

Final report

1.1 Project details

Project title	Bidrag til IEA ISGAN Annex 7: Smart grid omstilling og institutionaliseringer - markedsformninger og forbrugere
Project identification (program abbrev. and file)	EUDP, journal nr. 64015-0624
Name of the programme which has funded the project	Systems integration (systemintegration)
Project managing company/institution (name and address)	Technical University of Denmark, Department of Management Engineering, Produktionstorvet 426, 2800 Kongens Lyngby. Project leader: Simon Bolwig, Ph: 21327925, E-mail: sibo@dtu.dk
Project partners	The Danish Ecological Council The Danish Technological Institute
CVR (central business register)	30 06 09 46
Date for submission	30. October 2017

1.2 Short description of project objective and results

English

Objectives: The aim of the project is to enable and strengthen Danish participation in EIA-ISGAN Annex 7 and to help disseminate knowledge on smart grids between Danish stakeholders and the ISGAN Annex 7 international community. The project includes participation in the international meetings of Annex 7 and will disseminate information from its international and domestic activities to Danish stakeholders. This will be done through an annual smart grid transition seminar held in Denmark and through presentations at other workshops and meetings in Denmark.

Results: The project has created value for the development of a smart grid as part of a larger integrated and flexible energy system. It has strengthened dialogue and knowledge-sharing between the many actors, capacities and projects that work on smart grids, in Denmark and internationally, under the auspices of ISGAN. The concept of 'sustainable transition' has been useful in this context, as it can embrace and combine the many elements and interests involved in the development of a smart grid, as well as provide a focus on energy system dynamics in a broader societal context.

Danish

Formål: Projektet vil forbedre forståelsen blandt interessenter - indenfor industrien, staten, kommuner, ikke-statslige organisationer og forskning - af de politikker, institutioner, marked designs, og forbruger incitament, som kan bidrage til udviklingen af smart grid teknologier, og dermed skabe en klarere vision for, og sammenhæng i, omstillingen til et smart, fleksibelt og bæredygtigt energisystem. Projektets aktiviteter inkluderer deltagelse i internationale Annex 7 møder såvel som formidlings- og netværksaktiviteter i Danmark fokuseret omkring et årligt smart grid transitions seminar.

Resultater: Projektet har været værdifuldt for udviklingen af smart grid som en del af et større, fleksibelt og bæredygtigt energisystem. Det har styrket dialogen og vidensdelingen

imellem forskellige aktører, kapaciteter og projekter, som arbejder med smart grid, både i Danmark og internationalt, i regi af ISGAN. Begrebet 'bæredygtig omstilling' har været brugbart, da det kan favne og kombinere de mange elementer og interesser, som indgår i udviklingen af smart grid. Samtidig bibringer det et fokus på den dynamiske udvikling af energisystemet i en samfundsmæssig kontekst.

1.3 Executive summary

Participation in EIA-ISGAN Annex 7 has been an important source of information and inspiration for the project partners regarding social science-oriented research and innovation on smart grids, mainly, but not only, in Europe. A good knowledge network has been established, especially with researchers from Austria, Sweden, and the Netherlands, which can also be utilised for creating research projects especially targeting the H2020 Work Programme 2018-2020 for Secure, Clean and Efficient Energy.

The project has created value for the development of a smart grid as part of a larger integrated and flexible energy system. It has been an excellent platform for the dissemination of knowledge created by major research projects with DTU leadership, and has similarly enhanced stakeholder knowledge of the activities of the members of the Danish background group. The value of dialogue and knowledge sharing concerning smart grids was most evident at the final smart grid transitions seminar at DTU, which brought together new actors and stimulated discussions that would otherwise not have taken place.

The seminar and associated 28-page pamphlet served to enhance the visibility of Danish research and demonstration projects among stakeholders, alongside contributions from other European countries.

1.4 Project objectives

The aim of the project is to enable and strengthen Danish participation in EIA-ISGAN Annex 7, and to help disseminate knowledge on smart grids between Danish stakeholders and the ISGAN Annex 7 international community. The project includes participation in the international meetings of Annex 7 and ISGAN generally to some extent. In addition to bringing Danish perspectives to International smart grid discussions, the project will disseminate information from its international and domestic activities to Danish stakeholders broadly. This is done through an annual smart grid transition seminar held in Denmark, and through presentations at other workshops and meetings in Denmark.

