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Integration of Renewables and Recommendations for Dispatch Management

Update to Ministry of Energy

IESO0003548

Confidential Advice to Government

August 13, 2012

Outline

1. Refresher on operating challenges with growing wind investment
2. Impact on OPA renewable contracts
3. OPA's plan to address contract changes

Decision needed: Confirmation to Proceed with approach as outlined

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Issues Summary

- With variable generation quantities expected to double by the end of 2013, and ongoing high growth beyond, dispatch management is increasingly necessary to meet the operational challenges of managing renewable variability
- The IESO and the OPA are working together to design and implement efficient and environmentally sound dispatch processes.
 - No one fuel type is being singled out - additional options for mitigating SBG are being developed in conjunction with the IESO's SE-91 Renewables Integration Initiative
 - The current practice of avoiding renewable dispatch to manage SBG results in overcurtailment of inflexible baseload nuclear capacity driving increased requirements to run more expensive gas powered units

- Renewable dispatch is also needed to address local constraints and other operational issues, such as ramping
- Market rules for dispatching of renewable generators will be finalized by November and are the foundation for expanding the IESO's dispatch management tools to include variable generation resources, grid-connected wind generation in particular
- System efficiencies and operational benefits will be maximized by aligning OPA contracts with the new market rules

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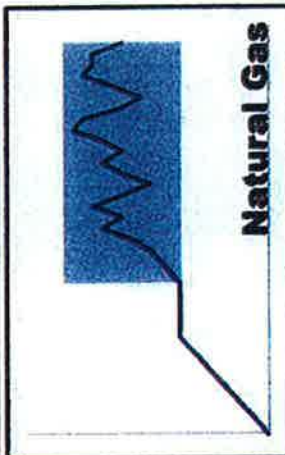
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Characteristics of Ontario's Fleet

Flexible



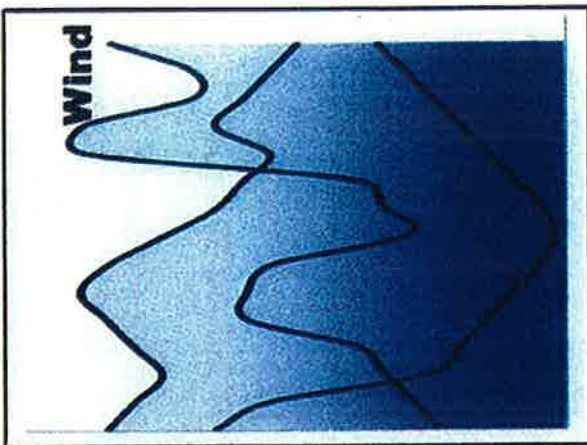
- Hydro: highly flexible when there's water
- Gas: highly flexible, if min. loading point is met
- Normally not running during surplus conditions

Baseload



- Limited flexibility to manoeuvre
- Can't "follow" demand

Variable



- Available output changes depending on conditions
- Highly flexible – but only if rules & contracts support dispatch management within available output

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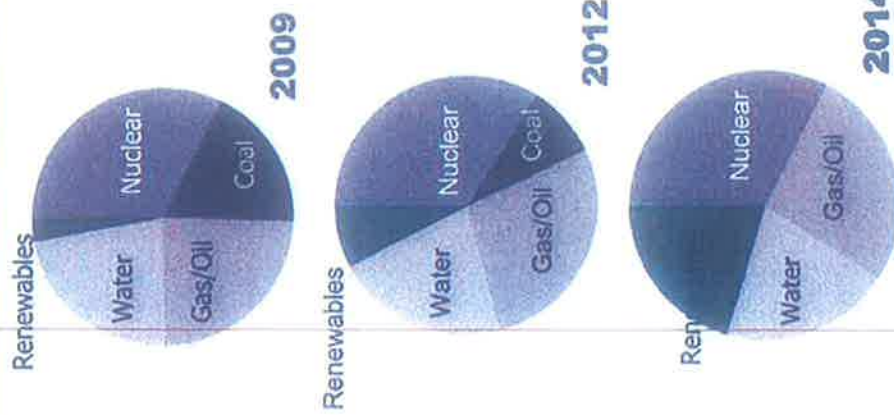


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A Changing Fuel Mix



* Capacity at year end

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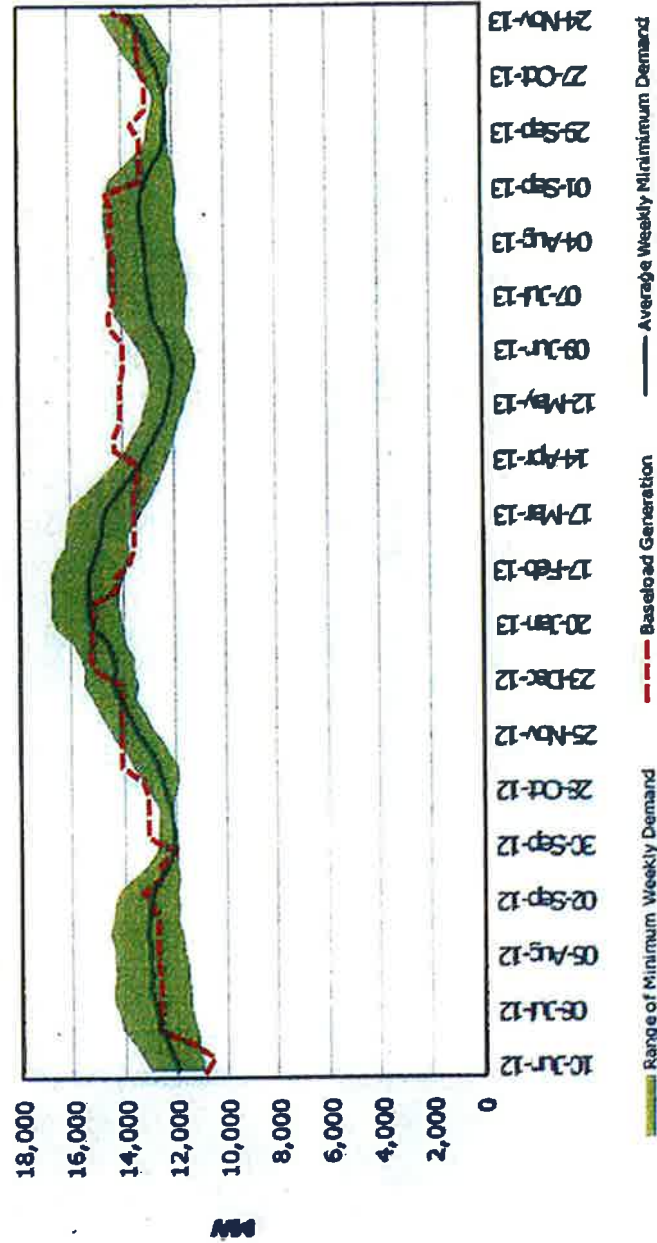
With the growing amount of renewable generation in the supply mix, it is increasingly important to expand dispatch management to capture the flexibility available from variable generation resources.

