平成16年度環境省委託事業

平成16年度CDM／JI事業調査

ハバロフスクエネルゴ社熱電供給プラントにおける
ボイラー燃料転換からの炭素クレジット獲得調査

報 告 書

平成16年3月

豊田通商株式会社

ＣＤＭ／ＪＩ事業調査及び温暖化対策クリーン開発メカニズム事業調査　概要版様式

(1)プロジェクト実施に係る基礎的要素

■提案プロジェクトの概要と企画立案の背景

今回当社にて取り組みを図っているプロジェクトは、ロシア統一電力システム社（略称 UES 社：RAO UES of Russia）の傘下であるハバロフスク州を管轄するハバロフスクエネルゴ社（エネルゴ：電力）が行う石炭から天然ガスへの燃料転換プロジェクトの JI 化である。当社は UES 社と京都議定書に関連するプロジェクの開発を行っており、2004 年春までの約 350 件の UES 社潜在 JI プロジェクトを検討した結果、該社の強い要望もあり、当該プロジェクトをトライアルとして JI 化することを合意した。

■ホスト国の概要

ロシアは人口約 1 億 4000 万人とほぼ日本と同じながら、広大な国土を有する国である。1990 年代のゴルバチョフ大統領からエリツイン大統領への変更により、民主主義の路線を歩み始めたが、急速な国営企業の民営化の中で、新興財閥（所謂成金）を生み出し、一方で民主主義についていけない大衆との間で大きな貧富の差を生み出すこととなり、ロシア経済が麻痺し 1990 年代は長い低迷の時代を歩んだ。その間日露では橋本総理時代において川奈会談が行われ、北方四島返還の目処が見え、ロシア向け投資が一時期活発化した時期があったが、その後会談の内容は撤回され、現在のプーチン大統領下では 2 島返還の方針が改めて確認されている。世界経済の流れの中で現在 BRICs（ブラジル・ロシア・インド・中国）の一国としてこれからの経済発展が期待されている国でも有り、また資源国として中東に変わる石油・天然ガスの輸出国として欧州・アジアから期待されてもいる。

■ホスト国の CDM/JI の受入のクライテリアやＤＮＡの設置状況など、CDM/JI に関する政策・状況

ロシア連邦政府は 2004 年 9 月に京都議定書批准を決定した。ロシアが京都議定書発効の鍵であったことは言うまでもなく、WTO 加盟との関連等様々な国際交渉要因を背景に批准を行ったとのことである。現在天然資源省及び経済発展貿易省が中心となり、京都議定書に関連する国内インフラ整備を行っている。インベントリー整備を含め欧州各国からの支援を受け、2006 年内に殆どのインフラ整備が終了する見通しである。また京都メカニズム関連の法案も既に下院に提出されており、検討が開始されている。国内排出権取引制度並びに欧州とのリンクについても同様に法案検討されている状況である。

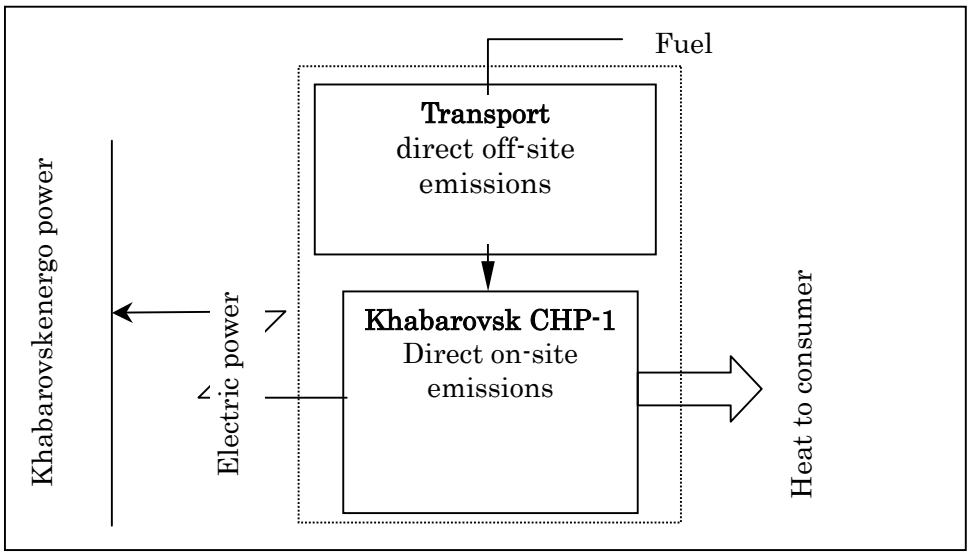
■調査の実施体制（国内・ホスト国・その他）

今回の調査ではエンジニアリングを含む日本からの輸出機器はなく、全てがロシア製の機器導入並びにロシア企業によるエンジニアリングが行われる予定である。またハバロフスクエネルゴ社は UES 社の傘下企業であり、UES 社は京都議定書専門子会社である ECF 社（Energy Carbon Fund）を有しており、PDD の開発並びに排出権の販売窓口を委託している。よって今回作成する PDD を ECF 社へ外部発注し、円滑な PDD 作成を行う事とした。

(2)プロジェクトの立案

■プロジェクトの具体的な内容
ハバロフスクエネルゴ社保有の第一火力発電所内 CHP19 基を石炭仕様から天然ガス仕様に変更するプロジェクトである。天然ガスはサハリン島におけるエクソンが中心となったサハリン１プロジェクトからの天然ガスを予定しており、パイプラインは既にサハリンからコムソモリスクを経て、ハバロフスクまで 129km を残すのみである。パイプライン埋設は月間 14 から 15km で進行しており、2005 年度内にはハバロフスク州まで到達する見込みである。ハバロフスクエネルゴ社はハバロフスク州までの本管から枝管を第一火力発電所まで建設し、2005 年内には CHP2 基の仕様変更を計画している。

■プロジェクト境界・ベースラインの設定・追加性の立証
（プロジェクト境界）
理論的に第一火力発電所 CHP において、プロジェクト実行後でも発電所内においてオペレーション並びにサーキットの変更はなく、また熱の需要家も変更はない。よってエネルギー関連のバウンダリー（燃料輸送・熱配送並びに化石燃料の燃焼）において、熱輸送を除く燃料輸送並びに化石燃料の燃焼にバウンダリーを絞ることとした。



（ベースラインの設定）
現在ハバロフスク火力発電所 CHP は燃料を主に石炭とし（助燃用として重油を一部使用）70%以上のハバロフスクエネルゴ管轄内の熱需要をまかなっているが、2012 年までの需要予測を 4 パターンで行い、ベースラインの設定を行った。ケース１としては、今後代替電力源が出来ることにより、電力・熱の供給が減少するケースである。ケース 2 としては、ハバロフスクエネルゴ社が FOREM（連邦電力卸売市場）からの購入を増やし、第一火力発電所の供給力を自身の手で減少させるケースである。ケース 3 としては、現在石炭仕様のボイラーが重油に置き換わるケースである。ケース 4 としては、第一火力発電所 CHP が現状のまま維持を継続し将来需要に対応行うケースである。以上 4 つを検討し、最終的にケース 4 を選択することとした。ベースラインの計算を行う際のキーファクターを電力及び熱の供給量、燃料の種類と使用量並びにエミッションファクターとし、計算を行った。

Parameters	Unit	Years						
		2006	2007	2008	2009	2010	2011	2012
Total GHG project emissions	**thous. t CO_2**	**3044,6**	**3090,2**	**3140,8**	**3140,8**	**3140,8**	**3140,8**	**3140,8**
GHG project emissions associated with electricity production	thous. t CO_2	1 605	1 650	1 701	1 701	1 701	1 701	1 701
GHG project emissions associated with heat production	thous.t CO_2	1 440	1 440	1 440	1 440	1 440	1 440	1 440
CEF under electricity production	**gCO_2/kWh**	**1 012**	**1 012**	**1 012**	**1 012**	**1 012**	**1 012**	**1 012**
CEF under heat production	**kgCO_2/Gcal**	**416**	**416**	**416**	**416**	**416**	**416**	**416**

（追加性の認証）
資金調達が困難であること、また燃料転換のコストメリットがないこと、石炭を継続使用することに法令的問題がないことから、今回のプロジェクトは追加性があると言える。

■プロジェクト実施による GHG 削減量(CO2 吸収量)及びリーケージ
天然ガス仕様による CO2 発生量を計算し、以下の通り削減量を計算した。

Parameters	Unit	Years					
		2007	2008	2009	2010	2011	2012
ANNUAL OUTPUT:							
electic energy	thous. MWh	1 630	1 680	1 680	1 680	1 680	1 680
heat	thous. Gcal	3 465	3 465	3 465	3 465	3 465	3 465
BASELINE							
CEF under electricity production	gCO_2/kWh	1 012	1 012	1 012	1 012	1 012	1 012
CEF under heat production	kgCO_2/Gcal	416	416	416	416	416	416
PROJECT							
CEF under electricity production	gCO_2/kWh	607	599	599	599	599	599
CEF under heat production	kgCO_2/Gcal	260	264	264	264	264	264
ERUs	**thous. t CO_2**	**1 201**	**1 221**	**1 221**	**1 221**	**1 221**	**1 221**
for 2008-2012 period	**thous. t CO_2**						**6 104**

■モニタリング計画
燃料輸送を除いたハバロフスク第一火力発電所 CHP における燃料使用をモニタリングすることとし、主要なポイントは天然ガスの消費量、石炭の消費量、電力のアウトプット、熱のアウトプットである。各カテゴリー別に現在計測しているデータの継続管理並びに推計を一部行うこととした。

■環境影響/その他の間接影響（植林の場合、リスク調査結果も含む）
社会的に石炭から天然ガスへハバロフスク州が大きな変換を行うことで環境問題は改善される見通しであり、またガスパイプライン工事を含め新規の雇用促進が図られることとなっている。ハバロフスクエネルゴ社自身はロシア連邦環境条例において二酸化硫黄を含め項目の管理が義務付けられているが、これも大幅に改善される予定である。以下の表はハバロフスクエネルゴ社において 2007 年から 2012 年までに改善される環境影響物質である。

Year	Coal ash	SO_2	NOx	Total
	t/y	t/y	t/y	t/y
2007	13 863,4	7 609,6	2 758,7	24 231,7
2008	14 090,5	7 734,2	2 803,9	24 628,6
2009	14 090,5	7 734,2	2 803,9	24 628,6
2010	14 090,5	7 734,2	2 803,9	24 628,6
2011	14 090,5	7 734,2	2 803,9	24 628,6
2012	14 090,5	7 734,2	2 803,9	24 628,6

■利害関係者のコメント
2003 年 3 月 24 日付けでハバロフスク州政府はハバロフスク州の天然ガス化促進に対し企業の努力を正式に求めている。ハバロフスクエネルゴ社は 2005 年 1 月 20 日付けの電気エンジニア新聞にて、サハリンからの天然ガス並びにパイプライン建設を待ち望んでいる旨を公表した。現時点において利害関係者からの反対意見はない。

(3)事業化に向けて

■プロジェクトの実施体制（国内・ホスト国・その他）
プロジェクト資金は基本的にハバロフスクエネルゴ社が業者前払い金として総費用のうち半分を負担し、残り半分を排出権購入者からのファイナンスにて補うスキームとなる。工事会社はハバロフスクエネルゴ社関連会社のハバロフスクエネルギーテクノロジー社が行う予定である。

■プロジェクト実施のための資金計画
プロジェクト費用は約 64 億円（16 億ルーブル）であり、工事はハバロフスクエネルギーテクノロジー社が請け負う事が 2004 年 11 月の入札で決定している。工事金額の内、半分の約 32 億円はハバロフスクエネルゴシャの自己資金で賄われる予定である。

■費用対効果
現行購入石炭価格と購入予定のガス価格では、ガス価格が石炭を上回る見込みであり、燃料転換における投資効果は基本的に存在しない。故にビジネスベースでは実行されないプロジェクトと言える。

■　具体的な事業化に向けての見込み・課題
商業プロジェクトとしての課題は排出権の買い手の有無による前払い金の支払にある。パイプライン建設を含む技術的な問題は既に解決され、商業許可もまもなく取得予定である。JI 化の課題として、ロシア政府内の京都議定書インフラ整備の確立並びに 6 条委員会のルールとなる。当面はロシア政府はトラック２で JI を推進する方針である、国連リスク（6 条委員会）が最大の課題となる模様。既にロシア政府には当該プロジェクトを承認申請出す旨は連絡済み。

目　　次

第1章
プロジェクトの背景

（1） 提案プロジェクトの前提条件

提案するプロジェクトは、サハリンⅠ資源開発からの天然ガスのハバロフスク市向け導管設置を背景とした、既存火力発電所ボイラーの石炭からの天然ガスへの燃料転換プロジェクトである。

「サハリンⅠプロジェクトの概要」

	サハリン１プロジェクト
事業主体	・エクソンネフテガス社 （米、エクソン・モービル子会社、オペレーター、30%） ・サハリン石油ガス開発（株）（通称：SODECO） （日、石油公団・伊藤忠・丸紅等出資 30%） ・ONGC ヴィデッシュ社（インド、20%） ・サハリンモルネフテガス・シェルフ社　（ロシア、11.5%） ・ロスネフチ・アストラ社（ロシア　8.5%）
投 資 額	約 120 億ドル以上
開発鉱区	オドプト､チャイヴォ､アルクトン・ダギ
推定可採埋 蔵 量	■石油　　約 23 億バレル （約 3.07 億トン） ■天然ガス　約 17 兆立方フィート （約 4,850 億立方メートル）
経　　緯	95.6　生産物分与契約締結 96.6　生産物分与契約発効 99.6　天然ガスパイプライン事業化調査開始 01.10　プロジェクト商業化宣言発表

「天然ガス導管設置プロジェクトの概要」

パイプラインの所有者：ダリトランスガス
工事業者：ダリエネルゴモンタージュ社
使用パイプライン：チェリヤービンスクパイプ会社製

現在のパイプライン埋設地点：シンダ村
（ハバロフスクまで後１２９km）
月間１４～１５km工事進行

「ハバロフスクエネルゴ社ボイラー燃料転換プロジェクト」

ハバロフスク第一熱併給発電所
CHP*-1　19基（石炭焚きボイラー）
*Combined Heat and Power

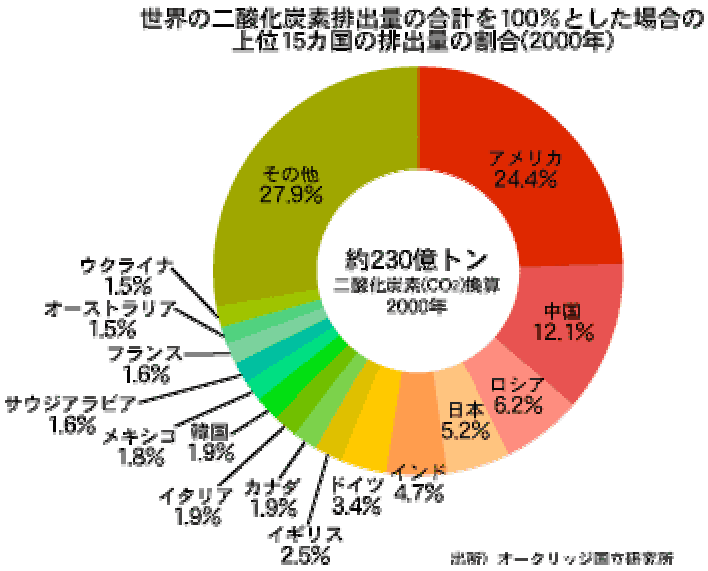
⇒

天然ガス焚きボイラーへ転換
（バーナー等を含む改造及び約１kmの枝管敷設）

サハリンⅠプロジェクトの商業化並びにガスパイプランのハバロフスク市までの建設を前提に、今回のハバロフスク市に位置する発電所ボイラーの燃転を検討

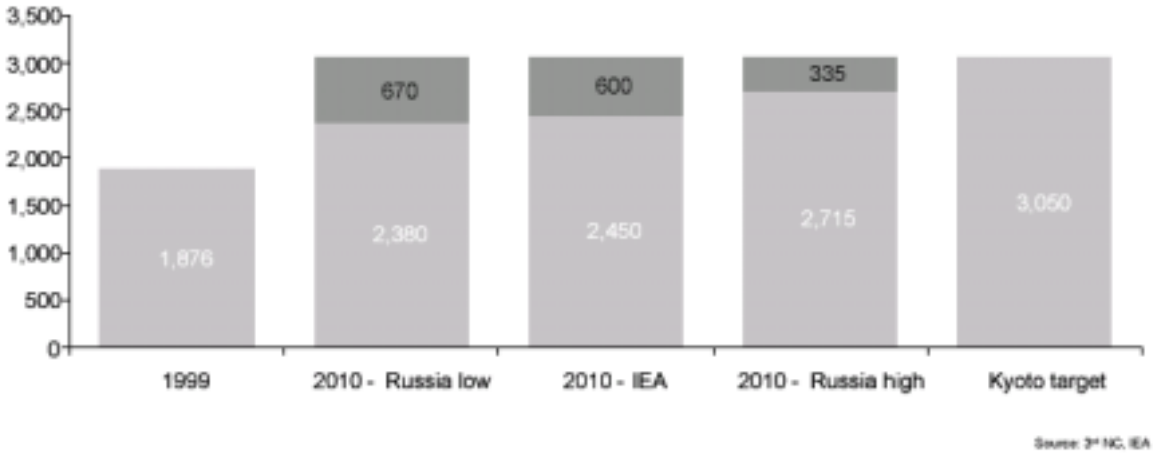
（2） ロシアでの JI 開発の意義

京都議定書第 17 条における排出権取引（Emission Trading）の実務は未だ未設定であるが、日本、欧州、カナダの目標達成需要に対し、ロシア初期割当量の移転が GG 取引（Government to Government）で行われた場合、需要は理論上消滅し、よって CDM/JI からのクレジットは流通価値を失う（CO2 削減の意義は残るが）のではないか？



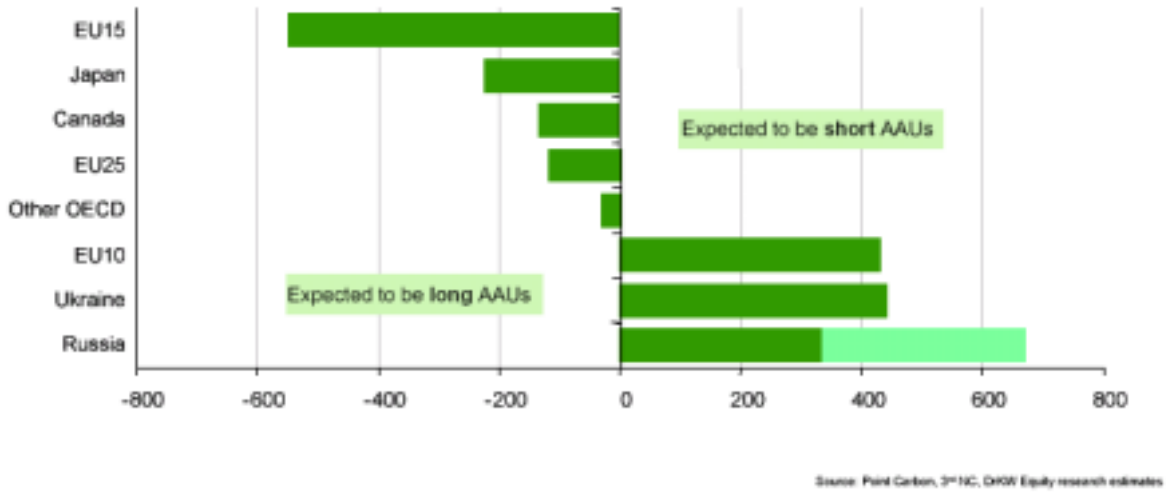
ロシアの温室効果ガス発生量

2010 年時点において、年間 670 百万トン～335 百万トンの AAU 供給が可能である。



排出権の需要予測

EU25 カ国体制では 1 億トン強、日本では 2 億トン強、カナダでは EU と同じく 1 億トン強の排出権の潜在需要が見込まれるが（主要 3 地域合計：4 億トン／年）、ロシアの AAU が全量取引されるとした場合、付属書 I 国間の京都議定書第 17 条に基づく ET で各国の目標はバランスする見込みである。



NGO 等の反対は予想されるが、正当な販売権利をロシアは京都議定書で得ていることから、これに表立って各国政府が反対することは（平たく言えば、ロシアが初期割当量を市場価格で売りたいと日本にアプローチがあった場合、日本は正当な理由なしにこれを断れるのかということである）、京都議定書そのものを否定することにも繋がる。

【回避策】

回避策として、ロシアとの JI を各国が推奨することで、第 17 条の行使抑止力とし、ロシアの初期割当量未使用分を第二次遵守期間へキャリーオーバーさせ、第二次遵守期間での付属書 I 国目標交渉において、±0％を最低交渉できれば、ロシアの経済成長により第二次遵守期間で初期割当量繰越なしを目指せるのではないか。

第三次以降を抜け道のない公正な目標設定とすべく、第二次遵守期間をソフトランディング期間とし、加えて、京都議定書継続の鍵は未だロシアに握られており、第二次遵守期間前には米国の参加示唆を引き出せるように各国の努力は継続して必要であり、そのロシアの交渉力を低下させる必要がある。

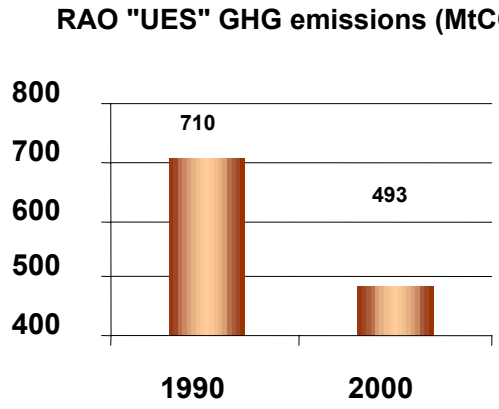
民間を超えたリスクがあるロシア JI 案件開発は官民共同で進めるべき

JI は COP/MOP１で始めてルール策定の母体である 6 条監督委員会が設立される見通しであり、それ故 CDM と比較して現段階からの企業による本格検討はリスクが存在する。通常であれば、6 条監督委員会設置後、ルールが決定され、かつロシアの京都議定書インフラが整い、京都議定書参加資格取得確認後、JI の開発を進めることが望ましい。
ただこの場合、JI の実現までに多少のリードタイムは当然必要であることから、第一次遵守期間内で実現可能な JI は非常に数が限られ、ロシア自身も JI 実施からのベネフィットを満足に獲得できず、第二次遵守期間への継続参加に対し難色を示す可能性もある。
故に、民間企業での民間努力を超えた開発リスク（国連ルールの未開発）をドナー国政府

がテイクすることで、Ready to Go の体制を官民共同でシェアすべく、今回の補助金による調査に応募し今回の開発を行った。同様の案件はまだ極東地域に広く存在し、また UES 社自身も数百件に及ぶプロジェクトリストを保有している。今回の調査のみに留まらず、継続して日露 JI の官民共同開発を行うことは決して意義・意味の双方に欠如するものではない。

日本の約半分の温室効果ガスを排出する UES 社との JI 開発連携

ロシアではガスプロムと UES 社の二大温室効果ガス排出業者が存在する（両社合計でロシア温室効果ガス発生量の約 40%）。
豊田通商はロシア最大の電力会社である UES 社（Unified Energy System 社、統一エネルギーシステム社）と京都議定書関連開発を行っており、UES 社保有の潜在 JI プロジェクトを複数検討した結果、既にオランダ政府が行っている ERUPT（Emission Reduction Procurement Tender）に 2 回参加経験があるハバロフスクエネルゴ社 JI 案件開発に取り組む事とした。



（3）ホスト国の概要

ロシアは正式にはロシア連邦（Russian Federation）であり、49 州、21 共和国他で構成されている。人口は約 144 百万人（2004 年推定値）で、国土面積は約 17 百万平方 km と、人口はほぼ日本と同じながら、日本の 45 倍以上の国土面積を保有する国である。

ロシアのソブリン債権（Sovereign Bond:国債、政府機関債など、中央政府により発行・発行・保証された債権）のレーティングとして、外貨建て長期債は今年 2 月に BB+から BBB-に引き上げられている（S&P)。背景にあるのは石油価格の上昇による経済安定化である。

	1998 年	1999 年	2000 年	2001 年	2002 年	2003 年
GDP	-5.3%	6.4%	10.0%	5.1%	4.7%	7.3%
インフレ（CPI）	84.4%	36.5%	20.2%	18.6%	15.1%	12.0%
鉱工業生産	-5.2%	11.0%	11.9%	4.9%	3.7%	7.0%
設備投資	-12.0%	5.3%	17.4%	8.7%	2.6%	12.5%
貿易収支（米ドル）	164 億	360 億	602 億	481 億	463 億	600 億
金外貨準備（年末/米ドル）	122 億	120 億	283 億	362 億	478 億	880 億(04 年 2 月）

（出典：金外貨準備はロシア中央銀行、それ以外はロシア統計国家委員会のデータで、2003 年 4 月以降に公表されたデータ修正を含む。2003 年のデータは全て暫定値。）

ロシアの GDP は 1990 年から低迷を続けたが、プーチン政権を機にプラスへ転じ、現在証券業界から BRICs（ブラジル、ロシア、インド、中国）の 1 国として、今後の経済成長が期待される国として位置付けられている。しかしながら、成長の主要因は石油を中心としたエネルギー価格の高騰であり、その意味で経済基盤は強固であるとはまだいえないであろう。

対外債務としては、2003 年に債務返済金額が 170 億ドルを超えたが、返済は順調の様子であり、2004 年の対外債務返済額は約 140 億ドルである（2004 年 1 月段階での対外債務残高は 1191 億ドル)。

政治はプーチン大統領の与党である統一ロシアが下院の大多数を占め、安定方向であるが、独占体制に入ったとの見方もある。

（4） ホスト国の京都議定書に関連したインフラ整備状況

2004 年 9 月にプーチン大統領は京都議定書批准を決定し､同年 10 月 27 日に上院が可決し、ロシアは正式に京都議定書を批准することとなり、伴い京都議定書が 2005 年 2 月 16 日に発効した。

これを受け、漸くロシア政府内では京都議定書インフラ整備が本格化しているが、未だ対外的に確立されたものはない｡受けて Point Carbon 社からはロシアのホスト国リスクは CC のレーティングとなっている｡このレーティングは 2005 年 2 月初旬に行われたロシア下院での京都議定書インフラ整備に関する公聴会でも引合いに出されている。

Ranking: 14 Feb 2005

Country	Rating	Last (5 Jan)
1. New Zealand	A	(-, -)
2. Bulgaria	BBB	(1, BBB)
3. Romania	BB+	(2, BB)
4. Czech Rep.	BB	(3, BB)
5. Hungary	BB	(5, BB)
6. Poland	BB	(6, BB)
7. Slovakia	BB-	(5, BB)
8. Estonia	BB-	(7, BB)
9. Ukraine	B-	(8, B)
10. Russia	CC+	(9, CC)

インフラ整備を早急に行うべく、京都議定書批准決議を受け、2004 年 9 月末に天然資源省指導で京都議定書インフラ整備に関するワーキングループが結成され、アクションプランが策定されている。このプランはフラトコフ首相へ提出され、最終認可を受け始動するものである。このアクションプランが順調に進めば、2006 年初旬には Point Carbon 社のレーティングも改善されるものと思われる。

内容	管轄省庁	期限
温室効果ガス発生量並びに吸収量に関する連邦法及びフレームワークの整備	経済発展貿易省、天然資源省、 産業エネルギー省、教育科学省、他 3 省庁	Q2 2005
インベントリーシステムの方法及び整備に関する規制の整備	天然資源省、産業エネルギー省、教育科学省、他 3 省庁	Q1 2005
レジストリーシステムの整備に関する規制の整備	天然資源省、産業エネルギー省、教育科学省、他 3 省庁	Q1 2005
国連気候変動枠組み条約室局へのインベントリーデータ提出（1990-2004）	水利気象環境局	Before June 1, 2006

また経済発展貿易省によると、JI 承認システムは 2005 年第 2QTR までに整備される予定とのことである。

（5） 京都メカニズム参加資格

JI（Joint Implementation:共同実施）に参加するには、京都メカニズム活用資格を有する必要がある。京都メカニズム参加資格の審査は、遵守委員会・執行部が決定することとなる

予定である。ロシアは現在準備段階であるが、未だ参加資格を得られるか否か、(4) のアクションプランの実行次第と言える。
また参加資格条件の内容次第では、トラック 2 としての参加も可能ではある。トラック 1 及びトラック 2 の違いは、所謂自分で判断出来る基盤が整っているか（所謂 18 歳未満か否か）であり、判断は不可能とされた場合、トラック 2 として、6 条監督委員会の指示の下、排出権の発行及び移転を行うこととなる。

要件	トラック 1	トラック 2	日本準備状況	露準備状況
DNA 整備	○	○	○	×
初期割当量の確定	○	○	○	×
国別登録簿の整備	○	○	○	×
インベントリー提出他	○	×	○	×

（6）6 条監督委員会

2005 年第 1 回 COP/MOP にて設置される予定の、トラック 2 参加国に対し CDM 理事会と同様の機能を保有する機関が、6 条監督委員会である。委員は 10 名で、付属書 I 国から 6 名、非付属書 I 国から 4 名にて構成される予定である。当該委員会は CDM 理事会にて OE を決定するのと同様に JI カテゴリーでの認定独立機関（AIE）を認定する。

（7） 持続可能な開発への貢献

ハバロフスク州ではサハリン I からのガス化奨励策を取っており、ハバロフスクエネルゴ社が抱えている、ガス価格が現行の石炭価格に比較しインセンティブがないことからの設備投資・資金調達の困難性を、JI ルールにて打開出来れば、同様の案件も多数出てくる事が予想される。

（8） 調査の実施体制

今回の調査ではエンジニアリングを含む日本からの輸出機器はなく、全てがロシア製の機器導入並びにロシア企業によるエンジニアリングが行われる予定である。またハバロフスクエネルゴ社は UES 社の傘下企業であり、UES 社は京都議定書専門子会社である ECF 社（Energy Carbon Fund）を有しており、PDD の開発並びに排出権の販売窓口を委託している。よって今回作成する PDD を ECF 社へ外部発注し、円滑な PDD 作成を行う事とした。

