



**South Australian Chamber of Mines and Energy**

# **Independent review into the future security of the national electricity market**

Submission to

**The Department of Environment and Energy**

**June 2017**

## **Contact**

Dr. Nigel Long

Director, Industry & Government Advocacy

P: (08) 8202 9933

M: 0448 848 038

E: [nlong@sacome.org.au](mailto:nlong@sacome.org.au)

## CONTENTS

<b>EXECUTIVE SUMMARY</b> .....	<b>3</b>
<b>RECOMMENDATIONS</b> .....	<b>4</b>
<b>RESPONSES TO QUESTIONS</b> .....	<b>5</b>
<b>1. Technology is Transforming the Electricity Sector</b> .....	<b>5</b>
1.1 How do we anticipate the impacts, influences and limitations of new technologies on system operations, and address these ahead of time? .....	5
<b>2. Consumers are Driving Change</b> .....	<b>6</b>
2.3 How do we ensure the needs of large-scale industrial consumers are met?.....	6
<b>3. The Transition to a Low Emissions Economy is Underway</b> .....	<b>7</b>
3.1 What role should the electricity sector play in meeting Australia’s greenhouse gas reduction targets?.....	7
3.2 What is the role for natural gas in reducing greenhouse gas emissions in the electricity sector?.....	7
3.3 What are the barriers to investment in the electricity sector? .....	8
3.4 What are the key elements of an emissions reduction policy to support investor confidence and a transition to a low emissions system? .....	8
<b>4. Integration of Variable Renewable Electricity</b> .....	<b>8</b>
4.1 What immediate actions could be taken to reduce the emerging risks around grid security and reliability with respect to frequency control, reduced system strength, or distributed energy resources?.....	8
4.3 Is there a need to introduce new planning and technical frameworks to complement current market operations?.....	9
<b>5. Market Design to Support Security and Reliability</b> .....	<b>9</b>
5.2 Is liquidity in the forward contract market for electricity adequate for the needs of commercial and industrial consumers and, if not, what can be done?.....	9
Figure 1: Future baseload wholesale prices CY 2017 indexed.....	10
5.3 Are commercial and industrial users experiencing difficulties in obtaining quotes for supply? .....	10
5.4 What impact will an increasing level of renewable generation have on the forward contract market and what new products might be required? .....	10
<b>6. Prices Have Risen Substantially</b> .....	<b>10</b>
6.1 What additional mechanisms, if any, could be implemented to improve the supply of natural gas for electricity generation?.....	10
<b>7. Energy Market Governance is Critical</b> .....	<b>11</b>
7.1 Is there a need for greater whole-of-system advice and planning in Australia’s energy markets? .....	11
7.6 How can decision-making be appropriately expedited to keep up with the pace of change? .....	11
<b>References</b> .....	<b>12</b>

## EXECUTIVE SUMMARY

The South Australian Chamber of Mines and Energy (“**SACOME**”) is the peak industry association for companies with business interests in the resources industry in South Australia, including those with business, vocational or professional interests in minerals exploration, mining and processing, oil and gas exploration, extraction and processing, power generation, transmission and distribution, logistics, transport, infrastructure, and those with clients in these sectors.

The South Australian market in the National Electricity Market (“**NEM**”) has the highest penetration of non-synchronous generation (42.2%; 2016) and is presently experiencing greater volatility and higher prices. The retirement of baseload generation in South Australia, due to changing market conditions, is resulting in a reduction of synchronous generation that has traditionally provided the frequency control and inertial services critical to the stability and reliability of the network.

The continuation of this trend may result in deindustrialisation of the State. SACOME members have identified that it is becoming increasingly difficult to justify further capital expenditure to upgrade or build new plant.

The Australian Energy Market Operator (“**AEMO**”) in partnership with network participants (i.e. TNSPs) conduct regular studies on the integration of non-synchronous technologies to identify issues; the Australian Electricity Market Commission (“**AEMC**”) along with the Australian Energy Regulator (“**AER**”) provide the necessary regulation and rules for the market to operate effectively. In this context, the powers to coordinate responses to critical issues of system security and strength are absent.

Events over the past 12 months in South Australia, such as the network characteristics at the time of the 28 September 2016 system black, have been well documented in prior assessments. Responses to these events to alter the market rules or policies have only occurred after actual event occurs. This is no longer acceptable by business or the public. There needs to be a mechanism that can direct governing bodies or AEMC to adjust policies or rules to mitigate a detrimental reduction in system strength where critical issues have been identified prior to failures occurring.

