New Clear Free

SOLUTIONS

Transitioning To A Low Carbon Economy
Carbon Tax and Investment Plan

The purpose of New Clear Free Solutions is to:

Provide energy oversight to the public and official decision makers using objective scientific, regulatory and financial information.

The objective of New Clear Free Solutions is to:

Ensure safe, affordable, and sustainable energy solutions for the public and environment.

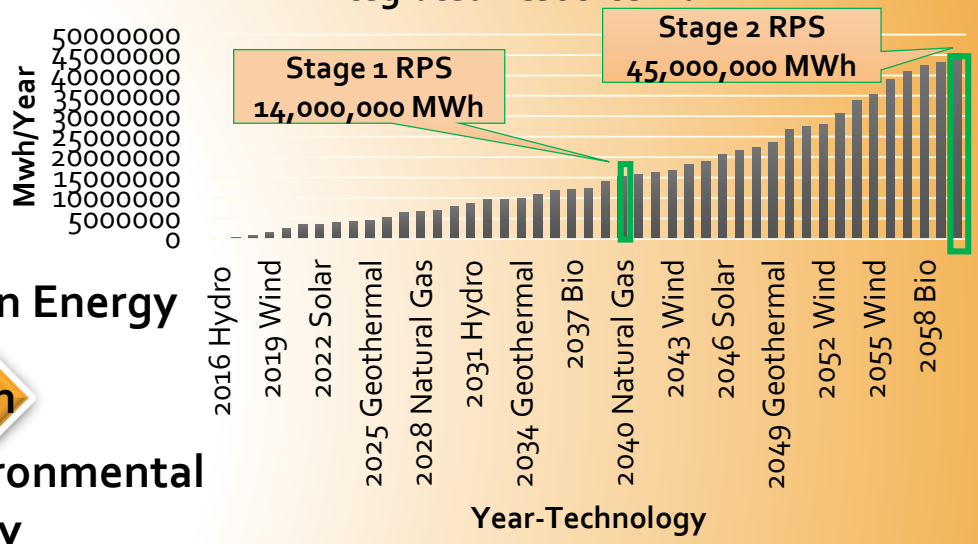
IF YOU FOCUS ON THE PROBLEM, YOU CAN'T SEE THE SOLUTION. NEVER FOCUS ON THE PROBLEM.

Year-Technolgy Type	Carbon Tax $/Year $20/Ton	Revenue From Investments – (O&M+Fuel) $/Year	Total Investment $/Year	Dividend
2016 Hydro	$300,000,000	$0	$300,000,000	
2017 Hydro	$300,000,000	$28,691,000	$328,691,000	
2018 Wind	$300,000,000	$60,125,911	$360,125,911	
2019 Wind	$300,000,000	$103,258,780	$403,258,780	
2020 Wind	$300,000,000	$151,557,743	$451,557,743	
2021 Natural Gas	$300,000,000	$205,641,552	$505,641,552	
2022 Solar	$300,000,000	$207,440,231	$507,440,231	
2023 Bio	$300,000,000	$234,443,008	$234,443,008	$300,000,000
2024 Bio	$300,000,000	$232,451,644	$232,451,644	$300,000,000
2025 Geothermal	$300,000,000	$230,477,194	$330,477,194	$200,000,000
2026 Geothermal	$300,000,000	$284,071,813	$384,071,813	$200,000,000

Summary

	Stage 1 Renewable Portfolio Standard 14,000,000 MWh/Year By 2040		Stage 2 Renewable Portfolio Standard 45,000,000 MWh/Year By 2060	
	% Generation	Capacity MW	% Generation	Capacity MW
Wind	30%	1,199	45%	5,779
Hydro	25%	999	10%	1,284
Solar	5%	320	15%	3,082
Geothermal	30%	533	20%	1,142
Bio	5%	320	5%	1,027
Natural Gas	5%	1,749	5%	6,235
Storage Tesla Power Wall	NA	400	NA	2,312

Integrated Resource Plan



Economy Wide Carbon Tax $20-30/Ton

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Public Investment Through NB Power

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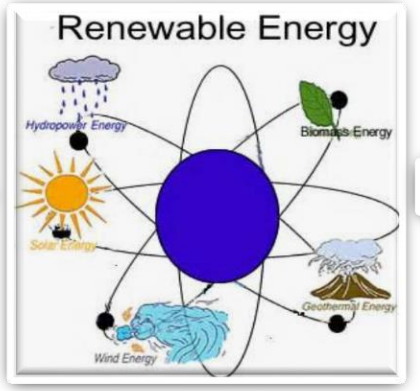


Jobs $ Social Policy

Green Energy

MWh

Environmental Policy

Reinvestment ROI-O&M-Fuel-Dividend

$

Priority

Displaced Cost + Increased Sales ROI

$ Economic Policy

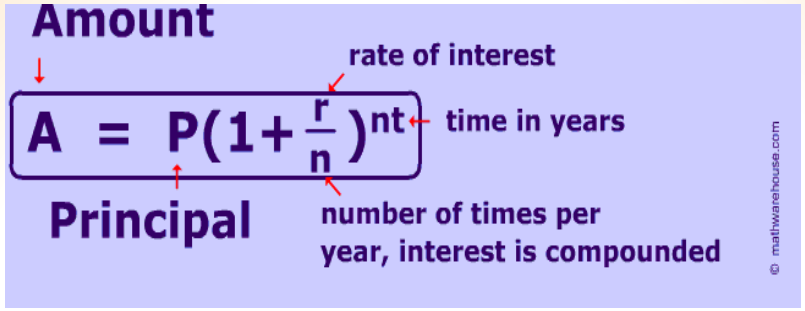
Fuel Shift
Efficiency
Adaptation

$ Uncertainty

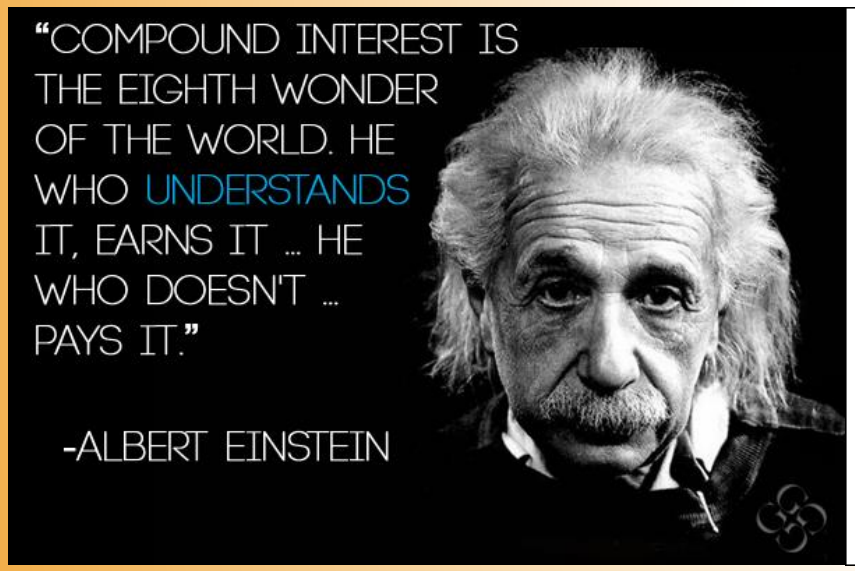
IRP Financial Details		
Year	Stage 1 RPS 2040	Stage 2 RPS 2060
Lifespan	30	30
Annual MWh	14,000,000	45,000,000
Total System Rate (PPA) $/MWh	$100.00	$100.00
Total System Cost @ 0% Interest $/MWh	$46.02	$49.11
Total Revenue $/Year	$1,400,000,000	$4,500,000,000
Total System Capital Investment $/Lifespan	$10,519,002,664	$38,649,355,023
Average Capital Investment $/Year	$350,633,422	$1,288,311,834
Total Fixed O & M $/Year (Generation)	$190,299,020	$655,488,139
Total Fuel $/Year	$51,730,000	$166,275,000
Total Transmission Cost $/MWh	$3.69	$3.69
Transmission Cost $/Year	$51,660,000	$166,050,000
Total O & M $/Year	$241,959,020	$821,538,139
Total Annual Expense $/Year	$644,322,442	$2,276,124,973
Total Net Earnings (Interest) $/Year	$755,677,558	$2,223,875,026.64
Total Net Profit/Interest $/Lifespan	$22,670,326,743	$66,716,250,799
Total Dividend $/Lifespan	$4,310,000,000	$27,374,153,558

