Renewable Energy: Challenges and Risks

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NASA/C3P – 2010 INTERNATIONAL WORKSHOP ON
ENVIRONMENT AND ENERGY
"Emerging Renewable and Alternative
Energy Technologies"
02-04 November 2010
San Diego, USA

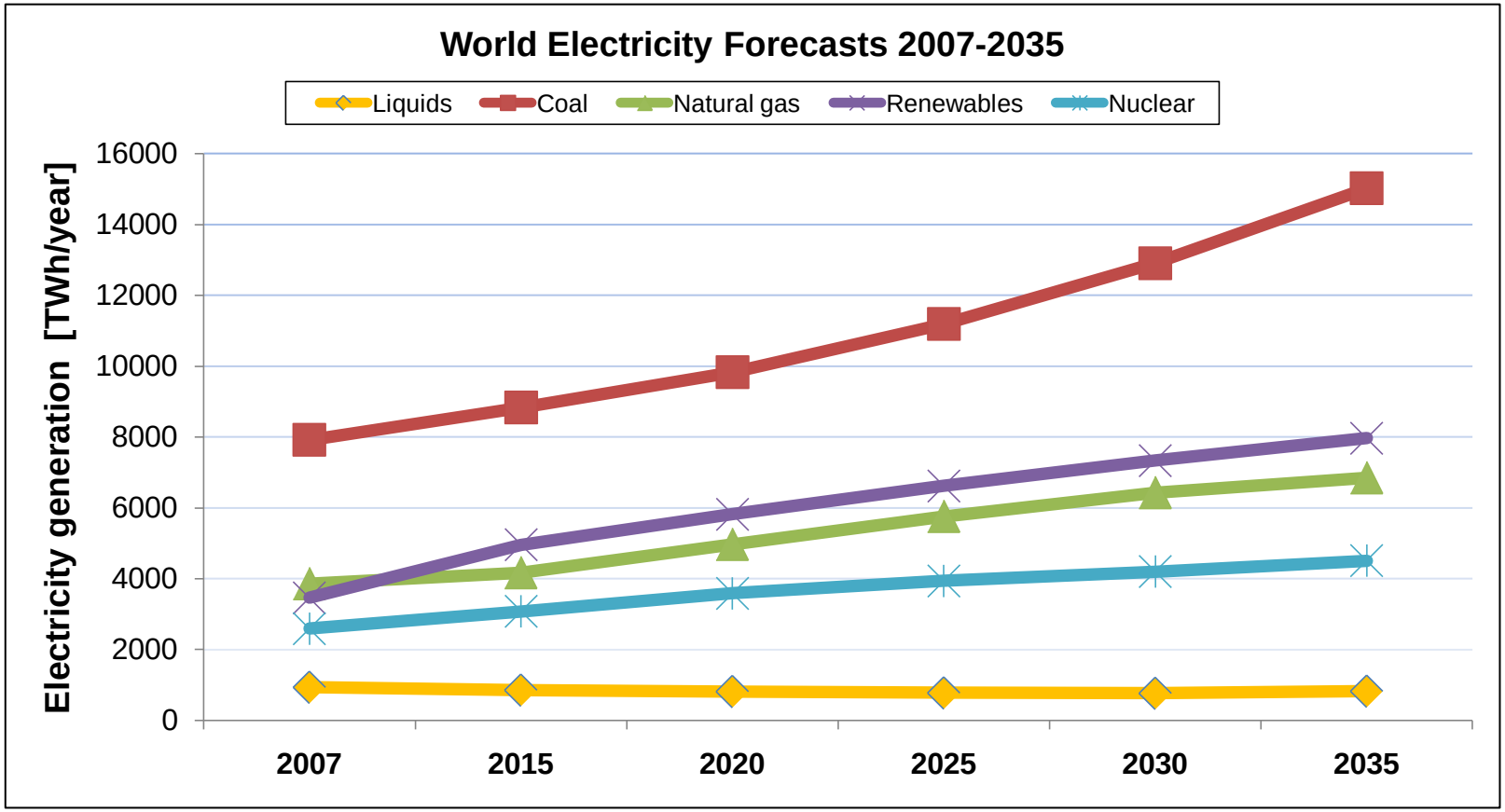
Summary

- Power Production
- Energy Future Trends
- RE Challenges
- Wind Power Risks
- Future Challenges
- Conclusions

