E. Abraham
Water Resources

Research profile

Dr Abraham is an Associate Professor of Water & Control Systems Engineering at Delft University of Technology.

His research interests are mainly in the application of numerical optimisation, control and systems theory to advance water management and environmental engineering applications and their nexuses with energy and agricultural sectors. Some of his research deals with operational optimization of multipurpose reservoirs, optimization and control for irrigation and water allocation, optimization of cropping patterns and infrastructure assessment - most within the context of the water-energy-food nexus. Within urban water systems, his research deals with optimal control and fault diagnosis for drinking water distribution networks, and the urban nexus of heating systems, and energy transitions.
New water and energy infrastructures need to be built at unprecedented rates in the global south, especially in Sub-Saharan Africa where some of Dr Abraham's work has a special focus. His work revolves around infrastructure planning and mangaement for climate adaptation, mitigation and their spatial aspects. Dr Abraham develops decision support tools that enable better monitoring of water and energy access, infrastructure optimisation for access and their operations through close collaboration with end users. With interdisciplinary expertise in water management, energy systems, control engineering and optimization, as well as a broad collaborative network that specializes beyond these subjects, he has coordinated or has worked in transnational projects that address the water-energy-food nexus and urban water-energy systems (EPIC AFRICA, ENLARGE, PCOCS, AGRICOAST, AQUACONNECT, WATERNEXUS). In his collaborative work, Edo aims to integrate sensititvity to values and is passionate about global development that is foregrounded in values such as equitable access to resources and infrastructure, environmental sustainability, (global) solidarity and social justice.
Before joining TU Delft in 2016, Dr Abraham was a Research Associate in the Environmental and Water Resources Engineering Group at Imperial College London. He has a PhD in Control Engineering (Aeronautics) and a first-class honours MEng degree in Electrical and Electronic Engineering. He received both the MEng and PhD degrees from Imperial College London, UK, in 2008 and 2013, respectively.

Employment

Water Resources

Delft University of Technology
15 Aug 2016 → 16 Mar 2052

Research outputs

A green hydrogen revolution in Africa remains elusive under current geopolitical realities

Dagnachew, A. G., Yalew, S. G., Tesfamichael, M., Okereke, C. & Abraham, E., 2024, In: Climate Policy. 12 p.

An identification algorithm of switched Box-Jenkins systems in the presence of bounded disturbances: An approach for approximating complex biological wastewater treatment models

Moradvandi, A., Abraham, E., Goudjil, A., De Schutter, B. & Lindeboom, R. E. F., 2024, In: Journal of Water Process Engineering. 60, 11 p., 105202.

Author Correction: Africa needs context-relevant evidence to shape its clean energy future

Mulugetta, Y., Sokona, Y., Trotter, P. A., Fankhauser, S., Omukuti, J., Somavilla Croxatto, L., Steffen, B., Tesfamichael, M., Abraham, E. & More Authors, 2024, In: Nature Energy. 9, 7, p. 907 1 p.

White Paper: Design for Justice

van de Poel, I., Secomandi, F., Abraham, E., van Uffelen, N., Feenstra, M., Liem, C., Melnyk, A., Rocco, R. & Moreno Inglés, A., 2024, Delft: Delft Design for Values Institute. 25 p.

A novel mechanistic modelling approach for microbial selection dynamics: Towards improved design and control of raceway reactors for purple bacteria

Alloul, A., Moradvandi, A., Puyol, D., Molina, R., Gardella, G., Vlaeminck, S. E., De Schutter, B., Abraham, E., Lindeboom, R. E. F. & Weissbrodt, D. G., 2023, In: Bioresource Technology. 390, 9 p., 129844.

A stochastic MPC framework for the control of pumping stations in polder systems with regard for uncertainty in inflow and hourly electricity prices
Heijden, T. V. D., Giesen, N. V. D., Palensky, P. & Abraham, E., 2023, *Proceedings of EGU General Assembly 2023, Vienna, Austria, 24-28 Apr 2023, EGU23-6203, https://doi.org/10.5194/egusphere-egu23-6203, 2023..* Vienna, Vol. EGU23-6203. 2 p. EGU 23-6203

Closed-loop simulation testing of a probabilistic DR framework for Day Ahead Market participation applied to Battery Energy Storage Systems
van der Heijden, T., Palensky, P., van de Giesen, N. & Abraham, E., 2023, *2023 IEEE 32nd International Symposium on Industrial Electronics, ISIE 2023 - Proceedings.* Piscataway: IEEE, p. 1-6 6 p.

