KAUNO TECHNOLOGIJOS UNIVERSITETAS
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LIETUVOS ENERGETIKOS INSTITUTAS

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$76,1$8-,1$1ý,86 (1(5*,-26 ,â7(./,86 1$8'2-$1ý (1(5*,-26 *$0<%26 7(&+12/2-,Ø Ë.,826(PALYGINAMASIS VERTINIMAS

Daktaro disertacijos santrauka
Socialiniai mokslai, ekonomika (04S)

2018, Kaunas

Disertacija rengta 2012±2017 m. Lietuvos energetikos instituto Energetikos NRPSOHNVLQLÐ W\ULPÐ ODERUDWRULMRMH

Mokslinis vadovas: prof. dr. Dalia â75(,0,.,(1 (Lietuvos energetikos institutas, Socialiniai mokslai, ekonomika ±04S).

Mokslinis konsultantas: dr. Tomas %$/(ä(17,6 (Liet XYRV DJUDUL HNRQRPLNRV LQVWLWXWDV 7HFKQRORJLMRV PRN ±R7T).

Redagavo: -ÌUDW¡ .X-O*XþLWHDNL\WW¡¡ LU $XUHOLMD *UDåLQD 5

Ekonomikos mokslo krypties daktaro disertacijos gynimo taryba:

3URI GU 'DLYD '80ý,89,(1 .DXQR WHFKQRORJLM ±04S) ±SLUPLQLQN¡

Prof. dr. Veselin '5$â.29,û Montenegro universitetas, Juodkalnija, ekonomika ± 04S);

Prof. habil. dr. Valentinas KLEVAS (Kauno technologijos universitetas, ekonomika ± 04S);

3URI GU $VWULGD 0,&(,.,(1 $OHNVDQGUR 6WXO ± 03S);

'RF GU $VWD 6$%21,(1 .DXQR WHFKQRO±RJLMR 04S).

Disertacija JLQDPD YLHãDPH HNRQRPLNRV NU\SWLHV WDU\ERV ³Y\NV P UXJSMÌþLR P¡QHVLR G YDO /L SRV¡GåLÐ VDO¡MH

Adresas: Breslaujos g. 3-202, 44403, Kaunas, Lietuva.

7HO IDNVDV doktorantura@lei.lt SDãWDV 'LVHUWDFLMRV VDQWUDXND LãVLÐVWD P OLH

6X GLVHUWDFLMD JDOLPD VXVLSDåLQWL http://ktu.edu, Kauno LQWHUQ technologijos universiteto (K. DQHODLþLR J .DXQDV XQLYHUVLWHWR ELEOLRWHNRVH . 'RQHODLþLR D institute (Breslaujos g. 3, Kaunas).

²9$'$6

Aktualumas. Augant energijos paklausai visame pasaulyje tradiciniai HQHUJLMRV LãWHNOLDL Q\NVWD
HQHUJLMRV LãWHNOLDL SDJ¡UHLQD ÐVDUD $(, SDWUDXNOL WUDGLFL
$WVLQDXMLQDQþLÐ HQHUJLMRV LãWHNOLÐ LU
gvild HQDPDV MDX VHQLDL $WVLQDXMLQDQþLÐ H
skatinimo klausimas yra YLHQDV SDJULQGLQLÐ /LHWXYRV
SROLWLNRV WLNVOÐ /LHWXYRV HQH
QHSULNODXVRP\E¡V LU YLHWRV ULQNRMH
HQHUJHWLNRV Energijos efektyvumo didinimo politikos gali remtis
WLHVLRJLQLDLV LU QHWLHVLRJLQLDLV NDLQÐ
panaikinimas ir LãRULQLÐ VQDXGÐ Q Degiojo kainos LQWHJU
PDåLQDQþLDLV tendencijas kainoms jautriuose sektoriuose ir
³UHQJLQ âLXRVH PLNL Naudojant AEI technologijas susidarantys
LãRULQLDL daug PDåHVQL QHL WUDGLFLQ Palyginus LãNDVWLQ
HQHUJLMRV LãWHNOLDLV ,ãRULQLDLV NDãWDLV
DSOLQNDL NXUL GDUR WUDGLFLQLR NXUR
deginimas. 'HMD ãL NRQNUHWL åDOLQLDL
WUDGLFLQLÐ HQHUJHWLNRV SURGXNWÐ NXUR
ãLXRV NDãWXV LU QHNRPSHQVXRMD MÐ GDURPR
jog vartotojai nesumoka visos WUDGLFLQLÐ HQHUJLMRV LãW
WUDGLFLQLDL HQHUJLMRV ãDOWLQLDL subsidijuojami ir nepaskirstomi
efektyviai. ,ãRULQLÐ LãODLGÐ QH³YHUWLQLPDV XåN
technologijoms prasiskverbti ³ULQN SDåHLGåLDPDV ULQNRV
Remiantis ekonomikos teorija, YLHQDV VWDELOLDXVLÐ ± AEI skatinimo iki
integruoti LãRULQLV NDãWXV ³ AEI kainas energijos (pagamintos naudojant AEI
technologijas) kaina ir parinkti tinkamas paramos priemones
\UD VXG¡WLQJDV PRNVOLQLV klausimas. AEI nauda nustatyti
WDLNRPDV J\YHQWRMÐ SDVLUHQJLPR PRN¡WL
YHUWLQLPDV QHV MLV OHLGåLD JDQ
SDU,DPWVLåYHOJLDQW ³ YLVXRPHQ¡V SULRULWHWXV
PRN¡WL VNDWLQWL NRQNUHþLDV $(, WHFKQROR
HQHUJLMD \UD QHLãYHQJLDPDV WYDUDXV HN
investuojant ³ DWVLQDXMLQDQþLRV HQHUJLMRV WHFKQR
GDXJHO³ YHLNVQLÐ 6LHNLDQW LãVSUÈVWL SROLWLNÐ
NXULRPLV EÌWÐ VSUHQGåLDPRV HVDPRV SUREO
WHFKQRORJLMÐ WYDUXPR YHUWLQLPR PHWRGLNÐ
SDVLHNWL ã³ WLNVOÐ 'LHJLDQW LU QDXGRMDQW

WHFKQRORJLMĐ WYDUXPR ³YHUWLQLPDV JDOL Xå

SDWHNLPR ³ ULQN EDUMHUDPV sudeti galimybe XRV DS

pasirengti SDVHNP¡PV DWVLUDQGDQþLRPV G¡O JDOLPĐ

,ãWLUWXV PRksas .OHYDV %LHNãD LU ,oki ir Pasak 0XUDX crergijos VNDLW

Lã WHNOLĐ JDP\ED SODWLQLPDV LU QDXGRMLPDV

YDOGåLDL YHUVOX Lpasiu Ugoms, Kitiems ir PLU Fiemas O kitiems

suinteresuotiesiems subjektams. Mokslininkai savo darbe, analizuodami AEI

LQWHJUDFLM ³ UHJLRQLQLXV, ISQHU¡åH¡WLNDV YSL

HVPLQLĐ UHJLRQLQ¡V HQHUJHWLNRV VLVWHPRV

naudojimas (Klevas ir kt., 2014). âDO\MH QH³PDQRPD IRUPXRWL

VNDWLQLPR SROLWLNRV QHåLQDQW HQHUJLMRV

WHFKQRORJLMĐ WHPD Klevas, Murauskaite, Kleviene ir QLQNĐ

Perednis (2013) nuomone, akivaizdu, kad SDJULQGLQ $(, WHFKQRO

nulemia vartotojas, o svarbiausia problema, lemianti, pvz., O¡WDXO¡V HQHUJL

DEVRUEFLMą, RGVDO SULHLFHVDUWRWRMĐ åLQLĐ WUÌNXPD

pDW HQHUJLMRV WLHN¡MĐ LU YDUWRWRMĐ VNL

YDUWRWRMDL GDO\YDXMD ³J\YHQGLQDQW /LHWXY

WDþLDX MĐ QXRPRQ¡ LNL ãLRO QHEXYR LãWLUWD

Klevas, Bobinaite, Maciukaitis ir Tarvydas (2018) WUÌNVWD W\ULPĐ N

DWVDN\WL ³ NODXVLPXV DSLH HNRQRPLQHV SUL

SROLWLN VX HNRQRPLQLPLV SDWLHNLPLV, $(, WHFKQR

QDFLRQDOLQLX PDVWX QDXG âLH PRNVOLQLQ

WHFKQRORJLMĐ GLHJLPR ³WDN HNRQRPLNDL VD

/LHWXYRMH WDLNRPRV $(, VNDWLQLPR SULHPRQ

HNRQRPLãNDL RSWLPDOLDXVLDV ir GLHJLPR

EUDQJLXV ³UHQJLQLXV, taip iãU WUÌNXPĐ VLVWHPĐ SDVLH

(Klevas ir kt., 2018)

'DXJHOLV /LHWXYRV PRNVOLQLQNĐ HQHUJHWLNRV GRUJLL

QDXGRMLPĐ VNDWLQLPR SROLWLND, daugiausia UHNRPHQGDFLMĐ JDP\EDV

VHNWRULXV, pvz. Klevas ir âWUHLPLNLHQ¡ (2006) NQ\JRMH Ä/LHWXYRV

ekonomikos pagrindai³ analizavo DWVLQDXMLQDQþLRV HQHUJ

VNDWLQLP LU ILQDQVLQHV EHL HNRQRPLQHV V Klevas (2015)

SDUHQJ¡ UHNRPHQGDFLMĐ ULQNLQ³ VNLUW YLHQ

vertinimo ir ilgalaiN¡V VNDWLQLPR VL; Katinas, Markevicius, ir Kaltenkaitis (2008)

Erlickyte ir Marciukaitis (2008) analizavo metodus NXULDLV EÌWĐ JD

LQWHJUXRWL $(, ³ /LHWXYRV HQHUJHWLNRV WDN ir Poåi

ýLHUL=HOHQ¡ (2008) DSWDU¡ /LHWXYRV HNRQRPLNRV WY Galinis,

/HNDYLþLXV (2010) DQDOL]DYR ,SDWVN Streimikiene,

%DOH]HQWLV ir Balezentis (2011) WãLHN¡¡ LU DSUDãą GDX

4

YHUWLQLPR VLVWHP VLHNLDQW SDVLULQNWL O
Gaigalis, Markevicius, Katinas ir Skema (2014) ±kaip AEI skatinimas Lietuvoje atitinka (6 VWUDWHJLM LU SROLWLN

7DþLDX AEI panaudojimo tema pasaul\MH \UD DSWDULDPD YLV LQGLYLGåLÌ plLkosâug ir ekologinio elgesio \UD JODXGåLDL VXVLM VX UH\ãLV åLQRWL HQHUJLMRV YDUWRWRMÐ SRåLÌULV (Ek, 2005; Stigka, Paravantis ir Mihalakakou, 2014). Pastaraisiais metais paskelbtuose W\ULPXRVH GDXJLDXVLD G¡PHVLR VNLUL preferencijoms (pasirinkimams), kurios, kaip pastebima, nuolat augo, kartu GLG¡MDQW LU VXUHQNDPÐ (Sundt ir Rehdanz, 2015). Egzistuoja GDXJ\EL¡ PHWRGÐ WRNLÐ YDUWRWRMR YHUWLQLPR PH PDY\]Gå Wood, Kenyon, Desvousges ir Morander (1995) savo darbuose DQDOL]DYR NHOLÐ DOWHUQDW\YLÐ VX 30 WHFKQRORJLMRPLV SVLFKRORJLQLXV Hanley ir Nevin (1999) DSUDã¡ 30 PHWRG NDLS WLQNDPL ÄLQGLYLGXDOÐ 30 Xå DSOLQNRVDXJLQ¡V J¡UÐ SDGLG¡MLPÐ. Roe, Teisl, Levy ir Russell (2001) savo W\ULP VN\U¡ 30 pasikeitusioms YDUWRWRMÐ DSOLQNRVDXJLQ¡V FKDU HOHNWURV WLHNLPR VULW\MH DWVNOHLVWL duomenis. Ek (2005) DQDOL]DYR HOHNWURV YDUWRWRM Bergmann, Hanley ir Wright (2006) naudojo pasirinkimo eksperimento PHWRG VLHNGDPL ³YHUWLQWL åPRQLÐ SRåLÌU³ ³ âNRWLMRV. Borchers, Duke ir Parsons (2007) SDWHLN¡ Lã YDGDV JDX pasirinkimo eksperimento modeliavimo metu, kai W\U¡ YDUWRWRMÐ SU 30 Xå VDYDQRULãN GDO\YDYLP programose Bell, Ol HO Farsi, Filippini ir Jakob (2008) naudojo pasirinkimo eks SHULPHQWR PHW siekdami ³YHUWLQWL YDUWRWRMÐ 30 Xå HQHU J\YHQDPXRVLXRVH SDVWDWXRVH. Bergmann, Colombo ir Hanley LMRM (2008) savo W\ULPH SDQDXGRGDPL SDVLULQNLPR HNV QXVWDW\WL SDJULQGLQLXV PLHVWH LU NDLPH skirtumus. Longo, Markandya ir Petrucci (2008), panaudodami pasirinkimo eks SHULPHQW¡ 'LGåLRVLRV %ULWDQLMRV virtinias HQHUJLM energetikos programas NXULRV VNDWLQD DWVLQDXMLQD Zografakis ir kt. (2010) W\U¡ .UHWRV J\YHQWRMÐ 30 Xå DW LãWHNOLÐ. Hrovatin (2012) DQDOL]DYR 30, Xå XWLOLWÄ DWVLQDXMLQDQþLÐ HQHUJLMRV. Ulli ir kt. (2014) WLU L3HNLQR J\YHQWRMÐ 30 Xå DWVLQDXM. ãLUQDHQLPLH %ROHJDåLMRV (2014) pilotiniame tyrime siekiant nustatyti pagrindinius rodiklius, GDUDQþLX ³WDUNHWXYRV QDPÐ ÌNLÐ 3VLULQNLPXR HNVSHULP Akcura (2015) QDJULQ¡MR QDPÐ ÌNLÐ SUHIHUHQFLMDV