第２章
プロジェクトの立案

（１） プロジェクトの具体的内容

①プロジェクトのロケーション

今回調査を行ったプロジェクトは、ロシア極東地域に位置するハバロフスク州ハバロフスク市にて発電・送電を行っている「ハバロフスクエネルゴ社」保有の第１熱併給発電所にて稼動している石炭焚きボイラー（CHP-1）19 基である。ハバロフスク地域はロシア連邦共和国の極東地域に位置し、同国の極東連邦地域の一部である。総面積は 788,600km^2 である。
この地域は 17 の行政地域と 2 つの市から構成されている。この 2 つの市とはハバロフスク市（人口約 617,800 人）とアムール川コモソモルスク市（人口約 298,500 人）である。すべてをあわせると 7 町、27 都市型居住区域、186 村落行政区域で構成されており、総人口は 1,571,000 人以上。うち 81%が市や町域に居住している。ハバロフスク地域は、極東地域の工業の中心である。産業としては、エネルギー集中型の産業やさまざまな社会層に広がる企業群が中心である。機械工業、金属（農機の製造、動力機械、造船、船舶の修理、鋳造機器など）、非鉄金属、林業、木材加工、製紙パルプ、石油精製、化学工業、漁業が基本産業である。石油精製施設はハバロフスク市とアムール川コモソモルスク市の２ヶ所にある。ここから実質的にすべての極東経済地域に石油製品が供給されている。
この２ヶ所で年間に精製することができる原油量は 1,000 万トンであり、うち 10%がサハリン島の油田から、オカとアムール川コモソモルスク市を結ぶパイプラインで供給され、残り 90%はシベリアから鉄道を経由して輸送されてくる。石炭採掘企業は、基本的には合資会社のウルガルゴール（Ulgalgol）で、この企業の採掘量は年に 250 万トン以上となっている。うち 90%以上は国内消費に回されている。

②ハバロフスクエネルゴ社の概要

ハバロフスクエネルゴ社は、ロシア国営企業の民営化指針を受け、1957 年設立のハバロフスクエネルゴ公社から、1993 年にハバロフスクエネルゴ社（Open Joint-Stock Company “Khabarovskenergo”）として設立された企業である。
該社は熱併給発電所を複数保有し、2,152MW の定格発電能力と 7,518Gcal/h の熱供給能力を保有している。ハバロフスクエネルギー会社は、ロシア東部の電気系統管理を行う開放型合資会社「UES オブロシア（UES of Russia）」の代表的組織である「オストクエナーゴ(Vostokenergo)」の統合電気系統システムに参加している。ハバロフスクエネルギー会社は複合電気会社であり、その活動は発電、送電、電気や熱の販売、関連する調査活動、設計、建設である。現在のところ、開放型合資会社「ハバロフスクエネルギー会社」は、7 つの火力発電所、3 つの大規模暖房用ボイラー発電所、配電関係 6 企業、配熱関係 2 企業を含む 24 の組織で構成されている。開放型合資会社「ハバロフスクエネルギー会社」は 100%経営権を有する子会社 9 社を擁している。開放型合資会社「ハバロフスク製造修理会社(Khabarovsk production and repair company)」開放型合資会社「ハバロフスク修理建設会社（Khabarovsk repair and construction company）」開放型合資会社「ハバロフスク修理設置会社（Khabarovsk repair and mounting company）開放型合資会社「ハバロフスクエネルギー技術会社（Khabarovsk energy technological

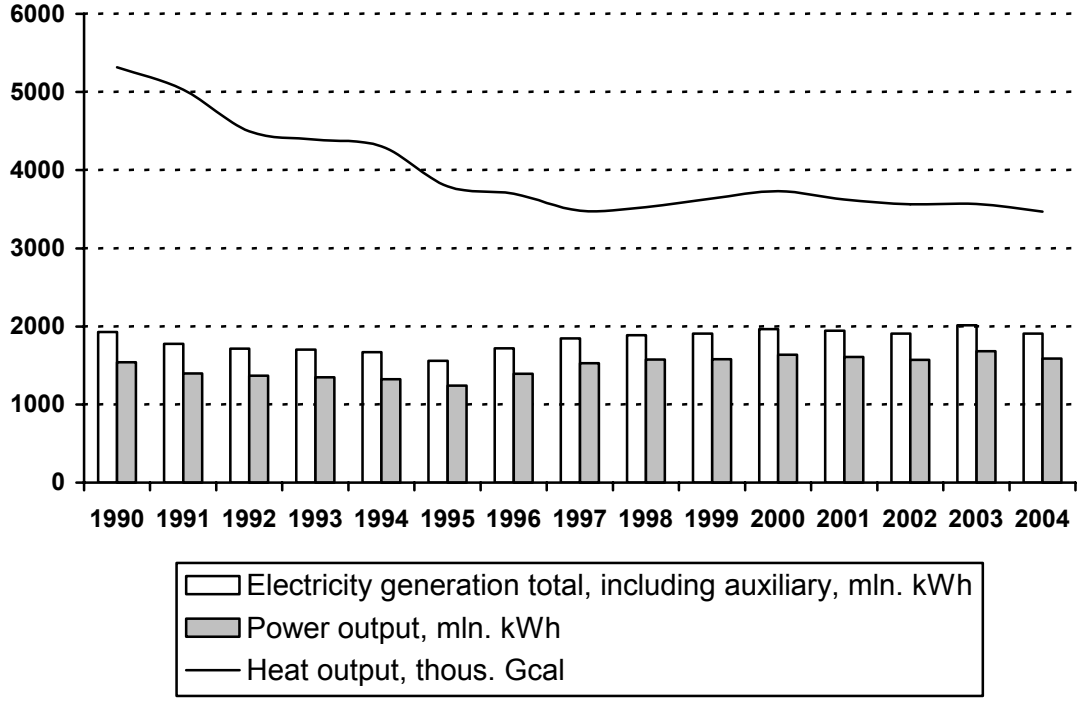
company）」開放型合資会社「アウトトランスポートエナーゴ（Avtotransportenergo）」開放型合資会社「エナーゴトルグ（Energotorg）」開放型合資会社「CK アグロエナーゴ（CK Argoenergo）」開放型合資会社「ロドニック・ズドロヴィア（Rodnik zdrovia（健康の泉 Spring of health））開放型合資会社「OJI アムルスカヤ・ジェムチュジナ（OJI Amurskaya zhemchuzhina アムール真珠 Amur pearl）」の 9 社である。同社の設置発電容量は 2,153MW で、熱容量は 7,194G cal/h(8,367MW)である。送電線の総延長は 1,500km で、すべての電圧レベルを送電することができ、また、送熱線の総延長は 400km を超える。220kV と 500ｋV の送電線でアムール地方に電気を供給し、110kV と 220kV の送電線がプリモルスク地方に電気を供給している。ハバロフスクの送電系統は、2 つのエネルギー地域で構成されている。1 つは相互接続エネルギー地域で、6 ヶ所の発電所から送電線で電気が供給される。もう 1 つはニコラエフエネルギー地域で、ニコラエフ CHP 発電所と 110ｋV の送電系統で構成されている。この地域は、他地域とは独立的に配電がおこなわれている。これらの送電系統で電気と熱をハバロフスク地域中部・南部およびユダヤ人自治区に供給している。この送電系統が網羅する地域の面積は 788,000km^2 で 1,605,000 人の住民に電気と熱を供給している。この送電系統に含まれる地域暖房システム源から送られる熱はハバロフスク、アムール川コモソモルスク、アムルスク、アムール川ニコラエフスク、ビロビジャンに供給されている。離村部および北部地域には、地域の 330 ヶ所にあるボイラー発電所と 86 ヶ所の小規模ディーゼル発電所から熱と電気が供給されている。これら 330 ヶ所のボイラー発電所の合計容量は 1,600G cal/h であり、ディーゼル発電所の合計設置容量は 118MW 以上である。この地域の発電産業の特徴は水資源が豊富であるが、CHP 発電所は基本エネルギー源として輸入燃料を使用している。主に褐炭、瀝青炭（68%）、炉重油(13.5%)、天然ガス（18.5%）が燃料として用いられている。

Name	Installed capacities		Fuel consumption, thous. tce		
	Power, MW	Heat, Gcal/h	Gas	Heavy oil	Coal
Khabarovsk CHP -1	462.5	1350	-	3000.9	1060
Khabarovsk CHP -2	-	610	-	128.8	-
Khabarovsk CHP -3	540	1380	-	19.2	1069
Komsomol'sk CHP -2 with subordinate Komsomol'sk CHP -1	275,5	975	263	4.7	403
Komsomol'sk CHP -3 with subordinate boiler-house "Dzemgi".	360	1240	588	23.5	-
Amursk CHP -1	285	1169	68	1	328
Nikolaevsk CHP	130.6	321	-	175	-
Maysk TPP	98.85	135	-	1	73
Birobidzhan CHP	-	338	-	1.3	117
TOTAL	2151.95	7518			

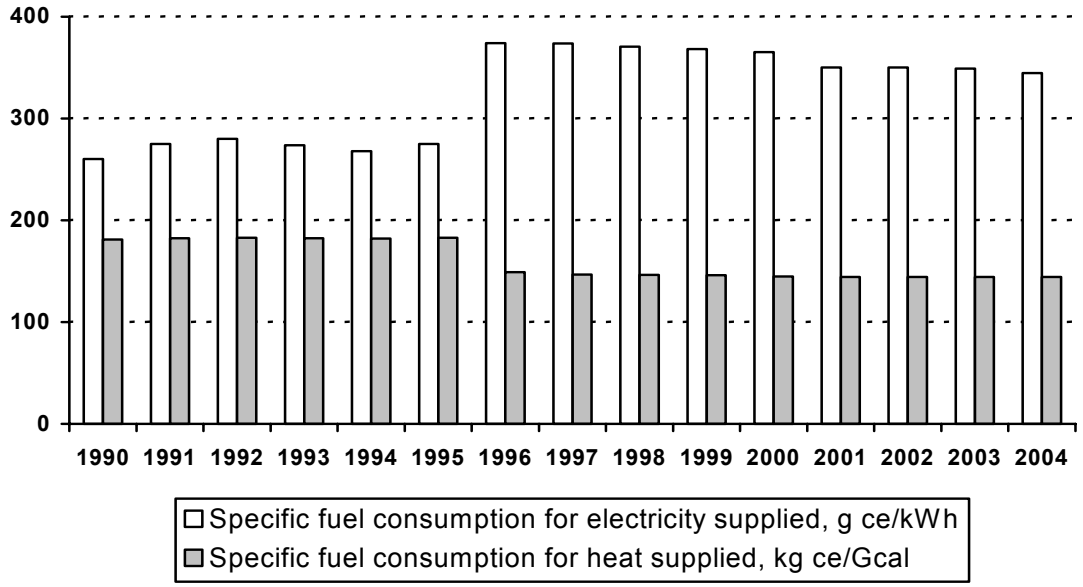
③ハバロフスクエネルゴ社 CHP-1 における発電他実績

Parameter	Value	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Electricity generation total, including auxiliary	mln. kWh	1928,4	1776,0	1717,7	1703,3	1671,4	1560,3	1718,6	1845,8	1889,8	1909,3	1967,9	1945,5	1908,2	2013.8	1908,1
Power output, total	mln. kWh	1539,8	1398,4	1367,8	1349,0	1323,3	1240,5	1393,2	1527,4	1576,1	1582,5	1636,5	1608,3	1571,1	1682.3	1589,1
Heat output, total	thous. Gcal	5316,6	5029,5	4498,8	4391,5	4303,4	3794,1	3700,3	3481,1	3524,3	3635,3	3731,7	3622,6	3563,6	3565.5	3468,8
Consumption of fuel equivalent, total	thous. tce	1363,7	1301,0	1206,0	1169,6	1138,0	1035,1	1072,4	1081,4	1099,1	1113,1	1137,8	1085,9	1064,3	1101.6	1054,2
Consumption of fuel equivalent for electricity supplied, total	thous. tce	400,6	384,4	382,7	369,5	354,4	340,9	521,0	570,8	583,7	582,5	597,5	563,1	550,0	587,0	554,46
Consumption of fuel equivalent for heat supplied, total	thous. tce	963,1	916,6	823,2	800,1	783,6	694,2	551,4	510,6	515,4	530,6	540,3	522,8	514,3	514,6	499,77
Specific consumption of fuel equivalent:																
for electricity supplied	g ce/kWh	260,2	274,9	279,8	273,9	267,8	274,8	373,9	373,7	370,4	368,1	365,1	350,1	350,1	349,0	344,4
for heat supplied	kg ce/Gcal	181,2	182,2	183,0	182,2	182,1	183,0	149,0	146,7	146,2	146,0	144,8	144,3	144,3	144,3	144,2

③発電・熱供給の実績推移
1990 年を境に発電実績は下降を余儀なくされるが、1996 年より上昇傾向にある。



④燃料消費量の推移
電力向けの燃料は 1996 年より飛躍的に消費が伸びているが、熱用燃料は 1996 年に若干下落し、その後安定して推移している。



⑤ハバロフスク CHP-1 での石炭購入先・消費量推移
1998 年時点では 7 炭鉱より 1,093 千トン石炭を使用していたが、2004 年時点では 3 炭鉱からの 1,051 千トンの購入消費量となっている。

炭種	Value	1998	1999	2000	2001	2002	2003	2004
ライチヒンスク炭	thous. tce	45,6	11,2	0,45	0,03			
ウルガルスク炭	thous. tce	200,2	139,3	164,6	80,4	370,2	329,8	482,4
ハラノルスク	thous. tce	164,6	395,0	427,8	251,2	232,2	261,6	171,1
チェルノゴルスク炭	thous. tce	2,6					1,9	
リクヒンスク炭	thous. tce	9,9					56,6	
アバカン炭	thous. tce	19,7						
アゼイスク炭	thous. tce	651,2	564,0	321,1	104,5	78,4		
ウルスヤスク炭	thous. tce			221,2	646,6	379,5	448,7	397,3
カラカンスク炭	thous. tce				0,044			
Total for year:	**thous. tce**	**1093**	**1109**	**1135**	**1082**	**1060**	**1099**	**1051**

⑥2006 年以降の電気・熱供給予測

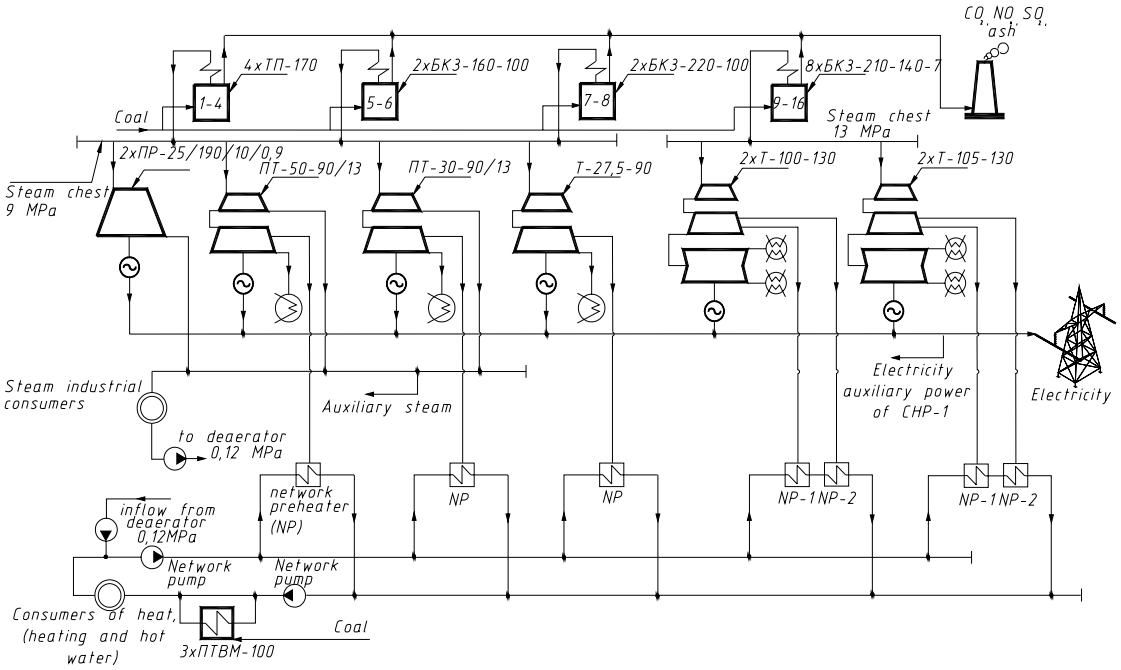
ハバロフスクエネルゴ社と 2005 年以降の電気・熱供給予測につき討議を行い、2012 年までの見通しを作成した。

Parameters	2005	2006	2007	2008	2009	2010	2011	2012
Power output, mln. kWh	1 580	1 585	1 630	1 680	1 680	1 680	1 680	1 680
Heat output, thous. Gcal	3 465	3 465	3 465	3 465	3 465	3 465	3 465	3 465

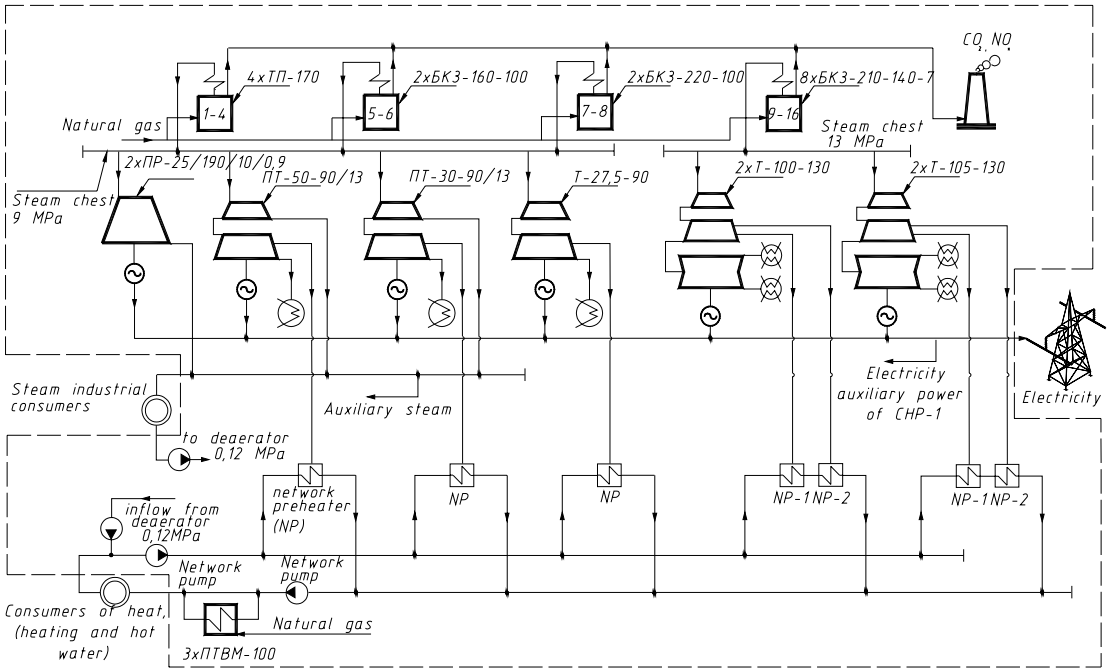
⑦プロジェクトの概要

今回のプロジェクトではハバロフスク熱併給発電所 CHP-1 に位置するボイラー19 基全てを石炭焚きからガス焚きへ変更を行う内容である。設備工事は、ハバロフスクエネルゴ社関連会社であるハバロフスクエネルゴテクノロジー社他 2 社が請け負う事が 2004 年 12 月に決定している。

（現在の石炭焚きボイラー）



（プロジェクト完了後の天然ガス焚きボイラー）



⑧対象設備の概要

今回対象とするハバロフスク CHP-1 のボイラー19 基は、その殆どが 1950 年代から 1960 年代に設置されたボイラーである。

（Steam boilers）

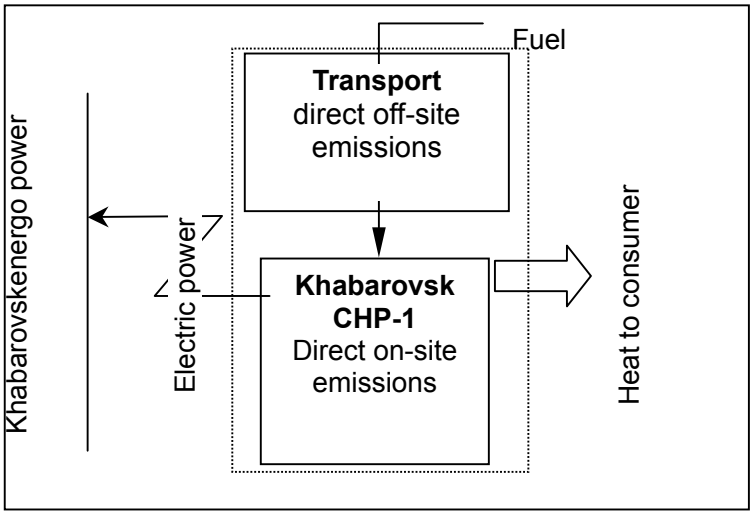
Station No.	Type	Manufacturer	Year of commissioning	Fuel	Steam parameters		Nominal output, t/h
					Pressure, kg/cm^2	Temperature, ^0C	
1	ТП-170	ТКЗ	1953	coal/heavy oil	100	540	170
2	ТП-170	ТКЗ	1955	coal/heavy oil	100	540	170
3	ТП-170	ТКЗ	1955	coal/heavy oil	100	540	170
4	ТП-170	ТКЗ	1958	coal/heavy oil	100	540	170
5	БКЗ-160-100-Ф	Barnaul boiler manufacturing works	1959	coal/heavy oil	100	540	160
6	БКЗ-160-100-Ф		1960	coal/heavy oil	100	540	160
7	БКЗ-220-100-Ф		1964	coal/heavy oil	100	540	220
8	БКЗ-220-100-Ф		1965	coal/heavy oil	100	540	220
9	БКЗ-210-140-Ф		1966	coal/heavy oil	140	560	210
10	БКЗ-210-140-Ф		1967	coal/heavy oil	140	560	210
11	БКЗ-210-140-Ф		1968	coal/heavy oil	140	560	210
12	БКЗ-210-140-Ф		1970	coal/heavy oil	140	560	210
13	БКЗ-210-140-Ф		1971	coal/heavy oil	140	560	210
14	БКЗ-210-140-Ф		1972	coal/heavy oil	140	560	210
15	БКЗ-210-140-Ф		1972	coal/heavy oil	140	560	210
16	БКЗ-210-140-Ф		1973	coal/heavy oil	140	560	210

（Hot water boiler-house）

Station No.	Type	Manufacturer	Year of manufacture	Fuel	Steam parameters		Nominal output, Gcal/h
					Pressure, kg/cm^2	Temperature, ^0C	
18	ПТВМ-100	Belgorod boiler manufacturing works	1978	heavy oil	25	70-150	100
19	ПТВМ-100		1979	heavy oil	25	70-150	100
20	ПТВМ-100		1981	heavy oil	25	70-150	100

（2）プロジェクト境界（バウンダリー）

本プロジェクトでは、ハバロフスクエネルゴ社 CHP-1 における石炭焚きボイラーを天然ガス焚きボイラーに変更する内容である。よって現状の内容と変更が生じる CHP-1 での燃料使用変更並びに燃料輸送を基本的なバウンダリーと定義する事とした。



（3）クレジット獲得期間

CDM では 10 年間若しくは 7 年間の 2 回ベースライン更新と明確になっているが、JI では同様のルールは未だ規定されていない。また京都議定書が第 2 次遵守期間以降も継続するか不明である。よって本プロジェクトにおいては、第一次遵守期間である 2008 年～2012 年までの 5 年間をクレジット獲得期間として設定する事とした。

（4）ベースラインの設定

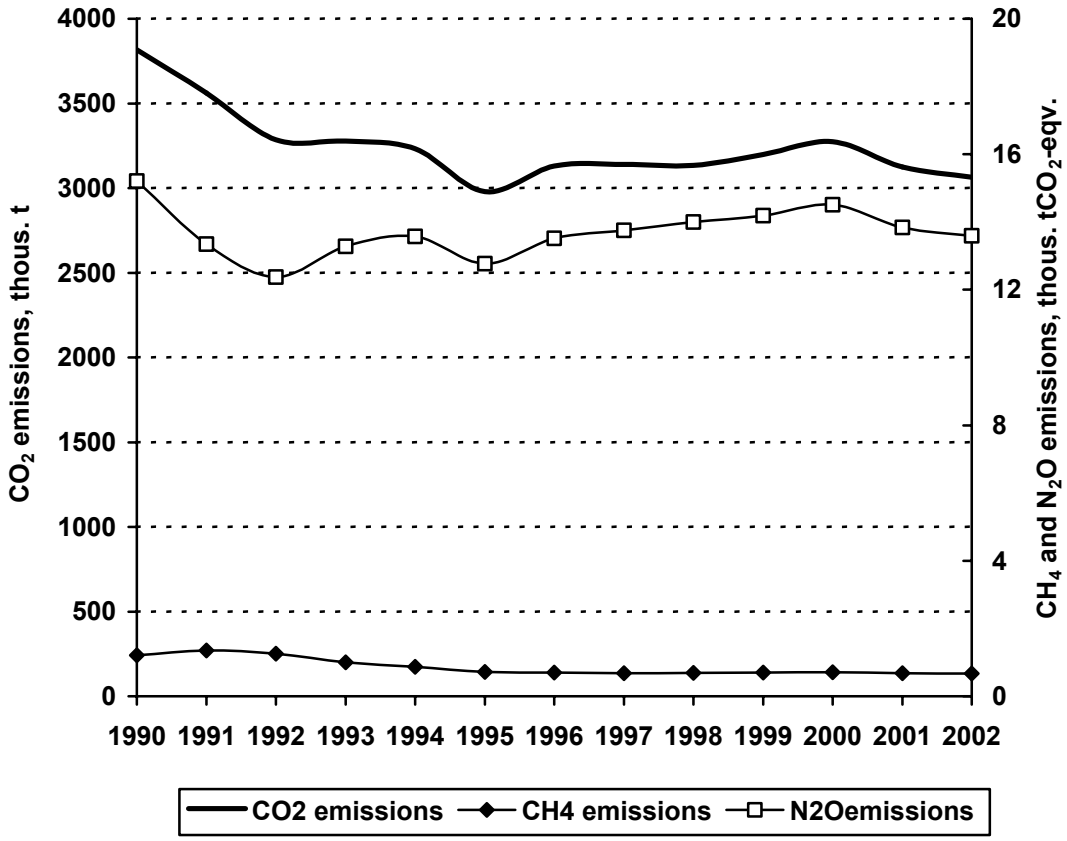
①CO2 排出係数の算出

CO2 排出係数を算出するに当たり、1999 年に作成され米国 Environmental Defense 社が評価を行った UES 社のインベントリーデータが存在する（このインベントリーの誤差は 4%と結果が出ている）。しかしながら個別には CO2 排出係数が異なることから、ECF 社により再度今回対象としている CHP-1 設備を含むハバロフスクエネルゴ社の CO2 排出係数を算出することとした。

この結果としてハバロフスクエネルゴ社 CHP-1 プラントにおける排出係数は 2.88t-Co2/tce と算出した（実績ベース）。

今回はこの係数を用いて、ベースラインの計算を行うこととした。

（温室効果ガス発生量の推移）



（燃料使用実績からの CO2 発生量）

Fuel balance

Fuel type	Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1) Raichihinsk coal	thous. tce	78,584	115,471	1,592	8,139	12,529	0,281	15,637	68,724	45,581	11,231	0,453	0,029	
2) Urgalsk coal	thous. tce	0,706	0,204	4,244	55,303	268,799	347,572	289,900	371,695	200,200	139,344	164,596	80,366	370,202
3) Kharanorsk coal	thous. tce	432,014	386,282	493,647	504,425	541,322	527,477	673,334	412,973	164,556	394,960	427,848	251,207	232,238
4) Chernogorsk coal	thous. tce			52,821		13,791	0,039	32,600		2,608				
5) Izykhinsk coal	thous. tce			2,839	59,525	66,199	5,155	18,191		9,917				
6) Abakan coal	thous. tce									19,683				
7) Azeisk coal	thous. tce		7,696	38,391	78,097	30,218	55,903	16,886	205,414	651,192	564,010	321,118	104,480	78,442
8) Urtuysk coal	thous. tce											221,154	646,639	379,531
Oil fuel	thous. tce	299,853	445,144	415,374	227,296	133,415	62,07	24,226	8,902	5,401	3,544	2,643	3,112	3,857

Fuel consumption by transport

	Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Petrol consumption	t/y	87,7	89,7	89,7	96,6	96,6	103,4	103,4	110,3	132,4	124,1	115,2	97,9	167,5
Diesel oil consumption	t/y	445,9	323,3	548,3	453,1	720,3	567,8	520,3	586,0	410,5	462,9	480,4	429,4	571,9

Average CO_2 emissions coefficients

	Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Average CO_2 emissions coefficient for solid fuel	t CO_2/tce	2,96	3,01	2,99	2,95	2,92	2,92	2,93	2,91	2,85	2,87	2,88	2,88	2,88
Average CO_2 emissions coefficient for oil fuel	t CO_2/tce	2,21	2,22	2,22	2,20	2,23	2,24	2,30	2,33	2,35	2,44	2,53	2,41	2,39

②直接・間接でのプロジェクト実行に伴う温室効果ガス排出量の変化

直接・間接での CO2 排出量の計算を行い、バウンダリーの中での保守的な数値を算出することとした。結論として、ハバロフスクエネルゴ社 CHP-1 での燃料消費に伴う温室効果ガス発生量及びプロジェクト実施後のエネルギー輸送（ガス）に関するパイプラインからのメタン漏出を保守的に加味することとした。

■考察

	Direct	Indirect
On Site	・ハバロフスク CHP-1 プラントからの燃料消費に伴う温室効果ガス排出量 ・ハバロフスク CHP-1 プラントにおける補助設備からの温室効果ガス排出量（石油タンクからの蒸発、石炭貯蔵設備における石炭のダスティング他）	燃料転換による電気・熱の消費需要の変化からの温室効果ガス排出量
Off Site	エネルギー輸送にかかる温室効果ガス排出量（石炭、ガス-ガスパイプラン、コンプレッサー他からの漏れ）	プロジェクト実施による他地域での温室効果ガス排出量