Any response to system security and strength must have the appropriate powers and assess future developments on a technology neutral basis to provide tangible solutions. As this review identifies low carbon as a key metric to consider, any low carbon policies should strive to unify under a single policy framework as to not create a fragmented national system where market failures occur and system strength is put at risk.

SACOME has responded to questions in the review that pertain to discussion on system strength and volatility in the South Australian market.

To ensure that businesses can remain globally competitive in South Australia, SACOME’s recommendations are:

## RECOMMENDATIONS

- 1.1 This review acknowledges there exists the ability to analyse and report on the conditions that impact on system security within AEMO and network stakeholders. SACOME further recommends rule changes to give AEMO, or another competent authority, greater powers of direction to ensure system security. These rule changes need to be expedited given the usual period required for them to come into force.
- 2.3 Continual assessment of system security is required and linked to powers that can direct market regulators and rule makers to alter the system to improve security if needed.
- 3.1 Targets to reduce emissions and plans to replace higher emitting generation should be technology neutral and incorporate a technical assessment that compares the proposed policy or project against a set of technical standards to ensure no net loss to system strength.

Nuclear power should be considered alongside other generation choices to ensure comprehensive assessments are undertaken with respect to system strength, affordability and low carbon criteria.
- 3.2 There needs to be an appropriate plan in place where proposals for new generation or low carbon market policies be assessed against the three metrics identified in this review, affordability, system strength (reliability & security), and low carbon. The gas markets review will also need to take into account the increasing difficulty to contract gas for variable generation to limit the impacts on affordability and system security.
- 3.4 There is a specific review of low carbon policies to ensure they are operating effectively to ensure a drive to lower carbon emissions while not at the expense of system strength or affordability. Any analysis and recommendations of the review must be technology neutral while ensuring there is an orderly transition to lower emissions generation sources. If required, delaying withdrawals of synchronous generation if it is shown to have a large detriment to system security.
- 4.1 The early adoption of rule changes to provide market mechanisms and signals to generators to provide the necessary frequency control and system strength services.
- 5.4 An investigation be undertaken to identify where low cost renewable generation can contribute to the forward contracts market and determine if a futures market can be established to enhance competition and liquidity.
- 6.1 There are legislative measures in place for strategic resources, such as natural gas, to ensure such resources are available for extraction and use unless precluded by proven scientific and/or environmental reasons.
- 7.6 There is continual monitoring of the assessments by AEMO with the assistance of private network operators. Additionally, any new powers are enabled to determine the level of criticality for system security issues identified and the issuing of rule and policy directives to ensure standards of system security are met.

## RESPONSES TO QUESTIONS

### 1. Technology is Transforming the Electricity Sector

#### 1.1 *How do we anticipate the impacts, influences and limitations of new technologies on system operations, and address these ahead of time?*

Through partnerships with network participants and market operators, any new energy policies that are assessed at the outset to have fundamental technical differences to the current fleet of generators should require a full integration assessment. In 2014 with increasing penetrations of wind and solar PV in the South Australian system the Australian Energy Market Operator (AEMO) in partnership with ElectraNet undertook an analysis of integration of renewable generation with the stated intent:

*“...to provide information about the secure operation of the South Australian power system under specific conditions”<sup>12</sup>*

In 2016 AEMO and ElectraNet provided an update to this study to report on the actions in the 2014 report and further steps required. This is an example of the level of detail that needs to be undertaken as these studies identified the critical components of the system to ensure stability and security, namely:

- 1) The Heywood interconnector linking SA and Victoria is operational<sup>3,4</sup>;
- 2) Power system frequency control in SA, particularly under conditions when the SA power system is, or could become, separated from the remainder of the National Electricity Market<sup>5</sup>; and,
- 3) Sufficient Synchronous generation is connected and operating in the SA power system<sup>6</sup>.

SACOME welcomes the inclusion of these studies to assess where there are limitations to the network. The actions also need to demonstrate the appropriate level of urgency for critical problems. These two studies identified the exact issues that were a part of the 28 September 2016 system black in South Australia.

This event was the result of a severe storm causing phase to ground faults along three transmission lines that resulted in the loss of 445MW of wind generation due to fault ride through constraints. The loss of generation resulted in flows across the Heywood interconnector increasing to 900MW causing the interconnector to trip to prevent damage. At the time of the storm, inertia in the South Australian grid was low due to the large level of intermittent non-synchronous generation online<sup>7</sup>. The combination of islanding, low inertial response and low levels of synchronous generation online resulted in the large rate of change of frequency (“**RoCoF**”) event that led to the system black.