Dispatch management of all resources is necessary to address:

- global oversupply (SBG)
- local oversupply (transmission congestion)
- operational needs (ramping)

Global Over Supply

- The IESO's most recent 18 month outlook shows significant exposure to SBG events through 2012 and 2013.



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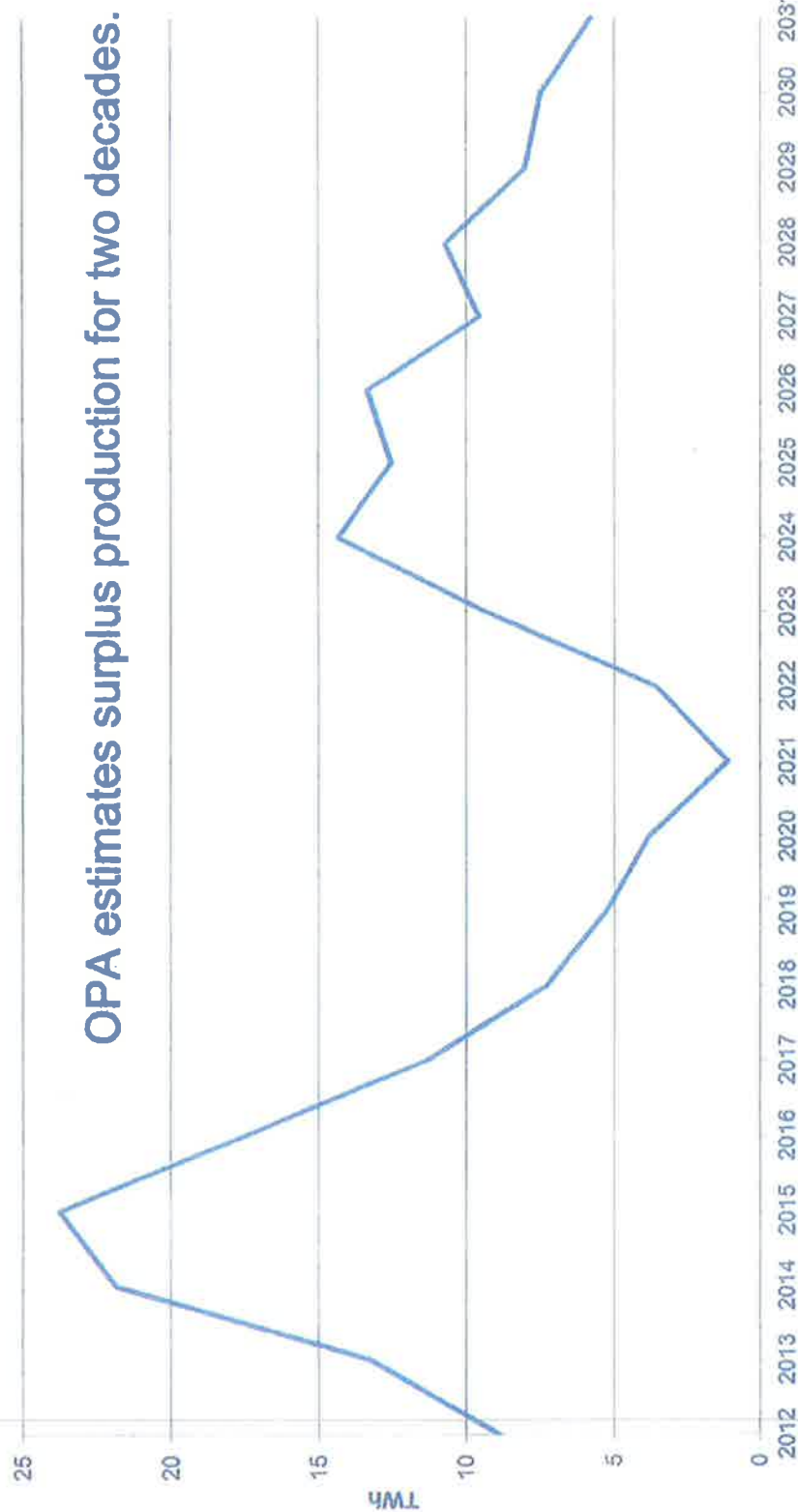
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A Long Term Perspective



