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Review and validation of EnergyPLAN

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ABSTRACT

Energy systems analyses are integrated elements in planning the transition towards renewable energy-based energy systems. This is due to a growing complexity arising from the wider exploitation of variable renewable energy sources (VRES) and an increasing reliance on sector integration as an enabler of temporal energy system integration, but it calls for consideration to the validity of modelling tools. This article synthesises EnergyPLAN applications through an analysis of its use both from a bibliometric and a case-geographical point of view and through a review of the evolution in the issues addressed and the results obtained using EnergyPLAN. This synthesis is provided with a view to addressing the validity and contribution of EnergyPLAN-based research. As of July 1st, 2022, EnergyPLAN has been applied in 315 peer-reviewed articles, and we see the very high application as an inferred internal validation. In addition, the review shows how the complexity of energy systems analyses has increased over time with early studies focusing on the role of wind power and the cogeneration of heat and power and later studies addressing contemporarily novel issues like the sector integration offered by using power-to-x in fully integrated renewable energy systems. Important findings developed through the application of EnergyPLAN includes the value of district heating in energy systems, the value of district heating for integration of VRES and more generally the importance of sector integration for resource-efficient renewable energy-based energy systems. The wide application across systems and development stages is interpreted as inferred validation through distributed stepwise replication.

1. Introduction

Renewable energy sources (RES) are a cornerstone in the transition towards a carbon-neutral society where every effort is made to ensure that anthropogenic global warming is limited, as e.g. outlined in the Paris Agreement [1]. Energy planning deals with the issue of enabling this transition – while at the same time acknowledging the links to demographic development and to developments in prosperity [2]. In a large survey, Salvia et al. [3] investigated climate change mitigation measures in 237 European cities, finding that 78% has mitigation plans – though only 25% strive for carbon neutrality.

As outlined in e.g. Ref. [4], there are three main steps or phases in the implementation of RES in the energy system:

1. In the introduction phase, RES are merely a supplement to an otherwise fossil energy system, and RES exploitation merely decreases the production on fossil-based generation units. Any RES contribution will be fully reflected in fossil fuel savings.
2. In the high-RES phase, the RES absorption capability of the energy systems becomes strained at times and the temporal characteristics of the energy system become an issue. In this phase, the RES implementation is not fully reflected in fossil fuel savings, as timing and other system restrictions may not permit the integration of the full production.
3. In the fully RES-based phase, the temporal issues become even more prominent, aggravated by the circumstance that, in this phase, there is no fossil-based generation capacity on which to fall back, if required. The system needs to be flexible and fully adept in ensuring that all energy needs are covered at the right time using RES that often have variable or fluctuating character.

For the fully RES-based systems, concepts such as sector integration or smart energy systems [5–7] have been suggested as an integrated approach through which the exploitation of synergies between hitherto disparate energy sectors can ensure the proper integration of RES into the energy system. One key element is that storage should first be used in

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the sectors where this is economically attractive – before resorting to, e.g., electricity storage, which is expensive and typically less efficient [8].

The complexity of the transition and the integration of RES vary with the nature of the RES, and while biomass-based units or reservoir-based hydro plants have dispatch characteristics that resemble those of fossil fuel-based units, focus is often on fluctuating or variable RES. These mainly include wind power, solar power, solar thermal, wave power, and run-of-river hydroelectric power. In most geographical settings, these are the primary options due to biomass constraints or topographical restrictions. Biomass is indeed an important topic in its own right, with a wide discussion on the extent to which its use is even sustainable [9,10] and many analyses try to restrict the use to what is locally available and at the same time sustainable [11,12]. Wind power and district heating have both been key elements in the transition in, e.g., Denmark, but while adding resource efficiency, both elements have also added complexity [13,14].

With complexity follows larger demands to the analyses required for designing appropriate transition pathways and ultimately to support policymaking and investment decision-making. A large number of tools or models are currently being applied to help identify feasible or optimal transition pathways for various geographical areas or for investigating elements of the transition including TIMES [15–17], Balmorel [18,19], Homer [20,21], energyPRO [22–27], Pypsa [28–31], the LUT Energy System Transition Model [32,33] and more.

In terms of modelling approaches, Chang and co-authors therefore also identify a trend towards a more sector-integrated approach in the modelling community [34]. Johannsen and his team, on the other hand, point to the circumstance that, e.g., urban planners often do not have the competence to engage is systems analyses and scenario-making at the complexity level required for planning the transition [35]. Similarly, Rozmi et al. [36] argue for the value of immersive visualization tools in energy systems analysis.

Lund and co-authors distinguish between denominated simulation and optimisation models [37], where optimisation models are characterised by an endogenous system design optimisation and simulation models only model systems described explicitly by the user. System design is thus an endogenous process using simulation models. Another main characteristic of the different modelling tools is their temporal resolution, i.e., whether they use hourly data for a full year or more, use time-slicing or even do not use any sub-yearly modelling to model the energy system.

The geographical target of transition pathway development ranges from cities and islands over countries to entire continents. Islands represent a particular and novel focus for transition planning research, and regarding the use of models in this context, Prina et al. [38] find that national-scale models are often applied in these cases. This is despite such cases requiring particular constraints due to, e.g., challenges arising from spatial and temporal resolution. They also note that compared to unit commitment models, models like EnergyPLAN rely on a simplified representation of system stability.

In a comparison of models, Klemm and Vennemann [39] address which models are suitable for multi-energy systems in mixed-used districts. Based on a survey of 145 models, they identify 13 models – including EnergyPLAN, energyPRO, HOMER, Markal, oemof and TIMES – as having the required characteristics for modelling such systems. In another comparison, Bouw et al. [40] identifies a gap in existing models in terms of their representation of buildings and retrofitting opportunities as well as in general lack in equal representation of heat and electricity sectors – though acknowledging that, e.g., EnergyPLAN as a general purpose model *"do treat all sectors with the same degree of detail"*.

EnergyPLAN is an example of one the more prominent modelling tools in the scientific literature [41]. It is a tool that has been under continuous development at Aalborg University since the turn of the millennium, and the first publications even precede the use of the name [42–44]. EnergyPLAN has been developed with the explicit purpose of designing and simulating high-RES energy systems. Thus, it operates with a 1 h temporal resolution for a full year and it has sectorial integration in its core to act as an enabler of the integration of RES into the energy system. It is a simulation model [37] based on *analytical programming* implying that EnergyPLAN employs pre-coded priorities and procedures to handle the behaviour of all units in each time step. It is thus, for instance, not based on the numerical solving of a series of connected balance equations, as in modelling tools based on linear programming.

A previous survey from 2015 showed that, at that time, EnergyPLAN had been applied 95 times to simulate case studies published in the journal literature [41]. Primary energy consumption, carbon dioxide emissions, costs, and excess generation were the most dominant characteristics that were applied to assess to which extent a given energy system was favourable.

Since that survey, the field in general and EnergyPLAN applications in particular have gained even further traction. This combined with the magnitude of the investments required for the energy transition increases the need for validation of EnergyPLAN. Rehman and Andersen [45] argue for two important elements of validation; internal and external. The former addresses the computational ability and the latter the appropriateness of the model under given circumstances. External validation is usually performed in the modelling-tool selection phase of the analysis in question, while internal validation regards the actual mathematical procedures of the tool in question. EnergyPLAN is documented in the manual [46] as well as in Ref. [47], but even so, strictly speaking, this does not constitute a validation.

In Ref. [48], the authors argue, with respect to the energyPRO modelling tool, that the sheer number of applications can function as an internal validation; what may be labelled *inferred internal validation*. The rationale being that the more a modelling tool is used, the lower is the likelihood that misrepresentations or actual programming errors are left unnoticed.

The aim of this article is to strengthen the internal validation of EnergyPLAN through a review of its application, and thus also to form a reference for further work applying EnergyPLAN. This review is based on analyses of journal articles which apply EnergyPLAN or refer to EnergyPLAN in other ways, as well as analyses on the geographical scale of the cases studied. Secondly, in a more in-depth part, a selection of case articles is analysed with a view to illustrating the evolution in types of analyses conducted and results gained using EnergyPLAN.

In its essence, the article is a synthesis article as it synthesises the application of EnergyPLAN from a quantitative as well as from a qualitative perspective. The quantitative element supports its validation, and the qualitative element synthesises some of its impacts on the energy systems analysis field. The qualitative element also serves to support the article's supposition of model validation through distributed stepwise replication. It is the first article to address the inferred validation of the EnergyPLAN model through such a synthesis of its application.

The article proceeds with an overview of the approach used for identifying studies applying EnergyPLAN in the literature in Section 2, and quantitative analyses of the usage of EnergyPLAN in Section 3. Section 4 presents a discussion of validation approaches including calibration, replication, and model comparisons, while Section 5 is a review of types of EnergyPLAN applications and the results of these over time. Lastly, conclusions are presented.

2. Methodology

One issue when identifying relevant work is that search facilities like Scopus [49] and Directory of Open Access Journals [50] do not enable users to perform full-text searches of journal articles. Thus, whether an article is identified properly using databases depends on where the authors have used the term EnergyPLAN in the given work. Observing Table 1, for instance, it is clear that there are many more occurrences of the term "EnergyPLAN" when making full-text searches in Elsevier's journals using ScienceDirect [51], than in a Scopus search where only

Table 1
Examples of differences in number of search results depending on search facility. Data as of June 1st, 2022. Results are neither checked for relevance nor type of publication. Scopus searches are made using the search string "TITLE-ABS-KEY (energyplan) AND DOI (10.xxxx/*)" where xxxx is the DOI root for the individual publisher.

Journal or publisher	Search results in Scopus (Title, Abstract & Keywords)	Search results using journal full-text search
IEEE	19	22
IJSEPM	12	12
Elsevier	169	781
MDPI (e.g., Energies)	25	27

titles, keywords and abstracts are included.

On the other hand, full text searches are also more likely to generate irrelevant matches that require manual evaluation. In the 2015 survey [41], 18% of the ScienceDirect results were thus not relevant in the context.

Therefore, the process needs to be split into more steps; screening of journals and in-depth search within these. This section details how articles have been identified for inclusion in the analyses and are subsequently analysed in a three-step approach, as outlined in Fig. 1. These steps are detailed in the following subsections.

2.1. Identification of journals and full-text search facilities

Using Scopus [29] and Directory of Open Access Journals [30], a series of journals may be identified where the term EnergyPLAN appear in the data indexed by these – typically in titles, keywords and abstract. This results in the journals listed in the second column in Table 2.

In many cases, these journals are but one of multiple journals of the publisher; however, using the journal identification as an entry point to identify the publishers' proprietary search engines enables the wider full-text search across the publishers' range of journals.

2.2. Article identification and characterisation

The identification of journal articles for inclusion in the analysis involves a selection of the type of publications for inclusion and an evaluation of the articles. First and foremost, only peer-reviewed journal articles are included in this survey. Some of the publishers' search facilities enable the inclusion or exclusion of different categories of work, which can assist in this regard. Taking ScienceDirect as an example, several categories may be selected or deselected, as shown in Table 3, which details the application.

Secondly, some peer-reviewed journal articles apply the term "EnergyPLAN" – though some in contexts irrelevant for this article. Here, the same labelling as used in Ref. [41] is applied:

1. Irrelevant in the context – e.g., through the reference to various websites containing the word energyplan or from articles preceding the tool in focus in this article
2. Duplication – mainly copies of article abstracts published separately from the main article
3. Referencing results – work that mentions results from EnergyPLAN analyses, but without detailing or describing the modelling tool

Table 2
Journals and publishers publishing EnergyPLAN work identified through Scopus and DOAJ.

Publisher	Journals	Publisher's full-text search facility
Econ Journals	Int. J of Energy Economics and Policy	https://econjournals.com/
Elsevier	Applied Energy, Energy, Smart Energy, Energy Policy - and more	https://www.sciencedirect.com/
IEEE	IEEE Access	https://ieeexplore.ieee.org/search/advanced
MDPI	Applied System Innovation; Energies; Sustainability	https://www.mdpi.com/
SAGE	Energy and Environment	https://journals.sagepub.com/
SDEWES	J of Sustainable Development of Energy, Water and Environment Systems	(No proprietary search engine – searched via Scopus and Google Scholar)
Serb. Soc. of Heat Transfer Eng.	Thermal Science	(No proprietary search engine – searched via Scopus and Google Scholar)
Springer	J of Modern Power Systems and Clean Energy – and more	https://link.springer.com/
Taylor & Francis	International Journal of Sustainable Energy	http://www.tandfonline.com
Wiley	Wind Energy - and more	https://onlinelibrary.wiley.com/search/advanced
WITPress	WIT Transactions on Ecology and the Environment	https://www.witpress.com/
AAU Press	Int. J of Sustainable Energy Planning and Management	https://journals.aau.dk/index.php/sepm

Table 3
Article categories used in ScienceDirect and application in the identification of work.

Included	Disregarded
Research articles, Review articles, Short communication	Conference papers, Books, Book chapters, Encyclopaedia, Conference abstracts, Book reviews, News, Editorials, other (Acknowledgements, Indexes, Contributor descriptions)

4. Characterisation – papers that consider EnergyPLAN as a candidate for analytical tool, characterises it, compares to other modelling tools or similar, or mentions it as an example of a model
5. Application – papers that present analyses where EnergyPLAN has been applied to one or more case studies.

Category 5 articles typically also contain elements of categories 3 and 4, while Category 4 articles also typically contain elements of Category 3 articles. However, here they are only characterised according to the highest category number.

Contrary to the analyses in Ref. [41], Categories 1 and 2 are excluded already in the initial article selection process.

Search results are harvested for storage in an Excel database depending on the facility of the journal in question. While for instance Scopus can export directly in CSV (comma-separated values) format, exports from ScienceDirect are in BibTeX format [52] which are subsequently converted to CSV using JabRef [53].

Since this is a very dynamic field in publishing, the article database

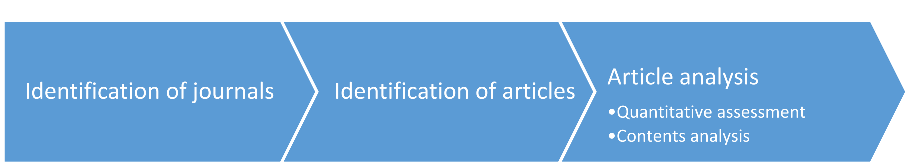

Fig. 1. Analytical approach for EnergyPLAN article analysis.

requires maintenance, which is a manageable task for most publishers due to their slow publication rate of EnergyPLAN articles. Specifically for Elsevier journals, however, the automated search and notification facility offered by ScienceDirect is used whereby an e-mail may be received when a new article containing a given search term is published.

3. Quantitative EnergyPLAN usage

This section provides an overview of the use of and reference to EnergyPLAN in the journal literature from a quantitative and geographical scope perspective, thus providing bibliometric data on its ability to model a variety of different systems.

3.1. Character and temporal evolution of EnergyPLAN references

The first usage of EnergyPLAN was found around the turn of the millennium, and the first published results were from an analysis of the interplay between wind power and cogeneration of heat and power (CHP) and the impacts on the transmission system from different operation strategies [43]. At this time, however, the tool had not yet received its name; thus, the first articles referring to the name were not published until 2003.

Applying the characterisation from Section 2 gives the tabular overview found in Table 4 –shown graphically in Fig. 2.

Not surprisingly, the first articles were applications only, and only later were results or the tool referenced in the literature. Fig. 2 shows a sustained increase by all three measures over the last two decades. Also, in the later years, reference to results or to EnergyPLAN itself has increased and has overtaken the application of the tool in the literature. This points towards a larger awareness of the tool as well as a focus on the results gained from EnergyPLAN modelling.

As seen in Fig. 3, as of July 1st, 2022, 39% or 315 of the articles demonstrate an actual application of EnergyPLAN; another 42% offer some level of characterisation of EnergyPLAN, and 19% refer to results without going more into detail about the tool itself. It should be noted, of course, that this survey does not capture any work that refers to EnergyPLAN analyses with a complete disregard for which tool was used in the referred work. Taking for instance the five highest cited articles in Scopus which both apply EnergyPLAN *and* use the term EnergyPLAN in title, abstract or keywords [10,65,71,97,122], as of July 1st, 2022, these

Table 4
Character of EnergyPLAN reference and temporal evolution in the journal literature. Updated up until July 1st, 2022.

	Application	Characterisation	Reference
2003	[54–58]	[59]	–
2004	–	–	–
2005	[60,61]	–	–
2006	[62–66]	–	–
2007	[67,68]	–	–
2008	[69–72]	[73]	[74]
2009	[75–81]	[82]	[83]
2010	[18,84–91]	[92]	[93,94]
2011	[95–107]	[108–115]	[116–121]
2012	[122–134]	[135,136]	[11, 137–141]
2013	[12,142–148]	[149–156]	[157–162]
2014	[163–181]	[182–195]	[196–207]
2015	[208–230]	[41,231–242]	[5, 243–250]
2016	[10,251–269]	[25,270–300]	[301–310]
2017	[311–327]	[328–363]	[364–370]
2018	[371–398]	[28,399–435]	[436–452]
2019	[16,453–483]	[31,33,36,484–518]	[519–540]
2020	[541–576]	[20,577–624]	[625–646]
2021	[647–686]	[34,38–40,47,48,687–700] [701–720] [721–739]	[740–757]
2022	[1,2,4,9,10,12, 758–783]	[3,5–8,11, 784–815]	[816–824]

are cited 1924 times in the literature – though they can of course be referenced for information not relating to the EnergyPLAN analyses and results. All five articles are EnergyPLAN application articles.

In general, EnergyPLAN has seen a substantial application in the journal literature. This is discussed further in relation to validation of EnergyPLAN in Section 6.

3.2. Geographical coverage

EnergyPLAN is applied to various scales in the literature, ranging from urban neighbourhoods to continents. For this overview, three different levels are included:

- Local
- Country
- Multi-country

For certain cases, adaptions are made compared to normal geographical understanding. Due to size, states or provinces in the USA, China, India, and Australia are treated as countries. Thus, a paper dealing with 10 US states [133] is not treated as a "local" geographical scale, but rather as a multi-country geographical scale.

In general, there is a prevalence for studies of countries, as seen in Fig. 4 and Table 5, and within this category, a certain prevalence of European case studies. However, as also seen, all inhabited continents are represented in the case studies conducted using EnergyPLAN in the journal literature. Africa is the continent with the least application of EnergyPLAN.

Fig. 5 shows a graphical representation of where EnergyPLAN has been applied in the journal literature, indicating that, e.g., all EU member countries have been analysed. The application in general has been global, albeit with a clear underrepresentation in Africa as well as Central and South-East Asia.

Different scales of applications provide different settings for energy systems analyses where small systems are more sensitive to issues of granularity in the modelling environment whereas the modelling of very large systems in single-node models like EnergyPLAN run the risk of not capturing internal bottlenecks and of evening out fluctuations from geographically disparate regions.

4. Approaches to model validation

This section presents an overview of different theoretical considerations to model validation as well as a discussion on calibration and model comparisons as part of validation and finally considerations regarding open source as a part of validation.

4.1. Theoretical considerations regarding validation

The validation of models and modelling tools is a recurring issue in the scientific literature. According to the Oxford Advanced Learner's Dictionary, validation is "to prove that something is true" [825], which is not possible to do with any scientific hypothesis; whereas the Oxford Learner's Dictionary of Academic English elaborates slightly with the definition "to prove that something is true or accurate" [826] and Merriam-Webster's defines validation as "to support or corroborate on a sound or authoritative basis" [827].

Sargent [828] argues that "*model verification and validation are critical in the development of a simulation model as a model and its results need to be 'correct'* ". However, as pointed out by Smiatek et al. "*Validation Is Not Verification*" [829], which is based on the fact that "*if the simulation model output data and the real world output data are consistent with each other, the simulation model is not rejected, but neither is it accepted or 'proven true'. It is provisionally accepted as 'valid' because it has not been falsified*" [830]. Both Wang & Grant and Rykiel forward the notion that validation "*means that a model is acceptable for its intended use because it meets*

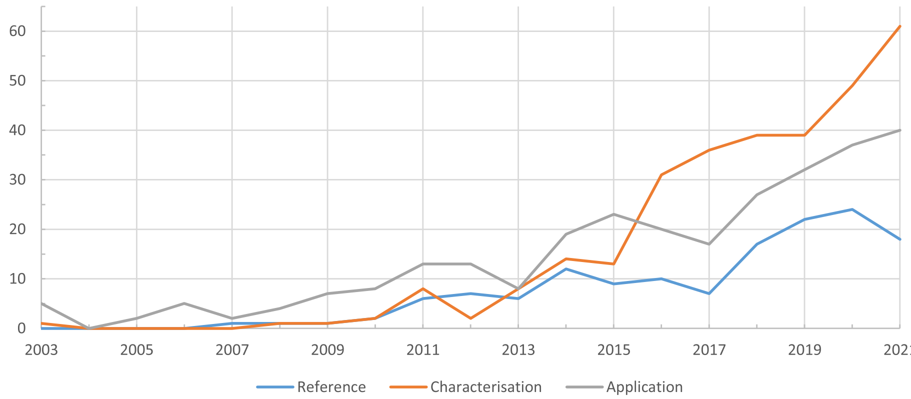

Fig. 2. Character and temporal evolution in the use of EnergyPLAN 2003–2021 in the journal literature. Partial data for 2022 are not shown.

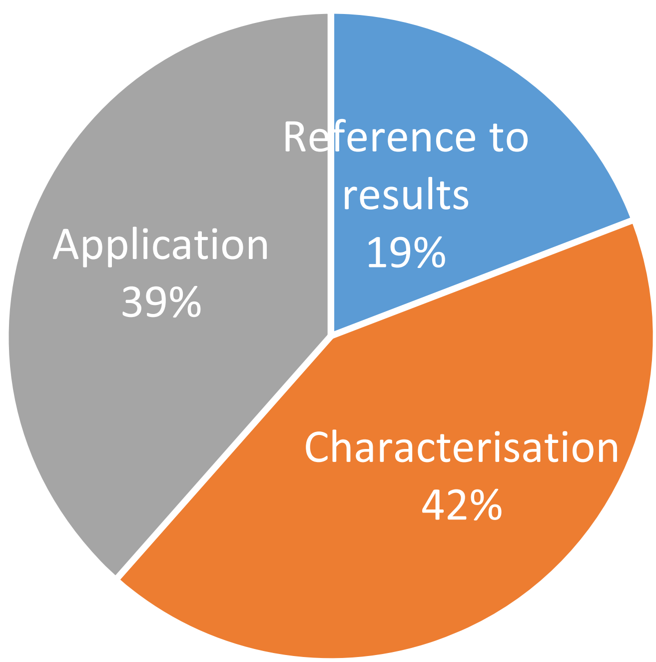

Fig. 3. Character of EnergyPLAN reference in the journal literature. Updated up until July 1st, 2022.

specified performance requirements." [831,832]

Helfenbein and DeSalle introduce the term corroborate, stating that *"Hypotheses, other than tautologies, that have been tested and not falsified have been corroborated"* [833].

Refsgaard & Henriksen [834] split the model validation into three elements – the conceptual model, the coding and the site-specific model, stating that a *"conceptual model is subject to confirmation or falsification like scientific theories. A model code may be verified within given ranges of applicability and ranges of accuracy, but it can never be universally verified. Similarly, a model may be validated, but only with reference to site-specific applications and to pre-specified performance (accuracy) criteria"*. Based on this, they arrive at the finding that a *"model's validity will always be limited in terms of space, time, boundary conditions and types of application."* [834]

A similar, disaggregated and more operational approach is given by Rykiel [832], saying that the *"validation process can be decomposed into several components: (1) operation, (2) theory, and (3) data."*

Finally, as pointed out by Kleindorfer et al. [835], there seems to be no way to validate a tool and a model in a traditional scientific understanding. Applying a courtroom analogy, the model and tool designers are left with the option of arguing for the credibility *"beyond reasonable doubt"*. Applying such approach to the EnergyPLAN tool and energy systems models made in EnergyPLAN, one may argue that the large application in the scientific literature shown in Section 3 lends credibility to EnergyPLAN and that is it validated through its application. In the case of EnergyPLAN, this is further supported by its shown ability to replicate a diversity of different energy systems across nations and energy system development stages.

4.2. Replication and calibration

From a more practical stance, some articles touch upon the issue of validation of EnergyPLAN through a discussion on calibration as in Refs. [375,547]. Focus is thus on the tool's ability to replicate systems described with existing statistical data. In the latter reference, this is the overall topic of the paper, where they first show that EnergyPLAN can replicate a given year and secondly suggest approaches to modelling multiple years despite, e.g., climatic differences between years. Other work provides a more integrated approach, addressing validation from a model theoretical perspective as well from a calibration/data perspective; e.g. Ref. [134].

Replication through calibration is useful for documenting the ability to model existing systems appropriately – thereby validating the output – however, it will by nature be limited as suggested by Ref. [834] to certain boundary conditions or as phrased by Kerr and Goethel *"Operational validation of the model using independent data may not be possible when the simulated scenario extends outside the realm of observed conditions"* [836] in a publication on fish stocks.

Energy planning models, however, are frequently applied to analyse future scenarios based on significant changes in the composition of the energy system. Thus, while a tool through a proper calibration may replicate a given system to match actual statistics, it is not per se a given that future systems will also match. Here, the situation is of course, that there is no statistics or measurements to match against. However, with a tool like EnergyPLAN that has been used to replicate multiple systems in the literature, a large variety of different systems have already been replicated as shown in Section 3. Thus, to take an example, a reference model for a given country with only individual boilers for heating may be set up and calibrated to adequately replicate the existing system. While this replication and calibration in the given case does not necessarily lend credibility to district heating analyses of that country, replication in other countries or systems with district heating will. Thus, analyses across different energy system development stages will support a model's validation – particularly for systems not at the forefront of development. This may be labelled validation through distributed stepwise replication.

Additional to the discussion of replication with the aim of validation is also the issue of replication by other researchers. In principle, the results of the use of tools for energy system analysis should be replicable

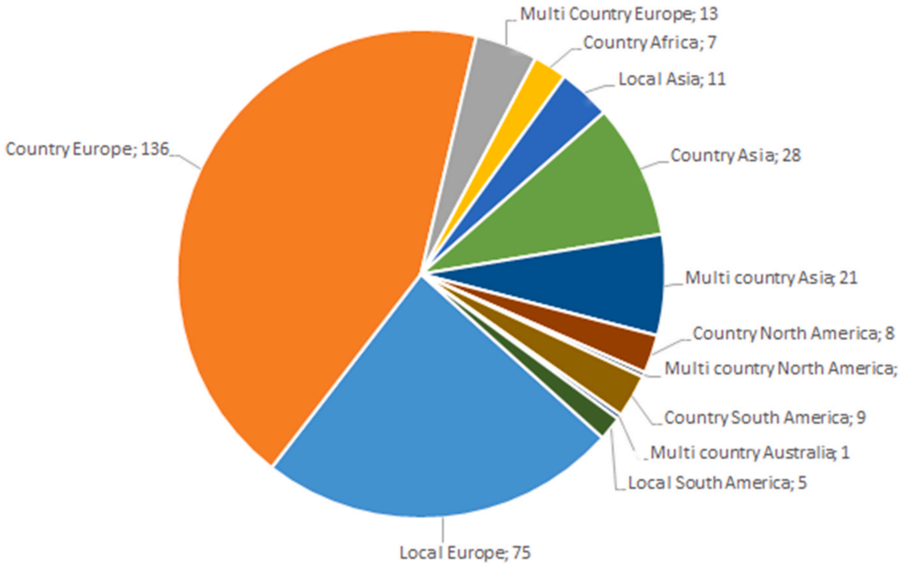

Fig. 4. Geographical coverage of EnergyPLAN applications in the journal literature. Updated up until July 1st, 2022.

Table 5
Characterisation of journal papers applying EnergyPLAN according to geographical scale. Updated up until July 1st' 2022.

	Local	Country	Multi-Country
Europe	[4, 68,86,91,96,98,99,101,123,126,127,148,171,173,174, 209,211,221,224,252,253,263,264,267,311,315,316], [371–374], [380,382,390,392,398,454,460,461,464,469,473,476,477, 480,544,545,547,551,554,557,558,560] [562,565–567,651, 652,659,660,668,670,672,681,684,761,772,775,778]	[1,9,10, 12,16,54–58,61–67,69–72,75–81,84,85,87–90,95,97, 100,102,103,105,107], [122,124,125,128–131,134,145–147, 168–170,178–181], [208,210,213–215,217–220,222,225,226, 229,254,256–258,261,262,266], [317–320,323,324,326,375, 378,379,385–387,389,395,397,453,457–459,463,465,468, 470,472] [474,479,482,483,542,546,549,555,561,568,571,573,575, 656,657,663,665,667,671,675,677,680,682,683,766,769,770, 774,780]	[10,106,177,255,259,265,322, 391,393,649,673,679,782]
Asia	[216,268,313,325,327,396,462,475,563,653,686,762]	[12, 132,142,144,164,166,172,176,227,230,269,312,314,383, 481,559,574,654,655,662,664,666,669,764,767,768,771,776]	[2, 104,143,228,251,260,321, 376,384,466,467,471,541,548, 550,552,569,650,674,758,765]
Africa		[570,576,647,648,777,781,783]	
North America		[163,165,167,212,223,381,388,478]	[133]
South America	[676,678,685,759,763]	[377,456,564,658,760,773,779]	
Australia			[553]

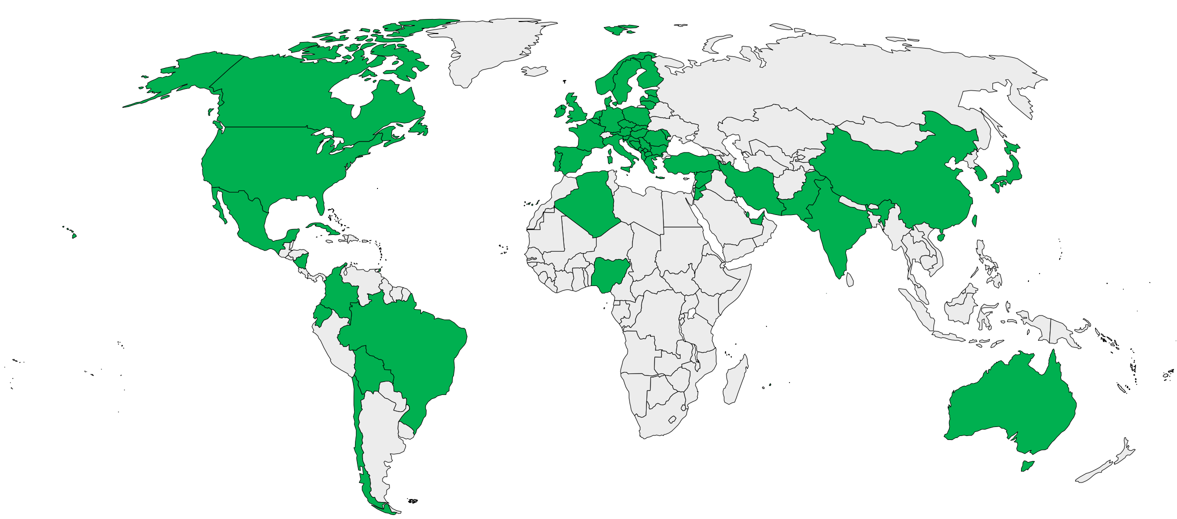

Fig. 5. Global application of EnergyPLAN applications in peer-reviewed journal articles. The map shows countries in which EnergyPLAN has been applied, though in many cases the application has not been to the entire country. Updated up until July 1st, 2022.

for other researchers. This requirement means that the tools and models as well as the data should be accessible for others to replicate.