UHPLDQWLV YLVL QDPĐ ÌNLDL SUlaYeslioAHEDL WX
WHFKQRORJLMĐ SDLQDXGRMLPR YDVDQRULãNR LQG¡
PDJULQGLQ¡ GtyrimoUproblemaWDFormuojant $(, Lã WHNOLĐ
VNDWLQLPR SROLWLN SULLPDQW VSUHQGLPXV
QXRPRQ EHW LU YLVXRPHQ y. YDåDYRWLRPLUS VHIM
NDGDQJL HQHUJLMRV YDUWRWRMĐ H, skatinantV \UD
QDXGRWL $(, LU ,MEXWLEÌQLRLDVJLMRVLQOXRPDLUMĐ
SULRULWHWXV EHL SDJULQGLQLXV YHLNVQLXV
HQHUJLMRV JDP\ERV WHFKQRORJLMĐ

Disertacijos tyrimo problema yra NRPSOHNVLQLapimanti WLHN QDPĐ
ÌNLĐ SRåLÌULR ³ $(, WHFKQRORJLMDV PRNVOLQL
QDPĐ ÌNLĐ SRåLÌULR VYRUIEXRMQHW³ $(, WLQNDPLQ
3Då\P¡WLQDLHWNXYRMH $(, VNDWLQLPR SROLWLND
skatinim HQHUJLMRV JDP\ERV VHNWRULXMH WDþL
NRQNUHþLRPV $(, WHFKQRORJLMRPVDJULQGLQ
SRåLÌULRIndividualiuose namuose diegiamas AEI technologijas
(mikrogeneracijos technologijas) isvarbiausi kriterijai, kuriais remdamiesi
energijos vartotojai IRUPXRMD VDYR SUHIHUHQFLMDV LNL
YDUWRWRMĐ QXRPRQ QHEXYR DWVLåYHOJWD

Mokslinio tyrimo objektas ± DWVLQDXMLQDQþLXV HQHU
QDXGRMDQþLRV WHFKQRORJLMRV individualiems namams WDLN\
(mikrogeneracijos technologijos)

Darbo tikslas ±atlikti AEI QDXGRMDQþLĐ HQHUJLMRV JDP
GLHJLDPĐ QDPĐ pal\ÌQLPRVH³ .YHUWLQLĐ WLNVOD
NRPSOHNVLãN± JYHUWLQLP $(, QXVWDW\PR JSDD
ÌNLĐ MRPV WHLNLDPDV SUHIHUHQFLMDV QDPĐ
DWVNLUDV $(, WHFKQRORJLMDV WDLSHSDWLQGĐ
(DV) pagal kitus svarbius ekonominis, socialinius ir aplinkosaugos kriterijus.
Moksli QLR W\ULPR WLNVOR VLHNLDPD QDJULQ¡MDQW

1) $WOLNWL PRNVOLQ¡V susistemintUpagrindines vinkosSåYDO
ydasir barjerus, stabdanþius atsinaujinanþiĐ HQHUJLMRV ir ;Lã WHNOL
2) NXVWDW\WL $(, QDXGRMDQþLĐ HQHUJLMR
GDXJLDNULWHULR YHUWLQLPR '9 LU SDVL

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[1] 6 YRNLDPÄ ÌNLV³ ãLXR DWYHMX YHQDWR JYHQDQþLĐ YLHQDPH E
EHQGU ELXGåHW LU NDUWX EHVLPDLWLQDQþLS EÌGHQWL EÌWL
ÌNLX WDLS SDW ODLNRPDV DWVNLUDL J\YHQDQWLV YLHQDV DV
HNRQRPLNRV VWDWLVWLNĐ QDJULQ¡MDPDV YLHQHWDV

YHUWLQLPR NULWHULMXV QDPÐ ÌNLXRVH M
rodiklius;

3) 3DUHQJWL DWVLQDXMLQDQþLXV QVþLÐ HQHUJLMRV JDP\EHRV WHFKQRORJLMÐ YHUWLQLPR QDP WHFKQRORJLMÐ ³J\YHQGDPÐ³DLQWLP QDPÌ LNR

4) Remiantis sudaryta metodika ir empiriniais duomenimis, atlikti SDVLUHQJLPR PRN¡WL 30 Xå $(, WHFKQRO vartotis HQHUJLMD SDJDPLQWD Lã $(, QDXGRMDQþL

5) Remiantis PM ir ekspertiniu tyrimu, atlikti /LHWXYRV QDPÐ ÌN diegiamÐ AEI technologijÐ SDO\JLQDP M ³apibendrinti YHUWLQLP UH]XOWDWXV pateikti rekomendacijas GDUWLQMR PRGHOLR WD ir jo tobulinimo.

'LVHUWDFLMRMH NHOLDPRV KLSRWH]¡V

1. 9DUWRWRMÐ SDÐ,YLUYLLQDYLPDV tiriamÐjÐ tuo Vos jÐPM Xå $(, WHFKQRORJLMDV QDPÐ ÌNLXRVH
   a) didesnes pajamas gaunantys gyventojai yra linkÐ daugiau mok¡WL Xå AEI technologijas namÐ ÌNLXRVH;
   b) jaunesni gyventojai link daugiau PRN¡WL Xå AEI technologijas QDPÐ ÌNLXRVH
   c) IDELDX vir Lã gyventojai linN daugiau mok¡ti Xå AEI technologijas QDPÐ ÌNLXRVH

2. /LHWXYRV QDPÐ ÌNLÐ 30 Xå $(, yra mažesnis palyginti WHFKQRORJ VX 9DNDUÐ (XURSRV ãDOLPLV

3. Daugiakriteris AEI technologijÐ vertinimas NXULV VXVLGHGD daugiakriterio vertinimo (DV) leidžia palyginti ir suranguoti AEI technologijas, DWVLåYHOJLDQW vartotojÐ preferencijas ir nustatyti Y\ULDXV\E¡V SDUDPRV kryptis $(, WHFKQRORJLMRPV

'LVHUWDFLQLR W\ULPR UH]XOWDWÐ P dokslinis naujumas:

- Parinkti ir susisteminti pagrindiniai kriterijai ir rodikliai, kuriais remiantis atliekamas $(, WHFKQRORJLMÐ VNLUWÐ LQ palyginamasis vertinimas;
- 3DUHQJWDV WHRULQLV PRGHOLV SDO\JLQD QDXGRWL LQGLYLGXDOLXRVH QDPXRVH YH YDUWRWRMÐ SUHIHUHQFLMDV ir pagrindinius QWLV kriterijus, pagal kuriuos QDPÐ ÌNLDL QXVSUHQGåLD GLH energijos technologijas namuose;
- Modelis ³J\YHQGDPÐ SDUHQJLDQW AEI technologijÐ daugiakriterio vertinimo metodik, NXUL VXVLGHGD LV daugiakriterio vertinimo (DV) bei leidžia palyginti ir suranguoti AEI technologijas,

DWVLåQ WVvisuomenės prefeUHQFLMDV LU QXsVWDW\V
paramos AEI technologijoms kryptis;

- Parengta metodika SULWDLN\WD /LHWXYRMH AEI plėtros WHFKQRORJLMĐ GLHJLPR DOWHUQDWyYRV SOLHVDL ³åYDOJDV DSLH /LHWXYRV HQHUJHWLNRV QDF ³GLHJWDV $(, WHFKQRORJLMDV .PLNURJHQHU

Praktinio taikymo sritys. $WOLNWDV $(, WHFKQRORJL QDXGRMDPĐ /LHWXYRV QDPĐ ÌNLXRVH Valstybė JLDN SDVLULQNWL UDFLRQDOL $(, QDXGRMLPR EHL prioritetines skatinimo sritis.

$WOLNXV GDXJLDX NDLS Ogalima teigti, kad LWHUDWWXURV ãD daugeliR PRNVOLQLQNĐ ir %HIIHUDQ, 2003; Dombi ir kt., 2014; Pohekar ir Ramachandran, 2004; Qin, Huang, Chakma, Nie ir Lin, 2008; Wang, Jing, Zhang ir Zhao, 2009; Wimmler ir kt., 2015) naudojamas ir UHNRPHQGXRMDPDV WHFKQRORJLMĐ SDOyJLQD GDXJLDNULWHULQLPĐ (arba daugiakriterio vertinimo (DV) metodas 'DXJLDNULWHUL¡ VSUHQGLPĐ DQDOL]¡ \U VSUHQGåLDQW NRPSOHNVLQHV LåURERLQLD SULLPDQW VSUHQGLPXV G¡O $(, LU MĐ WHFKQR kLQWDPĐMĐ JDOLPD DSVNDLþLXRWL V QDXGĐ LU VWUDWHJLMDV LU MĐ SRYHLN³ DSOLQNDL NLWL NRQWHNVWDV SROLWLQLDL WUÌNXPDL HVWHW kokybiniais W\ULPĐ PHWRGDV VXEMHNW\YLX VSUHQGLPX DQDOL]ė kiekybinius ir kokybinius rodiklius, politikai, pasinaudodami jos rezultatais, gali parinkti tinkamiausias ir inovatyviausias technologijas, kurioms UHLN¡WĐ WHLNWL SULRULWHWXV LU ³ NXULDV suformuluotus tikslus. '9 PHWRGDV \SDþLQJDL QDXGLQJDV VJHULD GYLHMĐ LU GDXJLDX DOWHUQDW\YLĐ DWVLQDXML DV metodu remtis nepakanka. Energijos YDUWRWRMDL yra itin svarbūs EÌWHQW energijos vartotojai PRNDX åVNDW, tai ir sprendimo kontekste DV metodas yra SUDtaS, O³¡ VW³WUDX3N LYHUWLQVLP OHYLLGåLRPHQ³¡V SRåLÌU³ LU Tai SULHLNL '9 PHWRGR $(, WHFKQRORJ SDUDPHWUĐ ³ Darbe SULRULWHWR PXåLNDLV N3 UDV $(, WHF vertinimas DWVSLQGLQWLV QDPĐ ÌNLĐ SUĐ HPLPHWRGFLM leis WĐ DXWL W³ $(,V WHFKQRORJLMĐ PRNXU]Lª WDW WLN HNVSHUWLQLP DSLH WHFKQRORJLMĐ MDL LP J\YHQWRMĐ QXRPRQ