■結果

	Direct	Indirect
On Site	・燃料消費における CO2 以外の CH4 及び N2O のシェアは 0.6%を超過しない事から今回 CO2 のみを考慮することとした。 ・温室効果ガス全体排出量のうち 0.08%程度の影響しかなく、今回考慮しないこととした。	プロジェクト実施後においても何ら需要に影響は与えないとして考慮しない事とした。
Off Site	・補助設備における温室効果ガス発生量の影響度は 3%程度であり今回考慮しないものとした。 ・ガスパイプラインからのメタン漏出は最大値を採用することで保守的に計算する事とした。	燃料転換を行いボイラー効率が良くなり、他発電所の供給量を減少させることで温室効果ガス排出削減は可能であるが、今回考慮しないこととした。

③ベースラインに影響を与える一般的な要素の分析

法律面、政治面、経済面、環境面、技術面において、プロジェクトに影響を与える要素を抽出し、ベースラインへの影響度を討議・分析した。

因子の説明	結果	影響
	法律	
ロシア議会（デュマ）が 2003 年に採択した電力事業の機能に関する連邦法	1. 電力ガス事業の自由化のプロセスとさまざまな燃料の入手可能性の増大 2. 事業の競争原理の導入 3. 規制当局による妥当な料金規制を伴うエネルギー料金の制限と低減	1. ベースライン作成 エネルギーの需要と供給の成長、ベースラン絶対値の上昇、特定数値（kWh あたり）の低減 2. 本プロジェクトの活動レベルと温室効果ガス排出量 エネルギーの需要と供給の成長、ベースラン絶対値の上昇、特定数値（kWh あたり）の低減 3. 本プロジェクトへのリスク リスク低減を促進
地域の法律 「ハバロフスク地域の租税公課に関するもの」 「ハバロフスク地域の投資活動に関するもの」	1. 地域に投資する投資家には優遇税制。優遇措置は毎年更新。	1. ベースライン ベースラインに影響なし。 2. 本プロジェクトの活動レベルと温室効果ガス排出量 「炭素」投資は、この因子から恩恵の可能性 3. 本プロジェクトへのリスク リスク低減の方向
環境法	1. 環境基準がますます強化されている。 2. ヨーロッパの基準（ISO-14000）等の遵守要求の傾向 ロシア連邦では 2 年毎に基準を更改	1. ベースライン 同発電所の補助電力消費量は温室効果ガス排出量とともに微増の予想 2. 本プロジェクトの活動レベルと温室効果ガス排出量 この因子は本プロジェクト実施の促進剤 3. 本プロジェクトへのリスク リスク低減の方向
京都議定書発効	ロシア連邦共和国政府の授権機関への JI プロジェク	1. ベースライン

JIプロジェクト承認に基づく国家手続き（法的因子）	トの委任、JI プロジェクト承認に基づく国家手続きの採択（2005） ロシア連邦共和国政府の授権機関への JI プロジェクトの委任、JI プロジェクト承認に基づく国家手続きの採択（2005 以降）	ベースラインに影響なし。 2．本プロジェクトの活動レベルと温室効果ガス排出量 この因子は本プロジェクト実施の実質的な促進剤 3．本プロジェクトへのリスク リスクを非常に低減 1．ベースライン ベースラインに影響なし。 2．本プロジェクトの活動レベルと温室効果ガス排出量 この因子は本プロジェクト実施に負の影響 3．本プロジェクトへのリスク リスクを増大。
政治		
連邦・地方選挙、政治情勢	• ロシアの政治情勢は比較的安定。 • ハバロフスク地域の知事選挙（2004 年 12 月）で、現職の V.イシャエフ候補当選が当選。 したがって、主な戦略や経済政策に大きな変化はないもよう。	1．ベースライン作成 エネルギーの需要と供給の成長、ベースラン絶対値の上昇、特定数値（kWh あたり）の低減 2．本プロジェクトの活動レベルと温室効果ガス排出量 エネルギーの需要と供給の成長、ベースラン絶対値の上昇、特定数値（kWh あたり）の低減 3．本プロジェクトへのリスク リスクやや低減
経済		
ハバロフスク地域で、連邦や地方の計画が実現するなどして、産業や農業が成長、	ハバロフスク CHP-1 でエネルギー生産量が上昇	1．ベースライン 絶対的数値が上昇、単位あたりの生産費用が

企業の分割再編や非専門部門の清算の加速化 エネルギー料金および燃料費	JSC「ハバロフスクエネルギー会社」の修理、建設などの非専門部門を分割して子会社化することにより、発電・発熱の経費を低減。 エネルギー料金や燃料費が常に上昇傾向。エネルギー料金は燃料費に直接依存しているから。 2005 年 1 月 1 日より、JSC「ハバロフスクエネルギー会社」では、電気使用料金を 8.4%、熱使用料金を 9.9%値上げした。2004 年のインフレ率は 12%（ロシア連邦共和国経済発展省予測）	低減。 2．本プロジェクトの活動レベルと温室効果ガス排出量 絶対的数値が上昇、特定数値（kWh あたり）の低減。 3．本プロジェクトへのリスク リスクに影響なし 1．ベースライン ベースラインに影響なし。 2．本プロジェクトの活動レベルと温室効果ガス排出量 本プロジェクトへの影響なし 3．本プロジェクトへのリスク リスクを低減 (1)および(2)への影響度は予測不能。 3．リスク この因子はリスクを微増させ、JSC「ハバロフスクエネルギー会社」の費用管理計画の実現を相殺。
社会人口統計		
ハバロフスクの人口増 労働需要、生活水準の向上要求	ハバロフスク市の人口は 2002 年には 15,000 人以上上昇。 結果、エネルギーに対する需要や供給の増加の見込み（また、発電所の発電効率も上昇する）	1．ベースライン エネルギーの需要の成長、ベースラン絶対値の上昇、特定数値（kWh あたり）の低減 2．本プロジェクトの活動レベルと温室効果ガス排出量 エネルギーの需要の成長、絶対的数値の上昇、特定数値（kWh あたり）の低減

		3．本プロジェクトへのリスク リスクを微増
環境		
ハバロフスク CHP-1 の地域への環境影響	ハバロフスク CHP-1 の負荷は小さいので、環境への当座の影響はむしろ小さい。エネルギー生産量が上昇するにつれ、石炭燃料では、この因子を大きく増幅させ、発電所内で消費する追加エネルギーも増えるであろう。ガス化すればこの因子を実質的に除去するであろう。	1．ベースライン この因子はベースラインの絶対値および特定数値を微増させる。 2．本プロジェクトの活動レベルと温室効果ガス排出量 この因子は排出量には実質的な影響はない。 3．本プロジェクトへのリスク リスクに影響はない
技術		
技術、ノウハウ、経験	JSC「ハバロフスクエネルギー会社」はボイラーをガス化するプロジェクトの実現に幅広い経験を有する（15 基以上）	1．ベースライン この因子はベースラインに影響しない。 2．本プロジェクトの活動レベルと温室効果ガス排出量 この因子は本プロジェクト実施を促進し、古い機器の使用を促進させる。 3．本プロジェクトへのリスク この因子はリスクを低減させる。

③ベースラインに影響を与える一般的な要素の分析

ベースラインの判定方法を選択するにあたり、初期データの有効性および提出された計算値の定量的点検が考察された。CHP-1 プラントでの近年（5 年から 10 年）の運転状況を分析し、2012 年までの数値を推定することができる。同時に、この分析は、ハバロフスク地域およびハバロフスク市の需要家の熱や電力に対する需要の動向予測で構成されていた。したがって、この場合、「過去の数値」と「将来予測」の両建てがより正確な方法である。ハバロフスク CHP-1 はハバロフスク市の工業地域に所在している。この発電所から市南部の需要家に熱を供給し、また、電気はオープン JSC「ハバロフスクエネルギー会社」に供給されている。発電される電気の 70%以上が熱サイクルによるものである。主な燃料は石炭である。発電システムの作動寿命を知ることにより、2012 年までの数字を推定することができる。このベースライン選択では、既存の発電装置を新しいものに交換することは考察されていない。

オプション1

ハバロフスク市（南部）では、2006年から2012年にかけて、代替電力源（たとえば、市のボイラーハウスなど）が運転を開始する予定。これに関し、CHP-1では熱や電力の生産が落ち、燃料消費量や温室効果ガス排出量も落ちる。

オプション2

JSC「ハバロフスクエネルギー会社」では、2006年から2012年にかけて、連邦電力卸売り市場（Federal Wholesale Market of the Electricity and Power, FOREM）からの電力購入量が増加する。ハバロフスクCHP-1発電所を含むCHPで生産される電力を代替することを目的とした、ブレイスク水力発電所で発電された電力も含む。

オプション3

2006年から2012年にかけて、石炭を燃料としていたCHP-1が重油燃料に交換される。その結果、CHP-1で生産されていた同量の熱や電気がこれに取り代わり、重油を燃料とすることにより、ベースラインは温室効果ガスの発生の低下を示す。

オプション4

2012年まで、既存の装置類を十分にメンテナンスし（3.3項）、3.2項の予測に基づく熱、電力の生産がおこなわれる。

ベースライン選択

上記のオプション１と3は可能性が低い。

オプション１について：このベースライン**オプション**の可能性を阻止する主な要因は、新しいエネルギー生産施設を建設するための投資活動の低さにある。ハバロフスク地域のエネルギー料金は、熱やエネルギーを生産して利益をあげるほど十分ではない。たとえば、既存の熱料金制度では、熱の生産はJSC「ハバロフスクエネルギー会社」に利益をもたらすものではない。2003年の数字では、熱の販売による収入は熱生産に要する費用の約76%であった。電力も加えて、エネルギー生産全体を見た場合、JSC「ハバロフスクエネルギー会社」の2003年の利益率は2%であった。2002年はまったく利益が上がっていなかった。加えて、本プロジェクト実施については、もう1つの障害がある。たとえば、市内に新しい施設を建設する土地が必要なことおよびプロジェクト実施企業の運転職員の訓練を行う必要性などである。

これらの障害はプロジェクトの実施の可能性を低くする。

オプション3について：計算上、標準的な燃料1トンあたりの費用で見た場合、重油の価格は石炭の1.5倍から2.5倍である（石炭の種類により異なる）。そのため、**オプ**

ション3を採用する経済的な妥当性はない。

オプション2について：ブレイスク水力発電所は、まず、プリモルスク地区の需要家に安定したエネルギーを供給すること、また、極東地域の石油化学、アルミニウム、林業を開発することを目的としている。ブレイスク水力発電所で生産された電力を含み、FOREMからの電力購入は、以前に締結された契約に基づいて行われる。FOREMから調達する電力の割合（FOREMからの電力購入・販売量の割合）は、オープンJSC「ハバロフスクエネルギー会社」の全体的な発電バランスの2～3%である。FOREMから購入する電力の割合を大きくすること（ハバロフスクCHP-1発電所の発電量を低くするためを含む）は、次の因子により限界がある（ハバロフスクCHP-1発電所の場合）。すなわち、ハバロフスクCHP-1発電所で生産される電力の70%以上が、地域の熱サイクルで行われているものであり、CHPの運営にはもっとも経済効率の良い方法である。熱交換サイクルによる発電、つまり、ボイラーハウス方式でCHPの装置を使用することは、同発電所の運転性能を損なう。したがって、CHPでの発電を水力発電に切り替えることは、CHPの性能全体が低下するため、可能性は低い。CHP-1での熱交換サイクルによる発電（30%）は、まず、季節的ピークや日中のピーク需要などの必要を満たすためという条件がつけられているのである。したがって、ピーク時負荷の実際の数値は計画負荷とは著しく異なる。このような与件を考えると、熱交換サイクルによる発電量すべてをFOREMからの購入に切り替えることは、契約違反による罰則金支払いの必要を考えると、限界がある。したがって、このベースラインの発生の可能性は低い。しかし、上記の限定因子は、JSC「ハバロフスクエネルギー会社」のエネルギーバランスのなかでFOREMから購入する電力量の割合の増加をまったく除去するものではなく、したがって、結果として、ハバロフスクCHP-1発電所の発電量は低下する。この与件を除去するため、控えめなアプローチに基づき、オープンJSC「ハバロフスクエネルギー会社」の専門家と相談のうえ、電力エネルギー生産の将来予測（○○項）を行った。

したがって、オプション４の事象がもっとも可能性のある事象であり、プロジェクト設計図書では、このベースラインに基づき、温室効果ガス排出計算に採用することとした。

今後の課題：現有設備の耐久性（2012 年迄）第三者レビューの必要性

④2012 年までの電気・熱供給並びに燃料使用からの CO2 排出係数計算

Parameters	Unit	Years						
		2006	2007	2008	2009	2010	2011	2012
Annual heat output	thous. Gcal	3465	3465	3465	3465	3465	3465	3465
Annual power output	mln. kWh	1585	1630	1680	1680	1680	1680	1680
Specific fuel equivalent consumption for heat supplied	kg/Gcal	144,4	144,4	144,4	144,4	144,4	144,4	144,4
Specific fuel equivalent consumption for electricity supplied	g/kWh	351,7	351,7	351,7	351,7	351,7	351,7	351,7
Annual fuel consumption for heat	thous. ton c.e.	500,3	500,3	500,3	500,3	500,3	500,3	500,3
Annual fuel consumption for electricity	thous. ton c.e.	557,5	573,3	590,9	590,9	590,9	590,9	590,9
Annual fuel consumption for heat and electricity, totally:	thous. ton c.e.	1057,8	1073,6	1091,2	1091,2	1091,2	1091,2	1091,2
coal firing	thous. ton c.e.	1054,6	1070,4	1087,9	1087,9	1087,9	1087,9	1087,9
heavy oil firing	thous. ton c.e.	3,2	3,2	3,3	3,3	3,3	3,3	3,3
Coefficient of CO_2 emission coal burning	t CO_2/tce	2,88	2,88	2,88	2,88	2,88	2,88	2,88
Coefficient of CO_2 emission heavy oil burning	t CO_2/tce	2,31	2,31	2,31	2,31	2,31	2,31	2,31

⑤ベースライン数値の設定

ベースライン数値として 2008 年以降 2012 年までの期間を 3,140.8 千トン／年と設定した。

Parameters	Unit	Years						
		2006	2007	2008	2009	2010	2011	2012
CO_2 emissions from fuel combustion								
coal	thous. tCO_2	3037,3	3082,7	3133,2	3133,2	3133,2	3133,2	3133,2
heavy oil	thous. tCO_2	7,3	7,4	7,6	7,6	7,6	7,6	7,6
CO_2 emission for heat output	thous. tCO_2	1439,9	1439,9	1439,9	1439,9	1439,9	1439,9	1439,9
CO_2 emission for power output	thous. tCO_2	1604,7	1650,2	1700,8	1700,8	1700,8	1700,8	1700,8
Specific CO_2 emissions for 1 Gcal output	$kgCO_2/Gcal$	416	416	416	416	416	416	416
Specific CO_2 emissions for 1 kWh output	gCO_2/kWh	1012	1012	1012	1012	1012	1012	1012
Total direct on-site GHG emissions	thous tCO_2	3044,6	3090,2	3140,8	3140,8	3140,8	3140,8	3140,8

Parameters	Unit	Years						
		2006	2007	2008	2009	2010	2011	2012
Total GHG baseline emissions	**thous. t CO_2**	**3044,6**	**3090,2**	**3140,8**	**3140,8**	**3140,8**	**3140,8**	**3140,8**
GHG project emissions associated with electricity production	thous. t CO_2	1 605	1 650	1 701	1 701	1 701	1 701	1 701
GHG project emissions associated with heat production	thous.t CO_2	1 440	1 440	1 440	1 440	1 440	1 440	1 440
CEF under electricity production	**gCO_2/kWh**	**1 012**	**1 012**	**1 012**	**1 012**	**1 012**	**1 012**	**1 012**
CEF under heat production	**$kgCO_2/Gcal$**	**416**	**416**	**416**	**416**	**416**	**416**	**416**

（5）プロジェクトベースラインの設定

購入する天然ガスの輸送にかかるメタンガス漏出を計算値に含み、プロジェクト実施後の温室効果ガス排出量を計算した。プロジェクトベースラインは 1,920 千トン／年と算出された。

Parameters	Unit	Years					
		2007	2008	2009	2010	2011	2012
Annual heat output	thous. Gcal	3 465	3 465	3 465	3 465	3 465	3 465
Annual power output	mln. kWh	1 630	1 680	1 680	1 680	1 680	1 680
Specific fuel equivalent consumption for heat supplied	kg/Gcal	139,8	142,1	142,1	142,1	142,1	142,1
Specific fuel equivalent consumption for electricity supplied	g/kWh	327,1	322,5	322,5	322,5	322,5	322,5
Annual fuel consumption for heat	thous. ton c.e.	484,5	492,4	492,4	492,4	492,4	492,4
Annual fuel consumption for electricity	thous. ton c.e.	533,1	541,9	541,9	541,9	541,9	541,9
Annual fuel consumption for heat and electricity, totally:	thous. ton c.e.	1 017,6	1 034,3	1 034,3	1 034,3	1 034,3	1 034,3
Coefficient of CO_2 emission gas burning	t CO_2/tce	1,62	1,62	1,62	1,62	1,62	1,62

（Direct-On Site からの温室効果ガス発生量）

Parameters	Unit	Year					
		2007	2008	2009	2010	2011	2012
CO_2 emission for heat output	thous. tCO_2	784,9	797,7	797,7	797,7	797,7	797,7
CO_2 emission for power output	thous. tCO_2	863,7	877,8	877,8	877,8	877,8	877,8
Specific CO_2 emissions for 1 Gcal output	$kgCO_2/Gcal$	227	230	230	230	230	230
Specific CO_2 emissions for 1 kWh output	gCO_2/kWh	530	523	523	523	523	523
Total direct on-site GHG emissions	thous tCO_2	**1 649**	**1 676**	**1 676**	**1 676**	**1 676**	**1 676**

（Direct-Off Site からの温室効果ガス発生量）

Parameters	Unit	Year					
		2007	2008	2009	2010	2011	2012
Quantity of burning gas at the Khabarovsk CHP-1	thous. ton c.e.	1 017,6	1 034,3	1 034,3	1 034,3	1 034,3	1 034,3
Direct off-site GHG emissions associated with production:							
electricity	thous. t CO_2-eqv	126	128	128	128	128	128
heat	thous. t CO_2-eqv	115	116	116	116	116	116
CH_4 emissions in CO_2-eqv. associated with gas delivery and transportation	thous. t CO_2-eqv	**240,5**	**244,5**	**244,5**	**244,5**	**244,5**	**244,5**

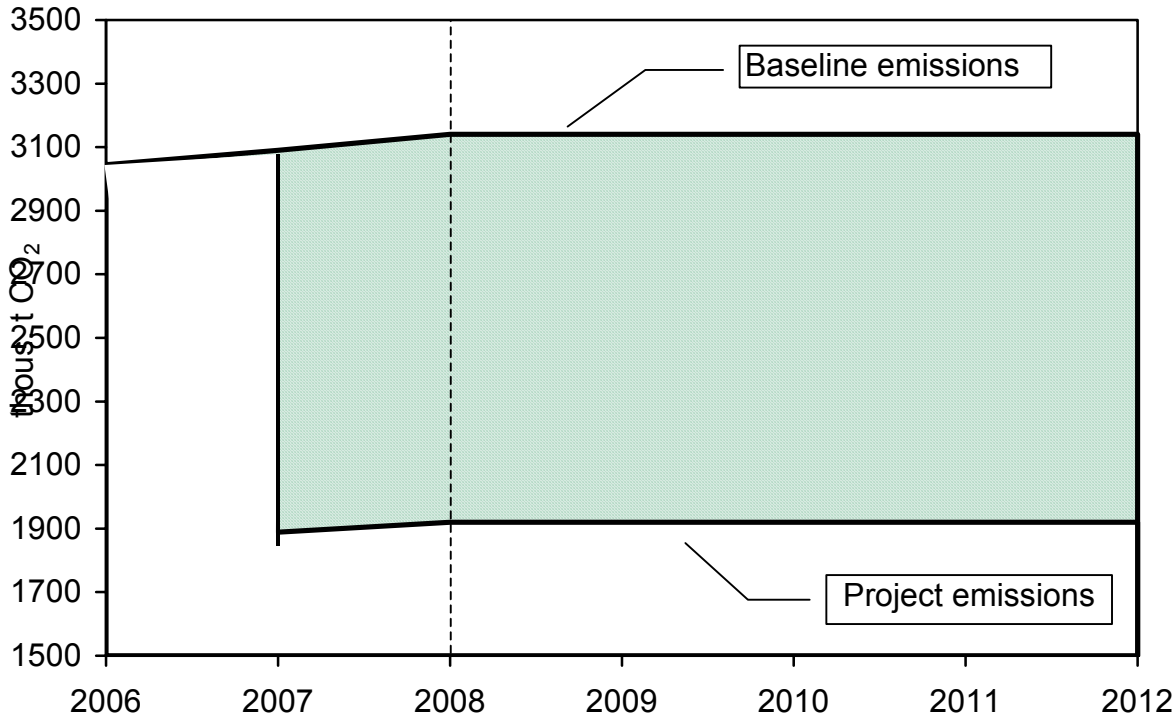
（プロジェクトベースライン）

Parameters	Unit	Year					
		2007	2008	2009	2010	2011	2012
GHG project emissions	**thous. tCO2-eqv**	**1889,1**	**1920,0**	**1920,0**	**1920,0**	**1920,0**	**1920,0**
GHG project emissions associated with electricity production	thous. tCO2-eqv	990	1 006	1 006	1 006	1 006	1 006
GHG project emissions associated with heat production	thous. tCO2-eqv	899	914	914	914	914	914
CEF under electricity production	**gCO_2/kWh**	**607**	**599**	**599**	**599**	**599**	**599**
CEF under heat production	**$kgCO_2/Gcal$**	**260**	**264**	**264**	**264**	**264**	**264**

（6）温室効果ガス削減量の算定

ベースライン並びにプロジェクトベースラインを鑑み削減量の計算を行った。

Parameters	Unit	Years					
		2007	2008	2009	2010	2011	2012
ANNUAL OUTPUT:							
electic energy	thous. MWh	1 630	1 680	1 680	1 680	1 680	1 680
heat	thous. Gcal	3 465	3 465	3 465	3 465	3 465	3 465
BASELINE							
CEF under electricity production	gCO_2/kWh	1 012	1 012	1 012	1 012	1 012	1 012
CEF under heat production	$kgCO_2/Gcal$	416	416	416	416	416	416
PROJECT							
CEF under electricity production	gCO_2/kWh	607	599	599	599	599	599
CEF under heat production	$kgCO_2/Gcal$	260	264	264	264	264	264
ERUs	**thous. t CO_2**	**1 201**	**1 221**	**1 221**	**1 221**	**1 221**	**1 221**
for 2008-2012 period	**thous. t CO_2**						**6 104**



（7）モニタリングプラン

ハバロフスクエネルゴ社 CHP-1 プラントにおける燃料消費並びにガス輸送にかかる漏出からの温室効果ガス発生量のモニタリング内容につき討議を行った。ガス輸送に関する温室効果ガス発生量は採用するデータがコントロール出来ない事から、実測することは困難であり、あくまでも計算上とし、実質的にはハバロフスク CHP-1 における燃料消費のモニタリングを主とすることとした。

№	Parameter	Data variable	Unit	Measured, calculated or estimated	Recording & archiving method (electronic/ paper)	Registration frequency
1.	Annual power output		kWh	measured	Electronic and paper Statistical report, Forms 15506-1, Form No 6-TP	continuously
2.	Annual heat output		Gcal	measured	Electronic and paper Statistical report, (Forms 15506-1, Form No 6-TP)	continuously
3.	Annual fuel consumption total		ton c.e.	measured	Electronic and paper Statistical report, (Forms 15506-1, Form No 6-TP)	continuously
3.1.	– including gas consumption during reporting period		thous. $м^3$, t c.e.	measured	Electronic and paper Statistical report	continuously
3.2.	– including coal consumption during reporting period		t c.e.	measured	Electronic and paper Statistical report	continuously
4.	Annual fuel consumption for power output		t c.e.	calculated	Electronic and paper Statistical report, (Forms 15506-1, Form No 6-TP)	monthly
4.1.	– including gas consumption during reporting period		thous. $м^3$, t c.e.	calculated	Electronic and paper Statistical report	monthly
4.2.	– including coal consumption during reporting period		t c.e.	calculated	Electronic and paper Statistical report	monthly

№	Parameter	Data variable	Unit	Measured, calculated or estimated	Recording & archiving method (electronic/ paper)	Registration frequency
5.	Annual fuel consumption for heat output		t c.e.	calculated	Electronic and paper Statistical report, (Forms 15506-1, Form No 6-TP)	monthly
5.1.	– including gas consumption during reporting period		thous. $м^3$, t c.e.	calculated	Electronic and paper Statistical report	monthly
5.2.	– including coal consumption during reporting period		t c.e.	calculated	Electronic and paper Statistical report	monthly
6.	Specific fuel consumption per:					
6.1.	– power output		g. c.e./kWh	calculated	Electronic and paper Statistical report Form 3-ТЕК (Forms 15506-1 [5, 6])	monthly
6.2.	– heat output		kg c.e./Gcal	calculated	Electronic and paper Statistical report, (Forms 15506-1, Form No 6-TP)	monthly
7.	Low heat value of natural gas		kcal/m^3, (MJ/m^3)	measured (laboratory test)	Electronic and paper Statistical report Form No 6-TP	monthly
8.	Chemical composition of natural gas:		%	measured (laboratory test)	Electronic and paper Statistical report	monthly

№	Parameter	Data variable	Unit	Measured, calculated or estimated	Recording & archiving method (electronic/ paper)	Registration frequency
8.1.	– CO_2		%			
8.2.	– CO		%			
8.3.	– CH_4		%			
8.4.	– C_nH_m		%			
9.	Coefficient of CO2 emission gas burning		t CO_2/t c.e.	calculated	Electronic and paper Statistical report	annually
10.	Coefficient of CO2 emission coal burning		t CO_2/t c.e.	in accordance with PDD		
11.	Direct on-site GHG emissions under the output			calculated	Electronic and paper Statistical report	annually
11.1.	– heat		t CO_2			

№	Parameter	Data variable	Unit	Measured, calculated or estimated	Recording & archiving method (electronic/ paper)	Registration frequency
11.2.	– electricity		t CO_2			
12.	CEF with production of:			calculated	Electronic and paper Statistical report	annually
12.1.	– heat		$kgCO_2$/ Gcal			
12.2.	– electricity		gCO_2/k Wh			
13.	CEF under baseline with production:			in accordance with PDD	Electronic and paper Statistical report	
13.1.	– heat		$kgCO_2$/ Gcal			
13.2.	– electricity		gCO_2/k Wh			
14.	GHG emission rediction		thous. t CO_2	calculated	Electronic and paper Statistical report	annually

（8）リーケージ

本プロジェクトではリーケージとして、プロジェクトバウンダリーの中で当てはまることはないことを討議の結果結論とした。

今後の課題：ガス化後の余剰石炭が諸外国へ輸出された場合リーケージになるのか？

（9） 環境影響評価（EIA：Environmental Impact Assessment）

プロジェクト実行後、ハバロフスクエネルゴ社 CHP-1 プラントにおいて、石炭からのフライアッシュを含む様々な以下の有害物質が削減される見通しである。

Year	Coal ash	SO_2	NOx	Total
	t/y	t/y	t/y	t/y
2007	13 863,4	7 609,6	2 758,7	24 231,7
2008	14 090,5	7 734,2	2 803,9	24 628,6
2009	14 090,5	7 734,2	2 803,9	24 628,6
2010	14 090,5	7 734,2	2 803,9	24 628,6
2011	14 090,5	7 734,2	2 803,9	24 628,6
2012	14 090,5	7 734,2	2 803,9	24 628,6

またガス化することにより、労働状況の改善が図られる事となる。

（10）利害関係者のコメント

ハバロフスク州政府はガス化を奨励しており、またハバロフスクエネルゴ社が本年 1 月に業界誌にてガス化プロジェクトを発表した以降も、付近住民他から何らクレームは存在していない。

今後の課題：付近住民からの直接ヒアリングが JI も必要か？

（11）追加性

①現在の石炭使用を継続することに法令的問題があるか否か？

サハリンⅠからの天然ガス使用を奨励するハバロフスク州の一般的な奨励は存在するが、石炭使用継続を中止させる法令は現在存在しない。

②燃料転換におけるエネルギー経費削減によるリターンはあるのか？

現行の石炭価格は 1,800 ルーブル／toe 前後で推移しており、購入予定のガス価格は 2,000 ルーブル／toe 前後が予想されている。よって燃料転換における投資メリットは基本的に存在しない。

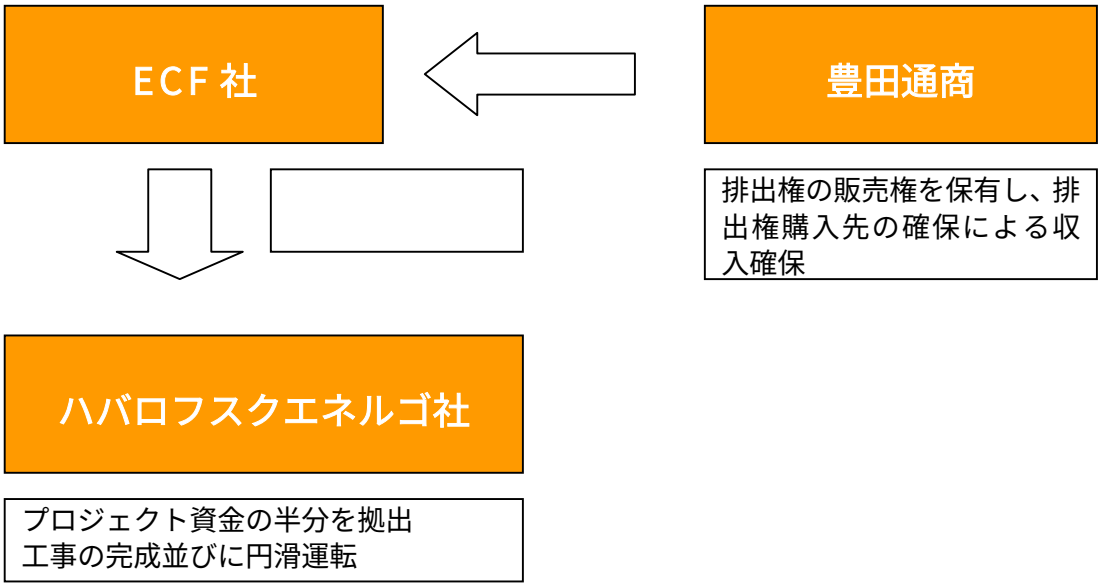
③排出権は追加的な資金となりえるのか？

プロジェクトの総投資額は 16 億ルーブル（約 64 億円）であり、この内半分の 32 億円をハバロフスクエネルゴ社が拠出し（銀行借入れ無し）、残り 32 億円を第一次遵守期間である 2008 年～2012 年までの 5 年間で排出権販売を基礎とした延べ払いを行う計画となっている。