Objectives and value proposition of ISGAN Annex 7

The International Smart Grid Action Network (ISGAN) is the Implementing Agreement for a Co-operative Programme on Smart Grids that functions within a framework created by the International Energy Agency. See www.iea-iscgan.org. Annex 7 of ISGAN was established at the ISGAN 5th Exco meeting in March 2013 in Moscow. Its main objective is to investigate institutional change associated with smart grid development, encouraging international, coordinated transdisciplinary research in the social sciences supporting and complementing technology-oriented smart grid activities. It aims to give support to policy makers in the field of smart grids by focusing on the direction, efficacy and efficiency of the energy system transition.

The revised Programme of Work (PoW) for Annex 7 for the period 09/2017 - 03/2020 was adopted at the 14th ExCo in September 2017, Genk, Belgium. The new PoW has the following objectives: Annex 7 "Smart Grids Transitions – on Institutional Change" investigates institutional, governance and socio-technical issues associated with Smart Grid deployment as a long term endeavour. It intends to support the development of transition pathways and processes leading to electricity systems with distributed energy resources feeding into local grids. The Annex aims at establishing an inter- and trans-disciplinary network of researchers and practitioners sparking off an international, coordinated trans-disciplinary research activity in the social sciences supporting and complementing technology oriented Smart Grid activities. Through this Annex, we intend to accumulate information and knowledge from innovation studies, political sciences, institutional economics, sociology and energy law, and

make it palpable for policymakers and other stakeholders at multiple administrative levels from and across smart grid related policy fields. This includes supporting policy development in the field of smart grid related research, technology development and innovation (RTI).

Annex 7 aims at supporting policymakers in the field of Smart Grids by focusing on the direction, efficacy and efficiency of the energy system transition. In order to complement other ISGAN Annexes, non-technical aspects and framework conditions conducive to Smart Grid deployment are at its focus, by addressing institutional aspects including, governance of the electricity system, policies and stakeholder processes, regulatory aspects and human behaviour. Such assessments are at the core of interest to ISGAN participants from all administrative levels. Beneficiaries of this Annex will be all ISGAN participants, especially government delegates who are in charge of promoting and enabling government policies relevant to the electricity system.

Project implementation

The project was delayed due mainly to necessary changes in project leadership caused by the leave of absence / resignation of project leaders at DTU. In early 2017, the current project leader took over the project and a revised work plan and budget was drafted together with the Danish Background group and subsequently approved by the EUDP responsible Hanne Thomassen. The revised work plan focused on organising a smart grid transition seminar in Denmark, including participation from the ISGAN Annex 7 group of experts, and an accompanying pamphlet describing the state-of-the-art of smart grid research and development projects in Denmark and abroad. These objectives were met fully.

The objective of participation in international ISGAN meetings was met to a large extent, although more such meetings and workshops could have been attended. Because many of the Annex 7 partner meetings were conducted via Skype, and one of them was held at DTU, there was less need for international travel than anticipated.

1.5 Project results and dissemination of results

1.5.1 Participation in EIA-ISGAN Annex 7

The Danish project partners participated in ISGAN Annex 7 through participation in the Annex 7 Partner Meetings comprising 15-20 smart grid experts from Europe, North America, Australia, and India. The experts and their organisations are listed in the Annex to this report. Five such partner meetings, including two workshops, were held between February 2016 and August 2017. The last meeting was hosted by DTU in connection with the ISGAN smart grid transition seminar on 23 August 2017 organised by the project and held at DTU. Three Annex 7 experts from the Netherlands, Sweden and Austria respectively attended this seminar with the latter as key note speaker.

The partner meetings shared information on research and policy projects/initiatives related to smart grids and the flexible energy system, including national research strategies for smart grids. They also discussed joint activities of the Annex 7 members, e.g. joint participation in workshops, conferences, and publications, and developed the programme of work for the next period (see reference in the Annex). The meetings also served to prepare inputs for the ISGAN Executive Committee Meetings, which were attended by the Annex 7 Operating Agency, AIT.

Finally, Annex 7 maintains a closed LinkedIn group on smart grid transition, found here: <https://www.linkedin.com/groups/7489503>. The group, which has 82 members, was used to report on the DTU smart grid transitions seminar. See the Annex.