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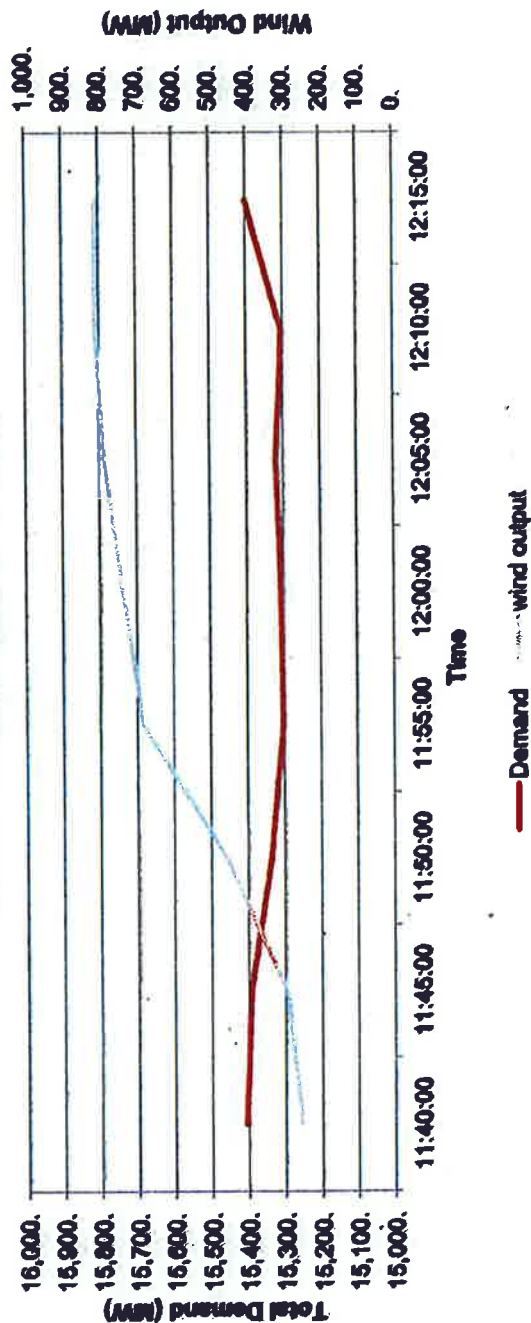
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Managing Variability

Wind Output May 27, 2012



•With the rapid change that can incur in wind and solar production, controlling renewable output is a must to ensure supply and demand are balanced and reliability is maintained

•With 1700 MW of installed wind capacity this 400MW change over 10 minutes was manageable. As wind resources come on line this would equate to an 800 MW change by 2014 and 1800MW change by 2018.

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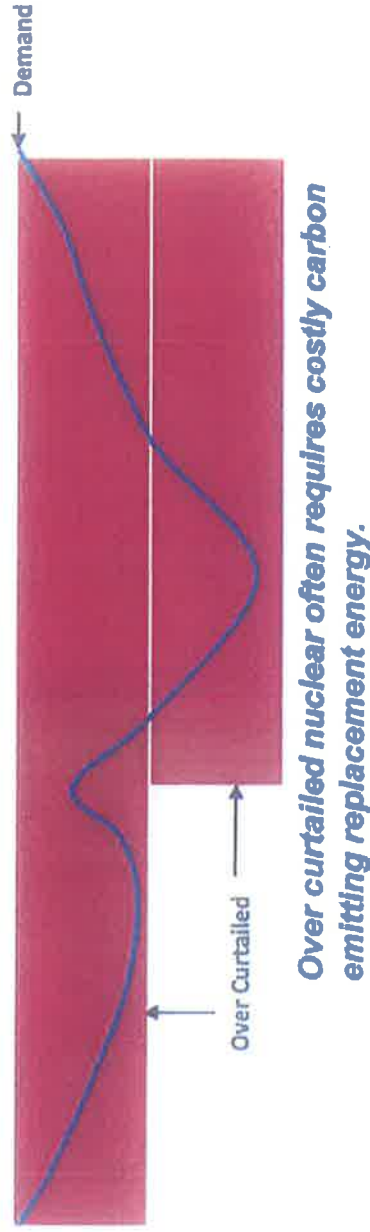
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Maximizing the Value of the Greener Fleet

- Without Renewable Dispatch (current situation)



- With Renewable Dispatch



Using flexible renewables minimizes over curtailment and its associated economic and environmental impacts.



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OPA CONTRACTS

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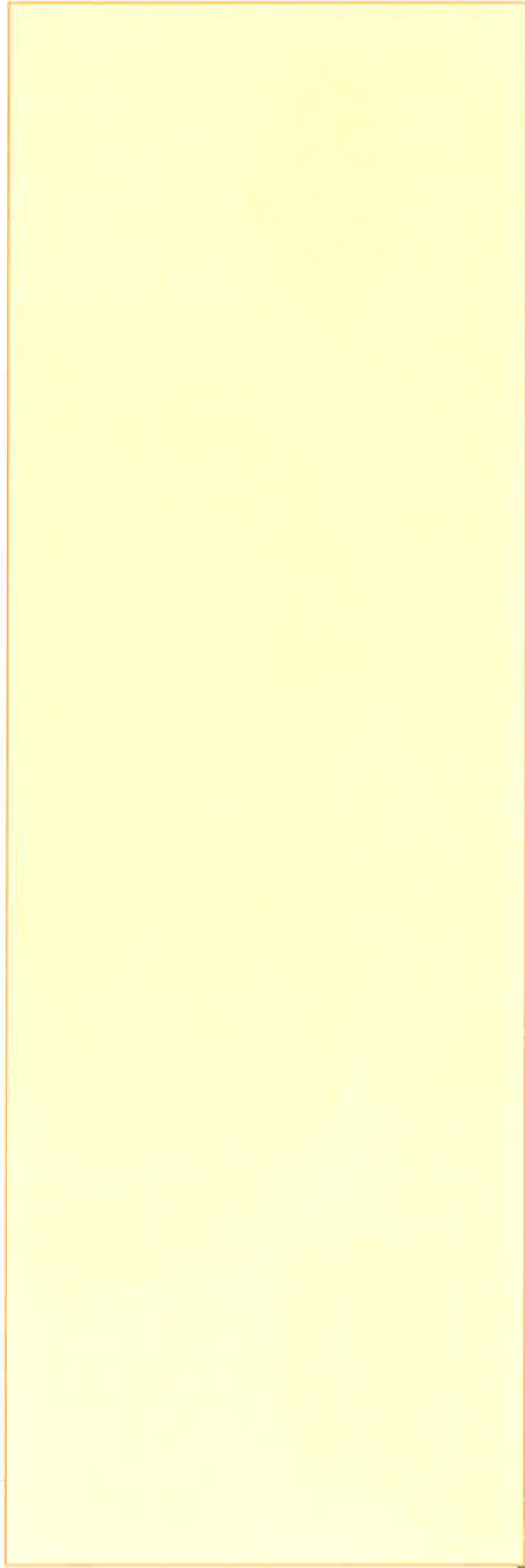
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Market Rule Changes and OPA Contracts

