td>Outlook period</td>
<td>From 2013 to 2040</td>
<td>From 2015 to 2050</td>
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Further updates expected, as at 2017.03.24
MAIN ASSUMPTIONS

- Population
- Fuel price assumptions
- Buildings demand data
- Industry demand data
- Transport demand data
- Renewables potential and costs
- Power generation and capacity
- Production sector data
- Energy investment data

MAIN RESULTS

- Buildings FED
- Industry FED
- Transport FED
- Renewable generation
- Installed capacity and generation
- Energy production, supply and net trade
- Energy investments
7th Edition of the Outlook: DRAFT model structure

Working document, no referencing or citing
Macroeconomic:
- Use OECD GDP forecasts (where available),

Buildings:
- Activity driven model (space/water heating, space cooling, lighting, appliances),
- Extensive work underway to address Commercial buildings end-use data unavailability,

Transport:
- Light Trucks and Buses added, taxis are considered
- Activity driven model,
- Modal shift,
- More detailed fuels analysis,
Industry:
- Bottom-up approach
- Moving away from ISIC,
- Energy-intensive sub-sectors are physical output driven, other sub-sectors - value added,

Renewables:
- Dedicated model no more,
- Integration with Electricity and Demand sectors,
Supply:
- Production and trade forecast

Electricity:
- Extensive list of technologies, including Renewables,
- Improved time-resolution

Heat:
- New model will accommodate commercial heating and cooling,

Investment:
- Demand sector investments, e.g. difference between reference and high efficiency appliances,
### Engaging the economy experts to review and comment our modelling assumptions

<table>
<thead>
<tr>
<th>Renewables assumptions for RESIDENTIAL &amp; COMMERCIAL BUILDINGS &amp; POWER in 20_USA</th>
<th>Indicator</th>
<th>Unit</th>
<th>2015</th>
<th>BAU</th>
<th>2015-2050,%</th>
<th>Comments</th>
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### 7th Edition of the Outlook: timeline *(draft)*

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
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<tbody>
<tr>
<td>Expert Economy Review of model results</td>
<td>Oct 2017</td>
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<tr>
<td>EWG review of Vol II</td>
<td>Sept 2018</td>
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<tr>
<td>EWG review of Vol I</td>
<td>Oct 2018</td>
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<tr>
<td>Outlook 7th edition released</td>
<td>April 2019</td>
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Renewable Energy technologies in the 6th Edition

Renewables

- HYDRO
  - Hydro
    - Pumped storage
  - Hydro
    - no grid storage
    - with grid storage

- WIND
  - Onshore
    - no grid storage
    - with grid storage
  - Offshore
    - no grid storage
    - with grid storage

- SOLAR
  - Solar Photovoltaics Utility
    - no grid storage
    - with grid storage
  - Solar Photovoltaics rooftops
    - no grid storage
    - with grid storage

- BIOENERGY
  - Concentrated Solar power
    - no grid storage
    - with grid storage

- GEOTHERMAL
  - Geothermal power
    - no grid storage
    - with grid storage
Renewable Energy technologies

Renewables

Hydropower
- Mini Hydro
- Small Hydro
- Large Hydro
- Pumped storage
- Wind Onshore
- Wind Offshore
- Solar PV - Residential
- Solar PV - Commercial
- Solar PV - Utility
- Concentrated Solar Power

Solar Power
- Solar thermal
- Bioenergy

Geothermal power
- Solid biomass
- Liquid fuels
- Gaseous fuels

Geothermal heat
- Direct heat
- Ground source heat

Marine
Space heating demand breakdown

Heating

Residential Heating Service Demand

- Share
- Coal
- Oil
- Natural Gas
- Electricity
- Heat pump
- District Heating
- Modern Biomass
- Traditional bio.
- Solar thermal
- Geothermal

Efficiency

Residential Energy Demand for

Total residential floor

Average area per HH

Total # of households

Climate (HDD)

- GDP per HH
- Building standards

Heating demand per m²

Total GDP

- # of HH

HH size

Building stock by year

Building Insulation Reqs

Population

APEC Asia Pacific Energy Research Centre
Renewables potential assessment
Estimates for Residential Rooftop solar PV and heat potential,