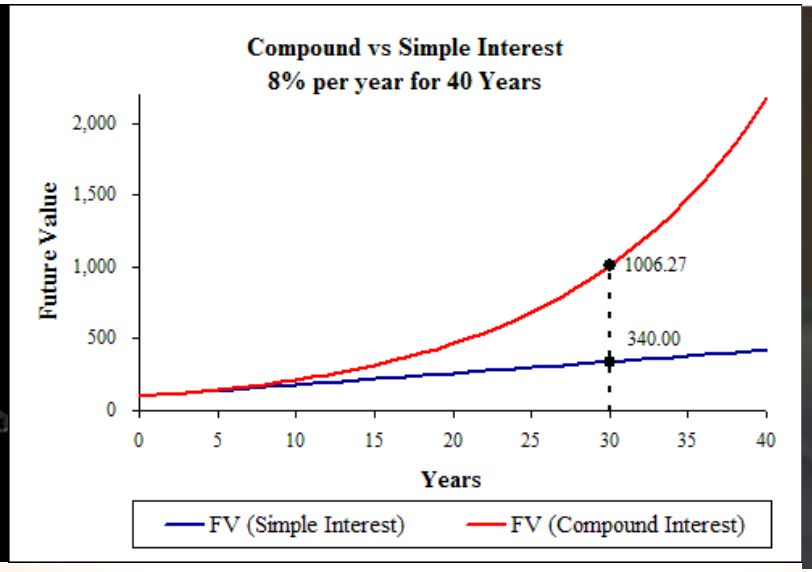
Carbon Tax and Investment Plan

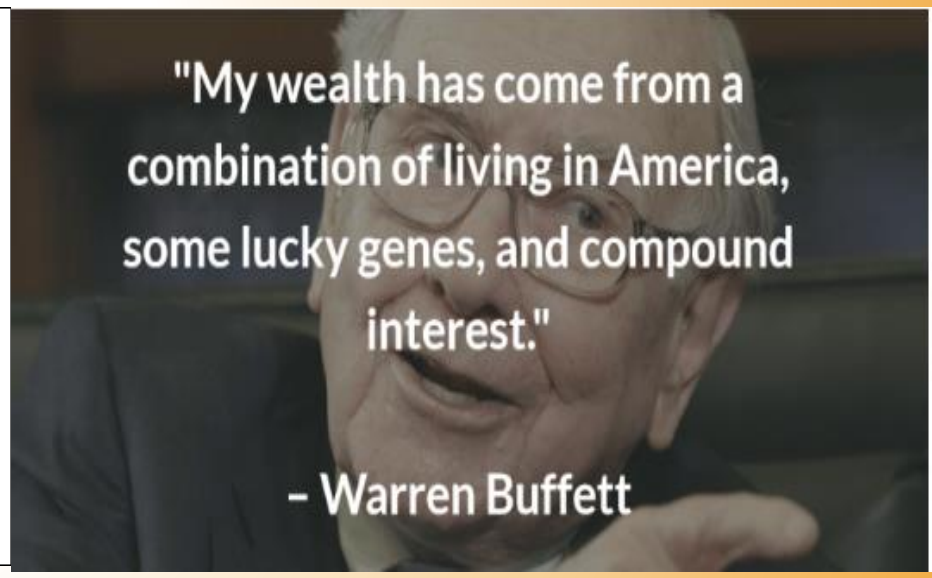
UNBSJ Professor of Economics, Dr. Rob Moir. "The concept of reinvesting in environmentally-friendlier energy production and energy efficiency to create a compound interest effect is founded economic theory. As such this policy should be considered by all provinces and not only New Brunswick."



NB Power System Planning Engineer Darren Clark: "We reviewed Mr. Rouse's model and functionally I believe the majority of what he is setting out to do, the model is accomplishing."







Modeling Objectives

The general purpose of the modeling is to reasonably demonstrate using todays technology and todays costs and todays rates that New Brunswick can reasonably transition to a low carbon economy by investing the carbon tax into renewable energy.

Stage 1 Renewable Portfolio Standard (Green The Grid)

The objective of this renewable portfolio standard (RPS) is to green the current "electricity" consumption to 95% renewable by 2040. 2014-2015 was used as the test year for comparison to the business as usual.

Stage 2 Renewable Portfolio Standard (Fuel Shift or Electrification)

The objective of this renewable portfolio standard is shift all remaining fossil fuel usage to 95% green "energy" by 2060 at the same or less cost than the fossil fuel equivalent. Stage 2 does not require the completion of stage 1 before commencing. The transition to stage 2 can begin as long as the fuel switch has a net carbon reduction. This is essentially the electrification of our transportation and industrial heat/steam.

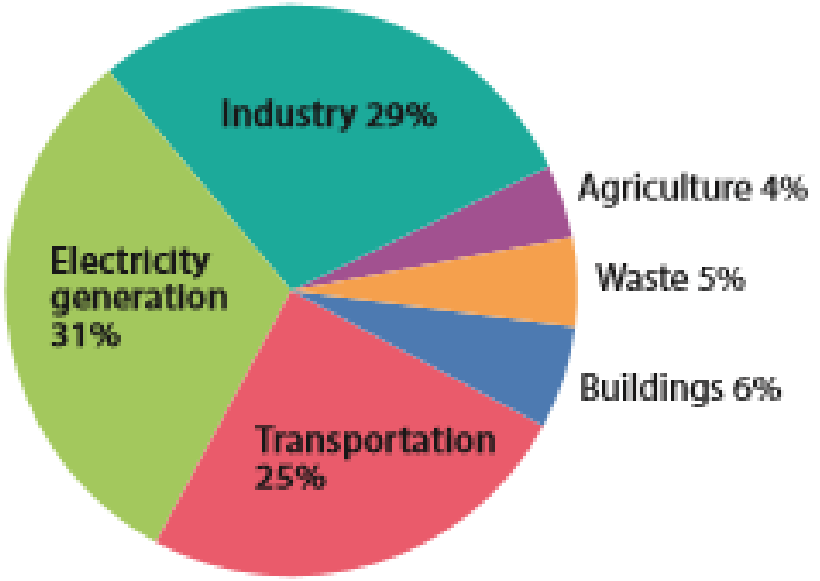
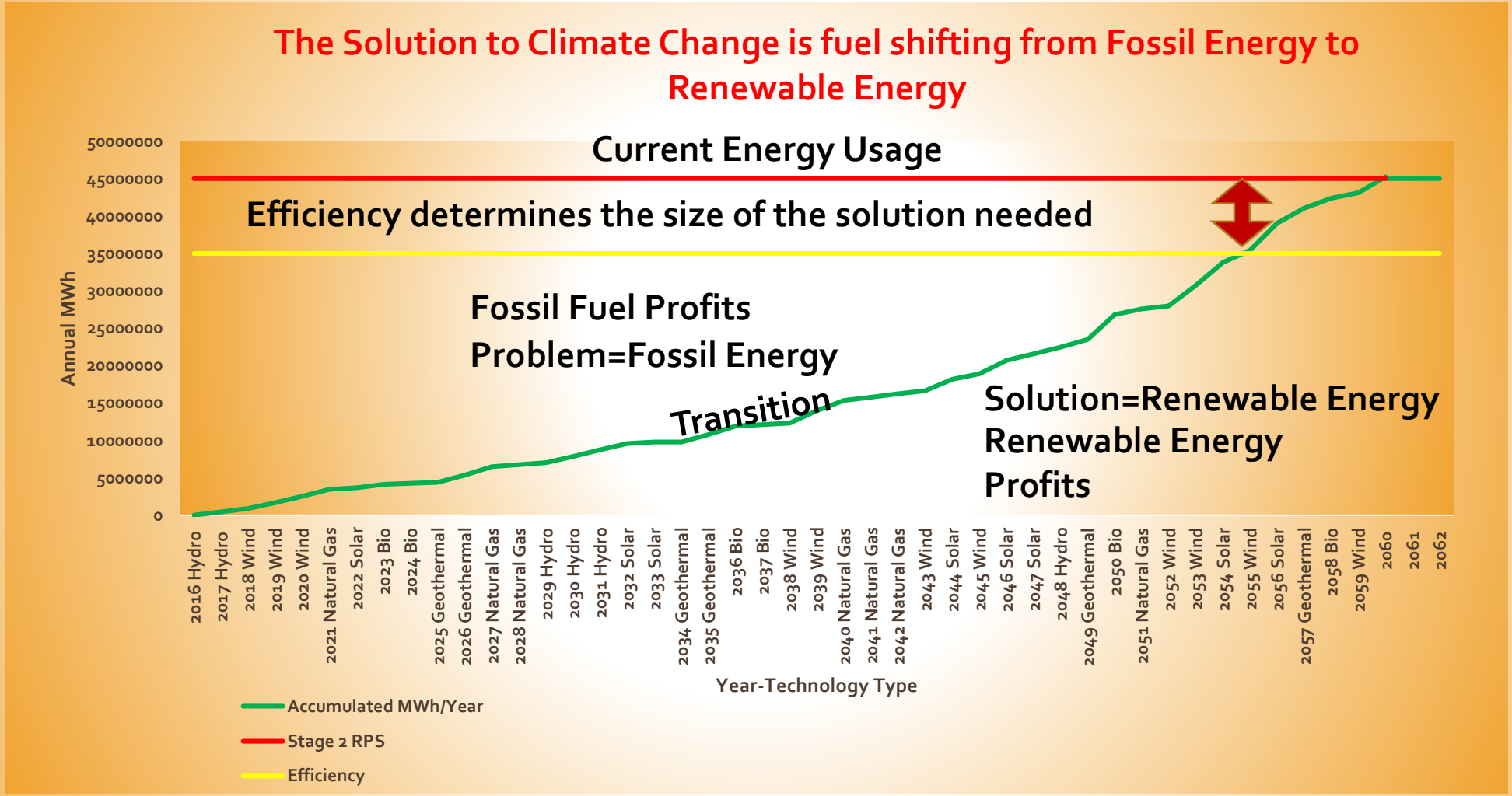


Figure 1: Distribution of GHG emissions in New Brunswick
Source: Environment Canada

The Solution = Renewable Energy



Technical Barriers? NO

Supply Side

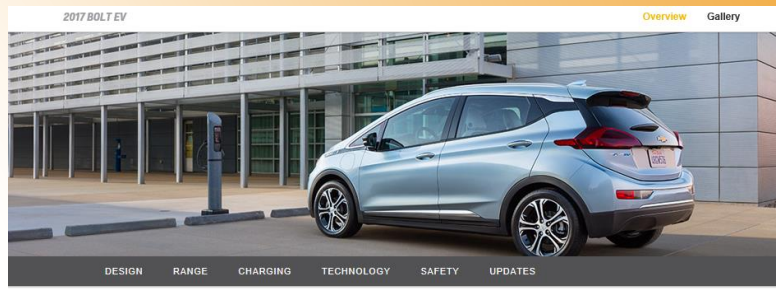
- Hydro
- Wind
- Solar
- Geothermal
- Biofuels
- Smart Grids
- Storage Thermal/Battery
- High Capacity Very Low Capacity Factor FF plants
- Enough Resources