- **OPA Contracts need to integrate with IESO Market Rules** in order for the IESO to efficiently administer the wholesale market and effectively operate the system
 - OPA contract amendments should contain appropriate provisions for generators to respond to IESO for dispatching during global surplus or local congestion issues
 - Dispatching wind is more cost effective for ratepayers than the status quo
 - Curtailing inflexible nuclear production results in additional costs for replacement power



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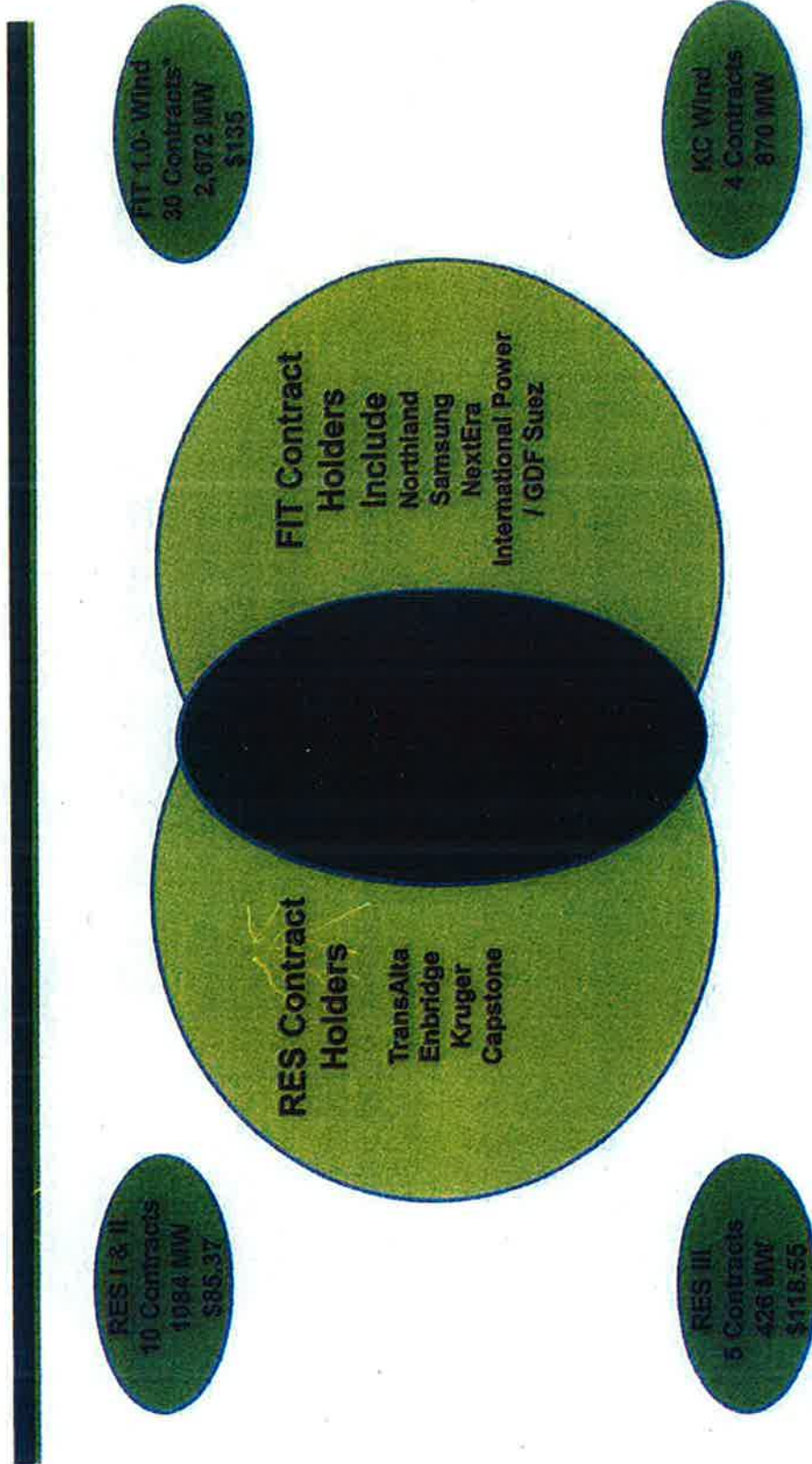


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Contract Counterparties



*Includes transmission connected facilities only. Data accurate as of June 30th, 2012.