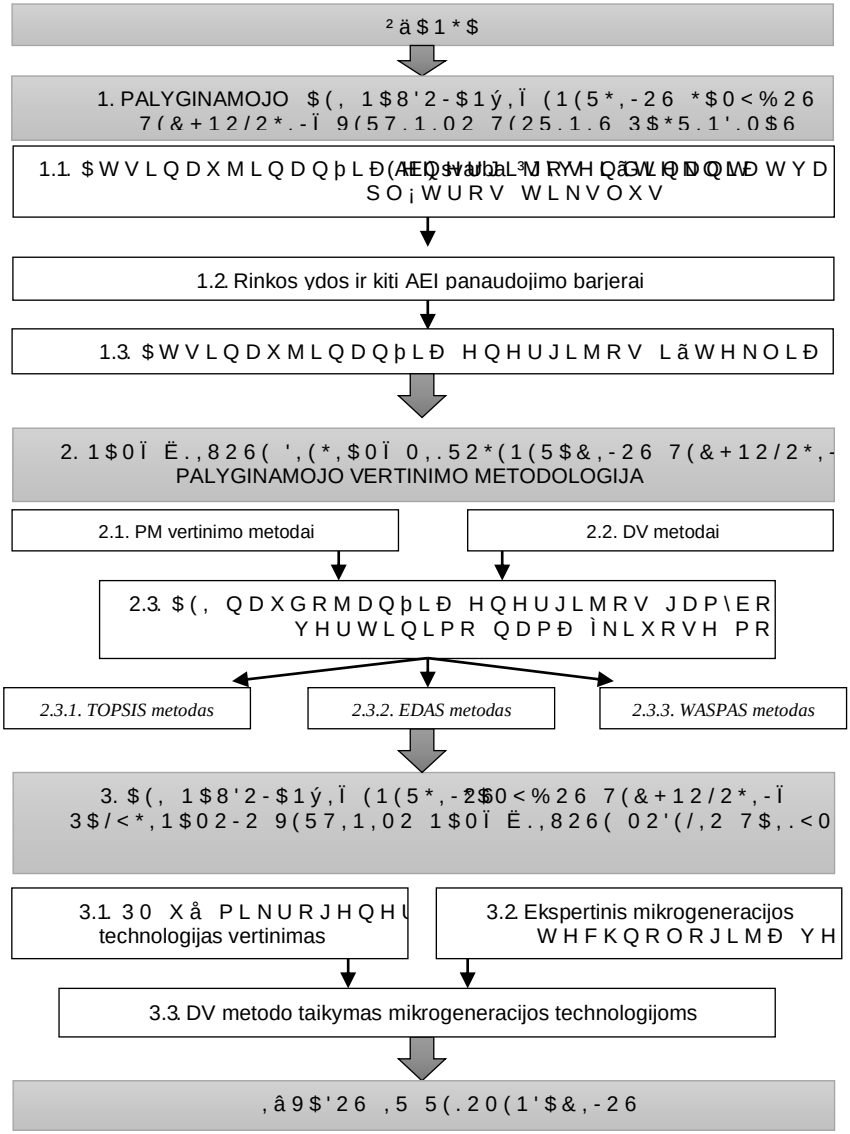
Metodologija. 'LVHUWDFLMRMH EH PRNV,O buvo ¡V OLV naudojamos skirtingos programos: faktorinis projektavimas buvo atliekamas

QDXGRMDQW 5 VWDWLVWLQL vertinimui atlikti buvo naudojama 30 programa STATA, o *Excel* programa buvo naudojama taikant DV PHWRG *Monte Carlo* MDXWUXPR DQDOL]

Darbo VWUXNWnUD. Pirmoje dalyje GD Ä3DO\JLQDPRML QDPXMLQDQþLXV HQHUJLMRV LãWHN JDP\ERV WHFKQRORJLMÐ YHUWLQLPR DWVLQDXMLQDQþLÐ HQHUJLMRV LãWHNOLÐ SO¡WURV WLNVOXV DQDOL]XRMDPRV kartu WYDUXPR YHUWLQLPDV \UD metodas, reikalingas VLHNLDQW DWOLNWL WYDUXPR YHU

Antroje disertacijos dalyje Ä1DPÐ ÌNLXRVH GLHJLDPÐ PL WHFKQRORJLMÐ YHUWLQLPR PRGHOLR NRQFHSFLMD galimai PM tyrimo ir daugiakriterio vertinimo metodai VNLUWL $(, WHFKQRORJLMR individualiuose namuose PLNURJHQHUDFLMRV palyginamajam YHUWLQLPXL 7DLS SDW ãLRMH atlikti parenkamos GDåQLDXVLDL /LHWXYRV QDPÐ ÌNLXRVH QDXGRM diegiamos individualiuose namuose DQDOL]XRMDPL LU kitose ãDO\VH DWOLNWL tyrimai 30 LU '9

7UHþLRMH GLVHUWDFLMRV GDOyje ÄHQHUJLMRV QDXGRMDQþLÐ HQHUJLMRV JDP\ERV WHFKQRORJLMÐ ÌNLXRVH PRGHOLR SULWDLN\PDV kartu 30 LU '9 LãDQDOL]XRMDQW MÐ WDLN\PR PHWRGLNDV ãLD PM vertinimo LU '9 PHWRGR WDLN\PR UH]XOWDWDL SDVLUHQJLPR PRNsuringuotus mikrogeneracijos technologijos QXR JHULDXVLDL YHUWLQDPÐ LNL SUDVþLDXVLD



1 pav. Disertacijos schema

Šaltinis: Sudarytaautorių

1. PALYGINAMOJO $76,1$8-,1$1ý,865 (*1,(26 ,â7(./,86 $(, 1$8'2-$1ý,Ï ENERGIJOS GAMYBOS TECH 12/2*,-Ï VERTINIMO TEORINIS P AGRINDIMAS

1.1. $WVLQDXMLQDQþLÐ HQHUJLMRV LãWHNOLÐ S energetikos SO¡WURV tikslus

âLDPH VN\ULXMH WYDUDXV YLVXRPHQLQLR SO¡WRWHV MDPD $(, V ³J\YHQGLQWLQLV WYDULQLV SO¡WURV WLNVOXV EHL $(, WHL

3DVDXO\MH HNRQRPLQHL SDG¡þLDL NLQWDQW YLHQDV Lã VYDUELDXVLÐ HNRQRPLQLR Y\VW\PR integracinis augimas (European Commission, 2013), Tvaraus augimo arba WYDULR,V VDPSWDUROD DSLEÌGLQDPDV SRåLÌULV ³ SUL¡PLP NXULXR VLHNLDPD Lã WLNUÐMÐ LU L HNRQRPLQLXV VNLUWXPXV 7YDULRV SO¡WURV SROLWLND 2006).

'DXJHOLV WYDULRV SO¡WURV VNLUVWR ³ WUL HNRQRPLQ³ LU $SOLQNRVDXJ³D UHLNDOLQJDV WYD HNRQRPLND \UD SULHPRQ¡ WYDULDL SO¡WUDL VRFLDOLQLV DVSHNWDV \UD WYDULRV SO¡WU YDGRYDV ²J\YHQGLQDQW ãLXRV HNRQRPLQ DSOLQNRVDXJLQLXV ,WHUQDFLRQDOLQ¡ DWRPLQ¡V HQHUJLMRV DJHQWÌUD âWUHLPLNLHQ¡ \UD ÐVPLQLÐ GUVWXPDV pasaulyje darnaus vystymosi tempai, pagrindas (International Atomic Energy Agency, 2006) Ä6LHNLDQW NDG HQHUJHWLND SDODL WYDUL SO¡WUL HQHUJHWLNRV SOâWUD LPLNLDH Ä7YDUL HQHUJHWLND HQHUJLMRV JDP\ED LU YDUWRML åPRQLMRV SO¡WURV WLNVOXV ir aplinkosaugini VRFLDOL DVSHNWXV âWUHLPLNLHQ¡ D

3DVDXOLR YDOVW\E¡V VLHNGDPRV ³J\YHQGLQWL VULW\MH GDåQLDXVLDL VXVLGXULD VX WULPLV

1. Energijos SULHLQDPXPX 7LN SURF SDVDXO 80 proc. pasaulyje pagamintos energijos (United Nations Development Programme, 2000) 0DåGDXJ GX PLOLMDUGDL EH J\YHQWRMDL QHWXUL NRPHUFLQ¡V HQHUJLMRV NDGDQJL DWHLW\MH ãLRVH ãDO\VH GLG¡M SROLWLQLV QHVWDELOXPDV JDOL GDU\WL HNRQRPLNDL LU SHUHLQDPRMR OLNWD Dël socialniam stabilumui (Klevas ir âWUHLPLNLHQ¡ 2 ¡WLQD VWD J\YHQWRMÐ SDUDPRV VLVWHPDV NXULRV X

PDåDV SDMDPRV WXULQþLRPV ãHLPRPV *HUD
SDJU³VWRP ELDOLQ¡ HQHUJLMRV ULQND WDUQD
interesams âWUHLPLNLHQ¡ D

2. (QHUJLMRV WLHNLPR SDWLNLPXPX 7DL JDO
energija bet kuriuo metu ir pakankamais kiekiais bei priimtinomis
kainomis (.OHYDV âWUHLPLNLHQ¡ E). Energijos tiekimo patikimumas
YDLGLQD OHPLDP YDLGPHQ³ EHW NXULRV ãD
RUJDQLQLR NXUR NXULXR SDUHPWD GDXJH
SDVLVNLUVW\PDV SDVDXOLR HJDOHPL\EHV WY\
HNRQRPLNRV JHRSROLWLNRV ir XåWLNULQWL J\ÅWLQLR SDVLQHNJHQ¡ DNRY E

3. (QHUJLMRV JDP\ERV LU YDUWRMLPR QHLJLD
DUED DWVLQDXMLQDQþLX MD Todėl naudojami organinio kuro
LãWHNOLDL NHOLD HNRORJLQLR DULDXU WHFKQRO
%ÌWLQD SO¡VWL LU ³J\YHQGLQWL WHFKQR
GYLGHJLQLR HPLVLMDV WDLS SDW ³J\YHQGL
priemones, pvz., tokias, kaip WDUãRV PRNHVþLÐ DU SUHN
nustatymas âWUHLPLNLHQ¡ E

Taigi pagrindinis darnaus energetikos vystymosi tikslas – XåWLNULQWL
HQHUJLMRV JDP\ED LU YDUWRMLPR DVSHNWÐ DXJLP LU HNRORJLQ³ GDUQXP LãVDXJDQW VWE
JOREDOLQLÐ VâWUXNWÌ UXPLNLH Jankauskas, 2007). 7RG¡O GDUQLRV
energetikos politikos tikslai, siekiant ³J\YHQGLQWL SDJULQGLQLQ
HQHUJHWLNRV Y\VW\PR XåGDYLQLXV \UD XåWLNU

± DXNãWRV NRN\E¡V HQHUJHWLQLÐ SDVODXJ
pasaulio gyventojui;

± SDWLNLP HQHUJLMRV WLHNLP YLGXWLQ¡ ilgalaikėje
perspektyvoje;

± JHUDL VXEDODQVXRWDV HQHUJHWLQLÐ WL
VLVWHPÐ GDUER HIHNW\YXP LU EHQGUDGDU

± energijos gamybos ir vartojimo GLGLQLP pereinant SDþ
ekonomikos ãDO\VH

± QXROLWLQ³ HQHUJHWLNRV SRYHLNLR DSOLQNDL PD
HNRORJLãNDV WHFKQRORJLMDV SHUHLQDQ
(QXOHPLDQþLÐ DPLR GXMÐ LU NW HPLVLM
WHFKQRORJLMÐ LU ODELDX QDXGRMDQW DWVLQDXMLQDQþLXV

Svarbiausias Lietuvos ir visos ES ilgalaikio scenarijaus, siekiant tvarios
HQHUJHWLNRV ³J\YHQGLQLPR HOHPHQWDV WXU¡
pakeitimas DWVLQDXMLQDQþLDLV (darnaus) QH ³PDQRPD XåWLNU
Y\VW\PRVL ÄQHSHUYHGXV³ JOREDOLâ WHPSHUDWÌURV

ýLHJLV -DQND.XVWDV $WVLQDXMLQDQþLRV HQHUJLMR
WHFKQRORJLMRV VPLQLV ³UDQNLV varijami kaip ev VLHNLDQW rgetikos
VLVWHPRV ³WDN SDVDXOLR NOLPDWXL LU
SULNODXVRP\E QXR XåVLHQLR QDIWRV LU GXM
$WVLQDXMLQDQþLDL± aeratiniai, geoterminiai, hidroterminiai
LãWHNOLDL LUHQ YDQGHQ\ML HQHUJLMD ELR
V YDUW\QĐ LU QXRWHNĐ SHUGLUELPR ³UHQJLQ
QHLãNDVWLQLĐ LãWHNOLĐ NXULĐ SDQDXGRMLP
bus galimas ateityje, energija (Lietuvos Respublikos Seimas, 2011). AEI savyje
DNXPXOLXRMD HVPLQHV NRN\EHV G¡O NXULĐ
HQHUJHWLNRV SO¡WURV (WVWLQJRV LU VWDELOLRV)
± $(, UHLãNDLDO GDXJLDX QHLãVHQNDPXP
± JDPWRV SURFHVĐ DS\WDNRV SUDVPH MLH
SDåDQJD RULHQWXRMDPD ³ åPRJDXV YHLN
gamtos apytakos procesais;
± WHFKQLQH SUDVPH SDGDU\WD SDåDQJD \U
pagamintos Lã $(, EUDQJXPR MLH QHJDOL SUDVLY
mastu.
$(, SO¡WUD \UD SDWUDXNOL WUDGLFLQ¡V HQ
HQHUJLMRV naudojimas LãWHNOLDL SDGLGLQD DSOLQNRV
NOLPDWR DWãLOLPRQW³ LãWHNOLDL LãPHWDPĐ GHGDOLPHV
$(, WHFKQRORJLMRV WHLNLD GYLJXE LãRULQ Q
1. $(, WHFKQRORJLMĐ QDXGRMLPDV QH WLN
SUREOHPDV EHW LU VXGDUR V O\JDV NRY
ekonomikos problemomis, taip SDW QHWLHVLRJLDL PDå
WHLJLDPDL YHLNLD ãDOLHV XåLPWXPR O\J³
WHFKQRORJLMRV VNDWLQD SUDPRQ¡V SO¡W
WHFKQRORJLMĐ HYROLXFLMD WUHL AEI technologijas
VLÌORPD GLHPJDåLDX Lã VLYV\VþLDXVLRVHQãLR
V O\JLQDL PDåLDXV HNRQRPLNDL]LDY (Karakosta LU
kt., 2013).
2. Naudojant AEI technologijas, VXVLGDUDQW\V LãRULQLD
PDåHVQL DUED MĐ palyginti VXLWãNDLQWĐ
LãWHNOLDLV ,ãRULQLDLV NDãWDLV DUED
DSOLQNDL NXUL GDUR WUDGLFLQLR NXUR
GXMĐ GHJLQLPDV 'HMDHåOLXJHWLQLĐ VUDXV
NDLQRVH ³ MDV QHDWVLåYHOJLDPD LU VXG
(Bridges ir kt 0LQ¡WRV HQHUJHWLNRV SUR
QHVWDELOLRV R SDþLĐ LãWHNOLĐ sánka DWVD