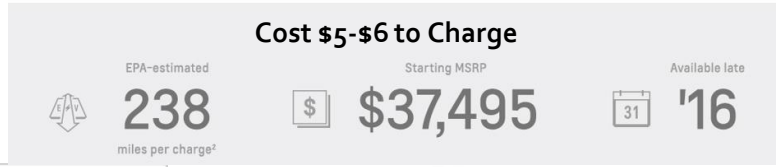
smart grid

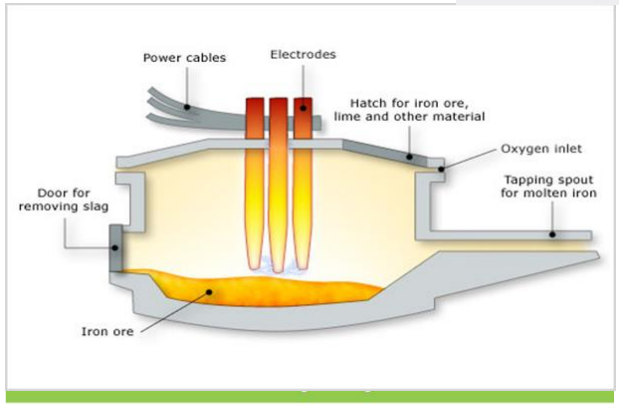
POWER SHIFT ATLANTIC ATLANTIQUE
An energy research project • Un projet de recherche sur l'énergie

Demand Side

- Electrode Boilers
- Electric Cars
- Electric Trains
- Electric Busses
- Electric Arc Furnace
- Heat Pump

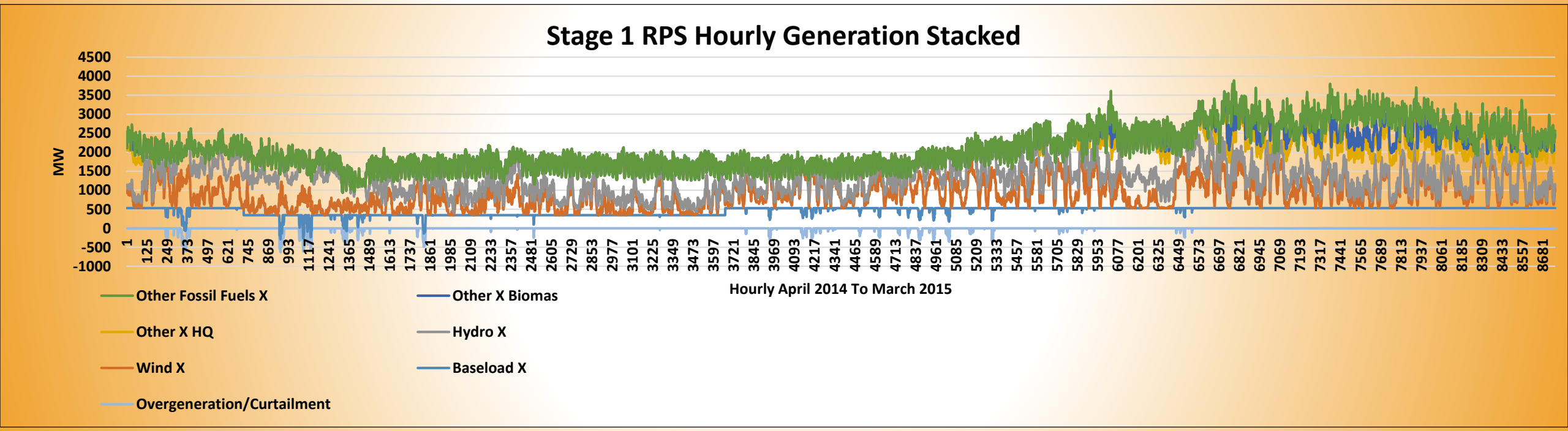






Technology will only get better with time

Stage 1 RPS Investment Details										
	% Generation	Capacity MW	Capacity Factor	Capital Cost $/MW	Total Capital Cost $	Total MWh/Year	Fixed O & M $/kw	Total Fixed O & M $/Year	Fuel Cost $/MWh	Total Fuel Cost $/Year
Wind	30.0%	1,168	0.40	$1,664,000	$1,944,372,603	4,094,400	45.98	$53,727,315	0	$0
Hydro	25.0%	974	0.40	$2,411,000	$2,347,697,489	3,412,000	14.7	$14,314,041	0	$0
Solar	0.0%	0	0.25	$2,480,000	$0	0	21.33	$0	0	$0
Geothermal	30.0%	530	0.88	$2,687,000	$1,423,918,864	4,094,400	116.12	$61,535,340	0	$0
Bio	5.0%	330	0.24	$3,765,000	$1,242,761,783	682,400	108.63	$35,856,896	35	$23,884,000
Natural Gas	5.0%	1,604	0.05	$664,000	$1,064,792,792	682,400	6.65	$10,663,964	70	$47,768,000
Hydro Quebec	5.0%	1,000	NA	NA	NA	682,400	NA	NA	38.9	$26,545,360
Storage Tesla Power Wall II		800	NA	$1,600,000	$1,280,000,000	NA	0	$0		



Financial Details Business As Usual Comparison

Year	Stage 1 IRP 2040	2014-15 NB Power Annual Report
Lifespan	30	NA
Annual MWh In Province	13,648,000	13,648,000
Annual MWh Export	4,575,000	4,575,000
Total Generation	18,223,000	18,223,000
Firm Capacity MW	4,237	NA
Firm Capacity Requirment MW	4,000	4,000
Total In Province Capacity MW	5,406	NA
Total System Rate (PPA) $/MWh	$100.67	$100.67
Export Rate $/MWh	$75.63	$75.63
Annual Export Revenue	$346,000,000.00	$346,000,000.00
Annual In Province Revenue $/Year	$1,374,000,000.00	$1,374,000,000.00
Total Revenue $/Year	$1,791,000,000	1,791,000,000
Total Revenue $/Lifespan	$53,730,000,000	NA
Export Total Cost $/MWh	$62.30	$62.30
Annual Export Cost	$285,000,000.00	$285,000,000.00
Export Margin	$61,000,000.00	$61,000,000.00
Total System Cost $/MWh	$77.70	$91.00
Total System Capital Investment $/Lifespan	$9,303,543,531	NA
Depreciation and Amortization Expense $/Year	$310,118,118	$239,000,000
Total Fixed O & M $/Year (Generation)	$176,097,556	NA
Total Fuel and Purchased Power Including Exports $/Year	$383,197,360	$826,000,000
Total Fuel $/Lifespan	$11,495,920,800	NA
Total Transmission/Distribution O&M Cost $/MWh	$14.00	NA
Transmission And Distribution O&M Cost $/Year	$191,072,000	NA
Total O & M $/Year	$367,169,556	$477,000,000
Total O & M $/Lifespan	$11,015,086,676	NA
Total Annual Expense $/Year	$1,060,485,034	NA
Total Expense $/Lifespan	$31,814,551,006	NA
Debt to Equity Ratio	0:100	96:4
Financing Cost/Interest	$0	$229,000,000
Taxes	$37,000,000	$37,000,000
Net Debt	$0	$4,913,000,000
Rate Increases	4-5% Once	2% Annually Forever
Total Net Earnings (Interest) $/Year	$693,514,966	$73,000,000
Total Net Profit/Interest $/Lifespan	$20,805,448,994	NA
Total Dividends Paid during IRP	$4,770,000,000	NA

Integrated Resource Plan

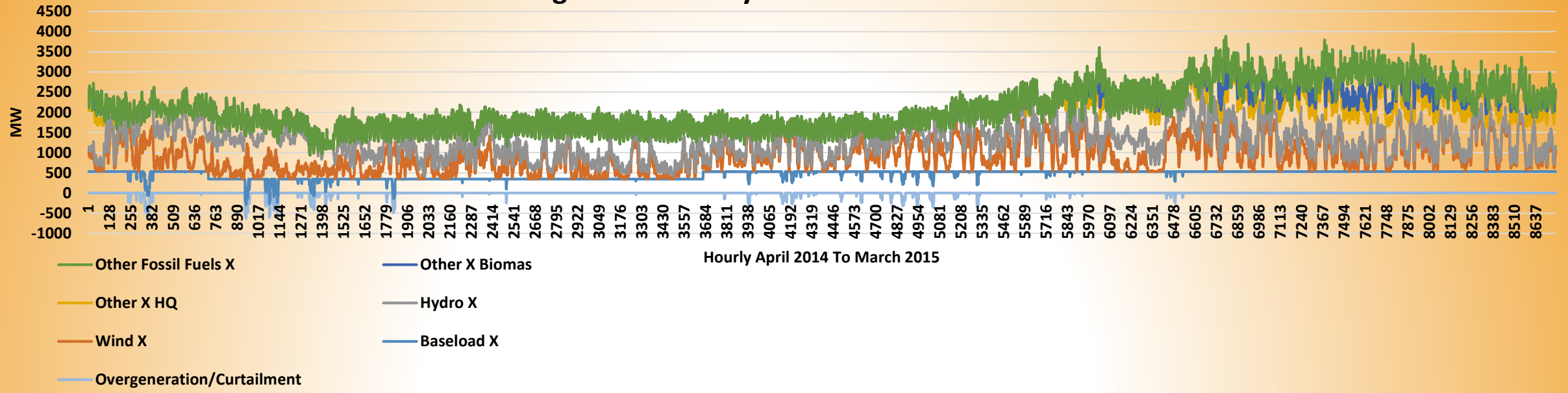
Blue=Calculated Yellow=Policy Grey=Cost and Performance Data US Government 2016 Energy Outlook.

