REN21 RENEWABLES GLOBAL FUTURES REPORT

FIRST REVIEW DRAFT

Lead Author and Research Director:
Dr. Eric Martinot, Institute for Sustainable Energy Policies
martinot@isep.or.jp

Report is a collaboration between
REN21 Renewable Energy Policy Network for the 21st Century
and Institute for Sustainable Energy Policies, Tokyo

Japan Renewable Energy Foundation
"Revision 2012 – New Renewable Direction for Japan"
Tokyo, Japan
March 9, 2012

REPORT SCOPE AND PURPOSE

- "Sister report" to Renewables Global Status Report
- What is our current thinking about the future of renewable energy?
- What is the range of credible possibilities for renewable energy futures?
- Tool for education and discussion – an objective framework for thinking about the future of renewables, not a specific vision or position
- Four primary forms of source material have been employed:
    - Published long-term scenarios and roadmaps
    - Interviews with experts from around the world, including industry leaders and visionaries
    - Government policy targets, including regional, national, state/provincial, municipal
    - Long-term action plans by local (city) governments

ENERGY – HOW MUCH FROM RENEWABLES?

Today: Sweden already gets half of its total energy from renewables. Countries over 20% include Austria, Denmark, Finland, Iceland, Latvia, New Zealand, and Portugal. Germany and several others are at 10%. Japan is 6%.

Scenarios: in 2010-2011 several scenarios were published showing 50-100% renewables shares of energy by 2050. Includes power, heat, and transport.

- International Energy Agency (IEA) ETP Blue Map: 40%
- IEA RETD ACES: 55%
- Greenpeace/EREC: 58%/80%
- European Commission Energy Roadmap 2050 (2011) "High RE" scenario: 75% for Europe

Interviewees: almost all believed at least 30-50% in the long term (typically 2050) and "should" get close to 100%. Electricity easiest, heat much more difficult, transport most difficult/uncertain.

ELECTRIC POWER – HOW MUCH FROM RENEWABLES?

Today: Many countries are already at high shares or targeting high shares: Spain (21% in 2010; 50% by 2020); Germany (14% in 2010; 50% by 2030); California (33% by 2020); Denmark (100% by 2030).

Scenarios:

	By Year	Electricity
IEA World Energy Outlook (2010) "New Policies"	2035	32%
IEA World Energy Outlook (2010) "450"	2035	45%
IEA Energy Technology Perspectives (2010) "Blue Map"	2050	58%
IEA Energy Technology Perspectives (2010) "Blue Map HR"	2050	75%
IEA RETD "ACES" (2010)	2030	61%
BP Energy Outlook 2030 (2010)	2030	~30%
Exxon-Mobil Outlook to 2030 (2010)	2030	~25%
U.S. DOE EIA International Energy Outlook (2010)	2030	23%
Greenpeace/EREC (2010) "Revolution"	2030	48%
	2050	79%
Greenpeace/EREC (2010) "Advanced Revolution"	2030	61%
	2050	95%
WWF (2011) "Ecofys Energy Scenario"	2050	100%

ELECTRIC POWER – HOW?

1. Balancing. Utilities will respond to the challenge of balancing large shares of variable renewables on power grids. There are a dozen different options. One of the most important options is "demand response" – contracting with customers to reduce load during specific conditions. *"Flexibility in power systems is the commodity of the future."*

2. Energy storage. We don't need to wait for storage technology to become commercial. There are commercial forms of storage emerging today, and companies are already making money building storage, but it will take a long time before we see large amounts of storage. *"There is a lot of headroom with other balancing options before storage becomes necessary."*

3. Natural gas. Natural gas and biomass are key compliment to variable renewables like solar and wind. In the future, we will see integrated renewables/gas business models, ownership, and policy.