(Nacionalinis DWVLQDXMLQDQþLĐ LãWHNOLĐ HQHU
7DLJL LãRULQLĐ LãODLGĐ QH³YHUWLQLPDV
WHFKQRORJLMĐ SUDVLVNYHUELPKlevas,³ ULQ
âWUHLPLN)LHQ¡

7DLJL QRUV DWVLQDXMLQD i privatūs ir QHUJLM
DNLYDL³GNÌVWLQ³ NXU YDUWRMDQþLĐ VLVWHPĐ
QHOHLGåLD LãVWXPWL ³SUDVWRV HQHKlevas, MRV UÌ
âWUHLPLN)LHQ¡

1.2. Rinkos ydos ir kiti DWVLQDXMLQDQþLĐ HQHUJLMRV (AEI) panaudojimo barjerai

$WVLQDXMLQDQþLĐ HQHUJLMRV LãWHNOLĐ Q
SULYDOXPĐ OHLGåLD VXNXUWL QDXMDV GDUER
³UHQJLQLĐ VWDW\ERV LU HNVSORDWDYLPR JUDQ
HQHUJLMRV LãPV PDåLQD HQHUJHWLNRV (Galinis ir kt., OLHV
2010) âLRV WHFKQRORJLMRV \UD ³YDLULDO\S¡V WF
QXR GDXJHOLR DSOLir kt., 2010). Atsinaujinančių energijos
ULERMD YDUåR QH LãWHNOLDL EHW WHFKQRORJ
WRG¡O VYDUEX DSLEU¡åWL NLHNYLHQR Lã ãLĐ YH

± Rinkos potencialas ± VLHNLDPD NDG UHLNDOLQJDV
HQHUJLMRV NLHNLV PDåWĐ SURJQR]XRMHPLDQ
ULQN ULERMDQþLRPLV V O\JRPLV NXULDV I
LU UHJXOLXRMD YDOGåLRV LQVWLWXFLMRV
ODXNLDPRPLV SULYDþLRPLV SDMDPRPLV L
SULYDþLRPLV NDLþLXRMDQW LU VXEVLG
SULYDþLRPLV GLVNRQWR ir kt., 2010). Pasaulio 9HUEU
YDOVW\E¡V VNLULDVL VDYR HNRQRPLNX N
SROLWLNRPLV WDLJL LU ULQNRV SRWHQFL
ski UWLQJDV 9HUWLQDQW VXLQRPHV LãWHNOLĐ
QHDSLEU¡åWXPR O\JLV NDG, kaip ekonominio SDQRP
YHLN¡MDL VXUHDJXRV ³ WDP WLNUXV SRO
QXVWDW\W NDLQĐ O\J³ YDUWir kt., 2010) SUHIHU

± Ekonominis potencialas ± DWVLQDXMLQDQþLRV HQH
SURJQR]XRMDPDV WXRPHW NDL \UD ³WUDXN
VRFLDOLQ¡V LU SULYDþLRV LãODLGRV 5HD
³YHUWLQDQW WLHNLR HQHUJLMRV YDUWRMLPR
DWVLUDQGDQW\V QHLJLDPL LãRULQLDL YHLN
VRFLDOLQ¡V GLVNRQWR QRUPRV VXEDODQV
(Verbruggen ir kt .RO NDV ãLV SRWHQFLDOD

1RULQW M³,vieQYHQ GLQPHLMD åLQJVXQLPHQ¡XU JHURY¡V VLHNLDPRLarba tarpu LUJ\UHãYRULQLÐ NDãWÐ LQW LãRULQLÐ NDãWÐ SDGDULQLÐ NRPSHQVDYLP WUDGLFLQLR NXUR GHJLQLPR SDVWDQJR QDXGD ãLXR DWYHMX WXU¡WÐ jDWMXVLLÐ galutiniai vartotojai (Verbruggen ir kt., 2010). Kaip ir prognozuojant ULQNRV SRWHQFLDO WDLS LU HNRQRPLNRV QHDSLEUÐ åWXPR O\JLV yra didelis apãsvarstant VXNHOLDPÐ QHLJLDPÐ SDGDULQLÐ ir kt., 2010).

± Darnaus vystymosi potencialas ± UHLNDOLQJDV DWVLQDXM kiekis JDXQDPDV WXRPHW NDL WYDUL is SO¡WU aspektais: aplinkos, ekonominiu ir socialiniu ýLD WDLS SDW UH HNRQRPLQLR DVSHNWR DWVLNDUWHL SROLWLãNX DGPLQLVWUDYLPX \UD VLHNLDPD SO¡WRWL HNRQRPLQLV LU VRFLDOLQLV LQWHUHVDL integruojami (Verbruggen ir kt., 2010).

± Techninis potencialas ± DWVLQDXMLQDQþLRVLRV energijos kiekis panaudojant naujas technologijas ar praktikas (Verbruggen ir kt., 2010).

Taigi egzistuojantys technologiniai, ekonominiai ir politiniai veiksniai VXGDUR EDUMHUXV ³YDLULRPV $(, WHFKQRORJLM QHDWVLVNLULDQþLRV QDXMRV SURGXNWÐ ULQNRV N plaþLDX AEI integruoti ³ EHQGU HQHUJHWLNRV VLVWHPRV WD aplinkosaugos, socialiniai, ekonominiai WHFKQLQLÐ LU LQ SUDWLãNL YHUWLQJ SODWHVQL (Mourmouris ir Potolias, 2013) kurie LãDQDOL]XRMDPL LU DSLEHQGULQDPL ãLDPH VN\

/¡WD $(, WHFKQRORJLMÐ VNODLGD DLãNLQD (Negro, Alkemade, Hekkert, 2012) 3LUPRML QHRNODVLNLQ¡ paradigma HN WHLJLD NDG± WLR LãNLãWRVL ULQNRV VWUXNWÈURV VLVWHPRV \GRV 6LHNLDQW WDLNRPRV ³YDLULRV lengvatos ir skatinantys tarifai (parama atitenka YLVLHPV HQHUJLMRV JDPLQWRMDPV QDXGRMDQ yra YLHQNDUWLQ¡ SDUDPD ,QYHVWLFLQLÐ O¡ãÐ ULERMDQþLDV SULHPRQHV (Gallin ir kt., 2010) 7Dþ LDX GDåQDL ULQND EÈQD ãLXR SDOLNXRWD OHQJYDWRV QHSDVLHNLD WLNVOLQLR DGUHVDWR 1HJUR $ONHPDGH +HNNHUW â³ QHRNODVLNLQ¡ SDUDGLJPD NXULD UHPLDQWLV SDEU Teigiama NDG LQRYDFLMÐ JUHLWLV veikia aplinka kurioje LU V ãLRV LQRYDFLMRV Y\VWRPRV 1HJUR $ONHPDG

YDGLQDPD LQRYDFLMĐ VLVWHPD WHFKQRORJLQ
,QRYDFLMĐ VLVWHPRV ir WHFKQRORJLMRV EQ¡V GDO\YLĐ WDLV
U\ãLĐ VLVWHPRV SDODLNDQWL ,Vtiga, kad På rinkos
WUÌNXPDL HJ]LVWXRWL LU GDXJ\E¡ NLWĐ ai VLVWHP
LQRYDFLMD, aiM¨ skliau. ¡Vl G¡OWD Q LkaipV vagintin³ $(, SO¡WURV
stabd³ HNRQRPLVWDL ³YDUGLMD ULQNRV EDUMHUXV
VNLUVWRPL ³ âWUHLPLNLHQ¡ 3DUHLJLV

± komercinius barjerus ± DWVLUDGXVLRV G¡O QDXM
NRQNXUHQFLMRV Vogijimis; SUDVWRPLV WHFKQRO
± NDLQĐ Lã NUG¡LS \PDVQĐ VXEVLGLMĐ LU QHO\
$(, WHFKQRORJLMRPV SDO\JLQWL VX ³SUDVW
± rinkos ydas ± QH³YHUWLQW $(, YLVXRPHQLQ QDX
± rinkos barjerus ± WRNLXV NDLS QHDGHNYDWL LQIR
NDSLWDOR DSULERMLPDL SDVLNHLWLPDV LQ
QXRPLQLQNĐ EHL GLGHO¡V VDQGRULĐ NDLQR
pat instituciniai barjerai.

1RU¡GDPL NRQNXUXRWL VX WUDGLFLQ¡PLV W
organinio ir brDQGXROLQLR NXUR QDXGRMLPDV $(, WX
NRPHUFLQLXV EDUMHUXV QHLãSO¡WRW LQIUDVW
QHEXYLP EÌGLQJ WUDGLFLQ¡PV WHFKQRORJLM
3O¡WRMDQW QDXMXV $(, EÌWLQRV WHFKQRORJLMRV
QDXMDL LQIUDVWUXNWÌUDL VXIRUPXRWL. Elektros WDþLD
HQHUJLMRV SDJDPLQWRV Lã $(, WLHNLPR V
âWUHLPLNLHQ¡ 3DUHLJLV

.DUWDLV EDUMHUDL ir tarpusavyje susi. Akademinis sprendimus
LQYHVWXRWL ³ QDXMDV G¡O WHFKQRORJLMĐ V¡NPLQ
$(, LU MĐ WHFKQRORJLMDV SLUPLDXVLD EÌWLQD
VWDEGDQþLXV EDUMHUXV LUAnagnostopoulou, 2014).QWL
3DY\]GåLXL PDå Y¡MR LU SRWY\QLĐ HQHUJLM
pasauliniame energijos panaudojimo kontekste. WHFKQRORJLMĐ
JDP\ERV V platus rasto ir pluoJimai (Hadian, Madani,
2015). Apibendrinant galima teigti, kad VNLUWLQJL ãDO\VH QDXGR
WHFKQRORJLMRV WDLS SDW, MDXQDXGRMLPDV
HNRQRPLQ¡ DSOLQND MDX PrLnkos ydos ir kitLQHLRV SR
SDQDXGRMLPR EDUMHUDLN³YDLULRV HWDLJ\V HUJPL
ãYHOQLQL SULHPRQ¡V WXUL EÌWL SULWDLN\WRV DWV

1.3. $WVLQDXMLQDQþLĐ HQHUJLMRV LãWHNOLĐ WHFKQRORJLMĐ vertinimas

5HLNLD SDEU¡åWL NDG $(, WHFKQRORJLMRV os XåWLNULQD WYDUXP \UD WHFKQLãNDL SDJU³VWD SULLPWLQRV WUDGLFLQLR EHXU ¡ LU ÌVWLþLDXVLDV HNRQRPLQLDL G L G¡ Instaliacijos kaina, gamybos prieinamumo svyravimai (Dombi ir kt., 2014; Stigka ir kt., 2014). Nepaisant to, mokslininkai sutaria, kad VSUHQGåLDQW ekologines problemas, YLHQLQWHOH LãHLWLPL WDPSD WU SDNHLWLPDV DWVLQDXMLQDQþLDLV (Hadian ir Madani, 2015).