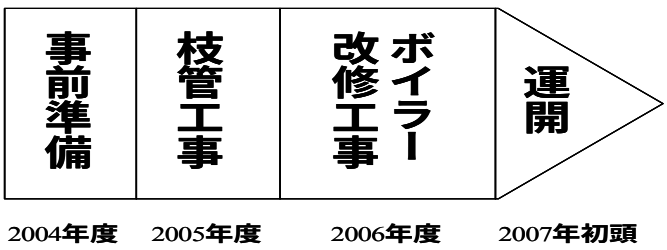
第３章
事業化に向けてのステップ

（1）プロジェクトの実施体制

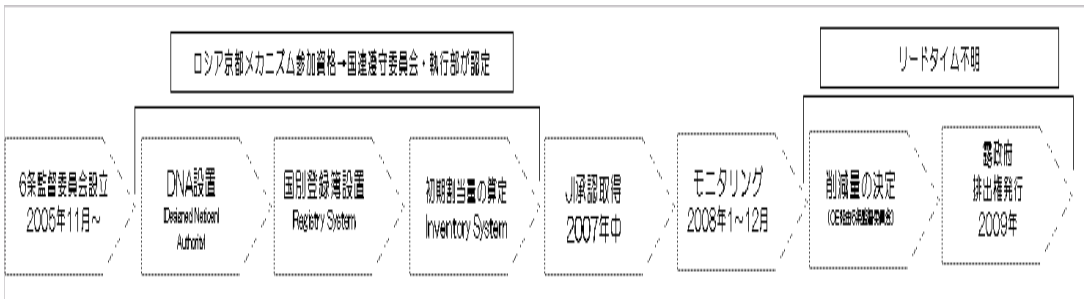
本プロジェクトは JI として認定され、かつ排出権の需要家との先渡し契約による収入の固定化がされない限り、実行されないプロジェクトである。日方は排出権の需要確保を主とし、露方は商業運転までの円滑なる実行を主として実施体制を組むこととした。



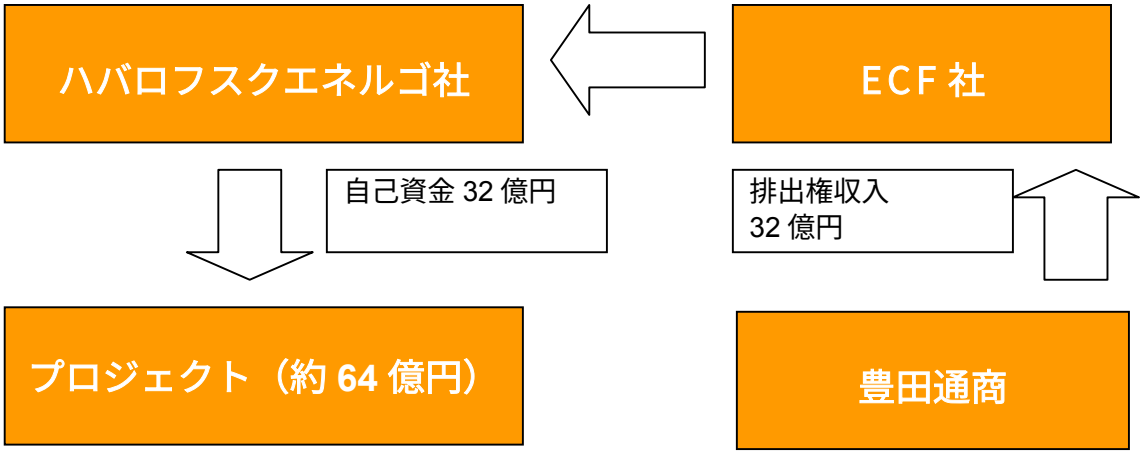
（2）プロジェクトスケジュール



（3）JI 申請



（3） プロジェクト実施のための資金計画



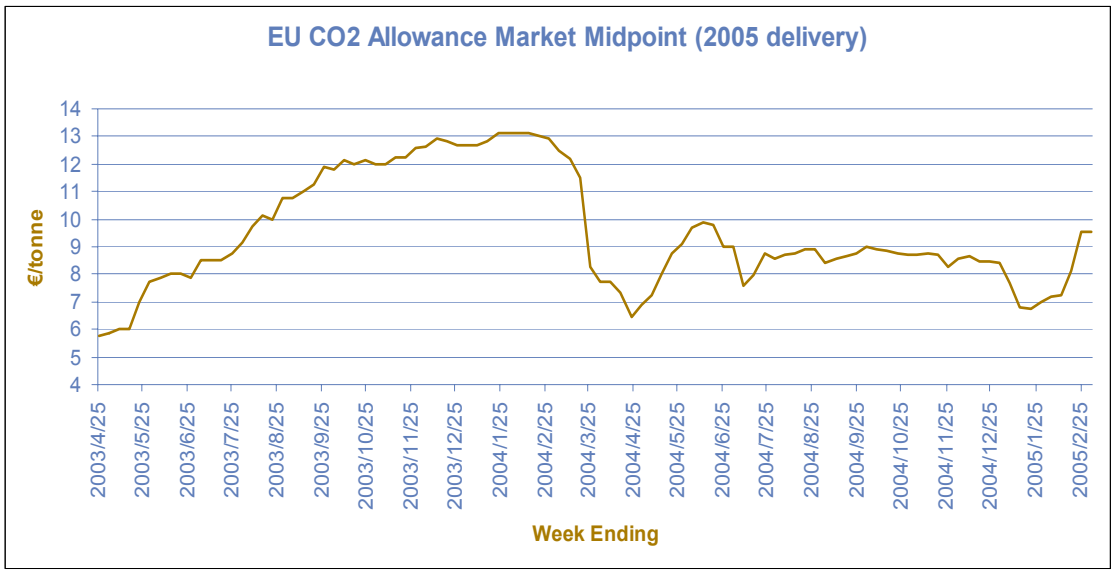
（4） 費用対効果

本プロジェクトにおいて、燃料転換からのエネルギー経費削減は、ガス価格が石炭価格と同等である限り、発生しない。また排出権販売を行い投資必要金額の半分を得ることとなっても、32 億円の投資に見合うハバロフスクエネルゴ社の投資効果は発生しない見込みである（IRR が依然としてマイナス）。但し今後のガス価格交渉次第では状況は変化する可能性がある。

Fundamentals Analysis
Khabarovskaya CHP-1 (Khabarovskenergo Jsc.

	FORECAST (000 EUR)	FORECAST (000 EUR)	FORECAST (000 EUR)	FORECAST (000 EUR)	FORECAST (000 EUR)	FORECAST (000 EUR)	FORECAST (000 EUR)	FORECAST (000 EUR)
Period	2006	2006	2007	2008	2009	2010	2011	2012
Energy Production Analysis								
Total Expenses	60,079	68,693	71,887	75,666	81,477	81,590	84,337	84,832
Heat only Expenses								
Electric only Expenses								
Shared Expenses	60,079	68,693	71,887	75,666	81,477	81,590	84,337	84,832
Costs to Heat (%)	47%	47%	47%	46%	46%	46%	46%	46%
Costs to Electricity (%)	53%	53%	53%	54%	54%	54%	54%	54%
Shared expenses attributable to Heat	28,414	32,488	33,996	34,886	37,395	37,562	38,665	38,892
Shared expenses attributable to Electric	31,666	36,205	37,890	40,970	44,123	44,368	45,671	45,939
Expenses attributable to Heat	28,414	32,488	33,996	34,886	37,395	37,562	38,665	38,892
Expenses attributable to Electricity	31,666	36,205	37,890	40,970	44,123	44,368	45,671	45,939
Cost per GCal of Heat Energy	8.2	9.4	9.7	10.0	10.8	10.8	11.2	11.2
Cost per MWh of Electric Energy	20.6	23.5	24.3	26.1	27.1	27.2	28.0	28.2
Average oil equivalent consumption per MWh of energy (TOE per MWh)	0.190	0.191	0.192	0.194	0.194	0.194	0.194	0.194
Efficiency Index (OPEX to Income)	83%	86%	86%	84%	83%	84%	87%	88%
Period	2006	2006	2007	2008	2009	2010	2011	2012
Profit / Loss	8,602	8,430	7,356	9,547	11,737	11,123	7,936	7,288
Loss Carried Forward (Begin of Period)								
Loss Carried Forward (End of Period)								
-Interest	0	0	0	0	0	0	0	0
-Taxes	(2,191)	(2,479)	(2,229)	(2,761)	(3,297)	(3,134)	(2,355)	(2,179)
=Net Income for DCF Evaluation	6,411	5,947	5,127	6,786	8,441	7,989	5,581	5,086
+Depreciation	2,590	2,590	3,482	3,482	3,482	3,482	3,482	3,482
=Operating Cash Flows for DCF	9,001	8,537	8,609	10,269	11,923	11,471	9,064	8,568
-Investments	(8,314)	(13,266)	0	0	0	0	0	0
=Free Cash Flows for DCF Evaluation	687	(4,729)	8,609	10,269	11,923	11,471	9,064	8,568
Return Analysis								
Internal Rate of Return of PCFs	#DIV/0!							

排出権販売での収入を 32 億円と見込む根拠として、2005 年に立上った欧州排出権市場でのスポット価格を下回っていることを必要条件とした。



（5）JI としての事業化の課題

ロシアでの JI 実現に関しては、ホスト国としてのリスクを含め様々な課題が挙げられる。

①ロシアが京都議定書参加資格を得られないケース
国別登録簿等トラック 2 までの資格が、ロシア政府が策定しているアクションプランが遅延した場合、取得出来ないケースがある。

②日本・ロシアが京都議定書参加資格を剥奪されるケース
日本が割当量を超過して販売することは考えにくいが、ロシアの急激な経済成長により第一遵守期間内で売りすぎが発生する可能性は若干なりとも生じる可能性がある。またインベントリーデータの不適切な時期での提出等が行われた事での資格剥奪の可能性もある。

③民間契約の不履行
ユーコスの例もあるが、ロシア政府方針での企業収用が行われ、民間企業同士での契約履行が破棄されるケース

④意図的な排出権発行遅延
日露関係という政治的な要因を背景とした意図的なロシア政府による排出権発行遅延の可能性もゼロとは言えない。

⑤その他
建設リスク、操業リスク等存在するが、商業ベースでのリスクコントロールは民間で対処は可能と考える。

添付

PDD (Project Design Document)

Project Design Document

for

"Switch of Khabarovsk CHP-1 Plant from Coal to Fire Natural Gas"

TOYOTA TSUSHO CORPORATION

2005

Abstract

Project Design Document (PDD) for JI Project "Switch of Khabarovsk CHP-1 from Coal to Fire Natural Gas" was prepared by request of Toyota Tsusho Corporation (TTC) and according to the Contract dated 29.11.04 No. 13/2004-*И* between Energy Carbon Fund (ECF) and TTC.

In 2004 TTC representatives together with ECF members visited Khabarovsk, JSC "Khabarovskenergo" and Khabarovsk CHP-1 for the project examination.

TTC, ECF and "Khabarovskenergo" agreed:

- "Khabarovskenergo" to provide for the project implementation,
- ECF to make the full PDD (including the Baseline Study, Monitoring Plan, evaluation of environmental effect caused by implementation of the project, stakeholders consultation activities, Additionality Test and Validation Report). ECF was authorized by JSC "Khabarovskenergo" to represent fully its interests in submitting project "Switch of Khabarovsk CHP-1 Plant from Coal to Fire Natural Gas" to potential carbon investor.
- TTC to finance development and determination of PDD, to realize searching and attraction of the third parties for the purpose of concluding a purchase agreement of the "Khabarovskenergo" ERUs, with such third parties. TTC will be a sole agent to sell all of carbon credit from this project.

Project Design Document was executed by Energy Carbon Fund and Open JSC "Scientific Research Institute YuzhVTI" (Baseline Study) in accordance with the Operational Guidelines for Project Design Document of Joint Implementation Projects of ERUPT.

Project information

Project characteristics

Supplier's name and address	Open Power and Electrification JSC «Khabarovskenergo», 49 Frunze Str., 680000, Khabarovsk, Russia
Company name	Open Power and Electrification JSC «Khabarovskenergo»
Legal address	49, Frunze str., Khabarovsk, 680000, Russia
Zip code + city address	680000, Khabarovsk
Postal address	49, Frunze str., Khabarovsk, 680000, Russia
Zip code+ city postal address	680000, Khabarovsk
Code	Russian Federation
Contact person	Mr. Alexander B. Rozhkov
Job title	Science and Technology Deputy General Director – Director of Open JSC "Khabarovsk energy technological company"
Telephone number	+7 4212 29 19 25
Fax number	+7 4212 29 19 26
E-mail	bvv@bvv.khv.ru
Date of registration	May 7, 1993
Bank account	40702810870000103155 Far East Bank Savings Bank of Russia, 02 subsidiary
Additional information:	
Local contact person	Mr. Nikolay N. Kobtsev – Director of "Khabarovsk CHP-1", 15 Svetovaya str., Khabarovsk, 680015, Russia Tel. +7 4212 55 63 59, fax +7 4212 55 65 38, E-mail: Htec1@khaben.elektra.ru
Other parties involved in the project (co-investors, owner, operator, users, etc.)	JSC «Khabarovskenergo» subsidiaries: «Komsomolsk heat networks», «Energosbyt»

Project Abstract

Project Title	"Switch of Khabarovsk CHP-1 Plant from Coal to Fire Natural Gas"
Abstract	The Project is designed to modernize and switch boilers № 1-19 from coal to fire natural gas with implementation of the measures to substantially increase the economic and ecological efficiency of CHP-1: – implementation of the gas supply technological complex for the Khabarovsk CHP-1 plant for gas transportation and supply directly to the boilers complete with the commercial gas accounting system at the CHP-1 plant in the gas distribution station and the process gas flow rate accounting for each boiler; – equipping of the gas distribution station with the process control system; – optimization of the equipment mix and operation of the boilers.
Project location	Khabarovsk CHP-1, Khabarovsk City
Project starting date	2005
Construction starting date	2005

Construction finishing date	2006

General description of the Khabarovsk Region, Khabarovsk City and Khabarovsk CHP-1 Plant

The Territory of the Khabarovsk Region

Khabarovsk region is situated in the Far East of the Russian Federation and is part of the Far East Federal district. Its total area is 788.6 thousand sq. km.
The territory of Khabarovsk region includes 17 administrative districts and two cities of regional submission: Khabarovsk (about 617.8 thousand people) and Komsomolsk-on-the-Amur (about 298.5 thousand people). The total number includes 7 cities, 27 towns 186 rural administrations, with the population more than 1571 thousand people, 81 % of which live in the cities.
Khabarovsk region is an industrial center of the Far East region. In its economic system the most important sectors are power-intensive branch and highly-developed social sphere.
The main industries include mechanical engineering and metallurgy (agricultural machineries production, power engineering industry, shipbuilding and ship repair, manufacture of the foundry equipment), nonferrous metallurgy, forestry, wood processing and pulp-and-paper, oil refining, chemical engineering and fishing industry.

Also, there are two oil refineries - in the cities of Khabarovsk and Komsomolsk-on-the-Amur, which provide petroleum products for almost all the Far East economic region.
The total processing capacity is 10 million t/y of crude petroleum, from which about 10 % is supplied from the Sakhalin island deposits through the oil pipeline Okha - Komsomolsk-on-the-Amur River, 90 % is delivered by railway from Siberia.
The main coal-mining plant is a Joint-Stock Company "Urgalugol" with production capacity more than 2.5 million tons of coal p. a.

The City of Khabarovsk

Today the city of Khabarovsk is considered to be a capital of the Far East region. It is located in the central part of the Far East, where most of federal and regional offices are located (the Far East military district headquarters, the Far East railway headquarters, Glavdalstrroj, Dallesprom, Dallesstroj holdings and etc.
Khabarovsk is the second populated city in the region and the fourth by the territory. It is located on the right bank of the Amur River at its junction with the Ussuri River, and is 45 km long with total area about 37 thousand ha. The city is subdivided into five districts: Krasnoflot, Kirov, Central, Zheleznodorozhny (Railway) and Promyshlenny (Industrial).
Khabarovsk is the largest industrial, transport, cultural and scientific center of the Far East. There are about 100 enterprises of mechanical engineering, metallurgy, construction, food, light and other industries n the city. The Khabarovsk railway hub is the largest in the region, and its river port is the largest on the Amur River.

Open Joint-Stock Company "Khabarovskenergo "

Open Joint-Stock Company (Open JSC) "Khabarovskenergo", founded in 1993 on the basis of the regional agency "Khabarovskenergo" is the main producer of electric power and heat in Khabarovsk region.
"Khabarovskenergo" is a part of integrated power system "Vostokenergo" –representative of the Russian Open JSC "UES of Russia" on the management of the power systems in the Eastern part of Russia - is a diversified power enterprise, which activities include generation and distribution of electric power and heat, and associated research activity, design and construction.

Now, the structure of Open JSC "Khabarovskenergo" includes 24 enterprises with 7 thermal power stations, 3 large heating boiler plants, 6 enterprises of electric networks, 2 enterprises of heat networks and others.
Open JSC "Khabarovskenergo" has nine hundred per cent subsidiaries: Open JSC "Khabarovsk production and repair company", Open JSC "Khabarovsk repair and construction company", Open JSC "Khabarovsk repair and mounting company", Open JSC "Khabarovsk energy technological company", Open JSC "Avtotransportenergo", Open JSC "Energotorg", Open JSC "СК" Agroenergo", Open JSC "Rodnik zdorovia (Spring of health)" and Open JSC "ОЛ" Amurskaya zhemchuzhina (Amur pearl) ".
The installed electric capacity of the power system is 2153 MW with heat capacity of - 7194 Gcal/h (8367 MW). Open JSC "Khabarovskenergo" includes 15000 km of electric transmission lines of all voltage levels and more than 400 km of heat lines. It's connected with Amur region by 220 and 500 kV transmission lines and with Primorsk region - by 110/220 kV transmission lines.
The Khabarovsk power system includes two energy areas – the interconnected energy area incorporating six power stations coupled by the system-forming transmission lines and Nikolaev energy area in the structure of Nikolaev CHP plant and 110kV networks. The Nikolaev energy area operates independently.
The power system supplies the central and southern areas of Khabarovsk territory and the Jewish autonomous region with electric power and heat.
The power system territory embraces 788 thousand sq. km with the population of 1605 thousand people. The heat from the district heating system sources, which belong to the power system, is supplied to Khabarovsk, Komsomolsk-on-the-Amur River, Amursk, Nikolaevsk-on-the-Amur River, and Birobidzhan.
Heat and electric power supply in the rural and northern areas is carried out from more than 330 local boiler plants with the total capacity of about 1600 Gcal/h and from 86 small diesel power stations of the total installed capacity of more than 118 MW.
The specific feature of the power industry of the region is that with the availability of enormous hydro resources the basic energy sources are the CHP plants, operating on the imported fuel. The major fuels for the power stations are brown and bituminous coals (68 %), furnace fuel oil (13.5 %) and natural gas (18.5 %).

Project Implementation background

The power generation in Khabarovsk region, including Open Joint Stock Company "Khabarovskenergo", depends on expensive imported fuel (coal, fuel oil) in many ways. Thus, under the program "Gasification of Sakhalin area, the Khabarovsk and Seaside regions", approved by the regulation of the Government of the Russian Federation, gasification of the region is being actively carried out.
In March, 2002 the Governor of Khabarovsk region Victor Ishayev has declared the beginning of the gas pipeline "Komsomolsk-on the-Amur River – Khabarovsk» construction of 502 km long. The gas delivery to Khabarovsk in new gas pipeline is scheduled for 2006.
The branch of Open Joint Stock Company "Khabarovskenergo" - Open Joint Stock Company "Khabarovsk repair-construction Company" - participates in the gas pipeline construction. By the beginning of 2004, Khabarovsk repair- Construction Company built 17.5 kilometers of the pipeline. Khabarovsk repair-construction Company plans to take active part in the construction of the gas pipeline till its commissioning date.
On the 22nd of April, 2002 the Government of Khabarovsk region and Open Joint Stock Company "Gasprom" concluded a long-term cooperation agreement.
July, 2004: General Director of Open Joint Stock Company "Khabarovskenergo" Valery M. Levit took part in signing of Memorandum of Understanding on sales of the natural gas from Sakhalin sea deposits to the buyers of Khabarovsk region. The Memorandum was signed by the Governor of Khabarovsk Region Victor Ishayev and the President of "Exxon Neftegas Limited" company (operator of the project "Sakhalin-1") Steve Terni.

Open Joint Stock Company “Khabarovskenergo” and Open Joint Stock Company “Khabarovskkraigas” will become potential buyers of Sakhalin gas. The signed Memorandums of Understanding define terms and regulations, which will enter Purchase and Sale Agreements.
The project implementation will allow increasing the power system stability and profitability, considerably improving the ecological situation (to reduce the amount of harmful emissions into the atmosphere of the city and to the water basin of the Amur River), and also working conditions at Khabarovsk CHP-1.

For the project implementation:

- The specifications of natural gas supply to the cogeneration station for Open Joint Stock Company “Khabarovskenergo” (the letter No. 443/3 dated 27.02.02) have been received from Open Joint Stock Company “Khabarovskkraigas”.
- 26.05.03 - Regulation No. 694 of the Mayor of Khabarovsk “On Permission for Open Joint Stock Company “Khabarovskenergo” to design technological subjects of Khabarovsk CHP-1 reconstruction.
- 30.06.03 – the architect- planning task of the project was authorized by the architect of the Khabarovsk city (No. 133).
- 2003 – Feasibility Study of the Project was made by Project Institute “Khabarovskenergoproject”.
- 2004 – Project Institute “Khabarovskenergoproject” stated making a detailed design of the project.
- Basic measures, goals and results of implementation of the project

Main operational arrangements implemented under the Project:

a) Implementation of the gas supply technological complex to Khabarovsk CHP-1 plant, designed for gas transportation directly to the consumer including:
   - high pressure gas line from the right-of-way of the Khabarovsk CHP-1 plant to the gas distribution substation;
   - factory-assembled gas distribution substation;
   - gas flow commercial accounting system installed at the gas distribution substation;
   - gas flow process accounting for each boiler;
   - medium pressure gas line located on the territory of the Khabarovsk CHP-1 over the existing and designed trestles running from the gas distribution substation to the main building;
   - gas lines within each boiler (inlet and control units) located in the boiler department;
   - provision of gas equipment for the burners per each boiler;
   - installation of gas burners;
   - air inlet to boiler burners;

a) Provision of the gas distribution substation with the process control system based on the computers and conventional I&C devices;
b) Optimization of boiler operating mode while ensuring the required dependability of power supply to the consumers.

Main Goals of the Project:

- increasing economic and ecological efficiency of Khabarovsk CHP-1 activities, the Open Joint Stock Company “Khabarovskenergo” subsidiary;
- obtaining extra profits due to electric power and heat primary cost reduction under existing electricity tariffs;
- satisfying the energy consumption growth by generating electric power and heat

by using more efficient equipment;

- providing grounds for heat and electric power output increase from the CHP-1 plant.

Implementation of the project will allow receiving the following results:

- increasing boiler efficiency by switching to natural gas and replacing the existing burners with more efficient burners;
- significant reduction of low-temperature corrosion that will result in service life of the boiler and the gas/air path increase;
- decreasing the CHP-1 auxiliary power requirements by 6%;
- decreasing specific fuel consumption of released heat from 351.7 to 322.5 g/kWh, and from 144.4 to 142.1 kg/Gcal , respectively;
- annual fuel saving about 55 tce;
- CO2 emissions reductions for 1 231 thous. t/y;
- annual atmospheric emissions of sulfur dioxide reduction by 7,7 thous. t., nitrogen oxide by 2.8 thous. t., fuel oil ash calculated on vanadium basis by 14,1 thous. t.

  The results are given for 2008.

To achieve the results of the project the following activities should be implemented:

a) To conclude equipment and materials delivery agreements.
b) the Open Joint Stock Company “Khabarovskenergo” will:
   - submit the project design documentation:
   - receive architectural planning task from the city planning board of the department of the architecture;
   - submit an expert review to the board of the state interdepartmental expertise of Khabarovsk Region, the main department of the natural resources and environmental protection for Khabarovsk region of the Ministry of the Natural Resources of the Russian Federation;
   - prepare the documents for permission on carrying out the reconstruction and mounting activities in accordance with the current legislation.
c) Perform the following construction and mounting works:
   - shared construction of urban 0.6 MPa gas distribution lines;
   - cut-in of gas lines to the Khabarovsk CHP-1 of the Open JSC “Khabarovskenergo” from the urban gas distribution networks;
   - construction of the high pressure gas line from the right-of-way of the Khabarovsk CHP-1 to the gas distribution substation;
   - installation of the gas distribution substation before the Khabarovsk CHP-1;
   - installation of the gas flow commercial accounting unit with the display of the readings from the automated gas flow and pressure accounting system to the process control system of the Open JSC “Khabarovskkraigas”;
   - installation of the gas flow process accounting system for each boiler;
   - installation of the medium pressure gas line located on the territory of the Khabarovsk CHP-1 over the existing and designed trestles running from the gas distribution substation to the main building;
   - installation of the gas lines within each boiler (inlet and control units) located in the boiler department;
   - provision of gas equipment for the burners per each boiler;
   - installation of gas burners;
   - provide air inlet for boiler burners;
   - provide boilers №1-16 и №18-20 with gas firing process control systems;
d) Financial operations for the project implementation.

Khabarovsk CHP-1, the subsidiary of Open JSC "Khabarovskenergo", and the Investor will implement the project professionally with the aim to minimize the heat cost for the consumers.

Project boundaries

Determination of the enterprises/facilities within the project boundaries/analysis

The project boundaries represent a list of enterprises, sites, installations and processes, which, to some extent, are associated with the project implementation and influence the GHG emissions.
All GHG emissions within the project boundaries should be monitored by the project Designer and can be related to the project activity.
Theoretically, the project boundaries for energy production at the CHP-1 plant can include GHG emissions associated with the production, transportation, reprocessing, distribution and combustion of fossil fuel, and distribution of the produced energy. However, such broad interpretation of the project boundaries for the present project is impracticable because all the above listed factors (besides fuel transportation) will not introduce any changes into GHG emissions when implementing the Project.
Practically, the optimal variant is the determination of the project boundaries for direct emissions associated only with energy production.
The essence of the project lies in modernization and switching coal-fired boilers of the Khabarovsk CHP-1 to fire gaseous fuel while keeping the possibility of using coal as the reserve oil and implementation of the measures that will substantially increase economic and ecological efficiency of the CHP-1 operation. Switching the boilers from coal to natural gas carried out at the CHP-1 will not result in any changes in the plant circuit and operating conditions and the amount of the products supplied. Khabarovsk CHP-1 delivers power and heat to the industrial and community consumers of Khabarovsk City and is operated according to the schedule of consumers' demand.
Project implementation will not change heat output (there will be no replacement) and the amount of fuel-fired at other enterprises beyond Khabarovsk CHP-1.
Thus, the project boundaries include only CHP-1 plant and transportation of the amount of fuel fired only in CHP-1 plant boilers.

Flowchart of the project boundaries with basic components and connections

The flowchart of the project boundaries with basic components and connections is illustrated in Fig. 1. **The project boundaries are designated by the dotted line.**

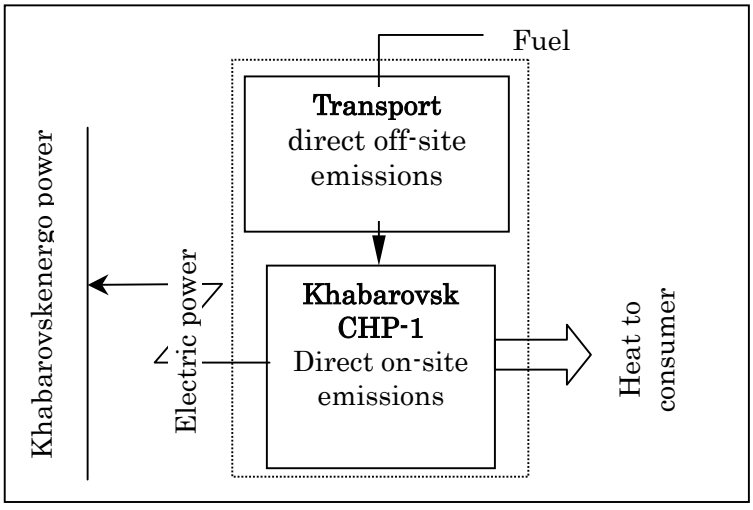


Fig. 1

The project boundaries include the following:

- Khabarovsk CHP-1.
- Fuel transportation to Khabarovsk CHP-1 plant.

The boundaries of the analysis are broader that the project boundaries. They cover the heat and power energy consumers connected to the CHP-1. **The boundaries of the analysis are designated by the dotted line.** The project initiator will annually prepare the protocol of monitoring and verification of the parameters controlled within the project boundaries and detect and periodically analyze the changes occurring within the boundaries of the analysis.

Analysis of the Production Delivery System

The process flow sheet of the facility with its main components and connections before and after the project implementation

The Khabarovsk CHP-1 site is located in the south district of the Khabarovsk City and borders on:

- industrial area – from the north;
- residential area – from the south;
- industrial area – from the east;
- residential area, industrial enterprises – from the west.

The nearest residential area is located within 200 m in the southward. The site relief is plain.