1.5.2 Smart grid transitions seminar and pamphlet

The engagement with Danish smart grid stakeholders was done partly through meetings with the project's background group and partly through the organisation of a smart grid seminar hosted by DTU.

The background group consisted of, aside DTU Management Engineering, The Danish Ecological Council, The Danish Technological Institute, and The Danish Intelligent Energy Alliance. A number of skype and face-to-face meetings were held with the background group. The first meetings focused on organisational issues as well as participation in the ISGAN Annex 7 activities, while the latter were centred on the planning of the smart grid transitions seminar and production of the pamphlet.

The smart grid transitions seminar was held at DTU on 23 August 2017 and titled 'Smart Grid Transitions and Consumer Behaviour'. The seminar gathered experts from research and industry, who presented and discussed central aspects of the transition to a smart electricity grid and flexible energy system. The focus was on the key role of consumer engagement in this transition as well as on solutions that operate at higher levels in the energy system. It featured among others, a keynote address by Klaus Kubeczko from the Austrian Institute of Technology, as well as a site-visit to the DTU PowerLabDK. The themes were presented in two main blocks:

1. Experiences from real-world demonstration projects (morning)
2. Consumer behaviour in relation to demand response (afternoon)

The seminar was a unique opportunity for participants to learn about innovative research and demonstration projects that will contribute to the transition to a smart grid in Denmark, Europe, and elsewhere. A list of participants can be found in the Annex and the seminar programme can be found [here](#). The collection of seminar presentations was distributed via a download [link](#) sent by e-mail to all participants on 6 November 2017. The e-mail and collection of presentations are in lieu of a separate seminar report.

In connection with the seminar, a 28-page publication titled "Smart Grid Transitions: System solutions and consumer behaviour" was developed to communicate some of the important research being undertaken on the subject in an easy-to-read format accessible to a broad range of stakeholders. The publication features mainly Danish research, but also contributions from abroad, for example Austria. The publication was available to seminar participants in a printed A5 version, and is available in a pdf version at DTU Orbit - link to it [here](#).

A professional research communicator with long experience with energy research was hired to review selected research articles, reports and project descriptions and 'translate' their highlights into a non-academic, layman language. Emphasis was also placed on producing attractive graphics to illustrate the points in the text.

1.6 Utilization of project results

Participation in EIA-ISGAN Annex 7 has been an important source of information and inspiration for the project partners regarding social science-oriented research and innovation on smart grids, mainly in Europe but also in countries such as the USA (and recently India). A good network has been established, especially with researchers from Austria, Sweden, and the Netherlands, which can also be utilised for creating research projects especially targeting the H2020 Work Programme 2018-2020 for Secure, Clean and Efficient Energy. It is also the hope that a project can be created that includes some of the non-European Annex 7 partners, for example India. The Annex 7 network can also be drawn upon to help implement existing projects such as PEAKapp, Flex4RES and CITIES. Finally, the knowledge acquired through the network can be used by the project partners in their engagement with Danish colleagues and stakeholders, as done for example at the ISGAN smart grid transitions seminar held at DTU in August 2017, which was very well attended.

The seminar and associated 28-page pamphlet served to enhance the visibility of Danish research and demonstration projects among stakeholders alongside contributions from other European countries. This enhanced awareness will be exploited in future research and research dissemination activities organised by the project partners.

So far, the pamphlet has been distributed at a number of different events in addition to our seminar with great success:

- Conference in Riga, 7th-8th September: Nordic-Baltic solutions for smarter cities in the region. Energy efficiency: Towards complex climate and energy plan
- Seminar at DTU, 12th October 2017: Data for smart municipalities (Supported by Gate 21, DTU, University of Copenhagen, University of Aalborg, Greater Copenhagen, KL, the Capital region, Vækstforum Capital region)
- IEA event at DTU, 13th October: Towards a Consumer-Driven Energy system – understanding human behavior. (Organized under the auspices of the Experts' Group on R&D Priority Setting and Evaluation EGRD)

1.7 Project conclusion and perspective

The work completed during this project has revolved around three focus areas:

- 1) Participation in the EIA-ISGAN Annex 7 group of experts
- 2) Seminar on Smart Grid Transitions and consumer behaviour
- 3) Easy-to-read publication titled Smart Grid Transitions: System Solutions and Consumer Behaviour

The project has created value for the development of a smart grid as part of a larger integrated and flexible energy system. It has strengthened dialogue and knowledge-sharing between the many actors, capacities and projects that work on smart grids, in Denmark and internationally, under the auspices of ISGAN. The concept of 'sustainable transition' has been useful in this context, as it can embrace and combine the many elements and interests involved in the development of a smart grid as well as provide a focus on system dynamics.