Enhancing water access monitoring through mapping multi-source usage and disaggregated geographic inequalities with machine learning and surveys
Geleijnse, J., Rutten, M., de Villiers, D., Bamwenda, J. T. & Abraham, E., 2023, In: Scientific Reports. 13, 1, 23 p., 13433.

Models and methods for hybrid system identification: a systematic survey
Moradvandi, A., Lindeboom, R. E. F., Abraham, E. & De Schutter, B., 2023, *IFAC-PapersOnLine.* Ishii, H., Ebihara, Y., Imura, J. & Yamakita, M. (eds.). 2 ed. Elsevier, p. 95-107 13 p. (IFAC-PapersOnLine; vol. 56, no. 2).

'Commoning practices' for energy justice? Perspectives on the heat transition in the city of Amsterdam
Kaandorp, C., Pessoa, I. T. M., Pesch, U., van de Giesen, N. & Abraham, E., 2023, In: Energy Research and Social Science. 108, 12 p., 103369.

A Bayesian Approach for Active Fault Isolation with an Application to Leakage Localization in Water Distribution Networks
van Lagen, G., Abraham, E. & Mohajerin Esfahani, P., 2022, In: IEEE Transactions on Control Systems Technology. 31 (2023), 2, p. 761-771 11 p.

Africa needs context-relevant evidence to shape its clean energy future
Mulugetta, Y., Sokona, Y., Trotter, P. A., Fankhauser, S., Omukuti, J., Somavilla Croxatto, L., Steffen, B., Tesfamichael, M., Abraham, E. & More Authors, 2022, In: Nature Energy. 7, 11, p. 1015-1022 8 p.

Day Ahead Market price scenario generation using a Combined Quantile Regression Deep Neural Network and a Non-parametric Bayesian Network: A framework for risk-based Demand Response
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Integrated assessment of renewable urban heating systems considering water use, committed emissions and energy justice
Kaandorp, C., van de Giesen, N. C. & Abraham, E., 2022. 1 p.

Multi-market demand response from pump-controlled open canal systems: an economic MPC approach to pump-scheduling
van der Heijden, T., Lugt, D., van Nooijen, R., Palensky, P. & Abraham, E., 2022, In: Journal of Hydroinformatics. 24, 4, p. 838-855 18 p.

Nonlinear model predictive control of salinity and water level in polder networks: Case study of Lissertocht catchment
Aydin, B. E., Oude Essink, G. H. P., Delsman, J. R., van de Giesen, N. & Abraham, E., 2022, In: Agricultural Water Management. 264, 107502.

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Kaandorp, C., van de Giesen, N. C. & Abraham, E., 2021. 1 p.

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Steffelbauer, D. B., Blokker, M., Buchberger, S. G., Knobbe, A. & Abraham, E., 2021, In: Journal of Water Resources Planning and Management. 147, 6, 12 p., 04021026.

Electricity price forecasting in European Day Ahead Markets: a greedy consideration of market integration
Van der Heijden, T., Lago, J., Palensky, P. & Abraham, E., 2021, In: IEEE Access. 9, p. 119954-119966 13 p., 9524683.

Operational planning of WEF infrastructure: quantifying the value of cooperation in the Eastern Nile basin
Verhagen, J., Zaag, P. V. D. & Abraham, E., 2021. 1 p.

Operational planning of WEF infrastructure: quantifying the value of information sharing and cooperation in the Eastern Nile basin
Verhagen, J., van der Zaag, P. & Abraham, E., 2021, In: Environmental Research Letters. 16, 8, 18 p., 085006.