4.3. Validation through comparison

Models may also be validated though comparisons to other models. Thus, in more cases, the same case study is investigated in EnergyPLAN and another modelling tool to validate the model outcomes. R Lund et al. [254] compare EnergyPLAN outcomes with a Modest-based model to investigate large-scale heat pumps in district heating, finding that the *"comparison does not show any significant differences"*, albeit a tendency for lower optimum of heat pumps and lower system costs for the EnergyPLAN-based model.

H Lund et al. [68] compare results from EnergyPLAN with H2RES (see model description in Ref. [837]) to evaluate the renewable energy transition of the island Mljet in Croatia. The two models had different scopes and coverage – EnergyPLAN targeting holistic systems and H2RES electricity systems only for instance – thus the comparison was for electricity-only systems. The article identified different approaches in the modelling of, e.g., hydrogen storage and minimum ancillary service provision, but the two models arrived at *"more or less the same results"* when analysing the island of Mljet.

Liao et al. [321] compare outcomes from their modelling tool with EnergyPLAN to assess results on North-West China. They find that EnergyPLAN underestimates wind and PV curtailment as a consequence of overestimating the flexibility of the system as it excludes *"the unit commitment constraints"*. It should be noted that EnergyPLAN does not exclude unit commitment constraints – though not all of the constraints in Ref. [321] are included. Thus, power balance, reserve capacity, and maximum generation are for instance included while ramping, minimum on and offline time constraints and inter-system constraints are not to address a sample of the constraints from Ref. [321]. Unfortunately, is not clear which of the mentioned constraints in particular have caused the deviations in the result.

In a comprehensive model analysis of Bolivia, Lopez et al. [773] compared the LUT Energy System Transition model and EnergyPLAN. They found that EnergyPLAN arrived at a 30% higher system costs due to differences in the modelling of synthetic natural gas – a major constituent in the LUT scenario. For the same reason, the use of EnergyPLAN would not lead to the same role of synthetic natural gas. Subsequently, EnergyPLAN's modelling of this sector was improved to address the identified issue.

Perkovic et al. [269] use EnergyPLAN as comparison for their analyses of desalination in Jordan, finding good agreement between the results from EnergyPLAN and from their proposed Mixed Integer Linear Programming model. Similarly, Laitinen et al. use EnergyPLAN to validate their tool EnFloMatch [651] for a system with a battery, an electricity demand, PV and wind power. They found *"very similar results"* from the two model runs. Lastly, Lyden et al. [815] use EnergyPLAN to compare with simulation results from the use of their PyLESA model on a case having PV, heat pump and thermal storage, showing *"similar overall results"*.

These model comparisons corroborate EnergyPLAN's credibility. Also, the fact that researchers find it valuable to use EnergyPLAN to validate new models and compare results with other models is a testament to the wide applicability range of EnergyPLAN and the years of development.

4.4. Open source as validation

EnergyPLAN is not an open-source model but rather open access. Thus, users do not have access to the actual implementation of the algorithms. This is opposed to initiatives such as OseMOSYS, where the first 2011 presentation [838] stressed a compact and accessible coding, or the PyPSA [29] environment.

Stokes [839] point to the challenge of validating open source models with no well-defined "software vendor" and thus possible uncontrolled evolutions but Groissböck [31] argue that, e.g., *"OseMOSYS, and pyPSA are mature enough based on a function comparison with commercial or proprietary tools for serious use"*. Interestingly, this is assessed based on functionality rather than, e.g., an internal validation of the coding. Likewise, in one of the early PyPSA application articles, validation was not so much considered with a view to the coding but rather *"through replication and extreme input testing"* where the extreme input testing shows whether changes in inputs provide expected results.

Open access will provide the expert user the opportunity to probe into the coding and with more users utilising a given model and possibly adapting it, it must be assumed that this does provide a high degree of internal validation of the coding. This is not an option for a model like EnergyPLAN where instead it may be argued that there is a case of distributed extreme input testing. For non-expert users, whether the source is open access or not does not per se offer validity or not.

5. EnergyPLAN results from the literature

This section reviews four categories of EnergyPLAN studies that may also be seen as a progression in terms of the level of complexity of the energy systems design and simulation. From the first studies, where focus was on the integration of CHP and RES into fossil-based systems with little sector integration, to some of the latest analyses, where EnergyPLAN is integrated with other modelling tools to form even more complex simulation environments. In this latest category, the aim is to address the integration between national energy systems or to form modelling environments that include both design optimisation and simulation approaches. The diversity and high application also support the notion of extreme input testing.

5.1. Early-stage sector integration studies

The early studies of sector integration using EnergyPLAN focused mainly on supplementing existing fossil-based energy systems and reducing the energy production of these technologies, as shown by the three phases listed in the Introduction. In these studies, the focus was only on a few energy sectors. More specifically, the review of the first stage shows how EnergyPLAN was instrumental in showing the feasibility of CHP combined with district heating and how this could help integrate RES into the energy systems. Many of the studies from the early 2000s used a scenario for the west Danish energy system in 2020 with 20% wind power integration as the basis for making different energy system analyses.

This scenario was modelled in an early version of EnergyPLAN that focused on the connection between the heating and electricity sectors, with the remaining energy sectors being included using simple representations.

Lund and Münster [54] used the scenario to evaluate different strategies for dealing with excess electricity production from wind power and later, Lund [65] used the scenario to identify an optimal mix of different types of variable RES in the electricity system.

Østergaard [62] used the scenario to analyse how wind power penetration could be increased in Western Denmark via sector integration, and Lund and Münster [63] used the scenario to analyse how to increase the flexibility in the Danish energy system, with a view to increasing the national utilisation of variable RES. The national flexibility options were compared with the potential to use the international transmission lines for balancing. Based on the total annual costs of the energy system, the study found that the share of wind power could be increased from 20% to 40% without significant imbalance issues in the electricity system.

Lund and Münster [64] used the scenario to analyse the energy system effects of changing a share of the passenger cars and vans in Denmark from oil-driven to battery electric vehicles and hydrogen fuel cell vehicles. The results were analysed using excess electricity production, socio-economic costs, and CO_2 emissions as criteria. Chen et al. [86] used the scenario to evaluate the energy system effect of using thermoelectric generators in CHP plants.

The 2020 scenario was not the only utilised scenario, as e.g. Münster and Lund [80] used a scenario for the Danish energy system in 2004 to analyse how different alternatives of utilising organic waste in the energy system could provide reductions in the fossil fuel consumption.

5.2. Full sector integration and smart energy systems

The progress from early stage studies to full sector integration was a process in which the research on different areas formed a new full system understanding as highlighted in Ref. [5]. Several studies have highlighted the importance of a variety of technologies to the large-scale integration of RES. In Ref. [81], seven different integration technologies were compared. Here, it became evident that it is not enough to conduct studies on how to reduce curtailment when analysing RES integration. Significant differences can be found among the technologies in terms of energy efficiency and thus the ability to reduce fossil fuel demands.

The first studies of fully 100% RES-based energy systems, however, revealed some challenges. Coherent analyses of full energy systems, such as in Refs. [75,95], formed a pathway together with the comparative assessments of different integration and technology studies presented in Ref. [81]. In fully renewable energy systems, bioenergy became a key parameter, especially in the transport sector [70]. A key solution to this challenge is electrofuels and power2X, due to a significantly more fuel-efficient conversion potential as well as a large potential to reduce the reliance on bioenergy in fully renewable energy systems [180].

EnergyPLAN has been used for the modelling of 100% RES-based energy systems for more than 15 years. As outlined in the previous section, it was initiated to address the large-scale penetration of RES -based electricity in the Danish context. This has meant that the tool already from this stage included sector integration on the thermal side, considering CHP as well as district heating. Already at an early stage, the tool also included large-scale heat pumps and thermal storage.

A significant challenge in the context of further integration of RES going beyond the heat and electricity sector is the transport sector. While EnergyPLAN included industry, transport as well as biogas from early stages, further developments took place to also include electrofuels for transport and industry as well as in relation to the dynamic modelling of these components. The transport sector can now be modelled with a variety of options from gaseous to liquid fuels, biofuels and power2X to electrofuels, as well as smart charge and V2G of electric vehicles [71]. Rather advanced modelling of electrofuels, transport solutions and power2X for transport and industry is now possible with fully dynamic abilities, such as presented in Korberg et al. [649].

The smart energy systems approach represents a level of systems integration that ensures balance between energy savings and energy efficiency on the one side and the integration of RES on the other, using several different energy vectors, infrastructures and storages [5] that are now better integrated in EnergyPLAN.

Several studies now use the smart energy systems approach, not only from a national level but also from a local, city, regional or island level, e.g. for Aalborg [545], Zagreb [372] as well as Madeira [557].

Other studies see technologies in the perspective of fully integrated renewable energy systems, e.g. for the effects of system design on infrastructures [379], the impact of electrification of ferries [566] and the use of biogas in smart energy systems [549].

In two works, Bačeković and Østergaard investigated the value of sector integration [372] and the value of integration between separate systems [373] finding a strong value of sector integration – and a lesser value of integration between systems. The former article finds that RES-based systems not based on sector integration results in biomass demands higher than the sustainably available quantity while integrated smart energy systems are much better at integrating fluctuating RES. Costs are similar in the two instances.

A coherent understanding of the roles and the design of energy systems based on RES is dependent on a system understanding. In fully integrated energy systems in EnergyPLAN, several different future contexts can be used in the analysis of different sides of the transition from more traditional energy systems.

5.3. Multi-tool analyses

EnergyPLAN has been and still is mostly used as a stand-alone energy system analyses tool. However, with a general increase in both modelling and computer power, a recent development is the increasing number of analyses that have been made which either combine EnergyPLAN with other energy system analysis tools or utilise EnergyPLAN as the computational engine in optimisation algorithms or other multi-run analyses. These multi-tool approaches form an even more complex modelling approach with, in general, two different approaches.

The first approach is to combine inputs and outputs from two different energy system modelling tools, for instance by linking outputs from one tool into EnergyPLAN, or vice versa. This approach typically has the aim to utilise the strengths of different energy system analysis tools to provide a greater insight into the energy systems, and maybe overcome any potential weaknesses that certain modelling tools might have.

De Luca and co-authors use this approach to link Trnsys and EnergyPLAN to evaluate the implementation of RES in Altavilla Silentina in Southern Italy [371]. With Trnsys, they are able to model PV in detail, then using EnergyPLAN to simulate the entire energy system using the PV outputs from Trnsys.

EnergyPLAN has also been combined with LEAP [840], utilising the benefit of LEAP's long-term projection of energy system development combined with EnergyPLAN's capabilities of investigating the annual operation of the energy system on an hourly basis. Bhuvanesh and co-authors [383] use this combination to investigate the case of Tamil Nadu in India. Kiwan and Al-Gharibeh [574] use the approach for Jordan, also combining it with another tool, SAM, to capture meteorological data and designing the power plants. Also Cantarero [381] utilises the same approach to investigate Nicaragua, by combining the long investment paths of LEAP with the hourly simulations from EnergyPLAN.

A similar approach is used by Thellufsen and co-authors to investigate the potential for district heating in Ireland. Here, the long-term investment paths are determined by Markal/TIMES [841], and combined with an hourly investigation of the potential for district heating in Ireland, using the features of EnergyPLAN [16].

Østergaard and co-authors [464] conduct a multi-tool analysis by comparing results from EnergyPLAN on the overall system level to more local analyses conducted in EnergyPRO, thus comparing the outputs to gain more insight into the consequences of implementing heat pumps in district heating systems.

EnergyPLAN has the distinct feature of including the entire energy system, whereas other modelling tools focus mostly on the electricity system. Thus, researchers have combined outputs from an electricity model and simulated this in EnergyPLAN to capture the whole energy system. This is the case for Groppi et al. [460] that use HOMER to optimise the electricity system of Favignana Island, Italy, and then use these outputs as inputs for EnergyPLAN to simulate the entire system. From HOMER, they calculate, for instance, RES capacity and electricity load.

EnergyPLAN uses demands as inputs, which has led researchers to link demand response modelling tools with EnergyPLAN. Olkkonen and co-authors model demand side response in the electricity sector, using their own demand response model, and generate an optimal use of flexible electricity demand on an hourly basis. The total system effect of this demand response is then investigated using EnergyPLAN [320]. Olkkonen and co-authors expand on this approach in a later study, also including a wind power simulation tool. Both examples are analyses of a

Finnish energy system [387].

The second overall approach concerns using EnergyPLAN as the computational solver in optimisation algorithms, agent-based models and other multi-run algorithms written in different tools, such as MATLAB, Python and other tools and languages. Here, EnergyPLAN, in most cases, is used to calculate a large number of scenarios for the same case, to assist researchers in identifying one or more optimal solutions to the posed research questions.

Several different applications have been developed to use EnergyPLAN as an energy system simulation core in an optimisation algorithm. One set of modelling tools focuses on single objective decision tools; as seen in the GenOpt and EnergyPLAN linking described by Bjelic and Rajakovic [214]. This has been applied to the case of Serbia and used for investigating how to combine different solutions in the energy system to the flexibility gap coming from implementing wind and solar energy [257]. Another developed tool which is useable for these single objective optimisations is the EnergyPLAN toolbox for MATLAB, developed by Cabrera et al. [613] This has been used for the case of Lanzarote [659]. These tools run EnergyPLAN with the objective of minimising or maximising one parameter, for instance CO_2 emissions or RES share.

Furthermore, a branch has developed looking at multi-objective/multi-criteria optimisation algorithms utilising EnergyPLAN. The early development of this application was initiated by Mahbub et al. [267], using Java to combine multi-objective evolutionary algorithms (MOEA) with EnergyPLAN and applying it to the case of Aalborg, Denmark. Viesi et al. continued the work utilising this application on Trento in Italy [572].

Another application is the ePLANopt protocol, which uses MOEA implemented in python programming, essentially running several EnergyPLAN analyses with the objective of identifying the optimal solutions for more optimisation criteria.

Typical for ePLANopt models is to investigate CO_2 emissions and total annual costs calculated by EnergyPLAN. If convergence is reached, the ePLANopt stops; if there is no convergence, it will generate new parameters and execute the tool again, thus being evolutionary. EPLANOpt has been used on cases in Italy [397] and South Tyrol [374], and has been developed to be able to calculate marginal abatement cost curves. Other multi-objective approaches have been developed such as by Bellochi et al. [565] and Menapace et al. [547].

By combining EnergyPLAN with single and multi-objective optimisation algorithms, EnergyPLAN has entered a much more comprehensive modelling scope, where computer algorithms are able to identify solutions much faster than the individual user. This both provides more details to an analysis, but also requires a sufficient overview from the researcher grasping the wide number of results and outcomes from such optimisation procedures.

A final EnergyPLAN development worth mentioning here is the development of help add-on tools to EnergyPLAN, which expands the capabilities of EnergyPLAN beyond the initial scope of the tool. The MultiNode add-on expands the capabilities of EnergyPLAN analyses, by allowing the user to investigate the consequences of linking two or more EnergyPLAN models through electricity transmission. It has been applied to investigate whether local system integration or electricity transmission benefits the energy system technically [322]; how a number of islands in Croatia can potentially link [398], and the linking between local and national energy systems in Croatia [373] and Denmark [253]. In a parallel development, Huang et al. have developed a multi-node approach to EnergyPLAN between the two cities Beijing and Zhangjiakou in China [563].

6. Conclusions

This paper has discussed the issue of how to validate complex energy systems modelling tools such as EnergyPLAN. There are different scientific views on how to do so, but consensus seems to be that it is difficult tantamount to impossible to do so in a traditional sense. This leads to statements as "A model code may be verified within given ranges of applicability and ranges of accuracy, but it can never be universally verified" [834] and the consequence that models and modelling tool developers are left with the choice of arguing for credibility "beyond reasonable doubt", as phrased by Kleindorfer et al. [695].

In this paper, we have operated from a point of departure of *inferred internal validation* – i.e., that the internal coding may be validated or corroborated simply through a large-scale application. We have thus synthesised EnergyPLAN's application both from a quantitative and qualitative perspective. Indeed, EnergyPLAN is one of the leading energy systems analyses modelling tools in use with 315 case studies in the journal literature as of July 1st, 2022. It is considered, mentioned, or reviewed in further 494 articles in the journal literature, and it may thus be stated that it has had and has a strong fingerprint on the modelling and energy systems analyses field.

The large-scale application of EnergyPLAN may serve as an inferred internal validation, i.e., the combined efforts of the researchers involved have tested EnergyPLAN and found it appropriate not only for modelling given systems but also for producing credible results.

The application across multiple countries and energy system development stages confirms the ability of EnergyPLAN to replicate different systems through calibration thus serving as an element in its validation. This is labelled validation through distributed stepwise replication.

Several authors have compared EnergyPLAN to other modelling tools and have in general found good agreement in obtained results, thus also serving as an element in its validation.

The review of EnergyPLAN applications demonstrates how EnergyPLAN has been instrumental in early analyses of CHP systems with varying degrees of RES penetration to later analyses of fully integrated smart energy systems, where the flexibility across all sectors is drawn upon to analyse and design RES-based energy systems with proper load-following capabilities.

An important early-phase finding reached using EnergyPLAN is the value of district heating in energy systems – as well as the value of district heating in assisting in the integration of fluctuating RES.

The review of EnergyPLAN applications for smart energy systems analyses has clearly shown the value of this possibility in EnergyPLAN and that there is a need to further understand the local or national roles or specific technologies' roles in future fully integrated systems. The problems addressed are typically related to e.g., balances between energy sources or bioenergy, the most feasible uses of these fuels, and the role of flexibility. A smart energy system approach highlights the need to understand that conclusions within energy systems are completely system dependent. Thus, the development of EnergyPLAN has followed or preceded the developments in the energy systems analysis community.

An important finding from this phase is the importance of aiming for integrated smart energy systems when transitioning to fully RES-based energy systems. Other options are possible, but they will result in poorer performance and a higher drain of non-fluctuating energy sources.

The specific review of the role of EnergyPLAN in simulation setups with other models also show how these multi-tool approaches only increase the role and potential of EnergyPLAN in future energy system analyses and the use of EnergyPLAN to validate new models supports its credibility and serves as a further inferred internal validation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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References

[1] United Nations. Framework convention on climate change [UNFCCC]. Paris agreement. In: Paris, France. United Nations; 2015. 10.FCCC/CP/2015/L.9.
[2] Østergaard PA, Sperling K. Towards sustainable energy planning and management. Int J Sustain Energy Plan Manag 2014;1:1–5. https://doi.org/10.5278/ijsepm.2014.1.1.
[3] Salvia M, Reckien D, Pietrapertosa F, Eckersley P, Spyridaki N-A, Krook-Riekkola A, et al. Will climate mitigation ambitions lead to carbon neutrality? An analysis of the local-level plans of 327 cities in the EU. Renew Sustain Energy Rev 2021;135:110253. https://doi.org/10.1016/j.rser.2020.110253.
[4] Lund H. Renewable energy systems - a smart energy systems approach to the choice and modeling of 100% renewable solutions. second ed. Academic Press; 2014.
[5] Mathiesen BV, Lund H, Connolly D, Wenzel H, Østergaard PA, Möller B, et al. Smart Energy Systems for coherent 100% renewable energy and transport solutions. Appl Energy 2015;145:139–54. https://doi.org/10.1016/j.apenergy.2015.01.075.
[6] Lund H, Andersen AN, Østergaard PA, Mathiesen BV, Connolly D. From electricity smart grids to smart energy systems - a market operation based approach and understanding. Energy 2012;42:96–102. https://doi.org/10.1016/j.energy.2012.04.003.
[7] Lund H, Mathiesen BV, Connolly D, Østergaard PA. Renewable energy systems - a smart energy systems approach to the choice and modelling of 100 % renewable solutions. Chem Eng Trans 2014;39:1–6. https://doi.org/10.3303/CET1439001.
[8] Lund H, Østergaard PA, Connolly D, Ridjan I, Mathiesen BV, Hvelplund F, et al. Energy storage and smart energy systems. Int J Sustain Energy Plan Manag 2016;11:3–14. https://doi.org/10.5278/ijsepm.2016.11.2.
[9] Mortensen AW, Mathiesen BV, Hansen AB, Pedersen SL, Grandal RD, Wenzel H. The role of electrification and hydrogen in breaking the biomass bottleneck of the renewable energy system – a study on the Danish energy system. Appl Energy 2020;275. https://doi.org/10.1016/j.apenergy.2020.115331.
[10] Connolly D, Lund H, Mathiesen BV. Smart Energy Europe: the technical and economic impact of one potential 100% renewable energy scenario for the European Union. Renew Sustain Energy Rev 2016;60:1634–53. https://doi.org/10.1016/j.rser.2016.02.025.
[11] Kwon PS, Østergaard PA. Comparison of future energy scenarios for Denmark: IDA 2050, CEESA (coherent energy and environmental system Analysis), and climate commission 2050. Energy 2012;46:275–82. https://doi.org/10.1016/j.energy.2012.08.022.
[12] Ridjan I, Mathiesen BV, Connolly D, Duić N. The feasibility of synthetic fuels in renewable energy systems. Energy 2013;57:76–84. https://doi.org/10.1016/j.energy.2013.01.046.
[13] Chittum A, Østergaard PA. How Danish communal heat planning empowers municipalities and benefits individual consumers. Energy Pol 2014;74:465–74. https://doi.org/10.1016/j.enpol.2014.08.001.
[14] Hvelplund F, Østergaard PA, Meyer NI. Incentives and barriers for wind power expansion and system integration in Denmark. Energy Pol 2017;107. https://doi.org/10.1016/j.enpol.2017.05.009.
[15] Gerboni R, Grosso D. Testing future hydrogen penetration at local scale through an optimisation tool. Int J Hydrogen Energy 2016;41. https://doi.org/10.1016/j.ijhydene.2016.10.094.
[16] Thellufsen JZ, Nielsen S, Lund H. Implementing cleaner heating solutions towards a future low-carbon scenario in Ireland. J Clean Prod 2019. https://doi.org/10.1016/j.jclepro.2018.12.303.
[17] Helgesen PI, Lind A, Ivanova O, Tomasgard A. Using a hybrid hard-linked model to analyze reduced climate gas emissions from transport. Energy 2018;156:196–212. https://doi.org/10.1016/j.energy.2018.05.005.
[18] Münster M, Morthorst PE, Larsen HV, Bregnbæk L, Werling J, Lindboe HH, et al. The role of district heating in the future Danish energy system. Energy 2012;48:47–55. https://doi.org/10.1016/j.energy.2012.06.011.
[19] Wiese F, Bramstoft R, Koduvere H, Pizarro Alonso A, Balyk O, Kirkerud JG, et al. Balmorel open source energy system model. Energy Strategy Rev 2018;20:26–34. https://doi.org/10.1016/j.esr.2018.01.003.
[20] Johannsen RM, Østergaard PA, Hanlin R. Hybrid photovoltaic and wind mini-grids in Kenya: techno-economic assessment and barriers to diffusion. Energy Sustain Dev 2020;54:111–26. https://doi.org/10.1016/j.esd.2019.11.002.
[21] Marino C, Nucara A, Panzera MF, Pietrafesa M, Varano V. Energetic and economic analysis of a stand alone photovoltaic system with hydrogen storage. Renew Energy 2019;142:316–29. https://doi.org/10.1016/J.RENENE.2019.04.079.
[22] Fragaki A, Andersen AN, Toke D. Exploration of economical sizing of gas engine and thermal store for combined heat and power plants in the UK. Energy 2008;33:1659–70. https://doi.org/10.1016/j.energy.2008.05.011.
[23] Sneum DM, Sandberg E. Economic incentives for flexible district heating in the Nordic countries. Int J Sustain Energy Plan Manag 2018;16. https://doi.org/10.5278/ijsepm.2018.16.3.
[24] Widzinski M. Simulation of an alternative energy system for district heating company in the light of changes in regulations of the emission of harmful substances into the atmosphere. Int J Sustain Energy Plan Manag 2019;24. https://doi.org/10.5278/ijsepm.3354.
[25] Østergaard PA, Andersen AN. Booster heat pumps and central heat pumps in district heating. Appl Energy 2016;184:1374–88. https://doi.org/10.1016/j.apenergy.2016.02.144.
[26] Sorknæs P, Lund H, Andersen AN, Ritter P. Small-scale combined heat and power as a balancing reserve for wind – the case of participation in the German secondary control reserve. Int J Sustain Energy Plan Manag 2014;4. https://doi.org/10.5278/ijsepm.2014.4.4.
[27] Østergaard PA, Andersen AN, Sorknæs P. The business-economic energy system modelling tool energyPRO. Energy 2022:EGY-D-22-02479R2. In press.
[28] Brown T, Schlachtberger D, Kies A, Schramm S, Greiner M. Synergies of sector coupling and transmission reinforcement in a cost-optimised, highly renewable European energy system. Energy 2018;160:720–39. https://doi.org/10.1016/j.energy.2018.06.222.
[29] Brown T, Hörsch J, Schlachtberger D. PyPSA: Python for power system analysis. J Open Res Software 2018;6. https://doi.org/10.5334/jors.188.
[30] Hörsch J, Hofmann F, Schlachtberger D, Brown T. PyPSA-Eur: an open optimisation model of the European transmission system. Energy Strategy Rev 2018;22:207–15. https://doi.org/10.1016/j.esr.2018.08.012.
[31] Groissböck M. Are open source energy system optimization tools mature enough for serious use? Renew Sustain Energy Rev 2019;102:234–48. https://doi.org/10.1016/j.rser.2018.11.020.
[32] Osorio-Aravena JC, Aghahosseini A, Bogdanov D, Caldera U, Muñoz-Cerón E, Breyer C. Transition toward a fully renewable-based energy system in Chile by 2050 across power, heat, transport and desalination sectors. Int J Sustain Energy Plan Manag 2020;25. https://doi.org/10.5278/ijsepm.3385.
[33] Child M, Kemfert C, Bogdanov D, Breyer C. Flexible electricity generation, grid exchange and storage for the transition to a 100% renewable energy system in Europe. Renew Energy 2019;139:80–101. https://doi.org/10.1016/j.renene.2019.02.077.
[34] Chang M, Thellufsen JZ, Zakeri B, Pickering B, Pfenninger S, Lund H, et al. Trends in tools and approaches for modelling the energy transition. Appl Energy 2021;290:116731. https://doi.org/10.1016/j.apenergy.2021.116731.
[35] Johannsen RM, Østergaard PA, Maya-Drysdale D, Krog Elmegaard Mouritsen L. Designing tools for energy system scenario making in municipal energy planning. Energies 2021;14:1442. https://doi.org/10.3390/en14051442.
[36] Azraff Bin Rozmi MD, Thirunavukkarasu GS, Jamei E, Seyedmahmoudian M, Mekhilef S, Stojcevski A, et al. Role of immersive visualization tools in renewable energy system development. Renew Sustain Energy Rev 2019;115:109363. https://doi.org/10.1016/j.rser.2019.109363.
[37] Lund H, Arler F, Østergaard PA, Hvelplund F, Connolly D, Mathiesen BV, et al. Simulation versus optimisation: theoretical positions in energy system modelling. Energies 2017;10:1–17. https://doi.org/10.3390/en10070840.
[38] Prina MG, Groppi D, Nastasi B, Garcia DA. Bottom-up energy system models applied to sustainable islands. Renew Sustain Energy Rev 2021;152:111625. https://doi.org/10.1016/j.rser.2021.111625.
[39] Klemm C, Vennemann P. Modeling and optimization of multi-energy systems in mixed-use districts: a review of existing methods and approaches. Renew Sustain Energy Rev 2021;135:110206. https://doi.org/10.1016/j.rser.2020.110206.
[40] Bouw K, Noorman KJ, Wiekens CJ, Faaij A. Local energy planning in the built environment: an analysis of model characteristics. Renew Sustain Energy Rev 2021;144:111030. https://doi.org/10.1016/j.rser.2021.111030.
[41] Østergaard PA. Reviewing EnergyPLAN simulations and performance indicator applications in EnergyPLAN simulations. Appl Energy 2015;154:921–33. https://doi.org/10.1016/j.apenergy.2015.05.086.
[42] Lund H, Clark WW. Management of fluctuations in wind power and CHP comparing two possible Danish strategies. Energy 2002;27:471–83. https://doi.org/10.1016/S0360-5442(01)00098-6.
[43] Lund H, Østergaard PA. Electric grid and heat planning scenarios with centralised and distributed sources of conventional, CHP and wind generation. Energy 2000;25. https://doi.org/10.1016/S0360-5442(99)00075-4.
[44] Lund H. Flexible energy systems: integration of electricity production from CHP and fluctuating renewable energy. Int J Energy Technol Pol 2002;1:250–61. https://doi.org/10.1504/ijetp.2003.002376.
[45] Rehman M, Pedersen SA. Validation of simulation models. J Exp Theor Artif Intell 2012;24:351–63. https://doi.org/10.1080/0952813X.2012.695459.
[46] Lund H, Thellufsen JZ. EnergyPLAN - advanced energy systems analysis computer model. 2020. https://doi.org/10.5281/zenodo.4017214., Version 15.1.
[47] Lund H, Thellufsen JZ, Østergaard PA, Sorknæs P, Skov IR, Mathiesen BV. EnergyPLAN – advanced analysis of smart energy systems. Smart Energy 2021:100007. https://doi.org/10.1016/j.segy.2021.100007.
[48] Østergaard PA, Andersen AN. Variable taxes promoting district heating heat pump flexibility. Energy 2021;221. https://doi.org/10.1016/j.energy.2021.119839.
[49] Elsevier BV. Scopus n.d, www.scopus.com.
[50] Directory of Open Access Journals. DOAJ n.d, https://doaj.org/.
[51] Elsevier. [Sciencedirect n.d. sciencedirect.com].
[52] Bibliography management with bibtex n.d. https://www.overleaf.com/learn/latex/bibliography_management_with_bibtex.
[53] The JabRef Developer Community. [JabRef n.d. https://www.jabref.org/.].