3ULHã LQYHVWXRMDQW ÌVWLS $(, WHFKQRORJLMDV ir atlikti AEI technologijĐ WYDUXPR YHUWLQLP SULLPWL RS energijos tiekimo sprendim ± ne visos AEI technologijos JDOL SDVLÌ WYDULDXVL NRQ NRQNUHþLRMH YLHWRMH (Luong, Liu ir Robey, 2012). Itin svarbu DWUDVWL SXVLDXVY\U WDUS HNRQRPLQLR SO¡WURV DSVHNWĐ 7HFKQRORJLMĐ WYDUXPR technologijas NXULRV Lã WLHVĐ XåWLNULQWĐ WYD DSOLQN (Luong ir kt., 2012).

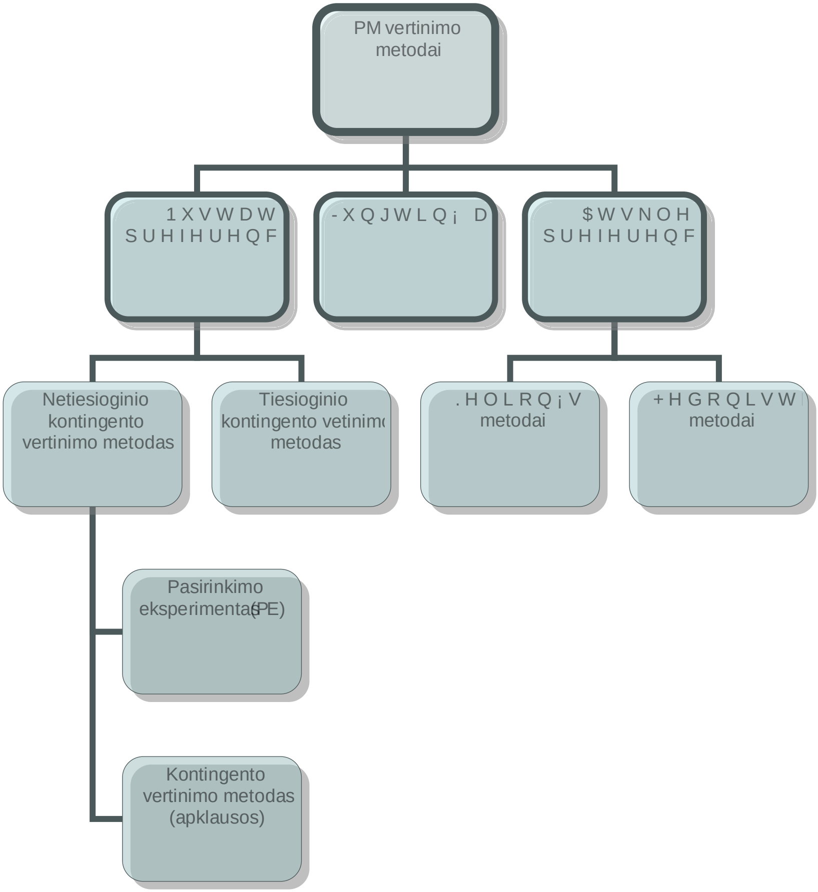
6LHNLDQW WYDULRV SO¡WURV SROLWLNRV YHLN problemas, nesukurdami QDXMĐ (Gohari ir kt., 2013; Hadian ir Madani, 2015; Hjorth ir Madani, 2014). R $(, WYDUXPR YHUWLQLPDV, JDOL taip pat XåNLUVWL dalbas VNHOL JDOLPLHPV $(, 9SLH¡QWDUV LãEDLJRV YHUWLQLPR GDXJLDX GDWHU¡ YHUWLQLPĐ '9 DUE WLQNDPDV SDVLULQNLPDV VSUHQGåLDQW NRP dideliais QHDSLEU¡åWXPDLV SULHãWDULQJDLV WLH LQIRUPDFLMRV IRUPRPLV HVDQW perspektyvoms bei VXG¡WLQJĐ LU EHVLSOHþLDQþLĐ ELRIL]LQLĐ E apskaita (Wang ir kt., 2009). 'DXJHOLV LãRULQLĐ NLQWDPĐM VSUHQGLPXV GWHFKQRORJLMĐ .DL NXULXRV Lã DSVNDLþLXRWL WDþLDX NLWL YHLNVQLDL WRN SROLWLQLDL WUÌNXPDL HVWHWLQLDL DVSHNWD subjektyviu sprendimu. '9 OHLGåLD ÌYHUWLQWL NULWHULMĐ SULLPDQþLDP DVPHQLXL NDL \UD GHHUQLDL, socialiniai HN LU NW NULWHULMDL EHL SDULQNWL JHULDXV AWVDNLQJL Xå VSUHQGLPD. Laisvai parinkti rezultatais, gal SDULQNWL WLQNDPLDXVLDV LU LQRYDW\YLDXVL prioritet LU ³ NXULDV UHLN¡WĐ RULHQWXRWLV SDJD PHWRGDV LU ³YDLULRV VNLUWLQJRV ãLL atlikti PHWRG DWVLQDXMLQDQþLRV HQHUJLMRV VLVWHPRV W HVPLQLV ãLR PHWRGR SUDQDãXPDV LU VXYRNLPR YLVXRPH

SUHIHUHQFLMÐ NXULH GHPRNUDWLQLÐ VLHNLDQW Be to, siekiant DOVW\
socialiai optimaliai iQYHVWXRWL ³DWVLQDXMLQDQþL HQH
$(, WHLNLDP LãWHNOLDP (Bergmann ir kt., 2006). 3DVDXO\MH AEI LãRULQ
naudai nustatyti WDLNRPDV J\YHQWRMÐ SDVLULQNLPDV
technologijas YHUWLQLPDV QHV MLV OHLGåLD ³SUHWHL
MLHPV WHLNLDPV DWVLåYHOJLDQW ³YLVXRPHQ¡V SU
SDVLUHQJLP PRN¡WL EHL VNDWLQWL Energijos NRQNUHþ
YDUWRWRMR SR åLÌUHV \³ $(, WHFKQRORJLMDV \UD Y
VXVLMXVLÐ su AEI panaudojimu. Tad GLVHUWDFLMRV DXWRU
daugiakriter³ $(, WHFKQRORJLMÐ EÌVHLQLÐ 3OHJPHX WRG
DWVNOHLGåLDQW ³ HQHUJLMRV YDUWRWRMÐ SRUH preferencijas.

2. 1$0Ï Ë.,826(',(*,$Ï0 0,.52*(1(5$&,-26 7(&+12/2*,-Ï 3$/<*,0 OJO VERTINIMO METODOLOGIJA

2.1. PDVLUHQJLPR PRN¡WL vertinimo metodai

3DVWDUDLVLDLV PHWDLV W\ULPÐ QDJULQ DWVLQDXMLQDQþL HQHUJLMÐ srityje, Pasirinkimo eksperimento WHFKQLNRV
LãDXJR LU VXULQNWL (Sundt ir Rehdanz, 2015). Be to, mini WD
W\ULPÐ VSHNWUDV \UD LWLQ SODWXV VNLULD
HQHUJHWLN DSUDãDQWL FKDUDNWHULVWLND EH
egzistuoja LU GDXJ\E¡ VNLUWLQJÐ (pvz., Johnson ir Nemet PHW
ir 1HPHW 0HQHJDNL ir Mikalauskienė, 2014; Sundt ir
Rehdanz, 2015) NXULH LãVDPLDL LãQDJULQ¡MDPL ãLDPH



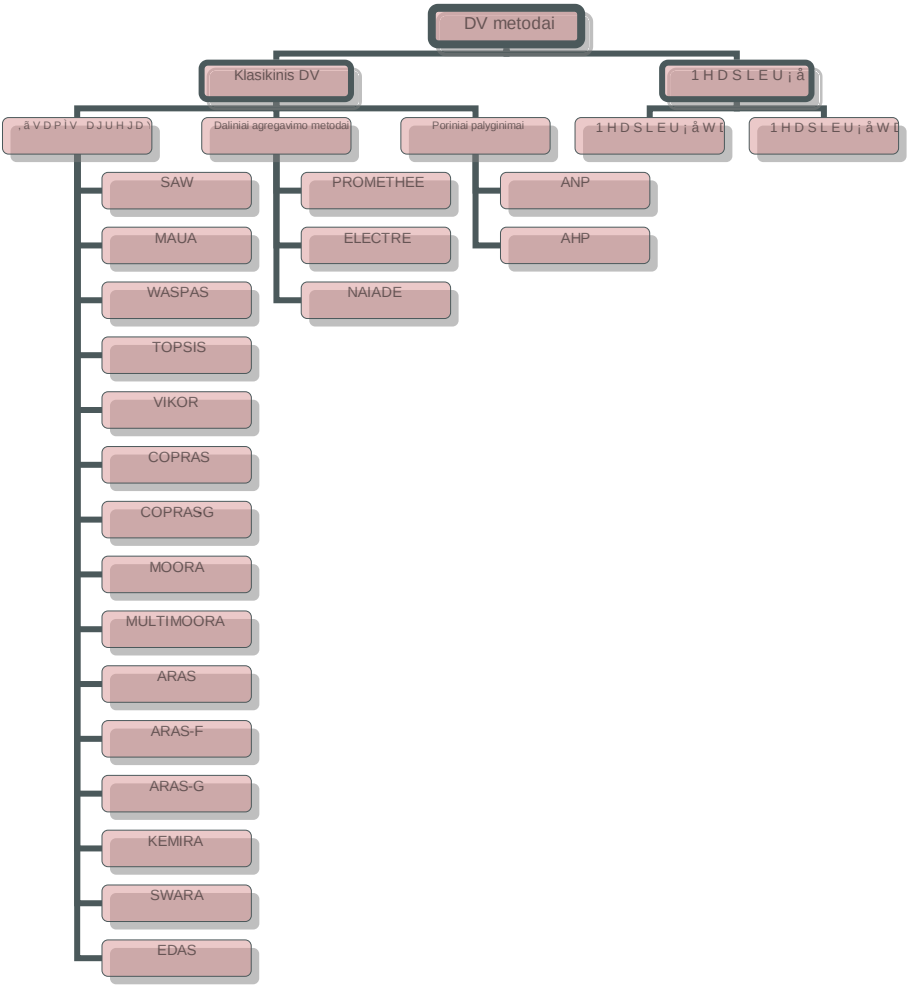
2 pav. PM vertinimo metodai

Šaltinis: Sudaryta autorės

5HQNDQWLV WDUS GYLHMŲ HNRQRPLQLŲ PNŲ PHW $(, WHFKQLNRV GLDJLDPĐ QDPĐ ÌNLXRVH PLNŲURJHQ vertinimui atlikti, pasirinkimo eksperimento (PE) ir kontingento vertinimo PHWRGR YHUWD SDå\P¡WL NDG SDVWDUXRMX PHWX vertinimo sferoje dominuoja PE (Navrud ir Bråten, 2007.) Be to, taikant QXVWDW\WĐ SUHIHUHQFLMĐ PHWRGXV PLNURJHQ DSLEÌGLQDQþLXV NULWHULMXV

2.2. Daugiakriterio vertinimo (DV) metodai

âLDPH VN\ULXMH LãDQDOL]XRMDPL LU VXVLV NXULH SDVWDUDLVLDLV PHWDLV GįO GLGįMDQþL $(, WHFKQRORJLQLR LU (NRQRPLQLR)L PR



3 pav. DV vertinimo metodai

Šaltinis: Sudaryta autorės

'DXJHOLV '9 yra PHWRGDL NRQNUHþLDL SUREOH
metodai netaikomi kitoms problemoms (Mardani, Jusoh ir Zavadskas, 2015), vis
G¡O WR JDOLPD Lã VNLUWL GYL SNDLþLDYLQLR ³ SLDLWH¡å
.ODVLNLQLDL '9 PHWRGDL VNLUWL NRPSOHNV
QXURGRPDV WLNVOXV DOWHUQDW\YÐ LU NRN\E
VNDLsþLX

2.3. $WVLQDXMLQDQþLXV HQHUJLMRV ãDOWLQLXV JDP\ERV WHFKQRORJLMÐ SDO\JLQDPRMR YHUV

6LHNLDQW ³YHUWLQWL PLNURJHQHUDFLMRV
Lietuvoje, tyrimui atlikti DWULQNWRV ãLRV WHFKQRORJLMRV: VDXOLþ
HOHNWULQ¡ ãLOXPRV NDWLODL Y¡MR HOHNWULQ¡V $Q
QXVWDW\WL Lã SDVLU heterogenine kontingento vertinimo pasirinkimo
eksperimento metodu, kai respondentai yra apklausiami pateikiant jiems
SDVLULQNLPR HNVSHULPHQWX JULQGåLDPRMH D
NULWHULMÐ UHLNã PHV %XYR SDVLULQNWL WH
1) WHFKQRORJLMRV NDLQD NDUWX VX ³UHQJLP
2) YLGXWLQ¡V LãODLGRV energijai SXåVTLQDXVLQ DW
3) technologijai suteikiama garantija
4) VSHFLDOLRV ³UHQJLQ¡ atba sistemos sukeliami LU nepatogumai;
5) JDOLP\E¡ parduoti pagaminta energija dalis su kaimynais.
6LHNLDQW DWOLNWL SDO\JLQDP M³ PLNURJ
/LHWXYRMH SDQDXGRMDQW '9 PHWRG EXYR SD
(NVSHUWÐ EXYR SUDãRPD ³YHUWLQWL, kaip SDþL
ir PM tyrime, tik remiantis aplinkosaugos, socialiniais, ekonominiais,
energetiniais, technologiniais ir politiniais kriterijais (1 lHQWHO¡) pagal Likerto
VNDO 7DLJL PLQ¡WRV PLNURJHQHUDFLMRV WHF
kriterijus DWLWLQNDQþLDV VDQþOLDXV SLE³GXRWL EDXOLQH¡V NROHNWRU
HOHNWULQHV ELRNXUR NDWLOXV LU Y¡MR HOHN