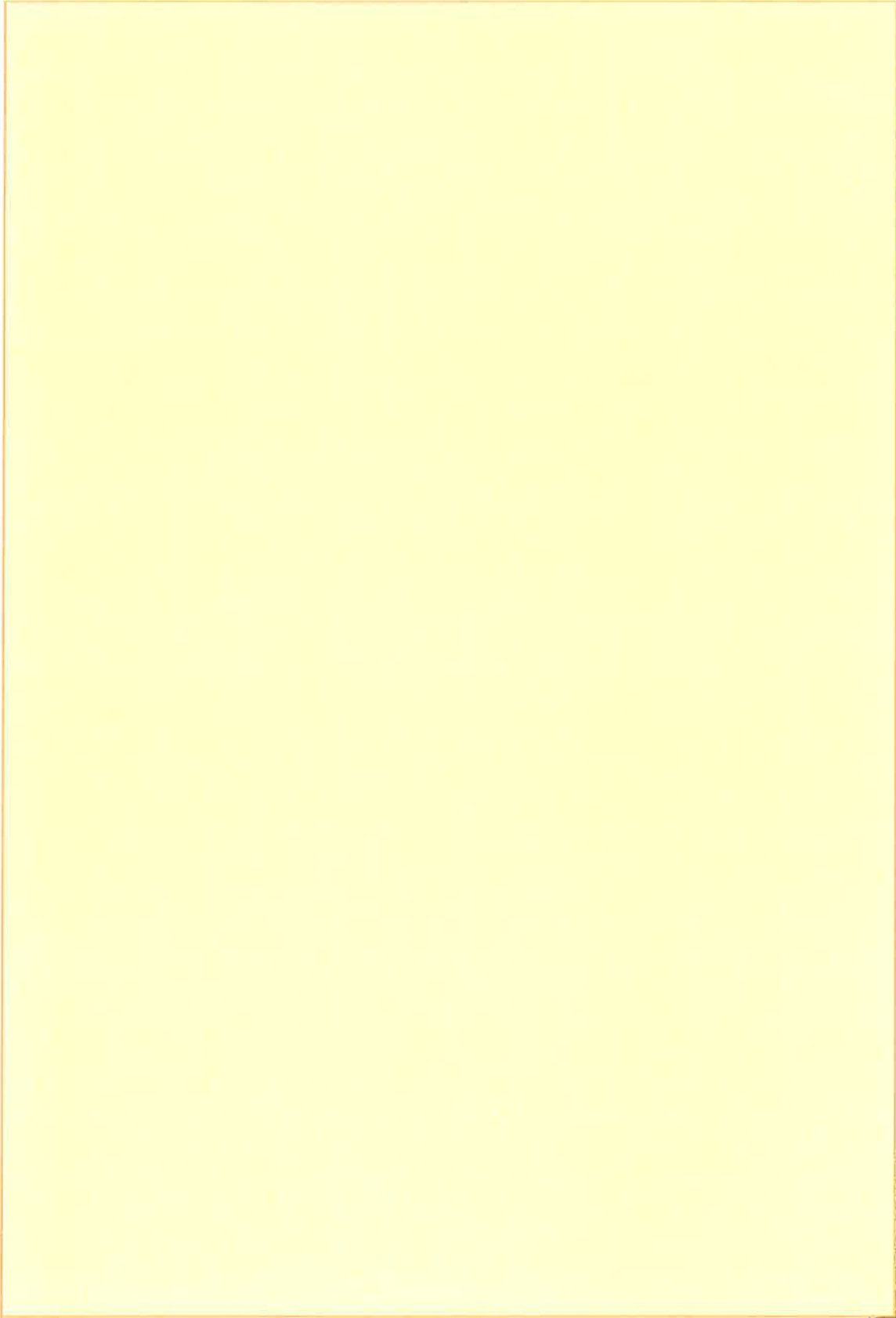


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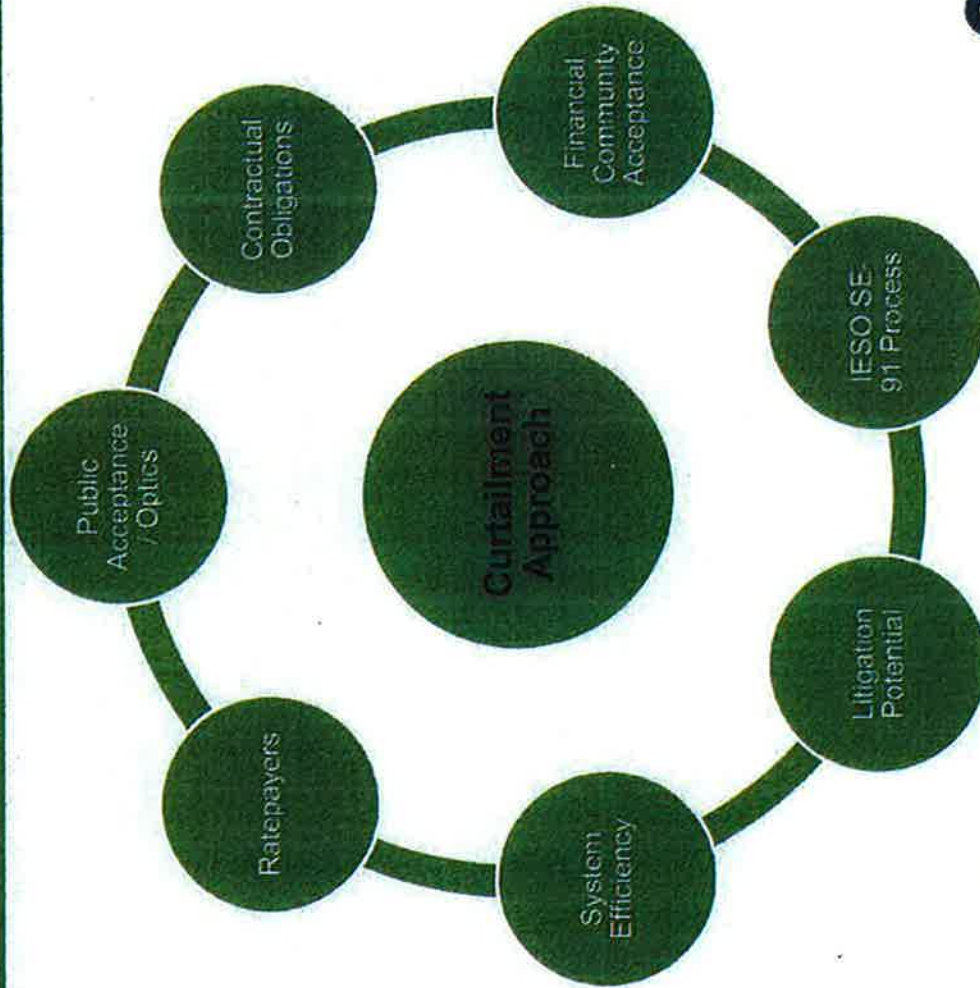






