



# New energy technologies and the implications for data collection and reporting

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## The world has only added more energy sources and processes

#### Global primary energy consumption by source



Primary energy is calculated based on the 'substitution method' which takes account of the inefficiencies in fossil fuel production by converting non-fossil energy into the energy inputs required if they had the same conversion losses as fossil fuels.





Source: Our World in Data based on Vaclav Smil (2017) and BP Statistical Review of World Energy

OurWorldInData.org/energy • CC BY

## Electricity is increasingly generated from wind and solar (APEC ED&SO 8)



#### **Electricity generation in REF (TWh)**



#### **Electricity generation in CN (TWh)**

- Growth in electricity generation to meet increased buildings and transport demand
- Higher growth in variable generation leads to a greater role for energy storage



## CN delivers ambitious CO<sub>2</sub> emissions reductions (APEC ED&SO 8)



### **Energy-related CO<sub>2</sub> emissions in REF (million tonnes)**

- The power and transport sectors are the most influential in driving emissions lower in CN ٠
- Carbon management (e.g., CCS) is an important contributor •



## The energy system of the present is (relatively) straightforward



## The energy system of the future is increasingly complex



## "New" technologies highlight important questions

#### **Electric Vehicles**

- How to capture charging demand? (homes vs commercial chargers)
- Real-time information flows

#### **Carbon capture**

- Energy vs "non-energy" use
- Capacity
- Performance and losses

#### Hydrogen

- Production type: fossil-based, electricity-based
- Utilization: blending, direct use (e.g., fuel cell), storage, production from other industrial processes (e.g., refining)
- Transport: ammonia, liquified

#### Energy storage (excluding pumped hydro)

- Capacity
- Two-way energy and information flow









## Data for "old" technologies and processes are important, too...

- End-use activities: heating, lighting, cooling, cooking, passenger-km, tonnes-km, etc
- Building inventories
- Vehicle stocks
- Vehicle sales
- Power plant capacities
- Water
- Land
- Methane emissions



## Data consumers have evolved

Open-source tools and methodologies have expanded analytical capabilities to more researchers and analysts

#### Computational tools such as machine learning and AI are data hungry

- Larger data sets = higher temporal resolution (days to minutes) ٠
- Different data sets = appliances, vehicles, electricity generation, ٠ electricity consumption, etc

#### Accessibility of datasets is hit or miss

- APIs improve access for data scraping and queries ٠
- Human friendly and machine friendly versions are needed ٠

#### List of models

- AMIRIS
- ASAM
- AnyMOD
- Backbone
- Balmorel
- Breakthrough Energy Model
- CAPOW
- CESAR-P
- Calliope
- CapacityExpansion
- DESSTINEE
- DIETER
- Demod
- Dispa-SET
- DynPP
- EA-PSM Electric Arc Flash
- EA-PSM Electric Short Circuit
- ELMOD
- ELTRAMOD
- EMLab-Generation
- EMMA
- EOLES elec
- EOLES elecRES
- ESO-X
- Energy Policy Simulator
- Energy Transition Model
- EnergyNumbers-Balancing
- EnergyRt
- EnergyScope
- Ficus
- FlexiGIS
- GAMAMOD
- GAMAMOD-DE

- - SIREN
- https://wiki.openmod-initiative.org/wiki/Main Page

- GRIMSEL-FLEX
- Genesys
- GridCal
- HighRES
- JMM
- Lemlab
- LoadProfileGenerator
- MEDEAS
- MOCES
- Maon
- Medea
- MicroGridsPy
- Mosaik
- MultiMod
- NEMO
- NEMO (SEI)
- OMEGAlpes
- OSeMOSYS
- Oemof OnSSET
- OpenTUMFlex
- PLEXOS Open EU
- POMATO
- Pandapipes
- Pandapower
- PowNet
- PowerMatcher
- PowerSimulations.jl
- PowerSimulationsDynamics.jl

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- PowerSystems.jl
- Pvlib python
- PyLESA
- PyPSA
- REopt
- Region4FLEX
- Renpass

APERC

## **Energy statistics are the "raw material" for many analyses**



APER An example workflow for a model-based analysis like the APEC Energy Demand and Supply Outlook

## A variety of methods, tools, and data are used to produce an outlook



clean and transform Energy Balance Tables and other databases

• move results from one step to the next

PERC

• Produce visualizations (interactive and Excel workbooks)

## **Closing thoughts**

- Decision making increasingly relies on quantitative analysis reliable data are fundamental inputs
- Many of the technologies and processes are not new, but their roles in energy systems are changing
- Energy systems are becoming less top-down, resulting in bi-directional energy and information flows
- There are many gaps for existing technologies and processes
- There are more data available for collection and reporting than ever, yet infrastructure for collecting and dissemination lags







## Thank you. Read the Outlook at <a href="https://aperc.or.jp/reports/outlook.php">https://aperc.or.jp/reports/outlook.php</a>

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