- An economy is split in urban and rural (urbanisation rate),
- Per capita floor size for urban and rural to calculate floor areas,
- Building footprints based on average floor count,
- Assume 1:1 ratio for footprint and roof area,
- Assume 10-25% of roof area is suitable for installations,
- Account for efficiency change from 2015 to 2050,
- Use average or regional insolation data,
- For max solar heat case:
  - Assume 3m² solar water heater collector size, however requires 8m² of roof,
  - Remaining area is covered with Solar PV with 80-90% density factor.

Note:
A trial calculation for Residential sector in Viet Nam:

- All urban areas roofs are covered by Solar Water Heaters (SWH),
- In rural areas Solar PV is 20-35%, gradually declines
Estimates for Industrial Rooftop solar PV and heat potential,

✓ Industry is split into sub-sectors,

✓ Individual plants with known production are assessed in sub-sectors,
  ✓ Assessment includes Value Added/Physical Output and Buildings footprint,

✓ Assume 10-30% of roof area is suitable for installations,

✓ Calculate the Value Added/Physical Output per 1m² of roof by sector,

✓ Account for efficiency change from 2015 to 2050,

✓ Use average or regional insolation data,

✓ For max solar heat case:
  ✓ Assume solar heating installations with 80% density,
  ✓ Assume Solar PV installation with 80-90% density.

Note:
For 7th Outlook, estimates for biomass supply potential will be included covering agricultural and forestry residues and animal wastes. Initial estimates for municipal solid waste might also be considered.

- Used the FAO database for agriculture production, area harvested, livestock and forestry production
Estimating biomass potential from agricultural residues

Projection for the total harvested area until 2050
Total Harvested Area = f (GDP, POP, Capital Stock)

Assume the productivity using its historical trend (logarithmic trend)

Production by crops = Harvested area * Productivity

Agriculture Residual = Production * Emission Rate (Waste)

Residual Available = Agriculture Residual * Available Rate
Estimating biomass potential from forestry residues

Projection for forest area = f(POP, Capital Stock)

Industrial wood = f(forest area, GDP Industry)
Wood fuel = f(forest area, industrial wood)
Wood chips = f(forest area, industrial wood)

Forest Residual = Wood Production * Emission Rate (Waste)

Residual Available = Production Residual * Available Rate

Source: woodpelletssolutions.co.uk
Source: energybook.info
Estimating biomass potential from animal waste

1. **Projection for Livestock Per Capita** = \( f(\text{historical trend logarithmic}) \)

2. **Number of Livestock** = livestock per capita * Population

3. **Animal Waste** = Number of Livestock * Emission Rate (Waste)

4. **Animal Waste Available** = Animal Waste * Available Rate

Sources:
- woodpelitesolutions.co.uk
- energybook.info
Estimating biomass potential from municipal solid waste

Projection for municipal solid waste = f(Waste per capita, POP, GDP per capita)

Available Municipal Waste = Volume of Municipal Waste * Recovery Rate

Note:

Higher recovery rate is assumed for developed economies with waste segregation policy/program.

In the case of Japan, the recovery rate is 50%.

Source: http://www.esru.strath.ac.uk/EandE/Web_sites/03-04/biomass/background%20info4.html

Source: care2.com
Other updates
Other updates

- **APERC – IEEJ: Renewable Heating and Cooling Study**
  - Calibrating fuel-based coefficients for temperature analysis,
  - IEEJ is preparing technical potential for Solar Thermal and Ground Source Heat Pumps in Industry,
  - Not-choice model, but potential-based uptake of RE for buildings,
  - Preliminary results are expected before the Annual Conference,

- **APERC has joined REN21**
  - First data submissions and chapter review for GSR2017,

- **APERC to support Chinese Taipei with “Filling the gap” project**
  - Quantitative analysis,
  - Data on costs, potentials, best practices, financing mechanisms etc.?
Thank you!

http://aperc.ieej.or.jp/