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Negotiating Environment



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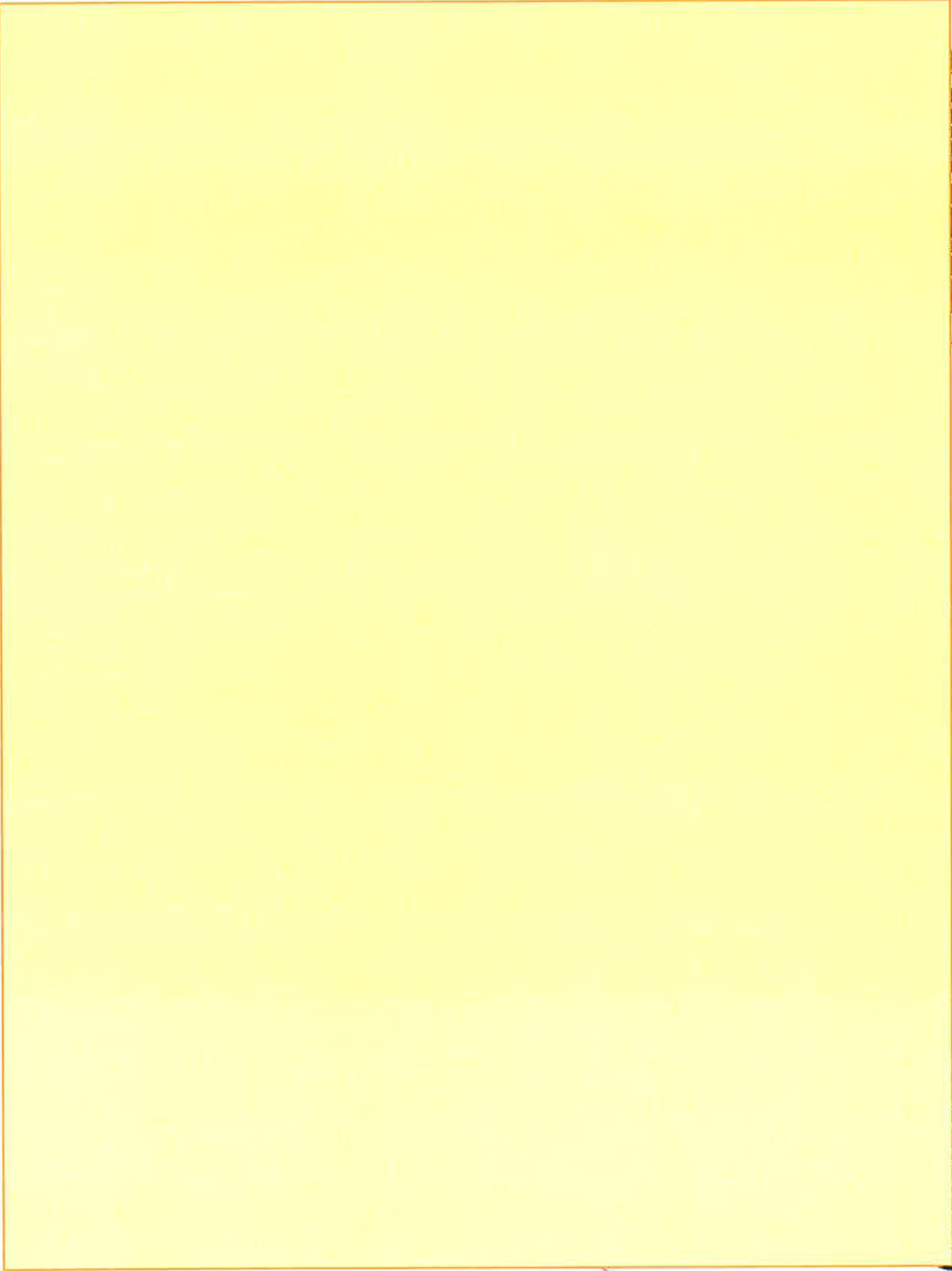
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Bottom Line

- System efficiencies and operational benefits will be maximized by aligning OPA contracts with the new market rules

- OPA has contractual obligations related to FIT 1.0 and RES III to address market rule changes
 - Suppliers can trigger obligations once Market Rule amendments are finalized
 - By November, OPA will be forced into discussions with FIT Suppliers