The need for dialogue and knowledge sharing at national and international level was most evident at the final seminar at DTU on 23 August 2017. The seminar had about 40 registered participants, including three from the ISGAN network representing Austria, Sweden and the Netherlands. At the request of the project's reference group, the seminar focused on *system solutions* and *consumer behaviour in relation to buildings*. It included experiences from major Danish research and demonstration projects as well as commercial technologies. These topics were also treated in an easily accessible manner in the 28-page pamphlet, produced as a part of the project and launched at the seminar.

The project has been an excellent platform for the dissemination of knowledge created by major research projects with DTU leadership, including Flex4RES, CITIES and EcoGrid 2.0, and it has likewise increased stakeholder awareness of the activities of members of the background group - The Danish Ecological Council, The Danish Technological Institute, and The Danish Intelligent Energy Alliance.

The value of dialogue and knowledge sharing within smart grids was evident at the seminar which brought together new actors and stimulated discussions that would otherwise not have taken place. Example are: the discussion of the flexibility possibilities created by refrigeration plants in supermarkets, and associated new ownership issues, spurred by a presentation by Danfoss; and the discussion on the role of 'aggregators' in the future energy system.

Regarding the international work in the ISGAN Annex 7 group, the project will be a good platform for this work in the future and has strengthened the Danish participation in the Annex and ISGAN more generally. On 24 August, DTU hosted a successful ISGAN Annex 7 video-link meeting, where four of the attendants were gathered in DTU's meeting room.

Finally, an application for a three-year extension of the project entitled "Deltagelse i IEA ISGAN Annex 7 Smart Grid Omstilling: Institutioner, Markeder og Forbrugere", reference number 64017-05203, was submitted to EUDP on 29 March 2017.

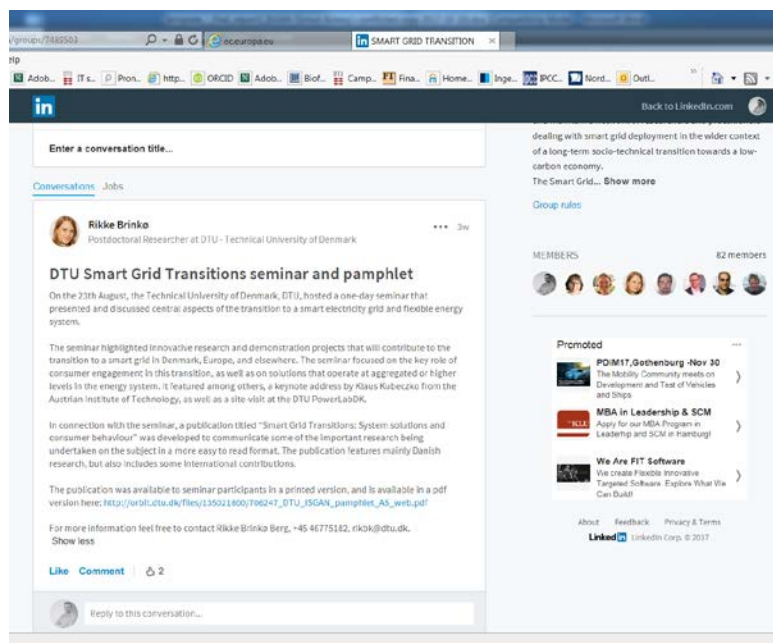
Annex

References

Sønderberg Petersen, L., Berg, R.B., Bergaentzlé, C., Bolwig, S. & Skytte, K. (2017). **Smart grid Transitions: System solutions and consumer behaviour**. Department of Management Engineering, Technical University of Denmark. Report. Download the report [here](#).

