GREEN JOBS PROJECT

Memo

Daniel Kammen
Meng Cai
Karim El Alami

December 2nd, 2014

Contents

Abstract

This memo presents the updated results that we got in Fall 2014: we first addressed the based model that was developed by Wei, et al. (2009), and then we discussed the update we recently made for national and regional modes (that have projections up to 2040). Lastly, we made the recommendation for the green jobs model improvement. The goal of this project is for each state to have a model locally to be as close as possible from the reality.

1 Base of the Green jobs project

1.1 The Green jobs project (2009)

The previous work can be found at http://rael.berkeley.edu/greenjobs, which focused on the creation of green jobs in the US until 2030. This model can be easily explained as follows:

Input

- As inputs we can modify the renewable portfolio standards (RPS) policies for 2020 to 2040: we have to make an assumption with a national policy that defines the importance of renewable energies comparing to the fossil ones. Also, we have to figure out what is the proportion for each renewable technology (solar, wind, biomass...). The default inputs that are in the data sheet are the data projection from the EIA.

- As an input, we can also modify the different numbers of job-years per GWh produced in this model, we chose to correspond these data with the numbers that we found in the literature (see tab technologies and jobs per MW)

- As an input, there is an indirect multiplier for each technology that we can modify. It depends on the technology but also on the evolution of the process. We chose to fix it at 90% of the direct jobs created.

Data

- As data, we inputted the multiplier from the literature. They were referred from EPRI 2001, REPP 2001 and NREL 2008. These different numbers provided an overview of the generation of jobs for each technology from different organizations. The final ratio is an average of the different data that we already have.

- As data, we use from the EIA to know what is the generation of the electricity in the US and what is the contribution of the renewable energy in that generation. The EIA also gives us a forecast about the evolution of this generation of electricity up to 2030. So we can easily model the number of creation of jobs until 2030.

Model

- The first model of creation of job is the model "business as usual" (BAU tab) assuming that nothing has been done to support the renewable energies. The renewable energy sector will continue to grow according to the EIA but less quickly than if there is a green policy.
- The second model is with the RPS model that we putted as inputs. With that, the renewable energy sector will increase and that leads to a more creation of green jobs.
- Our interest here is to evaluate the net increase of jobs within the green policy. That is why we subtract the green jobs created by the second model to the first one.

2 Updates

2.1 National model update

- We tried to focus on the national scale to understand the model. We began to update the former model because the data from the EIA are from 2009 and have already been out of date. Also, the ratio numbers such as jobs-year per GWh could have changed due to technology improvements that require less manufacturing and in fact less jobs created.
- We successfully updated the new EIA files (generation of electricity nationally and generation of electricity for the renewable energy sector).
- We searched for new numbers to update the ratios. Unfortunately, the EPRI, REPP and NREL did not keep update again data since 2009. We also tried to look at several papers dealing with the subjects but they rely generally on our previous study.
- We also extended our forecast until 2040 because it is the maximum of the EIA forecast.
- The new model is available and can be viewed and downloaded in http://rael.berkeley.edu/greenjobsupdate.

2.2 California model

Since California has abundant available data which can be inputted into the model, we started with California model as an example to analyze the green jobs creation in the regional level. We took two steps to achieve the completion of California model:

- The first step is to find the data from the EIA for California only and then updates the model.

- The second step is to achieve a more "local" model: by changing the national ratios job-years per GWh to the Californian one and also to determine the RPS that California wants to reach to 2020, 2030 and 2040.

The first step has been successfully achieved but the second step is more difficult due to the quality of the data that we found on the publications. For now, we cannot substitute entirely the job-years per GWh for each sector and for each particular type of jobs (construction or operation and maintenance). We focused primarly on modeling all the state generation of electricity.

2.3 RPS state by state

We tried to create an excel data sheet that gather every RPS for each state. We found the RPS information for 39 states in the US and these objectives are generally for 2020 or 2025. The results of the RPS data for all the states can be found in this link:

http://www.dsireusa.org/rpsdata/index.cfm

3 Models

3.1 Method

The model of the green jobs has been done for 48 states (we cannot find any data for Alaska and Hawaii). Unfortunately we did not have a direct access of the generation of electricity per state we had in fact to make some assumptions to use these data. We have found the regional forecast for the data until 2040. These regional data are relied to the regional grids in the United States that do not follow the limits of the states as we can see in this Figure: Starting from this map, the problem to solve is how to get data relied to a particular state. Our method to solve this problem was to:

- Add some regions in order to cover completely a certain number of states, US has been divided into 9 super regions (California, Florida, Michigan, Northeastern, New York, South, Center, Virginia-Carolina, Midwest).
- In each super region, we took the 2006-2010 energy profile of each state from the EIA website that composes the region and then compute the weight of this state in each kind of generation of electricity (fossil and non-fossil generation). Assuming that this weight won't vary a lot, we multiply it by the total generation of electricity for the super region and then we can achieve the generation of electricity for this state.