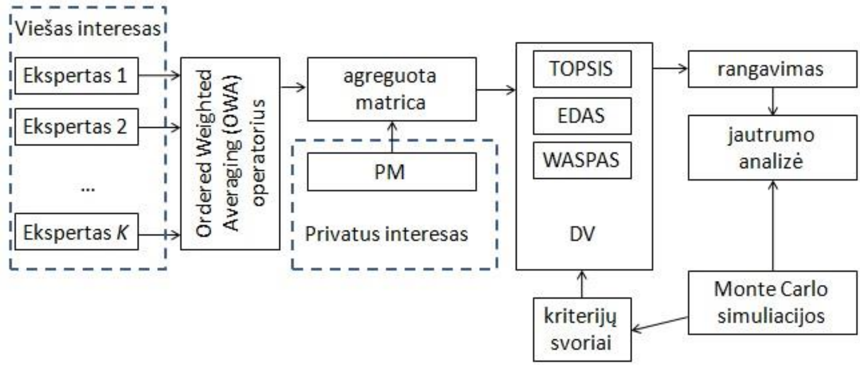
OHQWHO¡ '9 metodo kriterijai ir rodikliai

KRITERIJAI	.ULWHULMÐ DSLEÌGLQDQW\V 52'	
	Tvarumo rodiklis	Tiekimo patikimumo rodiklis
Aplinkosaugos	• Sukeliamas WULXNãPDV • CO_2 HPLVLMÐ atmosferoje • 8åLPDPDV åHP¡V SORW	• Prisitaikymas prie klimato kaitos

Socialinis	• Priimtinumas YLVXRPHQ¡M • 'DUER YLHW • 6RFLDOLQ¡ (	
Ekonominis	• Technologijos NDLQRV PDå • Eksploatavimo ir SULHåLÌURV • Trumpas atsipirkimo laikotarpis	• Jautrumas kuro NDLQĐ SRN
Energetinis		• Rinkos koncentracija tiekimui
Technologinis	• 3RWHQFLDO rinkos dydis • Potencialus WDUSWDXWL dydis	• 7HFKQRORJ branda • ,QRYDFLMĐ
Politinis		• Prisideda prie ãDOLHV H(QHSULNODX PDåLQLPR

Šaltinis: Sudaryta autorės

7DLJL W\ULPDV EXYR VXGDU\WDV Lã G.YLHMĐ 6LHNLDQW QXVWDW\WL HNVSHUWŲ, buvo panaudotas PRQJDLĐ VX (Ordered Weighted Average) operatorius WXRPHW 30 LU HNVSHUW UH]XOWDWDL EXYR DJUHJXRWL ³ YLHQ PDWULF DV metodai (TOPSIS, EDAS ir WASPAS), remiantis 17 LQGLNDWRULĐ LU papildomu ±30 DWVSLQGLQþLX YDUWRWRMĐ QXRPRQ technologijas. Pritaikius skirtingus DV metodus, EXYR QXVWDW\WL VNLU svertiniai vidurkiai, tad *Monte Carlo* metodu EXYR DWOLHNDPD ±MDXWU ãLRV DQDOL]ĖV, ar GDXJ WLNLXRVL QHGLGHOLXV SUHIHU GXRPHQĐ S, galutinis rezultatas nepasikeis. Galiausiai mikrogeneracijos WHFKQRORJLMRV \UD VXUDQJXRMDPRV QXR JHU YHUWLQLPR DX SDWHLNLDPDV WHEKQRORJLMĐ FLYMH modelis.



4 pav. PDO\JLQDPRMR PLNURJHQHUDFLMRV WHFKQRO

Šaltinis: Sudaryta autorės

3. ATSINAUJINANČIUS ENERGIJOS IŠTEKLIUS (AEI) NAUDOJANČIŲ ENERGIJOS GAMYBOS TECHNOLOGIJŲ PALYGINAMOJO VERTINIMO NAMŲ ŪKIUOSE MODELIO TAIKYMAS

3.1. 3DVLUHQJLPR PM)RNXåWLPLNURJHQHUDFLMRV V vertinimas

30 Xå VDXO¡V NROHNWRULXV NXULDPRO¡V elektrines buvo parengtas remiantis pasirinkimo eksperimento metodu, nurodant ãLDV NRQNUHþLDV(2 NUHLWHULMÐ UHLNãPHV

OHQWHO¡ 7HULMDL LU MÐ UHLNãP¡V QDXGRMDPL GLVN eksperimentui atlikti

Kriterijus	5HLNã nr. 1	5HLNã nr. 2	5HLNã nr. 3	5HLNã nr. 4
1. Technologijos kaina kartu su ³UHQJLPX (85	1500	3000	4500	6500
2. 9LGXWLQ¡V LãODL HQHUJLM SHU P¡Q	16	30	35	38
3. Technologijai suteikiama garantija, metai	2	5	10	13
4. 6SHFLDOLRV ³UHQ ir/arba sistemos sukeliami nepatogumai	Oras	Kuras	7ULXNã	1¡UD

5.	*DOLP\E¡ WHFKQR pagaminta energija dalytis su kaimynais	Labai åHPD	äHPD	9LGXW	'LGHO

Šaltinis: Sudaryta autoriaus

,PWLHV SDWLNLPXPDV EXYR QXVWDW\WDV 3DWLNLPDL LPþLDL EXYR UHLNDOLQJL UHVSRQ DWVDN¡ UHVSRQGHQWDL

3.2. (NVSHUWLQLV PLNURJHQHUDFLMRV WHFKQRORR

HNVSHUWĐ NXverslo atstovai, 3 politikai ir 6 mokslo DWVWRYDL DWOLNR WĐ SDþLĐ PLNURJHQHUDFLM HOHNWULQLĐ ELRNXUR NHUWLQLPĄ YHUWLQLPR DQNHWOHQWHO¡

OHQWHO¡ Ekspertinio vertinimo anketa

Nr.	***Technologiją X** apibūdinantys veiksniai*	*Vertinimo lygis*				
		Nesutinku				*Sutinku*
1.	7HFKQRORJLMRV ; QDXGRMLPDV VX	1 ‘	2 ‘	3 ‘	4 ‘	5 ‘
2.	Technologijos X naudojimas prisideda prie Č2 HPLVLMĐ atmosferoje augimo	1 ‘	2 ‘	3 ‘	4 ‘	5 ‘
3.	7HFKQRORJLMDL ; ³UHQJWL UHLNDO MLH LãNUDLSR JDPWRYDL]G³	1 ‘	2 ‘	3 ‘	4 ‘	5 ‘
4.	7HFKQRORJLMRV ; \UD DWVSDULRV HNVWUHPDOLHPV PHWHRURORJLQL	1 ‘	2 ‘	3 ‘	4 ‘	5 ‘
5.	7HFKQRORJLMRV ; QHSDODQNLDL Y	1 ‘	2 ‘	3 ‘	4 ‘	5 ‘
6.	7HFKQRORJLMRV ; QDXGRMLPDV VX (tiesiogiai arba netiesiogiai)	1 ‘	2 ‘	3 ‘	4 ‘	5 ‘
7.	Technologijos X naudojimas teigiamai veikia viso regiono VRFLDOLQ SDåDQJ	1 ‘	2 ‘	3 ‘	4 ‘	5 ‘
8.	7HFKQRORJLMRV ; NDLQD QXRODWR	1 ‘	2 ‘	3 ‘	4 ‘	5 ‘
9.	7HFKQRORJLMDL ; EÌGLQ JRLVUGSLUGHC LãOPDLGRV	1 ‘	2 ‘	3 ‘	4 ‘	5 ‘
10.	7HFKQRORJLMD ; atsiperkamo laikotarpiu	1 ‘	2 ‘	3 ‘	4 ‘	5 ‘
11.	7HFKQRORJLMRV ; NDLQD \UD MDXW svyravimams	1 ‘	2 ‘	3 ‘	4 ‘	5 ‘

12.	'LGHO¡ WHFKQRORJLMRV ;NRQFHQV VLVWHPRV VWDELOXP	1 ‘ 2 ‘ 3 ‘ 4 ‘ 5 ‘
13.	7HFKQRORJLMRV ; SDVLå\PL GLGHO	1 ‘ 2 ‘ 3 ‘ 4 ‘ 5 ‘
14.	7HFKQRORJLMRV ; SDVLå\PL GLGHO	1 ‘ 2 ‘ 3 ‘ 4 ‘ 5 ‘
15.	7HFKQRORJLMD ; WHFKQRORJLãNDL SDVDXOLQ¡MH ULQNRMH	1 ‘ 2 ‘ 3 ‘ 4 ‘ 5 ‘
16.	7HFKQRORJLMDV ; WHFKQRORJLãND	1 ‘ 2 ‘ 3 ‘ 4 ‘ 5 ‘
17.	7HFKQRORJLMRV ; QDXGRMLPDV SU QHSULNODXVRP\E¡V SO¡WURV	1 ‘ 2 ‘ 3 ‘ 4 ‘ 5 ‘

Šaltinis: Sudaryta autorės

3.3. Daugiakriterio vertinimo (DV) metodo taikymas mikrogeneracijos technologijoms

$SLEHQGULQDQW $(, WHFKQRORJLMÐ GLHJ (mikrogeneracijos WHFKQRORJLMÐ SDO\JLQDPRMR YHU SDWHLNLDPXV OHQWHOÙMH. Tyrimo rezultatai pateikti YHUWLQLPR ŠDOWLQLPHLVJWLX VN LU '9 QXURGDQþLRNXUR NDWLODL LU VDXO ³YHUWLQWL NDLS JHULDXVLRV PLNURJHQHUDFLM technologijos.

OHQWHOÙ. 0LNURJHQHUDFLMÐ SDO\JLQDPRMR YHUWLQLPR U

METODAS	TOPSIS				EDAS				WASPAS			
TECHNOLOGIJA / RANGAI	6DXO¡V N	6DXO¡V H	Biokuro katila	9¡MR M	6DXO¡V N	6DXO¡V H	Biokuro katila	9¡MR M	6DXO¡V N	6DXO¡V H	Biokuro katila	9¡MR M
1	0,5142	0,0450	0,4408	0,0000	0,2506	0,1170	0,6324	0,0000	0,1816	0,2244	0,5940	0,0000
2	0,4740	0,2700	0,2558	0,0002	0,6682	0,1686	0,1630	0,0002	0,6114	0,2340	0,1544	0,0002
3	0,0114	0,6850	0,2978	0,0058	0,0808	0,7144	0,2042	0,0006	0,2064	0,5416	0,2512	0,0008
4	0,0004	0,0000	0,0056	0,9940	0,0004	0,0000	0,0004	0,9992	0,0006	0,0000	0,0004	0,9990
STABILUMAS	51,42	68,5	44,08	99,4	66,82	71,44	63,24	99,92	61,14	54,16	59,4	99,9
SUTEIKTI RANGAI	1	3	2	4	2	3	1	4	2	3	1	4