According to the classification of SNiP (Construction Norms and Rules) 23-01-99 "Construction climatology", Khabarovsk City is characterized as follows:

- the coldest five-day period ambient air temperature – minus 31 ºC;
- the warmest month average maximum ambient air temperature – plus 25.7 ºC;
- average month maximum ambient air temperature:
- the coldest (January) – minus 22.3 ºC;
- the warmest (July) – plus 21.1 ºC;
- designed wind velocity – 9.0 m/s;
- prevailing wind direction – Southern-West.

The main products of the Khabarovsk CHP-1 plant are power and heat. The information about the district heating system (heat networks) of the Khabarovsk CHP-1 plant is given in Annex I.

The heat to the industrial enterprises and the population of the Khabarovsk City is supplied by subsidiary of JSC “Khabarovskenergo” – “Khabarovsk heat networks” via the Community and Housing Municipal Services (CHMS), which are specialized in heat distribution among the final consumers. The heat supply is carried out on the basis of the relevant contracts.

Now, the Khabarovsk CHP-1 installed electrical capacity is 435 MW, installed heat capacity is 1200.2 Gcal/h, main fuel used is a mixture of black and brown coals. The connected heat load of heating system with hot water is 753 Gcal/h, with steam – 114 Gcal/h in 2002. Annual heat output from CHP-1 in 2002 was – 3,563,621 Gcal/y, power output – 1,571,092 MW/y. Actual annual heat output was 2,361,000 Gcal, including with steam – 124,000 Gcal. The technical personnel of CHP-1 boiler department includes up to 110 persons in shift, the operation staff and maintenance staff of the boiler department consists of 18 people.

The following boilers are installed in the boiler department of the Khabarovsk CHP-1:

- **steam boilers – 4 boilers (No. 1-4) of the TP-170-100, 2 boilers (No. 5 and 6)**

of the BKZ-160-100F, 2 boilers (No. 7 and 8) of the BKZ-220-100F, 8 boilers (No. 7-16) of the BKZ-210-100F;

- **hot water boilers – 3 boilers (No. 18-20) of the PTVM-100.**

The following turbo units are installed in the turbine department: 1 - PT/50-90/13; 1 - PT-30-90/13; 1 - T-27.5-90; 2 - PR-25-90/10/0.9; 2 - T-100-130; 1 - T-105-130.

The characteristics of the boilers and turbines are given in Annex II.

To restore the condensate losses, the CHP plant is provided with the chemical water treatment plant. The capacity of the chemical water treatment plant is 1800 t/h to make up the district heating system (heat network).

In the existing flow sheet the mixture of black and brown coal as the main and reserve fuel is used.

The combustion products generated when firing coal are emitted into the atmosphere via the stack.

The design flow sheet uses natural gas as the main fuel and coal – as the reserve one.

As a result of switching the Khabarovsk CHP-1 to natural gas combustion while keeping the existing boiler capacity, the labor conditions and ecological situation in the city will be significantly improved - the emissions of ashes and sulfur from these boilers will be fully eliminated.

The Khabarovsk CHP-1 plant will be supplied with natural gas from the shelf of the Sakhalin Island via the main gas line "Komsomolsk-on-the Amur– Khabarovsk". The proposed date of the main gas line commissioning is 2005.

The Khabarovsk CHP-1 will be supplied with natural gas via the city high-pressure gas line from the gas distribution station (GDS) No. 1. The maximum gas pressure of the gas line connected to the Khabarovsk CHP-1 is 0.6 MPa.

No natural gas storage tanks are envisaged on the site of the Khabarovsk CHP-1. The natural gas pressure reduction and maitenance at the specified level in the gas supply system of the Khabarovsk CHP-1 will be provided by the equipment located on the factory-made gas distribution point (GDP).

Via the gas pipeline the dried gas with following (average) physical and chemical characteristics will be transported (letter 74/346ф of 2.06.03 "SakhalinNIPImorneft"):

- low heat value - 34830 kJ/m^3 (8320 kcal/m^3):
- relative specific weight by air – 0.6;
- methane 91.6; ethane – 3.5; propane – 0.9; butane – 0.5;
- pentane – 0.2; carbon dioxide – 0.8; nitrogen – 0.6;
- hydrogen sulfide - none.

Retrospective and perspective analyses of fuel supply, heat and electricity delivery, operating conditions of the enterprises/facilities included in the project boundaries

The flow sheet of the Khabarovsk CHP-1 (existing equipment) is illustrated in Fig. 2.

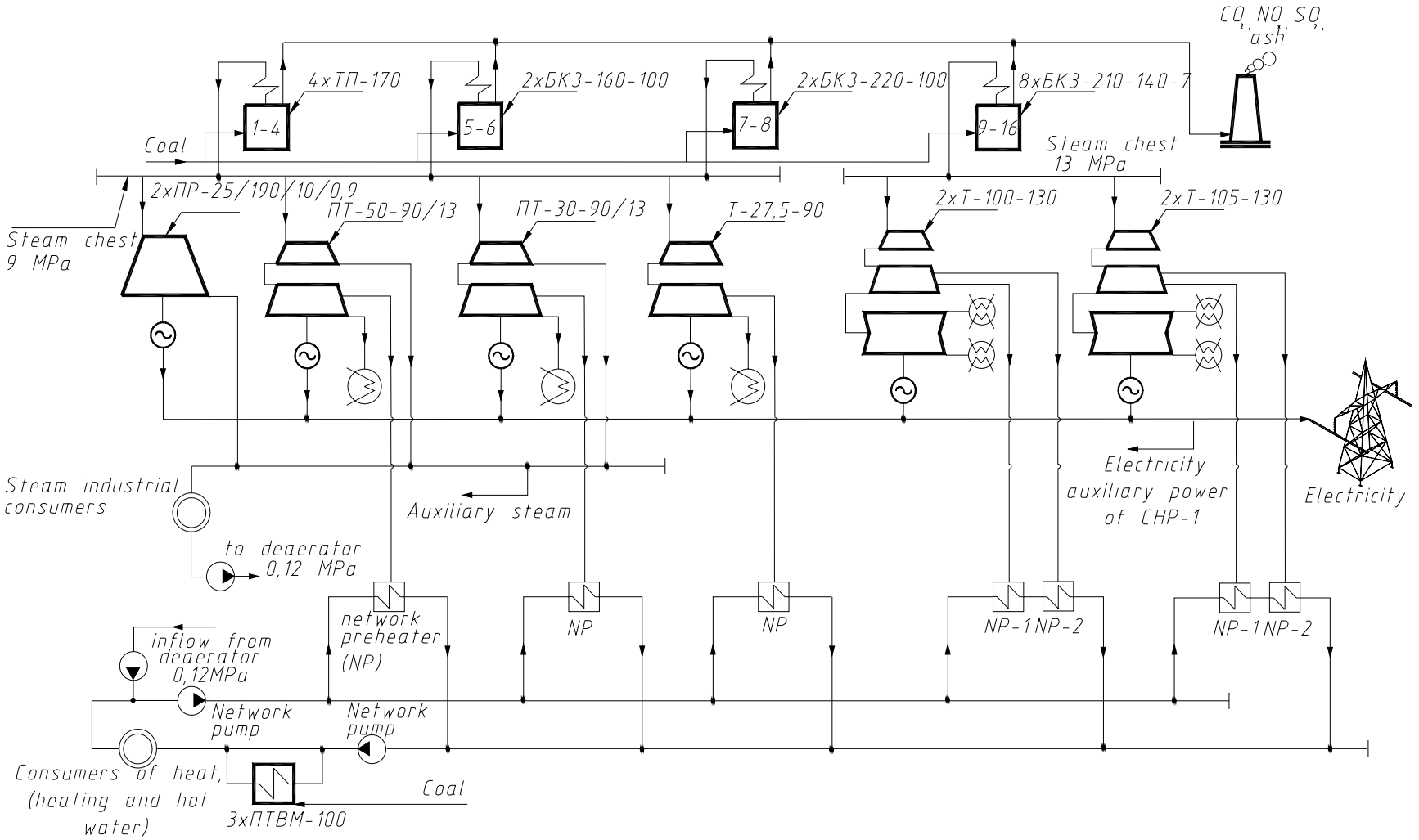
The main operating parameters during 1990-2004 are given in Table 1. The dynamics of variation of heat and power output from the Khabarovsk CHP-1 and specific consumption of fuel equivalent for electricity and heat supplied during this period is illustrated in Figs. 3 and 4.

List and quantity of coal burned at the Khabarovsk CHP-1 in 1998-2004 are presented in Table 2.

The analysis of retrospective data illustrates that over the last five years power output from the Khabarovsk CHP-1 has de-facto reached the 1990 level and has become stable. The increase/decrease of these parameters as compared with the previous year mainly depends on the change of average outdoor temperature during heating season. Some revival in economy of Khabarovsk Region (for example, according to the final balance

sheet of the Ministry of Economic Development and External Affairs of the Khabarovsk Region gross production output in 2004 equals to 104.5 % when compared to the same figure in 2003) allows making a tentative forecast of demand growth and concomitant increase of heat and power output from Khabarovsk CHP-1.

The growth in electricity and heat load as compared with 90s will lead to a more effective usage of generating equipment and to a decrease in specific fuel consumption.



Figs. 2 The current flowsheet of Khabarovsk CHP-1 and the product delivery system

Table 1
Basic performance characteristics of Khabarovsk CHP-1 during 1990-2004

Parameter	Value	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Electricity generation total, including auxiliary	mln. kWh	1928,4	1776,0	1717,7	1703,3	1671,4	1560,3	1718,6	1845,8	1889,8	1909,3	1967,9	1945,5	1908,2	2013.8	1908,1
Power output, total	mln. kWh	1539,8	1398,4	1367,8	1349,0	1323,3	1240,5	1393,2	1527,4	1576,1	1582,5	1636,5	1608,3	1571,1	1682.3	1589,1
Heat output, total	thous. Gcal	5316,6	5029,5	4498,8	4391,5	4303,4	3794,1	3700,3	3481,1	3524,3	3635,3	3731,7	3622,6	3563,6	3565.5	3468,8
Consumption of fuel equivalent, total	thous. tce	1363,7	1301,0	1206,0	1169,6	1138,0	1035,1	1072,4	1081,4	1099,1	1113,1	1137,8	1085,9	1064,3	1101.6	1054,2
Consumption of fuel equivalent for electricity supplied, total	thous. tce	400,6	384,4	382,7	369,5	354,4	340,9	521,0	570,8	583,7	582,5	597,5	563,1	550,0	587,0	554,46
Consumption of fuel equivalent for heat supplied, total	thous. tce	963,1	916,6	823,2	800,1	783,6	694,2	551,4	510,6	515,4	530,6	540,3	522,8	514,3	514,6	499,77
Specific consumption of fuel equivalent:																
for electricity supplied	g ce/kWh	260,2	274,9	279,8	273,9	267,8	274,8	373,9	373,7	370,4	368,1	365,1	350,1	350,1	349,0	344,4
for heat supplied	kg ce/Gcal	181,2	182,2	183,0	182,2	182,1	183,0	149,0	146,7	146,2	146,0	144,8	144,3	144,3	144,3	144,2

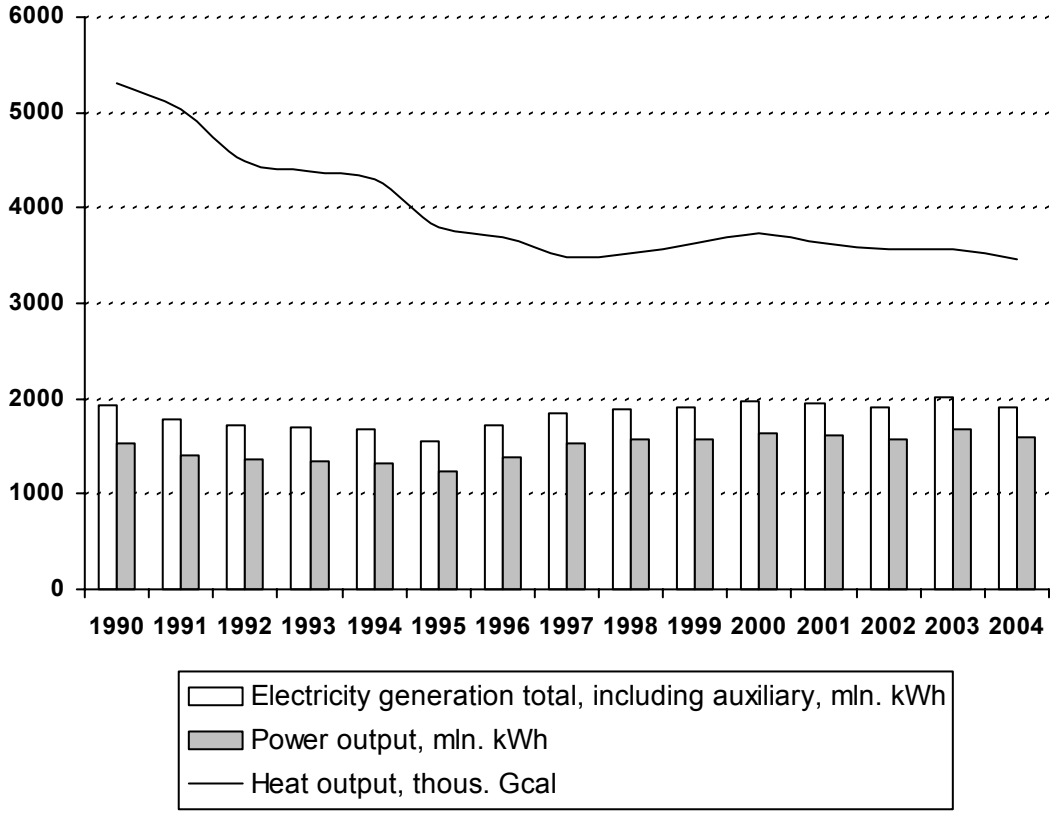


Fig. 3 Electricity and heat generation and power and heat output in 1990-2004

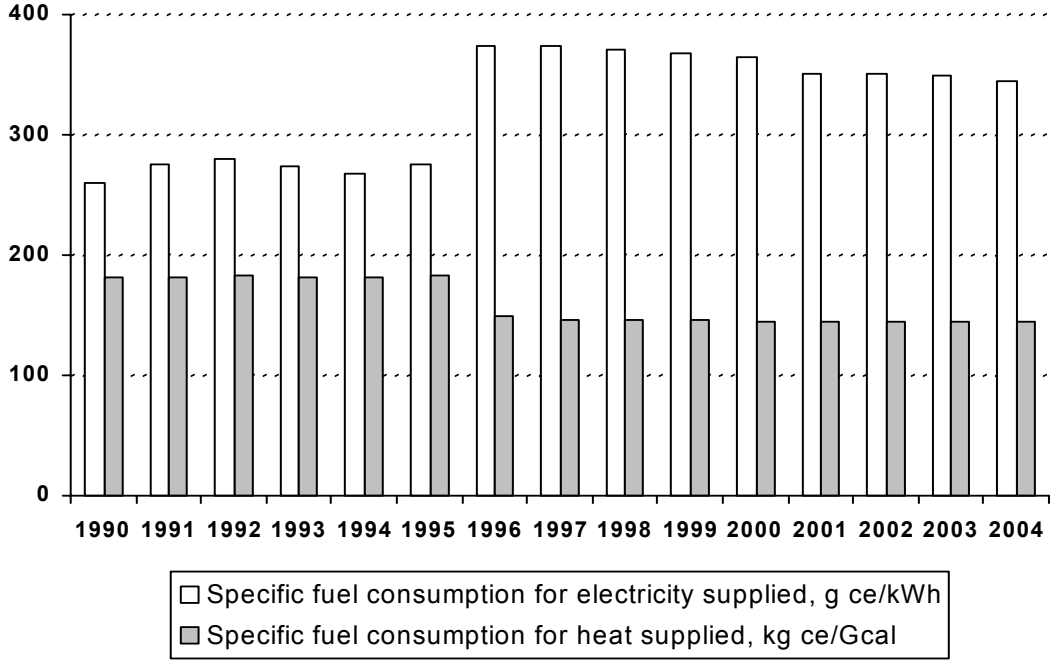


Fig. 4 Specific consumption of fuel equivalent for electricity and heat supplied

Table 2

List and quantity of the coals burned at the Khabarovsk CHP-1 in 1998-2004

Coal, region, deposit, coal type	Value	1998	1999	2000	2001	2002	2003	2004
1) Raichihinsk coal, FE*, Raichihinsk deposit, 2БР, Partizansk coalfield	thous. tce	45,6	11,2	0,45	0,03			
2) Urgalsk coal, FE, Urgalsk deposit, ГР, Partizansk coalfield	thous. tce	200,2	139,3	164,6	80,4	370,2	329,8	482,4
3) Haranorsk coal, ES**, Haranorsk deposit, 1БР, Chita region	thous. tce	164,6	395,0	427,8	251,2	232,2	261,6	171,1
4) Chernogorsk coal, ES, Chernogorsk deposit, ДР, Minusinsk coalfield	thous. tce	2,6					1,9	
5) Izykhinsk coal, ES, Izykhinsk deposit, ДР, Minusinsk coalfield	thous. tce	9,9					56,6	
6) Abakan coal, ES, Chernogorsk deposit, БР, Minusinsk coalfield	thous. tce	19,7						
7) Azeisk coal, ES, Azeisk deposit, 3БР, Minusinsk coalfield	thous. tce	651,2	564,0	321,1	104,5	78,4		
8) Urtuysk coal, ES, Urtuysk deposit, 2БР, Chita Region	thous. tce			221,2	646,6	379,5	448,7	397,3
9) Karakansk coal, ES, Kuznetsk coalfield, ДР	thous. tce				0,044			
Total for year:	**thous. tce**	**1093,8**	**1109,5**	**1135,2**	**1082,8**	**1060,3**	**1099**	**1051**

* - The Far East
** - Eastern Siberia

The decrease of specific fuel consumption is stipulated by change of fuel balance:

- Refusal to burn Raichihinsk coal that has significantly worse parameters as compared with the designed parameters at present;
- Replacement of Azeisk coal (the deposit is exhausted) by Urtuysk coal.

In last years the value of specific fuel consumption are practically stable (during 2001-2003 changes amounts to less than 0,3 %).

Perspective forecast of main baseline parameters

The perspective forecast of power and heat output (by the expert evaluation of "Khabarovskenergo" specialists) is presented in Table 3

Table 3

Perspective forecast of power and heat output during 2006-2010

Parameters	2005	2006	2007	2008	2009	2010	2011	2012
Power output, mln. kWh	1 580	1 585	1 630	1 680	1 680	1 680	1 680	1 680
Heat output, thous. Gcal	3 465	3 465	3 465	3 465	3 465	3 465	3 465	3 465

For comparison, the average values of power and heat output during 2000-2004 is 1617,5 million kWh and 3590,4 thous. Gcal respectively.
Taking into account that JSC “Khabarovskenergo” refused to burn the Raichihinsk coal and that Azeisk deposit is exhausted it can be forecasted that at the Khabarovsk CHP-1 three main types of coal will be burned within the baseline - Haranorsk, Urgalsk and Urtuysk coal.
The accepted perspective forecast of power and heat output corresponds to actual average values of these parameters during 2000-2004. Therefore for baseline estimate with the outlook up to 2012 the value of specific consumption of fuel equivalent is determined based on its average value over 2000-2004:

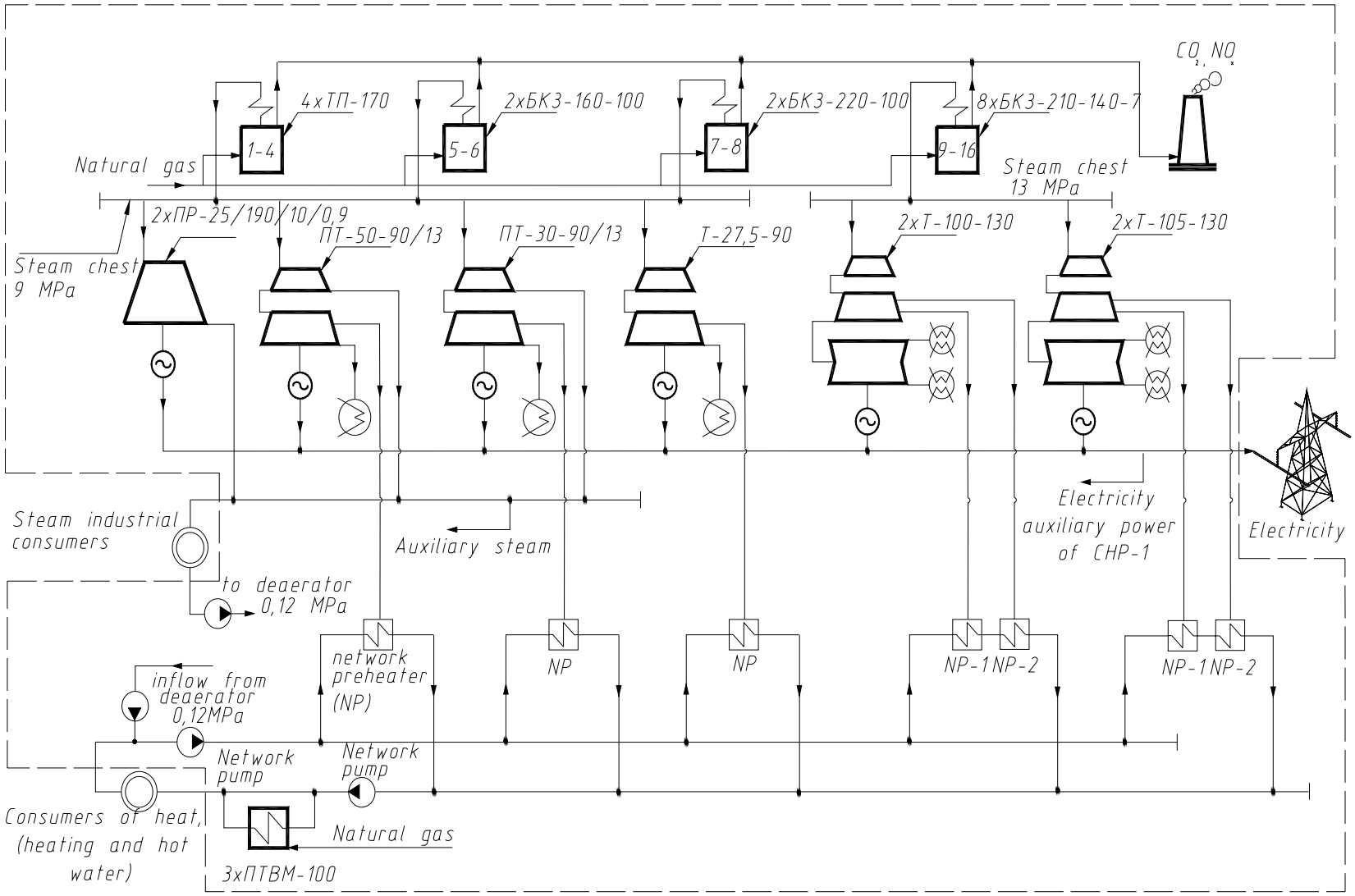
- for electricity supplied – 351,7 g ce/kWh,
- for heat supplied – 144,4 kg ce/Gcal.

Perspective forecast of main project parameters

The flow sheet of the Khabarovsk CHP-1 (existing equipment) under project implementation is illustrated in Fig. 5. As compared with the current flow sheet: **natural gas** will be the **main fuel** burned at the Khabarovsk CHP-1; SO_2 and ash emissions will be excluded almost completely.
Under project implementation the replacement of the electricity and heat generated from other sources does not take place, i.e. under the project the predictable heat and power output from Khabarovsk CHP-1 complies completely with heat and power output from Khabarovsk CHP-1 in the baseline (Table 3).
The switching of the boilers to natural gas leads to the increase of energy effectiveness of Khabarovsk CHP-1 due to gross efficiency of boilers increase and a decrease in the auxiliary electric power consumption.
Taking into account the increase of boilers energy effectiveness, the specific fuel consumption from natural gas combustion at Khabarovsk CHP-1 is equal to the following:

- for electricity supplied – 322.5 g ce/kWh,
- for heat supplied – 142.1 kg ce/Gcal.

These values are accepted based on conservative approach. Therefore, actual values of the specific fuel consumption are to be less than values given above. For example, at some CHP burning natural gas under the same conditions (type of used equipment, quantity and proportion of electric and heat power output etc.) the specific fuel consumption is equal to 305-320 g ce/kWh - for power output, 125-139 kg ce/Gcal - for heat output.
Justification and evaluation of the accepted values of the specific fuel consumption from natural gas combustion at the Khabarovsk CHP-1 are presented in Annex III.



Figs. 5 The flowsheet Khabarovsk CHP-1 and the product delivery system with JI project implementation

Brief characteristic of the main equipment of the enterprises/facilities included in the project boundaries

The characteristics of the main equipment of Khabarovsk CHP-1 plant are given in Annex II.

The state of the main and auxiliary equipment depends on duration and conditions of its operation, timely maintenance and repairs including replacement of components, parts or mechanisms, observance of the requirements and rules of technical operation, as well as of other directives. The equipment of the heat cycle of the Khabarovsk CHP-1 plant is in a satisfactory condition due to timely maintenance and replacement of some components during the repair.

The operating boilers of the Khabarovsk CHP-1 plant had been manufactured and commissioned during the period of 1953-1981 (Annex II). The duration of operation of the main and auxiliary equipment is specified in accordance with the statement of the Expert and Technical Committee carrying out the relevant examinations.

The technological complex of the gas supply to the Khabarovsk CHP-1 plant, which is designed for gas transportation and supply directly to the consumer, includes:

- high pressure gas line from the right-of-way of the Khabarovsk CHP-1 plant to the gas distribution substation;
- factory-assembled gas distribution substations 1 and 2;
- gas flow commercial accounting system installed at the gas distribution substation;
- gas flow process accounting for each boiler;
- two medium pressure gas lines located on the territory of the Khabarovsk CHP-1 plant over the existing and designed trestles running from the gas distribution substation to the main building;
- gas lines within each boiler (inlet and control units) located in the boiler department;
- provision of gas equipment for the burners per each boiler;
- installation of gas burners;
- air inlet to boiler burners;
- gas firing process control system.

The project envisages provision for boilers No. 1-16, 18-20 of natural gas equipment ensuring fuel automatic control and firing.

The gas lines located on the territory of Khabarovsk CHP-1 plant is laid over the existing and designed trestles running from the gas distribution substation to the main building.

The gas distribution substation is in fact the complex of the factory-made two-block complete set:

- block-box filters;
- reduction block-box with five trains of reduction;
- 3 working trains; 1 standby train; 1 small flow train.

The automation and alarm system of the reduction block envisages:

- block compartment gas content alarm;
- monitoring of gas flow, pressure and temperature;
- alarm on the trip of the relevant reduction lines;
- fire and block door opening alarms;
- Installation of the gas flow commercial accounting system.

The boilers are equipped with the gas-heavy oil device of gas burners. At the stage of the feasibility study the following equipment was included:

- 8 burners for PTVM-100 boilers (replacement of existing gas/oil burners);
- 6 burners for BKZ-220-100F boilers;
- 4 burners for TP-170 and BKZ-160-100F, BKZ-210-140F boilers;
- 2 burners for B-50-14/250 boilers.

During the installation process of gas burners provision shall be made for hot air inlet for combustion. The cross-section areas and locations of cutting-in the hot air ducts will be corrected at the stage of working design in accordance with layout drawings of the boiler manufacturers. To compensate for thermal displacement of the air ducts provision is made for lens compensators and spring-suspension fastening of the air ducts. In accordance with the manufacturer drawings the burners will be insulated with the insulation materials complete with lining the gauze with special compound.
Each air duct running from the existing hot air manifold is connected to the burner with the installation of the valve complete with the MEO drive. The insulation of the hot air ducts is made of the mineral cotton wool with lining the gauze using special compound.
In connection with switching the boilers to fire gaseous fuel and in accordance with SNiP (Construction norms and rules) 11-58-75 "Ventilation and conditioning" in the boiler department within the boiler bays the plenum air will be supplied in the amount of the triple air exchange.
To implement the conditions of economic relations between the gas supplier and the gas consumer the subsidiary of the Open Joint Stock Company “Khabarovskenergo” Khabarovsk CHP-1 plant, the gas flow rate accounting system will be installed in the gas distribution substation at the inlet of the reduction block-box.

The system is designed for automated collection and transfer of the data on:

- gas temperature;
- gas flow rate for each gas line train;
- gas pressure in each gas line train.

The information from the sensors of temperature, pressure and flow rate is processed on the multifunctional transducer (information collection and transfer device) and is transmitted over the communication lines to the operator computer to be displayed, recorded and archived. This information can also be transmitted via the modem of the process control system of the Open Joint Stock Company “Khabarovskkraigas”.
The gas accounting system is independent.
The used sensors of temperature, pressure and flow rate are made of the commercial domestic or foreign equipment.
For accounting of gas consumed by each boiler, the inlet unit locates the diaphragm, flow rate sensors with the data transfer to the recording device (computer).

The gas distribution substation is equipped with the process control system. The system is based on the computers and conventional I&C devices and is capable of performing the following functions:

- information (collection and processing of the data on gas distribution substation process parameters, emergency trips, alarms on normal operation and deviations of process parameters from specified values);
- automatic control and keeping pressure within the specified range;
- remote control from the switchboard room:
- automatic standby connection.
  The alarm circuit envisages:
- control of gas parameters;
- control of condition of filters and reduction lines;
- control of gas content in the block-boxes of the gas distribution substation.

The gas distribution substation locates the local control board.
The engineering and technical personnel of the boiler department of the Khabarovsk CHP-1 plant has 110 people per shift with the number of the operating and maintenance personnel of this department amounting to 18 persons.

Classification and Preliminary Estimation of GHG Emissions

In accordance with Appendix A to the Kyoto Protocol the following gases relate to GHGs:

- CO_2;
- N_2O;
- CH_4;
- SF_6;
- PFCs;
- HFCs.