Power Production

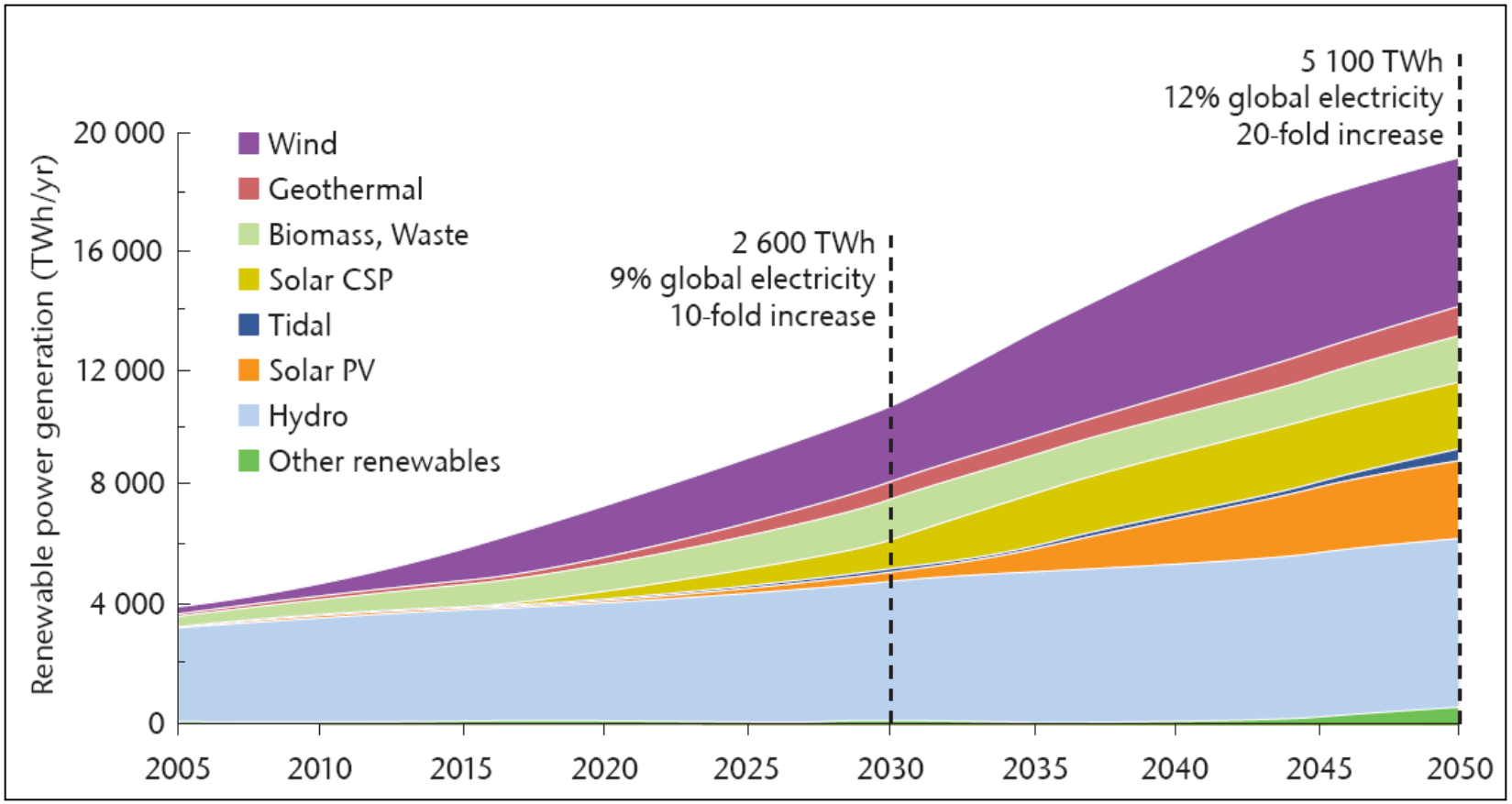
- Coal
- Oil & Gas
- Nuclear
- Renewable Energies

World Power



Source: Report #:DOE/EIA-0484(2010) - Energy Information Administration

Electricity from renewable energy



Source: IEA, 2008; Energy Technology Perspectives: Scenarios and Strategies to 2020, Paris, France