Year-Technolgy Type	Accumulated MWh/Year	Carbon Tax $/Year $24/Ton	Accumulated Reinvestent $/Year	Total Investment $/Year	Dividend	Technology Type Stage 1	Capacity Factor	In Service Capital Cost	Fixed O & M $/kw	Fuel Cost $/MWh	Capacity MWh	Total Fixed O & M $/Year	Total Fuel Cost $/Year	Generation MWh/Year	Income From Investment	PPA $/MWh	Income Minus (O & M + Fuel)
2016 Hydro	0	$370,000,000	$0	$370,000,000		Hydro	0.40	$2,411,000	14.7	0	153	$2,255,910.41	$0	537,735	$26,349,034	49	$24,093,123
2017 Hydro	537,735	$370,000,000	$24,093,123	$394,093,123		Hydro	0.40	$2,411,000	14.7	0	163	$2,402,807.51	$0	572,751	$28,064,792	49	$25,661,984
2018 Wind	1,110,486	$370,000,000	$49,755,107	$369,755,107	$50,000,000	Wind	0.34	$1,664,000	45.98	0	222	$10,217,151.35	$0	661,826	$32,429,478	49	$22,212,327
2019 Wind	1,772,312	$370,000,000	$71,967,434	$391,967,434	$50,000,000	Wind	0.34	$1,664,000	45.98	0	236	$10,830,927.06	$0	701,584	$34,377,617	49	$23,546,690
2020 Wind	2,473,896	$370,000,000	$95,514,124	$415,514,124	$50,000,000	Wind	0.34	$1,664,000	45.98	0	250	$11,481,574.18	$0	743,730	$36,442,786	49	$24,961,212
2021 Natural Gas	3,217,627	$370,000,000	$120,475,336	$340,475,336	$150,000,000	Natural Gas	0.04	$664,000	6.65	70	513	$3,409,881.00	$12,577,077	179,673	$8,803,954	49	-$7,183,004
2022 Geothermal	3,397,299	$370,000,000	$113,292,332	$293,292,332	$190,000,000	Geothermal	0.90	$2,687,000	116.12	0	109	$12,674,769.49	$0	860,557	$42,167,295	49	$29,492,525
2023 Bio	4,257,856	$370,000,000	$142,784,857	$212,784,857	$300,000,000	Bio	0.25	$3,765,000	108.63	35	57	$6,139,394.17	$4,331,995	123,771	$6,064,792	49	-$4,406,596
2024 Wind	4,381,627	$370,000,000	$138,378,261	$208,378,261	$300,000,000	Wind	0.34	$1,664,000	45.98	0	125	$5,757,952.18	$0	372,977	$18,275,875	49	$12,517,923
2025 Wind	4,754,605	$370,000,000	$150,896,184	$217,896,184	$303,000,000	Wind	0.34	$1,664,000	45.98	0	131	$6,020,953.45	$0	390,013	$19,110,648	49	$13,089,694
2026 Geothermal	5,144,618	$370,000,000	$163,985,878	$333,985,878	$200,000,000	Geothermal	0.90	$2,687,000	116.12	0	124	$14,433,360.70	$0	979,957	$48,017,897	49	$33,584,536
2027 Bio	6,124,575	$370,000,000	$197,570,414	$567,570,414	$0	Bio	0.25	$3,765,000	108.63	38.9	151	$16,375,876.26	$12,842,468	330,141	$16,176,887	49	-$13,041,457
2028 Wind	6,454,715	$370,000,000	$184,528,958	$354,528,958	$200,000,000	Wind	0.34	$1,664,000	45.98	0	213	$9,796,419.16	$0	634,573	$31,094,065	49	$21,297,645
2029 Hydro	7,089,288	$370,000,000	$205,826,603	$506,826,603	$69,000,000	Hydro	0.40	$2,411,000	14.7	0	210	$3,090,149.76	$0	736,591	$36,092,949	49	$33,002,799
2030 Hydro	7,825,879	$370,000,000	$238,829,403	$539,829,403	$69,000,000	Hydro	0.40	$2,411,000	14.7	0	224	$3,291,369.65	$0	784,555	$38,443,197	49	$35,151,828
2031 Hydro	8,610,434	$370,000,000	$273,981,230	$574,981,230	$69,000,000	Hydro	0.40	$2,411,000	14.7	0	238	$3,505,692.28	$0	835,643	$40,946,486	49	$37,440,794
2032 Natural Gas	9,446,077	$370,000,000	$311,422,024	$381,422,024	$300,000,000	Natural Gas	0.04	$664,000	6.65	70	574	$3,819,964.55	$14,089,638	201,281	$9,862,746	49	-$8,046,856
2033 Geothermal	9,647,357	$370,000,000	$303,375,168	$73,375,168	$600,000,000	Geothermal	0.90	$2,687,000	116.12	0	27	$3,170,943.26	$0	215,292	$10,549,312	49	$7,378,369
2034 Natural Gas	9,862,649	$370,000,000	$310,753,537	$180,753,537	$500,000,000	Natural Gas	0.04	$664,000	6.65	70	272	$1,810,257.56	$6,676,992	95,386	$4,673,894	49	-$3,813,355
2035 Geothermal	9,958,035	$370,000,000	$306,940,182	$26,940,182	$650,000,000	Geothermal	0.90	$2,687,000	116.12	0	10	$1,164,232.94	$0	79,046	$3,873,250	49	$2,709,017
2036 Bio	10,037,081	$370,000,000	$309,649,199	$79,649,199	$600,000,000	Bio	0.25	$3,765,000	108.63	35	21	$2,298,085.66	$1,621,543	46,330	$2,270,161	49	-$1,649,468
2037 Bio	10,083,411	$370,000,000	$307,999,731	$227,999,731	$450,000,000	Bio	0.25	$3,765,000	108.63	35	61	$6,578,382.67	$4,641,748	132,621	$6,498,447	49	-$4,721,684
2038 Geothermal	10,216,032	$370,000,000	$303,278,047	$623,278,047	$50,000,000	Geothermal	0.90	$2,687,000	116.12	0	232	$26,935,261.19	$0	1,828,777	$89,610,079	49	$62,674,818
2039 Wind	12,044,809	$370,000,000	$365,952,865	$435,952,865	$300,000,000	Wind	0.34	$1,664,000	45.98	0	262	$12,046,341.78	$0	780,314	$38,235,372	49	$26,189,030

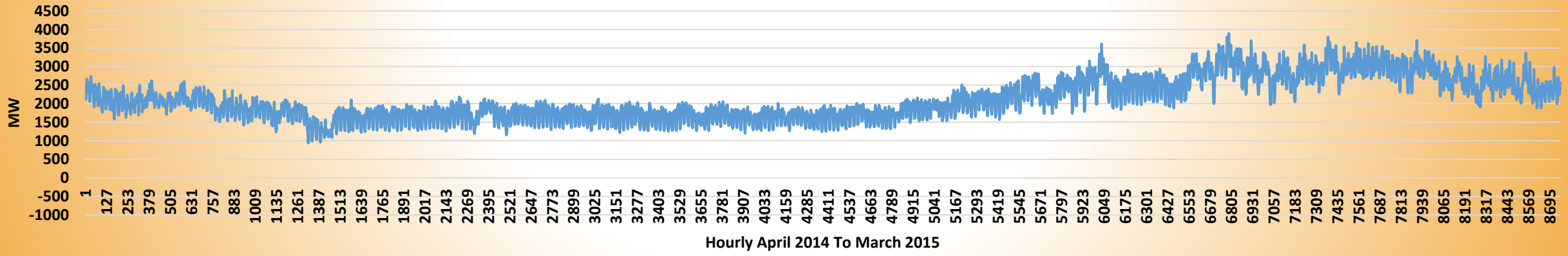
Sensitivity Analysis

Sensitiviity Case	Base Case	Buisness As Usual	Plus 10%-Net Earnings	Minus 10%-Net Earning	Plus 10% Difference From Base Case	Minus 10% Difference From Base Case
Captial Cost	$693,514,966	$73,000,000	$662,503,155	$724,526,778	-$31,011,812	$31,011,812
Wind Capacity Factor	$693,514,966	$73,000,000	$704,291,306	$680,343,885	$10,776,340	-$13,171,082
Fixed O and M	$693,514,966	$73,000,000	$675,905,211	$711,124,722	-$17,609,756	$17,609,756
Fuel Cost	$693,514,966	$73,000,000	$683,695,230	$703,334,702	-$9,819,736	$9,819,736
Lifespan	$693,514,966	$73,000,000	$721,707,523	$659,057,398	$28,192,556	-$34,457,569
Demand	$693,514,966	$73,000,000	$762,208,949	$624,781,097	$68,693,982	-$68,733,869
Rates	$693,514,966	$73,000,000	$830,894,486	$556,023,766	$137,379,520	-$137,491,200
Best/Worst Case Scenario	$693,514,966	$73,000,000	$514,259,696	$863,011,068	-$179,255,271	$169,496,101