Implementing Agreement for a Co-operative Programme on Smart Grids (ISGAN). **Annex 7: Smart Grid Transitions - on Institutional Change**. Programme of Work for the period 09/2017 - 03/2020. Document No.: ISGAN/E11-16/03/A7_PW. International Energy Agency and Austrian Institute of Technology (Annex 7 Operating Agent).

LinkedIn group on smart grids



ISGAN Annex 7 group of experts

European

Austrian Institute of Technology (Klaus Kubeczko, Manfred Paier), TU Eindhoven, Netherlands (Geert Verbong), KU Leuven/VITO, Belgium (Erik Laes), Eléctricité de France - EDF, France (Regine Belhomme), Ricerca sul Sistema Energetico - RSE, Italy (Stefano Maran, Simone Maggiore), Institute of Studies for the Integration of Systems - ISINNOVA, Italy (Andre Ricci), Chalmers University (Björn Sandén), Linköping University (Harald Rohrer), Institute for Innovation and Technology - IIT, Germany (Matthias Künzel), Baumgroup, Germany (Ludwig Karg), Technical University of Denmark, Denmark (Simon Bolwig, Klaus Skytte).

Non-European

U.S. Department of Energy, USA (Russel Conklin), National Smart Grid Mission, India (Atul Bali), Advanced Energy Centre at MaRS, Canada (James Larsen), CSIRO, Australia (Mark Paterson).

List of meetings with the ISGAN Annex 7 group of experts (Annex 7 partners)

Date	Type and place of meeting	Danish Participants	Topics
12/02/16	Annex 7 Partner Meeting, Teleconference.	Klaus Skytte, Simon Bolwig, Susanne B. Nielsen	Overview of Annex7 activities in the Progress Management Report; New contribution from DTU, Task 3 in Program of Work, Discussion of joint activities; Activities in Sweden, Belgium, France, Italy, Netherlands, Canada, Austria; Common activities (policy briefs, webinars, projects)
10/05/16	1-day workshop, in Linz, Austria, under the annual Austrian Smart Grid Week.	Simon Bolwig, Susanne B. Nielsen, Kjeld Nørregaard	Transition aspects in national strategic research agendas (SRAs) on smart grids; Issues of global relevance in SRAs; Linkages between smart grid transition and whole energy system; Development of general approach and scope for smart grid transition
11/10/16	1-day international workshop on flexibility in future energy systems organised by ISGAN and EIA, in partnership with the EU projects ELECTRA, Grid+Storage, and ERA-Net Smart Grids Plus. Union Internationale des Chemins de Fer (UIC), Paris, France.	Simon Bolwig	Increased need for flexibility in the present and future energy system using smart grids as an important enabling technology, to accommodate the increasing share of variable renewable energy, address problems related to ageing infrastructure and managing the rapid growth of electrification.
10/02/17	Annex 7 Partner Meeting, Teleconference.	Simon Bolwig, Kjeld Nørregaard	Update on Activities of Operating Agent and ISGAN matters until January 2017, Status of formal nominations and further commitments of engagement; Update on partners activities until January 2017, Discussion on new Program of Work activities and responsibilities.
24/08/17	Annex 7 Partner Meeting. Physical meeting at DTU with video link.	Simon Bolwig	Inputs to the ISGAN Executive Committee meeting; Reports by national delegates from Belgium, Denmark, France, Netherlands, Germany, Sweden, Austria; Program of Work for 09/2017 – 03/2020; ExCo14 related meetings in Genk; Role of ISGAN Annex 7 in the IST 2019 Conference;