Šaltinis: Sudaryta autorės

, â 9 $ ' 2 6 IR REKOMENDACIJOS

1. $ W O L N X V L ã V D P L Q L E W X H Y R D S W Ù U L R V W D S å S Y D L H J L
S O D þ L D X S D Q D X G R W L $ (, W U X N G R ³ Y D Barjerus E D U M H
J D O L P D V X V N L esminius sektorius N H W D L D S O L Q N R V D X J R V
V R F L D O L Q ¡ V H N R Q R P L Q ¡ V W H F ¡ K Q L Q ¡ V kaip V L Q L V W
pagrindin³ $ (, S O ¡ W U ³ R W R V W R D P E L G V W D L ³ Y D U G L M D U L Q N R V
Rinkos barjerai±tai neadekvati informacija, p L ¡ M L P R S U L H N D S L W D O
S D V L N H L W L P D V L Q L F L D W \ Y R P L V W D U p S G Q G H Ð ¡ W D
V D Q G R U L Ð N D L Q R V G D U D Q W P D å X V S L U N L P X V W
ydos ± W D L Q H ³ Y H U W L Q W D $ (, N Y L W D X L R S P H Q W a L ¡ H L Q W D X G Q
L ã R U L Q ¡ Q D X G D $ (, V N D W L Q L P R S U L H P R Q ¡ V \ U D
³ Y H L N K L P H N Y L H Q D Y D O V W \ E ¡ W X U L V D Y R $ (, V N D W
³ Y D L U L D L V E Ì G D L V W R G ¡ O S D V L Q D X G R M D Q W J H
W H F K Q R O Rinkti tyti pagrindines AEI technologijas, kurioms Lietuvos
Q D P Ð Ì N L D L W H L N L D S L U P H Q \ E W D L S Q X V W D W
N R Q N U H þ L R P V W H F K Q R O R J L M E P L V H Q $ (, V sektoriuje Ð R Y
X å N L U V W L N H O L P L Q ¡ W L H P V E D U M H U D P V

2. Egz L V W X R M D G D X J \ E ¡ vertinimo $ (, W Y H D U R G asaul L Q ¡ M H
S U D N W L N R W H L N G R å Q D L J \ Y H Q W R M Ð S D V L U H Q J L P R
5 H P L D Q W L V L ã D Q L Ð X L \ R Q X V W L W H W D W ã L U H D S D J U L Q
kriterijai: technologijos kaina kartu su³ U H Q J L P X Y L G X W L Q ¡ V L ã O D L
H Q H U J L M S H U P ¡ Q H V ³ W H F K Q R O R J L M D L V X W ³ U L H
V O \ J R V D U U E D V L V W H P R V V X N H O L D P L Q H S D W R J X
pagaminta energija dalytis su kaimynais. Daugiakriterio vertinimo (DV) analiz ,
kuri G D X J H O L R P R N V O L Q L Q N D P kaip itin tinkama H t Q G X R M D P
vertinimui, E X Y R ³ W U D X N W L ã L H $ (, W H F K Q R O R J L M Ð
V X N H O L D P D V W H U P L X V L ã P D V N L & 2 N L V D W P R V I H U R M H
S O R W D V S U L V L W D L N \ P D V S U L H N O L P D W R N D L W R
N Ì U L P D V V R F L D O L Q ¡ Q D X G D W H F K Q R O R J L M R V
S U L H å L Ì U R V L ã O D L G R V W U S X L P V S D W M D D X W W V L X S P L D U V L N P X
S R N \ þ L D P V U L Q N R V N R Q F H Q W U D F L M D W L H N L P X
S R W H Q F L D O X V W D U S W D X W L Q ¡ V U L Q N R V G \ G L V W
S U L V L G ¡ M L P D V S U L H ã D O L H V H Q H U J L M Integruotas Q ¡ V Q H S
Y L V Ð D X N ã þ L D N X U L P L H Q ¡ W M Ð W D L N \ P D V O H L G å L D
mikrogeneracijos technologijas.

3. 6 X N X U W D V P R G H O L V V X V L G H G ±ekonometrinio L H M Ð
P R G H O L R V N L U W R 3 0 ³ Y H U W L Q L P å X L R V L y G D O H N V S
apjungiamos W D L N D Q W ' 9 P H W R G N D G E Ì W privalu D O L P D

WLHN Yinterešo RMQDOL] (NRQRPHWULQLV PRGHOL
VXGDUDQWRJLVWLQLR (Logit) PRGHO³ buvo9 atliekamas trimis
skirtingais vertinimo metodais ±TOPSIS, EDAS ir WASPAS, kartu pritaikant
Monte Carlo MDXWUXPR *Monte Carlo* DQDOL]PHWRGDV OHLGåLD
mikrogeneracijos WHFKQRORJLMDV DWLHNWL PXQDYLPR

4. 6LHNLDQW ³YHUWLQWL HQHUJLMRV YDUW
GLHJLDPDV (mikrogeneracijos technologijas), LU MĐ SDVLUHQJLL
energija (pagaminta naudojant PLQ¡WDV technologijas) su kaimynais, buvo
sudaryta anketa ir atlikta apklausa. Tyrimui atlikti atrinktos keturios Lietuvos
QDPĐ ÌNLXRVH GDåQLDXVLDL HQHUJLMRV WHFK
NROHNWRULDL VDXO¡V LU Y¡MR HOHNWULQ¡V
buvo nustatyta respRQGHQWĐ GHPRJUDILQ¡V charakteristikos.
Atsakymams naudojant *R* statistin program, pritaikytas PDåLDXVLRV PLQJ
skirtumo (*LSD*) kriterij XV NXULV SDJULQG PLQ skirtumas tarp
VNLUWLQJDV SDMDPDV JDXQDQþLĐ UHVSRQGHQ
Q¡UD VWDWLVWLãNDL UHLNãPLQJL WDUS WLNUĐ
UH]XOWDWDPV ³WDNRV JDO¡MR WXULWLLEURWL
SDMDPĐ ,DåLD VLQLPR JUXS¡PV VDYH SULVN\U

Tyrime buvo pritaikytas QXVWDW\WĐ SUHIHUHQFLMĐ QH
vertinimo metodas ±respondentai buvo apklausiami pateikiant jiems pasirinkimo
HNVSHULPHQWX JULQGåLDPDV ³YDLULDV WHFK
PDNDUWRWLQDL UHVSRQGHQWĐ SDVLULQNLPDL
$(, WHFKQRORJLMDV DSLEÌGLQDQþLR LQGLFDWRULDXV
Nepaisant pasaulyje DXJDQþLRV mikrogeneracijos technologijĐ SDNODXV
tendencijos ir GDXJ\E¡V WHLJLDPĐ J\YHQWRMĐ 30
WHFKQRORJLMDV URGDQþLĐ W\ULPĐ /LHWXYRM
PLQ¡WHQGHQFLMD, kad Lietuvos QDPĐ ÌNLDL papildomai
mRN¡WL WLN XåDV GDXJLDX HOHNWURV NDWLOÐ
HOHNWUD veikiai buvo nustatytas QHLJLDPDV YDUWRWRMĐ 30
vDUWRWRMDL QRU¡WĐ NRPSHQVDFLMRV WDP
namuose. 6DXO¡V HOHNWULQ¡V EXYR QXVWDW\WRV N
technologijos R Y¡MR H±OHNWUR LQ¡ WLDL /LHWXYRV YD
technologijos. Pastarosios WHFKQRORJLMRV DWVLUDGLPD
SDYHLNVOH QDPĐ ÌNLĐ J\YHQWRMDL vartotojai 9¡MR apytiksliai
WÌNVW (85 PDåLDX elektrinės PLNDXO¡YHUWLQLPXL ³WD
HOHNWULQLĐ VXNHOLDPDV nurodytas kapvienas NLWLNUDV
DSLEÌGLQDQþLĐ ãLOXPRV technologija, kuri
naudojant reikia papildomai pirkti kur J\YHQWRMĐ WDLS SDW EX
T\ULPDV, kad Lietuvoje LãG¡NLRMR nustatyti ir ³YHUWLQDPDV ÌNLĐ 30

AEI technologijas, tDþLDX J\YHQWRMĐ SDVLUHQJLPDV PRN
WHFKQRORJLMDV \UD QHÌ\WLHQDLPLWL, VieksUt LWPRLQ
SDJHULQWL J\YHQWRMĐ SRåLÌU³ ³ MDV

,ãW\UXV Q DPpasirengimLDĐ Dalytis energija, gautanaudojant
mikrogeneracijos technologijas, SDDL,ãNg¡ MaRimosi energija JDOLP\E¡
UHVSRQGHQWDPV ExYkriterijus QLHuvos LgyventojĐ Jneigiamai
vertina JDOLP\E DWVLQaXdalytis su kaimynais FRQHżJLtatas
JDO¡MRmulentiWtaiãDOLHV N±nemiamos kolektyvizacijos patirties
SUDHLW\MH WUXNGDQþLRV J\YHQWRMĐ EHQGU
VULWW\VH 7DLJL QHLJLDPDV Dalijimosi JDYHQWRMDLenergija ãLÌþLL
galimybes reikDODXMD WROHVQLĐ W\ULPĐ

5. 6LHNLDQW DWOLNWL SDO\JLQDPMRM³ PLNURJH
/LHWXYRMH SDQDXGRMDQW ir PM tyrimo, EXYR SUD
(NVSHUWĐ EXYR SUDãRPD ³YHUWLQWL Wokias SDþLD
ir PM tyrime, remiantis aplinkosaugos, socialiniais, ekonominiais, energetiniais,
WHFKQRORJLQLDLV LU SROLWLQLDLVMLQ¡LW RVHUL
mikroJHQHUDFLMRV WHFKQRORJLMRV EXYR VXUDQJ
DSLEÌGLQDHNVWXRU¡LXNVRO VDXO¡V HOHNWULQHV ELR
EksSHUWĐ ÌYHUWLQLPDHJXRWL ³ YLHQ SDVLULQN
panaudota kaip pagrindas daugiakriterinam vertinimui atlikti trimis skirtingais
metodais (TOPSIS, EDAS ir WASPAS), remiantis PLQ¡17 ĐLQGLNDWRU
pagrindu ir vienu papildomu indikatoriumi± J\YHQWRMĐ W3LPLQGLQ
energLMRV YDUWRWRMĐ Skirtingais indikatoriams NDU\
generuojami skirtingi svoriai, t. y. taikoma *Monte Carlo* MDXWUXP. *Monte Carlo* DQDOL]¡
Carlo metodu buvo tikrinama, ar DWOLNXV QHGLGHOLXV SUHIHU
GXRPHQĐ S, gautiUH VXOWaWtas nepasikeis.

$SLEÌGLQDQW SDO\JLQDPRMR $(, WHFKQRORJ
namuose PLNURJHQHUDFLMRV tyrimo rezultatus Lietuvoje, galima
WHLJWL NDG SDO\JLQDPDVLV YHUWLQLPDV VXGL
GDOLHV SDQD,ãkaip ir PM tyrimas, EXYR NXUR NDWLODL
kolektoriai, atlikus DV, buvo nurodyti kaip geriausiai vertinamos
mikrogeneracijos technologijos. Vis G¡OWR metodai (EDAS ir WASPAS)
paURG¡ NDG ELRNXUR NDWLODPV t. y. DãLWEÌVKLQ
YHUWLQDPD NDLS JHULDXVLD technologija DVDXO¡V
kolektoriams buvo priskirtas rangas nr. 2. TOPSIS metodu DWOLNWD DQDOL]¡
NDG VDXOriams priskirtas rangas nr. 1, o biokuro katilams± rangas
nr. 2. âLXRV ãLHN WLHNDWXUD literatūroje SUHI]QWĐ PH
(TOPSIS, EDAS ir WASPAS) taikymo skirtumai. 9¡MRHIWULQ¡V YLVĐ
PHWRGĐ DWYHMX EXYR YHUWLQDPRV NDLS SUDVþ

99 proc. *Monte Carlo* VLPXOLDFLMĐ DWYHMX kuriuo prioritetas rangas nr. 3 44–63 proc. *Monte Carlo* VLPXOLDFLMĐ DWYHMX LQGLNDWRULĐ VYRUL taikant *Monte Carlo* simuliacijas, EXYR QXURG\WRV vertinamos mikrogeneracijos technologijos.

Remiantis atlikto tyrimo analize, pateikiamos taikymo ir tobulinimo rekomendacijos:

- 0LNURJHQHUDFLMRV WHFKQRORJLMĐ VXEV remLDQWLV 30-MHWL3QãWHDP WLNUDL WHFKQR WLN¡WLQD WDG vartotojai jas ir diegs noriai, tad VXEVLGLMDYLPR SURJUDPD ãLXR DWYHMX E
- 'LVHUWDFLMRV W\ULPDV DWVNOHLG¡ NDG nulemia QHYLHQRGXV UH]XOWDWXV ir tikslai, SDO\JLQDP M³ YHUWLQLP neuHN daugiakriterix vertinimo metodu ir taikyti *Monte Carlo* DQDOL]
- 9DOVW\E¡ IRUPXRGDPD $(, WHFKQRORJLMĐ DWVLåYHOJWL QH WLN ³ daugiakriteris vertinimas, bet LU ³ SULYDWĐ LQWHUHVĐ JUXSLĐ QXRPRQHV Taigi vDOVW\EHL EÌWĐ WLNVOLQJD VXEVLGLMX tyrimo rezultatais bei daugiakritere analize.