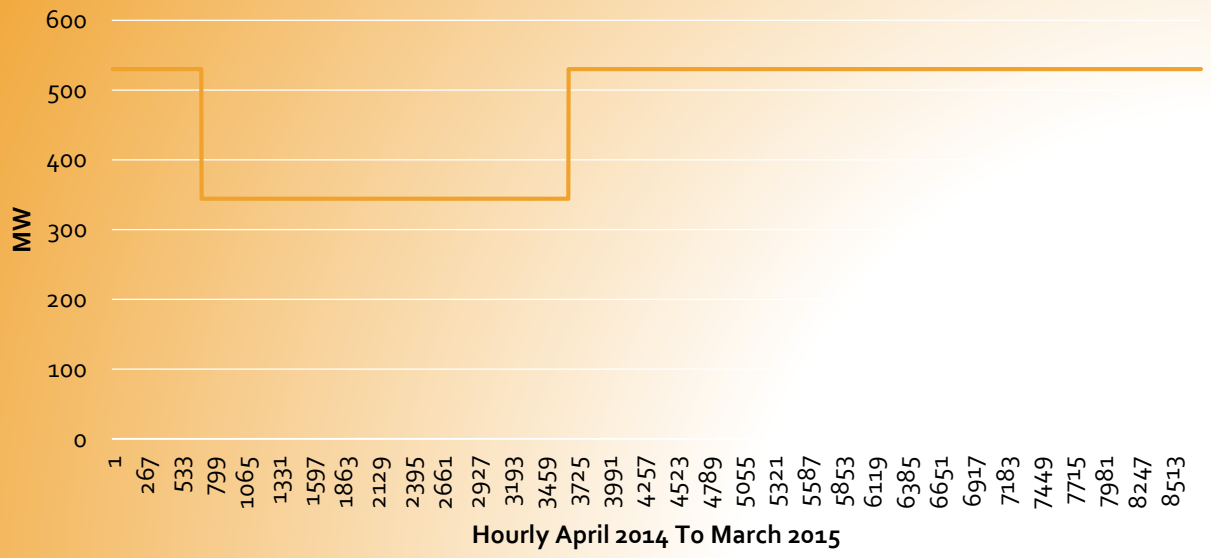
Stage 1 RPS Hourly Generation Stacked



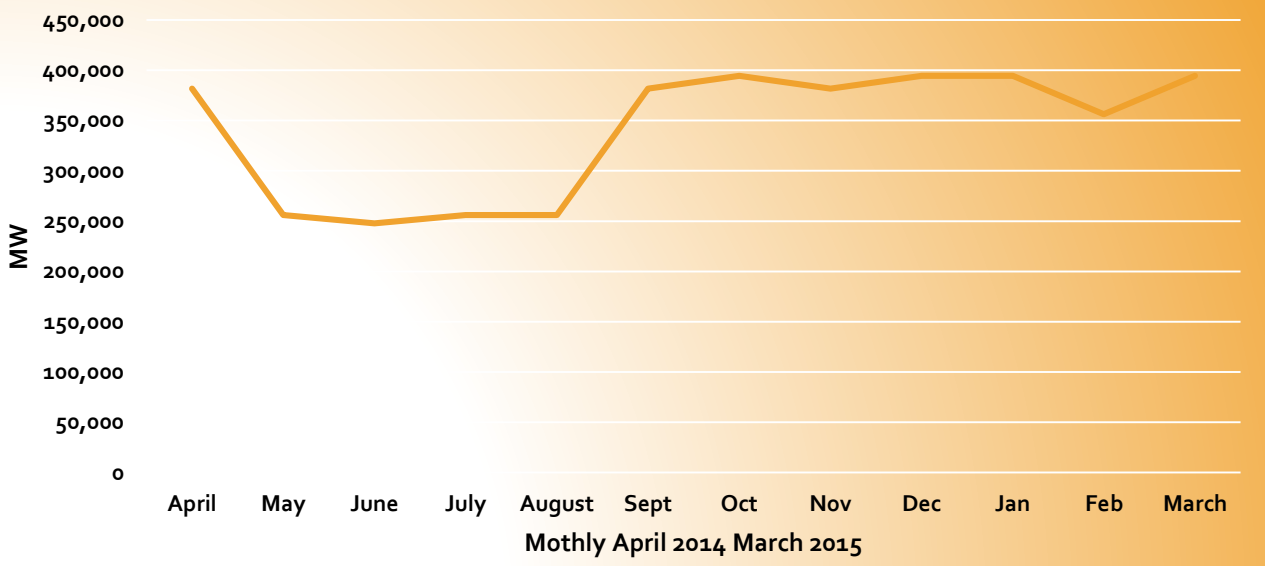
Total Demand BAU



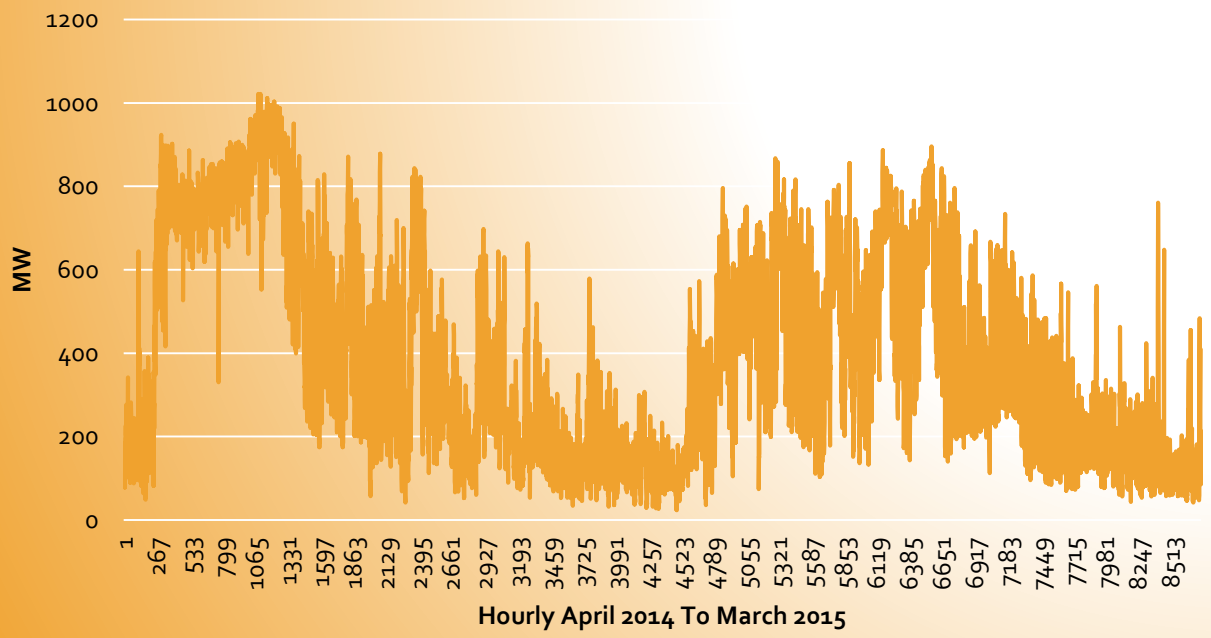
Baseload X



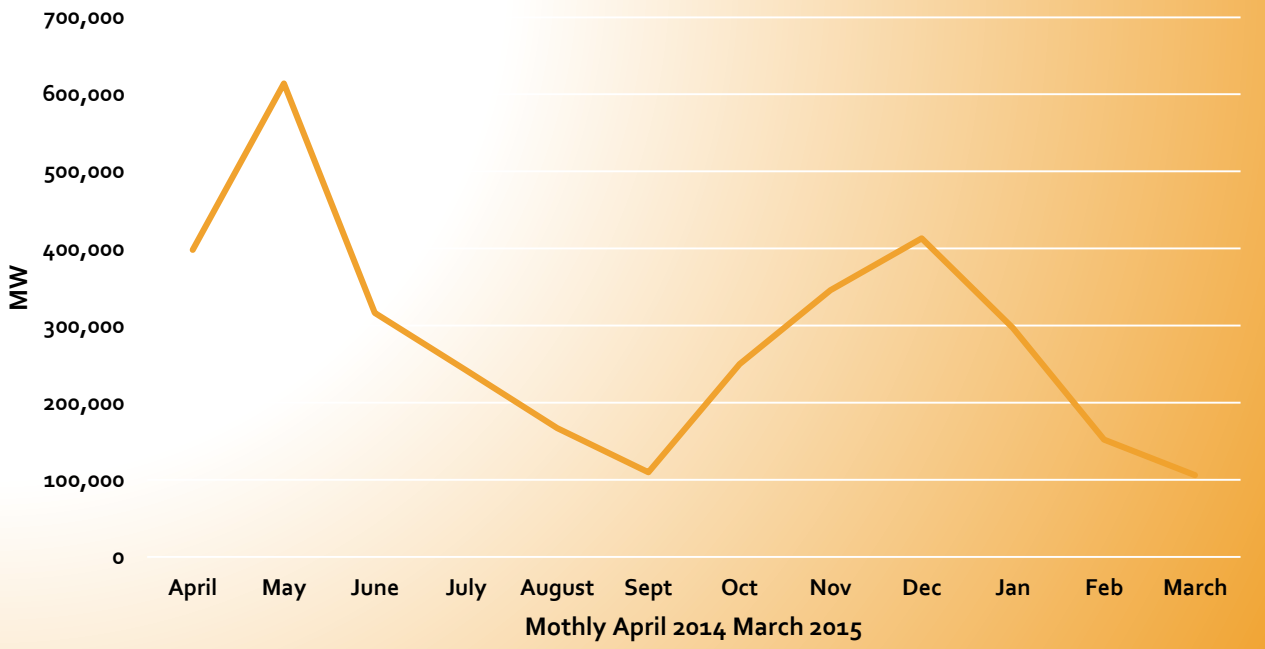
Baseload X



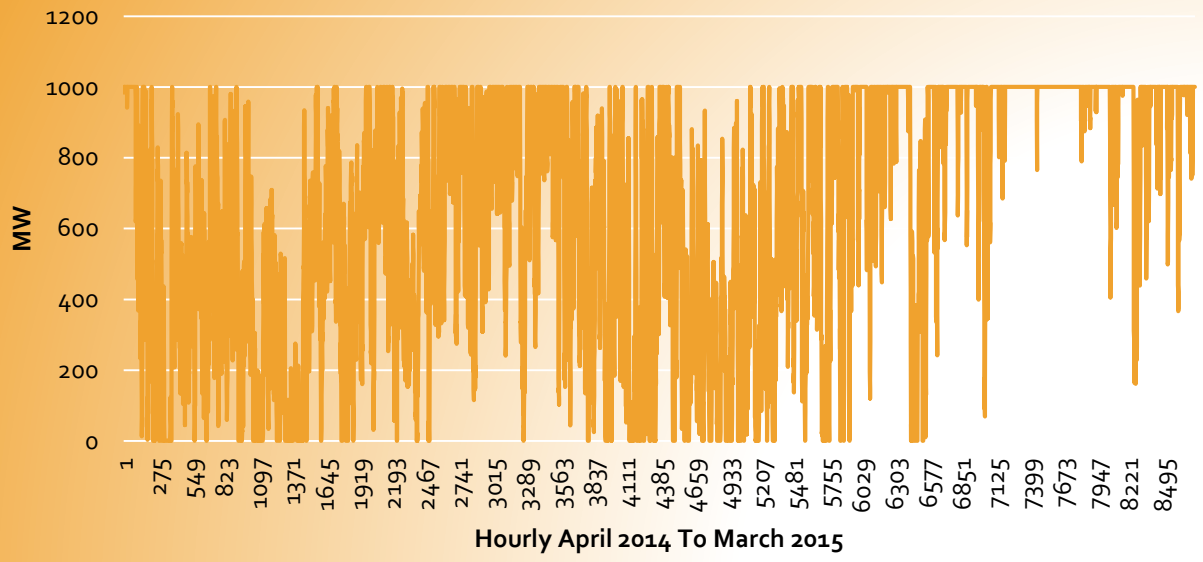
Hydro X



Hydro X



Other X HQ



