**Master Thesis scholarships at TIK within the theme:**

**"Electricity grids and the energy transition 2.0"**

We hereby announce master thesis scholarships for TIK students who would write their thesis in relation to the TIK project “Integration of Power Transmission Grids - Prospects and Challenges at National and European Levels in advancing the energy transition” (InGRID), see link below. The scholarship will be of maximum 20.000 NOK depending on the degree of thematic fit with the InGRID project. There will be a maximum of three scholarships. Those receiving a scholarship will work closely with the project researchers at TIK, Allan Dahl Andersen, Marie Byskov Lindberg and Olav Wicken, and will get access to data, competence, and networks in the project.

# Overall theme

Recent years have seen major changes in the electricity sector, with rising shares of renewable energy sources (RES) as one key aspect of the ongoing energy transition. Meanwhile, also the electricity grid—the backbone of the electricity sector—is changing and a key issue is how large shares of intermittent and distributed renewable power generation can be ‘integrated’ into the grid.

There are several challenges for RES integration. Intermittent renewables such PV or wind power enhance fluctuations in the grid and create a need for more "system flexibility" (i.e. to be able to balance consumption and production patterns in real time). Another challenge is that new RES such as offshore wind are often located far from demand centers, which calls for building new power lines and/or strengthening local power grids.

As a consequence of these trends, a variety of actors including traditional utilities and grid companies but also new technology and ICT firms are increasingly participating in grid transformation by investing in new power lines and new grid-related technologies (such as storage, smart grids, HVDC) and services (demand response, load shifting, energy efficiency). This ongoing transformation also involves an array of regulatory changes and technology-specific support policies.

The transformation of the electricity grid indicates a new phase of the energy transition. While phase 1.0 was primarily about the emergence of novel generation technologies (such as onshore wind and solar PV), the current phase 2.0 is increasingly about “systems integration” i.e. the challenge of managing the introduction of multiple new technologies and their interaction (which predominantly takes place via the grid) while maintaining the power system stable.

Against this background the InGRID project sets out to investigate a range of issues such as RES integration, system flexibility, smart grids, demand response, electricity storage, new transmission technologies, interconnectors, grid policies and regulation, centralization vs. decentralization, grid infrastructure and actors and strategies in the field of electricity distribution and transmission.

# Potential thesis topics

We propose three concrete areas within the overall theme where students can situate their master thesis work. Each area remain rather broad which leaves a space for the student to define her/his thesis according to personal preference.

1. **Local grids**: Analyze the transformation of local (urban or regional level) electricity grids and their operators (distribution system operators, DSOs) amidst disruptive changes in the grid such as electrical vehicles, smart metering, increasing shares of variable renewables which demands new technologies (particularly ICT and big data) and competences in an area that has been static for decades. Here a focus on the Oslo region—which is particularly advanced internationally regarding share of EVs, EV chargers, and smart meters—would be good choice. The student could consider innovation and competence building in DSOs and assess how they cope with change. Another possibility would be to take a technology focus on consider how ICT or electrical vehicles affect the grid. Methods and data would probably be interviews with key actors (Hafslund, technology providers, EV associations, municipality) and analysis of industry reports, news items, and policy documents.

1. **Offshore grids**: Offshore grids are evolving rapidly to accurate the energy transition–-particularly in the North Sea area—because (i) a growing number of offshore wind farms must be connected to the grid, (ii) because North Sea countries build more interconnector capacity to exploit price differences and to acquire more power system flexibility, and (iii) because of plans to build an entire offshore grid integrating both offshore wind parks and countries’ energy systems. Here there are many interesting sub-topics for a thesis. On point (i), one could analyze the intense competition between different cable technologies (AC and DC) in serving offshore wind as a case of technological competition in the energy transition. On point (ii), one could study how a key actor as Statnett develops and implement a grid strategy in the context of a European energy transition. On point (iii), one could analyze the different drivers and barriers for building a transnational offshore grid in the North Sea. Here the Kriegers Flak project could be an interesting case study for illuminating the larger technological and political issues involved.
2. **Grid management as transition tool**: Being able to rely on the power system of your neighboring countries is very helpful for integrating variable RES. In fact, it is one of the key arguments for building a North Sea grid. However, there are few cases of countries using interconnection capacity as a tool to integrate RES, and this aspect is rarely studied. Denmark is an obvious example. Denmark is the country with the highest share of intermittent renewable electricity production in Europe. The challenge with balancing these new and intermittent renewable sources has so far primarily been solved by deploying large transmission capacities to neighbouring countries: Norway, Sweden and Germany. Still, the development until 2050 remain challenging when Denmark aims to obtain 100% renewable energy in the system. Within this topic a student could focus on to which extent Denmark’s RES expansion has relied on transmission capacity and how this has been managed. Another focus would be to ask whether Denmark can continue to rely on its neighbours as its energy transition advances towards even higher shares of variable RES.