Probabilistic DAM price forecasting using a combined Quantile Regression Deep Neural Network with less-crossing quantiles
van der Heijden, T., Palensky, P. & Abraham, E., 2021, *IECON 2021 – 47th Annual Conference of the IEEE Industrial Electronics Society: Proceedings.* IEEE, 6 p. 9589097. (IECON 2021 - 47TH ANNUAL CONFERENCE OF THE IEEE INDUSTRIAL ELECTRONICS SOCIETY).

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Kaandorp, C., Giesen, N. V. D. & Abraham, E., 2021, In: Environmental Research Letters. 16, 5, p. 1-11 11 p., 055031.

Integrative technology hubs for urban food-energy-water nexuses and cost-benefit-risk tradeoffs (I): Global trends and technology metrics
Chang, N. B., Hossain, U., Valencia, A., Qiu, J., Zheng, Q. P., Kaandorp, C., Abraham, E., ten Veldhuis, M. C., van de Giesen, N. & More Authors, 2020, In: Critical Reviews in Environmental Science and Technology. 51 (2021), 13, p. 1397-1442 46 p.

Integrative technology hubs for urban food-energy-water nexuses and cost-benefit-risk tradeoffs (II): Design strategies for urban sustainability
Chang, N. B., Hossain, U., Valencia, A., Qiu, J., Zheng, Q. P., Kaandorp, C., Abraham, E., ten Veldhuis, M. C., van de Giesen, N. & More Authors, 2020, In: Critical Reviews in Environmental Science and Technology. 51 (2021), 14, p. 1533-1583 51 p.

Managing Water Quality in Intermittent Supply Systems: The Case of Mukono Town, Uganda
Sakomoto, T., Lutaaya, M. & Abraham, E., 2020, In: Water. 12, 3, 16 p., 806.

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Lin, N. M., Tian, X., Rutten, M., Abraham, E., Maestre, J. M. & van de Giesen, N., 2020, In: Water (Switzerland). 12, 7, p. 1-21 21 p., 1898.

Optimal Control for Precision Irrigation of a Large-Scale Plantation
Kassing, R. C., De Schutter, B. H. K. & Abraham, E., 2020, In: Water Resources Research. 56, 10, p. 1-22 22 p., e2019WR026989.

Smart solutions for intermittent supply systems
Abraham, E., Verbart, J. J. G. M. & van der Hoek, J. P., 2020, In: The Source – The magazine of the International Water Association. 21, p. 24-28 5 p.

Sustainable Water Resources Management in an Arid Area Using a Coupled Optimization-Simulation Modeling
Farrokhzadeh, S., Hashemi Monfared, S. A., Azizyan, G., Sardar Shahraki, A., Ertsen, M. W. & Abraham, E., 2020, In: Water. 12, 3, 26 p., 885.

The Battle of Post-Disaster Response and Restoration (BPDRR)
Paez, D., Filion, Y., Castro Gama, M. E., Santopietro, S., Sweetapple, C., Meng, F., Farmani, R., Abraham, E., Kapelan, Z. & More Authors, 2020, In: Journal of Water Resources Planning and Management. 146, 8, 13 p., 04020067.

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Aydin, B., Tian, X., Delsman, J., Oude Essink, G. H. P., Rutten, M. & Abraham, E., 1 Feb 2019, In: Environmental Modelling and Software. 112, p. 36-45 10 p.

A Heuristic Approach to Effective Sensor Placement for Salinity State Reconstruction in a Low-Lying Polder
Aydin, B., Hagedooren, H. & Abraham, E., 2019. 1 p.

A Multi-Objective Approach for the Analysis of a Water-Food-Ecosystems Nexus at Basin Scale
Farrokhzadeh, S., Abraham, E. & Ertsen, M., 2019. 1 p.

A greedy algorithm for optimal sensor placement to estimate salinity in polder networks
Aydin, B. E., Hagedooren, H., Rutten, M. M., Delsman, J., Essink, G. H. P. O., van de Giesen, N. & Abraham, E., 2019, In: Water (Switzerland). 11, 5, 17 p., 1101.

Identification of the methanogenesis inhibition mechanism using comparative analysis of mathematical models
Odriozola, M., Abraham, E., Lousada-Ferreira, M., Spanjers, H. & van Lier, J. B., 2019, In: Frontiers in Bioengineering and Biotechnology. 7, 16 p., 93.