The proposed project «Switch of Khabarovsk CHP-1 from Coal to Fire Natural Gas" is implemented at the power plant typical enterprise including no specific production facilities. Only first four of the above GHGs are typical for such projects.
Gas insulated equipment on the Khabarovsk CHP-1 is not used therefore SF_6 emissions are absent in the baseline and project. Thus, the calculations include only - CO_2, CH_4, N_2O.
The total value of the GHG emissions is expressed in CO_2-eqv.
Recalculation of GHG into CO_2-eqv. is carried out using the following specified coefficients:

for CH_4 К3 = 21 t CO_2-eqv./t CH_4;
N_2O К2 = 310 tCO_2-eqv./t N_2O.

For calculation of GHG emissions, the emission coefficient for the definite fuel is multiplied by the flow rate of specified fuel (in tons of the standard fuel), the results are summed. The fuel consumption depends on the volume of heat generation at the TPP and its efficiency.

CO_2 emission coefficients for different fuels fired at the Russian TPPs were determined in the «Inventory of GHG emissions from TPPs and boiler plants of the «electric power industry» branch in Russia (1990-1997)» [6]. The average weighted CO_2 emissions coefficient in firing coal was 1,62 t CO_2/tce, firing heavy oil – 2,28 t CO_2/tce, and firing coal – 2,76 t CO_2/tce.
The methodology of the inventory has been checked by the independent organization Environmental Defense (USA) in 2001. The inventory calculation error was 4% [13].
Also, for each facility depending on the fuel chemical composition the individual GHG emissions coefficient is possible that may differ from the above-mentioned coefficients.
In 2003 the inventory of GHG emissions of JSC "Khabarovskenergo" [5] including Khabarovsk CHP-1 was carried out by Energy Carbon Fund. The result of this inventory is presented in Annex IV and fig. 6. According this inventory for the mixture of coal burned at the Khabarovsk CHP-1 average weighted CO_2 emissions coefficient in firing coal in 1998-2002 (stabilization of fuel balance) was 2.88 t CO_2/tce.
The using individual CO_2 emissions coefficient represents the real situation and it would be correspond to factual report data under CO_2 emissions at the Khabarovsk CHP-1.

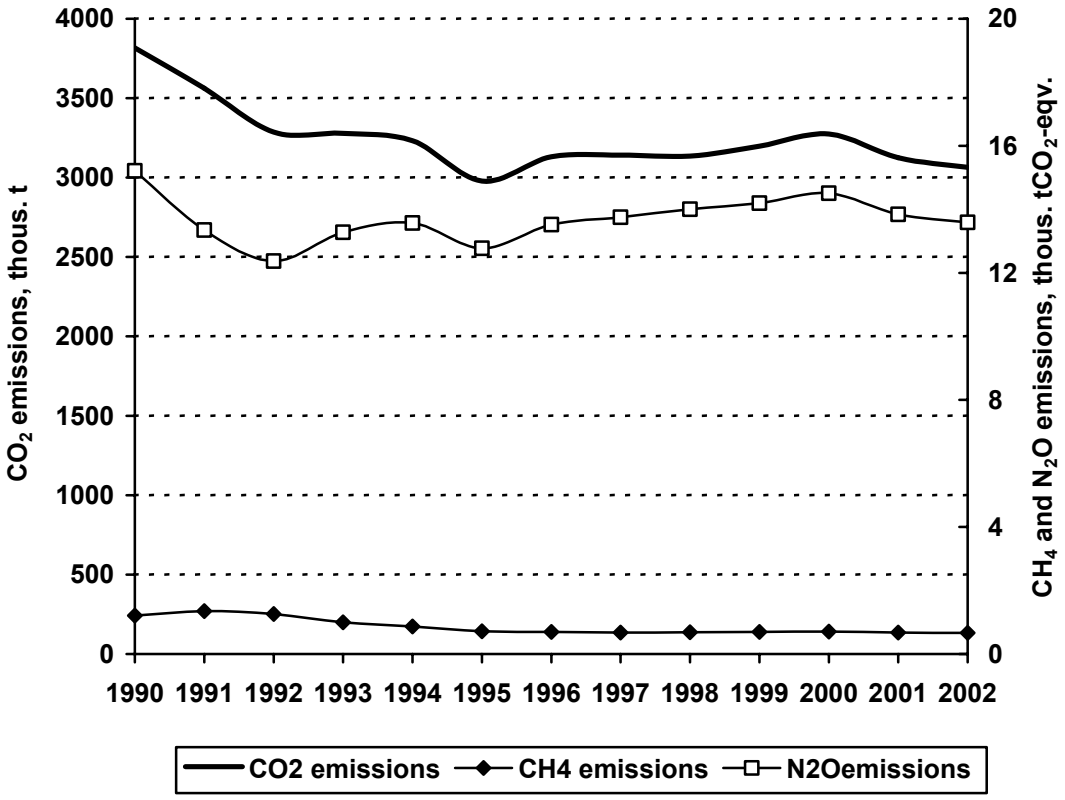


Fig. 6

GHG emissions classification

	Direct	Indirect
On Site	(1) Emissions from fuel combustion at Khabarovsk CHP-1. (2) Emissions from auxiliary facilities at Khabarovsk CHP-1 (evaporation from oil tanks, dusting, burning of coal at the coal storage of CHP-1, CH_4 leaks from plant gas facilities, as well as in lighting up of the boilers, plant vehicles etc.). Though they are not directly connected with fuel firing, nevertheless they are inevitable part of that system.	Emissions from shift in demand for energy services (rebound effect)
Off Site	Emissions as result of energy consumption of transportation of fuel deposit to Khabarovsk CHP-1: – coal – gas Methane leaks from the gas pipeline, compressors station and gas distribution station.	Emissions from shift in activity or demand in other places caused by the project

Direct on-site GHG emissions

These are GHG emissions which are directly associated with the project activity. The sources of the direct GHG emissions are the boilers of the Khabarovsk CHP-1 where in firing fuel CO_2, CH_4 and N_2O are formed as well as the emissions from other facilities not

associated with heat production (motor transport, leaks from the TPP gas facilities, leaks from he gas facilities, boiler lighting up, etc.).

(1) GHG emissions formed in fuel firing.

The share of the fuel oil in the total fuel balance of the Khabarovsk CHP-1 in the recent years (1998-2002) is 0.23-0,49 % maximum; hence, the share of the CO_2 emission in firing this fuel in the total GHG emissions will be not more than 0,4%. Therefore, to simplify the calculations, this fuel is ignored in the determination of the emissions.

In firing the fossil fuel at the power plants, apart from CO_2, CH_4 and N_2O are also formed. CH_4 and N_2O emissions in firing gaseous fuel can be estimated using the emission coefficient recommended by IPCC:

K_{CH4} = 1 kg CH_4/TJ;
K_{N2O} = 0.1 kg N_2O/TJ;

in firing coal:

K_{CH4} = 1 kg CH_4/TJ;
K_{N2O} = 1,4 kg N_2O/TJ.

Using the recalculation coefficient of 29.308 TJ/thous. tce and those to recalculate to CO_2-eqv., the value of GHG emissions f this type in CO_2-eqv. per 1 t of standard fuel (tce) will be:

For the gaseous fuel:

$$M_{CH4} = 1*10^{-3}\ tCH_4/TJ * 21\ tCO_2\text{-eqv./t CH4} * 29.308*10^{-3}\ TJ/tce = 616*10^{-6}\ t\ CO_2\text{-eqv./tce};$$

$$M_{N2O} = 0.1*10^{-3}\ tN_2O/TJ * 310\ tCO2\text{-eqv./t CH4} * 29.308*10^{-3}\ TJ/tce = 909*10^{-6}\ t\ CO_2\text{-eqv./tce};$$

For the coal:

$$M_{CH4} = 1*10^{-3}\ tCH_4/TJ * 21\ tCO_2\text{-eqv./t } CH_4 * 29.308*10^{-3}\ TJ/tce = 616*10^{-6}\ t\ CO_2\text{-eqv./tce};$$

$$M_{N2O} = 1,4*10^{-3}\ tN_2O/TJ * 310\ tCO_2\text{-eqv./t CH4} * 29.308*10^{-3}\ TJ/tce = 12\ 720*10^{-6}\ t\ CO_2\text{-eqv./tce}.$$

The value of CO_2 emissions per 1 tce, as was shown above, will be for natural gas at 1.621 t CO_2/tce, and for fuel oil – 2.27 t CO_2/tce.

Thus, the share of CH_4 and N_2O emissions in the total amount of GHG will be as follows:

in firing natural gas:

CH_4 - $100\% * 616*10^{-6} / (616*10^{-6} + 909*10^{-6} + 1.62) = 0.04\ \%$
N_2O - $100\% * 909*10^{-6} / (616*10^{-6} + 909*10^{-6} + 1.62) = 0.06\ \%$

in firing coal:

CH_4 - $100\% * 616*10^{-6} / (616*10^{-6} + 12\ 720*10^{-6} + 2.28) = 0.02\ \%$
N_2O - $100\% * 12\ 720*10^{-6} / (616*10^{-6} + 12\ 720*10^{-6} + 2.28) = 0.55\ \%$

Under inventory data [5] the share of CH_4 emissions in total CO_2 emissions of Khabarovsk CHP-1 amounts to 0.02 %, and N_2O – 0.44 %.

Hence, the total share of CH_4 and N_2O formed in firing fuel will not exceed 0.6% and this type of fuel can be cancelled from further consideration.

Therefore, in determination of the emissions of this type of GHGs, only CO_2 are considered.

(2) GHG emissions from auxiliary facilities.

Under the maximum fuel consumption for the motor transport (1994) the GHG emissions for this GHG emissions group comes to 2700 t CO_2/y which equal only 0.08 % of the total GHG emissions from the Khabarovsk CHP-1 (Annex IV). Therefore these emissions were not taken into account.

Thus, in further direct on-site GHG emissions only CO_2 emissions are considered that are directly associated with firing fuel at the Khabarovsk CHP-1.

Direct off-site emissions

These are GHG emissions directly associated with the technological decisions under the project but occurring outside Khabarovsk CHP-1.

(1) Emissions due to energy consumption for fuel transportation.
The project implementation will cause the gas delivery instead of coal delivery. Both changes will cause the change of energy consumption for fuel transportation from deposits to CHP-1 and correspondingly change in GHG emissions.
There are too many uncertainties which accompany the evaluation of this component of emissions (what of three main coals will dominate in the future at CHP-1, whether electrified parts of railroad will be possible to use, what are actual energy consumption for transporting gas from the Sakhalin-1 gas field to the site and how this will change in the future with inevitable drop of initial gas pressure at the gas field, etc.). The main parameters are difficult to monitor. Nevertheless, evaluation of these emissions was conducted. Though these emissions make approx. 3 % in the whole GHG emissions it is the opinion of the developers to ignore them in further considerations. The main reason of the proposed decision is that it leads to a more conservative way of calculating project reductions refusing from some non apparent increment of reductions.
The assumptions, initial data for calculations, calculation of those emissions are given in Annex V, the results – in the Table 4.

Table 4

Emissions from transportation of:	2008	2012
baseline (coal), thous. ton CO_2	70,6	70,6
project (gas), thous. ton CO_2	44,9	44,9

(2) Gas escape at output and in transportation system

Actual escape figures for the case were not available. Figures from [4] were used which for the former USSR are 175000-384000 kg CH_4/PJ.They correspond to a special study by RURGAS and JSC “Gasprom” [7] which figure approx. 1% of gas leaks for the whole gas system of Russia. Evaluation calculations for 1000 thous. tce of gas shows that gas escape amounts to approx. 240 thous. ton CO_2-eq. which is more than 14% of what occur in the project. So this direct off-site emission will be taken into consideration further on. The maximum number of 384,000 kg CH_4/PJ will be used.

Indirect on-site emissions

GHG emissions connected with the changes in the energy consumption due to the project implementation («rebound effect»). The project implementation will not bring any changes of quality of products (power and heat energy) as compared with baseline and change energy consumption related to it.
This effect doesn’t take place due to the project.

Indirect off-site emissions

GHG emissions associated with the change of energy generation at other enterprises due to project implementation. i.e., on the project implementation due to more effective technology (gas firing is more effective than coal firing) the production output increases at plant (in our case it is electrical and heat energy) and it leads to reduction of such production output at another plants.
Such sort of things is possible. However, this replacement is not important because of the following reasons. Replacement of heat power output at another CHPs of Khabarovsk city leads to increase of losses in heat network (increase of heat networks length). And increase of electricity production not by heating cycle - to worsening of technical and economic parameters at Khabarovsk CHP-1. Forecast of power output at Khabarovsk CHP-1 is accepted based on optimal load distribution between generating sources of Khabarovskenergo. Change of this balance leads to worsening of technical and economic parameters at replaced CHPs because of exploitation in unnominal regime.
Therefore, GHG emissions associated with the change of energy generation at other enterprises due to project implementation are insignificant. Rejection of such emissions examination simplifies calculation, execution of emissions monitoring and the main satisfies conservative approach.
There are no changes in energy generation at other enterprises; hence, indirect off-site emissions are not taken into account.

Key factors influencing the baseline and the project

General notes

All the factors made an impact on the baseline and on the project can be classified as follows:

- legal;
- political;
- economic;
- social-demographic;
- technical.

During JI project implementation in the power industry the main parameter that impacts on the baseline emissions and project emissions is heat and power output.
Khabarovsk CHP-1 is a typical power plant with local targets; it delivers generated electricity to of south district of the Khabarovsk.
Main industrial consumers of the town were strongly affected by economic crisis of ‘90s which resulted in significant reduction of heat and power output.
During the last years the parameters of Khabarovsk CHP-1 on power and heat output practically achieved the 1990 level. At that the number of factors allows to forecast increasing the demand and respectively the power and heat output in JSC “Khabarovskenergo” including the Khabarovsk CHP-1.
Development of Russian economy is envisaged with GDP annual growth rate from 5 % to 7 %, the most optimistic plans are to double GDP in the coming 10 years. At the same time the concept of leveling of disproportions between regions is adopted which should bring positive results for the Khabarovsk region with a comparatively low level of economic development. The regional Program “Main Directions of Development of the Fuel/Energy Complex of Khabarovsk Region for 2003-2005 and further up to 2010” is under development by the regional Government. The indicated factors will lead to the heat and electricity growth. Some revival of industrial production in the Khabarovsk Region during the last period confirms this forecast.
Big gas deposits (Sakhalin Shelf Deposits 1 and 2) are under development by international consortium. Main pipeline form those deposits will go through Khabarovsk Region. The Federal Program “Gasification of Sakhalin, Khabarovsk and Primorsk

Regions" adopted by the Government of the Russian Federation on 4 July 1999 fixed the delivery of gas in needed quantities.
The gasification will stimulate the development of the industry in the Khabarovsk Region and, as a result, increasing of electricity and heat consumption.
For gas receiving from these deposits JSC "Khabarovskenergo" are to take the share holding in the construction of the gas pipeline (in 2004 the JSC "Khabarovsk repair and construction organization" – the subsidiary of the JSC "Khabarovskenergo" – by own strength constructed 17.5 km of gas pipeline) and to carry out the works under switching of Khabarovsk CHP-1 to fire the natural gas.
Taking into account macroeconomic, regional and local tendencies the following general conclusions can be carried out:

- State and macro-level **legal, political, economic and socio-demographic factors** will influence the project and GHG emissions indirectly; all assumptions have been made conservative and the risk for the selected baseline and project scenarios to overstate the emission reduction is not given;
- the possibility/impossibility of Kyoto Protocol mechanism usage under project realization will make the greatest intensive impact on the project;
- regional and local **legal, political, economic, environmental and socio-demographic factors** are as well in favor of the project implementation (revival of industry, environmental and social demands, etc.);

Below, the qualitative estimation is given of the effect of the key factors on the propagation of the events within the baseline and in the project implementation.

Analysis of Key Factors

Factor description	Consequences	Influence
	Legal	
Federal Laws on the functioning of the power industry adopted by the Russian Parliament (Duma) in 2003	1.Libaralization processes in the power and gas sectors and easier access to various fuels 2. Creation of conditions for competition in the sector. 3. Limitation and reduction of tariffs for energy with reasonable regulation of tariffs by regional authorities.	1. <u>The baseline development</u> Will facilitate growth of energy demand and supply, raise of the baseline absolute figures and decrease in specific figures (per kWh) 2. <u>The project's activity level and GHG emissions</u> Will facilitate growth of energy demand and supply, raise of the baseline absolute figures and decrease in specific figures (per kWh) 3. <u>The risks for the project</u> Will facilitate reduction of risks
Regional laws: "On taxes in the Khabarovsk Region" "On investment activities in the Khabarovsk Region"	1. Preference tax treatment regime is imposed in the Region for investors. The list of preference treatment cases is revised annually.	1. <u>The baseline</u> Does not influence the baseline 2. <u>The project's activity level and GHG emissions</u> "Carbon" investments may benefit from the factor 3. <u>The risks</u> Directed at reduction of risks
Environmental laws	1.Environmental standards are becoming more tighten. 2. Environmental requirements have a tendency to meet European standards (for instance, ISO-14000). In the Russian Federation the standards are resumed after a two year interval	1. <u>The baseline</u> Auxiliary power consumption at the plant will slightly grow together with GHG emissions 2. <u>The project's activity level and GHG emissions</u> The factor will stimulate the implementation of the project 3. <u>The risks for the project</u> Directed at reduction of risks
Entering into force of the Kyoto Protocol. The national procedure under JI projects approval (it will be referred to legal factors).	Assignment the JI projects authorized body under the Government of the Russian Federation, adoption of the national procedure under JI projects approval in 2005.	1. <u>The baseline</u> Will not influence the baseline 2. <u>The project's activity level and GHG emissions</u> The factor substantially will stimulate the implementation of the project.

	Assignment the JI projects authorized body under the Government of the Russian Federation, adoption of the national procedure under JI projects approval later.	3. The risks for the project Significant reduces the risks. 1. The baseline Will not influence the baseline. 2. The project's activity level and GHG emissions This factor negatively influences the project activity level. 3. The risks for the project The factor increases the risks.
Political		
Federal and regional elections. Political tendencies.	• The political situation in Russia is comparatively stable, • During the recurrent Governor elections in the Khabarovsk Region (December 2004) the prior Governor V. Ishaev won. Thus, the main strategic and policy tendency in economy is unlikely to change.	1. The baseline Will facilitate growth of energy demand and supply, raise of the baseline absolute figures and decrease in specific figures (per kWh) 2. The project's activity level and GHG emissions Will facilitate growth of energy demand and supply, raise of the baseline absolute figures and decrease in specific figures (per kWh) 3. The risks Slightly reduces risks
Economic		
The growth of the industry and agriculture in the Khabarovsk Region, including owing to federal and regional program realization.	The growth of energy production at the Khabarovsk CHP-1	1. The baseline Absolute figures will grow, specific per unit of production will decrease 2. The project's activity level and GHG emissions Absolute figures will grow and specific figures will decrease (per kWh) 3. The risks Will not influence the risks
Company reforming with separation under the kinds of activities and liquidation of nonspecialized kind of	Separation of the subsidiaries of JSC "Khabarovskenergo" engaged repair, construction and other nonspecialized kinds of	1. The baseline Will not influence the baseline

activity. Tariffs for energy and fuel price	activity into separate associated companies is to be brought to expenses reduction under electricity and heat production. Tariff for energy and fuel price constantly are reconsidered towards increase, at that the tariffs for energy directly depend on fuel price. From January 1, 2005 for JSC "Khabarovskenergo" the electricity tariff has been increased by 8.4 %, the heat tariff – by 9.9 % at inflation level in 2004 12 % (the forecast of the Ministry of Economic Development and Trade of the Russian Federation	2. <u>The project's activity level and GHG emissions</u> Will not influence the project activities 3. <u>The risks for the project</u> Reduces the risks The influence of (1) and (2) are unpredictable <u>3. The risks</u> The factor will slightly enhance the risks and compensate the realization of the Expenses Control Program by the JSC "Khabarovskenergo"
Socio-demographic		
The growth of population of Khabarovsk. Demand in additional work places and improving the living standard	The population of Khabarovsk city increased more than 15 thousand from 2002. Will cause the growth of energy demand and supply (and will be accompanied by the efficiency improvement of the plant).	1. <u>The baseline</u> Will facilitate growth of energy demand and, hence, generation with the increase of the absolute figures and decrease in specific figures (per kWh). 2. <u>The project's activity level and GHG emissions</u> Will facilitate growth of energy demand and, hence, generation with the increase of the absolute figures and decrease in specific figures (per kWh). 3. <u>The risks for the project</u> This factor slightly increases the risks for the project
Environmental		
Local environmental impact from Khabarovsk CHP-1	Due to low loads at Khabarovsk CHP-1 the impact at the time being is rather weak. With increase of energy production the impact for a coal firing option the factor may become considerable causing additional energy self consumption at the plant. Switch to gas will practically eliminate the factor.	1. <u>The baseline</u> The factor will slightly increase the baseline in absolute and specific figures 2. <u>The project's activity level and GHG emissions</u> The factor will not practically influence the emissions level 3. <u>The risks</u>

		Will not influence the risks
Technical		
Technology, know-how and experience	JSC “Khabarovskenergo” has the wide experience under realization of the boilers conversion to gas projects (more than 15 boilers).	1. <u>The baseline</u> The factor will not influence the baseline <u>2. The project’s activity level and GHG emissions</u> The factor will facilitate to implement the project and to operate the retrofitted equipment <u>3.The risks</u> The factor will reduce the risks

Baseline Selection

Selection of the method for baseline determination

In the selection of the method for baseline determination consideration was given to the validity of the initial data and the possibility of quantitative checking of the submitted calculations. The analysis of the operation of the CHP-1 in recent (5-10) years enables extrapolation of the results for 2012.
At the same time the analysis was also made of the forecast for the demand by the customers of Khabarovsk Region and the Khabarovsk City on electricity and heat.
Therefore, in this case it is more correctly to use the combination of the «previous year method» and «forecast method».

Selection of the most valid baseline

The Khabarovsk CHP-1 is located in the industrial district of the Khabarovsk City. The plant supplies heat to the customers of the Southern district of the city and supplies the electricity to the networks of the Open JSC "Khabarovskenerg". More than 70 % of the electric power is generated in the heating cycle. The main fuel is coal.
The fleet life of the existing generating equipment allows its exploitation up to 2012 (Item …). In this connection, the baseline options with the replacement of the existing equipment by the new equipment were not considered.

Option 1
During the period of 2006-2012, in the Khabarovsk City (Southern district), the alternative power sources (for example, municipal boiler-houses) will be commissioned. In this connection, at the CHP-1 there is a decrease of heat and electricity generation, fuel consumption and greenhouse gas emissions.

Option 2
During the period of 2006-2012, the Open JSC "Khabarovskenergo" will increase the purchases of the electricity on the Federal Wholesale Market of the Electricity and Power (FOREM), including electric power generated by the Bureisk Hydroelectric Power Plant, with the purpose of replacement of the electricity generated at the CHPs, the Khabarovsk CHP-1 included.

Option 3
During the period of 2006-2012, the replacement of the coals fired at the CHP-1 will be made by heavy oil. As a result of such replacement, with the same figures of electricity and heat generation at the CHP-1, the baseline will show less greenhouse gas emissions firing heavy oil.

Option 4
The existing equipment with adequate maintenance (Items 3.3) will be exploited in the period until 2012 to generate electricity and heat energy pursuant to the forecast, given in Items 3.2.

Selection of the baseline.
The options 1 and 3 are least probable.

Option 1. The main barrier of a development of the events within the baseline on **option 1** is the low investment attractiveness of the new energy source construction. The existing energy tariffs in Khabarovsk Region provide very low profitability of electricity and heat generation. For example, with the existing heat tariffs heat generation is unprofitable for JSC “Khabarovskenergo”. Under the totals of 2003, the incomes of the

Open JSC "Khabarovskenergo" from heat sales were 76 % of the generating expenses. In combined electricity and heat generation, the profitability of generation as a whole at the Open JSC "Khabarovskenergo" in 2003 was about 2 %, and in 2002 was unprofitable.
Besides there are some secondary barriers obstructing the implementation of the project. For example, necessity in the land within the city boundaries to construct the new object, training of the operational personnel at the enterprise implementing the project, etc.
The combination of mentioned barriers makes the implementation of such projects improbable.

Option 3. The cost (in calculation per 1 ton of standard fuel) heavy oil exceeds the cost of coal as high as 1.5-2.5 time (for different types of coal) that makes **option 3** economically unreasonable.

Option 2. The commissioning of capacities at the Bureisk Hydroelectric Power Plant is first of all aimed at the reliable delivery of energy to the customers of the Primorsk Territory, also with due account for the development in the Far East Region of the petrochemical, aluminum and forest industry.
The purchasing of the electricity from the FOREM, including the Bureisk Hydroelectric Power Plant, is made on the previously concluded agreements. The share of the electric power received from FOREM (balance of purchasing/sale of the electricity on /with FOREM) makes in the general balance of the Open JSC "Khabarovskenergo" of about 2-3 %.
The large-scale purchasing of the electricity by the Open JSC "Khabarovskenergo" from the FOREM (including the purpose of decreasing generation by the Khabarovsk CHP-1) is limited by the following factors (for Khabarovsk CHP-1).
More than 70 % of the electric power at the Khabarovsk CHP-1 is generated in the district heat cycle, which is the most economical mode of the CHP operation. Generation of the electric power in the condensation cycle or exploitation of the CHP equipment in the boiler-house mode impairs the overall performance of the plant. Therefore, the effect of replacing the electric power generated at the CHP by the electricity generated by the Hydroelectric Power Plant will be reduced due to lower overall performance of the CHP as a whole.
Generation of the electric power at the CHP-1 in the condensation cycle (30 %) is conditioned first of all by the necessity of covering the seasonal and diurnal load peaks. Thus, the actual values of peak loads can considerably differ from the scheduled loads. The given circumstance limits full replacement of the electricity generated in the condensation cycle by the electric power from FOREM, as the violation of the agreements of purchasing can result in the penalties.
Therefore, the given option of the development of the events within the baseline is of low probability.
The above factors limit, but not fully eliminates the increase of the share of the electric power from FOREM in the general balance of the Open JSC "Khabarovskenergo" and, as a consequence, the decrease of the share of the electric power generated at the Khabarovsk CHP-1. To eliminate the given circumstance the forecast of the generation of the electrical energy for the perspective (Items…) after consultations with the specialists from the Open JSC "Khabarovskenergo" was made based on the conservative approach.

Thus, the most probable development of the events is Option 4 adopted for the calculations of greenhouse gas emissions within the baseline given in PDD.

Basic assumptions and quality estimation of the error of the initial data

The core elements used to calculate baseline emissions are:

- amount of heat and electricity supply;

- fuel by type and quantity;
- emission factors;

According to [5] maximum uncertainty of GHG emissions calculation at Khabarovsk CHP-1 for 1990-2002 amounts to 7 % (fig. 7).
The uncertainty includes uncertainties of emission indicator for every type of GHG and fuel, evaluation of burned fuel quantity at Khabarovsk CHP-1, its chemical structure, errors of usable measuring devices etc.
At Khabarovsk CHP-1 not only for the last two years (2003 and 2004) but in future the methodology of accounting (calculation) of fuel [8], electric energy, heat energy and etc. didn't change and won't change. Therefore above mentioned uncertainty should be accepted as uncertainty of calculation of direct on-site GHG emissions in baseline (without taking into account uncertainty of power and heat output forecast).
Uncertainty of calculation of direct on-site GHG emissions under the project (without taking into account uncertainty of power and heat output forecast) can be evaluated in 7%. At least, this uncertainty shouldn't exceed 7%, as uncertainty of gas calculation (2%) is less than uncertainty of solid fuel calculation (3,5%).

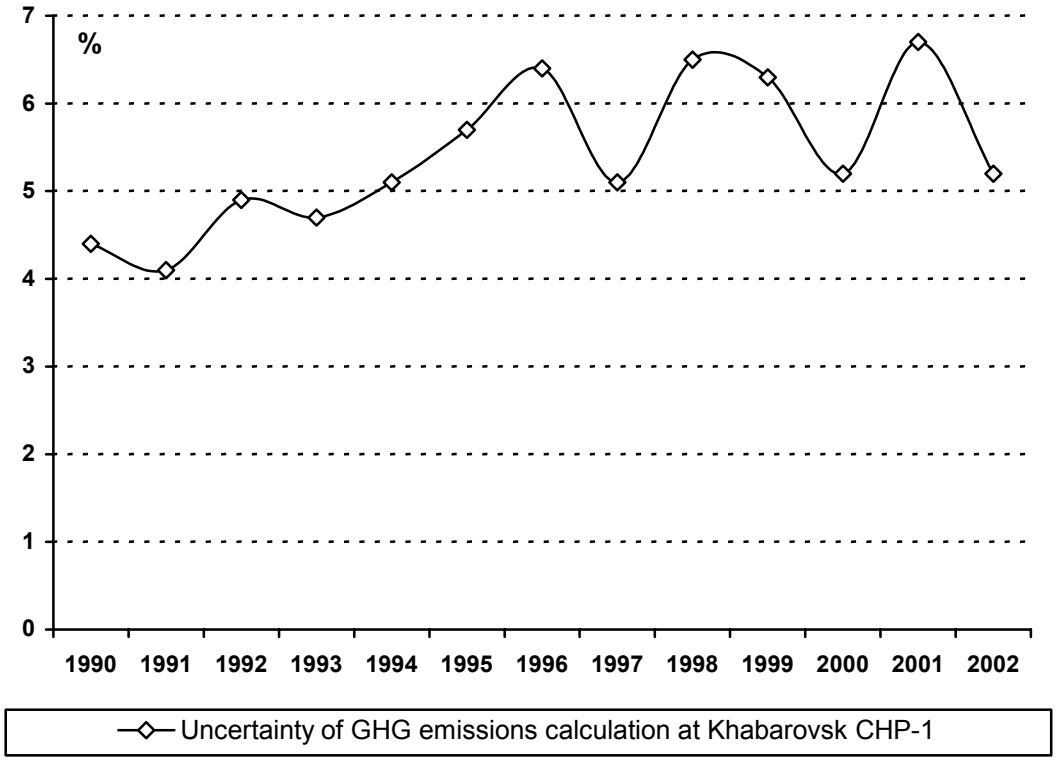


Fig. 7

Power and heat output forecast as well as uncertainty of emissions calculation of gas escape at output and in transportation system have the largest uncertainty.
Uncertainty of these values should be defined as "middle", based on the following criterions – "significant", "middle" and "insignificant". At the same time for GHG emissions measuring the conservative approach was used as both on forecast of annual power and heat output and on evaluation of gas escape at output and in transportation system. This approach will not decrease the uncertainty of indicated factors; moreover it can practically exclude "underproduction" of emissions reduction units over the errors and under the assumption made.