# Applying

## Who can apply?

All TIK master students can apply. Master students enrolled at other departments (e.g. political science, history, or geography) may also be eligible. In the latter case, please contact us to inquire further.

## How to apply?

Send an application by email to [allanda@tik.uio.no](mailto:allanda@tik.uio.no). There is an open deadline and we will consider applications as we receive them. Feel free to contact us if you have further questions or would like to discuss the proposed or related topics.

For your application please attach:

* CV
* Short description of your motivation for applying
* Short description of your preliminary ideas

# Informaiton sources for further exploration

InGRID project link - <http://www.sv.uio.no/tik/english/research/projects/ingrid/>

*Links for further exploration topic 1:*

* “Aspects of Electric Vehicles Charging and grid management” - <https://www.youtube.com/watch?v=G8Ap8-FedVw&t=4s>
* The Autowende has begun - <http://energypost.eu/autowende-begun/>
* Hva betyr elbiler for strømnettet? - <https://www.nve.no/Media/4720/elbil_str%C3%B8mnett_rapport.pdf>
* Elbiler og induksjonskomfyrer kan knekke lavspentnettet - <https://www.tu.no/artikler/elbiler-og-induksjonskomfyrer-kan-knekke-lavspentnettet/222638>
* Dobler antall millioner til FoU-prosjekter i nettselskapene - <https://www.tu.no/artikler/forskningsradet-doblet-stotten-til-fou-prosjekter-i-kraftnettselskapene/366813>
* Eierne må slutte å strupe kraftselskapene - <http://syslagronn.no/2015/12/15/syslagronn/eierne-ma-slutte-a-strupe-kraftselskapene_70373/?redirected_no_cookies=1>

*Links for further exploration topic 2:*

* Do we need to build a European supergrid to secure our energy supply? - <https://www.theguardian.com/big-energy-debate/european-supergrid-secure-energy-supply>
* North Sea Infrastructure (latest) - <https://www.youtube.com/watch?v=NI0sbiCNXtA&feature=youtu.be>
* Security alert: Europe needs more grids, more power plants – say grid operators and generators - <http://energypost.eu/security-alert-europe-needs-grids-power-plants-say-grid-operators-generators/>
* AC/DC Battle of the Currents revisited: HVDC vs. HVAC cables for offshore wind - <http://analysis.windenergyupdate.com/offshore-wind/hvdc-vs-hvac-cables-offshore-wind>
* Kriegers Flak - The world’s first offshore electricity ‘Supergrid’ - <http://denmark.dk/en/green-living/sustainable-projects/kriegers-flak-the-worlds-first-offshore-electricity-supergrid>

*Links for further exploration topic 3:*

* The Danish Experience with Integration Variable Renewable Energy - <https://www.agora-energiewende.de/en/topics/-agothem-/Produkt/produkt/217/The+Danish+Experience+with+Integrating+Variable+Renewable+Energy/>
* Why Germany needs a European Energiewende - <http://energypost.eu/14459-2/>
* How is Denmark Integrating and Balancing Renewable Energy Today? - <http://www.martinot.info/renewables2050/how-is-denmark-integrating-and-balancing-renewable-energy-today>
* “Overview of the Danish Power system and RES integration”
* The Power of Transformation - Wind, Sun and the Economics of Flexible Power Systems - <https://www.iea.org/publications/freepublications/publication/the-power-of-transformation---wind-sun-and-the-economics-of-flexible-power-systems.html>