4. Distributed power. Power systems will be a mix of centralized and distributed (on-site and remote): rooftop solar, local micro-grids serving small neighborhoods, small local wind farms, small biomass power plants with heat supply, dedicated power plants (i.e., wind/CSP for desalination), and large centralized wind, solar, geothermal, and hydro. Power systems become "multi-level."

HEATING AND COOLING – HOW MUCH FROM RENEWABLES?

Today: Modern biomass for heating widespread, about 2.5% of global primary energy supply. Solar hot water and heating capacity reached 185 GW (thermal) in 2010.

Scenarios:

	By Year	Heat
IEA World Energy Outlook (2010) "New Policies"	2035	16%
IEA World Energy Outlook (2010) "450"	2035	21%
IEA Energy Technology Perspectives (2010) "Blue Map"	2050	--
IEA Energy Technology Perspectives (2010) "Blue Map HR"	2050	--
IEA RETD "ACES" (2010)	2030	--
BP Energy Outlook 2030 (2010)	2030	--
Exxon-Mobil Outlook to 2030 (2010)	2030	--
U.S. DOE EIA International Energy Outlook (2010)	2030	--
Greenpeace/EREC (2010) "Revolution"	2030	45%
	2050	71%
Greenpeace/EREC (2010) "Advanced Revolution"	2030	49%
	2050	91%
WWF (2011) "Ecofys Energy Scenario"	2050	85%

HEATING AND COOLING – HOW?

1. Policy: Copenhagen plans that in the next decade, 98% of homes in Copenhagen will be connected to district heating system powered by biomass. Hamburg in 2009 enacted a Renewable Heating Act and Energy Efficiency Ordinance that will require new buildings to use renewable energy for a share of heating. EU directive on buildings requires near-zero-energy new buildings by 2018/2020.

2. Technologies:

- "Passive" houses – ("near-zero-energy" houses) very low heating requirements. *"With passive house designs, by 2020, we will realize that no sacrifices are needed and thermal comfort is not a luxury but a basic right."*
- Geothermal heat pumps
- Biomass pellet stoves
- Biomass small-scale combined-heat-and-power
- Solar heating for commercial buildings: *"There is a huge potential for future cost reduction of solar thermal, especially at larger scales than traditional household systems."*
- Solar heating for industrial process heat
- Heat storage: building materials, phase-change materials allow seasonal heat storage
- Solar electricity for cooling (reduce day-time air-conditioner electricity demand)
- Solar heat for cooling

TRANSPORT – HOW MUCH FROM RENEWABLES?

Today: biofuels about 3% of global road transport energy. Brazil today: 40% of light-duty fuel. Sweden today: 6%. EU target: 10% share (including electric vehicles) by 2020.

Scenarios:

	By Year	Transport
IEA World Energy Outlook (2010) "New Policies"	2035	8%
IEA World Energy Outlook (2010) "450"	2035	14%
IEA Energy Technology Perspectives (2010) "Blue Map"	2050	50%
IEA Energy Technology Perspectives (2010) "Blue Map HR"	2050	--
IEA RETD "ACES" (2010)	2030	--
BP Energy Outlook 2030 (2010)	2030	--
Exxon-Mobil Outlook to 2030 (2010)	2030	--
U.S. DOE EIA International Energy Outlook (2010)	2030	~3%
Greenpeace/EREC (2010) "Revolution"	2030	14%
	2050	39%
Greenpeace/EREC (2010) "Advanced Revolution"	2030	--
	2050	--
WWF (2011) "Ecofys Energy Scenario"	2050	100%

TRANSPORT – HOW?

1. Advanced biofuels: IEA World Energy Outlook says advanced biofuels are currently not competitive with conventional fuels and are mostly in the demonstration phase. They are expected to be commercialized by 2020 (NPS scenario). Biofuels 8% of road-transport energy by 2035.

Biofuels debates: Some interviewees thought that as much as half of all transportation fuel by 2050 could come from biofuels, others projected much less. They raised important debates:

- How sustainable can biofuels become in the long-term?
- What markets will make the most use of biomass in the future (power, heat, or liquid/gas fuels)?
- How long will it take to commercialize cellulosic-ethanol?

