Generating Resource Cost Forecast Methodology

Localization Approach for Dunsky's Generating Resource Cost Forecasts

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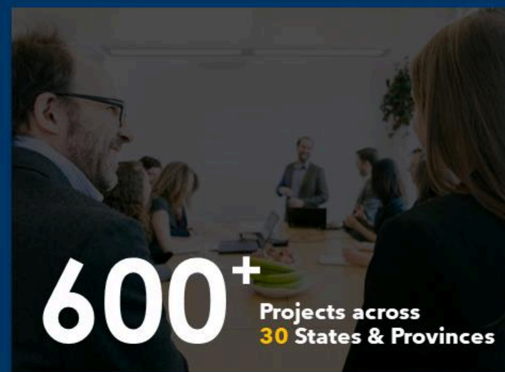
About Dunsky



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1. Introduction

There is substantial work and analysis collected around the globe to track the costs of generating resources. This forecasting method leverages those data and allows for localizing a forecast to a province, utility service territory, or other local regions.

The basis for this methodology is to partition the resource costs into components that can be adjusted based on local conditions and then recombine the adjusted components to get a location-specific forecast.

This approach allows for explicit assumptions about local costs like labour and taxes while taking advantage of more transportable information from other regions. For example, the local labour cost may be different than what is assumed in baseline data sets like the NREL ATB, but the estimated number of hours needed for specific tasks may be more consistent. By looking at individual cost components, each of these considerations can be discussed and vetted as part of compiling the forecast.

The general approach for the forecast methodology is as follows:

1. Research and catalogue forecasts and relevant information outside the region from baseline datasets, regulatory filings, research reports, academic and industrial papers, etc.
2. Using this research, develop a partition of the generating resource costs into components that are likely to need similar treatment in localizing the costs or are in distinct phases of the generating resource development.
3. Research the costs of similar generating resources in the focus region. Sources should include any recently completed projects or Power Purchase Agreements (PPAs) from these projects, utility projections from IRPs, interviews with local developers, etc.
4. Create a model to adjust the costs or range of costs in the generating resource cost partition based on the regional research where appropriate. Some adjustments may be based on a broader region that contains the local region of focus, e.g., adjustments between Canadian costs and US costs may be all that's needed, even if focusing on a single utility in Canada.
5. Recombine the forecast and localized component costs into a generating resource forecast for the local region.

While this approach is general, it allows for a carefully considered generating resource cost forecast. This forecast can be the basis for further analysis with capacity expansion models, energy system optimization models, production cost models, utility portfolio analysis, or other downstream analyses that need resource costs as an input.

2. Researching the Cost of Generating Resources

The basic strategy for researching the existing data is first to identify broadly applicable forecasts or information. For example, sources like the NREL ATB or Lazard data are intended to give a general picture of the cost of generating resources. NREL, in particular, gives a detailed breakdown of the capital cost percentage from different resource elements. The graphic in Figure 1 from NREL shows this breakdown for a land-based wind generation plant.