Maximizing Water--Food--Energy Nexus Synergies at Basin Scale
Burger, R. & Abraham, E., 2019, *Frontiers in Water-Energy-Nexus—Nature-Based Solutions, Advanced Technologies and Best Practices for Environmental Sustainability.* Naddeo, V., Balakrishnan, M. & Choo, K. H. (eds.). Cham: Springer, p. 67-70 4 p. (Advances in Science, Technology and Innovation).

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Pecci, F., Abraham, E. & Stoianov, I., 2019, In: Journal of Water Resources Planning and Management. 145, 5, 13 p., 04019014.

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van der Heijden, T. J. T. & Abraham, E., 2019, In: TU Delft DeltaLinks. 4 p.

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Pecci, F., Abraham, E. & Stoianov, I., Nov 2018, In: Optimization and Engineering. 20 (2019), p. 457-495 38 p.

Model Predictive Control of Salinity and Water Level in a Hypothetical Polder Ditch: Is it Possible to Use the Discretized Linearized Physical Equations for Optimization
Aydin, B., Rutten, M. & Abraham, E., 20 Sept 2018, *EPiC Series in Engineering: HIC 2018. 13th International Conference on Hydroinformatics.* La Loggia, G., Freni, G., Puleo, V. & De Marchis, M. (eds.). EasyChair, Vol. 3. p. 117-122 (EPiC Series in Engineering; vol. 3).

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Deuerlein, J., Gilbert, D., Abraham, E. & Piller, O., 15 Jul 2018, *WDSA / CCWI Joint Conference 2018* . Vol. Vol 1 (2018). 14 p.

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Abraham, E., Blokker, EJM. & Stoianov, I., Feb 2018, In: Journal of Water Resources Planning and Management. 144, 10 , 9 p., 04017093.

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Scalable Pareto set generation for multiobjective co-design problems in water distribution networks: a continuous relaxation approach
Pecci, F., Abraham, E. & Stoianov, I., 1 Mar 2017, In: Structural and Multidisciplinary Optimization. 55, 3, p. 857-869 13 p.

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Menke, R., Abraham, E., Parpas, P. & Stoianov, I., 2017, In: Procedia Engineering. 186, p. 584-591

Investigating trade-offs between the operating cost and green house gas emissions from water distribution systems
Menke, R., Kadehjian, K., Abraham, E. & Stoianov, I., 2017, In: Sustainable Energy Technologies and Assessments. 21, p. 13-22

Iterative Multistage Method for a Large Water Network Sectorization into DMAs under Multiple Design Objectives
Gilbert, D., Abraham, E., Montalvo, I. & Piller, O., 2017, In: Journal of Water Resources Planning and Management. 143, 11, 10 p.

Model Predictive Control of Salinity in a Polder Ditch under High Saline Groundwater Exfiltration Conditions: A Test Case
Aydin, B., Rutten, M., Abraham, E., Oude Essink, GHP. & Delsman, J., 2017, *20h World Congress of the International Federation of Automatic Control (IFAC), 2017.* Dochain, D., Henrion, D. & Peaucelle, D. (eds.). 1 ed. Elsevier, Vol. 50. p. 3160-3164 1740. (IFAC-PapersOnline; vol. 50, no. 1).

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Pecci, F., Abraham, E. & Stoianov, I., 2017, *IFAC-PapersOnLine.* Peaucelle, D., Dochain, D. & Henrion, D. (eds.). 1 ed. Elsevier, Vol. 50. p. 5373-5379 0423. (IFAC-PapersOnLine; vol. 50, no. 1).

Quadratic head loss approximations for optimisation problems in water supply networks
Pecci, F., Abraham, E. & I, S., 2017, In: Journal of Hydroinformatics. 19, 4, p. 493-506 14 p.

Smart Salinity Management in Low-lying Deltaic Areas: A Model Predictive Control Scheme Applied to a Test Canal
Aydin, B., Abraham, E., Rutten, M., Delsman, J. & Oude Essink, G. H. P., 2017, In: Geophysical Research Abstracts (online). 19, 1 p., EGU2017-14448.