2. Electric Vehicles: Assume a much larger transport role, but won't help renewables too much in the short term, except local mandates to supply charging stations from renewables. *"We are not going to deploy EVs to manage the variability of renewables; EVs must first prove their value on their own."*

Battery or fuel cell? *"The car of the future is clearly electric drive, but it's not clear if that's based on batteries or fuel cells."* Battery-EVs fill two specific niches: (1) fleet vehicles with high use and fixed stations (taxis, public transit, local trucks); (2) "micro-vehicles" (1-2 person cars, scooters).

3. Synthetic natural gas? Audi producing synthetic natural gas from renewables to supply a new fleet of natural gas vehicles.

INTEGRATION

Infrastructure. Integration of power, heat, and transport into much more integrated systems.

- Renewables integrated with natural gas and storage – natural gas as "balancing fuel"
- Denmark: use heat storage and CHP to balance variable renewable electricity (heat easier)
- "Vehicle-to-grid" (V2G) electric vehicles store power, reduce peaks, balance power systems
- "Double use" for electric vehicles to power house, store renewable power
- Make syngas or hydrogen for vehicle fuels using "excess" renewable power from grid
- "Passive" buildings with low energy requirements met entirely from renewables
- On-site solar PV to reduce peak air conditioning loads

Business models. Companies will integrate into existing businesses or create new businesses**:**

- Major engineering companies offer integrated solutions using renewables.
- "Local energy-service utilities" specialize in solar PV for buildings, intelligent energy management, grid connection, small-scale energy storage, ICT, efficient appliances, software.
- Third-party owned solar PV (Sun Edison model), or vendor finance of solar PV (GMAC model)

Policy. Policies in many sectors will integrate renewables**:**

- Power market regulation and structure
- Transport planning
- Urban planning, "smart cities," building codes and standards, district heat systems
- Water, food, sanitation policies (i.e., biorefineries, co-production of bioenergy and food)

TRANSFORMATION

Solar PV grid parity. *"We have reached the point of no return in solar PV…and will see continued cost reductions, including costs of integrated installations, not just the PV panels themselves."* Interviewees expressed confidence that grid parity was coming soon to a number of regions during the period 2012-2015, including Spain, Germany, Japan, and the U.S. states of Hawaii and California.

Transformational policies. New targets and goals for future shares, like 45% share of energy in Europe by 2030. Also new power-grid policies and regulation:

- How to establish power markets that incorporate a "price" for flexibility and balance?
- How to restructure utility reserve (ancillary) markets?
- How can policy support demand-response?
- What is the policy role for transmission planning, given the impacts on renewables?
- How to encourage efficient integration of natural gas with renewables?

Transformational business models:

- Renewable energy and natural gas become an integrated "back-to-back" business
- Major utilities enter downstream or customer-side businesses such as EVs and solar PV.
- Solar PV and wind supply 100% of daytime power in Germany – how to handle business changes?
- Local utilities are re-municipalizing (Germany/California), leading to local decisions for renewables.

TRANSFORMATION

Existing energy companies adapt and innovate, or fight back, or go out of business:

> *"Electric utility companies will face some of the greatest challenges in technical and institutional restructuring that they have ever faced in the past 100 years."*
>
> *"Utility revenue models will be unrecognizable beyond 2020."*
>
> *"There will be fights – the dying throes of the centralized fossil fuel and nuclear industries – it's going to get ugly."*

Debates:

1. Will utilities lead, follow, or be pushed?
2. Will alliances form between gas and renewables companies?
3. Will large centralized utilities cooperate or compete with local municipal utilities?
4. How far will oil companies go in trying to dominate the biofuels and electric mobility sectors?
5. Will large utility companies get involved in electric mobility as a new business model?