[54] Lund H, Münster E. Management of surplus electricity-production from a fluctuating renewable-energy source. Appl Energy 2003;76:65–74. https://doi.org/10.1016/S0306-2619(03)00048-5.
[55] Lund H, Münster E. Modelling of energy systems with a high percentage of CHP and wind power. Renew Energy 2003;28:2179–93. https://doi.org/10.1016/S0960-1481(03)00125-3.
[56] Østergaard PA. Transmission-grid requirements with scattered and fluctuating renewable electricity-sources. Appl Energy 2003;76. https://doi.org/10.1016/S0306-2619(03)00065-5.
[57] Lund H. Excess electricity diagrams and the integration of renewable energy. Int J Sustain Energy 2003;23:149–56. https://doi.org/10.1080/01425910412331290797.
[58] Østergaard PAPA. Heat savings in energy systems with substantial distributed generation. Int J Sustain Energy 2003;23:169–76. https://doi.org/10.1080/01425910412331290779.
[59] Duić N, Lerer M, Carvalho MG. Increasing the supply of renewable energy sources in island energy systems. Int J Sustain Energy 2003;23:177–86. https://doi.org/10.1080/01425910412331290760.
[60] Lund H. Large-scale integration of wind power into different energy systems. Energy 2005;30:2402–12. https://doi.org/10.1016/j.energy.2004.11.001.
[61] Østergaard PA. Modelling grid losses and the geographic distribution of electricity generation. Renew Energy 2005;30:977–87. https://doi.org/10.1016/j.renene.2004.09.007.
[62] Østergaard PA. Ancillary services and the integration of substantial quantities of wind power. Appl Energy 2006;83. https://doi.org/10.1016/j.apenergy.2005.04.007.
[63] Lund H, Münster E. Integrated energy systems and local energy markets. Energy Pol 2006;34:1152–60. https://doi.org/10.1016/j.enpol.2004.10.004.
[64] Lund H, Münster E. Integrated transportation and energy sector CO2 emission control strategies. Transport Pol 2006;13:426–33. https://doi.org/10.1016/j.tranpol.2006.03.003.
[65] Lund H. Large-scale integration of optimal combinations of PV, wind and wave power into the electricity supply. Renew Energy 2006;31:503–15. https://doi.org/10.1016/j.renene.2005.04.008.
[66] Lund H. Electric grid stability and the design of sustainable energy systems. Int J Sustain Energy 2005;24:45–54. https://doi.org/10.1080/14786450512331325910.
[67] Lund H. Renewable energy strategies for sustainable development. Energy 2007;32:912–9.
[68] Lund H, Duić N, Krajačić G, da Graça Carvalho M. Two energy system analysis models: a comparison of methodologies and results. Energy 2007;32:948–54. https://doi.org/10.1016/j.energy.2006.10.014.
[69] Østergaard PA. Geographic aggregation and wind power output variance in Denmark. Energy 2008;33:1453–60. https://doi.org/10.1016/j.energy.2008.04.016.
[70] Mathiesen BV, Lund H, Norgaard P. Integrated transport and renewable energy systems. Util Pol 2008;16:107–16. https://doi.org/10.1016/j.jup.2007.11.007.
[71] Lund H, Kempton W. Integration of renewable energy into the transport and electricity sectors through V2G. Energy Pol 2008;36:3578–87. https://doi.org/10.1016/j.enpol.2008.06.007.
[72] Salgi G, Lund H. System behaviour of compressed-air energy-storage in Denmark with a high penetration of renewable energy sources. Appl Energy 2008;85:182–9. https://doi.org/10.1016/j.apenergy.2007.07.006.
[73] Duić N, Krajačić G, da Graça Carvalho M. RenewIslands methodology for sustainable energy and resource planning for islands. Renew Sustain Energy Rev 2008;12:1032–62. https://doi.org/10.1016/j.rser.2006.10.015.
[74] Lise W, Kruseman G. Long-term price and environmental effects in a liberalised electricity market. Energy Econ 2008;30:230–48. https://doi.org/10.1016/j.eneco.2006.06.005.
[75] Lund H, Mathiesen BV. Energy system analysis of 100% renewable energy systems - the case of Denmark in years 2030 and 2050. Energy 2009;34:524–31. https://doi.org/10.1016/j.energy.2008.04.003.
[76] Lund H, Salgi G, Elmegaard B, Andersen AN. Optimal operation strategies of compressed air energy storage (CAES) on electricity spot markets with fluctuating prices. Appl Therm Eng 2009;29:799–806. https://doi.org/10.1016/j.applthermaleng.2008.05.020.
[77] Østergaard PA. Reviewing optimisation criteria for energy systems analyses of renewable energy integration. Energy 2009;34:1236–45. https://doi.org/10.1016/j.energy.2009.05.004.
[78] Lund H, Salgi G. The role of compressed air energy storage (CAES) in future sustainable energy systems. Energy Convers Manag 2009;50:1172–9.
[79] Mathiesen BV, Münster M, Fruergaard T. Uncertainties related to the identification of the marginal energy technology in consequential life cycle assessments. J Clean Prod 2009;17:1331–8. https://doi.org/10.1016/j.jclepro.2009.04.009.
[80] Münster M, Lund H. Use of waste for heat, electricity and transport—challenges when performing energy system analysis. Energy 2009;34:636–44. https://doi.org/10.1016/j.energy.2008.09.001.
[81] Mathiesen BV, Lund H. Comparative analyses of seven technologies to facilitate the integration of fluctuating renewable energy sources. IET Renew Power Gener 2009;3:190–204. https://doi.org/10.1049/iet-rpg:20080049.
[82] Segurado R, Pereira S, Pipio A, Alves L. Comparison between EMINENT and other energy technology assessment tools. J Clean Prod 2009;17:907–10. https://doi.org/10.1016/j.jclepro.2009.02.002.
[83] Göransson L, Johnsson F. Dispatch modeling of a regional power generation system – integrating wind power. Renew Energy 2009;34:1040–9. https://doi.org/10.1016/j.renene.2008.08.002.
[84] Münster M, Lund H. Comparing Waste-to-Energy technologies by applying energy system analysis. Waste Manag 2010;30:1251–63. https://doi.org/10.1016/j.wasman.2009.07.001.
[85] Möller B, Lund H. Conversion of individual natural gas to district heating: geographical studies of supply costs and consequences for the Danish energy system. Appl Energy 2010;87:1846–57.
[86] Chen M, Lund H, Rosendahl LA, Condra TJ. Energy efficiency analysis and impact evaluation of the application of thermoelectric power cycle to today's CHP systems. Appl Energy 2010;87:1231–8. https://doi.org/10.1016/j.apenergy.2009.06.009.
[87] Connolly D, Lund H, Mathiesen BV, Leahy M. Modelling the existing Irish energy-system to identify future energy costs and the maximum wind penetration feasible. Energy 2010;35:2164–73. https://doi.org/10.1016/j.energy.2010.01.037.
[88] Østergaard PA. Regulation strategies of cogeneration of heat and power (CHP) plants and electricity transit in Denmark. Energy 2010;35. https://doi.org/10.1016/j.energy.2010.02.005.
[89] Lund H, Mathiesen BV, Christensen P, Schmidt JH. Energy system analysis of marginal electricity supply in consequential LCA. Int J Life Cycle Assess 2010;15:260–71. https://doi.org/10.1007/s11367-010-0164-7.
[90] Lund H, Möller B, Mathiesen BV, Dyrelund A. The role of district heating in future renewable energy systems. Energy 2010;35:1381–90. https://doi.org/10.1016/j.energy.2009.11.023.
[91] Østergaard PA, Mathiesen BV, Möller B, Lund H. A renewable energy scenario for Aalborg Municipality based on low-temperature geothermal heat, wind power and biomass. Energy 2010;35:4892–901. https://doi.org/10.1016/j.energy.2010.08.041.
[92] Lund PD. Exploring past energy changes and their implications for the pace of penetration of new energy technologies. Energy 2010;35:647–56. https://doi.org/10.1016/j.energy.2009.10.037.
[93] Beaudin M, Zareipour H, Schellenberglabe A, Rosehart W. Energy storage for mitigating the variability of renewable electricity sources: an updated review. Energy Sustain Dev 2010;14:302–14. https://doi.org/10.1016/j.esd.2010.09.007.
[94] Meibom P, Karlsson K. Role of hydrogen in future North European power system in 2060. Int J Hydrogen Energy 2010;35:1853–63. https://doi.org/10.1016/j.ijhydene.2009.12.161.
[95] Mathiesen BV, Lund H, Karlsson K. 100% Renewable energy systems, climate mitigation and economic growth. Appl Energy 2011;88:488–501. https://doi.org/10.1016/j.apenergy.2010.03.001.
[96] Østergaard PA, Lund H. A renewable energy system in Frederikshavn using low-temperature geothermal energy for district heating. Appl Energy 2011;88:479–87. https://doi.org/10.1016/j.apenergy.2010.03.018.
[97] Connolly D, Lund H, Mathiesen BV, Leahy M. The first step towards a 100% renewable energy-system for Ireland. Appl Energy 2011;88:502–7. https://doi.org/10.1016/j.apenergy.2010.03.006.
[98] Haydt G, Leal V, Pina A, Silva CA. The relevance of the energy resource dynamics in the mid/long-term energy planning models. Renew Energy 2011;36:3068–74. https://doi.org/10.1016/J.RENENE.2011.03.028.
[99] Lund H, Marszal a, Heiselberg P. Zero energy buildings and mismatch compensation factors. Energy Build 2011;43:1646–54. https://doi.org/10.1016/j.enbuild.2011.03.006.
[100] Gota DI, Lund H, Miclea L. A Romanian energy system model and a nuclear reduction strategy. Energy 2011;36:6413–9. https://doi.org/10.1016/j.energy.2011.09.029.
[101] Pillai JR, Heussen K, Østergaard PA. Comparative analysis of hourly and dynamic power balancing models for validating future energy scenarios. Energy 2011;36. https://doi.org/10.1016/j.energy.2011.03.014.
[102] Nielsen S, Sorknæs P, Østergaard PA. Electricity market auction settings in a future Danish electricity system with a high penetration of renewable energy sources – a comparison of marginal pricing and pay-as-bid. Energy 2011;36:4434–44. https://doi.org/10.1016/j.energy.2011.03.079.
[103] Le NA, Bhattacharyya SC. Integration of wind power into the British system in 2020. Energy 2011;36:5975–83. https://doi.org/10.1016/j.energy.2011.08.018.
[104] Liu W, Lund H, Mathiesen BV. Large-scale integration of wind power into the existing Chinese energy system. Energy 2011;36:4753–60. https://doi.org/10.1016/j.energy.2011.05.007.
[105] Krajačić G, Duić N, Zmijarević Z, Mathiesen BV, Anić Vučinić A, Carvalho M da G. Planning for a 100 % independent energy system based on smart energy storage for integration of renewables and CO2 emissions reduction. Appl Therm Eng 2011;31:2073–83. https://doi.org/10.1016/j.applthermaleng.2011.03.014.
[106] Connolly D, Lund H, Finn P, Mathiesen BV, Leahy M. Practical operation strategies for pumped hydroelectric energy storage (PHES) utilising electricity price arbitrage. Energy Pol 2011;39:4189–96. https://doi.org/10.1016/j.enpol.2011.04.032.
[107] Franco A, Salza P. Strategies for optimal penetration of intermittent renewables in complex energy systems based on techno-operational objectives. Renew Energy 2011;36:743–53. https://doi.org/10.1016/J.RENENE.2010.07.022.
[108] Musango JK, Brent AC. Assessing the sustainability of energy technological systems in Southern Africa: a review and way forward. Technol Soc 2011;33:145–55. https://doi.org/10.1016/j.techsoc.2011.03.011.

[109] Segurado R, Krajačić G, Duić N, Alves L. Increasing the penetration of renewable energy resources in S. Vicente, Cape Verde. Appl Energy 2011;88:466–72. https://doi.org/10.1016/j.apenergy.2010.07.005.

[110] Pina A, Silva C, Ferrão P. Modeling hourly electricity dynamics for policy making in long-term scenarios. Energy Pol 2011;39:4692–702. https://doi.org/10.1016/j.enpol.2011.06.062.

[111] Eriksson O, Bisaillon M. Multiple system modelling of waste management. Waste Manag 2011;31:2620–30. https://doi.org/10.1016/j.wasman.2011.07.007.

[112] Manfren M, Caputo P, Costa G. Paradigm shift in urban energy systems through distributed generation: methods and models. Appl Energy 2011;88:1032–48. https://doi.org/10.1016/j.apenergy.2010.10.018.

[113] Gómez A, Zubizarreta J, Dopazo C, Fueyo N. Spanish energy roadmap to 2020: socioeconomic implications of renewable targets. Energy 2011;36:1973. https://doi.org/10.1016/j.energy.2010.02.046. –85.

[114] Markovic D, Cvetkovic D, Masic B. Survey of software tools for energy efficiency in a community. Renew Sustain Energy Rev 2011;15:4897–903. https://doi.org/10.1016/j.rser.2011.06.014.

[115] Kannan R. The development and application of a temporal MARKAL energy system model using flexible time slicing. Appl Energy 2011;88:2261–72. https://doi.org/10.1016/j.apenergy.2010.12.066.

[116] Ludig S, Haller M, Schmid E, Bauer N. Fluctuating renewables in a long-term climate change mitigation strategy. Energy 2011;36:6674–85. https://doi.org/10.1016/j.energy.2011.08.021.

[117] Krajačić G, Duić N, Carvalho M da G. How to achieve a 100% RES electricity supply for Portugal? Appl Energy 2011;88:508–17. https://doi.org/10.1016/j.apenergy.2010.09.006.

[118] Ekman CK. On the synergy between large electric vehicle fleet and high wind penetration – an analysis of the Danish case. Renew Energy 2011;36:546–53. https://doi.org/10.1016/j.renene.2010.08.001.

[119] Münster M, Meibom P. Optimization of use of waste in the future energy system. Energy 2011;36:1612–22. https://doi.org/10.1016/j.energy.2010.12.070.

[120] Shaahid SM. Review of research on autonomous wind farms and solar parks and their feasibility for commercial loads in hot regions. Renew Sustain Energy Rev 2011;15:3877–87. https://doi.org/10.1016/j.rser.2011.07.017.

[121] Karakoulidis K, Mavridis K, Bandekas DV, Adoniadis P, Potolias C, Vordos N. Techno-economic analysis of a stand-alone hybrid photovoltaic-diesel–battery-fuel cell power system. Renew Energy 2011;36:2238–44. https://doi.org/10.1016/j.renene.2010.12.003.

[122] Ćosić B, Krajačić GA. 100 % renewable energy system in the year 2050 : the case of Macedonia. Energy 2012;48:80–7. https://doi.org/10.1016/j.energy.2012.06.078.

[123] Østergaard PA. Comparing electricity, heat and biogas storages' impacts on renewable energy integration. Energy 2012;37:255–62. https://doi.org/10.1016/j.energy.2011.11.039.

[124] Connolly D, Lund H, Mathiesen BV, Pican E, Leahy M. The technical and economic implications of integrating fluctuating renewable energy using energy storage. Renew Energy 2012;43:47–60. https://doi.org/10.1016/J.RENENE.2011.11.003.

[125] Hedegaard K, Mathiesen BV, Lund H, Heiselberg P. Wind power integration using individual heat pumps - analysis of different heat storage options. Energy 2012;47. https://doi.org/10.1016/j.energy.2012.09.030.

[126] Brandoni C, Di Nicola G, Polonara F. Development of renewable energy strategies for small urban areas. WIT Trans Ecol Environ 2012;162:265–76. https://doi.org/10.2495/EID120241.

[127] Sperling K, Möller B. End-use energy savings and district heating expansion in a local renewable energy system – a short-term perspective. Appl Energy 2012;92:831–42. https://doi.org/10.1016/j.apenergy.2011.08.040.

[128] Ćosić B, Markovska N, Krajačić G, Taseska V, Duić N. Environmental and economic aspects of higher RES penetration into Macedonian power system. Appl Therm Eng 2012;43:158–62. https://doi.org/10.1016/j.applthermaleng.2011.10.042.

[129] Tonini D, Astrup T. LCA of biomass-based energy systems: a case study for Denmark. Appl Energy 2012;99:234–46. https://doi.org/10.1016/j.apenergy.2012.03.006.

[130] Mathiesen BV, Lund H, Connolly D. Limiting biomass consumption for heating in 100% renewable energy systems. Energy 2012;48:160–8. https://doi.org/10.1016/j.energy.2012.07.063.

[131] Lund H, Hvelplund F. The economic crisis and sustainable development: the design of job creation strategies by use of concrete institutional economics. Energy 2012;43:192–200.

[132] Hong L, Lund H, Möller B. The importance of flexible power plant operation for Jiangsu's wind integration. Energy 2012;41:499–507. https://doi.org/10.1016/j.energy.2012.02.038.

[133] Zhai P, Larsen P, Millstein D, Menon S, Masanet E. The potential for avoided emissions from photovoltaic electricity in the United States. Energy 2012;47:443–50. https://doi.org/10.1016/j.energy.2012.08.025.

[134] Lund H, Mathiesen BV. The role of Carbon Capture and Storage in a future sustainable energy system. Energy 2012;44:469–76. https://doi.org/10.1016/j.energy.2012.06.002.

[135] Welsch M, Howells M, Bazilian M, DeCarolis JF, Hermann S, Rogner HH. Modelling elements of smart grids – enhancing the OSeMOSYS (open source energy modelling system) code. Energy 2012;46:337–50. https://doi.org/10.1016/j.energy.2012.08.017.

[136] Rezvan AT, Gharneh NS, Gharehpetian GB. Robust optimization of distributed generation investment in buildings. Energy 2012;48:455–63. https://doi.org/10.1016/j.energy.2012.10.011.

[137] Yu D, Tan H, Ruan Y. An improved two-step floating catchment area method for supporting district building energy planning: a case study of Yongding County city, China. Appl Energy 2012;95:156–63. https://doi.org/10.1016/j.apenergy.2012.02.036.

[138] Klemeš JJ, Varbanov PS. Heat integration including heat exchangers, combined heat and power, heat pumps, separation processes and process control. Appl Therm Eng 2012;43:1–6. https://doi.org/10.1016/j.applthermaleng.2012.03.044.

[139] Comodi G, Cioccolanti L, Polonara F, Brandoni C. Local authorities in the context of energy and climate policy. Energy Pol 2012;51:737–48. https://doi.org/10.1016/j.enpol.2012.09.019.

[140] Tarroja B, Mueller F, Eichman JD, Samuelsen S. Metrics for evaluating the impacts of intermittent renewable generation on utility load-balancing. Energy 2012;42:546–62. https://doi.org/10.1016/j.energy.2012.02.040.

[141] Li X, Hubacek K, Siu YL. Wind power in China – dream or reality? Energy 2012;37:51–60. https://doi.org/10.1016/j.energy.2011.09.030.

[142] Hong L, Lund H, Mathiesen BV, Möller B. 2050 Pathway to an active renewable energy scenario for Jiangsu province. Energy Pol 2013;53:267–78. https://doi.org/10.1016/j.enpol.2012.10.055.

[143] Hong L, Zhou N, Fridley D, Raczkowski C. Assessment of China's renewable energy contribution during the 12th Five Year Plan. Energy Pol 2013;62:1533–43. https://doi.org/10.1016/j.enpol.2013.07.110.

[144] Liu W, Hu W, Lund H, Chen Z. Electric vehicles and large-scale integration of wind power – the case of Inner Mongolia in China. Appl Energy 2013;104:445–56. https://doi.org/10.1016/j.apenergy.2012.11.003.

[145] Pina A, Silva CA, Ferrão P. High-resolution modeling framework for planning electricity systems with high penetration of renewables. Appl Energy 2013;112:215–23. https://doi.org/10.1016/j.apenergy.2013.05.074.

[146] Batas Bjelić I, Rajaković N, Ćosić B, Duić N. Increasing wind power penetration into the existing Serbian energy system. Energy 2013;57:30–7. https://doi.org/10.1016/j.energy.2013.03.043.

[147] Kwon PS, Østergaard PA. Priority order in using biomass resources – energy systems analyses of future scenarios for Denmark. Energy 2013;63:86–94. https://doi.org/10.1016/j.energy.2013.10.005.

[148] Østergaard PA. Wind power integration in Aalborg Municipality using compression heat pumps and geothermal absorption heat pumps. Energy 2013;49:502–8. https://doi.org/10.1016/j.energy.2012.11.030.

[149] Caballero F, Sauma E, Yanine F. Business optimal design of a grid-connected hybrid PV (photovoltaic)-wind energy system without energy storage for an Easter Island's block. Energy 2013;61:248–61. https://doi.org/10.1016/j.energy.2013.08.030.

[150] Eichman JD, Mueller F, Tarroja B, Schell LS, Samuelsen S. Exploration of the integration of renewable resources into California's electric system using the Holistic Grid Resource Integration and Deployment (HiGRID) tool. Energy 2013;50:353–63. https://doi.org/10.1016/j.energy.2012.11.024.

[151] Perković L, Silva P, Ban M, Kranjčević N, Duić N. Harvesting high altitude wind energy for power production: the concept based on Magnus' effect. Appl Energy 2013;101:151–60. https://doi.org/10.1016/j.apenergy.2012.06.061.

[152] Rubio Rodríguez MA, Feitó Cespón M, De Ruyck J, Ocaña Guevara VS, Verma VK. Life cycle modeling of energy matrix scenarios, Belgian power and partial heat mixes as case study. Appl Energy 2013;107:329–37. https://doi.org/10.1016/j.apenergy.2013.02.052.

[153] Andersen FM, Larsen HV, Boomsma TK. Long-term forecasting of hourly electricity load: identification of consumption profiles and segmentation of customers. Energy Convers Manag 2013;68:244–52. https://doi.org/10.1016/j.enconman.2013.01.018.

[154] Suberu MY, Mustafa MW, Bashir N, Muhamad NA, Mokhtar AS. Power sector renewable energy integration for expanding access to electricity in sub-Saharan Africa. Renew Sustain Energy Rev 2013;25:630–42. https://doi.org/10.1016/j.rser.2013.04.033.

[155] Goodbody C, Walsh E, McDonnell KP, Owende P. Regional integration of renewable energy systems in Ireland – the role of hybrid energy systems for small communities. Int J Electr Power Energy Syst 2013;44:713–20. https://doi.org/10.1016/j.ijepes.2012.08.012.

[156] Reddi KR, Li W, Wang B, Moon Y. System dynamics modelling of hybrid renewable energy systems and combined heating and power generator. Int J Sustain Eng 2013;6:31–47. https://doi.org/10.1080/19397038.2012.689781.

[157] Alagoz BB, Kaygusuz A, Akcin M, Alagoz S. A closed-loop energy price controlling method for real-time energy balancing in a smart grid energy market. Energy 2013;59:95–104. https://doi.org/10.1016/j.energy.2013.06.074.

[158] Yılmaz S, Selim H. A review on the methods for biomass to energy conversion systems design. Renew Sustain Energy Rev 2013;25:420–30. https://doi.org/10.1016/j.rser.2013.05.015.

[159] Venkatesh G, Elmi RA. Economic–environmental analysis of handling biogas from sewage sludge digesters in WWTPs (wastewater treatment plants) for energy recovery: case study of Bekkelaget WWTP in Oslo (Norway). Energy 2013;58:220–35. https://doi.org/10.1016/j.energy.2013.05.025.

[160] Kiani B, Rowe A, Wild P, Pitt L, Sopinka A, Pedersen TF. Optimal electricity system planning in a large hydro jurisdiction: will British Columbia soon become a major importer of electricity? Energy Pol 2013;54:311–9. https://doi.org/10.1016/j.enpol.2012.11.040.

[161] Yucekaya A. The operational economics of compressed air energy storage systems under uncertainty. Renew Sustain Energy Rev 2013;22:298–305. https://doi.org/10.1016/j.rser.2013.01.047.

[162] Suomalainen K, Silva C, Ferrão P, Connors S. Wind power design in isolated energy systems: impacts of daily wind patterns. Appl Energy 2013;101:533–40. https://doi.org/10.1016/j.apenergy.2012.06.027.
[163] Ouellette A, Rowe A, Sopinka A, Wild P. Achieving emissions reduction through oil sands cogeneration in Alberta's deregulated electricity market. Energy Pol 2014;71:13–21. https://doi.org/10.1016/j.enpol.2014.04.020.
[164] Ma T, Ostergaard PA, Lund H, Yang H, Lu L. An energy system model for Hong Kong in 2020. Energy 2014;68. https://doi.org/10.1016/j.energy.2014.02.096.
[165] Oropeza-Perez I, Østergaard PA. The influence of an estimated energy saving due to natural ventilation on the Mexican energy system. Energy 2014;64:1080–91. https://doi.org/10.1016/j.energy.2013.11.009.
[166] Novosel T, Ćosić B, Krajačić G, Duić N, Pukšec T, Mohsen MS, et al. The influence of reverse osmosis desalination in a combination with pump storage on the penetration of wind and PV energy: a case study for Jordan. Energy 2014;76: 73–81. https://doi.org/10.1016/j.energy.2014.03.088.
[167] Duquette J, Wild P, Rowe A. The potential benefits of widespread combined heat and power based district energy networks in the province of Ontario. Energy 2014;67:41–51. https://doi.org/10.1016/j.energy.2013.12.038.
[168] Hagos DA, Gebremedhin A, Zethraeus B. Towards a flexible energy system – a case study for Inland Norway. Appl Energy 2014;130:41–50. https://doi.org/10.1016/j.apenergy.2014.05.022.
[169] Cerovac T, Ćosić B, Pukšec T, Duić N. Wind energy integration into future energy systems based on conventional plants – the case study of Croatia. Appl Energy 2014;135:643–55. https://doi.org/10.1016/j.apenergy.2014.06.055.
[170] Lund H, Thellufsen JZ, Aggerholm S, Wichtten KB, Nielsen S, Mathiesen BV, et al. Heat saving strategies in sustainable smart energy systems. Int J Sustain Energy Plan Manag 2014:3–16. https://doi.org/10.5278/ijsepm.2014.4.2. 04.
[171] Waenn A, Connolly D, Gallachóir BÓ. Investigating 100% renewable energy supply at regional level using scenario analysis. Int J Sustain Energy Plan Manag 2014;3:21–32. https://doi.org/10.5278/ijsepm.2014.3.3.
[172] Østergaard PA, Lund H, Mathiesen BV. Energy system impacts of desalination in Jordan. Int J Sustain Energy Plan Manag 2014;1. https://doi.org/10.5278/ijsepm.2014.1.3.
[173] Brandoni C, Arteconi A, Ciriachi G, Polonara F. Optimal management of renewable and fossil fuel energy systems in a smart community. WIT Trans Ecol Environ 2014;181:255–66. https://doi.org/10.2495/EID140221.
[174] Brandoni C, Arteconi A, Ciriachi G, Polonara F. Assessing the impact of micro-generation technologies on local sustainability. Energy Convers Manag 2014;87: 1281–90. https://doi.org/10.1016/J.ENCONMAN.2014.04.070.
[175] Kwon PS, Østergaard PA. Assessment and evaluation of flexible demand in a Danish future energy scenario. Appl Energy 2014;134:309–20. https://doi.org/10.1016/j.apenergy.2014.08.044.
[176] Sadri A, Ardehali MM, Amirnekooei K. General procedure for long-term energy-environmental planning for transportation sector of developing countries with limited data based on LEAP (long-range energy alternative planning) and EnergyPLAN. Energy 2014;77:831–43. https://doi.org/10.1016/j.energy.2014.09.067.
[177] Connolly D, Lund H, Mathiesen BVV, Werner S, Möller B, Persson U, et al. Heat roadmap Europe: combining district heating with heat savings to decarbonise the EU energy system. Energy Pol 2014;65:475–89. https://doi.org/10.1016/j.enpol.2013.10.035.
[178] Sáfián F. Modelling the Hungarian energy system - the first step towards sustainable energy planning. Energy 2014;69:58–66. https://doi.org/10.1016/j.energy.2014.02.067.
[179] Fernandes L, Ferreira P. Renewable energy scenarios in the Portuguese electricity system. Energy 2014;69:51–7. https://doi.org/10.1016/j.energy.2014.02.098.
[180] Ridjan I, Mathiesen BV, Connolly D. Synthetic fuel production costs by means of solid oxide electrolysis cells. Energy 2014;76:104–13. https://doi.org/10.1016/j.energy.2014.04.002.
[181] Edmunds RK, Cockerill TT, Foxon TJ, Ingham DB, Pourkashanian M. Technical benefits of energy storage and electricity interconnections in future British power systems. Energy 2014;70:577–87. https://doi.org/10.1016/j.energy.2014.04.041.
[182] Henning H-M, Palzer A. A comprehensive model for the German electricity and heat sector in a future energy system with a dominant contribution from renewable energy technologies—Part I: Methodology. Renew Sustain Energy Rev 2014;30:1003–18. https://doi.org/10.1016/j.rser.2013.09.012.
[183] Rezaie B, Reddy BV, Rosen MA. An enviro-economic function for assessing energy resources for district energy systems. Energy 2014;70:159–64. https://doi.org/10.1016/j.energy.2014.03.101.
[184] Tafarte P, Das S, Eichhorn M, Thrän D. Small adaptations, big impacts: options for an optimized mix of variable renewable energy sources. Energy 2014;72:80–92. https://doi.org/10.1016/j.energy.2014.04.094.
[185] Timmerman J, Vandevelde L, Van Eetvelde G. Towards low carbon business park energy systems: classification of techno-economic energy models. Energy 2014; 75:68–80. https://doi.org/10.1016/j.energy.2014.05.092.
[186] Palzer A, Henning H-M. A future German energy system with a dominating contribution from renewable energies: a holistic model based on hourly simulation. Energy Technol 2014;2:13–28. https://doi.org/10.1002/ente.201300083.
[187] Wiese F, Bökenkamp G, Wingenbach C, Hohmeyer O. An open source energy system simulation model as an instrument for public participation in the development of strategies for a sustainable future. WIREs Energy Environ 2014;3: 490–504. https://doi.org/10.1002/wene.109.
[188] Soshinskaya M, Crijns-Graus WHJ, van der Meer J, Guerrero JM. Application of a microgrid with renewables for a water treatment plant. Appl Energy 2014;134: 20–34. https://doi.org/10.1016/j.apenergy.2014.07.097.
[189] Elliston B, MacGill I, Diesendorf M. Comparing least cost scenarios for 100% renewable electricity with low emission fossil fuel scenarios in the Australian National Electricity Market. Renew Energy 2014;66:196–204. https://doi.org/10.1016/j.renene.2013.12.010.
[190] Amorim F, Pina A, Gerbelová H, Pereira da Silva P, Vasconcelos J, Martins V. Electricity decarbonisation pathways for 2050 in Portugal: a TIMES (The Integrated MARKAL-EFOM System) based approach in closed versus open systems modelling. Energy 2014;69:104–12. https://doi.org/10.1016/j.energy.2014.01.052.
[191] Kılkış Ş. Energy system analysis of a pilot net-zero exergy district. Energy Convers Manag 2014;87:1077–92. https://doi.org/10.1016/j.enconman.2014.05.014.
[192] Mancarella P. MES (multi-energy systems): an overview of concepts and evaluation models. Energy 2014;65:1–17. https://doi.org/10.1016/j.energy.2013.10.041.
[193] Sonar D, Soni SL, Sharma D. Micro-trigeneration for energy sustainability: technologies, tools and trends. Appl Therm Eng 2014;71:790–6. https://doi.org/10.1016/j.applthermaleng.2013.11.037.
[194] Prasad RD, Bansal RC, Raturi A. Multi-faceted energy planning: a review. Renew Sustain Energy Rev 2014;38:686–99. https://doi.org/10.1016/j.rser.2014.07.021.
[195] Arigliano A, Caricato P, Grieco A, Guerriero E. Producing, storing, using and selling renewable energy: the best mix for the small medium industry. Comput Ind 2014;65:408–18. https://doi.org/10.1016/j.compind.2014.01.006.
[196] Flores JR, Montagna JM, Vecchietti A. An optimization approach for long term investments planning in energy. Appl Energy 2014;122:162–78. https://doi.org/10.1016/j.apenergy.2014.02.002.
[197] Petrovic SN, Karlsson KB. Danish heat atlas as a support tool for energy system models. Energy Convers Manag 2014;87:1063–76. https://doi.org/10.1016/j.enconman.2014.04.084.
[198] Morel J, Obara S, Morizane Y. Operation strategy for a power grid supplied by 100% renewable energy at a cold region in Japan. J Sustain Dev Energy, Water Environ Syst 2014;2:270–83. https://doi.org/10.13044/j.sdewes.2014.02.0022.
[199] Bessa R, Moreira C, Silva B, Matos M. Handling renewable energy variability and uncertainty in power systems operation. WIREs Energy Environ 2014;3:156–78. https://doi.org/10.1002/wene.76.
[200] Mwasilu F, Justo JJ, Kim E-K, Do TD, Jung J-W. Electric vehicles and smart grid interaction: a review on vehicle to grid and renewable energy sources integration. Renew Sustain Energy Rev 2014;34:501–16. https://doi.org/10.1016/j.rser.2014.03.031.
[201] Farnoosh A, Lantz F, Percebois J. Electricity generation analyses in an oil-exporting country: transition to non-fossil fuel based power units in Saudi Arabia. Energy 2014;69:299–308. https://doi.org/10.1016/j.energy.2014.03.017.
[202] Cochran J, Mai T, Bazilian M. Meta-analysis of high penetration renewable energy scenarios. Renew Sustain Energy Rev 2014;29:246–53. https://doi.org/10.1016/j.rser.2013.08.089.
[203] Fehrenbach D, Merkel E, McKenna R, Karl U, Fichtner W. On the economic potential for electric load management in the German residential heating sector – an optimising energy system model approach. Energy 2014;71:263–76. https://doi.org/10.1016/j.energy.2014.04.061.
[204] Stadler M, Groissböck M, Cardoso G, Marnay C. Optimizing distributed energy resources and building retrofits with the strategic DER-CAModel. Appl Energy 2014;132:557–67. https://doi.org/10.1016/j.apenergy.2014.07.041.
[205] Zábojník J, Dvořák M. Power grid simulation model for long term operation planning. Appl Therm Eng 2014;70:1294–305. https://doi.org/10.1016/j.applthermaleng.2014.05.064.
[206] Centeno Brito M, Lobato K, Nunes P, Serra F. Sustainable energy systems in an imaginary island. Renew Sustain Energy Rev 2014;37:229–42. https://doi.org/10.1016/j.rser.2014.05.008.
[207] Andresen GB, Rodriguez RA, Becker S, Greiner M. The potential for arbitrage of wind and solar surplus power in Denmark. Energy 2014;76:49–58. https://doi.org/10.1016/j.energy.2014.03.033.
[208] Novosel T, Perković L, Ban M, Keko H, Pukšec T, Krajačić G, et al. Agent based modelling and energy planning - utilization of MATSim for transport energy demand modelling. Energy 2015;92:466–75. https://doi.org/10.1016/j.energy.2015.05.091.
[209] Assefa Hagos D, Gebremedhin A, Folsland Bolkesjø T. Comparing the value of bioenergy in the heating and transport sectors of an electricity-intensive energy system in Norway. Energy Pol 2015;85:386–96. https://doi.org/10.1016/j.enpol.2015.06.021.
[210] Lund R, Mathiesen BV. Large combined heat and power plants in sustainable energy systems. Appl Energy 2015;142:389–95. https://doi.org/10.1016/j.apenergy.2015.01.013.
[211] Kontu K, Rinne S, Olkkonen V, Lahdelma R, Salminen P. Multicriteria evaluation of heating choices for a new sustainable residential area. Energy Build 2015;93: 169–79. https://doi.org/10.1016/j.enbuild.2015.02.003.
[212] Vidal-Amaro JJ, Østergaard PA, Sheinbaum-Pardo C. Optimal energy mix for transitioning from fossil fuels to renewable energy sources – the case of the Mexican electricity system. Appl Energy 2015;150:80–96. https://doi.org/10.1016/j.apenergy.2015.03.133.
[213] Udrene L, Bazbauers G. Role of vehicle-to-grid systems for electric load shifting and integration of intermittent sources in Latvian power system. Energy Proc 2015;72:156–62. https://doi.org/10.1016/j.egypro.2015.06.022.

