

# Renewable Integration Model and Analysis

## Objectives

- Formulate methodology that quantifies the amount of conventional generation needed to integrate a given portfolio of renewable resources
- Provide a wide range of flexibility in simulating and estimating the system impact associated with renewable generation based on resource-specific characteristics
- Calculate the fixed and variable costs of accommodating variable generation on the system

## Data Input

Historical minute-by-minute load and wind/solar data

Generation's capital and operational costs and capabilities

## Analytical Approach

Estimate incremental system-wide operational need to integrate renewable resources

Estimate system's reliability need

Quantify the conventional generation capacity needed using a technology screening curve

Estimate fixed and variable costs of integrating renewable energy resources

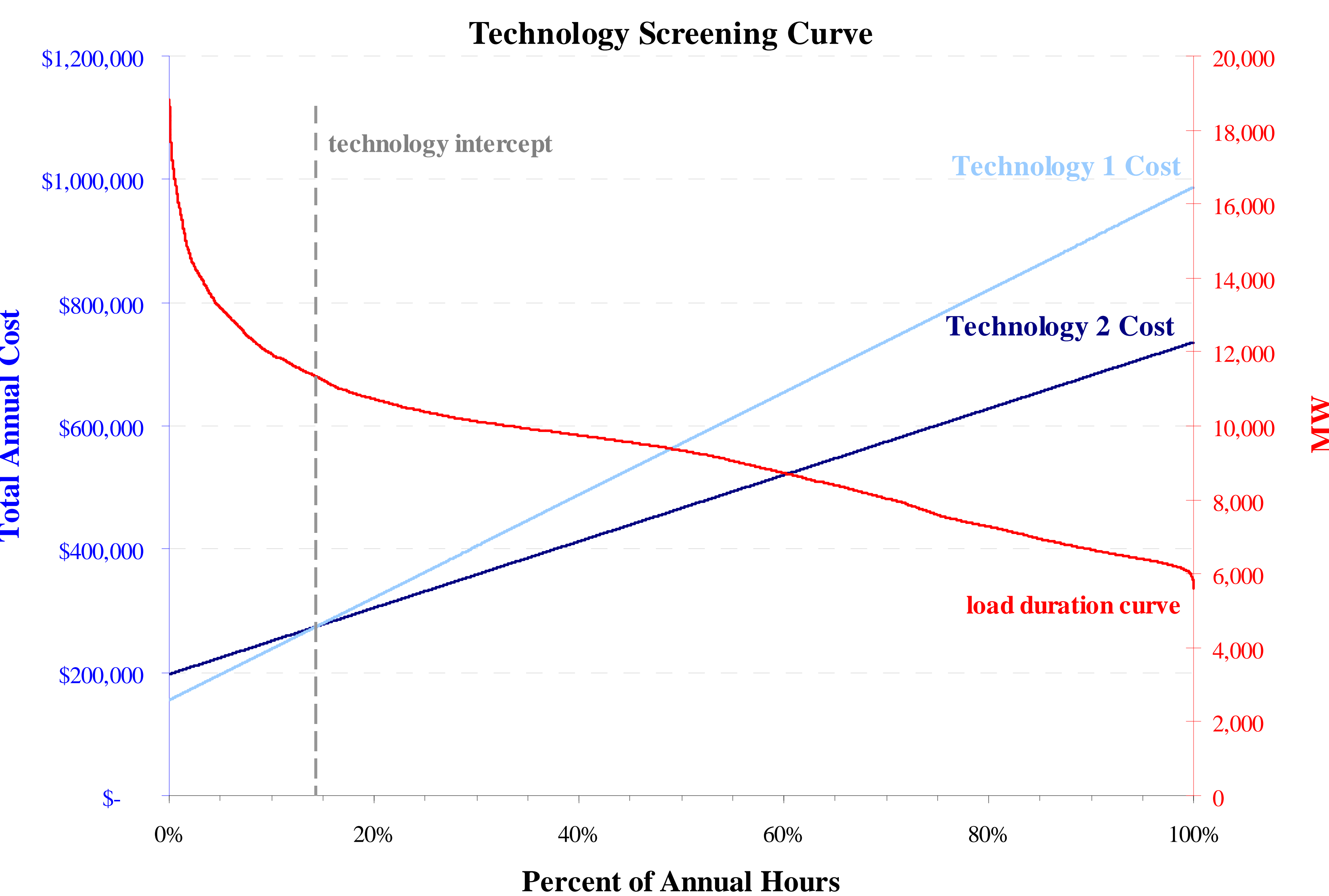
## Output

Estimated amount of regulation, load-following, day-ahead unit commitment, and ramping needed by season or month

Incremental generating capacity need for renewable integration (assuming not provided by existing system)

Optimal mix of resources (based on input assumptions about available technologies and costs)

Fixed and variable costs of integration (based on adjustable assumptions)



ENTER BASE YEAR PARAMETERS BELOW					
	5-min Forecast Error St. Dev	INTRA 5-min Volatility St. Dev	HA Forecast Error St. Dev.	INTRA-Hour Volatility St. Dev.	DA Forecast Error St. Dev.
	(MW)	(MW)	(MW)	(MW)	(MW)
Season					
SPRING	126.28	48.73	704.91	418.15	908.87
SUMMER	145.32	57.85	1,120.84	547.79	1,050.01
FALL	115.56	49.97	885.93	453.26	1,230.35
WINTER	120.35	54.51	864.41	459.69	551.58

ANNUAL CORRELATION COEFFICIENTS					
	5min LOAD Forecast Error	INTRA 5-min IR Variability	HA LOAD Forecast Error	INTRA HR IR Variability	DA IR Forecast Error
5min IR Forecast Error	0	0.5			
INTRA 5-min LOAD Variability	0.5				
HA IR Forecast Error			0	0.5	0
INTRA HR Load Variability			0.5		
DA LOAD Forecast Error			0.5		

Year	Existing Wind				
2008	Capacity	1500	(MW)	Capacity Credit (%)	5%
2020	Capacity	3000	(MW)	Capacity Credit (%)	5%
Season	5-min Forecast Error St. Dev	INTRA 5-min Volatility St. Dev	HA Forecast Error St. Dev.	INTRA-Hour Volatility St. Dev.	DA Forecast Error St. Dev.
	(% of CAP)	(% of CAP)	(% of CAP)	(% of CAP)	(% of CAP)
SPRING	0.99%	0.22%	11.60%	1.26%	11.11%
SUMMER	0.82%	0.20%	10.31%	1.14%	6.83%
FALL	0.81%	0.28%	10.31%	1.04%	11.23%
WINTER	0.74%	0.16%	9.02%	0.90%	7.19%

ANNUAL 5-min Forecast Correlation Coefficients				
	Existing Wind	New Wind	Existing Solar	New Solar
Existing Wind				
New Wind	0.185			
Existing Solar	-0.13	-0.195		
New Solar	-0.07	-0.21	0.98	

ANNUAL DA Forecast Error Correlation Coefficients				
	Existing Wind	New Wind	Existing Solar	New Solar
Existing Wind				
New Wind	0.072363			
Existing Solar	-0.067457	-0.271971		
New Solar	-0.121161	-0.261215	0.946037	

## Contact Information

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