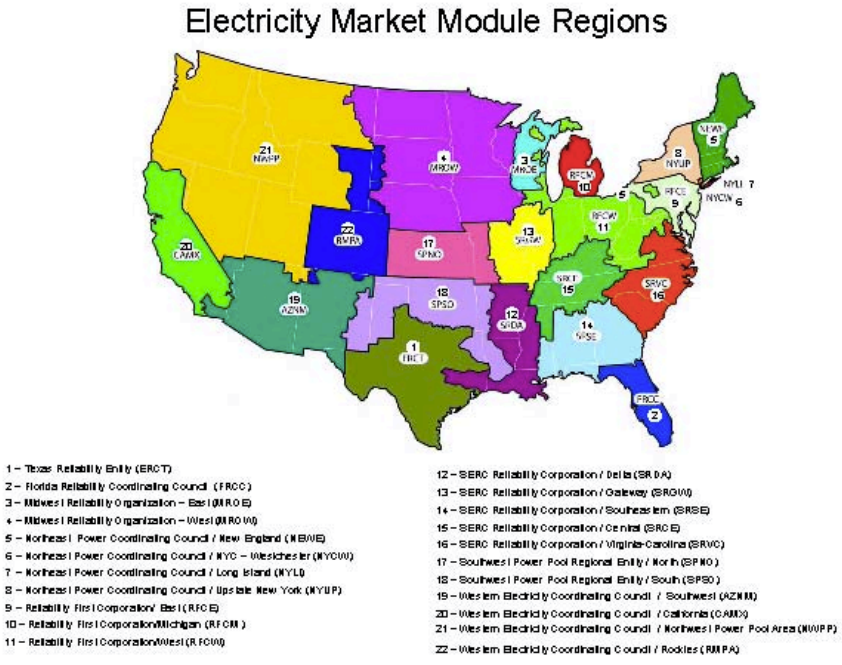

Figure 1: Map of the USA grid according to the EIA

3.2 Results

We achieved the 48 states model (all the US states except Hawaii and Alaska) and we updated the generation of electricity for all the renewable and non-renewable part. The only parameters that remain blank are the generation of electricity due to the *solar thermal* and the *small hydropower*.

All the data sheets are available on the website and we are waiting for the final results to fill the US interactive map that we created.

4 Improvement

4.1 Find the data

Our main concern is the quality of the data, we would like to have direct local data (not issued from a calculation) in order to have a more precise model to update. We made some calculations to get the local generation data, so that there are some approximations that have been made to get our results.

4.2 Improve the coefficient

We are currently conducting a survey to improve the coefficients jobs/year/Mwh for each of the renewable energies. Our guess is that all the coefficients won't change drastically except for the solar industry. We will make the update as soon as we have the data.

4.3 Improve the state model

We still have to figure out the data for the solar thermal industry, and the small hydraulic industry and its trend. We still have to find these data per state or calculate them.

4.4 Improve the general model

The model of the creation of green jobs seems to be incomplete. The cost dimension is not taken in account in our model. What we can imagine is adding the output cost in our model in order to know what the cost of this policy is. We have a very recent good paper from Lazard's that evaluate the cost of the renewable energies that we can use for this model. Also the model seems to be not optimal, we have as an input the RPS policy of the state but we can imagine that we try to optimize the contribution of each renewable energy depending on some constraints (cost, capacity, saturation of jobs in one field, etc) and try to solve this model in order to fix the "optimal" RPS and as the consequence the cost and the number of jobs relied to it.

Conclusion

The new green job calculator can provide a tool in order to evaluate the creation of green jobs in each state. We deliberately decided to keep a lot of input in the model in order to keep the

liberty of choosing what is the green policy for a given state but also what are the technologies that we can promote more and if it is preferable to keep the renewable technologies that are already in the state or promote other renewable energies which results to the creation of jobs. If in this fall we did evaluate the economical impact of this green policy we can also complete the work to evaluate the financial impact of this policy, in terms of investment in the technologies but also in the different incentives that the state can make in order to increase the generation of electricity with renewable energies.