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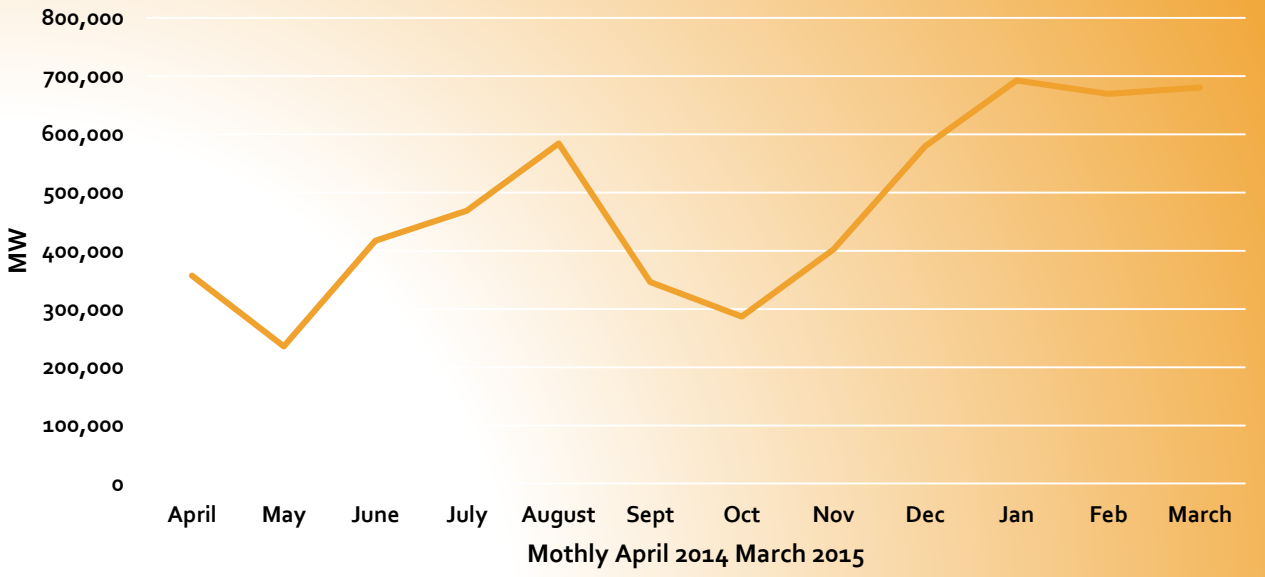

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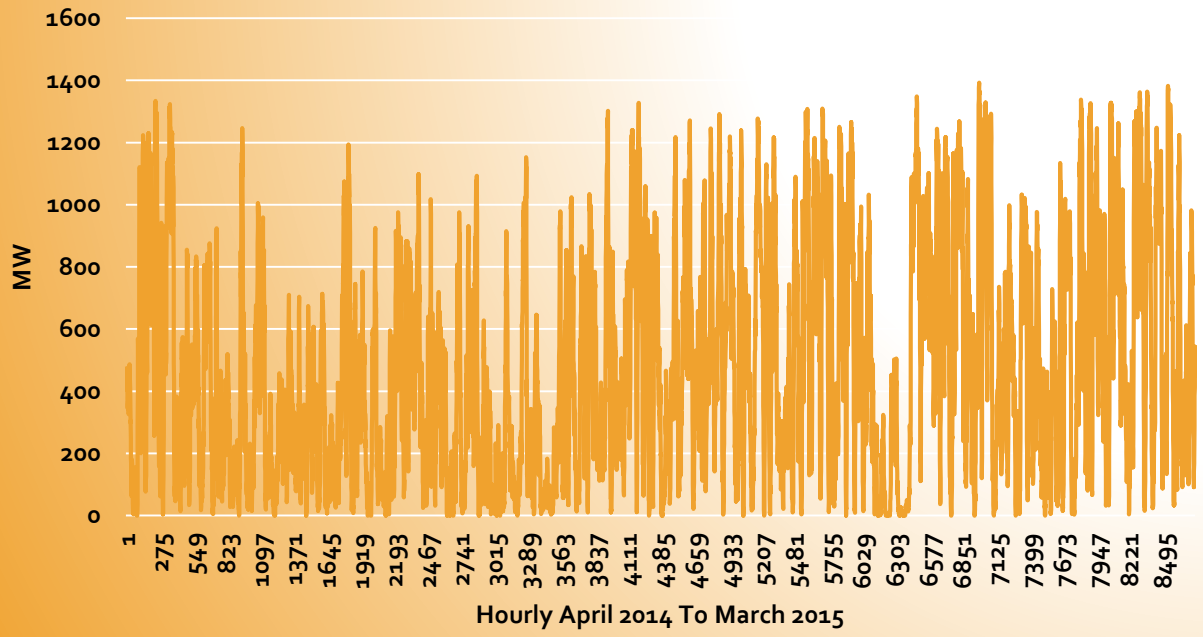

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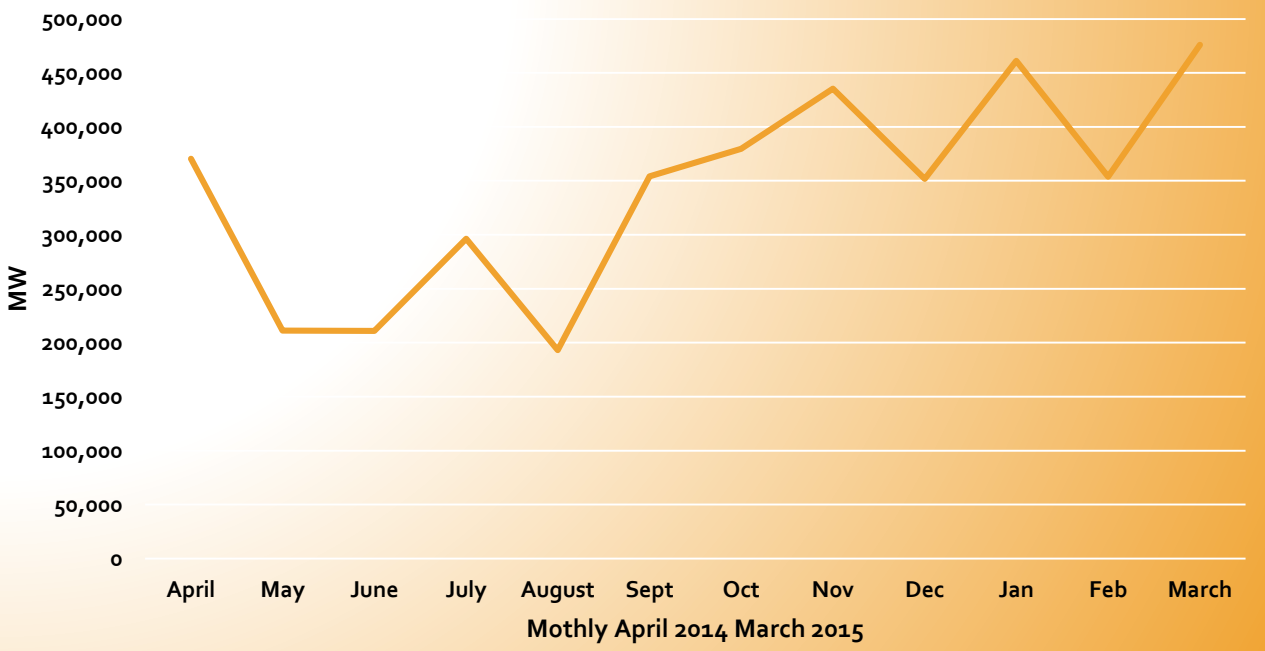
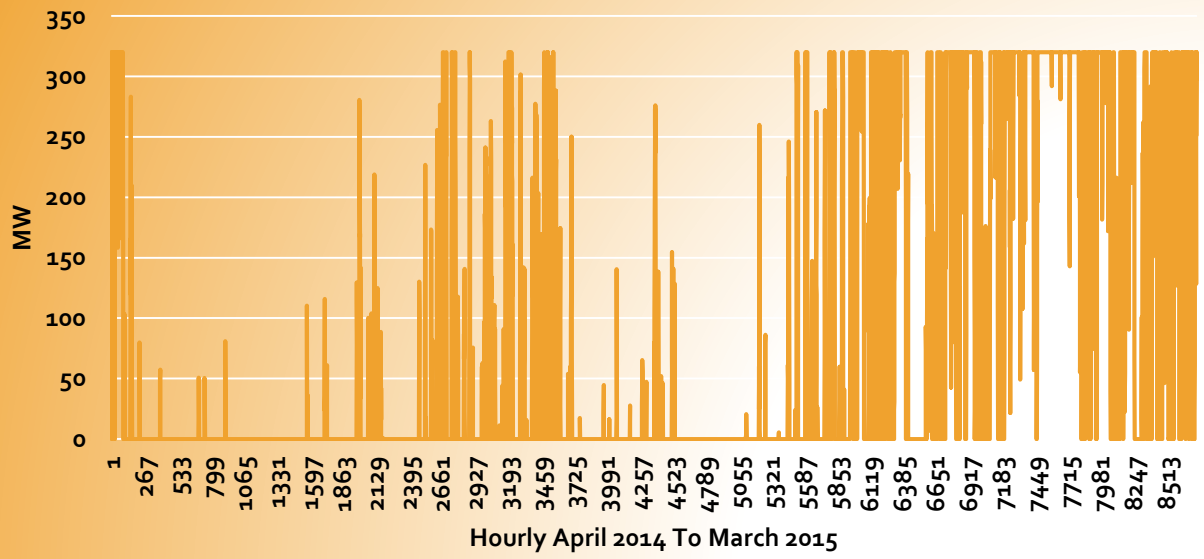