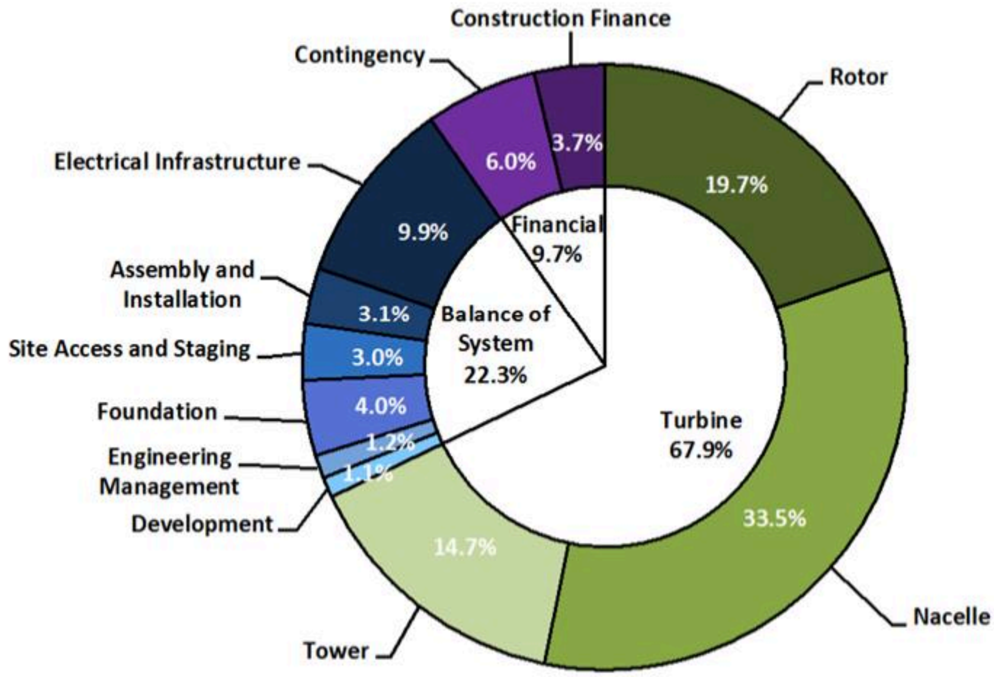


Figure ES1. CapEx for the land-based reference wind power plant project
Source: NREL

Figure 1-NREL ATB Land-Based Wind Capital Cost Allocation

An example of the localization of the costs is the assembly and installation costs. The local labour market impacts this. In the model, we pull in labour costs for various categories and apply these rates to the number of hours estimated for this part of the capital costs. For regional wages, we pull this information from the Government of Canada's job bank data, as shown in figure 2.

Find out how much people working as a "construction labourer" earned last year in Alberta.

Prevailing wages

Note that these wages were updated on November 16th, 2022 based on the 2016 version of the NOC. Learn more about our methodology.

Hourly wages by community/area

Community/Area	Low ($/hour)	Median ($/hour)	High ($/hour)	Note
Alberta	16.96	20.00	35.00	Note

Figure 2 - Regional Wages from the Canadian Job Bank

We can then apply the Canada-specific labour costs to specific project costs based on the NREL partition of resource costs. An example from a workbook model is shown in Figure 3.

[Appendix E. Summary of Land-Based System Cost Breakdown Structure 2013 Cost of Wind Energy Review (nrel.gov)](nrel.gov)	% Cost Breakdown	% Labour	% Sub-Labour
Development (US$2022/kW)	100%		
Permitting and leasing	10%		8%
Permit acquisition activities		75%	
Lease acquisition activities		75%	
Public outreach		100%	
Professional advisory services	10%	100%	10%
Engineering	25%		25%
PreFront End Engineering Design		100%	
FEED		100%	
Engineering certification		100%	
Site characterization	25%		21%
Siting and scoping		100%	
Studies and surveys		100%	
Meteorological (met) station and installation		25%	
Wind resource analysis		100%	
Geotechnical and geophysical surveys		100%	

Figure 3 - NREL Labour Breakdown Incorporated into the Model

We then combine these data in a model to derive component-level costs that are adjusted to the localized considerations. Figure 4 shows an example forecast that gives a detailed cost partition.