---

<sup>1</sup> (Australian Energy Market Operator 2014)

<sup>2</sup> (Australian Energy Market Operator 2016b)

<sup>3</sup> *ibid*

<sup>4</sup> *ibid*

<sup>5</sup> (Australian Energy Market Operator 2014)

<sup>6</sup> (Australian Energy Market Operator 2016b)

<sup>7</sup> (Australian Energy Market Operator 2016c)

The elements in this event were all reported in the October 2014 and February 2016 reports by AEMO and ElectraNet<sup>8</sup>. When the decision to retire Northern was announced and the market operating Heywood at near capacity (78%<sup>9</sup>) combined with high levels of non-synchronous generation this should have triggered urgent action from AEMO and Governments to implement network changes to ensure system security. One key action was to monitor and respond to low inertia conditions (high non-synchronous generation) by limiting interconnector flows. On 28 September 2016 Heywood was operating at near capacity into South Australia in a period of low inertia conditions with only 330MW of synchronous generation online to provide the islanded inertial response.

**SACOME recommends** that this review acknowledges there exists the ability to analyse and report on the conditions that impact on system security within AEMO and network stakeholders. SACOME further recommends rule changes to give AEMO, or another competent authority, greater powers of direction to ensure system security. These rule changes need to be expedited given the usual period required for them to come into force.

In South Australia's case, there should have been a signal or directive to improve the inertia in the system to ensure that a RoCoF limit was not exceeded that could lead to system black, as occurred on 28 September 2016.

## 2. Consumers are Driving Change

### 2.3 *How do we ensure the needs of large-scale industrial consumers are met?*

Large industrial users SACOME represents identify that affordability, reliability and security are key criteria that are required to be able to operate competitively. The review into the future security of the NEM identifies the energy trilemma of affordability, system strength, and low carbon generation. While SACOME members are striving to limit their emissions to move into a low carbon future, however, this cannot be at the total expense of their operations that are critical to the South Australian economy and community.

As discussed in the response to question 1.1 there needs to be a mechanism to issue notifications or alerts to enhance system strength when prior assessments identify key components that impact a markets system strength. Then there needs to exist the market mechanisms to ensure that security standards are adhered to.

The events in South Australia over the past 12 months have impacted SACOME members in the areas of reduced production, damaged plant and loss of revenue. For some members who are looking to expand or upgrade existing operations, these market failures are increasing the risk perception of potential investors.

**SACOME recommends** that continual assessment of system security is required and linked to powers that can direct market regulators and rule makers to alter the system to improve security if needed.

---

<sup>8</sup> For further discussion on the limits of large penetrations of non-synchronous intermittent generation see the following studies. The impacts of large penetrations of generation as outlined in the following studies predates the findings in the AEMO-ElectraNet studies in 2014 and 2016, hence these impacts are well known: (Deloitte Access Economics 2015), (Kyritsis 2017), (Milligan 2016), (Poolla n.d.), (Tielens 2012), (Ulbig 2014)

<sup>9</sup> (Australian Energy Market Operator 2016c); Using figures in report of 500MW across Heywood.

### 3. The Transition to a Low Emissions Economy is Underway

#### 3.1 *What role should the electricity sector play in meeting Australia's greenhouse gas reduction targets?*

SACOME recommends an orderly transition to reduce pollution and carbon emissions while maintaining system strength. There needs to be a technical assessment of the changes to the market from proposed or planned projects to determine the overall net impact of emission reductions. These issues require assessment in terms of their criticality. To determine the least cost, highest abatement of emissions pathway, all technology choices should be available for assessment.

SACOME notes with respect to technology neutrality, the review on page 63, appendix D, lists all available technologies it has excluded nuclear power that also has an operating emissions of 0 kg CO<sub>2</sub>-e/MWh. As demonstrated in other jurisdictions, for example France and Sweden, nuclear provides a clear avenue for emissions reduction. Nuclear is classified as a synchronous generator that provides the traditional system strength services that other thermal generators provide, essentially a like-for-like replacement with no detrimental impact on inertia and frequency control.

**SACOME recommends** that targets to reduce emissions and plans to replace higher emitting generation should be technology neutral and incorporate a technical assessment that compares the proposed policy or project against a set of technical standards to ensure no net loss to system strength.