List of meetings in Denmark including meetings with Danish background group

Date	Place and type of meeting	Danish Participants	Topics
February - March 2016	Three meetings among DTU and DTI project partners to prepare for ISGAN workshop in Linz, Austria, and in connection with project start-up.	Kjeld Nørregaard, Susanne B. Nielsen, Simon Bolwig, Klaus Skytte	Danish experiences and inputs to the Linz meeting. Among others experiences from Lyngby Knowledge City.
03-07/03/17	Email exchange with of Nadeem Niwaz, Danish Energy Agency and Danish representative at ISGAN, prior to ExCom meeting in Japan, March 2016.	Susanne B. Nielsen	Content of EUDP project.
03/04/16	"Good answers from research depend on good questions" - A brainstorm session in Lyngby Knowledge City, Network for Climate and Green Technology.	Susanne B. Nielsen	The potential contribution of research to the development of Lyngby Knowledge City.
04/04/17	Meeting with Danish background group. Skype.	Kjeld Nørregaard, Simon Bolwig, Søren Dyck-Madsen	Work plan; preparation of smart grid seminar and pamphlet
10/05/17	Meeting with Danish background group, at Danish Energy Association - Intelligent Energy.	Kjeld Nørregaard, Simon Bolwig, Søren Dyck-Madsen, Helle Juhler-Verdoner, Klaus Skytte, Rikke Brinkø	Preparation of smart grid seminar and pamphlet; Smart grid projects at DTU Management Engineering, Danish Technological Institute, Danish Ecological Council and Danish Energy Association
08/06/17	Meeting with Danish background group. Skype.	Kjeld Nørregaard, Simon Bolwig, Søren Dyck-Madsen, Helle Juhler-Verdoner, Rikke Brinkø	Preparation of smart grid seminar and pamphlet;
30-31/05/17	The Fourth General Consortium Meeting for the CITIES Project (Centre for IT-Intelligent Energy Systems in Cities), Aarhus, Denmark. More information here	Rikke Brinkø; CITIES project participants	Long term and seasonal storage; Classification of electricity consumption; Markets for integrated energy systems; Forecasting and predictive control technology for smart energy systems; Decision-making under uncertainty for energy companies in smart cities; Large smart energy projects. See full programme here
23/08/17	ISGAN Smart Grid Seminar "Smart grid transitions - system solutions and consumer behaviour in buildings", DTU Management Engineering, 23 August 2017. More information here	The list of participants is found in this Annex.	Smart grid system solutions; Site visit at DTU PowerLabDK; Consumer behaviour in buildings. See full list of topics discussed at the seminar here

List of participants for the ISGAN Smart Grid Seminar, DTU, 23 August 2017

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Revised work plan March - August 2017

EIA-ISGAN Annex 7 project revised project plan, March - August 2017					
#	Activity	WP	Period/dates	Responsible	Assist
1	Participate in ISGAN Annex 7 meetings and communications (incl at IST 2017 Conference, Gothenburg, 19-21 June - www.ist2017.org)	1		DTU	DTI, AIT
2	Hold 3 meetings in Danish background group	2	4 April; 1-11 May; 7-11 August	DTU (1st meeting, planning), DTU (2nd meeting), DTU (3rd meeting)	
3	Convene a 1-day smart-grid stakeholder seminar in Greater Copenhagen (DTU or DIEA), 21-25 August 2017	4	23 August, kl. 10 - 16	DTU	DTI, DØR, DIEA
4	Organise smart grid seminar	4	1 April - 23 August	DTU	DIEA, DTI, DØR
4	Prepare scientific or policy contributions to smart grid seminar	4	1 May - 15 August	DTU	DTI
5	Prepare a 'policy brief' for smart grid seminar	4	1 May - 15 August	DTU	TI, DØR
6	Prepare report from smart grid seminar	4	28 - 31 August	DTU	DTI
7	Prepare inputs to the ISGAN Annex 7 Linked-in discussion group https://www.linkedin.com/groups/7489503	4	1 June - 31 August	DTU	AIT
8	Project management	5	1 March - 31 August	DTU	
All Activities			1 March - 31 August		

Project partners	
DTU	Danmarks Tekniske Universitet (Simon Bolwig, Klaus Skytte, Rikke Brinkø)
DTI	Danish Technological Institute (Kjeld Nørregaard)
DØR	Det Økologiske Råd (Søren Dyck-Madsen)
Other key participants	
DIEA	Danish Intelligent Energy Alliance www.ienergi.dk (Helle Juhler-Verdoner)
AIT	Austrian Institute of Technology (Klaus Kubeczko, Manfred Paier)
DEA	Danish Energy Agency (Hanne Thomassen)
Other participants and stakeholders	
	Science journalist (e.g., Maj Dang Trong - www.majdangtrong.com)
	DTU researchers (input to seminar)
	Invited foreign researchers to seminar (e.g. AIT, TU Eindhoven, NIFU, Aalto)
	Danish smart grid stakeholders (at seminar in August)