/,7(5$7Ë5$

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6. ýLHJLV 5 *Ekonomika ir aplinka: Subalansuotos plėtros valdymas* .DXQDV 9\WDXWR 'LGåLRMR XQLYHUVLWH

7. ý L H J L V 5 ¡ = H O H Q L Ì W / L H W X Y R V H N R Q R P L N R vystymosi aspektu. *Taikomoji ekonomika: Sisteminiai tyrimai, 2*(2), 11-28.

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ABSTRACT

Relevance.While the demand of energy is increasing around the world, the traditional energy resources are depleting, and its acquisition methods are damaging to the environment. Renewable energy sources (RES) is an attractive alternative to traditional energy. The issue of RES and its usage promoting is addressed by the European Union long ago and is one of the Lithuanian energy policy objectives set out in the National Energy Strategy and in the Law of Energy of the Republic of Lithuania. Energy efficiency policies can be based on direct and indirect price mechanisms, such as subsidies elimination and the integration of external costs in energy prices, which reduce consumption trends in price sensitive sectors and equipment. The issue arising from external costs while using RES technologies are significantly lower or absent compared with fossil energy. External costs mean an external damage to the environment caused by burning traditional fuels (coal, oil, and natural gas). Unfortunately, this particular damage, external cost (externalities), is not reflected in the prices of traditional fuels and ultimate consumer of traditional energy products, however, does not pay these costs or does not compensate people forharm done to them, they do not face the full cost of the services they purchase, i.e. their energy use is being implicitly subsidized, thus energy resources are not allocated efficiently. Scientists agree that underestimating external costs prevents penetration of RES technologies into the market on a large scale (. O H Y D V â W U H L P L N L H Q ¡

According to economic theory, the main goal of promotion of RES is to integrate the external benefits of renewables into the price of energy produced from RES. Identifying these benefits and selecting the appropriate support P H D V X U H V L V D F R P S O H [V F L H Q W L I L F W D V N $ V V H pay (WTP) is being applied in the world for external benefits determination. This particular method allows to evaluate external benefits of RES technology as well as to justify their subsidies while considering the priorities of society and F R Q V X P H U V ¶ Z L O O L Q J Q H V V W R S D \ D Q G S U R P R W H

Moreover, although renewable energy is the inevitable choice for sustainable economic growth, many factors still need to be taken into consideration when investing in a renewable energy technology. Moving towards a sustainable future requires policy actions that solve existing problems without creating new ones and sustainability assessment of renewable energy technologies could be the key for reaching that goal successfully. Properly conducted sustainability assessment of RES technologies can prevent potential barriers or limit them while implementing and using RES technologies, also

creating an opportunity to prepare for possible consequences arising from feasible disadvantages of RES.

Literature overview. According to .OHYDV %LHNãD 0XUDXV ³Production, distribution and the use of energy resources in the region are the challenges for central and local government, business and social service, FXVWRPHUV DQG RWKHU VWDNHKROGHUV´ 6FL integration into the regional energy development scenarios and noted one of the main goals for the development of regional energy system should be the use of RES (Klevas et al., 2014). Forming policy for the promotion of RES based on subsidiHV DQG LQFHQWLYHV LV LPSRVVLEOH LI preferences for RES technologies are unknown. Lithuanian scientists, Klevas, Murauskaite, Kleviene & Perednis (2013) agree, it is evident that the main market for RES technology is decided by the consumer, and most important problem, determining the slow absorption process of, for instance, solar energy on the part of the consumer, is the lack of knowledge and organisation, deterrent amount of investments, and especially differences between energy suppliers and users in the heating sector. Consumers are involved in implementing the objectives of Lithuanian RES energy policy, yet their opinion has not been investigated and taken into consideration. Furthermore according to Klevas, Bobinaite, Maciukaitis & Tarvydas (2018), ³WKHUH LV D ODFN RI U would give answers to questions on economic assumptions that would link energy policy to economic results and would justify benefits of the use of RES WHFKQRORJLHV RQ D These scientists, while estimating the impact of wind power technologies implementation on the economy in their work, noted, currently RES support measures applied in Lithuania do not encourage project developers to choose economically optimal technologies and often unreasonably expensive plants are installed, operational rates of which are not always justified. ³7KH PDLQ GHILFLHQF\ RI WKLV W\SH RI SURPRWLRQ DFKLHYHPHQW RI WDUJHWV´ (Klevas et al., 2018). In Lithuania issues discussed in scientific literature mostly deal with RES and their technologies promotion on the supply side. For instance, .OHYDV âWUHLPLNLHQơ Perednis in particular SDUW RI WKHLU /LWKXDQLDQ ³%DODQFH RI HQHUJ\ HFRQRP\´ promotion of renewable energy economy, including the financial and economic promotion measures; Klevas (2015) presented recommendations for the establishment of unified principles for the efficiency estimation of RES technologies and long-term incentive system; Katinas, Markevicius, Erlickyte & Marciukaitis (2008) examined the ways in which assistance can be maximized to infiltrate RES Lithuanian electricity sector and their potential impact on the environment; ýLHJLV =HOHQLWH discussed the economic development

aspect of sustainability of Lithuania; * D O L Q L V / H N D Y L þ L X V 0 L ã
analyzed wider exploitation of RES; 6 W U H L P L N L H Q H % D O H] H Q W L V
Balezentis (2012) clarified the multiple criteria decision system, choosing the most sustainable energy technologies; Gaigalis, Markevicius, Katinas & Skema (2014) outlined the analysis of RES promotion in Lithuania in compliance with the EU strategy and policy. However, the issue of RES technology assessment in the world is addressed much more versatile. A strong correlation between environmental attitude and ecological behavior intention has been established. it is important to know the attitudes of energy consumers since attitudes are the foundations of their resulting behavior (Ek, 2005; Stigka, Paravantis & Mihalakakou, 2014). A number of studies published over the last years focusing
R Q F R Q V X P H U V ¶ S U H I H U H Q F H V towards renewables has increased steadily, thus resulting in a flood of data (Sundt & Rehdanz, 2015). Valuation methods and survey types can vary widely. For instance, Wood, Kenyon, Desvousges & Morander (1995) in their work have analyzed WTP among several key customer segments one of which was residential. Hanley & Nevin (1999) used WTP
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WTP for changes in environmental characteristics of residential electricity service using price and environmental disclosure statements. Ek (2005) analysed
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preferences over environmental and social impacts of hydro, on-shore and off-shore wind power and biomass in Scotland. Borchers, Duke & Parsons (2007) presented findings of a contingent choice experimental design used to estimate consumer preferences and WTP for voluntary participation in green energy electricity programs. Banfi, Farsi, Filippini & Jakob (2008) used a choice
H [S H U L P H Q W P H W K R G W R H Y D O X D W H -saving measures in F R Q V X P H U V
6 Z L W] H U O D Q G ¶ V U H V L G H Q W L D O Bergmann, Colombo & Hanley (2008) in their investigation used choice experiment method while focusing on differences in preferences between urban and rural residents. Longo, Markandya & Petrucci (2008) investigated WTP of United Kingdom energy users for different characteristics of energy programs that stimulate the production of renewable energy by using choice experiment. Zografakis et al. (2010) conducted a contingent valuation method study to analyze and to evaluate W K H F L W L] H Q V
acceptance and WTP for renewable energy sources in Crete. = R U L ü + U R Y D W
(2012) in their study analyzed WTP in Slovenia for electricity generated from RES. Guo et al. (2014) in order to assess the value of renewable electricity and

obtain information on consumer preferences, estimated WTP of Beijing, China, residents for renewable electricity. Wu et al. (2014) in their pilot study on assessment of WTP in Lithuanian households used choice experiment method in order to provide main drivers of WTP for renewables. Akcura (2015) analysed households' preferences and WTP under a mandatory scheme where all households contribute compared to a voluntary scheme where only those who wish to pay to support renewables do so.

The main problem of the dissertation. It is important to know the attitudes of energy consumers since their attitudes are the foundations of their resulting behavior. Thus, while developing promotion policy for the use of renewables and their technology, not only expert opinions become a necessity opinions of households[2], their priorities and the key factors that determine their choice between different energy production technologies must be considered.

The problem of dissertation research is complex, combining both: the lack of research on the knowledge and the lack of consumers' opinion on the forming policy for the promotion of RES based on subsidies and incentives. Lithuanian RES promotion policy is primarily directed towards the promotion of renewable energy in the manufacturing sector, however, volume of support for specific renewable energy technologies lacks a scientific basis. Until now how households' attitudes towards so-called microgeneration technologies - renewable energy generation technologies that are installed in households, as well as criteria according to which households choose to install renewable energy technologies at home, have not been researched and consumers' opinion on the

Object of dissertation - renewable energy cogeneration technologies in households.

Purpose statement - to carry out comparative assessment of RES generation technologies (microgeneration) in Lithuanian households. The latter includes a comprehensive assessment - the best setting of microgeneration technologies according to households' willingness to pay for individual (thus separate) microgeneration technologies, as well as multi criteria evaluation of microgeneration technologies based on other important economic, social and environmental criteria. The purpose statement is being pursued by analyzing the following tasks:

[2] Definition household, in this respect, means a social unit composed of those living together in the same dwelling. A household is also considered to be a single person living alone. The term "household" is often the smallest unit of economists and statisticians.

1) Literature review, systematization of market failures and RES barriers that hinder RES development;
2) Establishment of evaluation criteria of WTP and multi-criteria methods for RES technologies applied in households (microgeneration technologies), thereby justifying them and selecting evaluation indicators;
3) Developing a model for the evaluation of RES technologies applied in households (microgeneration technologies) and their application instrumentation;
4) Performing the assessment of energy consumers WTP for RES technologies applied in households (microgeneration technologies) as well as their willingness to share the energy from their renewable energy technology based on the established instrumentation and collected empirical data;
5) Performing comparative assessment of RES technologies applied in households (microgeneration technologies) in Lithuania based on households WTP for RES technologies and microgeneration technologies as well as summarizing the results of comparative assessment and, on the basis of it, making recommendations on the application of the model and its improvement.

Practical application of research. Comparative assessment of microgeneration technologies would allow the state to choose a rational policy for the use and promotion of RES, to allocate funds for promotion among technologies, to form priority promotion areas, to establish the amount of support, subsidies, for different RES technologies applied in households.

After reviewing over 200 literature sources, it has been concluded that the method for comparative assessment of RES technologies used and recommend by many researchers is Multi-Criteria Decision Method (MCDM) or Multi-Criteria Analysis (MCA). MCDM is an appropriate choice for solving complex problems. A large number of external variables play a relevant role in orienting decision making and while some of these variables can be manipulated by numerical models, such as cost-benefit analysis, market penetration strategies and environmental impacts, other factors dealing with social and cultural context, political drawbacks and aesthetic aspects, can be assessed only in a qualitative way or with subjective judgment. Therefore, MCDM can give the decision maker considerable help in the selection of the most suitable RES technologies. However, while considering the fact decision makers have wide options of many different techniques, which more or less has equal weight, one can say it can be compensated by its ability to deal with complex problems,

nonetheless, nowadays, it might be not enough to decide between trade-offs alternative sources in order to choose the most beneficial one. It is highly important to know the attitudes of electricity consumers as well since they are paying for RES promotion. Thus, in this dissertation, MCA method is being ³EDFNHG XS´ ZLWK DGGLWLRQDO DQDO\VLV U society, i.e. WTP ± besides the parameters describing RES technology, KRXVHKROGV¶ :73 FULWHULD ZDV LQFOXGHG L preferences for RES technologies. WTP integration in MCA will suggest the best result which would satisfy decision maker and would be made by taking into account residents opinion.

Scientific novelty:

- The main criteria for comparative assessment of microgeneration technologies were analysed and systematized;
- The theoretical model for comparative assessment of renewable energy technologies in households (microgeneration technologies) was created capturing household attitudes towards RES technologies and the main criteria according to which households choose to install renewable energy technologies at home;
- The model was implemented by developing a multi-criteria assessment methodology for RES technologies, which consists of WTP and MCDM, allowing comparing and ranking RES technologies, thereby considering public preferences and determining directions of government support for RES technologies.
- The prepared methodology was applied for assessment of renewable energy technologies in Lithuanian households for the first time, providing valuable insights in Lithuanian households' willingness to pay for RES technologies embedded in their houses (microgeneration technologies)

Hypotheses of dissertation:

1. &RQVXPHUV¶ ZHDOWK HGXFDWLRQ DQG D technologies in households:
    d) Consumers with higher income tend to pay more for RES technologies in their households;
    e) Younger residents tend to pay more for RES technologies in their households;
    f) Residents with higher education tend to pay more for RES technologies in their households.
2. Lithuanian households have relatively little WTP for RES technologies, while comparing it with Western European countries.

3. Multi-criteria decision method (combined of WTP and MCDM) allows comparing and gathering RES technologies, while considering the preferences of society and determining directions of government support for RES technologies.

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