Other X Biomas



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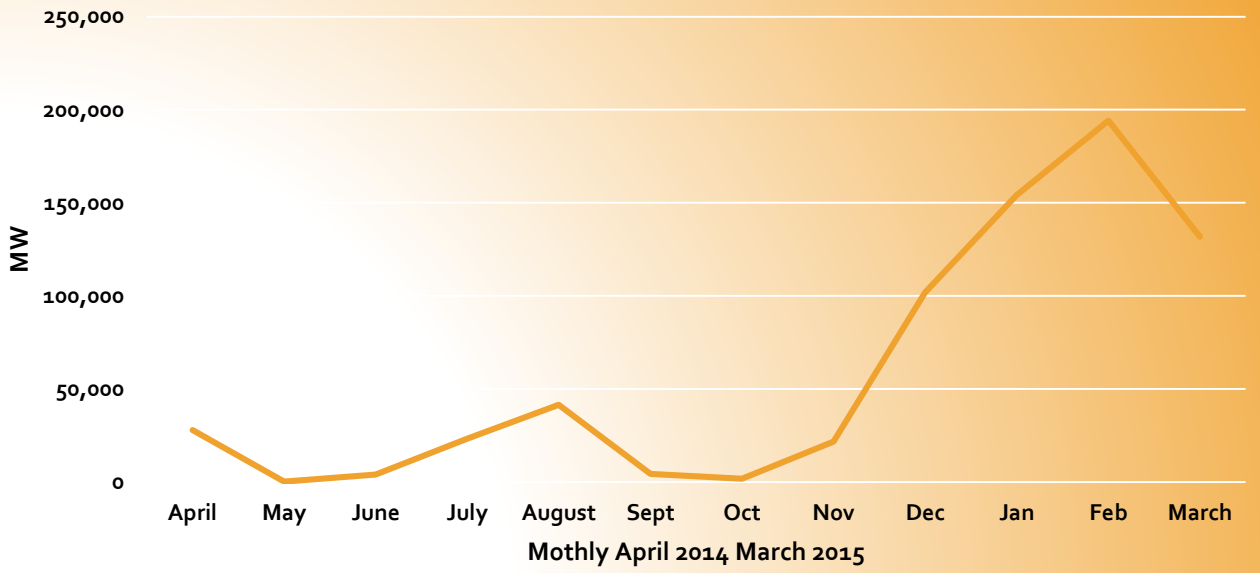

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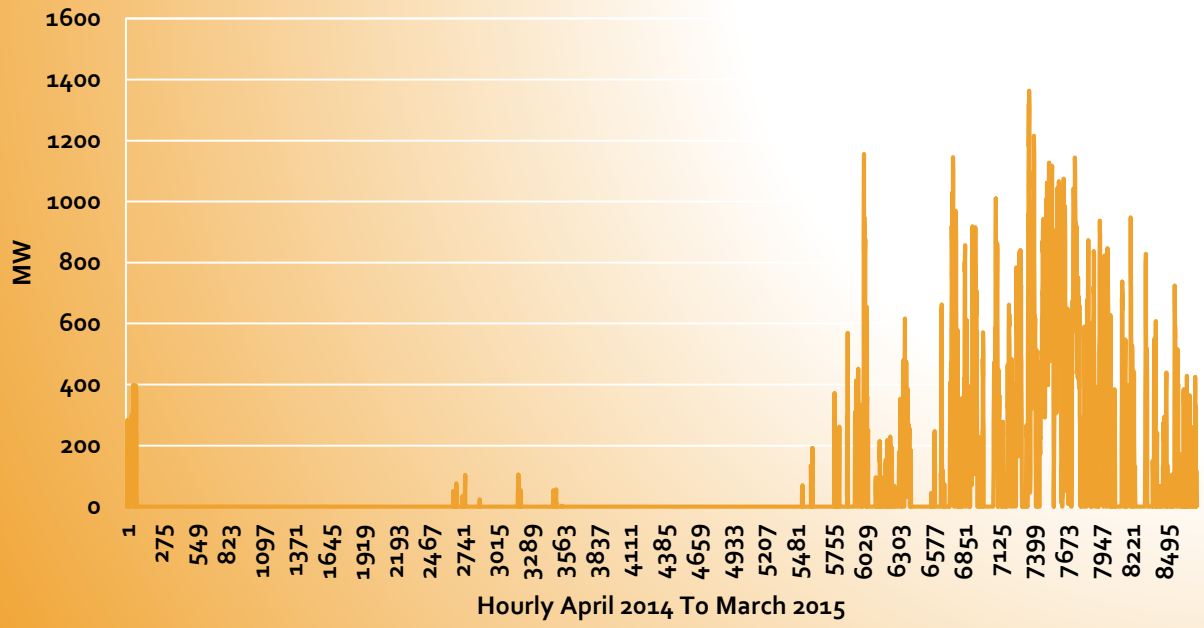