**SACOME recommends** that nuclear power should be considered alongside other generation choices to ensure comprehensive assessments are undertaken with respect to system strength, affordability and low carbon criteria.

#### 3.2 *What is the role for natural gas in reducing greenhouse gas emissions in the electricity sector?*

Gas generation either through a combined cycle or open cycle gas turbine (“**CCGT**” & “**OCGT**”) provides a like for like replacement to existing emissions intensive generation that has existed in the NEM based on dispatchability of electricity and synchronicity. Modern gas fired turbines have lifecycle emissions of between 670 and 450g CO<sub>2</sub>e/kWh irrespective of whether the gas is conventional or unconventional<sup>10</sup>.

However, an assessment is required into how upstream gas markets operate, as the ability to source affordable gas in a market that incorporates a high penetration of variable generation is becoming increasingly difficult. SACOME members have identified that the ability to contract long term gas is becoming increasingly difficult and may lead to market failure as gas generation becomes more variable.

Generators with gas contracts that have obligations for annual and daily contract quantities with maximum daily and hourly quantity limits, may violate the terms of these contracts when a high variable in generation is required. The difficulty in determining the quantities within tolerance margins under variable generation can lead generators to purchase gas on the spot market that can result in high generation costs and thereby higher cost of

---

<sup>10</sup> (National Renewable Energy Laboratory 2014)

electricity. This was seen with the additional demand for gas on the 7 July 2016 high price event.

**SACOME recommends** there needs to be an appropriate plan in place where proposals for new generation or low carbon market policies be assessed against the three metrics identified in this review, affordability, system strength (reliability & security), and low carbon. The gas markets review will also need to take into account the increasing difficulty to contract gas for variable generation to limit the impacts on affordability and system security.

### *3.3 What are the barriers to investment in the electricity sector?*

### *3.4 What are the key elements of an emissions reduction policy to support investor confidence and a transition to a low emissions system?*

Currently there are technology choices in the market that provide two of the three key metrics outlined in the review, affordability and low carbon, but they are at the detriment to the third, system strength.

Non-synchronous generation in the market is subsidised through the RET that provides renewable energy generators with up to \$92/MWh. This means that those generators with low operating and maintenance costs can bid into the market first and displace other generation. By the variable nature of the two dominating renewable energy technologies in the market (wind and solar PV) are always deployed when they produce with no regard for system strength criteria. Uncertainty with national and state energy policies has precluded investment in all generation including low carbon generations and storage that is required to limit the variable nature of this generation.

**SACOME recommends** that there is a specific review of low carbon policies to ensure they are operating effectively to ensure a drive to lower carbon emissions while not at the expense of system strength or affordability. Any analysis and recommendations of the review must be technology neutral while ensuring there is an orderly transition to lower emissions generation sources. If required, delaying withdrawals of synchronous generation if it is shown to have a large detriment to system security.

## **4. Integration of Variable Renewable Electricity**

### *4.1 What immediate actions could be taken to reduce the emerging risks around grid security and reliability with respect to frequency control, reduced system strength, or distributed energy resources?*

Currently there is an AEMC assessment of a series of rule changes that were proposed by the South Australian government and generators to introduce market mechanisms to ensure system strength and frequency control. This is in parallel to the System Security Market Frameworks (“**SSMF**”) review by the Commission that will detail a set of options to deliver secure energy at the best price for consumers.

The outcomes of this review alongside the AEMO Future Power System Security (“**FPSS**”) program reports are required to be assessed by a competent body to ensure that further changes to rules or technical standards are addressed.



**SACOME recommends** the early adoption of rule changes to provide market mechanisms and signals to generators to provide the necessary frequency control and system strength services.

#### ***4.3 Is there a need to introduce new planning and technical frameworks to complement current market operations?***

##### ***4.3.1 Should there be new rules for generator connection and disconnections?***

An assessment is required to determine system strength which should factor into retirements and appropriate measures taken by all managers of the NEM at no net loss to consumer or supplier. If these assessments determine a detriment to the market in terms of affordability, security or reliability then there should be technical limits and rules to ensure no net detriment.

##### ***4.3.2 Should all generators be required to provide system security services or should such services continue to be procured separately by the power system operator?***

Generators that enter the market that are shown through an independent assessment to reduce system strength should procure their own or install plant to ensure that there is no deterioration of system strength. market mechanisms are required to provide incentives for system strength services, such as frequency control and inertia.