Exploring Optimal Pump Scheduling in Water Distribution Networks with Branch and Bound Methods
Menke, R., Abraham, E., Parpas, P. & Stoianov, I., 1 Nov 2016, In: Water Resources Management. 30, 14, p. 5333-5349 17 p.

Demonstrating demand response from water distribution system through pump scheduling
Menke, R., Abraham, E., Parpas, P. & Stoianov, I., 15 May 2016, In: Applied Energy. 170, p. 377-387 11 p.

A Graph-Theoretic Framework for Assessing the Resilience of Sectorised Water Distribution Networks
Herrera, M., Abraham, E. & Stoianov, I., 1 Mar 2016, In: Water Resources Management. 30, 5, p. 1685-1699 15 p.

Sparse null space algorithms for hydraulic analysis of large-scale water supply networks
Abraham, E. & Stoianov, I., 1 Mar 2016, In: Journal of Hydraulic Engineering (Reston). 142, 3, 04015058.

An efficient null space inexact Newton method for hydraulic simulation of water distribution networks
Abraham, E. & Stoianov, I., 2016, In: ArXiv.org.

Constraint preconditioned inexact Newton method for hydraulic simulation of large-scale water distribution networks
Abraham, E. & Stoianov, I., 2016, (E-pub ahead of print) In: IEEE Transactions on Control of Network Systems. p. 610-619 7463053.

Modeling Variable Speed Pumps for Optimal Pump Scheduling
Menke, R., Abraham, E. & Stoianov, I., 2016, *World Environmental and Water Resources Congress 2016: Watershed Management, Irrigation and Drainage, and Water Resources Planning and Management - Papers from Sessions of the Proceedings of the 2016 World Environmental and Water Resources Congress.* American Society of Civil Engineers (ASCE), p. 199-209 11 p.

Control of water distribution networks with dynamic DMA topology using strictly feasible sequential convex programming
Wright, R., Abraham, E., Parpas, P. & Stoianov, I., 1 Dec 2015, In: Water Resources Research. 51, 12, p. 9925-9941 17 p.

WaterBox: A testbed for monitoring and controlling smart water networks
Kartakis, S., Abraham, E. & McCann, J. A., 13 Apr 2015, *1st ACM International Workshop on Cyber-Physical Systems for Smart Water Networks, CySWater 2015.* Association for Computing Machinery (ACM), 8

Lower-order H_∞ filter design for bilinear systems with bounded inputs
Abraham, E. & Kerrigan, E. C., 15 Feb 2015, In: IEEE Transactions on Signal Processing. 63, 4, p. 895-906 12 p., 6996039.

Approximation of system components for pump scheduling optimisation
Menke, R., Abraham, E., Parpas, P. & Stoianov, I., 2015, In: Procedia Engineering. 119, 1, p. 1059-1068 10 p.

Efficient preconditioned iterative methods for hydraulic simulation of large scale water distribution networks
Abraham, E. & Stoianov, I., 2015, In: Procedia Engineering. 119, 1, p. 623-632 10 p.

Graph-theoretic surrogate measures for analysing the resilience of water distribution networks
Herrera, M., Abraham, E. & Stoianov, I., 2015, In: Procedia Engineering. 119, 1, p. 1241-1248 8 p.

Mathematical programming methods for pressure management in water distribution systems
Pecci, F., Abraham, E. & Stoianov, I., 2015, In: Procedia Engineering. 119, 1, p. 937-946 10 p.

Optimized control of pressure reducing valves in water distribution networks with dynamic topology
Wright, R., Abraham, E., Parpas, P. & Stoianov, I., 2015, In: Procedia Engineering. 119, 1, p. 1003-1011 9 p.

Estimator design for input-constrained bilinear systems with application to wave energy conversion
Abraham, E. & Kerrigan, E. C., 2013, *2013 IEEE 52nd Annual Conference on Decision and Control, CDC 2013.* IEEE, p. 5686-5691 6 p. 6760785. (Proceedings of the IEEE Conference on Decision and Control).

Optimal active control and optimization of a wave energy converter
Abraham, E. & Kerrigan, E. C., 2013, In: IEEE Transactions on Sustainable Energy. 4, 2, p. 324-332 9 p., 6353624.