[214] Batas Bjelić I, Rajaković N. Simulation-based optimization of sustainable national energy systems. Energy 2015;91:1087–98. https://doi.org/10.1016/J.ENERGY.2015.09.006.
[215] Rinne S, Syri S. The possibilities of combined heat and power production balancing large amounts of wind power in Finland. Energy 2015;82:1034–46. https://doi.org/10.1016/j.energy.2015.02.002.
[216] Chen J, Song X. Economics of energy storage technology in active distribution networks. J Mod Power Syst Clean Energy 2015;3:583–8. https://doi.org/10.1007/s40565-015-0148-5.
[217] Batas Bjelić I, Rajaković N, Ćosić B, Duić N. A realistic eu vision of a lignite-based energy system in transition: case study of Serbia. Therm Sci 2015;9:371–82. https://doi.org/10.2298/TSCI140613118B.
[218] Hasovic Z, Cosic B, Omerbegovic Arapovic A, Duic N. Impact of new power investments up to year 2020 on the energy system of Bosnia and Herzegovina. Therm Sci 2015;19:771–80. https://doi.org/10.2298/TSCI150105042H.
[219] Zakeri B, Rinne S, Syri S. Wind integration into energy systems with a high share of nuclear power-what are the compromises? Energies 2015;8. https://doi.org/10.3390/en8042493.
[220] Nunes P, Farias T, Brito MC. Day charging electric vehicles with excess solar electricity for a sustainable energy system. Energy 2015;80:263–74. https://doi.org/10.1016/j.energy.2014.11.069.
[221] Šare A, Krajačić G, Pukšec T, Duić N. The integration of renewable energy sources and electric vehicles into the power system of the Dubrovnik region. Energy Sustain Soc 2015;5:1–16. https://doi.org/10.1186/s13705-015-0055-7.
[222] Østergaard PA, Andersen FM, Kwon PS. Energy systems scenario modelling and long term forecasting of hourly electricity Demand. Int J Sustain Energy Plan Manag 2015;7. https://doi.org/10.5278/ijsepm.2015.7.8.
[223] Vidal-Amaro JJ, Østergaard PA, Sheinbaum-Pardo C. Analysis of large-scale integration of renewable energy sources in the Mexican electricity system. WIT Trans Ecol Environ 2015;195:449–61. https://doi.org/10.2495/ESUS150381.
[224] Neves D, Pina A, Silva CA. Demand response modeling: a comparison between tools. Appl Energy 2015;146:288–97. https://doi.org/10.1016/j.apenergy.2015.02.057.
[225] Nunes P, Farias T, Brito MC. Enabling solar electricity with electric vehicles smart charging. Energy 2015;87:10–20. https://doi.org/10.1016/j.energy.2015.04.044.
[226] Thellufsen JZ, Lund H. Energy saving synergies in national energy systems, 103; 2015. p. 259–65. https://doi.org/10.1016/j.enconman.2015.06.052.
[227] Cho S, Kim J. Feasibility and impact analysis of a renewable energy source (RES)-based energy system in Korea. Energy 2015;85:317–28. https://doi.org/10.1016/j.energy.2015.03.081.
[228] Xiong W, Wang Y, Mathiesen BV, Lund H, Zhang X. Heat roadmap China: new heat strategy to reduce energy consumption towards 2030. Energy 2015;81:274–85. https://doi.org/10.1016/j.energy.2014.12.039.
[229] Zakeri B, Syri S, Rinne S. Higher renewable energy integration into the existing energy system of Finland – is there any maximum limit? Energy 2015;92:244–59. https://doi.org/10.1016/j.energy.2015.01.007.
[230] Novosel T, Ćosić B, Pukšec T, Krajačić G, Duić N, Mathiesen BV, et al. Integration of renewables and reverse osmosis desalination - case study for the Jordanian energy system with a high share of wind and photovoltaics. Energy 2014;92:270–8. https://doi.org/10.1016/j.energy.2015.06.057.
[231] Liu L, Kong F, Liu X, Peng Y, Wang Q. A review on electric vehicles interacting with renewable energy in smart grid. Renew Sustain Energy Rev 2015;51:648–61. https://doi.org/10.1016/j.rser.2015.06.036.
[232] Aldeman MR, Jo JH, Loomis DG. The technical potential for wind energy in Illinois. Energy 2015;90:1082–90. https://doi.org/10.1016/j.energy.2015.02.042.
[233] Vinagre Díaz JJ, Wilby MR, Rodríguez González AB. The wasted energy: a metric to set up appropriate targets in our path towards fully renewable energy systems. Energy 2015;90:900. https://doi.org/10.1016/j.energy.2015.07.118. –9.
[234] Andresen GB, Søndergaard AA, Greiner M. Validation of Danish wind time series from a new global renewable energy atlas for energy system analysis. Energy 2015;93:1074–88. https://doi.org/10.1016/j.energy.2015.09.071.
[235] Saxena A, Varun, El-Sebaii AA. A thermodynamic review of solar air heaters. Renew Sustain Energy Rev 2015;43:863–90. https://doi.org/10.1016/j.rser.2014.11.059.
[236] Oshiro K, Masui T. Diffusion of low emission vehicles and their impact on CO2 emission reduction in Japan. Energy Pol 2015;81:215–25. https://doi.org/10.1016/j.enpol.2014.09.010.
[237] Škugor B, Deur J. Dynamic programming-based optimisation of charging an electric vehicle fleet system represented by an aggregate battery model. Energy 2015;92:456–65. https://doi.org/10.1016/j.energy.2015.03.057.
[238] Mahesh A, Sandhu KS. Hybrid wind/photovoltaic energy system developments: critical review and findings. Renew Sustain Energy Rev 2015;52:1135–47. https://doi.org/10.1016/j.rser.2015.08.008.
[239] Huang Z, Yu H, Peng Z, Zhao M. Methods and tools for community energy planning: a review. Renew Sustain Energy Rev 2015;42:1335–48. https://doi.org/10.1016/j.rser.2014.11.042.
[240] Said M, El-Shimy M, Abdelraheem MA. Photovoltaics energy: improved modeling and analysis of the levelized cost of energy (LCOE) and grid parity – Egypt case study. Sustain Energy Technol Assessments 2015;9:37–48. https://doi.org/10.1016/j.seta.2014.11.003.
[241] Asmar JAL, Kouta R, Chaccour K, Assad JEL, Laghrouche S, Eid E, et al. Power generation and cogeneration management algorithm with renewable energy integration. Energy Proc 2015;74:1394–401. https://doi.org/10.1016/j.egypro.2015.07.785.
[242] Codina Gironès V, Moret S, Maréchal F, Favrat D. Strategic energy planning for large-scale energy systems: a modelling framework to aid decision-making. Energy 2015;90:173–86. https://doi.org/10.1016/j.energy.2015.06.008.
[243] Koltsaklis NE, Georgiadis MC. A multi-period, multi-regional generation expansion planning model incorporating unit commitment constraints. Appl Energy 2015;158:310–31. https://doi.org/10.1016/j.apenergy.2015.08.054.
[244] Killinger S, Mainzer K, McKenna R, Kreifels N, Fichtner W. A regional optimisation of renewable energy supply from wind and photovoltaics with respect to three key energy-political objectives. Energy 2015;84:563–74. https://doi.org/10.1016/j.energy.2015.03.050.
[245] Fang S-C, Chang I-C, Yu T-Y. Assessment of the behavior and characteristics of electric scooter use on islands. J Clean Prod 2015;108:1193–202. https://doi.org/10.1016/j.jclepro.2015.07.095.
[246] Kılkış Ş. Exergy transition planning for net-zero districts. Energy 2015;92:515–31. https://doi.org/10.1016/j.energy.2015.02.009.
[247] Pfenninger S, Keirstead J. Renewables, nuclear, or fossil fuels? Scenarios for Great Britain's power system considering costs, emissions and energy security. Appl Energy 2015;152:83–93. https://doi.org/10.1016/j.apenergy.2015.04.102.
[248] Omri E, Chtourou N, Bazin D. Solar thermal energy for sustainable development in Tunisia: the case of the PROSOL project. Renew Sustain Energy Rev 2015;41:1312–23. https://doi.org/10.1016/j.rser.2014.09.023.
[249] Morel J, Obara S, Morizane Y. Stability enhancement of a power system containing high-penetration intermittent renewable generation. J Sustain Dev Energy Water Environ Syst 2015;3. https://doi.org/10.13044/j.sdewes.2015.03.0012.
[250] van Leeuwen RP, Fink J, de Wit JB, Smit GJM. Upscaling a district heating system based on biogas cogeneration and heat pumps. Energy Sustain Soc 2015;5:1–13. https://doi.org/10.1186/s13705-015-0044-x.
[251] Xiong W, Wang Y, Mathiesen BV, Zhang X. Case study of the constraints and potential contributions regarding wind curtailment in Northeast China. Energy 2016. https://doi.org/10.1016/j.energy.2016.03.093.
[252] Novosel T, Pukšec T, Krajačić G, Duić N. Role of district heating in systems with a high share of renewables: case study for the city of osijek. Energy Proc 2016;95:337–43. https://doi.org/10.1016/j.egypro.2016.09.019.
[253] Thellufsen JZ, Lund H. Roles of local and national energy systems in the integration of renewable energy. Appl Energy 2016;183:419–29. https://doi.org/10.1016/j.apenergy.2016.09.005.
[254] Lund R, Ilic DD, Trygg L. Socioeconomic potential for introducing large-scale heat pumps in district heating in Denmark. J Clean Prod 2016;139:219–29. https://doi.org/10.1016/j.jclepro.2016.07.135.
[255] Olkkonen V, Syri S. Spatial and temporal variations of marginal electricity generation: the case of the Finnish, Nordic, and European energy systems up to 2030. J Clean Prod 2016;126:515–25. https://doi.org/10.1016/j.jclepro.2016.03.112.
[256] Child M, Breyer C. The role of energy storage solutions in a 100% renewable Finnish energy system. Energy Proc 2016;99:25–34. https://doi.org/10.1016/j.egypro.2016.10.094.
[257] Batas Bjelić I, Rajaković N, Krajačić G, Duić N. Two methods for decreasing the flexibility gap in national energy systems. Energy 2016;115:1701–9. https://doi.org/10.1016/j.energy.2016.07.151.
[258] Child M, Breyer C. Vision and initial feasibility analysis of a recarbonised Finnish energy system for 2050. Renew Sustain Energy Rev 2016;66:517–36. https://doi.org/10.1016/j.rser.2016.07.001.
[259] Dominković DF, Bačeković I, Ćosić B, Krajačić G, Pukšec T, Duić N, et al. Zero carbon energy system of south east europe in 2050. Appl Energy 2016;184. https://doi.org/10.1016/j.apenergy.2016.03.046.
[260] Sun X, Zhang B, Tang X, McLellan BC, Höök M. Sustainable energy transitions in China: renewable options and impacts on the electricity system. Energies 2016;9. https://doi.org/10.3390/en9120980.
[261] Dedinec A, Jovanovski B, Gajduk A, Markovska N, Kocarev L. Analysis of renewable energy sources and electric vehicle penetration into energy systems predominantly based on lignite. Eur Phys J Spec Top 2016;225:595–608. https://doi.org/10.1140/epjst/e2015-50099-y.
[262] Lund R, Mohammadi S. Choice of insulation standard for pipe networks in 4th generation district heating systems. Appl Therm Eng 2016;98. https://doi.org/10.1016/j.applthermaleng.2015.12.015.
[263] Mahbub MS, Cozzini M, Østergaard PA, Alberti F. Combining multi-objective evolutionary algorithms and descriptive analytical modelling in energy scenario design. Appl Energy 2016;164:140–51. https://doi.org/10.1016/j.apenergy.2015.11.042.
[264] Mahbub MS, Viesi D, Crema L. Designing optimized energy scenarios for an Italian Alpine valley: the case of Giudicarie Esteriori. Energy 2016;116:236–49. https://doi.org/10.1016/j.energy.2016.09.090.
[265] Hansen K, Connolly D, Lund H, Drysdale D, Thellufsen JZ. Heat Roadmap Europe: identifying the balance between saving heat and supplying heat. Energy 2016. https://doi.org/10.1016/j.energy.2016.06.033.
[266] Komušanac I, Ćosić B, Duić N. Impact of high penetration of wind and solar PV generation on the country power system load: the case study of Croatia. Appl Energy 2016;184:1470–82. https://doi.org/10.1016/j.apenergy.2016.06.099.
[267] Mahbub MS, Wagner M, Crema L. Incorporating domain knowledge into the optimization of energy systems. Appl Soft Comput 2016;47:483–93. https://doi.org/10.1016/j.asoc.2016.06.013.
[268] Yue C-D, Chen C-S, Lee Y-C. Integration of optimal combinations of renewable energy sources into the energy supply of Wang-An Island. Renew Energy 2016;86:930–42. https://doi.org/10.1016/j.renene.2015.08.073.

[269] Perković L, Novosel T, Pukšec T, Ćosić B, Mustafa M, Krajačić G, et al. Modeling of optimal energy flows for systems with close integration of sea water desalination and renewable energy sources: case study for Jordan. Energy Convers Manag 2016;110:249–59. https://doi.org/10.1016/j.enconman.2015.12.029.

[270] Mahmud K, Town GE. A review of computer tools for modeling electric vehicle energy requirements and their impact on power distribution networks. Appl Energy 2016;172:337–59. https://doi.org/10.1016/j.apenergy.2016.03.100.

[271] Cleary B, Duffy A, Bach B, Vitina A, O'Connor A, Conlon M. Estimating the electricity prices, generation costs and CO2 emissions of large scale wind energy exports from Ireland to Great Britain. Energy Pol 2016;91:38–48. https://doi.org/10.1016/j.enpol.2015.12.036.

[272] Krakowski V, Assoumou E, Mazauric V, Maïzi N. Reprint of Feasible path toward 40–100% renewable energy shares for power supply in France by 2050: a prospective analysis. Appl Energy 2016;184:501–22. https://doi.org/10.1016/j.apenergy.2016.11.003.

[273] Krakowski V, Assoumou E, Mazauric V, Maïzi N. Feasible path toward 40–100% renewable energy shares for power supply in France by 2050: a prospective analysis. Appl Energy 2016;171:501–22. https://doi.org/10.1016/j.apenergy.2016.03.094.

[274] Shang C, Srinivasan D, Reindl T. Generation-scheduling-coupled battery sizing of stand-alone hybrid power systems. Energy 2016;114:671–82. https://doi.org/10.1016/j.energy.2016.07.123.

[275] Nastasi B, Lo Basso G. Hydrogen to link heat and electricity in the transition towards future Smart Energy Systems. Energy 2016;110:5–22. https://doi.org/10.1016/j.energy.2016.03.097.

[276] Poncelet K, Delarue E, Six D, Duerinck J, D'haeseleer W. Impact of the level of temporal and operational detail in energy-system planning models. Appl Energy 2016;162:631–43. https://doi.org/10.1016/j.apenergy.2015.10.100.

[277] Olsthoorn D, Haghighat F, Mirzaei PA. Integration of storage and renewable energy into district heating systems: a review of modelling and optimization. Sol Energy 2016;136:49–64. https://doi.org/10.1016/j.solener.2016.06.054.

[278] Damsø T, Kjær T, Christensen TB. Local climate action plans in climate change mitigation – examining the case of Denmark. Energy Pol 2016;89:74–83. https://doi.org/10.1016/j.enpol.2015.11.013.

[279] Prebeg P, Gasparovic G, Krajacic G, Duic N. Long-term energy planning of Croatian power system using multi-objective optimization with focus on renewable energy and integration of electric vehicles. Appl Energy 2016. https://doi.org/10.1016/j.apenergy.2016.03.086.

[280] Staffell I, Rustomji M. Maximising the value of electricity storage. J Energy Storage 2016;8:212–25. https://doi.org/10.1016/j.est.2016.08.010.

[281] Hall LMH, Buckley AR. A review of energy systems models in the UK: prevalent usage and categorisation. Appl Energy 2016;169:607–28. https://doi.org/10.1016/j.apenergy.2016.02.044.

[282] Prinsloo G, Dobson R, Mammoli A. Model based design of a novel Stirling solar micro-cogeneration system with performance and fuel transition analysis for rural African village locations. Sol Energy 2016;133:315–30. https://doi.org/10.1016/j.solener.2016.04.014.

[283] Blumberga D, Blumberga A, Barisa A, Rosa M, Lauka D. Modelling the Latvian power market to evaluate its environmental long-term performance. Appl Energy 2016;162:1593–600. https://doi.org/10.1016/j.apenergy.2015.06.016.

[284] Liu X, Mancarella P. Modelling, assessment and Sankey diagrams of integrated electricity-heat-gas networks in multi-vector district energy systems. Appl Energy 2016;167:336–52. https://doi.org/10.1016/j.apenergy.2015.08.089.

[285] Zahboune H, Zouggar S, Krajacic G, Varbanov PS, Elhafyani M, Ziani E. Optimal hybrid renewable energy design in autonomous system using Modified Electric System Cascade Analysis and Homer software. Energy Convers Manag 2016;126:909–22. https://doi.org/10.1016/j.enconman.2016.08.061.

[286] Simoglou CK, Bakirtzis EA, Biskas PN, Bakirtzis AG. Optimal operation of insular electricity grids under high RES penetration. Renew Energy 2016;86:1308–16. https://doi.org/10.1016/j.renene.2015.09.064.

[287] Lunz B, Stöcker P, Eckstein S, Nebel A, Samadi S, Erlach B, et al. Scenario-based comparative assessment of potential future electricity systems – a new methodological approach using Germany in 2050 as an example. Appl Energy 2016;171:555–80. https://doi.org/10.1016/j.apenergy.2016.03.087.

[288] Ziemele J, Gravelsins A, Blumberga A, Vigants G, Blumberga D. System dynamics model analysis of pathway to 4th generation district heating in Latvia. Energy 2016;110:85–94. https://doi.org/10.1016/j.energy.2015.11.073.

[289] Gómez A, Dopazo C, Fueyo N. The "cost of not doing" energy planning: the Spanish energy bubble. Energy 2016;101:434–46. https://doi.org/10.1016/j.energy.2016.02.004.

[290] Quiggin D, Buswell R. The implications of heat electrification on national electrical supply-demand balance under published 2050 energy scenarios. Energy 2016;98:253–70. https://doi.org/10.1016/j.energy.2015.11.060.

[291] Staffell I, Pfenninger S. Using bias-corrected reanalysis to simulate current and future wind power output. Energy 2016;114:1224–39. https://doi.org/10.1016/J.ENERGY.2016.08.068.

[292] Li D, He J, Li L. A review of renewable energy applications in buildings in the hot-summer and warm-winter region of China. Renew Sustain Energy Rev 2016;57:327–36. https://doi.org/10.1016/j.rser.2015.12.124.

[293] Ishizaka A, Siraj S, Nemery P. Which energy mix for the UK (United Kingdom)? An evolutive descriptive mapping with the integrated GAIA (graphical analysis for interactive aid)–AHP (analytic hierarchy process) visualization tool. Energy 2016;95:602–11. https://doi.org/10.1016/j.energy.2015.12.009.

[294] Mezősi A, Kácsor E, Á Beöthy, Törőcsik Á, Szabó L. Modelling support policies and renewable energy sources deployment in the Hungarian district heating sector. Energy Environ 2016;28:70–87. https://doi.org/10.1177/0958305X16685473.

[295] Abdollahi E, Wang H, Lahdelma R. An optimization method for multi-area combined heat and power production with power transmission network. Appl Energy 2016;168:248–56. https://doi.org/10.1016/j.apenergy.2016.01.067.

[296] Salehin S, Ferdaous MT, Chowdhury RM, Shithi SS, Rofi MSRB, Mohammed MA. Assessment of renewable energy systems combining techno-economic optimization with energy scenario analysis. Energy 2016;112:729–41. https://doi.org/10.1016/j.energy.2016.06.110.

[297] Dedinec A, Filiposka S, Dedinec A, Kocarev L. Deep belief network based electricity load forecasting: an analysis of Macedonian case. Energy 2016;115:1688–700. https://doi.org/10.1016/j.energy.2016.07.090.

[298] Hori K, Matsui T, Hasuike T, Fukui K, Machimura T. Development and application of the renewable energy regional optimization utility tool for environmental sustainability: REROUTES. Renew Energy 2016;93:548–61. https://doi.org/10.1016/j.renene.2016.02.051.

[299] Nielsen MG, Morales JM, Zugno M, Pedersen TE, Madsen H. Economic valuation of heat pumps and electric boilers in the Danish energy system. Appl Energy 2016;167:189–200. https://doi.org/10.1016/j.apenergy.2015.08.115.

[300] Eser P, Singh A, Chokani N, Abhari RS. Effect of increased renewables generation on operation of thermal power plants. Appl Energy 2016;164:723–32. https://doi.org/10.1016/j.apenergy.2015.12.017.

[301] Hong S, Chung Y, Kim J, Chun D. Analysis on the level of contribution to the national greenhouse gas reduction target in Korean transportation sector using LEAP model. Renew Sustain Energy Rev 2016;60:549–59. https://doi.org/10.1016/j.rser.2015.12.164.

[302] Tarroja B, Zhang L, Wifvat V, Shaffer B, Samuelsen S. Assessing the stationary energy storage equivalency of vehicle-to-grid charging battery electric vehicles. Energy 2016;106:673–90. https://doi.org/10.1016/j.energy.2016.03.094.

[303] Lai W, Ma Q, Lu H, Weng S, Fan J, Fang H. Effects of wind intermittence and fluctuation on reverse osmosis desalination process and solution strategies. Desalination 2016;395:17–27. https://doi.org/10.1016/j.desal.2016.05.019.

[304] Hu J, Morais H, Sousa T, Lind M. Electric vehicle fleet management in smart grids: a review of services, optimization and control aspects. Renew Sustain Energy Rev 2016;56:1207–26. https://doi.org/10.1016/j.rser.2015.12.014.

[305] Heinen S, Burke D, O'Malley M. Electricity, gas, heat integration via residential hybrid heating technologies – an investment model assessment. Energy 2016;109:906–19. https://doi.org/10.1016/j.energy.2016.04.126.

[306] Zivkovic M, Pereverza K, Pasichnyi O, Madzarevic A, Ivezic D, Kordas O. Exploring scenarios for more sustainable heating: the case of Niš, Serbia. Energy 2016;115:1758–70. https://doi.org/10.1016/j.energy.2016.06.034.

[307] Moret S, Peduzzi E, Gerber L, Maréchal F. Integration of deep geothermal energy and woody biomass conversion pathways in urban systems. Energy Convers Manag 2016;129:305–18. https://doi.org/10.1016/j.enconman.2016.09.079.

[308] Pereira S, Ferreira P, Vaz AIF. Optimization modeling to support renewables integration in power systems. Renew Sustain Energy Rev 2016;55:316–25. https://doi.org/10.1016/j.rser.2015.10.116.

[309] Wang F-C, Chen H-C. The development and optimization of customized hybrid power systems. Int J Hydrogen Energy 2016;41:12261–72. https://doi.org/10.1016/j.ijhydene.2016.05.247.

[310] Bertsch V, Fichtner W. A participatory multi-criteria approach for power generation and transmission planning. Ann Oper Res 2016;245:177–207. https://doi.org/10.1007/s10479-015-1791-y.

[311] Mahbub MS, Viesi D, Cattani S, Crema L. An innovative multi-objective optimization approach for long-term energy planning. Appl Energy 2017;208:1487–504. https://doi.org/10.1016/j.apenergy.2017.08.245.

[312] Ali H, Sanjaya S, Suryadi B, Weller SR. Analysing CO2 emissions from Singapore's electricity generation sector: strategies for 2020 and beyond. Enery 2017;124. https://doi.org/10.1016/j.energy.2017.01.112.

[313] Liu L, Zhu T, Pan Y, Wang H. Multiple energy complementation based on distributed energy systems – case study of Chongming county, China. Appl Energy 2017;192:329–36. https://doi.org/10.1016/j.apenergy.2016.07.049.

[314] Dominković DF, Rashid KABA, Romagnoli A, Pedersen AS, Leong KC, Krajačić G, et al. Potential of district cooling in hot and humid climates. Appl Energy 2017;208:49–61. https://doi.org/10.1016/j.apenergy.2017.09.052.

[315] Child M, Nordling A, Breyer C. Scenarios for a sustainable energy system in the Åland Islands in 2030. Energy Convers Manag 2017;137:49–60. https://doi.org/10.1016/j.enconman.2017.01.039.

[316] Tomić T, Dominković DF, Pfeifer A, Schneider DR, Pedersen AS, Duić N. Waste to energy plant operation under the influence of market and legislation conditioned changes. Energy 2017;137:1119–29. https://doi.org/10.1016/j.energy.2017.04.080.

[317] Calise F, D'Accadia MD, Barletta C, Battaglia V, Pfeifer A, Duic N. Detailed modelling of the deep decarbonisation scenarios with demand response technologies in the heating and cooling sector: a case study for Italy. Energies 2017;10. https://doi.org/10.3390/en10101535.

[318] Child M, Haukkala T, Breyer C. The role of solar photovoltaics and energy storage solutions in a 100 % renewable energy system for Finland in 2050. Sustainability 2017;9:1–25. https://doi.org/10.3390/su9081358.

[319] Lund R, Østergaard DS, Yang X, Mathiesen BV. Comparison of low-temperature district heating concepts in a long-term energy system perspective. Int J Sustain Energy Plan Manag 2017;12:5–18. https://doi.org/10.5278/ijsepm.2017.12.2.

[320] Olkkonen V, Rinne S, Hast A, Syri S. Benefits of DSM measures in the future Finnish energy system. Energy 2017;137:729–38. https://doi.org/10.1016/j.energy.2017.05.186.