Future Trends

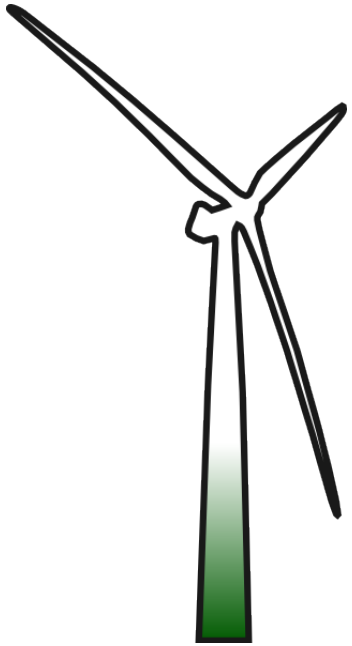
- Coal with a major role in Energy Production
- Nuclear will be also a major player
- RE has already overlead O&G
- Wind power will lead RE

RE Challenges

- Reduction of carbon emissions
- Acquisition of carbon credits
- ROI lower than half of design lifetime
- New and higher power generation systems
- Offshore wind generation with floating platforms
- After 2030 Hydro and other RE equivalent

Wind Power Risks

- Direct Risks
- Indirect risks due to other energy power systems
- Environmental issues



Wind Power Risks assessment

The conceptual risk by definition:

$$R_{i,j} = p_{i,j} \times c_{i,j}$$ With $i = 1,\ldots,n$ and $j = 1,\ldots,m$

$$R_{i,j} = \begin{bmatrix} p_{1,1} \times c_{1,1} & \cdot & \cdot & \cdot & \cdot & \cdot & p_{1,m} \times c_{1,m} \\ p_{2,1} \times c_{2,1} & \cdot & \cdot & \cdot & \cdot & \cdot & p_{2,m} \times c_{2,m} \\ \cdot & & & & & & \cdot \\ \cdot & & & & & & \cdot \\ p_{n,1} \times c_{n,1} & \cdot & \cdot & \cdot & \cdot & \cdot & p_{n,m} \times c_{n,m} \end{bmatrix}$$

$$c_{i,j} = \text{downtime cost}_{i,j} + \text{inspection \& maitenance cost}_{i,j}$$

Direct Risks

- **Failure risk of component (*i*):**

$$R_i = \sum_{j=1}^{m} R_{i,j}$$

- **Failure risk of wind turbine (*j:*)**

$$R'_j = \sum_{i=1}^{n} R_{i,j}$$

- **Failure risk of wind farms (*R*):**

$$R = \sum_{i=1}^{n} R_i = \sum_{j=1}^{m} R'_j = \sum_{j=1}^{m} \sum_{i=1}^{n} R_{i,j}$$

Indirect Risks

One can considered also Indirect Risks

$$Indirect\ Risks = \varphi\,[CPS] + \varphi\,[Other\ RE]$$

- **CPS –** Conventional Power Systems
- **Other RE –** Other Renewable Energies

Indirect Risks related to other Systems

- φ **(CPS) – Conventional Power Systems**

  Lifetime decay due to Fatigue and Creep-Fatigue damage (high cycle loading)

- φ **(Other RE) – Other Renewable Energies**

  Logistics, Availability of Resources

Total Risks

Total Risks (R_T) can be defined as the sum of direct and Indirect Risks

$$R_T = R + \varphi[CPS] + \varphi[Other\ RE]$$

Direct Risks: $$R = \sum_{i=1}^{n} R_i = \sum_{j=1}^{m} R'_j = \sum_{j=1}^{m} \sum_{i=1}^{n} R_{i,j}$$

Indirect Risks:

- **CPS –** Conventional Power Systems
- **Other RE –** Other Renewable Energies

Future Challenges

- **Improvement of Grid Management**
- **Balance within the grid made by other RE**
- **Improvement in reliability of WPG systems**
- **Search for other buffer Energy Sources**
- **Production and Storage of Hydrogen** (During Lower demand periods)

Conclusions

- **RE will have a main role in Power Production**
- **Improvement on Maintainability and Reliability of RE/WPG systems**
- **RE projects with a good Profitability (ROI)**

Conclusions

- **Decrease costs related to Maintainability** (Using wider monitoring and condition assessment systems)

- **Change for other buffer solutions for power systems**

- **Coal and Gas Power production must operate in Base Load regime**

Thank you for your attention!

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