Others - technical, mechanical errors (for example, means of measurements) and mistakes (rounding off), should not render significant influence on the accuracy of the determination of the amount of GHG emissions within the baseline and the project.

Estimation of GHG baseline emissions

Table 5

Initial information for calculation GHG baseline emissions

Parameters	Unit	Years						
		2006	2007	2008	2009	2010	2011	2012
Annual heat output	thous. Gcal	3465	3465	3465	3465	3465	3465	3465
Annual power output	mln. kWh	1585	1630	1680	1680	1680	1680	1680
Specific fuel equivalent consumption for heat supplied	kg/Gcal	144,4	144,4	144,4	144,4	144,4	144,4	144,4
Specific fuel equivalent consumption for electricity supplied	g/kWh	351,7	351,7	351,7	351,7	351,7	351,7	351,7
Annual fuel consumption for heat	thous. ton c.e.	500,3	500,3	500,3	500,3	500,3	500,3	500,3
Annual fuel consumption for electricity	thous. ton c.e.	557,5	573,3	590,9	590,9	590,9	590,9	590,9
Annual fuel consumption for heat and electricity, totally:	thous. ton c.e.	1057,8	1073,6	1091,2	1091,2	1091,2	1091,2	1091,2
coal firing	thous. ton c.e.	1054,6	1070,4	1087,9	1087,9	1087,9	1087,9	1087,9
heavy oil firing	thous. ton c.e.	3,2	3,2	3,3	3,3	3,3	3,3	3,3
Coefficient of CO_2 emission coal burning	t CO_2/tce	2,88	2,88	2,88	2,88	2,88	2,88	2,88
Coefficient of CO_2 emission heavy oil burning	t CO_2/tce	2,31	2,31	2,31	2,31	2,31	2,31	2,31

Table 6

Direct on-site GHG baseline emissions

Parameters	Unit	Years						
		2006	2007	2008	2009	2010	2011	2012
CO_2 emissions from fuel combustion								
coal	thous. tCO_2	3037,3	3082,7	3133,2	3133,2	3133,2	3133,2	3133,2
heavy oil	thous. tCO_2	7,3	7,4	7,6	7,6	7,6	7,6	7,6
CO_2 emission for heat output	thous. tCO_2	1439,9	1439,9	1439,9	1439,9	1439,9	1439,9	1439,9
CO_2 emission for power output	thous. tCO_2	1604,7	1650,2	1700,8	1700,8	1700,8	1700,8	1700,8
Specific CO_2 emissions for 1 Gcal output	$kgCO_2$/Gcal	416	416	416	416	416	416	416
Specific CO_2 emissions for 1 kWh output	gCO_2/kWh	1012	1012	1012	1012	1012	1012	1012
Total direct on-site GHG emissions	thous tCO_2	3044,6	3090,2	3140,8	3140,8	3140,8	3140,8	3140,8

Direct off-site GHG baseline emissions
Emissions associated with the energy consumption of fuel transportation – don't take into account
Indirect on-site GHG emissions are absent
Indirect off-site GHG emissions are not taken into account

Table 7

Results of the calculations of GHG baseline emissions

Parameters	Unit	Years						
		2006	2007	2008	2009	2010	2011	2012
Total GHG baseline emissions	**thous. t CO_2**	**3044,6**	**3090,2**	**3140,8**	**3140,8**	**3140,8**	**3140,8**	**3140,8**
GHG project emissions associated with electricity production	thous. t CO_2	1 605	1 650	1 701	1 701	1 701	1 701	1 701
GHG project emissions associated with heat production	thous.t CO_2	1 440	1 440	1 440	1 440	1 440	1 440	1 440
CEF under electricity production	**gCO_2/kWh**	**1 012**	**1 012**	**1 012**	**1 012**	**1 012**	**1 012**	**1 012**
CEF under heat production	**$kgCO_2$/Gcal**	**416**	**416**	**416**	**416**	**416**	**416**	**416**

Estimation of GHG project emissions

Table 8

Initial information for calculation GHG project emissions

Parameters	Unit	Years					
		2007	2008	2009	2010	2011	2012
Annual heat output	thous. Gcal	3 465	3 465	3 465	3 465	3 465	3 465
Annual power output	mln. kWh	1 630	1 680	1 680	1 680	1 680	1 680
Specific fuel equivalent consumption for heat supplied	kg/Gcal	139,8	142,1	142,1	142,1	142,1	142,1
Specific fuel equivalent consumption for electricity supplied	g/kWh	327,1	322,5	322,5	322,5	322,5	322,5
Annual fuel consumption for heat	thous. ton c.e.	484,5	492,4	492,4	492,4	492,4	492,4
Annual fuel consumption for electricity	thous. ton c.e.	533,1	541,9	541,9	541,9	541,9	541,9
Annual fuel consumption for heat and electricity, totally:	thous. ton c.e.	1 017,6	1 034,3	1 034,3	1 034,3	1 034,3	1 034,3
Coefficient of CO_2 emission gas burning	t CO_2/tce	1,62	1,62	1,62	1,62	1,62	1,62

Table 9

Direct on-site GHG project emissions

Parameters	Unit	Year					
		2007	2008	2009	2010	2011	2012
CO_2 emission for heat output	thous. tCO_2	784,9	797,7	797,7	797,7	797,7	797,7
CO_2 emission for power output	thous. tCO_2	863,7	877,8	877,8	877,8	877,8	877,8
Specific CO_2 emissions for 1 Gcal output	$kgCO_2$/Gcal	227	230	230	230	230	230
Specific CO_2 emissions for 1 kWh output	gCO_2/kWh	530	523	523	523	523	523
Total direct on-site GHG emissions	thous tCO_2	**1 649**	**1 676**	**1 676**	**1 676**	**1 676**	**1 676**

Table 10

Direct off-site GHG project emissions

Emissions associated with the energy consumption of fuel transportation – don't take into account

Emissions associated with CH4 leaks in fuel production and transportation:

Parameters	Unit	Year					
		2007	2008	2009	2010	2011	2012
Quantity of burning gas at the Khabarovsk CHP-1	thous. ton c.e.	1 017,6	1 034,3	1 034,3	1 034,3	1 034,3	1 034,3
Direct off-site GHG emissions associated with production:							
electricity	thous. t CO_2-eqv	126	128	128	128	128	128
heat	thous. t CO_2-eqv	115	116	116	116	116	116
CH_4 emissions in CO_2-eqv. associated with gas delivery and transportation	thous. t CO_2-eqv	**240,5**	**244,5**	**244,5**	**244,5**	**244,5**	**244,5**

Indirect on-site GHG emissions are absent
Indirect off-site GHG emissions are not taken into account

Table 11
Results of the calculations of GHG project emissions

Parameters	Unit	Year					
		2007	2008	2009	2010	2011	2012
GHG project emissions	**thous. tCO2-eqv**	**1889,1**	**1920,0**	**1920,0**	**1920,0**	**1920,0**	**1920,0**
GHG project emissions associated with electricity production	thous. tCO2-eqv	990	1 006	1 006	1 006	1 006	1 006
GHG project emissions associated with heat production	thous. tCO2-eqv	899	914	914	914	914	914
CEF under electricity production	**gCO_2/kWh**	**607**	**599**	**599**	**599**	**599**	**599**
CEF under heat production	**kgCO_2/Gcal**	**260**	**264**	**264**	**264**	**264**	**264**

Estimation of GHG emission reduction

Table 12

Final results of estimation of GHG Emission Reduction Units by the project

Parameters	Unit	Years					
		2007	**2008**	**2009**	**2010**	**2011**	**2012**
ANNUAL OUTPUT:							
electic energy	thous. MWh	1 630	1 680	1 680	1 680	1 680	1 680
heat	thous. Gcal	3 465	3 465	3 465	3 465	3 465	3 465
BASELINE							
CEF under electricity production	gCO_2/kWh	1 012	1 012	1 012	1 012	1 012	1 012
CEF under heat production	$kgCO_2/Gcal$	416	416	416	416	416	416
PROJECT							
CEF under electricity production	gCO_2/kWh	607	599	599	599	599	599
CEF under heat production	$kgCO_2/Gcal$	260	264	264	264	264	264
ERUs	**thous. t CO_2**	**1 201**	**1 221**	**1 221**	**1 221**	**1 221**	**1 221**
for 2008-2012 period	**thous. t CO_2**						**6 104**

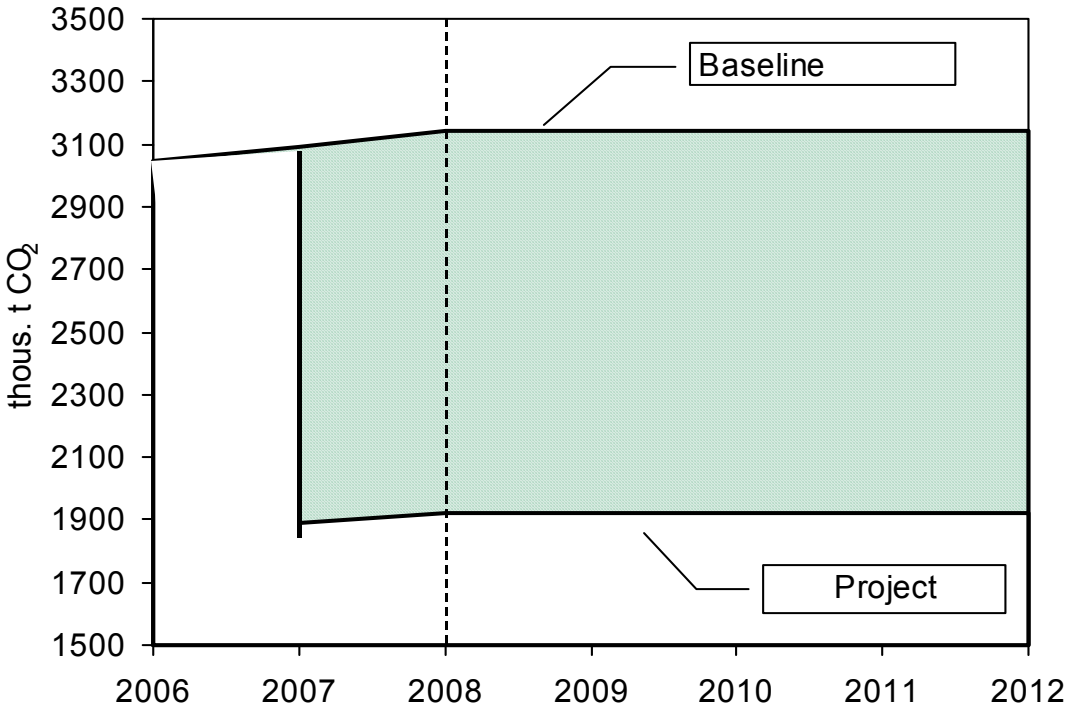


Fig. 7 GHG emissions under baseline and project

Crediting period

The calendar schedule of project implementation and the crediting period

The detailed calendar schedule is given in the business plan within the project. The period of the construction and mounting works is specified in the calendar schedule (in accordance with the experience of conducting such works in Russia).

Start date of the JI project	2005
Construction works	05.2005-10.2006
Start of ERUs generation	01.2007
Crediting time of the project (only relevant if the project crediting time will end before 2012)	5 years – 1-st commitment period (2008–2012)

The project can provide "early" ERUs (before 2008) as well as emission reductions after 2012.

Lifetime of the project

To determine the project life (the objective emission crediting period for the project baselines in the field of electric generation) there are different criteria/factors that shall be accounted for, including:

- technical life of the equipment;
- economic life of power plants;
- depreciation period.

The technical lifetime of the main elements of the boilers, turbines and pipelines of TPPs in the Russian Federation is determined by the sectoral normative documents [9-13].

Distribution of responsibility of the participants of the project for its implementation

Khabarovskenergo – full responsibilities of the project implementation, general management;

Khabarovsk CHP-1 – performance of the plant under the projected mode;

Khabarovsk energy technological company – "everyday" control and project monitoring;

KhabarovskenergoProject – project concept design and drawings;

EnergoRemstroyComplex – construction works.

Energy Carbon Fund:

- organizes and conducts the training seminar on recording the required data, monitoring and reporting on the project GHG emissions,
- methodological support in the project GHG emissions monitoring and control of the fulfillment thereof.

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Annex I

Data about district heating system by
Khabarovsk CHP-1 for 2002(Reporting date - 20 February 2003)

Parameters	Value
1	2
Fuel type: - main - reserve	 coal coal
Heat capacity: **In hot-water**, Gcal/h: - installed, total, including hot-water boiler, Gcal/h - available, **In steam**, t/h: - installed - available	 1210 300 1108 3120 2496
Output of makeup demineralizer for heat supply system inflow, t/h	1800
Anticipated heat load of district heating system, Gcal/h	800
Anticipated input of heat capacity during the year - in hot-water, Gcal/h - in steam, t/h	 0 0
Water heat network:	
Type of heat supply system	open
Design temperature chart T1/T2, ºC - design temperature of heating-system water t_1 - design temperature of heating-system water t_2 - design temperature of heating-system water on shear - outside temperature under which it is carried out - enterprise approved the shear	 130 70 0 0 JSC “Khabarovskenergo”
Installed heat load in accordance with the in force contracts, Gcal/h: - housing and communal services: total for heating and ventilation for hot-water supply - industry: total for heating and ventilation for hot-water supply total	 554 457 97 199 176 23 753
Heating system water consumption: Design, t/h Actual: - average hourly, t/h - max, t/h	 15400 15001 16949

1	2
Steam part:	
Steam consumption, t/h	
- plan	109
- actual	22
Condensate return, %:	
- plan	1
- actual	2
Actual min outside temperature during heating period and respective to it characteristics:	
- actual min outside temperature, ºC	-33
- water temperature in flow pipeline, ºC	104
- water temperature in return pipeline, ºC	67
- heating-system water consumption, t/h	15672
- actual heat output, Gcal/h	716
- specific water consumption for Gcal supplied, t/Gcal	151
Actual annual heat output, thous. Gcal.:	
- in hot water	2237
- in steam	124
Total	2361
Electricity consumption for heat-transfer pumping, thous. kWh	39886
- on heat source	12372
- on feed-pump	
Makeup water consumption during heating period:	
Average hourly:	
- plan, t/h	2800
- fact, t/h	2540
Actual max	3430
Specific heating-system water consumption for associate Gcal/h, t/h/Gcal/h:	
- design	20
- actual:	
average	20
max	0
Specific electricity consumption for transport of 1 Gcal of heat output, kWh/Gcal:	
- heat source	18
- heat source + feed-pump	39892
Annual losses of heat and heating-system water:	
Heat losses due thermal insulation in % from annual heat output:	
Water heat network:	6
- plan	8
- fact	
Steam network:	0
- plan	0
- fact	

Annex II

Characteristics of the Khabarovsk CHP-1 main equipment

Steam boilers

Station No.	Type	Manufacturer	Year of commissioning	Fuel	Steam parameters		Nominal output, t/h
					Pressure, kg/cm^2	Temperature, ^0C	
1	2	3	4	5	6	7	8
1	ТП-170	ТКЗ	1953	coal/heavy oil	100	540	170
2	ТП-170	ТКЗ	1955	coal/heavy oil	100	540	170
3	ТП-170	ТКЗ	1955	coal/heavy oil	100	540	170
4	ТП-170	ТКЗ	1958	coal/heavy oil	100	540	170
5	БКЗ-160-100-Ф	Barnaul boiler manufacturing works	1959	coal/heavy oil	100	540	160
6	БКЗ-160-100-Ф		1960	coal/heavy oil	100	540	160
7	БКЗ-220-100-Ф		1964	coal/heavy oil	100	540	220
8	БКЗ-220-100-Ф		1965	coal/heavy oil	100	540	220
9	БКЗ-210-140-Ф		1966	coal/heavy oil	140	560	210
10	БКЗ-210-140-Ф		1967	coal/heavy oil	140	560	210
11	БКЗ-210-140-Ф		1968	coal/heavy oil	140	560	210
12	БКЗ-210-140-Ф		1970	coal/heavy oil	140	560	210
13	БКЗ-210-140-Ф		1971	coal/heavy oil	140	560	210
14	БКЗ-210-140-Ф		1972	coal/heavy oil	140	560	210
15	БКЗ-210-140-Ф		1972	coal/heavy oil	140	560	210
16	БКЗ-210-140-Ф		1973	coal/heavy oil	140	560	210

Hot water boiler-house

Station No.	Type	Manufacturer	Year of manufacture	Fuel	Steam parameters		Nominal output, Gcal/h
					Pressure, kg/cm^2	Temperature, ^0C	
18	ПТВМ-100	Belgorod boiler manufacturing works	1978	heavy oil	25	70-150	100
19	ПТВМ-100		1979	heavy oil	25	70-150	100
20	ПТВМ-100		1981	heavy oil	25	70-150	100

Steam turbines

Station No.	Type	Manufacturer	Year of commissioning	Installed capacity, MW	Live steam parameters		Nominal heat capacity, Gcal/h	
					Pressure, kg/cm^2	Temperature, ^0C	Industrial	Heating
1	ПТ-50-90/13				90	535		
2	ПТ-30-90/13				90	535		
3	Т-27,5-90				90	535		
4	ПР-25-90/10/0,9				90	535		
5	ПР-25-90/10/0,9				90	535		
6	Т-100-130	УТМЗ		100	140	565	-	160
7	Т-100-130			100	140	565	-	160
8	Т-105-130			100	140	565	-	160

Annex III

The calculation of perspective specific fuel consumptions for power and heat output while gas firing at Khabarovsk CHP-1

On switching CHP-1 boilers from coal to fire natural gas the efficiency of electricity and heat production is increasing (Item 3.2).
The main generating equipment of Khabarovsk CHP-1 divides into two groups:

- Group of equipment with pressure 90 kg/cm^2: steam boilers No 1-8 and steam turbines No 1-5,
- Group of equipment with pressure 130 kg/cm^2: steam boilers No 9-16 and steam turbines No 6-8.

The shares of groups of equipment (φ^{90} и φ^{130}) in fuel consumption at CHP-1 are presented in Table 1.

Table 1

Parameters	Unit	Group of equipment with pressure 90 kg/cm^2	Group of equipment with pressure 130 kg/cm^2	Total
Annual fuel consumption - 2003	thous. tce	388 361	713 259	1 101 620
Annual fuel consumption - 2004	thous. tce	387 485	666 741	1 054 226
Share (φ)	-	0,36	0,64	-

According to the reports of CHPs the actual estimates of effective economy of boilers of 130 kg/cm^2 equipment group (БКЗ-210-140) и boilers of 90 kg/cm^2 equipment group data is presented in Table 2 and Table 3, respectively.

Increase of equipment operation efficiency may be calculated by the formula:

$$\beta = (N^{90}_{gas} \times \varphi^{90} + N^{130}_{gas} \times \varphi^{130}) / (N^{90}_{coal} \times \varphi^{90} + N^{130}_{coal} \times \varphi^{130}), \text{ где}$$

N^i - net efficiency of boiler while firing coal and gas for each i type of equipment.

At that the value of N^i (Table 2 and Table 3) is selected based on conservative approach – largest value for coal and least value for gas.

Table 2

The actual estimates of effective economy of boilers of 90 kg/cm^2 equipment group

CHP	Fuel		Boiler		Efficiency of boiler, %				
	Type	%	Type	Number	1987		1988		1997
					gross	net	gross	net	gross
Khabarovsk CHP-1	coal heavy oil	88 12	ТП-170 БКЗ-160-100Ф БКЗ-220-100Ф	4 2 2	87,7	81,9	87,6	82,1	85,6 (2004 –87,53)
Vorkuta CHP-2	coal heavy oil	99 1	ТП-170 БКЗ-160-100Ф БКЗ-220-100Ф	2 3 3	88,6	82,6	88,3	82,1	87,7
Barnaul CHP-2	coal heavy oil	96 4	ТП-170 ТП-230	3 2	86,9	81,0	86,1	80,8	86,5
Efremovsk CHP	gas heavy oil	72 28	БКЗ-160-100ГМ	5	92,2	88	92,6	88,2	92,7
Penza CHP-1	gas heavy oil	92 8	ТП-170 ТП-15 ТП-47	3 2 1	92,3	87,3	92	87,8	92,6
CHP-16 JSC “Mosenergo”	gas heavy oil	99 1	ТП-170 ТП-26	3 2	94		94		93,3
Saratov CHP-2	gas heavy oil	77 23	ТП-170	5	91,3	86,7	91	86,6	92,5
Novomoskovsk TPP	gas coal	88 11	Шихау БКЗ-220-100Ф ТП-230	4 3 1	91,7	86,1	91,7	86,5	93,1 (gas)
Bezmensk TPP	gas	100	БКЗ-160-100ГМ	5	93,8	88,6	93,6	88,7	

Table 3

The actual estimates of effective economy of boilers of 130 kg/cm^2 equipment group (БКЗ-210-140)

CHP	Fuel		Boiler		Average load	Efficiency of boiler, %					Excess air coefficient after boiler	air inflow in boiler-smoke sucker duct, %	Off-gas temperature, ^{0}C	Heat losses, %	
	Type	%	Type	Number		1988		1997		1998				q_2	q_4
						gross	net	gross	net	gross					
Khabarovsk CHP-1	coal heavy oil	94 6	БКЗ-210-140	8	107	89,0	83,3	89,0	82,8	88,0	1,48	40	154	9,1	0,8
Smolensk CHP-2	gas heavy oil	92 8	БКЗ-210-140 ТГМЕ-464	4 1	138	94,3	89,9	94,2	90,3	94,9	1,04	-	123	5,2	-
Tumen CHP-1	gas	100	БКЗ-210-140	11	112	93,2	88,1	93,2	89,2	93,6	1,14	14	122	5,2	-
Chelyabinsk CHP-2	gas coal	84 16	БКЗ-210-140	9	103	93,6	89,1	93,6	89,1	93,6	1,20	35	135	5,5	0,1
Svetlograd CHP	gas heavy oil	88 12	БКЗ-210-140	4	97	93,1	87,5	93,2	87,6		-	-	152	5,5	-
Tver CHP-3	gas heavy oil coal	84 4 12	БКЗ-210-140	4						93,4					
Chelaybinsk CHP-2	gas coal	90 10	БКЗ-210-140	9						93,6					

The results of estimate are presented in Table 4.

Table 4

Parameters	Unit	Group of equipment with pressure 90 kg/cm^2	Group of equipment with pressure 130 kg/cm^2	Average value for CHP-1
Net efficiency of boiler for coal	%	82,1	83,3	82,5
Net efficiency of boiler for gas	%	87,3	87,5	87,4
β	-	-	-	1,06

The values of average coefficients (during 2000-2004) of fuel referring to electricity production (k^e) and heat production (k^h) at CHP-1 are presented in Table 5.

Table 5

	Unit	Fuel consumption for production		
		Electricity	Heat	Total
2000	thous. tce	597,5	540,3	1137,8
2001	thous. tce	563,1	522,8	1085,9
2002	thous. tce	550,0	514,3	1064,3
2003	thous. tce	587,0	514,6	1101,6
2004	thous. tce	554,5	499,8	1054,2
Average value of coefficient (k)	-	0,52	0,48	-

The estimate of perspective specific fuel consumption for power and heat output while gas firing at CHP-1 taking into account assumption are presented in Table 6.

Table 6

Parameters	Unit	Years					
		2007	**2008**	**2009**	**2010**	**2011**	**2012**
Annual heat output	thous. Gcal	3465,0	3465,0	3465,0	3465,0	3465,0	3465,0
Annual power output	mln. kWh	1630,0	1680,0	1680,0	1680,0	1680,0	1680,0
Annual fuel consumption for coal firing	thous. tce	1073,6	1091,2	1091,2	1091,2	1091,2	1091,2
Annual fuel consumption for gas firing	thous. tce	1017,6	1034,3	1034,3	1034,3	1034,3	1034,3
Annual fuel consumption for heat	thous. tce	484,5	492,4	492,4	492,4	492,4	492,4
Annual fuel consumption for electricity	thous. tce	533,1	541,9	541,9	541,9	541,9	541,9
Specific fuel equivalent consumption for heat supplied	kg/Gcal	139,8	142,1	142,1	142,1	142,1	142,1
Specific fuel equivalent consumption for electricity supplied	g/kWh	327,1	322,5	322,5	322,5	322,5	322,5

Annex IV

Fuel balance

Fuel type	Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1) Raichihinsk coal	thous. tce	78,584	115,471	1,592	8,139	12,529	0,281	15,637	68,724	45,581	11,231	0,453	0,029	
2) Urgalsk coal	thous. tce	0,706	0,204	4,244	55,303	268,799	347,572	289,900	371,695	200,200	139,344	164,596	80,366	370,202
3) Kharanorsk coal	thous. tce	432,014	386,282	493,647	504,425	541,322	527,477	673,334	412,973	164,556	394,960	427,848	251,207	232,238
4) Chernogorsk coal	thous. tce			52,821		13,791	0,039	32,600		2,608				
5) Izykhinsk coal	thous. tce			2,839	59,525	66,199	5,155	18,191		9,917				
6) Abakan coal	thous. tce									19,683				
7) Azeisk coal	thous. tce		7,696	38,391	78,097	30,218	55,903	16,886	205,414	651,192	564,010	321,118	104,480	78,442
8) Urtuysk coal	thous. tce											221,154	646,639	379,531
Oil fuel	thous. tce	299,853	445,144	415,374	227,296	133,415	62,07	24,226	8,902	5,401	3,544	2,643	3,112	3,857

Fuel consumption by transport

	Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Petrol consumption	t/y	87,7	89,7	89,7	96,6	96,6	103,4	103,4	110,3	132,4	124,1	115,2	97,9	167,5
Diesel oil consumption	t/y	445,9	323,3	548,3	453,1	720,3	567,8	520,3	586,0	410,5	462,9	480,4	429,4	571,9

Average CO_2 emissions coefficients

	Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Average CO_2 emissions coefficient for solid fuel	t CO_2/tce	2,96	3,01	2,99	2,95	2,92	2,92	2,93	2,91	2,85	2,87	2,88	2,88	2,88
Average CO_2 emissions coefficient for oil fuel	t CO_2/tce	2,21	2,22	2,22	2,20	2,23	2,24	2,30	2,33	2,35	2,44	2,53	2,41	2,39

GHG emissions

Total emissions

	Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CH_4 emission	thous. t CO_2	1,21	1,35	1,26	1,00	0,87	0,72	0,70	0,68	0,69	0,70	0,71	0,68	0,67
CH_4 share	%	0,03	0,04	0,04	0,03	0,03	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02
N_2O emissions	thous. t CO_2	15,21	13,35	12,37	13,28	13,57	12,77	13,52	13,75	14,00	14,19	14,51	13,84	13,59
N_2O share	%	0,40	0,37	0,38	0,40	0,42	0,43	0,43	0,44	0,44	0,44	0,44	0,44	0,44
CO_2 emissions	thous. t CO_2	3815,82	3561,69	3285,54	3277,47	3232,75	2978,71	3130,20	3140,85	3134,76	3197,57	3274,98	3125,15	3063,98
CO_2 share	%	99,57	99,59	99,59	99,57	99,56	99,55	99,55	99,54	99,53	99,54	99,54	99,54	99,54
GHG emissions total	thous. t CO_2	3832,25	3576,40	3299,17	3291,75	3247,19	2992,20	3144,41	3155,28	3149,45	3212,45	3290,20	3139,67	3078,23

Stationary fuelburn plants

	Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CH_4 emissions	thous. t CO_2	1,21	1,35	1,25	1,00	0,86	0,71	0,69	0,68	0,68	0,69	0,70	0,67	0,66
N_2O emissions	thous. t CO_2	15,17	13,31	12,32	13,22	13,51	12,72	13,46	13,69	13,94	14,13	14,45	13,79	13,51
CO_2 emissions	thous. t CO_2	3814,10	3560,36	3283,49	3275,70	3230,12	2976,55	3128,19	3138,61	3133,01	3195,68	3273,06	3123,46	3061,60
Emissions under the group total	thous. t CO_2	3830,48	3575,02	3297,06	3289,92	3244,49	2989,98	3142,35	3152,97	3147,64	3210,50	3288,22	3137,92	3075,77
Share in total emissions	%	99,95	99,96	99,94	99,94	99,92	99,93	99,93	99,93	99,94	99,94	99,94	99,94	99,92

Transport of enterprise

	Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CH_4 emissions	thous. t CO_2	0,00	0,00	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01

N_2O emissions	thous. t CO_2	0,05	0,04	0,05	0,05	0,07	0,06	0,06	0,06	0,06	0,06	0,06	0,05	0,08
CO_2 emissions	thous. t CO_2	1,72	1,33	2,05	1,77	2,63	2,16	2,01	2,24	1,75	1,89	1,92	1,70	2,38
Emissions under the group total	thous. t CO_2	1,77	1,38	2,11	1,83	2,70	2,22	2,07	2,31	1,81	1,96	1,98	1,75	2,47
Share in total emissions	%	0,05	0,04	0,06	0,06	0,08	0,07	0,07	0,07	0,06	0,06	0,06	0,06	0,08

Annex V

The most significant direct off-site emissions to be estimated are the emissions due to energy use of coal railway supply and gas pumping via the gas pipeline to Khabarovsk CHP-1.

According to the information obtained from the railway company, specific diesel fuel consumption for railway transport of goods is 47-52 kg per 10 thous. t×km.

To Khabarovsk CHP-1, the Urgalsk coal (Khabarovsk Region) is transported by diesel locomotive at a distance of 540 km, the Kharanorsk and the Urtuysk coals (Chita Region) is supplied via the electrified railway area and by diesel locomotive at a distance of 2700 km each. The share of the Urgalsk, Kharanorsk and Urtuysk coals in the total fuel balance constitutes 0.26, 0.4 and 0.34, respectively. CHP-1 as well consumes coals from Azeisk and Raichikhinsk deposits (during 1999-2002). But the reserve of coals from Azeisk deposit is estimated at в 0 year, and quality of Raichikhinsk coal became significantly worse of the project parameters (for example, heat value of delivered fuel – no more than 2100 kcal/kg, against designed– 2900-3100 kcal/kg). Therefore these coals most likely will not be burned at the CHP-1 and they were not taken into consideration.