[321] Liao S, Yao W, Han X, Wen J, Cheng S. Chronological operation simulation framework for regional power system under high penetration of renewable

energy using meteorological data. Appl Energy 2017;203:816–28. https://doi.org/10.1016/j.apenergy.2017.06.086.
[322] Thellufsen JZ, Lund H. Cross-border versus cross-sector interconnectivity in renewable energy systems. Energy 2017;124:492–501. https://doi.org/10.1016/j.energy.2017.02.112.
[323] Nunes P, Brito MC. Displacing natural gas with electric vehicles for grid stabilization. Energy 2017;141:87–96. https://doi.org/10.1016/j.energy.2017.09.064.
[324] Connolly D. Economic viability of electric roads compared to oil and batteries for all forms of road transport. Energy Strategy Rev 2017;18:235–49. https://doi.org/10.1016/j.esr.2017.09.005.
[325] Zhao G, Guerrero JM, Jiang K, Chen S. Energy modelling towards low carbon development of Beijing in 2030. Energy 2017;121:107–13. https://doi.org/10.1016/j.energy.2017.01.019.
[326] Kamenders A, Vilcane L, Indzere Z, Blumberga D. Heat demand and energy resources balance change in Latvia. Energy Proc 2017;113:411–6. https://doi.org/10.1016/j.egypro.2017.04.025.
[327] Noorollahi Y, Itoi R, Yousefi H, Mohammadi M, Farhadi A. Modeling for diversifying electricity supply by maximizing renewable energy use in Ebino city southern Japan. Sustain Cities Soc 2017;34:371–84. https://doi.org/10.1016/j.scs.2017.06.022.
[328] Tozzi P, Jo JH. A comparative analysis of renewable energy simulation tools: performance simulation model vs. system optimization. Renew Sustain Energy Rev 2017;80:390–8. https://doi.org/10.1016/j.rser.2017.05.153.
[329] Mirjat NH, Uqaili MA, Harijan K, Das Valasai G, Shaikh F, Waris M. A review of energy and power planning and policies of Pakistan. Renew Sustain Energy Rev 2017;79:110–27. https://doi.org/10.1016/j.rser.2017.05.040.
[330] Guzzi F, Neves D, Silva CA. Integration of smart grid mechanisms on microgrids energy modelling. Energy 2017;129:321–30. https://doi.org/10.1016/j.energy.2017.04.084.
[331] Zerrahn A, Schill WP. Long-run power storage requirements for high shares of renewables: review and a new model. Renew Sustain Energy Rev 2017;79:1518–34. https://doi.org/10.1016/j.rser.2016.11.098.
[332] Dhakouani A, Gardumi F, Znouda E, Bouden C, Howells M. Long-term optimisation model of the Tunisian power system. Energy 2017;141:550–62. https://doi.org/10.1016/j.energy.2017.09.093.
[333] Weiss O, Bogdanov D, Salovaara K, Honkapuro S. Market designs for a 100% renewable energy system: case isolated power system of Israel. Energy 2017;119:266–77. https://doi.org/10.1016/j.energy.2016.12.055.
[334] Ma W, Fang S, Liu G, Zhou R. Modeling of district load forecasting for distributed energy system. Appl Energy 2017;204:181–205. https://doi.org/10.1016/j.apenergy.2017.07.009.
[335] Dominković DF, Bačeković I, Sveinbjörnsson D, Pedersen AS, Krajačić G. On the way towards smart energy supply in cities: the impact of interconnecting geographically distributed district heating grids on the energy system. Energy 2017. https://doi.org/10.1016/j.energy.2017.02.162.
[336] Gopisetty S, Treffinger P, Reindl LM. Open-source energy planning tool with easy-to-parameterize components for the conception of polygeneration systems. Energy 2017;126:756–65. https://doi.org/10.1016/j.energy.2017.03.013.
[337] Watson D, Binnie Y, Duncan K, Dorville J-F. Photurgen: the open source software for the analysis and design of hybrid solar wind energy systems in the Caribbean region: a brief introduction to its development policy. Energy Rep 2017;3:61–9. https://doi.org/10.1016/j.egyr.2017.03.001.
[338] Wierzbowski M, Filipiak I, Lyzwa W. Polish energy policy 2050 – an instrument to develop a diversified and sustainable electricity generation mix in coal-based energy system. Renew Sustain Energy Rev 2017;74:51–70. https://doi.org/10.1016/j.rser.2017.02.046.
[339] Dullinger C, Struckl W, Kozek M. Simulation-based multi-objective system optimization of train traction systems. Simulat Model Pract Theor 2017;72:104–17. https://doi.org/10.1016/j.simpat.2016.12.008.
[340] Haas J, Cebulla F, Cao K, Nowak W, Palma-Behnke R, Rahmann C, et al. Challenges and trends of energy storage expansion planning for flexibility provision in low-carbon power systems – a review. Renew Sustain Energy Rev 2017;80:603–19. https://doi.org/10.1016/j.rser.2017.05.201.
[341] Lund H, Østergaard PA, Connolly D, Mathiesen BV. Smart energy and smart energy systems. Energy 2017;137. https://doi.org/10.1016/j.energy.2017.05.123.
[342] Batas-Bjelic I, Rajakovic N, Duic N. Smart municipal energy grid within electricity market. Energy 2017;137:1277–85. https://doi.org/10.1016/j.energy.2017.06.177.
[343] Sabo ML, Mariun N, Hizam H, Mohd Radzi MA, Zakaria A. Spatial matching of large-scale grid-connected photovoltaic power generation with utility demand in Peninsular Malaysia. Appl Energy 2017;191:663–88. https://doi.org/10.1016/j.apenergy.2017.01.087.
[344] Delmastro C, Martinsson F, Dulac J, Corgnati SP. Sustainable urban heat strategies: perspectives from integrated district energy choices and energy conservation in buildings. Case studies in Torino and Stockholm. Energy 2017;138:1209–20. https://doi.org/10.1016/j.energy.2017.08.019.
[345] Gauché P, Rudman J, Mabaso M, Landman WA, von Backström TW, Brent AC. System value and progress of CSP. Sol Energy 2017;152:106–39. https://doi.org/10.1016/j.solener.2017.03.072.
[346] Spiller E, Sopher P, Martin N, Mirzatuny M, Zhang X. The environmental impacts of green technologies in TX. Energy Econ 2017;68:199–214. https://doi.org/10.1016/j.eneco.2017.09.009.
[347] Jensen IG, Skovsgaard L. The impact of CO2-costs on biogas usage. Energy 2017;134:289–300. https://doi.org/10.1016/j.energy.2017.06.019.
[348] Quiquerez L, Lachal B, Monnard M, Faessler J. The role of district heating in achieving sustainable cities: comparative analysis of different heat scenarios for Geneva. Energy Proc 2017;116:78–90. https://doi.org/10.1016/j.egypro.2017.05.057.
[349] Lind A, Espegren K. The use of energy system models for analysing the transition to low-carbon cities – the case of Oslo. Energy Strategy Rev 2017;15:44–56. https://doi.org/10.1016/j.esr.2017.01.001.
[350] Handayani K, Krozer Y, Filatova T. Trade-offs between electrification and climate change mitigation: an analysis of the Java-Bali power system in Indonesia. Appl Energy 2017;208:1020–37. https://doi.org/10.1016/j.apenergy.2017.09.048.
[351] Yazdanie M, Densing M, Wokaun A. Cost optimal urban energy systems planning in the context of national energy policies: a case study for the city of Basel. Energy Pol 2017;110:176–90. https://doi.org/10.1016/j.enpol.2017.08.009.
[352] Torabi Moghadam S, Delmastro C, Corgnati SP, Lombardi P. Urban energy planning procedure for sustainable development in the built environment: a review of available spatial approaches. J Clean Prod 2017;165:811–27. https://doi.org/10.1016/j.jclepro.2017.07.142.
[353] Roux C, Schalbart P, Peuportier B. Development of an electricity system model allowing dynamic and marginal approaches in LCA—tested in the French context of space heating in buildings. Int J Life Cycle Assess 2017;22:1177–90. https://doi.org/10.1007/s11367-016-1229-z.
[354] Rudra S, Rosendahl L. Techno-economic analysis of a local district heating plant under fuel flexibility and performance. Energy Effic 2017;10:613–24. https://doi.org/10.1007/s12053-016-9475-2.
[355] Domingues N, Neves-Silva R, de Melo JJ. Decision making in the electricity sector using performance indicators. Energy, Ecol Environ 2017;2:60–84. https://doi.org/10.1007/s40974-016-0043-6.
[356] Ghazi Z, Doustmohammadi A. Fault detection and power distribution optimization of smart grids based on hybrid Petri net. Energy Syst 2017;8:465–93. https://doi.org/10.1007/s12667-016-0205-9.
[357] Canales FA, Beluco A, Mendes CAB. Modelling a hydropower plant with reservoir with the micropower optimisation model (HOMER). Int J Sustain Energy 2017;36:654–67. https://doi.org/10.1080/14786451.2015.1080706.
[358] Mulholland E, Rogan F, Ó Gallachóir BP. From technology pathways to policy roadmaps to enabling measures – a multi-model approach. Energy 2017;138:1030–41. https://doi.org/10.1016/j.energy.2017.07.116.
[359] Vivas FJ, De las Heras A, Segura F, Andújar JM. H2RES2 simulator. A new solution for hydrogen hybridization with renewable energy sources-based systems. Int J Hydrogen Energy 2017;42:13510–31. https://doi.org/10.1016/j.ijhydene.2017.02.139.
[360] Solomon AA, Child M, Caldera U, Breyer C. How much energy storage is needed to incorporate very large intermittent renewables? Energy Proc 2017;135:283–93. https://doi.org/10.1016/j.egypro.2017.09.520.
[361] Wang X, Li Z, Meng H, Wu J. Identification of key energy efficiency drivers through global city benchmarking: a data driven approach. Appl Energy 2017;190:18–28. https://doi.org/10.1016/j.apenergy.2016.12.111.
[362] Simoes S, Zeyringer M, Mayr D, Huld T, Nijs W, Schmidt J. Impact of different levels of geographical disaggregation of wind and PV electricity generation in large energy system models: a case study for Austria. Renew Energy 2017;105:183–98. https://doi.org/10.1016/j.renene.2016.12.020.
[363] Collins S, Deane JP, Poncelet K, Panos E, Pietzcker RC, Delarue E, et al. Integrating short term variations of the power system into integrated energy system models: a methodological review. Renew Sustain Energy Rev 2017;76:839–56. https://doi.org/10.1016/j.rser.2017.03.090.
[364] Karjunen H, Tynjälä T, Hyppänen T. A method for assessing infrastructure for CO2 utilization: a case study of Finland. Appl Energy 2017;205:33–43. https://doi.org/10.1016/j.apenergy.2017.07.111.
[365] Santos-Alamillos FJ, Archer CL, Noel L, Budischak C, Facciolo W. Assessing the economic feasibility of the gradual decarbonization of a large electric power system. J Clean Prod 2017;147:130–41. https://doi.org/10.1016/j.jclepro.2017.01.097.
[366] Capellán-Pérez I, de Castro C, Arto I. Assessing vulnerabilities and limits in the transition to renewable energies: land requirements under 100% solar energy scenarios. Renew Sustain Energy Rev 2017;77:760–82. https://doi.org/10.1016/j.rser.2017.03.137.
[367] Merzic A, Music M, Haznadar Z. Conceptualizing sustainable development of conventional power systems in developing countries – a contribution towards low carbon future. Energy 2017;126:112–23. https://doi.org/10.1016/j.energy.2017.03.016.
[368] Perković L, Mikulčić H, Pavlinek L, Wang X, Vujanović M, Tan H, et al. Coupling of cleaner production with a day-ahead electricity market: a hypothetical case study. J Clean Prod 2017;143:1011–20. https://doi.org/10.1016/j.jclepro.2016.12.019.
[369] van Sluisveld MAE, Hof AF, van Vuuren DP, Boot P, Criqui P, Matthes FC, et al. Low-carbon strategies towards 2050: comparing ex-ante policy evaluation studies and national planning processes in Europe. Environ Sci Pol 2017;78:89–96. https://doi.org/10.1016/j.envsci.2017.08.022.
[370] Pursiheimo E, Holttinen H, Koljonen T. Path toward 100% renewable energy future and feasibility of power-to-gas technology in Nordic countries. IET Renew Power Gener 2017;11:1695–706. https://doi.org/10.1049/iet-rpg.2017.0021.
[371] De Luca G, Fabozzi S, Massarotti N, Vanoli L. A renewable energy system for a nearly zero greenhouse city: case study of a small city in southern Italy. Energy 2018;143:347–62. https://doi.org/10.1016/j.energy.2017.07.004.
[372] Bačeković I, Østergaard PA. A smart energy system approach vs a non-integrated renewable energy system approach to designing a future energy system in Zagreb. Energy 2018;155. https://doi.org/10.1016/j.energy.2018.05.075.

[373] Bacekovic I, Østergaard PA. Local smart energy systems and cross-system integration. Energy 2018;151:812–25. https://doi.org/10.1016/j.energy.2018.03.098.
[374] Prina MG, Cozzini M, Garegnani G, Manzolini G, Moser D, Filippi Oberegger U, et al. Multi-objective optimization algorithm coupled to EnergyPLAN software: the EPLANopt model. Energy 2018;149:213–21. https://doi.org/10.1016/J.ENERGY.2018.02.050.
[375] Figueiredo R, Nunes P, Brito MC. Multiyear calibration of simulations of energy systems. Energy 2018;157:932–9. https://doi.org/10.1016/j.energy.2018.05.188.
[376] Zhang D, Mu S, Chan CC, Zhou GY. Optimization of renewable energy penetration in regional energy system. Energy Proc 2018;152:922–7. https://doi.org/10.1016/j.egypro.2018.09.094.
[377] Dranka GG, Ferreira P. Planning for a renewable future in the Brazilian power system. Energy 2018;164:496–511. https://doi.org/10.1016/j.energy.2018.08.164.
[378] Bellocchi S, Gambini M, Manno M, Stilo T, Vellini M. Positive interactions between electric vehicles and renewable energy sources in CO2-reduced energy scenarios: the Italian case. Energy 2018;161:172–82. https://doi.org/10.1016/j.energy.2018.07.068.
[379] Lund H. Renewable heating strategies and their consequences for storage and grid infrastructures comparing a smart grid to a smart energy systems approach. Energy 2018;151. https://doi.org/10.1016/j.energy.2018.03.010.
[380] Marczinkowski HM, Østergaard PA. Residential versus communal combination of photovoltaic and battery in smart energy systems. Energy 2018;152:466–75.
[381] Vanegas Cantarero MM. Reviewing the Nicaraguan transition to a renewable energy system: why is "business-as-usual" no longer an option? Energy Pol 2018;120:580–92. https://doi.org/10.1016/J.ENPOL.2018.05.062.
[382] Cabrera P, Lund H, Carta JA. Smart renewable energy penetration strategies on islands: the case of Gran Canaria. Energy 2018;162:421–43. https://doi.org/10.1016/j.energy.2018.08.020.
[383] Bhuvanesh A, Jaya Christa ST, Kannan S, Karuppasamy Pandiyan M. Aiming towards pollution free future by high penetration of renewable energy sources in electricity generation expansion planning. Futures 2018;104:25–36. https://doi.org/10.1016/j.futures.2018.07.002.
[384] You W, Geng Y, Dong H, Wilson J, Pan H, Wu R, et al. Technical and economic assessment of RES penetration by modelling China's existing energy system. Energy 2018;165:900–10. https://doi.org/10.1016/j.energy.2018.10.043.
[385] Djørup S, Thellufsen JZ, Sorknæs P. The electricity market in a renewable energy system. Energy 2018;162:148–57.
[386] Lund H, Østergaard PA, Chang M, Werner S, Svendsen S, Sorknæs P, et al. The status of 4th generation district heating: research and results. Energy 2018;164:147–59. https://doi.org/10.1016/j.energy.2018.08.206.
[387] Olkkonen V, Ekström J, Hast A, Syri S. Utilising demand response in the future Finnish energy system with increased shares of baseload nuclear power and variable renewable energy. Energy 2018;164:204–17. https://doi.org/10.1016/j.energy.2018.08.210.
[388] Vidal-Amaro JJ, Sheinbaum-Pardo C. A transition strategy from fossil fuels to renewable energy sources in the mexican electricity system. J Sustain Dev Energy, Water Environ Syst 2018;6:47–66. https://doi.org/10.13044/j.sdewes.d5.0170.
[389] Bianco V, Marchitto A, Scarpa F, Tagliafico LA. Heat pumps for buildings heating: energy, environmental, and economic issues. Energy Environ 2018;31:116–29. https://doi.org/10.1177/0958305X18787272.
[390] Child M, Nordling A, Breyer C. The impacts of high V2G participation in a 100% renewable åland energy system. Energies 2018;11. https://doi.org/10.3390/en11092206.
[391] Wang H, Di Pietro G, Wu X, Lahdelma R, Verda V, Haavisto I. Renewable and sustainable energy transitions for countries with different climates and renewable energy sources potentials. Energies 2018;11. https://doi.org/10.3390/en11123523.
[392] Meschede H, Child M, Breyer C. Assessment of sustainable energy system configuration for a small Canary island in 2030. Energy Convers Manag 2018;165:363–72. https://doi.org/10.1016/j.enconman.2018.03.061.
[393] Hansen K, Mathiesen BV. Comprehensive assessment of the role and potential for solar thermal in future energy systems. 2018. https://doi.org/10.1016/j.solener.2018.04.039.
[394] Perez N, Riederer P, Inard C. Development of a multiobjective optimization procedure dedicated to the design of district energy concept. Energy Build 2018;178:11–25. https://doi.org/10.1016/j.enbuild.2018.07.061.
[395] Jääskeläinen J, Veijalainen N, Syri S, Marttunen M, Zakeri B. Energy security impacts of a severe drought on the future Finnish energy system. J Environ Manag 2018;217:542–54. https://doi.org/10.1016/j.jenvman.2018.03.017.
[396] Wang K, Chen S, Liu L, Zhu T, Gan Z. Enhancement of renewable energy penetration through energy storage technologies in a CHP-based energy system for Chongming, China. Energy 2018;162:988–1002. https://doi.org/10.1016/j.energy.2018.08.037.
[397] Prina MG, Fanali L, Manzolini G, Moser D, Sparber W. Incorporating combined cycle gas turbine flexibility constraints and additional costs into the EPLANopt model: the Italian case study. Energy 2018;160:33–43. https://doi.org/10.1016/j.energy.2018.07.007.
[398] Pfeifer A, Dobravec V, Pavlinek L, Krajačić G, Duić N. Integration of renewable energy and demand response technologies in interconnected energy systems. Energy 2018;161:447–55. https://doi.org/10.1016/j.energy.2018.07.134.
[399] Andersen AN, Østergaard PA. A method for assessing support schemes promoting flexibility at district energy plants. Appl Energy 2018;225. https://doi.org/10.1016/j.apenergy.2018.05.053.
[400] Østergaard PA, Andersen AN. Economic feasibility of booster heat pumps in heat pump-based district heating systems. Energy 2018;155:921–9. https://doi.org/10.1016/J.ENERGY.2018.05.076.
[401] Brynolf S, Taljegard M, Grahn M, Hansson J. Electrofuels for the transport sector: a review of production costs. Renew Sustain Energy Rev 2018;81:1887–905. https://doi.org/10.1016/j.rser.2017.05.288.
[402] Sadiqa A, Gulagi A, Breyer C. Energy transition roadmap towards 100% renewable energy and role of storage technologies for Pakistan by 2050. Energy 2018;147:518–33. https://doi.org/10.1016/j.energy.2018.01.027.
[403] Bianco V, Scarpa F. Impact of the phase out of French nuclear reactors on the Italian power sector. Energy 2018;150:722–34. https://doi.org/10.1016/j.energy.2018.03.017.
[404] Schmidt D, Kallert A, Blesl M, Svendsen S, Li H, Nord N, et al. Low temperature district heating for future energy systems. Energy Proc 2017;116:26–38. https://doi.org/10.1016/J.EGYPRO.2017.05.052.
[405] Cook T, Shaver L, Arbaje P. Modeling constraints to distributed generation solar photovoltaic capacity installation in the US Midwest. Appl Energy 2018;210:1037–50. https://doi.org/10.1016/j.apenergy.2017.08.108.
[406] Liu Y, Yu S, Zhu Y, Wang D, Liu J. Modeling, planning, application and management of energy systems for isolated areas: a review. Renew Sustain Energy Rev 2018;82:460–70. https://doi.org/10.1016/j.rser.2017.09.063.
[407] Crespo del Granado P, van Nieuwkoop RH, Kardakos EG, Schaffner C. Modelling the energy transition: a nexus of energy system and economic models. Energy Strategy Rev 2018;20:229–35. https://doi.org/10.1016/j.esr.2018.03.004.
[408] Gabrielli P, Gazzani M, Martelli E, Mazzotti M. Optimal design of multi-energy systems with seasonal storage. Appl Energy 2018;219:408–24. https://doi.org/10.1016/j.apenergy.2017.07.142.
[409] Wu B, Maleki A, Pourfayaz F, Rosen MA. Optimal design of stand-alone reverse osmosis desalination driven by a photovoltaic and diesel generator hybrid system. Sol Energy 2018;163:91–103. https://doi.org/10.1016/j.solener.2018.01.016.
[410] Lyden A, Pepper R, Tuohy PG. A modelling tool selection process for planning of community scale energy systems including storage and demand side management. Sustain Cities Soc 2018. https://doi.org/10.1016/J.SCS.2018.02.003.
[411] Reichenberg L, Siddiqui AS, Wogrin S. Policy implications of downscaling the time dimension in power system planning models to represent variability in renewable output. Energy 2018;159:870–7. https://doi.org/10.1016/j.energy.2018.06.160.
[412] Bloess A, Schill W-P, Zerrahn A. Power-to-heat for renewable energy integration: a review of technologies, modeling approaches, and flexibility potentials. Appl Energy 2018;212:1611–26. https://doi.org/10.1016/j.apenergy.2017.12.073.
[413] Tarroja B, Shaffer BP, Samuelsen S. Resource portfolio design considerations for materially-efficient planning of 100% renewable electricity systems. Energy 2018;157:460–71. https://doi.org/10.1016/j.energy.2018.05.184.
[414] Amaral AR, Rodrigues E, Rodrigues Gaspar A, Gomes Á. Review on performance aspects of nearly zero-energy districts. Sustain Cities Soc 2018;43:406–20. https://doi.org/10.1016/j.scs.2018.08.039.
[415] Ward KR, Staffell I. Simulating price-aware electricity storage without linear optimisation. J Energy Storage 2018;20:78–91. https://doi.org/10.1016/j.est.2018.08.022.
[416] Sorknæs P. Simulation method for a pit seasonal thermal energy storage system with a heat pump in a district heating system. Energy 2018;152:533–8. https://doi.org/10.1016/j.energy.2018.03.152.
[417] Solomon AA, Bogdanov D, Breyer C. Solar driven net zero emission electricity supply with negligible carbon cost: Israel as a case study for Sun Belt countries. Energy 2018;155:87–104. https://doi.org/10.1016/j.energy.2018.05.014.
[418] Jalil-Vega F, Hawkes AD. Spatially resolved model for studying decarbonisation pathways for heat supply and infrastructure trade-offs. Appl Energy 2018;210:1051–72. https://doi.org/10.1016/j.apenergy.2017.05.091.
[419] Welder L, Ryberg DS, Kotzur L, Grube T, Robinius M, Stolten D. Spatio-temporal optimization of a future energy system for power-to-hydrogen applications in Germany. Energy 2018;158:1130–49. https://doi.org/10.1016/j.energy.2018.05.059.
[420] Bramstoft R, Pizarro Alonso A, Karlsson K, Kofoed-Wiuff A, Münster M. STREAM–an energy scenario modelling tool. Energy Strategy Rev 2018;21:62–70. https://doi.org/10.1016/j.esr.2018.04.001.
[421] Lopion P, Markewitz P, Robinius M, Stolten D. A review of current challenges and trends in energy systems modeling. Renew Sustain Energy Rev 2018;96:156–66. https://doi.org/10.1016/j.rser.2018.07.045.
[422] Ma W, Xue X, Liu G. Techno-economic evaluation for hybrid renewable energy system: application and merits. Energy 2018;159:385–409. https://doi.org/10.1016/j.energy.2018.06.101.
[423] Jalil-Vega F, Hawkes AD. The effect of spatial resolution on outcomes from energy systems modelling of heat decarbonisation. Energy 2018;155:339–50. https://doi.org/10.1016/j.energy.2018.04.160.
[424] Dominković DF, Bačeković I, Pedersen AS, Krajačić G. The future of transportation in sustainable energy systems: opportunities and barriers in a clean energy transition. Renew Sustain Energy Rev 2018;82:1823–38. https://doi.org/10.1016/j.rser.2017.06.117.
[425] Hilpert S, Kaldemeyer C, Krien U, Günther S, Wingenbach C, Plessmann G. The Open Energy Modelling Framework (oemof) - a new approach to facilitate open science in energy system modelling. Energy Strategy Rev 2018;22:16–25. https://doi.org/10.1016/j.esr.2018.07.001.
[426] Hanley ES, Deane JP, Gallachóir BPÓ. The role of hydrogen in low carbon energy futures–A review of existing perspectives. Renew Sustain Energy Rev 2018;82:3027–45. https://doi.org/10.1016/j.rser.2017.10.034.

[427] Koutra S, Becue V, Gallas M-A, Ioakimidis CS. Towards the development of a net-zero energy district evaluation approach: a review of sustainable approaches and assessment tools. Sustain Cities Soc 2018;39:784–800. https://doi.org/10.1016/j.scs.2018.03.011.
[428] Senatla M, Bansal RC. Review of planning methodologies used for determination of optimal generation capacity mix: the cases of high shares of PV and wind. IET Renew Power Gener 2018;12:1222–33. https://doi.org/10.1049/iet-rpg.2017.0380.
[429] Kriechbaum L, Scheiber G, Kienberger T. Grid-based multi-energy systems-modelling, assessment, open source modelling frameworks and challenges. Energy Sustain Soc 2018;8:1–19. https://doi.org/10.1186/s13705-018-0176-x.
[430] Ringkjøb HK, Haugan PM, Solbrekke IM. A review of modelling tools for energy and electricity systems with large shares of variable renewables. Renew Sustain Energy Rev 2018;96:440–59. https://doi.org/10.1016/j.rser.2018.08.002.
[431] Mehigan L, Deane JP, Gallachóir BPÓ, Bertsch V. A review of the role of distributed generation (DG) in future electricity systems. Energy 2018;163:822–36. https://doi.org/10.1016/j.energy.2018.08.022.
[432] Barisa A, Rosa M. A system dynamics model for CO2 emission mitigation policy design in road transport sector. Energy Proc 2018;147:419–27. https://doi.org/10.1016/j.egypro.2018.07.112.
[433] Wiese F, Baldini M. Conceptual model of the industry sector in an energy system model: a case study for Denmark. J Clean Prod 2018;203:427–43. https://doi.org/10.1016/j.jclepro.2018.08.229.
[434] Putna O, Janošťák F, Šomplák R, Pavlas M. Demand modelling in district heating systems within the conceptual design of a waste-to-energy plant. Energy 2018;163:1125–39. https://doi.org/10.1016/j.energy.2018.08.059.
[435] McPherson M, Tahseen S. Deploying storage assets to facilitate variable renewable energy integration: the impacts of grid flexibility, renewable penetration, and market structure. Energy 2018;145:856–70. https://doi.org/10.1016/j.energy.2018.01.002.
[436] Hajebrahimi A, Kamwa I, Huneault M. A novel approach for plug-in electric vehicle planning and electricity load management in presence of a clean disruptive technology. Energy 2018;158:975–85. https://doi.org/10.1016/j.energy.2018.06.085.
[437] Blanco H, Faaij A. A review at the role of storage in energy systems with a focus on Power to Gas and long-term storage. Renew Sustain Energy Rev 2018;81:1049–86. https://doi.org/10.1016/j.rser.2017.07.062.
[438] Aghamolaei R, Shamsi MH, Tahsildoost M, O'Donnell J. Review of district-scale energy performance analysis: outlooks towards holistic urban frameworks. Sustain Cities Soc 2018;41:252–64. https://doi.org/10.1016/j.scs.2018.05.048.
[439] Koltsaklis NE, Dagoumas AS. State-of-the-art generation expansion planning: a review. Appl Energy 2018;230:563–89. https://doi.org/10.1016/j.apenergy.2018.08.087.
[440] Child M, Bogdanov D, Breyer C. The role of storage technologies for the transition to a 100% renewable energy system in Europe. Energy Proc 2018;155:44–60. https://doi.org/10.1016/j.egypro.2018.11.067.
[441] Chung M, Shin K-Y, Jeoune D-S, Park S-Y, Lee W-J, Im Y-H. Economic evaluation of renewable energy systems for the optimal planning and design in korea – a case study. J Sustain Dev Energy, Water Environ Syst 2018;6:725–41. https://doi.org/10.13044/j.sdewes.d6.0216.
[442] Novikova A, Csoknyai T, Popović MJ, Stanković B, Szalay Z. Assessment of decarbonisation scenarios for the residential buildings of Serbia. Therm Sci 2018;22. https://doi.org/10.2298/TSCI171221229N.
[443] Ramirez Camargo L, Stoeglehner G. Spatiotemporal modelling for integrated spatial and energy planning. Energy Sustain Soc 2018;8:1–29. https://doi.org/10.1186/s13705-018-0174-z.
[444] Li B, Li X, Bai X, Li Z. Storage capacity allocation strategy for distribution network with distributed photovoltaic generators. J Mod Power Syst Clean Energy 2018;6:1234–43. https://doi.org/10.1007/s40565-018-0429-x.
[445] Li P-H, Pye S. Assessing the benefits of demand-side flexibility in residential and transport sectors from an integrated energy systems perspective. Appl Energy 2018;228:965–79. https://doi.org/10.1016/j.apenergy.2018.06.153.
[446] Lund H, Sorknæs P, Mathiesen BV, Hansen K. Beyond sensitivity analysis: a methodology to handle fuel and electricity prices when designing energy scenarios. Energy Res Social Sci 2018. https://doi.org/10.1016/j.erss.2017.11.013.
[447] Mabrouk MT, Haurant P, Dessarthe V, Meyer P, Lacarrière B. Combining a dynamic simulation tool and a multi-criteria decision aiding algorithm for improving existing District Heating. Energy Proc 2018;149:266–75. https://doi.org/10.1016/j.egypro.2018.08.191.
[448] McKenna R, Bertsch V, Mainzer K, Fichtner W. Combining local preferences with multi-criteria decision analysis and linear optimization to develop feasible energy concepts in small communities. Eur J Oper Res 2018;268:1092–110. https://doi.org/10.1016/j.ejor.2018.01.036.
[449] Deason W. Comparison of 100% renewable energy system scenarios with a focus on flexibility and cost. Renew Sustain Energy Rev 2018;82:3168–78. https://doi.org/10.1016/j.rser.2017.10.026.
[450] Li H, Campana PE, Tan Y, Yan J. Feasibility study about using a stand-alone wind power driven heat pump for space heating. Appl Energy 2018;228:1486–98. https://doi.org/10.1016/j.apenergy.2018.06.146.
[451] Lund H, Duic N, Østergaard PA, Mathiesen BV. Future district heating systems and technologies: on the role of smart energy systems and 4th generation district heating. Energy 2018;165:614–9. https://doi.org/10.1016/J.ENERGY.2018.09.115.
[452] Dominković DF, Dobravec V, Jiang Y, Nielsen PS, Krajačić G. Modelling smart energy systems in tropical regions. Energy 2018;155:592–609. https://doi.org/10.1016/j.energy.2018.05.007.
[453] Askeland K, Bozhkova KN, Sorknæs P. Balancing Europe: can district heating affect the flexibility potential of Norwegian hydropower resources? Renew Energy 2019;141:646–56. https://doi.org/10.1016/J.RENENE.2019.03.137.
[454] Alves M, Segurado R, Costa M. Increasing the penetration of renewable energy sources in isolated islands through the interconnection of their power systems. The case of Pico and Faial islands, Azores. Energy 2019;182:502–10. https://doi.org/10.1016/j.energy.2019.06.081.
[455] Dorotić H, Doračić B, Dobravec V, Pukšec T, Krajačić G, Duić N. Integration of transport and energy sectors in island communities with 100% intermittent renewable energy sources. Renew Sustain Energy Rev 2019;99:109–24. https://doi.org/10.1016/J.RSER.2018.09.033.
[456] Pupo-Roncallo O, Campillo J, Ingham D, Hughes K, Pourkashanian M. Large scale integration of renewable energy sources (RES) in the future Colombian energy system. Energy 2019;186:115805. https://doi.org/10.1016/j.energy.2019.07.135.
[457] Bellocchi S, De Falco M, Gambini M, Manno M, Stilo T, Vellini M. Opportunities for power-to-Gas and Power-to-liquid in CO2-reduced energy scenarios: the Italian case. Energy 2019;175:847–61. https://doi.org/10.1016/j.energy.2019.03.116.
[458] Sorknæs P, Djørup SR, Lund H, Thellufsen JZ. Quantifying the influence of wind power and photovoltaic on future electricity market prices. Energy Convers Manag 2019;180:312–24. https://doi.org/10.1016/J.ENCONMAN.2018.11.007.
[459] Figueiredo R, Nunes P, Meireles M, Madaleno M, Brito MC. Replacing coal-fired power plants by photovoltaics in the Portuguese electricity system. J Clean Prod 2019;222:129–42. https://doi.org/10.1016/j.jclepro.2019.02.217.
[460] Groppi D, Astiaso Garcia D, Lo Basso G, De Santoli L. Synergy between smart energy systems simulation tools for greening small Mediterranean islands. Renew Energy 2019;135:515–24. https://doi.org/10.1016/j.renene.2018.12.043.
[461] Segurado R, Pereira S, Correia D, Costa M. Techno-economic analysis of a trigeneration system based on biomass gasification. Renew Sustain Energy Rev 2019;103:501–14. https://doi.org/10.1016/j.rser.2019.01.008.
[462] Bonati A, De Luca G, Fabozzi S, Massarotti N, Vanoli L. The integration of exergy criterion in energy planning analysis for 100% renewable system. Energy 2019;174:749–67. https://doi.org/10.1016/j.energy.2019.02.089.
[463] Prina MG, Lionetti M, Manzolini G, Sparber W, Moser D. Transition pathways optimization methodology through EnergyPLAN software for long-term energy planning. Appl Energy 2019;235:356–68. https://doi.org/10.1016/j.apenergy.2018.10.099.
[464] Østergaard PA, Jantzen J, Marczinkowski HM, Kristensen M. Business and socioeconomic assessment of introducing heat pumps with heat storage in small-scale district heating systems. Renew Energy 2019;139:904–14. https://doi.org/10.1016/J.RENENE.2019.02.140.
[465] Hobley A. Will gas be gone in the United Kingdom (UK) by 2050? An impact assessment of urban heat decarbonisation and low emission vehicle uptake on future UK energy system scenarios. Renew Energy 2019;142:695–705. https://doi.org/10.1016/j.renene.2019.04.052.
[466] Tahir MF, Haoyong C, Mehmood K, Ali N, Bhutto JA. Integrated energy system modeling of China for 2020 by incorporating demand response, heat pump and thermal storage. IEEE Access 2019;7:40095–108. https://doi.org/10.1109/ACCESS.2019.2905684.
[467] Tahir MF, Haoyong C, Khan A, Javed MS, Laraik NA, Mehmood K. Optimizing size of variable renewable energy sources by incorporating energy storage and demand response. IEEE Access 2019;7:103115–26. https://doi.org/10.1109/ACCESS.2019.2929297.
[468] Child M, Ilonen R, Vavilov M, Kolehmainen M, Breyer C. Scenarios for sustainable energy in Scotland. Wind Energy 2019;22:666–84. https://doi.org/10.1002/we.2314.
[469] Maninnerby H, Bergerland S, Lazarou S, Theocharis A. Electric vehicle penetration in distribution network: a Swedish case study. Appl Syst Innov 2019;2. https://doi.org/10.3390/asi2030019.
[470] Bellocchi S, Manno M, Noussan M, Vellini M. Impact of grid-scale electricity storage and electric vehicles on renewable energy penetration: a case study for Italy. Energies 2019;12. https://doi.org/10.3390/en12071303.
[471] Tahir MF, Chen H, Javed MS, Jameel I, Khan A, Adnan S. Integration of different individual heating scenarios and energy storages into hybrid energy system model of China for 2030. Energies 2019;12. https://doi.org/10.3390/en12112083.
[472] Drysdale D, Mathiesen BV, Paardekooper S. Transitioning to a 100% renewable energy system in Denmark by 2050: assessing the impact from expanding the building stock at the same time. Energy Effic 2019. https://doi.org/10.1007/s12053-018-9649-1.
[473] Marczinkowski HM, Østergaard PA, Djørup SR. Transitioning island energy systems—local conditions, development phases, and renewable energy integration. Energies 2019;12. https://doi.org/10.3390/en12183484.
[474] Ibrahimi N, Gebremedhin A, Sahiti A. Achieving a flexible and sustainable energy system: the case of kosovo. Energies 2019;12. https://doi.org/10.3390/en12244753.
[475] Zhang H, Zhou L, Huang X, Zhang X. Decarbonizing a large City's heating system using heat pumps: a case study of Beijing. Energy 2019;186:115820. https://doi.org/10.1016/j.energy.2019.07.150.
[476] Meschede H, Hesselbach J, Child M, Breyer C. On the impact of probabilistic weather data on the economically optimal design of renewable energy systems – a case study on La Gomera island. Int J Sustain Energy Plan Manag 2019. https://doi.org/10.5278/ijsepm.3142.