System Cost Breakdown										
CAPEX (2022$M) - Alberta										
Equipment (2022$M)	**$ 228.47**	**$ 224.44**	**$ 219.97**	**$ 214.90**	**$ 209.12**	**$ 206.61**	**$ 203.35**	**$ 199.22**	**$ 194.12**	**$**
Turbine										
Rotor - Blades ($M)	$ 43.28	$ 45.19	$ 46.96	$ 48.46	$ 49.59	$ 51.27	$ 52.51	$ 53.22	$ 53.33	$
Rotor ($M)	$ 26.75	$ 25.50	$ 24.24	$ 22.99	$ 21.74	$ 20.90	$ 20.06	$ 19.23	$ 18.39	$
Nacelle Module ($M)	$ 118.40	$ 113.42	$ 108.23	$ 102.85	$ 97.29	$ 93.45	$ 89.46	$ 85.35	$ 81.12	$
Tower Module ($M)	$ 40.04	$ 38.97	$ 37.86	$ 36.72	$ 35.53	$ 34.98	$ 34.41	$ 33.81	$ 33.17	$
Transportation Costs Adder ($M)	$ -	$ 1.36	$ 2.66	$ 3.88	$ 4.96	$ 6.01	$ 6.90	$ 7.61	$ 8.11	$
Installation (2022$M)	**$ 79.01**	**$ 75.57**	**$ 72.11**	**$ 68.63**	**$ 65.13**	**$ 62.86**	**$ 60.57**	**$ 58.27**	**$ 55.96**	**$**
Development (CA$M)	$ 4.82	$ 4.67	$ 4.52	$ 4.36	$ 4.19	$ 4.10	$ 4.00	$ 3.90	$ 3.80	$
Engineering and project management (CA$M)	$ 2.87	$ 2.79	$ 2.70	$ 2.60	$ 2.50	$ 2.45	$ 2.39	$ 2.33	$ 2.27	$
Foundation (CA$M)	$ 18.46	$ 17.67	$ 16.87	$ 16.06	$ 15.25	$ 14.72	$ 14.20	$ 13.66	$ 13.13	$
Site access and staging (CA$M)	$ 9.82	$ 9.36	$ 8.90	$ 8.44	$ 7.98	$ 7.67	$ 7.36	$ 7.06	$ 6.75	$
Assembly and installation (CA$M)	$ 10.89	$ 10.45	$ 10.00	$ 9.54	$ 9.08	$ 8.79	$ 8.50	$ 8.20	$ 7.90	$
Electrical infrastructure (CA$M)	$ 32.15	$ 30.64	$ 29.14	$ 27.63	$ 26.12	$ 25.12	$ 24.11	$ 23.11	$ 22.10	$
Soft Costs (2022$M)	**$ 34.60**	**$ 33.89**	**$ 33.12**	**$ 32.27**	**$ 31.32**	**$ 30.87**	**$ 30.32**	**$ 29.65**	**$ 28.85**	**$**
Sales tax	$ 11.42	$ 11.22	$ 11.00	$ 10.75	$ 10.46	$ 10.33	$ 10.17	$ 9.96	$ 9.71	$
Contingency	$ 7.20	$ 7.07	$ 6.93	$ 6.77	$ 6.59	$ 6.51	$ 6.41	$ 6.28	$ 6.11	$
Profit	$ 15.98	$ 15.60	$ 15.19	$ 14.75	$ 14.27	$ 14.03	$ 13.74	$ 13.41	$ 13.03	$

Figure 4 - System Cost Breakdown Example

Using this approach, we can create a forecast that allows for forecasts that 1) give a better representation of the underlying assumptions and 2) can be adjusted as new information is available for each parameter. This approach also creates a structure for researching and adjusting regional costs based on things always driven by location, such as taxes and transportation to the site. Finally, while it is not necessary to know the generating characteristics for total project cost forecasts, they are needed for commonly referenced normalized costs like the Levelized Cost of Energy (LCOE).

Example of Partitioning Costs

Hundreds of different costs for a wind project must be paid before any energy is injected into the electric grid. For example, there are costs for site preparation and building the foundations, costs for turbine blades, costs for transporting the blades from where they are manufactured to the site, etc.

Trying to catalogue each of these costs would be difficult and complex to forecast. Instead, we gather similar costs into categories where more detailed data (e.g., an LBNL report focused on turbine blade costs) or more regional data are available (e.g., IRENA's report on renewable generating costs).

Using this approach, we can partition the operating expense for a wind plant as follows:

- System-Related Expenses:
  - Turbine Operations & Maintenance
  - Balance of Plant Operations & Maintenance
  - Asset Management Operations & Maintenance
- Property-Related Expenses:
  - Land Lease
  - Property Tax
- Administration Related Costs

For this example, in the partition of the operating expenses, we see different labour categories, property leasing expenses that vary based on location, and tax-related expenses that depend on the jurisdiction. Researching regional adjustments for operating expenses involves looking at data for the cost of local labour, the local taxes a project would be subject to, and the market rate for a long-term property lease for a wind project. By looking at local resources and adjusting the forecast based on current and expected future local conditions, the forecast can be more relevant for regional analyses.