It may be necessary to consider the introduction of a “capacity charge” to ensure that that additional normally underutilised synchronous power generation could be brought online in an expedited manner.

## **5. Market Design to Support Security and Reliability**

### ***5.2 Is liquidity in the forward contract market for electricity adequate for the needs of commercial and industrial consumers and, if not, what can be done?***

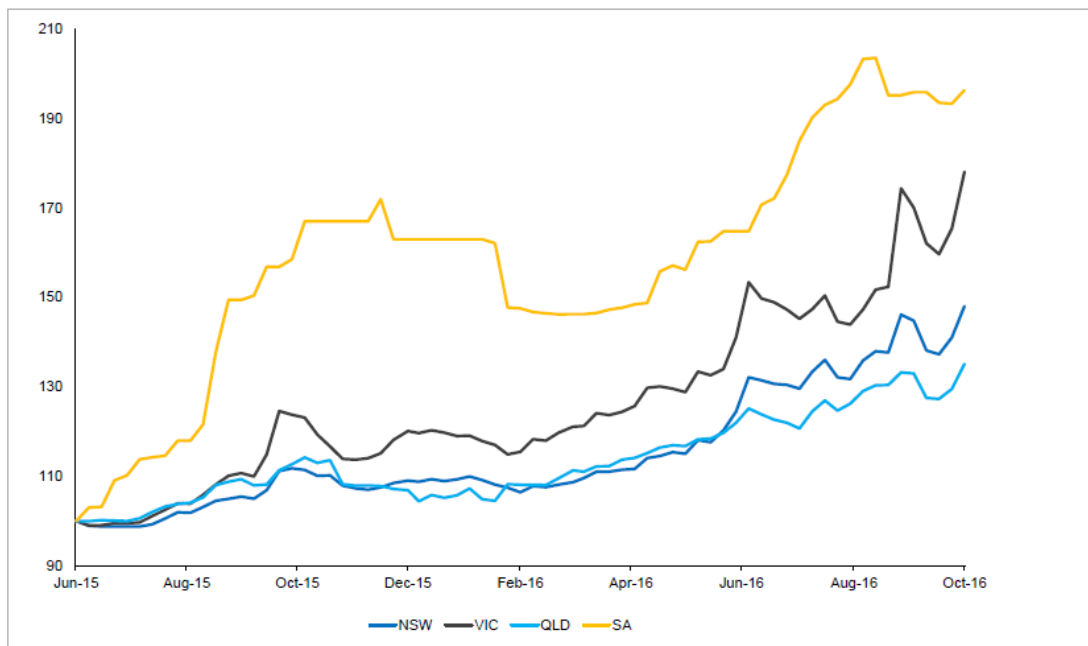
Based on consultation with energy market traders and operators SACOME has been informed that there is negligible liquidity in the South Australian forward contract market. This is shown by estimates of the Herfindahl-Hirschman Index in the South Australian market of 3300-3400<sup>11</sup> demonstrating the lack of competition that has seen futures pricing above \$100/MWh, illustrated in Figure 1.

SACOME members are reporting that they are being offered forward contracts between \$120/MWh and \$190/MWh because of the volatility and liquidity in the market attracting a significant risk premium. This is exacerbated by the loss of baseload generation that resulted in the forward contract prices seen in figure 1 where the withdrawal date of Northern is just prior to the indexed Jun-15 date.

---

<sup>11</sup> (McConnell 2016)

Figure 1: Future baseload wholesale prices CY 2017 indexed



Source: NEM Futures

### 5.3 Are commercial and industrial users experiencing difficulties in obtaining quotes for supply?

As discussed above in question 5.2 SACOME members are reporting difficulties in obtaining affordable quotes for supply.

### 5.4 What impact will an increasing level of renewable generation have on the forward contract market and what new products might be required?

Unless non-synchronous generation can contribute to a competitive forward contract market there should be an assessment as to whether limits are put on further development of this type of generation. Generation companies in the future may be required to ensure that there is a portfolio of dispatchable synchronous generation in a single market to maintain affordability and system strength, or to request non-synchronous generators provide sufficient level of synthetic inertia to ensure affordability and system strength.

**SACOME recommends** an investigation is undertaken to see where low cost non-synchronous generation can contribute to the forward contracts market and determine if a futures market can be established to enhance competition and liquidity.