[477] Drysdale D, Vad Mathiesen B, Lund H. From carbon calculators to energy system Analysis in cities. Energies 2019;12. https://doi.org/10.3390/en12122307.
[478] Cantarero MMV. Decarbonizing the transport sector: the promethean responsibility of Nicaragua. J Environ Manag 2019;245:311–21. https://doi.org/10.1016/j.jenvman.2019.05.109.
[479] Hansen K. Decision-making based on energy costs: comparing levelized cost of energy and energy system costs. Energy Strategy Rev 2019;24:68–82. https://doi.org/10.1016/j.esr.2019.02.003.
[480] Marczinkowski HMHM, Østergaard PAPA. Evaluation of electricity storage versus thermal storage as part of two different energy planning approaches for the islands samsø and orkney. Energy 2019;175. https://doi.org/10.1016/j.energy.2019.03.103.
[481] Eveloy V, Gebreegziabher T. Excess electricity and power-to-gas storage potential in the future renewable-based power generation sector in the United Arab Emirates. Energy 2019;166:426–50. https://doi.org/10.1016/j.energy.2018.10.088.
[482] Hansen K, Mathiesen BV, Skov IR. Full energy system transition towards 100% renewable energy in Germany in 2050. Renew Sustain Energy Rev 2019;102:1–13. https://doi.org/10.1016/J.RSER.2018.11.038.
[483] Pfeifer A, Krajačić G, Ljubas D, Duić N. Increasing the integration of solar photovoltaics in energy mix on the road to low emissions energy system – economic and environmental implications. Renew Energy 2019. https://doi.org/10.1016/J.RENENE.2019.05.080.
[484] Sandberg E, Kirkerud JG, Trømborg E, Bolkesjø TF. Energy system impacts of grid tariff structures for flexible power-to-district heat. Energy 2019;168:772–81. https://doi.org/10.1016/j.energy.2018.11.035.
[485] Scheller F, Bruckner T. Energy system optimization at the municipal level: an analysis of modeling approaches and challenges. Renew Sustain Energy Rev 2019;105:444–61. https://doi.org/10.1016/j.rser.2019.02.005.
[486] Limpens G, Moret S, Jeanmart H, Maréchal F, EnergyScope TD. A novel open-source model for regional energy systems. Appl Energy 2019;255:113729. https://doi.org/10.1016/j.apenergy.2019.113729.
[487] Li C, Zhou D, Wang H, Cheng H, Li D. Feasibility assessment of a hybrid PV/diesel/battery power system for a housing estate in the severe cold zone—a case study of Harbin, China. Energy 2019;185:671–81. https://doi.org/10.1016/j.energy.2019.07.079.
[488] Kumar A, Singh AR, Deng Y, He X, Kumar P, Bansal RC. Integrated assessment of a sustainable microgrid for a remote village in hilly region. Energy Convers Manag 2019;180:442–72. https://doi.org/10.1016/j.enconman.2018.10.084.
[489] Abrell J, Eser P, Garrison JB, Savelsberg J, Weigt H. Integrating economic and engineering models for future electricity market evaluation: a Swiss case study. Energy Strategy Rev 2019;25:86–106. https://doi.org/10.1016/j.esr.2019.04.003.
[490] Baleta J, Mikulčić H, Klemeš JJ, Urbaniec K, Duić N. Integration of energy, water and environmental systems for a sustainable development. J Clean Prod 2019;215:1424–36. https://doi.org/10.1016/j.jclepro.2019.01.035.
[491] Lindberg KB, Seljom P, Madsen H, Fischer D, Korpås M. Long-term electricity load forecasting: current and future trends. Util Pol 2019;58:102–19. https://doi.org/10.1016/j.jup.2019.04.001.
[492] Chen S, Liu P, Li Z. Multi-regional power generation expansion planning with air pollutants emission constraints. Renew Sustain Energy Rev 2019;112:382–94. https://doi.org/10.1016/j.rser.2019.05.062.
[493] Bellocchi S, Klöckner K, Manno M, Noussan M, Vellini M. On the role of electric vehicles towards low-carbon energy systems: Italy and Germany in comparison. Appl Energy 2019;255:113848. https://doi.org/10.1016/j.apenergy.2019.113848.
[494] Haikarainen C, Pettersson F, Saxén H. Optimising the regional mix of intermittent and flexible energy technologies. J Clean Prod 2019;219:508–17. https://doi.org/10.1016/j.jclepro.2019.02.103.
[495] Abdollahi E, Wang H, Lahdelma R. Parametric optimization of long-term multi-area heat and power production with power storage. Appl Energy 2019;235:802–12. https://doi.org/10.1016/j.apenergy.2018.11.015.
[496] Algunaibet IM, Pozo C, , Galán-Martín Á, Guillén-Gosálbez G. Quantifying the cost of leaving the Paris Agreement via the integration of life cycle assessment, energy systems modeling and monetization. Appl Energy 2019;242:588–601. https://doi.org/10.1016/j.apenergy.2019.03.081.
[497] Hache E, Palle A. Renewable energy source integration into power networks, research trends and policy implications: a bibliometric and research actors survey analysis. Energy Pol 2019;124:23–35. https://doi.org/10.1016/j.enpol.2018.09.036.
[498] van der Heijde B, Vandermeulen A, Salenbien R, Helsen L. Representative days selection for district energy system optimisation: a solar district heating system with seasonal storage. Appl Energy 2019;248:79–94. https://doi.org/10.1016/j.apenergy.2019.04.030.
[499] Dagoumas AS, Koltsaklis NE. Review of models for integrating renewable energy in the generation expansion planning. Appl Energy 2019;242:1573–87. https://doi.org/10.1016/J.APENERGY.2019.03.194.
[500] Riva F, Gardumi F, Tognollo A, Colombo E. Soft-linking energy demand and optimisation models for local long-term electricity planning: an application to rural India. Energy 2019;166:32–46. https://doi.org/10.1016/j.energy.2018.10.067.
[501] Piacentino A, Duic N, Markovska N, Mathiesen BV, Guzović Z, Eveloy V, et al. Sustainable and cost-efficient energy supply and utilisation through innovative concepts and technologies at regional, urban and single-user scales. Energy 2019;182:254–68. https://doi.org/10.1016/j.energy.2019.06.015.
[502] Savvidis G, Siala K, Weissbart C, Schmidt L, Borggrefe F, Kumar S, et al. The gap between energy policy challenges and model capabilities. Energy Pol 2019;125:503–20. https://doi.org/10.1016/j.enpol.2018.10.033.
[503] Chen R, Rao Z, Liu G, Chen Y, Liao S. The long-term forecast of energy demand and uncertainty evaluation with limited data for energy-imported cities in China: a case study in Hunan. Energy Proc 2019;160:396–403. https://doi.org/10.1016/j.egypro.2019.02.173.
[504] Dahash A, Mieck S, Ochs F, Krautz HJ. A comparative study of two simulation tools for the technical feasibility in terms of modeling district heating systems: an optimization case study. Simulat Model Pract Theor 2019;91:48–68. https://doi.org/10.1016/j.simpat.2018.11.008.
[505] Balyk O, Andersen KS, Dockweiler S, Gargiulo M, Karlsson K, Næraa R, et al. Times-DK: Technology-rich multi-sectoral optimisation model of the Danish energy system. Energy Strategy Rev 2019;23:13–22. https://doi.org/10.1016/j.esr.2018.11.003.
[506] Bogdanov D, Toktarova A, Breyer C. Transition towards 100% renewable power and heat supply for energy intensive economies and severe continental climate conditions: case for Kazakhstan. Appl Energy 2019;253:113606. https://doi.org/10.1016/j.apenergy.2019.113606.
[507] Abbasabadi N, Mehdi Ashayeri JK. Urban energy use modeling methods and tools: a review and an outlook. Build Environ 2019;161:106270. https://doi.org/10.1016/j.buildenv.2019.106270.
[508] Machado PG, Mouette D, Villanueva LD, Esparta AR, Mendes Leite B, Moutinho dos Santos E. Energy systems modeling: trends in research publication. WIREs Energy Environ 2019;8:e333. https://doi.org/10.1002/wene.333.
[509] Helistö N, Kiviluoma J, Holttinen H, Lara JD, Hodge B-M. Including operational aspects in the planning of power systems with large amounts of variable generation: a review of modeling approaches. WIREs Energy Environ 2019;8:e341. https://doi.org/10.1002/wene.341.
[510] Wang Y, Su X, Qi L, Shang P, Xu Y. Feasibility of peaking carbon emissions of the power sector in China's eight regions: decomposition, decoupling, and prediction analysis. Environ Sci Pollut Res 2019;26:29212–33. https://doi.org/10.1007/s11356-019-05909-1.
[511] Malla S, Timilsina GR. Assessment of long-term sustainable end-use energy demand in Romania. Int J Sustain Energy 2019;38:253–75. https://doi.org/10.1080/14786451.2018.1482301.
[512] Venturini G, Tattini J, Mulholland E, Gallachóir BÓ. Improvements in the representation of behavior in integrated energy and transport models. Int J Sustain Transp 2019;13:294–313. https://doi.org/10.1080/15568318.2018.1466220.
[513] Rosso-Cerón AM, Kafarov V, Latorre-Bayona G, Quijano-Hurtado R. A novel hybrid approach based on fuzzy multi-criteria decision-making tools for assessing sustainable alternatives of power generation in San Andrés Island. Renew Sustain Energy Rev 2019;110:159–73. https://doi.org/10.1016/j.rser.2019.04.053.
[514] Andersen AN, Østergaard PA. Analytic versus solver-based calculated daily operations of district energy plants. Energy 2019;175:333–44. https://doi.org/10.1016/j.energy.2019.03.096.
[515] Oberle S, Elsland R. Are open access models able to assess today's energy scenarios? Energy Strategy Rev 2019;26:100396. https://doi.org/10.1016/j.esr.2019.100396.
[516] Ferrari S, Zagarella F, Caputo P, Bonomolo M. Assessment of tools for urban energy planning. Energy 2019;176:544–51. https://doi.org/10.1016/j.energy.2019.04.054.
[517] Dahl M, Brun A, Andresen GB. Cost sensitivity of optimal sector-coupled district heating production systems. Energy 2019;166:624–36. https://doi.org/10.1016/j.energy.2018.10.044.
[518] Walnum HT, Hauge ÅL, Lindberg KB, Mysen M, Nielsen BF, Sørnes K. Developing a scenario calculator for smart energy communities in Norway: identifying gaps between vision and practice. Sustain Cities Soc 2019;46:101418. https://doi.org/10.1016/j.scs.2019.01.003.
[519] Lombardi F, Rocco MV, Colombo E. A multi-layer energy modelling methodology to assess the impact of heat-electricity integration strategies: the case of the residential cooking sector in Italy. Energy 2019;170:1249–60. https://doi.org/10.1016/j.energy.2019.01.004.
[520] Oree V, Sayed Hassen SZ, Fleming PJ. A multi-objective framework for long-term generation expansion planning with variable renewables. Appl Energy 2019;253:113589. https://doi.org/10.1016/j.apenergy.2019.113589.
[521] Caglayan DG, Heinrichs HU, Linssen J, Robinius M, Stolten D. Impact of different weather years on the design of hydrogen supply pathways for transport needs. Int J Hydrogen Energy 2019;44:25442–56. https://doi.org/10.1016/j.ijhydene.2019.08.032.
[522] Prasad RD, Raturi A. Low carbon alternatives and their implications for Fiji's electricity sector. Util Pol 2019;56:1–19. https://doi.org/10.1016/j.jup.2018.10.007.
[523] Adeoye O, Spataru C. Modelling and forecasting hourly electricity demand in West African countries. Appl Energy 2019;242:311–33. https://doi.org/10.1016/j.apenergy.2019.03.057.
[524] Sedlar DK, Vulin D, Krajačić G, Jukić L. Offshore gas production infrastructure reutilisation for blue energy production. Renew Sustain Energy Rev 2019;108:159–74. https://doi.org/10.1016/j.rser.2019.03.052.
[525] Liu B, Zhou B, Yang D, Yang Z, Cui M. Optimal capacity planning of combined renewable energy source-pumped storage and seawater desalination systems. Glob Energy Interconnect 2019;2:310–7. https://doi.org/10.1016/j.gloei.2019.11.003.
[526] Hvelplund F, Krog L, Nielsen S, Terkelsen E, Madsen KB. Policy paradigms for optimal residential heat savings in a transition to 100% renewable energy

systems. Energy Pol 2019;134:110944. https://doi.org/10.1016/j.enpol.2019.110944.
[527] Ferrari S, Zagarella F, Caputo P, D'Amico A. Results of a literature review on methods for estimating buildings energy demand at district level. Energy 2019;175:1130–7. https://doi.org/10.1016/j.energy.2019.03.172.
[528] Kamal A, Al-Ghamdi SG, Koc M. Revaluing the costs and benefits of energy efficiency: a systematic review. Energy Res Social Sci 2019;54:68–84. https://doi.org/10.1016/j.erss.2019.03.012.
[529] Dranka GG, Ferreira P. Review and assessment of the different categories of demand response potentials. Energy 2019;179:280–94. https://doi.org/10.1016/j.energy.2019.05.009.
[530] Pearre NS, Ribberink H. Review of research on V2X technologies, strategies, and operations. Renew Sustain Energy Rev 2019;105:61–70. https://doi.org/10.1016/j.rser.2019.01.047.
[531] Fragaki A, Markvart T, Laskos G. All UK electricity supplied by wind and photovoltaics – the 30–30 rule. Energy 2019;169:228–37. https://doi.org/10.1016/j.energy.2018.11.151.
[532] Taseska-Gjorgievska V, Todorovski M, Markovska N, Dedinec A. An integrated approach for analysis of higher penetration of variable renewable energy: coupling of the long-term energy planning tools and power transmission network models. J Sustain Dev Energy, Water Environ Syst 2019;7:615–30. https://doi.org/10.13044/j.sdewes.d7.0264.
[533] Bhuvanesh A, Jaya Christa ST, Kannan S, Karuppasamy Pandiyan M, Gangatharan K. Application of differential evolution algorithm and its variants for solving energy storage technologies integrated generation expansion planning. Iran J Sci Technol - Trans Electr Eng 2019;43:883–96. https://doi.org/10.1007/s40998-019-00190-x.
[534] Vakilifard NA, Bahri P, Anda M, Ho G. An interactive planning model for sustainable urban water and energy supply. Appl Energy 2019;235:332–45. https://doi.org/10.1016/j.apenergy.2018.10.128.
[535] Aryanpur V, Atabaki MS, Marzband M, Siano P, Ghayoumi K. An overview of energy planning in Iran and transition pathways towards sustainable electricity supply sector. Renew Sustain Energy Rev 2019;112:58–74. https://doi.org/10.1016/j.rser.2019.05.047.
[536] Weinand JM, McKenna R, Kleinebrahm M, Mainzer K. Assessing the contribution of simultaneous heat and power generation from geothermal plants in off-grid municipalities. Appl Energy 2019;255:113824. https://doi.org/10.1016/j.apenergy.2019.113824.
[537] Santos A, Carvalho A, Barbosa-Póvoa AP, Marques A, Amorim P. Assessment and optimization of sustainable forest wood supply chains – a systematic literature review. For Policy Econ 2019;105:112–35. https://doi.org/10.1016/j.forpol.2019.05.026.
[538] Pieper H, Ommen T, Elmegaard B, Brix Markussen W. Assessment of a combination of three heat sources for heat pumps to supply district heating. Energy 2019;176:156–70. https://doi.org/10.1016/j.energy.2019.03.165.
[539] Zajacs A, Borodiņecs A. Assessment of development scenarios of district heating systems. Sustain Cities Soc 2019;48:101540. https://doi.org/10.1016/j.scs.2019.101540.
[540] Jing R, Wang M, Zhang Z, Liu J, Liang H, Meng C, et al. Comparative study of posteriori decision-making methods when designing building integrated energy systems with multi-objectives. Energy Build 2019;194:123–39. https://doi.org/10.1016/j.enbuild.2019.04.023.
[541] Laha P, Chakraborty B, Østergaard PA. Electricity system scenario development of India with import independence in 2030. Renew Energy 2020:151. https://doi.org/10.1016/j.renene.2019.11.059.
[542] Bellocchi S, Manno M, Noussan M, Prina MG, Vellini M. Electrification of transport and residential heating sectors in support of renewable penetration: scenarios for the Italian energy system. Energy 2020;196:117062. https://doi.org/10.1016/j.energy.2020.117062.
[543] Alves M, Segurado R, Costa M. On the road to 100% renewable energy systems in isolated islands. Energy 2020;198:117321. https://doi.org/10.1016/j.energy.2020.117321.
[544] Bartolini A, Comodi G, Salvi D, Østergaard PA. Renewables self-consumption potential in districts with high penetration of electric vehicles. Energy 2020;213. https://doi.org/10.1016/j.energy.2020.118653.
[545] Thellufsen JZ, Lund H, Sorknæs P, Østergaard PA, Chang M, Drysdale D, et al. Smart energy cities in a 100% renewable energy context. Renew Sustain Energy Rev 2020;129. https://doi.org/10.1016/j.rser.2020.109922.
[546] Sorknæs P, Lund H, Skov IR, Djørup S, Skytte K, Morthorst PE, et al. Smart Energy Markets - future electricity, gas and heating markets. Renew Sustain Energy Rev 2020;119. https://doi.org/10.1016/j.rser.2019.109655.
[547] Menapace A, Thellufsen JZ, Pernigotto G, Roberti F, Gasparella A, Righetti M, et al. The design of 100 % renewable smart urb an energy systems: the case of Bozen-Bolzano. Energy 2020. https://doi.org/10.1016/j.energy.2020.118198.
[548] Yuan M, Thellufsen JZ, Lund H, Liang Y. The first feasible step towards clean heating transition in urban agglomeration: a case study of Beijing-Tianjin-Hebei region. Energy Convers Manag 2020. https://doi.org/10.1016/j.enconman.2020.113282.
[549] Korberg AD, Skov IR, Mathiesen BV. The role of biogas and biogas-derived fuels in a 100% renewable energy system in Denmark. Energy 2020;199:117426. https://doi.org/10.1016/j.energy.2020.117426.
[550] Bamisile O, Obiora S, Huang Q, Okonkwo EC, Olagoke O, Shokanbi A, et al. Towards a sustainable and cleaner environment in China: dynamic analysis of vehicle-to-grid, batteries and hydro storage for optimal RE integration. Sustain Energy Technol Assessments 2020;42:100872. https://doi.org/10.1016/j.seta.2020.100872.
[551] Malka L, Konomi I, Gjeta A, Drenova S, Gjikoka J. An approach to the large-scale integration of wind energy in Albania. Int J Energy Econ Pol 2020;10. https://doi.org/10.32479/ijeep.9917.
[552] Tahir MF, Hayong C. Socioeconomic analysis of integrated energy system of China for 2020. IEEE Syst J 2020:1. https://doi.org/10.1109/JSYST.2020.2977657. –10.
[553] De Rosa L, Castro R. Forecasting and assessment of the 2030 australian electricity mix paths towards energy transition. Energy 2020;205:118020. https://doi.org/10.1016/j.energy.2020.118020.
[554] Fischer R, Elfgren E, Toffolo A. Towards optimal sustainable energy systems in nordic municipalities. Energies 2020;13. https://doi.org/10.3390/en13020290.
[555] Prina MG, Manzolini G, Moser D, Vaccaro R, Sparber W. Multi-objective optimization model EPLANopt for energy transition analysis and comparison with climate-change scenarios. Energies 2020;13. https://doi.org/10.3390/en13123255.
[556] Dranka GG, Ferreira P. Electric vehicles and biofuels synergies in the Brazilian energy system. Energies 2020;13. https://doi.org/10.3390/en13174423.
[557] Marczinkowski HM, Barros L. Technical approaches and institutional alignment to 100% renewable energy system transition of madeira island-electrification, smart energy and the required flexible market conditions. Energies 2020;13. https://doi.org/10.3390/en13174434.
[558] Abrahamsen FE, Ruud SG, Gebremedhin A. Moving toward a sustainable energy system: a case study of viken county of Norway. Energies 2020;13. https://doi.org/10.3390/en13225912.
[559] Krepl V, Shaheen HI, Fandi G, Smutka L, Muller Z, Tlustý J, et al. The role of renewable energies in the sustainable development of post-crisis electrical power sectors reconstruction. Energies 2020;13. https://doi.org/10.3390/en13236326.
[560] Stermieri L, Delmastro C, Becchio C, Corgnati SP. Linking dynamic building simulation with long-term energy system planning to improve buildings urban energy planning strategies. Smart Cities 2020;3:1242–65. https://doi.org/10.3390/smartcities3040061.
[561] Askeland K, Rygg BJ, Sperling K. The role of 4th generation district heating (4GDH) in a highly electrified hydropower dominated energy system. Int J Sustain Energy Plan Manag 2020. https://doi.org/10.5278/ijsepm.3683.
[562] Prina MG, Moser D, Vaccaro R, Sparber W. EPLANopt optimization model based on EnergyPLAN applied at regional level: the future competition on excess electricity production from renewables. Int J Sustain Energy Plan Manag 2020;27. https://doi.org/10.5278/ijsepm.3504.
[563] Huang X, Zhang H, Zhang X. Decarbonising electricity systems in major cities through renewable cooperation – a case study of Beijing and Zhangjiakou. Energy 2020;190:116444. https://doi.org/10.1016/j.energy.2019.116444.
[564] Paardekooper S, Lund H, Chang M, Nielsen S, Moreno D, Thellufsen JZ. Heat Roadmap Chile: a national district heating plan for air pollution decontamination and decarbonisation. J Clean Prod 2020:272.
[565] Bellocchi S, De Iulio R, Guidi G, Manno M, Nastasi B, Noussan M, et al. Analysis of smart energy system approach in local alpine regions - a case study in Northern Italy. Energy 2020;202:117748. https://doi.org/10.1016/j.energy.2020.117748.
[566] Pfeifer A, Prebeg P, Duić N. Challenges and opportunities of zero emission shipping in smart islands: a study of zero emission ferry lines. ETransportation 2020;3:100048. https://doi.org/10.1016/j.etran.2020.100048.
[567] Sorknæs P, Østergaard PA, Thellufsen JZ, Lund H, Nielsen S, Djørup SR, et al. The benefits of 4th generation district heating in a 100% renewable energy system. Appl Energy 2020;213. https://doi.org/10.1016/j.energy.2020.119030.
[568] Kumar S, Loosen M, Madlener R. Assessing the potential of low-carbon technologies in the German energy system. J Environ Manag 2020;262:110345. https://doi.org/10.1016/j.jenvman.2020.110345.
[569] Bamisile O, Huang Q, Dagbasi M, Adebayo V, Adun H, Hu W. Steady-state and process modeling of a novel wind-biomass comprehensive energy system: an energy conservation, exergy and performance analysis. Energy Convers Manag 2020;220:113139. https://doi.org/10.1016/j.enconman.2020.113139.
[570] Bamisile O, Huang Q, Xu X, Hu W, Liu W, Liu Z, et al. An approach for sustainable energy planning towards 100 % electrification of Nigeria by 2030. Energy 2020;197:117172. https://doi.org/10.1016/j.energy.2020.117172.
[571] Meha D, Pfeifer A, Duić N, Lund H. Increasing the integration of variable renewable energy in coal-based energy system using power to heat technologies: the case of Kosovo. Energy 2020;212:118762. https://doi.org/10.1016/j.energy.2020.118762.
[572] Viesi D, Crema L, Mahbub MS, Verones S, Brunelli R, Baggio P, et al. Integrated and dynamic energy modelling of a regional system: a cost-optimized approach in the deep decarbonisation of the Province of Trento (Italy). Energy 2020:209. https://doi.org/10.1016/j.energy.2020.118378.
[573] Klöckner K, Letmathe P. Is the coherence of coal phase-out and electrolytic hydrogen production the golden path to effective decarbonisation? Appl Energy 2020;279:115779. https://doi.org/10.1016/j.apenergy.2020.115779.
[574] Kiwan S, Al-Gharibeh E. Jordan toward a 100% renewable electricity system. Renew Energy 2020;147:423–36. https://doi.org/10.1016/j.renene.2019.09.004.
[575] Graça Gomes J, Medeiros Pinto J, Xu H, Zhao C, Hashim H. Modeling and planning of the electricity energy system with a high share of renewable supply for Portugal. Energy 2020;211:118713. https://doi.org/10.1016/j.energy.2020.118713.
[576] Edoo MN, Ah King RTF. New insights into the technical challenges of the Mauritius long term energy strategy. Energy 2020;195:116975. https://doi.org/10.1016/j.energy.2020.116975.
[577] Bissiri M, Moura P, Figueiredo NC, Pereira da Silva P. A geospatial approach towards defining cost-optimal electrification pathways in West Africa. Energy 2020;200:117471. https://doi.org/10.1016/j.energy.2020.117471.