3. Comparing and Analyzing Localized Costs

There are multiple reasons to localize costs:

1. Two or more jurisdictions can be compared using local costs.

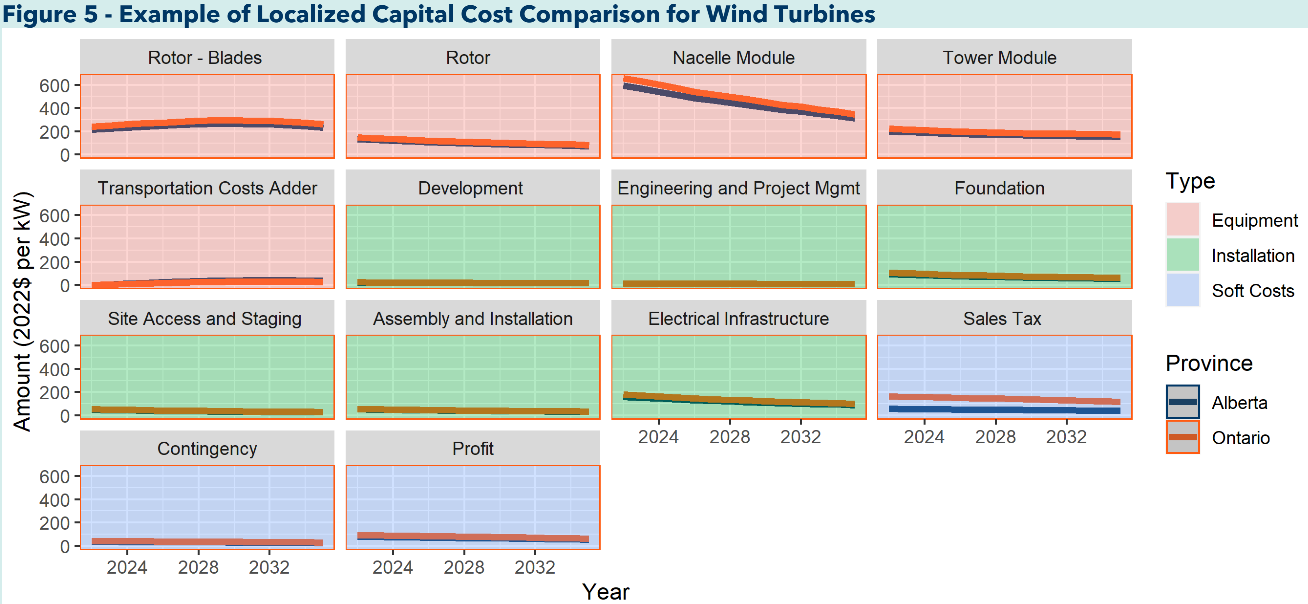
2. Downstream modelling can use better-informed costs and have more relevant conclusions about the cost of system expansion.
3. Local risks, e.g., wages and transportation, can be explored and incorporated in range forecasts with global risks.

The localization can also be used to highlight the relative costs impacting the competitiveness of different resources. A good example of this is the local taxes that are included in the costs. For example, some jurisdictions have more favourable tax treatment for renewable resources that may increase their competitiveness with other resources. Analyzing the underlying cost components can more easily surface these considerations and bring them into policy discussions.

Example of Comparing Regional Costs

Partitioning wind capital costs allows for detailed comparisons between jurisdictions to see what elements drive a cost difference. In this example, we've compared the provinces of Alberta and Ontario. This partition allows for seeing which costs have a more significant impact on the project and seeing where there are noticeable differences between costs. In this example, the sales tax is the most distinct difference between the two regions.

Figure 5 - Example of Localized Capital Cost Comparison for Wind Turbines



4. Conclusion

Dunsky's approach to forecasting regional generating resource costs allows us to produce highly relevant and detailed forecasts that consider the differences between regions, Canada and the US or two provinces in Canada. Our regional forecasts give policymakers and utilities a better basis for comparing the costs of different policies or portfolios.

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