According to the information obtained from Open JSC "Gasprom", specific energy consumption for pipeline pumping of natural gas is 32-35 kg of fuel eqv./mln.m^3×km.

Gas to the power station is supplied from the Sakhalin-1 gas field at a distance of about 900 km. In implementing the project, Khabarovsk CHP-1 gas requirements will be of the order of 260 mln. m^3/y.

The methodology of defining GHG emissions is to calculate absolute consumption of fuel needed to transport appropriate fuel from a certain deposit to the plant using specific figures and then through emission factors to calculate absolute emissions. Calculations are given in table below:

No	Parameters	Unit	Calculation	2008	2012
Baseline					
1	Coal consumption	10 thous. tce		109,2	109,2
2	Recalculation factor into natural fuel	t/tce		2,2	2,2
3	Coal consumed at CHP-1	10 thous.t	p.1*p.2	238,1	238,1
4	Kharanorsk	10 thous.t	0.22*p.3	52,4	52,4
5	Urtuysk coal	10 thous.t	0.40*p.3	95,2	95,2
6	Urgalsk	10 thous.t	0.38*p.3	90,5	90,5
7	Distance from the deposit	-	-		
8	Kharanorsk	km	-	2700	2700
9	For Urtuysk coal	km		2700	2700
10	Urgalsk	km	-	543	543
11	Specific diesel fuel consumption at the railway	kg/(10 thous. t x km)	-	52	52
12	Diezel fuel consumption	-	-		
13	Kharanorsk coal	ton (1000 kg)	p.4*p.8*p.11 /1000	7353	7353
14	For Urtuysk coal	ton (1000 kg)	p.5*p.9*p.11 /1000	13370	13370
15	Urgalsk coal	ton (1000 kg)	p.6*p.10*p.11 /1000	2554	2554
16	Total	ton	p.13+p.14+p. 15	23277	23277
17	Recalculation factor of diesel fuel into ton c.e.	ton c.e./ton	-	1,4	1,4
18	Consumption of diesel fuel at the railway	ton c.e.	p.18 * p.19	32588	32588
19	Diezel emission factor	tCO_2/t c.e.	-	2,17	2,17
20	**Emissions due to coal transportation**	**t CO_2**	**p. 20 * p.21**	**70717**	**70717**
Project					
21	Gas consumption at CHP-1	thous. tce		1020,0	1020,0
22	Recalculation factor into natural fuel	mln.m3/tce		0,86	0,86
23	Gas consumed at CHP-1	mln.m3	-	881,3	881,3
24	Distance from the gas field	km	-	900	900
25	Specific gas consumption for gas transportation	kg of fuel eqv. /(mln.m^3 x km)	-	35	35
26	Gas consumption for gas transportation	tce (1000 kg of fuel eqv)	p.23*p.24*p.2 5 /1000	27760	27760
27	Gas emission factor	t CO_2-eqv./tce	-	1,62	1,62
28	**Emissions due to gas transportation**	**t CO2-eqv**	**p.26 * p. 27**	**44971**	**44971**

Monitoring plan

Methodology of Monitoring

Within the project boundaries are:

- Khabarovsk CHP-1;
- Fuel transportation systems from fuel deposits to the plant.

As it is shown in 4.2 emissions from fuel transportation systems can be dismissed from calculations of total emissions; thus the Monitoring Plan considers only parameters of Khabarovsk CHP-1.
The main methodology for defining GHG emissions is their calculation using fuel consumption data and emission factors for each type of fuel. Thus the fuel accounting system is the core element of GHG emission monitoring. Electricity and heat output should be also considered to define specific emissions per kWh of the equipment under control.

Requirements

Requirements for fuel accounting

The fuel accounting in the power sector is based on existing system of fuel control and registration “Instructions on Fuel Accounting at TPPs. RD 34.09.105.96”. According to this document all fuel that is delivered to a power plant, stored and used for technological purposes must be strictly accounted.

This includes:

- Determination of quantity and quality of the fuel;
- Periodic inventory;
- Claims to the fuel deliverers in case the fuel does not meet the contracted parameters.

To account fuel quantity and define fuel quality thermal power plants should be equipped by special meters, devices and apparatus. The data on fuel delivered and consumed is to be presented in state statistical reports as well as in inter-corporative reports. Primary data on fuel consumption is registered in special register books, in invoices and are used to prepare monthly and annual reports (the so called form No. 15506, form No. 6-TP), both presenting the main performance parameters of a power plant. The latter report includes the aggregated data on the delivered and consumed fuel.
Forms of the already established monitoring measures (Form 6-TP, Form No. 15506) are given in Annex 1.

Besides, the annual report 6-TP includes aggregated monthly data on:

- installed capacities of a TPPs (electrical and thermal - Part 1, line 11, columns 1 and 2);
- power and heat output (Part 2, line 22, columns 10 and 3);
- fuel used for power and heat production (Part 3, column 2, lines 32 and 33);
- type and quantity burned fuel (Part 4, column 3, lines: mazut – 42, gas – 43, coal - 44).

The quantity and quality of liquid and solid fuels should be controlled before the fuel take-over from the deliverer and before fuel burning.
Fuel quality control is conducted by special chemical laboratories of TPPs, which periodically make tests of the fuel got from deliverers and taken from TPP stores for burning. Fail in meeting the contracted quality is the cause to claim the deliverers.

The list of the main parameters of fuel consumption is as follows:

Gas: gas pressure at the measuring device (diaphragm);
gas temperature before and after diaphragm.-

Heavy oil: weigh of oil when emptying the railway tanks;
oil level in tanks;
oil temperature in tanks;
oil density in tanks.

Coal: weigh of coal delivered to the plant;
weigh of coal delivered to the plant boilers;
moisture and ash content, heat value.

The statistical reports “15506” and “6-TP” can serve as basic documents for GHG emission monitoring provision. The report “15506” is filled in monthly used different primary data on daily fuel delivery, its consumption, generation of energy. The annual report 6-TP includes accumulated monthly data on:

- installed capacities of a TPP (electrical and thermal);
- power and heat output;
- fuel used for power and heat production;
- fuel by types and the fuel balance (delivery of fuel, fuel reserve, fuel quality – i.e. heat value, ash, moisture and sulfur content).

Maximum metering error of fuel consumption should not exceed:

- 3.5 % for coal;
- 1.6% for heavy oil;
- 2.0% for gas.

Actual magnitudes of inaccuracy and errors at concrete power plants can be lower than the above figures.

The coal to Khabarovsk CHP-1 is supplied via the electrified railway. The weighing of incoming fuel is carried out via the track scales. The personnel of fuel supply department shift-time estimate the solid fuel expended for process needs in natural expression. The tool measuring of available solid fuel is carried out periodically.

While implementing the project, the natural gas flow at the Khabarovsk CHP-1 will be measured by applying the up-to-date proven stationary measurement devices.

Requirements for electricity and heat output

The electricity and heat supplied are measured by the relevant electrical and heat meters applied in the power industry.

In the project implementation at the Khabarovsk CHP-1, all processes, including data measurement and recording are carried out from the operator location on the electrical engineering block.

The means and methods for each measurement point are given in the table below.

Measu-reme nt point	Control means	Measureme nt method	Calibration method	Calibration frequency	Institution carrying out measureme nts
Natural gas consumptio n	Standardize d measuring device (diaphragm+ differential manometer+ secondary device)	Differential pressure+ pressure conversation into uniform current signal	Verifying device	Once a year	Khabarovsk CHP-1
Coal consumptio n	Track scales BB-200	Conversatio n of mechanical power into electrical power using piezometric sensors	Verifying device	Once a year	Khabarovsk CHP-1
Power output	By standardized electricity meters	Inductive	Verifying device	Once a year	Khabarovsk CHP-1
Heat output	Restriction (diaphragms)	Determinatio n of matter consumption via pressure differential	Verifying device	Once a year	Khabarovsk CHP-1
	Measuring converter	Pressure conversation into uniform current signal	Verifying device	Once a year	Khabarovsk CHP-1
	Thermal converter of resistance	Dependence of resistance on temperature	Verifying device	Once in 4 years	Khabarovsk CHP-1

Calibration

Use is made of the measurement methods approved (certified) by the bodies of the State Standard of the Russian Federation. The measurement errors of the devices the readings of which are controlled in monitoring, meet the requirements laid down in the Rules effective in the Russian Federation.

Actual sectoral standards on inaccuracy of measurements of:

- coal weighing is not more than ±1.75%;
- heavy oil volume measurement (which is recalculated further on in weight units) is not more than ± 0.5-0.8%;
- direct gas consumption measurements is not more than ± 0.3-1.0%.

The Control Equipment and Facilities Workshop (CEFW) of is available at the TPP ensuring operation of the measurement equipment and carrying out monitoring of adequate readings thereof. The CEFW equipment and devices are subject to periodical

checking in accordance with the relevant scheduled (Annex 2). Checking is carried out on the test facilities using the standard devices. The TPP also has the fleet of I&C equipment and devices to be applied in case of failure of any equipment and devices.

The Monitoring Plan

Monitoring Plan
(for the purposes of the project the summarized reporting data is presented once a year)

№	Parameter	Data variable	Unit	Measured, calculated or estimated	Recording & archiving method (electronic/ paper)	Registration frequency
15.	Annual power output		kWh	measured	Electronic and paper Statistical report, Forms 15506-1, Form No 6-TP	continuously
16.	Annual heat output		Gcal	measured	Electronic and paper Statistical report, (Forms 15506-1, Form No 6-TP)	continuously
17.	Annual fuel consumption total		ton c.e.	measured	Electronic and paper Statistical report, (Forms 15506-1, Form No 6-TP)	continuously
17.1.	– including gas consumption during reporting period		thous. $м^3$, t c.e.	measured	Electronic and paper Statistical report	continuously
17.2.	– including coal consumption during reporting period		t c.e.	measured	Electronic and paper Statistical report	continuously
18.	Annual fuel consumption for power output		t c.e.	calculated	Electronic and paper Statistical report, (Forms 15506-1, Form	monthly

№	Parameter	Data variable	Unit	Measured, calculated or estimated	Recording & archiving method (electronic/ paper)	Registration frequency
					No 6-TP)	
18.1.	– including gas consumption during reporting period		thous. м^3, t c.e.	calculated	Electronic and paper Statistical report	monthly
18.2.	– including coal consumption during reporting period		t c.e.	calculated	Electronic and paper Statistical report	monthly
19.	Annual fuel consumption for heat output		t c.e.	calculated	Electronic and paper Statistical report, (Forms 15506-1, Form No 6-TP)	monthly
19.1.	– including gas consumption during reporting period		thous. м^3, t c.e.	calculated	Electronic and paper Statistical report	monthly
19.2.	– including coal consumption during reporting period		t c.e.	calculated	Electronic and paper Statistical report	monthly
20.	Specific fuel consumption per:					
20.1.	– power output		g. c.e./kWh	calculated	Electronic and paper Statistical report Form 3-TEK (Forms 15506-1 [5, 6])	monthly

№	Parameter	Data variable	Unit	Measured, calculated or estimated	Recording & archiving method (electronic/ paper)	Registration frequency
20.2.	– heat output		kg c.e./Gcal	calculated	Electronic and paper Statistical report, (Forms 15506-1, Form No 6-TP)	monthly
21.	Low heat value of natural gas		kcal/m^3, (MJ/m^3)	measured (laboratory test)	Electronic and paper Statistical report Form No 6-TP	monthly
22.	Chemical composition of natural gas:		%	measured (laboratory test)	Electronic and paper Statistical report	monthly
22.1.	– CO_2		%			
22.2.	– CO		%			
22.3.	– CH_4		%			
22.4.	– C_nH_m		%			
23.	Coefficient of CO_2 emission gas burning		t CO_2/t c.e.	calculated	Electronic and paper Statistical report	annually

№	Parameter	Data variable	Unit	Measured, calculated or estimated	Recording & archiving method (electronic/ paper)	Registration frequency
24.	Coefficient of CO_2 emission coal burning		t CO_2/t c.e.	in accordance with PDD		
25.	Direct on-site GHG emissions under the output			calculated	Electronic and paper Statistical report	annually
25.1.	– heat		t CO_2			
25.2.	– electricity		t CO_2			
26.	CEF with production of:			calculated	Electronic and paper Statistical report	annually
26.1.	– heat		kgCO_2/Gcal			
26.2.	– electricity		gCO_2/kWh			
27.	CEF under baseline with production:			in accordance with PDD	Electronic and paper Statistical report	
27.1.	– heat		kgCO_2/Gcal			

№	Parameter	Data variable	Unit	Measured, calculated or estimated	Recording & archiving method (electronic/ paper)	Registration frequency
27.2.	– electricity		gCO_2/kWh			
28.	GHG emission rediction		thous. t CO_2	calculated	Electronic and paper Statistical report	annually

Accociated Environmental Impact

Project gross emissions assessment according to the baseline, meeting environmental requirements, environmental impact assessment

In accordance with the Russian regulatory procedural documents the following substances are subject to monitoring at power plants and boilers:

- **Fly ash**
- Nitrogen dioxide
- Nitrogen oxide
- Sulfur dioxide
- Carbon oxide
- Heavy oil ash (recalculated to vanadium)
- Soot and carcinogenic hydrocarbons (both only for boilers with capacity less than 30 t/hour).

Emissions of the mentioned above substances are measured as follows: grams/second (average for 20 min) and in tones (for a longer period – a month, a quarter, half a year, a year).

The received data is tabulated in forms 2-TP (air) of governmental accounting.

In our case, at the plants within the project boundaries the following substances will be emitted: sulfur oxides and fuel oil ash – when fuel oil firing, nitrogen oxides - both when firing fuel oil and natural gas.

According to the Federal Laws of the Russian Federation “Environmental Protection Act” (No. 7-FZ dated 10.01.2002) and “Environmental Expert Review Act” (No. 65-FZ dated 25.06.1995) project environmental impact assessment is made. This document is developed together with other project design documentation and is its integral part. The projects for which such assessment is made are as follows:

- new construction;
- reconstruction/ rehabilitation of a plant with a full change of the main technology, production volume increase (due to the project implementation);
- substitution of currently used fuel and raw materials for the inferior ones.

The present project is not related to any listed above variants.

Nevertheless, the Feasibility Study, that contains “Environmental Protection” section with emissions verification and estimation data obtained from the boilers with nominal output and maximum ground level concentration on the boarder of residential and sanitary protection areas, shall pass obligatory State environmental expert review.
The copies of the Expert Committee Findings on the Feasibility Study materials (title page, conclusions) and of the Environmental Protection Agency of the Ministry of Natural Resources of the Russian Federation in Khabarovsk Region Regulation “Approval of the Expert Committee Findings” are given in Annex I.
The main finding of the Committee is that the project conforms to the legislative requirements and the environmental impact level is permissible.

Environmental impact from project implementation is described below.

The ecological effect gained from the project implementation (reduction of SO_2, NO_x and coal ash gross emissions) is reached due the following factors:

– Usage of pollution-free fuel (natural gas instead of coal),

– Increase of fuel combustion efficiency due to boilers efficiency coefficient increase and application of modern, more effective burners.

For estimation of the ecological effect the following data was used:

– From the base line - retrospective data for emissions from coal combustion at Khabarovsk CHP-1 during the period of 1999-2003,
– Under the project - data for NO_x emissions from natural gas combustion in steam boilers.

Returns on pollutant emissions from the Khabarovsk CHP-1

In accordance with Operating Rules and Regulations for power plants and electrical networks of the Russian Federation [14] at all power plants of JSC "Khabarovskenergo", including Khabarovsk CHP-1, emissions accounting and monitoring are regularly made. Emissions assessment from CHP is carried out in accordance with the methodology of Russia [15].
Table 1 shows the returns on emissions at Khabarovsk CHP-1 from 1999 till 2003.

Table 1

Reported year	Total*	Coal ash	SO_2	NO_x	Fuel coal fired
	t/y	t/y	t/y	t/y	thous. tce
1999	36 892,6	14 723,0	16 427,3	4 632,6	1 109,5
2000	25 868,9	13 102,4	6 268,9	5 362,2	1 135,2
2001	24 713,7	11 979,6	6 022,6	5 628,5	1 082,8
2002	26 643,1	15 421,7	4 789,9	5 370,9	1 060,4
2003	27 676,5	15 617,2	5 377,1	5 583,6	1 098,4

* - besides the emissions given in Table 1 at Khabarovsk CHP-1 under fuel oil combustion oil ash is also emitted. However, the percentage of fuel oil in the fuel balance is only 0.23-0,49 %, and the amount of fuel oil ash in the gross emissions is less than 0.001 % (0.22-0.25 t/y), thus, such emissions are not accounted when assessing environmental impact.

Based on the returns, an average specific value of emissions per the combusted fuel amount is the following:

NOx - 4.84 t of NO_x/thous. tce of coal;
SO_2 - 7.09 t of SO_2/thous. tce of coal;
Fuel coal ash - 12.91 t /thous. tce of coal.

NO_x emissions data when combusting natural gas in steam boilers

The volume of NO_x emissions when combusting natural gas in steam boilers depends on many factors, such as the type of boilers, actual load, application of $DeNO_x$ technologies, etc.
According to the information received from the Environmental Protection Department of Russian Thermal Engineering Institute, the concentration of nitrogen oxides in flue gases when combusting natural gas in pulverized coal-fired boilers can reach 500 mg/nm^3.
For example, when combusting natural gas in the boilers of Pskov Thermal Power Plant (TPP) (project fuel - coal) in 2000 2824.7 t of NO_x were emitted into the atmosphere (annual gas consumption – 747.8 thous. t) which corresponds to the concentration of NO_x in the leaving gases at the level of 400 mg/nm^3, in 2001 – 2932.0 t of NO_x (747.8 thous. t) or 360 mg/nm^3.
When providing modernization of the boilers at Khabarovsk CHP–1 it is supposed to apply the cyclone-swirl technology for gaseous fuel combustion (designers - «Nonprofit scientific and educational organization of the Far East State Technical University» and Technological Center «Modernization of boiler equipment» in Vladivostok). The given

technology allows reducing NO_x emissions for 70% in comparison with common conventional gas/oil devices (gas-heavy oil device burners) and is being successfully operated for boiler units at the Okhinskaya and Yakutskaya CHP.
For the estimation of ecological effect, the NO_x concentration in the flue gases was assumed at the level of 250 mg/nm^3, which corresponds to NO_x specific emissions at the level of 2.4 t of NO_x/thous. tce of gas.

Environmental Impact Assessment

When implementing the project of switching the boilers at Khabarovsk CHP-1 to natural gas combustion the gross emissions of sulphurous anhydride and of coal fly ash to the atmosphere will be eliminated, that will provide considerable improvement of the ecological situation not only in the City of Khabarovsk, but also in Khabarovsk Region.

The results of pollutant emissions accounting in the base line and in the project for the period till 2012 are given in Tables 2-4.

Table 2

The forecast of pollutant emissions in the project base line

Year	Fuel consumption	Coal ash	SO_2	NOx	Total
	tce/y	t/y	t/y	t/y	t/y
2007	1 073,6	13 863,4	7 609,6	5 201,0	26 674,0
2008	1 091,2	14 090,5	7 734,2	5 286,2	27 110,9
2009	1 091,2	14 090,5	7 734,2	5 286,2	27 110,9
2010	1 091,2	14 090,5	7 734,2	5 286,2	27 110,9
2011	1 091,2	14 090,5	7 734,2	5 286,2	27 110,9
2012	1 091,2	14 090,5	7 734,2	5 286,2	27 110,9

Table 3
The forecast of pollutant emissions when implementing the project

Year	Fuel consumption	Coal ash	SO_2	NOx	Total
	tce/y	t/y	t/y	t/y	t/y
2007	1 017,6	0,0	0,0	2 442,3	2 442,3
2008	1 034,3	0,0	0,0	2 482,3	2 482,3
2009	1 034,3	0,0	0,0	2 482,3	2 482,3
2010	1 034,3	0,0	0,0	2 482,3	2 482,3
2011	1 034,3	0,0	0,0	2 482,3	2 482,3
2012	1 034,3	0,0	0,0	2 482,3	2 482,3

Table 4
Results of pollutant emissions assessment in the period from 2007 to 2012 when implementing the project

Year	Coal ash	SO_2	NOx	Total
	t/y	t/y	t/y	t/y

2007	13 863,4	7 609,6	2 758,7	24 231,7
2008	14 090,5	7 734,2	2 803,9	24 628,6
2009	14 090,5	7 734,2	2 803,9	24 628,6
2010	14 090,5	7 734,2	2 803,9	24 628,6
2011	14 090,5	7 734,2	2 803,9	24 628,6
2012	14 090,5	7 734,2	2 803,9	24 628,6

Transboundary Transfer

The Russian Federation has SO_2 and NO_x emissions reductions obligations under the Transboundary Transfer Convention. Such obligations are related only to the emissions made in Ciscaucasian Russia. Khabarovsk CHP-1 is located in the Far East. That is why OAO “Khabarovskenergo” and CHP-1 do not carry out special emissions monitoring under the Convention.

Besides, when implementing the project pollutant emissions into the atmosphere are reduced. The values of SO_2, NO_x and fly ash emission reductions are given above.

Conclusions:

The Khabarovsk CHP-1 is not considered to be a source of emissions under the Transboundary Transfer Convention. Even if such emissions occurred, they would have been reduced when implementing the project.

Social Impact

The installation of the gas using equipment at Khabarovsk CHP-1 will allow improving labor conditions; first of all by means of improving the reliability of the equipment operation, cost savings on fuel preparation and storage, catching the fly ash, warehousing and storage of ash and slag waste.

When implementing the project, the ecological situation in the City of Khabarovsk will be considerably improved.
The service of gas pipelines and gas equipment will be carried out by the same specialists who served the fuel oil fired boilers and passed training and examination in the safety regulations at gas facilities and other regulatory documents for gas facilities. Therefore, the implementation of the project will not result in job cuts.

Annex I

THE MINISTRY OF NATURAL RESOURCES OF THE RUSSIAN FEDERATION

Main Department of Natural Resources and Environmental Protection
The Ministry of Natural Resources of the Russian Federation on the Khabarovsk Territory

STATE ECOLOGICAL EXPERTISE

680013,. Khabarovsk, Kadrovy Pereulok , 6, tel. 21-19-98

Of 31.05 2004, No. 5-3/1698

APPROVED BY:
Order No. 419 P of 31.05.2004 on the Main Department of Natural Resources and Environmental Protection of the Ministry of Natural Resources of the Russian Federation on the Khabarovsk Territory

THE STATEMENT
of the Commission of experts of state ecological expertise on materials of the

Feasibility Report on the reconstruction of the Khabarovsk CHP-1 to fire natural gas.

City of Khabarovsk, May, 2004.

The Commission of experts approved by the order No.218/P of 02.04.2004 of the Main Department of Natural Resources and Environmental Protection of the Ministry of Natural Resources of the Russian Federation on Khabarovsk territory, including:

The chief of the Commission – Pilina T.N., freelance expert;.
The accountable secretary - Artemieva I.V. - leading specialist of the department of state ecological expertise;
The members of the commission of experts - Romakina N. P., freelance expert;
- Tarasova N.V., freelance expert;
- Krasnopolov A.V, freelance expert

МИНИСТЕРСТВО ПРИРОДНЫХ РЕСУРСОВ
РОССИЙСКОЙ ФЕДЕРАЦИИ

Главное управление природных ресурсов и охраны окружающей среды
МПР России по Хабаровскому краю

ГОСУДАРСТВЕННАЯ ЭКОЛОГИЧЕСКАЯ ЭКСПЕРТИЗА

680013 , г. Хабаровск, пер. Кадровый, 6-а,тел.21-19-98

От 31.05. 2004 г. № 53/1698

УТВЕРЖДЕНО
приказом по Главному управлению
природных ресурсов и охраны окружающей
среды МПР России по Хабаровскому краю
от 31.05. 2004 г. № 419/П

ЗАКЛЮЧЕНИЕ

экспертной комиссии государственной экологической экспертизы по материалам ТЭО на реконструкцию Хабаровской ТЭЦ-1 под использование в виде топлива природного газа.

г. Хабаровск май 2004 г.

Экспертная комиссия, утверждённая приказом по Главному управлению природных ресурсов и охраны окружающей среды МПР России по Хабаровскому краю № 218/П от 2.04.04 г., в составе:

Руководитель комиссии – Пилина Т.И., внештатный эксперт; .

Ответственный секретарь – Артемьева И.В., ведущий специалист отдела государственной экологической экспертизы;

Члены экспертной комиссии - Ромакина Н.П., внештатный эксперт;

- Тарасова Н.В., внештатный эксперт;
- Краснополов А.В., внештатный эксперт

Conclusions:

1. The commission of the experts, having considered the Feasibility Report on the reconstruction of the Khabarovsk CHP-1 to fire natural gas, hereby states that the submitted materials in the scope and contents, basically conform the requirements of the legislative acts of the Russian Federation and the normative documents on the issues of the environmental protection and natural resources.

   The Feasibility Report envisages the appropriate nature protection measures, contains the materials of evaluation of the environment impact and validates the ecological capability of implementation of the proposed activity.

2. Based on the results of the analysis of the submitted materials and considering the positive statements of the monitoring and supervisory bodies (agencies), the commission of experts considers that in the submitted materials of the project,

The accountable secretary _____ Artemieva I.V

the level of the environmental impact in implementing the Feasibility Report on the reconstruction of the Khabarovsk CHP-1 to fire natural gas is adequate.

The implementation of the design solutions is possible.

Signed by:

The chief of the Commission: Pilina T.N.,
The accountable secretary: Artemieva I.V.,
The members of the Commission: Romakina N. P.,
Tarasova N.V.,
Krasnopolov A.V,

The accountable secretary _____ Artemieva I.V

- для оксидов азота на 70%;
- для оксида углерода на 50%;
- для диоксида серы и взвешенных веществ на 100%.

Благодаря малым коэффициентам избытка воздуха в топке котлов уменьшается расход и объем дымовых газов, что ведет к уменьшению зоны влияния повышенных концентраций загрязняющих веществ в 2 раза.

Сопоставление результатов расчетов рассеивания максимальных концентраций для существующего и проектируемого положения по долям вкладов ПДК в контрольных точках показало:

- при сжигании природного газа (проектируемое положение) доли вкладов загрязняющих веществ составляют менее 1 ПДК с учетом высотной застройки;
- при сжигании твердого топлива (существующее положение) доли вкладов загрязняющих веществ составляют более 5 ПДК с учетом высотной застройки.

Перевод котлов ТЭЦ на сжигание природного газа приведет к оздоровлению экологической обстановки в городе, позволит достичь нормативов предельно-допустимых выбросов.

Выводы:

1. Экспертная комиссия, рассмотрев материалы ТЭО на реконструкцию Хабаровской ТЭЦ-1 под использование в виде топлива природного газа, отмечает, что представленные материалы по объему и содержанию, в основном, соответствуют требованиям законодательных актов Российской Федерации и нормативных документов по вопросам охраны окружающей среды и природных ресурсов.

   В ТЭО предусмотрены соответствующие природоохранные мероприятия, содержатся материалы по оценке воздействия на окружающую природную среду и обоснована экологическая возможность реализации намечаемой деятельности.

2. По результатам анализа представленных материалов и с учетом положительных заключений (согласований) контрольных и надзорных органов, экспертная комиссия считает допустимым, представленный в

Ответственный секретарь _____ И.В. Артемьева

материалах проекта, уровень воздействия на окружающую среду при реализации ТЭО на реконструкцию Хабаровской ТЭЦ-1 под использование в виде топлива природного газа.

Реализация проектных решений возможна.

Подписи:

Руководитель комиссии: Т.И. Пилина

Ответственный секретарь: И.В. Артемьева

Члены комиссии: Н.П. Ромакина

Н.В. Тарасова

А.С. Краснополов

Ответственный секретарь _____ И.В. Артемьева

THE MINISTRY OF NATURAL RESOURCES OF THE RUSSIAN FEDERATION

Main Department of Natural Resources and Environmental Protection
The Ministry of Natural Resources of the Russian Federation on the Khabarovsk Territory

THE ORDER
City of Khabarovsk

about the approval of the statement by the Commission
of experts of the State ecological expertise

on the materials "The Feasibility Report on the Reconstruction of the Khabarovsk CHP-1 to F ire Natural Gas"

Pursuant to the Federal Act "About Ecological Expertise" (Article 18):

1. Approve the Statement of the Commission of experts of the State ecological expertise set up to execute the Order No. 218/P of the Main Department of Natural Resources and Environmental Protection of the Ministry of Natural Resources of the Russian Federation on Khabarovsk territory of April 02, 2004

on the materials "The Feasibility Report on the Reconstruction of the Khabarovsk CHP-1 to fire natural gas "

2. Set up the term of action of said Statement to implement the object, but not more than for five years

Deputy Head of the Main Department of
Natural Resources on the Khabarovsk Territory **V.M. Boltrushko,**

Копия верна

МИНИСТЕРСТВО ПРИРОДНЫХ РЕСУРСОВ РОССИЙСКОЙ ФЕДЕРАЦИИ

ГЛАВНОЕ УПРАВЛЕНИЕ ПРИРОДНЫХ РЕСУРСОВ И ОХРАНЫ
ОКРУЖАЮЩЕЙ СРЕДЫ МПР РОССИИ
ПО ХАБАРОВСКОМУ КРАЮ

ПРИКАЗ

г. ХАБАРОВСК

31.05.04 № 419/П

Об утверждении заключения экспертной комиссии
Государственной экологической экспертизы

по материалам « ТЭО на реконструкцию Хабаровской ТЭЦ-1 под использование в виде топлива природного газа»

В соответствии с Федеральным законом «Об экологической экспертизе» (ст. 18)

ПРИКАЗЫВАЮ:

1. Утвердить заключение экспертной комиссии государственной экологической экспертизы, образованной во исполнение приказа Главного Управления природных ресурсов и охраны окружающей среды МПР Россия по Хабаровскому краю от «02» апреля 2004 г. № 218/П

по материалам «ТЭО на реконструкцию Хабаровской ТЭЦ-1 под использование в виде топлива природного газа»

2. Установить срок действия указанного заключения - **на срок реализации объекта, но не более 5 лет**

Заместитель начальника
ГУПР по Хабаровскому краю **В.М.Болтрушко**

004135 *