- Approach must be defined for curtailment provisions in FIT 2.0 contract



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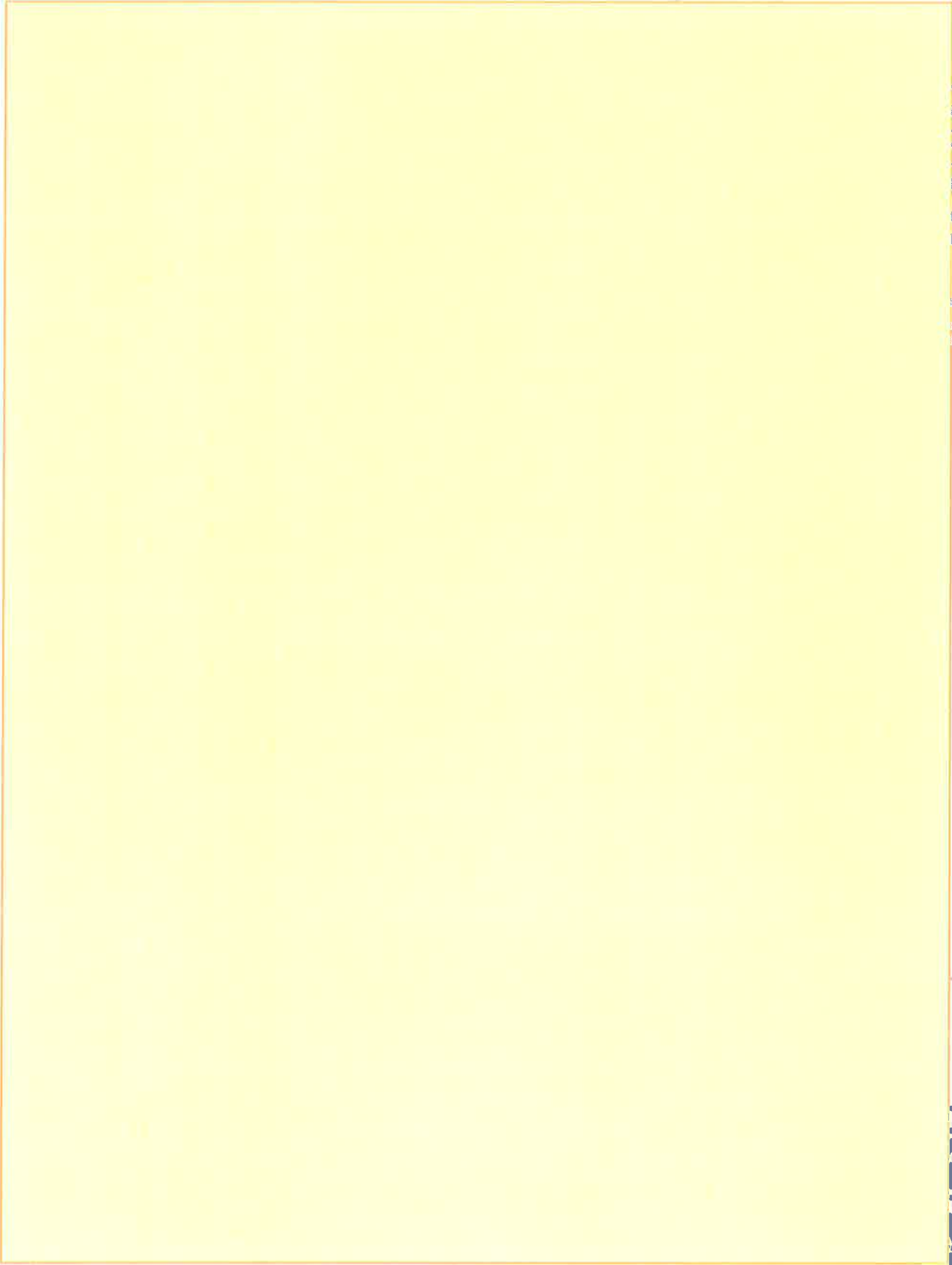


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Appendix A: Additional Information



Existing OPA Wind/Solar Contracts (1)

Contract Type	Affected Fuel Type	# of Contracts	# of MW
RES I/II 2004-2005 Competitive Procurement	Wind	10 (39.6 to 197.8 MW)	1084 MW
RES III 2009 Competitive Procurement	Wind	5 (50.6 to 99.4MW)	426 MW

Notes

1. Prices subject to escalation

Prices limit on how low a generator may offer energy into the wholesale market where the lowest allowable offer is -2000(\$/MWh). In periods of low demand, generators with the lowest offers would be the last to be dispatched off, as they are the most expensive resource. For instance, of two generators offering at -1 (\$/MWh) and -2,000 (\$/MWh), the one offering -\$1 would be dispatched off first as it is the more expensive resource.

In addition to their Contract Price, RES I, II and III generators who have contract prices <\$120/MWh also receive \$10/MWh from the Federal ecoEnergy program. The ecoEnergy credit is provided for 10 years of production.

in dollars



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Existing OPA Wind/Solar Contracts (2)

Contract Type	Fuel Type	# of Contracts	Total MW
FIT 1.0 2010-2011 Standard Offer	Wind	75 (61 are >5MW)	2813 MW
	Solar ³	1590 (94 > 5MW)	1196 MW
Korean Consortium 2010-2011	Wind	4 (2- Phase I and 2- Phase II)	870 MW
	Solar	2 (1- Phase I and 1- Phase II)	200MW

Notes:

- Based on 2009 Price schedule, subject to escalation
- Places limit on how low a generator may offer energy into the wholesale market where the lowest allowable offer is -2,000(\$/MWh). In periods of low demand, generators with the lowest offers would be the last to be dispatched off, as they are the most economic resource. For instance, of two generators offering at -1 (\$/MWh) and -2,000 (\$/MWh), the one offering -1 (\$/MWh) would be dispatched off first as it is the more expensive resource.



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- **Power Purchase Agreements (PPAs) only pay generators when they produce**
 - This incents facilities to maximize production, which is important during times when the electricity is needed
 - OPA has PPA-style contracts with:
 - Renewable resources: RES, RESOP, FIT, HCl, Renewable CHP
 - Nuclear resources: Bruce Power

The Economics of Curtailment

Wind Curtailment Cost
Payment to OPG and small Hydro for Production
★ Payment to OPG Nuclear for Production
★ Payment to Bruce Nuclear for Production
★ Curtailment Payment to Wind Suppliers for a Few Consecutive Hours of Curtailment
Total Costs of Paying for Wind Curtailment

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Other Resources Curtailment Costs
Payment to OPG and small Hydro for Production
★ Payment to OPG Nuke for Production (through increased rates)
★ Equivalent Payments to Bruce Nuclear for Lost Production
★ Payment to Wind Suppliers for Production
★ Cost of Natural Gas Production (or Imports) to Offset Lost Nuclear Production
★ Environmental Benefits of Using Natural Gas for Hydrogen to Offset Lost Nuclear Production
Total Costs of Not Paying for Wind Curtailment

Bruce Nuclear gets paid whether it operates or not, and due to the longer down-times for nuclear, replacement gas production is needed, resulting in higher costs.