[578] Farrokhifar M, Nie Y, Pozo D. Energy systems planning: a survey on models for integrated power and natural gas networks coordination. Appl Energy 2020;262: 114567. https://doi.org/10.1016/j.apenergy.2020.114567.
[579] Chiu M-C, Hsu H-W, Wu M-C, Lee M-Y. Future thinking on power planning: a balanced model of regions, seasons and environment with a case of Taiwan. Futures 2020;122:102599. https://doi.org/10.1016/j.futures.2020.102599.
[580] Groissböck M, Gusmão A. Impact of renewable resource quality on security of supply with high shares of renewable energies. Appl Energy 2020;277:115567. https://doi.org/10.1016/j.apenergy.2020.115567.
[581] Yue X, Patankar N, Decarolis J, Chiodi A, Rogan F, Deane JP, et al. Least cost energy system pathways towards 100% renewable energy in Ireland by 2050. Energy 2020;207:118264. https://doi.org/10.1016/j.energy.2020.118264.
[582] Chen S, Liu P, Li Z. Low carbon transition pathway of power sector with high penetration of renewable energy. Renew Sustain Energy Rev 2020;130:109985. https://doi.org/10.1016/j.rser.2020.109985.
[583] Muñoz I, Hernández P, Pérez-Iribarren E, Pedrero J, Arrizabalaga E, Hermoso N. Methodology for integrated modelling and impact assessment of city energy system scenarios. Energy Strategy Rev 2020;32:100553. https://doi.org/10.1016/j.esr.2020.100553.
[584] Fleischer CE. Minimising the effects of spatial scale reduction on power system models. Energy Strategy Rev 2020;32:100563. https://doi.org/10.1016/j.esr.2020.100563.
[585] Kirchem D, Lynch MÁ, Bertsch V, Casey E. Modelling demand response with process models and energy systems models: potential applications for wastewater treatment within the energy-water nexus. Appl Energy 2020;260:114321. https://doi.org/10.1016/j.apenergy.2019.114321.
[586] Lyrio de Oliveira L, García Kerdan I, de Oliveira Ribeiro C, Oller do Nascimento CA, Rego EE, Giarola S, et al. Modelling the technical potential of bioelectricity production under land use constraints: a multi-region Brazil case study. Renew Sustain Energy Rev 2020;123:109765. https://doi.org/10.1016/j.rser.2020.109765.
[587] Gunkel PA, Koduvere H, Kirkerud JG, Fausto FJ, Ravn H. Modelling transmission systems in energy system analysis: a comparative study. J Environ Manag 2020; 262:110289. https://doi.org/10.1016/j.jenvman.2020.110289.
[588] Fattahi A, Sijm J, Faaij A. A systemic approach to analyze integrated energy system modeling tools , a review of national models. Renew Sustain Energy Rev 2020;133:110195. https://doi.org/10.1016/j.rser.2020.110195.
[589] Besagni G, Borgarello M, Premoli Vilà L, Najafi B, Rinaldi F. MOIRAE – bottom-up MOdel to compute the energy consumption of the Italian REsidential sector: model design, validation and evaluation of electrification pathways. Energy 2020; 211:118674. https://doi.org/10.1016/j.energy.2020.118674.
[590] Prina MG, Casalicchio V, Kaldemeyer C, Manzolini G, Moser D, Wanitschke A, et al. Multi-objective investment optimization for energy system models in high temporal and spatial resolution. Appl Energy 2020;264:114728. https://doi.org/10.1016/j.apenergy.2020.114728.
[591] Murray P, Carmeliet J, Orehounig K. Multi-objective optimisation of power-to-mobility in decentralised multi-energy systems. Energy 2020;205:117792. https://doi.org/10.1016/j.energy.2020.117792.
[592] Xiao X, Li F, Ye Z, Xi Z, Ma D, Yang S. Optimal configuration of energy storage for remotely delivering wind power by ultra-high voltage lines. J Energy Storage 2020;31:101571. https://doi.org/10.1016/j.est.2020.101571.
[593] Wehbe N. Optimization of Lebanon's power generation scenarios to meet the electricity demand by 2030. Electr J 2020;33:106764. https://doi.org/10.1016/j.tej.2020.106764.
[594] Haikarainen C, Pettersson F, Saxén H. Optimized phasing of the development of a regional energy system. Energy 2020;206:118129. https://doi.org/10.1016/j.energy.2020.118129.
[595] Henao F, Dyner I. Renewables in the optimal expansion of colombian power considering the Hidroituango crisis. Renew Energy 2020;158:612–27. https://doi.org/10.1016/j.renene.2020.05.055.
[596] Weinand JM, Scheller F, McKenna R. Reviewing energy system modelling of decentralized energy autonomy. Energy 2020;203:117817. https://doi.org/10.1016/j.energy.2020.117817.
[597] Ringkjøb H-K, Haugan PM, Seljom P, Lind A, Wagner F, Mesfun S. Short-term solar and wind variability in long-term energy system models - a European case study. Energy 2020;209:118377. https://doi.org/10.1016/j.energy.2020.118377.
[598] Xu Y, Yan C, Liu H, Wang J, Yang Z, Jiang Y. Smart energy systems: a critical review on design and operation optimization. Sustain Cities Soc 2020;62:102369. https://doi.org/10.1016/j.scs.2020.102369.
[599] Pilpola S, Lund PD. Analyzing the effects of uncertainties on the modelling of low-carbon energy system pathways. Energy 2020;201:117652. https://doi.org/10.1016/J.ENERGY.2020.117652.
[600] Jalil-Vega F, García Kerdan I, Hawkes AD. Spatially-resolved urban energy systems model to study decarbonisation pathways for energy services in cities. Appl Energy 2020;262:114445. https://doi.org/10.1016/j.apenergy.2019.114445.
[601] Andersen AN, Østergaard PA. Support schemes adapting district energy combined heat and power for the role as a flexibility provider in renewable energy systems. Energy 2020;192:116639. https://doi.org/10.1016/j.energy.2019.116639.
[602] Dioha MO, Kumar A. Sustainable energy pathways for land transport in Nigeria. Util Pol 2020;64:101034. https://doi.org/10.1016/j.jup.2020.101034.
[603] Dominković DF, Stunjek G, Blanco I, Madsen H, Krajačić G. Technical, economic and environmental optimization of district heating expansion in an urban agglomeration. Energy 2020;197. https://doi.org/10.1016/j.energy.2020.117243.
[604] Arnaudo M, Topel M, Laumert B. Techno-economic analysis of demand side flexibility to enable the integration of distributed heat pumps within a Swedish neighborhood. Energy 2020;195. https://doi.org/10.1016/j.energy.2020.117012.
[605] Sandoval-Reyes M, Haurant P, Sandoval-Reyes TR, Eskander MM, Silva CA, Lacarrière B. Techno-economic feasibility of trigeneration systems with Thermal storage: the impact of the load size and spark spread rates. Sustain Cities Soc 2020;52:101745. https://doi.org/10.1016/j.scs.2019.101745.
[606] Hong T, Chen Y, Luo X, Luo N, Lee SH. Ten questions on urban building energy modeling. Build Environ 2020;168:106508. https://doi.org/10.1016/j.buildenv.2019.106508.
[607] Ahmadi E, McLellan B, Tezuka T. The economic synergies of modelling the renewable energy-water nexus towards sustainability. Renew Energy 2020;162: 1347–66. https://doi.org/10.1016/j.renene.2020.08.059.
[608] Pavičević M, Mangipinto A, Nijs W, Lombardi F, Kavvadias K, Jiménez Navarro JP, et al. The potential of sector coupling in future European energy systems: soft linking between the Dispa-SET and JRC-EU-TIMES models. Appl Energy 2020;267:115100. https://doi.org/10.1016/j.apenergy.2020.115100.
[609] Berger M, Radu D, Fonteneau R, Deschuyteneer T, Detienne G, Ernst D. The role of power-to-gas and carbon capture technologies in cross-sector decarbonisation strategies. Elec Power Syst Res 2020;180:106039. https://doi.org/10.1016/j.epsr.2019.106039.
[610] Prina MG, Manzolini G, Moser D, Nastasi B, Sparber W. Classification and challenges of bottom-up energy system models - a review. Renew Sustain Energy Rev 2020;129:109917. https://doi.org/10.1016/j.rser.2020.109917.
[611] Ben Amer S, Gregg JS, Sperling K, Drysdale D. Too complicated and impractical? An exploratory study on the role of energy system models in municipal decision-making processes in Denmark. Energy Res Social Sci 2020;70:101673. https://doi.org/10.1016/j.erss.2020.101673.
[612] Bissiri M, Moura P, Figueiredo NC, Silva PP. Towards a renewables-based future for West African States: a review of power systems planning approaches. Renew Sustain Energy Rev 2020;134:110019. https://doi.org/10.1016/j.rser.2020.110019.
[613] Cabrera P, Lund H, Thellufsen JZ, Sorknæs P. The MATLAB Toolbox for EnergyPLAN: a tool to extend energy planning studies. Sci Comput Program 2020; 191:102405. https://doi.org/10.1016/j.scico.2020.102405.
[614] Pavičević M, Quoilin S, Zucker A, Krajačić G, Pukšec T, Duić N. Applying the dispa-SET model to the western balkans power system. J Sustain Dev Energy, Water Environ Syst 2020;8. https://doi.org/10.13044/j.sdewes.d7.0273.
[615] Wirtz M, Remmen P, Müller D. EHDO: a free and open-source webtool for designing and optimizing multi-energy systems based on MILP. Comput Appl Eng Educ 2020. https://doi.org/10.1002/cae.22352. n/a.
[616] Tu T, Rajarathnam GP, Vassallo AM. Optimal sizing and operating strategy of a stand-alone generation–load–storage system: an island case study. Energy Storage 2020;2:e102. https://doi.org/10.1002/est2.102.
[617] Greiml M, Traupman A, Sejkora C, Kriechbaum L, Böckl B, Pichler P, et al. Modelling and model assessment of grid based multi-energy systems. Int J Sustain Energy Plan Manag 2020;29. https://doi.org/10.5278/ijsepm.3598.
[618] Islas-Samperio JM, Birlain-Escalante MO, Grande-Acosta GK. Toward a low-carbon industrial sector in Mexico. Energy Sources B Energy Econ Plann 2020;15: 545–71. https://doi.org/10.1080/15567249.2020.1753855.
[619] Cuisinier E, Bourasseau C, Ruby A, Lemaire P, Penz B. Techno-economic planning of local energy systems through optimization models: a survey of current methods. Int J Energy Res 2020. https://doi.org/10.1002/er.6208. n/a.
[620] Pfeifer A, Krajačić G, Haas R, Duić N. Consequences of different strategic decisions of market coupled zones on the development of energy systems based on coal and hydropower. Energy 2020;210:118522. https://doi.org/10.1016/j.energy.2020.118522.
[621] Moret S, Babonneau F, Bierlaire M, Maréchal F. Decision support for strategic energy planning: a robust optimization framework. Eur J Oper Res 2020;280: 539–54. https://doi.org/10.1016/j.ejor.2019.06.015.
[622] Yang D, Tang Q, Zhou B, Bu S, Cao J. District energy system modeling and optimal operation considering CHP units dynamic response to wind power ramp events. Sustain Cities Soc 2020;63:102449. https://doi.org/10.1016/j.scs.2020.102449.
[623] Calise F, Cappiello FL, Dentice d'Accadia M, Vicidomini M. Energy efficiency in small districts: dynamic simulation and technoeconomic analysis. Energy Convers Manag 2020;220:113022. https://doi.org/10.1016/j.enconman.2020.113022.
[624] Guerello A, Page S, Holburn G, Balzarova M. Energy for off-grid homes: reducing costs through joint hybrid system and energy efficiency optimization. Energy Build 2020;207:109478. https://doi.org/10.1016/j.enbuild.2019.109478.
[625] Bagherian MA, Mehranzamir K. A comprehensive review on renewable energy integration for combined heat and power production. Energy Convers Manag 2020;224:113454. https://doi.org/10.1016/j.enconman.2020.113454.
[626] Louis J-N, Allard S, Kotrotsou F, Debusschere V. A multi-objective approach to the prospective development of the European power system by 2050. Energy 2020; 191:116539. https://doi.org/10.1016/j.energy.2019.116539.
[627] Pieper H, Ommen T, Kjær Jensen J, Elmegaard B, Brix Markussen W. Comparison of COP estimation methods for large-scale heat pumps used in energy planning. Energy 2020;205:117994. https://doi.org/10.1016/j.energy.2020.117994.
[628] Koltsaklis NE, Dagoumas AS, Seritan G, Porumb R. Energy transition in the South East Europe: the case of the Romanian power system. Energy Rep 2020;6: 2376–93. https://doi.org/10.1016/j.egyr.2020.07.032.
[629] Curto D, Favuzza S, Franzitta V, Musca R, Navarro Navia MA, Zizzo G. Evaluation of the optimal renewable electricity mix for Lampedusa island: the adoption of a technical and economical methodology. J Clean Prod 2020;263:121404. https://doi.org/10.1016/j.jclepro.2020.121404.

[630] Gunkel PA, Bergaentzlé C, Græsted Jensen I, Scheller F. From passive to active: flexibility from electric vehicles in the context of transmission system development. Appl Energy 2020;277:115526. https://doi.org/10.1016/j.apenergy.2020.115526.
[631] Groissböck M. Impact of spatial renewable resource quality on optimum renewable expansion. Renew Energy 2020;160:1396–407. https://doi.org/10.1016/j.renene.2020.07.041.
[632] Dorotić H, Ban M, Pukšec T, Duić N. Impact of wind penetration in electricity markets on optimal power-to-heat capacities in a local district heating system. Renew Sustain Energy Rev 2020;132:110095. https://doi.org/10.1016/j.rser.2020.110095.
[633] Zhang T, Zhao R, Ballantyne EEF, Stone D. Increasing urban tram system efficiency, with battery storage and electric vehicle charging. Transport Res Transport Environ 2020;80:102254. https://doi.org/10.1016/j.trd.2020.102254.
[634] Zhou J, Wu Y, Dong H, Tao Y, Xu C. Proposal and comprehensive analysis of gas-wind-photovoltaic-hydrogen integrated energy system considering multi-participant interest preference. J Clean Prod 2020;265:121679. https://doi.org/10.1016/j.jclepro.2020.121679.
[635] Dong S, Kremers E, Brucoli M, Rothman R, Brown S. Techno-enviro-economic assessment of household and community energy storage in the UK. Energy Convers Manag 2020;205:112330. https://doi.org/10.1016/j.enconman.2019.112330.
[636] Lim JY, How BS, Rhee G, Hwangbo S, Yoo CK. Transitioning of localized renewable energy system towards sustainable hydrogen development planning: P-graph approach. Appl Energy 2020;263:114635. https://doi.org/10.1016/j.apenergy.2020.114635.
[637] Zhang X, Pellegrino F, Shen J, Copertaro B, Huang P, Kumar Saini P, et al. A preliminary simulation study about the impact of COVID-19 crisis on energy demand of a building mix at a district in Sweden. Appl Energy 2020;280:115954. https://doi.org/10.1016/j.apenergy.2020.115954.
[638] Schwele A, Kazempour J, Pinson P. Do unit commitment constraints affect generation expansion planning? A scalable stochastic model. Energy Syst 2020;11:247–82. https://doi.org/10.1007/s12667-018-00321-z.
[639] Kilkis B. An exergy-rational district energy model for 100% renewable cities with distance limitations. Therm Sci 2020;24:3685–705. https://doi.org/10.2298/TSCI200412287K.
[640] Welfle A, Thornley P, Röder M. A review of the role of bioenergy modelling in renewable energy research & policy development. Biomass Bioenergy 2020;136:105542. https://doi.org/10.1016/j.biombioe.2020.105542.
[641] Doluweera G, Hahn F, Bergerson J, Pruckner M. A scenario-based study on the impacts of electric vehicles on energy consumption and sustainability in Alberta. Appl Energy 2020;268:114961. https://doi.org/10.1016/j.apenergy.2020.114961.
[642] Uyar TS, Beşikci D, Sulukan E. An urban techno-economic hydrogen penetration scenario analysis for Burdur, Turkey. Int J Hydrogen Energy 2020;45:26545–58. https://doi.org/10.1016/j.ijhydene.2019.05.144.
[643] Dorotić H, Pukšec T, Duić N. Analysis of displacing natural gas boiler units in district heating systems by using multi-objective optimization and different taxing approaches. Energy Convers Manag 2020;205:112411. https://doi.org/10.1016/j.enconman.2019.112411.
[644] Quintana-Rojo C, Callejas-Albiñana F-E, Tarancón M-Á, del Río P. Assessing the feasibility of deployment policies in wind energy systems. A sensitivity analysis on a multiequational econometric framework. Energy Econ 2020;86:104688. https://doi.org/10.1016/j.eneco.2020.104688.
[645] Seljom P, Rosenberg E, Schäffer LE, Fodstad M. Bidirectional linkage between a long-term energy system and a short-term power market model. Energy 2020;198:117311. https://doi.org/10.1016/j.energy.2020.117311.
[646] Anke C-P, Hobbie H, Schreiber S, Möst D. Coal phase-outs and carbon prices: interactions between EU emission trading and national carbon mitigation policies. Energy Pol 2020;144:111647. https://doi.org/10.1016/j.enpol.2020.111647.
[647] Bamisile O, Babatunde A, Adun H, Yimen N, Mukhtar M, Huang Q, et al. Electrification and renewable energy nexus in developing countries; an overarching analysis of hydrogen production and electric vehicles integrality in renewable energy penetration. Energy Convers Manag 2021;236:114023. https://doi.org/10.1016/j.enconman.2021.114023.
[648] Bamisile O, Obiora S, Huang Q, Yimen N, Abdelkhalikh Idriss I, Cai D, et al. Impact of economic development on CO2 emission in Africa; the role of BEVs and hydrogen production in renewable energy integration. Int J Hydrogen Energy 2021;46:2755–73. https://doi.org/10.1016/j.ijhydene.2020.10.134.
[649] Korberg AD, Mathiesen BV, Clausen LR, Skov IR. The role of biomass gasification in low-carbon energy and transport systems. Smart Energy 2021;1:100006. https://doi.org/10.1016/j.segy.2021.100006.
[650] Laha P, Chakraborty B. Low carbon electricity system for India in 2030 based on multi-objective multi-criteria assessment. Renew Sustain Energy Rev 2021;135:110356. https://doi.org/10.1016/j.rser.2020.110356.
[651] Laitinen A, Lindholm O, Hasan A, Reda F, Hedman Å. A techno-economic analysis of an optimal self-sufficient district. Energy Convers Manag 2021;236:114041. https://doi.org/10.1016/j.enconman.2021.114041.
[652] Liu W, Best F, Crijns-Graus W. Exploring the pathways towards a sustainable heating system – a case study of Utrecht in The Netherlands. J Clean Prod 2021;280:125036. https://doi.org/10.1016/j.jclepro.2020.125036.
[653] Nam H, Nam H, Lee D. Potential of hydrogen replacement in natural-gas-powered fuel cells in Busan, South Korea based on the 2050 clean energy Master Plan of Busan Metropolitan City. Energy 2021;221:119783. https://doi.org/10.1016/j.energy.2021.119783.
[654] Noorollahi Y, Khatibi A, Eslami S. Replacing natural gas with solar and wind energy to supply the thermal demand of buildings in Iran: a simulation approach. Sustain Energy Technol Assessments 2021;44:101047. https://doi.org/10.1016/j.seta.2021.101047.
[655] Noorollahi Y, Golshanfard A, Ansaripour S, Khaledi A, Shadi M. Solar energy for sustainable heating and cooling energy system planning in arid climates. Energy 2021;218:119421. https://doi.org/10.1016/j.energy.2020.119421.
[656] Pfeifer A, Herc L, Batas Bjelić I, Duić N. Flexibility index and decreasing the costs in energy systems with high share of renewable energy. Energy Convers Manag 2021;240:114258. https://doi.org/10.1016/j.enconman.2021.114258.
[657] Prina MG, Fornaroli FC, Moser D, Manzolini G, Sparber W. Optimisation method to obtain marginal abatement cost-curve through EnergyPLAN software. Smart Energy 2021;1:100002. https://doi.org/10.1016/j.segy.2021.100002.
[658] Pupo-Roncallo O, Campillo J, Ingham D, Ma L, Pourkashanian M. The role of energy storage and cross-border interconnections for increasing the flexibility of future power systems: the case of Colombia. Smart Energy 2021;2:100016. https://doi.org/10.1016/j.segy.2021.100016.
[659] Cabrera P, Carta JA, Lund H, Thellufsen JZ. Large-scale optimal integration of wind and solar photovoltaic power in water-energy systems on islands. Energy Convers Manag 2021;235:113982. https://doi.org/10.1016/j.enconman.2021.113982.
[660] Vaccaro R, Rocco MV. Quantifying the impact of low carbon transition scenarios at regional level through soft-linked energy and economy models: the case of South-Tyrol Province in Italy. Energy 2021;220:119742. https://doi.org/10.1016/j.energy.2020.119742.
[661] Pupo-Roncallo O, Ingham D, Pourkashanian M. Techno-economic benefits of grid-scale energy storage in future energy systems. Energy Rep 2020;6:242–8. https://doi.org/10.1016/j.egyr.2020.03.030.
[662] Noorollahi Y, Lund H, Nielsen S, Thellufsen JZ. Energy transition in petroleum rich nations: case study of Iran. Smart Energy 2021;3:100026. https://doi.org/10.1016/j.segy.2021.100026.
[663] Hasterok D, Castro R, Landrat M, Pikoń K, Doepfert M, Morais H. Polish energy transition 2040: energy mix optimization using grey wolf optimizer. Energies 2021;14. https://doi.org/10.3390/en14020501.
[664] Yuan M, Thellufsen JZ, Lund H, Liang Y. The electrification of transportation in energy transition. Energy 2021;236:121564. https://doi.org/10.1016/j.energy.2021.121564.
[665] Olkkonen V, Hirvonen J, Heljo J, Syri S. Effectiveness of building stock sustainability measures in a low-carbon energy system: a scenario analysis for Finland until 2050. Energy 2021;235:121399. https://doi.org/10.1016/j.energy.2021.121399.
[666] Okonkwo EC, Wole-Osho I, Bamisile O, Abid M, Al-Ansari T. Grid integration of renewable energy in Qatar: potentials and limitations. Energy 2021;235:121310. https://doi.org/10.1016/j.energy.2021.121310.
[667] Hrnčić B, Pfeifer A, Jurić F, Duić N, Ivanović V, Vušanović I. Different investment dynamics in energy transition towards a 100% renewable energy system. Energy 2021;237:121526. https://doi.org/10.1016/j.energy.2021.121526.
[668] Yuan M, Thellufsen JZ, Sorknæs P, Lund H, Liang Y. District heating in 100% renewable energy systems: combining industrial excess heat and heat pumps. Energy Convers Manag 2021;244:114527. https://doi.org/10.1016/j.enconman.2021.114527.
[669] Luo S, Hu W, Liu W, Xu X, Huang Q, Chen Z, et al. Transition pathways towards a deep decarbonization energy system—a case study in Sichuan, China. Appl Energy 2021;302:117507. https://doi.org/10.1016/j.apenergy.2021.117507.
[670] Calise F, Fabozzi S, Vanoli L, Vicidomini M. A sustainable mobility strategy based on electric vehicles and photovoltaic panels for shopping centers. Sustain Cities Soc 2021;70:102891. https://doi.org/10.1016/j.scs.2021.102891.
[671] Meha D, Pfeifer A, Sahiti N, Rolph Schneider D, Duić N. Sustainable transition pathways with high penetration of variable renewable energy in the coal-based energy systems. Appl Energy 2021;304:117865. https://doi.org/10.1016/j.apenergy.2021.117865.
[672] Matak N, Tomić T, Schneider DR, Krajačić G. Integration of WtE and district cooling in existing Gas-CHP based district heating system – central European city perspective. Smart Energy 2021;4:100043. https://doi.org/10.1016/j.segy.2021.100043.
[673] Sorknæs P. Hybrid energy networks and electrification of district heating under different energy system conditions. Energy Rep 2021;7:222–36. https://doi.org/10.1016/j.egyr.2021.08.152.
[674] Tahir MF, Haoyong C, Guangze H. Exergy hub based modelling and performance evaluation of integrated energy system. J Energy Storage 2021;41:102912. https://doi.org/10.1016/j.est.2021.102912.
[675] Vallera AM, Nunes PM, Brito MC. Why we need battery swapping technology. Energy Pol 2021;157:112481. https://doi.org/10.1016/j.enpol.2021.112481.
[676] Korkeakoski M. Towards 100% renewables by 2030: transition alternatives for a sustainable electricity sector in isla de la Juventud, Cuba. Energies 2021:14. https://doi.org/10.3390/en14102862.
[677] Bjelic IRB, Rajaković NLJ. National energy and climate planning in Serbia: from lagging behind to an ambitious EU candidate? Int J Sustain Energy Plan Manag 2021;32. https://doi.org/10.5278/ijsepm.6300.
[678] Arévalo P, Tostado-Véliz M, Jurado F. Repowering feasibility study of a current hybrid renewable system. Case study, galapagos islands. Electricity 2021;2:487–502. https://doi.org/10.3390/electricity2040029.
[679] Pereira GM, Castro R, Santos P. Carbon emissions and renewables' share in the future iberian power system. Inventions 2022;7. https://doi.org/10.3390/inventions7010004.

[680] Dimnik J, Novak P, Muhič S. Decarbonising power system with high share of renewables and optionally with or without nuclear, Slovenia case. Therm Sci 2021. https://doi.org/10.2298/TSCI201117342D.
[681] Calise F, Duic N, Pfeifer A, Vicidomini M, Orlando AM. Moving the system boundaries in decarbonization of large islands. Energy Convers Manag 2021;234:113956. https://doi.org/10.1016/j.enconman.2021.113956.
[682] Doepfert M, Castro R. Techno-economic optimization of a 100% renewable energy system in 2050 for countries with high shares of hydropower: the case of Portugal. Renew Energy 2021;165:491–503. https://doi.org/10.1016/j.renene.2020.11.061.
[683] Figueiredo R, Nunes P, Brito MC. The resilience of a decarbonized power system to climate variability: Portuguese case study. Energy 2021;224:120125. https://doi.org/10.1016/j.energy.2021.120125.
[684] Groppi D, Nastasi B, Prina MG, Astiaso Garcia D. The EPLANopt model for Favignana island's energy transition. Energy Convers Manag 2021;241:114295. https://doi.org/10.1016/j.enconman.2021.114295.
[685] Icaza D, Borge-Diez D, Galindo SP. Proposal of 100% renewable energy production for the City of Cuenca- Ecuador by 2050. Renew Energy 2021;170:1324–41. https://doi.org/10.1016/j.renene.2021.02.067.
[686] Izanloo M, Noorollahi Y, Aslani A. Future energy planning to maximize renewable energy share for the south Caspian Sea climate. Renew Energy 2021;175:660–75. https://doi.org/10.1016/j.renene.2021.05.008.
[687] Barone G, Buonomano A, Forzano C, Giuzio GF, Palombo A. Increasing renewable energy penetration and energy independence of island communities: a novel dynamic simulation approach for energy, economic, and environmental analysis, and optimization. J Clean Prod 2021:127558. https://doi.org/10.1016/j.jclepro.2021.127558.
[688] Besagni G, Premoli Vilà L, Borgarello M, Trabucchi A, Merlo M, Rodeschini J, et al. Electrification pathways of the Italian residential sector under socio-demographic constrains: looking towards 2040. Energy 2021;217:119438. https://doi.org/10.1016/j.energy.2020.119438.
[689] Bogdanov D, Gulagi A, Fasihi M, Breyer C. Full energy sector transition towards 100% renewable energy supply: integrating power, heat, transport and industry sectors including desalination. Appl Energy 2021;283:116273. https://doi.org/10.1016/j.apenergy.2020.116273.
[690] Gjorgievski VZ, Cundeva S, Georghiou GE. Social arrangements, technical designs and impacts of energy communities: a review. Renew Energy 2021;169:1138–56. https://doi.org/10.1016/j.renene.2021.01.078.
[691] Hoang AT, Pham VV, Nguyen XP. Integrating renewable sources into energy system for smart city as a sagacious strategy towards clean and sustainable process. J Clean Prod 2021;305:127161. https://doi.org/10.1016/j.jclepro.2021.127161.
[692] Javed MS, Ma T, Jurasz J, Mikulik J. A hybrid method for scenario-based techno-economic-environmental analysis of off-grid renewable energy systems. Renew Sustain Energy Rev 2021;139:110725. https://doi.org/10.1016/j.rser.2021.110725.
[693] Maeder M, Weiss O, Boulouchos K. Assessing the need for flexibility technologies in decarbonized power systems: a new model applied to Central Europe. Appl Energy 2021;282:116050. https://doi.org/10.1016/j.apenergy.2020.116050.
[694] Martínez-Gordón R, Morales-España G, Sijm J, Faaij APC. A review of the role of spatial resolution in energy systems modelling: lessons learned and applicability to the North Sea region. Renew Sustain Energy Rev 2021;141:110857. https://doi.org/10.1016/j.rser.2021.110857.
[695] Maruf MNI. Open model-based analysis of a 100% renewable and sector-coupled energy system–The case of Germany in 2050. Appl Energy 2021;288:116618. https://doi.org/10.1016/j.apenergy.2021.116618.
[696] McKenna R, Hernando DA, ben Brahim T, Bolwig S, Cohen JJ, Reichl J. Analyzing the energy system impacts of price-induced demand-side-flexibility with empirical data. J Clean Prod 2021;279:123354. https://doi.org/10.1016/j.jclepro.2020.123354.
[697] Musacchio A, Bartocci P, Serra A, Cencioni L, Colantoni S, Fantozzi F. Decarbonizing materials sourcing and machining in the gas turbine sector, through a cost-carbon footprint nexus analysis. J Clean Prod 2021;310:127392. https://doi.org/10.1016/j.jclepro.2021.127392.
[698] Potrč S, Čuček L, Martin M, Kravanja Z. Sustainable renewable energy supply networks optimization – the gradual transition to a renewable energy system within the European Union by 2050. Renew Sustain Energy Rev 2021;146:111186. https://doi.org/10.1016/j.rser.2021.111186.
[699] Reza Hosseini SH, Allahham A, Vahidinasab V, Walker SL, Taylor P. Techno-economic-environmental evaluation framework for integrated gas and electricity distribution networks considering impact of different storage configurations. Int J Electr Power Energy Syst 2021;125:106481. https://doi.org/10.1016/j.ijepes.2020.106481.
[700] Rikkas R, Lahdelma R. Energy supply and storage optimization for mixed-type buildings. Energy 2021;231:120839. https://doi.org/10.1016/j.energy.2021.120839.
[701] Rinaldi A, Soini MC, Streicher K, Patel MK, Parra D. Decarbonising heat with optimal PV and storage investments: a detailed sector coupling modelling framework with flexible heat pump operation. Appl Energy 2021;282:116110. https://doi.org/10.1016/j.apenergy.2020.116110.
[702] Sandvall A, Hagberg M, Lygnerud K. Modelling of urban excess heat use in district heating systems. Energy Strategy Rev 2021;33:100594. https://doi.org/10.1016/j.esr.2020.100594.
[703] Tanoto Y, Haghdadi N, Bruce A, MacGill I. Reliability-cost trade-offs for electricity industry planning with high variable renewable energy penetrations in emerging economies: a case study of Indonesia's Java-Bali grid. Energy 2021;227:120474. https://doi.org/10.1016/j.energy.2021.120474.
[704] Wang Y, Gillich A, Lu D, Saber EM, Yebiyo M, Kang R, et al. Performance prediction and evaluation on the first balanced energy networks (BEN) part I: BEN and building internal factors. Energy 2021;221:119797. https://doi.org/10.1016/j.energy.2021.119797.
[705] Yazdanie M, Orehounig K. Advancing urban energy system planning and modeling approaches: gaps and solutions in perspective. Renew Sustain Energy Rev 2021;137:110607. https://doi.org/10.1016/j.rser.2020.110607.
[706] Sarı A, Sulukan E, Özkan D, Sıdkı Uyar T. Environmental impact assessment of hydrogen-based auxiliary power system onboard. Int J Hydrogen Energy 2021. https://doi.org/10.1016/j.ijhydene.2021.05.150.
[707] Ayele GT, Mabrouk MT, Haurant P, Laumert B, Lacarrière B. Optimal heat and electric power flows in the presence of intermittent renewable source, heat storage and variable grid electricity tariff. Energy Convers Manag 2021;243:114430. https://doi.org/10.1016/j.enconman.2021.114430.
[708] Sánchez Diéguez M, Fattahi A, Sijm J, Morales España G, Faaij A. Modelling of decarbonisation transition in national integrated energy system with hourly operational resolution. Adv Appl Energy 2021;3:100043. https://doi.org/10.1016/j.adapen.2021.100043.
[709] Gonzato S, Bruninx K, Delarue E. Long term storage in generation expansion planning models with a reduced temporal scope. Appl Energy 2021;298:117168. https://doi.org/10.1016/j.apenergy.2021.117168.
[710] Mimica M, Krajačić G. The Smart Islands method for defining energy planning scenarios on islands. Energy 2021;237:121653. https://doi.org/10.1016/j.energy.2021.121653.
[711] Kilkis B. An exergy-based minimum carbon footprint model for optimum equipment oversizing and temperature peaking in low-temperature district heating systems. Energy 2021;236:121339. https://doi.org/10.1016/j.energy.2021.121339.
[712] Elmorshedy MF, Elkadeem MR, Kotb KM, Taha IBM, Mazzeo D. Optimal design and energy management of an isolated fully renewable energy system integrating batteries and supercapacitors. Energy Convers Manag 2021;245:114584. https://doi.org/10.1016/j.enconman.2021.114584.
[713] Bartolini A, Mazzoni S, Comodi G, Romagnoli A. Impact of carbon pricing on distributed energy systems planning. Appl Energy 2021;301:117324. https://doi.org/10.1016/j.apenergy.2021.117324.
[714] Gaspar I, Castro R, Sousa T. Optimisation and economic feasibility of Battery Energy Storage Systems in electricity markets: the Iberian market case study. J Clean Prod 2021;324:129255. https://doi.org/10.1016/j.jclepro.2021.129255.
[715] Agathokleous RA, Kalogirou SA. PV roofs as the first step towards 100% RES electricity production for Mediterranean islands: the case of Cyprus. Smart Energy 2021;4:100053. https://doi.org/10.1016/j.segy.2021.100053.
[716] He W, Tao L, Han L, Sun Y, Campana PE, Yan J. Optimal analysis of a hybrid renewable power system for a remote island. Renew Energy 2021;179:96–104. https://doi.org/10.1016/j.renene.2021.07.034.
[717] Calixto S, Köseoğlu C, Cozzini M, Manzolini G. Monitoring and aggregate modelling of an existing neutral temperature district heating network. Energy Rep 2021;7:140–9. https://doi.org/10.1016/j.egyr.2021.08.162.
[718] Elberry AM, Thakur J, Veysey J. Seasonal hydrogen storage for sustainable renewable energy integration in the electricity sector: a case study of Finland. J Energy Storage 2021;44:103474. https://doi.org/10.1016/j.est.2021.103474.
[719] Mehedi TH, Gemechu E, Davis M, Kumar A. A framework to identify marginal electricity production technologies for consequential life cycle assessment: a case study of the electricity sector. Sustain Energy Technol Assessments 2021;47:101450. https://doi.org/10.1016/j.seta.2021.101450.
[720] Sarhan A, Ramachandaramurthy VK, Kiong TS, Ekanayake J. Definitions and dimensions for electricity security assessment: a Review. Sustain Energy Technol Assessments 2021;48:101626. https://doi.org/10.1016/j.seta.2021.101626.
[721] Sasanpour S, Cao K-K, Gils HC, Jochem P. Strategic policy targets and the contribution of hydrogen in a 100% renewable European power system. Energy Rep 2021;7:4595–608. https://doi.org/10.1016/j.egyr.2021.07.005.
[722] Franke K, Sensfuß F, Bernath C, Lux B. Carbon-neutral energy systems and the importance of flexibility options: a case study in China. Comput Ind Eng 2021;162:107712. https://doi.org/10.1016/j.cie.2021.107712.
[723] Gonzalez-Trevizo ME, Martinez-Torres KE, Armendariz-Lopez JF, Santamouris M, Bojorquez-Morales G, Luna-Leon A. Research trends on environmental, energy and vulnerability impacts of Urban Heat Islands: an overview. Energy Build 2021;246:111051. https://doi.org/10.1016/j.enbuild.2021.111051.
[724] Herc L, Pfeifer A, Feijoo F, Duić N. Energy system transitions pathways with the new H2RES model: a comparison with existing planning tool. E-Prime - Adv Electr Eng Electron Energy 2021;1:100024. https://doi.org/10.1016/j.prime.2021.100024.
[725] Lyden A, Flett G, Tuohy PG. PyLESA: a Python modelling tool for planning-level Local, integrated, and smart Energy Systems Analysis. SoftwareX 2021;14:100699. https://doi.org/10.1016/j.softx.2021.100699.
[726] R MG, M SD, A F, G ME, J S, A.P·C F. Modelling a highly decarbonised North Sea energy system in 2050: a multinational approach. Adv Appl Energy 2021:100080. https://doi.org/10.1016/j.adapen.2021.100080.
[727] Randriantsoa ANA, Fakra DAH, Ranjaranimaro MP, Rachadi MNM, Gatina JC. A new multiscale tool for simulating smart-grid energy management based on a systemic approach. Comput Electr Eng 2021;94:107292. https://doi.org/10.1016/j.compeleceng.2021.107292.
[728] Ullah KR, Prodanovic V, Pignatta G, Deletic A, Santamouris M. Technological advancements towards the net-zero energy communities: a review on 23 case