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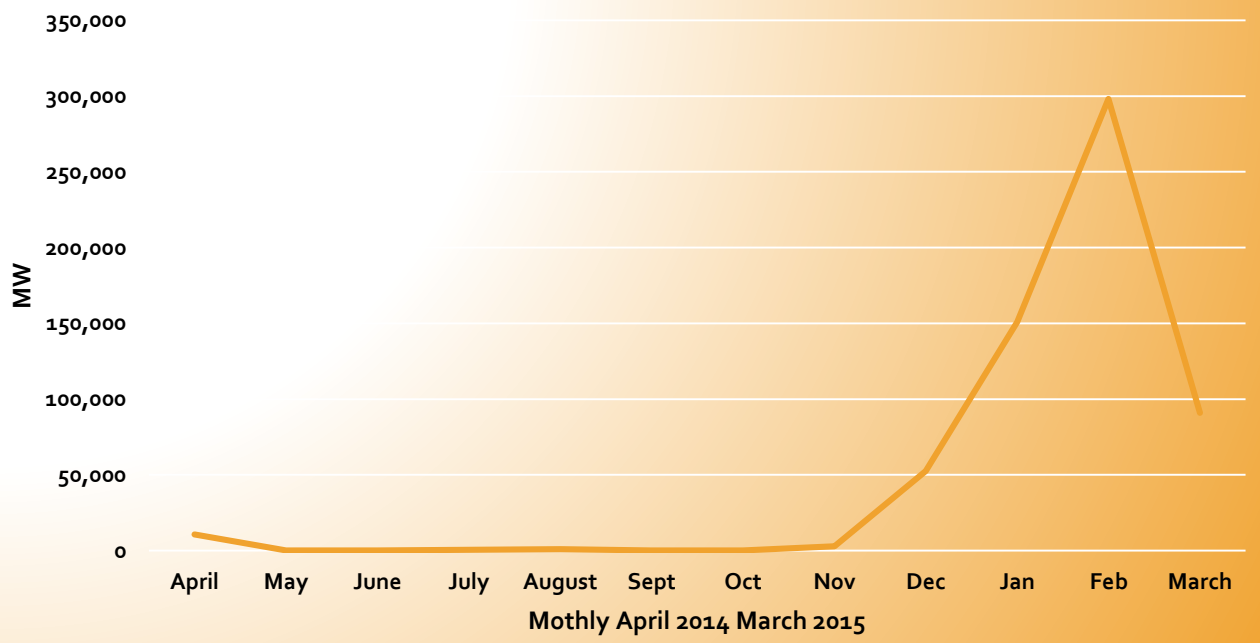
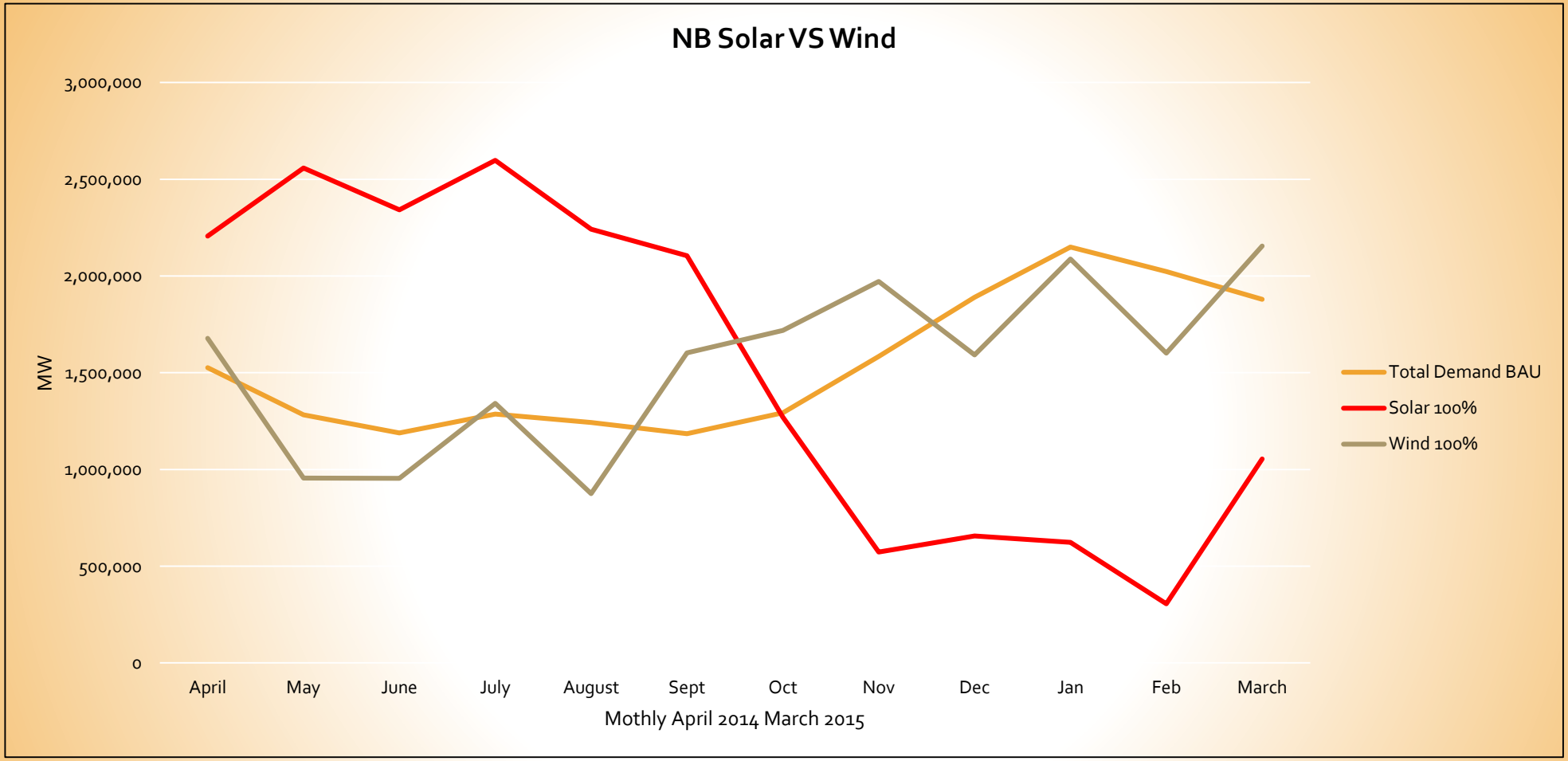
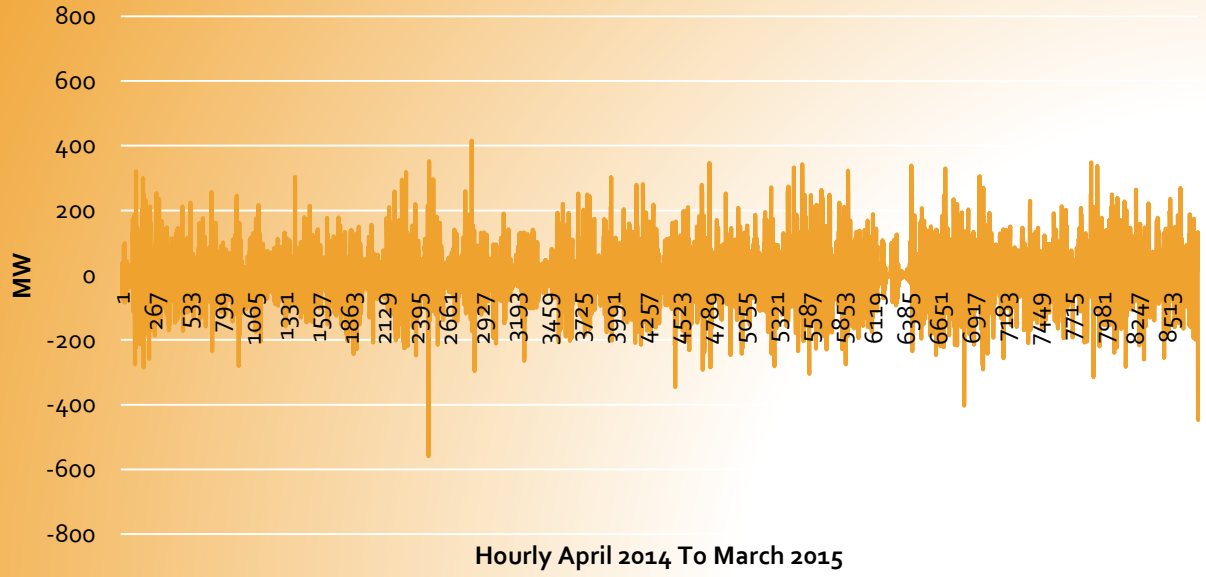
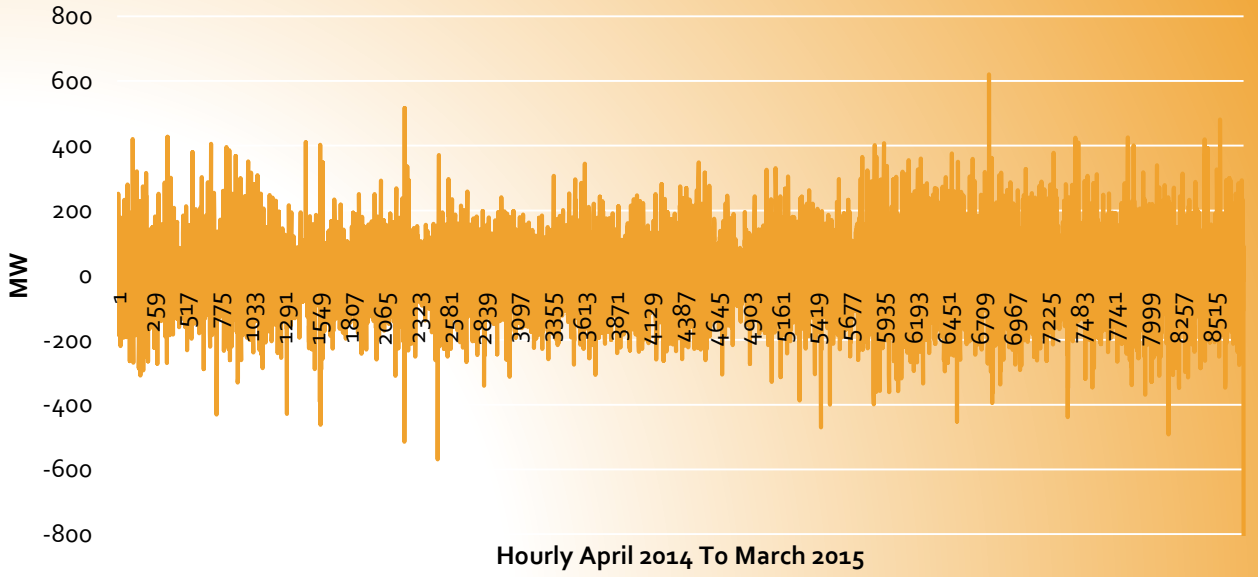



NB Solar VS Wind
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
MW
April
May
June
July
August
Sept
Oct
Nov
Dec
Jan
Feb
March
Mothly April 2014 March 2015
Total Demand BAU
Solar 100%
Wind 100%

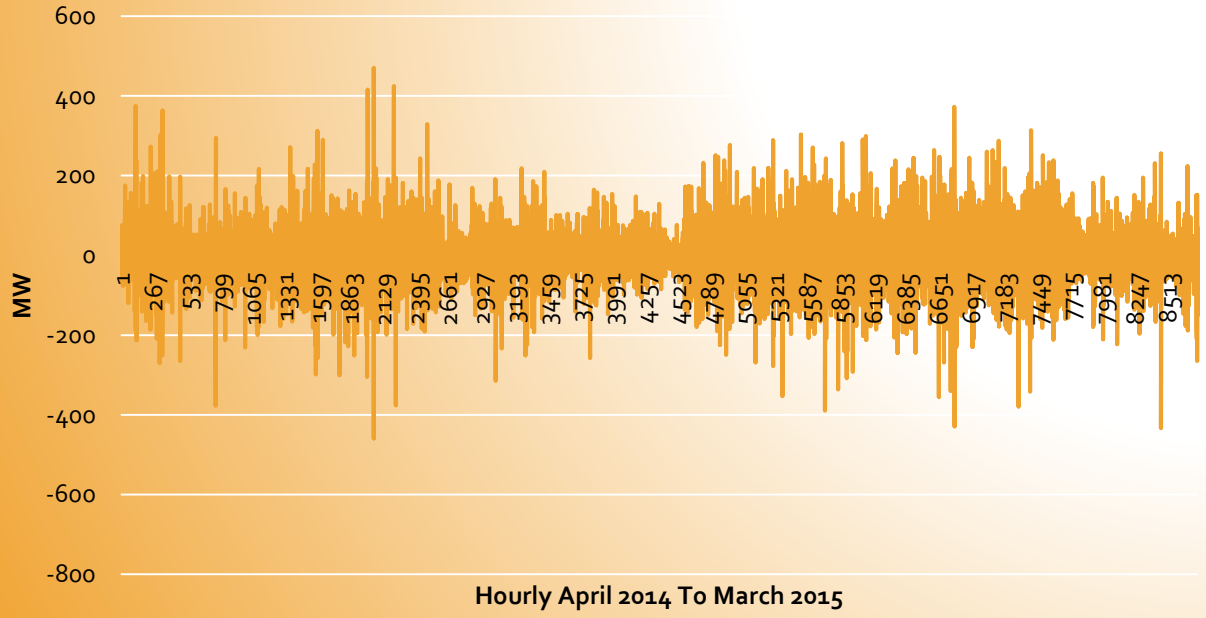
Wind Power Hourly Change



Other X Hourly Change



Hydro X Hourly Change



Other Hourly Change BAU