Optimal active control of a wave energy converter
Abraham, E. & Kerrigan, E. C., 2012, *51st IEEE Conference on Decision and Control*. p. 2415-2420

Activities

Journal of Hydroinformatics (Journal)
E. Abraham (Editor)
2022 → …

Environmental Research Letters (Journal)
E. Abraham (Editor), Edward Byers (Editor), simon parkinson (Editor) & Zarrar Khan (Editor)
Oct 2020 → Jan 2021

Multi-scale water-energy-land nexus planning to manage socio-economic, climatic, and technological change (Session Convener at EGU 2019)
E. Abraham (Contributor)
7 May 2020

Energy Systems (Journal)
E. Abraham (Editor)
2020 → …

Water (Journal)
Simon Parkinson (Editor), Edward Byers (Editor) & E. Abraham (Editor)
Jul 2019 → Mar 2020

EGU General Assembly 2019
Edo Abraham (Member of programme committee)
10 Apr 2019

1st IFAC workshop on Control Methods for Water Resource Systems (Event)
Edo Abraham (Chair)
Jan 2019 → Sept 2019

Maximizing water-food-energy nexus synergies at Basin Scale
E. Abraham (Speaker)
15 Nov 2018

Energy Systems (Journal)
E. Abraham (Editorial board member)
Aug 2018 → …

IEEE (External organisation)
E. Abraham (Member)
Feb 2018 → Mar 2018

IEEE Conference on Control Technology and Applications (Event)
E. Abraham (Editor)
Mar 2017 → Jul 2017

Drinking Water Engineering and Science (Journal)
E. Abraham (Editor)
19 Jan 2017 → 30 Jun 2017

Sustainable Management of Water Distribution Systems Using Model-based Optimization Tools and Renewable Energy
E. Abraham (Speaker)
16 Jan 2017 → 17 Jan 2017

ICA 2017 (Event)
E. Abraham (Member)
Jan 2017 → Jun 2017

ICA 2017 (Event)
E. Abraham (Member)
2017

Prizes

First Place Award for outstanding achievements in The Battle of the Leakage Detection and Isolation Methods (BattleDIM) 2020
Steffelbauer, D.B. (Recipient), Deuerlein, Jochen (Recipient), Gilbert, Denis (Recipient), Piller, Olivier (Recipient) & Abraham, E. (Recipient), 3 Sept 2020

Press/Media

Balancing water, food and energy to drive sustainable development
E. Abraham
31/01/23
1 item of Media coverage

Digitale transformatie werpt vruchten af voor de watersector
E. Abraham
29/03/21
1 item of Media coverage

Doris van Halem in de media 2023
D. van Halem, E. Abraham & G.C.M. Wiersma
14/03/23 → 26/08/23
3 Media contributions

Enlarge the focus.
C. Kaandorp, E. Abraham & I. Tempels Moreno Pessôa
17/09/21
1 Media contribution

Project results from ENLARGE pave the way for sustainable urban heating, tailored to neighbourhood needs without compromising energy resilience or social justice
E. Abraham
16/05/22
1 Media contribution

Vergroot de focus
C. Kaandorp, E. Abraham & I. Tempels Moreno Pessôa
3/12/20

1 Media contribution

You should know this about the 700 agreements at the UN Water Conference of the Netherlands and Tajikistan
E. Abraham
31/03/23
1 item of Media coverage

Datasets/Software

Data for the paper: Optimal Control for Precision Irrigation of a Large-Scale Plantation
Kassing, R. C. (Creator) & Abraham, E. (Creator), TU Delft - 4TU.ResearchData, 6 Jan 2020
DOI: 10.4121/UUID:4FB3A35F-1786-45EE-A2F8-65A391FA86D0

Multi-scale water and energy use model: Workbook accompanying the paper 'The water use of heating pathways to 2050: analysis of national and urban energy scenarios'.
Kaandorp, C. (Creator), van de Giesen, N. C. (Creator) & Abraham, E. (Creator), TU Delft - 4TU.ResearchData, 14 Mar 2023
DOI: 10.4121/22257079