studies around the globe. Sol Energy 2021;224:1107–26. https://doi.org/10.1016/j.solener.2021.06.056.
[729] Kartalidis A, Atsonios K, Nikolopoulos N. Enhancing the self-resilience of high-renewable energy sources, interconnected islanding areas through innovative energy production, storage, and management technologies: grid simulations and energy assessment. Int J Energy Res 2021;45. https://doi.org/10.1002/er.6691.
[730] Koltsaklis NE, Panapakidis IP, Christoforidis GC. Assessing the impacts of energy storage on the electricity market-clearing algorithms. Int Trans Electr Energy Syst 2021;31:e12968. https://doi.org/10.1002/2050-7038.12968.
[731] Sharma H, Mishra S. Optimization of solar grid-based virtual power plant using distributed energy resources customer adoption model: a case study of Indian power sector. Arabian J Sci Eng 2021. https://doi.org/10.1007/s13369-021-05975-z.
[732] Masoomi M, Panahi M, Samadi R. Demand side management for electricity in Iran: cost and emission analysis using LEAP modeling framework. Environ Dev Sustain 2021. https://doi.org/10.1007/s10668-021-01676-7.
[733] Ighravwe DE, Babatunde MO, Mosetlhe TC, Aikhuele D, Akinyele D. A MCDM-based framework for the selection of renewable energy system simulation tool for teaching and learning at university level. Environ Dev Sustain 2021. https://doi.org/10.1007/s10668-021-01981-1.
[734] Jiao Z, Yin Y, Ran L, Gao Z. Integrating vehicle-to-grid contract design with power dispatching optimisation: managerial insights, and carbon footprints mitigation. Int J Prod Res 2021:1–26. https://doi.org/10.1080/00207543.2021.1956694.
[735] Koivunen T, Syri S, Veijalainen N. Contributing factors for electricity storage in a carbon-free power system. Int J Energy Res n.d.;46. doi:10.1002/er.7252.
[736] Wang Y, Zhang S, Chow D, Kuckelkorn JM. Evaluation and optimization of district energy network performance: present and future. Renew Sustain Energy Rev 2021;139:110577. https://doi.org/10.1016/j.rser.2020.110577.
[737] Hanna R, Gross R. How do energy systems model and scenario studies explicitly represent socio-economic, political and technological disruption and discontinuity? Implications for policy and practitioners. Energy Pol 2021;149:111984. https://doi.org/10.1016/j.enpol.2020.111984.
[738] Ahmadi S, Saboohi Y, Vakili A. Frameworks, quantitative indicators, characters, and modeling approaches to analysis of energy system resilience: a review. Renew Sustain Energy Rev 2021;144:110988. https://doi.org/10.1016/j.rser.2021.110988.
[739] Ali Z, Liaquat R, Husain Khoja A, Safdar U. A comparison of energy policies of Pakistan and their impact on bioenergy development. Sustain Energy Technol Assessments 2021;46:101246. https://doi.org/10.1016/j.seta.2021.101246.
[740] Abd Alla S, Bianco V, Tagliafico LA, Scarpa F. Pathways to electric mobility integration in the Italian automotive sector. Energy 2021;221:119882. https://doi.org/10.1016/j.energy.2021.119882.
[741] Ben Sassi H, Alaoui C, Errahimi F, Es-Sbai N. Vehicle-to-grid technology and its suitability for the Moroccan national grid. J Energy Storage 2021;33:102023. https://doi.org/10.1016/j.est.2020.102023.
[742] Syahputra R, Soesanti I. Renewable energy systems based on micro-hydro and solar photovoltaic for rural areas: a case study in Yogyakarta, Indonesia. Energy Rep 2021;7:472–90. https://doi.org/10.1016/j.egyr.2021.01.015.
[743] Varbanov PS, Jia X, Lim JS. Process assessment, integration and optimisation: the path towards cleaner production. J Clean Prod 2021;281:124602. https://doi.org/10.1016/j.jclepro.2020.124602.
[744] Verschelde T, D'haeseleer W. Methodology for a global sensitivity analysis with machine learning on an energy system planning model in the context of thermal networks. Energy 2021;232:120987. https://doi.org/10.1016/j.energy.2021.120987.
[745] Wang J, Sun C, Qi C, Zhou Z, Zhao J, Zheng J. Promoting the performance of district heating from waste heat recovery in China: a general solving framework based on the two-stage branch evaluation method. Energy 2021;220:119757. https://doi.org/10.1016/j.energy.2021.119757.
[746] Balasubramanian S, Balachandra P. Effectiveness of demand response in achieving supply-demand matching in a renewables dominated electricity system: a modelling approach. Renew Sustain Energy Rev 2021;147:111245. https://doi.org/10.1016/j.rser.2021.111245.
[747] Koltsaklis NE, Dagoumas AS, Mladenov V. Electricity market clearing algorithms: a case study of the Bulgarian power system. Energy Sources B Energy Econ Plann 2021;16:91–117. https://doi.org/10.1080/15567249.2020.1845252.
[748] Al-Masri HMK, Magableh SK, Abuelrub A, Alzaareer K. Realistic coordination and sizing of a solar array combined with pumped hydro storage system. J Energy Storage 2021;41:102915. https://doi.org/10.1016/j.est.2021.102915.
[749] Al Hasibi RA. Multi-objective analysis of sustainable generation expansion planning based on renewable energy potential: a case study of bali province of Indonesia. Int J Sustain Energy Plan Manag 2021:31. https://doi.org/10.5278/ijsepm.6474.
[750] Giarola S, Molar-Cruz A, Vaillancourt K, Bahn O, Sarmiento L, Hawkes A, et al. The role of energy storage in the uptake of renewable energy: a model comparison approach. Energy Pol 2021;151:112159. https://doi.org/10.1016/j.enpol.2021.112159.
[751] Groppi D, Pfeifer A, Garcia DA, Krajačić G, Duić N. A review on energy storage and demand side management solutions in smart energy islands. Renew Sustain Energy Rev 2021;135:110183. https://doi.org/10.1016/j.rser.2020.110183.
[752] Herenčić L, Melnjak M, Capuder T, Andročec I, Rajšl I. Techno-economic and environmental assessment of energy vectors in decarbonization of energy islands. Energy Convers Manag 2021;236:114064. https://doi.org/10.1016/j.enconman.2021.114064.
[753] Hussain A, Perwez U, Ullah K, Kim C-H, Asghar N. Long-term scenario pathways to assess the potential of best available technologies and cost reduction of avoided carbon emissions in an existing 100% renewable regional power system: a case study of Gilgit-Baltistan (GB), Pakistan. Energy 2021;221:119855. https://doi.org/10.1016/j.energy.2021.119855.
[754] Nielsen TB, Lund H, Østergaard PA, Duic N, Mathiesen BV. Perspectives on energy efficiency and smart energy systems from the 5th SESAAU2019 conference. Energy 2021;216. https://doi.org/10.1016/j.energy.2020.119260.
[755] Ninčević Pašalić I, Ćukušić M, Jadrić M. Smart city research advances in Southeast Europe. Int J Inf Manag 2021;58:102127. https://doi.org/10.1016/j.ijinfomgt.2020.102127.
[756] Reyseliani N, Purwanto WW. Pathway towards 100% renewable energy in Indonesia power system by 2050. Renew Energy 2021;176:305–21. https://doi.org/10.1016/j.renene.2021.05.118.
[757] Rezaei M, Sameti M, Nasiri F. An enviro-economic optimization of a hybrid energy system from biomass and geothermal resources for low-enthalpy areas. Energy Clim Chang 2021;2:100040. https://doi.org/10.1016/j.egycc.2021.100040.
[758] Rana A, Gróf G. Assessment of the electricity system transition towards high share of renewable energy sources in South asian countries. Energies 2022;15. https://doi.org/10.3390/en15031139.
[759] Arévalo P, Cano A, Jurado F. Mitigation of carbon footprint with 100% renewable energy system by 2050: the case of Galapagos islands. Energy 2022;245:123247. https://doi.org/10.1016/j.energy.2022.123247.
[760] Ramadhar Singh R, Clarke RM, Chadee XT. Transitioning from 100 percent natural gas power to include renewable energy in a hydrocarbon economy. Smart Energy 2022;5:100060. https://doi.org/10.1016/j.segy.2021.100060.
[761] Zhou W, Hagos DA, Stikbakke S, Huang L, Cheng X, Onstein E. Assessment of the impacts of different policy instruments on achieving the deep decarbonization targets of island energy systems in Norway – the case of Hinnøya. Energy 2022;246:123249. https://doi.org/10.1016/j.energy.2022.123249.
[762] Alnaqbi SA, Alasad S, Aljaghoub H, Alami AH, Abdelkareem MA, Olabi AG. Applicability of hydropower generation and pumped hydro energy storage in the Middle East and North Africa. Energies 2022;15. https://doi.org/10.3390/en15072412.
[763] Icaza-Alvarez D, Jurado F, Tostado-Véliz M, Arevalo P. Decarbonization of the Galapagos Islands. Proposal to transform the energy system into 100% renewable by 2050. Renew Energy 2022;189:199–220. https://doi.org/10.1016/j.renene.2022.03.008.
[764] Zeng X, Chen G, Luo S, Teng Y, Zhang Z, Zhu T. Renewable transition in the power and transport sectors under the goal of carbon-neutral in Sichuan, China. Energy Rep 2022;8:738–48. https://doi.org/10.1016/j.egyr.2022.02.213.
[765] Tahir MF, Haoyong C, Guangze H. Evaluating individual heating alternatives in integrated energy system by employing energy and exergy analysis. Energy 2022;249:123753. https://doi.org/10.1016/j.energy.2022.123753.
[766] Herc L, Pfeifer A, Duić N, Wang F. Economic viability of flexibility options for smart energy systems with high penetration of renewable energy. Energy 2022:123739. https://doi.org/10.1016/j.energy.2022.123739.
[767] Bamisile O, Dongsheng C, Li J, Mukhtar M, Wang X, Duo J, et al. An innovative approach for geothermal-wind hybrid comprehensive energy system and hydrogen production modeling/process analysis. Int J Hydrogen Energy 2022;47:13261–88. https://doi.org/10.1016/j.ijhydene.2022.02.084.
[768] Nadeem A, Rossi M, Corradi E, Jin L, Comodi G, Sheikh NA. Energy-Environmental planning of electric vehicles (EVs): a case study of the national energy system of Pakistan. Energies 2022;15. https://doi.org/10.3390/en15093054.
[769] Luo S, Hu W, Liu W, Cao D, Du Y, Zhang Z, et al. Impact analysis of COVID-19 pandemic on the future green power sector: a case study in The Netherlands. Renew Energy 2022;191:261–77. https://doi.org/10.1016/j.renene.2022.04.053.
[770] Borge-Diez D, Icaza D, Trujillo-Cueva DF, Açıkkalp E. Renewable energy driven heat pumps decarbonization potential in existing residential buildings: roadmap and case study of Spain. Energy 2022:123481. https://doi.org/10.1016/j.energy.2022.123481.
[771] Amil C, Yılmazoğlu MZ. The importance of hydrogen for energy diversity of Turkey's energy production: 2030 projection. Int J Hydrogen Energy 2022;47:19935–46. https://doi.org/10.1016/j.ijhydene.2022.03.274.
[772] Groppi D, Nastasi B, Prina MG. The EPLANoptMAC model to plan the decarbonisation of the maritime transport sector of a small island. Energy 2022:124342. https://doi.org/10.1016/j.energy.2022.124342.
[773] Lopez G, Aghahosseini A, Child M, Khalili S, Fasihi M, Bogdanov D, et al. Impacts of model structure, framework, and flexibility on perspectives of 100% renewable energy transition decision-making. Renew Sustain Energy Rev 2022;164:112452. https://doi.org/10.1016/j.rser.2022.112452.
[774] Herc L, Pfeifer A, Duić N. Optimization of the possible pathways for gradual energy system decarbonization. Renew Energy 2022. https://doi.org/10.1016/j.renene.2022.05.005.
[775] de Maigret J, Viesi D, Mahbub MS, Testi M, Cuonzo M, Thellufsen JZ, et al. A multi-objective optimization approach in defining the decarbonization strategy of a refinery. Smart Energy 2022;6:100076. https://doi.org/10.1016/j.segy.2022.100076.
[776] Bamisile O, Wang X, Adun H, Joseph Ejiyi C, Obiora S, Huang Q, et al. A 2030 and 2050 feasible/sustainable decarbonization perusal for China's Sichuan Province: a deep carbon neutrality analysis and EnergyPLAN. Energy Convers Manag 2022;261:115605. https://doi.org/10.1016/j.enconman.2022.115605.
[777] Dioha MO, Duan L, Ruggles TH, Bellocchi S, Caldeira K. Exploring the role of electric vehicles in Africa's energy transition: a Nigerian case study. iScience 2022:103926. https://doi.org/10.1016/j.isci.2022.103926.

[778] Fischer R, Toffolo A. Is total system cost minimization fair to all the actors of an energy system? Not according to game theory. Energy 2022;239:122253. https://doi.org/10.1016/j.energy.2021.122253.
[779] Icaza D, Borge-Diez D, Galindo SP. Analysis and proposal of energy planning and renewable energy plans in South America: case study of Ecuador. Renew Energy 2022;182:314–42. https://doi.org/10.1016/j.renene.2021.09.126.
[780] Kany MS, Mathiesen BV, Skov IR, Korberg AD, Thellufsen JZ, Lund H, et al. Energy efficient decarbonisation strategy for the Danish transport sector by 2045. Smart Energy 2022;5:100063. https://doi.org/10.1016/j.segy.2022.100063.
[781] Keiner D, Salcedo-Puerto O, Immonen E, van Sark WGJHM, Nizam Y, Shadiya F, et al. Powering an island energy system by offshore floating technologies towards 100% renewables: a case for the Maldives. Appl Energy 2022;308:118360. https://doi.org/10.1016/j.apenergy.2021.118360.
[782] Luo S, Hu W, Liu W, Liu Z, Huang Q, Chen Z. Flexibility enhancement measures under the COVID-19 pandemic – a preliminary comparative analysis in Denmark, The Netherlands, and Sichuan of China. Energy 2022;239:122166. https://doi.org/10.1016/j.energy.2021.122166.
[783] Makhloufi S, Khennas S, Bouchaib S, Arab AH. Multi-objective cuckoo search algorithm for optimized pathways for 75 % renewable electricity mix by 2050 in Algeria. Renew Energy 2022;185:1410–24. https://doi.org/10.1016/j.renene.2021.10.088.
[784] Samuel A, Krishnamoorthy M, Ananthan B, Subramanian K, Murugesan KP. Application of metaheuristic algorithms for solving real-world electricity demand forecasting and generation expansion planning problems. Iran J Sci Technol Trans Electr Eng 2022. https://doi.org/10.1007/s40998-022-00480-x.
[785] Bianco V, Marmori C. Modelling the deployment of energy efficiency measures for the residential sector. The case of Italy. Sustain Energy Technol Assessments 2022;49:101777. https://doi.org/10.1016/j.seta.2021.101777.
[786] Saeid Atabaki M, Mohammadi M, Aryanpur V. An integrated simulation-optimization modelling approach for sustainability assessment of electricity generation system. Sustain Energy Technol Assessments 2022;52:102010. https://doi.org/10.1016/j.seta.2022.102010.
[787] Sanongboon P, Pettigrew T. Hybrid energy system optimization model: electrification of Ontario's residential space and water heating case study. Energy Clim Chang 2022;3:100070. https://doi.org/10.1016/j.egycc.2021.100070.
[788] Tang X, Bai H, Zhang Y, Pan S, Wu P, Zhou C, et al. Simulation and analysis of integrated energy conversion and storage systems using CloudPSS-IESLab. Energy Rep 2022;8:1372–82. https://doi.org/10.1016/j.egyr.2021.11.098.
[789] Wyrwa A, Suwała W, Pluta M, Raczyński M, Zyśk J, Tokarski S. A new approach for coupling the short- and long-term planning models to design a pathway to carbon neutrality in a coal-based power system. Energy 2022;239:122438. https://doi.org/10.1016/j.energy.2021.122438.
[790] Luo N, Langevin J, Chandra-Putra H, Lee SH. Quantifying the effect of multiple load flexibility strategies on commercial building electricity demand and services via surrogate modeling. Appl Energy 2022;309:118372. https://doi.org/10.1016/j.apenergy.2021.118372.
[791] Mimica M, Sinovčić Z, Jokić A, Krajačić G. The role of the energy storage and the demand response in the robust reserve and network-constrained joint electricity and reserve market. Elec Power Syst Res 2022;204:107716. https://doi.org/10.1016/j.epsr.2021.107716.
[792] Sahoo S, van Stralen JNP, Zuidema C, Sijm J, Yamu C, Faaij A. Regionalization of a national integrated energy system model: a case study of the northern Netherlands. Appl Energy 2022;306:118035. https://doi.org/10.1016/j.apenergy.2021.118035.
[793] Süsser D, Gaschnig H, Ceglarz A, Stavrakas V, Flamos A, Lilliestam J. Better suited or just more complex? On the fit between user needs and modeller-driven improvements of energy system models. Energy 2022;239:121909. https://doi.org/10.1016/j.energy.2021.121909.
[794] Thimet PJ, Mavromatidis G. Review of model-based electricity system transition scenarios: an analysis for Switzerland, Germany, France, and Italy. Renew Sustain Energy Rev 2022;159:112102. https://doi.org/10.1016/j.rser.2022.112102.
[795] Fodstad M, Crespo del Granado P, Hellemo L, Knudsen BR, Pisciella P, Silvast A, et al. Next frontiers in energy system modelling: a review on challenges and the state of the art. Renew Sustain Energy Rev 2022;160:112246. https://doi.org/10.1016/j.rser.2022.112246.
[796] Borasio M, Moret S. Deep decarbonisation of regional energy systems: a novel modelling approach and its application to the Italian energy transition. Renew Sustain Energy Rev 2022;153:111730. https://doi.org/10.1016/j.rser.2021.111730.
[797] Heider A, Reibsch R, Blechinger P, Linke A, Hug G. Flexibility options and their representation in open energy modelling tools. Energy Strategy Rev 2021;38:100737. https://doi.org/10.1016/j.esr.2021.100737.
[798] Ahmad T, Madonski R, Zhang D, Huang C, Mujeeb A. Data-driven probabilistic machine learning in sustainable smart energy/smart energy systems: key developments, challenges, and future research opportunities in the context of smart grid paradigm. Renew Sustain Energy Rev 2022;160:112128. https://doi.org/10.1016/j.rser.2022.112128.
[799] Daniilidis A, Mindel JE, De Oliveira Filho F, Guglielmetti L. Techno-economic assessment and operational CO2 emissions of High-Temperature Aquifer Thermal Energy Storage (HT-ATES) using demand-driven and subsurface-constrained dimensioning. Energy 2022;249:123682. https://doi.org/10.1016/j.energy.2022.123682.
[800] Ozoliņa SA, Pakere I, Jaunzems D, Blumberga A, Grāvelsiņš A, Dubrovskis D, et al. Can energy sector reach carbon neutrality with biomass limitations? Energy 2022;249:123797. https://doi.org/10.1016/j.energy.2022.123797.
[801] Ferrada F, Babonneau F, Homem-de-Mello T, Jalil-Vega F. Energy planning policies for residential and commercial sectors under ambitious global and local emissions objectives: a Chilean case study. J Clean Prod 2022;350:131299. https://doi.org/10.1016/j.jclepro.2022.131299.
[802] Bompard E, Ciocia A, Grosso D, Huang T, Spertino F, Jafari M, et al. Assessing the role of fluctuating renewables in energy transition: methodologies and tools. Appl Energy 2022;314:118968. https://doi.org/10.1016/j.apenergy.2022.118968.
[803] Østergaard PA, Werner S, Dyrelund A, Lund H, Arabkoohsar A, Sorknæs P, et al. The four generations of district cooling - a categorization of the development in district cooling from origin to future prospect. Energy 2022;253. https://doi.org/10.1016/j.energy.2022.124098.
[804] Salah SI, Eltaweel M, Abeykoon C. Towards a sustainable energy future for Egypt: a systematic review of renewable energy sources, technologies, challenges, and recommendations. Clean Eng Technol 2022;8:100497. https://doi.org/10.1016/j.clet.2022.100497.
[805] Al-Ghussain L, Ahmad AD, Abubaker AM, Hassan MA. Exploring the feasibility of green hydrogen production using excess energy from a country-scale 100% solar-wind renewable energy system. Int J Hydrogen Energy 2022. https://doi.org/10.1016/j.ijhydene.2022.04.289.
[806] Russo MA, Carvalho D, Martins N, Monteiro A. Forecasting the inevitable: a review on the impacts of climate change on renewable energy resources. Sustain Energy Technol Assessments 2022;52:102283. https://doi.org/10.1016/j.seta.2022.102283.
[807] Chennaif M, Maaouane M, Zahboune H, Elhafyani M, Zouggar S. Tri-objective techno-economic sizing optimization of Off-grid and On-grid renewable energy systems using Electric system Cascade Extended analysis and system Advisor Model. Appl Energy 2022;305:117844. https://doi.org/10.1016/j.apenergy.2021.117844.
[808] Ziemele J, Dace E. An analytical framework for assessing the integration of the waste heat into a district heating system: case of the city of Riga. Energy 2022;254:124285. https://doi.org/10.1016/j.energy.2022.124285.
[809] Paardekooper S, Lund H, Thellufsen JZ, Bertelsen N, Mathiesen BV. Heat Roadmap Europe: strategic heating transition typology as a basis for policy recommendations. Energy Effic 2022;15:32. https://doi.org/10.1007/s12053-022-10030-3.
[810] Chong CT, Fan Y Van, Lee CT, Klemeš JJ. Post COVID-19 ENERGY sustainability and carbon emissions neutrality. Energy 2022;241:122801. https://doi.org/10.1016/j.energy.2021.122801.
[811] Ding Y, Lyu Y, Lu S, Wang R. Load shifting potential assessment of building thermal storage performance for building design. Energy 2022;243:123036. https://doi.org/10.1016/j.energy.2021.123036.
[812] Golmohamadi H, Larsen KG, Jensen PG, Hasrat IR. Integration of flexibility potentials of district heating systems into electricity markets: a review. Renew Sustain Energy Rev 2022;159:112200. https://doi.org/10.1016/j.rser.2022.112200.
[813] Gutierrez-Garcia F, Arcos-Vargas A, Gomez-Exposito A. Robustness of electricity systems with nearly 100% share of renewables: a worst-case study. Renew Sustain Energy Rev 2022;155:111932. https://doi.org/10.1016/j.rser.2021.111932.
[814] Krumm A, Süsser D, Blechinger P. Modelling social aspects of the energy transition: what is the current representation of social factors in energy models? Energy 2022;239:121706. https://doi.org/10.1016/j.energy.2021.121706.
[815] Lyden A, Tuohy PG. Planning level sizing of heat pumps and hot water tanks incorporating model predictive control and future electricity tariffs. Energy 2022;238:121731. https://doi.org/10.1016/j.energy.2021.121731.
[816] Pukšec T, Duić N. Sustainability of energy, water and environmental systems: a view of recent advances. Clean Technol Environ Policy 2022. https://doi.org/10.1007/s10098-022-02281-6.
[817] Zapata S, Castaneda M, Aristizabal AJ, Dyner I. Renewables for supporting supply adequacy in Colombia. Energy 2022;239:122157. https://doi.org/10.1016/j.energy.2021.122157.
[818] Dominković DF, Weinand JM, Scheller F, D'Andrea M, McKenna R. Reviewing two decades of energy system analysis with bibliometrics. Renew Sustain Energy Rev 2022;153:111749. https://doi.org/10.1016/j.rser.2021.111749.
[819] Fortes P, Simoes SG, Amorim F, Siggini G, Sessa V, Saint-Drenan Y-M, et al. How sensitive is a carbon-neutral power sector to climate change? The interplay between hydro, solar and wind for Portugal. Energy 2022;239:122106. https://doi.org/10.1016/j.energy.2021.122106.
[820] Liang T, Webley PA, Chen Y-C, She X, Li Y, Ding Y. The optimal design and operation of a hybrid renewable micro-grid with the decoupled liquid air energy storage. J Clean Prod 2022;334:130189. https://doi.org/10.1016/j.jclepro.2021.130189.
[821] Wei H, Zhang Y, Wang Y, Hua W, Jing R, Zhou Y. Planning integrated energy systems coupling V2G as a flexible storage. Energy 2022;239:122215. https://doi.org/10.1016/j.energy.2021.122215.
[822] Armin R, Seyedali M, Mehdi A, Alberg ØP, Abolfazl A, Meysam MN. Development of smart energy systems for communities: technologies, policies and applications. Energy 2022:123540. https://doi.org/10.1016/j.energy.2022.123540.
[823] Su Y, Hiltunen P, Syri S, Khatiwada D. Decarbonization strategies of Helsinki metropolitan area district heat companies. Renew Sustain Energy Rev 2022;160:112274. https://doi.org/10.1016/j.rser.2022.112274.
[824] Zhang W, Maleki A. Modeling and optimization of a stand-alone desalination plant powered by solar/wind energies based on back-up systems using a hybrid algorithm. Energy 2022:124341. https://doi.org/10.1016/j.energy.2022.124341.
[825] Oxford Advanced Leaner's Dictionary n.d. https://www.oxfordlearnersdictionaries.com/definition/english/.

[826] Oxford Learner's Dictionary of Academic English n.d. https://www.oxfordlearnersdictionaries.com/definition/academic/.
[827] Merriam-Webster nd. https://www.merriam-webster.com/.
[828] Sargent RG. An introductory tutorial on verification and validation of simulation models. Proc - Winter Simul Conf 2016;2016– Febru:1729–40. https://doi.org/10.1109/WSC.2015.7408291.
[829] Smiatek J, Jung A, Bluhmki E. Validation is not verification: precise terminology and scientific methods in bioprocess modeling. Trends Biotechnol 2021. https://doi.org/10.1016/j.tibtech.2021.04.003.
[830] Herskovitz P. A theoretical framework for simulation validation: popper's falsifications. Int J Model Simulat 1991;11:51–5.
[831] Wang H-H, Grant WE. Chapter 10 - how good ("valid") are models?Wang H-H, Grant WE, editors. Ecol Model An Introd to Art Sci Model Ecol Syst 2019;31: 191–214. https://doi.org/10.1016/B978-0-444-64163-2.00010-4. Elsevier.
[832] Rykiel EJ. Testing ecological models: the meaning of validation. Ecol Model 1996; 90:229–44. https://doi.org/10.1016/0304-3800(95)00152-2.
[833] Helfenbein KG, DeSalle R. Falsifications and corroborations: karl Popper's influence on systematics. Mol Phylogenet Evol 2005;35:271–80. https://doi.org/10.1016/j.ympev.2005.01.003.
[834] Refsgaard JC, Henriksen HJ. Modelling guidelines—terminology and guiding principles. Adv Water Resour 2004;27:71–82. https://doi.org/10.1016/j.advwatres.2003.08.006.
[835] Kleindorfer GB, O'Neill L, Ganeshan R. Validation in simulation: various positions in the philosophy of science. Manag Sci 1998;44:1087–99. https://doi.org/10.1287/mnsc.44.8.1087.
[836] Kerr LA, Goethel DR. Chapter twenty one - simulation modeling as a tool for synthesis of stock identification information. In: Cadrin SX, Kerr LA, Mariani S, editors. Stock identif. Methods. second ed. second ed. San Diego: Academic Press; 2014. p. 501–33. https://doi.org/10.1016/B978-0-12-397003-9.00021-7.
[837] Gašparović G, Krajačić G, Duić N, Baotić M. New energy planning software for analysis of island energy systems and microgrid operations – H2RES software as a tool to 100% renewable energy system. Comput Aided Chem Eng 2014;33: 1855–60. https://doi.org/10.1016/B978-0-444-63455-9.50144-6.
[838] Howells M, Rogner H, Strachan N, Heaps C, Huntington H, Kypreos S, et al. OSeMOSYS: the open source energy modeling system. An introduction to its ethos, structure and development. Energy Pol 2011;39:5850–70. https://doi.org/10.1016/j.enpol.2011.06.033.
[839] Stokes D. 21 - validation and regulatory compliance of free/open source software. In: Harland L, Forster M, editors. Open source softw. Life sci. Res. Woodhead Publishing; 2012. p. 481–504. https://doi.org/10.1533/9781908818249.481.
[840] Heaps C. LEAP: the low emissions analysis platform. MA, USA: Stock Environ Institute Somerville; 2022. https://leap.sei.org.
[841] Loulou R, Goldstein G, Noble K. Documentation for the MARKAL family of models. ETSAP 2004.

Further reading

[1] Sorknæs Peter, et al. Electrification of the industrial sector in 100% renewable energy scenarios. Energy 2022. https://doi.org/10.1016/j.energy.2022.124339.
[2] Luo, et al. Study on the decarbonization in China's power sector under the background of carbon neutrality by 2060. Renew Sustain Energy Rev 2022. https://doi.org/10.1016/j.rser.2022.112618.
[3] Song, et al. A critical survey of integrated energy system: Summaries, methodologies and analysis. Energy Conver Manag 2022. https://doi.org/10.1016/j.enconman.2022.115863.
[4] Ahmen, Nguyen. Analysis of future carbon-neutral energy system – The case of Växjö Municipality, Sweden. Smart Energy 2022. https://doi.org/10.1016/j.segy.2022.100082.
[5] Pakhere. Spatial analyses of smart energy system implementation through system dynamics and GIS modelling. Wind power case study in Latvia. Smart Energy 2022. https://doi.org/10.1016/j.segy.2022.100081.
[6] Gronier. A taxonomy of models for investigating hydrogen energy systems. Renew Sustain Energy Rev 2022. https://doi.org/10.1016/j.rser.2022.112698.
[7] Horak, et al. A review of spatio-temporal urban energy system modeling for urban decarbonization strategy formulation. Renew Sustain Energy Rev 2022. https://doi.org/10.1016/j.rser.2022.112426.
[8] Horak, et al. A review of spatio-temporal urban energy system modeling for urban decarbonization strategy formulation. Renew Sustain Energy Rev 2022. https://doi.org/10.1016/j.rser.2022.112426.
[9] Reker, et al. Integration of vertical solar power plants into a future German energy system. Smart Energy 2022. https://doi.org/10.1016/j.segy.2022.100083.
[10] Lund Henrik, et al. The role of sustainable bioenergy in a fully decarbonised society. Renew Energy 2022. https://doi.org/10.1016/j.renene.2022.06.026.
[11] Lameh, et al. On the development of minimum marginal abatement cost curves for the synthesis of integrated CO2 emissions reduction strategies. J Clean Prod 2022. https://doi.org/10.1016/j.jclepro.2022.132848.
[12] Wang. Decarbonization of China's electricity systems with hydropower penetration and pumped-hydro storage: Comparing the policies with a techno-economic analysis. Renew Energy 2022. https://doi.org/10.1016/j.renene.2022.06.080.