It is therefore more cost-effective to pay for wind to curtail than paying for nuclear or hydro curtailment.



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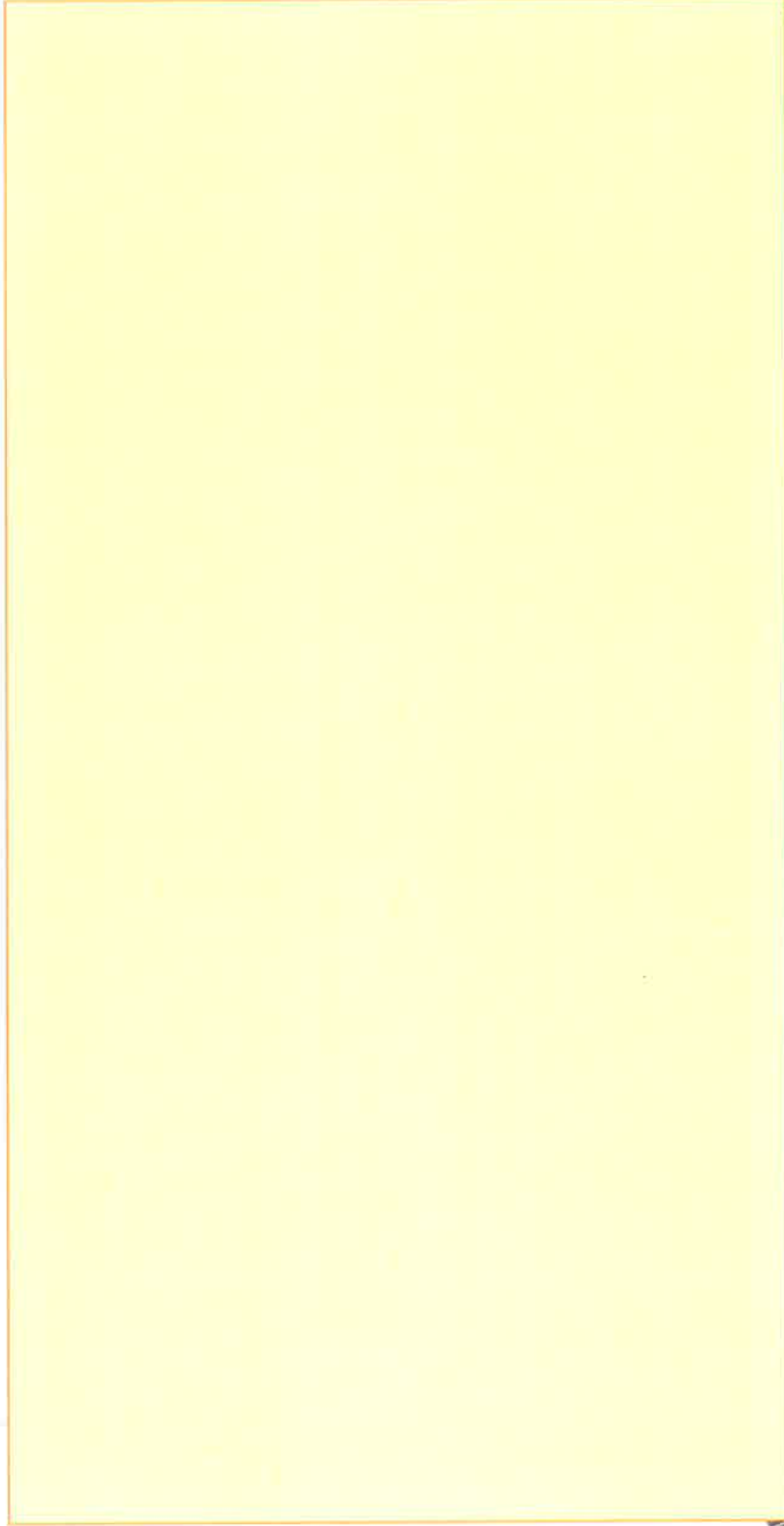


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OPA Contracts: Efficient Risk Sharing

- Intent of contracts is to alleviate the risk associated with capital cost recovery due to volatility of an 'energy only' market



RES Suppliers and Market Rule Changes

- OPA, IESO and Suppliers have had significant discussions as to the intent and meaning of Section 3.2
 - OPA believes that the clause has some meaning and therefore results in Suppliers being responsible for some risk
 - RES Suppliers are adamant they were never intended to be dispatchable facilities

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Wind Curtailment in Other Jurisdictions

Jurisdiction	Curtail Wind Output?	Curtailment Signal	Payments during curtailment
ERCOT (Texas)	Yes	Transmission congestion (otherwise wind facilities respond to zonal market prices)	Historically received out-of-merit payments (equivalent to CSMC), but only up to daily operating limit
Midwest ISO	Yes	Global surplus supply or transmission congestion	None - payments based on Locational Marginal Pricing* (LMP) only
NYISO	Yes	Economic dispatch	None - payments based on LMP only
PJM	Yes	During "constrained operations" or "light load events"	None - payments based on LMP only
Bonneville Power Administration (Pacific Northwest)	Yes, wind is must run until a system imbalance occurs	BPA can assign generation limits to wind plants based on scheduled output plus a pro rata allocation of balancing reserves	No compensation
Southern California Edison	Yes	Economic dispatch	Generators to be paid for curtailed hours, but must deliver energy at end of PPA at a discounted price
Germany	Yes, wind is must run until a system imbalance occurs	Only curtailed for grid congestion	Transmission operators obligated to take all electricity from renewable sources. If curtailed for system reliability wind is compensated at an established tariff rate
Alberta Electric System Operator	Yes	Wind power is only curtailed to manage transmission constraints and other reliability events	No compensation

* LMP is a market pricing approach that provides market participants a signal of the price of electricity at every location on the grid, as it accounts for the additional costs of electricity caused by transmission congestion and line loss at various points on the grid.



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