## 6. Prices Have Risen Substantially

### 6.1 What additional mechanisms, if any, could be implemented to improve the supply of natural gas for electricity generation?

The recent decisions by the Victorian government and the South Australian liberal party to announce moratoriums and exploration bans on conventional and unconventional gas involving hydraulic fracture stimulation are detrimental to the continued supply of gas. These policies damage the reputation of the jurisdiction in which they occur for further

exploration and production investment, send an incorrect message that these resources are too dangerous to extract, and lock up a critically needed strategic energy source.

Successive inquiries into unconventional gas have shown that properly regulated and monitored projects, and decades of safe operation in many jurisdictions locally and internationally, have demonstrated to pose no risk to the public or environment. This is reinforced by the established record of compliance and negligible impact by gas companies in South Australia. However, while the recommendations of these inquiries do not recommend moratoria and demonstrate no systemic harm, a contrary policy position is taken on the development of gas for political purposes alone.

**SACOME recommends** that there are legislative measures in place where a resource is deemed to be a strategic resource, such as natural gas, should be available for extraction and use unless precluded by proven causal scientific and/or environmental reasons.

## 7. Energy Market Governance is Critical

### 7.1 *Is there a need for greater whole-of-system advice and planning in Australia's energy markets?*

#### 7.1.1 *If so, what are the most appropriate governance arrangement to support whole-of-system advice and planning?*

As discussed in earlier responses there are presently the correct authorities that can assess the market in partnership with network stakeholders to identify opportunities and risks, and those to manage and regulate the rules of the NEM. There exists standards that are set and measured to ensure system strength. However, there is not the coordinated approach to take these assessments to provide rule and policy directives to ensure system security.

Recent experiences in South Australia demonstrate that events could have been prevented if the outcomes identified in the assessments were acted upon with the necessary urgency.

#### 7.1.2 *Do the roles of ministers and energy market institutions need further clarification?*

The roles of ministers and energy market institutions require further clarification. .

### 7.6 *How can decision-making be appropriately expedited to keep up with the pace of change?*

Continuation of annual reviews of system strength are required as they impact the continued development of variable non-synchronous integration.

**SACOME recommends** continual monitoring of the assessments by AEMO with the assistance of private network operators. Additionally, new powers should be enabled to determine the level of criticality for system security issues identified and the issuing of rule and policy directives to ensure standards of system security are met.

## REFERENCES

- Australian Energy Market Operator. 2016c. *Black System South Australia 28 September 2016 - Third Preliminary Report*. Melbourne: AEMO.
- Australian Energy Market Operator. 2014. *Renewable Energy Integration in South Australia. Study*, Australia: AEMO & ElectraNet, 18.
- Australian Energy Market Operator. 2016a. *South Australian Electricity Report*. Melbourne: AEMO.
- Australian Energy Market Operator. 2016b. *Update to Renewable Energy Integration in South Australia*. Melbourne: AEMO.
- Deloitte Access Economics. 2015. *Energy Markets and the implications of renewables - South Australian case study*. Sydney: Deloitte.
- Kyritsis, E., Andersson, J. & Serletis, A. 2017. "Electricity Prices, large-scale renewable integration, and policy implications." *Energy Policy* 101: 550-560.
- McConnell, D. 2016. *Winds of Change: An Analysis of recent changes in the South Australian Energy Market*. Melbourne: Melbourne Energy Institute.
- Milligan, M. et al. 2016. "Wholesale electricity market design with increasing levels of Renewable Generation: Revenue sufficiency and long-term reliability." *The Electricity Journal* 29: 26-38.
- National Renewable Energy Laboratory. 2014. *Natural Gas-Fired Generation Results – Life Cycle Assessment Harmonization*. 21 July. Accessed February 8, 2017. [http://www.nrel.gov/analysis/sustain\\_lca\\_ngas.html](http://www.nrel.gov/analysis/sustain_lca_ngas.html).
- Poolla, B.K., Bolognani, S. & Dorfler, F. n.d. *Placing rotational inertia in power grids*. Zurich: ETH Zurich.
- Tielens, P. & Van Hertem, D. 2012. *Grid Inertia and Frequency Control in Power Systems with High Penetration of Renewables*. Hervelee: ELECTA research group.
- Ulbig, A., Borsche, T.S. & Andersson, G. 2014. *Impact of low rotational inertia on power system stability and operation*. Zurich: Power Systems Laboratory, ETH Zurich.